



# Integrated Resource Plan



## 2015



Submitted to the  
North Dakota Public Service Commission  
July 1, 2015

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Volume III: Attachment B

**Montana-Dakota Utilities Co.  
2015 Integrated Resource Plan**

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Attachment B**



**MONTANA-DAKOTA  
UTILITIES CO.**

A Division of MDU Resources Group, Inc.

# **Attachment B**

## **DEMAND-SIDE ANALYSIS DOCUMENTATION**

# Demand-Side Analysis

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## **DEMAND-SIDE ANALYSIS**

### **Overview**

Montana-Dakota recognizes the value that Demand-Side Management (DSM) can play in meeting its customer's future energy requirements with the growing demand for electricity and the need for additional supply-side resources. However, the implementation of DSM programs cannot be done without cost consideration to the customers and the Company's shareholders. Interests need to be balanced to achieve results at an affordable cost to both the utility and its customers. Montana-Dakota has focused on a proven list of DSM programs that are best suited for the Company's load shape.

Montana-Dakota DSM analysis is completed on a state by state approach (Montana, North Dakota, and South Dakota) versus an Integrated System approach, due to the complexities of offering DSM programs across multiple jurisdictions and then in total for the Integrated System. The true value of DSM can only be achieved as an integrated resource implemented across all jurisdictions; however, cost recovery is necessary in each jurisdiction in order for full implementation to occur. In some cases, particularly in the case of demand response programs, the cost of infrastructure is such that if full system implementation is not achieved, the program may not be feasible.

Provided in this Attachment is a detailed discussion of Montana-Dakota's demand-side analysis and approach. In order to fully implement any of the described programs, Montana-Dakota will seek, and must have, regulatory approval and cost recovery.

### **Energy Efficiency**

At this time Montana-Dakota has not commissioned a study to define the achievable potential for energy efficiency for its Integrated System. However, Montana-Dakota has commissioned and completed an Energy Efficiency Potential and Market Assessment Study for the Montana service territory as a starting point and to provide a guide to refining the achievable energy efficiency throughout its integrated system.

Based on the results of the Montana study and Montana-Dakota's market knowledge of the service territory Montana-Dakota estimates the achievable annual energy reduction of 0.35 percent of annual energy sales (MWh) and 1.78% of demand (MW) savings in 2034.

The Montana-Service territory achievable potential identified in the Nexant Study was used to project the savings that could be achievable in Montana. The achievable potential is estimated to be 0.25 percent of energy sales in Montana over the IRP planning period. Table B-1, contains the estimated achievable potential for the Montana service territory.

The Montana-Service territory achievable potential identified in the Nexant Study was used as a basis to project the savings that could be achievable in North Dakota. The achievable potential is estimated to be 0.39 percent of energy sales in North Dakota over the IRP planning period. Table B-2, below contains the estimated achievable potential for the North Dakota service territory.

The Montana-Service territory achievable potential identified in the Nexant Study was used to project the savings that could be achievable in South Dakota. The achievable potential is estimated to be 0.25 percent of energy sales in South Dakota over the IRP planning period. Table B-3, contains the estimated achievable potential for the Montana service territory.

Montana-Dakota understands that these goals are lower than national averages for achievable potential; however, based on the results of the Montana service territory study, the small rural customer base, and limited contractor networks, Montana-Dakota feels these targets are appropriate.

**Table B-1: Montana Achievable Energy Efficiency (MWh)**

<b>YEAR</b>	<b>Residential Sales (MWh)</b>	<b>Achievable EE %</b>	<b>Achievable MWh</b>	<b>Small C&amp;I Sales (MWh)</b>	<b>Achievable EE %</b>	<b>Achievable MWh</b>	<b>Large C&amp;I Sales (MWh)</b>	<b>Achievable EE %</b>	<b>Achievable MWh</b>	<b>Street Lighting Sales (MWh)</b>	<b>Achievable EE %</b>	<b>Miscellaneous Sales (MWh)</b>	<b>Achievable EE %</b>	<b>Total Sales Sales (MWh)</b>	<b>Achievable EE %</b>	<b>Achievable MWh</b>
2015	204,393	0.05%	102	141,520	0.05%	71	480,054	0.05%	240	7,028	0.00%	7,752	0.00%	840,747	0.05%	413
2016	208,942	0.10%	209	148,120	0.10%	148	511,687	0.10%	512	7,028	0.00%	7,762	0.00%	883,539	0.10%	869
2017	213,018	0.10%	213	154,231	0.10%	154	583,946	0.10%	584	7,028	0.00%	7,771	0.00%	965,994	0.10%	951
2018	217,146	0.20%	434	160,515	0.20%	321	637,786	0.10%	638	7,028	0.00%	7,780	0.00%	1,030,255	0.14%	1,393
2019	221,305	0.20%	443	166,984	0.20%	334	662,494	0.20%	1,325	7,028	0.00%	7,790	0.00%	1,065,601	0.20%	2,102
2020	225,494	0.20%	451	173,628	0.20%	347	669,911	0.20%	1,340	7,028	0.00%	7,799	0.00%	1,083,860	0.20%	2,138
2021	229,713	0.30%	689	180,455	0.20%	361	677,371	0.20%	1,355	7,028	0.00%	7,809	0.00%	1,102,376	0.22%	2,405
2022	232,815	0.30%	698	187,475	0.30%	562	684,876	0.30%	2,055	7,028	0.00%	7,818	0.00%	1,120,012	0.30%	3,315
2023	235,917	0.30%	708	194,676	0.30%	584	692,426	0.30%	2,077	7,028	0.00%	7,827	0.00%	1,137,874	0.30%	3,369
2024	238,502	0.30%	716	201,246	0.30%	604	700,023	0.30%	2,100	7,028	0.00%	7,837	0.00%	1,154,636	0.30%	3,419
2025	241,087	0.30%	723	207,978	0.30%	624	707,666	0.30%	2,123	7,028	0.00%	7,846	0.00%	1,171,605	0.30%	3,470
2026	243,155	0.30%	729	213,991	0.30%	642	715,356	0.30%	2,146	7,028	0.00%	7,856	0.00%	1,187,386	0.30%	3,518
2027	245,223	0.30%	736	220,140	0.30%	660	723,094	0.30%	2,169	7,028	0.00%	7,865	0.00%	1,203,350	0.30%	3,565
2028	246,257	0.30%	739	224,607	0.30%	674	730,882	0.30%	2,193	7,028	0.00%	7,874	0.00%	1,216,648	0.30%	3,605
2029	247,291	0.30%	742	229,155	0.30%	687	738,720	0.30%	2,216	7,028	0.00%	7,884	0.00%	1,230,078	0.30%	3,645
2030	248,325	0.30%	745	233,752	0.30%	701	746,608	0.30%	2,240	7,028	0.00%	7,893	0.00%	1,243,606	0.30%	3,686
2031	249,359	0.30%	748	238,432	0.30%	715	754,548	0.30%	2,264	7,028	0.00%	7,902	0.00%	1,257,269	0.30%	3,727
2032	250,393	0.30%	751	243,183	0.30%	730	762,552	0.30%	2,288	7,028	0.00%	7,912	0.00%	1,271,068	0.30%	3,768
2033	250,910	0.30%	753	247,026	0.30%	741	770,609	0.30%	2,312	7,028	0.00%	7,921	0.00%	1,283,494	0.30%	3,806
2034	251,427	0.30%	754	250,930	0.30%	753	778,721	0.30%	2,336	7,028	0.00%	7,931	0.00%	1,296,037	0.30%	3,843
<b>Cumulative</b>														<b>22,745,436</b>	<b>0.25%</b>	<b>57,008</b>

**Table B-2: North Dakota Achievable Energy Efficiency (MWh)**

<u>YEAR</u>	<u>Residential Sales (MWh)</u>	<u>Achievable EE %</u>	<u>Achievable MWh</u>	<u>Small C&amp;I Sales (MWh)</u>	<u>Achievable EE %</u>	<u>Achievable MWh</u>	<u>Large C&amp;I Sales (MWh)</u>	<u>Achievable EE %</u>	<u>Achievable MWh</u>	<u>Street Lighting Sales (MWh)</u>	<u>Achievable EE %</u>	<u>Miscellaneous Sales (MWh)</u>	<u>Achievable EE %</u>	<u>Total Sales Sales (MWh)</u>	<u>Achievable EE %</u>	<u>Achievable MWh</u>
2015	848,901	0.10%	849	676,022	0.10%	676	686,749	0.10%	687	19,895	0.00%	48,147	0.00%	2,279,714	0.10%	2,212
2016	886,395	0.15%	1,330	740,510	0.15%	1,111	764,461	0.15%	1,147	19,895	0.00%	48,518	0.00%	2,459,779	0.15%	3,587
2017	915,304	0.15%	1,373	794,928	0.15%	1,192	815,111	0.15%	1,223	19,895	0.00%	48,889	0.00%	2,594,127	0.15%	3,788
2018	944,540	0.20%	1,889	852,200	0.20%	1,704	824,058	0.20%	1,648	19,895	0.00%	49,259	0.00%	2,689,952	0.19%	5,242
2019	974,022	0.20%	1,948	912,403	0.20%	1,825	833,131	0.20%	1,666	19,895	0.00%	49,630	0.00%	2,789,081	0.20%	5,439
2020	992,441	0.30%	2,977	955,423	0.30%	2,866	842,307	0.30%	2,527	19,895	0.00%	50,001	0.00%	2,860,067	0.29%	8,371
2021	1,011,083	0.30%	3,033	999,992	0.30%	3,000	851,611	0.30%	2,555	19,895	0.00%	50,371	0.00%	2,932,952	0.29%	8,588
2022	1,024,724	0.40%	4,099	1,046,104	0.40%	4,184	859,412	0.40%	3,438	19,895	0.00%	50,742	0.00%	3,000,877	0.39%	11,721
2023	1,033,817	0.40%	4,135	1,082,759	0.40%	4,331	867,322	0.40%	3,469	19,895	0.00%	51,113	0.00%	3,054,906	0.39%	11,936
2024	1,042,911	0.50%	5,215	1,120,361	0.50%	5,602	875,355	0.50%	4,377	19,895	0.00%	51,483	0.00%	3,110,005	0.49%	15,193
2025	1,050,868	0.50%	5,254	1,158,941	0.50%	5,795	883,524	0.50%	4,418	19,895	0.00%	51,854	0.00%	3,165,082	0.49%	15,467
2026	1,058,825	0.50%	5,294	1,198,509	0.50%	5,993	891,796	0.50%	4,459	19,895	0.00%	52,225	0.00%	3,221,250	0.49%	15,746
2027	1,066,782	0.50%	5,334	1,239,083	0.50%	6,195	900,232	0.50%	4,501	19,895	0.00%	52,595	0.00%	3,278,587	0.49%	16,030
2028	1,074,738	0.50%	5,374	1,280,684	0.50%	6,403	908,774	0.50%	4,544	19,895	0.00%	52,966	0.00%	3,337,057	0.49%	16,321
2029	1,082,695	0.50%	5,413	1,323,333	0.50%	6,617	917,448	0.50%	4,587	19,895	0.00%	53,337	0.00%	3,396,708	0.49%	16,617
2030	1,090,652	0.50%	5,453	1,367,004	0.50%	6,835	926,245	0.50%	4,631	19,895	0.00%	53,707	0.00%	3,457,503	0.49%	16,920
2031	1,098,609	0.50%	5,493	1,411,782	0.50%	7,059	935,203	0.50%	4,676	19,895	0.00%	54,078	0.00%	3,519,567	0.49%	17,228
2032	1,106,566	0.50%	5,533	1,457,650	0.50%	7,288	944,335	0.50%	4,722	19,895	0.00%	54,449	0.00%	3,582,895	0.49%	17,543
2033	1,114,523	0.50%	5,573	1,504,625	0.50%	7,523	953,608	0.50%	4,768	19,895	0.00%	54,820	0.00%	3,647,471	0.49%	17,864
2034	1,122,480	0.50%	5,612	1,552,721	0.50%	7,764	963,023	0.50%	4,815	19,895	0.00%	55,190	0.00%	3,713,309	0.49%	18,191
<b>Cumulative</b>														<b>62,090,886</b>	<b>0.39%</b>	<b>244,002</b>

**Table B-3: South Dakota Achievable Energy Efficiency (MWh)**

YEAR	Residential	Achievable	Achievable	Small C&I	Achievable	Achievable	Large C&I	Achievable	Achievable	Street Lighting	Achievable	Miscellaneous	Achievable	Total Sales	Achievable	Achievable
	Sales (MWh)	EE %	MWh	Sales (MWh)	EE %	MWh	Sales (MWh)	EE %	MWh	Sales (MWh)	EE %	Sales (MWh)	EE %	Sales (MWh)	EE %	MWh
2015	75,877	0.05%	38	37,171	0.05%	19	38,260	0.05%	19	2,661	0.00%	1,865	0.00%	155,834	0.05%	76
2016	75,912	0.10%	76	37,634	0.10%	38	44,796	0.10%	45	2,661	0.00%	1,865	0.00%	162,868	0.10%	158
2017	75,912	0.10%	76	38,103	0.10%	38	45,951	0.10%	46	2,661	0.00%	1,865	0.00%	164,492	0.10%	160
2018	75,912	0.20%	152	38,566	0.20%	77	47,154	0.10%	47	2,661	0.00%	1,865	0.00%	166,158	0.17%	276
2019	75,900	0.20%	152	39,047	0.20%	78	48,234	0.20%	96	2,661	0.00%	1,865	0.00%	167,707	0.19%	326
2020	75,877	0.20%	152	39,534	0.20%	79	49,354	0.20%	99	2,661	0.00%	1,865	0.00%	169,291	0.19%	330
2021	75,848	0.30%	228	40,026	0.20%	80	50,502	0.20%	101	2,661	0.00%	1,865	0.00%	170,902	0.24%	409
2022	75,808	0.30%	227	40,525	0.30%	122	51,668	0.30%	155	2,661	0.00%	1,865	0.00%	172,527	0.29%	504
2023	75,751	0.30%	227	41,030	0.30%	123	52,877	0.30%	159	2,661	0.00%	1,865	0.00%	174,184	0.29%	509
2024	75,693	0.30%	227	41,541	0.30%	125	53,995	0.30%	162	2,661	0.00%	1,865	0.00%	175,755	0.29%	514
2025	75,636	0.30%	227	42,047	0.30%	126	55,126	0.30%	165	2,661	0.00%	1,865	0.00%	177,335	0.29%	518
2026	75,567	0.30%	227	42,571	0.30%	128	56,296	0.30%	169	2,661	0.00%	1,865	0.00%	178,960	0.29%	523
2027	75,486	0.30%	226	43,102	0.30%	129	57,483	0.30%	172	2,661	0.00%	1,865	0.00%	180,597	0.29%	528
2028	75,417	0.30%	226	43,639	0.30%	131	58,709	0.30%	176	2,661	0.00%	1,865	0.00%	182,291	0.29%	533
2029	75,325	0.30%	226	44,183	0.30%	133	59,951	0.30%	180	2,661	0.00%	1,865	0.00%	183,985	0.29%	538
2030	75,245	0.30%	226	44,721	0.30%	134	61,234	0.30%	184	2,661	0.00%	1,865	0.00%	185,726	0.29%	544
2031	75,153	0.30%	225	45,279	0.30%	136	62,548	0.30%	188	2,661	0.00%	1,865	0.00%	187,506	0.29%	549
2032	75,061	0.30%	225	45,843	0.30%	138	63,893	0.30%	192	2,661	0.00%	1,865	0.00%	189,323	0.29%	554
2033	74,969	0.30%	225	46,415	0.30%	139	65,268	0.30%	196	2,661	0.00%	1,865	0.00%	191,178	0.29%	560
2034	74,877	0.30%	225	46,993	0.30%	141	66,677	0.30%	200	2,661	0.00%	1,865	0.00%	193,073	0.29%	566
<b>Cumulative</b>														<b>3,529,683</b>	<b>0.25%</b>	<b>8,675</b>

## **Demand Response**

As discussed later in this Attachment, Montana-Dakota continues to pursue a demand response portfolio that includes a Commercial Demand Response Program and the Company's current Interruptible Demand Response rates. These two programs currently combine to offer approximately 23.4 MW of demand response to Montana-Dakota's integrated system. The demand response goal from the two programs is 31 MW by 2018 or 4.4 percent of the total forecasted Integrated System peak demand in 2018.

Montana-Dakota is also considering adding a Residential Air Conditioning Cycling program to the current Demand Response portfolio, which could add an additional 10MW of demand response. The Residential A/C Cycling program would use a programmable Wi-Fi thermostat to control a customer's air conditioner during times of peak demand on the system. Customers' would receive and rebate on the purchase of the thermostat and an annual capacity payment for their participation in the program. This program would also provide additional energy efficiency savings through the use of the programmable thermostat functions.

## **DSM Program Overview**

Montana-Dakota currently offers Energy Efficiency DSM Programs only in Montana which are funded through the Universal Systems Benefit Charge. Demand Response DSM Programs are available to commercial customers in Montana, North Dakota, and South Dakota. The following is an overview of program details associated with each residential and commercial DSM measure that is currently being offered or is being considered for implementation. The overview provides a description of the program, jurisdictions where the program is or will be offered, DSM measures included in the program, incentive levels, and the marketing and promotion plan.

### **Residential Cooling Program**

This program offers rebates to Montana-Dakota residential customers installing high-efficiency air conditioning equipment in single family dwellings. This program is available to residential electric customers in Montana and is applicable to high-efficiency central air conditioners and window air conditioners. Heat pump systems do not qualify for this program. The residential cooling program includes:

- Tier 1 Central Air Conditioner Program: This program is applicable to existing residential electric customers who are replacing a central air conditioning unit. The

new central air conditioning unit must have a minimum 14.5 SEER rating in order to qualify for the rebate.

- Tier 2 Central Air Conditioner Program: This program is applicable to new construction and existing residential electric customers. The new central air conditioning unit must have a minimum 16 SEER rating in order to qualify for the rebate.
- Window Air Conditioning Program: The program is applicable to residential electric customers who purchase an ENERGY STAR®-rated window air conditioning unit. Qualifying equipment is eligible for a rebate.

Program Incentives:

<b>Measure</b>	<b>Incentive Level</b>
Tier 1 Central Air Conditioner – 14.5 SEER or greater	\$100/ton
Tier 2 Central Air Conditioner – 16 SEER or greater	\$200/ton
Window Air Conditioner	\$50

Montana-Dakota will effectively market the program through following:

- Website,
- Bill inserts,
- Pamphlets and brochures,
- Newspaper inserts
- Direct mail
- HVAC contractors

**Residential Thermal Storage with an Air Source Heat Pump (ASHP)**

This program offers rebates to Montana-Dakota residential electric customers when they purchase and install a brick electric thermal storage unit with a high-efficiency air-source heat pump (ASHP). This program is available to residential electric customers in Montana.

The program applies to the purchase and installation of a brick electric thermal storage unit with a new high-efficiency air source heat pump. The maximum capacity for the thermal

storage unit is limited to 38.4 kW with an ASHP that must have a minimum efficiency rating of 8.2 HSPF/13 SEER/ 12 EER.

Program Incentive:

Measure	Incentive Level
Thermal Storage and ASHP Program	\$60/kW

Montana-Dakota will effectively market the program through the following:

- Website,
- Bill inserts,
- Pamphlets and brochures,
- Direct mail,
- Newspaper inserts,
- HVAC contractor and builder relationships and promotion.

**Residential CFL Lighting Program**

This program offers rebates to Montana-Dakota residential customers when they install high-efficiency compact fluorescent lighting (CFL) in single family dwellings. This program is available to residential electric customers in Montana and provides a rebate on a per bulb basis.

The residential CFL lighting program applies to residential electric customers who purchase and utilize high-efficiency CFL light bulbs in their home. The rebate applies to the number of bulbs purchased, with a maximum of 15 bulbs. Customers must mail in the rebate request, including proof of purchase.

Program Incentive:

Measure	Incentive Level
Residential CFL Lighting	\$2/bulb
Residential LED Lighting (Proposed)	

Montana-Dakota will effectively market the program through the following:

- Website,
- Bill inserts,

- Pamphlets and brochures,
- Direct mail,
- Newspaper inserts,
- HVAC contractor and builder relationships and promotion.

Future program considerations:

- Include LED into the Residential lighting program on a per bulb basis
- Explore point of sale options

### **Commercial Prescriptive Programs**

These programs offer prescriptive rebates to Montana-Dakota's commercial/industrial customers when they install high-efficiency lighting, cooling equipment, and motor systems. These programs will be available to Montana-Dakota's commercial customers in Montana that are served under a general service electric tariff. The commercial prescriptive programs include:

- **Commercial Lighting Program:** This program is designed to incent customers to replace fluorescent lighting systems with more efficient technology and lighting systems. The baseline equipment for a standard retrofit was T-12 technology to T-8 technology. As the market for lighting retrofits matures T-8 technology will become the baseline and T-5 technology or better is considered high efficiency. The lighting rebate covers a variety of fixtures and applications and the baseline and high efficiency lighting standard will be adjusted accordingly. The program also offers a custom project feature to capture savings due to changes in fixture type and de-lamping.
- **Commercial Cooling Program:** This program is designed to cover the most common types of cooling equipment and includes prescriptive rebates for standard central air conditioning systems, split systems, and packaged systems. The rebates are based on a prescriptive \$/ton for each type of cooling equipment. This program will be discontinued on a prescriptive basis in 2016, however commercial cooling equipment will still be available under the Commercial Partnership Program.
- **Commercial Motor Program:** This program is designed to cover new motors installed by customers and as replacement for existing motors. The new motor must be a National Electrical Manufacturers Association (NEMA) Premium Motor® to qualify for

a rebate. Variable Speed Drive rebates will also be offered under the motor program. Rebates will be based on a prescriptive \$/hp.

Program Incentives:

Measure	Incentive Level
Commercial Lighting Program	\$0.40 per watt
Tier 1 Central Air Conditioner – 14.5 SEER or greater	\$100 per ton
Tier 2 Central Air Conditioner – 16 SEER or greater	\$200 per ton
Commercial Cooling Split Systems (2015 only)	\$100 per ton
Commercial Cooling Packaged Systems (2015 only)	\$100 per ton
Commercial Motors - Replacement	\$15 per HP
Commercial Motors – New or replace on failure	\$4 per HP
Variable Speed Drives	\$30 per HP

Montana-Dakota will market the program through the following:

- Website,
- Key account representatives,
- Pamphlets and brochures,
- Newspaper inserts,
- HVAC contractor relationships and promotion.

**Commercial Partnership Program**

This program offers rebates to Montana-Dakota’s commercial and industrial customers installing energy conservation measures that are not eligible under the prescriptive rebates due to the variability in the energy savings and cost of the project. Rebates are based on the amount of energy savings, and the project must pass the Total Resource Cost test (TRC) with a Benefit/Cost ratio greater than one. This program is available to Montana-Dakota’s general service customers in Montana.

The commercial partnership program is designed to lower the initial cost of a variety of energy-efficient upgrades that are not available for any of the prescriptive rebates. While the incentive levels for this program are project specific, other criteria under this program are:

- Equipment installed must be more efficient than the industry standard;
- Simple payback must be greater than 1 year;
- Rebate cannot exceed 50 percent of the incremental cost of the equipment;
- Rebate will be based on the amount of energy and demand saved;
- Weatherization is not eligible for a rebate;
- Distributed renewable generation such as solar and wind under 50 kW will be considered under a net metering arrangement;
- Additional measurement and verification of the energy savings maybe required; and
- Rebate is also available to new construction.

The incentive levels for this program will be project specific. Montana-Dakota will market the program through the following:

- Website,
- Key account representatives,
- Pamphlets and brochures, and
- HVAC contractor relationships and promotion.

### **Commercial Demand Response Program**

The Commercial Demand Response Program was launched in June of 2012 and is offered to commercial and industrial electric customers with a load of 50 kW or higher, with a priority focused on customers with loads of 150 kW or higher. This program is administered by a third-party demand response aggregator under contract with Montana-Dakota. The third-party aggregator is responsible for customer enrollment, settlement, and administration of the program on behalf of Montana-Dakota. This program is available to commercial and industrial electric customers in Montana, North Dakota, and South Dakota.

The program applies to commercial and industrial electric customers who agree to shed non-critical load during a demand response event initiated by Montana-Dakota. The program provides for a one-hour notification of an event, with a four-hour maximum event period, and

for up to 50 hours per year for customers located outside of the Williston node and up to 100 hours per year for customers located within the Williston node.

Participating customers will receive a capacity and energy payment for participating in the program, and payment amounts will be pursuant to a negotiated contract between the customer and the third-party aggregator, who is marketing the program on behalf of Montana-Dakota.

Montana-Dakota promotes the program with support from the third-party aggregator's marketing and promotion efforts through the following:

- Key account representatives,
- Website,
- Webinars,
- Direct Mail, and
- Trade shows and public awareness events.

### **Interruptible Demand Response Rate**

The Interruptible Demand Response Rate has been available for several years and is offered to commercial and industrial electric customers with loads of 500 kW or higher. This program is administered by Montana-Dakota and the rate is offered as an optional rate for customers to consider for their power service. The rates reflect a discounted demand charge in exchange for the load being available to call upon for reduction during demand response events. This program is available to commercial and industrial electric customers in Montana and North Dakota.

The program applies to commercial and industrial electric customers who agree to shed their entire load during a demand response event initiated by Montana-Dakota. The program provides for a one-hour notification of an event, with no maximum event time period, and for up to 100 hours per year.

Montana-Dakota's marketing and promotion efforts are primarily through the following:

- Key account representatives,
- Website,
- Architect and engineering contractors

## Residential Demand Response (Proposed)

The Residential A/C Cycling program would be offered to residential and small commercial customers in all states. The program would use a programmable Wi-Fi thermostat to control a customer's air conditioner during times of peak demand on the system. Customers' would receive a rebate on the purchase of the thermostat and an annual capacity payment for their participation in the program. This program would also provide additional energy efficiency savings through the use of the programmable thermostat functions.

Program Incentives:

Measure	Incentive Level
Wi-Fi Programmable Thermostat Rebate	\$60 one-time rebate
Residential Demand Response Capacity Payment	\$40 per year

Montana-Dakota will effectively market the program through the following:

- Website,
- Bill inserts,
- Pamphlets and brochures,
- Direct mail,
- Newspaper inserts,
- HVAC contractor and builder relationships and promotion.

## DSM Methodology

In order to balance all interests and achieve cost-effective DSM for customers and utility shareholders, a cost-benefit analysis from different perspectives was performed on potential DSM measures. The perspectives or "tests" are not intended to be used individually or in isolation, rather they must be compared to each other. This multi-perspective approach will allow consideration of tradeoffs between the various tests. However, the impacts measured from the Total Resource Cost Test will necessarily determine if a program is economically feasible. Once a program is determined feasible, all other test results are considered to determine if a program is to be implemented. Therefore, even if a program is feasible it may not be implemented due to tradeoffs with other tests and other identified factors.

## **Benefit/Cost Analysis**

Montana-Dakota used a Microsoft Excel© spreadsheet-based model (Montana-Dakota DSM Model) to run benefit/cost analyses for each considered DSM program. The basic function of this evaluation tool is to calculate each DSM program's benefits and costs over its projected life on a discounted cash flow basis and determine its cost effectiveness on a stand-alone basis. The programs were evaluated using five different cost-effectiveness tests:

- Participant Test considers the economic impact of a program on the participating customers;
- Utility Test considers the impact on the utility;
- Societal Cost Test includes environmental externalities and considers the impact on the "society" (both the participating and non-participating customers);
- Ratepayer Test includes quantifiable benefits and costs of a given program and considers its impact on ratepayers; and
- Total Resource Cost Test (TRC) reflects the total benefits and costs to all customers (both the participants and non-participants).

For each test, the merits of the DSM program are evaluated based on the net present value (NPV) of the annual benefits and costs over the analysis horizon. The NPV calculation is based on the discount rate associated with each test and assumes the cash flows occur at the end of the year. The following section explains the process of evaluating the programs from each of the five perspectives.

### **Participant Test**

The Participant Test is a measure of the quantifiable benefits and costs brought about by a customer's participation in a DSM program. For purposes of evaluating the merits of a particular DSM program, quantifiable benefits include any incentives received by a participant and the reduction in a participant's electric bill through reduced energy use and/or demand. Quantifiable costs include any costs the customer incurs in order to participate in a DSM program, such as increased appliance costs or the availability of a back-up fuel source. The NPV calculation is based on the participant discount rate. The participant net benefit is calculated by the following equation:

$$\text{Net Benefit} = \text{Total Annual Benefits} - \text{Total Annual Costs}$$

where

$$\begin{aligned} \text{Total Annual Benefits} &= \text{Energy Savings (kWh)} \\ &+ \text{Demand Savings (kW)} \\ &+ \text{Incentive} \\ &+ \text{Other Savings} \\ \text{Total Annual Costs} &= \text{Direct Costs} + \text{Other Costs} \end{aligned}$$

A benefit/cost ratio greater than one for the Participant Test indicates the DSM program will result in savings to the participant over the life of the program.

### **Ratepayer Test**

The Ratepayer Test is a measure of the quantifiable benefits and costs the utility incurs as a result of customer participation in a DSM program. For purposes of evaluating the merits of a particular DSM program, quantifiable benefits include any reduction in purchased power costs due to decreased customer energy and demand, along with a reduction in variable operation and maintenance costs. Quantifiable costs to the utility include incentive and administrative costs, along with the loss of electric margin due to reduced sales. The NPV calculation is based on the utility discount rate. The utility net benefit is calculated by the following equation:

$$\text{Net Benefit} = \text{Annual Cost of Energy Saved} - \text{Annual Project Costs}$$

where

$$\begin{aligned} \text{Annual Cost of Energy Saved} &= \text{Energy Savings (kWh)}^* \\ &+ \text{Peak Demand Savings (kW)}^* \\ &+ \text{O\&M Savings} \\ \text{Annual Project Costs} &= \text{Total Project Costs} + \text{Lost Margin} \end{aligned}$$

\*kWh and kW savings include losses and reserve requirement savings.

A benefit/cost ratio greater than one for the Ratepayer Test indicates the DSM program will reduce overall rates.

### **Societal Cost Test**

The Societal Cost Test measures the net costs of a DSM program as a resource option based on the total costs of the program (both the participants' costs and the utility's costs). This test also includes a factor for environmental externalities, which for the purpose of this analysis is based a \$30/ton cost of carbon dioxide (CO<sub>2</sub>). This test is a summation of the benefit and cost terms in the Participant Test and the Ratepayer Test. The NPV calculation is based on the societal discount rate. The total cost net benefit is calculated by the following equation:

$$\text{Net Benefit} = \text{Annual Cost of Energy Saved} - \text{Annual Project Costs}$$

where

$$\begin{aligned} \text{Annual Cost of Energy Saved} &= \text{Energy Savings (kWh)}^* \\ &+ \text{Demand Savings (kW)}^* \\ &+ \text{O\&M Savings} \\ &+ \text{Avoided Environmental Damage} \\ \text{Annual Project Costs} &= \text{Total Project Costs} \end{aligned}$$

*\*kWh and kW savings include losses and reserve requirement savings.*

A benefit/cost ratio greater than one for the Societal Cost Test indicates the DSM program is cost effective to both the utility and its ratepayers on a societal cost basis.

### **Utility Test**

The Utility Test is a measure of the quantifiable benefits and costs placed on ratepayers due to changes in the utility's revenues and operating costs as a result of the DSM program. The Utility test includes the same benefits and costs as the Ratepayer Test, except the quantifiable costs exclude lost margin. The NPV calculation is based on the utility discount rate. The ratepayer net benefit is calculated by the following equation:

$$\text{Net Benefit} = \text{Annual Cost of Energy Saved} - \text{Annual Project Costs}$$

where

$$\begin{aligned} \text{Annual Cost of Energy Saved} &= \text{Energy Savings (kWh)}^* \\ &+ \text{Demand Savings (kW)}^* \\ &+ \text{O\&M Savings} \\ \text{Annual Project Costs} &= \text{Total Project} \end{aligned}$$

*\*kWh and kW savings include losses and reserve requirement savings.*

A benefit/cost ratio greater than one for the Utility Test indicates the cost of energy saved is greater than the cost of saving the energy.

### **Total Resource Cost Test (TRC)**

The Total Resource Cost Test (TRC) reflects the total benefits and costs to all customers (participants and non-participants) in the utility service territory. The key difference between the TRC and utility test is that the TRC does not include program incentives, which are considered zero net transfers from a regional perspective. Instead, the TRC includes the net measures costs and net avoided costs. The NPV calculation is based on the utility discount rate. The total cost net benefit is calculated by the following equation:

$$\text{Net Benefit} = \text{Annual Cost of Energy Saved} - \text{Annual Project Costs}$$

where

$$\text{Annual Cost of Energy Saved} = \text{Energy Savings (kWh)}^*$$

$$\begin{aligned}
 & \text{Annual Project Costs} && + \text{Demand Savings (kW)*} \\
 & && + \text{O\&M Savings} \\
 & && = \text{Total Project Costs net of incentive costs}
 \end{aligned}$$

*\*kWh and kW savings include losses and reserve requirement savings.*

A benefit/cost ratio greater than one for the TRC Test indicates the DSM program is cost effective to all customers, both participating and non-participating.

Montana-Dakota evaluated each program’s feasibility based on the results of the TRC Test. If the benefit/cost ratio for the TRC Tests were greater than one, the DSM program(s) are considered feasible and will be further evaluated.

### **DSM Model Input Data**

Montana-Dakota’s DSM Model is dependent on the input data to determine the cost-benefit of each program. Recent Company operational and financial data is used for the general model data inputs, and estimated supply cost avoidance is used based on marginal energy costs and capacity costs of adding the next supply resource including reserve requirements and losses. Program specific data is also used for each program being evaluated. The operational, financial, and program data inputs used for each program model run are provided in Appendix A to this Attachment, and sources of the data are shown in Table B-4.

Also shown in Table B-4 are the inputs for avoided system energy costs and capacity costs applicable to the DSM measures. Avoided energy costs are based on the system marginal energy cost that is projected for the next 10 years and escalated by 0.06 percent annually thereafter. The avoided capacity costs are based on the estimated levelized cost of a combustion turbine. These costs are the same across all three states in Montana-Dakota’s Integrated System. The retail energy rate and demand costs vary across the states and are based on the average cost for the majority of the rate class to which the DSM measure is applicable.

**Montana-Dakota Utilities Co.  
Input Data Summary  
Electric Conservation Model  
Table B-4**

Input No.	Input Data Description	Information Source	Montana Residential	Montana Commercial	North Dakota Residential	North Dakota Commercial	South Dakota Residential	South Dakota Commercial
1	Retail Rate (Summer)	System average retail rate for customer class based	\$0.09033	\$0.06569	\$0.08197	\$0.08579	\$0.09021	\$0.07621
	Retail Rate (Winter)	System average retail rate for customer class based	\$0.07591	0.05369	\$0.07128	0.06943	\$0.08577	0.07438
	Retail Escalation Rate		4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
1a	Fuel Cost Adjustment	Average fuel cost adjustment for customer class base to be effective January 1, 2011	\$0.00418	\$0.00418	\$0.00496	\$0.00496	\$0.00815	\$0.00815
	Fuel Escalation Rate		2.80%	2.80%	2.80%	2.80%	2.80%	2.80%
2	System Marginal Energy Costs							
	Escalation Rate (after Yr. 10)	Actual costs for years 1 through 10 Escalation factor applied after year 10	3.00000%	3.00000%	3.00000%	3.00000%	3.00000%	3.00000%
3	Retail Summer Demand Cost (\$/kW/season)	Seasonal demand cost based on program availability	\$0.00	\$38.00	\$0.00	\$45.00	\$0.00	\$20.00
	Retail Winter Demand Cost (\$/kW/season)	Seasonal demand cost based on program availability	\$0.00	\$68.00	\$0.00	\$66.00	\$0.00	\$40.00
3a	Escalation Rate		4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
	Electric Margin (\$/KWh)	Average margin applicable to customer class	\$0.06075	\$0.04381	\$0.05993	\$0.05530	\$0.05546	\$0.03409
4	Escalation Rate		4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
	Avoided Capacity Costs (\$/kW/yr.)	Demand cost based on estimated levelized cost of combustion turbine	\$85.62	\$85.62	\$85.62	\$85.62	\$85.62	\$85.62
5	Reserve Capacity	Based on MISO Non-Coincident Peak	14.30%	14.30%	14.30%	14.30%	14.30%	14.30%
	Escalation Rate		3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
6	Variable O&M	Montana-Dakota's historical information	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Escalation Rate		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
7	Environmental Damage Factor	\$30 / ton Carbon Cost	30.7%	30.7%	30.7%	30.7%	30.7%	30.7%
	Escalation Rate		3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
8	Participation Discount Rate	Federal Reserve Consumer Credit Interest rate 12 Months ended September 30, 2010	10.22%	10.22%	10.22%	10.22%	10.22%	10.22%
	Utility Discount Rate	Montana-Dakota's authorized average cost of capital	9.610%	9.610%	8.699%	8.699%	9.610%	9.610%
10	Societal Discount Rate	Equal to the 30 year T-Bill rate average for 2010	3.34%	3.34%	3.34%	3.34%	3.34%	3.34%
11	General Input Data Year	2010	2015	2015	2015	2015	2015	2015
12	Project Analysis Yr. 1	Year(s) program will be implemented	2016	2016	2016	2016	2016	2016
	Yr. 2		2017	2017	2017	2017	2017	2017
	Yr. 3		2018	2018	2018	2018	2018	2018
13	Utility Project Costs	Total direct cost to the utility caused by implementing the program(s)						
	Admin Costs	Administration costs						
	Promo Costs	Promotional costs						
14	Direct Participant Project Costs (\$/Part.)	Direct costs that the participant is required to pay to participate in the DSM program						
	Escalation Rate Yr. 1	Consumer Price Index based on 3 yr. average	1.73%	1.73%	1.73%	1.73%	1.73%	1.73%
	Yr. 2	Consumer Price Index based on 3 yr. average	1.73%	1.73%	1.73%	1.73%	1.73%	1.73%
	Yr. 3	Consumer Price Index based on 3 yr. average	1.73%	1.73%	1.73%	1.73%	1.73%	1.73%
14a	Other Participant Costs (Annual \$/Part.) Yr. 1		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Yr. 2		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Yr. 3		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Escalation Rate Yr. 1		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Yr. 2		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Yr. 3		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
14b	Other Participant Savings (Annual \$/Part.) Yr. 1		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Yr. 2		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Yr. 3		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Escalation Rate Yr. 1		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Yr. 2		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Yr. 3		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
15	Project Life	Based on the estimated useful life of the energy saving equipment						
16	Avg. Summer Demand Reduction	Avg demand reduction (kW) caused by the DSM program						
16a	Avg. Winter Demand Reduction	Avg demand reduction (kW) caused by the DSM program						
17	Avg. Winter Energy Reduction	Avg energy reduction (kWh) caused by the DSM program						
17a	Avg. Summer Energy Reduction	Avg energy reduction (kWh) caused by the DSM program						
18a	System Demand Line Loss Factor Yr. 1	Historical demand line loss factor	12.980%	12.980%	12.980%	12.980%	12.980%	12.980%
	Yr. 2		12.980%	12.980%	12.980%	12.980%	12.980%	12.980%
	Yr. 3		12.980%	12.980%	12.980%	12.980%	12.980%	12.980%
18b	System Energy Line Loss Factor Yr. 1	Historical energy line loss factor	7.7350%	7.7350%	7.7350%	7.7350%	7.7350%	7.7350%
	Yr. 2		7.7350%	7.7350%	7.7350%	7.7350%	7.7350%	7.7350%
	Yr. 3		7.7350%	7.7350%	7.7350%	7.7350%	7.7350%	7.7350%
19	Number of Participants	Total projected participation by customers, kW load target, or equipment saturation						
20	Incentive/Participant	Incentive provided to the participant						
21	Effective Tax Rate	Effective tax rate	39.3875%	39.3875%	37.94%	37.94%	35.00%	35.00%
22	Total Annual Summer Kwh Saved	Total Kwh saved from the program in the year implemented						
	Total Annual Winter Kwh Saved	Total Kwh saved from the program in the year implemented						
23	Total Annual Summer Kw Saved	Total Kw saved from the program in the year implemented						
	Total Annual Winter Kw Saved	Total Kw saved from the program in the year implemented						
24	System Marginal Energy Cost	Need to change the hard entry in the 14.5 SEER CostBen Tab						
	Yr. 1		\$0.03570	\$0.03570	\$0.03570	\$0.03570	\$0.03570	\$0.03570
	Yr. 2		\$0.03790	\$0.03790	\$0.03790	\$0.03790	\$0.03790	\$0.03790
	Yr. 3		\$0.03900	\$0.03900	\$0.03900	\$0.03900	\$0.03900	\$0.03900
	Yr. 4		\$0.04000	\$0.04000	\$0.04000	\$0.04000	\$0.04000	\$0.04000
	Yr. 5		\$0.04250	\$0.04250	\$0.04250	\$0.04250	\$0.04250	\$0.04250
	Yr. 6		\$0.04470	\$0.04470	\$0.04470	\$0.04470	\$0.04470	\$0.04470
	Yr. 7		\$0.04780	\$0.04780	\$0.04780	\$0.04780	\$0.04780	\$0.04780
	Yr. 8		\$0.04950	\$0.04950	\$0.04950	\$0.04950	\$0.04950	\$0.04950
	Yr. 9		\$0.05270	\$0.05270	\$0.05270	\$0.05270	\$0.05270	\$0.05270

## DSM Model Results

Based on the methodology and data inputs discussed above, a portfolio of programs was developed for Montana, North Dakota, and South Dakota. The complete DSM Model runs for each state and each program are provided in Appendix A to this Attachment, and a summary by state of the cost-benefit ratios is shown in Tables B-5 (Montana), B-6 (North Dakota), and B-7 (South Dakota).

**Montana-Dakota Utilities Co.  
Montana Electric DSM Program Summary  
Table B-5**

Benefit/Cost Ratios						
DSM Program	Customer Class	RIM	Utility	Societal	Participant	Total Resource Cost
Total Portfolio		2.01	2.41	3.07	3.62	2.06
<b>Residential Programs</b>						
Central Air Conditioning Tier 1 (14.5 SEER)	Residential	1.02	1.23	1.68	0.85	0.75
Central Air Conditioning Tier 2 (16 SEER) - Replacement	Residential	0.98	1.16	1.57	0.82	0.70
Central Air Conditioning Tier 2 - New	Residential	0.93	1.09	1.51	0.82	0.67
Window AC Units	Residential	0.64	0.71	1.39	1.50	0.80
Thermal Storage with ASHP	Residential	4.55	7.83	8.76	1.35	4.39
Residential Lighting	Residential	1.35	7.95	17.03	18.14	9.85
<b>Demand Response</b>						
Residential AC Cycling	Residential	1.87	1.70	2.53	2.94	1.61
<b>Commercial Programs</b>						
Commercial Lighting	Commercial	1.45	4.86	6.85	4.33	3.03
Commercial Motors - Replacement	Commercial	1.45	4.03	0.88	0.50	0.38
Commercial Motors - New / on Failure	Commercial	1.69	6.74	1.27	0.69	0.55
Variable Speed Drives - VFD'S	Commercial	1.21	9.95	4.07	3.13	1.95
Commercial Partnership Program (Custom)	Commercial	1.68	4.96	4.86	3.68	2.73
<b>Demand Response</b>						
Commercial Demand Response Program	Commercial	2.13	2.13	2.95	73.25	2.13
Interruptible Rate DR Program	Commercial	2.84	2.88	3.76	16.82	2.71

**Montana-Dakota Utilities Co.  
North Dakota Electric DSM Program Summary  
Table B-6**

Benefit/Cost Ratios						
DSM Program	Customer Class	RIM	Utility	Societal	Participant	Total Resource Cost
Total Portfolio		2.03	2.47	3.14	4.33	2.12
<b>Residential Programs</b>						
Central Air Conditioning Tier 1 (14.5 SEER)	Residential	1.09	1.27	1.69	0.76	0.76
Central Air Conditioning Tier 2 (16 SEER) - Replacement	Residential	1.00	1.15	1.53	0.74	0.68
Central Air Conditioning Tier 2 - New	Residential	1.01	1.54	1.54	0.74	0.69
Window AC Units	Residential	0.63	0.68	1.34	1.39	0.78
Thermal Storage with ASHP	Residential	4.71	8.20	8.97	1.30	4.50
Residential Lighting	Residential	1.44	11.35	19.57	16.60	11.35
<b>Demand Response</b>						
Residential AC Cycling	Residential	1.69	1.69	2.46	2.24	1.59
<b>Commercial Programs</b>						
Commercial Lighting	Commercial	1.68	7.05	9.65	6.18	4.28
Commercial Motors - Replacement	Commercial	1.27	4.30	0.89	0.61	0.39
Commercial Motors - New / on Failure	Commercial	1.41	7.07	1.27	0.82	0.55
Variable Speed Drives - VFD'S	Commercial	0.99	10.70	4.12	4.01	1.98
Commercial Partnership Program (Custom)	Commercial	1.46	5.27	5.01	4.46	2.82
<b>Demand Response</b>						
Commercial Demand Response Program	Commercial	2.12	2.12	2.92	23.00	2.11
Interruptible Rate DR Program	Commercial	2.84	2.88	3.76	16.82	2.71

**Montana-Dakota Utilities Co.**  
**South Dakota Electric DSM Program Summary**  
**Table B-7**

Benefit/Cost Ratios						
DSM Program	Customer Class	RIM	Utility	Societal	Participant	Total Resource Cost
Total Portfolio		1.92	2.52	3.13	3.48	1.98
<b>Residential Programs</b>						
Central Air Conditioning Tier 1 (14.5 SEER)	Residential	1.08	1.26	1.76	0.84	0.78
Central Air Conditioning Tier 2 (16 SEER)	Residential	0.92	1.07	1.49	0.81	0.66
Central Air Conditioning Tier 2 - New	Residential	0.93	1.07	1.52	0.81	0.68
Window AC Units	Residential	0.54	0.59	1.12	1.50	0.66
Thermal Storage with ASHP	Residential					
Residential Lighting	Residential	1.49	9.59	16.60	19.19	9.59
<b>Demand Response</b>						
Residential AC Cycling	Residential	1.68	1.68	2.45	2.86	1.59
<b>Commercial Programs</b>						
Commercial Lighting	Commercial	2.26	6.21	8.95	5.62	3.96
Commercial Motors - Replacement	Commercial	1.69	3.88	0.90	0.58	0.39
Commercial Motors - New / on Failure	Commercial	2.11	6.70	1.36	0.80	0.58
Variable Speed Drives - VFD'S	Commercial	1.49	9.32	4.01	4.01	1.93
Commercial Partnership Program (Custom)	Commercial	1.88	4.40	4.52	4.02	2.54
<b>Demand Response</b>						
Commercial Demand Response Program	Commercial	2.19	2.19	2.96	4.73	2.11
Interruptible Rate DR Program	Commercial					

The overall results show that many of the existing programs for residential air conditioning and commercial motors are no longer cost effective across all states. The primary drivers are the increased baseline efficiency standards and higher incremental costs of the equipment. These factors along with relatively lower energy costs cause the measures to fail the TRC test. Some of the programs do pass or are very close to passing the RIM, Utility, Societal, and Participant test.

The American Council for an Energy Efficient Economy (ACEEE) 2014 study The best value for America's energy dollar: A national review of the cost of utility energy efficiency programs states the average first year acquisition cost for energy efficiency programs to range from \$0.02 to \$0.042 per kWh, with an average lifetime cost of \$0.028 per kWh. The portfolio of measures analyzed in this IRP has a total first year acquisition cost of \$0.69 per kWh, with a lifetime cost of \$0.041 per kWh. The higher cost than the national average can be primarily attributable to the mix of demand response included in the portfolio. On a cost per kW basis the portfolio of program first year cost is \$68.67 per kW and a third year cost of \$73.82 per kW.

## Technical Reference Manual (TRM)

The underlying demand-side resource program designs and evaluation criteria, cost information, and other assumptions that are particular to the programs studied vary by program. The majority of the information is derived from the Minnesota Technical Resource

Manual (TRM) that was developed for the state by Franklin Energy, with input from the state and various stakeholder groups, and is used by utilities in Minnesota as part of their Conservation Improvement Programs. The Minnesota TRM was adjusted to reflect weather data specific to Montana-Dakota's service territory. Utilizing the TRM allows Montana-Dakota to use a deemed savings approach to evaluation, measurement, and verification (EM&V) for prescriptive measures. The deemed savings approach to EM&V allows Montana-Dakota to keep administration costs low while providing an appropriate level of verification for prescriptive measures.

This TRM uses generally accepted engineering algorithms, along with developed operating data to determine the savings of each DSM measure. Along with the calculations, other program parameters are defined. The parameters include baseline efficiency standards, high-efficiency standards, incremental costs, and peak demand factors.

A summary description of the key variables for each DSM measure and a summary list of sources for participant cost, equipment life, and peak load factors for each DSM program are provided in Appendix B to this Attachment.

**Appendix A**

**DSM Benefit/Cost Analysis**

**Montana-Dakota Utilities Co.**  
**Montana Electric DSM Program Summary**  
**Table B-5**

<b>Benefit/Cost Ratios</b>						
<b>DSM Program</b>	<b>Customer Class</b>	<b>RIM</b>	<b>Utility</b>	<b>Societal</b>	<b>Participant</b>	<b>Total Resource Cost</b>
<b>Total Portfolio</b>		<b>2.01</b>	<b>2.41</b>	<b>3.07</b>	<b>3.62</b>	<b>2.06</b>
<b>Residential Programs</b>						
Central Air Conditioning Tier 1 (14.5 SEER)	Residential	1.02	1.23	1.68	0.85	0.75
Central Air Conditioning Tier 2 (16 SEER) - Replacement	Residential	0.98	1.16	1.57	0.82	0.70
Central Air Conditioning Tier 2 - New	Residential	0.93	1.09	1.51	0.82	0.67
Window AC Units	Residential	0.64	0.71	1.39	1.50	0.80
Thermal Storage with ASHP	Residential	4.55	7.83	8.76	1.35	4.39
Residential Lighting	Residential	1.35	7.95	17.03	18.14	9.85
<b>Demand Response</b>						
Residential AC Cycling	Residential	1.87	1.70	2.53	2.94	1.61
<b>Commercial Programs</b>						
Commerical Lighting	Commerical	1.45	4.86	6.85	4.33	3.03
Commercial Motors - Replacement	Commerical	1.45	4.03	0.88	0.50	0.38
Commerical Motors - New / on Failure	Commerical	1.69	6.74	1.27	0.69	0.55
Variable Speed Drives - VFD'S	Commerical	1.21	9.95	4.07	3.13	1.95
Commercial Partnership Program (Custom)	Commerical	1.68	4.96	4.86	3.68	2.73
<b>Demand Response</b>						
Commercial Demand Response Program	Commercial	2.13	2.13	2.95	73.25	2.13
Interruptible Rate DR Program	Commercial	2.84	2.88	3.76	16.82	2.71

**Montana-Dakota Utilities Co.**  
**North Dakota Electric DSM Program Summary**  
**Table B-6**

Benefit/Cost Ratios						
DSM Program	Customer Class	RIM	Utility	Societal	Participant	Total Resource Cost
Total Portfolio		2.03	2.47	3.14	4.33	2.12
<b>Residential Programs</b>						
Central Air Conditioning Tier 1 (14.5 SEER)	Residential	1.09	1.27	1.69	0.76	0.76
Central Air Conditioning Tier 2 (16 SEER) - Replacement	Residential	1.00	1.15	1.53	0.74	0.68
Central Air Conditioning Tier 2 - New	Residential	1.01	1.54	1.54	0.74	0.69
Window AC Units	Residential	0.63	0.68	1.34	1.39	0.78
Thermal Storage with ASHP	Residential	4.71	8.20	8.97	1.30	4.50
Residential Lighting	Residential	1.44	11.35	19.57	16.60	11.35
<b>Demand Response</b>						
Residential AC Cycling	Residential	1.69	1.69	2.46	2.24	1.59
<b>Commercial Programs</b>						
Commerical Lighting	Commerical	1.68	7.05	9.65	6.18	4.28
Commercial Motors - Replacement	Commerical	1.27	4.30	0.89	0.61	0.39
Commerical Motors - New / on Failure	Commerical	1.41	7.07	1.27	0.82	0.55
Variable Speed Drives - VFD'S	Commerical	0.99	10.70	4.12	4.01	1.98
Commercial Partnership Program (Custom)	Commercial	1.46	5.27	5.01	4.46	2.82
<b>Demand Response</b>						
Commercial Demand Response Program	Commercial	2.12	2.12	2.92	23.00	2.11
Interruptible Rate DR Program	Commercial	2.84	2.88	3.76	16.82	2.71

**Montana-Dakota Utilities Co.**  
**South Dakota Electric DSM Program Summary**  
**Table B-7**

Benefit/Cost Ratios						
DSM Program	Customer Class	RIM	Utility	Societal	Participant	Total Resource Cost
Total Portfolio		1.92	2.52	3.13	3.48	1.98
<b>Residential Programs</b>						
Central Air Conditioning Tier 1 (14.5 SEER)	Residential	1.08	1.26	1.76	0.84	0.78
Central Air Conditioning Tier 2 (16 SEER)	Residential	0.92	1.07	1.49	0.81	0.66
Central Air Conditioning Tier 2 - New	Residential	0.93	1.07	1.52	0.81	0.68
Window AC Units	Residential	0.54	0.59	1.12	1.50	0.66
Thermal Storage with ASHP	Residential					
Residential Lighting	Residential	1.49	9.59	16.60	19.19	9.59
<b>Demand Response</b>						
Residential AC Cycling	Residential	1.68	1.68	2.45	2.86	1.59
<b>Commercial Programs</b>						
Commerical Lighting	Commerical	2.26	6.21	8.95	5.62	3.96
Commercial Motors - Replacement	Commerical	1.69	3.88	0.90	0.58	0.39
Commerical Motors - New / on Failure	Commerical	2.11	6.70	1.36	0.80	0.58
Variable Speed Drives - VFD'S	Commerical	1.49	9.32	4.01	4.01	1.93
Commercial Partnership Program (Custom)	Commercial	1.88	4.40	4.52	4.02	2.54
<b>Demand Response</b>						
Commercial Demand Response Program	Commercial	2.19	2.19	2.96	4.73	2.11
Interruptible Rate DR Program	Commercial					

**Montana-Dakota Utilities Co.**  
**Electric Utility - Montana**  
**Demand-Side Management and Conservation Portfolio**  
**2016 - 2018 Program Years**

Program	Participants	Lifetime Energy Reduction	2018 Demand Reduction	Total Cost	Lifetime Cost/Kwh	2018 Cost/KW
<b>Residential Programs</b>						
Central Air Conditioning Tier 1 (14.5 SEER)	35	99,090	11	\$12,585	\$0.127	\$1,144.09
Central Air Conditioning Tier 2 (16 SEER) - Replacement	35	179,189	21	25,171	0.140	1,198.62
Central Air Conditioning Tier 2 - New	15	76,788	9	11,267	0.147	1,251.89
Window AC Units	15	3,348	1	939	0.280	939.00
Thermal Storage with ASHP	12	858,284	237	33,419	0.039	141.01
Residential Lighting	9,000	2,356,164	62	14,872	0.006	239.87
Total	<u>9,112</u>	<u>3,572,863</u>	<u>341</u>	<u>\$98,253</u>	<u>\$0.027</u>	<u>\$288.13</u>
<b>Demand Response</b>						
Residential AC Cycling	812	7,654,384	1,356	\$197,034	NA	\$145.31
<b>Total Residential</b>	<u>9,924</u>	<u>11,227,247</u>	<u>1,697</u>	<u>\$295,287</u>	<u>\$0.026</u>	<u>\$174.01</u>
<b>Commercial Programs</b>						
Commercial Lighting	20	9,614,320	108	\$75,504	\$0.008	\$699.11
Commercial Motors - Replacement	30	1,315,235	18	13,571	0.010	753.94
Commercial Motors - New / on Failure	30	590,034	8	3,620	0.006	452.50
Variable Speed Drives - VFD'S	20	6,711,030	0	18,402	0.003	#DIV/0!
Commercial Partnership Program (Custom)	10	10,773,502	338	121,455	0.011	359.33
Total Commercial	<u>110</u>	<u>29,004,121</u>	<u>472</u>	<u>\$232,552</u>	<u>\$0.008</u>	<u>\$492.69</u>
<b>Demand Response</b>						
Commercial Demand Response Program	2	1,629,498	7,344	\$1,148,926	\$0.705	\$156.44
Interruptible Rate DR Program	2	280,110	18,080	18,991	0.068	1.05
Total Commercial	<u>4</u>	<u>1,909,608</u>	<u>25,424</u>	<u>\$1,167,917</u>	<u>\$0.612</u>	<u>\$45.94</u>
<b>Total Commercial</b>	<u>114</u>	<u>30,913,729</u>	<u>25,896</u>	<u>\$1,400,469</u>	<u>\$0.045</u>	<u>\$54.08</u>
<b>Education and Outreach</b>				\$41,600		
<b>Total Programs without DR</b>	<u>9,222</u>	<u>32,576,984</u>	<u>813</u>	<u>\$372,405</u>	<u>\$0.011</u>	<u>\$458.06</u>
<b>Total Demand Response</b>	816	9,563,992	26,780	\$1,364,951	\$0.143	\$50.97
<b>Total Programs</b>	<u>10,038</u>	<u>42,140,976</u>	<u>27,593</u>	<u>\$1,737,356</u>	<u>\$0.041</u>	<u>\$62.96</u>

**Montana-Dakota Utilities Co.**  
**Electric Utility - North Dakota**  
**Demand-Side Management and Conservation Portfolio**  
**2016 - 2018 Program Years**

Program	Participants	Lifetime Energy Reduction	2018 Demand Reduction	Total Cost	Lifetime Cost/Kwh	2018 Cost/KW
<b>Residential Programs</b>						
Central Air Conditioning Tier 1 (14.5 SEER)	70	154,747	23	\$24,177	\$0.156	\$1,051.17
Central Air Conditioning Tier 2 (16 SEER) - Replacement	260	1,038,653	156	180,156	0.173	1,154.85
Central Air Conditioning Tier 2 - New	370	1,478,087	222	255,316	0.173	1,150.07
Window AC Units	155	27,053	7	8,831	0.326	1,261.57
Thermal Storage with ASHP	35	2,503,312	692	92,841	0.037	134.16
Residential Lighting	30,000	7,853,886	1,836	34,769	0.004	18.94
Total	30,890	13,055,738	2,936	\$596,090	\$0.046	\$203.03
<b>Demand Response</b>						
Residential AC Cycling	3,045	7,654,384	3,389	\$873,983	NA	\$257.89
<b>Total Residential</b>	<u>33,935</u>	<u>20,710,122</u>	<u>6,325</u>	<u>\$1,470,073</u>	\$0.071	\$232.42
<b>Commercial Programs</b>						
Commerical Lighting	60	28,842,947	650	\$210,678	\$0.007	\$324.12
Commercial Motors - Replacement	45	1,984,604	28	19,299	0.010	689.25
Commerical Motors - New / on Failure	45	890,329	12	5,147	0.006	428.92
Variable Speed Drives - VFD'S	45	15,099,810	0	38,599	0.003	#DIV/0!
Commercial Partnership Program (Custom)	22	23,701,702	746	251,681	0.011	337.37
Total Commercial	217	70,519,392	1,436	\$525,404	\$0.007	\$365.88
<b>Demand Response</b>						
Commercial Demand Response Program	8	1,925,764	8,700	\$100,454	\$0.052	\$11.55
Interruptible Rate DR Program	0	3,014,291	146,422	198,289	0.066	1.35
	8	4,940,055	155,122	\$298,743	\$0.060	\$1.93
<b>Total Commercial</b>	<u>225</u>	<u>75,459,447</u>	<u>156,558</u>	<u>\$824,147</u>	\$0.011	\$5.26
<b>Education and Outreach</b>				\$70,000		
<b>Total Programs without DR</b>	<u>31,107</u>	<u>83,575,130</u>	<u>4,372</u>	<u>\$1,191,494</u>	\$0.014	\$272.53
<b>Total Demand Response</b>	3,053	12,594,439	158,511	\$1,172,726	\$0.093	\$7.40
<b>Total Programs</b>	<u>34,160</u>	<u>96,169,569</u>	<u>162,883</u>	<u>\$2,364,220</u>	\$0.025	\$14.51

**Montana-Dakota Utilities Co.  
Electric Utility - South Dakota  
Demand-Side Management and Conservation Portfolio  
2016 - 2018 Program Years**

Program	Participants	Lifetime Energy Reduction	2018 Demand Reduction	Total Cost	Lifetime Cost/Kwh	2018 Cost/KW
<b>Residential Programs</b>						
Central Air Conditioning Tier 1 (14.5 SEER)	17	46,477	6	\$6,473	\$0.139	\$1,078.83
Central Air Conditioning Tier 2 (16 SEER)	17	84,060	10	12,945	0.154	1,294.50
Central Air Conditioning Tier 2 - New	6	29,664	4	4,875	0.164	1,218.75
Window AC Units	6	1,341	0	407	0.304	1,507.41
Thermal Storage with ASHP	0	0	0	0	#DIV/0!	#DIV/0!
Residential Lighting	3,000	785,385	180	4,063	0.005	22.57
Total	3,046	946,927	200	\$28,763	\$0.030	\$143.62
<b>Demand Response</b>						
Residential AC Cycling	203	1,820,726	226	\$16,436	NA	\$72.73
<b>Total Residential</b>	<u>3,249</u>	<u>2,767,653</u>	<u>426</u>	<u>\$45,199</u>	\$0.016	\$106.03
<b>Commercial Programs</b>						
Commerical Lighting	10	4,807,152	108	\$39,814	\$0.008	\$368.65
Commercial Motors - Replacement	6	263,032	4	2,902	0.011	725.50
Commerical Motors - New / on Failure	6	118,010	2	774	0.007	387.00
Variable Speed Drives - VFD'S	5	1,677,764	0	4,902	0.003	#DIV/0!
Commercial Partnership Program (Custom)	3	3,232,060	102	40,627	0.013	398.30
Total Commercial	<u>30</u>	<u>10,098,018</u>	<u>216</u>	<u>\$89,019</u>	\$0.009	\$412.13
<b>Demand Response</b>						
Commercial Demand Response Program	4	215,471	904	\$8,988	\$0.042	\$9.94
Interruptible Rate DR Program	0	0	0	0	#DIV/0!	#DIV/0!
Total Commercial	<u>4</u>	<u>215,471</u>	<u>904</u>	<u>\$8,988</u>	\$0.042	\$9.94
<b>Total Commercial</b>	<u>34</u>	<u>10,313,489</u>	<u>1,120</u>	<u>\$98,007</u>	\$0.010	\$87.51
<b>Education and Outreach</b>				\$22,850		
<b>Total Programs without DR</b>	<u>3,076</u>	<u>11,044,945</u>	<u>416</u>	<u>\$140,632</u>	\$0.013	\$337.84
<b>Total Demand Response</b>	207	2,036,197	1,130	\$25,424	\$0.012	\$22.50
<b>Total Programs</b>	<u>3,283</u>	<u>13,081,142</u>	<u>1,546</u>	<u>\$166,056</u>	\$0.013	\$107.39

**Montana-Dakota Utilities Co.**  
**Electric Utility - Integrated System Total**  
**Demand-Side Management and Conservation Portfolio**  
**2016 - 2018 Program Years**

<b>Program</b>	<b>Participants</b>	<b>Lifetime Energy Reduction</b>	<b>2018 Demand Reduction</b>	<b>Total Cost</b>	<b>Lifetime Cost/Kwh</b>	<b>2018 Cost/KW</b>
<b>Residential Programs</b>						
Central Air Conditioning Tier 1 (14.5 SEER)	122	300,314	40	\$43,235	\$0.144	\$1,080.88
Central Air Conditioning Tier 2 (16 SEER) - Replacement	312	1,301,902	187	218,272	0.168	1,167.23
Central Air Conditioning Tier 2 - New	391	1,584,539	235	271,458	0.171	1,155.14
Window AC Units	176	31,742	8	10,177	0.321	1,230.59
Thermal Storage with ASHP	47	3,361,596	929	126,260	0.038	135.91
Residential Lighting	42,000	10,995,435	2,078	53,704	0.005	25.84
<b>Total</b>	<b>43,048</b>	<b>17,575,528</b>	<b>3,477</b>	<b>\$723,106</b>	<b>\$0.041</b>	<b>\$207.95</b>
<b>Demand Response</b>						
Residential AC Cycling	4,060	17,129,494	4,971	\$1,087,453	NA	\$218.76
<b>Total Residential</b>	<b>47,108</b>	<b>34,705,022</b>	<b>8,448</b>	<b>\$1,810,559</b>	<b>\$0.052</b>	<b>\$214.31</b>
<b>Commercial Programs</b>						
Commercial Lighting	90	43,264,419	866	\$325,996	\$0.008	\$376.44
Commercial Motors - Replacement	81	3,562,871	50	35,772	0.010	715.44
Commercial Motors - New / on Failure	81	1,598,373	22	9,541	0.006	433.68
Variable Speed Drives - VFD'S	70	23,488,604	0	61,903	0.003	#DIV/0!
Commercial Partnership Program (Custom)	35	37,707,264	1,186	413,763	0.011	348.87
<b>Total Commercial</b>	<b>357</b>	<b>109,621,531</b>	<b>2,124</b>	<b>\$846,975</b>	<b>\$0.008</b>	<b>\$398.76</b>
<b>Demand Response</b>						
Commercial Demand Response Program	14	3,770,733	16,948	\$1,258,368	\$0.334	\$74.25
Interruptible Rate DR Program	2	3,294,401	164,502	\$217,280	0.066	1.32
	16	7,065,134	181,450	\$1,475,648	\$0.209	\$8.13
<b>Total Commercial</b>	<b>373</b>	<b>116,686,665</b>	<b>183,574</b>	<b>\$2,322,623</b>	<b>\$0.020</b>	<b>\$12.65</b>
<b>Education and Outreach</b>				\$134,450		
<b>Total Programs without DR</b>	<b>43,405</b>	<b>127,197,059</b>	<b>5,601</b>	<b>\$1,704,531</b>	<b>\$0.013</b>	<b>\$304.31</b>
<b>Total Demand Response</b>	<b>4,076</b>	<b>24,194,628</b>	<b>186,421</b>	<b>\$2,563,101</b>	<b>\$0.106</b>	<b>\$13.75</b>
<b>Total Programs</b>	<b>47,481</b>	<b>151,391,687</b>	<b>192,022</b>	<b>\$4,267,632</b>	<b>\$0.028</b>	<b>\$22.22</b>

**Montana-Dakota Utilities Co.  
Input Data Summary  
Electric Conservation Model**

**Table B-4**

Input No.	Input Data Description	Information Source	Montana Residential	Montana Commercial	North Dakota Residential	North Dakota Commercial	South Dakota Residential	South Dakota Commercial
1	Retail Rate (Summer)	System average retail rate for customer class based	\$0.09033	\$0.06569	\$0.08197	\$0.08579	\$0.09021	\$0.07621
	Retail Rate (Winter)	System average retail rate for customer class based	\$0.07591	0.05369	\$0.07128	0.06943	\$0.08577	0.07438
	Retail Escalation Rate		4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
1a	Fuel Cost Adjustment	Average fuel cost adjustment for customer class base to be effective January 1, 2011	\$0.00418	\$0.00418	\$0.00496	\$0.00496	\$0.00815	\$0.00815
	Fuel Escalation Rate		2.80%	2.80%	2.80%	2.80%	2.80%	2.80%
2	System Marginal Energy Costs	Actual costs for years 1 through 10						
	Escalation Rate (after Yr. 10)	Escalation factor applied after year 10	3.00000%	3.00000%	3.00000%	3.00000%	3.00000%	3.00000%
3	Retail Summer Demand Cost (\$/kW/season)	Seasonal demand cost based on program availability	\$0.00	\$38.00	\$0.00	\$45.00	\$0.00	\$20.00
3a	Retail Winter Demand Cost (\$/kW/season)	Seasonal demand cost based on program availability	\$0.00	\$68.00	\$0.00	\$66.00	\$0.00	\$40.00
	Escalation Rate		4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
4	Electric Margin (\$/KWh)	Average margin applicable to customer class	\$0.06075	\$0.04381	\$0.05993	\$0.05530	\$0.05546	\$0.03409
	Escalation Rate		4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
5	Avoided Capacity Costs (\$/kW/yr.)	Demand cost based on estimated levelized cost of combustion turbine	\$85.62	\$85.62	\$85.62	\$85.62	\$85.62	\$85.62
	Reserve Capacity	Based on MISO Non-Coincident Peak	14.30%	14.30%	14.30%	14.30%	14.30%	14.30%
	Escalation Rate		3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
6	Variable O&M	Montana-Dakota's historical information	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Escalation Rate		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
7	Environmental Damage Factor	\$30 / ton Carbon Cost	30.7%	30.7%	30.7%	30.7%	30.7%	30.7%
	Escalation Rate		3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
8	Participation Discount Rate	Federal Reserve Consumer Credit Interest rate 12 Months ended September 30, 2010	10.22%	10.22%	10.22%	10.22%	10.22%	10.22%
9	Utility Discount Rate	Montana-Dakota's authorized average cost of capital	9.610%	9.610%	8.699%	8.699%	9.610%	9.610%
10	Societal Discount Rate	Equal to the 30 year T-Bill rate average for 2010	3.34%	3.34%	3.34%	3.34%	3.34%	3.34%

**Montana-Dakota Utilities Co.  
Input Data Summary  
Electric Conservation Model**

**Table B-4**

Input No.	Input Data Description	Information Source	Montana Residential	Montana Commercial	North Dakota Residential	North Dakota Commercial	South Dakota Residential	South Dakota Commercial
11	General Input Data Year	2010	2015	2015	2015	2015	2015	2015
12	Project Analysis Yr. 1	Year(s) program will be implemented	2016	2016	2016	2016	2016	2016
	Yr. 2		2017	2017	2017	2017	2017	2017
	Yr. 3		2018	2018	2018	2018	2018	2018
13	Utility Project Costs	Total direct cost to the utility caused by implementing the program(s)						
	Admin Costs	Administration costs						
	Promo Costs	Promotional costs						
14	Direct Participant Project Costs (\$/Part.)	Direct costs that the participant is required to pay to participate in the DSM program						
	Escalation Rate Yr. 1	Consumer Price Index based on 3 yr. average	1.73%	1.73%	1.73%	1.73%	1.73%	1.73%
	Yr. 2	Consumer Price Index based on 3 yr. average	1.73%	1.73%	1.73%	1.73%	1.73%	1.73%
	Yr. 3	Consumer Price Index based on 3 yr. average	1.73%	1.73%	1.73%	1.73%	1.73%	1.73%
14a	Other Participant Costs (Annual \$/Part.) Yr. 1		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Yr. 2		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Yr. 3		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Escalation Rate Yr. 1		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Yr. 2		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Yr. 3		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
14b	Other Participant Savings (Annual \$/Part.) Yr. 1		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Yr. 2		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Yr. 3		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Escalation Rate Yr. 1		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Yr. 2		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Yr. 3		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
15	Project Life	Based on the estimated useful life of the energy saving equipment						
16	Avg. Summer Demand Reduction	Avg demand reduction (kW) caused by the DSM program						

**Montana-Dakota Utilities Co.  
Input Data Summary  
Electric Conservation Model**

**Table B-4**

<b>Input No.</b>	<b>Input Data Description</b>	<b>Information Source</b>	<b>Montana Residential</b>	<b>Montana Commercial</b>	<b>North Dakota Residential</b>	<b>North Dakota Commercial</b>	<b>South Dakota Residential</b>	<b>South Dakota Commercial</b>
16a	Avg. Winter Demand Reduction	Avg demand reduction (kW) caused by the DSM program						
17	Avg. Winter Energy Reduction	Avg energy reduction (kWh) caused by the DSM program						
17a	Avg. Summer Energy Reduction	Avg energy reduction (kWh) caused by the DSM program						
18a	System Demand Line Loss Factor Yr. 1	Historical demand line loss factor	12.980%	12.980%	12.980%	12.980%	12.980%	12.980%
	Yr. 2		12.980%	12.980%	12.980%	12.980%	12.980%	12.980%
	Yr. 3		12.980%	12.980%	12.980%	12.980%	12.980%	12.980%
18b	System Energy Line Loss Factor Yr. 1	Historical energy line loss factor	7.7350%	7.7350%	7.7350%	7.7350%	7.7350%	7.7350%
	Yr. 2		7.7350%	7.7350%	7.7350%	7.7350%	7.7350%	7.7350%
	Yr. 3		7.7350%	7.7350%	7.7350%	7.7350%	7.7350%	7.7350%
19	Number of Participants	Total projected participation by customers, kW load target, or equipment saturation						
20	Incentive/Participant	Incentive provided to the participant						
21	Effective Tax Rate	Effective tax rate	39.3875%	39.3875%	37.94%	37.94%	35.00%	35.00%
22	Total Annual Summer Kwh Saved	Total Kwh saved from the program in the year implemented						
	Total Annual Winter Kwh Saved	Total Kwh saved from the program in the year implemented						
23	Total Annual Summer Kw Saved	Total Kw saved from the program in the year implemented						
	Total Annual Winter Kw Saved	Total Kw saved from the program in the year implemented						

Montana Electric DSM Programs  
 Technical Assumptions

2011 - 2013 Program Years	Participation Assumptions			Technical Assumptions											Cost Assumptions				
	Customer Class	Number of Participants Year 1	Number of Participants Year 2	Number of Participants Year 3	Project Life	Baseline Efficiency	Average High Efficiency	Average Summer kWh Saved /part	Average Winter kWh Saved /part	Average Summer kW Saved /part	Average Winter kW Saved /part	Average Peak Load Factor of Measure	coincident Summer Peak Avg kW Saved / Part	coincident Winter Peak Avg kW Saved / Part	Average Non-Energy Benefits / Part	Cost Std Equip	Cost High Eff Equip	incremental Cost	Average Incentive /Part
<b>Residential Programs</b>																			
Central Air Conditioning Tier 1 (14.5 SEER)	Residential	5	10	20	18	13.0	14.50	146	0	0.2900	0.0000	1.0000	0.2900	0.0000	0.00	NA	NA	\$534	\$300
Central Air Conditioning Tier 2 (16 SEER) - Replacement	Residential	5	10	20	18	13.0	16.00	264	0	0.5300	0.0000	1.0000	0.5300	0.0000	0.00	NA	NA	1,071	600
Central Air Conditioning Tier 2 - New	Residential	5	5	5	18	13.0	16.00	264	0	0.5300	0.0000	1.0000	0.5300	0.0000	0.00	NA	NA	1,071	600
Window AC Units	Residential	5	5	5	9	10.9	11.30	23	0	0.0400	0.0000	1.0000	0.0400	0.0000	0.00	NA	NA	43	50
Thermal Storage with ASHP	Residential	2	5	5	14	1.3	1.74	0	4,742	0.0000	35.0000	0.5000	0.0000	17.5000	0.00	NA	NA	4,500	2,304
Residential Lighting	Residential	3,000	3,000	3,000	9	43.0	17.00	9	18	0.0031	0.0025	1.0000	0.0031	0.0025	0.00	NA	NA	1	1
<b>Demand Response</b>																			
Residential AC Cycling	Residential	0	400	412	15	NA	NA	0	0	3.6000	0.0000	0.2800	1.0000	0.0000	0.00	NA	NA	0	50
<b>Commercial Programs</b>																			
Commercial Lighting	Commercial	5	10	5	18	T-12	T-8	8,263	16,526	4.8000	4.8000	1.0000	4.8000	4.8000	0.00	NA	NA	5,345	3,060
Commercial Motors - Replacement	Commercial	5	10	15	20	92.4	94.60	727	1,453	0.2700	0.2700	1.0000	0.2700	0.2700	0.00	NA	NA	4,719	375
Commercial Motors - New / on Failure	Commercial	5	10	15	20	93.6	94.60	326	652	0.12	0.1200	1.0000	0.1200	0.1200	0.00	NA	NA	1,458	100
Variable Speed Drives - VFD'S	Commercial	5	5	10	15	NA	NA	6,921	13,843	0.0000	0.0000	0.7500	0.0000	0.0000	0.00	NA	NA	4,540	750
Commercial Partnership Program (Custom)	Commercial	2	3	5	10	NA	NA	50,000	50,000	20.0000	20.0000	0.7500	15.0000	15.0000	0.00	NA	NA	20,000	10,000
<b>Demand Response</b>																			
Commercial Demand Response Program	Commercial	0	3	5	10	NA	NA	10,000	0	400.0000	0.0000	1.0000	400.0000	0.0000	0.00	NA	NA	0	0
Interruptible Rate DR Program	Commercial	0	0	0	NA	NA	10,000	0	400.0000	0.0000	1.0000	400.0000	0.0000	0.00	NA	NA	0	0	
<b>Totals</b>		<b>10,042</b>	<b>3,044</b>	<b>3,476</b>	<b>3,522</b>														
Total Less Demand Response		3,044	3,473	3,105															

**Additional Technical Notes**

\*Average kW savings per season is base on total kW saved & allocated to season based on normal usage patterns of the technology. (i.e. AC summer only, motors 4 months summer & 8 months winter)  
 \*\*Air Conditioning tune-up, consisting of computerized diagnostic and refrigerant charge / air flow corrections

North Dakota Electric DSM Programs  
 Technical Assumptions

2011 - 2013 Program Years	Participation Assumptions			Technical Assumptions												Cost Assumptions			
	Customer Class	Number of Participants Year 1	Number of Participants Year 2	Number of Participants Year 3	Project Life	Baseline Efficiency	Average High Efficiency	Average Summer kWh Saved /part	Average Winter kWh Saved /part	Average Summer kW Saved /part	Average Winter kW Saved /part	Average Peak Load Factor of Measure	coincident Summer Peak Avg kW Saved / Part	coincident Winter Peak Avg kW Saved / Part	Average Non-Energy Benefits /Part	Cost Std Equip	Cost High Eff Equip	incremental Cost	Average Incentive /Part
<b>Residential Programs</b>																			
Central Air Conditioning Tier 1 (14.5 SEER)	Residential	20	20	30	18	13.0	14.50	114	0	0.2900	0.0000	1.0000	0.2900	0.0000	0.00	NA	NA	\$534	\$300
Central Air Conditioning Tier 2 (16 SEER) - Replacement	Residential	80	80	100	18	13.0	16.00	206	0	0.5300	0.0000	1.0000	0.5300	0.0000	0.00	NA	NA	1,071	600
Central Air Conditioning Tier 2 - New	Residential	100	120	150	18	13.0	16.00	206	0	0.5300	0.0000	1.0000	0.5300	0.0000	0.00	NA	NA	1,071	600
Window AC Units	Residential	30	50	75	9	10.9	11.30	18	0	0.0400	0.0000	1.0000	0.0400	0.0000	0.00	NA	NA	43	50
Thermal Storage with ASHP	Residential	10	10	15	14	1.3	1.74	0	4,742	0.0000	35.0000	0.5000	0.0000	17.5000	0.00	NA	NA	4,500	2,304
Residential Lighting	Residential	10,000	10,000	10,000	9	43.0	17.00	9	18	0.0031	0.0025	1.0000	0.0031	0.0025	0.00	NA	NA	1	1
<b>Demand Response</b>																			
Residential AC Cycling	Residential	0	1,500	1,545	15	NA	NA	0	0	3.60	0.00	0.28	1.00	0.00	0.00	NA	NA	0	50
<b>Commercial Programs</b>																			
Commercial Lighting	Commercial	15	20	25	18	T-12	T-8	8,263	16,526	4.8000	4.8000	1.0000	4.8000	4.8000	0.00	NA	NA	5,345	3,060
Commercial Motors - Replacement	Commercial	10	15	20	20	92.4	94.60	727	1,453	0.2700	0.2700	1.0000	0.2700	0.2700	0.00	NA	NA	4,719	375
Commercial Motors - New / on Failure	Commercial	10	15	20	20	93.6	94.60	326	652	0.12	0.1200	1.0000	0.1200	0.1200	0.00	NA	NA	1,458	100
Variable Speed Drives - VFD'S	Commercial	10	15	20	15	NA	NA	6,921	13,843	0.0000	0.0000	0.7500	0.0000	0.0000	0.00	NA	NA	4,540	750
Commercial Partnership Program (Custom)	Commercial	5	7	10	10	NA	NA	50,000	50,000	20.00	20.00	0.75	15.00	15.00	0.00	NA	NA	20,000	10,000
<b>Demand Response</b>																			
Commercial Demand Response Program	Commercial	0	9	18	10	NA	NA	10,000	0	400.00	0.00	1.00	400.00	0.00	0.00	NA	NA	0	0
Interruptible Rate DR Program	Commercial	0	0	0		NA	NA	10,000	0	1333.00	0.00	1.00	1333.00	0.00	0.00	NA	NA	0	0
<b>Totals</b>		<b>34,179</b>	<b>10,290</b>	<b>11,861</b>	<b>12,028</b>														
Total Less Demand Response			10,290	10,352	10,465														

**Additional Technical Notes**

\*Average kW savings per season is based on total kW saved & allocated to season based on normal usage patterns of the technology. (i.e. AC summer only, motors 4 months summer & 8 months winter)  
 \*\*Air Conditioning tune-up, consisting of computerized diagnostic and refrigerant charge / air flow corrections

South Dakota Electric DSM Programs  
 Technical Assumptions

2011 - 2013 Program Years	Participation Assumptions			Technical Assumptions												Cost Assumptions			
	Customer Class	Number of Participants Year 1	Number of Participants Year 2	Number of Participants Year 3	Project Life	Baseline Efficiency	Average High Efficiency	Average Summer kWh Saved /part	Average Winter kWh Saved /part	Average Summer kW Saved /part	Average Winter kW Saved /part	Average Peak Load Factor of Measure	coincident Summer Peak Avg kW Saved / Part	coincident Winter Peak Avg kW Saved /Part	Average Non-Energy Benefits /Part	Cost Std Equip	Cost High Eff Equip	incremental Cost	Average Incentive /Part
<b>Residential Programs</b>																			
Central Air Conditioning Tier 1 (14.5 SEER)	Residential	2	5	10	18	13.0	14.50	141	0	0.2900	0.0000	1.0000	0.2900	0.0000	0.00	NA	NA	\$534	\$300
Central Air Conditioning Tier 2 (16 SEER)	Residential	2	5	10	18	13.0	16.00	255	0	0.5300	0.0000	1.0000	0.5300	0.0000	0.00	NA	NA	1,071	600
Central Air Conditioning Tier 2 - New	Residential	2	2	2	18	13.0	16.00	255	0	0.5300	0.0000	1.0000	0.5300	0.0000	0.00	NA	NA	1,071	600
Window AC Units	Residential	2	2	2	9	10.9	11.30	23	0	0.0400	0.0000	1.0000	0.0400	0.0000	0.00	NA	NA	43	50
Thermal Storage with ASHP	Residential				14	1.3	1.74	0	4,742	0.0000	35.0000	0.5000	0.0000	17.5000	0.00	NA	NA	4,500	2,304
Residential Lighting	Residential	1,000	1,000	1,000	9	43.0	17.00	9	18	0.0031	0.0025	1.0000	0.0031	0.0025	0.00	NA	NA	1	1
<b>Demand Response</b>																			
Residential AC Cycling	Residential	0	100	103	15	NA	NA	0	0	3.60	0.00	0.28	1.00	0.00	0.00	NA	NA	0	50
<b>Commercial Programs</b>																			
Commerical Lighting	Commerical	2	3	5	18	T-12	T-8	8,263	16,526	4,8000	4,8000	1.0000	4,8000	4,8000	0.00	NA	NA	5,345	3,060
Commercial Motors - Replacement	Commerical	1	2	3	20	92.4	94.60	727	1,453	0.2700	0.2700	1.0000	0.2700	0.2700	0.00	NA	NA	4,719	375
Commercial Motors - New / on Failure	Commerical	1	2	3	20	93.6	94.60	326	652	0.12	0.1200	1.0000	0.1200	0.1200	0.00	NA	NA	1,458	100
Variable Speed Drives - VFD'S	Commerical	1	2	2	15	NA	NA	6,921	13,843	0.0000	0.0000	0.7500	0.0000	0.0000	0.00	NA	NA	4,540	750
Commercial Partnership Program (Custom)	Commerical	1	1	1	10	NA	NA	50,000	50,000	20.00	20.00	0.75	15.00	15.00	0.00	NA	NA	20,000	10,000
<b>Demand Response</b>																			
Commercial Demand Response Program	Commerical	0	1	2	10	NA	NA	10,000	0	400.00	0.00	1.00	400.00	0.00	0.00	NA	NA	0	0
Interruptible Rate DR Program	Commerical																		
<b>Totals</b>		<b>3,282</b>	<b>1,014</b>	<b>1,125</b>	<b>1,143</b>														
Total Less Demand Response			1,014	1,024	1,038														

**Additional Technical Notes**

\*Average kW savings per season is base on total kW saved & allocated to season based on normal usage patterns of the technology. (i.e. AC summer only, motors 4 months summer & 8 months winter)  
 \*\*Air Conditioning tune-up, consisting of computerized diagnostic and refrigerant charge / air flow corrections

## Commercial Demand Response Program

This program is marketed and aggregated by Cpower of behalf of Montana-Dakota. Commercial customers with loads in excess of 150 kW are targeted. All load will be shed during events and load with back-up generation is allowed to participate.

### Program kW Goals - Integrated System

Summer 2015	10,000
Summer 2016	2,500
Summer 2017	2,500
Summer 2018	0
<b>Projected kW</b>	<b>15,000</b>
Overall goal remains	25,000

	Lg Ind Customers	Sm ind Customers	Lg Comm Customers	Total Customers
Montana	37	83	227	347
North Dakota	43	57	787	887
South Dakota	5	2	95	102
<b>Total</b>	<b>85</b>	<b>142</b>	<b>1,109</b>	<b>1,336</b>

Customer counts as of December 31, 2014

### Assumptions

Resource on average needed for:		25 hrs/yr
Capacity Cost	\$	4.17 kW/month
Average Load Factor		100%
Energy Cost	\$	0.30 kWh

	2015				
	Participation Goal	kW Goal	Capacity Cost	Energy Cost	kWh Saved
Montana	4	4,500	\$ 225,180	\$ 33,750	112,500
North Dakota	26	5,500	\$ 275,220	\$ 41,250	137,500
South Dakota	-	-	\$ -	\$ -	-
<b>Total</b>	<b>30</b>	<b>10,000</b>	<b>\$ 500,400</b>	<b>\$ 75,000</b>	<b>250,000</b>

	2016				
	Participation Goal	kW Goal	Capacity Cost	Energy Cost	kWh Saved
Montana	5	5,500	\$ 275,220	\$ 41,250	137,500
North Dakota	30	6,600	\$ 330,264	\$ 49,500	165,000
South Dakota	2	400	\$ 20,016	\$ 3,000	10,000
<b>Total</b>	<b>37</b>	<b>12,500</b>	<b>\$ 625,500</b>	<b>\$ 93,750</b>	<b>312,500</b>

	2017				
	Participation Goal	kW Goal	Capacity Cost	Energy Cost	kWh Saved
Montana	6	6,500	\$ 325,260	\$ 48,750	162,500
North Dakota	34	7,700	\$ 385,308	\$ 57,750	192,500
South Dakota	4	800	\$ 40,032	\$ 6,000	20,000
<b>Total</b>	<b>44</b>	<b>15,000</b>	<b>\$ 750,600</b>	<b>\$ 112,500</b>	<b>375,000</b>

	2018				
	Participation Goal	kW Goal	Capacity Cost	Energy Cost	kWh Saved
Montana	6	6,500	\$ 325,260	\$ 48,750	162,500
North Dakota	34	7,700	\$ 385,308	\$ 57,750	192,500
South Dakota	4	800	\$ 40,032	\$ 6,000	20,000
<b>Total</b>	<b>44</b>	<b>15,000</b>	<b>\$ 750,600</b>	<b>\$ 112,500</b>	<b>375,000</b>

# IT Demand Response Rate

Available to customers over 500 kW  
 Currently only available in North Dakota / Montana

## Program kW Goals - Integrated System

Summer 2015	14,400
Summer 2016	1,000
Summer 2017	600
Summer 2018	-
	<b>16,000</b>

2015					
	Participation Goal	kW Goal	Capacity Cost	Energy Cost	kWh Avoided
Montana	-	-	\$ -	\$ -	-
North Dakota	7	14,400	\$ 649,728	\$ 36,975	310,875
South Dakota	-	-	\$ -	\$ -	-
<b>Total</b>	<b>7</b>	<b>14,400</b>	<b>\$ 649,728</b>	<b>\$ 36,975</b>	<b>310,875</b>

2016					
	Participation Goal	kW Goal	Capacity Cost	Energy Cost	kWh Avoided
Montana	1	1,000	\$ 45,120	\$ -	16,250
North Dakota	7	14,400	\$ 649,728	\$ 36,975	310,875
South Dakota	-	-	\$ -	\$ -	-
<b>Total</b>	<b>8</b>	<b>15,400</b>	<b>\$ 694,848</b>	<b>\$ 36,975</b>	<b>327,125</b>

2017					
	Participation Goal	kW Goal	Capacity Cost	Energy Cost	kWh Avoided
Montana	2	1,600	\$ 72,192	\$ -	26,000
North Dakota	7	14,400	\$ 649,728	\$ 36,975	310,875
South Dakota	-	-	\$ -	\$ -	-
<b>Total</b>	<b>9</b>	<b>16,000</b>	<b>\$ 721,920</b>	<b>\$ 36,975</b>	<b>336,875</b>

2018					
	Participation Goal	kW Goal	Capacity Cost	Energy Cost	kWh Avoided
Montana	2	1,600	\$ 72,192	-	26,000
North Dakota	7	14,400	\$ 649,728	36,975	310,875
South Dakota	-	-	\$ -	-	-
<b>Total</b>	<b>9</b>	<b>16,000</b>	<b>\$ 721,920</b>	<b>\$ 36,975</b>	<b>336,875</b>

## Assumptions

Resource on average needed for:	25 hrs/yr
Capacity Cost	\$ 3.76 kW/month
Avoided energy available for payment	217,500 kWh
Energy Cost	\$ 0.17 kWh
Average kW per customer	1000 kW
Program Life	10 years

## Air Conditioning Cycling Program

Program will be a 100% Wi-Fi Thermostat based program for central AC to both residential and small commercial customers.  
Incentive will be provided as a monthly bill credit for summer peak season 4-months.

	Residential Customers	Sm Commercial Customers	AC Saturation	Total Available	Goal	Saturation	State %
Montana	20,114	5,056	60%	15,102	2,000	13.2%	20%
North Dakota	75,508	11,555	60%	52,238	7,500	14.4%	75%
South Dakota	6,556	1,827	60%	5,030	500	9.9%	5%
<b>Total</b>	<b>102,178</b>	<b>18,438</b>		<b>72,370</b>	<b>10,000</b>	<b>13.8%</b>	

As of December 2014

Program Costs	\$/Unit	Year 0 2016	Year 1 2017	Year 2 2018	Year 3 2019	Year 4 2020	Year 5 2021	Year 6 2022	Year 7 2023	Year 8 2024	Year 9 2025	Year 10 2026	Year 11 2027	Year 12 2028	Year 13 2029	Year 14 2030	Year 15 2031	Total
DRAS Development	One Time Fee	\$ 100,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
DRAS Annual licensing Fee	\$3.00	\$ -	\$ 1,200	\$ 2,436	\$ 3,709	\$ 5,020	\$ 6,371	\$ 6,411	\$ 6,452	\$ 6,493	\$ 6,533	\$ 6,574	\$ 6,614	\$ 6,655	\$ 6,695	\$ 6,736	\$ 6,776	\$ 944,700
T-Stat Annual licensing Fee	\$20.00	\$ -	\$ 40,000	\$ 80,000	\$ 120,000	\$ 160,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000
Customer Connection Cost	\$50.00	\$ -	\$ 100,000	\$ 103,000	\$ 106,090	\$ 109,273	\$ 112,551	\$ 3,377	\$ 3,377	\$ 3,377	\$ 3,377	\$ 3,377	\$ 3,377	\$ 3,377	\$ 3,377	\$ 3,377	\$ 3,377	\$ 3,377
Marketing budget (In House or Hwell ?)	\$	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,001	\$ 10,002	\$ 10,003	\$ 10,004	\$ 10,005	\$ 10,005
Customer Incentive Costs (\$10/month)	\$40.00	\$ -	\$ 80,000	\$ 160,000	\$ 240,000	\$ 320,000	\$ 400,000	\$ 400,000	\$ 400,000	\$ 400,000	\$ 400,000	\$ 400,000	\$ 400,000	\$ 400,000	\$ 400,000	\$ 400,000	\$ 400,000	\$ 400,000
Thermostat Rebate Cost	\$60.00	\$ -	\$ 120,000	\$ 123,600	\$ 127,308	\$ 131,127	\$ 135,061	\$ 4,052	\$ 4,052	\$ 4,052	\$ 4,052	\$ 4,052	\$ 4,052	\$ 4,052	\$ 4,052	\$ 4,052	\$ 4,052	\$ 4,052
<b>Total Cost</b>	<b>\$</b>	<b>\$ 120,000</b>	<b>\$ 361,200</b>	<b>\$ 489,036</b>	<b>\$ 617,107</b>	<b>\$ 745,420</b>	<b>\$ 873,983</b>	<b>\$ 623,840</b>	<b>\$ 623,880</b>	<b>\$ 623,921</b>	<b>\$ 623,961</b>	<b>\$ 624,002</b>	<b>\$ 624,043</b>	<b>\$ 624,085</b>	<b>\$ 624,126</b>	<b>\$ 624,168</b>	<b>\$ 624,210</b>	<b>\$ 9,446,983</b>
Cost per kW		\$ 241	\$ 122.26	\$ 102.85	\$ 93.18	\$ 87.40	\$ 62.38	\$ 62.39	\$ 62.39	\$ 62.40	\$ 62.40	\$ 62.40	\$ 62.40	\$ 62.41	\$ 62.41	\$ 62.42	\$ 62.42	\$ 944.70
MT Cost	\$	\$ 24,000	\$ 72,240	\$ 97,807	\$ 123,421	\$ 149,084	\$ 174,797	\$ 124,768	\$ 124,776	\$ 124,784	\$ 124,792	\$ 124,800	\$ 124,809	\$ 124,817	\$ 124,825	\$ 124,834	\$ 124,842	\$ 1,889,397
ND Cost	\$	\$ 90,000	\$ 270,900	\$ 366,777	\$ 462,830	\$ 559,065	\$ 655,487	\$ 467,880	\$ 467,910	\$ 467,941	\$ 467,971	\$ 468,001	\$ 468,033	\$ 468,064	\$ 468,095	\$ 468,126	\$ 468,157	\$ 7,085,237
SD Cost	\$	\$ 6,000	\$ 18,060	\$ 24,452	\$ 30,855	\$ 37,271	\$ 43,699	\$ 31,192	\$ 31,194	\$ 31,196	\$ 31,198	\$ 31,200	\$ 31,202	\$ 31,204	\$ 31,206	\$ 31,208	\$ 31,210	\$ 472,349
<b>Participation</b>																		
Montana		0	400	412	424	437	450	14	14	14	14	14	14	14	14	14	14	14
North Dakota		0	1,500	1,545	1,591	1,639	1,688	51	51	51	51	51	51	51	51	51	51	51
South Dakota		0	100	103	106	109	113	3	3	3	3	3	3	3	3	3	3	3
Total Participation		0	2,000	2,060	2,122	2,185	2,251	68	68	68	68	68	68	68	68	68	68	68
<b>Commulative total</b>			<b>2,000</b>	<b>4,000</b>	<b>6,000</b>	<b>8,000</b>	<b>10,000</b>	<b>10,000</b>	<b>10,000</b>	<b>10,000</b>	<b>10,000</b>	<b>10,000</b>	<b>10,000</b>	<b>10,000</b>	<b>10,000</b>	<b>10,000</b>	<b>10,000</b>	<b>10,000</b>

By State Breakdown	Total Participation	\$kW	Total Cost	kW	kWh Annual	kWh Lifetime (10yrs)
Montana	\$ 2,000	\$ 944.70	\$ 1,889,397	2,000	538,000	5,380,000
North Dakota	\$ 7,500	\$ 944.70	\$ 7,085,237	7,500	1,575,000	15,750,000
South Dakota	\$ 500	\$ 944.70	\$ 472,349	500	130,000	1,300,000

### Data Input

Churn Rate	3.0%
kW per partipate (all States)	1.0
MT kWh saved per participant	269
ND kWh saved per participant	210
SD kWh saved per participant	260

### Kwh Savings

Per Cadmus Study from October 2014 average annual savings is 19.1% with Programmable Thermostat

MT = 3 ton unit 13 SEER unit averag annual usage	1,406 kWh/yr
ND = 3 ton unit 13 SEER unit averag annual usage	1,098 kWh/yr
SD = 3 ton unit 13 SEER unit averag annual usage	1,360 kWh/yr

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Total Program with Demand Response**  
 Program Years: **2016 - 2018**

<u>Input Data</u>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =				
Retail Rate Winter (\$/kWh) =				
Retail Escalation Rate =				
1a) Power Supply Cost Adjustment				
Fuel Escalation Rate =				
2) Avg. System Marginal Energy Cost (\$/kWh) =				
Escalation Rate =				
3) Retail Summer Demand Rate (\$/kW/season) =				
3a) Retail Winter Demand Rate (\$/kW/season) =				
Escalation Rate =				
4) Electric Margin (\$/kWh) =				
Escalation Rate =				
5) System Peak Shaving Demand Cost (\$/kW/yr)				
Reserve Capacity=				
Escalation Rate =				
6) System Variable O&M (\$/kWh) =				
Escalation Rate =				
7) Environmental Damage Factor =				
Escalation Rate =				
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$57,444	\$59,212	\$59,601
Incentive Costs =		57,743	120,830	141,375
Total Utility Project Costs =		\$115,187	\$180,042	\$200,976
14) Direct Participant Costs (\$/Part.) =				
Escalation Rate =				
14a) Other Participant Costs (Annual \$/Part.) =				
Escalation Rate =				
14b) Other Participant Savings (Annual \$/Part.) =				
Escalation Rate =				
15) Project Life (Years) =				
16) Avg Summer kW/part. Saved =				
16a) Avg Winter kW/part Saved =				
17) Avg. Summer kWh/Part. Saved =				
17a) Avg. Winter kWh/Part. Saved =				
18a) System Demand Line Loss Factor				
18b) System Energy Line Loss Factor				
19) Number of Participants =		3,046	3,475	3,517
20) Incentive/Participant =				
21) Effective Federal & State Income Tax Rate =				
22) Annual Summer Kwh Saved		252,920	452,650	523,783
Annual Winter Kwh Saved		325,854	483,235	580,345
23) Annual Summer KW Saved		2,072	2,117	546
Annual Winter KW Saved		76	146	178
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$5,159,808	2.01	
Utility Cost Test		\$6,000,726	2.41	
Societal Test		\$13,263,531	3.07	
Participant Test		\$2,287,226	3.62	
Total Resource Cost Test		\$5,286,341	2.06	

**Table 1  
Ratepayer Impact Test**

Project: **Total Program with Demand Response**  
 Program Years: **2016 - 2018**

		Benefits										Costs						Annual Benefits		
t	Year	Summer kWh Requirements Reduction (A1)	Winter kWh Requirements Reduction (A2)	Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Total Energy Reduction (K)	Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Direct Program Costs (O)	Total Project Costs (O)	Less Costs (P)
1	2016	393,685	351,059	744,744		\$26,586		\$0	7,513	\$757,310	\$783,896		691,274	\$20,190	\$97,495	\$57,743	\$340,470	\$515,898	\$267,998	
2	2017	881,348	871,673	1,753,021		66,439		0	10,067	1,045,155	1,111,594		1,627,159	50,679	124,341	96,830	446,250	718,100	393,494	
3	2018	1,442,168	1,496,908	2,939,076		114,625		0	10,869	1,162,332	1,276,957		2,728,059	88,917	124,934	116,655	471,817	802,323	474,634	
4	2019	1,558,091	1,496,908	3,054,999		122,199		0	11,321	1,247,008	1,369,207		2,835,659	97,643	72,192	0	497,431	667,266	701,941	
5	2020	1,674,013	1,496,908	3,170,921		134,763		0	11,773	1,335,648	1,470,411		2,943,259	106,987	72,192	0	523,094	702,273	768,138	
6	2021	1,789,936	1,496,908	3,286,844		146,924		0	12,225	1,428,491	1,575,415		3,050,859	116,950	72,192	0	548,807	737,949	837,466	
7	2022	1,789,936	1,496,908	3,286,844		157,111		0	12,225	1,471,401	1,628,512		3,050,859	122,214	72,192	0	498,778	693,184	935,328	
8	2023	1,789,936	1,496,908	3,286,844		162,699		0	12,225	1,515,534	1,678,233		3,050,859	127,713	72,192	0	498,786	698,691	979,542	
9	2024	1,789,936	1,496,908	3,286,844		173,218		0	12,225	1,561,011	1,734,229		3,050,859	133,471	72,192	0	498,794	704,457	1,029,772	
10	2025	1,639,522	1,438,731	3,078,253		167,089		0	7,118	936,159	1,103,248		2,857,244	130,194	72,192	0	239,872	442,258	660,990	
11	2026	1,458,133	1,272,819	2,730,952		152,688		0	4,772	646,462	799,150		2,534,879	120,809	27,072	0	182,340	330,221	468,929	
12	2027	1,229,881	1,053,040	2,282,921		131,473		0	2,842	396,545	528,018		2,119,014	106,103	0	0	124,809	230,912	297,106	
13	2028	960,543	783,702	1,744,245		103,471		0	2,672	384,020	487,491		1,619,014	87,347	0	0	124,817	212,164	275,327	
14	2029	960,543	783,702	1,744,245		106,572		0	2,672	395,536	502,108		1,619,014	91,278	0	0	124,825	216,103	286,005	
15	2030	960,543	773,484	1,734,027		109,121		0	2,633	401,453	510,574		1,609,530	94,708	0	0	124,834	219,542	291,032	
16	2031	923,261	673,371	1,596,632		103,494		0	2,534	397,938	501,432		1,482,000	91,633	0	0	124,842	216,475	284,957	
17	2032	425,766	573,259	999,025		66,695		0	1,092	176,632	243,327		816,470	46,219	0	0	0	46,219	197,108	
18	2033	231,802	424,121	655,923		45,102		0	640	106,631	151,733		608,830	36,119	0	0	0	36,119	115,614	
19	2034	183,661	335,099	518,760		36,738		0	141	24,197	60,935		481,515	29,863	0	0	0	29,863	31,072	
20	2035	88,800	157,056	245,856		17,933		0	75	13,256	31,189		228,205	14,850	0	0	0	14,850	16,339	
Total =				42,140,976					127,634		\$17,547,659		39,004,561					\$8,234,867	\$9,312,792	
											NPV = \$10,251,482								\$5,091,674	5,159,808
Total NPV =					\$5,159,808															
Benefit/Cost Ratio =					<u>2.01</u>															

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(C = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Total Program with Demand Response**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$26,586	\$0	\$757,310	\$783,896	\$495,708	\$495,708	\$288,188
2017	66,439	0	1,045,155	1,111,594	667,421	667,421	444,173
2018	114,625	0	1,162,332	1,276,957	713,406	713,406	563,551
2019	122,199	0	1,247,008	1,369,207	569,623	569,623	799,584
2020	134,763	0	1,335,648	1,470,411	595,286	595,286	875,125
2021	146,924	0	1,428,491	1,575,415	620,999	620,999	954,416
2022	157,111	0	1,471,401	1,628,512	570,970	570,970	1,057,542
2023	162,699	0	1,515,534	1,678,233	570,978	570,978	1,107,255
2024	173,218	0	1,561,011	1,734,229	570,986	570,986	1,163,243
2025	167,089	0	936,159	1,103,248	312,064	312,064	791,184
2026	152,688	0	646,462	799,150	209,412	209,412	589,738
2027	131,473	0	396,545	528,018	124,809	124,809	403,209
2028	103,471	0	384,020	487,491	124,817	124,817	362,674
2029	106,572	0	395,536	502,108	124,825	124,825	377,283
2030	109,121	0	401,453	510,574	124,834	124,834	385,740
2031	103,494	0	397,938	501,432	124,842	124,842	376,590
2032	66,695	0	176,632	243,327	0	0	243,327
2033	45,102	0	106,631	151,733	0	0	151,733
2034	36,738	0	24,197	60,935	0	0	60,935
2035	17,933	0	13,256	31,189	0	0	31,189
Total =				\$17,547,659		\$6,520,980	\$11,026,679
NPV =				\$10,251,482		\$4,250,756	6,000,726
Total NPV =		\$6,000,726					
Benefit/Cost Ratio =		2.41					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Total Program with Demand Response**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$26,586	\$0	\$757,310	\$247,876	\$1,031,772	\$499,523	\$93,925	\$593,448	\$438,324
2017	66,439	0	1,045,155	362,042	1,473,636	676,460	171,630	848,090	625,546
2018	114,625	0	1,162,332	428,378	1,705,335	727,373	232,195	959,568	745,767
2019	122,199	0	1,247,008	473,105	1,842,312	588,943	21,380	610,323	1,231,989
2020	134,763	0	1,335,648	523,315	1,993,726	620,415	21,900	642,315	1,351,411
2021	146,924	0	1,428,491	577,506	2,152,921	652,415	22,420	674,835	1,478,086
2022	157,111	0	1,471,401	614,879	2,243,391	603,800	4,980	608,780	1,634,611
2023	162,699	0	1,515,534	652,661	2,330,894	605,285	4,980	610,265	1,720,629
2024	173,218	0	1,561,011	694,672	2,428,901	606,839	4,980	611,819	1,817,082
2025	167,089	0	936,159	455,178	1,558,426	344,890	4,980	349,870	1,208,556
2026	152,688	0	646,462	339,609	1,138,759	242,639	2,218	244,857	893,902
2027	131,473	0	396,545	231,118	759,136	158,403	560	158,963	600,173
2028	103,471	0	384,020	219,780	707,271	159,924	560	160,484	546,787
2029	106,572	0	395,536	233,161	735,269	161,514	560	162,074	573,195
2030	109,121	0	401,453	244,205	754,779	163,173	560	163,733	591,046
2031	103,494	0	397,938	247,029	748,461	164,906	560	165,466	582,995
2032	66,695	0	176,632	123,469	366,796	0	0	0	366,796
2033	45,102	0	106,631	79,304	231,037	0	0	0	231,037
2034	36,738	0	24,197	32,803	93,738	0	0	0	93,738
2035	17,933	0	13,256	17,295	48,484	0	0	0	48,484
Total =					\$24,345,044			\$7,564,890	\$16,780,154
					NPV = \$19,685,946			\$6,422,415	13,263,531
Total NPV =		\$13,263,531							
Benefit/Cost Ratio =		<u>3.07</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Total Program with Demand Response**  
 Program Years: **2016 - 2018**

Year	Benefits											Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$57,743			691,274	\$45,629	6,572	76			\$65,673	\$28,875	\$197,920	\$154,193	\$0	\$154,193	\$43,727
2017	120,830			1,627,159	114,143	8,688	222			103,531	34,125	372,629	302,408	0	302,408	70,221
2018	141,375			2,728,059	199,881	9,223	399			114,925	34,125	490,306	393,061	0	393,061	97,245
2019	25,440			2,835,659	220,474	9,623	399			115,994	34,125	396,033	49,831	0	49,831	346,202
2020	26,220			2,943,259	242,501	10,023	399			117,111	34,125	419,957	52,033	0	52,033	367,924
2021	27,000			3,050,859	266,074	10,423	399			118,279	34,125	445,478	54,298	0	54,298	391,180
2022	840			3,050,859	278,042	10,423	399			119,499	34,125	432,506	5,999	0	5,999	426,507
2023	840			3,050,859	290,554	10,423	399			120,774	34,125	446,293	6,026	0	6,026	440,267
2024	840			3,050,859	303,629	10,423	399			122,106	34,125	460,700	6,054	0	6,054	454,646
2025	840			2,857,244	295,645	5,913	390			110,362	10,500	417,347	6,082	0	6,082	411,265
2026	840			2,534,879	274,552	3,874	351			58,618	5,250	339,260	3,349	0	3,349	335,911
2027	840			2,119,014	241,560	2,220	297			21,826	0	264,226	1,720	0	1,720	262,506
2028	840			1,619,014	199,543	2,145	222			8,719	0	209,102	1,750	0	1,750	207,352
2029	840			1,619,014	208,521	2,145	222			9,111	0	218,472	1,780	0	1,780	216,692
2030	840			1,609,530	216,512	2,145	187			9,522	0	226,874	1,811	0	1,811	225,063
2031	840			1,482,000	210,500	2,145	100			9,950	0	221,290	1,842	0	1,842	219,448
2032	0			816,470	100,809	145	12			10,398	0	111,207	0	0	0	111,207
2033	0			608,830	78,886	145	12			10,866	0	89,752	0	0	0	89,752
2034	0			481,515	65,234	114	12			9,250	0	74,484	0	0	0	74,484
2035	0			228,205	32,499	56	12			5,267	0	37,766	0	0	0	37,766
Total =						106,868	4,908					\$5,871,602			\$1,042,237	\$4,829,365
												NPV = \$3,160,687			\$873,462	2,287,226
Total NPV =				\$2,287,226												
Benefit/Cost Ratio =				<u>3.62</u>												

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Total Program with Demand Response**  
 Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$26,586	\$757,310	\$783,896	\$499,523	\$93,925	\$593,448	\$190,448
2017	66,439	1,045,155	1,111,594	676,460	171,630	848,090	263,504
2018	114,625	1,162,332	1,276,957	727,373	232,195	959,568	317,389
2019	122,199	1,247,008	1,369,207	588,943	21,380	610,323	758,884
2020	134,763	1,335,648	1,470,411	620,415	21,900	642,315	828,096
2021	146,924	1,428,491	1,575,415	652,415	22,420	674,835	900,580
2022	157,111	1,471,401	1,628,512	603,800	4,980	608,780	1,019,732
2023	162,699	1,515,534	1,678,233	605,285	4,980	610,265	1,067,968
2024	173,218	1,561,011	1,734,229	606,839	4,980	611,819	1,122,410
2025	167,089	936,159	1,103,248	344,890	4,980	349,870	753,378
2026	152,688	646,462	799,150	242,639	2,218	244,857	554,293
2027	131,473	396,545	528,018	158,403	560	158,963	369,055
2028	103,471	384,020	487,491	159,924	560	160,484	327,007
2029	106,572	395,536	502,108	161,514	560	162,074	340,034
2030	109,121	401,453	510,574	163,173	560	163,733	346,841
2031	103,494	397,938	501,432	164,906	560	165,466	335,966
2032	66,695	176,632	243,327	0	0	0	243,327
2033	45,102	106,631	151,733	0	0	0	151,733
2034	36,738	24,197	60,935	0	0	0	60,935
2035	17,933	13,256	31,189	0	0	0	31,189
Total =			\$17,547,659			\$7,564,890	\$9,982,769
NPV =			\$10,251,482			\$4,965,141	5,286,341

Total NPV = \$5,286,341  
 Benefit/Cost Ratio = 2.06

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
NORTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Total Program with Demand Response**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =				
Retail Rate Winter (\$/kWh) =				
Retail Escalation Rate =				
1a) Power Supply Cost Adjustment				
Fuel Escalation Rate =				
2) Avg. System Marginal Energy Cost (\$/kWh) =				
Escalation Rate =				
3) Retail Summer Demand Rate (\$/kW/season) =				
3a) Retail Winter Demand Rate (\$/kW/season) =				
Escalation Rate =				
4) Electric Margin (\$/kWh) =				
Escalation Rate =				
5) System Peak Shaving Demand Cost (\$/kW/yr)				
Reserve Capacity=				
Escalation Rate =				
6) System Variable O&M (\$/kWh) =				
Escalation Rate =				
7) Environmental Damage Factor =				
Escalation Rate =				
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	8.70%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$168,874	\$155,679	\$160,372
Incentive Costs =		\$256,690	\$401,115	\$501,010
Total Utility Project Costs =		\$425,564	\$556,794	\$661,382
14) Direct Participant Costs (\$/Part.) =				
Escalation Rate =				
14a) Other Participant Costs (Annual \$/Part.) =				
Escalation Rate =				
14b) Other Participant Savings (Annual \$/Part.) =				
Escalation Rate =				
15) Project Life (Years) =				
16) Avg Summer kW/part. Saved =				
16a) Avg Winter kW/part Saved =				
17) Avg. Summer kWh/Part. Saved =				
17a) Avg. Winter kWh/Part. Saved =				
18a) System Demand Line Loss Factor				
18b) System Energy Line Loss Factor				
19) Number of Participants =		10,294	11,856	12,010
20) Incentive/Participant =				
21) Effective Federal & State Income Tax Rate =				
22) Annual Summer Kwh Saved		611,085	1,111,750	1,336,775
Annual Winter Kwh Saved		884,790	1,147,160	1,483,240
23) Annual Summer KW Saved		1,383	2,951	1,997
Annual Winter KW Saved		356	412	570
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$15,122,949	2.03	
Utility Cost Test		\$17,717,289	2.47	
Societal Test		\$39,055,803	3.14	
Participant Test		\$9,261,247	4.33	
Total Resource Cost Test		\$15,718,697	2.12	

**Table 1**  
**Ratepayer Impact Test**

Project: **Total Program with Demand Response**  
Program Years: **2016 - 2018**

		Benefits										Costs						Annual Benefits Less Costs		
t	Year	Summer kWh Requirements Reduction (A1)	Winter kWh Requirements Reduction (A2)	Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Total Energy Reduction (K)	Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Direct Program Costs (O)	Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2016	806,488	953,229	1,759,717		\$74,779		\$0	8,179	\$2,464,371	\$2,539,150		1,944,250	\$69,153	\$782,583	\$256,690	\$469,764	\$1,578,190	\$960,960	
2	2017	2,004,231	2,189,122	4,193,353		171,622		0	11,979	2,932,721	3,104,343		4,203,160	157,023	778,817	311,115	713,958	1,960,913	1,143,430	
3	2018	3,434,228	3,787,090	7,221,318		294,695		0	14,829	3,325,634	3,620,329		7,013,725	273,884	785,345	408,310	809,835	2,277,374	1,342,955	
4	2019	3,773,593	3,787,090	7,560,683		315,825		0	16,524	3,612,163	3,927,988		7,328,725	299,856	686,703	0	905,888	1,892,447	2,035,541	
5	2020	4,112,958	3,787,090	7,900,048		349,985		0	18,219	3,912,678	4,262,663		7,643,725	327,573	686,703	0	1,002,123	2,016,399	2,246,264	
6	2021	4,452,323	3,787,090	8,239,413		383,272		0	19,914	4,227,999	4,611,271		7,958,725	357,213	686,703	0	1,098,545	2,142,461	2,468,810	
7	2022	4,452,323	3,787,090	8,239,413		409,852		0	19,914	4,355,000	4,764,852		7,958,725	373,331	686,703	0	910,938	1,970,972	2,793,880	
8	2023	4,452,323	3,787,090	8,239,413		424,430		0	19,914	4,485,622	4,910,052		7,958,725	390,110	686,703	0	910,968	1,987,781	2,922,271	
9	2024	4,452,323	3,787,090	8,239,413		451,868		0	19,914	4,620,223	5,072,091		7,958,725	407,658	686,703	0	910,999	2,005,360	3,066,731	
10	2025	4,206,643	3,593,167	7,799,810		423,375		0	13,631	1,792,749	2,216,124		7,239,810	387,412	0	0	594,559	981,971	1,234,153	
11	2026	3,809,748	3,129,907	6,939,655		387,995		0	12,147	1,645,554	2,033,549		6,441,410	360,171	0	0	531,295	891,466	1,142,083	
12	2027	3,304,632	2,558,911	5,863,543		337,682		0	10,595	1,478,321	1,816,003		5,442,560	318,307	0	0	468,033	786,340	1,029,663	
13	2028	2,765,957	2,020,236	4,786,193		283,918		0	10,257	1,474,136	1,758,054		4,442,560	273,238	0	0	468,064	741,302	1,016,752	
14	2029	2,765,957	2,020,236	4,786,193		292,437		0	10,257	1,518,345	1,810,782		4,442,560	285,534	0	0	468,095	753,629	1,057,153	
15	2030	2,765,957	1,969,148	4,735,105		297,980		0	10,059	1,533,696	1,831,676		4,395,140	295,048	0	0	468,126	763,174	1,068,502	
16	2031	2,691,394	1,768,922	4,460,316		289,117		0	9,862	1,548,728	1,837,845		4,140,080	290,771	0	0	468,157	758,928	1,078,917	
17	2032	882,723	1,468,584	2,351,307		156,973		0	1,091	176,470	333,443		2,182,490	155,421	0	0	0	155,421	178,022	
18	2033	733,596	1,170,309	1,903,905		130,912		0	1,091	181,771	312,683		1,767,210	131,673	0	0	0	131,673	181,010	
19	2034	557,658	903,245	1,460,903		103,462		0	814	139,683	243,145		1,356,015	105,530	0	0	0	105,530	137,615	
20	2035	332,773	547,159	879,932		64,182		0	472	83,427	147,609		816,755	66,398	0	0	0	66,398	81,211	
Total =				107,559,633					229,662		\$51,153,652		102,635,075					\$23,967,729	\$27,185,923	
											NPV = \$29,764,479								\$14,641,530	15,122,949
Total NPV =						\$15,122,949														
Benefit/Cost Ratio =						<u>2.03</u>														

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (B) = Avg. System Marginal Energy Cost (2), escalated  
 (C) = (C) x (D)  
 (D) = System Variable O&M Savings (6), escalated  
 (E) = (C) x (F)  
 (F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity  
 (H) = (F) + (G)  
 (I) = (C) + (E) + (H)  
 (J) = Electric Margin (4), escalated

(K = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)  
 (L = [(J) + (K)] x 1-Inverse of Tax Rate (21)  
 (M = Program Admin Costs (13)  
 (N = Incentive/Participant (20) x Number of Participants (19)  
 (O = (L) + (M) + (N)  
 (P = (I) - (O)

**Table 2**  
**Utility Test**

Project: **Total Program with Demand Response**  
Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$74,779	\$0	\$2,464,371	\$2,539,150	\$1,509,037	\$1,509,037	\$1,030,113
2017	171,622	0	2,932,721	3,104,343	1,803,890	1,803,890	1,300,453
2018	294,695	0	3,325,634	3,620,329	2,003,490	2,003,490	1,616,839
2019	315,825	0	3,612,163	3,927,988	1,592,591	1,592,591	2,335,397
2020	349,985	0	3,912,678	4,262,663	1,688,826	1,688,826	2,573,837
2021	383,272	0	4,227,999	4,611,271	1,785,248	1,785,248	2,826,023
2022	409,852	0	4,355,000	4,764,852	1,597,641	1,597,641	3,167,211
2023	424,430	0	4,485,622	4,910,052	1,597,671	1,597,671	3,312,381
2024	451,868	0	4,620,223	5,072,091	1,597,702	1,597,702	3,474,389
2025	423,375	0	1,792,749	2,216,124	594,559	594,559	1,621,565
2026	387,995	0	1,645,554	2,033,549	531,295	531,295	1,502,254
2027	337,682	0	1,478,321	1,816,003	468,033	468,033	1,347,970
2028	283,918	0	1,474,136	1,758,054	468,064	468,064	1,289,990
2029	292,437	0	1,518,345	1,810,782	468,095	468,095	1,342,687
2030	297,980	0	1,533,696	1,831,676	468,126	468,126	1,363,550
2031	289,117	0	1,548,728	1,837,845	468,157	468,157	1,369,688
2032	156,973	0	176,470	333,443	0	0	333,443
2033	130,912	0	181,771	312,683	0	0	312,683
2034	103,462	0	139,683	243,145	0	0	243,145
2035	64,182	0	83,427	147,609	0	0	147,609
Total =				\$51,153,652	\$18,642,425	\$32,511,227	
NPV =				\$29,764,479	\$12,047,190	17,717,289	
Total NPV =		\$17,717,289					
Benefit/Cost Ratio =		<u>2.47</u>					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Total Program with Demand Response**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$74,779	\$0	\$2,464,371	\$802,905	\$3,342,055	\$1,514,817	\$318,279	\$1,833,096	\$1,508,959
2017	171,622	0	2,932,721	1,011,073	4,115,416	1,823,432	466,444	2,289,876	1,825,540
2018	294,695	0	3,325,634	1,214,502	4,834,831	2,036,969	581,824	2,618,793	2,216,038
2019	315,825	0	3,612,163	1,357,243	5,285,231	1,641,223	79,514	1,720,737	3,564,494
2020	349,985	0	3,912,678	1,517,069	5,779,732	1,753,900	81,434	1,835,334	3,944,398
2021	383,272	0	4,227,999	1,690,372	6,301,643	1,868,151	83,394	1,951,545	4,350,098
2022	409,852	0	4,355,000	1,799,073	6,563,925	1,684,283	17,914	1,702,197	4,861,728
2023	424,430	0	4,485,622	1,909,512	6,819,564	1,688,212	17,914	1,706,126	5,113,438
2024	451,868	0	4,620,223	2,031,703	7,103,794	1,692,312	17,914	1,710,226	5,393,568
2025	423,375	0	1,792,749	914,332	3,130,456	686,271	2,040	688,311	2,442,145
2026	387,995	0	1,645,554	864,177	2,897,726	625,640	2,040	627,680	2,270,046
2027	337,682	0	1,478,321	794,877	2,610,880	565,054	2,040	567,094	2,043,786
2028	283,918	0	1,474,136	792,601	2,550,655	569,457	2,040	571,497	1,979,158
2029	292,437	0	1,518,345	840,864	2,651,646	574,051	2,040	576,091	2,075,555
2030	297,980	0	1,533,696	876,083	2,707,759	578,846	2,040	580,886	2,126,873
2031	289,117	0	1,548,728	905,404	2,743,249	583,860	2,040	585,900	2,157,349
2032	156,973	0	176,470	169,197	502,640	0	0	0	502,640
2033	130,912	0	181,771	163,423	476,106	0	0	0	476,106
2034	103,462	0	139,683	130,891	374,036	0	0	0	374,036
2035	64,182	0	83,427	81,845	229,454	0	0	0	229,454
Total =					\$71,020,798			\$21,565,389	\$49,455,409
					NPV = \$57,294,559			\$18,238,756	39,055,803
Total NPV =								\$39,055,803	
Benefit/Cost Ratio =								<u>3.14</u>	

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Total Program with Demand Response**  
 Program Years: **2016 - 2018**

Year	Benefits											Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$256,690			1,944,250	\$159,095	21,283	356			\$686,509	\$34,650	\$1,136,944	\$584,433	\$0	\$584,433	\$552,511
2017	401,115			4,203,160	355,964	24,235	768			715,600	40,425	1,513,104	896,863	0	896,863	616,241
2018	501,010			7,013,725	617,968	26,185	1,338			752,639	40,425	1,912,042	1,139,174	0	1,139,174	772,868
2019	95,460			7,328,725	676,593	27,685	1,338			756,258	40,425	1,568,736	186,273	0	186,273	1,382,463
2020	98,340			7,643,725	739,196	29,185	1,338			760,042	40,425	1,638,003	194,450	0	194,450	1,443,553
2021	101,280			7,958,725	806,108	30,685	1,338			763,995	40,425	1,711,808	202,971	0	202,971	1,508,837
2022	3,060			7,958,725	842,352	30,685	1,338			768,124	40,425	1,653,961	21,625	0	21,625	1,632,336
2023	3,060			7,958,725	880,276	30,685	1,338			772,441	40,425	1,696,202	21,724	0	21,724	1,674,478
2024	3,060			7,958,725	919,888	30,685	1,338			776,951	40,425	1,740,324	21,825	0	21,825	1,718,499
2025	3,060			7,239,810	870,091	10,754	1,308			115,883	11,550	1,000,584	6,054	0	6,054	994,530
2026	3,060			6,441,410	809,516	9,547	1,203			104,088	5,775	922,439	6,159	0	6,159	916,280
2027	3,060			5,442,560	715,370	8,309	1,068			85,650	0	804,080	6,266	0	6,266	797,814
2028	3,060			4,442,560	610,014	8,159	918			59,999	0	673,073	6,374	0	6,374	666,699
2029	3,060			4,442,560	637,457	8,159	918			62,698	0	703,215	6,484	0	6,484	696,731
2030	3,060			4,395,140	659,625	8,159	743			65,519	0	728,204	6,596	0	6,596	721,608
2031	3,060			4,140,080	651,000	8,159	568			68,467	0	722,527	6,711	0	6,711	715,816
2032	0			2,182,490	347,456	659	305			71,548	0	419,004	0	0	0	419,004
2033	0			1,767,210	294,412	659	305			74,769	0	369,181	0	0	0	369,181
2034	0			1,356,015	235,953	486	233			59,688	0	295,641	0	0	0	295,641
2035	0			816,755	148,444	279	137			36,675	0	185,119	0	0	0	185,119
Total =						314,642	18,196					\$21,394,191			\$3,313,982	\$18,080,209
												NPV = \$12,039,872			\$2,778,625	9,261,247
Total NPV =				\$9,261,247												
Benefit/Cost Ratio =				<u>4.33</u>												

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Total Program with Demand Response**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$74,779	\$2,464,371	\$2,539,150	\$1,514,817	\$318,279	\$1,833,096	\$706,054
2017	171,622	2,932,721	3,104,343	1,823,432	466,444	2,289,876	814,467
2018	294,695	3,325,634	3,620,329	2,036,969	581,824	2,618,793	1,001,536
2019	315,825	3,612,163	3,927,988	1,641,223	79,514	1,720,737	2,207,251
2020	349,985	3,912,678	4,262,663	1,753,900	81,434	1,835,334	2,427,329
2021	383,272	4,227,999	4,611,271	1,868,151	83,394	1,951,545	2,659,726
2022	409,852	4,355,000	4,764,852	1,684,283	17,914	1,702,197	3,062,655
2023	424,430	4,485,622	4,910,052	1,688,212	17,914	1,706,126	3,203,926
2024	451,868	4,620,223	5,072,091	1,692,312	17,914	1,710,226	3,361,865
2025	423,375	1,792,749	2,216,124	686,271	2,040	688,311	1,527,813
2026	387,995	1,645,554	2,033,549	625,640	2,040	627,680	1,405,869
2027	337,682	1,478,321	1,816,003	565,054	2,040	567,094	1,248,909
2028	283,918	1,474,136	1,758,054	569,457	2,040	571,497	1,186,557
2029	292,437	1,518,345	1,810,782	574,051	2,040	576,091	1,234,691
2030	297,980	1,533,696	1,831,676	578,846	2,040	580,886	1,250,790
2031	289,117	1,548,728	1,837,845	583,860	2,040	585,900	1,251,945
2032	156,973	176,470	333,443	0	0	0	333,443
2033	130,912	181,771	312,683	0	0	0	312,683
2034	103,462	139,683	243,145	0	0	0	243,145
2035	64,182	83,427	147,609	0	0	0	147,609
Total =			\$51,153,652			\$21,565,389	\$29,588,263
NPV =			\$29,764,479			\$14,045,782	15,718,697

Total NPV = \$15,718,697  
Benefit/Cost Ratio = 2.12

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
SOUTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Total Program with Demand Response**  
 Program Years: **2016 - 2018**

<u>Input Data</u>		<u>First Year</u>	<u>Second Year</u>	<u>Third Year</u>
1) Retail Rate Summer (\$/kWh) =				
Retail Rate Winter (\$/kWh) =				
Retail Escalation Rate =				
1a) Power Supply Cost Adjustment				
Fuel Escalation Rate =				
2) Avg. System Marginal Energy Cost (\$/kWh) =				
Escalation Rate =				
3) Retail Summer Demand Rate (\$/kW/season) =				
3a) Retail Winter Demand Rate (\$/kW/season) =				
Escalation Rate =				
4) Electric Margin (\$/kWh) =				
Escalation Rate =				
5) System Peak Shaving Demand Cost (\$/kW/yr)				
Reserve Capacity=				
Escalation Rate =				
6) System Variable O&M (\$/kWh) =				
Escalation Rate =				
7) Environmental Damage Factor =				
Escalation Rate =				
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$14,686	\$13,127	\$13,726
Incentive Costs =		\$21,445	\$34,430	\$45,705
Total Utility Project Costs =		\$36,131	\$47,557	\$59,431
14) Direct Participant Costs (\$/Part.) =				
Escalation Rate =				
14a) Other Participant Costs (Annual \$/Part.) =				
Escalation Rate =				
14b) Other Participant Savings (Annual \$/Part.) =				
Escalation Rate =				
15) Project Life (Years) =				
16) Avg Summer kW/part. Saved =				
16a) Avg Winter kW/part Saved =				
17) Avg. Summer kWh/Part. Saved =				
17a) Avg. Winter kWh/Part. Saved =				
18a) System Demand Line Loss Factor				
18b) System Energy Line Loss Factor				
19) Number of Participants =		1,016	1,126	1,141
20) Incentive/Participant =				
21) Effective Federal & State Income Tax Rate =				
22) Annual Summer Kwh Saved		94,848	138,273	148,612
Annual Winter Kwh Saved		117,000	149,474	184,631
23) Annual Summer KW Saved		431	538	155
Annual Winter KW Saved		28	33	43

<b>Test Results</b>	<b>NPV</b>	<b>B/C</b>
Ratepayer Impact Measure Test	\$798,502	1.92
Utility Cost Test	\$1,005,791	2.52
Societal Test	\$2,353,146	3.13
Participant Test	\$618,775	3.48
<b>Total Resource Cost Test</b>	<b>\$826,609</b>	<b>1.98</b>

**Table 1  
Ratepayer Impact Test**

Project: **Total Program with Demand Response**  
 Program Years: **2016 - 2018**

t	Year	Benefits										Costs						Annual Benefits Less Costs (P)		
		Summer kWh Requirements Reduction (A1)	Winter kWh Requirements Reduction (A2)	Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Total Energy Reduction (K)	Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)		Direct Program Costs (O)	Total Project Costs (O)
1	2016	102,184	126,050	228,234		\$8,150		\$0	517	\$52,124	\$60,274		211,848	\$4,958	\$14,686	\$21,445	\$29,016	\$70,105	(\$9,831)	
2	2017	251,153	287,085	538,238		20,400		0	1,163	120,762	141,162		499,595	12,459	13,127	28,430	64,092	118,108	23,054	
3	2018	410,418	485,999	896,417		34,960		0	1,386	148,249	183,209		832,058	21,708	13,726	39,525	70,484	145,443	37,766	
4	2019	438,429	485,999	924,428		36,978		0	1,499	165,146	202,124		858,058	23,729	0	0	76,887	100,616	101,508	
5	2020	466,440	485,999	952,439		40,479		0	1,612	182,914	223,393		884,058	25,884	0	0	83,303	109,187	114,206	
6	2021	494,452	485,999	980,451		43,828		0	1,725	201,598	245,426		910,058	28,188	0	0	89,731	117,919	127,507	
7	2022	494,452	485,999	980,451		46,865		0	1,725	207,652	254,517		910,058	29,455	0	0	77,224	106,679	147,838	
8	2023	494,452	485,999	980,451		48,535		0	1,725	213,882	262,417		910,058	30,783	0	0	77,226	108,009	154,408	
9	2024	494,452	485,999	980,451		51,671		0	1,725	220,300	271,971		910,058	32,169	0	0	77,228	109,397	162,574	
10	2025	484,706	466,607	951,313		51,636		0	1,719	226,106	277,742		883,012	32,203	0	0	77,230	109,433	168,309	
11	2026	410,320	393,346	803,666		44,933		0	1,225	165,964	210,897		745,966	28,488	0	0	54,216	82,704	128,193	
12	2027	335,933	320,087	656,020		37,781		0	733	102,274	140,055		608,920	24,374	0	0	31,202	55,576	84,479	
13	2028	282,065	266,219	548,284		32,524		0	699	100,460	132,984		508,920	21,809	0	0	31,204	53,013	79,971	
14	2029	282,065	266,219	548,284		33,500		0	699	103,472	136,972		508,920	22,791	0	0	31,206	53,997	82,975	
15	2030	282,065	266,219	548,284		34,504		0	699	106,578	141,082		508,920	23,816	0	0	31,208	55,024	86,058	
16	2031	274,608	251,305	525,913		34,089		0	699	109,770	143,859		488,156	24,021	0	0	31,210	55,231	88,628	
17	2032	119,640	221,478	341,118		22,773		0	134	21,676	44,449		316,628	14,054	0	0	0	14,054	30,395	
18	2033	104,727	191,650	296,377		20,379		0	134	22,325	42,704		275,100	12,791	0	0	0	12,791	29,913	
19	2034	85,522	156,041	241,563		17,108		0	108	18,532	35,640		224,220	10,900	0	0	0	10,900	24,740	
20	2035	56,132	102,628	158,760		11,580		0	70	12,374	23,954		147,363	7,483	0	0	0	7,483	16,471	
Total =				13,081,142					19,998		\$3,174,831		12,141,974					\$1,495,669	\$1,679,162	
NPV =											\$1,668,553							\$870,051	798,502	
Total NPV =						\$798,502														
Benefit/Cost Ratio =						<u>1.92</u>														

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (B) = Avg. System Marginal Energy Cost (2), escalated  
 (C) = (B) x (D)  
 (D) = System Variable O&M Savings (6), escalated  
 (E) = (C) x (F)  
 (F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity  
 (H) = (F) + (G)  
 (I) = (C) + (E) + (H)  
 (J) = Electric Margin (4), escalated  
 (K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)  
 (L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)  
 (M) = Program Admin Costs (13)  
 (N) = Incentive/Participant (20) x Number of Participants (19)  
 (O) = (L) + (M) + (N)  
 (P) = (I) - (O)

**Table 2  
Utility Test**

Project: **Total Program with Demand Response**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$8,150	\$0	\$52,124	\$60,274	\$65,147	\$65,147	(\$4,873)
2017	20,400	0	120,762	141,162	105,649	105,649	35,513
2018	34,960	0	148,249	183,209	123,735	123,735	59,474
2019	36,978	0	165,146	202,124	76,887	76,887	125,237
2020	40,479	0	182,914	223,393	83,303	83,303	140,090
2021	43,828	0	201,598	245,426	89,731	89,731	155,695
2022	46,865	0	207,652	254,517	77,224	77,224	177,293
2023	48,535	0	213,882	262,417	77,226	77,226	185,191
2024	51,671	0	220,300	271,971	77,228	77,228	194,743
2025	51,636	0	226,106	277,742	77,230	77,230	200,512
2026	44,933	0	165,964	210,897	54,216	54,216	156,681
2027	37,781	0	102,274	140,055	31,202	31,202	108,853
2028	32,524	0	100,460	132,984	31,204	31,204	101,780
2029	33,500	0	103,472	136,972	31,206	31,206	105,766
2030	34,504	0	106,578	141,082	31,208	31,208	109,874
2031	34,089	0	109,770	143,859	31,210	31,210	112,649
2032	22,773	0	21,676	44,449	0	0	44,449
2033	20,379	0	22,325	42,704	0	0	42,704
2034	17,108	0	18,532	35,640	0	0	35,640
2035	11,580	0	12,374	23,954	0	0	23,954
<b>Total =</b>				\$3,174,831		\$1,063,606	\$2,111,225
				<b>NPV =</b>	\$1,668,553	\$662,762	1,005,791
<b>Total NPV =</b>		\$1,005,791					
<b>Benefit/Cost Ratio =</b>		<u>2.52</u>					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Total Program with Demand Response**  
 Program Years: **2016 - 2018**

Year	Benefits				Annual Total Decrease (E)	Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)		Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$8,150	\$0	\$52,124	\$19,059	\$79,333	\$65,363	\$32,400	\$97,763	(\$18,430)
2017	20,400	0	120,762	45,975	187,137	107,054	50,292	157,346	29,791
2018	34,960	0	148,249	61,462	244,671	126,202	58,209	184,411	60,260
2019	36,978	0	165,146	69,838	271,962	80,507	4,240	84,747	187,215
2020	40,479	0	182,914	79,505	302,898	88,174	4,360	92,534	210,364
2021	43,828	0	201,598	89,966	335,392	95,960	4,520	100,480	234,912
2022	46,865	0	207,652	96,099	350,616	83,733	120	83,853	266,763
2023	48,535	0	213,882	102,053	364,470	84,029	120	84,149	280,321
2024	51,671	0	220,300	108,942	380,913	84,336	120	84,456	296,457
2025	51,636	0	226,106	114,591	392,333	84,659	120	84,779	307,554
2026	44,933	0	165,964	89,622	300,519	61,643	120	61,763	238,756
2027	37,781	0	102,274	61,303	201,358	38,613	120	38,733	162,625
2028	32,524	0	100,460	59,954	192,938	38,949	120	39,069	153,869
2029	33,500	0	103,472	63,606	200,578	39,299	120	39,419	161,159
2030	34,504	0	106,578	67,479	208,561	39,665	120	39,785	168,776
2031	34,089	0	109,770	70,871	214,730	40,048	120	40,168	174,562
2032	22,773	0	21,676	22,555	67,004	0	0	0	67,004
2033	20,379	0	22,325	22,319	65,023	0	0	0	65,023
2034	17,108	0	18,532	19,187	54,827	0	0	0	54,827
2035	11,580	0	12,374	13,281	37,235	0	0	0	37,235
Total =					\$4,452,498			\$1,313,455	\$3,139,043
NPV =					\$3,455,931			\$1,102,785	2,353,146
Total NPV =		\$2,353,146							
Benefit/Cost Ratio =		<u>3.13</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Total Program with Demand Response**  
 Program Years: **2016 - 2018**

Year	Benefits											Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$21,445			211,848	\$17,014	431	28			\$2,736	\$2,100	\$43,295	\$54,672	\$0	\$54,672	(\$11,377)
2017	34,430			499,595	42,222	969	61			5,940	4,200	86,792	87,470	0	87,470	(678)
2018	45,705			832,058	73,519	1,122	105			8,908	4,200	132,332	109,402	0	109,402	22,930
2019	6,360			858,058	79,625	1,222	105			9,204	4,200	99,389	11,353	0	11,353	88,036
2020	6,540			884,058	86,128	1,322	105			9,514	4,200	106,382	11,876	0	11,876	94,506
2021	6,780			910,058	93,061	1,422	105			9,835	4,200	113,876	12,525	0	12,525	101,351
2022	180			910,058	97,247	1,422	105			10,173	4,200	111,800	338	0	338	111,462
2023	180			910,058	101,628	1,422	105			10,527	4,200	116,535	344	0	344	116,191
2024	180			910,058	106,200	1,422	105			10,894	4,200	121,474	350	0	350	121,124
2025	180			883,012	107,310	1,419	102			11,280	4,200	122,970	356	0	356	122,614
2026	180			745,966	94,857	1,001	84			9,055	2,100	106,192	362	0	362	105,830
2027	180			608,920	81,059	583	66			6,716	0	87,955	369	0	369	87,586
2028	180			508,920	71,365	568	51			5,423	0	76,968	375	0	375	76,593
2029	180			508,920	74,576	568	51			5,667	0	80,423	381	0	381	80,042
2030	180			508,920	77,930	568	51			5,922	0	84,032	388	0	388	83,644
2031	180			488,156	78,287	568	51			6,188	0	84,655	395	0	395	84,260
2032	0			316,628	50,445	68	51			6,468	0	56,913	0	0	0	56,913
2033	0			275,100	45,840	68	51			6,758	0	52,598	0	0	0	52,598
2034	0			224,220	39,049	55	41			5,677	0	44,726	0	0	0	44,726
2035	0			147,363	26,816	56	27			4,341	0	31,157	0	0	0	31,157
Total =						16,276	1,450					\$1,760,464			\$290,956	\$1,469,508
												NPV = \$868,436			\$249,661	618,775
Total NPV =				\$618,775												
Benefit/Cost Ratio =				<u>3.48</u>												

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Total Program with Demand Response**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$8,150	\$52,124	\$60,274	\$65,363	\$32,400	\$97,763	(\$37,489)
2017	20,400	120,762	141,162	107,054	50,292	157,346	(16,184)
2018	34,960	148,249	183,209	126,202	58,209	184,411	(1,202)
2019	36,978	165,146	202,124	80,507	4,240	84,747	117,377
2020	40,479	182,914	223,393	88,174	4,360	92,534	130,859
2021	43,828	201,598	245,426	95,960	4,520	100,480	144,946
2022	46,865	207,652	254,517	83,733	120	83,853	170,664
2023	48,535	213,882	262,417	84,029	120	84,149	178,268
2024	51,671	220,300	271,971	84,336	120	84,456	187,515
2025	51,636	226,106	277,742	84,659	120	84,779	192,963
2026	44,933	165,964	210,897	61,643	120	61,763	149,134
2027	37,781	102,274	140,055	38,613	120	38,733	101,322
2028	32,524	100,460	132,984	38,949	120	39,069	93,915
2029	33,500	103,472	136,972	39,299	120	39,419	97,553
2030	34,504	106,578	141,082	39,665	120	39,785	101,297
2031	34,089	109,770	143,859	40,048	120	40,168	103,691
2032	22,773	21,676	44,449	0	0	0	44,449
2033	20,379	22,325	42,704	0	0	0	42,704
2034	17,108	18,532	35,640	0	0	0	35,640
2035	11,580	12,374	23,954	0	0	0	23,954
Total =			\$3,174,831			\$1,313,455	\$1,861,376
NPV =			\$1,668,553			\$841,944	826,609

Total NPV = \$826,609  
Benefit/Cost Ratio = 1.98

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Central Air Conditioning Tier 1 (14.5 SEER)**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09033			
Retail Rate Winter (\$/kWh) =	\$0.07591			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00418			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.06075			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$636	\$539	\$910
Incentive Costs =		1,500	3,000	6,000
Total Utility Project Costs =		\$2,136	\$3,539	\$6,910
14) Direct Participant Costs (\$/Part.) =		\$534	\$534	\$534
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		18	18	NA
16) Avg Summer kW/part. Saved =		0.290	0.290	0.290
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		146	146	146
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		5	10	20
20) Incentive/Participant =		\$300	\$300	\$300
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		730	1,460	2,920
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		1	3	6
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$309	1.02	
Utility Cost Test		\$2,581	1.23	
Societal Test		\$13,555	1.68	
Participant Test		(\$2,508)	0.85	
Total Resource Cost Test		(\$4,620)	0.75	

**Table 1  
Ratepayer Impact Test**

Project: **Central Air Conditioning Tier 1 (14.5 SEER)**  
 Program Years: **2016 - 2018**

t	Year											Costs						Annual Benefits Less Costs (P)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2016	786	\$0.03570	\$28	\$0.00000	\$0	2	0	2	\$100.80	\$202	\$230	\$0.06348	730	0	730	\$28	\$636	\$1,500	\$2,164	(\$1,934)	
2	2017	2,359	0.03790	89	0.00000	0	5	0	5	103.82	519	608	0.06634	2,190	0	2,190	88	539	3,000	3,627	(3,019)	
3	2018	5,505	0.03900	215	0.00000	0	11	0	11	106.94	1,176	1,391	0.06933	5,110	0	5,110	215	910	6,000	7,125	(5,734)	
4	2019	5,505	0.04000	220	0.00000	0	11	0	11	110.15	1,212	1,432	0.07245	5,110	0	5,110	224	0	0	224	1,208	
5	2020	5,505	0.04250	234	0.00000	0	11	0	11	113.45	1,248	1,482	0.07571	5,110	0	5,110	234	0	0	234	1,248	
6	2021	5,505	0.04470	246	0.00000	0	11	0	11	116.85	1,285	1,531	0.07911	5,110	0	5,110	245	0	0	245	1,286	
7	2022	5,505	0.04780	263	0.00000	0	11	0	11	120.36	1,324	1,587	0.08267	5,110	0	5,110	256	0	0	256	1,331	
8	2023	5,505	0.04950	272	0.00000	0	11	0	11	123.97	1,364	1,636	0.08639	5,110	0	5,110	268	0	0	268	1,368	
9	2024	5,505	0.05270	290	0.00000	0	11	0	11	127.69	1,405	1,695	0.09028	5,110	0	5,110	280	0	0	280	1,415	
10	2025	5,505	0.05428	299	0.00000	0	11	0	11	131.52	1,447	1,746	0.09434	5,110	0	5,110	292	0	0	292	1,454	
11	2026	5,505	0.05591	308	0.00000	0	11	0	11	135.47	1,490	1,798	0.09859	5,110	0	5,110	305	0	0	305	1,493	
12	2027	5,505	0.05759	317	0.00000	0	11	0	11	139.53	1,535	1,852	0.10302	5,110	0	5,110	319	0	0	319	1,533	
13	2028	5,505	0.05932	327	0.00000	0	11	0	11	143.72	1,581	1,908	0.10766	5,110	0	5,110	333	0	0	333	1,575	
14	2029	5,505	0.06110	336	0.00000	0	11	0	11	148.03	1,628	1,964	0.11251	5,110	0	5,110	348	0	0	348	1,616	
15	2030	5,505	0.06293	346	0.00000	0	11	0	11	152.47	1,677	2,023	0.11757	5,110	0	5,110	364	0	0	364	1,659	
16	2031	5,505	0.06482	357	0.00000	0	11	0	11	157.04	1,727	2,084	0.12286	5,110	0	5,110	381	0	0	381	1,703	
17	2032	5,505	0.06676	368	0.00000	0	11	0	11	161.75	1,779	2,147	0.12839	5,110	0	5,110	398	0	0	398	1,749	
18	2033	5,505	0.06876	379	0.00000	0	11	0	11	166.61	1,833	2,212	0.13417	5,110	0	5,110	416	0	0	416	1,796	
19	2034	4,719	0.07082	334	0.00000	0	10	0	10	171.60	1,716	2,050	0.14020	4,380	0	4,380	372	0	0	372	1,678	
20	2035	3,146	0.07294	229	0.00000	0	7	0	7	176.75	1,237	1,466	0.14651	2,920	0	2,920	259	0	0	259	1,207	
Total =		99,090							200			\$32,842				91,980				\$18,210	\$14,632	
												NPV =									\$13,388	309

Total NPV = \$309  
 Benefit/Cost Ratio = 1.02

**Worksheet Calculations**

- (A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses
- (B) = Avg. System Marginal Energy Cost (2), escalated
- (C) = (B) x (D)
- (D) = System Variable O&M Savings (6), escalated
- (E) = (C) x (F)
- (F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses
- (G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity
- (H) = (F) + (G)
- (I) = (C) + (E) + (H)
- (J) = Electric Margin (4), escalated
- (K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
- (L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
- (M) = Program Admin Costs (13)
- (N) = Incentive/Participant (20) x Number of Participants (19)
- (O) = (L) + (M) + (N)
- (P) = (I) - (O)

**Table 2  
Utility Test**

Project: **Central Air Conditioning Tier 1 (14.5 SEER)**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$28	\$0	\$202	\$230	\$2,136	\$2,136	(\$1,906)
2017	89	0	519	608	3,539	3,539	(2,931)
2018	215	0	1,176	1,391	6,910	6,910	(5,519)
2019	220	0	1,212	1,432	0	0	1,432
2020	234	0	1,248	1,482	0	0	1,482
2021	246	0	1,285	1,531	0	0	1,531
2022	263	0	1,324	1,587	0	0	1,587
2023	272	0	1,364	1,636	0	0	1,636
2024	290	0	1,405	1,695	0	0	1,695
2025	299	0	1,447	1,746	0	0	1,746
2026	308	0	1,490	1,798	0	0	1,798
2027	317	0	1,535	1,852	0	0	1,852
2028	327	0	1,581	1,908	0	0	1,908
2029	336	0	1,628	1,964	0	0	1,964
2030	346	0	1,677	2,023	0	0	2,023
2031	357	0	1,727	2,084	0	0	2,084
2032	368	0	1,779	2,147	0	0	2,147
2033	379	0	1,833	2,212	0	0	2,212
2034	334	0	1,716	2,050	0	0	2,050
2035	229	0	1,237	1,466	0	0	1,466
Total =				\$32,842	\$12,585	\$20,257	
NPV =				\$13,697	\$11,116	2,581	
Total NPV =		\$2,581					
Benefit/Cost Ratio =		<u>1.23</u>					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Central Air Conditioning Tier 1 (14.5 SEER)**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$28	\$0	\$202	\$73	\$303	\$2,136	\$1,170	\$3,306	(\$3,003)
2017	89	0	519	198	806	3,539	2,340	5,879	(5,073)
2018	215	0	1,176	467	1,858	6,910	4,680	11,590	(9,732)
2019	220	0	1,212	495	1,927	0	0	0	1,927
2020	234	0	1,248	527	2,009	0	0	0	2,009
2021	246	0	1,285	561	2,092	0	0	0	2,092
2022	263	0	1,324	599	2,186	0	0	0	2,186
2023	272	0	1,364	636	2,272	0	0	0	2,272
2024	290	0	1,405	679	2,374	0	0	0	2,374
2025	299	0	1,447	720	2,466	0	0	0	2,466
2026	308	0	1,490	764	2,562	0	0	0	2,562
2027	317	0	1,535	811	2,663	0	0	0	2,663
2028	327	0	1,581	860	2,768	0	0	0	2,768
2029	336	0	1,628	912	2,876	0	0	0	2,876
2030	346	0	1,677	968	2,991	0	0	0	2,991
2031	357	0	1,727	1,027	3,111	0	0	0	3,111
2032	368	0	1,779	1,089	3,236	0	0	0	3,236
2033	379	0	1,833	1,156	3,368	0	0	0	3,368
2034	334	0	1,716	1,104	3,154	0	0	0	3,154
2035	229	0	1,237	813	2,279	0	0	0	2,279
Total =					\$47,301			\$20,775	\$26,526
				NPV =	\$33,403			\$19,848	13,555
Total NPV =		\$13,555							
Benefit/Cost Ratio =		<u>1.68</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Central Air Conditioning Tier 1 (14.5 SEER)**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$1,500	\$0.09439	\$0.07933	730	0	730	\$69	1	0	\$0.000	\$0.000	\$0	\$0	\$1,569	\$2,716	\$0	\$2,716	(\$1,147)
2017	3,000	0.09864	0.08290	2,190	0	2,190	216	4	0	0.000	0.000	0	0	3,216	5,526	0	5,526	(2,310)
2018	6,000	0.10308	0.08663	5,110	0	5,110	527	10	0	0.000	0.000	0	0	6,527	11,244	0	11,244	(4,717)
2019	0	0.10772	0.09052	5,110	0	5,110	550	10	0	0.000	0.000	0	0	550	0	0	0	550
2020	0	0.11257	0.09460	5,110	0	5,110	575	10	0	0.000	0.000	0	0	575	0	0	0	575
2021	0	0.11763	0.09885	5,110	0	5,110	601	10	0	0.000	0.000	0	0	601	0	0	0	601
2022	0	0.12293	0.10330	5,110	0	5,110	628	10	0	0.000	0.000	0	0	628	0	0	0	628
2023	0	0.12846	0.10795	5,110	0	5,110	656	10	0	0.000	0.000	0	0	656	0	0	0	656
2024	0	0.13424	0.11281	5,110	0	5,110	686	10	0	0.000	0.000	0	0	686	0	0	0	686
2025	0	0.14028	0.11789	5,110	0	5,110	717	10	0	0.000	0.000	0	0	717	0	0	0	717
2026	0	0.14659	0.12319	5,110	0	5,110	749	10	0	0.000	0.000	0	0	749	0	0	0	749
2027	0	0.15319	0.12873	5,110	0	5,110	783	10	0	0.000	0.000	0	0	783	0	0	0	783
2028	0	0.16008	0.13453	5,110	0	5,110	818	10	0	0.000	0.000	0	0	818	0	0	0	818
2029	0	0.16729	0.14058	5,110	0	5,110	855	10	0	0.000	0.000	0	0	855	0	0	0	855
2030	0	0.17481	0.14691	5,110	0	5,110	893	10	0	0.000	0.000	0	0	893	0	0	0	893
2031	0	0.18268	0.15352	5,110	0	5,110	933	10	0	0.000	0.000	0	0	933	0	0	0	933
2032	0	0.19090	0.16043	5,110	0	5,110	975	10	0	0.000	0.000	0	0	975	0	0	0	975
2033	0	0.19949	0.16765	5,110	0	5,110	1,019	10	0	0.000	0.000	0	0	1,019	0	0	0	1,019
2034	0	0.20847	0.17519	4,380	0	4,380	913	9	0	0.000	0.000	0	0	913	0	0	0	913
2035	0	0.21785	0.18307	2,920	0	2,920	636	6	0	0.000	0.000	0	0	636	0	0	0	636
Total =				91,980	0			180	0					\$24,299			\$19,486	\$4,813
														NPV = \$14,477			\$16,985	(2,508)
Total NPV =																		(\$2,508)
Benefit/Cost Ratio =																		0.85

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Central Air Conditioning Tier 1 (14.5 SEER)**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$28	\$202	\$230	\$2,136	\$1,170	\$3,306	(\$3,076)
2017	89	519	608	3,539	2,340	5,879	(5,271)
2018	215	1,176	1,391	6,910	4,680	11,590	(10,199)
2019	220	1,212	1,432	0	0	0	1,432
2020	234	1,248	1,482	0	0	0	1,482
2021	246	1,285	1,531	0	0	0	1,531
2022	263	1,324	1,587	0	0	0	1,587
2023	272	1,364	1,636	0	0	0	1,636
2024	290	1,405	1,695	0	0	0	1,695
2025	299	1,447	1,746	0	0	0	1,746
2026	308	1,490	1,798	0	0	0	1,798
2027	317	1,535	1,852	0	0	0	1,852
2028	327	1,581	1,908	0	0	0	1,908
2029	336	1,628	1,964	0	0	0	1,964
2030	346	1,677	2,023	0	0	0	2,023
2031	357	1,727	2,084	0	0	0	2,084
2032	368	1,779	2,147	0	0	0	2,147
2033	379	1,833	2,212	0	0	0	2,212
2034	334	1,716	2,050	0	0	0	2,050
2035	229	1,237	1,466	0	0	0	1,466
Total =			\$32,842			\$20,775	\$12,067
NPV =			\$13,697			\$18,316	(4,620)

Total NPV = (\$4,620)  
Benefit/Cost Ratio = 0.75

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
NORTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Central Air Conditioning Tier 1 (14.5 SEER)**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.08197			
Retail Rate Winter (\$/kWh) =	\$0.07128			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00496			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05993			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	8.70%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$1,459	\$770	\$948
Incentive Costs =		6,000	6,000	9,000
Total Utility Project Costs =		\$7,459	\$6,770	\$9,948
14) Direct Participant Costs (\$/Part.) =		\$534	\$534	\$534
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		18	18	18
16) Avg Summer kW/part. Saved =		0.290	0.290	0.290
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		114	114	114
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		20	20	30
20) Incentive/Participant =		\$300	\$300	\$300
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		2,280	2,280	3,420
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		6	6	9
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$2,261	1.09	
Utility Cost Test		\$5,811	1.27	
Societal Test		\$27,091	1.69	
Participant Test		(\$8,274)	0.76	
Total Resource Cost Test		(\$8,981)	0.76	

**Table 1  
Ratepayer Impact Test**

Project: **Central Air Conditioning Tier 1 (14.5 SEER)**  
Program Years: **2016 - 2018**

t	Year											Costs						Annual Benefits Less Costs (P)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2016	2,456	\$0.03570	\$88	\$0.00000	\$0	7	0	7	\$100.80	\$706	\$794	\$0.06263	2,280	0	2,280	\$87	\$1,459	\$6,000	\$7,546	(\$6,752)	
2	2017	4,913	0.03790	186	0.00000	0	13	0	13	103.82	1,350	1,536	0.06545	4,560	0	4,560	181	770	6,000	6,951	(5,415)	
3	2018	8,597	0.03900	335	0.00000	0	23	0	23	106.94	2,460	2,795	0.06839	7,980	0	7,980	331	948	9,000	10,279	(7,484)	
4	2019	8,597	0.04000	344	0.00000	0	23	0	23	110.15	2,533	2,877	0.07147	7,980	0	7,980	346	0	0	346	2,531	
5	2020	8,597	0.04250	365	0.00000	0	23	0	23	113.45	2,609	2,974	0.07468	7,980	0	7,980	361	0	0	361	2,613	
6	2021	8,597	0.04470	384	0.00000	0	23	0	23	116.85	2,688	3,072	0.07804	7,980	0	7,980	377	0	0	377	2,695	
7	2022	8,597	0.04780	411	0.00000	0	23	0	23	120.36	2,768	3,179	0.08156	7,980	0	7,980	394	0	0	394	2,785	
8	2023	8,597	0.04950	426	0.00000	0	23	0	23	123.97	2,851	3,277	0.08523	7,980	0	7,980	412	0	0	412	2,865	
9	2024	8,597	0.05270	453	0.00000	0	23	0	23	127.69	2,937	3,390	0.08906	7,980	0	7,980	431	0	0	431	2,959	
10	2025	8,597	0.05428	467	0.00000	0	23	0	23	131.52	3,025	3,492	0.09307	7,980	0	7,980	450	0	0	450	3,042	
11	2026	8,597	0.05591	481	0.00000	0	23	0	23	135.47	3,116	3,597	0.09726	7,980	0	7,980	470	0	0	470	3,127	
12	2027	8,597	0.05759	495	0.00000	0	23	0	23	139.53	3,209	3,704	0.10163	7,980	0	7,980	492	0	0	492	3,212	
13	2028	8,597	0.05932	510	0.00000	0	23	0	23	143.72	3,306	3,816	0.10621	7,980	0	7,980	514	0	0	514	3,302	
14	2029	8,597	0.06110	525	0.00000	0	23	0	23	148.03	3,405	3,930	0.11099	7,980	0	7,980	537	0	0	537	3,393	
15	2030	8,597	0.06293	541	0.00000	0	23	0	23	152.47	3,507	4,048	0.11598	7,980	0	7,980	561	0	0	561	3,487	
16	2031	8,597	0.06482	557	0.00000	0	23	0	23	157.04	3,612	4,169	0.12120	7,980	0	7,980	586	0	0	586	3,583	
17	2032	8,597	0.06676	574	0.00000	0	23	0	23	161.75	3,720	4,294	0.12665	7,980	0	7,980	613	0	0	613	3,681	
18	2033	8,597	0.06876	591	0.00000	0	23	0	23	166.61	3,832	4,423	0.13235	7,980	0	7,980	640	0	0	640	3,783	
19	2034	6,141	0.07082	435	0.00000	0	16	0	16	171.60	2,746	3,181	0.13831	5,700	0	5,700	478	0	0	478	2,703	
20	2035	3,685	0.07294	269	0.00000	0	10	0	10	176.75	1,768	2,037	0.14453	3,420	0	3,420	300	0	0	300	1,737	
Total =		154,747							414			\$64,585				143,640				\$32,738	\$31,847	
												NPV =									\$25,466	2,261
Total NPV =			\$2,261																			
Benefit/Cost Ratio =			1.09																			

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (B) = Avg. System Marginal Energy Cost (2), escalated  
 (C) = (C) x (D)  
 (D) = System Variable O&M Savings (6), escalated  
 (E) = (C) x (F)  
 (F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity  
 (H) = (F) + (G)  
 (I) = (C) + (E) + (H)  
 (J) = Electric Margin (4), escalated

(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)  
 (L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)  
 (M) = Program Admin Costs (13)  
 (N) = Incentive/Participant (20) x Number of Participants (19)  
 (O) = (L) + (M) + (N)  
 (P) = (I) - (O)

**Table 2  
Utility Test**

Project: **Central Air Conditioning Tier 1 (14.5 SEER)**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$88	\$0	\$706	\$794	\$7,459	\$7,459	(\$6,665)
2017	186	0	1,350	1,536	6,770	6,770	(5,234)
2018	335	0	2,460	2,795	9,948	9,948	(7,153)
2019	344	0	2,533	2,877	0	0	2,877
2020	365	0	2,609	2,974	0	0	2,974
2021	384	0	2,688	3,072	0	0	3,072
2022	411	0	2,768	3,179	0	0	3,179
2023	426	0	2,851	3,277	0	0	3,277
2024	453	0	2,937	3,390	0	0	3,390
2025	467	0	3,025	3,492	0	0	3,492
2026	481	0	3,116	3,597	0	0	3,597
2027	495	0	3,209	3,704	0	0	3,704
2028	510	0	3,306	3,816	0	0	3,816
2029	525	0	3,405	3,930	0	0	3,930
2030	541	0	3,507	4,048	0	0	4,048
2031	557	0	3,612	4,169	0	0	4,169
2032	574	0	3,720	4,294	0	0	4,294
2033	591	0	3,832	4,423	0	0	4,423
2034	435	0	2,746	3,181	0	0	3,181
2035	269	0	1,768	2,037	0	0	2,037
Total =				\$64,585		\$24,177	\$40,408
NPV =				\$27,727		\$21,916	5,811
Total NPV =		\$5,811					
Benefit/Cost Ratio =		1.27					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Central Air Conditioning Tier 1 (14.5 SEER)**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$88	\$0	\$706	\$251	\$1,045	\$7,459	\$4,680	\$12,139	(\$11,094)
2017	186	0	1,350	500	2,036	6,770	4,680	11,450	(9,414)
2018	335	0	2,460	938	3,733	9,948	7,020	16,968	(13,235)
2019	344	0	2,533	994	3,871	0	0	0	3,871
2020	365	0	2,609	1,058	4,032	0	0	0	4,032
2021	384	0	2,688	1,126	4,198	0	0	0	4,198
2022	411	0	2,768	1,200	4,379	0	0	0	4,379
2023	426	0	2,851	1,274	4,551	0	0	0	4,551
2024	453	0	2,937	1,358	4,748	0	0	0	4,748
2025	467	0	3,025	1,441	4,933	0	0	0	4,933
2026	481	0	3,116	1,529	5,126	0	0	0	5,126
2027	495	0	3,209	1,621	5,325	0	0	0	5,325
2028	510	0	3,306	1,720	5,536	0	0	0	5,536
2029	525	0	3,405	1,825	5,755	0	0	0	5,755
2030	541	0	3,507	1,936	5,984	0	0	0	5,984
2031	557	0	3,612	2,054	6,223	0	0	0	6,223
2032	574	0	3,720	2,179	6,473	0	0	0	6,473
2033	591	0	3,832	2,312	6,735	0	0	0	6,735
2034	435	0	2,746	1,712	4,893	0	0	0	4,893
2035	269	0	1,768	1,129	3,166	0	0	0	3,166
Total =					\$92,742		\$40,557	\$52,185	
NPV =					\$66,199		\$39,108	27,091	
Total NPV =		\$27,091							
Benefit/Cost Ratio =		1.69							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Central Air Conditioning Tier 1 (14.5 SEER)**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$6,000	\$0.08566	\$0.07449	2,280	0	2,280	\$195	6	0	\$0.000	\$0.000	\$0	\$0	\$6,195	\$10,865	\$0	\$10,865	(\$4,670)
2017	6,000	0.08951	0.07784	4,560	0	4,560	408	12	0	0.000	0.000	0	0	6,408	11,053	0	11,053	(4,645)
2018	9,000	0.09354	0.08134	7,980	0	7,980	746	20	0	0.000	0.000	0	0	9,746	16,866	0	16,866	(7,120)
2019	0	0.09775	0.08500	7,980	0	7,980	780	20	0	0.000	0.000	0	0	780	0	0	0	780
2020	0	0.10215	0.08883	7,980	0	7,980	815	20	0	0.000	0.000	0	0	815	0	0	0	815
2021	0	0.10675	0.09283	7,980	0	7,980	852	20	0	0.000	0.000	0	0	852	0	0	0	852
2022	0	0.11155	0.09700	7,980	0	7,980	890	20	0	0.000	0.000	0	0	890	0	0	0	890
2023	0	0.11657	0.10137	7,980	0	7,980	930	20	0	0.000	0.000	0	0	930	0	0	0	930
2024	0	0.12182	0.10593	7,980	0	7,980	972	20	0	0.000	0.000	0	0	972	0	0	0	972
2025	0	0.12730	0.11070	7,980	0	7,980	1,016	20	0	0.000	0.000	0	0	1,016	0	0	0	1,016
2026	0	0.13303	0.11568	7,980	0	7,980	1,062	20	0	0.000	0.000	0	0	1,062	0	0	0	1,062
2027	0	0.13901	0.12088	7,980	0	7,980	1,109	20	0	0.000	0.000	0	0	1,109	0	0	0	1,109
2028	0	0.14527	0.12632	7,980	0	7,980	1,159	20	0	0.000	0.000	0	0	1,159	0	0	0	1,159
2029	0	0.15180	0.13201	7,980	0	7,980	1,211	20	0	0.000	0.000	0	0	1,211	0	0	0	1,211
2030	0	0.15864	0.13795	7,980	0	7,980	1,266	20	0	0.000	0.000	0	0	1,266	0	0	0	1,266
2031	0	0.16577	0.14415	7,980	0	7,980	1,323	20	0	0.000	0.000	0	0	1,323	0	0	0	1,323
2032	0	0.17323	0.15064	7,980	0	7,980	1,382	20	0	0.000	0.000	0	0	1,382	0	0	0	1,382
2033	0	0.18103	0.15742	7,980	0	7,980	1,445	20	0	0.000	0.000	0	0	1,445	0	0	0	1,445
2034	0	0.18918	0.16450	5,700	0	5,700	1,078	15	0	0.000	0.000	0	0	1,078	0	0	0	1,078
2035	0	0.19769	0.17191	3,420	0	3,420	676	9	0	0.000	0.000	0	0	676	0	0	0	676
Total =				143,640	0			362	0					\$40,315			\$38,784	\$1,531
														NPV = \$26,503			\$34,776	(8,274)
Total NPV =				(\$8,274)														
Benefit/Cost Ratio =				0.76														

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Central Air Conditioning Tier 1 (14.5 SEER)**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$88	\$706	\$794	\$7,459	\$4,680	\$12,139	(\$11,345)
2017	186	1,350	1,536	6,770	4,680	11,450	(9,914)
2018	335	2,460	2,795	9,948	7,020	16,968	(14,173)
2019	344	2,533	2,877	0	0	0	2,877
2020	365	2,609	2,974	0	0	0	2,974
2021	384	2,688	3,072	0	0	0	3,072
2022	411	2,768	3,179	0	0	0	3,179
2023	426	2,851	3,277	0	0	0	3,277
2024	453	2,937	3,390	0	0	0	3,390
2025	467	3,025	3,492	0	0	0	3,492
2026	481	3,116	3,597	0	0	0	3,597
2027	495	3,209	3,704	0	0	0	3,704
2028	510	3,306	3,816	0	0	0	3,816
2029	525	3,405	3,930	0	0	0	3,930
2030	541	3,507	4,048	0	0	0	4,048
2031	557	3,612	4,169	0	0	0	4,169
2032	574	3,720	4,294	0	0	0	4,294
2033	591	3,832	4,423	0	0	0	4,423
2034	435	2,746	3,181	0	0	0	3,181
2035	269	1,768	2,037	0	0	0	2,037
Total =			\$64,585			\$40,557	\$24,028
NPV =			\$27,727			\$36,708	(8,981)
Total NPV =			(\$8,981)				
Benefit/Cost Ratio =			0.76				

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
SOUTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Central Air Conditioning Tier 1 (14.5 SEER)**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09021			
Retail Rate Winter (\$/kWh) =	\$0.08577			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00815			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05546			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$354	\$399	\$620
Incentive Costs =		600	1,500	3,000
Total Utility Project Costs =		\$954	\$1,899	\$3,620
14) Direct Participant Costs (\$/Part.) =		\$534	\$534	\$534
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		18	18	18
16) Avg Summer kW/part. Saved =		0.290	0.290	0.290
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		141	141	141
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		2	5	10
20) Incentive/Participant =		\$300	\$300	\$300
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		282	705	1,410
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		1	1	3
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$508	1.08	
Utility Cost Test		\$1,479	1.26	
Societal Test		\$7,530	1.76	
Participant Test		(\$1,305)	0.84	
Total Resource Cost Test		(\$2,003)	0.78	

**Table 1  
Ratepayer Impact Test**

Project: **Central Air Conditioning Tier 1 (14.5 SEER)**  
Program Years: **2016 - 2018**

t	Year											Costs					Annual Benefits Less Costs (P)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)		Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)
1	2016	304	\$0.03570	\$11	\$0.00000	\$0	1	0	1	\$100.80	\$101	\$112	\$0.05796	282	0	282	\$10	\$354	\$600	\$964	(\$852)
2	2017	1,063	0.03790	40	0.00000	0	2	0	2	103.82	208	248	0.06056	987	0	987	36	399	1,500	1,935	(1,687)
3	2018	2,582	0.03900	101	0.00000	0	6	0	6	106.94	642	743	0.06329	2,397	0	2,397	92	620	3,000	3,712	(2,969)
4	2019	2,582	0.04000	103	0.00000	0	6	0	6	110.15	661	764	0.06614	2,397	0	2,397	96	0	0	96	668
5	2020	2,582	0.04250	110	0.00000	0	6	0	6	113.45	681	791	0.06911	2,397	0	2,397	100	0	0	100	691
6	2021	2,582	0.04470	115	0.00000	0	6	0	6	116.85	701	816	0.07222	2,397	0	2,397	105	0	0	105	711
7	2022	2,582	0.04780	123	0.00000	0	6	0	6	120.36	722	845	0.07547	2,397	0	2,397	110	0	0	110	735
8	2023	2,582	0.04950	128	0.00000	0	6	0	6	123.97	744	872	0.07887	2,397	0	2,397	115	0	0	115	757
9	2024	2,582	0.05270	136	0.00000	0	6	0	6	127.69	766	902	0.08242	2,397	0	2,397	120	0	0	120	782
10	2025	2,582	0.05428	140	0.00000	0	6	0	6	131.52	789	929	0.08613	2,397	0	2,397	125	0	0	125	804
11	2026	2,582	0.05591	144	0.00000	0	6	0	6	135.47	813	957	0.09000	2,397	0	2,397	131	0	0	131	826
12	2027	2,582	0.05759	149	0.00000	0	6	0	6	139.53	837	986	0.09405	2,397	0	2,397	137	0	0	137	849
13	2028	2,582	0.05932	153	0.00000	0	6	0	6	143.72	862	1,015	0.09829	2,397	0	2,397	143	0	0	143	872
14	2029	2,582	0.06110	158	0.00000	0	6	0	6	148.03	888	1,046	0.10271	2,397	0	2,397	149	0	0	149	897
15	2030	2,582	0.06293	162	0.00000	0	6	0	6	152.47	915	1,077	0.10733	2,397	0	2,397	156	0	0	156	921
16	2031	2,582	0.06482	167	0.00000	0	6	0	6	157.04	942	1,109	0.11216	2,397	0	2,397	163	0	0	163	946
17	2032	2,582	0.06676	172	0.00000	0	6	0	6	161.75	971	1,143	0.11721	2,397	0	2,397	170	0	0	170	973
18	2033	2,582	0.06876	178	0.00000	0	6	0	6	166.61	1,000	1,178	0.12248	2,397	0	2,397	178	0	0	178	1,000
19	2034	2,279	0.07082	161	0.00000	0	5	0	5	171.60	858	1,019	0.12799	2,115	0	2,115	164	0	0	164	855
20	2035	1,519	0.07294	111	0.00000	0	3	0	3	176.75	530	641	0.13375	1,410	0	1,410	114	0	0	114	527
Total =		46,477							107			\$17,193				43,146				\$8,887	\$8,306
												NPV =	\$7,179							\$6,671	508
Total NPV =												\$508									
Benefit/Cost Ratio =												<u>1.08</u>									

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (B) = Avg. System Marginal Energy Cost (2), escalated  
 (C) = (B) x (D)  
 (D) = System Variable O&M Savings (6), escalated  
 (E) = (C) x (F)  
 (F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity  
 (H) = (F) + (G)  
 (I) = (C) + (E) + (H)  
 (J) = Electric Margin (4), escalated

(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)  
 (L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)  
 (M) = Program Admin Costs (13)  
 (N) = Incentive/Participant (20) x Number of Participants (19)  
 (O) = (L) + (M) + (N)  
 (P) = (I) - (O)

**Table 2  
Utility Test**

Project: **Central Air Conditioning Tier 1 (14.5 SEER)**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Project Costs (E)	Total Project Costs (F)	
2016	\$11	\$0	\$101	\$112	\$954	\$954	(\$842)
2017	40	0	208	248	1,899	1,899	(1,651)
2018	101	0	642	743	3,620	3,620	(2,877)
2019	103	0	661	764	0	0	764
2020	110	0	681	791	0	0	791
2021	115	0	701	816	0	0	816
2022	123	0	722	845	0	0	845
2023	128	0	744	872	0	0	872
2024	136	0	766	902	0	0	902
2025	140	0	789	929	0	0	929
2026	144	0	813	957	0	0	957
2027	149	0	837	986	0	0	986
2028	153	0	862	1,015	0	0	1,015
2029	158	0	888	1,046	0	0	1,046
2030	162	0	915	1,077	0	0	1,077
2031	167	0	942	1,109	0	0	1,109
2032	172	0	971	1,143	0	0	1,143
2033	178	0	1,000	1,178	0	0	1,178
2034	161	0	858	1,019	0	0	1,019
2035	111	0	530	641	0	0	641
Total =				\$17,193		\$6,473	\$10,720
NPV =				\$7,179		\$5,700	1,479
Total NPV =				\$1,479			
Benefit/Cost Ratio =				<u>1.26</u>			

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Central Air Conditioning Tier 1 (14.5 SEER)**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$11	\$0	\$101	\$35	\$147	\$954	\$468	\$1,422	(\$1,275)
2017	40	0	208	81	329	1,899	1,170	3,069	(2,740)
2018	101	0	642	249	992	3,620	2,340	5,960	(4,968)
2019	103	0	661	264	1,028	0	0	0	1,028
2020	110	0	681	282	1,073	0	0	0	1,073
2021	115	0	701	299	1,115	0	0	0	1,115
2022	123	0	722	319	1,164	0	0	0	1,164
2023	128	0	744	339	1,211	0	0	0	1,211
2024	136	0	766	361	1,263	0	0	0	1,263
2025	140	0	789	383	1,312	0	0	0	1,312
2026	144	0	813	407	1,364	0	0	0	1,364
2027	149	0	837	432	1,418	0	0	0	1,418
2028	153	0	862	458	1,473	0	0	0	1,473
2029	158	0	888	486	1,532	0	0	0	1,532
2030	162	0	915	515	1,592	0	0	0	1,592
2031	167	0	942	546	1,655	0	0	0	1,655
2032	172	0	971	580	1,723	0	0	0	1,723
2033	178	0	1,000	616	1,794	0	0	0	1,794
2034	161	0	858	549	1,568	0	0	0	1,568
2035	111	0	530	355	996	0	0	0	996
Total =					\$24,749			\$10,451	\$14,298
				NPV =	\$17,503			\$9,973	7,530
Total NPV =					\$7,530				
Benefit/Cost Ratio =					<u>1.76</u>				

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Central Air Conditioning Tier 1 (14.5 SEER)**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$600	\$0.09427	\$0.08963	282	0	282	\$27	1	0	\$0.000	\$0.000	\$0	\$0	\$627	\$1,086	\$0	\$1,086	(\$459)
2017	1,500	0.09851	0.09366	987	0	987	97	2	0	0.000	0.000	0	0	1,597	2,763	0	2,763	(1,166)
2018	3,000	0.10294	0.09788	2,397	0	2,397	247	5	0	0.000	0.000	0	0	3,247	5,622	0	5,622	(2,375)
2019	0	0.10758	0.10228	2,397	0	2,397	258	5	0	0.000	0.000	0	0	258	0	0	0	258
2020	0	0.11242	0.10689	2,397	0	2,397	269	5	0	0.000	0.000	0	0	269	0	0	0	269
2021	0	0.11748	0.11169	2,397	0	2,397	282	5	0	0.000	0.000	0	0	282	0	0	0	282
2022	0	0.12276	0.11672	2,397	0	2,397	294	5	0	0.000	0.000	0	0	294	0	0	0	294
2023	0	0.12829	0.12197	2,397	0	2,397	308	5	0	0.000	0.000	0	0	308	0	0	0	308
2024	0	0.13406	0.12746	2,397	0	2,397	321	5	0	0.000	0.000	0	0	321	0	0	0	321
2025	0	0.14009	0.13320	2,397	0	2,397	336	5	0	0.000	0.000	0	0	336	0	0	0	336
2026	0	0.14640	0.13919	2,397	0	2,397	351	5	0	0.000	0.000	0	0	351	0	0	0	351
2027	0	0.15299	0.14546	2,397	0	2,397	367	5	0	0.000	0.000	0	0	367	0	0	0	367
2028	0	0.15987	0.15200	2,397	0	2,397	383	5	0	0.000	0.000	0	0	383	0	0	0	383
2029	0	0.16706	0.15884	2,397	0	2,397	400	5	0	0.000	0.000	0	0	400	0	0	0	400
2030	0	0.17458	0.16599	2,397	0	2,397	418	5	0	0.000	0.000	0	0	418	0	0	0	418
2031	0	0.18244	0.17346	2,397	0	2,397	437	5	0	0.000	0.000	0	0	437	0	0	0	437
2032	0	0.19065	0.18126	2,397	0	2,397	457	5	0	0.000	0.000	0	0	457	0	0	0	457
2033	0	0.19923	0.18942	2,397	0	2,397	478	5	0	0.000	0.000	0	0	478	0	0	0	478
2034	0	0.20819	0.19795	2,115	0	2,115	440	4	0	0.000	0.000	0	0	440	0	0	0	440
2035	0	0.21756	0.20685	1,410	0	1,410	307	6	0	0.000	0.000	0	0	307	0	0	0	307
Total =				43,146	0			93	0					\$11,577			\$9,471	\$2,106
														NPV = \$6,916			\$8,221	(1,305)

Total NPV = (\$1,305)  
 Benefit/Cost Ratio = 0.84

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Central Air Conditioning Tier 1 (14.5 SEER)**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)	
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)		
2016	\$11	\$101	\$112	\$954	\$468	\$1,422	(\$1,310)	
2017	40	208	248	1,899	1,170	3,069	(2,821)	
2018	101	642	743	3,620	2,340	5,960	(5,217)	
2019	103	661	764	0	0	0	764	
2020	110	681	791	0	0	0	791	
2021	115	701	816	0	0	0	816	
2022	123	722	845	0	0	0	845	
2023	128	744	872	0	0	0	872	
2024	136	766	902	0	0	0	902	
2025	140	789	929	0	0	0	929	
2026	144	813	957	0	0	0	957	
2027	149	837	986	0	0	0	986	
2028	153	862	1,015	0	0	0	1,015	
2029	158	888	1,046	0	0	0	1,046	
2030	162	915	1,077	0	0	0	1,077	
2031	167	942	1,109	0	0	0	1,109	
2032	172	971	1,143	0	0	0	1,143	
2033	178	1,000	1,178	0	0	0	1,178	
2034	161	858	1,019	0	0	0	1,019	
2035	111	530	641	0	0	0	641	
Total =			\$17,193	Total =			\$10,451	\$6,742
NPV =			\$7,179	Total =			\$9,183	(2,003)

Total NPV = (\$2,003)  
Benefit/Cost Ratio = 0.78

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Central Air Conditioning Tier 2 (16 SEER) - Replacement**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09033			
Retail Rate Winter (\$/kWh) =	\$0.07591			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00418			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.06075			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$1,273	\$1,077	\$1,821
Incentive Costs =		3,000	6,000	12,000
Total Utility Project Costs =		\$4,273	\$7,077	\$13,821
14) Direct Participant Costs (\$/Part.) =		\$1,071	\$1,071	\$1,071
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		18	18	18
16) Avg Summer kW/part. Saved =		0.530	0.530	0.530
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		264	264	264
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		5	10	20
20) Incentive/Participant =		\$600	\$600	\$600
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		1,320	2,640	5,280
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		3	5	11
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		(\$633)	0.98	
Utility Cost Test		\$3,477	1.16	
Societal Test		\$22,875	1.57	
Participant Test		(\$6,132)	0.82	
Total Resource Cost Test		(\$11,016)	0.70	

**Table 1  
Ratepayer Impact Test**

Project: **Central Air Conditioning Tier 2 (16 SEER) - Replacement**  
 Program Years: **2016 - 2018**

t	Year												Costs					Annual Benefits Less Costs (P)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2016	1,422	\$0.03570	\$51	\$0.00000	\$0	3	0	3	\$100.80	\$302	\$353	\$0.06348	1,320	0	1,320	\$51	\$1,273	\$3,000	\$4,324	(\$3,971)	
2	2017	4,266	0.03790	162	0.00000	0	9	0	9	103.82	934	1,096	0.06634	3,960	0	3,960	159	1,077	6,000	7,236	(6,140)	
3	2018	9,955	0.03900	388	0.00000	0	21	0	21	106.94	2,246	2,634	0.06933	9,240	0	9,240	388	1,821	12,000	14,209	(11,575)	
4	2019	9,955	0.04000	398	0.00000	0	21	0	21	110.15	2,313	2,711	0.07245	9,240	0	9,240	406	0	0	406	2,305	
5	2020	9,955	0.04250	423	0.00000	0	21	0	21	113.45	2,382	2,805	0.07571	9,240	0	9,240	424	0	0	424	2,381	
6	2021	9,955	0.04470	445	0.00000	0	21	0	21	116.85	2,454	2,899	0.07911	9,240	0	9,240	443	0	0	443	2,456	
7	2022	9,955	0.04780	476	0.00000	0	21	0	21	120.36	2,528	3,004	0.08267	9,240	0	9,240	463	0	0	463	2,541	
8	2023	9,955	0.04950	493	0.00000	0	21	0	21	123.97	2,603	3,096	0.08639	9,240	0	9,240	484	0	0	484	2,612	
9	2024	9,955	0.05270	525	0.00000	0	21	0	21	127.69	2,681	3,206	0.09028	9,240	0	9,240	506	0	0	506	2,700	
10	2025	9,955	0.05428	540	0.00000	0	21	0	21	131.52	2,762	3,302	0.09434	9,240	0	9,240	528	0	0	528	2,774	
11	2026	9,955	0.05591	557	0.00000	0	21	0	21	135.47	2,845	3,402	0.09859	9,240	0	9,240	552	0	0	552	2,850	
12	2027	9,955	0.05759	573	0.00000	0	21	0	21	139.53	2,930	3,503	0.10302	9,240	0	9,240	577	0	0	577	2,926	
13	2028	9,955	0.05932	591	0.00000	0	21	0	21	143.72	3,018	3,609	0.10766	9,240	0	9,240	603	0	0	603	3,006	
14	2029	9,955	0.06110	608	0.00000	0	21	0	21	148.03	3,109	3,717	0.11251	9,240	0	9,240	630	0	0	630	3,087	
15	2030	9,955	0.06293	626	0.00000	0	21	0	21	152.47	3,202	3,828	0.11757	9,240	0	9,240	658	0	0	658	3,170	
16	2031	9,955	0.06482	645	0.00000	0	21	0	21	157.04	3,298	3,943	0.12286	9,240	0	9,240	688	0	0	688	3,255	
17	2032	9,955	0.06676	665	0.00000	0	21	0	21	161.75	3,397	4,062	0.12839	9,240	0	9,240	719	0	0	719	3,343	
18	2033	9,955	0.06876	685	0.00000	0	21	0	21	166.61	3,499	4,184	0.13417	9,240	0	9,240	751	0	0	751	3,433	
19	2034	8,533	0.07082	604	0.00000	0	18	0	18	171.60	3,089	3,693	0.14020	7,920	0	7,920	673	0	0	673	3,020	
20	2035	5,688	0.07294	415	0.00000	0	12	0	12	176.75	2,121	2,536	0.14651	5,280	0	5,280	469	0	0	469	2,067	
Total =		179,189							378			\$61,583				166,320				\$35,343	\$26,240	
												NPV =									\$26,343	(633)
Total NPV =																						
Benefit/Cost Ratio =																						0.98

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Central Air Conditioning Tier 2 (16 SEER) - Replacement**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$51	\$0	\$302	\$353	\$4,273	\$4,273	(\$3,920)
2017	162	0	934	1,096	7,077	7,077	(5,981)
2018	388	0	2,246	2,634	13,821	13,821	(11,187)
2019	398	0	2,313	2,711	0	0	2,711
2020	423	0	2,382	2,805	0	0	2,805
2021	445	0	2,454	2,899	0	0	2,899
2022	476	0	2,528	3,004	0	0	3,004
2023	493	0	2,603	3,096	0	0	3,096
2024	525	0	2,681	3,206	0	0	3,206
2025	540	0	2,762	3,302	0	0	3,302
2026	557	0	2,845	3,402	0	0	3,402
2027	573	0	2,930	3,503	0	0	3,503
2028	591	0	3,018	3,609	0	0	3,609
2029	608	0	3,109	3,717	0	0	3,717
2030	626	0	3,202	3,828	0	0	3,828
2031	645	0	3,298	3,943	0	0	3,943
2032	665	0	3,397	4,062	0	0	4,062
2033	685	0	3,499	4,184	0	0	4,184
2034	604	0	3,089	3,693	0	0	3,693
2035	415	0	2,121	2,536	0	0	2,536
Total =				\$61,583	\$25,171	\$36,412	
NPV =				\$25,710	\$22,233	3,477	
Total NPV =				\$3,477			
Benefit/Cost Ratio =				1.16			

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Central Air Conditioning Tier 2 (16 SEER) - Replacement**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs			Annual Benefits Less Costs (I)	
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)		Annual Total Increase (H)
2016	\$51	\$0	\$302	\$112	\$465	\$4,273	\$2,355	\$6,628	(\$6,163)
2017	162	0	934	357	1,453	7,077	4,710	11,787	(10,334)
2018	388	0	2,246	884	3,518	13,821	9,420	23,241	(19,723)
2019	398	0	2,313	937	3,648	0	0	0	3,648
2020	423	0	2,382	998	3,803	0	0	0	3,803
2021	445	0	2,454	1,063	3,962	0	0	0	3,962
2022	476	0	2,528	1,134	4,138	0	0	0	4,138
2023	493	0	2,603	1,204	4,300	0	0	0	4,300
2024	525	0	2,681	1,284	4,490	0	0	0	4,490
2025	540	0	2,762	1,362	4,664	0	0	0	4,664
2026	557	0	2,845	1,446	4,848	0	0	0	4,848
2027	573	0	2,930	1,533	5,036	0	0	0	5,036
2028	591	0	3,018	1,627	5,236	0	0	0	5,236
2029	608	0	3,109	1,726	5,443	0	0	0	5,443
2030	626	0	3,202	1,831	5,659	0	0	0	5,659
2031	645	0	3,298	1,942	5,885	0	0	0	5,885
2032	665	0	3,397	2,061	6,123	0	0	0	6,123
2033	685	0	3,499	2,187	6,371	0	0	0	6,371
2034	604	0	3,089	1,988	5,681	0	0	0	5,681
2035	415	0	2,121	1,406	3,942	0	0	0	3,942
Total =					\$88,665			\$41,656	\$47,009
					NPV = \$62,672			\$39,797	22,875
Total NPV =					\$22,875				
Benefit/Cost Ratio =					1.57				

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Central Air Conditioning Tier 2 (16 SEER) - Replacement**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$3,000	\$0.09439	\$0.07933	1,320	0	1,320	\$125	3	0	\$0.000	\$0.000	\$0	\$0	\$3,125	\$5,448	\$0	\$5,448	(\$2,323)
2017	6,000	0.09864	0.08290	3,960	0	3,960	391	8	0	0.000	0.000	0	0	6,391	11,084	0	11,084	(4,693)
2018	12,000	0.10308	0.08663	9,240	0	9,240	952	19	0	0.000	0.000	0	0	12,952	22,551	0	22,551	(9,599)
2019	0	0.10772	0.09052	9,240	0	9,240	995	19	0	0.000	0.000	0	0	995	0	0	0	995
2020	0	0.11257	0.09460	9,240	0	9,240	1,040	19	0	0.000	0.000	0	0	1,040	0	0	0	1,040
2021	0	0.11763	0.09885	9,240	0	9,240	1,087	19	0	0.000	0.000	0	0	1,087	0	0	0	1,087
2022	0	0.12293	0.10330	9,240	0	9,240	1,136	19	0	0.000	0.000	0	0	1,136	0	0	0	1,136
2023	0	0.12846	0.10795	9,240	0	9,240	1,187	19	0	0.000	0.000	0	0	1,187	0	0	0	1,187
2024	0	0.13424	0.11281	9,240	0	9,240	1,240	19	0	0.000	0.000	0	0	1,240	0	0	0	1,240
2025	0	0.14028	0.11789	9,240	0	9,240	1,296	19	0	0.000	0.000	0	0	1,296	0	0	0	1,296
2026	0	0.14659	0.12319	9,240	0	9,240	1,354	19	0	0.000	0.000	0	0	1,354	0	0	0	1,354
2027	0	0.15319	0.12873	9,240	0	9,240	1,415	19	0	0.000	0.000	0	0	1,415	0	0	0	1,415
2028	0	0.16008	0.13453	9,240	0	9,240	1,479	19	0	0.000	0.000	0	0	1,479	0	0	0	1,479
2029	0	0.16729	0.14058	9,240	0	9,240	1,546	19	0	0.000	0.000	0	0	1,546	0	0	0	1,546
2030	0	0.17481	0.14691	9,240	0	9,240	1,615	19	0	0.000	0.000	0	0	1,615	0	0	0	1,615
2031	0	0.18268	0.15352	9,240	0	9,240	1,688	19	0	0.000	0.000	0	0	1,688	0	0	0	1,688
2032	0	0.19090	0.16043	9,240	0	9,240	1,764	19	0	0.000	0.000	0	0	1,764	0	0	0	1,764
2033	0	0.19949	0.16765	9,240	0	9,240	1,843	19	0	0.000	0.000	0	0	1,843	0	0	0	1,843
2034	0	0.20847	0.17519	7,920	0	7,920	1,651	16	0	0.000	0.000	0	0	1,651	0	0	0	1,651
2035	0	0.21785	0.18307	5,280	0	5,280	1,150	11	0	0.000	0.000	0	0	1,150	0	0	0	1,150
Total =				166,320	0			342	0					\$45,954			\$39,083	\$6,871
														NPV = \$27,935			\$34,067	(6,132)

Total NPV = (\$6,132)  
 Benefit/Cost Ratio = 0.82

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Central Air Conditioning Tier 2 (16 SEER) - Replacement**  
 Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$51	\$302	\$353	\$4,273	\$2,355	\$6,628	(\$6,275)
2017	162	934	1,096	7,077	4,710	11,787	(10,691)
2018	388	2,246	2,634	13,821	9,420	23,241	(20,607)
2019	398	2,313	2,711	0	0	0	2,711
2020	423	2,382	2,805	0	0	0	2,805
2021	445	2,454	2,899	0	0	0	2,899
2022	476	2,528	3,004	0	0	0	3,004
2023	493	2,603	3,096	0	0	0	3,096
2024	525	2,681	3,206	0	0	0	3,206
2025	540	2,762	3,302	0	0	0	3,302
2026	557	2,845	3,402	0	0	0	3,402
2027	573	2,930	3,503	0	0	0	3,503
2028	591	3,018	3,609	0	0	0	3,609
2029	608	3,109	3,717	0	0	0	3,717
2030	626	3,202	3,828	0	0	0	3,828
2031	645	3,298	3,943	0	0	0	3,943
2032	665	3,397	4,062	0	0	0	4,062
2033	685	3,499	4,184	0	0	0	4,184
2034	604	3,089	3,693	0	0	0	3,693
2035	415	2,121	2,536	0	0	0	2,536
Total =			\$61,583			\$41,656	\$19,927
NPV =			\$25,710			\$36,726	(11,016)
Total NPV =							(\$11,016)
Benefit/Cost Ratio =							<u>0.70</u>

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
NORTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Central Air Conditioning Tier 2 (16 SEER) - Replacement**  
 Program Years: **2016 - 2018**

<b>Input Data</b>			First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.08197	13) Utility Project Costs			
Retail Rate Winter (\$/kWh) =	\$0.07128	Admin & Promotion Costs =	\$11,673	\$6,163	\$6,320
Retail Escalation Rate =	4.50%	Incentive Costs =	48,000	48,000	60,000
1a) Power Supply Cost Adjustment	\$0.00496	Total Utility Project Costs =	<u>\$59,673</u>	<u>\$54,163</u>	<u>\$66,320</u>
Fuel Escalation Rate =	2.80%	14) Direct Participant Costs (\$/Part.) =	\$1,071	\$1,071	\$1,071
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000	Escalation Rate =	1.73%	1.73%	1.73%
Escalation Rate =	3.00%	14a) Other Participant Costs (Annual \$/Part.) =	\$0	\$0	\$0
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00	Escalation Rate =	0.00%	0.00%	0.00%
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00	14b) Other Participant Savings (Annual \$/Part.) =	\$0	\$0	\$0
Escalation Rate =	4.50%	Escalation Rate =	0%	0%	0%
4) Electric Margin (\$/kWh) =	\$0.05993	15) Project Life (Years) =	18	18	18
Escalation Rate =	4.50%	16) Avg Summer kW/part. Saved =	0.530	0.530	0.530
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62	16a) Avg Winter kW/part Saved =	0.000	0.000	0.000
Reserve Capacity=	14.3%	17) Avg. Summer kWh/Part. Saved =	206	206	206
Escalation Rate =	3.00%	17a) Avg. Winter kWh/Part. Saved =	0	0	0
6) System Variable O&M (\$/kWh) =	\$0.00000	18a) System Demand Line Loss Factor	12.9800%	12.9800%	12.9800%
Escalation Rate =	0.00%	18b) System Energy Line Loss Factor	7.7350%	7.7350%	7.7350%
7) Environmental Damage Factor =	31%	19) Number of Participants =	80	80	100
Escalation Rate =	3.00%	20) Incentive/Participant =	\$600	\$600	\$600
8) Participant Discount Rate =	10.22%	21) Effective Federal & State Income Tax Rate =			39.39%
9) Utility Discount Rate =	8.70%	22) Annual Summer Kwh Saved	16,480	16,480	20,600
10) Societal Discount Rate =	3.34%	Annual Winter Kwh Saved	0	0	0
11) General Input Data Year =	2015	23) Annual Summer KW Saved	42	42	53
12) Project Analysis Year 1 =	2016	Annual Winter KW Saved	0	0	0
Project Analysis Year 2 =	2017				
Project Analysis Year 3 =	2018				
		<b>Test Results</b>	<b>NPV</b>	<b>B/C</b>	
		Ratepayer Impact Measure Test	\$232	1.00	
		Utility Cost Test	\$24,135	1.15	
		Societal Test	\$155,787	1.53	
		Participant Test	(\$67,948)	0.74	
		Total Resource Cost Test	(\$87,124)	0.68	

**Table 1  
Ratepayer Impact Test**

Project: **Central Air Conditioning Tier 2 (16 SEER) - Replacement**  
 Program Years: **2016 - 2018**

t	Year											Costs						Annual Benefits Less Costs (P)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2016	17,755	\$0.03570	\$634	0.00000	\$0	48	0	48	\$100.80	\$4,838	\$5,472	\$0.06263	16,480	0	16,480	\$626	\$11,673	\$48,000	\$60,299	(\$54,827)	
2	2017	35,509	0.03790	1,346	0.00000	0	96	0	96	103.82	9,967	11,313	0.06545	32,960	0	32,960	1,308	6,163	48,000	55,471	(44,158)	
3	2018	57,703	0.03900	2,250	0.00000	0	156	0	156	106.94	16,683	18,933	0.06839	53,560	0	53,560	2,220	6,320	60,000	68,540	(49,607)	
4	2019	57,703	0.04000	2,308	0.00000	0	156	0	156	110.15	17,183	19,491	0.07147	53,560	0	53,560	2,320	0	0	2,320	17,171	
5	2020	57,703	0.04250	2,452	0.00000	0	156	0	156	113.45	17,698	20,150	0.07468	53,560	0	53,560	2,424	0	0	2,424	17,726	
6	2021	57,703	0.04470	2,579	0.00000	0	156	0	156	116.85	18,229	20,808	0.07804	53,560	0	53,560	2,533	0	0	2,533	18,275	
7	2022	57,703	0.04780	2,758	0.00000	0	156	0	156	120.36	18,776	21,534	0.08156	53,560	0	53,560	2,648	0	0	2,648	18,886	
8	2023	57,703	0.04950	2,856	0.00000	0	156	0	156	123.97	19,339	22,195	0.08523	53,560	0	53,560	2,767	0	0	2,767	19,428	
9	2024	57,703	0.05270	3,041	0.00000	0	156	0	156	127.69	19,920	22,961	0.08906	53,560	0	53,560	2,891	0	0	2,891	20,070	
10	2025	57,703	0.05428	3,132	0.00000	0	156	0	156	131.52	20,517	23,649	0.09307	53,560	0	53,560	3,021	0	0	3,021	20,628	
11	2026	57,703	0.05591	3,226	0.00000	0	156	0	156	135.47	21,133	24,359	0.09726	53,560	0	53,560	3,157	0	0	3,157	21,202	
12	2027	57,703	0.05759	3,323	0.00000	0	156	0	156	139.53	21,767	25,090	0.10163	53,560	0	53,560	3,299	0	0	3,299	21,791	
13	2028	57,703	0.05932	3,423	0.00000	0	156	0	156	143.72	22,420	25,843	0.10621	53,560	0	53,560	3,448	0	0	3,448	22,395	
14	2029	57,703	0.06110	3,526	0.00000	0	156	0	156	148.03	23,093	26,619	0.11099	53,560	0	53,560	3,603	0	0	3,603	23,016	
15	2030	57,703	0.06293	3,631	0.00000	0	156	0	156	152.47	23,785	27,416	0.11598	53,560	0	53,560	3,765	0	0	3,765	23,651	
16	2031	57,703	0.06482	3,740	0.00000	0	156	0	156	157.04	24,498	28,238	0.12120	53,560	0	53,560	3,935	0	0	3,935	24,303	
17	2032	57,703	0.06676	3,852	0.00000	0	156	0	156	161.75	25,233	29,085	0.12665	53,560	0	53,560	4,112	0	0	4,112	24,973	
18	2033	57,703	0.06876	3,968	0.00000	0	156	0	156	166.61	25,991	29,959	0.13235	53,560	0	53,560	4,297	0	0	4,297	25,662	
19	2034	39,948	0.07082	2,829	0.00000	0	108	0	108	171.60	18,533	21,362	0.13831	37,080	0	37,080	3,109	0	0	3,109	18,253	
20	2035	22,193	0.07294	1,619	0.00000	0	60	0	60	176.75	10,605	12,224	0.14453	20,600	0	20,600	1,805	0	0	1,805	10,419	
Total =		1,038,653							2,808			\$436,701				964,080				\$237,444	\$199,257	
												NPV =									\$188,191	232
Total NPV =																					\$232	
Benefit/Cost Ratio =																					<u>1.00</u>	

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Central Air Conditioning Tier 2 (16 SEER) - Replacement**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$634	\$0	\$4,838	\$5,472	\$59,673	\$59,673	(\$54,201)
2017	1,346	0	9,967	11,313	54,163	54,163	(42,850)
2018	2,250	0	16,683	18,933	66,320	66,320	(47,387)
2019	2,308	0	17,183	19,491	0	0	19,491
2020	2,452	0	17,698	20,150	0	0	20,150
2021	2,579	0	18,229	20,808	0	0	20,808
2022	2,758	0	18,776	21,534	0	0	21,534
2023	2,856	0	19,339	22,195	0	0	22,195
2024	3,041	0	19,920	22,961	0	0	22,961
2025	3,132	0	20,517	23,649	0	0	23,649
2026	3,226	0	21,133	24,359	0	0	24,359
2027	3,323	0	21,767	25,090	0	0	25,090
2028	3,423	0	22,420	25,843	0	0	25,843
2029	3,526	0	23,093	26,619	0	0	26,619
2030	3,631	0	23,785	27,416	0	0	27,416
2031	3,740	0	24,498	28,238	0	0	28,238
2032	3,852	0	25,233	29,085	0	0	29,085
2033	3,968	0	25,991	29,959	0	0	29,959
2034	2,829	0	18,533	21,362	0	0	21,362
2035	1,619	0	10,605	12,224	0	0	12,224
Total =				\$436,701		\$180,156	\$256,545
NPV =				\$188,423		\$164,288	24,135
Total NPV =				\$24,135			
Benefit/Cost Ratio =				1.15			

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Central Air Conditioning Tier 2 (16 SEER) - Replacement**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
	2016	\$634	\$0	\$4,838	\$1,730	\$7,202	\$59,673	\$37,680	
2017	1,346	0	9,967	3,685	14,998	54,163	37,680	91,843	(76,845)
2018	2,250	0	16,683	6,351	25,284	66,320	47,100	113,420	(88,136)
2019	2,308	0	17,183	6,735	26,226	0	0	0	26,226
2020	2,452	0	17,698	7,171	27,321	0	0	0	27,321
2021	2,579	0	18,229	7,628	28,436	0	0	0	28,436
2022	2,758	0	18,776	8,131	29,665	0	0	0	29,665
2023	2,856	0	19,339	8,632	30,827	0	0	0	30,827
2024	3,041	0	19,920	9,197	32,158	0	0	0	32,158
2025	3,132	0	20,517	9,757	33,406	0	0	0	33,406
2026	3,226	0	21,133	10,352	34,711	0	0	0	34,711
2027	3,323	0	21,767	10,982	36,072	0	0	0	36,072
2028	3,423	0	22,420	11,651	37,494	0	0	0	37,494
2029	3,526	0	23,093	12,361	38,980	0	0	0	38,980
2030	3,631	0	23,785	13,113	40,529	0	0	0	40,529
2031	3,740	0	24,498	13,911	42,149	0	0	0	42,149
2032	3,852	0	25,233	14,758	43,843	0	0	0	43,843
2033	3,968	0	25,991	15,658	45,617	0	0	0	45,617
2034	2,829	0	18,533	11,500	32,862	0	0	0	32,862
2035	1,619	0	10,605	6,778	19,002	0	0	0	19,002
Total =					\$626,782			\$302,616	\$324,166
				NPV =	\$448,221			\$292,434	155,787
Total NPV =	\$155,787								
Benefit/Cost Ratio =	<u>1.53</u>								

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Central Air Conditioning Tier 2 (16 SEER) - Replacement**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Summer Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
	2016	\$48,000	\$0.08566	\$0.07449	16,480	0	16,480	\$1,412	42	0	\$0.000	\$0.000	\$0	\$0	\$49,412	\$87,162	\$0	
2017	48,000	0.08951	0.07784	32,960	0	32,960	2,950	85	0	0.000	0.000	0	0	50,950	88,670	0	88,670	(37,720)
2018	60,000	0.09354	0.08134	53,560	0	53,560	5,010	138	0	0.000	0.000	0	0	65,010	112,755	0	112,755	(47,745)
2019	0	0.09775	0.08500	53,560	0	53,560	5,235	138	0	0.000	0.000	0	0	5,235	0	0	0	5,235
2020	0	0.10215	0.08883	53,560	0	53,560	5,471	138	0	0.000	0.000	0	0	5,471	0	0	0	5,471
2021	0	0.10675	0.09283	53,560	0	53,560	5,718	138	0	0.000	0.000	0	0	5,718	0	0	0	5,718
2022	0	0.11155	0.09700	53,560	0	53,560	5,975	138	0	0.000	0.000	0	0	5,975	0	0	0	5,975
2023	0	0.11657	0.10137	53,560	0	53,560	6,243	138	0	0.000	0.000	0	0	6,243	0	0	0	6,243
2024	0	0.12182	0.10593	53,560	0	53,560	6,525	138	0	0.000	0.000	0	0	6,525	0	0	0	6,525
2025	0	0.12730	0.11070	53,560	0	53,560	6,818	138	0	0.000	0.000	0	0	6,818	0	0	0	6,818
2026	0	0.13303	0.11568	53,560	0	53,560	7,125	138	0	0.000	0.000	0	0	7,125	0	0	0	7,125
2027	0	0.13901	0.12088	53,560	0	53,560	7,445	138	0	0.000	0.000	0	0	7,445	0	0	0	7,445
2028	0	0.14527	0.12632	53,560	0	53,560	7,781	138	0	0.000	0.000	0	0	7,781	0	0	0	7,781
2029	0	0.15180	0.13201	53,560	0	53,560	8,130	138	0	0.000	0.000	0	0	8,130	0	0	0	8,130
2030	0	0.15864	0.13795	53,560	0	53,560	8,497	138	0	0.000	0.000	0	0	8,497	0	0	0	8,497
2031	0	0.16577	0.14415	53,560	0	53,560	8,879	138	0	0.000	0.000	0	0	8,879	0	0	0	8,879
2032	0	0.17323	0.15064	53,560	0	53,560	9,278	138	0	0.000	0.000	0	0	9,278	0	0	0	9,278
2033	0	0.18103	0.15742	53,560	0	53,560	9,696	138	0	0.000	0.000	0	0	9,696	0	0	0	9,696
2034	0	0.18918	0.16450	37,080	0	37,080	7,015	95	0	0.000	0.000	0	0	7,015	0	0	0	7,015
2035	0	0.19769	0.17191	20,600	0	20,600	4,072	53	0	0.000	0.000	0	0	4,072	0	0	0	4,072
Total =				964,080	0			2,483	0					\$285,275			\$288,587	(\$3,312)
														NPV = \$192,477			\$260,425	(67,948)

Total NPV = (\$67,948)  
 Benefit/Cost Ratio = 0.74

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Central Air Conditioning Tier 2 (16 SEER) - Replacement**  
 Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$634	\$4,838	\$5,472	\$59,673	\$37,680	\$97,353	(\$91,881)
2017	1,346	9,967	11,313	54,163	37,680	91,843	(80,530)
2018	2,250	16,683	18,933	66,320	47,100	113,420	(94,487)
2019	2,308	17,183	19,491	0	0	0	19,491
2020	2,452	17,698	20,150	0	0	0	20,150
2021	2,579	18,229	20,808	0	0	0	20,808
2022	2,758	18,776	21,534	0	0	0	21,534
2023	2,856	19,339	22,195	0	0	0	22,195
2024	3,041	19,920	22,961	0	0	0	22,961
2025	3,132	20,517	23,649	0	0	0	23,649
2026	3,226	21,133	24,359	0	0	0	24,359
2027	3,323	21,767	25,090	0	0	0	25,090
2028	3,423	22,420	25,843	0	0	0	25,843
2029	3,526	23,093	26,619	0	0	0	26,619
2030	3,631	23,785	27,416	0	0	0	27,416
2031	3,740	24,498	28,238	0	0	0	28,238
2032	3,852	25,233	29,085	0	0	0	29,085
2033	3,968	25,991	29,959	0	0	0	29,959
2034	2,829	18,533	21,362	0	0	0	21,362
2035	1,619	10,605	12,224	0	0	0	12,224
Total =			\$436,701			\$302,616	\$134,085
NPV =			\$188,423			\$275,547	(87,124)

Total NPV = (\$87,124)  
 Benefit/Cost Ratio = 0.68

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
SOUTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Central Air Conditioning Tier 2 (16 SEER)**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09021			
Retail Rate Winter (\$/kWh) =	\$0.08577			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00815			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05546			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$708	\$798	\$1,239
Incentive Costs =		1,200	3,000	6,000
Total Utility Project Costs =		\$1,908	\$3,798	\$7,239
14) Direct Participant Costs (\$/Part.) =		\$1,071	\$1,071	\$1,071
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		18	18	18
16) Avg Summer kW/part. Saved =		0.530	0.530	0.530
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		255	255	255
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		2	5	10
20) Incentive/Participant =		\$600	\$600	\$600
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		510	1,275	2,550
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		1	3	5
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		(\$992)	0.92	
Utility Cost Test		\$765	1.07	
Societal Test		\$9,793	1.49	
Participant Test		(\$3,135)	0.81	
Total Resource Cost Test		(\$6,246)	0.66	

**Table 1  
Ratepayer Impact Test**

Project: **Central Air Conditioning Tier 2 (16 SEER) - Replacement**  
 Program Years: **2016 - 2018**

t	Year											Costs						Annual Benefits Less Costs (P)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2016	549	\$0.03570	\$20	\$0.00000	\$0	1	0	1	\$100.80	\$101	\$121	\$0.05796	510	0	510	\$18	\$708	\$1,200	\$1,926	(\$1,805)	
2	2017	1,923	0.03790	73	0.00000	0	4	0	4	103.82	415	488	0.06056	1,785	0	1,785	66	798	3,000	3,864	(3,376)	
3	2018	4,670	0.03900	182	0.00000	0	10	0	10	106.94	1,069	1,251	0.06329	4,335	0	4,335	166	1,239	6,000	7,405	(6,154)	
4	2019	4,670	0.04000	187	0.00000	0	10	0	10	110.15	1,102	1,289	0.06614	4,335	0	4,335	174	0	0	174	1,115	
5	2020	4,670	0.04250	198	0.00000	0	10	0	10	113.45	1,135	1,333	0.06911	4,335	0	4,335	182	0	0	182	1,151	
6	2021	4,670	0.04470	209	0.00000	0	10	0	10	116.85	1,169	1,378	0.07222	4,335	0	4,335	190	0	0	190	1,188	
7	2022	4,670	0.04780	223	0.00000	0	10	0	10	120.36	1,204	1,427	0.07547	4,335	0	4,335	198	0	0	198	1,229	
8	2023	4,670	0.04950	231	0.00000	0	10	0	10	123.97	1,240	1,471	0.07887	4,335	0	4,335	207	0	0	207	1,264	
9	2024	4,670	0.05270	246	0.00000	0	10	0	10	127.69	1,277	1,523	0.08242	4,335	0	4,335	217	0	0	217	1,306	
10	2025	4,670	0.05428	253	0.00000	0	10	0	10	131.52	1,315	1,568	0.08613	4,335	0	4,335	226	0	0	226	1,342	
11	2026	4,670	0.05591	261	0.00000	0	10	0	10	135.47	1,355	1,616	0.09000	4,335	0	4,335	236	0	0	236	1,380	
12	2027	4,670	0.05759	269	0.00000	0	10	0	10	139.53	1,395	1,664	0.09405	4,335	0	4,335	247	0	0	247	1,417	
13	2028	4,670	0.05932	277	0.00000	0	10	0	10	143.72	1,437	1,714	0.09829	4,335	0	4,335	258	0	0	258	1,456	
14	2029	4,670	0.06110	285	0.00000	0	10	0	10	148.03	1,480	1,765	0.10271	4,335	0	4,335	270	0	0	270	1,495	
15	2030	4,670	0.06293	294	0.00000	0	10	0	10	152.47	1,525	1,819	0.10733	4,335	0	4,335	282	0	0	282	1,537	
16	2031	4,670	0.06482	303	0.00000	0	10	0	10	157.04	1,570	1,873	0.11216	4,335	0	4,335	295	0	0	295	1,578	
17	2032	4,670	0.06676	312	0.00000	0	10	0	10	161.75	1,618	1,930	0.11721	4,335	0	4,335	308	0	0	308	1,622	
18	2033	4,670	0.06876	321	0.00000	0	10	0	10	166.61	1,666	1,987	0.12248	4,335	0	4,335	322	0	0	322	1,665	
19	2034	4,121	0.07082	292	0.00000	0	9	0	9	171.60	1,544	1,836	0.12799	3,825	0	3,825	297	0	0	297	1,539	
20	2035	2,747	0.07294	200	0.00000	0	6	0	6	176.75	1,061	1,261	0.13375	2,550	0	2,550	207	0	0	207	1,054	
Total =		84,060							180			\$29,314				78,030				\$17,311	\$12,003	
												NPV =									\$13,155	(992)
Total NPV =																						
Benefit/Cost Ratio =																						<u>0.92</u>

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Central Air Conditioning Tier 2 (16 SEER) - Replacement**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$20	\$0	\$101	\$121	\$1,908	\$1,908	(\$1,787)
2017	73	0	415	488	3,798	3,798	(3,310)
2018	182	0	1,069	1,251	7,239	7,239	(5,988)
2019	187	0	1,102	1,289	0	0	1,289
2020	198	0	1,135	1,333	0	0	1,333
2021	209	0	1,169	1,378	0	0	1,378
2022	223	0	1,204	1,427	0	0	1,427
2023	231	0	1,240	1,471	0	0	1,471
2024	246	0	1,277	1,523	0	0	1,523
2025	253	0	1,315	1,568	0	0	1,568
2026	261	0	1,355	1,616	0	0	1,616
2027	269	0	1,395	1,664	0	0	1,664
2028	277	0	1,437	1,714	0	0	1,714
2029	285	0	1,480	1,765	0	0	1,765
2030	294	0	1,525	1,819	0	0	1,819
2031	303	0	1,570	1,873	0	0	1,873
2032	312	0	1,618	1,930	0	0	1,930
2033	321	0	1,666	1,987	0	0	1,987
2034	292	0	1,544	1,836	0	0	1,836
2035	200	0	1,061	1,261	0	0	1,261
Total =				\$29,314		\$12,945	\$16,369
NPV =				\$12,163		\$11,398	765
Total NPV =				\$765			
Benefit/Cost Ratio =				<u>1.07</u>			

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3**  
**Societal Cost Test**

Project: **Central Air Conditioning Tier 2 (16 SEER) - Replacement**  
Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$20	\$0	\$101	\$38	\$159	\$1,908	\$942	\$2,850	(\$2,691)
2017	73	0	415	159	647	3,798	2,355	6,153	(5,506)
2018	182	0	1,069	420	1,671	7,239	4,710	11,949	(10,278)
2019	187	0	1,102	445	1,734	0	0	0	1,734
2020	198	0	1,135	474	1,807	0	0	0	1,807
2021	209	0	1,169	505	1,883	0	0	0	1,883
2022	223	0	1,204	539	1,966	0	0	0	1,966
2023	231	0	1,240	572	2,043	0	0	0	2,043
2024	246	0	1,277	610	2,133	0	0	0	2,133
2025	253	0	1,315	647	2,215	0	0	0	2,215
2026	261	0	1,355	687	2,303	0	0	0	2,303
2027	269	0	1,395	728	2,392	0	0	0	2,392
2028	277	0	1,437	773	2,487	0	0	0	2,487
2029	285	0	1,480	820	2,585	0	0	0	2,585
2030	294	0	1,525	870	2,689	0	0	0	2,689
2031	303	0	1,570	923	2,796	0	0	0	2,796
2032	312	0	1,618	979	2,909	0	0	0	2,909
2033	321	0	1,666	1,038	3,025	0	0	0	3,025
2034	292	0	1,544	988	2,824	0	0	0	2,824
2035	200	0	1,061	699	1,960	0	0	0	1,960
Total =					\$42,228		\$20,952	\$21,276	
NPV =					\$29,786		\$19,993	9,793	
Total NPV =		\$9,793							
Benefit/Cost Ratio =		<u>1.49</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Central Air Conditioning Tier 2 (16 SEER) - Replacement**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$1,200	\$0.09427	\$0.08963	510	0	510	\$48	1	0	\$0.000	\$0.000	\$0	\$0	\$1,248	\$2,179	\$0	\$2,179	(\$931)
2017	3,000	0.09851	0.09366	1,785	0	1,785	176	4	0	0.000	0.000	0	0	3,176	5,542	0	5,542	(2,366)
2018	6,000	0.10294	0.09788	4,335	0	4,335	446	9	0	0.000	0.000	0	0	6,446	11,276	0	11,276	(4,830)
2019	0	0.10758	0.10228	4,335	0	4,335	466	9	0	0.000	0.000	0	0	466	0	0	0	466
2020	0	0.11242	0.10689	4,335	0	4,335	487	9	0	0.000	0.000	0	0	487	0	0	0	487
2021	0	0.11748	0.11169	4,335	0	4,335	509	9	0	0.000	0.000	0	0	509	0	0	0	509
2022	0	0.12276	0.11672	4,335	0	4,335	532	9	0	0.000	0.000	0	0	532	0	0	0	532
2023	0	0.12829	0.12197	4,335	0	4,335	556	9	0	0.000	0.000	0	0	556	0	0	0	556
2024	0	0.13406	0.12746	4,335	0	4,335	581	9	0	0.000	0.000	0	0	581	0	0	0	581
2025	0	0.14009	0.13320	4,335	0	4,335	607	9	0	0.000	0.000	0	0	607	0	0	0	607
2026	0	0.14640	0.13919	4,335	0	4,335	635	9	0	0.000	0.000	0	0	635	0	0	0	635
2027	0	0.15299	0.14546	4,335	0	4,335	663	9	0	0.000	0.000	0	0	663	0	0	0	663
2028	0	0.15987	0.15200	4,335	0	4,335	693	9	0	0.000	0.000	0	0	693	0	0	0	693
2029	0	0.16706	0.15884	4,335	0	4,335	724	9	0	0.000	0.000	0	0	724	0	0	0	724
2030	0	0.17458	0.16599	4,335	0	4,335	757	9	0	0.000	0.000	0	0	757	0	0	0	757
2031	0	0.18244	0.17346	4,335	0	4,335	791	9	0	0.000	0.000	0	0	791	0	0	0	791
2032	0	0.19065	0.18126	4,335	0	4,335	826	9	0	0.000	0.000	0	0	826	0	0	0	826
2033	0	0.19923	0.18942	4,335	0	4,335	864	9	0	0.000	0.000	0	0	864	0	0	0	864
2034	0	0.20819	0.19795	3,825	0	3,825	796	8	0	0.000	0.000	0	0	796	0	0	0	796
2035	0	0.21756	0.20685	2,550	0	2,550	555	11	0	0.000	0.000	0	0	555	0	0	0	555
Total =				78,030	0			168	0					\$21,912			\$18,997	\$2,915
														NPV = \$13,354			\$16,489	(3,135)

Total NPV = (\$3,135)  
 Benefit/Cost Ratio = 0.81

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Central Air Conditioning Tier 2 (16 SEER) - Replacement**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$20	\$101	\$121	\$1,908	\$942	\$2,850	(\$2,729)
2017	73	415	488	3,798	2,355	6,153	(5,665)
2018	182	1,069	1,251	7,239	4,710	11,949	(10,698)
2019	187	1,102	1,289	0	0	0	1,289
2020	198	1,135	1,333	0	0	0	1,333
2021	209	1,169	1,378	0	0	0	1,378
2022	223	1,204	1,427	0	0	0	1,427
2023	231	1,240	1,471	0	0	0	1,471
2024	246	1,277	1,523	0	0	0	1,523
2025	253	1,315	1,568	0	0	0	1,568
2026	261	1,355	1,616	0	0	0	1,616
2027	269	1,395	1,664	0	0	0	1,664
2028	277	1,437	1,714	0	0	0	1,714
2029	285	1,480	1,765	0	0	0	1,765
2030	294	1,525	1,819	0	0	0	1,819
2031	303	1,570	1,873	0	0	0	1,873
2032	312	1,618	1,930	0	0	0	1,930
2033	321	1,666	1,987	0	0	0	1,987
2034	292	1,544	1,836	0	0	0	1,836
2035	200	1,061	1,261	0	0	0	1,261
Total =			\$29,314			\$20,952	\$8,362
NPV =			\$12,163			\$18,409	(6,246)
Total NPV =			(\$6,246)				
Benefit/Cost Ratio =			<u>0.66</u>				

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Central Air Conditioning Tier 2 - New**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09033			
Retail Rate Winter (\$/kWh) =	\$0.07591			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00418			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.06075			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$1,273	\$539	\$455
Incentive Costs =		3,000	3,000	3,000
Total Utility Project Costs =		\$4,273	\$3,539	\$3,455
14) Direct Participant Costs (\$/Part.) =		\$1,071	\$1,071	\$1,071
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		18	18	NA
16) Avg Summer kW/part. Saved =		0.530	0.530	0.530
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		264	264	264
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		5	5	5
20) Incentive/Participant =		\$600	\$600	\$600
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		1,320	1,320	1,320
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		3	3	3
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		(\$863)	0.93	
Utility Cost Test		\$935	1.09	
Societal Test		\$9,012	1.51	
Participant Test		(\$2,709)	0.82	
Total Resource Cost Test		(\$5,530)	0.67	

**Table 1  
Ratepayer Impact Test**

Project: **Central Air Conditioning Tier 2 - New**  
Program Years: **2016 - 2018**

t	Year												Costs					Annual Benefits Less Costs (P)			
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)
1	2016	1,422	\$0.03570	\$51	\$0.00000	\$0	3	0	3	\$100.80	\$302	\$353	\$0.06348	1,320	0	1,320	\$51	\$1,273	\$3,000	\$4,324	(\$3,971)
2	2017	2,844	0.03790	108	0.00000	0	6	0	6	103.82	623	731	0.06634	2,640	0	2,640	106	539	3,000	3,645	(2,914)
3	2018	4,266	0.03900	166	0.00000	0	9	0	9	106.94	962	1,128	0.06933	3,960	0	3,960	166	455	3,000	3,621	(2,493)
4	2019	4,266	0.04000	171	0.00000	0	9	0	9	110.15	991	1,162	0.07245	3,960	0	3,960	174	0	0	174	988
5	2020	4,266	0.04250	181	0.00000	0	9	0	9	113.45	1,021	1,202	0.07571	3,960	0	3,960	182	0	0	182	1,020
6	2021	4,266	0.04470	191	0.00000	0	9	0	9	116.85	1,052	1,243	0.07911	3,960	0	3,960	190	0	0	190	1,053
7	2022	4,266	0.04780	204	0.00000	0	9	0	9	120.36	1,083	1,287	0.08267	3,960	0	3,960	198	0	0	198	1,089
8	2023	4,266	0.04950	211	0.00000	0	9	0	9	123.97	1,116	1,327	0.08639	3,960	0	3,960	207	0	0	207	1,120
9	2024	4,266	0.05270	225	0.00000	0	9	0	9	127.69	1,149	1,374	0.09028	3,960	0	3,960	217	0	0	217	1,157
10	2025	4,266	0.05428	232	0.00000	0	9	0	9	131.52	1,184	1,416	0.09434	3,960	0	3,960	226	0	0	226	1,190
11	2026	4,266	0.05591	239	0.00000	0	9	0	9	135.47	1,219	1,458	0.09859	3,960	0	3,960	237	0	0	237	1,221
12	2027	4,266	0.05759	246	0.00000	0	9	0	9	139.53	1,256	1,502	0.10302	3,960	0	3,960	247	0	0	247	1,255
13	2028	4,266	0.05932	253	0.00000	0	9	0	9	143.72	1,293	1,546	0.10766	3,960	0	3,960	258	0	0	258	1,288
14	2029	4,266	0.06110	261	0.00000	0	9	0	9	148.03	1,332	1,593	0.11251	3,960	0	3,960	270	0	0	270	1,323
15	2030	4,266	0.06293	268	0.00000	0	9	0	9	152.47	1,372	1,640	0.11757	3,960	0	3,960	282	0	0	282	1,358
16	2031	4,266	0.06482	277	0.00000	0	9	0	9	157.04	1,413	1,690	0.12286	3,960	0	3,960	295	0	0	295	1,395
17	2032	4,266	0.06676	285	0.00000	0	9	0	9	161.75	1,456	1,741	0.12839	3,960	0	3,960	308	0	0	308	1,433
18	2033	4,266	0.06876	293	0.00000	0	9	0	9	166.61	1,499	1,792	0.13417	3,960	0	3,960	322	0	0	322	1,470
19	2034	2,844	0.07082	201	0.00000	0	6	0	6	171.60	1,030	1,231	0.14020	2,640	0	2,640	224	0	0	224	1,007
20	2035	1,422	0.07294	104	0.00000	0	3	0	3	176.75	530	634	0.14651	1,320	0	1,320	117	0	0	117	517
Total =		76,788							162			\$26,050				71,280				\$15,544	\$10,506
												NPV =	\$11,312							\$12,175	(863)
Total NPV =																					(\$863)
Benefit/Cost Ratio =																					0.93

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (B) = Avg. System Marginal Energy Cost (2), escalated  
 (C) = (C) x (D)  
 (D) = System Variable O&M Savings (6), escalated  
 (E) = (C) x (F)  
 (F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity  
 (H) = (F) + (G)  
 (I) = (C) + (E) + (H)  
 (J) = Electric Margin (4), escalated

(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)  
 (L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)  
 (M) = Program Admin Costs (13)  
 (N) = Incentive/Participant (20) x Number of Participants (19)  
 (O) = (L) + (M) + (N)  
 (P) = (I) - (O)

**Table 2  
Utility Test**

Project: **Central Air Conditioning Tier 2 - New**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$51	\$0	\$302	\$353	\$4,273	\$4,273	(\$3,920)
2017	108	0	623	731	3,539	3,539	(2,808)
2018	166	0	962	1,128	3,455	3,455	(2,327)
2019	171	0	991	1,162	0	0	1,162
2020	181	0	1,021	1,202	0	0	1,202
2021	191	0	1,052	1,243	0	0	1,243
2022	204	0	1,083	1,287	0	0	1,287
2023	211	0	1,116	1,327	0	0	1,327
2024	225	0	1,149	1,374	0	0	1,374
2025	232	0	1,184	1,416	0	0	1,416
2026	239	0	1,219	1,458	0	0	1,458
2027	246	0	1,256	1,502	0	0	1,502
2028	253	0	1,293	1,546	0	0	1,546
2029	261	0	1,332	1,593	0	0	1,593
2030	268	0	1,372	1,640	0	0	1,640
2031	277	0	1,413	1,690	0	0	1,690
2032	285	0	1,456	1,741	0	0	1,741
2033	293	0	1,499	1,792	0	0	1,792
2034	201	0	1,030	1,231	0	0	1,231
2035	104	0	530	634	0	0	634
Total =				\$26,050		\$11,267	\$14,783
NPV =				\$11,312		\$10,377	935
Total NPV =				\$935			
Benefit/Cost Ratio =				1.09			

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Central Air Conditioning Tier 2 - New**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$51	\$0	\$302	\$112	\$465	\$4,273	\$2,355	\$6,628	(\$6,163)
2017	108	0	623	238	969	3,539	2,355	5,894	(4,925)
2018	166	0	962	378	1,506	3,455	2,355	5,810	(4,304)
2019	171	0	991	402	1,564	0	0	0	1,564
2020	181	0	1,021	428	1,630	0	0	0	1,630
2021	191	0	1,052	456	1,699	0	0	0	1,699
2022	204	0	1,083	486	1,773	0	0	0	1,773
2023	211	0	1,116	516	1,843	0	0	0	1,843
2024	225	0	1,149	550	1,924	0	0	0	1,924
2025	232	0	1,184	584	2,000	0	0	0	2,000
2026	239	0	1,219	620	2,078	0	0	0	2,078
2027	246	0	1,256	657	2,159	0	0	0	2,159
2028	253	0	1,293	697	2,243	0	0	0	2,243
2029	261	0	1,332	740	2,333	0	0	0	2,333
2030	268	0	1,372	784	2,424	0	0	0	2,424
2031	277	0	1,413	833	2,523	0	0	0	2,523
2032	285	0	1,456	883	2,624	0	0	0	2,624
2033	293	0	1,499	937	2,729	0	0	0	2,729
2034	201	0	1,030	663	1,894	0	0	0	1,894
2035	104	0	530	352	986	0	0	0	986
Total =					\$37,366			\$18,332	\$19,034
					NPV = \$26,784			\$17,772	9,012
Total NPV =		\$9,012							
Benefit/Cost Ratio =		<u>1.51</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Central Air Conditioning Tier 2 - New**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$3,000	\$0.09439	\$0.07933	1,320	0	1,320	\$125	3	0	\$0.000	\$0.000	\$0	\$0	\$3,125	\$5,448	\$0	\$5,448	(\$2,323)
2017	3,000	0.09864	0.08290	2,640	0	2,640	260	5	0	0.000	0.000	0	0	3,260	5,542	0	5,542	(2,282)
2018	3,000	0.10308	0.08663	3,960	0	3,960	408	8	0	0.000	0.000	0	0	3,408	5,638	0	5,638	(2,230)
2019	0	0.10772	0.09052	3,960	0	3,960	427	8	0	0.000	0.000	0	0	427	0	0	0	427
2020	0	0.11257	0.09460	3,960	0	3,960	446	8	0	0.000	0.000	0	0	446	0	0	0	446
2021	0	0.11763	0.09885	3,960	0	3,960	466	8	0	0.000	0.000	0	0	466	0	0	0	466
2022	0	0.12293	0.10330	3,960	0	3,960	487	8	0	0.000	0.000	0	0	487	0	0	0	487
2023	0	0.12846	0.10795	3,960	0	3,960	509	8	0	0.000	0.000	0	0	509	0	0	0	509
2024	0	0.13424	0.11281	3,960	0	3,960	532	8	0	0.000	0.000	0	0	532	0	0	0	532
2025	0	0.14028	0.11789	3,960	0	3,960	556	8	0	0.000	0.000	0	0	556	0	0	0	556
2026	0	0.14659	0.12319	3,960	0	3,960	580	8	0	0.000	0.000	0	0	580	0	0	0	580
2027	0	0.15319	0.12873	3,960	0	3,960	607	8	0	0.000	0.000	0	0	607	0	0	0	607
2028	0	0.16008	0.13453	3,960	0	3,960	634	8	0	0.000	0.000	0	0	634	0	0	0	634
2029	0	0.16729	0.14058	3,960	0	3,960	662	8	0	0.000	0.000	0	0	662	0	0	0	662
2030	0	0.17481	0.14691	3,960	0	3,960	692	8	0	0.000	0.000	0	0	692	0	0	0	692
2031	0	0.18268	0.15352	3,960	0	3,960	723	8	0	0.000	0.000	0	0	723	0	0	0	723
2032	0	0.19090	0.16043	3,960	0	3,960	756	8	0	0.000	0.000	0	0	756	0	0	0	756
2033	0	0.19949	0.16765	3,960	0	3,960	790	8	0	0.000	0.000	0	0	790	0	0	0	790
2034	0	0.20847	0.17519	2,640	0	2,640	550	5	0	0.000	0.000	0	0	550	0	0	0	550
2035	0	0.21785	0.18307	1,320	0	1,320	288	3	0	0.000	0.000	0	0	288	0	0	0	288
Total =				71,280	0			144	0					\$19,498			\$16,628	\$2,870
														NPV = \$12,408			\$15,117	(2,709)
Total NPV =																		(\$2,709)
Benefit/Cost Ratio =																		0.82

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Central Air Conditioning Tier 2 - New**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$51	\$302	\$353	\$4,273	\$2,355	\$6,628	(\$6,275)
2017	108	623	731	3,539	2,355	5,894	(5,163)
2018	166	962	1,128	3,455	2,355	5,810	(4,682)
2019	171	991	1,162	0	0	0	1,162
2020	181	1,021	1,202	0	0	0	1,202
2021	191	1,052	1,243	0	0	0	1,243
2022	204	1,083	1,287	0	0	0	1,287
2023	211	1,116	1,327	0	0	0	1,327
2024	225	1,149	1,374	0	0	0	1,374
2025	232	1,184	1,416	0	0	0	1,416
2026	239	1,219	1,458	0	0	0	1,458
2027	246	1,256	1,502	0	0	0	1,502
2028	253	1,293	1,546	0	0	0	1,546
2029	261	1,332	1,593	0	0	0	1,593
2030	268	1,372	1,640	0	0	0	1,640
2031	277	1,413	1,690	0	0	0	1,690
2032	285	1,456	1,741	0	0	0	1,741
2033	293	1,499	1,792	0	0	0	1,792
2034	201	1,030	1,231	0	0	0	1,231
2035	104	530	634	0	0	0	634
Total =			\$26,050			\$18,332	\$7,718
NPV =			\$11,312			\$16,841	(5,530)
Total NPV =			(\$5,530)				
Benefit/Cost Ratio =			0.67				

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
NORTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Central Air Conditioning Tier 2 - New**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.08197			
Retail Rate Winter (\$/kWh) =	\$0.07128			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00496			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05993			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	8.70%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$14,591	\$9,245	\$9,480
Incentive Costs =		60,000	72,000	90,000
Total Utility Project Costs =		\$74,591	\$81,245	\$99,480
14) Direct Participant Costs (\$/Part.) =		\$1,071	\$1,071	\$1,071
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		18	18	18
16) Avg Summer kW/part. Saved =		0.530	0.530	0.530
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		206	206	206
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		100	120	150
20) Incentive/Participant =		\$600	\$600	\$600
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		20,600	24,720	30,900
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		53	64	80
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$1,746	1.01	
Utility Cost Test		\$35,666	1.15	
Societal Test		\$223,783	1.54	
Participant Test		(\$96,325)	0.74	
Total Resource Cost Test		(\$121,803)	0.69	

**Table 1  
Ratepayer Impact Test**

Project: **Central Air Conditioning Tier 2 - New**  
Program Years: **2016 - 2018**

t	Year												Costs						Annual Benefits Less Costs (P)			
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)	Program Admin Costs (M)		Incentive Costs (N)	Total Project Costs (O)	
1	2016	22,193	\$0.03570	\$792	\$0.00000	\$0	60	0	60	\$100.80	\$6,048	\$6,840	\$0.06263	20,600	0	20,600	\$782	\$14,591	\$60,000	\$75,373	(\$68,533)	
2	2017	48,826	0.03790	1,851	0.00000	0	132	0	132	103.82	13,704	15,555	0.06545	45,320	0	45,320	1,798	9,245	72,000	83,043	(67,488)	
3	2018	82,116	0.03900	3,203	0.00000	0	222	0	222	106.94	23,741	26,944	0.06839	76,220	0	76,220	3,160	9,480	90,000	102,640	(75,696)	
4	2019	82,116	0.04000	3,285	0.00000	0	222	0	222	110.15	24,453	27,738	0.07147	76,220	0	76,220	3,302	0	0	3,302	24,436	
5	2020	82,116	0.04250	3,490	0.00000	0	222	0	222	113.45	25,186	28,676	0.07468	76,220	0	76,220	3,450	0	0	3,450	25,226	
6	2021	82,116	0.04470	3,671	0.00000	0	222	0	222	116.85	25,941	29,612	0.07804	76,220	0	76,220	3,605	0	0	3,605	26,007	
7	2022	82,116	0.04780	3,925	0.00000	0	222	0	222	120.36	26,720	30,645	0.08156	76,220	0	76,220	3,768	0	0	3,768	26,877	
8	2023	82,116	0.04950	4,065	0.00000	0	222	0	222	123.97	27,521	31,586	0.08523	76,220	0	76,220	3,938	0	0	3,938	27,648	
9	2024	82,116	0.05270	4,328	0.00000	0	222	0	222	127.69	28,347	32,675	0.08906	76,220	0	76,220	4,114	0	0	4,114	28,561	
10	2025	82,116	0.05428	4,457	0.00000	0	222	0	222	131.52	29,197	33,654	0.09307	76,220	0	76,220	4,300	0	0	4,300	29,354	
11	2026	82,116	0.05591	4,591	0.00000	0	222	0	222	135.47	30,074	34,665	0.09726	76,220	0	76,220	4,493	0	0	4,493	30,172	
12	2027	82,116	0.05759	4,729	0.00000	0	222	0	222	139.53	30,976	35,705	0.10163	76,220	0	76,220	4,695	0	0	4,695	31,010	
13	2028	82,116	0.05932	4,871	0.00000	0	222	0	222	143.72	31,906	36,777	0.10621	76,220	0	76,220	4,907	0	0	4,907	31,870	
14	2029	82,116	0.06110	5,017	0.00000	0	222	0	222	148.03	32,863	37,880	0.11099	76,220	0	76,220	5,128	0	0	5,128	32,752	
15	2030	82,116	0.06293	5,168	0.00000	0	222	0	222	152.47	33,848	39,016	0.11598	76,220	0	76,220	5,358	0	0	5,358	33,658	
16	2031	82,116	0.06482	5,323	0.00000	0	222	0	222	157.04	34,863	40,186	0.12120	76,220	0	76,220	5,599	0	0	5,599	34,587	
17	2032	82,116	0.06676	5,482	0.00000	0	222	0	222	161.75	35,909	41,391	0.12665	76,220	0	76,220	5,851	0	0	5,851	35,540	
18	2033	82,116	0.06876	5,646	0.00000	0	222	0	222	166.61	36,987	42,633	0.13235	76,220	0	76,220	6,114	0	0	6,114	36,519	
19	2034	59,922	0.07082	4,244	0.00000	0	162	0	162	171.60	27,799	32,043	0.13831	55,620	0	55,620	4,663	0	0	4,663	27,380	
20	2035	33,290	0.07294	2,428	0.00000	0	90	0	90	176.75	15,908	18,336	0.14453	30,900	0	30,900	2,707	0	0	2,707	15,629	
Total =		1,478,087							3,996			\$622,557				1,371,960				\$337,048	\$285,509	
												NPV = \$267,180									\$265,434	1,746
Total NPV =			\$1,746																			
Benefit/Cost Ratio =			<u>1.01</u>																			

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (B) = Avg. System Marginal Energy Cost (2), escalated  
 (C) = (C) x (D)  
 (D) = System Variable O&M Savings (6), escalated  
 (E) = (C) x (F)  
 (F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity  
 (H) = (F) + (G)  
 (I) = (C) + (E) + (H)  
 (J) = Electric Margin (4), escalated

(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)  
 (L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)  
 (M) = Program Admin Costs (13)  
 (N) = Incentive/Participant (20) x Number of Participants (19)  
 (O) = (L) + (M) + (N)  
 (P) = (I) - (O)

**Table 2  
Utility Test**

Project: **Central Air Conditioning Tier 2 - New**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$792	\$0	\$6,048	\$6,840	\$74,591	\$74,591	(\$67,751)
2017	1,851	0	13,704	15,555	81,245	81,245	(65,690)
2018	3,203	0	23,741	26,944	99,480	99,480	(72,536)
2019	3,285	0	24,453	27,738	0	0	27,738
2020	3,490	0	25,186	28,676	0	0	28,676
2021	3,671	0	25,941	29,612	0	0	29,612
2022	3,925	0	26,720	30,645	0	0	30,645
2023	4,065	0	27,521	31,586	0	0	31,586
2024	4,328	0	28,347	32,675	0	0	32,675
2025	4,457	0	29,197	33,654	0	0	33,654
2026	4,591	0	30,074	34,665	0	0	34,665
2027	4,729	0	30,976	35,705	0	0	35,705
2028	4,871	0	31,906	36,777	0	0	36,777
2029	5,017	0	32,863	37,880	0	0	37,880
2030	5,168	0	33,848	39,016	0	0	39,016
2031	5,323	0	34,863	40,186	0	0	40,186
2032	5,482	0	35,909	41,391	0	0	41,391
2033	5,646	0	36,987	42,633	0	0	42,633
2034	4,244	0	27,799	32,043	0	0	32,043
2035	2,428	0	15,908	18,336	0	0	18,336
Total =				\$622,557		\$255,316	\$367,241
NPV =				\$267,180		\$231,514	35,666
Total NPV =		\$35,666					
Benefit/Cost Ratio =		<u>1.15</u>					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3**  
**Societal Cost Test**

Project: **Central Air Conditioning Tier 2 - New**  
Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$792	\$0	\$6,048	\$2,163	\$9,003	\$74,591	\$47,100	\$121,691	(\$112,688)
2017	1,851	0	13,704	5,066	20,621	81,245	56,520	137,765	(117,144)
2018	3,203	0	23,741	9,039	35,983	99,480	70,650	170,130	(134,147)
2019	3,285	0	24,453	9,584	37,322	0	0	0	37,322
2020	3,490	0	25,186	10,206	38,882	0	0	0	38,882
2021	3,671	0	25,941	10,855	40,467	0	0	0	40,467
2022	3,925	0	26,720	11,571	42,216	0	0	0	42,216
2023	4,065	0	27,521	12,284	43,870	0	0	0	43,870
2024	4,328	0	28,347	13,088	45,763	0	0	0	45,763
2025	4,457	0	29,197	13,885	47,539	0	0	0	47,539
2026	4,591	0	30,074	14,731	49,396	0	0	0	49,396
2027	4,729	0	30,976	15,628	51,333	0	0	0	51,333
2028	4,871	0	31,906	16,581	53,358	0	0	0	53,358
2029	5,017	0	32,863	17,590	55,470	0	0	0	55,470
2030	5,168	0	33,848	18,661	57,677	0	0	0	57,677
2031	5,323	0	34,863	19,797	59,983	0	0	0	59,983
2032	5,482	0	35,909	21,003	62,394	0	0	0	62,394
2033	5,646	0	36,987	22,282	64,915	0	0	0	64,915
2034	4,244	0	27,799	17,250	49,293	0	0	0	49,293
2035	2,428	0	15,908	10,167	28,503	0	0	0	28,503
Total =					\$893,988		\$429,586	\$464,402	
NPV =					\$638,097		\$414,314	223,783	
Total NPV =		\$223,783							
Benefit/Cost Ratio =		<u>1.54</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Central Air Conditioning Tier 2 - New**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$60,000	\$0.08566	\$0.07449	20,600	0	20,600	\$1,765	53	0	\$0.000	\$0.000	\$0	\$0	\$61,765	\$108,953	\$0	\$108,953	(\$47,188)
2017	72,000	0.08951	0.07784	45,320	0	45,320	4,057	117	0	0.000	0.000	0	0	76,057	133,005	0	133,005	(56,948)
2018	90,000	0.09354	0.08134	76,220	0	76,220	7,130	196	0	0.000	0.000	0	0	97,130	169,133	0	169,133	(72,003)
2019	0	0.09775	0.08500	76,220	0	76,220	7,451	196	0	0.000	0.000	0	0	7,451	0	0	0	7,451
2020	0	0.10215	0.08883	76,220	0	76,220	7,786	196	0	0.000	0.000	0	0	7,786	0	0	0	7,786
2021	0	0.10675	0.09283	76,220	0	76,220	8,136	196	0	0.000	0.000	0	0	8,136	0	0	0	8,136
2022	0	0.11155	0.09700	76,220	0	76,220	8,502	196	0	0.000	0.000	0	0	8,502	0	0	0	8,502
2023	0	0.11657	0.10137	76,220	0	76,220	8,885	196	0	0.000	0.000	0	0	8,885	0	0	0	8,885
2024	0	0.12182	0.10593	76,220	0	76,220	9,285	196	0	0.000	0.000	0	0	9,285	0	0	0	9,285
2025	0	0.12730	0.11070	76,220	0	76,220	9,703	196	0	0.000	0.000	0	0	9,703	0	0	0	9,703
2026	0	0.13303	0.11568	76,220	0	76,220	10,140	196	0	0.000	0.000	0	0	10,140	0	0	0	10,140
2027	0	0.13901	0.12088	76,220	0	76,220	10,595	196	0	0.000	0.000	0	0	10,595	0	0	0	10,595
2028	0	0.14527	0.12632	76,220	0	76,220	11,072	196	0	0.000	0.000	0	0	11,072	0	0	0	11,072
2029	0	0.15180	0.13201	76,220	0	76,220	11,570	196	0	0.000	0.000	0	0	11,570	0	0	0	11,570
2030	0	0.15864	0.13795	76,220	0	76,220	12,092	196	0	0.000	0.000	0	0	12,092	0	0	0	12,092
2031	0	0.16577	0.14415	76,220	0	76,220	12,635	196	0	0.000	0.000	0	0	12,635	0	0	0	12,635
2032	0	0.17323	0.15064	76,220	0	76,220	13,204	196	0	0.000	0.000	0	0	13,204	0	0	0	13,204
2033	0	0.18103	0.15742	76,220	0	76,220	13,798	196	0	0.000	0.000	0	0	13,798	0	0	0	13,798
2034	0	0.18918	0.16450	55,620	0	55,620	10,522	143	0	0.000	0.000	0	0	10,522	0	0	0	10,522
2035	0	0.19769	0.17191	30,900	0	30,900	6,109	80	0	0.000	0.000	0	0	6,109	0	0	0	6,109
Total =				1,371,960	0			3,529	0					\$406,437			\$411,091	(\$4,654)
														NPV = \$272,522			\$368,847	(96,325)

Total NPV = (\$96,325)  
 Benefit/Cost Ratio = 0.74

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Central Air Conditioning Tier 2 - New**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$792	\$6,048	\$6,840	\$74,591	\$47,100	\$121,691	(\$114,851)
2017	1,851	13,704	15,555	81,245	56,520	137,765	(122,210)
2018	3,203	23,741	26,944	99,480	70,650	170,130	(143,186)
2019	3,285	24,453	27,738	0	0	0	27,738
2020	3,490	25,186	28,676	0	0	0	28,676
2021	3,671	25,941	29,612	0	0	0	29,612
2022	3,925	26,720	30,645	0	0	0	30,645
2023	4,065	27,521	31,586	0	0	0	31,586
2024	4,328	28,347	32,675	0	0	0	32,675
2025	4,457	29,197	33,654	0	0	0	33,654
2026	4,591	30,074	34,665	0	0	0	34,665
2027	4,729	30,976	35,705	0	0	0	35,705
2028	4,871	31,906	36,777	0	0	0	36,777
2029	5,017	32,863	37,880	0	0	0	37,880
2030	5,168	33,848	39,016	0	0	0	39,016
2031	5,323	34,863	40,186	0	0	0	40,186
2032	5,482	35,909	41,391	0	0	0	41,391
2033	5,646	36,987	42,633	0	0	0	42,633
2034	4,244	27,799	32,043	0	0	0	32,043
2035	2,428	15,908	18,336	0	0	0	18,336
Total =			\$622,557			\$429,586	\$192,971
NPV =			\$267,180			\$388,983	(121,803)
Total NPV =			(\$121,803)				
Benefit/Cost Ratio =			<u>0.69</u>				

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
SOUTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Central Air Conditioning Tier 2 - New**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09021			
Retail Rate Winter (\$/kWh) =	\$0.08577			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00815			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05546			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$708	\$319	\$248
Incentive Costs =		1,200	1,200	1,200
Total Utility Project Costs =		\$1,908	\$1,519	\$1,448
14) Direct Participant Costs (\$/Part.) =		\$1,071	\$1,071	\$1,071
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		18	18	18
16) Avg Summer kW/part. Saved =		0.530	0.530	0.530
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		255	255	255
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		2	2	2
20) Incentive/Participant =		\$600	\$600	\$600
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		510	510	510
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		1	1	1
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		(\$335)	0.93	
Utility Cost Test		\$298	1.07	
Societal Test		\$3,909	1.52	
Participant Test		(\$1,144)	0.81	
Total Resource Cost Test		(\$2,287)	0.68	



**Table 2  
Utility Test**

Project: **Central Air Conditioning Tier 2 - New**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$20	\$0	\$101	\$121	\$1,908	\$1,908	(\$1,787)
2017	42	0	208	250	1,519	1,519	(1,269)
2018	64	0	428	492	1,448	1,448	(956)
2019	66	0	441	507	0	0	507
2020	70	0	454	524	0	0	524
2021	74	0	467	541	0	0	541
2022	79	0	481	560	0	0	560
2023	82	0	496	578	0	0	578
2024	87	0	511	598	0	0	598
2025	89	0	526	615	0	0	615
2026	92	0	542	634	0	0	634
2027	95	0	558	653	0	0	653
2028	98	0	575	673	0	0	673
2029	101	0	592	693	0	0	693
2030	104	0	610	714	0	0	714
2031	107	0	628	735	0	0	735
2032	110	0	647	757	0	0	757
2033	113	0	666	779	0	0	779
2034	78	0	343	421	0	0	421
2035	40	0	177	217	0	0	217
Total =				\$11,062		\$4,875	\$6,187
				NPV = \$4,797		\$4,499	298
Total NPV =				\$298			
Benefit/Cost Ratio =				<u>1.07</u>			

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Central Air Conditioning Tier 2 - New**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$20	\$0	\$101	\$38	\$159	\$1,908	\$942	\$2,850	(\$2,691)
2017	42	0	208	81	331	1,519	942	2,461	(2,130)
2018	64	0	428	165	657	1,448	942	2,390	(1,733)
2019	66	0	441	175	682	0	0	0	682
2020	70	0	454	186	710	0	0	0	710
2021	74	0	467	198	739	0	0	0	739
2022	79	0	481	211	771	0	0	0	771
2023	82	0	496	225	803	0	0	0	803
2024	87	0	511	240	838	0	0	0	838
2025	89	0	526	254	869	0	0	0	869
2026	92	0	542	269	903	0	0	0	903
2027	95	0	558	286	939	0	0	0	939
2028	98	0	575	303	976	0	0	0	976
2029	101	0	592	322	1,015	0	0	0	1,015
2030	104	0	610	342	1,056	0	0	0	1,056
2031	107	0	628	362	1,097	0	0	0	1,097
2032	110	0	647	384	1,141	0	0	0	1,141
2033	113	0	666	407	1,186	0	0	0	1,186
2034	78	0	343	227	648	0	0	0	648
2035	40	0	177	120	337	0	0	0	337
Total =					\$15,857			\$7,701	\$8,156
					NPV = \$11,378			\$7,469	3,909
Total NPV =	\$3,909								
Benefit/Cost Ratio =	<u>1.52</u>								

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Central Air Conditioning Tier 2 - New**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$1,200	\$0.09427	\$0.08963	510	0	510	\$48	1	0	\$0.000	\$0.000	\$0	\$0	\$1,248	\$2,179	\$0	\$2,179	(\$931)
2017	1,200	0.09851	0.09366	1,020	0	1,020	100	2	0	0.000	0.000	0	0	1,300	2,217	0	2,217	(917)
2018	1,200	0.10294	0.09788	1,530	0	1,530	157	3	0	0.000	0.000	0	0	1,357	2,255	0	2,255	(898)
2019	0	0.10758	0.10228	1,530	0	1,530	165	3	0	0.000	0.000	0	0	165	0	0	0	165
2020	0	0.11242	0.10689	1,530	0	1,530	172	3	0	0.000	0.000	0	0	172	0	0	0	172
2021	0	0.11748	0.11169	1,530	0	1,530	180	3	0	0.000	0.000	0	0	180	0	0	0	180
2022	0	0.12276	0.11672	1,530	0	1,530	188	3	0	0.000	0.000	0	0	188	0	0	0	188
2023	0	0.12829	0.12197	1,530	0	1,530	196	3	0	0.000	0.000	0	0	196	0	0	0	196
2024	0	0.13406	0.12746	1,530	0	1,530	205	3	0	0.000	0.000	0	0	205	0	0	0	205
2025	0	0.14009	0.13320	1,530	0	1,530	214	3	0	0.000	0.000	0	0	214	0	0	0	214
2026	0	0.14640	0.13919	1,530	0	1,530	224	3	0	0.000	0.000	0	0	224	0	0	0	224
2027	0	0.15299	0.14546	1,530	0	1,530	234	3	0	0.000	0.000	0	0	234	0	0	0	234
2028	0	0.15987	0.15200	1,530	0	1,530	245	3	0	0.000	0.000	0	0	245	0	0	0	245
2029	0	0.16706	0.15884	1,530	0	1,530	256	3	0	0.000	0.000	0	0	256	0	0	0	256
2030	0	0.17458	0.16599	1,530	0	1,530	267	3	0	0.000	0.000	0	0	267	0	0	0	267
2031	0	0.18244	0.17346	1,530	0	1,530	279	3	0	0.000	0.000	0	0	279	0	0	0	279
2032	0	0.19065	0.18126	1,530	0	1,530	292	3	0	0.000	0.000	0	0	292	0	0	0	292
2033	0	0.19923	0.18942	1,530	0	1,530	305	3	0	0.000	0.000	0	0	305	0	0	0	305
2034	0	0.20819	0.19795	1,020	0	1,020	212	2	0	0.000	0.000	0	0	212	0	0	0	212
2035	0	0.21756	0.20685	510	0	510	111	3	0	0.000	0.000	0	0	111	0	0	0	111
Total =				27,540	0			56	0					\$7,650			\$6,651	\$999
														NPV = \$4,903			\$6,047	(1,144)

Total NPV = (\$1,144)  
 Benefit/Cost Ratio = 0.81

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Central Air Conditioning Tier 2 - New**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$20	\$101	\$121	\$1,908	\$942	\$2,850	(\$2,729)
2017	42	208	250	1,519	942	2,461	(2,211)
2018	64	428	492	1,448	942	2,390	(1,898)
2019	66	441	507	0	0	0	507
2020	70	454	524	0	0	0	524
2021	74	467	541	0	0	0	541
2022	79	481	560	0	0	0	560
2023	82	496	578	0	0	0	578
2024	87	511	598	0	0	0	598
2025	89	526	615	0	0	0	615
2026	92	542	634	0	0	0	634
2027	95	558	653	0	0	0	653
2028	98	575	673	0	0	0	673
2029	101	592	693	0	0	0	693
2030	104	610	714	0	0	0	714
2031	107	628	735	0	0	0	735
2032	110	647	757	0	0	0	757
2033	113	666	779	0	0	0	779
2034	78	343	421	0	0	0	421
2035	40	177	217	0	0	0	217
Total =			\$11,062			\$7,701	\$3,361
NPV =			\$4,797			\$7,085	(2,287)

Total NPV = (\$2,287)  
Benefit/Cost Ratio = 0.68

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Window AC Units**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09033			
Retail Rate Winter (\$/kWh) =	\$0.07591			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00418			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.06075			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$106	\$45	\$38
Incentive Costs =		250	250	250
Total Utility Project Costs =		\$356	\$295	\$288
14) Direct Participant Costs (\$/Part.) =		\$43	\$43	\$43
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		9	9	9
16) Avg Summer kW/part. Saved =		0.040	0.040	0.040
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		23	23	23
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		5	5	5
20) Incentive/Participant =		\$50	\$50	\$50
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		115	115	115
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		0	0	0
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		(\$342)	0.64	
Utility Cost Test		(\$248)	0.71	
Societal Test		\$312	1.39	
Participant Test		\$303	1.50	
Total Resource Cost Test		(\$152)	0.80	

**Table 1  
Ratepayer Impact Test**

Project: **Window AC Units**  
Program Years: **2016 - 2018**

t	Year											Costs					Annual Benefits Less Costs (P)					
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)		Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2016	124	\$0.03570	\$4	\$0.00000	\$0	0	0	0	\$100.80	\$0	\$4	\$0.06348	115	0	115	\$4	\$106	\$250	\$360	(\$356)	
2	2017	248	0.03790	9	0.00000	0	0	0	0	103.82	0	9	0.06634	230	0	230	9	45	250	304	(295)	
3	2018	372	0.03900	15	0.00000	0	1	0	1	106.94	107	122	0.06933	345	0	345	14	38	250	302	(180)	
4	2019	372	0.04000	15	0.00000	0	1	0	1	110.15	110	125	0.07245	345	0	345	15	0	0	15	110	
5	2020	372	0.04250	16	0.00000	0	1	0	1	113.45	113	129	0.07571	345	0	345	16	0	0	16	113	
6	2021	372	0.04470	17	0.00000	0	1	0	1	116.85	117	134	0.07911	345	0	345	17	0	0	17	117	
7	2022	372	0.04780	18	0.00000	0	1	0	1	120.36	120	138	0.08267	345	0	345	17	0	0	17	121	
8	2023	372	0.04950	18	0.00000	0	1	0	1	123.97	124	142	0.08639	345	0	345	18	0	0	18	124	
9	2024	372	0.05270	20	0.00000	0	1	0	1	127.69	128	148	0.09028	345	0	345	19	0	0	19	129	
10	2025	248	0.05428	13	0.00000	0	0	0	0	131.52	0	13	0.09434	230	0	230	13	0	0	13	0	
11	2026	124	0.05591	7	0.00000	0	0	0	0	135.47	0	7	0.09859	115	0	115	7	0	0	7	0	
12	2027	0	0.05759	0	0.00000	0	0	0	0	139.53	0	0	0.10302	0	0	0	0	0	0	0	0	
13	2028	0	0.05932	0	0.00000	0	0	0	0	143.72	0	0	0.10766	0	0	0	0	0	0	0	0	
14	2029	0	0.06110	0	0.00000	0	0	0	0	148.03	0	0	0.11251	0	0	0	0	0	0	0	0	
15	2030	0	0.06293	0	0.00000	0	0	0	0	152.47	0	0	0.11757	0	0	0	0	0	0	0	0	
16	2031	0	0.06482	0	0.00000	0	0	0	0	157.04	0	0	0.12286	0	0	0	0	0	0	0	0	
17	2032	0	0.06676	0	0.00000	0	0	0	0	161.75	0	0	0.12839	0	0	0	0	0	0	0	0	
18	2033	0	0.06876	0	0.00000	0	0	0	0	166.61	0	0	0.13417	0	0	0	0	0	0	0	0	
19	2034	0	0.07082	0	0.00000	0	0	0	0	171.60	0	0	0.14020	0	0	0	0	0	0	0	0	
20	2035	0	0.07294	0	0.00000	0	0	0	0	176.75	0	0	0.14651	0	0	0	0	0	0	0	0	
Total =		3,348						7				\$971				3,105				\$1,088	(\$117)	
												NPV =	\$617								\$959	(342)
Total NPV =																						(\$342)
Benefit/Cost Ratio =																						0.64

Worksheet Calculations	
(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Window AC Units**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$4	\$0	\$0	\$4	\$356	\$356	(\$352)
2017	9	0	0	9	295	295	(286)
2018	15	0	107	122	288	288	(166)
2019	15	0	110	125	0	0	125
2020	16	0	113	129	0	0	129
2021	17	0	117	134	0	0	134
2022	18	0	120	138	0	0	138
2023	18	0	124	142	0	0	142
2024	20	0	128	148	0	0	148
2025	13	0	0	13	0	0	13
2026	7	0	0	7	0	0	7
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$971		\$939	\$32
				NPV = \$617		\$865	(248)
Total NPV =							(\$248)
Benefit/Cost Ratio =							<u>0.71</u>

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Window AC Units**  
Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$4	\$0	\$0	\$1	\$5	\$356	(\$35)	\$321	(\$316)
2017	9	0	0	3	12	295	(35)	260	(248)
2018	15	0	107	41	163	288	(35)	253	(90)
2019	15	0	110	43	168	0	0	0	168
2020	16	0	113	46	175	0	0	0	175
2021	17	0	117	49	183	0	0	0	183
2022	18	0	120	52	190	0	0	0	190
2023	18	0	124	55	197	0	0	0	197
2024	20	0	128	59	207	0	0	0	207
2025	13	0	0	5	18	0	0	0	18
2026	7	0	0	3	10	0	0	0	10
2027	0	0	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$1,328			\$834	\$494
					NPV = \$1,122			\$810	312
Total NPV =								\$312	
Benefit/Cost Ratio =								<u>1.39</u>	

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Window AC Units**  
Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$250	\$0.09439	\$0.07933	115	0	115	\$11	0	0	\$0.000	\$0.000	\$0	\$0	\$261	\$219	\$0	\$219	\$42
2017	250	0.09864	0.08290	230	0	230	23	0	0	0.000	0.000	0	0	273	223	0	223	50
2018	250	0.10308	0.08663	345	0	345	36	1	0	0.000	0.000	0	0	286	226	0	226	60
2019	0	0.10772	0.09052	345	0	345	37	1	0	0.000	0.000	0	0	37	0	0	0	37
2020	0	0.11257	0.09460	345	0	345	39	1	0	0.000	0.000	0	0	39	0	0	0	39
2021	0	0.11763	0.09885	345	0	345	41	1	0	0.000	0.000	0	0	41	0	0	0	41
2022	0	0.12293	0.10330	345	0	345	42	1	0	0.000	0.000	0	0	42	0	0	0	42
2023	0	0.12846	0.10795	345	0	345	44	1	0	0.000	0.000	0	0	44	0	0	0	44
2024	0	0.13424	0.11281	345	0	345	46	1	0	0.000	0.000	0	0	46	0	0	0	46
2025	0	0.14028	0.11789	230	0	230	32	0	0	0.000	0.000	0	0	32	0	0	0	32
2026	0	0.14659	0.12319	115	0	115	17	0	0	0.000	0.000	0	0	17	0	0	0	17
2027	0	0.15319	0.12873	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2028	0	0.16008	0.13453	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2029	0	0.16729	0.14058	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2030	0	0.17481	0.14691	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2031	0	0.18268	0.15352	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2032	0	0.19090	0.16043	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.19949	0.16765	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.20847	0.17519	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.21785	0.18307	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				3,105	0			7	0					\$1,118			\$668	\$450
														NPV = \$910			\$607	303
Total NPV =																		\$303
Benefit/Cost Ratio =																		1.50

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Window AC Units**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$4	\$0	\$4	\$356	(\$35)	\$321	(\$317)
2017	9	0	9	295	(35)	260	(251)
2018	15	107	122	288	(35)	253	(131)
2019	15	110	125	0	0	0	125
2020	16	113	129	0	0	0	129
2021	17	117	134	0	0	0	134
2022	18	120	138	0	0	0	138
2023	18	124	142	0	0	0	142
2024	20	128	148	0	0	0	148
2025	13	0	13	0	0	0	13
2026	7	0	7	0	0	0	7
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
			Total = \$971			\$834	\$137
			NPV = \$617			\$769	(152)

Total NPV = (\$152)  
Benefit/Cost Ratio = 0.80

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
NORTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Window AC Units**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.08197			
Retail Rate Winter (\$/kWh) =	\$0.07128			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00496			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05993			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	8.70%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$365	\$321	\$395
Incentive Costs =		1,500	2,500	3,750
Total Utility Project Costs =		\$1,865	\$2,821	\$4,145
14) Direct Participant Costs (\$/Part.) =		\$43	\$43	\$43
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		9	9	9
16) Avg Summer kW/part. Saved =		0.040	0.040	0.040
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		18	18	18
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		30	50	75
20) Incentive/Participant =		\$50	\$50	\$50
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		540	900	1,350
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		1	2	3
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		(\$3,236)	0.63	
Utility Cost Test		(\$2,490)	0.68	
Societal Test		\$2,542	1.34	
Participant Test		\$2,369	1.39	
Total Resource Cost Test		(\$1,523)	0.78	

**Table 1  
Ratepayer Impact Test**

Project: **Window AC Units**  
Program Years: **2016 - 2018**

t	Year											Costs					Annual Benefits Less Costs (P)					
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)		Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2016	582	\$0.03570	\$21	\$0.00000	\$0	1	0	1	\$100.80	\$101	\$122	\$0.06263	540	0	540	\$20	\$365	\$1,500	\$1,885	(\$1,763)	
2	2017	1,551	0.03790	59	0.00000	0	4	0	4	103.82	415	474	0.06545	1,440	0	1,440	57	321	2,500	2,878	(2,404)	
3	2018	3,006	0.03900	117	0.00000	0	7	0	7	106.94	749	866	0.06839	2,790	0	2,790	116	395	3,750	4,261	(3,395)	
4	2019	3,006	0.04000	120	0.00000	0	7	0	7	110.15	771	891	0.07147	2,790	0	2,790	121	0	0	121	770	
5	2020	3,006	0.04250	128	0.00000	0	7	0	7	113.45	794	922	0.07468	2,790	0	2,790	126	0	0	126	796	
6	2021	3,006	0.04470	134	0.00000	0	7	0	7	116.85	818	952	0.07804	2,790	0	2,790	132	0	0	132	820	
7	2022	3,006	0.04780	144	0.00000	0	7	0	7	120.36	843	987	0.08156	2,790	0	2,790	138	0	0	138	849	
8	2023	3,006	0.04950	149	0.00000	0	7	0	7	123.97	868	1,017	0.08523	2,790	0	2,790	144	0	0	144	873	
9	2024	3,006	0.05270	158	0.00000	0	7	0	7	127.69	894	1,052	0.08906	2,790	0	2,790	151	0	0	151	901	
10	2025	2,424	0.05428	132	0.00000	0	6	0	6	131.52	789	921	0.09307	2,250	0	2,250	127	0	0	127	794	
11	2026	1,454	0.05591	81	0.00000	0	3	0	3	135.47	406	487	0.09726	1,350	0	1,350	80	0	0	80	407	
12	2027	0	0.05759	0	0.00000	0	0	0	0	139.53	0	0	0.10163	0	0	0	0	0	0	0	0	
13	2028	0	0.05932	0	0.00000	0	0	0	0	143.72	0	0	0.10621	0	0	0	0	0	0	0	0	
14	2029	0	0.06110	0	0.00000	0	0	0	0	148.03	0	0	0.11099	0	0	0	0	0	0	0	0	
15	2030	0	0.06293	0	0.00000	0	0	0	0	152.47	0	0	0.11598	0	0	0	0	0	0	0	0	
16	2031	0	0.06482	0	0.00000	0	0	0	0	157.04	0	0	0.12120	0	0	0	0	0	0	0	0	
17	2032	0	0.06676	0	0.00000	0	0	0	0	161.75	0	0	0.12665	0	0	0	0	0	0	0	0	
18	2033	0	0.06876	0	0.00000	0	0	0	0	166.61	0	0	0.13235	0	0	0	0	0	0	0	0	
19	2034	0	0.07082	0	0.00000	0	0	0	0	171.60	0	0	0.13831	0	0	0	0	0	0	0	0	
20	2035	0	0.07294	0	0.00000	0	0	0	0	176.75	0	0	0.14453	0	0	0	0	0	0	0	0	
Total =		27,053						63				\$8,691				25,110				\$10,043	(\$1,352)	
												NPV =	\$5,399								\$8,635	(3,236)
Total NPV =			(\$3,236)																			
Benefit/Cost Ratio =			0.63																			

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (B) = Avg. System Marginal Energy Cost (2), escalated  
 (C) = (B) x (D)  
 (D) = System Variable O&M Savings (6), escalated  
 (E) = (C) x (F)  
 (F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity  
 (H) = (F) + (G)  
 (I) = (C) + (E) + (H)  
 (J) = Electric Margin (4), escalated

(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)  
 (L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)  
 (M) = Program Admin Costs (13)  
 (N) = Incentive/Participant (20) x Number of Participants (19)  
 (O) = (L) + (M) + (N)  
 (P) = (I) - (O)

**Table 2  
Utility Test**

Project: **Window AC Units**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$21	\$0	\$101	\$122	\$1,865	\$1,865	(\$1,743)
2017	59	0	415	474	2,821	2,821	(2,347)
2018	117	0	749	866	4,145	4,145	(3,279)
2019	120	0	771	891	0	0	891
2020	128	0	794	922	0	0	922
2021	134	0	818	952	0	0	952
2022	144	0	843	987	0	0	987
2023	149	0	868	1,017	0	0	1,017
2024	158	0	894	1,052	0	0	1,052
2025	132	0	789	921	0	0	921
2026	81	0	406	487	0	0	487
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$8,691	\$8,831	(\$140)	
NPV =				\$5,399	\$7,889	(2,490)	
Total NPV =				(\$2,490)			
Benefit/Cost Ratio =				<u>0.68</u>			

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Window AC Units**  
Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$21	\$0	\$101	\$39	\$161	\$1,865	(\$210)	\$1,655	(\$1,494)
2017	59	0	415	154	628	2,821	(350)	2,471	(1,843)
2018	117	0	749	291	1,157	4,145	(525)	3,620	(2,463)
2019	120	0	771	308	1,199	0	0	0	1,199
2020	128	0	794	328	1,250	0	0	0	1,250
2021	134	0	818	349	1,301	0	0	0	1,301
2022	144	0	843	373	1,360	0	0	0	1,360
2023	149	0	868	396	1,413	0	0	0	1,413
2024	158	0	894	421	1,473	0	0	0	1,473
2025	132	0	789	380	1,301	0	0	0	1,301
2026	81	0	406	207	694	0	0	0	694
2027	0	0	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$11,937		\$7,746	\$4,191	
NPV =					\$9,978		\$7,436	2,542	
Total NPV =		\$2,542							
Benefit/Cost Ratio =		<u>1.34</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Window AC Units**  
Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$1,500	\$0.08566	\$0.07449	540	0	540	\$46	1	0	\$0.000	\$0.000	\$0	\$0	\$1,546	\$1,312	\$0	\$1,312	\$234
2017	2,500	0.08951	0.07784	1,440	0	1,440	129	3	0	0.000	0.000	0	0	2,629	2,225	0	2,225	404
2018	3,750	0.09354	0.08134	2,790	0	2,790	261	6	0	0.000	0.000	0	0	4,011	3,395	0	3,395	616
2019	0	0.09775	0.08500	2,790	0	2,790	273	6	0	0.000	0.000	0	0	273	0	0	0	273
2020	0	0.10215	0.08883	2,790	0	2,790	285	6	0	0.000	0.000	0	0	285	0	0	0	285
2021	0	0.10675	0.09283	2,790	0	2,790	298	6	0	0.000	0.000	0	0	298	0	0	0	298
2022	0	0.11155	0.09700	2,790	0	2,790	311	6	0	0.000	0.000	0	0	311	0	0	0	311
2023	0	0.11657	0.10137	2,790	0	2,790	325	6	0	0.000	0.000	0	0	325	0	0	0	325
2024	0	0.12182	0.10593	2,790	0	2,790	340	6	0	0.000	0.000	0	0	340	0	0	0	340
2025	0	0.12730	0.11070	2,250	0	2,250	286	5	0	0.000	0.000	0	0	286	0	0	0	286
2026	0	0.13303	0.11568	1,350	0	1,350	180	3	0	0.000	0.000	0	0	180	0	0	0	180
2027	0	0.13901	0.12088	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2028	0	0.14527	0.12632	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2029	0	0.15180	0.13201	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2030	0	0.15864	0.13795	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2031	0	0.16577	0.14415	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2032	0	0.17323	0.15064	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.18103	0.15742	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.18918	0.16450	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.19769	0.17191	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				25,110	0			54	0					\$10,484			\$6,932	\$3,552
														NPV = \$8,494			\$6,125	2,369

Total NPV = \$2,369  
Benefit/Cost Ratio = 1.39

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Window AC Units**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$21	\$101	\$122	\$1,865	(\$210)	\$1,655	(\$1,533)
2017	59	415	474	2,821	(350)	2,471	(1,997)
2018	117	749	866	4,145	(525)	3,620	(2,754)
2019	120	771	891	0	0	0	891
2020	128	794	922	0	0	0	922
2021	134	818	952	0	0	0	952
2022	144	843	987	0	0	0	987
2023	149	868	1,017	0	0	0	1,017
2024	158	894	1,052	0	0	0	1,052
2025	132	789	921	0	0	0	921
2026	81	406	487	0	0	0	487
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$8,691			\$7,746	\$945
NPV =			\$5,399			\$6,922	(1,523)

Total NPV = (\$1,523)  
Benefit/Cost Ratio = 0.78

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
SOUTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
Project: **Window AC Units**  
Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09021			
Retail Rate Winter (\$/kWh) =	\$0.08577			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00815			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05546			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$59	\$27	\$21
Incentive Costs =		100	100	100
Total Utility Project Costs =		\$159	\$127	\$121
14) Direct Participant Costs (\$/Part.) =		\$43	\$43	\$43
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		9	9	9
16) Avg Summer kW/part. Saved =		0.040	0.040	0.040
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		23	23	23
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		2	2	2
20) Incentive/Participant =		\$50	\$50	\$50
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		46	46	46
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		0	0	0
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		(\$190)	0.54	
Utility Cost Test		(\$155)	0.59	
Societal Test		\$44	1.12	
Participant Test		\$121	1.50	
Total Resource Cost Test		(\$116)	0.66	

**Table 1  
Ratepayer Impact Test**

Project: **Window AC Units**  
Program Years: **2016 - 2018**

t	Year											Costs					Annual Benefits Less Costs (P)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)		Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)
1	2016	50	\$0.03570	\$2	\$0.00000	\$0	0.1	0	0	\$100.80	\$9	\$11	\$0.05796	46	0	46	\$2	\$59	\$100	\$161	(\$150)
2	2017	99	0.03790	4	0.00000	0	0.2	0	0	103.82	19	23	0.06056	92	0	92	3	27	100	130	(107)
3	2018	149	0.03900	6	0.00000	0	0.3	0	0	106.94	29	35	0.06329	138	0	138	5	21	100	126	(91)
4	2019	149	0.04000	6	0.00000	0	0.3	0	0	110.15	30	36	0.06614	138	0	138	6	0	0	6	30
5	2020	149	0.04250	6	0.00000	0	0.3	0	0	113.45	31	37	0.06911	138	0	138	6	0	0	6	31
6	2021	149	0.04470	7	0.00000	0	0.3	0	0	116.85	32	39	0.07222	138	0	138	6	0	0	6	33
7	2022	149	0.04780	7	0.00000	0	0.3	0	0	120.36	32	39	0.07547	138	0	138	6	0	0	6	33
8	2023	149	0.04950	7	0.00000	0	0.3	0	0	123.97	33	40	0.07887	138	0	138	7	0	0	7	33
9	2024	149	0.05270	8	0.00000	0	0.3	0	0	127.69	34	42	0.08242	138	0	138	7	0	0	7	35
10	2025	99	0.05428	5	0.00000	0	0.2	0	0	131.52	24	29	0.08613	92	0	92	5	0	0	5	24
11	2026	50	0.05591	3	0.00000	0	0.1	0	0	135.47	12	15	0.09000	46	0	46	3	0	0	3	12
12	2027	0	0.05759	0	0.00000	0	0.0	0	0	139.53	0	0	0.09405	0	0	0	0	0	0	0	0
13	2028	0	0.05932	0	0.00000	0	0.0	0	0	143.72	0	0	0.09829	0	0	0	0	0	0	0	0
14	2029	0	0.06110	0	0.00000	0	0.0	0	0	148.03	0	0	0.10271	0	0	0	0	0	0	0	0
15	2030	0	0.06293	0	0.00000	0	0.0	0	0	152.47	0	0	0.10733	0	0	0	0	0	0	0	0
16	2031	0	0.06482	0	0.00000	0	0.0	0	0	157.04	0	0	0.11216	0	0	0	0	0	0	0	0
17	2032	0	0.06676	0	0.00000	0	0.0	0	0	161.75	0	0	0.11721	0	0	0	0	0	0	0	0
18	2033	0	0.06876	0	0.00000	0	0.0	0	0	166.61	0	0	0.12248	0	0	0	0	0	0	0	0
19	2034	0	0.07082	0	0.00000	0	0.0	0	0	171.60	0	0	0.12799	0	0	0	0	0	0	0	0
20	2035	0	0.07294	0	0.00000	0	0.0	0	0	176.75	0	0	0.13375	0	0	0	0	0	0	0	0
Total =		1,341						2				\$346			1,242				\$463	(\$117)	
												NPV =	\$221							\$411	(190)
Total NPV =																				(\$190)	
Benefit/Cost Ratio =																				<u>0.54</u>	

Worksheet Calculations	
(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Window AC Units**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$2	\$0	\$9	\$11	\$159	\$159	(\$148)
2017	4	0	19	23	127	127	(104)
2018	6	0	29	35	121	121	(86)
2019	6	0	30	36	0	0	36
2020	6	0	31	37	0	0	37
2021	7	0	32	39	0	0	39
2022	7	0	32	39	0	0	39
2023	7	0	33	40	0	0	40
2024	8	0	34	42	0	0	42
2025	5	0	24	29	0	0	29
2026	3	0	12	15	0	0	15
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$346		\$407	(\$61)
				NPV = \$221		\$376	(155)
Total NPV =							(\$155)
Benefit/Cost Ratio =							<u>0.59</u>

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Window AC Units**  
Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$2	\$0	\$9	\$3	\$14	\$159	(\$14)	\$145	(\$131)
2017	4	0	19	7	30	127	(14)	113	(83)
2018	6	0	29	12	47	121	(14)	107	(60)
2019	6	0	30	12	48	0	0	0	48
2020	6	0	31	13	50	0	0	0	50
2021	7	0	32	14	53	0	0	0	53
2022	7	0	32	15	54	0	0	0	54
2023	7	0	33	16	56	0	0	0	56
2024	8	0	34	17	59	0	0	0	59
2025	5	0	24	12	41	0	0	0	41
2026	3	0	12	6	21	0	0	0	21
2027	0	0	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$473			\$365	\$108
					NPV = \$399			\$355	44
Total NPV =					\$44				
Benefit/Cost Ratio =					<u>1.12</u>				

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Window AC Units**  
Program Years: **2016 - 2018**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$100	\$0.09427	\$0.08963	46	0	46	\$4	0	0	\$0.000	\$0.000	\$0	\$0	\$104	\$87	\$0	\$87	\$17
2017	100	0.09851	0.09366	92	0	92	9	0	0	0.000	0.000	0	0	109	89	0	89	20
2018	100	0.10294	0.09788	138	0	138	14	0	0	0.000	0.000	0	0	114	91	0	91	23
2019	0	0.10758	0.10228	138	0	138	15	0	0	0.000	0.000	0	0	15	0	0	0	15
2020	0	0.11242	0.10689	138	0	138	16	0	0	0.000	0.000	0	0	16	0	0	0	16
2021	0	0.11748	0.11169	138	0	138	16	0	0	0.000	0.000	0	0	16	0	0	0	16
2022	0	0.12276	0.11672	138	0	138	17	0	0	0.000	0.000	0	0	17	0	0	0	17
2023	0	0.12829	0.12197	138	0	138	18	0	0	0.000	0.000	0	0	18	0	0	0	18
2024	0	0.13406	0.12746	138	0	138	19	0	0	0.000	0.000	0	0	19	0	0	0	19
2025	0	0.14009	0.13320	92	0	92	13	0	0	0.000	0.000	0	0	13	0	0	0	13
2026	0	0.14640	0.13919	46	0	46	7	0	0	0.000	0.000	0	0	7	0	0	0	7
2027	0	0.15299	0.14546	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2028	0	0.15987	0.15200	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2029	0	0.16706	0.15884	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2030	0	0.17458	0.16599	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2031	0	0.18244	0.17346	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2032	0	0.19065	0.18126	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.19923	0.18942	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.20819	0.19795	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.21756	0.20685	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				1,242	0			0	0					\$448			\$267	\$181
														NPV = \$364			\$243	121

Total NPV = \$121  
Benefit/Cost Ratio = 1.50

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Window AC Units**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$2	\$9	\$11	\$159	(\$14)	\$145	(\$134)
2017	4	19	23	127	(14)	113	(90)
2018	6	29	35	121	(14)	107	(72)
2019	6	30	36	0	0	0	36
2020	6	31	37	0	0	0	37
2021	7	32	39	0	0	0	39
2022	7	32	39	0	0	0	39
2023	7	33	40	0	0	0	40
2024	8	34	42	0	0	0	42
2025	5	24	29	0	0	0	29
2026	3	12	15	0	0	0	15
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$346			\$365	(\$19)
NPV =			\$221			\$337	(116)

Total NPV = (\$116)  
Benefit/Cost Ratio = 0.66

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Thermal Storage with ASHP**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09033			
Retail Rate Winter (\$/kWh) =	\$0.07591			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00418			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.06075			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$1,955	\$2,068	\$1,748
Incentive Costs =		4,608	11,520	11,520
Total Utility Project Costs =		\$6,563	\$13,588	\$13,268
14) Direct Participant Costs (\$/Part.) =		\$4,500	\$4,500	\$4,500
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		14	14	14
16) Avg Summer kW/part. Saved =		0.000	0.000	0.000
16a) Avg Winter kW/part Saved =		17.500	17.500	17.500
17) Avg. Summer kWh/Part. Saved =		0	0	0
17a) Avg. Winter kWh/Part. Saved =		4,742	4,742	4,742
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		2	5	5
20) Incentive/Participant =		\$2,304	\$2,304	\$2,304
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		0	0	0
Annual Winter Kwh Saved		9,484	23,710	23,710
23) Annual Summer KW Saved		0	0	0
Annual Winter KW Saved		35	88	88
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$183,368	4.55	
Utility Cost Test		\$204,950	7.83	
Societal Test		\$445,954	8.76	
Participant Test		\$17,579	1.35	
Total Resource Cost Test		\$181,402	4.39	

**Table 1  
Ratepayer Impact Test**

Project: **Thermal Storage with ASHP**  
Program Years: **2016 - 2018**

t	Year												Costs					Annual Benefits Less Costs (P)			
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)
1	2016	10,218	\$0.03570	\$365	\$0.00000	\$0	0	40	40	\$100.80	\$4,032	\$4,397	\$0.06348	0	9,484	9,484	\$365	\$1,955	\$4,608	\$6,928	(\$2,531)
2	2017	35,762	0.03790	1,355	0.00000	0	0	138	138	103.82	14,327	15,682	0.06634	0	33,194	33,194	1,335	2,068	11,520	14,923	759
3	2018	61,306	0.03900	2,391	0.00000	0	0	237	237	106.94	25,345	27,736	0.06933	0	56,904	56,904	2,391	1,748	11,520	15,659	12,077
4	2019	61,306	0.04000	2,452	0.00000	0	0	237	237	110.15	26,106	28,558	0.07245	0	56,904	56,904	2,499	0	0	2,499	26,059
5	2020	61,306	0.04250	2,606	0.00000	0	0	237	237	113.45	26,888	29,494	0.07571	0	56,904	56,904	2,611	0	0	2,611	26,883
6	2021	61,306	0.04470	2,740	0.00000	0	0	237	237	116.85	27,693	30,433	0.07911	0	56,904	56,904	2,729	0	0	2,729	27,704
7	2022	61,306	0.04780	2,930	0.00000	0	0	237	237	120.36	28,525	31,455	0.08267	0	56,904	56,904	2,851	0	0	2,851	28,604
8	2023	61,306	0.04950	3,035	0.00000	0	0	237	237	123.97	29,381	32,416	0.08639	0	56,904	56,904	2,980	0	0	2,980	29,436
9	2024	61,306	0.05270	3,231	0.00000	0	0	237	237	127.69	30,263	33,494	0.09028	0	56,904	56,904	3,114	0	0	3,114	30,380
10	2025	61,306	0.05428	3,328	0.00000	0	0	237	237	131.52	31,170	34,498	0.09434	0	56,904	56,904	3,254	0	0	3,254	31,244
11	2026	61,306	0.05591	3,428	0.00000	0	0	237	237	135.47	32,106	35,534	0.09859	0	56,904	56,904	3,400	0	0	3,400	32,134
12	2027	61,306	0.05759	3,531	0.00000	0	0	237	237	139.53	33,069	36,600	0.10302	0	56,904	56,904	3,533	0	0	3,533	33,047
13	2028	61,306	0.05932	3,637	0.00000	0	0	237	237	143.72	34,062	37,699	0.10766	0	56,904	56,904	3,713	0	0	3,713	33,986
14	2029	61,306	0.06110	3,746	0.00000	0	0	237	237	148.03	35,083	38,829	0.11251	0	56,904	56,904	3,881	0	0	3,881	34,948
15	2030	51,088	0.06293	3,215	0.00000	0	0	198	198	152.47	30,189	33,404	0.11757	0	47,420	47,420	3,379	0	0	3,379	30,025
16	2031	25,544	0.06482	1,656	0.00000	0	0	99	99	157.04	15,547	17,203	0.12286	0	23,710	23,710	1,766	0	0	1,766	15,437
17	2032	0	0.06676	0	0.00000	0	0	0	0	161.75	0	0	0.12839	0	0	0	0	0	0	0	0
18	2033	0	0.06876	0	0.00000	0	0	0	0	166.61	0	0	0.13417	0	0	0	0	0	0	0	0
19	2034	0	0.07082	0	0.00000	0	0	0	0	171.60	0	0	0.14020	0	0	0	0	0	0	0	0
20	2035	0	0.07294	0	0.00000	0	0	0	0	176.75	0	0	0.14651	0	0	0	0	0	0	0	0
Total =		858,284							3,319			\$467,432			796,656				\$77,240	\$390,192	
												NPV = \$234,953							\$51,585	183,368	
Total NPV =			\$183,368																		
Benefit/Cost Ratio =			<u>4.55</u>																		

Worksheet Calculations	
(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Thermal Storage with ASHP**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$365	\$0	\$4,032	\$4,397	\$6,563	\$6,563	(\$2,166)
2017	1,355	0	14,327	15,682	13,588	13,588	2,094
2018	2,391	0	25,345	27,736	13,268	13,268	14,468
2019	2,452	0	26,106	28,558	0	0	28,558
2020	2,606	0	26,888	29,494	0	0	29,494
2021	2,740	0	27,693	30,433	0	0	30,433
2022	2,930	0	28,525	31,455	0	0	31,455
2023	3,035	0	29,381	32,416	0	0	32,416
2024	3,231	0	30,263	33,494	0	0	33,494
2025	3,328	0	31,170	34,498	0	0	34,498
2026	3,428	0	32,106	35,534	0	0	35,534
2027	3,531	0	33,069	36,600	0	0	36,600
2028	3,637	0	34,062	37,699	0	0	37,699
2029	3,746	0	35,083	38,829	0	0	38,829
2030	3,215	0	30,189	33,404	0	0	33,404
2031	1,656	0	15,547	17,203	0	0	17,203
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$467,432		\$33,419	\$434,013
			NPV =	\$234,953		\$30,003	204,950
Total NPV =		\$204,950					
Benefit/Cost Ratio =		<u>7.83</u>					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Thermal Storage with ASHP**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$365	\$0	\$4,032	\$1,390	\$5,787	\$6,563	\$4,392	\$10,955	(\$5,168)
2017	1,355	0	14,327	5,108	20,790	13,588	10,980	24,568	(3,778)
2018	2,391	0	25,345	9,305	37,041	13,268	10,980	24,248	12,793
2019	2,452	0	26,106	9,868	38,426	0	0	0	38,426
2020	2,606	0	26,888	10,497	39,991	0	0	0	39,991
2021	2,740	0	27,693	11,156	41,589	0	0	0	41,589
2022	2,930	0	28,525	11,877	43,332	0	0	0	43,332
2023	3,035	0	29,381	12,607	45,023	0	0	0	45,023
2024	3,231	0	30,263	13,417	46,911	0	0	0	46,911
2025	3,328	0	31,170	14,233	48,731	0	0	0	48,731
2026	3,428	0	32,106	15,101	50,635	0	0	0	50,635
2027	3,531	0	33,069	16,020	52,620	0	0	0	52,620
2028	3,637	0	34,062	16,996	54,695	0	0	0	54,695
2029	3,746	0	35,083	18,031	56,860	0	0	0	56,860
2030	3,215	0	30,189	15,977	49,381	0	0	0	49,381
2031	1,656	0	15,547	8,475	25,678	0	0	0	25,678
2032	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$657,490			\$59,771	\$597,719
					NPV = \$503,389			\$57,435	445,954
Total NPV =					\$445,954				
Benefit/Cost Ratio =					<u>8.76</u>				

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Thermal Storage with ASHP**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$4,608	\$0.09439	\$0.07933	0	9,484	9,484	\$752	0	35	\$0.000	\$0.000	\$0	\$0	\$5,360	\$9,156	\$0	\$9,156	(\$3,796)
2017	11,520	0.09864	0.08290	0	33,194	33,194	2,752	0	123	0.000	0.000	0	0	14,272	23,285	0	23,285	(9,013)
2018	11,520	0.10308	0.08663	0	56,904	56,904	4,930	0	210	0.000	0.000	0	0	16,450	23,688	0	23,688	(7,238)
2019	0	0.10772	0.09052	0	56,904	56,904	5,151	0	210	0.000	0.000	0	0	5,151	0	0	0	5,151
2020	0	0.11257	0.09460	0	56,904	56,904	5,383	0	210	0.000	0.000	0	0	5,383	0	0	0	5,383
2021	0	0.11763	0.09885	0	56,904	56,904	5,625	0	210	0.000	0.000	0	0	5,625	0	0	0	5,625
2022	0	0.12293	0.10330	0	56,904	56,904	5,878	0	210	0.000	0.000	0	0	5,878	0	0	0	5,878
2023	0	0.12846	0.10795	0	56,904	56,904	6,143	0	210	0.000	0.000	0	0	6,143	0	0	0	6,143
2024	0	0.13424	0.11281	0	56,904	56,904	6,419	0	210	0.000	0.000	0	0	6,419	0	0	0	6,419
2025	0	0.14028	0.11789	0	56,904	56,904	6,708	0	210	0.000	0.000	0	0	6,708	0	0	0	6,708
2026	0	0.14659	0.12319	0	56,904	56,904	7,010	0	210	0.000	0.000	0	0	7,010	0	0	0	7,010
2027	0	0.15319	0.12873	0	56,904	56,904	7,325	0	210	0.000	0.000	0	0	7,325	0	0	0	7,325
2028	0	0.16008	0.13453	0	56,904	56,904	7,655	0	210	0.000	0.000	0	0	7,655	0	0	0	7,655
2029	0	0.16729	0.14058	0	56,904	56,904	8,000	0	210	0.000	0.000	0	0	8,000	0	0	0	8,000
2030	0	0.17481	0.14691	0	47,420	47,420	6,966	0	175	0.000	0.000	0	0	6,966	0	0	0	6,966
2031	0	0.18268	0.15352	0	23,710	23,710	3,640	0	88	0.000	0.000	0	0	3,640	0	0	0	3,640
2032	0	0.19090	0.16043	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.19949	0.16765	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.20847	0.17519	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.21785	0.18307	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				0	796,656			0	2,941					\$117,985		\$56,129	\$61,856	
														NPV = \$67,359		\$49,781	17,579	

Total NPV = \$17,579  
 Benefit/Cost Ratio = 1.35

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Thermal Storage with ASHP**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$365	\$4,032	\$4,397	\$6,563	\$4,392	\$10,955	(\$6,558)
2017	1,355	14,327	15,682	13,588	10,980	24,568	(8,886)
2018	2,391	25,345	27,736	13,268	10,980	24,248	3,488
2019	2,452	26,106	28,558	0	0	0	28,558
2020	2,606	26,888	29,494	0	0	0	29,494
2021	2,740	27,693	30,433	0	0	0	30,433
2022	2,930	28,525	31,455	0	0	0	31,455
2023	3,035	29,381	32,416	0	0	0	32,416
2024	3,231	30,263	33,494	0	0	0	33,494
2025	3,328	31,170	34,498	0	0	0	34,498
2026	3,428	32,106	35,534	0	0	0	35,534
2027	3,531	33,069	36,600	0	0	0	36,600
2028	3,637	34,062	37,699	0	0	0	37,699
2029	3,746	35,083	38,829	0	0	0	38,829
2030	3,215	30,189	33,404	0	0	0	33,404
2031	1,656	15,547	17,203	0	0	0	17,203
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$467,432			\$59,771	\$407,661
NPV =			\$234,953			\$53,552	181,402
Total NPV =			\$181,402				
Benefit/Cost Ratio =			<u>4.39</u>				

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
NORTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Thermal Storage with ASHP**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.08197			
Retail Rate Winter (\$/kWh) =	\$0.07128			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00496			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05993			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	8.70%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$5,603	\$2,958	\$3,640
Incentive Costs =		23,040	23,040	34,560
Total Utility Project Costs =		\$28,643	\$25,998	\$38,200
14) Direct Participant Costs (\$/Part.) =		\$4,500	\$4,500	\$4,500
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		14	14	14
16) Avg Summer kW/part. Saved =		0.000	0.000	0.000
16a) Avg Winter kW/part Saved =		17.500	17.500	17.500
17) Avg. Summer kWh/Part. Saved =		0	0	0
17a) Avg. Winter kWh/Part. Saved =		4,742	4,742	4,742
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		10	10	15
20) Incentive/Participant =		\$2,304	\$2,304	\$2,304
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		0	0	0
Annual Winter Kwh Saved		47,420	47,420	71,130
23) Annual Summer KW Saved		0	0	0
Annual Winter KW Saved		175	175	263
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$543,916	4.71	
Utility Cost Test		\$606,343	8.20	
Societal Test		\$1,304,675	8.97	
Participant Test		\$43,830	1.30	
Total Resource Cost Test		\$536,931	4.50	

**Table 1**  
**Ratepayer Impact Test**

Project: **Thermal Storage with ASHP**  
Program Years: **2016 - 2018**

t	Year											Costs						Annual Benefits Less Costs (P)			
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)
1	2016	51,088	\$0.03570	\$1,824	\$0.00000	\$0	0	198	198	\$100.80	\$19,958	\$21,782	\$0.06263	0	47,420	47,420	\$1,800	\$5,603	\$23,040	\$30,443	(\$8,661)
2	2017	102,176	0.03790	3,872	0.00000	0	0	395	395	103.82	41,009	44,881	0.06545	0	94,840	94,840	3,762	2,958	23,040	29,760	15,121
3	2018	178,808	0.03900	6,974	0.00000	0	0	692	692	106.94	74,002	80,976	0.06839	0	165,970	165,970	6,880	3,640	34,560	45,080	35,896
4	2019	178,808	0.04000	7,152	0.00000	0	0	692	692	110.15	76,224	83,376	0.07147	0	165,970	165,970	7,190	0	0	7,190	76,186
5	2020	178,808	0.04250	7,599	0.00000	0	0	692	692	113.45	78,507	86,106	0.07468	0	165,970	165,970	7,513	0	0	7,513	78,593
6	2021	178,808	0.04470	7,993	0.00000	0	0	692	692	116.85	80,860	88,853	0.07804	0	165,970	165,970	7,851	0	0	7,851	81,002
7	2022	178,808	0.04780	8,547	0.00000	0	0	692	692	120.36	83,289	91,836	0.08156	0	165,970	165,970	8,205	0	0	8,205	83,631
8	2023	178,808	0.04950	8,851	0.00000	0	0	692	692	123.97	85,787	94,638	0.08523	0	165,970	165,970	8,574	0	0	8,574	86,064
9	2024	178,808	0.05270	9,423	0.00000	0	0	692	692	127.69	88,361	97,784	0.08906	0	165,970	165,970	8,959	0	0	8,959	88,825
10	2025	178,808	0.05428	9,706	0.00000	0	0	692	692	131.52	91,012	100,718	0.09307	0	165,970	165,970	9,363	0	0	9,363	91,355
11	2026	178,808	0.05591	9,997	0.00000	0	0	692	692	135.47	93,745	103,742	0.09726	0	165,970	165,970	9,784	0	0	9,784	93,958
12	2027	178,808	0.05759	10,298	0.00000	0	0	692	692	139.53	96,555	106,853	0.10163	0	165,970	165,970	10,224	0	0	10,224	96,629
13	2028	178,808	0.05932	10,607	0.00000	0	0	692	692	143.72	99,454	110,061	0.10621	0	165,970	165,970	10,685	0	0	10,685	99,376
14	2029	178,808	0.06110	10,925	0.00000	0	0	692	692	148.03	102,437	113,362	0.11099	0	165,970	165,970	11,165	0	0	11,165	102,197
15	2030	127,720	0.06293	8,037	0.00000	0	0	494	494	152.47	75,320	83,357	0.11598	0	118,550	118,550	8,334	0	0	8,334	75,023
16	2031	76,632	0.06482	4,967	0.00000	0	0	297	297	157.04	46,641	51,608	0.12120	0	71,130	71,130	5,225	0	0	5,225	46,383
17	2032	0	0.06676	0	0.00000	0	0	0	0	161.75	0	0	0.12665	0	0	0	0	0	0	0	0
18	2033	0	0.06876	0	0.00000	0	0	0	0	166.61	0	0	0.13235	0	0	0	0	0	0	0	0
19	2034	0	0.07082	0	0.00000	0	0	0	0	171.60	0	0	0.13831	0	0	0	0	0	0	0	0
20	2035	0	0.07294	0	0.00000	0	0	0	0	176.75	0	0	0.14453	0	0	0	0	0	0	0	0
Total =		2,503,312						9,688				\$1,359,933			2,323,580				\$218,355	\$1,141,578	
												NPV = \$690,500								\$146,584	543,916
Total NPV =			\$543,916																		
Benefit/Cost Ratio =			<u>4.71</u>																		

Worksheet Calculations	
(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Thermal Storage with ASHP**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$1,824	\$0	\$19,958	\$21,782	\$28,643	\$28,643	(\$6,861)
2017	3,872	0	41,009	44,881	25,998	25,998	18,883
2018	6,974	0	74,002	80,976	38,200	38,200	42,776
2019	7,152	0	76,224	83,376	0	0	83,376
2020	7,599	0	78,507	86,106	0	0	86,106
2021	7,993	0	80,860	88,853	0	0	88,853
2022	8,547	0	83,289	91,836	0	0	91,836
2023	8,851	0	85,787	94,638	0	0	94,638
2024	9,423	0	88,361	97,784	0	0	97,784
2025	9,706	0	91,012	100,718	0	0	100,718
2026	9,997	0	93,745	103,742	0	0	103,742
2027	10,298	0	96,555	106,853	0	0	106,853
2028	10,607	0	99,454	110,061	0	0	110,061
2029	10,925	0	102,437	113,362	0	0	113,362
2030	8,037	0	75,320	83,357	0	0	83,357
2031	4,967	0	46,641	51,608	0	0	51,608
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$1,359,933		\$92,841	\$1,267,092
NPV =				\$690,500		\$84,157	606,343
Total NPV =		\$606,343					
Benefit/Cost Ratio =		<u>8.20</u>					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Thermal Storage with ASHP**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$1,824	\$0	\$19,958	\$6,888	\$28,670	\$28,643	\$21,960	\$50,603	(\$21,933)
2017	3,872	0	41,009	14,618	59,499	25,998	21,960	47,958	11,541
2018	6,974	0	74,002	27,165	108,141	38,200	32,940	71,140	37,001
2019	7,152	0	76,224	28,809	112,185	0	0	0	112,185
2020	7,599	0	78,507	30,645	116,751	0	0	0	116,751
2021	7,993	0	80,860	32,571	121,424	0	0	0	121,424
2022	8,547	0	83,289	34,675	126,511	0	0	0	126,511
2023	8,851	0	85,787	36,805	131,443	0	0	0	131,443
2024	9,423	0	88,361	39,169	136,953	0	0	0	136,953
2025	9,706	0	91,012	41,554	142,272	0	0	0	142,272
2026	9,997	0	93,745	44,086	147,828	0	0	0	147,828
2027	10,298	0	96,555	46,770	153,623	0	0	0	153,623
2028	10,607	0	99,454	49,620	159,681	0	0	0	159,681
2029	10,925	0	102,437	52,641	166,003	0	0	0	166,003
2030	8,037	0	75,320	39,869	123,226	0	0	0	123,226
2031	4,967	0	46,641	25,424	77,032	0	0	0	77,032
2032	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$1,911,242		\$169,701	\$1,741,541	
NPV =					\$1,468,302		\$163,627	1,304,675	
Total NPV =		\$1,304,675							
Benefit/Cost Ratio =		<u>8.97</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Thermal Storage with ASHP**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$23,040	\$0.08566	\$0.07449	0	47,420	47,420	\$3,532	0	175	\$0.000	\$0.000	\$0	\$0	\$26,572	\$45,779	\$0	\$45,779	(\$19,207)
2017	23,040	0.08951	0.07784	0	94,840	94,840	7,382	0	350	0.000	0.000	0	0	30,422	46,570	0	46,570	(16,148)
2018	34,560	0.09354	0.08134	0	165,970	165,970	13,500	0	613	0.000	0.000	0	0	48,060	71,064	0	71,064	(23,004)
2019	0	0.09775	0.08500	0	165,970	165,970	14,107	0	613	0.000	0.000	0	0	14,107	0	0	0	14,107
2020	0	0.10215	0.08883	0	165,970	165,970	14,743	0	613	0.000	0.000	0	0	14,743	0	0	0	14,743
2021	0	0.10675	0.09283	0	165,970	165,970	15,407	0	613	0.000	0.000	0	0	15,407	0	0	0	15,407
2022	0	0.11155	0.09700	0	165,970	165,970	16,099	0	613	0.000	0.000	0	0	16,099	0	0	0	16,099
2023	0	0.11657	0.10137	0	165,970	165,970	16,824	0	613	0.000	0.000	0	0	16,824	0	0	0	16,824
2024	0	0.12182	0.10593	0	165,970	165,970	17,581	0	613	0.000	0.000	0	0	17,581	0	0	0	17,581
2025	0	0.12730	0.11070	0	165,970	165,970	18,373	0	613	0.000	0.000	0	0	18,373	0	0	0	18,373
2026	0	0.13303	0.11568	0	165,970	165,970	19,199	0	613	0.000	0.000	0	0	19,199	0	0	0	19,199
2027	0	0.13901	0.12088	0	165,970	165,970	20,062	0	613	0.000	0.000	0	0	20,062	0	0	0	20,062
2028	0	0.14527	0.12632	0	165,970	165,970	20,965	0	613	0.000	0.000	0	0	20,965	0	0	0	20,965
2029	0	0.15180	0.13201	0	165,970	165,970	21,910	0	613	0.000	0.000	0	0	21,910	0	0	0	21,910
2030	0	0.15864	0.13795	0	118,550	118,550	16,354	0	438	0.000	0.000	0	0	16,354	0	0	0	16,354
2031	0	0.16577	0.14415	0	71,130	71,130	10,253	0	263	0.000	0.000	0	0	10,253	0	0	0	10,253
2032	0	0.17323	0.15064	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.18103	0.15742	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.18918	0.16450	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.19769	0.17191	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				0	2,323,580			0	8,582					\$326,931			\$163,413	\$163,518
														NPV = \$190,357			\$146,527	43,830

Total NPV = \$43,830  
 Benefit/Cost Ratio = 1.30

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Thermal Storage with ASHP**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$1,824	\$19,958	\$21,782	\$28,643	\$21,960	\$50,603	(\$28,821)
2017	3,872	41,009	44,881	25,998	21,960	47,958	(3,077)
2018	6,974	74,002	80,976	38,200	32,940	71,140	9,836
2019	7,152	76,224	83,376	0	0	0	83,376
2020	7,599	78,507	86,106	0	0	0	86,106
2021	7,993	80,860	88,853	0	0	0	88,853
2022	8,547	83,289	91,836	0	0	0	91,836
2023	8,851	85,787	94,638	0	0	0	94,638
2024	9,423	88,361	97,784	0	0	0	97,784
2025	9,706	91,012	100,718	0	0	0	100,718
2026	9,997	93,745	103,742	0	0	0	103,742
2027	10,298	96,555	106,853	0	0	0	106,853
2028	10,607	99,454	110,061	0	0	0	110,061
2029	10,925	102,437	113,362	0	0	0	113,362
2030	8,037	75,320	83,357	0	0	0	83,357
2031	4,967	46,641	51,608	0	0	0	51,608
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$1,359,933			\$169,701	\$1,190,232
NPV =			\$690,500			\$153,569	536,931

Total NPV = \$536,931  
Benefit/Cost Ratio = 4.50

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Residential Lighting**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09033			
Retail Rate Winter (\$/kWh) =	\$0.07591			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00418			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.06075			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$1,680	\$711	\$601
Incentive Costs =		3,960	3,960	3,960
Total Utility Project Costs =		\$5,640	\$4,671	\$4,561
14) Direct Participant Costs (\$/Part.) =		\$1	\$1	\$1
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		9	9	9
16) Avg Summer kW/part. Saved =		0.003	0.003	0.003
16a) Avg Winter kW/part Saved =		0.003	0.003	0.003
17) Avg. Summer kWh/Part. Saved =		9	9	9
17a) Avg. Winter kWh/Part. Saved =		18	18	18
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		3,000	3,000	3,000
20) Incentive/Participant =		\$1	\$1	\$1
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		27,000	27,000	27,000
Annual Winter Kwh Saved		54,000	54,000	54,000
23) Annual Summer KW Saved		9	9	9
Annual Winter KW Saved		9	9	9
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$28,413	1.35	
Utility Cost Test		\$95,252	7.95	
Societal Test		\$186,668	17.03	
Participant Test		\$145,142	18.14	
Total Resource Cost Test		\$97,887	9.85	

**Table 1  
Ratepayer Impact Test**

Project: **Residential Lighting**  
Program Years: **2016 - 2018**

t	Year											Costs						Annual Benefits Less Costs (P)			
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)
1	2016	87,265	\$0.03570	\$3,115	\$0.00000	\$0	10	10	20	\$100.80	\$2,016	\$5,131	\$0.06348	27,000	54,000	81,000	\$3,117	\$1,680	\$3,960	\$8,757	(\$3,626)
2	2017	174,531	0.03790	6,615	0.00000	0	20	20	40	103.82	4,153	10,768	0.06634	54,000	108,000	162,000	6,514	711	3,960	11,185	(417)
3	2018	261,796	0.03900	10,210	0.00000	0	31	31	62	106.94	6,630	16,840	0.06933	81,000	162,000	243,000	10,212	601	3,960	14,773	2,067
4	2019	261,796	0.04000	10,472	0.00000	0	31	31	62	110.15	6,829	17,301	0.07245	81,000	162,000	243,000	10,671	0	0	10,671	6,630
5	2020	261,796	0.04250	11,126	0.00000	0	31	31	62	113.45	7,034	18,160	0.07571	81,000	162,000	243,000	11,151	0	0	11,151	7,009
6	2021	261,796	0.04470	11,702	0.00000	0	31	31	62	116.85	7,245	18,947	0.07911	81,000	162,000	243,000	11,652	0	0	11,652	7,295
7	2022	261,796	0.04780	12,514	0.00000	0	31	31	62	120.36	7,462	19,976	0.08267	81,000	162,000	243,000	12,176	0	0	12,176	7,800
8	2023	261,796	0.04950	12,959	0.00000	0	31	31	62	123.97	7,686	20,645	0.08639	81,000	162,000	243,000	12,724	0	0	12,724	7,921
9	2024	261,796	0.05270	13,797	0.00000	0	31	31	62	127.69	7,917	21,714	0.09028	81,000	162,000	243,000	13,297	0	0	13,297	8,417
10	2025	174,531	0.05428	9,474	0.00000	0	20	20	40	131.52	5,261	14,735	0.09434	54,000	108,000	162,000	9,263	0	0	9,263	5,472
11	2026	87,265	0.05591	4,879	0.00000	0	10	10	20	135.47	2,709	7,588	0.09859	27,000	54,000	81,000	4,840	0	0	4,840	2,748
12	2027	0	0.05759	0	0.00000	0	0	0	0	139.53	0	0	0.10302	0	0	0	0	0	0	0	0
13	2028	0	0.05932	0	0.00000	0	0	0	0	143.72	0	0	0.10766	0	0	0	0	0	0	0	0
14	2029	0	0.06110	0	0.00000	0	0	0	0	148.03	0	0	0.11251	0	0	0	0	0	0	0	0
15	2030	0	0.06293	0	0.00000	0	0	0	0	152.47	0	0	0.11757	0	0	0	0	0	0	0	0
16	2031	0	0.06482	0	0.00000	0	0	0	0	157.04	0	0	0.12286	0	0	0	0	0	0	0	0
17	2032	0	0.06676	0	0.00000	0	0	0	0	161.75	0	0	0.12839	0	0	0	0	0	0	0	0
18	2033	0	0.06876	0	0.00000	0	0	0	0	166.61	0	0	0.13417	0	0	0	0	0	0	0	0
19	2034	0	0.07082	0	0.00000	0	0	0	0	171.60	0	0	0.14020	0	0	0	0	0	0	0	0
20	2035	0	0.07294	0	0.00000	0	0	0	0	176.75	0	0	0.14651	0	0	0	0	0	0	0	0
Total =		2,356,164							554			\$171,805				2,187,000			\$120,489	\$51,316	
												NPV = \$108,950							\$80,537	28,413	
Total NPV =			\$28,413																		
Benefit/Cost Ratio =			<u>1.35</u>																		

Worksheet Calculations	
(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Residential Lighting**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$3,115	\$0	\$2,016	\$5,131	\$5,640	\$5,640	(\$509)
2017	6,615	0	4,153	10,768	4,671	4,671	6,097
2018	10,210	0	6,630	16,840	4,561	4,561	12,279
2019	10,472	0	6,829	17,301	0	0	17,301
2020	11,126	0	7,034	18,160	0	0	18,160
2021	11,702	0	7,245	18,947	0	0	18,947
2022	12,514	0	7,462	19,976	0	0	19,976
2023	12,959	0	7,686	20,645	0	0	20,645
2024	13,797	0	7,917	21,714	0	0	21,714
2025	9,474	0	5,261	14,735	0	0	14,735
2026	4,879	0	2,709	7,588	0	0	7,588
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$171,805		\$14,872	\$156,933
				NPV = \$108,950		\$13,698	95,252
Total NPV =		\$95,252					
Benefit/Cost Ratio =		<u>7.95</u>					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Residential Lighting**  
Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$3,115	\$0	\$2,016	\$1,622	\$6,753	\$5,640	(\$960)	\$4,680	\$2,073
2017	6,615	0	4,153	3,507	14,275	4,671	(960)	3,711	10,564
2018	10,210	0	6,630	5,649	22,489	4,561	(960)	3,601	18,888
2019	10,472	0	6,829	5,978	23,279	0	0	0	23,279
2020	11,126	0	7,034	6,463	24,623	0	0	0	24,623
2021	11,702	0	7,245	6,945	25,892	0	0	0	25,892
2022	12,514	0	7,462	7,542	27,518	0	0	0	27,518
2023	12,959	0	7,686	8,029	28,674	0	0	0	28,674
2024	13,797	0	7,917	8,698	30,412	0	0	0	30,412
2025	9,474	0	5,261	6,079	20,814	0	0	0	20,814
2026	4,879	0	2,709	3,225	10,813	0	0	0	10,813
2027	0	0	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$235,542			\$11,992	\$223,550
				NPV =	\$198,311			\$11,643	186,668
Total NPV =		\$186,668							
Benefit/Cost Ratio =		<u>17.03</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Residential Lighting**  
Program Years: **2016 - 2018**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$3,960	\$0.09439	\$0.07933	27,000	54,000	81,000	\$6,832	9	9	\$0.000	\$0.000	\$0	\$0	\$10,792	\$3,052	\$0	\$3,052	\$7,740
2017	3,960	0.09864	0.08290	54,000	108,000	162,000	14,280	18	18	0.000	0.000	0	0	18,240	3,105	0	3,105	15,135
2018	3,960	0.10308	0.08663	81,000	162,000	243,000	22,384	27	27	0.000	0.000	0	0	26,344	3,158	0	3,158	23,186
2019	0	0.10772	0.09052	81,000	162,000	243,000	23,390	27	27	0.000	0.000	0	0	23,390	0	0	0	23,390
2020	0	0.11257	0.09460	81,000	162,000	243,000	24,443	27	27	0.000	0.000	0	0	24,443	0	0	0	24,443
2021	0	0.11763	0.09885	81,000	162,000	243,000	25,542	27	27	0.000	0.000	0	0	25,542	0	0	0	25,542
2022	0	0.12293	0.10330	81,000	162,000	243,000	26,692	27	27	0.000	0.000	0	0	26,692	0	0	0	26,692
2023	0	0.12846	0.10795	81,000	162,000	243,000	27,893	27	27	0.000	0.000	0	0	27,893	0	0	0	27,893
2024	0	0.13424	0.11281	81,000	162,000	243,000	29,149	27	27	0.000	0.000	0	0	29,149	0	0	0	29,149
2025	0	0.14028	0.11789	54,000	108,000	162,000	20,307	18	18	0.000	0.000	0	0	20,307	0	0	0	20,307
2026	0	0.14659	0.12319	27,000	54,000	81,000	10,610	9	9	0.000	0.000	0	0	10,610	0	0	0	10,610
2027	0	0.15319	0.12873	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2028	0	0.16008	0.13453	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2029	0	0.16729	0.14058	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2030	0	0.17481	0.14691	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2031	0	0.18268	0.15352	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2032	0	0.19090	0.16043	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.19949	0.16765	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.20847	0.17519	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.21785	0.18307	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				729,000	1,458,000			243	243					\$243,402			\$9,315	\$234,087
														NPV = \$153,611			\$8,469	145,142
Total NPV =				\$145,142														
Benefit/Cost Ratio =				18.14														

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Residential Lighting**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$3,115	\$2,016	\$5,131	\$5,640	(\$960)	\$4,680	\$451
2017	6,615	4,153	10,768	4,671	(960)	3,711	7,057
2018	10,210	6,630	16,840	4,561	(960)	3,601	13,239
2019	10,472	6,829	17,301	0	0	0	17,301
2020	11,126	7,034	18,160	0	0	0	18,160
2021	11,702	7,245	18,947	0	0	0	18,947
2022	12,514	7,462	19,976	0	0	0	19,976
2023	12,959	7,686	20,645	0	0	0	20,645
2024	13,797	7,917	21,714	0	0	0	21,714
2025	9,474	5,261	14,735	0	0	0	14,735
2026	4,879	2,709	7,588	0	0	0	7,588
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$171,805			\$11,992	\$159,813
NPV =			\$108,950			\$11,063	97,887

Total NPV = \$97,887  
Benefit/Cost Ratio = 9.85

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Residential AC Cycling**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09033			
Retail Rate Winter (\$/kWh) =	\$0.07591			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00418			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.06075			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$0	\$6,074	\$7,179
Incentive Costs =		0	24,000	24,720
Direct Program Costs =		0	0	135,061
Total Utility Project Costs =		\$0	\$30,074	\$166,960
14) Direct Participant Costs (\$/Part.) =		\$100	\$100	\$100
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		15	15	15
16) Avg Summer kWh/part. Saved =		1,000	1,000	1,000
16a) Avg Winter kWh/part Saved =		0,000	0,000	0,000
17) Avg. Summer kWh/Part. Saved =		269	269	269
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		0	400	412
20) Incentive/Participant =		\$60	\$60	\$60
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		0	107,600	110,828
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		0	400	412
Annual Winter KW Saved		0	0	0

<b>Test Results</b>	<b>NPV</b>	<b>B/C</b>
Ratepayer Impact Measure Test	\$1,009,451	1.87
Utility Cost Test	\$819,068	1.70
Societal Test	\$2,836,061	2.53
Participant Test	\$341,444	2.94
Total Resource Cost Test	\$752,177	1.61



**Table 2  
Utility Test**

Project: **Residential AC Cycling**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$0	\$0	\$0	\$0	\$24,000	\$24,000	(\$24,000)
2017	4,393	0	46,927	51,320	82,641	82,641	(31,321)
2018	9,042	0	96,674	105,716	114,029	114,029	(8,313)
2019	13,911	0	149,363	163,274	137,596	137,596	25,678
2020	19,707	0	205,118	224,825	168,835	168,835	55,990
2021	25,909	0	264,081	289,990	200,594	200,594	89,396
2022	27,706	0	272,014	299,720	151,726	151,726	147,994
2023	28,691	0	280,172	308,863	152,947	152,947	155,916
2024	30,546	0	288,579	319,125	154,224	154,224	164,901
2025	31,461	0	297,235	328,696	155,556	155,556	173,140
2026	32,406	0	306,162	338,568	156,950	156,950	181,618
2027	33,380	0	315,338	348,718	158,403	158,403	190,315
2028	34,383	0	324,807	359,190	159,924	159,924	199,266
2029	35,414	0	334,548	369,962	161,514	161,514	208,448
2030	36,475	0	344,582	381,057	163,173	163,173	217,884
2031	37,571	0	354,910	392,481	164,906	164,906	227,575
2032	7,971	0	148,325	156,296	0	0	156,296
2033	0	0	77,474	77,474	0	0	77,474
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$4,515,275		\$2,307,018	\$2,208,257
				NPV = \$1,981,095		\$1,162,027	819,068
Total NPV =							\$819,068
Benefit/Cost Ratio =							<u>1.70</u>

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Residential AC Cycling**  
Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$0	\$0	\$0	\$0	\$0	\$24,000	\$0	\$24,000	(\$24,000)
2017	4,393	0	46,927	16,715	68,035	82,641	16,000	98,641	(30,606)
2018	9,042	0	96,674	35,464	141,180	114,029	16,480	130,509	10,671
2019	13,911	0	149,363	56,416	219,690	137,596	16,960	154,556	65,134
2020	19,707	0	205,118	80,015	304,840	168,835	17,480	186,315	118,525
2021	25,909	0	264,081	106,303	396,293	200,594	18,000	218,594	177,699
2022	27,706	0	272,014	113,166	412,886	151,726	560	152,286	260,600
2023	28,691	0	280,172	120,116	428,979	152,947	560	153,507	275,472
2024	30,546	0	288,579	127,830	446,955	154,224	560	154,784	292,171
2025	31,461	0	297,235	135,614	464,310	155,556	560	156,116	308,194
2026	32,406	0	306,162	143,878	482,446	156,950	560	157,510	324,936
2027	33,380	0	315,338	152,637	501,355	158,403	560	158,963	342,392
2028	34,383	0	324,807	161,937	521,127	159,924	560	160,484	360,643
2029	35,414	0	334,548	171,797	541,759	161,514	560	162,074	379,685
2030	36,475	0	344,582	182,258	563,315	163,173	560	163,733	399,582
2031	37,571	0	354,910	193,354	585,835	164,906	560	165,466	420,369
2032	7,971	0	148,325	79,308	235,604	0	0	0	235,604
2033	0	0	77,474	40,492	117,966	0	0	0	117,966
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$6,432,575		\$2,397,538	\$4,035,037	
NPV =					\$4,691,327		\$1,855,266	2,836,061	
Total NPV =		\$2,836,061							
Benefit/Cost Ratio =		<u>2.53</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Residential AC Cycling**  
 Program Years: **2016 - 2018**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$0	\$0.09439	\$0.07933	0	0	0	\$0	0	0	\$0.000	\$0.000	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2017	24,000	0.09864	0.08290	107,600	0	107,600	10,614	400	0	0.000	0.000	0	0	34,614	41,396	0	41,396	(6,782)
2018	24,720	0.10308	0.08663	215,200	0	215,200	22,183	800	0	0.000	0.000	0	0	46,903	43,375	0	43,375	3,528
2019	25,440	0.10772	0.09052	322,800	0	322,800	34,772	1,200	0	0.000	0.000	0	0	60,212	45,411	0	45,411	14,801
2020	26,220	0.11257	0.09460	430,400	0	430,400	48,450	1,600	0	0.000	0.000	0	0	74,670	47,613	0	47,613	27,057
2021	27,000	0.11763	0.09885	538,000	0	538,000	63,285	2,000	0	0.000	0.000	0	0	90,285	49,878	0	49,878	40,407
2022	840	0.12293	0.10330	538,000	0	538,000	66,136	2,000	0	0.000	0.000	0	0	66,976	1,579	0	1,579	65,397
2023	840	0.12846	0.10795	538,000	0	538,000	69,111	2,000	0	0.000	0.000	0	0	69,951	1,606	0	1,606	68,345
2024	840	0.13424	0.11281	538,000	0	538,000	72,221	2,000	0	0.000	0.000	0	0	73,061	1,634	0	1,634	71,427
2025	840	0.14028	0.11789	538,000	0	538,000	75,471	2,000	0	0.000	0.000	0	0	76,311	1,662	0	1,662	74,649
2026	840	0.14659	0.12319	538,000	0	538,000	78,865	2,000	0	0.000	0.000	0	0	79,705	1,691	0	1,691	78,014
2027	840	0.15319	0.12873	538,000	0	538,000	82,416	2,000	0	0.000	0.000	0	0	83,256	1,720	0	1,720	81,536
2028	840	0.16008	0.13453	538,000	0	538,000	86,123	2,000	0	0.000	0.000	0	0	86,963	1,750	0	1,750	85,213
2029	840	0.16729	0.14058	538,000	0	538,000	90,002	2,000	0	0.000	0.000	0	0	90,842	1,780	0	1,780	89,062
2030	840	0.17481	0.14691	538,000	0	538,000	94,048	2,000	0	0.000	0.000	0	0	94,888	1,811	0	1,811	93,077
2031	840	0.18268	0.15352	538,000	0	538,000	98,282	2,000	0	0.000	0.000	0	0	99,122	1,842	0	1,842	97,280
2032	0	0.19090	0.16043	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.19949	0.16765	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.20847	0.17519	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.21785	0.18307	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				6,994,000	0			26,000	0				\$1,127,759			\$244,748	\$883,011	
													NPV = \$517,846			\$176,403	341,444	

Total NPV = \$341,444  
 Benefit/Cost Ratio = 2.94

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Residential AC Cycling**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$0	\$0	\$0	\$24,000	\$0	\$24,000	(\$24,000)
2017	4,393	46,927	51,320	82,641	16,000	98,641	(47,321)
2018	9,042	96,674	105,716	114,029	16,480	130,509	(24,793)
2019	13,911	149,363	163,274	137,596	16,960	154,556	8,718
2020	19,707	205,118	224,825	168,835	17,480	186,315	38,510
2021	25,909	264,081	289,990	200,594	18,000	218,594	71,396
2022	27,706	272,014	299,720	151,726	560	152,286	147,434
2023	28,691	280,172	308,863	152,947	560	153,507	155,356
2024	30,546	288,579	319,125	154,224	560	154,784	164,341
2025	31,461	297,235	328,696	155,556	560	156,116	172,580
2026	32,406	306,162	338,568	156,950	560	157,510	181,058
2027	33,380	315,338	348,718	158,403	560	158,963	189,755
2028	34,383	324,807	359,190	159,924	560	160,484	198,706
2029	35,414	334,548	369,962	161,514	560	162,074	207,888
2030	36,475	344,582	381,057	163,173	560	163,733	217,324
2031	37,571	354,910	392,481	164,906	560	165,466	227,015
2032	7,971	148,325	156,296	0	0	0	156,296
2033	0	77,474	77,474	0	0	0	77,474
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$4,515,275			\$2,397,538	\$2,117,737
NPV =			\$1,981,095			\$1,228,918	752,177

Total NPV = \$752,177  
Benefit/Cost Ratio = 1.61

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
NORTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Residential AC Cycling**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.08197			
Retail Rate Winter (\$/kWh) =	\$0.07128			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00496			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05993			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	8.70%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$0	\$18,178	\$22,625
Incentive Costs =		0	90,000	92,700
Direct Program Costs =		0	0	873,983
Total Utility Project Costs =		\$0	\$108,178	\$989,308
14) Direct Participant Costs (\$/Part.) =		\$100	\$100	\$100
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		15	15	15
16) Avg Summer kWh/part. Saved =		1,000	1,000	1,000
16a) Avg Winter kWh/part Saved =		0,000	0,000	0,000
17) Avg. Summer kWh/Part. Saved =		210	210	210
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		0	1,500	1,545
20) Incentive/Participant =		\$60	\$60	\$60
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		0	315,000	324,450
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		0	1,500	1,545
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$2,889,668	1.69	
Utility Cost Test		\$2,889,668	1.69	
Societal Test		\$9,778,846	2.46	
Participant Test		\$822,321	2.24	
Total Resource Cost Test		\$2,639,011	1.59	

**Table 1  
Ratepayer Impact Test**

Project: **Residential AC Cycling**  
Program Years: **2016 - 2018**

t	Year	Benefits										Costs							Annual Benefits Less Costs (Q)			
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)	Program Admin Costs (M)		Incentive Costs (N)	Direct Program Costs (O)	Total Project Costs (P)
1	2016	0	\$0.03570	\$0	\$0.00000	\$0	0	0	0	\$100.80	\$0	\$0	\$0.06263	0	0	0	\$0	\$0	\$0	\$90,000	\$90,000	(\$90,000)
2	2017	339,365	\$0.03790	12,862	0.00000	0	1,695	0	1,695	103.82	175,975	188,837	0.06545	315,000	0	315,000	12,496	18,178	0	270,900	301,574	(112,737)
3	2018	678,731	\$0.03900	26,471	0.00000	0	3,389	0	3,389	106.94	362,420	388,891	0.06839	630,000	0	630,000	26,115	22,625	0	366,777	415,517	(26,626)
4	2019	1,018,096	\$0.04000	40,724	0.00000	0	5,084	0	5,084	110.15	560,003	600,727	0.07147	945,000	0	945,000	40,937	0	0	462,830	503,767	96,960
5	2020	1,357,461	\$0.04250	57,692	0.00000	0	6,779	0	6,779	113.45	769,078	826,770	0.07468	1,260,000	0	1,260,000	57,034	0	0	559,065	616,099	210,671
6	2021	1,696,826	\$0.04470	75,848	0.00000	0	8,474	0	8,474	116.85	990,187	1,066,035	0.07804	1,575,000	0	1,575,000	74,501	0	0	655,487	729,988	336,047
7	2022	1,696,826	\$0.04780	81,108	0.00000	0	8,474	0	8,474	120.36	1,019,931	1,101,039	0.08156	1,575,000	0	1,575,000	77,861	0	0	467,880	545,741	555,298
8	2023	1,696,826	\$0.04950	83,993	0.00000	0	8,474	0	8,474	123.97	1,050,522	1,134,515	0.08523	1,575,000	0	1,575,000	81,365	0	0	467,910	549,275	585,240
9	2024	1,696,826	\$0.05270	89,423	0.00000	0	8,474	0	8,474	127.69	1,082,045	1,171,468	0.08906	1,575,000	0	1,575,000	85,021	0	0	467,941	552,962	618,506
10	2025	1,696,826	\$0.05428	92,104	0.00000	0	8,474	0	8,474	131.52	1,114,500	1,206,604	0.09307	1,575,000	0	1,575,000	88,849	0	0	467,971	556,820	649,784
11	2026	1,696,826	\$0.05591	94,870	0.00000	0	8,474	0	8,474	135.47	1,147,973	1,242,843	0.09726	1,575,000	0	1,575,000	92,849	0	0	468,001	560,850	681,993
12	2027	1,696,826	\$0.05759	97,720	0.00000	0	8,474	0	8,474	139.53	1,182,377	1,280,097	0.10163	1,575,000	0	1,575,000	97,021	0	0	468,033	565,054	715,043
13	2028	1,696,826	\$0.05932	100,656	0.00000	0	8,474	0	8,474	143.72	1,217,883	1,318,539	0.10621	1,575,000	0	1,575,000	101,393	0	0	468,064	569,457	749,082
14	2029	1,696,826	\$0.06110	103,676	0.00000	0	8,474	0	8,474	148.03	1,254,406	1,358,082	0.11099	1,575,000	0	1,575,000	105,956	0	0	468,095	574,051	784,031
15	2030	1,696,826	\$0.06293	106,781	0.00000	0	8,474	0	8,474	152.47	1,292,031	1,398,812	0.11598	1,575,000	0	1,575,000	110,720	0	0	468,126	578,846	819,966
16	2031	1,696,826	\$0.06482	109,988	0.00000	0	8,474	0	8,474	157.04	1,330,757	1,440,745	0.12120	1,575,000	0	1,575,000	115,703	0	0	468,157	583,860	856,885
17	2032	0	\$0.06676	0	0.00000	0	0	0	0	161.75	0	0	0.12665	0	0	0	0	0	0	0	0	0
18	2033	0	\$0.06876	0	0.00000	0	0	0	0	166.61	0	0	0.13235	0	0	0	0	0	0	0	0	0
19	2034	0	\$0.07082	0	0.00000	0	0	0	0	171.60	0	0	0.13831	0	0	0	0	0	0	0	0	0
20	2035	0	\$0.07294	0	0.00000	0	0	0	0	176.75	0	0	0.14453	0	0	0	0	0	0	0	0	0
Total =		22,058,739							110,161			\$15,724,004			20,475,000					\$8,293,861	\$7,430,143	
												NPV = \$7,085,365									\$4,195,697	2,889,668
Total NPV =			\$2,889,668																			
Benefit/Cost Ratio =			1.69																			

Worksheet Calculations	
(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Residential AC Cycling**  
Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$0	\$0	\$0	\$0	\$90,000	\$90,000	(\$90,000)
2017	12,862	0	175,975	188,837	301,574	301,574	(112,737)
2018	26,471	0	362,420	388,891	415,517	415,517	(26,626)
2019	40,724	0	560,003	600,727	503,767	503,767	96,960
2020	57,692	0	769,078	826,770	616,099	616,099	210,671
2021	75,848	0	990,187	1,066,035	729,988	729,988	336,047
2022	81,108	0	1,019,931	1,101,039	545,741	545,741	555,298
2023	83,993	0	1,050,522	1,134,515	549,275	549,275	585,240
2024	89,423	0	1,082,045	1,171,468	552,962	552,962	618,506
2025	92,104	0	1,114,500	1,206,604	556,820	556,820	649,784
2026	94,870	0	1,147,973	1,242,843	560,850	560,850	681,993
2027	97,720	0	1,182,377	1,280,097	565,054	565,054	715,043
2028	100,656	0	1,217,883	1,318,539	569,457	569,457	749,082
2029	103,676	0	1,254,406	1,358,082	574,051	574,051	784,031
2030	106,781	0	1,292,031	1,398,812	578,846	578,846	819,966
2031	109,988	0	1,330,757	1,440,745	583,860	583,860	856,885
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$15,724,004	\$8,293,861	\$7,430,143	
NPV =				\$7,085,365	\$4,195,697	2,889,668	
Total NPV =				\$2,889,668			
Benefit/Cost Ratio =				1.69			

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Residential AC Cycling**  
Program Years: **2016 - 2018**

Year	Benefits				Costs			Annual Benefits Less Costs (I)	
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)		Annual Total Increase (H)
2016	\$0	\$0	\$0	\$0	\$0	\$90,000	\$0	\$90,000	(\$90,000)
2017	12,862	0	175,975	61,504	250,341	301,574	60,000	361,574	(111,233)
2018	26,471	0	362,420	130,460	519,351	415,517	61,800	477,317	42,034
2019	40,724	0	560,003	207,570	808,297	503,767	63,640	567,407	240,890
2020	57,692	0	769,078	294,245	1,121,015	616,099	65,560	681,659	439,356
2021	75,848	0	990,187	390,781	1,456,816	729,988	67,520	797,508	659,308
2022	81,108	0	1,019,931	415,721	1,516,760	545,741	2,040	547,781	968,979
2023	83,993	0	1,050,522	441,211	1,575,726	549,275	2,040	551,315	1,024,411
2024	89,423	0	1,082,045	469,250	1,640,718	552,962	2,040	555,002	1,085,716
2025	92,104	0	1,114,500	497,823	1,704,427	556,820	2,040	558,860	1,145,567
2026	94,870	0	1,147,973	528,158	1,771,001	560,850	2,040	562,890	1,208,111
2027	97,720	0	1,182,377	560,309	1,840,406	565,054	2,040	567,094	1,273,312
2028	100,656	0	1,217,883	594,450	1,912,989	569,457	2,040	571,497	1,341,492
2029	103,676	0	1,254,406	630,646	1,988,728	574,051	2,040	576,091	1,412,637
2030	106,781	0	1,292,031	669,046	2,067,858	578,846	2,040	580,886	1,486,972
2031	109,988	0	1,330,757	709,776	2,150,521	583,860	2,040	585,900	1,564,621
2032	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$22,324,954		\$8,632,781	\$13,692,173	
NPV =					\$16,470,742		\$6,691,896	9,778,846	
Total NPV =		\$9,778,846							
Benefit/Cost Ratio =		2.46							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Residential AC Cycling**  
Program Years: **2016 - 2018**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$0	\$0.08566	\$0.07449	0	0	0	\$0	0	0	\$0.000	\$0.000	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2017	90,000	0.08951	0.07784	315,000	0	315,000	28,196	1,500	0	0.000	0.000	0	0	118,196	\$155,235	0	155,235	(37,039)
2018	92,700	0.09354	0.08134	630,000	0	630,000	58,930	3,000	0	0.000	0.000	0	0	151,630	\$162,658	0	162,658	(11,028)
2019	95,460	0.09775	0.08500	945,000	0	945,000	92,374	4,500	0	0.000	0.000	0	0	187,834	\$170,399	0	170,399	17,435
2020	98,340	0.10215	0.08883	1,260,000	0	1,260,000	128,709	6,000	0	0.000	0.000	0	0	227,049	\$178,576	0	178,576	48,473
2021	101,280	0.10675	0.09283	1,575,000	0	1,575,000	168,131	7,500	0	0.000	0.000	0	0	269,411	\$187,097	0	187,097	82,314
2022	3,060	0.11155	0.09700	1,575,000	0	1,575,000	175,691	7,500	0	0.000	0.000	0	0	178,751	\$5,751	0	5,751	173,000
2023	3,060	0.11657	0.10137	1,575,000	0	1,575,000	183,598	7,500	0	0.000	0.000	0	0	186,658	\$5,850	0	5,850	180,808
2024	3,060	0.12182	0.10593	1,575,000	0	1,575,000	191,867	7,500	0	0.000	0.000	0	0	194,927	\$5,951	0	5,951	188,976
2025	3,060	0.12730	0.11070	1,575,000	0	1,575,000	200,498	7,500	0	0.000	0.000	0	0	203,558	\$6,054	0	6,054	197,504
2026	3,060	0.13303	0.11568	1,575,000	0	1,575,000	209,522	7,500	0	0.000	0.000	0	0	212,582	\$6,159	0	6,159	206,423
2027	3,060	0.13901	0.12088	1,575,000	0	1,575,000	218,941	7,500	0	0.000	0.000	0	0	222,001	\$6,266	0	6,266	215,735
2028	3,060	0.14527	0.12632	1,575,000	0	1,575,000	228,800	7,500	0	0.000	0.000	0	0	231,860	\$6,374	0	6,374	225,486
2029	3,060	0.15180	0.13201	1,575,000	0	1,575,000	239,085	7,500	0	0.000	0.000	0	0	242,145	\$6,484	0	6,484	235,661
2030	3,060	0.15864	0.13795	1,575,000	0	1,575,000	249,858	7,500	0	0.000	0.000	0	0	252,918	\$6,596	0	6,596	246,322
2031	3,060	0.16577	0.14415	1,575,000	0	1,575,000	261,088	7,500	0	0.000	0.000	0	0	264,148	\$6,711	0	6,711	257,437
2032	0	0.17323	0.15064	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
2033	0	0.18103	0.15742	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
2034	0	0.18918	0.16450	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
2035	0	0.19769	0.17191	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
Total =				20,475,000	0			97,500	0					\$3,143,668			\$916,161	\$2,227,507
														NPV = \$1,483,287			\$660,967	822,321
Total NPV =																	\$822,321	
Benefit/Cost Ratio =																	2.24	

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Residential AC Cycling**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$0	\$0	\$0	\$90,000	\$0	\$90,000	(\$90,000)
2017	12,862	175,975	188,837	301,574	60,000	361,574	(172,737)
2018	26,471	362,420	388,891	415,517	61,800	477,317	(88,426)
2019	40,724	560,003	600,727	503,767	63,640	567,407	33,320
2020	57,692	769,078	826,770	616,099	65,560	681,659	145,111
2021	75,848	990,187	1,066,035	729,988	67,520	797,508	268,527
2022	81,108	1,019,931	1,101,039	545,741	2,040	547,781	553,258
2023	83,993	1,050,522	1,134,515	549,275	2,040	551,315	583,200
2024	89,423	1,082,045	1,171,468	552,962	2,040	555,002	616,466
2025	92,104	1,114,500	1,206,604	556,820	2,040	558,860	647,744
2026	94,870	1,147,973	1,242,843	560,850	2,040	562,890	679,953
2027	97,720	1,182,377	1,280,097	565,054	2,040	567,094	713,003
2028	100,656	1,217,883	1,318,539	569,457	2,040	571,497	747,042
2029	103,676	1,254,406	1,358,082	574,051	2,040	576,091	781,991
2030	106,781	1,292,031	1,398,812	578,846	2,040	580,886	817,926
2031	109,988	1,330,757	1,440,745	583,860	2,040	585,900	854,845
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$15,724,004			\$8,632,781	\$7,091,223
NPV =			\$7,085,365			\$4,446,353	2,639,011
Total NPV =			\$2,639,011				
Benefit/Cost Ratio =			1.59				

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
SOUTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Residential AC Cycling**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09021			
Retail Rate Winter (\$/kWh) =	\$0.08577			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00815			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05546			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =	\$0	\$2,036	\$2,133	
Incentive Costs =	0	6,000	6,180	
Direct Program Costs =	0	0	87	
Total Utility Project Costs =	\$0	\$8,036	\$8,400	
14) Direct Participant Costs (\$/Part.) =	\$100	\$100	\$100	
Escalation Rate =	1.73%	1.73%	1.73%	
14a) Other Participant Costs (Annual \$/Part.) =	\$0	\$0	\$0	
Escalation Rate =	0.00%	0.00%	0.00%	
14b) Other Participant Savings (Annual \$/Part.) =	\$0	\$0	\$0	
Escalation Rate =	0%	0%	0%	
15) Project Life (Years) =	15	15	15	
16) Avg Summer kWh/part. Saved =	1,000	1,000	1,000	
16a) Avg Winter kW/part Saved =	0,000	0,000	0,000	
17) Avg. Summer kWh/Part. Saved =	260	260	260	
17a) Avg. Winter kWh/Part. Saved =	0	0	0	
18a) System Demand Line Loss Factor	12.9800%	12.9800%	12.9800%	
18b) System Energy Line Loss Factor	7.7350%	7.7350%	7.7350%	
19) Number of Participants =	0	100	103	
20) Incentive/Participant =	\$60	\$60	\$60	
21) Effective Federal & State Income Tax Rate =			39.39%	
22) Annual Summer Kwh Saved	0	26,000	26,780	
Annual Winter Kwh Saved	0	0	0	
23) Annual Summer KW Saved	0	100	103	
Annual Winter KW Saved	0	0	0	
<b>Test Results</b>	<b>NPV</b>	<b>B/C</b>		
Ratepayer Impact Measure Test	\$194,708	1.68		
Utility Cost Test	\$194,708	1.68		
Societal Test	\$661,894	2.45		
Participant Test	\$81,826	2.86		
Total Resource Cost Test	\$178,059	1.59		

**Table 1  
Ratepayer Impact Test**

Project: **Residential AC Cycling**  
Program Years: **2016 - 2018**

t	Year											Costs							Annual Benefits Less Costs (Q)			
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)	Program Admin Costs (M)		Incentive Costs (N)	Direct Program Costs (O)	Total Project Costs (P)
1	2016	0	\$0.03570	\$0	0.00000	\$0	0	0	0	\$100.80	\$0	\$0	\$0.05796	0	0	0	\$0	\$0	\$0	\$6,000	\$6,000	(\$6,000)
2	2017	28,011	0.03790	1,062	0.00000	0	113	0	113	103.82	11,732	12,794	0.06056	26,000	0	26,000	954	2,036	0	18,060	21,050	(8,256)
3	2018	56,022	0.03900	2,185	0.00000	0	226	0	226	106.94	24,168	26,353	0.06329	52,000	0	52,000	1,995	2,133	0	24,452	28,580	(2,227)
4	2019	84,033	0.04000	3,361	0.00000	0	339	0	339	110.15	37,341	40,702	0.06614	78,000	0	78,000	3,127	0	0	30,855	33,982	6,720
5	2020	112,044	0.04250	4,762	0.00000	0	452	0	452	113.45	51,279	56,041	0.06911	104,000	0	104,000	4,356	0	0	37,271	41,627	14,414
6	2021	140,056	0.04470	6,261	0.00000	0	565	0	565	116.85	66,020	72,281	0.07222	130,000	0	130,000	5,691	0	0	43,699	49,390	22,891
7	2022	140,056	0.04780	6,695	0.00000	0	565	0	565	120.36	68,003	74,698	0.07547	130,000	0	130,000	5,947	0	0	31,192	37,139	37,559
8	2023	140,056	0.04950	6,933	0.00000	0	565	0	565	123.97	70,043	76,976	0.07887	130,000	0	130,000	6,215	0	0	31,194	37,409	39,567
9	2024	140,056	0.05270	7,381	0.00000	0	565	0	565	127.69	72,145	79,526	0.08242	130,000	0	130,000	6,494	0	0	31,196	37,690	41,836
10	2025	140,056	0.05428	7,602	0.00000	0	565	0	565	131.52	74,309	81,911	0.08613	130,000	0	130,000	6,787	0	0	31,198	37,985	43,926
11	2026	140,056	0.05591	7,831	0.00000	0	565	0	565	135.47	76,541	84,372	0.09000	130,000	0	130,000	7,092	0	0	31,200	38,292	46,080
12	2027	140,056	0.05759	8,066	0.00000	0	565	0	565	139.53	78,834	86,900	0.09405	130,000	0	130,000	7,411	0	0	31,202	38,613	48,287
13	2028	140,056	0.05932	8,308	0.00000	0	565	0	565	143.72	81,202	89,510	0.09829	130,000	0	130,000	7,745	0	0	31,204	38,949	50,561
14	2029	140,056	0.06110	8,557	0.00000	0	565	0	565	148.03	83,637	92,194	0.10271	130,000	0	130,000	8,093	0	0	31,206	39,299	52,895
15	2030	140,056	0.06293	8,814	0.00000	0	565	0	565	152.47	86,146	94,960	0.10733	130,000	0	130,000	8,457	0	0	31,208	39,665	55,295
16	2031	140,056	0.06482	9,078	0.00000	0	565	0	565	157.04	88,728	97,806	0.11216	130,000	0	130,000	8,838	0	0	31,210	40,048	57,758
17	2032	0	0.06676	0	0.00000	0	0	0	0	161.75	0	0	0.11721	0	0	0	0	0	0	0	0	0
18	2033	0	0.06876	0	0.00000	0	0	0	0	166.61	0	0	0.12248	0	0	0	0	0	0	0	0	0
19	2034	0	0.07082	0	0.00000	0	0	0	0	171.60	0	0	0.12799	0	0	0	0	0	0	0	0	0
20	2035	0	0.07294	0	0.00000	0	0	0	0	176.75	0	0	0.13375	0	0	0	0	0	0	0	0	0
Total =		1,820,726							7,345			\$1,067,024				1,690,000				\$565,718	\$501,306	
												\$480,710								\$286,002	194,708	
NPV =																						
Total NPV =			\$194,708																			
Benefit/Cost Ratio =			1.68																			

Worksheet Calculations	
(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Residential AC Cycling**  
Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$0	\$0	\$0	\$0	\$6,000	\$6,000	(\$6,000)
2017	1,062	0	11,732	12,794	21,050	21,050	(8,256)
2018	2,185	0	24,168	26,353	28,580	28,580	(2,227)
2019	3,361	0	37,341	40,702	33,982	33,982	6,720
2020	4,762	0	51,279	56,041	41,627	41,627	14,414
2021	6,261	0	66,020	72,281	49,390	49,390	22,891
2022	6,695	0	68,003	74,698	37,139	37,139	37,559
2023	6,933	0	70,043	76,976	37,409	37,409	39,567
2024	7,381	0	72,145	79,526	37,690	37,690	41,836
2025	7,602	0	74,309	81,911	37,985	37,985	43,926
2026	7,831	0	76,541	84,372	38,292	38,292	46,080
2027	8,066	0	78,834	86,900	38,613	38,613	48,287
2028	8,308	0	81,202	89,510	38,949	38,949	50,561
2029	8,557	0	83,637	92,194	39,299	39,299	52,895
2030	8,814	0	86,146	94,960	39,665	39,665	55,295
2031	9,078	0	88,728	97,806	40,048	40,048	57,758
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$1,067,024	\$565,718	\$501,306	
NPV =				\$480,710	\$286,002	194,708	
Total NPV =				\$194,708			
Benefit/Cost Ratio =				1.68			

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3**  
**Societal Cost Test**

Project: **Residential AC Cycling**  
Program Years: **2016 - 2018**

Year	Benefits				Costs			Annual Benefits Less Costs (I)	
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)		Annual Total Increase (H)
2016	\$0	\$0	\$0	\$0	\$0	\$6,000	\$0	\$6,000	(\$6,000)
2017	1,062	0	11,732	4,167	16,961	21,050	4,000	25,050	(8,089)
2018	2,185	0	24,168	8,841	35,194	28,580	4,120	32,700	2,494
2019	3,361	0	37,341	14,064	54,766	33,982	4,240	38,222	16,544
2020	4,762	0	51,279	19,945	75,986	41,627	4,360	45,987	29,999
2021	6,261	0	66,020	26,496	98,777	49,390	4,520	53,910	44,867
2022	6,695	0	68,003	28,204	102,902	37,139	120	37,259	65,643
2023	6,933	0	70,043	29,936	106,912	37,409	120	37,529	69,383
2024	7,381	0	72,145	31,855	111,381	37,690	120	37,810	73,571
2025	7,602	0	74,309	33,795	115,706	37,985	120	38,105	77,601
2026	7,831	0	76,541	35,855	120,227	38,292	120	38,412	81,815
2027	8,066	0	78,834	38,037	124,937	38,613	120	38,733	86,204
2028	8,308	0	81,202	40,355	129,865	38,949	120	39,069	90,796
2029	8,557	0	83,637	42,812	135,006	39,299	120	39,419	95,587
2030	8,814	0	86,146	45,419	140,379	39,665	120	39,785	100,594
2031	9,078	0	88,728	48,184	145,990	40,048	120	40,168	105,822
2032	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$1,514,989		\$588,158	\$926,831	
NPV =					\$1,117,642		\$455,748	661,894	
Total NPV =		\$661,894							
Benefit/Cost Ratio =		<u>2.45</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Residential AC Cycling**  
 Program Years: **2016 - 2018**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$0	\$0.09427	\$0.08963	0	0	0	\$0	0	0	\$0.000	\$0.000	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2017	6,000	0.09851	0.09366	26,000	0	26,000	2,561	100	0	0.000	0.000	0	0	8,561	\$10,349	0	10,349	(1,788)
2018	6,180	0.10294	0.09788	52,000	0	52,000	5,353	200	0	0.000	0.000	0	0	11,533	\$10,844	0	10,844	689
2019	6,360	0.10758	0.10228	78,000	0	78,000	8,391	300	0	0.000	0.000	0	0	14,751	\$11,353	0	11,353	3,398
2020	6,540	0.11242	0.10689	104,000	0	104,000	11,692	400	0	0.000	0.000	0	0	18,232	\$11,876	0	11,876	6,356
2021	6,780	0.11748	0.11169	130,000	0	130,000	15,272	500	0	0.000	0.000	0	0	22,052	\$12,525	0	12,525	9,527
2022	180	0.12276	0.11672	130,000	0	130,000	15,959	500	0	0.000	0.000	0	0	16,139	\$338	0	338	15,801
2023	180	0.12829	0.12197	130,000	0	130,000	16,678	500	0	0.000	0.000	0	0	16,858	\$344	0	344	16,514
2024	180	0.13406	0.12746	130,000	0	130,000	17,428	500	0	0.000	0.000	0	0	17,608	\$350	0	350	17,258
2025	180	0.14009	0.13320	130,000	0	130,000	18,212	500	0	0.000	0.000	0	0	18,392	\$356	0	356	18,036
2026	180	0.14640	0.13919	130,000	0	130,000	19,032	500	0	0.000	0.000	0	0	19,212	\$362	0	362	18,850
2027	180	0.15299	0.14546	130,000	0	130,000	19,889	500	0	0.000	0.000	0	0	20,069	\$369	0	369	19,700
2028	180	0.15987	0.15200	130,000	0	130,000	20,783	500	0	0.000	0.000	0	0	20,963	\$375	0	375	20,588
2029	180	0.16706	0.15884	130,000	0	130,000	21,718	500	0	0.000	0.000	0	0	21,898	\$381	0	381	21,517
2030	180	0.17458	0.16599	130,000	0	130,000	22,695	500	0	0.000	0.000	0	0	22,875	\$388	0	388	22,487
2031	180	0.18244	0.17346	130,000	0	130,000	23,717	500	0	0.000	0.000	0	0	23,897	\$395	0	395	23,502
2032	0	0.19065	0.18126	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
2033	0	0.19923	0.18942	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
2034	0	0.20819	0.19795	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
2035	0	0.21756	0.20685	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
Total =				1,690,000	0			6,500	0					\$273,040			\$60,605	\$212,435
														NPV = \$125,717			\$43,891	81,826
Total NPV =				\$81,826														
Benefit/Cost Ratio =				<u>2.86</u>														

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Residential AC Cycling**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$0	\$0	\$0	\$6,000	\$0	\$6,000	(\$6,000)
2017	1,062	11,732	12,794	21,050	4,000	25,050	(12,256)
2018	2,185	24,168	26,353	28,580	4,120	32,700	(6,347)
2019	3,361	37,341	40,702	33,982	4,240	38,222	2,480
2020	4,762	51,279	56,041	41,627	4,360	45,987	10,054
2021	6,261	66,020	72,281	49,390	4,520	53,910	18,371
2022	6,695	68,003	74,698	37,139	120	37,259	37,439
2023	6,933	70,043	76,976	37,409	120	37,529	39,447
2024	7,381	72,145	79,526	37,690	120	37,810	41,716
2025	7,602	74,309	81,911	37,985	120	38,105	43,806
2026	7,831	76,541	84,372	38,292	120	38,412	45,960
2027	8,066	78,834	86,900	38,613	120	38,733	48,167
2028	8,308	81,202	89,510	38,949	120	39,069	50,441
2029	8,557	83,637	92,194	39,299	120	39,419	52,775
2030	8,814	86,146	94,960	39,665	120	39,785	55,175
2031	9,078	88,728	97,806	40,048	120	40,168	57,638
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$1,067,024			\$588,158	\$478,866
NPV =			\$480,710			\$302,651	178,059
Total NPV =			\$178,059				
Benefit/Cost Ratio =			<u>1.59</u>				

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Commerical Lighting**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.06569			
Retail Rate Winter (\$/kWh) =	\$0.05369			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00418			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$38.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$68.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.04381			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$6,490	\$5,493	\$2,321
Incentive Costs =		15,300	30,600	15,300
Total Utility Project Costs =		\$21,790	\$36,093	\$17,621
14) Direct Participant Costs (\$/Part.) =		\$5,345	\$5,345	\$5,345
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		18	18	18
16) Avg Summer kW/part. Saved =		4.800	4.800	4.800
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		8,263	8,263	8,263
17a) Avg. Winter kWh/Part. Saved =		16,526	16,526	16,526
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		5	10	5
20) Incentive/Participant =		\$3,060	\$3,060	\$3,060
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		41,315	82,630	41,315
Annual Winter Kwh Saved		82,630	165,260	82,630
23) Annual Summer KW Saved		24	48	24
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$105,219	1.45	
Utility Cost Test		\$267,522	4.86	
Societal Test		\$686,727	6.85	
Participant Test		\$335,164	4.33	
Total Resource Cost Test		\$225,740	3.03	

**Table 1  
Ratepayer Impact Test**

Project: **Commerical Lighting**  
Program Years: **2016 - 2018**

t	Year												Costs					Annual Benefits Less Costs (P)			
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)
1	2016	133,532	\$0.03570	\$4,767	\$0.00000	\$0	27	0	27	\$100.80	\$2,722	\$7,489	\$0.04578	41,315	82,630	123,945	\$3,439	\$6,490	\$15,300	\$25,229	(\$17,740)
2	2017	400,596	0.03790	15,183	0.00000	0	81	0	81	103.82	8,409	23,592	0.04784	123,945	247,890	371,835	10,782	5,493	30,600	46,875	(23,283)
3	2018	534,129	0.03900	20,831	0.00000	0	108	0	108	106.94	11,550	32,381	0.04999	165,260	330,520	495,780	15,022	2,321	15,300	32,643	(262)
4	2019	534,129	0.04000	21,365	0.00000	0	108	0	108	110.15	11,896	33,261	0.05224	165,260	330,520	495,780	15,698	0	0	15,698	17,563
5	2020	534,129	0.04250	22,700	0.00000	0	108	0	108	113.45	12,253	34,953	0.05460	165,260	330,520	495,780	16,408	0	0	16,408	18,545
6	2021	534,129	0.04470	23,876	0.00000	0	108	0	108	116.85	12,620	36,496	0.05705	165,260	330,520	495,780	17,144	0	0	17,144	19,352
7	2022	534,129	0.04780	25,531	0.00000	0	108	0	108	120.36	12,999	38,530	0.05962	165,260	330,520	495,780	17,916	0	0	17,916	20,614
8	2023	534,129	0.04950	26,439	0.00000	0	108	0	108	123.97	13,389	39,828	0.06230	165,260	330,520	495,780	18,721	0	0	18,721	21,107
9	2024	534,129	0.05270	28,149	0.00000	0	108	0	108	127.69	13,791	41,940	0.06511	165,260	330,520	495,780	19,566	0	0	19,566	22,374
10	2025	534,129	0.05428	28,993	0.00000	0	108	0	108	131.52	14,204	43,197	0.06804	165,260	330,520	495,780	20,446	0	0	20,446	22,751
11	2026	534,129	0.05591	29,863	0.00000	0	108	0	108	135.47	14,631	44,494	0.07110	165,260	330,520	495,780	21,366	0	0	21,366	23,128
12	2027	534,129	0.05759	30,760	0.00000	0	108	0	108	139.53	15,069	45,829	0.07430	165,260	330,520	495,780	22,327	0	0	22,327	23,502
13	2028	534,129	0.05932	31,685	0.00000	0	108	0	108	143.72	15,522	47,207	0.07764	165,260	330,520	495,780	23,331	0	0	23,331	23,876
14	2029	534,129	0.06110	32,635	0.00000	0	108	0	108	148.03	15,987	48,622	0.08113	165,260	330,520	495,780	24,380	0	0	24,380	24,242
15	2030	534,129	0.06293	33,613	0.00000	0	108	0	108	152.47	16,467	50,080	0.08478	165,260	330,520	495,780	25,477	0	0	25,477	24,603
16	2031	534,129	0.06482	34,622	0.00000	0	108	0	108	157.04	16,960	51,582	0.08860	165,260	330,520	495,780	26,625	0	0	26,625	24,957
17	2032	534,129	0.06676	35,658	0.00000	0	108	0	108	161.75	17,469	53,127	0.09259	165,260	330,520	495,780	27,824	0	0	27,824	25,303
18	2033	534,129	0.06876	36,727	0.00000	0	108	0	108	166.61	17,994	54,721	0.09675	165,260	330,520	495,780	29,074	0	0	29,074	25,647
19	2034	400,596	0.07082	28,370	0.00000	0	81	0	81	171.60	13,900	42,270	0.10111	123,945	247,890	371,835	22,788	0	0	22,788	19,482
20	2035	133,532	0.07294	9,740	0.00000	0	27	0	27	176.75	4,772	14,512	0.10566	41,315	82,630	123,945	7,938	0	0	7,938	6,574
Total =		9,614,320							1,944			\$784,111				8,924,040			\$461,776	\$322,335	
												NPV =								\$231,688	105,219
Total NPV =			\$105,219																		
Benefit/Cost Ratio =			<u>1.45</u>																		

Worksheet Calculations	
(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Commerical Lighting**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$4,767	\$0	\$2,722	\$7,489	\$21,790	\$21,790	(\$14,301)
2017	15,183	0	8,409	23,592	36,093	36,093	(12,501)
2018	20,831	0	11,550	32,381	17,621	17,621	14,760
2019	21,365	0	11,896	33,261	0	0	33,261
2020	22,700	0	12,253	34,953	0	0	34,953
2021	23,876	0	12,620	36,496	0	0	36,496
2022	25,531	0	12,999	38,530	0	0	38,530
2023	26,439	0	13,389	39,828	0	0	39,828
2024	28,149	0	13,791	41,940	0	0	41,940
2025	28,993	0	14,204	43,197	0	0	43,197
2026	29,863	0	14,631	44,494	0	0	44,494
2027	30,760	0	15,069	45,829	0	0	45,829
2028	31,685	0	15,522	47,207	0	0	47,207
2029	32,635	0	15,987	48,622	0	0	48,622
2030	33,613	0	16,467	50,080	0	0	50,080
2031	34,622	0	16,960	51,582	0	0	51,582
2032	35,658	0	17,469	53,127	0	0	53,127
2033	36,727	0	17,994	54,721	0	0	54,721
2034	28,370	0	13,900	42,270	0	0	42,270
2035	9,740	0	4,772	14,512	0	0	14,512
Total =				\$784,111		\$75,504	\$708,607
NPV =				\$336,907		\$69,385	267,522
Total NPV =				\$267,522			
Benefit/Cost Ratio =				<u>4.86</u>			

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Commerical Lighting**  
Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$4,767	\$0	\$2,722	\$2,368	\$9,857	\$21,790	\$11,425	\$33,215	(\$23,358)
2017	15,183	0	8,409	7,684	31,276	36,093	22,850	58,943	(27,667)
2018	20,831	0	11,550	10,863	43,244	17,621	11,425	29,046	14,198
2019	21,365	0	11,896	11,493	44,754	0	0	0	44,754
2020	22,700	0	12,253	12,440	47,393	0	0	0	47,393
2021	23,876	0	12,620	13,378	49,874	0	0	0	49,874
2022	25,531	0	12,999	14,548	53,078	0	0	0	53,078
2023	26,439	0	13,389	15,489	55,317	0	0	0	55,317
2024	28,149	0	13,791	16,800	58,740	0	0	0	58,740
2025	28,993	0	14,204	17,822	61,019	0	0	0	61,019
2026	29,863	0	14,631	18,908	63,402	0	0	0	63,402
2027	30,760	0	15,069	20,060	65,889	0	0	0	65,889
2028	31,685	0	15,522	21,283	68,490	0	0	0	68,490
2029	32,635	0	15,987	22,578	71,200	0	0	0	71,200
2030	33,613	0	16,467	23,953	74,033	0	0	0	74,033
2031	34,622	0	16,960	25,412	76,994	0	0	0	76,994
2032	35,658	0	17,469	26,958	80,085	0	0	0	80,085
2033	36,727	0	17,994	28,600	83,321	0	0	0	83,321
2034	28,370	0	13,900	22,755	65,025	0	0	0	65,025
2035	9,740	0	4,772	8,047	22,559	0	0	0	22,559
Total =					\$1,125,550			\$121,204	\$1,004,346
					NPV = \$804,179			\$117,452	686,727
Total NPV =		\$686,727							
Benefit/Cost Ratio =		<u>6.85</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Commerical Lighting**  
 Program Years: **2016 - 2018**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$15,300	\$0.06865	\$0.05611	41,315	82,630	123,945	\$7,473	24	0	\$39,710	\$71,060	\$953	\$0	\$23,726	\$27,187	\$0	\$27,187	(\$3,461)
2017	30,600	0.07174	0.05863	123,945	247,890	371,835	23,426	72	0	41,497	74,258	2,988	0	57,014	55,315	0	55,315	1,699
2018	15,300	0.07496	0.06127	165,260	330,520	495,780	32,639	96	0	43,364	77,599	4,163	0	52,102	28,136	0	28,136	23,966
2019	0	0.07834	0.06403	165,260	330,520	495,780	34,110	96	0	45,316	81,091	4,350	0	38,460	0	0	0	38,460
2020	0	0.08186	0.06691	165,260	330,520	495,780	35,643	96	0	47,355	84,740	4,546	0	40,189	0	0	0	40,189
2021	0	0.08555	0.06992	165,260	330,520	495,780	37,248	96	0	49,486	88,554	4,751	0	41,999	0	0	0	41,999
2022	0	0.08940	0.07306	165,260	330,520	495,780	38,922	96	0	51,713	92,539	4,964	0	43,886	0	0	0	43,886
2023	0	0.09342	0.07635	165,260	330,520	495,780	40,674	96	0	54,040	96,703	5,188	0	45,862	0	0	0	45,862
2024	0	0.09762	0.07979	165,260	330,520	495,780	42,505	96	0	56,472	101,054	5,421	0	47,926	0	0	0	47,926
2025	0	0.10201	0.08338	165,260	330,520	495,780	44,417	96	0	59,013	105,602	5,665	0	50,082	0	0	0	50,082
2026	0	0.10661	0.08713	165,260	330,520	495,780	46,417	96	0	61,668	110,354	5,920	0	52,337	0	0	0	52,337
2027	0	0.11140	0.09105	165,260	330,520	495,780	48,504	96	0	64,443	115,320	6,187	0	54,691	0	0	0	54,691
2028	0	0.11642	0.09515	165,260	330,520	495,780	50,689	96	0	67,343	120,509	6,465	0	57,154	0	0	0	57,154
2029	0	0.12165	0.09943	165,260	330,520	495,780	52,967	96	0	70,374	125,932	6,766	0	59,723	0	0	0	59,723
2030	0	0.12713	0.10391	165,260	330,520	495,780	55,354	96	0	73,541	131,599	7,060	0	62,414	0	0	0	62,414
2031	0	0.13285	0.10858	165,260	330,520	495,780	57,843	96	0	76,850	137,521	7,378	0	65,221	0	0	0	65,221
2032	0	0.13883	0.11347	165,260	330,520	495,780	60,447	96	0	80,308	143,710	7,710	0	68,157	0	0	0	68,157
2033	0	0.14507	0.11857	165,260	330,520	495,780	63,164	96	0	83,922	150,177	8,057	0	71,221	0	0	0	71,221
2034	0	0.15160	0.12391	123,945	247,890	371,835	49,506	72	0	87,699	156,935	6,314	0	55,820	0	0	0	55,820
2035	0	0.15843	0.12948	41,315	82,630	123,945	17,244	24	0	91,645	163,997	2,199	0	19,443	0	0	0	19,443
Total =				2,974,680	5,949,360			1,728	0					\$1,007,427			\$110,638	\$896,789
														NPV = \$435,697			\$100,533	335,164
Total NPV =			\$335,164															
Benefit/Cost Ratio =			<u>4.33</u>															

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Commerical Lighting**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$4,767	\$2,722	\$7,489	\$21,790	\$11,425	\$33,215	(\$25,726)
2017	15,183	8,409	23,592	36,093	22,850	58,943	(35,351)
2018	20,831	11,550	32,381	17,621	11,425	29,046	3,335
2019	21,365	11,896	33,261	0	0	0	33,261
2020	22,700	12,253	34,953	0	0	0	34,953
2021	23,876	12,620	36,496	0	0	0	36,496
2022	25,531	12,999	38,530	0	0	0	38,530
2023	26,439	13,389	39,828	0	0	0	39,828
2024	28,149	13,791	41,940	0	0	0	41,940
2025	28,993	14,204	43,197	0	0	0	43,197
2026	29,863	14,631	44,494	0	0	0	44,494
2027	30,760	15,069	45,829	0	0	0	45,829
2028	31,685	15,522	47,207	0	0	0	47,207
2029	32,635	15,987	48,622	0	0	0	48,622
2030	33,613	16,467	50,080	0	0	0	50,080
2031	34,622	16,960	51,582	0	0	0	51,582
2032	35,658	17,469	53,127	0	0	0	53,127
2033	36,727	17,994	54,721	0	0	0	54,721
2034	28,370	13,900	42,270	0	0	0	42,270
2035	9,740	4,772	14,512	0	0	0	14,512
Total =			\$784,111			\$121,204	\$662,907
NPV =			\$336,907			\$111,166	225,740

Total NPV = \$225,740  
Benefit/Cost Ratio = 3.03

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
NORTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Commerical Lighting**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.08579			
Retail Rate Winter (\$/kWh) =	\$0.06943			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00496			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$45.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$66.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05530			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	8.70%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$11,162	\$7,858	\$8,058
Incentive Costs =		45,900	61,200	76,500
Total Utility Project Costs =		\$57,062	\$69,058	\$84,558
14) Direct Participant Costs (\$/Part.) =		\$5,345	\$5,345	\$5,345
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		18	18	18
16) Avg Summer kW/part. Saved =		4,800	4,800	4,800
16a) Avg Winter kW/part Saved =		4,800	4,800	4,800
17) Avg. Summer kWh/Part. Saved =		8,263	8,263	8,263
17a) Avg. Winter kWh/Part. Saved =		16,526	16,526	16,526
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		15	20	25
20) Incentive/Participant =		\$3,060	\$3,060	\$3,060
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		123,945	165,260	206,575
Annual Winter Kwh Saved		247,890	330,520	413,150
23) Annual Summer KW Saved		72	96	120
Annual Winter KW Saved		72	96	120
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$543,020	1.68	
Utility Cost Test		\$1,152,860	7.05	
Societal Test		\$2,898,179	9.65	
Participant Test		\$1,541,268	6.18	
Total Resource Cost Test		\$1,029,345	4.28	

**Table 1**  
**Ratepayer Impact Test**

Project: **Commerical Lighting**  
Program Years: **2016 - 2018**

t	Year											Costs					Annual Benefits Less Costs (P)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)		Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)
1	2016	400,596	\$0.03570	\$14,301	\$0.00000	\$0	81	81	162	\$100.80	\$16,330	\$30,631	\$0.05779	123,945	247,890	371,835	\$13,025	\$11,162	\$45,900	\$70,087	(\$39,456)
2	2017	934,725	0.03790	35,426	0.00000	0	190	190	380	103.82	39,452	74,878	0.06039	289,205	578,410	867,615	31,758	7,858	61,200	100,816	(25,938)
3	2018	1,602,386	0.03900	62,493	0.00000	0	325	325	650	106.94	69,511	132,004	0.06311	495,780	991,560	1,487,340	56,895	8,058	76,500	141,453	(9,449)
4	2019	1,602,386	0.04000	64,095	0.00000	0	325	325	650	110.15	71,598	135,693	0.06595	495,780	991,560	1,487,340	59,455	0	0	59,455	76,238
5	2020	1,602,386	0.04250	68,101	0.00000	0	325	325	650	113.45	73,743	141,844	0.06891	495,780	991,560	1,487,340	62,123	0	0	62,123	79,721
6	2021	1,602,386	0.04470	71,627	0.00000	0	325	325	650	116.85	75,953	147,580	0.07201	495,780	991,560	1,487,340	64,918	0	0	64,918	82,662
7	2022	1,602,386	0.04780	76,594	0.00000	0	325	325	650	120.36	78,234	154,828	0.07526	495,780	991,560	1,487,340	67,848	0	0	67,848	86,980
8	2023	1,602,386	0.04950	79,318	0.00000	0	325	325	650	123.97	80,581	159,899	0.07864	495,780	991,560	1,487,340	70,895	0	0	70,895	89,004
9	2024	1,602,386	0.05270	84,446	0.00000	0	325	325	650	127.69	82,999	167,445	0.08218	495,780	991,560	1,487,340	74,086	0	0	74,086	93,359
10	2025	1,602,386	0.05428	86,978	0.00000	0	325	325	650	131.52	85,488	172,466	0.08588	495,780	991,560	1,487,340	77,422	0	0	77,422	95,044
11	2026	1,602,386	0.05591	89,589	0.00000	0	325	325	650	135.47	88,056	177,645	0.08974	495,780	991,560	1,487,340	80,902	0	0	80,902	96,743
12	2027	1,602,386	0.05759	92,281	0.00000	0	325	325	650	139.53	90,695	182,976	0.09378	495,780	991,560	1,487,340	84,544	0	0	84,544	98,432
13	2028	1,602,386	0.05932	95,054	0.00000	0	325	325	650	143.72	93,418	188,472	0.09800	495,780	991,560	1,487,340	88,348	0	0	88,348	100,124
14	2029	1,602,386	0.06110	97,906	0.00000	0	325	325	650	148.03	96,220	194,126	0.10241	495,780	991,560	1,487,340	92,324	0	0	92,324	101,802
15	2030	1,602,386	0.06293	100,838	0.00000	0	325	325	650	152.47	99,106	199,944	0.10702	495,780	991,560	1,487,340	96,480	0	0	96,480	103,464
16	2031	1,602,386	0.06482	103,867	0.00000	0	325	325	650	157.04	102,076	205,943	0.11184	495,780	991,560	1,487,340	100,825	0	0	100,825	105,118
17	2032	1,602,386	0.06676	106,975	0.00000	0	325	325	650	161.75	105,138	212,113	0.11687	495,780	991,560	1,487,340	105,360	0	0	105,360	106,753
18	2033	1,602,386	0.06876	110,180	0.00000	0	325	325	650	166.61	108,297	218,477	0.12213	495,780	991,560	1,487,340	110,102	0	0	110,102	108,375
19	2034	1,201,789	0.07082	85,111	0.00000	0	244	244	488	171.60	83,741	168,852	0.12762	371,835	743,670	1,115,505	86,288	0	0	86,288	82,564
20	2035	667,661	0.07294	48,699	0.00000	0	136	136	272	176.75	48,076	96,775	0.13337	206,575	413,150	619,725	50,098	0	0	50,098	46,677

Total = 28,842,947 11,702 NPV = \$3,162,591 26,772,120 \$1,684,374 \$1,478,217  
\$800,286 \$1,343,306 543,020

Total NPV = \$543,020  
Benefit/Cost Ratio = 1.68

Worksheet Calculations	
(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Commerical Lighting**  
Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$14,301	\$0	\$16,330	\$30,631	\$57,062	\$57,062	(\$26,431)
2017	35,426	0	39,452	74,878	69,058	69,058	5,820
2018	62,493	0	69,511	132,004	84,558	84,558	47,446
2019	64,095	0	71,598	135,693	0	0	135,693
2020	68,101	0	73,743	141,844	0	0	141,844
2021	71,627	0	75,953	147,580	0	0	147,580
2022	76,594	0	78,234	154,828	0	0	154,828
2023	79,318	0	80,581	159,899	0	0	159,899
2024	84,446	0	82,999	167,445	0	0	167,445
2025	86,978	0	85,488	172,466	0	0	172,466
2026	89,589	0	88,056	177,645	0	0	177,645
2027	92,281	0	90,695	182,976	0	0	182,976
2028	95,054	0	93,418	188,472	0	0	188,472
2029	97,906	0	96,220	194,126	0	0	194,126
2030	100,838	0	99,106	199,944	0	0	199,944
2031	103,867	0	102,076	205,943	0	0	205,943
2032	106,975	0	105,138	212,113	0	0	212,113
2033	110,180	0	108,297	218,477	0	0	218,477
2034	85,111	0	83,741	168,852	0	0	168,852
2035	48,699	0	48,076	96,775	0	0	96,775
Total =				\$3,162,591		\$210,678	\$2,951,913
NPV =				\$1,343,306		\$190,446	1,152,860
Total NPV =		\$1,152,860					
Benefit/Cost Ratio =		7.05					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Commerical Lighting**  
Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$14,301	\$0	\$16,330	\$9,686	\$40,317	\$57,062	\$34,275	\$91,337	(\$51,020)
2017	35,426	0	39,452	24,387	99,265	69,058	45,700	114,758	(15,493)
2018	62,493	0	69,511	44,283	176,287	84,558	57,125	141,683	34,604
2019	64,095	0	71,598	46,886	182,579	0	0	0	182,579
2020	68,101	0	73,743	50,482	192,326	0	0	0	192,326
2021	71,627	0	75,953	54,099	201,679	0	0	0	201,679
2022	76,594	0	78,234	58,459	213,287	0	0	0	213,287
2023	79,318	0	80,581	62,184	222,083	0	0	0	222,083
2024	84,446	0	82,999	67,073	234,518	0	0	0	234,518
2025	86,978	0	85,488	71,156	243,622	0	0	0	243,622
2026	89,589	0	88,056	75,492	253,137	0	0	0	253,137
2027	92,281	0	90,695	80,090	263,066	0	0	0	263,066
2028	95,054	0	93,418	84,971	273,443	0	0	0	273,443
2029	97,906	0	96,220	90,145	284,271	0	0	0	284,271
2030	100,838	0	99,106	95,632	295,576	0	0	0	295,576
2031	103,867	0	102,076	101,457	307,400	0	0	0	307,400
2032	106,975	0	105,138	107,631	319,744	0	0	0	319,744
2033	110,180	0	108,297	114,186	332,663	0	0	0	332,663
2034	85,111	0	83,741	90,897	259,749	0	0	0	259,749
2035	48,699	0	48,076	53,659	150,434	0	0	0	150,434
Total =					\$4,545,446			\$347,778	\$4,197,668
NPV =					\$3,233,237			\$335,058	2,898,179
Total NPV =		\$2,898,179							
Benefit/Cost Ratio =		<u>9.65</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Commerical Lighting**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$45,900	\$0.08965	\$0.07255	123,945	247,890	371,835	\$29,096	72	72	\$47,025	\$68,970	\$8,352	\$0	\$83,348	\$81,562	\$0	\$81,562	\$1,786
2017	61,200	0.09368	0.07582	289,205	578,410	867,615	70,948	168	168	49,141	72,074	20,364	0	152,512	110,631	0	110,631	41,881
2018	76,500	0.09790	0.07923	495,780	991,560	1,487,340	127,098	288	288	51,352	75,317	36,481	0	240,079	140,681	0	140,681	99,398
2019	0	0.10231	0.08280	495,780	991,560	1,487,340	132,824	288	288	53,663	78,706	38,122	0	170,946	0	0	0	170,946
2020	0	0.10691	0.08652	495,780	991,560	1,487,340	138,794	288	288	56,078	82,248	39,838	0	178,632	0	0	0	178,632
2021	0	0.11172	0.09042	495,780	991,560	1,487,340	145,045	288	288	58,602	85,949	41,631	0	186,676	0	0	0	186,676
2022	0	0.11675	0.09448	495,780	991,560	1,487,340	151,565	288	288	61,239	89,817	43,504	0	195,069	0	0	0	195,069
2023	0	0.12200	0.09874	495,780	991,560	1,487,340	158,392	288	288	63,995	93,859	45,462	0	203,854	0	0	0	203,854
2024	0	0.12749	0.10318	495,780	991,560	1,487,340	165,516	288	288	66,874	98,082	47,507	0	213,023	0	0	0	213,023
2025	0	0.13323	0.10782	495,780	991,560	1,487,340	172,963	288	288	69,884	102,496	49,645	0	222,608	0	0	0	222,608
2026	0	0.13922	0.11267	495,780	991,560	1,487,340	180,742	288	288	73,028	107,108	51,879	0	232,621	0	0	0	232,621
2027	0	0.14549	0.11775	495,780	991,560	1,487,340	188,887	288	288	76,315	111,928	54,214	0	243,101	0	0	0	243,101
2028	0	0.15204	0.12304	495,780	991,560	1,487,340	197,380	288	288	79,749	116,965	56,654	0	254,034	0	0	0	254,034
2029	0	0.15888	0.12858	495,780	991,560	1,487,340	206,264	288	288	83,338	122,228	59,203	0	265,467	0	0	0	265,467
2030	0	0.16603	0.13437	495,780	991,560	1,487,340	215,550	288	288	87,088	127,729	61,867	0	277,417	0	0	0	277,417
2031	0	0.17350	0.14041	495,780	991,560	1,487,340	225,243	288	288	91,007	133,476	64,651	0	289,894	0	0	0	289,894
2032	0	0.18131	0.14673	495,780	991,560	1,487,340	235,381	288	288	95,102	139,483	67,560	0	302,941	0	0	0	302,941
2033	0	0.18947	0.15333	495,780	991,560	1,487,340	245,971	288	288	99,382	145,760	70,601	0	316,572	0	0	0	316,572
2034	0	0.19799	0.16023	371,835	743,670	1,115,505	192,778	216	216	103,854	152,319	55,333	0	248,111	0	0	0	248,111
2035	0	0.20690	0.16745	206,575	413,150	619,725	111,922	120	120	108,527	159,173	32,124	0	144,046	0	0	0	144,046

Total = 8,924,040 17,848,080 5,184 5,184 \$4,420,951 \$332,874 \$4,088,077  
 NPV = \$1,839,004 \$297,737 1,541,268

Total NPV = \$1,541,268  
 Benefit/Cost Ratio = 6.18

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Commerical Lighting**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$14,301	\$16,330	\$30,631	\$57,062	\$34,275	\$91,337	(\$60,706)
2017	35,426	39,452	74,878	69,058	45,700	114,758	(39,880)
2018	62,493	69,511	132,004	84,558	57,125	141,683	(9,679)
2019	64,095	71,598	135,693	0	0	0	135,693
2020	68,101	73,743	141,844	0	0	0	141,844
2021	71,627	75,953	147,580	0	0	0	147,580
2022	76,594	78,234	154,828	0	0	0	154,828
2023	79,318	80,581	159,899	0	0	0	159,899
2024	84,446	82,999	167,445	0	0	0	167,445
2025	86,978	85,488	172,466	0	0	0	172,466
2026	89,589	88,056	177,645	0	0	0	177,645
2027	92,281	90,695	182,976	0	0	0	182,976
2028	95,054	93,418	188,472	0	0	0	188,472
2029	97,906	96,220	194,126	0	0	0	194,126
2030	100,838	99,106	199,944	0	0	0	199,944
2031	103,867	102,076	205,943	0	0	0	205,943
2032	106,975	105,138	212,113	0	0	0	212,113
2033	110,180	108,297	218,477	0	0	0	218,477
2034	85,111	83,741	168,852	0	0	0	168,852
2035	48,699	48,076	96,775	0	0	0	96,775
Total =			\$3,162,591			\$347,778	\$2,814,813
NPV =			\$1,343,306			\$313,962	1,029,345

Total NPV = \$1,029,345  
Benefit/Cost Ratio = 4.28

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
SOUTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Commerical Lighting**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.07621			
Retail Rate Winter (\$/kWh) =	\$0.07438			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00815			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$20.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$40.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.03409			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$3,613	\$2,441	\$3,160
Incentive Costs =		6,120	9,180	15,300
Total Utility Project Costs =		\$9,733	\$11,621	\$18,460
14) Direct Participant Costs (\$/Part.) =		\$5,345	\$5,345	\$5,345
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		18	18	18
16) Avg Summer kW/part. Saved =		4,800	4,800	4,800
16a) Avg Winter kW/part Saved =		4,800	4,800	4,800
17) Avg. Summer kWh/Part. Saved =		8,263	8,263	8,263
17a) Avg. Winter kWh/Part. Saved =		16,526	16,526	16,526
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		2	3	5
20) Incentive/Participant =		\$3,060	\$3,060	\$3,060
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		16,526	24,789	41,315
Annual Winter Kwh Saved		33,052	49,578	82,630
23) Annual Summer KW Saved		10	14	24
Annual Winter KW Saved		10	14	24
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$123,873	2.26	
Utility Cost Test		\$186,128	6.21	
Societal Test		\$478,465	8.95	
Participant Test		\$226,995	5.62	
Total Resource Cost Test		\$165,794	3.96	



**Table 2  
Utility Test**

Project: **Commerical Lighting**  
Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$1,907	\$0	\$2,218	\$4,125	\$9,733	\$9,733	(\$5,608)
2017	5,061	0	5,606	10,667	11,621	11,621	(954)
2018	10,415	0	11,550	21,965	18,460	18,460	3,505
2019	10,683	0	11,896	22,579	0	0	22,579
2020	11,350	0	12,253	23,603	0	0	23,603
2021	11,938	0	12,620	24,558	0	0	24,558
2022	12,766	0	12,999	25,765	0	0	25,765
2023	13,220	0	13,389	26,609	0	0	26,609
2024	14,074	0	13,791	27,865	0	0	27,865
2025	14,496	0	14,204	28,700	0	0	28,700
2026	14,932	0	14,631	29,563	0	0	29,563
2027	15,380	0	15,069	30,449	0	0	30,449
2028	15,842	0	15,522	31,364	0	0	31,364
2029	16,318	0	15,987	32,305	0	0	32,305
2030	16,806	0	16,467	33,273	0	0	33,273
2031	17,311	0	16,960	34,271	0	0	34,271
2032	17,829	0	17,469	35,298	0	0	35,298
2033	18,363	0	17,994	36,357	0	0	36,357
2034	15,131	0	14,758	29,889	0	0	29,889
2035	9,740	0	9,545	19,285	0	0	19,285
Total =				\$528,490		\$39,814	\$488,676
NPV =				\$221,828		\$35,700	186,128
Total NPV =		\$186,128					
Benefit/Cost Ratio =		6.21					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Commerical Lighting**  
Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$1,907	\$0	\$2,218	\$1,304	\$5,429	\$9,733	\$4,570	\$14,303	(\$8,874)
2017	5,061	0	5,606	3,474	14,141	11,621	6,855	18,476	(4,335)
2018	10,415	0	11,550	7,369	29,334	18,460	11,425	29,885	(551)
2019	10,683	0	11,896	7,802	30,381	0	0	0	30,381
2020	11,350	0	12,253	8,400	32,003	0	0	0	32,003
2021	11,938	0	12,620	9,002	33,560	0	0	0	33,560
2022	12,766	0	12,999	9,728	35,493	0	0	0	35,493
2023	13,220	0	13,389	10,348	36,957	0	0	0	36,957
2024	14,074	0	13,791	11,162	39,027	0	0	0	39,027
2025	14,496	0	14,204	11,841	40,541	0	0	0	40,541
2026	14,932	0	14,631	12,563	42,126	0	0	0	42,126
2027	15,380	0	15,069	13,328	43,777	0	0	0	43,777
2028	15,842	0	15,522	14,140	45,504	0	0	0	45,504
2029	16,318	0	15,987	15,001	47,306	0	0	0	47,306
2030	16,806	0	16,467	15,914	49,187	0	0	0	49,187
2031	17,311	0	16,960	16,883	51,154	0	0	0	51,154
2032	17,829	0	17,469	17,911	53,209	0	0	0	53,209
2033	18,363	0	17,994	19,002	55,359	0	0	0	55,359
2034	15,131	0	14,758	16,090	45,979	0	0	0	45,979
2035	9,740	0	9,545	10,693	29,978	0	0	0	29,978
Total =					\$760,445		\$62,664	\$697,781	
NPV =					\$538,631		\$60,166	478,465	
Total NPV =		\$478,465							
Benefit/Cost Ratio =		<u>8.95</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Commerical Lighting**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$6,120	\$0.07964	\$0.07773	16,526	33,052	49,578	\$3,885	10	10	\$20.900	\$41.800	\$627	\$0	\$10,632	\$10,875	\$0	\$10,875	(\$243)
2017	9,180	0.08322	0.08122	41,315	82,630	123,945	10,149	24	24	21.841	43.681	1,573	0	20,902	16,595	0	16,595	4,307
2018	15,300	0.08697	0.08488	82,630	165,260	247,890	21,214	48	48	22.823	45.647	3,287	0	39,801	28,136	0	28,136	11,665
2019	0	0.09088	0.08870	82,630	165,260	247,890	22,168	48	48	23.850	47.701	3,434	0	25,602	0	0	0	25,602
2020	0	0.09497	0.09269	82,630	165,260	247,890	23,165	48	48	24.924	49.847	3,589	0	26,754	0	0	0	26,754
2021	0	0.09925	0.09686	82,630	165,260	247,890	24,208	48	48	26.045	52.090	3,750	0	27,958	0	0	0	27,958
2022	0	0.10371	0.10122	82,630	165,260	247,890	25,297	48	48	27.217	54.434	3,919	0	29,216	0	0	0	29,216
2023	0	0.10838	0.10578	82,630	165,260	247,890	26,437	48	48	28.442	56.884	4,096	0	30,533	0	0	0	30,533
2024	0	0.11326	0.11054	82,630	165,260	247,890	27,627	48	48	29.722	59.444	4,280	0	31,907	0	0	0	31,907
2025	0	0.11835	0.11551	82,630	165,260	247,890	28,868	48	48	31.059	62.119	4,473	0	33,341	0	0	0	33,341
2026	0	0.12368	0.12071	82,630	165,260	247,890	30,168	48	48	32.457	64.914	4,674	0	34,842	0	0	0	34,842
2027	0	0.12924	0.12614	82,630	165,260	247,890	31,525	48	48	33.918	67.835	4,884	0	36,409	0	0	0	36,409
2028	0	0.13506	0.13182	82,630	165,260	247,890	32,945	48	48	35.444	70.888	5,104	0	38,049	0	0	0	38,049
2029	0	0.14114	0.13775	82,630	165,260	247,890	34,427	48	48	37.039	74.078	5,334	0	39,761	0	0	0	39,761
2030	0	0.14749	0.14395	82,630	165,260	247,890	35,976	48	48	38.706	77.411	5,574	0	41,550	0	0	0	41,550
2031	0	0.15412	0.15042	82,630	165,260	247,890	37,593	48	48	40.447	80.895	5,824	0	43,417	0	0	0	43,417
2032	0	0.16106	0.15719	82,630	165,260	247,890	39,286	48	48	42.268	84.535	6,087	0	45,373	0	0	0	45,373
2033	0	0.16831	0.16427	82,630	165,260	247,890	41,055	48	48	44.170	88.339	6,360	0	47,415	0	0	0	47,415
2034	0	0.17588	0.17166	66,104	132,208	198,312	34,321	38	38	46.157	92.314	5,262	0	39,583	0	0	0	39,583
2035	0	0.18380	0.17938	41,315	82,630	123,945	22,416	24	24	48.234	96.469	3,473	0	25,889	0	0	0	25,889
Total =				1,487,340	2,974,680			864	864					\$668,934		\$55,606	\$613,328	
														NPV = \$276,086		\$49,091	226,995	

Total NPV = \$226,995  
 Benefit/Cost Ratio = 5.62

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Commerical Lighting**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$1,907	\$2,218	\$4,125	\$9,733	\$4,570	\$14,303	(\$10,178)
2017	5,061	5,606	10,667	11,621	6,855	18,476	(7,809)
2018	10,415	11,550	21,965	18,460	11,425	29,885	(7,920)
2019	10,683	11,896	22,579	0	0	0	22,579
2020	11,350	12,253	23,603	0	0	0	23,603
2021	11,938	12,620	24,558	0	0	0	24,558
2022	12,766	12,999	25,765	0	0	0	25,765
2023	13,220	13,389	26,609	0	0	0	26,609
2024	14,074	13,791	27,865	0	0	0	27,865
2025	14,496	14,204	28,700	0	0	0	28,700
2026	14,932	14,631	29,563	0	0	0	29,563
2027	15,380	15,069	30,449	0	0	0	30,449
2028	15,842	15,522	31,364	0	0	0	31,364
2029	16,318	15,987	32,305	0	0	0	32,305
2030	16,806	16,467	33,273	0	0	0	33,273
2031	17,311	16,960	34,271	0	0	0	34,271
2032	17,829	17,469	35,298	0	0	0	35,298
2033	18,363	17,994	36,357	0	0	0	36,357
2034	15,131	14,758	29,889	0	0	0	29,889
2035	9,740	9,545	19,285	0	0	0	19,285
Total =			\$528,490			\$62,664	\$465,826
NPV =			\$221,828			\$56,034	165,794

Total NPV = \$165,794  
Benefit/Cost Ratio = 3.96

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Commercial Motors - Replacement**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.06569			
Retail Rate Winter (\$/kWh) =	\$0.05369			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00418			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$38.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$68.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.04381			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$795	\$673	\$853
Incentive Costs =		1,875	3,750	5,625
Total Utility Project Costs =		\$2,670	\$4,423	\$6,478
14) Direct Participant Costs (\$/Part.) =		\$4,719	\$4,719	\$4,719
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		20	20	20
16) Avg Summer kW/part. Saved =		0.270	0.270	0.270
16a) Avg Winter kW/part Saved =		0.270	0.270	0.270
17) Avg. Summer kWh/Part. Saved =		727	727	727
17a) Avg. Winter kWh/Part. Saved =		1,453	1,453	1,453
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		5	10	15
20) Incentive/Participant =		\$375	\$375	\$375
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		3,635	7,270	10,905
Annual Winter Kwh Saved		7,265	14,530	21,795
23) Annual Summer KW Saved		1	3	4
Annual Winter KW Saved		1	3	4
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$15,031	1.45	
Utility Cost Test		\$36,598	4.03	
Societal Test		(\$17,061)	0.88	
Participant Test		(\$65,098)	0.50	
Total Resource Cost Test		(\$78,988)	0.38	

**Table 1  
Ratepayer Impact Test**

Project: **Commercial Motors - Replacement**  
 Program Years: **2016 - 2018**

t	Year											Costs					Annual Benefits Less Costs (P)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)		Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)
1	2016	11,743	\$0.03570	\$419	\$0.00000	\$0	2	2	4	\$100.80	\$403	\$822	\$0.04578	3,635	7,265	10,900	\$302	\$795	\$1,875	\$2,972	(\$2,150)
2	2017	35,230	0.03790	1,335	0.00000	0	5	5	10	103.82	1,038	2,373	0.04784	10,905	21,795	32,700	948	673	3,750	5,371	(2,998)
3	2018	70,459	0.03900	2,748	0.00000	0	9	9	18	106.94	1,925	4,673	0.04999	21,810	43,590	65,400	1,982	853	5,625	8,460	(3,787)
4	2019	70,459	0.04000	2,818	0.00000	0	9	9	18	110.15	1,983	4,801	0.05224	21,810	43,590	65,400	2,071	0	0	2,071	2,730
5	2020	70,459	0.04250	2,995	0.00000	0	9	9	18	113.45	2,042	5,037	0.05460	21,810	43,590	65,400	2,164	0	0	2,164	2,873
6	2021	70,459	0.04470	3,150	0.00000	0	9	9	18	116.85	2,103	5,253	0.05705	21,810	43,590	65,400	2,261	0	0	2,261	2,992
7	2022	70,459	0.04780	3,368	0.00000	0	9	9	18	120.36	2,166	5,534	0.05962	21,810	43,590	65,400	2,363	0	0	2,363	3,171
8	2023	70,459	0.04950	3,488	0.00000	0	9	9	18	123.97	2,231	5,719	0.06230	21,810	43,590	65,400	2,470	0	0	2,470	3,249
9	2024	70,459	0.05270	3,713	0.00000	0	9	9	18	127.69	2,298	6,011	0.06511	21,810	43,590	65,400	2,581	0	0	2,581	3,430
10	2025	70,459	0.05428	3,825	0.00000	0	9	9	18	131.52	2,367	6,192	0.06804	21,810	43,590	65,400	2,697	0	0	2,697	3,495
11	2026	70,459	0.05591	3,939	0.00000	0	9	9	18	135.47	2,438	6,377	0.07110	21,810	43,590	65,400	2,818	0	0	2,818	3,559
12	2027	70,459	0.05759	4,058	0.00000	0	9	9	18	139.53	2,512	6,570	0.07430	21,810	43,590	65,400	2,945	0	0	2,945	3,625
13	2028	70,459	0.05932	4,180	0.00000	0	9	9	18	143.72	2,587	6,767	0.07764	21,810	43,590	65,400	3,078	0	0	3,078	3,689
14	2029	70,459	0.06110	4,305	0.00000	0	9	9	18	148.03	2,665	6,970	0.08113	21,810	43,590	65,400	3,216	0	0	3,216	3,754
15	2030	70,459	0.06293	4,434	0.00000	0	9	9	18	152.47	2,744	7,178	0.08478	21,810	43,590	65,400	3,361	0	0	3,361	3,817
16	2031	70,459	0.06482	4,567	0.00000	0	9	9	18	157.04	2,827	7,394	0.08860	21,810	43,590	65,400	3,512	0	0	3,512	3,882
17	2032	70,459	0.06676	4,704	0.00000	0	9	9	18	161.75	2,912	7,616	0.09259	21,810	43,590	65,400	3,670	0	0	3,670	3,946
18	2033	70,459	0.06876	4,845	0.00000	0	9	9	18	166.61	2,999	7,844	0.09675	21,810	43,590	65,400	3,835	0	0	3,835	4,009
19	2034	70,459	0.07082	4,990	0.00000	0	9	9	18	171.60	3,089	8,079	0.10111	21,810	43,590	65,400	4,008	0	0	4,008	4,071
20	2035	70,459	0.07294	5,139	0.00000	0	9	9	18	176.75	3,182	8,321	0.10566	21,810	43,590	65,400	4,188	0	0	4,188	4,133
Total =		1,315,235							338			\$119,531				1,220,800			\$68,041	\$51,490	
												NPV =	\$48,695							\$33,664	15,031
Total NPV =			\$15,031																		
Benefit/Cost Ratio =			1.45																		

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (B) = Avg. System Marginal Energy Cost (2), escalated  
 (C) = (C) x (D)  
 (D) = System Variable O&M Savings (6), escalated  
 (E) = (C) x (F)  
 (F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity  
 (H) = (F) + (G)  
 (I) = (C) + (E) + (H)  
 (J) = Electric Margin (4), escalated

(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)  
 (L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)  
 (M) = Program Admin Costs (13)  
 (N) = Incentive/Participant (20) x Number of Participants (19)  
 (O) = (L) + (M) + (N)  
 (P) = (I) - (O)

**Table 2  
Utility Test**

Project: **Commercial Motors - Replacement**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$419	\$0	\$403	\$822	\$2,670	\$2,670	(\$1,848)
2017	1,335	0	1,038	2,373	4,423	4,423	(2,050)
2018	2,748	0	1,925	4,673	6,478	6,478	(1,805)
2019	2,818	0	1,983	4,801	0	0	4,801
2020	2,995	0	2,042	5,037	0	0	5,037
2021	3,150	0	2,103	5,253	0	0	5,253
2022	3,368	0	2,166	5,534	0	0	5,534
2023	3,488	0	2,231	5,719	0	0	5,719
2024	3,713	0	2,298	6,011	0	0	6,011
2025	3,825	0	2,367	6,192	0	0	6,192
2026	3,939	0	2,438	6,377	0	0	6,377
2027	4,058	0	2,512	6,570	0	0	6,570
2028	4,180	0	2,587	6,767	0	0	6,767
2029	4,305	0	2,665	6,970	0	0	6,970
2030	4,434	0	2,744	7,178	0	0	7,178
2031	4,567	0	2,827	7,394	0	0	7,394
2032	4,704	0	2,912	7,616	0	0	7,616
2033	4,845	0	2,999	7,844	0	0	7,844
2034	4,990	0	3,089	8,079	0	0	8,079
2035	5,139	0	3,182	8,321	0	0	8,321
Total =				\$119,531		\$13,571	\$105,960
NPV =				\$48,695		\$12,097	36,598
Total NPV =		\$36,598					
Benefit/Cost Ratio =		<u>4.03</u>					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Commercial Motors - Replacement**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$419	\$0	\$403	\$260	\$1,082	\$2,670	\$21,720	\$24,390	(\$23,308)
2017	1,335	0	1,038	773	3,146	4,423	43,440	47,863	(44,717)
2018	2,748	0	1,925	1,568	6,241	6,478	65,160	71,638	(65,397)
2019	2,818	0	1,983	1,659	6,460	0	0	0	6,460
2020	2,995	0	2,042	1,793	6,830	0	0	0	6,830
2021	3,150	0	2,103	1,926	7,179	0	0	0	7,179
2022	3,368	0	2,166	2,089	7,623	0	0	0	7,623
2023	3,488	0	2,231	2,224	7,943	0	0	0	7,943
2024	3,713	0	2,298	2,408	8,419	0	0	0	8,419
2025	3,825	0	2,367	2,555	8,747	0	0	0	8,747
2026	3,939	0	2,438	2,710	9,087	0	0	0	9,087
2027	4,058	0	2,512	2,876	9,446	0	0	0	9,446
2028	4,180	0	2,587	3,051	9,818	0	0	0	9,818
2029	4,305	0	2,665	3,237	10,207	0	0	0	10,207
2030	4,434	0	2,744	3,433	10,611	0	0	0	10,611
2031	4,567	0	2,827	3,643	11,037	0	0	0	11,037
2032	4,704	0	2,912	3,865	11,481	0	0	0	11,481
2033	4,845	0	2,999	4,100	11,944	0	0	0	11,944
2034	4,990	0	3,089	4,349	12,428	0	0	0	12,428
2035	5,139	0	3,182	4,614	12,935	0	0	0	12,935
Total =					\$172,664		\$143,891	\$28,773	\$28,773
				NPV =	\$120,727		\$137,788	(17,061)	(17,061)
Total NPV =		(\$17,061)							
Benefit/Cost Ratio =		<u>0.88</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Commercial Motors - Replacement**  
 Program Years: **2016 - 2018**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings (J)	Other Participant Savings (K)	Total Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$1,875	\$0.06865	\$0.05611	3,635	7,265	10,900	\$657	1	1	\$39.710	\$71.060	\$111	\$0	\$2,643	\$24,003	\$0	\$24,003	(\$21,360)
2017	3,750	0.07174	0.05863	10,905	21,795	32,700	2,060	4	4	41.497	74.258	463	0	6,273	48,837	0	48,837	(42,564)
2018	5,625	0.07496	0.06127	21,810	43,590	65,400	4,306	8	8	43.364	77.599	968	0	10,899	74,523	0	74,523	(63,624)
2019	0	0.07834	0.06403	21,810	43,590	65,400	4,500	8	8	45.316	81.091	1,011	0	5,511	0	0	0	5,511
2020	0	0.08186	0.06691	21,810	43,590	65,400	4,702	8	8	47.355	84.740	1,057	0	5,759	0	0	0	5,759
2021	0	0.08555	0.06992	21,810	43,590	65,400	4,914	8	8	49.486	88.554	1,104	0	6,018	0	0	0	6,018
2022	0	0.08940	0.07306	21,810	43,590	65,400	5,134	8	8	51.713	92.539	1,154	0	6,288	0	0	0	6,288
2023	0	0.09342	0.07635	21,810	43,590	65,400	5,366	8	8	54.040	96.703	1,206	0	6,572	0	0	0	6,572
2024	0	0.09762	0.07979	21,810	43,590	65,400	5,607	8	8	56.472	101.054	1,260	0	6,867	0	0	0	6,867
2025	0	0.10201	0.08338	21,810	43,590	65,400	5,859	8	8	59.013	105.602	1,317	0	7,176	0	0	0	7,176
2026	0	0.10661	0.08713	21,810	43,590	65,400	6,123	8	8	61.668	110.354	1,376	0	7,499	0	0	0	7,499
2027	0	0.11140	0.09105	21,810	43,590	65,400	6,399	8	8	64.443	115.320	1,438	0	7,837	0	0	0	7,837
2028	0	0.11642	0.09515	21,810	43,590	65,400	6,687	8	8	67.343	120.509	1,503	0	8,190	0	0	0	8,190
2029	0	0.12165	0.09943	21,810	43,590	65,400	6,987	8	8	70.374	125.932	1,570	0	8,557	0	0	0	8,557
2030	0	0.12713	0.10391	21,810	43,590	65,400	7,302	8	8	73.541	131.599	1,641	0	8,943	0	0	0	8,943
2031	0	0.13285	0.10858	21,810	43,590	65,400	7,630	8	8	76.850	137.521	1,715	0	9,345	0	0	0	9,345
2032	0	0.13883	0.11347	21,810	43,590	65,400	7,974	8	8	80.308	143.710	1,792	0	9,766	0	0	0	9,766
2033	0	0.14507	0.11857	21,810	43,590	65,400	8,332	8	8	83.922	150.177	1,873	0	10,205	0	0	0	10,205
2034	0	0.15160	0.12391	21,810	43,590	65,400	8,708	8	8	87.699	156.935	1,957	0	10,665	0	0	0	10,665
2035	0	0.15843	0.12948	21,810	43,590	65,400	9,099	8	8	91.645	163.997	2,045	0	11,144	0	0	0	11,144
Total =				407,120	813,680			149	149					\$156,157			\$147,363	\$8,794
														NPV = \$64,558			\$129,655	(65,098)
Total NPV =																		(\$65,098)
Benefit/Cost Ratio =																		0.50

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Commercial Motors - Replacement**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)	
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)		
2016	\$419	\$403	\$822	\$2,670	\$21,720	\$24,390	(\$23,568)	
2017	1,335	1,038	2,373	4,423	43,440	47,863	(45,490)	
2018	2,748	1,925	4,673	6,478	65,160	71,638	(66,965)	
2019	2,818	1,983	4,801	0	0	0	4,801	
2020	2,995	2,042	5,037	0	0	0	5,037	
2021	3,150	2,103	5,253	0	0	0	5,253	
2022	3,368	2,166	5,534	0	0	0	5,534	
2023	3,488	2,231	5,719	0	0	0	5,719	
2024	3,713	2,298	6,011	0	0	0	6,011	
2025	3,825	2,367	6,192	0	0	0	6,192	
2026	3,939	2,438	6,377	0	0	0	6,377	
2027	4,058	2,512	6,570	0	0	0	6,570	
2028	4,180	2,587	6,767	0	0	0	6,767	
2029	4,305	2,665	6,970	0	0	0	6,970	
2030	4,434	2,744	7,178	0	0	0	7,178	
2031	4,567	2,827	7,394	0	0	0	7,394	
2032	4,704	2,912	7,616	0	0	0	7,616	
2033	4,845	2,999	7,844	0	0	0	7,844	
2034	4,990	3,089	8,079	0	0	0	8,079	
2035	5,139	3,182	8,321	0	0	0	8,321	
Total =			\$119,531				\$143,891	(\$24,360)
NPV =			\$48,695				\$127,684	(78,988)

Total NPV = (\$78,988)  
Benefit/Cost Ratio = 0.38

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
NORTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Commercial Motors - Replacement**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.08579			
Retail Rate Winter (\$/kWh) =	\$0.06943			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00496			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$45.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$66.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05530			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	8.70%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$912	\$722	\$790
Incentive Costs =		3,750	5,625	7,500
Total Utility Project Costs =		\$4,662	\$6,347	\$8,290
14) Direct Participant Costs (\$/Part.) =		\$4,719	\$4,719	\$4,719
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		20	20	20
16) Avg Summer kW/part. Saved =		0.270	0.270	0.270
16a) Avg Winter kW/part Saved =		0.270	0.270	0.270
17) Avg. Summer kWh/Part. Saved =		727	727	727
17a) Avg. Winter kWh/Part. Saved =		1,453	1,453	1,453
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		10	15	20
20) Incentive/Participant =		\$375	\$375	\$375
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		7,270	10,905	14,540
Annual Winter Kwh Saved		14,530	21,795	29,060
23) Annual Summer KW Saved		3	4	5
Annual Winter KW Saved		3	4	5
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$15,983	1.27	
Utility Cost Test		\$57,192	4.30	
Societal Test		(\$22,116)	0.89	
Participant Test		(\$77,474)	0.61	
Total Resource Cost Test		(\$118,008)	0.39	

**Table 1**  
**Ratepayer Impact Test**

Project: **Commercial Motors - Replacement**  
Program Years: **2016 - 2018**

t	Year											Costs					Annual Benefits Less Costs (P)					
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)		Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2016	23,486	\$0.03570	\$838	\$0.00000	\$0	3	3	6	\$100.80	\$605	\$1,443	\$0.05779	7,270	14,530	21,800	\$764	\$912	\$3,750	\$5,426	(\$3,983)	
2	2017	58,716	0.03790	2,225	0.00000	0	8	8	16	103.82	1,661	3,886	0.06039	18,175	36,325	54,500	1,995	722	5,625	8,342	(4,456)	
3	2018	105,689	0.03900	4,122	0.00000	0	14	14	28	106.94	2,994	7,116	0.06311	32,715	65,385	98,100	3,753	790	7,500	12,043	(4,927)	
4	2019	105,689	0.04000	4,228	0.00000	0	14	14	28	110.15	3,084	7,312	0.06595	32,715	65,385	98,100	3,921	0	0	3,921	3,391	
5	2020	105,689	0.04250	4,492	0.00000	0	14	14	28	113.45	3,177	7,669	0.06891	32,715	65,385	98,100	4,097	0	0	4,097	3,572	
6	2021	105,689	0.04470	4,724	0.00000	0	14	14	28	116.85	3,272	7,996	0.07201	32,715	65,385	98,100	4,282	0	0	4,282	3,714	
7	2022	105,689	0.04780	5,052	0.00000	0	14	14	28	120.36	3,370	8,422	0.07526	32,715	65,385	98,100	4,475	0	0	4,475	3,947	
8	2023	105,689	0.04950	5,232	0.00000	0	14	14	28	123.97	3,471	8,703	0.07864	32,715	65,385	98,100	4,676	0	0	4,676	4,027	
9	2024	105,689	0.05270	5,570	0.00000	0	14	14	28	127.69	3,575	9,145	0.08218	32,715	65,385	98,100	4,886	0	0	4,886	4,259	
10	2025	105,689	0.05428	5,737	0.00000	0	14	14	28	131.52	3,683	9,420	0.08588	32,715	65,385	98,100	5,106	0	0	5,106	4,314	
11	2026	105,689	0.05591	5,909	0.00000	0	14	14	28	135.47	3,793	9,702	0.08974	32,715	65,385	98,100	5,336	0	0	5,336	4,366	
12	2027	105,689	0.05759	6,087	0.00000	0	14	14	28	139.53	3,907	9,994	0.09378	32,715	65,385	98,100	5,576	0	0	5,576	4,418	
13	2028	105,689	0.05932	6,269	0.00000	0	14	14	28	143.72	4,024	10,293	0.09800	32,715	65,385	98,100	5,827	0	0	5,827	4,466	
14	2029	105,689	0.06110	6,458	0.00000	0	14	14	28	148.03	4,145	10,603	0.10241	32,715	65,385	98,100	6,089	0	0	6,089	4,514	
15	2030	105,689	0.06293	6,651	0.00000	0	14	14	28	152.47	4,269	10,920	0.10702	32,715	65,385	98,100	6,364	0	0	6,364	4,556	
16	2031	105,689	0.06482	6,851	0.00000	0	14	14	28	157.04	4,397	11,248	0.11184	32,715	65,385	98,100	6,650	0	0	6,650	4,598	
17	2032	105,689	0.06676	7,056	0.00000	0	14	14	28	161.75	4,529	11,585	0.11687	32,715	65,385	98,100	6,949	0	0	6,949	4,636	
18	2033	105,689	0.06876	7,267	0.00000	0	14	14	28	166.61	4,665	11,932	0.12213	32,715	65,385	98,100	7,262	0	0	7,262	4,670	
19	2034	105,689	0.07082	7,485	0.00000	0	14	14	28	171.60	4,805	12,290	0.12762	32,715	65,385	98,100	7,588	0	0	7,588	4,702	
20	2035	105,689	0.07294	7,709	0.00000	0	14	14	28	176.75	4,949	12,658	0.13337	32,715	65,385	98,100	7,930	0	0	7,930	4,728	
Total =		1,984,604						526				\$182,337				1,842,100				\$122,825	\$59,512	
												NPV =									\$58,562	15,983
Total NPV =												\$15,983										
Benefit/Cost Ratio =												1.27										

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (B) = Avg. System Marginal Energy Cost (2), escalated  
 (C) = (C) x (D)  
 (D) = System Variable O&M Savings (6), escalated  
 (E) = (C) x (F)  
 (F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity  
 (H) = (F) + (G)  
 (I) = (C) + (E) + (H)  
 (J) = Electric Margin (4), escalated

(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)  
 (L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)  
 (M) = Program Admin Costs (13)  
 (N) = Incentive/Participant (20) x Number of Participants (19)  
 (O) = (L) + (M) + (N)  
 (P) = (I) - (O)

**Table 2  
Utility Test**

Project: **Commercial Motors - Replacement**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$838	\$0	\$605	\$1,443	\$4,662	\$4,662	(\$3,219)
2017	2,225	0	1,661	3,886	6,347	6,347	(2,461)
2018	4,122	0	2,994	7,116	8,290	8,290	(1,174)
2019	4,228	0	3,084	7,312	0	0	7,312
2020	4,492	0	3,177	7,669	0	0	7,669
2021	4,724	0	3,272	7,996	0	0	7,996
2022	5,052	0	3,370	8,422	0	0	8,422
2023	5,232	0	3,471	8,703	0	0	8,703
2024	5,570	0	3,575	9,145	0	0	9,145
2025	5,737	0	3,683	9,420	0	0	9,420
2026	5,909	0	3,793	9,702	0	0	9,702
2027	6,087	0	3,907	9,994	0	0	9,994
2028	6,269	0	4,024	10,293	0	0	10,293
2029	6,458	0	4,145	10,603	0	0	10,603
2030	6,651	0	4,269	10,920	0	0	10,920
2031	6,851	0	4,397	11,248	0	0	11,248
2032	7,056	0	4,529	11,585	0	0	11,585
2033	7,267	0	4,665	11,932	0	0	11,932
2034	7,485	0	4,805	12,290	0	0	12,290
2035	7,709	0	4,949	12,658	0	0	12,658
Total =				\$182,337		\$19,299	\$163,038
NPV =				\$74,545		\$17,353	57,192
Total NPV =		\$57,192					
Benefit/Cost Ratio =		4.30					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Commercial Motors - Replacement**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$838	\$0	\$605	\$456	\$1,899	\$4,662	\$43,440	\$48,102	(\$46,203)
2017	2,225	0	1,661	1,266	5,152	6,347	65,160	71,507	(66,355)
2018	4,122	0	2,994	2,387	9,503	8,290	86,880	95,170	(85,667)
2019	4,228	0	3,084	2,527	9,839	0	0	0	9,839
2020	4,492	0	3,177	2,729	10,398	0	0	0	10,398
2021	4,724	0	3,272	2,931	10,927	0	0	0	10,927
2022	5,052	0	3,370	3,180	11,602	0	0	0	11,602
2023	5,232	0	3,471	3,385	12,088	0	0	0	12,088
2024	5,570	0	3,575	3,663	12,808	0	0	0	12,808
2025	5,737	0	3,683	3,887	13,307	0	0	0	13,307
2026	5,909	0	3,793	4,123	13,825	0	0	0	13,825
2027	6,087	0	3,907	4,374	14,368	0	0	0	14,368
2028	6,269	0	4,024	4,640	14,933	0	0	0	14,933
2029	6,458	0	4,145	4,924	15,527	0	0	0	15,527
2030	6,651	0	4,269	5,223	16,143	0	0	0	16,143
2031	6,851	0	4,397	5,541	16,789	0	0	0	16,789
2032	7,056	0	4,529	5,879	17,464	0	0	0	17,464
2033	7,267	0	4,665	6,236	18,168	0	0	0	18,168
2034	7,485	0	4,805	6,616	18,906	0	0	0	18,906
2035	7,709	0	4,949	7,019	19,677	0	0	0	19,677
Total =					\$263,323		\$214,779	\$48,544	
NPV =					\$184,299		\$206,415	(22,116)	
Total NPV =		(\$22,116)							
Benefit/Cost Ratio =		0.89							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Commercial Motors - Replacement**  
 Program Years: **2016 - 2018**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$3,750	\$0.08965	\$0.07255	7,270	14,530	21,800	\$1,706	3	3	\$47.025	\$68.970	\$348	\$0	\$5,804	\$48,006	\$0	\$48,006	(\$42,202)
2017	5,625	0.09368	0.07582	18,175	36,325	54,500	4,457	7	7	49.141	72.074	849	0	10,931	73,255	0	73,255	(62,324)
2018	7,500	0.09790	0.07923	32,715	65,385	98,100	8,383	12	12	51.352	75.317	1,520	0	17,403	99,364	0	99,364	(81,961)
2019	0	0.10231	0.08280	32,715	65,385	98,100	8,761	12	12	53.663	78.706	1,588	0	10,349	0	0	0	10,349
2020	0	0.10691	0.08652	32,715	65,385	98,100	9,155	12	12	56.078	82.248	1,660	0	10,815	0	0	0	10,815
2021	0	0.11172	0.09042	32,715	65,385	98,100	9,567	12	12	58.602	85.949	1,735	0	11,302	0	0	0	11,302
2022	0	0.11675	0.09448	32,715	65,385	98,100	9,997	12	12	61.239	89.817	1,813	0	11,810	0	0	0	11,810
2023	0	0.12200	0.09874	32,715	65,385	98,100	10,447	12	12	63.995	93.859	1,894	0	12,341	0	0	0	12,341
2024	0	0.12749	0.10318	32,715	65,385	98,100	10,917	12	12	66.874	98.082	1,979	0	12,896	0	0	0	12,896
2025	0	0.13323	0.10782	32,715	65,385	98,100	11,408	12	12	69.884	102.496	2,069	0	13,477	0	0	0	13,477
2026	0	0.13922	0.11267	32,715	65,385	98,100	11,922	12	12	73.028	107.108	2,162	0	14,084	0	0	0	14,084
2027	0	0.14549	0.11775	32,715	65,385	98,100	12,459	12	12	76.315	111.928	2,259	0	14,718	0	0	0	14,718
2028	0	0.15204	0.12304	32,715	65,385	98,100	13,019	12	12	79.749	116.965	2,361	0	15,380	0	0	0	15,380
2029	0	0.15888	0.12858	32,715	65,385	98,100	13,605	12	12	83.338	122.228	2,467	0	16,072	0	0	0	16,072
2030	0	0.16603	0.13437	32,715	65,385	98,100	14,217	12	12	87.088	127.729	2,578	0	16,795	0	0	0	16,795
2031	0	0.17350	0.14041	32,715	65,385	98,100	14,857	12	12	91.007	133.476	2,694	0	17,551	0	0	0	17,551
2032	0	0.18131	0.14673	32,715	65,385	98,100	15,525	12	12	95.102	139.483	2,815	0	18,340	0	0	0	18,340
2033	0	0.18947	0.15333	32,715	65,385	98,100	16,224	12	12	99.382	145.760	2,942	0	19,166	0	0	0	19,166
2034	0	0.19799	0.16023	32,715	65,385	98,100	16,954	12	12	103.854	152.319	3,074	0	20,028	0	0	0	20,028
2035	0	0.20690	0.16745	32,715	65,385	98,100	17,717	12	12	108.527	159.173	3,212	0	20,929	0	0	0	20,929
Total =				614,315	1,227,785			226	226					\$290,191			\$220,625	\$69,566
														NPV = \$118,786			\$196,260	(77,474)

Total NPV = (\$77,474)  
 Benefit/Cost Ratio = 0.61

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Commercial Motors - Replacement**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$838	\$605	\$1,443	\$4,662	\$43,440	\$48,102	(\$46,659)
2017	2,225	1,661	3,886	6,347	65,160	71,507	(67,621)
2018	4,122	2,994	7,116	8,290	86,880	95,170	(88,054)
2019	4,228	3,084	7,312	0	0	0	7,312
2020	4,492	3,177	7,669	0	0	0	7,669
2021	4,724	3,272	7,996	0	0	0	7,996
2022	5,052	3,370	8,422	0	0	0	8,422
2023	5,232	3,471	8,703	0	0	0	8,703
2024	5,570	3,575	9,145	0	0	0	9,145
2025	5,737	3,683	9,420	0	0	0	9,420
2026	5,909	3,793	9,702	0	0	0	9,702
2027	6,087	3,907	9,994	0	0	0	9,994
2028	6,269	4,024	10,293	0	0	0	10,293
2029	6,458	4,145	10,603	0	0	0	10,603
2030	6,651	4,269	10,920	0	0	0	10,920
2031	6,851	4,397	11,248	0	0	0	11,248
2032	7,056	4,529	11,585	0	0	0	11,585
2033	7,267	4,665	11,932	0	0	0	11,932
2034	7,485	4,805	12,290	0	0	0	12,290
2035	7,709	4,949	12,658	0	0	0	12,658
Total =			\$182,337			\$214,779	(\$32,442)
NPV =			\$74,545			\$192,553	(118,008)

Total NPV = (\$118,008)  
Benefit/Cost Ratio = 0.39

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
SOUTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Commercial Motors - Replacement**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.07621			
Retail Rate Winter (\$/kWh) =	\$0.07438			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00815			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$20.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$40.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.03409			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$221	\$199	\$232
Incentive Costs =		375	750	1,125
Total Utility Project Costs =		\$596	\$949	\$1,357
14) Direct Participant Costs (\$/Part.) =		\$4,719	\$4,719	\$4,719
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		20	20	20
16) Avg Summer kW/part. Saved =		0.270	0.270	0.270
16a) Avg Winter kW/part Saved =		0.270	0.270	0.270
17) Avg. Summer kWh/Part. Saved =		727	727	727
17a) Avg. Winter kWh/Part. Saved =		1,453	1,453	1,453
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		1	2	3
20) Incentive/Participant =		\$375	\$375	\$375
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		727	1,454	2,181
Annual Winter Kwh Saved		1,453	2,906	4,359
23) Annual Summer KW Saved		0	1	1
Annual Winter KW Saved		0	1	1

<b>Test Results</b>	<b>NPV</b>	<b>B/C</b>
Ratepayer Impact Measure Test	\$4,110	1.69
Utility Cost Test	\$7,467	3.88
Societal Test	(\$2,689)	0.90
Participant Test	(\$10,896)	0.58
Total Resource Cost Test	(\$15,650)	0.39

**Table 1**  
**Ratepayer Impact Test**

Project: **Commercial Motors - Replacement**  
Program Years: **2016 - 2018**

t	Year											Costs					Annual Benefits Less Costs (P)					
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)		Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2016	2,348	\$0.03570	\$84	\$0.00000	\$0	0	0	0	\$100.80	\$0	\$84	\$0.03562	727	1,453	2,180	\$47	\$221	\$375	\$643	(\$559)	
2	2017	7,046	0.03790	267	0.00000	0	1	1	2	103.82	208	475	0.03723	2,181	4,359	6,540	148	199	750	1,097	(622)	
3	2018	14,091	0.03900	550	0.00000	0	2	2	4	106.94	428	978	0.03890	4,362	8,718	13,080	308	232	1,125	1,665	(687)	
4	2019	14,091	0.04000	564	0.00000	0	2	2	4	110.15	441	1,005	0.04065	4,362	8,718	13,080	322	0	0	322	683	
5	2020	14,091	0.04250	599	0.00000	0	2	2	4	113.45	454	1,053	0.04248	4,362	8,718	13,080	337	0	0	337	716	
6	2021	14,091	0.04470	630	0.00000	0	2	2	4	116.85	467	1,097	0.04439	4,362	8,718	13,080	352	0	0	352	745	
7	2022	14,091	0.04780	674	0.00000	0	2	2	4	120.36	481	1,155	0.04639	4,362	8,718	13,080	368	0	0	368	787	
8	2023	14,091	0.04950	698	0.00000	0	2	2	4	123.97	496	1,194	0.04848	4,362	8,718	13,080	384	0	0	384	810	
9	2024	14,091	0.05270	743	0.00000	0	2	2	4	127.69	511	1,254	0.05066	4,362	8,718	13,080	402	0	0	402	852	
10	2025	14,091	0.05428	765	0.00000	0	2	2	4	131.52	526	1,291	0.05294	4,362	8,718	13,080	420	0	0	420	871	
11	2026	14,091	0.05591	788	0.00000	0	2	2	4	135.47	542	1,330	0.05532	4,362	8,718	13,080	439	0	0	439	891	
12	2027	14,091	0.05759	812	0.00000	0	2	2	4	139.53	558	1,370	0.05781	4,362	8,718	13,080	458	0	0	458	912	
13	2028	14,091	0.05932	836	0.00000	0	2	2	4	143.72	575	1,411	0.06041	4,362	8,718	13,080	479	0	0	479	932	
14	2029	14,091	0.06110	861	0.00000	0	2	2	4	148.03	592	1,453	0.06313	4,362	8,718	13,080	501	0	0	501	952	
15	2030	14,091	0.06293	887	0.00000	0	2	2	4	152.47	610	1,497	0.06597	4,362	8,718	13,080	523	0	0	523	974	
16	2031	14,091	0.06482	913	0.00000	0	2	2	4	157.04	628	1,541	0.06894	4,362	8,718	13,080	547	0	0	547	994	
17	2032	14,091	0.06676	941	0.00000	0	2	2	4	161.75	647	1,588	0.07205	4,362	8,718	13,080	571	0	0	571	1,017	
18	2033	14,091	0.06876	969	0.00000	0	2	2	4	166.61	666	1,635	0.07529	4,362	8,718	13,080	597	0	0	597	1,038	
19	2034	14,091	0.07082	998	0.00000	0	2	2	4	171.60	686	1,684	0.07867	4,362	8,718	13,080	624	0	0	624	1,060	
20	2035	14,091	0.07294	1,028	0.00000	0	2	2	4	176.75	707	1,735	0.08222	4,362	8,718	13,080	652	0	0	652	1,083	
Total =		263,032						74				\$24,830				244,160				\$11,381	\$13,449	
												NPV =	\$10,058								\$5,948	4,110
Total NPV =			\$4,110																			
Benefit/Cost Ratio =			1.69																			

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (B) = Avg. System Marginal Energy Cost (2), escalated  
 (C) = (C) x (D)  
 (D) = System Variable O&M Savings (6), escalated  
 (E) = (C) x (F)  
 (F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity  
 (H) = (F) + (G)  
 (I) = (C) + (E) + (H)  
 (J) = Electric Margin (4), escalated

(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)  
 (L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)  
 (M) = Program Admin Costs (13)  
 (N) = Incentive/Participant (20) x Number of Participants (19)  
 (O) = (L) + (M) + (N)  
 (P) = (I) - (O)

**Table 2  
Utility Test**

Project: **Commercial Motors - Replacement**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$84	\$0	\$0	\$84	\$596	\$596	(\$512)
2017	267	0	208	475	949	949	(474)
2018	550	0	428	978	1,357	1,357	(379)
2019	564	0	441	1,005	0	0	1,005
2020	599	0	454	1,053	0	0	1,053
2021	630	0	467	1,097	0	0	1,097
2022	674	0	481	1,155	0	0	1,155
2023	698	0	496	1,194	0	0	1,194
2024	743	0	511	1,254	0	0	1,254
2025	765	0	526	1,291	0	0	1,291
2026	788	0	542	1,330	0	0	1,330
2027	812	0	558	1,370	0	0	1,370
2028	836	0	575	1,411	0	0	1,411
2029	861	0	592	1,453	0	0	1,453
2030	887	0	610	1,497	0	0	1,497
2031	913	0	628	1,541	0	0	1,541
2032	941	0	647	1,588	0	0	1,588
2033	969	0	666	1,635	0	0	1,635
2034	998	0	686	1,684	0	0	1,684
2035	1,028	0	707	1,735	0	0	1,735
Total =				\$24,830		\$2,902	\$21,928
NPV =				\$10,058		\$2,591	7,467
Total NPV =		\$7,467					
Benefit/Cost Ratio =		<u>3.88</u>					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Commercial Motors - Replacement**  
 Program Years: **2016 - 2018**

Year	Benefits				Annual Total Decrease (E)	Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)		Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$84	\$0	\$0	\$27	\$111	\$596	\$4,344	\$4,940	(\$4,829)
2017	267	0	208	155	630	949	8,688	9,637	(9,007)
2018	550	0	428	328	1,306	1,357	13,032	14,389	(13,083)
2019	564	0	441	347	1,352	0	0	0	1,352
2020	599	0	454	375	1,428	0	0	0	1,428
2021	630	0	467	402	1,499	0	0	0	1,499
2022	674	0	481	436	1,591	0	0	0	1,591
2023	698	0	496	464	1,658	0	0	0	1,658
2024	743	0	511	502	1,756	0	0	0	1,756
2025	765	0	526	533	1,824	0	0	0	1,824
2026	788	0	542	565	1,895	0	0	0	1,895
2027	812	0	558	600	1,970	0	0	0	1,970
2028	836	0	575	636	2,047	0	0	0	2,047
2029	861	0	592	675	2,128	0	0	0	2,128
2030	887	0	610	716	2,213	0	0	0	2,213
2031	913	0	628	759	2,300	0	0	0	2,300
2032	941	0	647	806	2,394	0	0	0	2,394
2033	969	0	666	855	2,490	0	0	0	2,490
2034	998	0	686	907	2,591	0	0	0	2,591
2035	1,028	0	707	962	2,697	0	0	0	2,697
Total =					\$35,880			\$28,966	\$6,914
					NPV = \$25,050			\$27,739	(2,689)
Total NPV =									(\$2,689)
Benefit/Cost Ratio =									<u>0.90</u>

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Commercial Motors - Replacement**  
 Program Years: **2016 - 2018**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$375	\$0.07964	\$0.07773	727	1,453	2,180	\$171	0	0	\$20.900	\$41.800	\$0	\$0	\$546	\$4,801	\$0	\$4,801	(\$4,255)
2017	750	0.08322	0.08122	2,181	4,359	6,540	536	1	1	21.841	43.681	66	0	1,352	9,767	0	9,767	(8,415)
2018	1,125	0.08697	0.08488	4,362	8,718	13,080	1,119	2	2	22.823	45.647	137	0	2,381	14,905	0	14,905	(12,524)
2019	0	0.09088	0.08870	4,362	8,718	13,080	1,170	2	2	23.850	47.701	143	0	1,313	0	0	0	1,313
2020	0	0.09497	0.09269	4,362	8,718	13,080	1,222	2	2	24.924	49.847	150	0	1,372	0	0	0	1,372
2021	0	0.09925	0.09686	4,362	8,718	13,080	1,277	2	2	26.045	52.090	156	0	1,433	0	0	0	1,433
2022	0	0.10371	0.10122	4,362	8,718	13,080	1,335	2	2	27.217	54.434	163	0	1,498	0	0	0	1,498
2023	0	0.10838	0.10578	4,362	8,718	13,080	1,395	2	2	28.442	56.884	171	0	1,566	0	0	0	1,566
2024	0	0.11326	0.11054	4,362	8,718	13,080	1,458	2	2	29.722	59.444	178	0	1,636	0	0	0	1,636
2025	0	0.11835	0.11551	4,362	8,718	13,080	1,523	2	2	31.059	62.119	186	0	1,709	0	0	0	1,709
2026	0	0.12368	0.12071	4,362	8,718	13,080	1,592	2	2	32.457	64.914	195	0	1,787	0	0	0	1,787
2027	0	0.12924	0.12614	4,362	8,718	13,080	1,663	2	2	33.918	67.835	204	0	1,867	0	0	0	1,867
2028	0	0.13506	0.13182	4,362	8,718	13,080	1,738	2	2	35.444	70.888	213	0	1,951	0	0	0	1,951
2029	0	0.14114	0.13775	4,362	8,718	13,080	1,817	2	2	37.039	74.078	222	0	2,039	0	0	0	2,039
2030	0	0.14749	0.14395	4,362	8,718	13,080	1,898	2	2	38.706	77.411	232	0	2,130	0	0	0	2,130
2031	0	0.15412	0.15042	4,362	8,718	13,080	1,984	2	2	40.447	80.895	243	0	2,227	0	0	0	2,227
2032	0	0.16106	0.15719	4,362	8,718	13,080	2,073	2	2	42.268	84.535	254	0	2,327	0	0	0	2,327
2033	0	0.16831	0.16427	4,362	8,718	13,080	2,166	2	2	44.170	88.339	265	0	2,431	0	0	0	2,431
2034	0	0.17588	0.17166	4,362	8,718	13,080	2,264	2	2	46.157	92.314	277	0	2,541	0	0	0	2,541
2035	0	0.18380	0.17938	4,362	8,718	13,080	2,366	8	2	48.234	96.469	579	0	2,945	0	0	0	2,945
Total =				81,424	162,736			43	37					\$37,051			\$29,473	\$7,578
														NPV = \$15,035			\$25,931	(10,896)

Total NPV = (\$10,896)  
 Benefit/Cost Ratio = 0.58

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Commercial Motors - Replacement**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$84	\$0	\$84	\$596	\$4,344	\$4,940	(\$4,856)
2017	267	208	475	949	8,688	9,637	(9,162)
2018	550	428	978	1,357	13,032	14,389	(13,411)
2019	564	441	1,005	0	0	0	1,005
2020	599	454	1,053	0	0	0	1,053
2021	630	467	1,097	0	0	0	1,097
2022	674	481	1,155	0	0	0	1,155
2023	698	496	1,194	0	0	0	1,194
2024	743	511	1,254	0	0	0	1,254
2025	765	526	1,291	0	0	0	1,291
2026	788	542	1,330	0	0	0	1,330
2027	812	558	1,370	0	0	0	1,370
2028	836	575	1,411	0	0	0	1,411
2029	861	592	1,453	0	0	0	1,453
2030	887	610	1,497	0	0	0	1,497
2031	913	628	1,541	0	0	0	1,541
2032	941	647	1,588	0	0	0	1,588
2033	969	666	1,635	0	0	0	1,635
2034	998	686	1,684	0	0	0	1,684
2035	1,028	707	1,735	0	0	0	1,735
Total =			\$24,830			\$28,966	(\$4,136)
NPV =			\$10,058			\$25,709	(15,650)

Total NPV = (\$15,650)  
Benefit/Cost Ratio = 0.39

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Commercial Motors - New / on Failure**  
 Program Years: **2016 - 2018**

**Input Data**

1) Retail Rate Summer (\$/kWh) =	\$0.06569
Retail Rate Winter (\$/kWh) =	\$0.05369
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	\$0.00418
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000
Escalation Rate =	3.00%
3) Retail Summer Demand Rate (\$/kW/season) =	\$38.00
3a) Retail Winter Demand Rate (\$/kW/season) =	\$68.00
Escalation Rate =	4.50%
4) Electric Margin (\$/kWh) =	\$0.04381
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62
Reserve Capacity=	14.3%
Escalation Rate =	3.00%
6) System Variable O&M (\$/kWh) =	\$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	10.22%
9) Utility Discount Rate =	9.61%
10) Societal Discount Rate =	3.34%
11) General Input Data Year =	2015
12) Project Analysis Year 1 =	2016
Project Analysis Year 2 =	2017
Project Analysis Year 3 =	2018

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	\$212	\$180	\$228
Incentive Costs =	500	1,000	1,500
Total Utility Project Costs =	\$712	\$1,180	\$1,728
14) Direct Participant Costs (\$/Part.) =	\$1,458	\$1,458	\$1,458
Escalation Rate =	1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =	\$0	\$0	\$0
Escalation Rate =	0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =	\$0	\$0	\$0
Escalation Rate =	0%	0%	0%
15) Project Life (Years) =	20	20	20
16) Avg Summer kW/part. Saved =	0.120	0.120	0.120
16a) Avg Winter kW/part Saved =	0.120	0.120	0.120
17) Avg. Summer kWh/Part. Saved =	326	326	326
17a) Avg. Winter kWh/Part. Saved =	652	652	652
18a) System Demand Line Loss Factor	12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor	7.7350%	7.7350%	7.7350%
19) Number of Participants =	5	10	15
20) Incentive/Participant =	\$100	\$100	\$100
21) Effective Federal & State Income Tax Rate =			39.39%
22) Annual Summer Kwh Saved	1,630	3,260	4,890
Annual Winter Kwh Saved	3,260	6,520	9,780
23) Annual Summer KW Saved	1	1	2
Annual Winter KW Saved	1	1	2

Test Results	NPV	B/C
Ratepayer Impact Measure Test	\$8,844	1.69
Utility Cost Test	\$18,520	6.74
Societal Test	\$11,455	1.27
Participant Test	(\$12,331)	0.69
Total Resource Cost Test	(\$17,614)	0.55

**Table 1  
Ratepayer Impact Test**

Project: **Commerical Motors - New / on Failure**  
 Program Years: **2016 - 2018**

t	Year											Electric Margin (J)	Costs					Annual Benefits Less Costs (P)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)		Total Savings (I)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2016	5,268	\$0.03570	\$188	\$0.00000	\$0	1	1	2	\$100.80	\$202	\$390	\$0.04578	1,630	3,260	4,890	\$136	\$212	\$500	\$848	(\$458)	
2	2017	15,804	0.03790	599	0.00000	0	2	2	4	103.82	415	1,014	0.04784	4,890	9,780	14,670	425	180	1,000	1,605	(591)	
3	2018	31,609	0.03900	1,233	0.00000	0	4	4	8	106.94	856	2,089	0.04999	9,780	19,560	29,340	889	228	1,500	2,617	(528)	
4	2019	31,609	0.04000	1,264	0.00000	0	4	4	8	110.15	881	2,145	0.05224	9,780	19,560	29,340	929	0	0	929	1,216	
5	2020	31,609	0.04250	1,343	0.00000	0	4	4	8	113.45	908	2,251	0.05460	9,780	19,560	29,340	971	0	0	971	1,280	
6	2021	31,609	0.04470	1,413	0.00000	0	4	4	8	116.85	935	2,348	0.05705	9,780	19,560	29,340	1,015	0	0	1,015	1,333	
7	2022	31,609	0.04780	1,511	0.00000	0	4	4	8	120.36	963	2,474	0.05962	9,780	19,560	29,340	1,060	0	0	1,060	1,414	
8	2023	31,609	0.04950	1,565	0.00000	0	4	4	8	123.97	992	2,557	0.06230	9,780	19,560	29,340	1,108	0	0	1,108	1,449	
9	2024	31,609	0.05270	1,666	0.00000	0	4	4	8	127.69	1,022	2,688	0.06511	9,780	19,560	29,340	1,158	0	0	1,158	1,530	
10	2025	31,609	0.05428	1,716	0.00000	0	4	4	8	131.52	1,052	2,768	0.06804	9,780	19,560	29,340	1,210	0	0	1,210	1,558	
11	2026	31,609	0.05591	1,767	0.00000	0	4	4	8	135.47	1,084	2,851	0.07110	9,780	19,560	29,340	1,264	0	0	1,264	1,587	
12	2027	31,609	0.05759	1,820	0.00000	0	4	4	8	139.53	1,116	2,936	0.07430	9,780	19,560	29,340	1,321	0	0	1,321	1,615	
13	2028	31,609	0.05932	1,875	0.00000	0	4	4	8	143.72	1,150	3,025	0.07764	9,780	19,560	29,340	1,381	0	0	1,381	1,644	
14	2029	31,609	0.06110	1,931	0.00000	0	4	4	8	148.03	1,184	3,115	0.08113	9,780	19,560	29,340	1,443	0	0	1,443	1,672	
15	2030	31,609	0.06293	1,989	0.00000	0	4	4	8	152.47	1,220	3,209	0.08478	9,780	19,560	29,340	1,508	0	0	1,508	1,701	
16	2031	31,609	0.06482	2,049	0.00000	0	4	4	8	157.04	1,256	3,305	0.08860	9,780	19,560	29,340	1,576	0	0	1,576	1,729	
17	2032	31,609	0.06676	2,110	0.00000	0	4	4	8	161.75	1,294	3,404	0.09259	9,780	19,560	29,340	1,647	0	0	1,647	1,757	
18	2033	31,609	0.06876	2,173	0.00000	0	4	4	8	166.61	1,333	3,506	0.09675	9,780	19,560	29,340	1,721	0	0	1,721	1,785	
19	2034	31,609	0.07082	2,239	0.00000	0	4	4	8	171.60	1,373	3,612	0.10111	9,780	19,560	29,340	1,798	0	0	1,798	1,814	
20	2035	31,609	0.07294	2,306	0.00000	0	4	4	8	176.75	1,414	3,720	0.10566	9,780	19,560	29,340	1,879	0	0	1,879	1,841	
Total =		590,034							150			\$53,407				547,680				\$28,059	\$25,348	
												NPV =	\$21,747								\$12,903	8,844
Total NPV =																					\$8,844	
Benefit/Cost Ratio =																					<u>1.69</u>	

Worksheet Calculations	
(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Commerical Motors - New / on Failure**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$188	\$0	\$202	\$390	\$712	\$712	(\$322)
2017	599	0	415	1,014	1,180	1,180	(166)
2018	1,233	0	856	2,089	1,728	1,728	361
2019	1,264	0	881	2,145	0	0	2,145
2020	1,343	0	908	2,251	0	0	2,251
2021	1,413	0	935	2,348	0	0	2,348
2022	1,511	0	963	2,474	0	0	2,474
2023	1,565	0	992	2,557	0	0	2,557
2024	1,666	0	1,022	2,688	0	0	2,688
2025	1,716	0	1,052	2,768	0	0	2,768
2026	1,767	0	1,084	2,851	0	0	2,851
2027	1,820	0	1,116	2,936	0	0	2,936
2028	1,875	0	1,150	3,025	0	0	3,025
2029	1,931	0	1,184	3,115	0	0	3,115
2030	1,989	0	1,220	3,209	0	0	3,209
2031	2,049	0	1,256	3,305	0	0	3,305
2032	2,110	0	1,294	3,404	0	0	3,404
2033	2,173	0	1,333	3,506	0	0	3,506
2034	2,239	0	1,373	3,612	0	0	3,612
2035	2,306	0	1,414	3,720	0	0	3,720
Total =				\$53,407		\$3,620	\$49,787
NPV =				\$21,747		\$3,227	18,520
Total NPV =		\$18,520					
Benefit/Cost Ratio =		6.74					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Commerical Motors - New / on Failure**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$188	\$0	\$202	\$123	\$513	\$712	\$6,790	\$7,502	(\$6,989)
2017	599	0	415	330	1,344	1,180	13,580	14,760	(13,416)
2018	1,233	0	856	701	2,790	1,728	20,370	22,098	(19,308)
2019	1,264	0	881	741	2,886	0	0	0	2,886
2020	1,343	0	908	801	3,052	0	0	0	3,052
2021	1,413	0	935	861	3,209	0	0	0	3,209
2022	1,511	0	963	934	3,408	0	0	0	3,408
2023	1,565	0	992	994	3,551	0	0	0	3,551
2024	1,666	0	1,022	1,077	3,765	0	0	0	3,765
2025	1,716	0	1,052	1,142	3,910	0	0	0	3,910
2026	1,767	0	1,084	1,212	4,063	0	0	0	4,063
2027	1,820	0	1,116	1,285	4,221	0	0	0	4,221
2028	1,875	0	1,150	1,364	4,389	0	0	0	4,389
2029	1,931	0	1,184	1,446	4,561	0	0	0	4,561
2030	1,989	0	1,220	1,535	4,744	0	0	0	4,744
2031	2,049	0	1,256	1,628	4,933	0	0	0	4,933
2032	2,110	0	1,294	1,727	5,131	0	0	0	5,131
2033	2,173	0	1,333	1,832	5,338	0	0	0	5,338
2034	2,239	0	1,373	1,944	5,556	0	0	0	5,556
2035	2,306	0	1,414	2,063	5,783	0	0	0	5,783
Total =					\$77,147			\$44,360	\$32,787
				NPV =	\$53,933			\$42,478	11,455
Total NPV =		\$11,455							
Benefit/Cost Ratio =		<u>1.27</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Commerical Motors - New / on Failure**  
 Program Years: **2016 - 2018**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$500	\$0.06865	\$0.05611	1,630	3,260	4,890	\$295	1	1	\$39.710	\$71.060	\$111	\$0	\$906	\$7,416	\$0	\$7,416	(\$6,510)
2017	1,000	0.07174	0.05863	4,890	9,780	14,670	924	2	2	41.497	74.258	232	0	2,156	15,089	0	15,089	(12,933)
2018	1,500	0.07496	0.06127	9,780	19,560	29,340	1,932	4	4	43.364	77.599	484	0	3,916	23,025	0	23,025	(19,109)
2019	0	0.07834	0.06403	9,780	19,560	29,340	2,019	4	4	45.316	81.091	506	0	2,525	0	0	0	2,525
2020	0	0.08186	0.06691	9,780	19,560	29,340	2,109	4	4	47.355	84.740	528	0	2,637	0	0	0	2,637
2021	0	0.08555	0.06992	9,780	19,560	29,340	2,204	4	4	49.486	88.554	552	0	2,756	0	0	0	2,756
2022	0	0.08940	0.07306	9,780	19,560	29,340	2,303	4	4	51.713	92.539	577	0	2,880	0	0	0	2,880
2023	0	0.09342	0.07635	9,780	19,560	29,340	2,407	4	4	54.040	96.703	603	0	3,010	0	0	0	3,010
2024	0	0.09762	0.07979	9,780	19,560	29,340	2,515	4	4	56.472	101.054	630	0	3,145	0	0	0	3,145
2025	0	0.10201	0.08338	9,780	19,560	29,340	2,629	4	4	59.013	105.602	658	0	3,287	0	0	0	3,287
2026	0	0.10661	0.08713	9,780	19,560	29,340	2,747	4	4	61.668	110.354	688	0	3,435	0	0	0	3,435
2027	0	0.11140	0.09105	9,780	19,560	29,340	2,870	4	4	64.443	115.320	719	0	3,589	0	0	0	3,589
2028	0	0.11642	0.09515	9,780	19,560	29,340	3,000	4	4	67.343	120.509	751	0	3,751	0	0	0	3,751
2029	0	0.12165	0.09943	9,780	19,560	29,340	3,135	4	4	70.374	125.932	785	0	3,920	0	0	0	3,920
2030	0	0.12713	0.10391	9,780	19,560	29,340	3,276	4	4	73.541	131.599	821	0	4,097	0	0	0	4,097
2031	0	0.13285	0.10858	9,780	19,560	29,340	3,423	4	4	76.850	137.521	857	0	4,280	0	0	0	4,280
2032	0	0.13883	0.11347	9,780	19,560	29,340	3,577	4	4	80.308	143.710	896	0	4,473	0	0	0	4,473
2033	0	0.14507	0.11857	9,780	19,560	29,340	3,738	4	4	83.922	150.177	936	0	4,674	0	0	0	4,674
2034	0	0.15160	0.12391	9,780	19,560	29,340	3,906	4	4	87.699	156.935	979	0	4,885	0	0	0	4,885
2035	0	0.15843	0.12948	9,780	19,560	29,340	4,082	4	4	91.645	163.997	1,023	0	5,105	0	0	0	5,105
Total =				182,560	365,120			75	75					\$69,427		\$45,530	\$23,897	
														NPV = \$27,728		\$40,059	(12,331)	
Total NPV =																		(\$12,331)
Benefit/Cost Ratio =																		0.69

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Commerical Motors - New / on Failure**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$188	\$202	\$390	\$712	\$6,790	\$7,502	(\$7,112)
2017	599	415	1,014	1,180	13,580	14,760	(13,746)
2018	1,233	856	2,089	1,728	20,370	22,098	(20,009)
2019	1,264	881	2,145	0	0	0	2,145
2020	1,343	908	2,251	0	0	0	2,251
2021	1,413	935	2,348	0	0	0	2,348
2022	1,511	963	2,474	0	0	0	2,474
2023	1,565	992	2,557	0	0	0	2,557
2024	1,666	1,022	2,688	0	0	0	2,688
2025	1,716	1,052	2,768	0	0	0	2,768
2026	1,767	1,084	2,851	0	0	0	2,851
2027	1,820	1,116	2,936	0	0	0	2,936
2028	1,875	1,150	3,025	0	0	0	3,025
2029	1,931	1,184	3,115	0	0	0	3,115
2030	1,989	1,220	3,209	0	0	0	3,209
2031	2,049	1,256	3,305	0	0	0	3,305
2032	2,110	1,294	3,404	0	0	0	3,404
2033	2,173	1,333	3,506	0	0	0	3,506
2034	2,239	1,373	3,612	0	0	0	3,612
2035	2,306	1,414	3,720	0	0	0	3,720
Total =			\$53,407			\$44,360	\$9,047
NPV =			\$21,747			\$39,361	(17,614)

Total NPV = (\$17,614)  
Benefit/Cost Ratio = 0.55

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
NORTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Commercial Motors - New / on Failure**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.08579			
Retail Rate Winter (\$/kWh) =	\$0.06943			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00496			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$45.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$66.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05530			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	8.70%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$243	\$193	\$211
Incentive Costs =		1,000	1,500	2,000
Total Utility Project Costs =		\$1,243	\$1,693	\$2,211
14) Direct Participant Costs (\$/Part.) =		\$1,458	\$1,458	\$1,458
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		20	20	20
16) Avg Summer kW/part. Saved =		0.120	0.120	0.120
16a) Avg Winter kW/part Saved =		0.120	0.120	0.120
17) Avg. Summer kWh/Part. Saved =		326	326	326
17a) Avg. Winter kWh/Part. Saved =		652	652	652
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		10	15	20
20) Incentive/Participant =		\$100	\$100	\$100
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		3,260	4,890	6,520
Annual Winter Kwh Saved		6,520	9,780	13,040
23) Annual Summer KW Saved		1	2	2
Annual Winter KW Saved		1	2	2
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$9,586	1.41	
Utility Cost Test		\$28,074	7.07	
Societal Test		\$17,342	1.27	
Participant Test		(\$10,613)	0.82	
Total Resource Cost Test		(\$26,696)	0.55	

**Table 1  
Ratepayer Impact Test**

Project: **Commerical Motors - New / on Failure**  
Program Years: **2016 - 2018**

t	Year											Costs					Annual Benefits Less Costs (P)					
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)		Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2016	10,536	\$0.03570	\$376	\$0.00000	\$0	1	1	2	\$100.80	\$202	\$578	\$0.05779	3,260	6,520	9,780	\$343	\$243	\$1,000	\$1,586	(\$1,008)	
2	2017	26,341	0.03790	998	0.00000	0	3	3	6	103.82	623	1,621	0.06039	8,150	16,300	24,450	895	193	1,500	2,588	(967)	
3	2018	47,414	0.03900	1,849	0.00000	0	6	6	12	106.94	1,283	3,132	0.06311	14,670	29,340	44,010	1,683	211	2,000	3,894	(762)	
4	2019	47,414	0.04000	1,897	0.00000	0	6	6	12	110.15	1,322	3,219	0.06595	14,670	29,340	44,010	1,759	0	0	1,759	1,460	
5	2020	47,414	0.04250	2,015	0.00000	0	6	6	12	113.45	1,361	3,376	0.06891	14,670	29,340	44,010	1,838	0	0	1,838	1,538	
6	2021	47,414	0.04470	2,119	0.00000	0	6	6	12	116.85	1,402	3,521	0.07201	14,670	29,340	44,010	1,921	0	0	1,921	1,600	
7	2022	47,414	0.04780	2,266	0.00000	0	6	6	12	120.36	1,444	3,710	0.07526	14,670	29,340	44,010	2,008	0	0	2,008	1,702	
8	2023	47,414	0.04950	2,347	0.00000	0	6	6	12	123.97	1,488	3,835	0.07864	14,670	29,340	44,010	2,098	0	0	2,098	1,737	
9	2024	47,414	0.05270	2,499	0.00000	0	6	6	12	127.69	1,532	4,031	0.08218	14,670	29,340	44,010	2,192	0	0	2,192	1,839	
10	2025	47,414	0.05428	2,574	0.00000	0	6	6	12	131.52	1,578	4,152	0.08588	14,670	29,340	44,010	2,291	0	0	2,291	1,861	
11	2026	47,414	0.05591	2,651	0.00000	0	6	6	12	135.47	1,626	4,277	0.08974	14,670	29,340	44,010	2,394	0	0	2,394	1,883	
12	2027	47,414	0.05759	2,731	0.00000	0	6	6	12	139.53	1,674	4,405	0.09378	14,670	29,340	44,010	2,502	0	0	2,502	1,903	
13	2028	47,414	0.05932	2,813	0.00000	0	6	6	12	143.72	1,725	4,538	0.09800	14,670	29,340	44,010	2,614	0	0	2,614	1,924	
14	2029	47,414	0.06110	2,897	0.00000	0	6	6	12	148.03	1,776	4,673	0.10241	14,670	29,340	44,010	2,732	0	0	2,732	1,941	
15	2030	47,414	0.06293	2,984	0.00000	0	6	6	12	152.47	1,830	4,814	0.10702	14,670	29,340	44,010	2,855	0	0	2,855	1,959	
16	2031	47,414	0.06482	3,073	0.00000	0	6	6	12	157.04	1,884	4,957	0.11184	14,670	29,340	44,010	2,983	0	0	2,983	1,974	
17	2032	47,414	0.06676	3,165	0.00000	0	6	6	12	161.75	1,941	5,106	0.11687	14,670	29,340	44,010	3,118	0	0	3,118	1,988	
18	2033	47,414	0.06876	3,260	0.00000	0	6	6	12	166.61	1,999	5,259	0.12213	14,670	29,340	44,010	3,258	0	0	3,258	2,001	
19	2034	47,414	0.07082	3,358	0.00000	0	6	6	12	171.60	2,059	5,417	0.12762	14,670	29,340	44,010	3,404	0	0	3,404	2,013	
20	2035	47,414	0.07294	3,458	0.00000	0	6	6	12	176.75	2,121	5,579	0.13337	14,670	29,340	44,010	3,558	0	0	3,558	2,021	
Total =		890,329						224				\$80,200				826,410				\$51,593	\$28,607	
												NPV =	\$32,702								\$23,116	9,586
Total NPV =													\$9,586									
Benefit/Cost Ratio =													1.41									

Worksheet Calculations	
(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Commerical Motors - New / on Failure**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$376	\$0	\$202	\$578	\$1,243	\$1,243	(\$665)
2017	998	0	623	1,621	1,693	1,693	(72)
2018	1,849	0	1,283	3,132	2,211	2,211	921
2019	1,897	0	1,322	3,219	0	0	3,219
2020	2,015	0	1,361	3,376	0	0	3,376
2021	2,119	0	1,402	3,521	0	0	3,521
2022	2,266	0	1,444	3,710	0	0	3,710
2023	2,347	0	1,488	3,835	0	0	3,835
2024	2,499	0	1,532	4,031	0	0	4,031
2025	2,574	0	1,578	4,152	0	0	4,152
2026	2,651	0	1,626	4,277	0	0	4,277
2027	2,731	0	1,674	4,405	0	0	4,405
2028	2,813	0	1,725	4,538	0	0	4,538
2029	2,897	0	1,776	4,673	0	0	4,673
2030	2,984	0	1,830	4,814	0	0	4,814
2031	3,073	0	1,884	4,957	0	0	4,957
2032	3,165	0	1,941	5,106	0	0	5,106
2033	3,260	0	1,999	5,259	0	0	5,259
2034	3,358	0	2,059	5,417	0	0	5,417
2035	3,458	0	2,121	5,579	0	0	5,579
Total =				\$80,200		\$5,147	\$75,053
				NPV = \$32,702		\$4,628	28,074
Total NPV =				\$28,074			
Benefit/Cost Ratio =				<u>7.07</u>			

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Commerical Motors - New / on Failure**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$376	\$0	\$202	\$183	\$761	\$1,243	\$13,580	\$14,823	(\$14,062)
2017	998	0	623	528	2,149	1,693	20,370	22,063	(19,914)
2018	1,849	0	1,283	1,051	4,183	2,211	27,160	29,371	(25,188)
2019	1,897	0	1,322	1,112	4,331	0	0	0	4,331
2020	2,015	0	1,361	1,202	4,578	0	0	0	4,578
2021	2,119	0	1,402	1,291	4,812	0	0	0	4,812
2022	2,266	0	1,444	1,401	5,111	0	0	0	5,111
2023	2,347	0	1,488	1,491	5,326	0	0	0	5,326
2024	2,499	0	1,532	1,615	5,646	0	0	0	5,646
2025	2,574	0	1,578	1,713	5,865	0	0	0	5,865
2026	2,651	0	1,626	1,818	6,095	0	0	0	6,095
2027	2,731	0	1,674	1,928	6,333	0	0	0	6,333
2028	2,813	0	1,725	2,046	6,584	0	0	0	6,584
2029	2,897	0	1,776	2,170	6,843	0	0	0	6,843
2030	2,984	0	1,830	2,303	7,117	0	0	0	7,117
2031	3,073	0	1,884	2,442	7,399	0	0	0	7,399
2032	3,165	0	1,941	2,591	7,697	0	0	0	7,697
2033	3,260	0	1,999	2,749	8,008	0	0	0	8,008
2034	3,358	0	2,059	2,916	8,333	0	0	0	8,333
2035	3,458	0	2,121	3,093	8,672	0	0	0	8,672
Total =					\$115,843			\$66,257	\$49,586
				NPV =	\$81,018			\$63,676	17,342
Total NPV =	\$17,342								
Benefit/Cost Ratio =	1.27								

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Commerical Motors - New / on Failure**  
 Program Years: **2016 - 2018**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$1,000	\$0.08965	\$0.07255	3,260	6,520	9,780	\$765	1	1	\$47.025	\$68.970	\$116	\$0	\$1,881	\$14,832	\$0	\$14,832	(\$12,951)
2017	1,500	0.09368	0.07582	8,150	16,300	24,450	1,999	3	3	49.141	72.074	364	0	3,863	22,633	0	22,633	(18,770)
2018	2,000	0.09790	0.07923	14,670	29,340	44,010	3,761	5	5	51.352	75.317	633	0	6,394	30,700	0	30,700	(24,306)
2019	0	0.10231	0.08280	14,670	29,340	44,010	3,930	5	5	53.663	78.706	662	0	4,592	0	0	0	4,592
2020	0	0.10691	0.08652	14,670	29,340	44,010	4,107	5	5	56.078	82.248	692	0	4,799	0	0	0	4,799
2021	0	0.11172	0.09042	14,670	29,340	44,010	4,292	5	5	58.602	85.949	723	0	5,015	0	0	0	5,015
2022	0	0.11675	0.09448	14,670	29,340	44,010	4,485	5	5	61.239	89.817	755	0	5,240	0	0	0	5,240
2023	0	0.12200	0.09874	14,670	29,340	44,010	4,687	5	5	63.995	93.859	789	0	5,476	0	0	0	5,476
2024	0	0.12749	0.10318	14,670	29,340	44,010	4,898	5	5	66.874	98.082	825	0	5,723	0	0	0	5,723
2025	0	0.13323	0.10782	14,670	29,340	44,010	5,118	5	5	69.884	102.496	862	0	5,980	0	0	0	5,980
2026	0	0.13922	0.11267	14,670	29,340	44,010	5,348	5	5	73.028	107.108	901	0	6,249	0	0	0	6,249
2027	0	0.14549	0.11775	14,670	29,340	44,010	5,589	5	5	76.315	111.928	941	0	6,530	0	0	0	6,530
2028	0	0.15204	0.12304	14,670	29,340	44,010	5,840	5	5	79.749	116.965	984	0	6,824	0	0	0	6,824
2029	0	0.15888	0.12858	14,670	29,340	44,010	6,103	5	5	83.338	122.228	1,028	0	7,131	0	0	0	7,131
2030	0	0.16603	0.13437	14,670	29,340	44,010	6,378	5	5	87.088	127.729	1,074	0	7,452	0	0	0	7,452
2031	0	0.17350	0.14041	14,670	29,340	44,010	6,665	5	5	91.007	133.476	1,122	0	7,787	0	0	0	7,787
2032	0	0.18131	0.14673	14,670	29,340	44,010	6,965	5	5	95.102	139.483	1,173	0	8,138	0	0	0	8,138
2033	0	0.18947	0.15333	14,670	29,340	44,010	7,278	5	5	99.382	145.760	1,226	0	8,504	0	0	0	8,504
2034	0	0.19799	0.16023	14,670	29,340	44,010	7,606	5	5	103.854	152.319	1,281	0	8,887	0	0	0	8,887
2035	0	0.20690	0.16745	14,670	29,340	44,010	7,948	5	5	108.527	159.173	1,339	0	9,287	0	0	0	9,287
Total =				275,470	550,940			94	94					\$125,752			\$68,165	\$57,587
														NPV = \$50,024			\$60,637	(10,613)

Total NPV = (\$10,613)  
 Benefit/Cost Ratio = 0.82

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Commerical Motors - New / on Failure**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$376	\$202	\$578	\$1,243	\$13,580	\$14,823	(\$14,245)
2017	998	623	1,621	1,693	20,370	22,063	(20,442)
2018	1,849	1,283	3,132	2,211	27,160	29,371	(26,239)
2019	1,897	1,322	3,219	0	0	0	3,219
2020	2,015	1,361	3,376	0	0	0	3,376
2021	2,119	1,402	3,521	0	0	0	3,521
2022	2,266	1,444	3,710	0	0	0	3,710
2023	2,347	1,488	3,835	0	0	0	3,835
2024	2,499	1,532	4,031	0	0	0	4,031
2025	2,574	1,578	4,152	0	0	0	4,152
2026	2,651	1,626	4,277	0	0	0	4,277
2027	2,731	1,674	4,405	0	0	0	4,405
2028	2,813	1,725	4,538	0	0	0	4,538
2029	2,897	1,776	4,673	0	0	0	4,673
2030	2,984	1,830	4,814	0	0	0	4,814
2031	3,073	1,884	4,957	0	0	0	4,957
2032	3,165	1,941	5,106	0	0	0	5,106
2033	3,260	1,999	5,259	0	0	0	5,259
2034	3,358	2,059	5,417	0	0	0	5,417
2035	3,458	2,121	5,579	0	0	0	5,579
Total =			\$80,200			\$66,257	\$13,943
NPV =			\$32,702			\$59,398	(26,696)

Total NPV = (\$26,696)  
Benefit/Cost Ratio = 0.55

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
SOUTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Commerical Motors - New / on Failure**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.07621			
Retail Rate Winter (\$/kWh) =	\$0.07438			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00815			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$20.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$40.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.03409			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$59	\$53	\$62
Incentive Costs =		100	200	300
Total Utility Project Costs =		\$159	\$253	\$362
14) Direct Participant Costs (\$/Part.) =		\$1,458	\$1,458	\$1,458
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		20	20	20
16) Avg Summer kW/part. Saved =		0.120	0.120	0.120
16a) Avg Winter kW/part Saved =		0.120	0.120	0.120
17) Avg. Summer kWh/Part. Saved =		326	326	326
17a) Avg. Winter kWh/Part. Saved =		652	652	652
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		1	2	3
20) Incentive/Participant =		\$100	\$100	\$100
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		326	652	978
Annual Winter Kwh Saved		652	1,304	1,956
23) Annual Summer KW Saved		0	0	0
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$2,435	2.11	
Utility Cost Test		\$3,941	6.70	
Societal Test		\$3,092	1.36	
Participant Test		(\$1,583)	0.80	
Total Resource Cost Test		(\$3,286)	0.58	

**Table 1  
Ratepayer Impact Test**

Project: **Commerical Motors - New / on Failure**  
Program Years: **2016 - 2018**

t	Year											Costs					Annual Benefits Less Costs (P)					
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)		Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2016	1,053	\$0.03570	\$38	\$0.00000	\$0	0	0	0	\$100.80	\$0	\$38	\$0.03562	326	652	978	\$21	\$59	\$100	\$180	(\$142)	
2	2017	3,161	0.03790	120	0.00000	0	0	0	0	103.82	0	120	0.03723	978	1,956	2,934	66	53	200	319	(199)	
3	2018	6,322	0.03900	247	0.00000	0	1	1	2	106.94	214	461	0.03890	1,956	3,912	5,868	138	62	300	500	(39)	
4	2019	6,322	0.04000	253	0.00000	0	1	1	2	110.15	220	473	0.04065	1,956	3,912	5,868	145	0	0	145	328	
5	2020	6,322	0.04250	269	0.00000	0	1	1	2	113.45	227	496	0.04248	1,956	3,912	5,868	151	0	0	151	345	
6	2021	6,322	0.04470	283	0.00000	0	1	1	2	116.85	234	517	0.04439	1,956	3,912	5,868	158	0	0	158	359	
7	2022	6,322	0.04780	302	0.00000	0	1	1	2	120.36	241	543	0.04639	1,956	3,912	5,868	165	0	0	165	378	
8	2023	6,322	0.04950	313	0.00000	0	1	1	2	123.97	248	561	0.04848	1,956	3,912	5,868	172	0	0	172	389	
9	2024	6,322	0.05270	333	0.00000	0	1	1	2	127.69	255	588	0.05066	1,956	3,912	5,868	180	0	0	180	408	
10	2025	6,322	0.05428	343	0.00000	0	1	1	2	131.52	263	606	0.05294	1,956	3,912	5,868	188	0	0	188	418	
11	2026	6,322	0.05591	353	0.00000	0	1	1	2	135.47	271	624	0.05532	1,956	3,912	5,868	197	0	0	197	427	
12	2027	6,322	0.05759	364	0.00000	0	1	1	2	139.53	279	643	0.05781	1,956	3,912	5,868	206	0	0	206	437	
13	2028	6,322	0.05932	375	0.00000	0	1	1	2	143.72	287	662	0.06041	1,956	3,912	5,868	215	0	0	215	447	
14	2029	6,322	0.06110	386	0.00000	0	1	1	2	148.03	296	682	0.06313	1,956	3,912	5,868	225	0	0	225	457	
15	2030	6,322	0.06293	398	0.00000	0	1	1	2	152.47	305	703	0.06597	1,956	3,912	5,868	235	0	0	235	468	
16	2031	6,322	0.06482	410	0.00000	0	1	1	2	157.04	314	724	0.06894	1,956	3,912	5,868	245	0	0	245	479	
17	2032	6,322	0.06676	422	0.00000	0	1	1	2	161.75	324	746	0.07205	1,956	3,912	5,868	256	0	0	256	490	
18	2033	6,322	0.06876	435	0.00000	0	1	1	2	166.61	333	768	0.07529	1,956	3,912	5,868	268	0	0	268	500	
19	2034	6,322	0.07082	448	0.00000	0	1	1	2	171.60	343	791	0.07867	1,956	3,912	5,868	280	0	0	280	511	
20	2035	6,322	0.07294	461	0.00000	0	1	1	2	176.75	354	815	0.08222	1,956	3,912	5,868	292	0	0	292	523	
Total =		118,010						36				\$11,561				109,536				\$4,577	\$6,984	
												NPV =	\$4,632								\$2,197	2,435

Total NPV = \$2,435  
Benefit/Cost Ratio = 2.11

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (B) = Avg. System Marginal Energy Cost (2), escalated  
 (C) = (C) x (D)  
 (D) = System Variable O&M Savings (6), escalated  
 (E) = (C) x (F)  
 (F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity  
 (H) = (F) + (G)  
 (I) = (C) + (E) + (H)  
 (J) = Electric Margin (4), escalated

(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)  
 (L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)  
 (M) = Program Admin Costs (13)  
 (N) = Incentive/Participant (20) x Number of Participants (19)  
 (O) = (L) + (M) + (N)  
 (P) = (I) - (O)

**Table 2  
Utility Test**

Project: **Commerical Motors - New / on Failure**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$38	\$0	\$0	\$38	\$159	\$159	(\$121)
2017	120	0	0	120	253	253	(133)
2018	247	0	214	461	362	362	99
2019	253	0	220	473	0	0	473
2020	269	0	227	496	0	0	496
2021	283	0	234	517	0	0	517
2022	302	0	241	543	0	0	543
2023	313	0	248	561	0	0	561
2024	333	0	255	588	0	0	588
2025	343	0	263	606	0	0	606
2026	353	0	271	624	0	0	624
2027	364	0	279	643	0	0	643
2028	375	0	287	662	0	0	662
2029	386	0	296	682	0	0	682
2030	398	0	305	703	0	0	703
2031	410	0	314	724	0	0	724
2032	422	0	324	746	0	0	746
2033	435	0	333	768	0	0	768
2034	448	0	343	791	0	0	791
2035	461	0	354	815	0	0	815
Total =				\$11,561		\$774	\$10,787
				NPV = \$4,632		\$691	3,941
Total NPV =							\$3,941
Benefit/Cost Ratio =							<u>6.70</u>

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Commerical Motors - New / on Failure**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$38	\$0	\$0	\$12	\$50	\$159	\$1,358	\$1,517	(\$1,467)
2017	120	0	0	39	159	253	2,716	2,969	(2,810)
2018	247	0	214	155	616	362	4,074	4,436	(3,820)
2019	253	0	220	163	636	0	0	0	636
2020	269	0	227	177	673	0	0	0	673
2021	283	0	234	190	707	0	0	0	707
2022	302	0	241	205	748	0	0	0	748
2023	313	0	248	218	779	0	0	0	779
2024	333	0	255	236	824	0	0	0	824
2025	343	0	263	250	856	0	0	0	856
2026	353	0	271	265	889	0	0	0	889
2027	364	0	279	281	924	0	0	0	924
2028	375	0	287	298	960	0	0	0	960
2029	386	0	296	317	999	0	0	0	999
2030	398	0	305	336	1,039	0	0	0	1,039
2031	410	0	314	357	1,081	0	0	0	1,081
2032	422	0	324	379	1,125	0	0	0	1,125
2033	435	0	333	401	1,169	0	0	0	1,169
2034	448	0	343	426	1,217	0	0	0	1,217
2035	461	0	354	452	1,267	0	0	0	1,267
Total =					\$16,718			\$8,922	\$7,796
					NPV = \$11,636			\$8,544	3,092
Total NPV =	\$3,092								
Benefit/Cost Ratio =	<u>1.36</u>								

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Commerical Motors - New / on Failure**  
 Program Years: **2016 - 2018**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$100	\$0.07964	\$0.07773	326	652	978	\$77	0	0	\$20.900	\$41.800	\$0	\$0	\$177	\$1,483	\$0	\$1,483	(\$1,306)
2017	200	0.08322	0.08122	978	1,956	2,934	240	0	0	21.841	43.681	0	0	440	3,018	0	3,018	(2,578)
2018	300	0.08697	0.08488	1,956	3,912	5,868	502	1	1	22.823	45.647	68	0	870	4,605	0	4,605	(3,735)
2019	0	0.09088	0.08870	1,956	3,912	5,868	525	1	1	23.850	47.701	72	0	597	0	0	0	597
2020	0	0.09497	0.09269	1,956	3,912	5,868	548	1	1	24.924	49.847	75	0	623	0	0	0	623
2021	0	0.09925	0.09686	1,956	3,912	5,868	573	1	1	26.045	52.090	78	0	651	0	0	0	651
2022	0	0.10371	0.10122	1,956	3,912	5,868	599	1	1	27.217	54.434	82	0	681	0	0	0	681
2023	0	0.10838	0.10578	1,956	3,912	5,868	626	1	1	28.442	56.884	85	0	711	0	0	0	711
2024	0	0.11326	0.11054	1,956	3,912	5,868	654	1	1	29.722	59.444	89	0	743	0	0	0	743
2025	0	0.11835	0.11551	1,956	3,912	5,868	683	1	1	31.059	62.119	93	0	776	0	0	0	776
2026	0	0.12368	0.12071	1,956	3,912	5,868	714	1	1	32.457	64.914	97	0	811	0	0	0	811
2027	0	0.12924	0.12614	1,956	3,912	5,868	746	1	1	33.918	67.835	102	0	848	0	0	0	848
2028	0	0.13506	0.13182	1,956	3,912	5,868	780	1	1	35.444	70.888	106	0	886	0	0	0	886
2029	0	0.14114	0.13775	1,956	3,912	5,868	815	1	1	37.039	74.078	111	0	926	0	0	0	926
2030	0	0.14749	0.14395	1,956	3,912	5,868	852	1	1	38.706	77.411	116	0	968	0	0	0	968
2031	0	0.15412	0.15042	1,956	3,912	5,868	890	1	1	40.447	80.895	121	0	1,011	0	0	0	1,011
2032	0	0.16106	0.15719	1,956	3,912	5,868	930	1	1	42.268	84.535	127	0	1,057	0	0	0	1,057
2033	0	0.16831	0.16427	1,956	3,912	5,868	972	1	1	44.170	88.339	133	0	1,105	0	0	0	1,105
2034	0	0.17588	0.17166	1,956	3,912	5,868	1,016	1	1	46.157	92.314	138	0	1,154	0	0	0	1,154
2035	0	0.18380	0.17938	1,956	3,912	5,868	1,061	4	1	48.234	96.469	289	0	1,350	0	0	0	1,350
Total =				36,512	73,024				21	18				\$16,385		\$9,106	\$7,279	(1,583)
														NPV =	\$6,428		\$8,012	

Total NPV = (\$1,583)  
 Benefit/Cost Ratio = 0.80

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Commerical Motors - New / on Failure**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$38	\$0	\$38	\$159	\$1,358	\$1,517	(\$1,479)
2017	120	0	120	253	2,716	2,969	(2,849)
2018	247	214	461	362	4,074	4,436	(3,975)
2019	253	220	473	0	0	0	473
2020	269	227	496	0	0	0	496
2021	283	234	517	0	0	0	517
2022	302	241	543	0	0	0	543
2023	313	248	561	0	0	0	561
2024	333	255	588	0	0	0	588
2025	343	263	606	0	0	0	606
2026	353	271	624	0	0	0	624
2027	364	279	643	0	0	0	643
2028	375	287	662	0	0	0	662
2029	386	296	682	0	0	0	682
2030	398	305	703	0	0	0	703
2031	410	314	724	0	0	0	724
2032	422	324	746	0	0	0	746
2033	435	333	768	0	0	0	768
2034	448	343	791	0	0	0	791
2035	461	354	815	0	0	0	815
Total =			\$11,561			\$8,922	\$2,639
NPV =			\$4,632			\$7,918	(3,286)

Total NPV = (\$3,286)  
Benefit/Cost Ratio = 0.58

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Variable Speed Drives - VFD'S**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.06569			
Retail Rate Winter (\$/kWh) =	\$0.05369			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00418			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$38.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$68.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.04381			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$1,591	\$673	\$1,138
Incentive Costs =		3,750	3,750	7,500
Total Utility Project Costs =		\$5,341	\$4,423	\$8,638
14) Direct Participant Costs (\$/Part.) =		\$4,540	\$4,540	\$4,540
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		15	15	15
16) Avg Summer kW/part. Saved =		0.000	0.000	0.000
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		6,921	6,921	6,921
17a) Avg. Winter kWh/Part. Saved =		13,843	13,843	13,843
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		5	5	10
20) Incentive/Participant =		\$750	\$750	\$750
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		34,605	34,605	69,210
Annual Winter Kwh Saved		69,215	69,215	138,430
23) Annual Summer KW Saved		0	0	0
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$29,075	1.21	
Utility Cost Test		\$148,245	9.95	
Societal Test		\$277,589	4.07	
Participant Test		\$178,225	3.13	
Total Resource Cost Test		\$80,461	1.95	

**Table 1  
Ratepayer Impact Test**

Project: **Variable Speed Drives - VFD'S**  
Program Years: **2016 - 2018**

t	Year											Costs						Annual Benefits Less Costs (P)			
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)
1	2016	111,851	\$0.03570	\$3,993	\$0.00000	\$0	0	0	0	\$100.80	\$0	\$3,993	\$0.04578	34,605	69,215	103,820	\$2,881	\$1,591	\$3,750	\$8,222	(\$4,229)
2	2017	223,701	0.03790	8,478	0.00000	0	0	0	0	103.82	0	8,478	0.04784	69,210	138,430	207,640	6,021	673	3,750	10,444	(1,966)
3	2018	447,402	0.03900	17,449	0.00000	0	0	0	0	106.94	0	17,449	0.04999	138,420	276,860	415,280	12,583	1,138	7,500	21,221	(3,772)
4	2019	447,402	0.04000	17,896	0.00000	0	0	0	0	110.15	0	17,896	0.05224	138,420	276,860	415,280	13,149	0	0	13,149	4,747
5	2020	447,402	0.04250	19,015	0.00000	0	0	0	0	113.45	0	19,015	0.05460	138,420	276,860	415,280	13,743	0	0	13,743	5,272
6	2021	447,402	0.04470	19,999	0.00000	0	0	0	0	116.85	0	19,999	0.05705	138,420	276,860	415,280	14,360	0	0	14,360	5,639
7	2022	447,402	0.04780	21,386	0.00000	0	0	0	0	120.36	0	21,386	0.05962	138,420	276,860	415,280	15,007	0	0	15,007	6,379
8	2023	447,402	0.04950	22,146	0.00000	0	0	0	0	123.97	0	22,146	0.06230	138,420	276,860	415,280	15,682	0	0	15,682	6,464
9	2024	447,402	0.05270	23,578	0.00000	0	0	0	0	127.69	0	23,578	0.06511	138,420	276,860	415,280	16,389	0	0	16,389	7,189
10	2025	447,402	0.05428	24,285	0.00000	0	0	0	0	131.52	0	24,285	0.06804	138,420	276,860	415,280	17,126	0	0	17,126	7,159
11	2026	447,402	0.05591	25,014	0.00000	0	0	0	0	135.47	0	25,014	0.07110	138,420	276,860	415,280	17,897	0	0	17,897	7,117
12	2027	447,402	0.05759	25,766	0.00000	0	0	0	0	139.53	0	25,766	0.07430	138,420	276,860	415,280	18,702	0	0	18,702	7,064
13	2028	447,402	0.05932	26,540	0.00000	0	0	0	0	143.72	0	26,540	0.07764	138,420	276,860	415,280	19,543	0	0	19,543	6,997
14	2029	447,402	0.06110	27,336	0.00000	0	0	0	0	148.03	0	27,336	0.08113	138,420	276,860	415,280	20,421	0	0	20,421	6,915
15	2030	447,402	0.06293	28,155	0.00000	0	0	0	0	152.47	0	28,155	0.08478	138,420	276,860	415,280	21,340	0	0	21,340	6,815
16	2031	335,551	0.06482	21,750	0.00000	0	0	0	0	157.04	0	21,750	0.08860	103,815	207,645	311,460	16,726	0	0	16,726	5,024
17	2032	223,701	0.06676	14,934	0.00000	0	0	0	0	161.75	0	14,934	0.09259	69,210	138,430	207,640	11,653	0	0	11,653	3,281
18	2033	0	0.06876	0	0.00000	0	0	0	0	166.61	0	0	0.09675	0	0	0	0	0	0	0	0
19	2034	0	0.07082	0	0.00000	0	0	0	0	171.60	0	0	0.10111	0	0	0	0	0	0	0	0
20	2035	0	0.07294	0	0.00000	0	0	0	0	176.75	0	0	0.10566	0	0	0	0	0	0	0	0
Total =		6,711,030						0				\$347,720				6,229,200			\$271,625	\$76,095	
												NPV =	\$164,811						\$135,736	29,075	
Total NPV =			\$29,075																		
Benefit/Cost Ratio =			<u>1.21</u>																		

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Variable Speed Drives - VFD'S**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$3,993	\$0	\$0	\$3,993	\$5,341	\$5,341	(\$1,348)
2017	8,478	0	0	8,478	4,423	4,423	4,055
2018	17,449	0	0	17,449	8,638	8,638	8,811
2019	17,896	0	0	17,896	0	0	17,896
2020	19,015	0	0	19,015	0	0	19,015
2021	19,999	0	0	19,999	0	0	19,999
2022	21,386	0	0	21,386	0	0	21,386
2023	22,146	0	0	22,146	0	0	22,146
2024	23,578	0	0	23,578	0	0	23,578
2025	24,285	0	0	24,285	0	0	24,285
2026	25,014	0	0	25,014	0	0	25,014
2027	25,766	0	0	25,766	0	0	25,766
2028	26,540	0	0	26,540	0	0	26,540
2029	27,336	0	0	27,336	0	0	27,336
2030	28,155	0	0	28,155	0	0	28,155
2031	21,750	0	0	21,750	0	0	21,750
2032	14,934	0	0	14,934	0	0	14,934
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$347,720		\$18,402	\$329,318
			NPV =	\$164,811		\$16,566	148,245
Total NPV =		\$148,245					
Benefit/Cost Ratio =		<u>9.95</u>					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Variable Speed Drives - VFD'S**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$3,993	\$0	\$0	\$1,263	\$5,256	\$5,341	\$18,950	\$24,291	(\$19,035)
2017	8,478	0	0	2,761	11,239	4,423	18,950	23,373	(12,134)
2018	17,449	0	0	5,854	23,303	8,638	37,900	46,538	(23,235)
2019	17,896	0	0	6,184	24,080	0	0	0	24,080
2020	19,015	0	0	6,767	25,782	0	0	0	25,782
2021	19,999	0	0	7,331	27,330	0	0	0	27,330
2022	21,386	0	0	8,075	29,461	0	0	0	29,461
2023	22,146	0	0	8,613	30,759	0	0	0	30,759
2024	23,578	0	0	9,445	33,023	0	0	0	33,023
2025	24,285	0	0	10,020	34,305	0	0	0	34,305
2026	25,014	0	0	10,630	35,644	0	0	0	35,644
2027	25,766	0	0	11,278	37,044	0	0	0	37,044
2028	26,540	0	0	11,965	38,505	0	0	0	38,505
2029	27,336	0	0	12,694	40,030	0	0	0	40,030
2030	28,155	0	0	13,466	41,621	0	0	0	41,621
2031	21,750	0	0	10,715	32,465	0	0	0	32,465
2032	14,934	0	0	7,578	22,512	0	0	0	22,512
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$492,359		\$94,202	\$398,157	
				NPV =	\$368,076		\$90,487	277,589	
Total NPV =	\$277,589								
Benefit/Cost Ratio =	<u>4.07</u>								

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Variable Speed Drives - VFD'S**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$3,750	\$0.06865	\$0.05611	34,605	69,215	103,820	\$6,259	0	0	\$39,710	\$71,060	\$0	\$0	\$10,009	\$23,093	\$0	\$23,093	(\$13,084)
2017	3,750	0.07174	0.05863	69,210	138,430	207,640	13,081	0	0	41,497	74,258	0	0	16,831	23,492	0	23,492	(6,661)
2018	7,500	0.07496	0.06127	138,420	276,860	415,280	27,339	0	0	43,364	77,599	0	0	34,839	47,797	0	47,797	(12,958)
2019	0	0.07834	0.06403	138,420	276,860	415,280	28,571	0	0	45,316	81,091	0	0	28,571	0	0	0	28,571
2020	0	0.08186	0.06691	138,420	276,860	415,280	29,856	0	0	47,355	84,740	0	0	29,856	0	0	0	29,856
2021	0	0.08555	0.06992	138,420	276,860	415,280	31,200	0	0	49,486	88,554	0	0	31,200	0	0	0	31,200
2022	0	0.08940	0.07306	138,420	276,860	415,280	32,602	0	0	51,713	92,539	0	0	32,602	0	0	0	32,602
2023	0	0.09342	0.07635	138,420	276,860	415,280	34,069	0	0	54,040	96,703	0	0	34,069	0	0	0	34,069
2024	0	0.09762	0.07979	138,420	276,860	415,280	35,603	0	0	56,472	101,054	0	0	35,603	0	0	0	35,603
2025	0	0.10201	0.08338	138,420	276,860	415,280	37,205	0	0	59,013	105,602	0	0	37,205	0	0	0	37,205
2026	0	0.10661	0.08713	138,420	276,860	415,280	38,880	0	0	61,668	110,354	0	0	38,880	0	0	0	38,880
2027	0	0.11140	0.09105	138,420	276,860	415,280	40,628	0	0	64,443	115,320	0	0	40,628	0	0	0	40,628
2028	0	0.11642	0.09515	138,420	276,860	415,280	42,458	0	0	67,343	120,509	0	0	42,458	0	0	0	42,458
2029	0	0.12165	0.09943	138,420	276,860	415,280	44,367	0	0	70,374	125,932	0	0	44,367	0	0	0	44,367
2030	0	0.12713	0.10391	138,420	276,860	415,280	46,366	0	0	73,541	131,599	0	0	46,366	0	0	0	46,366
2031	0	0.13285	0.10858	103,815	207,645	311,460	36,338	0	0	76,850	137,521	0	0	36,338	0	0	0	36,338
2032	0	0.13883	0.11347	69,210	138,430	207,640	25,316	0	0	80,308	143,710	0	0	25,316	0	0	0	25,316
2033	0	0.14507	0.11857	0	0	0	0	0	0	83,922	150,177	0	0	0	0	0	0	0
2034	0	0.15160	0.12391	0	0	0	0	0	0	87,699	156,935	0	0	0	0	0	0	0
2035	0	0.15843	0.12948	0	0	0	0	0	0	91,645	163,997	0	0	0	0	0	0	0
Total =				2,076,300	4,152,900			0	0					\$565,138			\$94,382	\$470,756
														NPV = \$261,976			\$83,751	178,225
Total NPV =			\$178,225															
Benefit/Cost Ratio =			<u>3.13</u>															

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Variable Speed Drives - VFD'S**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$3,993	\$0	\$3,993	\$5,341	\$18,950	\$24,291	(\$20,298)
2017	8,478	0	8,478	4,423	18,950	23,373	(14,895)
2018	17,449	0	17,449	8,638	37,900	46,538	(29,089)
2019	17,896	0	17,896	0	0	0	17,896
2020	19,015	0	19,015	0	0	0	19,015
2021	19,999	0	19,999	0	0	0	19,999
2022	21,386	0	21,386	0	0	0	21,386
2023	22,146	0	22,146	0	0	0	22,146
2024	23,578	0	23,578	0	0	0	23,578
2025	24,285	0	24,285	0	0	0	24,285
2026	25,014	0	25,014	0	0	0	25,014
2027	25,766	0	25,766	0	0	0	25,766
2028	26,540	0	26,540	0	0	0	26,540
2029	27,336	0	27,336	0	0	0	27,336
2030	28,155	0	28,155	0	0	0	28,155
2031	21,750	0	21,750	0	0	0	21,750
2032	14,934	0	14,934	0	0	0	14,934
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$347,720			\$94,202	\$253,518
NPV =			\$164,811			\$84,350	80,461

Total NPV = \$80,461  
Benefit/Cost Ratio = 1.95

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
NORTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Variable Speed Drives - VFD'S**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.08579			
Retail Rate Winter (\$/kWh) =	\$0.06943			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00496			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$45.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$66.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05530			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	8.70%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$1,824	\$1,445	\$1,580
Incentive Costs =		7,500	11,250	15,000
Total Utility Project Costs =		\$9,324	\$12,695	\$16,580
14) Direct Participant Costs (\$/Part.) =		\$4,540	\$4,540	\$4,540
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		15	15	15
16) Avg Summer kW/part. Saved =		0.000	0.000	0.000
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		6,921	6,921	6,921
17a) Avg. Winter kWh/Part. Saved =		13,843	13,843	13,843
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		10	15	20
20) Incentive/Participant =		\$750	\$750	\$750
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		69,210	103,815	138,420
Annual Winter Kwh Saved		138,430	207,645	276,860
23) Annual Summer KW Saved		0	0	0
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		(\$2,226)	0.99	
Utility Cost Test		\$336,653	10.70	
Societal Test		\$626,873	4.12	
Participant Test		\$568,434	4.01	
Total Resource Cost Test		\$183,796	1.98	



**Table 2  
Utility Test**

Project: **Variable Speed Drives - VFD'S**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$7,986	\$0	\$0	\$7,986	\$9,324	\$9,324	(\$1,338)
2017	21,196	0	0	21,196	12,695	12,695	8,501
2018	39,260	0	0	39,260	16,580	16,580	22,680
2019	40,266	0	0	40,266	0	0	40,266
2020	42,783	0	0	42,783	0	0	42,783
2021	44,997	0	0	44,997	0	0	44,997
2022	48,118	0	0	48,118	0	0	48,118
2023	49,829	0	0	49,829	0	0	49,829
2024	53,051	0	0	53,051	0	0	53,051
2025	54,641	0	0	54,641	0	0	54,641
2026	56,282	0	0	56,282	0	0	56,282
2027	57,973	0	0	57,973	0	0	57,973
2028	59,715	0	0	59,715	0	0	59,715
2029	61,507	0	0	61,507	0	0	61,507
2030	63,349	0	0	63,349	0	0	63,349
2031	50,751	0	0	50,751	0	0	50,751
2032	29,869	0	0	29,869	0	0	29,869
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$781,573		\$38,599	\$742,974
				NPV = \$371,359		\$34,706	336,653
Total NPV =		\$336,653					
Benefit/Cost Ratio =		<u>10.70</u>					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Variable Speed Drives - VFD'S**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$7,986	\$0	\$0	\$2,525	\$10,511	\$9,324	\$37,900	\$47,224	(\$36,713)
2017	21,196	0	0	6,903	28,099	12,695	56,850	69,545	(41,446)
2018	39,260	0	0	13,170	52,430	16,580	75,800	92,380	(39,950)
2019	40,266	0	0	13,913	54,179	0	0	0	54,179
2020	42,783	0	0	15,226	58,009	0	0	0	58,009
2021	44,997	0	0	16,495	61,492	0	0	0	61,492
2022	48,118	0	0	18,168	66,286	0	0	0	66,286
2023	49,829	0	0	19,378	69,207	0	0	0	69,207
2024	53,051	0	0	21,250	74,301	0	0	0	74,301
2025	54,641	0	0	22,544	77,185	0	0	0	77,185
2026	56,282	0	0	23,918	80,200	0	0	0	80,200
2027	57,973	0	0	25,375	83,348	0	0	0	83,348
2028	59,715	0	0	26,922	86,637	0	0	0	86,637
2029	61,507	0	0	28,562	90,069	0	0	0	90,069
2030	63,349	0	0	30,300	93,649	0	0	0	93,649
2031	50,751	0	0	25,002	75,753	0	0	0	75,753
2032	29,869	0	0	15,156	45,025	0	0	0	45,025
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$1,106,380			\$209,149	\$897,231
					NPV = \$827,899			\$201,026	626,873
Total NPV =		\$626,873							
Benefit/Cost Ratio =		<u>4.12</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Variable Speed Drives - VFD'S**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$7,500	\$0.08965	\$0.07255	69,210	138,430	207,640	\$16,248	0	0	\$47.025	\$68.970	\$0	\$0	\$23,748	\$46,185	\$0	\$46,185	(\$22,437)
2017	11,250	0.09368	0.07582	173,025	346,075	519,100	42,448	0	0	49.141	72.074	0	0	53,698	70,477	0	70,477	(16,779)
2018	15,000	0.09790	0.07923	311,445	622,935	934,380	79,846	0	0	51.352	75.317	0	0	94,846	95,595	0	95,595	(749)
2019	0	0.10231	0.08280	311,445	622,935	934,380	83,443	0	0	53.663	78.706	0	0	83,443	0	0	0	83,443
2020	0	0.10691	0.08652	311,445	622,935	934,380	87,193	0	0	56.078	82.248	0	0	87,193	0	0	0	87,193
2021	0	0.11172	0.09042	311,445	622,935	934,380	91,120	0	0	58.602	85.949	0	0	91,120	0	0	0	91,120
2022	0	0.11675	0.09448	311,445	622,935	934,380	95,216	0	0	61.239	89.817	0	0	95,216	0	0	0	95,216
2023	0	0.12200	0.09874	311,445	622,935	934,380	99,505	0	0	63.995	93.859	0	0	99,505	0	0	0	99,505
2024	0	0.12749	0.10318	311,445	622,935	934,380	103,981	0	0	66.874	98.082	0	0	103,981	0	0	0	103,981
2025	0	0.13323	0.10782	311,445	622,935	934,380	108,659	0	0	69.884	102.496	0	0	108,659	0	0	0	108,659
2026	0	0.13922	0.11267	311,445	622,935	934,380	113,545	0	0	73.028	107.108	0	0	113,545	0	0	0	113,545
2027	0	0.14549	0.11775	311,445	622,935	934,380	118,663	0	0	76.315	111.928	0	0	118,663	0	0	0	118,663
2028	0	0.15204	0.12304	311,445	622,935	934,380	123,998	0	0	79.749	116.965	0	0	123,998	0	0	0	123,998
2029	0	0.15888	0.12858	311,445	622,935	934,380	129,579	0	0	83.338	122.228	0	0	129,579	0	0	0	129,579
2030	0	0.16603	0.13437	311,445	622,935	934,380	135,413	0	0	87.088	127.729	0	0	135,413	0	0	0	135,413
2031	0	0.17350	0.14041	242,235	484,505	726,740	110,057	0	0	91.007	133.476	0	0	110,057	0	0	0	110,057
2032	0	0.18131	0.14673	138,420	276,860	415,280	65,721	0	0	95.102	139.483	0	0	65,721	0	0	0	65,721
2033	0	0.18947	0.15333	0	0	0	0	0	0	99.382	145.760	0	0	0	0	0	0	0
2034	0	0.19799	0.16023	0	0	0	0	0	0	103.854	152.319	0	0	0	0	0	0	0
2035	0	0.20690	0.16745	0	0	0	0	0	0	108.527	159.173	0	0	0	0	0	0	0
Total =				4,671,675	9,344,025			0	0					\$1,638,385			\$212,257	\$1,426,128
														NPV = \$757,250			\$188,816	568,434
Total NPV =																		\$568,434
Benefit/Cost Ratio =																		<u>4.01</u>

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Variable Speed Drives - VFD'S**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$7,986	\$0	\$7,986	\$9,324	\$37,900	\$47,224	(\$39,238)
2017	21,196	0	21,196	12,695	56,850	69,545	(48,349)
2018	39,260	0	39,260	16,580	75,800	92,380	(53,120)
2019	40,266	0	40,266	0	0	0	40,266
2020	42,783	0	42,783	0	0	0	42,783
2021	44,997	0	44,997	0	0	0	44,997
2022	48,118	0	48,118	0	0	0	48,118
2023	49,829	0	49,829	0	0	0	49,829
2024	53,051	0	53,051	0	0	0	53,051
2025	54,641	0	54,641	0	0	0	54,641
2026	56,282	0	56,282	0	0	0	56,282
2027	57,973	0	57,973	0	0	0	57,973
2028	59,715	0	59,715	0	0	0	59,715
2029	61,507	0	61,507	0	0	0	61,507
2030	63,349	0	63,349	0	0	0	63,349
2031	50,751	0	50,751	0	0	0	50,751
2032	29,869	0	29,869	0	0	0	29,869
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$781,573			\$209,149	\$572,424
NPV =			\$371,359			\$187,563	183,796

Total NPV = \$183,796  
Benefit/Cost Ratio = 1.98

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
SOUTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Variable Speed Drives - VFD'S**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.07621			
Retail Rate Winter (\$/kWh) =	\$0.07438			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00815			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$20.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$40.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.03409			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$443	\$399	\$310
Incentive Costs =		750	1,500	1,500
Total Utility Project Costs =		\$1,193	\$1,899	\$1,810
14) Direct Participant Costs (\$/Part.) =		\$4,540	\$4,540	\$4,540
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		15	15	15
16) Avg Summer kW/part. Saved =		0.000	0.000	0.000
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		6,921	6,921	6,921
17a) Avg. Winter kWh/Part. Saved =		13,843	13,843	13,843
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		1	2	2
20) Incentive/Participant =		\$750	\$750	\$750
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		6,921	13,842	13,842
Annual Winter Kwh Saved		13,843	27,686	27,686
23) Annual Summer KW Saved		0	0	0
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$13,645	1.49	
Utility Cost Test		\$36,878	9.32	
Societal Test		\$69,017	4.01	
Participant Test		\$63,337	4.01	
Total Resource Cost Test		\$19,863	1.93	

**Table 1  
Ratepayer Impact Test**

Project: **Variable Speed Drives - VFD'S**  
Program Years: **2016 - 2018**

t	Year											Costs					Annual Benefits Less Costs (P)					
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)		Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2016	22,370	\$0.03570	\$799	\$0.00000	\$0	0	0	0	\$100.80	\$0	\$799	\$0.03562	6,921	13,843	20,764	\$448	\$443	\$750	\$1,641	(\$842)	
2	2017	67,110	0.03790	2,543	0.00000	0	0	0	0	103.82	0	2,543	0.03723	20,763	41,529	62,292	1,406	399	1,500	3,305	(762)	
3	2018	111,851	0.03900	4,362	0.00000	0	0	0	0	106.94	0	4,362	0.03890	34,605	69,215	103,820	2,448	310	1,500	4,258	104	
4	2019	111,851	0.04000	4,474	0.00000	0	0	0	0	110.15	0	4,474	0.04065	34,605	69,215	103,820	2,558	0	0	2,558	1,916	
5	2020	111,851	0.04250	4,754	0.00000	0	0	0	0	113.45	0	4,754	0.04248	34,605	69,215	103,820	2,673	0	0	2,673	2,081	
6	2021	111,851	0.04470	5,000	0.00000	0	0	0	0	116.85	0	5,000	0.04439	34,605	69,215	103,820	2,793	0	0	2,793	2,207	
7	2022	111,851	0.04780	5,346	0.00000	0	0	0	0	120.36	0	5,346	0.04639	34,605	69,215	103,820	2,919	0	0	2,919	2,427	
8	2023	111,851	0.04950	5,537	0.00000	0	0	0	0	123.97	0	5,537	0.04848	34,605	69,215	103,820	3,051	0	0	3,051	2,486	
9	2024	111,851	0.05270	5,895	0.00000	0	0	0	0	127.69	0	5,895	0.05066	34,605	69,215	103,820	3,188	0	0	3,188	2,707	
10	2025	111,851	0.05428	6,071	0.00000	0	0	0	0	131.52	0	6,071	0.05294	34,605	69,215	103,820	3,331	0	0	3,331	2,740	
11	2026	111,851	0.05591	6,254	0.00000	0	0	0	0	135.47	0	6,254	0.05532	34,605	69,215	103,820	3,481	0	0	3,481	2,773	
12	2027	111,851	0.05759	6,441	0.00000	0	0	0	0	139.53	0	6,441	0.05781	34,605	69,215	103,820	3,638	0	0	3,638	2,803	
13	2028	111,851	0.05932	6,635	0.00000	0	0	0	0	143.72	0	6,635	0.06041	34,605	69,215	103,820	3,801	0	0	3,801	2,834	
14	2029	111,851	0.06110	6,834	0.00000	0	0	0	0	148.03	0	6,834	0.06313	34,605	69,215	103,820	3,973	0	0	3,973	2,861	
15	2030	111,851	0.06293	7,039	0.00000	0	0	0	0	152.47	0	7,039	0.06597	34,605	69,215	103,820	4,151	0	0	4,151	2,888	
16	2031	89,480	0.06482	5,800	0.00000	0	0	0	0	157.04	0	5,800	0.06894	27,684	55,372	83,056	3,471	0	0	3,471	2,329	
17	2032	44,741	0.06676	2,987	0.00000	0	0	0	0	161.75	0	2,987	0.07205	13,842	27,686	41,528	1,814	0	0	1,814	1,173	
18	2033	0	0.06876	0	0.00000	0	0	0	0	166.61	0	0	0.07529	0	0	0	0	0	0	0	0	
19	2034	0	0.07082	0	0.00000	0	0	0	0	171.60	0	0	0.07867	0	0	0	0	0	0	0	0	
20	2035	0	0.07294	0	0.00000	0	0	0	0	176.75	0	0	0.08222	0	0	0	0	0	0	0	0	
Total =		1,677,764						0				\$86,771				1,557,300				\$54,046	\$32,725	
												NPV =	\$41,310								\$27,665	13,645
Total NPV =			\$13,645																			
Benefit/Cost Ratio =			1.49																			

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Variable Speed Drives - VFD'S**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$799	\$0	\$0	\$799	\$1,193	\$1,193	(\$394)
2017	2,543	0	0	2,543	1,899	1,899	644
2018	4,362	0	0	4,362	1,810	1,810	2,552
2019	4,474	0	0	4,474	0	0	4,474
2020	4,754	0	0	4,754	0	0	4,754
2021	5,000	0	0	5,000	0	0	5,000
2022	5,346	0	0	5,346	0	0	5,346
2023	5,537	0	0	5,537	0	0	5,537
2024	5,895	0	0	5,895	0	0	5,895
2025	6,071	0	0	6,071	0	0	6,071
2026	6,254	0	0	6,254	0	0	6,254
2027	6,441	0	0	6,441	0	0	6,441
2028	6,635	0	0	6,635	0	0	6,635
2029	6,834	0	0	6,834	0	0	6,834
2030	7,039	0	0	7,039	0	0	7,039
2031	5,800	0	0	5,800	0	0	5,800
2032	2,987	0	0	2,987	0	0	2,987
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$86,771		\$4,902	\$81,869
				NPV = \$41,310		\$4,432	36,878
Total NPV =		\$36,878					
Benefit/Cost Ratio =		<u>9.32</u>					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Variable Speed Drives - VFD'S**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$799	\$0	\$0	\$253	\$1,052	\$1,193	\$3,790	\$4,983	(\$3,931)
2017	2,543	0	0	828	3,371	1,899	7,580	9,479	(6,108)
2018	4,362	0	0	1,463	5,825	1,810	7,580	9,390	(3,565)
2019	4,474	0	0	1,546	6,020	0	0	0	6,020
2020	4,754	0	0	1,692	6,446	0	0	0	6,446
2021	5,000	0	0	1,833	6,833	0	0	0	6,833
2022	5,346	0	0	2,018	7,364	0	0	0	7,364
2023	5,537	0	0	2,153	7,690	0	0	0	7,690
2024	5,895	0	0	2,361	8,256	0	0	0	8,256
2025	6,071	0	0	2,505	8,576	0	0	0	8,576
2026	6,254	0	0	2,658	8,912	0	0	0	8,912
2027	6,441	0	0	2,819	9,260	0	0	0	9,260
2028	6,635	0	0	2,991	9,626	0	0	0	9,626
2029	6,834	0	0	3,173	10,007	0	0	0	10,007
2030	7,039	0	0	3,367	10,406	0	0	0	10,406
2031	5,800	0	0	2,857	8,657	0	0	0	8,657
2032	2,987	0	0	1,516	4,503	0	0	0	4,503
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$122,804		\$23,852	\$98,952	
NPV =					\$91,965		\$22,948	69,017	
Total NPV =		\$69,017							
Benefit/Cost Ratio =		<u>4.01</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Variable Speed Drives - VFD'S**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$750	\$0.07964	\$0.07773	6,921	13,843	20,764	\$1,627	0	0	\$20,900	\$41,800	\$0	\$0	\$2,377	\$4,619	\$0	\$4,619	(\$2,242)
2017	1,500	0.08322	0.08122	20,763	41,529	62,292	5,101	0	0	21,841	43,681	0	0	6,601	9,397	0	9,397	(2,796)
2018	1,500	0.08697	0.08488	34,605	69,215	103,820	8,885	0	0	22,823	45,647	0	0	10,385	9,559	0	9,559	826
2019	0	0.09088	0.08870	34,605	69,215	103,820	9,284	0	0	23,850	47,701	0	0	9,284	0	0	0	9,284
2020	0	0.09497	0.09269	34,605	69,215	103,820	9,702	0	0	24,924	49,847	0	0	9,702	0	0	0	9,702
2021	0	0.09925	0.09686	34,605	69,215	103,820	10,139	0	0	26,045	52,090	0	0	10,139	0	0	0	10,139
2022	0	0.10371	0.10122	34,605	69,215	103,820	10,595	0	0	27,217	54,434	0	0	10,595	0	0	0	10,595
2023	0	0.10838	0.10578	34,605	69,215	103,820	11,072	0	0	28,442	56,884	0	0	11,072	0	0	0	11,072
2024	0	0.11326	0.11054	34,605	69,215	103,820	11,570	0	0	29,722	59,444	0	0	11,570	0	0	0	11,570
2025	0	0.11835	0.11551	34,605	69,215	103,820	12,091	0	0	31,059	62,119	0	0	12,091	0	0	0	12,091
2026	0	0.12368	0.12071	34,605	69,215	103,820	12,635	0	0	32,457	64,914	0	0	12,635	0	0	0	12,635
2027	0	0.12924	0.12614	34,605	69,215	103,820	13,203	0	0	33,918	67,835	0	0	13,203	0	0	0	13,203
2028	0	0.13506	0.13182	34,605	69,215	103,820	13,798	0	0	35,444	70,888	0	0	13,798	0	0	0	13,798
2029	0	0.14114	0.13775	34,605	69,215	103,820	14,419	0	0	37,039	74,078	0	0	14,419	0	0	0	14,419
2030	0	0.14749	0.14395	34,605	69,215	103,820	15,067	0	0	38,706	77,411	0	0	15,067	0	0	0	15,067
2031	0	0.15412	0.15042	27,684	55,372	83,056	12,596	0	0	40,447	80,895	0	0	12,596	0	0	0	12,596
2032	0	0.16106	0.15719	13,842	27,686	41,528	6,581	0	0	42,268	84,535	0	0	6,581	0	0	0	6,581
2033	0	0.16831	0.16427	0	0	0	0	0	0	44,170	88,339	0	0	0	0	0	0	0
2034	0	0.17588	0.17166	0	0	0	0	0	0	46,157	92,314	0	0	0	0	0	0	0
2035	0	0.18380	0.17938	0	0	0	0	0	0	48,234	96,469	0	0	0	0	0	0	0
Total =				519,075	1,038,225			0	0					\$182,115			\$23,575	\$158,540
														NPV = \$84,351			\$21,013	63,337
Total NPV =			\$63,337															
Benefit/Cost Ratio =			<u>4.01</u>															

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Variable Speed Drives - VFD'S**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$799	\$0	\$799	\$1,193	\$3,790	\$4,983	(\$4,184)
2017	2,543	0	2,543	1,899	7,580	9,479	(6,936)
2018	4,362	0	4,362	1,810	7,580	9,390	(5,028)
2019	4,474	0	4,474	0	0	0	4,474
2020	4,754	0	4,754	0	0	0	4,754
2021	5,000	0	5,000	0	0	0	5,000
2022	5,346	0	5,346	0	0	0	5,346
2023	5,537	0	5,537	0	0	0	5,537
2024	5,895	0	5,895	0	0	0	5,895
2025	6,071	0	6,071	0	0	0	6,071
2026	6,254	0	6,254	0	0	0	6,254
2027	6,441	0	6,441	0	0	0	6,441
2028	6,635	0	6,635	0	0	0	6,635
2029	6,834	0	6,834	0	0	0	6,834
2030	7,039	0	7,039	0	0	0	7,039
2031	5,800	0	5,800	0	0	0	5,800
2032	2,987	0	2,987	0	0	0	2,987
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$86,771			\$23,852	\$62,919
NPV =			\$41,310			\$21,447	19,863

Total NPV = \$19,863  
Benefit/Cost Ratio = 1.93

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Commercial Partnership Program (Custom)**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.06569			
Retail Rate Winter (\$/kWh) =	\$0.05369			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00418			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$38.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$68.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.04381			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$8,484	\$5,385	\$7,586
Incentive Costs =		20,000	30,000	50,000
Total Utility Project Costs =		\$28,484	\$35,385	\$57,586
14) Direct Participant Costs (\$/Part.) =		\$20,000	\$20,000	\$20,000
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		10	10	10
16) Avg Summer kW/part. Saved =		15,000	15,000	15,000
16a) Avg Winter kW/part Saved =		15,000	15,000	15,000
17) Avg. Summer kWh/Part. Saved =		50,000	50,000	50,000
17a) Avg. Winter kWh/Part. Saved =		50,000	50,000	50,000
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		2	3	5
20) Incentive/Participant =		\$10,000	\$10,000	\$10,000
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		100,000	150,000	250,000
Annual Winter Kwh Saved		100,000	150,000	250,000
23) Annual Summer KW Saved		30	45	75
Annual Winter KW Saved		30	45	75
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$218,019	1.68	
Utility Cost Test		\$430,526	4.96	
Societal Test		\$820,050	4.86	
Participant Test		\$491,910	3.68	
Total Resource Cost Test		\$341,540	2.73	

**Table 1  
Ratepayer Impact Test**

Project: **Commercial Partnership Program (Custom)**  
 Program Years: **2016 - 2018**

t	Year											Costs					Annual Benefits Less Costs (P)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)		Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)
1	2016	215,470	\$0.03570	\$7,692	\$0.00000	\$0	34	34	68	\$100.80	\$6,854	\$14,546	\$0.04578	100,000	100,000	200,000	\$5,550	\$8,484	\$20,000	\$34,034	(\$19,488)
2	2017	538,676	0.03790	20,416	0.00000	0	85	85	170	103.82	17,649	38,065	0.04784	250,000	250,000	500,000	14,499	5,385	30,000	49,884	(11,819)
3	2018	1,077,350	0.03900	42,017	0.00000	0	169	169	338	106.94	36,146	78,163	0.04999	500,000	500,000	1,000,000	30,300	7,586	50,000	87,886	(9,723)
4	2019	1,077,350	0.04000	43,094	0.00000	0	169	169	338	110.15	37,231	80,325	0.05224	500,000	500,000	1,000,000	31,664	0	0	31,664	48,661
5	2020	1,077,350	0.04250	45,787	0.00000	0	169	169	338	113.45	38,346	84,133	0.05460	500,000	500,000	1,000,000	33,094	0	0	33,094	51,039
6	2021	1,077,350	0.04470	48,158	0.00000	0	169	169	338	116.85	39,495	87,653	0.05705	500,000	500,000	1,000,000	34,579	0	0	34,579	53,074
7	2022	1,077,350	0.04780	51,497	0.00000	0	169	169	338	120.36	40,682	92,179	0.05962	500,000	500,000	1,000,000	36,137	0	0	36,137	56,042
8	2023	1,077,350	0.04950	53,329	0.00000	0	169	169	338	123.97	41,902	95,231	0.06230	500,000	500,000	1,000,000	37,762	0	0	37,762	57,469
9	2024	1,077,350	0.05270	56,776	0.00000	0	169	169	338	127.69	43,159	99,935	0.06511	500,000	500,000	1,000,000	39,465	0	0	39,465	60,470
10	2025	1,077,350	0.05428	58,479	0.00000	0	169	169	338	131.52	44,454	102,933	0.06804	500,000	500,000	1,000,000	41,241	0	0	41,241	61,692
11	2026	861,880	0.05591	48,188	0.00000	0	136	136	272	135.47	36,848	85,036	0.07110	400,000	400,000	800,000	34,476	0	0	34,476	50,560
12	2027	538,676	0.05759	31,022	0.00000	0	85	85	170	139.53	23,720	54,742	0.07430	250,000	250,000	500,000	22,518	0	0	22,518	32,224
13	2028	0	0.05932	0	0.00000	0	0	0	0	143.72	0	0	0.07764	0	0	0	0	0	0	0	0
14	2029	0	0.06110	0	0.00000	0	0	0	0	148.03	0	0	0.08113	0	0	0	0	0	0	0	0
15	2030	0	0.06293	0	0.00000	0	0	0	0	152.47	0	0	0.08478	0	0	0	0	0	0	0	0
16	2031	0	0.06482	0	0.00000	0	0	0	0	157.04	0	0	0.08860	0	0	0	0	0	0	0	0
17	2032	0	0.06676	0	0.00000	0	0	0	0	161.75	0	0	0.09259	0	0	0	0	0	0	0	0
18	2033	0	0.06876	0	0.00000	0	0	0	0	166.61	0	0	0.09675	0	0	0	0	0	0	0	0
19	2034	0	0.07082	0	0.00000	0	0	0	0	171.60	0	0	0.10111	0	0	0	0	0	0	0	0
20	2035	0	0.07294	0	0.00000	0	0	0	0	176.75	0	0	0.10566	0	0	0	0	0	0	0	0
Total =		10,773,502							3,384			\$912,941			10,000,000				\$482,740	\$430,201	
												NPV =	\$539,224							\$321,205	218,019
Total NPV =			\$218,019																		
Benefit/Cost Ratio =			<u>1.68</u>																		

Worksheet Calculations	
(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Commercial Partnership Program (Custom)**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$7,692	\$0	\$6,854	\$14,546	\$28,484	\$28,484	(\$13,938)
2017	20,416	0	17,649	38,065	35,385	35,385	2,680
2018	42,017	0	36,146	78,163	57,586	57,586	20,577
2019	43,094	0	37,231	80,325	0	0	80,325
2020	45,787	0	38,346	84,133	0	0	84,133
2021	48,158	0	39,495	87,653	0	0	87,653
2022	51,497	0	40,682	92,179	0	0	92,179
2023	53,329	0	41,902	95,231	0	0	95,231
2024	56,776	0	43,159	99,935	0	0	99,935
2025	58,479	0	44,454	102,933	0	0	102,933
2026	48,188	0	36,848	85,036	0	0	85,036
2027	31,022	0	23,720	54,742	0	0	54,742
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$912,941		\$121,455	\$791,486
			NPV =	\$539,224		\$108,698	430,526
Total NPV =		\$430,526					
Benefit/Cost Ratio =		<u>4.96</u>					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Commercial Partnership Program (Custom)**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$7,692	\$0	\$6,854	\$4,600	\$19,146	\$28,484	\$20,000	\$48,484	(\$29,338)
2017	20,416	0	17,649	12,398	50,463	35,385	30,000	65,385	(14,922)
2018	42,017	0	36,146	26,221	104,384	57,586	50,000	107,586	(3,202)
2019	43,094	0	37,231	27,755	108,080	0	0	0	108,080
2020	45,787	0	38,346	29,943	114,076	0	0	0	114,076
2021	48,158	0	39,495	32,131	119,784	0	0	0	119,784
2022	51,497	0	40,682	34,804	126,983	0	0	0	126,983
2023	53,329	0	41,902	37,035	132,266	0	0	0	132,266
2024	56,776	0	43,159	40,030	139,965	0	0	0	139,965
2025	58,479	0	44,454	42,468	145,401	0	0	0	145,401
2026	48,188	0	36,848	36,137	121,173	0	0	0	121,173
2027	31,022	0	23,720	23,961	78,703	0	0	0	78,703
2028	0	0	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$1,260,424			\$221,455	\$1,038,969
					NPV = \$1,032,550			\$212,500	820,050
Total NPV =		\$820,050							
Benefit/Cost Ratio =		<u>4.86</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Commercial Partnership Program (Custom)**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$20,000	\$0.06865	\$0.05611	100,000	100,000	200,000	\$12,476	30	30	\$39.710	\$71.060	\$3,323	\$0	\$35,799	\$40,692	\$0	\$40,692	(\$4,893)
2017	30,000	0.07174	0.05863	250,000	250,000	500,000	32,593	75	75	41.497	74.258	8,682	0	71,275	62,094	0	62,094	9,181
2018	50,000	0.07496	0.06127	500,000	500,000	1,000,000	68,115	150	150	43.364	77.599	18,144	0	136,259	105,280	0	105,280	30,979
2019	0	0.07834	0.06403	500,000	500,000	1,000,000	71,185	150	150	45.316	81.091	18,961	0	90,146	0	0	0	90,146
2020	0	0.08186	0.06691	500,000	500,000	1,000,000	74,385	150	150	47.355	84.740	19,814	0	94,199	0	0	0	94,199
2021	0	0.08555	0.06992	500,000	500,000	1,000,000	77,735	150	150	49.486	88.554	20,706	0	98,441	0	0	0	98,441
2022	0	0.08940	0.07306	500,000	500,000	1,000,000	81,230	150	150	51.713	92.539	21,638	0	102,868	0	0	0	102,868
2023	0	0.09342	0.07635	500,000	500,000	1,000,000	84,885	150	150	54.040	96.703	22,611	0	107,496	0	0	0	107,496
2024	0	0.09762	0.07979	500,000	500,000	1,000,000	88,705	150	150	56.472	101.054	23,629	0	112,334	0	0	0	112,334
2025	0	0.10201	0.08338	500,000	500,000	1,000,000	92,695	150	150	59.013	105.602	24,692	0	117,387	0	0	0	117,387
2026	0	0.10661	0.08713	400,000	400,000	800,000	77,496	120	120	61.668	110.354	20,643	0	98,139	0	0	0	98,139
2027	0	0.11140	0.09105	250,000	250,000	500,000	50,613	75	75	64.443	115.320	13,482	0	64,095	0	0	0	64,095
2028	0	0.11642	0.09515	0	0	0	0	0	0	67.343	120.509	0	0	0	0	0	0	0
2029	0	0.12165	0.09943	0	0	0	0	0	0	70.374	125.932	0	0	0	0	0	0	0
2030	0	0.12713	0.10391	0	0	0	0	0	0	73.541	131.599	0	0	0	0	0	0	0
2031	0	0.13285	0.10858	0	0	0	0	0	0	76.850	137.521	0	0	0	0	0	0	0
2032	0	0.13883	0.11347	0	0	0	0	0	0	80.308	143.710	0	0	0	0	0	0	0
2033	0	0.14507	0.11857	0	0	0	0	0	0	83.922	150.177	0	0	0	0	0	0	0
2034	0	0.15160	0.12391	0	0	0	0	0	0	87.699	156.935	0	0	0	0	0	0	0
2035	0	0.15843	0.12948	0	0	0	0	0	0	91.645	163.997	0	0	0	0	0	0	0
Total =				5,000,000	5,000,000			1,500	1,500					\$1,128,438			\$208,066	\$920,372
														NPV = \$675,599			\$183,690	491,910

Total NPV = \$491,910  
 Benefit/Cost Ratio = 3.68

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Commercial Partnership Program (Custom)**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$7,692	\$6,854	\$14,546	\$28,484	\$20,000	\$48,484	(\$33,938)
2017	20,416	17,649	38,065	35,385	30,000	65,385	(27,320)
2018	42,017	36,146	78,163	57,586	50,000	107,586	(29,423)
2019	43,094	37,231	80,325	0	0	0	80,325
2020	45,787	38,346	84,133	0	0	0	84,133
2021	48,158	39,495	87,653	0	0	0	87,653
2022	51,497	40,682	92,179	0	0	0	92,179
2023	53,329	41,902	95,231	0	0	0	95,231
2024	56,776	43,159	99,935	0	0	0	99,935
2025	58,479	44,454	102,933	0	0	0	102,933
2026	48,188	36,848	85,036	0	0	0	85,036
2027	31,022	23,720	54,742	0	0	0	54,742
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$912,941			\$221,455	\$691,486
NPV =			\$539,224			\$197,684	341,540

Total NPV = \$341,540  
Benefit/Cost Ratio = 2.73

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
NORTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Commercial Partnership Program (Custom)**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.08579			
Retail Rate Winter (\$/kWh) =	\$0.06943			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00496			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$45.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$66.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05530			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	8.70%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$12,160	\$8,988	\$10,533
Incentive Costs =		50,000	70,000	100,000
Total Utility Project Costs =		\$62,160	\$78,988	\$110,533
14) Direct Participant Costs (\$/Part.) =		\$20,000	\$20,000	\$20,000
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		10	10	10
16) Avg Summer kW/part. Saved =		15,000	15,000	15,000
16a) Avg Winter kW/part Saved =		15,000	15,000	15,000
17) Avg. Summer kWh/Part. Saved =		50,000	50,000	50,000
17a) Avg. Winter kWh/Part. Saved =		50,000	50,000	50,000
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		5	7	10
20) Incentive/Participant =		\$10,000	\$10,000	\$10,000
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		250,000	350,000	500,000
Annual Winter Kwh Saved		250,000	350,000	500,000
23) Annual Summer KW Saved		75	105	150
Annual Winter KW Saved		75	105	150
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$373,634	1.46	
Utility Cost Test		\$965,832	5.27	
Societal Test		\$1,817,923	5.01	
Participant Test		\$1,406,579	4.46	
Total Resource Cost Test		\$768,735	2.82	



**Table 2  
Utility Test**

Project: **Commercial Partnership Program (Custom)**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$19,231	\$0	\$17,136	\$36,367	\$62,160	\$62,160	(\$25,793)
2017	48,998	0	42,151	91,149	78,988	78,988	12,161
2018	92,437	0	79,777	172,214	110,533	110,533	61,681
2019	94,807	0	82,172	176,979	0	0	176,979
2020	100,732	0	84,634	185,366	0	0	185,366
2021	105,947	0	87,170	193,117	0	0	193,117
2022	113,294	0	89,789	203,083	0	0	203,083
2023	117,323	0	92,482	209,805	0	0	209,805
2024	124,908	0	95,257	220,165	0	0	220,165
2025	128,653	0	98,114	226,767	0	0	226,767
2026	102,399	0	78,031	180,430	0	0	180,430
2027	62,045	0	47,161	109,206	0	0	109,206
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$2,004,648		\$251,681	\$1,752,967
NPV =				\$1,192,056		\$226,224	965,832
Total NPV =				\$965,832			
Benefit/Cost Ratio =				<u>5.27</u>			

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Commercial Partnership Program (Custom)**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$19,231	\$0	\$17,136	\$11,500	\$47,867	\$62,160	\$50,000	\$112,160	(\$64,293)
2017	48,998	0	42,151	29,687	120,836	78,988	70,000	148,988	(28,152)
2018	92,437	0	79,777	57,772	229,986	110,533	100,000	210,533	19,453
2019	94,807	0	82,172	61,152	238,131	0	0	0	238,131
2020	100,732	0	84,634	65,971	251,337	0	0	0	251,337
2021	105,947	0	87,170	70,792	263,909	0	0	0	263,909
2022	113,294	0	89,789	76,678	279,761	0	0	0	279,761
2023	117,323	0	92,482	81,593	291,398	0	0	0	291,398
2024	124,908	0	95,257	88,190	308,355	0	0	0	308,355
2025	128,653	0	98,114	93,560	320,327	0	0	0	320,327
2026	102,399	0	78,031	76,675	257,105	0	0	0	257,105
2027	62,045	0	47,161	47,800	157,006	0	0	0	157,006
2028	0	0	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$2,766,018			\$471,681	\$2,294,337
					NPV = \$2,271,399			\$453,476	1,817,923
Total NPV =								\$1,817,923	
Benefit/Cost Ratio =								<u>5.01</u>	

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Commercial Partnership Program (Custom)**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$50,000	\$0.08965	\$0.07255	250,000	250,000	500,000	\$40,550	75	75	\$47.025	\$68.970	\$8,700	\$0	\$99,250	\$101,730	\$0	\$101,730	(\$2,480)
2017	70,000	0.09368	0.07582	600,000	600,000	1,200,000	101,700	180	180	49.141	72.074	21,819	0	193,519	144,886	0	144,886	48,633
2018	100,000	0.09790	0.07923	1,100,000	1,100,000	2,200,000	194,843	330	330	51.352	75.317	41,801	0	336,644	210,561	0	210,561	126,083
2019	0	0.10231	0.08280	1,100,000	1,100,000	2,200,000	203,621	330	330	53.663	78.706	43,682	0	247,303	0	0	0	247,303
2020	0	0.10691	0.08652	1,100,000	1,100,000	2,200,000	212,773	330	330	56.078	82.248	45,648	0	258,421	0	0	0	258,421
2021	0	0.11172	0.09042	1,100,000	1,100,000	2,200,000	222,354	330	330	58.602	85.949	47,702	0	270,056	0	0	0	270,056
2022	0	0.11675	0.09448	1,100,000	1,100,000	2,200,000	232,353	330	330	61.239	89.817	49,848	0	282,201	0	0	0	282,201
2023	0	0.12200	0.09874	1,100,000	1,100,000	2,200,000	242,814	330	330	63.995	93.859	52,092	0	294,906	0	0	0	294,906
2024	0	0.12749	0.10318	1,100,000	1,100,000	2,200,000	253,737	330	330	66.874	98.082	54,436	0	308,173	0	0	0	308,173
2025	0	0.13323	0.10782	1,100,000	1,100,000	2,200,000	265,155	330	330	69.884	102.496	56,885	0	322,040	0	0	0	322,040
2026	0	0.13922	0.11267	850,000	850,000	1,700,000	214,107	255	255	73.028	107.108	45,935	0	260,042	0	0	0	260,042
2027	0	0.14549	0.11775	500,000	500,000	1,000,000	131,620	150	150	76.315	111.928	28,236	0	159,856	0	0	0	159,856
2028	0	0.15204	0.12304	0	0	0	0	0	0	79.749	116.965	0	0	0	0	0	0	0
2029	0	0.15888	0.12858	0	0	0	0	0	0	83.338	122.228	0	0	0	0	0	0	0
2030	0	0.16603	0.13437	0	0	0	0	0	0	87.088	127.729	0	0	0	0	0	0	0
2031	0	0.17350	0.14041	0	0	0	0	0	0	91.007	133.476	0	0	0	0	0	0	0
2032	0	0.18131	0.14673	0	0	0	0	0	0	95.102	139.483	0	0	0	0	0	0	0
2033	0	0.18947	0.15333	0	0	0	0	0	0	99.382	145.760	0	0	0	0	0	0	0
2034	0	0.19799	0.16023	0	0	0	0	0	0	103.854	152.319	0	0	0	0	0	0	0
2035	0	0.20690	0.16745	0	0	0	0	0	0	108.527	159.173	0	0	0	0	0	0	0
Total =				11,000,000	11,000,000			3,300	3,300					\$3,032,411			\$457,177	\$2,575,234
														NPV = \$1,813,084			\$406,505	1,406,579

Total NPV = \$1,406,579  
 Benefit/Cost Ratio = 4.46

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Commercial Partnership Program (Custom)**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$19,231	\$17,136	\$36,367	\$62,160	\$50,000	\$112,160	(\$75,793)
2017	48,998	42,151	91,149	78,988	70,000	148,988	(57,839)
2018	92,437	79,777	172,214	110,533	100,000	210,533	(38,319)
2019	94,807	82,172	176,979	0	0	0	176,979
2020	100,732	84,634	185,366	0	0	0	185,366
2021	105,947	87,170	193,117	0	0	0	193,117
2022	113,294	89,789	203,083	0	0	0	203,083
2023	117,323	92,482	209,805	0	0	0	209,805
2024	124,908	95,257	220,165	0	0	0	220,165
2025	128,653	98,114	226,767	0	0	0	226,767
2026	102,399	78,031	180,430	0	0	0	180,430
2027	62,045	47,161	109,206	0	0	0	109,206
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$2,004,648			\$471,681	\$1,532,967
NPV =			\$1,192,056			\$423,320	768,735

Total NPV = \$768,735  
Benefit/Cost Ratio = 2.82

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
SOUTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Commercial Partnership Program (Custom)**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.07621			
Retail Rate Winter (\$/kWh) =	\$0.07438			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00815			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$20.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$40.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.03409			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$5,903	\$2,659	\$2,065
Incentive Costs =		10,000	10,000	10,000
Total Utility Project Costs =		\$15,903	\$12,659	\$12,065
14) Direct Participant Costs (\$/Part.) =		\$20,000	\$20,000	\$20,000
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		10	10	10
16) Avg Summer kW/part. Saved =		15,000	15,000	15,000
16a) Avg Winter kW/part Saved =		15,000	15,000	15,000
17) Avg. Summer kWh/Part. Saved =		50,000	50,000	50,000
17a) Avg. Winter kWh/Part. Saved =		50,000	50,000	50,000
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		1	1	1
20) Incentive/Participant =		\$10,000	\$10,000	\$10,000
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		50,000	50,000	50,000
Annual Winter Kwh Saved		50,000	50,000	50,000
23) Annual Summer KW Saved		15	15	15
Annual Winter KW Saved		15	15	15
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$76,986	1.88	
Utility Cost Test		\$127,309	4.40	
Societal Test		\$240,794	4.52	
Participant Test		\$170,483	4.02	
Total Resource Cost Test		\$99,862	2.54	

**Table 1  
Ratepayer Impact Test**

Project: **Commercial Partnership Program (Custom)**  
Program Years: **2016 - 2018**

t	Year											Costs					Annual Benefits Less Costs (P)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)		Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)
1	2016	107,736	\$0.03570	\$3,846	\$0.00000	\$0	17	17	34	\$100.80	\$3,427	\$7,273	\$0.03562	50,000	50,000	100,000	\$2,159	\$5,903	\$10,000	\$18,062	(\$10,789)
2	2017	215,470	0.03790	8,166	0.00000	0	34	34	68	103.82	7,060	15,226	0.03723	100,000	100,000	200,000	4,513	2,659	10,000	17,172	(1,946)
3	2018	323,206	0.03900	12,605	0.00000	0	51	51	102	106.94	10,908	23,513	0.03890	150,000	150,000	300,000	7,073	2,065	10,000	19,138	4,375
4	2019	323,206	0.04000	12,928	0.00000	0	51	51	102	110.15	11,235	24,163	0.04065	150,000	150,000	300,000	7,392	0	0	7,392	16,771
5	2020	323,206	0.04250	13,736	0.00000	0	51	51	102	113.45	11,572	25,308	0.04248	150,000	150,000	300,000	7,724	0	0	7,724	17,584
6	2021	323,206	0.04470	14,447	0.00000	0	51	51	102	116.85	11,919	26,366	0.04439	150,000	150,000	300,000	8,072	0	0	8,072	18,294
7	2022	323,206	0.04780	15,449	0.00000	0	51	51	102	120.36	12,277	27,726	0.04639	150,000	150,000	300,000	8,435	0	0	8,435	19,291
8	2023	323,206	0.04950	15,999	0.00000	0	51	51	102	123.97	12,645	28,644	0.04848	150,000	150,000	300,000	8,815	0	0	8,815	19,829
9	2024	323,206	0.05270	17,033	0.00000	0	51	51	102	127.69	13,024	30,057	0.05066	150,000	150,000	300,000	9,212	0	0	9,212	20,845
10	2025	323,206	0.05428	17,544	0.00000	0	51	51	102	131.52	13,415	30,959	0.05294	150,000	150,000	300,000	9,626	0	0	9,626	21,333
11	2026	215,470	0.05591	12,047	0.00000	0	34	34	68	135.47	9,212	21,259	0.05532	100,000	100,000	200,000	6,706	0	0	6,706	14,553
12	2027	107,736	0.05759	6,205	0.00000	0	17	17	34	139.53	4,744	10,949	0.05781	50,000	50,000	100,000	3,504	0	0	3,504	7,445
13	2028	0	0.05932	0	0.00000	0	0	0	0	143.72	0	0	0.06041	0	0	0	0	0	0	0	0
14	2029	0	0.06110	0	0.00000	0	0	0	0	148.03	0	0	0.06313	0	0	0	0	0	0	0	0
15	2030	0	0.06293	0	0.00000	0	0	0	0	152.47	0	0	0.06597	0	0	0	0	0	0	0	0
16	2031	0	0.06482	0	0.00000	0	0	0	0	157.04	0	0	0.06894	0	0	0	0	0	0	0	0
17	2032	0	0.06676	0	0.00000	0	0	0	0	161.75	0	0	0.07205	0	0	0	0	0	0	0	0
18	2033	0	0.06876	0	0.00000	0	0	0	0	166.61	0	0	0.07529	0	0	0	0	0	0	0	0
19	2034	0	0.07082	0	0.00000	0	0	0	0	171.60	0	0	0.07867	0	0	0	0	0	0	0	0
20	2035	0	0.07294	0	0.00000	0	0	0	0	176.75	0	0	0.08222	0	0	0	0	0	0	0	0
Total =		3,232,060							1,020			\$271,443				3,000,000				\$123,858	\$147,585
												NPV =	\$164,803							\$87,817	76,986
Total NPV =			\$76,986																		
Benefit/Cost Ratio =			<u>1.88</u>																		

Worksheet Calculations	
(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Commercial Partnership Program (Custom)**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$3,846	\$0	\$3,427	\$7,273	\$15,903	\$15,903	(\$8,630)
2017	8,166	0	7,060	15,226	12,659	12,659	2,567
2018	12,605	0	10,908	23,513	12,065	12,065	11,448
2019	12,928	0	11,235	24,163	0	0	24,163
2020	13,736	0	11,572	25,308	0	0	25,308
2021	14,447	0	11,919	26,366	0	0	26,366
2022	15,449	0	12,277	27,726	0	0	27,726
2023	15,999	0	12,645	28,644	0	0	28,644
2024	17,033	0	13,024	30,057	0	0	30,057
2025	17,544	0	13,415	30,959	0	0	30,959
2026	12,047	0	9,212	21,259	0	0	21,259
2027	6,205	0	4,744	10,949	0	0	10,949
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0

Total = \$271,443 \$40,627 \$230,816  
 NPV = \$164,803 \$37,494 127,309

Total NPV = \$127,309  
 Benefit/Cost Ratio = 4.40

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Commercial Partnership Program (Custom)**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$3,846	\$0	\$3,427	\$2,300	\$9,573	\$15,903	\$10,000	\$25,903	(\$16,330)
2017	8,166	0	7,060	4,959	20,185	12,659	10,000	22,659	(2,474)
2018	12,605	0	10,908	7,888	31,401	12,065	10,000	22,065	9,336
2019	12,928	0	11,235	8,349	32,512	0	0	0	32,512
2020	13,736	0	11,572	9,007	34,315	0	0	0	34,315
2021	14,447	0	11,919	9,665	36,031	0	0	0	36,031
2022	15,449	0	12,277	10,469	38,195	0	0	0	38,195
2023	15,999	0	12,645	11,140	39,784	0	0	0	39,784
2024	17,033	0	13,024	12,040	42,097	0	0	0	42,097
2025	17,544	0	13,415	12,773	43,732	0	0	0	43,732
2026	12,047	0	9,212	9,034	30,293	0	0	0	30,293
2027	6,205	0	4,744	4,792	15,741	0	0	0	15,741
2028	0	0	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$373,859		\$70,627	\$303,232	
NPV =					\$309,285		\$68,491	240,794	
Total NPV =		\$240,794							
Benefit/Cost Ratio =		<u>4.52</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Commercial Partnership Program (Custom)**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$10,000	\$0.07964	\$0.07773	50,000	50,000	100,000	\$7,869	15	15	\$20.900	\$41.800	\$941	\$0	\$18,810	\$20,346	\$0	\$20,346	(\$1,536)
2017	10,000	0.08322	0.08122	100,000	100,000	200,000	16,444	30	30	21.841	43.681	1,966	0	28,410	20,698	0	20,698	7,712
2018	10,000	0.08697	0.08488	150,000	150,000	300,000	25,778	45	45	22.823	45.647	3,081	0	38,859	21,056	0	21,056	17,803
2019	0	0.09088	0.08870	150,000	150,000	300,000	26,937	45	45	23.850	47.701	3,220	0	30,157	0	0	0	30,157
2020	0	0.09497	0.09269	150,000	150,000	300,000	28,149	45	45	24.924	49.847	3,365	0	31,514	0	0	0	31,514
2021	0	0.09925	0.09686	150,000	150,000	300,000	29,417	45	45	26.045	52.090	3,516	0	32,933	0	0	0	32,933
2022	0	0.10371	0.10122	150,000	150,000	300,000	30,740	45	45	27.217	54.434	3,674	0	34,414	0	0	0	34,414
2023	0	0.10838	0.10578	150,000	150,000	300,000	32,124	45	45	28.442	56.884	3,840	0	35,964	0	0	0	35,964
2024	0	0.11326	0.11054	150,000	150,000	300,000	33,570	45	45	29.722	59.444	4,012	0	37,582	0	0	0	37,582
2025	0	0.11835	0.11551	150,000	150,000	300,000	35,079	45	45	31.059	62.119	4,193	0	39,272	0	0	0	39,272
2026	0	0.12368	0.12071	100,000	100,000	200,000	24,439	30	30	32.457	64.914	2,921	0	27,360	0	0	0	27,360
2027	0	0.12924	0.12614	50,000	50,000	100,000	12,769	15	15	33.918	67.835	1,526	0	14,295	0	0	0	14,295
2028	0	0.13506	0.13182	0	0	0	0	0	0	35.444	70.888	0	0	0	0	0	0	0
2029	0	0.14114	0.13775	0	0	0	0	0	0	37.039	74.078	0	0	0	0	0	0	0
2030	0	0.14749	0.14395	0	0	0	0	0	0	38.706	77.411	0	0	0	0	0	0	0
2031	0	0.15412	0.15042	0	0	0	0	0	0	40.447	80.895	0	0	0	0	0	0	0
2032	0	0.16106	0.15719	0	0	0	0	0	0	42.268	84.535	0	0	0	0	0	0	0
2033	0	0.16831	0.16427	0	0	0	0	0	0	44.170	88.339	0	0	0	0	0	0	0
2034	0	0.17588	0.17166	0	0	0	0	0	0	46.157	92.314	0	0	0	0	0	0	0
2035	0	0.18380	0.17938	0	0	0	0	0	0	48.234	96.469	0	0	0	0	0	0	0
Total =				1,500,000	1,500,000			450	450					\$369,570			\$62,100	\$307,470
														NPV = \$226,940			\$56,457	170,483

Total NPV = \$170,483  
 Benefit/Cost Ratio = 4.02

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Commercial Partnership Program (Custom)**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$3,846	\$3,427	\$7,273	\$15,903	\$10,000	\$25,903	(\$18,630)
2017	8,166	7,060	15,226	12,659	10,000	22,659	(7,433)
2018	12,605	10,908	23,513	12,065	10,000	22,065	1,448
2019	12,928	11,235	24,163	0	0	0	24,163
2020	13,736	11,572	25,308	0	0	0	25,308
2021	14,447	11,919	26,366	0	0	0	26,366
2022	15,449	12,277	27,726	0	0	0	27,726
2023	15,999	12,645	28,644	0	0	0	28,644
2024	17,033	13,024	30,057	0	0	0	30,057
2025	17,544	13,415	30,959	0	0	0	30,959
2026	12,047	9,212	21,259	0	0	0	21,259
2027	6,205	4,744	10,949	0	0	0	10,949
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$271,443			\$70,627	\$200,816
NPV =			\$164,803			\$64,941	99,862

Total NPV = \$99,862  
Benefit/Cost Ratio = 2.54

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Commercial Demand Response Program**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.06569			
Retail Rate Winter (\$/kWh) =	\$0.05369			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00418			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$38.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$68.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.04381			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$27,880	\$28,692	\$27,864
Incentive Costs =		0	0	0
Direct Program Costs =		316,470	374,010	374,010
Total Utility Project Costs =		\$344,350	\$402,702	\$401,874
14) Direct Participant Costs (\$/Part.) =		\$0	\$0	\$0
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		10	10	10
16) Avg Summer kW/part. Saved =		1,000.000	1,000.000	1,000.000
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		25,000	25,000	25,000
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		1	1	0
20) Incentive/Participant =		\$0	\$0	\$0
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		25,000	25,000	0
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		1,000	1,000	0
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$2,862,248	2.13	
Utility Cost Test		\$2,862,248	2.13	
Societal Test		\$6,161,044	2.95	
Participant Test		\$413,434	73.25	
Total Resource Cost Test		\$2,856,512	2.13	

**Table 1  
Ratepayer Impact Test**

Project: **Commercial Demand Response Program**  
Program Years: **2016 - 2018**

t	Year											Costs							Annual Benefits Less Costs (P)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)	Program Admin Costs (M)		Incentive Costs (N)	Direct Program Costs (O)	Total Project Costs (O)	
0	2015						5,084							112,500							\$258,930		
1	2016	148,136	\$0.03570	\$5,288	\$0.00000	\$0	6,214	0	6,214	\$100.80	\$626,371	\$631,659	\$0.04578	137,500	0	137,500	\$3,815	\$27,880	\$0	\$316,470	\$348,165	\$283,494	
2	2017	175,070	0.03790	6,635	0.00000	0	7,344	0	7,344	103.82	762,454	769,089	0.04784	162,500	0	162,500	4,712	28,692	0	374,010	407,414	361,675	
3	2018	175,070	0.03900	6,828	0.00000	0	7,344	0	7,344	106.94	785,367	792,195	0.04999	162,500	0	162,500	4,924	27,864	0	374,010	406,798	385,397	
4	2019	175,070	0.04000	7,003	0.00000	0	7,344	0	7,344	110.15	808,942	815,945	0.05224	162,500	0	162,500	5,145	0	0	374,010	379,155	436,790	
5	2020	175,070	0.04250	7,440	0.00000	0	7,344	0	7,344	113.45	833,177	840,617	0.05460	162,500	0	162,500	5,378	0	0	374,010	379,388	461,229	
6	2021	175,070	0.04470	7,826	0.00000	0	7,344	0	7,344	116.85	858,146	865,972	0.05705	162,500	0	162,500	5,619	0	0	374,010	379,629	486,343	
7	2022	175,070	0.04780	8,368	0.00000	0	7,344	0	7,344	120.36	883,924	892,292	0.05962	162,500	0	162,500	5,872	0	0	374,010	379,882	512,410	
8	2023	175,070	0.04950	8,666	0.00000	0	7,344	0	7,344	123.97	910,436	919,102	0.06230	162,500	0	162,500	6,136	0	0	374,010	380,146	538,956	
9	2024	175,070	0.05270	9,226	0.00000	0	7,344	0	7,344	127.69	937,755	946,981	0.06511	162,500	0	162,500	6,413	0	0	374,010	380,423	566,558	
10	2025	53,868	0.05428	2,924	0.00000	0	2,260	0	2,260	131.52	297,235	300,159	0.06804	50,000	0	50,000	2,062	0	0	115,080	117,142	183,017	
11	2026	26,934	0.05591	1,506	0.00000	0	1,130	0	1,130	135.47	153,081	154,587	0.07110	25,000	0	25,000	1,077	0	0	57,540	58,617	95,970	
12	2027	0	0.05759	0	0.00000	0	0	0	0	139.53	0	0	0.07430	0	0	0	0	0	0	0	0	0	
13	2028	0	0.05932	0	0.00000	0	0	0	0	143.72	0	0	0.07764	0	0	0	0	0	0	0	0	0	
14	2029	0	0.06110	0	0.00000	0	0	0	0	148.03	0	0	0.08113	0	0	0	0	0	0	0	0	0	
15	2030	0	0.06293	0	0.00000	0	0	0	0	152.47	0	0	0.08478	0	0	0	0	0	0	0	0	0	
16	2031	0	0.06482	0	0.00000	0	0	0	0	157.04	0	0	0.08860	0	0	0	0	0	0	0	0	0	
17	2032	0	0.06676	0	0.00000	0	0	0	0	161.75	0	0	0.09259	0	0	0	0	0	0	0	0	0	
18	2033	0	0.06876	0	0.00000	0	0	0	0	166.61	0	0	0.09675	0	0	0	0	0	0	0	0	0	
19	2034	0	0.07082	0	0.00000	0	0	0	0	171.60	0	0	0.10111	0	0	0	0	0	0	0	0	0	
20	2035	0	0.07294	0	0.00000	0	0	0	0	176.75	0	0	0.10566	0	0	0	0	0	0	0	0	0	
Total =		1,629,498							68,356			\$7,928,598				1,512,500				\$3,616,759	\$4,311,839		
												NPV =	\$5,387,728								\$2,525,480	2,862,248	
Total NPV =			\$2,862,248																				
Benefit/Cost Ratio =			<u>2.13</u>																				

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Commercial Demand Response Program**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$5,288	\$0	\$626,371	\$631,659	\$348,165	\$348,165	\$283,494
2017	6,635	0	762,454	769,089	407,414	407,414	361,675
2018	6,828	0	785,367	792,195	406,798	406,798	385,397
2019	7,003	0	808,942	815,945	379,155	379,155	436,790
2020	7,440	0	833,177	840,617	379,388	379,388	461,229
2021	7,826	0	858,146	865,972	379,629	379,629	486,343
2022	8,368	0	883,924	892,292	379,882	379,882	512,410
2023	8,666	0	910,436	919,102	380,146	380,146	538,956
2024	9,226	0	937,755	946,981	380,423	380,423	566,558
2025	2,924	0	297,235	300,159	117,142	117,142	183,017
2026	1,506	0	153,081	154,587	58,617	58,617	95,970
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
<b>Total =</b>				\$7,928,598	\$3,616,759	\$3,616,759	\$4,311,839
				NPV = \$5,387,728	\$2,525,480	\$2,525,480	2,862,248

Total NPV = \$2,862,248  
 Benefit/Cost Ratio = 2.13

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Commercial Demand Response Program**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$5,288	\$0	\$626,371	\$199,737	\$831,396	\$348,165	\$3,000	\$351,165	\$480,231
2017	6,635	0	762,454	250,489	1,019,578	407,414	3,000	410,414	609,164
2018	6,828	0	785,367	265,755	1,057,950	406,798	0	406,798	651,152
2019	7,003	0	808,942	281,934	1,097,879	379,155	0	379,155	718,724
2020	7,440	0	833,177	299,173	1,139,790	379,388	0	379,388	760,402
2021	7,826	0	858,146	317,443	1,183,415	379,629	0	379,629	803,786
2022	8,368	0	883,924	336,904	1,229,196	379,882	0	379,882	849,314
2023	8,666	0	910,436	357,437	1,276,539	380,146	0	380,146	896,393
2024	9,226	0	937,755	379,328	1,326,309	380,423	0	380,423	945,886
2025	2,924	0	297,235	123,840	423,999	117,142	0	117,142	306,857
2026	1,506	0	153,081	65,693	220,280	58,617	0	58,617	161,663
2027	0	0	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$10,806,331		\$3,622,759	\$7,183,572	
NPV =					\$9,324,454		\$3,163,410	6,161,044	

Total NPV = \$6,161,044  
 Benefit/Cost Ratio = 2.95

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Commercial Demand Response Program**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
				112,500				4,500										
2016	\$0	\$0.06865	\$0.05611	137,500	0	137,500	\$9,439	5,500	0	\$2.919	\$71,060	\$16,055	\$28,875	\$54,369	\$3,000	\$0	\$3,000	\$51,369
2017	0	0.07174	0.05863	162,500	0	162,500	11,658	6,500	0	2.919	74,258	18,974	34,125	64,757	3,000	0	3,000	61,757
2018	0	0.07496	0.06127	162,500	0	162,500	12,181	6,500	0	2.919	77,599	18,974	34,125	65,280	0	0	0	65,280
2019	0	0.07834	0.06403	162,500	0	162,500	12,730	6,500	0	2.919	81,091	18,974	34,125	65,829	0	0	0	65,829
2020	0	0.08186	0.06691	162,500	0	162,500	13,302	6,500	0	2.919	84,740	18,974	34,125	66,401	0	0	0	66,401
2021	0	0.08555	0.06992	162,500	0	162,500	13,902	6,500	0	2.919	88,554	18,974	34,125	67,001	0	0	0	67,001
2022	0	0.08940	0.07306	162,500	0	162,500	14,528	6,500	0	2.919	92,539	18,974	34,125	67,627	0	0	0	67,627
2023	0	0.09342	0.07635	162,500	0	162,500	15,181	6,500	0	2.919	96,703	18,974	34,125	68,280	0	0	0	68,280
2024	0	0.09762	0.07979	162,500	0	162,500	15,863	6,500	0	2.919	101,054	18,974	34,125	68,962	0	0	0	68,962
2025	0	0.10201	0.08338	50,000	0	50,000	5,101	2,000	0	2.919	105,602	5,838	10,500	21,439	0	0	0	21,439
2026	0	0.10661	0.08713	25,000	0	25,000	2,665	1,000	0	2.919	110,354	2,919	5,250	10,834	0	0	0	10,834
2027	0	0.11140	0.09105	0	0	0	0	0	0	2.919	115,320	0	0	0	0	0	0	0
2028	0	0.11642	0.09515	0	0	0	0	0	0	2.919	120,509	0	0	0	0	0	0	0
2029	0	0.12165	0.09943	0	0	0	0	0	0	2.919	125,932	0	0	0	0	0	0	0
2030	0	0.12713	0.10391	0	0	0	0	0	0	2.919	131,599	0	0	0	0	0	0	0
2031	0	0.13285	0.10858	0	0	0	0	0	0	2.919	137,521	0	0	0	0	0	0	0
2032	0	0.13883	0.11347	0	0	0	0	0	0	2.919	143,710	0	0	0	0	0	0	0
2033	0	0.14507	0.11857	0	0	0	0	0	0	2.919	150,177	0	0	0	0	0	0	0
2034	0	0.15160	0.12391	0	0	0	0	0	0	2.919	156,935	0	0	0	0	0	0	0
2035	0	0.15843	0.12948	0	0	0	0	0	0	2.919	163,997	0	0	0	0	0	0	0
<b>Total =</b>				<b>1,512,500</b>	<b>0</b>			<b>60,500</b>	<b>0</b>					<b>\$620,779</b>			<b>\$6,000</b>	<b>\$614,779</b>
														<b>NPV = \$419,156</b>			<b>\$5,722</b>	<b>413,434</b>

Total NPV = \$413,434  
 Benefit/Cost Ratio = 73.25

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Commercial Demand Response Program**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$5,288	\$626,371	\$631,659	\$348,165	\$3,000	\$351,165	\$280,494
2017	6,635	762,454	769,089	407,414	3,000	410,414	358,675
2018	6,828	785,367	792,195	406,798	0	406,798	385,397
2019	7,003	808,942	815,945	379,155	0	379,155	436,790
2020	7,440	833,177	840,617	379,388	0	379,388	461,229
2021	7,826	858,146	865,972	379,629	0	379,629	486,343
2022	8,368	883,924	892,292	379,882	0	379,882	512,410
2023	8,666	910,436	919,102	380,146	0	380,146	538,956
2024	9,226	937,755	946,981	380,423	0	380,423	566,558
2025	2,924	297,235	300,159	117,142	0	117,142	183,017
2026	1,506	153,081	154,587	58,617	0	58,617	95,970
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$7,928,598			\$3,622,759	\$4,305,839
NPV =			\$5,387,728			\$2,531,217	2,856,512

Total NPV = \$2,856,512  
Benefit/Cost Ratio = 2.13

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
NORTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Commercial Demand Response Program**  
 Program Years: **2016 - 2018**

<u>Input Data</u>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.08579			
Retail Rate Winter (\$/kWh) =	\$0.06943			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00496			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$45.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$66.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05530			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	8.70%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$33,456	\$33,989	\$33,009
Incentive Costs =		0	0	0
Direct Program Costs =		0	0	0
Total Utility Project Costs =		\$33,456	\$33,989	\$33,009
14) Direct Participant Costs (\$/Part.) =		\$0	\$0	\$0
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		10	10	10
16) Avg Summer kW/part. Saved =		275.000	275.000	275.000
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		6,875	6,875	6,875
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		4	4	0
20) Incentive/Participant =		\$0	\$0	\$0
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		27,500	27,500	0
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		1,100	1,100	0
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$3,374,450	2.12	
Utility Cost Test		\$3,374,450	2.12	
Societal Test		\$7,246,685	2.92	
Participant Test		\$503,537	23.00	
Total Resource Cost Test		\$3,351,502	2.11	

**Table 1  
Ratepayer Impact Test**

Project: **Commercial Demand Response Program**  
Program Years: **2016 - 2018**

t	Year											Electric Margin (J)	Costs					Annual Benefits Less Costs (Q)						
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)		Total Savings (I)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Direct Program Costs (O)	Total Project Costs (P)		
1	2016	177,763	\$0.03570	\$6,346	\$0.00000	\$0	6,214	7,457	0	7,457	\$100.80	\$751,666	\$758,012	\$0.05779	137,500	165,000	0	165,000	\$5,780	\$33,456	\$0	\$316,470	\$419,000	\$339,012
2	2017	207,390	0.03790	7,860	0.00000	0	8,700	8,700	0	8,700	103.82	903,234	911,094	0.06039	192,500	192,500	0	192,500	7,046	33,989	0	\$443,058	484,093	427,001
3	2018	207,390	0.03900	8,088	0.00000	0	8,700	8,700	0	8,700	106.94	930,378	938,466	0.06311	192,500	192,500	0	192,500	7,364	33,009	0	\$443,058	483,431	455,035
4	2019	207,390	0.04000	8,296	0.00000	0	8,700	8,700	0	8,700	110.15	958,305	966,601	0.06595	192,500	192,500	0	192,500	7,695	0	0	\$443,058	450,753	515,848
5	2020	207,390	0.04250	8,814	0.00000	0	8,700	8,700	0	8,700	113.45	987,015	995,829	0.06891	192,500	192,500	0	192,500	8,040	0	0	\$443,058	451,098	544,731
6	2021	207,390	0.04470	9,270	0.00000	0	8,700	8,700	0	8,700	116.85	1,016,595	1,025,865	0.07201	192,500	192,500	0	192,500	8,402	0	0	\$443,058	451,460	574,405
7	2022	207,390	0.04780	9,913	0.00000	0	8,700	8,700	0	8,700	120.36	1,047,132	1,057,045	0.07526	192,500	192,500	0	192,500	8,781	0	0	\$443,058	451,839	605,206
8	2023	207,390	0.04950	10,266	0.00000	0	8,700	8,700	0	8,700	123.97	1,078,539	1,088,805	0.07864	192,500	192,500	0	192,500	9,176	0	0	\$443,058	452,234	636,571
9	2024	207,390	0.05270	10,929	0.00000	0	8,700	8,700	0	8,700	127.69	1,110,903	1,121,832	0.08218	192,500	192,500	0	192,500	9,589	0	0	\$443,058	452,647	669,185
10	2025	59,254	0.05428	3,216	0.00000	0	2,486	2,486	0	2,486	131.52	326,959	330,175	0.08588	55,000	55,000	0	55,000	2,863	0	0	\$126,588	129,451	200,724
11	2026	29,627	0.05591	1,656	0.00000	0	1,243	1,243	0	1,243	135.47	168,389	170,045	0.08974	27,500	27,500	0	27,500	1,496	0	0	\$63,294	64,790	105,255
12	2027	0	0.05759	0	0.00000	0	0	0	0	0	139.53	0	0	0.09378	0	0	0	0	0	0	0	0	0	0
13	2028	0	0.05932	0	0.00000	0	0	0	0	0	143.72	0	0	0.09800	0	0	0	0	0	0	0	0	0	0
14	2029	0	0.06110	0	0.00000	0	0	0	0	0	148.03	0	0	0.10241	0	0	0	0	0	0	0	0	0	0
15	2030	0	0.06293	0	0.00000	0	0	0	0	0	152.47	0	0	0.10702	0	0	0	0	0	0	0	0	0	0
16	2031	0	0.06482	0	0.00000	0	0	0	0	0	157.04	0	0	0.11184	0	0	0	0	0	0	0	0	0	0
17	2032	0	0.06676	0	0.00000	0	0	0	0	0	161.75	0	0	0.11687	0	0	0	0	0	0	0	0	0	0
18	2033	0	0.06876	0	0.00000	0	0	0	0	0	166.61	0	0	0.12213	0	0	0	0	0	0	0	0	0	0
19	2034	0	0.07082	0	0.00000	0	0	0	0	0	171.60	0	0	0.12762	0	0	0	0	0	0	0	0	0	0
20	2035	0	0.07294	0	0.00000	0	0	0	0	0	176.75	0	0	0.13337	0	0	0	0	0	0	0	0	0	0
Total =		1,925,764						80,786				\$9,363,769			1,787,500							\$4,290,796	\$5,072,973	\$5,072,973
												NPV =	\$6,375,891										\$3,001,441	3,374,450
Total NPV =			\$3,374,450																					
Benefit/Cost Ratio =			<u>2.12</u>																					

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Commercial Demand Response Program**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$6,346	\$0	\$751,666	\$758,012	\$419,000	\$419,000	\$339,012
2017	7,860	0	903,234	911,094	484,093	484,093	427,001
2018	8,088	0	930,378	938,466	483,431	483,431	455,035
2019	8,296	0	958,305	966,601	450,753	450,753	515,848
2020	8,814	0	987,015	995,829	451,098	451,098	544,731
2021	9,270	0	1,016,595	1,025,865	451,460	451,460	574,405
2022	9,913	0	1,047,132	1,057,045	451,839	451,839	605,206
2023	10,266	0	1,078,539	1,088,805	452,234	452,234	636,571
2024	10,929	0	1,110,903	1,121,832	452,647	452,647	669,185
2025	3,216	0	326,959	330,175	129,451	129,451	200,724
2026	1,656	0	168,389	170,045	64,790	64,790	105,255
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
<b>Total =</b>				<b>\$9,363,769</b>		<b>\$4,290,796</b>	<b>\$5,072,973</b>
<b>NPV =</b>				<b>\$6,375,891</b>		<b>\$3,001,441</b>	<b>3,374,450</b>
<b>Total NPV =</b>							<b>\$3,374,450</b>
<b>Benefit/Cost Ratio =</b>							<b>2.12</b>

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Commercial Demand Response Program**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$6,346	\$0	\$751,666	\$239,691	\$997,703	\$419,000	\$12,000	\$431,000	\$566,703
2017	7,860	0	903,234	296,740	1,207,834	484,093	12,000	496,093	711,741
2018	8,088	0	930,378	314,825	1,253,291	483,431	0	483,431	769,860
2019	8,296	0	958,305	333,991	1,300,592	450,753	0	450,753	849,839
2020	8,814	0	987,015	354,413	1,350,242	451,098	0	451,098	899,144
2021	9,270	0	1,016,595	376,055	1,401,920	451,460	0	451,460	950,460
2022	9,913	0	1,047,132	399,110	1,456,155	451,839	0	451,839	1,004,316
2023	10,266	0	1,078,539	423,435	1,512,240	452,234	0	452,234	1,060,006
2024	10,929	0	1,110,903	449,367	1,571,199	452,647	0	452,647	1,118,552
2025	3,216	0	326,959	136,224	466,399	129,451	0	129,451	336,948
2026	1,656	0	168,389	72,262	242,307	64,790	0	64,790	177,517
2027	0	0	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$12,759,882			\$4,314,796	\$8,445,086
					NPV = \$11,018,799			\$3,772,114	7,246,685
Total NPV =									\$7,246,685
Benefit/Cost Ratio =									<u>2.92</u>

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Commercial Demand Response Program**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$0	\$0.08965	\$0.07255	137,500	0	165,000	\$14,792	6,600	0	\$2.919	\$68.970	\$19,265	\$34,650	\$68,707	\$12,000	\$0	\$12,000	\$56,707
2017	0	0.09368	0.07582	192,500	0	192,500	18,033	7,700	0	2.919	72.074	22,476	40,425	80,934	12,000	0	12,000	68,934
2018	0	0.09790	0.07923	192,500	0	192,500	18,846	7,700	0	2.919	75.317	22,476	40,425	81,747	0	0	0	81,747
2019	0	0.10231	0.08280	192,500	0	192,500	19,695	7,700	0	2.919	78.706	22,476	40,425	82,596	0	0	0	82,596
2020	0	0.10691	0.08652	192,500	0	192,500	20,580	7,700	0	2.919	82.248	22,476	40,425	83,481	0	0	0	83,481
2021	0	0.11172	0.09042	192,500	0	192,500	21,506	7,700	0	2.919	85.949	22,476	40,425	84,407	0	0	0	84,407
2022	0	0.11675	0.09448	192,500	0	192,500	22,474	7,700	0	2.919	89.817	22,476	40,425	85,375	0	0	0	85,375
2023	0	0.12200	0.09874	192,500	0	192,500	23,485	7,700	0	2.919	93.859	22,476	40,425	86,386	0	0	0	86,386
2024	0	0.12749	0.10318	192,500	0	192,500	24,542	7,700	0	2.919	98.082	22,476	40,425	87,443	0	0	0	87,443
2025	0	0.13323	0.10782	55,000	0	55,000	7,328	2,200	0	2.919	102.496	6,422	11,550	25,300	0	0	0	25,300
2026	0	0.13922	0.11267	27,500	0	27,500	3,829	1,100	0	2.919	107.108	3,211	5,775	12,815	0	0	0	12,815
2027	0	0.14549	0.11775	0	0	0	0	0	0	2.919	111.928	0	0	0	0	0	0	0
2028	0	0.15204	0.12304	0	0	0	0	0	0	2.919	116.965	0	0	0	0	0	0	0
2029	0	0.15888	0.12858	0	0	0	0	0	0	2.919	122.228	0	0	0	0	0	0	0
2030	0	0.16603	0.13437	0	0	0	0	0	0	2.919	127.729	0	0	0	0	0	0	0
2031	0	0.17350	0.14041	0	0	0	0	0	0	2.919	133.476	0	0	0	0	0	0	0
2032	0	0.18131	0.14673	0	0	0	0	0	0	2.919	139.483	0	0	0	0	0	0	0
2033	0	0.18947	0.15333	0	0	0	0	0	0	2.919	145.760	0	0	0	0	0	0	0
2034	0	0.19799	0.16023	0	0	0	0	0	0	2.919	152.319	0	0	0	0	0	0	0
2035	0	0.20690	0.16745	0	0	0	0	0	0	2.919	159.173	0	0	0	0	0	0	0
Total =				1,787,500	0			71,500	0					\$779,191			\$24,000	\$755,191
														NPV = \$526,424			\$22,887	503,537
Total NPV =			\$503,537															
Benefit/Cost Ratio =			<u>23.00</u>															

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Commercial Demand Response Program**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$6,346	\$751,666	\$758,012	\$419,000	\$12,000	\$431,000	\$327,012
2017	7,860	903,234	911,094	484,093	12,000	496,093	415,001
2018	8,088	930,378	938,466	483,431	0	483,431	455,035
2019	8,296	958,305	966,601	450,753	0	450,753	515,848
2020	8,814	987,015	995,829	451,098	0	451,098	544,731
2021	9,270	1,016,595	1,025,865	451,460	0	451,460	574,405
2022	9,913	1,047,132	1,057,045	451,839	0	451,839	605,206
2023	10,266	1,078,539	1,088,805	452,234	0	452,234	636,571
2024	10,929	1,110,903	1,121,832	452,647	0	452,647	669,185
2025	3,216	326,959	330,175	129,451	0	129,451	200,724
2026	1,656	168,389	170,045	64,790	0	64,790	105,255
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
		Total =	\$9,363,769			\$4,314,796	\$5,048,973
		NPV =	\$6,375,891			\$3,024,389	3,351,502

Total NPV = \$3,351,502  
Benefit/Cost Ratio = 2.11

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
SOUTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Commercial Demand Response Program**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.07621			
Retail Rate Winter (\$/kWh) =	\$0.07438			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00815			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$20.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$40.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.03409			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$2,028	\$3,531	\$3,429
Incentive Costs =		0	0	0
Direct Program Costs =		0	0	0
Total Utility Project Costs =		\$2,028	\$3,531	\$3,429
14) Direct Participant Costs (\$/Part.) =		\$0	\$0	\$0
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		10	10	10
16) Avg Summer kW/part. Saved =		200.000	200.000	200.000
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		5,000	5,000	5,000
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		2	2	0
20) Incentive/Participant =		\$0	\$0	\$0
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		10,000	10,000	0
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		400	400	0
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$371,876	2.19	
Utility Cost Test		\$371,876	2.19	
Societal Test		\$819,775	2.96	
Participant Test		\$42,717	4.73	
Total Resource Cost Test		\$360,402	2.11	

**Table 1**  
**Ratepayer Impact Test**

Project: **Commercial Demand Response Program**  
Program Years: **2016 - 2018**

t	Year												Costs						Annual Benefits Less Costs (Q)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)	Program Admin Costs (M)		Incentive Costs (N)	Direct Program Costs (O)	Total Project Costs (P)	
1	2016	10,774	\$0.03570	\$385	\$0.00000	\$0	452	0	452	\$100.80	\$45,562	\$45,947	\$0.03562	10,000	0	10,000	\$216	\$2,028	\$0	\$23,016	\$25,260	\$20,687	
2	2017	21,547	0.03790	817	0.00000	0	904	0	904	103.82	93,853	94,670	0.03723	20,000	0	20,000	451	3,531	0	46,032	50,014	44,656	
3	2018	21,547	0.03900	840	0.00000	0	904	0	904	106.94	96,674	97,514	0.03890	20,000	0	20,000	472	3,429	0	46,032	49,933	47,581	
4	2019	21,547	0.04000	862	0.00000	0	904	0	904	110.15	99,576	100,438	0.04065	20,000	0	20,000	493	0	0	46,032	46,525	53,913	
5	2020	21,547	0.04250	916	0.00000	0	904	0	904	113.45	102,559	103,475	0.04248	20,000	0	20,000	515	0	0	46,032	46,547	56,928	
6	2021	21,547	0.04470	963	0.00000	0	904	0	904	116.85	105,632	106,595	0.04439	20,000	0	20,000	538	0	0	46,032	46,570	60,025	
7	2022	21,547	0.04780	1,030	0.00000	0	904	0	904	120.36	108,805	109,835	0.04639	20,000	0	20,000	562	0	0	46,032	46,594	63,241	
8	2023	21,547	0.04950	1,067	0.00000	0	904	0	904	123.97	112,069	113,136	0.04848	20,000	0	20,000	588	0	0	46,032	46,620	66,516	
9	2024	21,547	0.05270	1,136	0.00000	0	904	0	904	127.69	115,432	116,568	0.05066	20,000	0	20,000	614	0	0	46,032	46,646	69,922	
10	2025	21,547	0.05428	1,170	0.00000	0	904	0	904	131.52	118,894	120,064	0.05294	20,000	0	20,000	642	0	0	46,032	46,674	73,390	
11	2026	10,774	0.05591	602	0.00000	0	452	0	452	135.47	61,232	61,834	0.05532	10,000	0	10,000	335	0	0	23,016	23,351	38,483	
12	2027	0	0.05759	0	0.00000	0	0	0	0	139.53	0	0	0.05781	0	0	0	0	0	0	0	0	0	
13	2028	0	0.05932	0	0.00000	0	0	0	0	143.72	0	0	0.06041	0	0	0	0	0	0	0	0	0	
14	2029	0	0.06110	0	0.00000	0	0	0	0	148.03	0	0	0.06313	0	0	0	0	0	0	0	0	0	
15	2030	0	0.06293	0	0.00000	0	0	0	0	152.47	0	0	0.06597	0	0	0	0	0	0	0	0	0	
16	2031	0	0.06482	0	0.00000	0	0	0	0	157.04	0	0	0.06894	0	0	0	0	0	0	0	0	0	
17	2032	0	0.06676	0	0.00000	0	0	0	0	161.75	0	0	0.07205	0	0	0	0	0	0	0	0	0	
18	2033	0	0.06876	0	0.00000	0	0	0	0	166.61	0	0	0.07529	0	0	0	0	0	0	0	0	0	
19	2034	0	0.07082	0	0.00000	0	0	0	0	171.60	0	0	0.07867	0	0	0	0	0	0	0	0	0	
20	2035	0	0.07294	0	0.00000	0	0	0	0	176.75	0	0	0.08222	0	0	0	0	0	0	0	0	0	
Total =		215,471							9,040			\$1,070,076				200,000					\$474,734	\$595,342	
																						\$313,008	371,876
NPV =																							

Total NPV = \$371,876  
Benefit/Cost Ratio = 2.19

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Commercial Demand Response Program**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$385	\$0	\$45,562	\$45,947	\$25,260	\$25,260	\$20,687
2017	817	0	93,853	94,670	50,014	50,014	44,656
2018	840	0	96,674	97,514	49,933	49,933	47,581
2019	862	0	99,576	100,438	46,525	46,525	53,913
2020	916	0	102,559	103,475	46,547	46,547	56,928
2021	963	0	105,632	106,595	46,570	46,570	60,025
2022	1,030	0	108,805	109,835	46,594	46,594	63,241
2023	1,067	0	112,069	113,136	46,620	46,620	66,516
2024	1,136	0	115,432	116,568	46,646	46,646	69,922
2025	1,170	0	118,894	120,064	46,674	46,674	73,390
2026	602	0	61,232	61,834	23,351	23,351	38,483
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
<b>Total =</b>				\$1,070,076	\$474,734	\$474,734	\$595,342
				NPV = \$684,884	\$313,008	\$313,008	371,876
Total NPV =				\$371,876			
Benefit/Cost Ratio =				<u>2.19</u>			

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3**  
**Societal Cost Test**

Project: **Commercial Demand Response Program**  
Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$385	\$0	\$45,562	\$14,529	\$60,476	\$25,260	\$6,000	\$31,260	\$29,216
2017	817	0	93,853	30,834	125,504	50,014	6,000	56,014	69,490
2018	840	0	96,674	32,713	130,227	49,933	0	49,933	80,294
2019	862	0	99,576	34,704	135,142	46,525	0	46,525	88,617
2020	916	0	102,559	36,826	140,301	46,547	0	46,547	93,754
2021	963	0	105,632	39,075	145,670	46,570	0	46,570	99,100
2022	1,030	0	108,805	41,471	151,306	46,594	0	46,594	104,712
2023	1,067	0	112,069	43,998	157,134	46,620	0	46,620	110,514
2024	1,136	0	115,432	46,693	163,261	46,646	0	46,646	116,615
2025	1,170	0	118,894	49,536	169,600	46,674	0	46,674	122,926
2026	602	0	61,232	26,277	88,111	23,351	0	23,351	64,760
2027	0	0	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$1,466,732			\$486,734	\$979,998
					NPV = \$1,237,187			\$417,412	819,775
Total NPV =	\$819,775								
Benefit/Cost Ratio =	<u>2.96</u>								

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Commercial Demand Response Program**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2016	\$0	\$0.07964	\$0.07773	10,000	0	10,000	\$796	400	0	\$2.919	\$41,800	\$1,168	\$2,100	\$4,064	\$6,000	\$0	\$6,000	(\$1,936)
2017	0	0.08322	0.08122	20,000	0	20,000	1,664	800	0	2.919	43,681	2,335	4,200	8,199	6,000	0	6,000	2,199
2018	0	0.08697	0.08488	20,000	0	20,000	1,739	800	0	2.919	45,647	2,335	4,200	8,274	0	0	0	8,274
2019	0	0.09088	0.08870	20,000	0	20,000	1,818	800	0	2.919	47,701	2,335	4,200	8,353	0	0	0	8,353
2020	0	0.09497	0.09269	20,000	0	20,000	1,899	800	0	2.919	49,847	2,335	4,200	8,434	0	0	0	8,434
2021	0	0.09925	0.09686	20,000	0	20,000	1,985	800	0	2.919	52,090	2,335	4,200	8,520	0	0	0	8,520
2022	0	0.10371	0.10122	20,000	0	20,000	2,074	800	0	2.919	54,434	2,335	4,200	8,609	0	0	0	8,609
2023	0	0.10838	0.10578	20,000	0	20,000	2,168	800	0	2.919	56,884	2,335	4,200	8,703	0	0	0	8,703
2024	0	0.11326	0.11054	20,000	0	20,000	2,265	800	0	2.919	59,444	2,335	4,200	8,800	0	0	0	8,800
2025	0	0.11835	0.11551	20,000	0	20,000	2,367	800	0	2.919	62,119	2,335	4,200	8,902	0	0	0	8,902
2026	0	0.12368	0.12071	10,000	0	10,000	1,237	400	0	2.919	64,914	1,168	2,100	4,505	0	0	0	4,505
2027	0	0.12924	0.12614	0	0	0	0	0	0	2.919	67,835	0	0	0	0	0	0	0
2028	0	0.13506	0.13182	0	0	0	0	0	0	2.919	70,888	0	0	0	0	0	0	0
2029	0	0.14114	0.13775	0	0	0	0	0	0	2.919	74,078	0	0	0	0	0	0	0
2030	0	0.14749	0.14395	0	0	0	0	0	0	2.919	77,411	0	0	0	0	0	0	0
2031	0	0.15412	0.15042	0	0	0	0	0	0	2.919	80,895	0	0	0	0	0	0	0
2032	0	0.16106	0.15719	0	0	0	0	0	0	2.919	84,535	0	0	0	0	0	0	0
2033	0	0.16831	0.16427	0	0	0	0	0	0	2.919	88,339	0	0	0	0	0	0	0
2034	0	0.17588	0.17166	0	0	0	0	0	0	2.919	92,314	0	0	0	0	0	0	0
2035	0	0.18380	0.17938	0	0	0	0	0	0	2.919	96,469	0	0	0	0	0	0	0
<b>Total =</b>				<b>200,000</b>	<b>0</b>			<b>8,000</b>	<b>0</b>					<b>\$85,363</b>			<b>\$12,000</b>	<b>\$73,363</b>
														<b>NPV = \$54,160</b>			<b>\$11,444</b>	<b>42,717</b>

Total NPV = \$42,717  
 Benefit/Cost Ratio = 4.73

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Commercial Demand Response Program**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$385	\$45,562	\$45,947	\$25,260	\$6,000	\$31,260	\$14,687
2017	817	93,853	94,670	50,014	6,000	56,014	38,656
2018	840	96,674	97,514	49,933	0	49,933	47,581
2019	862	99,576	100,438	46,525	0	46,525	53,913
2020	916	102,559	103,475	46,547	0	46,547	56,928
2021	963	105,632	106,595	46,570	0	46,570	60,025
2022	1,030	108,805	109,835	46,594	0	46,594	63,241
2023	1,067	112,069	113,136	46,620	0	46,620	66,516
2024	1,136	115,432	116,568	46,646	0	46,646	69,922
2025	1,170	118,894	120,064	46,674	0	46,674	73,390
2026	602	61,232	61,834	23,351	0	23,351	38,483
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$1,070,076			\$486,734	\$583,342
NPV =			\$684,884			\$324,482	360,402

Total NPV = \$360,402  
Benefit/Cost Ratio = 2.11

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Interruptible Rate DR Program**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.06569			
Retail Rate Winter (\$/kWh) =	\$0.05369			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00418			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$38.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$68.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.04381			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity =	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$5,069	\$7,063	\$6,859
Incentive Costs =		0	0	0
Total Utility Project Costs =		\$5,069	\$7,063	\$6,859
14) Direct Participant Costs (\$/Part.) =		\$0	\$0	\$0
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		10	10	10
16) Avg Summer kW/part. Saved =		1,000.000	600.000	1,000.000
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		16,250	9,750	16,250
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		1	1	0
20) Incentive/Participant =		\$0	\$0	\$0
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		16,250	9,750	0
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		1,000	600	0
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$892,050	2.84	
Utility Cost Test		\$897,822	2.88	
Societal Test		\$1,809,286	3.76	
Participant Test		\$452,803	16.82	
Total Resource Cost Test		\$868,542	2.71	

**Table 1  
Ratepayer Impact Test**

Project: **Interruptible Rate DR Program**  
 Program Years: **2016 - 2018**

t	Year											Costs						Annual Benefits Less Costs (P)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2016	17,507	\$0.03570	\$625	\$0.00000	\$0	1,130	0	1,130	\$100.80	\$113,904	\$114,529	\$0.04578	16,250	0	16,250	\$451	\$45,120	\$0	\$45,571	\$68,958	
2	2017	28,011	0.03790	1,062	0.00000	0	1,808	0	1,808	103.82	187,707	188,769	0.04784	26,000	0	26,000	754	72,192	0	72,946	115,823	
3	2018	28,011	0.03900	1,092	0.00000	0	1,808	0	1,808	106.94	193,348	194,440	0.04999	26,000	0	26,000	788	72,192	0	72,980	121,460	
4	2019	28,011	0.04000	1,120	0.00000	0	1,808	0	1,808	110.15	199,151	200,271	0.05224	26,000	0	26,000	823	72,192	0	73,015	127,256	
5	2020	28,011	0.04250	1,190	0.00000	0	1,808	0	1,808	113.45	205,118	206,308	0.05460	26,000	0	26,000	860	72,192	0	73,052	133,256	
6	2021	28,011	0.04470	1,252	0.00000	0	1,808	0	1,808	116.85	211,265	212,517	0.05705	26,000	0	26,000	899	72,192	0	73,091	139,426	
7	2022	28,011	0.04780	1,339	0.00000	0	1,808	0	1,808	120.36	217,611	218,950	0.05962	26,000	0	26,000	940	72,192	0	73,132	145,818	
8	2023	28,011	0.04950	1,387	0.00000	0	1,808	0	1,808	123.97	224,138	225,525	0.06230	26,000	0	26,000	982	72,192	0	73,174	152,351	
9	2024	28,011	0.05270	1,476	0.00000	0	1,808	0	1,808	127.69	230,864	232,340	0.06511	26,000	0	26,000	1,026	72,192	0	73,218	159,122	
10	2025	28,011	0.05428	1,520	0.00000	0	1,808	0	1,808	131.52	237,788	239,308	0.06804	26,000	0	26,000	1,072	72,192	0	73,264	166,044	
11	2026	10,504	0.05591	587	0.00000	0	678	0	678	135.47	91,849	92,436	0.07110	9,750	0	9,750	420	27,072	0	27,492	64,944	
12	2027	0	0.05759	0	0.00000	0	0	0	0	139.53	0	0	0.07430	0	0	0	0	0	0	0	0	
13	2028	0	0.05932	0	0.00000	0	0	0	0	143.72	0	0	0.07764	0	0	0	0	0	0	0	0	
14	2029	0	0.06110	0	0.00000	0	0	0	0	148.03	0	0	0.08113	0	0	0	0	0	0	0	0	
15	2030	0	0.06293	0	0.00000	0	0	0	0	152.47	0	0	0.08478	0	0	0	0	0	0	0	0	
16	2031	0	0.06482	0	0.00000	0	0	0	0	157.04	0	0	0.08860	0	0	0	0	0	0	0	0	
17	2032	0	0.06676	0	0.00000	0	0	0	0	161.75	0	0	0.09259	0	0	0	0	0	0	0	0	
18	2033	0	0.06876	0	0.00000	0	0	0	0	166.61	0	0	0.09675	0	0	0	0	0	0	0	0	
19	2034	0	0.07082	0	0.00000	0	0	0	0	171.60	0	0	0.10111	0	0	0	0	0	0	0	0	
20	2035	0	0.07294	0	0.00000	0	0	0	0	176.75	0	0	0.10566	0	0	0	0	0	0	0	0	
Total =		280,110							18,080			\$2,125,393				260,000				\$730,935	\$1,394,458	
												NPV = \$1,376,036									\$483,986	892,050
Total NPV =			\$892,050																			
Benefit/Cost Ratio =			<u>2.84</u>																			

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (B) = Avg. System Marginal Energy Cost (2), escalated  
 (C) = (C) x (D)  
 (D) = System Variable O&M Savings (6), escalated  
 (E) = (C) x (F)  
 (F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses  
 (G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity  
 (H) = (F) + (G)  
 (I) = (C) + (E) + (H)  
 (J) = Electric Margin (4), escalated

(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)  
 (L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)  
 (M) = Program Admin Costs (13)  
 (N) = Incentive/Participant (20) x Number of Participants (19)  
 (O) = (L) + (M) + (N)  
 (P) = (I) - (O)

**Table 2  
Utility Test**

Project: **Interruptible Rate DR Program**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$625	\$0	\$113,904	\$114,529	\$45,120	\$45,120	\$69,409
2017	1,062	0	187,707	188,769	72,192	72,192	116,577
2018	1,092	0	193,348	194,440	72,192	72,192	122,248
2019	1,120	0	199,151	200,271	72,192	72,192	128,079
2020	1,190	0	205,118	206,308	72,192	72,192	134,116
2021	1,252	0	211,265	212,517	72,192	72,192	140,325
2022	1,339	0	217,611	218,950	72,192	72,192	146,758
2023	1,387	0	224,138	225,525	72,192	72,192	153,333
2024	1,476	0	230,864	232,340	72,192	72,192	160,148
2025	1,520	0	237,788	239,308	72,192	72,192	167,116
2026	587	0	91,849	92,436	27,072	27,072	65,364
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$2,125,393		\$721,920	\$1,403,473
				NPV = \$1,376,036		\$478,214	897,822
Total NPV =		\$897,822					
Benefit/Cost Ratio =		<u>2.88</u>					

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Interruptible Rate DR Program**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$625	\$0	\$113,904	\$36,215	\$150,744	\$45,120	\$2,763	\$47,883	\$102,861
2017	1,062	0	187,707	61,481	250,250	72,192	4,420	76,612	173,638
2018	1,092	0	193,348	65,228	259,668	72,192	4,420	76,612	183,056
2019	1,120	0	199,151	69,200	269,471	72,192	4,420	76,612	192,859
2020	1,190	0	205,118	73,424	279,732	72,192	4,420	76,612	203,120
2021	1,252	0	211,265	77,903	290,420	72,192	4,420	76,612	213,808
2022	1,339	0	217,611	82,669	301,619	72,192	4,420	76,612	225,007
2023	1,387	0	224,138	87,706	313,231	72,192	4,420	76,612	236,619
2024	1,476	0	230,864	93,067	325,407	72,192	4,420	76,612	248,795
2025	1,520	0	237,788	98,734	338,042	72,192	4,420	76,612	261,430
2026	587	0	91,849	39,282	131,718	27,072	1,658	28,730	102,988
2027	0	0	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$2,910,302			\$766,121	\$2,144,181
					NPV = \$2,465,017			\$655,731	1,809,286
Total NPV =		\$1,809,286							
Benefit/Cost Ratio =		<u>3.76</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Interruptible Rate DR Program**  
 Program Years: **2016 - 2018**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$0	\$0.06865	\$0.05611	16,250	0	16,250	\$1,116	1,000	0	\$39.710	\$71.060	\$45,120	\$0	\$46,236	\$2,763	\$0	\$2,763	\$43,473
2017	0	0.07174	0.05863	26,000	0	26,000	1,865	1,600	0	41.497	74.258	72,192	0	74,057	4,420	0	4,420	69,637
2018	0	0.07496	0.06127	26,000	0	26,000	1,949	1,600	0	43.364	77.599	72,192	0	74,141	4,420	0	4,420	69,721
2019	0	0.07834	0.06403	26,000	0	26,000	2,037	1,600	0	45.316	81.091	72,192	0	74,229	4,420	0	4,420	69,809
2020	0	0.08186	0.06691	26,000	0	26,000	2,128	1,600	0	47.355	84.740	72,192	0	74,320	4,420	0	4,420	69,900
2021	0	0.08555	0.06992	26,000	0	26,000	2,224	1,600	0	49.486	88.554	72,192	0	74,416	4,420	0	4,420	69,996
2022	0	0.08940	0.07306	26,000	0	26,000	2,324	1,600	0	51.713	92.539	72,192	0	74,516	4,420	0	4,420	70,096
2023	0	0.09342	0.07635	26,000	0	26,000	2,429	1,600	0	54.040	96.703	72,192	0	74,621	4,420	0	4,420	70,201
2024	0	0.09762	0.07979	26,000	0	26,000	2,538	1,600	0	56.472	101.054	72,192	0	74,730	4,420	0	4,420	70,310
2025	0	0.10201	0.08338	26,000	0	26,000	2,652	1,600	0	59.013	105.602	72,192	0	74,844	4,420	0	4,420	70,424
2026	0	0.10661	0.08713	9,750	0	9,750	1,039	600	0	61.668	110.354	27,072	0	28,111	1,658	0	1,658	26,453
2027	0	0.11140	0.09105	0	0	0	0	0	0	64.443	115.320	0	0	0	0	0	0	0
2028	0	0.11642	0.09515	0	0	0	0	0	0	67.343	120.509	0	0	0	0	0	0	0
2029	0	0.12165	0.09943	0	0	0	0	0	0	70.374	125.932	0	0	0	0	0	0	0
2030	0	0.12713	0.10391	0	0	0	0	0	0	73.541	131.599	0	0	0	0	0	0	0
2031	0	0.13285	0.10858	0	0	0	0	0	0	76.850	137.521	0	0	0	0	0	0	0
2032	0	0.13883	0.11347	0	0	0	0	0	0	80.308	143.710	0	0	0	0	0	0	0
2033	0	0.14507	0.11857	0	0	0	0	0	0	83.922	150.177	0	0	0	0	0	0	0
2034	0	0.15160	0.12391	0	0	0	0	0	0	87.699	156.935	0	0	0	0	0	0	0
2035	0	0.15843	0.12948	0	0	0	0	0	0	91.645	163.997	0	0	0	0	0	0	0
<b>Total =</b>				<b>260,000</b>	<b>0</b>			<b>16,000</b>	<b>0</b>					<b>\$744,221</b>			<b>\$44,201</b>	<b>\$700,020</b>
														<b>NPV = \$481,426</b>			<b>\$28,623</b>	<b>452,803</b>

Total NPV = \$452,803  
 Benefit/Cost Ratio = 16.82

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Interruptible Rate DR Program**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$625	\$113,904	\$114,529	\$45,120	\$2,763	\$47,883	\$66,646
2017	1,062	187,707	188,769	72,192	4,420	76,612	112,157
2018	1,092	193,348	194,440	72,192	4,420	76,612	117,828
2019	1,120	199,151	200,271	72,192	4,420	76,612	123,659
2020	1,190	205,118	206,308	72,192	4,420	76,612	129,696
2021	1,252	211,265	212,517	72,192	4,420	76,612	135,905
2022	1,339	217,611	218,950	72,192	4,420	76,612	142,338
2023	1,387	224,138	225,525	72,192	4,420	76,612	148,913
2024	1,476	230,864	232,340	72,192	4,420	76,612	155,728
2025	1,520	237,788	239,308	72,192	4,420	76,612	162,696
2026	587	91,849	92,436	27,072	1,658	28,730	63,706
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$2,125,393			\$766,121	\$1,359,272
NPV =			\$1,376,036			\$507,494	868,542

Total NPV = \$868,542  
Benefit/Cost Ratio = 2.71

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
NORTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Interruptible Rate DR Program**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.08579			
Retail Rate Winter (\$/kWh) =	\$0.06943			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00496			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$45.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$66.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05530			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	8.70%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$72,994	\$63,565	\$61,730
Incentive Costs =		0	0	0
Total Utility Project Costs =		\$72,994	\$63,565	\$61,730
14) Direct Participant Costs (\$/Part.) =		\$0	\$0	\$0
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		10	10	10
16) Avg Summer kW/part. Saved =		1,000.000	1,000.000	1,000.000
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		16,250	16,250	16,250
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		0	0	0
20) Incentive/Participant =		\$0	\$0	\$0
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		0	0	0
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		0	0	0
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$7,263,240	2.62	
Utility Cost Test		\$7,344,821	2.67	
Societal Test		\$14,352,297	3.58	
Participant Test		\$4,193,106	42.98	
Total Resource Cost Test		\$7,243,045	2.61	



**Table 2  
Utility Test**

Project: **Interruptible Rate DR Program**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$11,957	\$0	\$1,639,927	\$1,651,884	\$686,703	\$686,703	\$965,181
2017	12,694	0	1,689,060	1,701,754	686,703	686,703	1,015,051
2018	13,062	0	1,739,820	1,752,882	686,703	686,703	1,066,179
2019	13,397	0	1,792,044	1,805,441	686,703	686,703	1,118,738
2020	14,234	0	1,845,732	1,859,966	686,703	686,703	1,173,263
2021	14,971	0	1,901,047	1,916,018	686,703	686,703	1,229,315
2022	16,009	0	1,958,151	1,974,160	686,703	686,703	1,287,457
2023	16,579	0	2,016,883	2,033,462	686,703	686,703	1,346,759
2024	17,650	0	2,077,404	2,095,054	686,703	686,703	1,408,351
2025	0	0	0	0	0	0	0
2026	0	0	0	0	0	0	0
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$16,790,621	\$6,180,327	\$6,180,327	\$10,610,294
				NPV = \$11,747,632	\$4,402,811	\$4,402,811	7,344,821
Total NPV =				\$7,344,821			
Benefit/Cost Ratio =				<u>2.67</u>			

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Interruptible Rate DR Program**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$11,957	\$0	\$1,639,927	\$522,342	\$2,174,226	\$686,703	\$15,874	\$702,577	\$1,471,649
2017	12,694	0	1,689,060	554,255	2,256,009	686,703	15,874	702,577	1,553,432
2018	13,062	0	1,739,820	588,034	2,340,916	686,703	15,874	702,577	1,638,339
2019	13,397	0	1,792,044	623,836	2,429,277	686,703	15,874	702,577	1,726,700
2020	14,234	0	1,845,732	661,957	2,521,923	686,703	15,874	702,577	1,819,346
2021	14,971	0	1,901,047	702,362	2,618,380	686,703	15,874	702,577	1,915,803
2022	16,009	0	1,958,151	745,386	2,719,546	686,703	15,874	702,577	2,016,969
2023	16,579	0	2,016,883	790,810	2,824,272	686,703	15,874	702,577	2,121,695
2024	17,650	0	2,077,404	839,206	2,934,260	686,703	15,874	702,577	2,231,683
2025	0	0	0	0	0	0	0	0	0
2026	0	0	0	0	0	0	0	0	0
2027	0	0	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$22,818,809			\$6,323,193	\$16,495,616
					NPV = \$19,916,770			\$5,564,473	14,352,297
Total NPV =	\$14,352,297								
Benefit/Cost Ratio =	<u>3.58</u>								

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Interruptible Rate DR Program**  
 Program Years: **2016 - 2018**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$0	\$0.08965	\$0.07255	310,875	0	310,875	\$27,870	14,400	0	\$47.025	\$68.970	\$649,728	\$0	\$677,598	\$15,874	\$0	\$15,874	\$661,724
2017	0	0.09368	0.07582	310,875	0	310,875	29,123	14,400	0	49.141	72.074	\$649,728	0	678,851	15,874	0	15,874	662,977
2018	0	0.09790	0.07923	310,875	0	310,875	30,435	14,400	0	51.352	75.317	\$649,728	0	680,163	15,874	0	15,874	664,289
2019	0	0.10231	0.08280	310,875	0	310,875	31,806	14,400	0	53.663	78.706	\$649,728	0	681,534	15,874	0	15,874	665,660
2020	0	0.10691	0.08652	310,875	0	310,875	33,236	14,400	0	56.078	82.248	\$649,728	0	682,964	15,874	0	15,874	667,090
2021	0	0.11172	0.09042	310,875	0	310,875	34,731	14,400	0	58.602	85.949	\$649,728	0	684,459	15,874	0	15,874	668,585
2022	0	0.11675	0.09448	310,875	0	310,875	36,295	14,400	0	61.239	89.817	\$649,728	0	686,023	15,874	0	15,874	670,149
2023	0	0.12200	0.09874	310,875	0	310,875	37,927	14,400	0	63.995	93.859	\$649,728	0	687,655	15,874	0	15,874	671,781
2024	0	0.12749	0.10318	310,875	0	310,875	39,633	14,400	0	66.874	98.082	\$649,728	0	689,361	15,874	0	15,874	673,487
2025	0	0.13323	0.10782	0	0	0	0	0	0	69.884	102.496	0	0	0	0	0	0	0
2026	0	0.13922	0.11267	0	0	0	0	0	0	73.028	107.108	0	0	0	0	0	0	0
2027	0	0.14549	0.11775	0	0	0	0	0	0	76.315	111.928	0	0	0	0	0	0	0
2028	0	0.15204	0.12304	0	0	0	0	0	0	79.749	116.965	0	0	0	0	0	0	0
2029	0	0.15888	0.12858	0	0	0	0	0	0	83.338	122.228	0	0	0	0	0	0	0
2030	0	0.16603	0.13437	0	0	0	0	0	0	87.088	127.729	0	0	0	0	0	0	0
2031	0	0.17350	0.14041	0	0	0	0	0	0	91.007	133.476	0	0	0	0	0	0	0
2032	0	0.18131	0.14673	0	0	0	0	0	0	95.102	139.483	0	0	0	0	0	0	0
2033	0	0.18947	0.15333	0	0	0	0	0	0	99.382	145.760	0	0	0	0	0	0	0
2034	0	0.19799	0.16023	0	0	0	0	0	0	103.854	152.319	0	0	0	0	0	0	0
2035	0	0.20690	0.16745	0	0	0	0	0	0	108.527	159.173	0	0	0	0	0	0	0
<b>Total =</b>				<b>2,797,875</b>	<b>0</b>			<b>129,600</b>	<b>0</b>					<b>\$6,148,608</b>			<b>\$142,866</b>	<b>\$6,005,742</b>
														<b>NPV = \$4,292,992</b>			<b>\$99,887</b>	<b>4,193,106</b>

Total NPV = #####  
 Benefit/Cost Ratio = 42.98

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Interruptible Rate DR Program**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$11,957	\$1,639,927	\$1,651,884	\$686,703	\$15,874	\$702,577	\$949,307
2017	12,694	1,689,060	1,701,754	686,703	15,874	702,577	999,177
2018	13,062	1,739,820	1,752,882	686,703	15,874	702,577	1,050,305
2019	13,397	1,792,044	1,805,441	686,703	15,874	702,577	1,102,864
2020	14,234	1,845,732	1,859,966	686,703	15,874	702,577	1,157,389
2021	14,971	1,901,047	1,916,018	686,703	15,874	702,577	1,213,441
2022	16,009	1,958,151	1,974,160	686,703	15,874	702,577	1,271,583
2023	16,579	2,016,883	2,033,462	686,703	15,874	702,577	1,330,885
2024	17,650	2,077,404	2,095,054	686,703	15,874	702,577	1,392,477
2025	0	0	0	0	0	0	0
2026	0	0	0	0	0	0	0
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$16,790,621			\$6,323,193	\$10,467,428
NPV =			\$11,747,632			\$4,504,587	7,243,045
Total NPV =			\$7,243,045				
Benefit/Cost Ratio =			<u>2.61</u>				

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
SOUTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
Project: **Interruptible Rate DR Program**  
Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.07621			
Retail Rate Winter (\$/kWh) =	\$0.07438			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00815			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$20.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$40.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.03409			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$0	\$0	\$0
Incentive Costs =		0	0	0
Total Utility Project Costs =		\$0	\$0	\$0
14) Direct Participant Costs (\$/Part.) =		\$0	\$0	\$0
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		0	0	0
16) Avg Summer kW/part. Saved =		0.000	0.000	0.000
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		0	0	0
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		0	0	0
20) Incentive/Participant =		\$0	\$0	\$0
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		0	0	0
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		0	0	0
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		\$0	#DIV/0!	
Utility Cost Test		\$0	#DIV/0!	
Societal Test		\$0	#DIV/0!	
Participant Test		\$0	#DIV/0!	
Total Resource Cost Test		\$0	#DIV/0!	

**Table 1  
Ratepayer Impact Test**

Project: **Interruptible Rate DR Program**  
 Program Years: **2016 - 2018**

t	Year	Benefits										Costs					Annual Benefits Less Costs (P)					
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)		Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2016	0	\$0.03570	\$0	\$0.00000	\$0	0	0	0	\$100.80	\$0	\$0	\$0.03562	0	0	0	\$0	\$0	\$0	\$0	\$0	\$0
2	2017	0	0.03790	0	0.00000	0	0	0	0	103.82	0	0	0.03723	0	0	0	0	0	0	0	0	0
3	2018	0	0.03900	0	0.00000	0	0	0	0	106.94	0	0	0.03890	0	0	0	0	0	0	0	0	0
4	2019	0	0.04000	0	0.00000	0	0	0	0	110.15	0	0	0.04065	0	0	0	0	0	0	0	0	0
5	2020	0	0.04250	0	0.00000	0	0	0	0	113.45	0	0	0.04248	0	0	0	0	0	0	0	0	0
6	2021	0	0.04470	0	0.00000	0	0	0	0	116.85	0	0	0.04439	0	0	0	0	0	0	0	0	0
7	2022	0	0.04780	0	0.00000	0	0	0	0	120.36	0	0	0.04639	0	0	0	0	0	0	0	0	0
8	2023	0	0.04950	0	0.00000	0	0	0	0	123.97	0	0	0.04848	0	0	0	0	0	0	0	0	0
9	2024	0	0.05270	0	0.00000	0	0	0	0	127.69	0	0	0.05066	0	0	0	0	0	0	0	0	0
10	2025	0	0.05428	0	0.00000	0	0	0	0	131.52	0	0	0.05294	0	0	0	0	0	0	0	0	0
11	2026	0	0.05591	0	0.00000	0	0	0	0	135.47	0	0	0.05532	0	0	0	0	0	0	0	0	0
12	2027	0	0.05759	0	0.00000	0	0	0	0	139.53	0	0	0.05781	0	0	0	0	0	0	0	0	0
13	2028	0	0.05932	0	0.00000	0	0	0	0	143.72	0	0	0.06041	0	0	0	0	0	0	0	0	0
14	2029	0	0.06110	0	0.00000	0	0	0	0	148.03	0	0	0.06313	0	0	0	0	0	0	0	0	0
15	2030	0	0.06293	0	0.00000	0	0	0	0	152.47	0	0	0.06597	0	0	0	0	0	0	0	0	0
16	2031	0	0.06482	0	0.00000	0	0	0	0	157.04	0	0	0.06894	0	0	0	0	0	0	0	0	0
17	2032	0	0.06676	0	0.00000	0	0	0	0	161.75	0	0	0.07205	0	0	0	0	0	0	0	0	0
18	2033	0	0.06876	0	0.00000	0	0	0	0	166.61	0	0	0.07529	0	0	0	0	0	0	0	0	0
19	2034	0	0.07082	0	0.00000	0	0	0	0	171.60	0	0	0.07867	0	0	0	0	0	0	0	0	0
20	2035	0	0.07294	0	0.00000	0	0	0	0	176.75	0	0	0.08222	0	0	0	0	0	0	0	0	0
Total =		0						0				\$0									\$0	\$0

NPV = \$0

Total NPV = \$0  
 Benefit/Cost Ratio = #DIV/0!

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Interruptible Rate DR Program**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2017	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0
2023	0	0	0	0	0	0	0
2024	0	0	0	0	0	0	0
2025	0	0	0	0	0	0	0
2026	0	0	0	0	0	0	0
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0

Total = \$0 \$0 \$0  
 NPV = \$0 \$0 0

Total NPV = \$0  
 Benefit/Cost Ratio = #DIV/0!

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Interruptible Rate DR Program**  
 Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2017	0	0	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0	0	0
2023	0	0	0	0	0	0	0	0	0
2024	0	0	0	0	0	0	0	0	0
2025	0	0	0	0	0	0	0	0	0
2026	0	0	0	0	0	0	0	0	0
2027	0	0	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$0			\$0	\$0
				NPV =	\$0			\$0	0

Total NPV = \$0  
 Benefit/Cost Ratio = #DIV/0!

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Interruptible Rate DR Program**  
 Program Years: **2016 - 2018**

Year	Benefits														Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)		
2016	\$0	\$0.07964	\$0.07773	0	0	0	\$0	0	0	\$20.900	\$41.800	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
2017	0	0.08322	0.08122	0	0	0	0	0	0	21.841	43.681	0	0	0	0	0	0	0	
2018	0	0.08697	0.08488	0	0	0	0	0	0	22.823	45.647	0	0	0	0	0	0	0	
2019	0	0.09088	0.08870	0	0	0	0	0	0	23.850	47.701	0	0	0	0	0	0	0	
2020	0	0.09497	0.09269	0	0	0	0	0	0	24.924	49.847	0	0	0	0	0	0	0	
2021	0	0.09925	0.09686	0	0	0	0	0	0	26.045	52.090	0	0	0	0	0	0	0	
2022	0	0.10371	0.10122	0	0	0	0	0	0	27.217	54.434	0	0	0	0	0	0	0	
2023	0	0.10838	0.10578	0	0	0	0	0	0	28.442	56.884	0	0	0	0	0	0	0	
2024	0	0.11326	0.11054	0	0	0	0	0	0	29.722	59.444	0	0	0	0	0	0	0	
2025	0	0.11835	0.11551	0	0	0	0	0	0	31.059	62.119	0	0	0	0	0	0	0	
2026	0	0.12368	0.12071	0	0	0	0	0	0	32.457	64.914	0	0	0	0	0	0	0	
2027	0	0.12924	0.12614	0	0	0	0	0	0	33.918	67.835	0	0	0	0	0	0	0	
2028	0	0.13506	0.13182	0	0	0	0	0	0	35.444	70.888	0	0	0	0	0	0	0	
2029	0	0.14114	0.13775	0	0	0	0	0	0	37.039	74.078	0	0	0	0	0	0	0	
2030	0	0.14749	0.14395	0	0	0	0	0	0	38.706	77.411	0	0	0	0	0	0	0	
2031	0	0.15412	0.15042	0	0	0	0	0	0	40.447	80.895	0	0	0	0	0	0	0	
2032	0	0.16106	0.15719	0	0	0	0	0	0	42.268	84.535	0	0	0	0	0	0	0	
2033	0	0.16831	0.16427	0	0	0	0	0	0	44.170	88.339	0	0	0	0	0	0	0	
2034	0	0.17588	0.17166	0	0	0	0	0	0	46.157	92.314	0	0	0	0	0	0	0	
2035	0	0.18380	0.17938	0	0	0	0	0	0	48.234	96.469	0	0	0	0	0	0	0	
<b>Total =</b>				0	0				0	0							\$0	\$0	\$0
																	NPV = \$0	\$0	\$0

Total NPV = \$0  
 Benefit/Cost Ratio = #DIV/0!

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Interruptible Rate DR Program**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2017	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0
2023	0	0	0	0	0	0	0
2024	0	0	0	0	0	0	0
2025	0	0	0	0	0	0	0
2026	0	0	0	0	0	0	0
2027	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
	Total =		\$0			\$0	\$0
	NPV =		\$0			\$0	0

Total NPV = \$0  
Benefit/Cost Ratio = #DIV/0!

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

# Electric Energy Efficiency

## Marketing , Education, and Outreach Program

### Program Primary areas of Focus

- 1) Advertising / Promotion of Programs
- 2) Dealer & Builder Market Transformation Meetings
- 3) Customer Education & Promotion

### **Montana**

<u>Program Cost Summary</u>	2016	2017	2018	<u>Notes</u>
	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	
News Paper Inserts	\$1,500	\$1,500	\$1,500	Split with gas marketing if available Spring and Fall inserts
Radio Advertising	1,200	1,200	1,200	Spring and Fall runs
Billboards	2,500	2,500	2,500	Year long contract - rotating locations
Direct Mail	10,000	5,000	5,000	All customers yr 1, 12,000 in year 2 & 3
Co-op Advertising with Dealers	0	0	0	50% of cost of ad up to \$500
Bill Inserts	0	0	0	Spring and Fall runs
Dealer & Builder Meetings	0	0	0	Larger Communities
Customer Education & Promotion	0	0	0	Trade Shows and other Energy Awareness Events
Misc promotional offers	2,000	2,000	2,000	Dealer promotions / spiffs
<b>Total Education &amp; Outreach</b>	<b>\$17,200</b>	<b>\$12,200</b>	<b>\$12,200</b>	

*Entered into "Total Program" Model under Direct operating costs*

### **North Dakota**

<u>Program Cost Summary</u>	2016	2017	2018	<u>Notes</u>
	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	
News Paper Inserts	\$2,000	\$2,000	\$2,000	Split with gas marketing if available Spring and Fall inserts
Radio Advertising	2,000	2,000	2,000	Spring and Fall runs
Billboards	6,000	6,000	6,000	Year long contract - rotating locations
Direct Mail	15,000	5,000	5,000	All customers yr 1, 12,000 in year 2 & 3
Bill Inserts	0	0	0	Spring and Fall runs
Co-op Advertising with Dealers	0	0	0	50% of cost of ad up to \$500
Dealer & Builder Meetings	0	0	0	Larger Communities
Customer Education & Promotion	0	0	0	Trade Shows and other Energy Awareness Events
Misc promotional offers	5,000	5,000	5,000	Dealer promotions / spiffs
<b>Total Education &amp; Outreach</b>	<b>\$30,000</b>	<b>\$20,000</b>	<b>\$20,000</b>	

*Entered into "Total Program" Model under Direct operating costs*

### **South Dakota**

<u>Program Cost Summary</u>	2016	2017	2018	<u>Notes</u>
	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	
News Paper Inserts	\$550	\$550	\$550	Split with gas marketing if available Spring and Fall inserts
Radio Advertising	800	800	800	Spring and Fall runs
Billboards	600	600	600	Year long contract - rotating locations
Direct Mail	7,000	3,500	3,500	All customers yr 1, 12,000 in year 2 & 3
Bill Inserts	0	0	0	Spring and Fall runs
Co-op Advertising with Dealers	0	0	0	50% of cost of ad up to \$500
Dealer & Builder Meetings	0	0	0	Larger Communities
Customer Education & Promotion	0	0	0	Trade Shows and other Energy Awareness Events
Misc promotional offers	1,000	1,000	1,000	Dealer promotions / spiffs
<b>Total Education &amp; Outreach</b>	<b>\$9,950</b>	<b>\$6,450</b>	<b>\$6,450</b>	

*Entered into "Total Program" Model under Direct operating costs*

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Residential LED Lighting**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09033			
Retail Rate Winter (\$/kWh) =	\$0.07591			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00418			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.06075			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$8,920	\$4,416	\$3,847
Incentive Costs =		30,000	30,000	30,000
Total Utility Project Costs =		\$38,920	\$34,416	\$33,847
14) Direct Participant Costs (\$/Part.) =		\$10	\$10	\$10
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		10	10	10
16) Avg Summer kW/part. Saved =		0.004	0.004	0.004
16a) Avg Winter kW/part Saved =		0.003	0.003	0.003
17) Avg. Summer kWh/Part. Saved =		10	10	10
17a) Avg. Winter kWh/Part. Saved =		20	20	20
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		3,000	3,000	3,000
20) Incentive/Participant =		\$10	\$10	\$10
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		30,000	30,000	30,000
Annual Winter Kwh Saved		60,000	60,000	60,000
23) Annual Summer KW Saved		12	12	12
Annual Winter KW Saved		9	9	9
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		(\$45,453)	0.75	
Utility Cost Test		\$35,263	1.36	
Societal Test		\$147,254	2.42	
Participant Test		\$169,270	3.00	
Total Resource Cost Test		\$35,263	1.36	

**Table 1  
Ratepayer Impact Test**

Project: **Residential LED Lighting**  
Program Years: **2016 - 2018**

t	Year											Costs							Annual Benefits Less Costs (P)			
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)	Program Admin Costs (M)		Incentive Costs (N)	Total Project Costs (O)	
1	2016	96,962	\$0.03570	\$3,462	\$0.00000	\$0	14	10	24	\$100.80	\$2,419	\$5,881	\$0.06348	30,000	60,000	90,000	\$3,463	\$8,920	\$30,000	\$42,383	(\$36,502)	
2	2017	193,923	0.03790	7,350	0.00000	0	27	20	47	103.82	4,880	12,230	0.06634	60,000	120,000	180,000	7,238	4,416	30,000	41,654	(29,424)	
3	2018	290,885	0.03900	11,345	0.00000	0	41	31	72	106.94	7,700	19,045	0.06933	90,000	180,000	270,000	11,346	3,847	30,000	45,193	(26,148)	
4	2019	290,885	0.04000	11,635	0.00000	0	41	31	72	110.15	7,931	19,566	0.07245	90,000	180,000	270,000	11,857	0	0	11,857	7,709	
5	2020	290,885	0.04250	12,363	0.00000	0	41	31	72	113.45	8,168	20,531	0.07571	90,000	180,000	270,000	12,390	0	0	12,390	8,141	
6	2021	290,885	0.04470	13,003	0.00000	0	41	31	72	116.85	8,413	21,416	0.07911	90,000	180,000	270,000	12,947	0	0	12,947	8,469	
7	2022	290,885	0.04780	13,904	0.00000	0	41	31	72	120.36	8,666	22,570	0.08267	90,000	180,000	270,000	13,529	0	0	13,529	9,041	
8	2023	290,885	0.04950	14,399	0.00000	0	41	31	72	123.97	8,926	23,325	0.08639	90,000	180,000	270,000	14,138	0	0	14,138	9,187	
9	2024	290,885	0.05270	15,330	0.00000	0	41	31	72	127.69	9,194	24,524	0.09028	90,000	180,000	270,000	14,775	0	0	14,775	9,749	
10	2025	290,885	0.05428	15,789	0.00000	0	41	31	72	131.52	9,469	25,258	0.09434	90,000	180,000	270,000	15,439	0	0	15,439	9,819	
11	2026	193,923	0.05591	10,842	0.00000	0	27	20	47	135.47	6,367	17,209	0.09859	60,000	120,000	180,000	10,756	0	0	10,756	6,453	
12	2027	96,962	0.05759	5,584	0.00000	0	14	10	24	139.53	3,349	8,933	0.10302	30,000	60,000	90,000	5,620	0	0	5,620	3,313	
13	2028	0	0.05932	0	0.00000	0	0	0	0	143.72	0	0	0.10766	0	0	0	0	0	0	0	0	
14	2029	0	0.06110	0	0.00000	0	0	0	0	148.03	0	0	0.11251	0	0	0	0	0	0	0	0	
15	2030	0	0.06293	0	0.00000	0	0	0	0	152.47	0	0	0.11757	0	0	0	0	0	0	0	0	
16	2031	0	0.06482	0	0.00000	0	0	0	0	157.04	0	0	0.12286	0	0	0	0	0	0	0	0	
17	2032	0	0.06676	0	0.00000	0	0	0	0	161.75	0	0	0.12839	0	0	0	0	0	0	0	0	
18	2033	0	0.06876	0	0.00000	0	0	0	0	166.61	0	0	0.13417	0	0	0	0	0	0	0	0	
19	2034	0	0.07082	0	0.00000	0	0	0	0	171.60	0	0	0.14020	0	0	0	0	0	0	0	0	
20	2035	0	0.07294	0	0.00000	0	0	0	0	176.75	0	0	0.14651	0	0	0	0	0	0	0	0	
Total =		2,908,850						718				\$220,488				2,700,000				\$240,681	(\$20,193)	
												NPV =	\$133,754								\$179,207	(45,453)
Total NPV =																					(\$45,453)	
Benefit/Cost Ratio =																					<u>0.75</u>	

**Worksheet Calculations**

(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(K) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L) = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M) = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N) = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O) = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P) = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Residential LED Lighting**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$3,462	\$0	\$2,419	\$5,881	\$38,920	\$38,920	(\$33,039)
2017	7,350	0	4,880	12,230	34,416	34,416	(22,186)
2018	11,345	0	7,700	19,045	33,847	33,847	(14,802)
2019	11,635	0	7,931	19,566	0	0	19,566
2020	12,363	0	8,168	20,531	0	0	20,531
2021	13,003	0	8,413	21,416	0	0	21,416
2022	13,904	0	8,666	22,570	0	0	22,570
2023	14,399	0	8,926	23,325	0	0	23,325
2024	15,330	0	9,194	24,524	0	0	24,524
2025	15,789	0	9,469	25,258	0	0	25,258
2026	10,842	0	6,367	17,209	0	0	17,209
2027	5,584	0	3,349	8,933	0	0	8,933
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$220,488		\$107,183	\$113,305
				NPV = \$133,754		\$98,491	35,263
Total NPV =							\$35,263
Benefit/Cost Ratio =							1.36

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Residential LED Lighting**  
Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$3,462	\$0	\$2,419	\$1,860	\$7,741	\$38,920	\$0	\$38,920	(\$31,179)
2017	7,350	0	4,880	3,983	16,213	34,416	0	34,416	(18,203)
2018	11,345	0	7,700	6,389	25,434	33,847	0	33,847	(8,413)
2019	11,635	0	7,931	6,761	26,327	0	0	0	26,327
2020	12,363	0	8,168	7,307	27,838	0	0	0	27,838
2021	13,003	0	8,413	7,851	29,267	0	0	0	29,267
2022	13,904	0	8,666	8,522	31,092	0	0	0	31,092
2023	14,399	0	8,926	9,071	32,396	0	0	0	32,396
2024	15,330	0	9,194	9,823	34,347	0	0	0	34,347
2025	15,789	0	9,469	10,421	35,679	0	0	0	35,679
2026	10,842	0	6,367	7,313	24,522	0	0	0	24,522
2027	5,584	0	3,349	3,910	12,843	0	0	0	12,843
2028	0	0	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$303,699			\$107,183	\$196,516
					NPV = \$251,172			\$103,918	147,254
Total NPV =									\$147,254
Benefit/Cost Ratio =									<u>2.42</u>

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Residential LED Lighting**  
 Program Years: **2016 - 2018**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$30,000	\$0.09439	\$0.07933	30,000	60,000	90,000	\$7,592	12	9	\$0.000	\$0.000	\$0	\$0	\$37,592	\$30,519	\$0	\$30,519	\$7,073
2017	30,000	0.09864	0.08290	60,000	120,000	180,000	15,866	24	18	0.000	0.000	0	0	45,866	31,047	0	31,047	14,819
2018	30,000	0.10308	0.08663	90,000	180,000	270,000	24,871	36	27	0.000	0.000	0	0	54,871	31,584	0	31,584	23,287
2019	0	0.10772	0.09052	90,000	180,000	270,000	25,988	36	27	0.000	0.000	0	0	25,988	0	0	0	25,988
2020	0	0.11257	0.09460	90,000	180,000	270,000	27,159	36	27	0.000	0.000	0	0	27,159	0	0	0	27,159
2021	0	0.11763	0.09885	90,000	180,000	270,000	28,380	36	27	0.000	0.000	0	0	28,380	0	0	0	28,380
2022	0	0.12293	0.10330	90,000	180,000	270,000	29,658	36	27	0.000	0.000	0	0	29,658	0	0	0	29,658
2023	0	0.12846	0.10795	90,000	180,000	270,000	30,992	36	27	0.000	0.000	0	0	30,992	0	0	0	30,992
2024	0	0.13424	0.11281	90,000	180,000	270,000	32,387	36	27	0.000	0.000	0	0	32,387	0	0	0	32,387
2025	0	0.14028	0.11789	90,000	180,000	270,000	33,845	36	27	0.000	0.000	0	0	33,845	0	0	0	33,845
2026	0	0.14659	0.12319	60,000	120,000	180,000	23,578	24	18	0.000	0.000	0	0	23,578	0	0	0	23,578
2027	0	0.15319	0.12873	30,000	60,000	90,000	12,320	12	9	0.000	0.000	0	0	12,320	0	0	0	12,320
2028	0	0.16008	0.13453	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2029	0	0.16729	0.14058	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2030	0	0.17481	0.14691	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2031	0	0.18268	0.15352	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2032	0	0.19090	0.16043	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.19949	0.16765	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.20847	0.17519	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.21785	0.18307	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				900,000	1,800,000			360	270					\$382,636			\$93,150	\$289,486
														NPV = \$253,956			\$84,686	169,270
Total NPV =					\$169,270													
Benefit/Cost Ratio =					<u>3.00</u>													

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Residential LED Lighting**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$3,462	\$2,419	\$5,881	\$38,920	\$0	\$38,920	(\$33,039)
2017	7,350	4,880	12,230	34,416	0	34,416	(22,186)
2018	11,345	7,700	19,045	33,847	0	33,847	(14,802)
2019	11,635	7,931	19,566	0	0	0	19,566
2020	12,363	8,168	20,531	0	0	0	20,531
2021	13,003	8,413	21,416	0	0	0	21,416
2022	13,904	8,666	22,570	0	0	0	22,570
2023	14,399	8,926	23,325	0	0	0	23,325
2024	15,330	9,194	24,524	0	0	0	24,524
2025	15,789	9,469	25,258	0	0	0	25,258
2026	10,842	6,367	17,209	0	0	0	17,209
2027	5,584	3,349	8,933	0	0	0	8,933
2028	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$220,488		\$107,183	\$113,305	
NPV =			\$133,754		\$98,491	35,263	
Total NPV =			\$35,263				
Benefit/Cost Ratio =			<u>1.36</u>				

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Residential AC Cycling**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09033			
Retail Rate Winter (\$/kWh) =	\$0.07591			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00418			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.06075			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$0	\$4,308	\$3,750
Incentive Costs =		0	24,000	24,720
Direct Program Costs =		0	0	0
Total Utility Project Costs =		\$0	\$28,308	\$28,470
14) Direct Participant Costs (\$/Part.) =		\$100	\$100	\$100
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		15	15	15
16) Avg Summer kW/part. Saved =		0.000	0.000	0.000
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		269	269	269
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		0	400	412
20) Incentive/Participant =		\$60	\$60	\$60
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		0	107,600	110,828
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		0	0	0
Annual Winter KW Saved		0	0	0

<b>Test Results</b>	<b>NPV</b>	<b>B/C</b>
Ratepayer Impact Measure Test	(\$37,043)	0.73
Utility Cost Test	(\$45,661)	0.66
Societal Test	(\$19,976)	0.91
Participant Test	\$170,724	3.33
Total Resource Cost Test	(\$73,975)	0.55

**Table 1  
Ratepayer Impact Test**

Project: **Residential AC Cycling**  
Program Years: **2016 - 2018**

t	Year											Costs							Annual Benefits Less Costs (Q)					
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)	Program Admin Costs (M)		Incentive Costs (N)	Direct Program Costs (O)	Total Project Costs (P)		
1	2016	0	\$0.03570	\$0	\$0.00000	\$0	0	0	0	0	0	0	0	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2	2017	121,566	\$0.03790	4,607	0.00000	0	0	0	0	\$103.82	\$0	\$4,607	\$0.06634	107,600	0	107,600	\$4,327	4,308	24,000	0	32,635	(\$28,028)		
3	2018	246,780	\$0.03900	9,624	0.00000	0	0	0	0	\$106.94	0	9,624	0.06933	218,428	0	218,428	\$9,179	3,750	24,720	0	37,649	(\$28,025)		
4	2019	246,780	\$0.04000	9,871	0.00000	0	0	0	0	\$110.15	0	9,871	0.07245	218,428	0	218,428	\$9,592	0	0	0	9,592	\$279		
5	2020	246,780	\$0.04250	10,488	0.00000	0	0	0	0	\$113.45	0	10,488	0.07571	218,428	0	218,428	\$10,024	0	0	0	10,024	\$464		
6	2021	246,780	\$0.04470	11,031	0.00000	0	0	0	0	\$116.85	0	11,031	0.07911	218,428	0	218,428	\$10,474	0	0	0	10,474	\$557		
7	2022	246,780	\$0.04780	11,796	0.00000	0	0	0	0	\$120.36	0	11,796	0.08267	218,428	0	218,428	\$10,945	0	0	0	10,945	\$851		
8	2023	246,780	\$0.04950	12,216	0.00000	0	0	0	0	\$123.97	0	12,216	0.08639	218,428	0	218,428	\$11,438	0	0	0	11,438	\$778		
9	2024	246,780	\$0.05270	13,005	0.00000	0	0	0	0	\$127.69	0	13,005	0.09028	218,428	0	218,428	\$11,953	0	0	0	11,953	\$1,052		
10	2025	246,780	\$0.05428	13,395	0.00000	0	0	0	0	\$131.52	0	13,395	0.09434	218,428	0	218,428	\$12,490	0	0	0	12,490	\$905		
11	2026	246,780	\$0.05591	13,797	0.00000	0	0	0	0	\$135.47	0	13,797	0.09859	218,428	0	218,428	\$13,053	0	0	0	13,053	\$744		
12	2027	246,780	\$0.05759	14,212	0.00000	0	0	0	0	\$139.53	0	14,212	0.10302	218,428	0	218,428	\$13,639	0	0	0	13,639	\$573		
13	2028	246,780	\$0.05932	14,639	0.00000	0	0	0	0	\$143.72	0	14,639	0.10766	218,428	0	218,428	\$14,254	0	0	0	14,254	\$385		
14	2029	246,780	\$0.06110	15,078	0.00000	0	0	0	0	\$148.03	0	15,078	0.11251	218,428	0	218,428	\$14,896	0	0	0	14,896	\$182		
15	2030	246,780	\$0.06293	15,530	0.00000	0	0	0	0	\$152.47	0	15,530	0.11757	218,428	0	218,428	\$15,566	0	0	0	15,566	(\$36)		
16	2031	246,780	\$0.06482	15,996	0.00000	0	0	0	0	\$157.04	0	15,996	0.12286	218,428	0	218,428	\$16,266	0	0	0	16,266	(\$270)		
17	2032	125,213	\$0.06676	8,359	0.00000	0	0	0	0	\$161.75	0	8,359	0.12839	110,828	0	110,828	\$8,625	0	0	0	8,625	(\$266)		
18	2033	0	\$0.06876	0	0.00000	0	0	0	0	\$166.61	0	0	0.13417	0	0	0	\$0	0	0	0	0	\$0		
19	2034	0	\$0.07082	0	0.00000	0	0	0	0	\$171.60	0	0	0.14020	0	0	0	\$0	0	0	0	0	\$0		
20	2035	0	\$0.07294	0	0.00000	0	0	0	0	\$176.75	0	0	0.14651	0	0	0	\$0	0	0	0	0	\$0		
Total =		3,701,699						0		\$193,644				3,276,420						\$243,499	(\$49,855)			
										NPV =		\$98,296								\$135,339	(37,043)			
Total NPV =																								
Benefit/Cost Ratio =																								

Worksheet Calculations	
(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(I = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Residential AC Cycling**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2017	4,607	0	0	4,607	32,635	32,635	(28,028)
2018	9,624	0	0	9,624	37,649	37,649	(28,025)
2019	9,871	0	0	9,871	9,592	9,592	279
2020	10,488	0	0	10,488	10,024	10,024	464
2021	11,031	0	0	11,031	10,474	10,474	557
2022	11,796	0	0	11,796	10,945	10,945	851
2023	12,216	0	0	12,216	11,438	11,438	778
2024	13,005	0	0	13,005	11,953	11,953	1,052
2025	13,395	0	0	13,395	12,490	12,490	905
2026	13,797	0	0	13,797	13,053	13,053	744
2027	14,212	0	0	14,212	13,639	13,639	573
2028	14,639	0	0	14,639	14,254	14,254	385
2029	15,078	0	0	15,078	14,896	14,896	182
2030	15,530	0	0	15,530	15,566	15,566	(36)
2031	15,996	0	0	15,996	16,266	16,266	(270)
2032	8,359	0	0	8,359	8,625	8,625	(266)
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$193,644	\$243,499	\$243,499	(\$49,855)
				NPV = \$89,678		\$135,339	(45,661)
Total NPV =							(\$45,661)
Benefit/Cost Ratio =							<u>0.66</u>

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Residential AC Cycling**  
Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2017	4,607	0	0	1,500	6,107	32,635	16,000	48,635	(42,528)
2018	9,624	0	0	3,229	12,853	37,649	16,480	54,129	(41,276)
2019	9,871	0	0	3,411	13,282	9,592	0	9,592	3,690
2020	10,488	0	0	3,733	14,221	10,024	0	10,024	4,197
2021	11,031	0	0	4,044	15,075	10,474	0	10,474	4,601
2022	11,796	0	0	4,454	16,250	10,945	0	10,945	5,305
2023	12,216	0	0	4,751	16,967	11,438	0	11,438	5,529
2024	13,005	0	0	5,209	18,214	11,953	0	11,953	6,261
2025	13,395	0	0	5,527	18,922	12,490	0	12,490	6,432
2026	13,797	0	0	5,863	19,660	13,053	0	13,053	6,607
2027	14,212	0	0	6,221	20,433	13,639	0	13,639	6,794
2028	14,639	0	0	6,600	21,239	14,254	0	14,254	6,985
2029	15,078	0	0	7,002	22,080	14,896	0	14,896	7,184
2030	15,530	0	0	7,428	22,958	15,566	0	15,566	7,392
2031	15,996	0	0	7,880	23,876	16,266	0	16,266	7,610
2032	8,359	0	0	4,242	12,601	8,625	0	8,625	3,976
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$274,738		\$275,979	(\$1,241)	
NPV =					\$203,791		\$223,767	(19,976)	
Total NPV =		(\$19,976)							
Benefit/Cost Ratio =		<u>0.91</u>							

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Residential AC Cycling**  
 Program Years: **2016 - 2018**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$0	\$0.09439	\$0.07933	0	0	0	\$0	0	0	\$0.000	\$0.000	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2017	24,000	0.09864	0.08290	107,600	0	107,600	10,614	0	0	0.000	0.000	0	0	34,614	41,396	0	41,396	(6,782)
2018	24,720	0.10308	0.08663	218,428	0	218,428	22,516	0	0	0.000	0.000	0	0	47,236	43,375	0	43,375	3,861
2019	0	0.10772	0.09052	218,428	0	218,428	23,529	0	0	0.000	0.000	0	0	23,529	0	0	0	23,529
2020	0	0.11257	0.09460	218,428	0	218,428	24,588	0	0	0.000	0.000	0	0	24,588	0	0	0	24,588
2021	0	0.11763	0.09885	218,428	0	218,428	25,694	0	0	0.000	0.000	0	0	25,694	0	0	0	25,694
2022	0	0.12293	0.10330	218,428	0	218,428	26,851	0	0	0.000	0.000	0	0	26,851	0	0	0	26,851
2023	0	0.12846	0.10795	218,428	0	218,428	28,059	0	0	0.000	0.000	0	0	28,059	0	0	0	28,059
2024	0	0.13424	0.11281	218,428	0	218,428	29,322	0	0	0.000	0.000	0	0	29,322	0	0	0	29,322
2025	0	0.14028	0.11789	218,428	0	218,428	30,641	0	0	0.000	0.000	0	0	30,641	0	0	0	30,641
2026	0	0.14659	0.12319	218,428	0	218,428	32,019	0	0	0.000	0.000	0	0	32,019	0	0	0	32,019
2027	0	0.15319	0.12873	218,428	0	218,428	33,461	0	0	0.000	0.000	0	0	33,461	0	0	0	33,461
2028	0	0.16008	0.13453	218,428	0	218,428	34,966	0	0	0.000	0.000	0	0	34,966	0	0	0	34,966
2029	0	0.16729	0.14058	218,428	0	218,428	36,541	0	0	0.000	0.000	0	0	36,541	0	0	0	36,541
2030	0	0.17481	0.14691	218,428	0	218,428	38,183	0	0	0.000	0.000	0	0	38,183	0	0	0	38,183
2031	0	0.18268	0.15352	218,428	0	218,428	39,902	0	0	0.000	0.000	0	0	39,902	0	0	0	39,902
2032	0	0.19090	0.16043	110,828	0	110,828	21,157	0	0	0.000	0.000	0	0	21,157	0	0	0	21,157
2033	0	0.19949	0.16765	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.20847	0.17519	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.21785	0.18307	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				3,276,420	0			0	0					\$506,763			\$84,771	\$421,992
														NPV = \$243,986			\$73,262	170,724

Total NPV = \$170,724  
 Benefit/Cost Ratio = 3.33

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5  
Total Resource Cost Test**

Company: **Residential AC Cycling**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2017	4,607	0	4,607	32,635	16,000	48,635	(44,028)
2018	9,624	0	9,624	37,649	16,480	54,129	(44,505)
2019	9,871	0	9,871	9,592	0	9,592	279
2020	10,488	0	10,488	10,024	0	10,024	464
2021	11,031	0	11,031	10,474	0	10,474	557
2022	11,796	0	11,796	10,945	0	10,945	851
2023	12,216	0	12,216	11,438	0	11,438	778
2024	13,005	0	13,005	11,953	0	11,953	1,052
2025	13,395	0	13,395	12,490	0	12,490	905
2026	13,797	0	13,797	13,053	0	13,053	744
2027	14,212	0	14,212	13,639	0	13,639	573
2028	14,639	0	14,639	14,254	0	14,254	385
2029	15,078	0	15,078	14,896	0	14,896	182
2030	15,530	0	15,530	15,566	0	15,566	(36)
2031	15,996	0	15,996	16,266	0	16,266	(270)
2032	8,359	0	8,359	8,625	0	8,625	(266)
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
		Total =	\$193,644			\$275,979	(\$82,335)
		NPV =	\$89,678			\$163,653	(73,975)
Total NPV =			(\$73,975)				
Benefit/Cost Ratio =			<u>0.55</u>				

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
NORTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Residential AC Cycling**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.08197			
Retail Rate Winter (\$/kWh) =	\$0.07128			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00496			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05993			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	8.70%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =		\$0	\$11,557	\$9,765
Incentive Costs =		0	90,000	92,700
Direct Program Costs =		0	0	0
Total Utility Project Costs =		\$0	\$101,557	\$102,465
14) Direct Participant Costs (\$/Part.) =		\$100	\$100	\$100
Escalation Rate =		1.73%	1.73%	1.73%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		15	15	15
16) Avg Summer kWh/part. Saved =		0.000	0.000	0.000
16a) Avg Winter kWh/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		210	210	210
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		12.9800%	12.9800%	12.9800%
18b) System Energy Line Loss Factor		7.7350%	7.7350%	7.7350%
19) Number of Participants =		0	1,500	1,545
20) Incentive/Participant =		\$60	\$60	\$60
21) Effective Federal & State Income Tax Rate =				39.39%
22) Annual Summer Kwh Saved		0	315,000	324,450
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		0	0	0
Annual Winter KW Saved		0	0	0
<b>Test Results</b>		<b>NPV</b>	<b>B/C</b>	
Ratepayer Impact Measure Test		(\$163,230)	0.62	
Utility Cost Test		(\$163,230)	0.62	
Societal Test		(\$114,394)	0.84	
Participant Test		\$419,494	2.53	
Total Resource Cost Test		(\$269,408)	0.49	

**Table 1**  
**Ratepayer Impact Test**

Project: **Residential AC Cycling**  
Program Years: **2016 - 2018**

t	Year											Costs							Annual Benefits Less Costs (Q)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)	Program Admin Costs (M)		Incentive Costs (N)	Direct Program Costs (O)	Total Project Costs (P)	
1	2016	0	\$0.03570	\$0	\$0.00000	\$0	0	0	0	\$100.80	\$0	\$0	\$0.06263	0	0	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2	2017	355,887	\$0.03790	13,488	0.00000	0	0	0	0	103.82	0	13,488	0.06545	315,000	0	315,000	12,496	11,557	90,000	0	114,053	(100,565)	
3	2018	722,451	\$0.03900	28,176	0.00000	0	0	0	0	106.94	0	28,176	0.06839	639,450	0	639,450	26,507	9,765	92,700	0	128,972	(100,796)	
4	2019	722,451	\$0.04000	28,898	0.00000	0	0	0	0	110.15	0	28,898	0.07147	639,450	0	639,450	27,701	0	0	0	27,701	1,197	
5	2020	722,451	\$0.04250	30,704	0.00000	0	0	0	0	113.45	0	30,704	0.07468	639,450	0	639,450	28,945	0	0	0	28,945	1,759	
6	2021	722,451	\$0.04470	32,294	0.00000	0	0	0	0	116.85	0	32,294	0.07804	639,450	0	639,450	30,247	0	0	0	30,247	2,047	
7	2022	722,451	\$0.04780	34,533	0.00000	0	0	0	0	120.36	0	34,533	0.08156	639,450	0	639,450	31,612	0	0	0	31,612	2,921	
8	2023	722,451	\$0.04950	35,761	0.00000	0	0	0	0	123.97	0	35,761	0.08523	639,450	0	639,450	33,034	0	0	0	33,034	2,727	
9	2024	722,451	\$0.05270	38,073	0.00000	0	0	0	0	127.69	0	38,073	0.08906	639,450	0	639,450	34,518	0	0	0	34,518	3,555	
10	2025	722,451	\$0.05428	39,215	0.00000	0	0	0	0	131.52	0	39,215	0.09307	639,450	0	639,450	36,073	0	0	0	36,073	3,142	
11	2026	722,451	\$0.05591	40,392	0.00000	0	0	0	0	135.47	0	40,392	0.09726	639,450	0	639,450	37,697	0	0	0	37,697	2,695	
12	2027	722,451	\$0.05759	41,606	0.00000	0	0	0	0	139.53	0	41,606	0.10163	639,450	0	639,450	39,390	0	0	0	39,390	2,216	
13	2028	722,451	\$0.05932	42,856	0.00000	0	0	0	0	143.72	0	42,856	0.10621	639,450	0	639,450	41,166	0	0	0	41,166	1,690	
14	2029	722,451	\$0.06110	44,142	0.00000	0	0	0	0	148.03	0	44,142	0.11099	639,450	0	639,450	43,018	0	0	0	43,018	1,124	
15	2030	722,451	\$0.06293	45,464	0.00000	0	0	0	0	152.47	0	45,464	0.11598	639,450	0	639,450	44,952	0	0	0	44,952	512	
16	2031	722,451	\$0.06482	46,829	0.00000	0	0	0	0	157.04	0	46,829	0.12120	639,450	0	639,450	46,975	0	0	0	46,975	(146)	
17	2032	366,564	\$0.06676	24,472	0.00000	0	0	0	0	161.75	0	24,472	0.12665	324,450	0	324,450	24,907	0	0	0	24,907	(435)	
18	2033	0	\$0.06876	0	0.00000	0	0	0	0	166.61	0	0	0.13235	0	0	0	0	0	0	0	0	0	
19	2034	0	\$0.07082	0	0.00000	0	0	0	0	171.60	0	0	0.13831	0	0	0	0	0	0	0	0	0	
20	2035	0	\$0.07294	0	0.00000	0	0	0	0	176.75	0	0	0.14453	0	0	0	0	0	0	0	0	0	
Total =		10,836,765						0				\$566,903				9,591,750				\$743,260	(\$176,357)		
												NPV =	\$262,538								\$425,768	(163,230)	
Total NPV =																							
Benefit/Cost Ratio =																							

Worksheet Calculations	
(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(I = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Residential AC Cycling**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2017	13,488	0	0	13,488	114,053	114,053	(100,565)
2018	28,176	0	0	28,176	128,972	128,972	(100,796)
2019	28,898	0	0	28,898	27,701	27,701	1,197
2020	30,704	0	0	30,704	28,945	28,945	1,759
2021	32,294	0	0	32,294	30,247	30,247	2,047
2022	34,533	0	0	34,533	31,612	31,612	2,921
2023	35,761	0	0	35,761	33,034	33,034	2,727
2024	38,073	0	0	38,073	34,518	34,518	3,555
2025	39,215	0	0	39,215	36,073	36,073	3,142
2026	40,392	0	0	40,392	37,697	37,697	2,695
2027	41,606	0	0	41,606	39,390	39,390	2,216
2028	42,856	0	0	42,856	41,166	41,166	1,690
2029	44,142	0	0	44,142	43,018	43,018	1,124
2030	45,464	0	0	45,464	44,952	44,952	512
2031	46,829	0	0	46,829	46,975	46,975	(146)
2032	24,472	0	0	24,472	24,907	24,907	(435)
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =				\$566,903	\$743,260		(\$176,357)
NPV =				\$262,538	\$425,768		(163,230)
Total NPV =				(\$163,230)			
Benefit/Cost Ratio =				0.62			

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3  
Societal Cost Test**

Project: **Residential AC Cycling**  
Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2017	13,488	0	0	4,393	17,881	114,053	60,000	174,053	(156,172)
2018	28,176	0	0	9,452	37,628	128,972	61,800	190,772	(153,144)
2019	28,898	0	0	9,985	38,883	27,701	0	27,701	11,182
2020	30,704	0	0	10,927	41,631	28,945	0	28,945	12,686
2021	32,294	0	0	11,838	44,132	30,247	0	30,247	13,885
2022	34,533	0	0	13,039	47,572	31,612	0	31,612	15,960
2023	35,761	0	0	13,907	49,668	33,034	0	33,034	16,634
2024	38,073	0	0	15,251	53,324	34,518	0	34,518	18,806
2025	39,215	0	0	16,179	55,394	36,073	0	36,073	19,321
2026	40,392	0	0	17,165	57,557	37,697	0	37,697	19,860
2027	41,606	0	0	18,211	59,817	39,390	0	39,390	20,427
2028	42,856	0	0	19,321	62,177	41,166	0	41,166	21,011
2029	44,142	0	0	20,498	64,640	43,018	0	43,018	21,622
2030	45,464	0	0	21,745	67,209	44,952	0	44,952	22,257
2031	46,829	0	0	23,070	69,899	46,975	0	46,975	22,924
2032	24,472	0	0	12,418	36,890	24,907	0	24,907	11,983
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$804,302		\$865,060	(\$60,758)	
NPV =					\$596,603		\$710,997	(114,394)	
Total NPV =					(\$114,394)				
Benefit/Cost Ratio =					0.84				

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Residential AC Cycling**  
 Program Years: **2016 - 2018**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$0	\$0.08566	\$0.07449	0	0	0	\$0	0	0	\$0.000	\$0.000	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2017	90,000	0.08951	0.07784	315,000	0	315,000	28,196	0	0	0.000	0.000	0	0	118,196	\$155,235	0	155,235	(37,039)
2018	92,700	0.09354	0.08134	639,450	0	639,450	59,814	0	0	0.000	0.000	0	0	152,514	\$162,658	0	162,658	(10,144)
2019	0	0.09775	0.08500	639,450	0	639,450	62,506	0	0	0.000	0.000	0	0	62,506	\$0	0	0	62,506
2020	0	0.10215	0.08883	639,450	0	639,450	65,320	0	0	0.000	0.000	0	0	65,320	\$0	0	0	65,320
2021	0	0.10675	0.09283	639,450	0	639,450	68,261	0	0	0.000	0.000	0	0	68,261	\$0	0	0	68,261
2022	0	0.11155	0.09700	639,450	0	639,450	71,331	0	0	0.000	0.000	0	0	71,331	\$0	0	0	71,331
2023	0	0.11657	0.10137	639,450	0	639,450	74,541	0	0	0.000	0.000	0	0	74,541	\$0	0	0	74,541
2024	0	0.12182	0.10593	639,450	0	639,450	77,898	0	0	0.000	0.000	0	0	77,898	\$0	0	0	77,898
2025	0	0.12730	0.11070	639,450	0	639,450	81,402	0	0	0.000	0.000	0	0	81,402	\$0	0	0	81,402
2026	0	0.13303	0.11568	639,450	0	639,450	85,066	0	0	0.000	0.000	0	0	85,066	\$0	0	0	85,066
2027	0	0.13901	0.12088	639,450	0	639,450	88,890	0	0	0.000	0.000	0	0	88,890	\$0	0	0	88,890
2028	0	0.14527	0.12632	639,450	0	639,450	92,893	0	0	0.000	0.000	0	0	92,893	\$0	0	0	92,893
2029	0	0.15180	0.13201	639,450	0	639,450	97,069	0	0	0.000	0.000	0	0	97,069	\$0	0	0	97,069
2030	0	0.15864	0.13795	639,450	0	639,450	101,442	0	0	0.000	0.000	0	0	101,442	\$0	0	0	101,442
2031	0	0.16577	0.14415	639,450	0	639,450	106,002	0	0	0.000	0.000	0	0	106,002	\$0	0	0	106,002
2032	0	0.17323	0.15064	324,450	0	324,450	56,204	0	0	0.000	0.000	0	0	56,204	\$0	0	0	56,204
2033	0	0.18103	0.15742	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
2034	0	0.18918	0.16450	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
2035	0	0.19769	0.17191	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
Total =				9,591,750	0			0	0					\$1,399,535			\$317,893	\$1,081,642
														NPV = \$694,227			\$274,733	419,494

Total NPV = \$419,494  
 Benefit/Cost Ratio = 2.53

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Residential AC Cycling**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2017	13,488	0	13,488	114,053	60,000	174,053	(160,565)
2018	28,176	0	28,176	128,972	61,800	190,772	(162,596)
2019	28,898	0	28,898	27,701	0	27,701	1,197
2020	30,704	0	30,704	28,945	0	28,945	1,759
2021	32,294	0	32,294	30,247	0	30,247	2,047
2022	34,533	0	34,533	31,612	0	31,612	2,921
2023	35,761	0	35,761	33,034	0	33,034	2,727
2024	38,073	0	38,073	34,518	0	34,518	3,555
2025	39,215	0	39,215	36,073	0	36,073	3,142
2026	40,392	0	40,392	37,697	0	37,697	2,695
2027	41,606	0	41,606	39,390	0	39,390	2,216
2028	42,856	0	42,856	41,166	0	41,166	1,690
2029	44,142	0	44,142	43,018	0	43,018	1,124
2030	45,464	0	45,464	44,952	0	44,952	512
2031	46,829	0	46,829	46,975	0	46,975	(146)
2032	24,472	0	24,472	24,907	0	24,907	(435)
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$566,903			\$865,060	(\$298,157)
NPV =			\$262,538			\$531,946	(269,408)
Total NPV =			(\$269,408)				
Benefit/Cost Ratio =			0.49				

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**ELECTRIC DEMAND SIDE MANAGEMENT (DSM) PROGRAMS  
SOUTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS**

Company: **Montana-Dakota Utilities Co.**  
 Project: **Residential AC Cycling**  
 Program Years: **2016 - 2018**

<b>Input Data</b>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09021			
Retail Rate Winter (\$/kWh) =	\$0.08577			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.00815			
Fuel Escalation Rate =	2.80%			
2) Avg. System Marginal Energy Cost (\$/kWh) =	\$0.00000			
Escalation Rate =	3.00%			
3) Retail Summer Demand Rate (\$/kW/season) =	\$0.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$0.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05546			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.22%			
9) Utility Discount Rate =	9.61%			
10) Societal Discount Rate =	3.34%			
11) General Input Data Year =	2015			
12) Project Analysis Year 1 =	2016			
Project Analysis Year 2 =	2017			
Project Analysis Year 3 =	2018			
13) Utility Project Costs				
Admin & Promotion Costs =	\$0	\$1,595	\$1,276	
Incentive Costs =	0	6,000	6,180	
Direct Program Costs =	0	0	87	
Total Utility Project Costs =	\$0	\$7,595	\$7,543	
14) Direct Participant Costs (\$/Part.) =	\$100	\$100	\$100	
Escalation Rate =	1.73%	1.73%	1.73%	
14a) Other Participant Costs (Annual \$/Part.) =	\$0	\$0	\$0	
Escalation Rate =	0.00%	0.00%	0.00%	
14b) Other Participant Savings (Annual \$/Part.) =	\$0	\$0	\$0	
Escalation Rate =	0%	0%	0%	
15) Project Life (Years) =	15	15	15	
16) Avg Summer kWh/part. Saved =	0.000	0.000	0.000	
16a) Avg Winter kWh/part Saved =	0.000	0.000	0.000	
17) Avg. Summer kWh/Part. Saved =	260	260	260	
17a) Avg. Winter kWh/Part. Saved =	0	0	0	
18a) System Demand Line Loss Factor	12.9800%	12.9800%	12.9800%	
18b) System Energy Line Loss Factor	7.7350%	7.7350%	7.7350%	
19) Number of Participants =	0	100	103	
20) Incentive/Participant =	\$60	\$60	\$60	
21) Effective Federal & State Income Tax Rate =			39.39%	
22) Annual Summer Kwh Saved	0	26,000	26,780	
Annual Winter Kwh Saved	0	0	0	
23) Annual Summer KW Saved	0	0	0	
Annual Winter KW Saved	0	0	0	
<b>Test Results</b>	<b>NPV</b>	<b>B/C</b>		
Ratepayer Impact Measure Test	(\$10,394)	0.68		
Utility Cost Test	(\$10,394)	0.68		
Societal Test	(\$3,434)	0.93		
Participant Test	\$40,928	3.23		
Total Resource Cost Test	(\$17,473)	0.55		

**Table 1**  
**Ratepayer Impact Test**

Project: **Residential AC Cycling**  
Program Years: **2016 - 2018**

t	Year											Costs							Annual Benefits Less Costs (Q)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)	Program Admin Costs (M)		Incentive Costs (N)	Direct Program Costs (O)	Total Project Costs (P)	
1	2016	0	\$0.03570	\$0	\$0.00000	\$0	0	0	0	\$100.80	\$0	\$0	\$0.05796	0	0	0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2	2017	29,375	0.03790	1,113	0.00000	0	0	0	0	103.82	0	1,113	0.06056	26,000	0	26,000	954	1,595	6,000	0	8,549	(7,436)	
3	2018	59,631	0.03900	2,326	0.00000	0	0	0	0	106.94	0	2,326	0.06329	52,780	0	52,780	2,025	1,276	6,180	0	9,481	(7,155)	
4	2019	59,631	0.04000	2,385	0.00000	0	0	0	0	110.15	0	2,385	0.06614	52,780	0	52,780	2,116	0	0	0	2,116	269	
5	2020	59,631	0.04250	2,534	0.00000	0	0	0	0	113.45	0	2,534	0.06911	52,780	0	52,780	2,211	0	0	0	2,211	323	
6	2021	59,631	0.04470	2,666	0.00000	0	0	0	0	116.85	0	2,666	0.07222	52,780	0	52,780	2,310	0	0	0	2,310	356	
7	2022	59,631	0.04780	2,850	0.00000	0	0	0	0	120.36	0	2,850	0.07547	52,780	0	52,780	2,414	0	0	0	2,414	436	
8	2023	59,631	0.04950	2,952	0.00000	0	0	0	0	123.97	0	2,952	0.07887	52,780	0	52,780	2,523	0	0	0	2,523	429	
9	2024	59,631	0.05270	3,143	0.00000	0	0	0	0	127.69	0	3,143	0.08242	52,780	0	52,780	2,637	0	0	0	2,637	506	
10	2025	59,631	0.05428	3,237	0.00000	0	0	0	0	131.52	0	3,237	0.08613	52,780	0	52,780	2,755	0	0	0	2,755	482	
11	2026	59,631	0.05591	3,334	0.00000	0	0	0	0	135.47	0	3,334	0.09000	52,780	0	52,780	2,879	0	0	0	2,879	455	
12	2027	59,631	0.05759	3,434	0.00000	0	0	0	0	139.53	0	3,434	0.09405	52,780	0	52,780	3,009	0	0	0	3,009	425	
13	2028	59,631	0.05932	3,537	0.00000	0	0	0	0	143.72	0	3,537	0.09829	52,780	0	52,780	3,144	0	0	0	3,144	393	
14	2029	59,631	0.06110	3,643	0.00000	0	0	0	0	148.03	0	3,643	0.10271	52,780	0	52,780	3,286	0	0	0	3,286	357	
15	2030	59,631	0.06293	3,753	0.00000	0	0	0	0	152.47	0	3,753	0.10733	52,780	0	52,780	3,434	0	0	0	3,434	319	
16	2031	59,631	0.06482	3,865	0.00000	0	0	0	0	157.04	0	3,865	0.11216	52,780	0	52,780	3,588	0	0	0	3,588	277	
17	2032	30,256	0.06676	2,020	0.00000	0	0	0	0	161.75	0	2,020	0.11721	26,780	0	26,780	1,903	0	0	0	1,903	117	
18	2033	0	0.06876	0	0.00000	0	0	0	0	166.61	0	0	0.12248	0	0	0	0	0	0	0	0	0	
19	2034	0	0.07082	0	0.00000	0	0	0	0	171.60	0	0	0.12799	0	0	0	0	0	0	0	0	0	
20	2035	0	0.07294	0	0.00000	0	0	0	0	176.75	0	0	0.13375	0	0	0	0	0	0	0	0	0	
Total =		894,465						0				\$46,792				791,700					\$56,239	(\$9,447)	
												NPV =	\$21,670									\$32,064	(10,394)
Total NPV =					(\$10,394)																		
Benefit/Cost Ratio =					<u>0.68</u>																		

Worksheet Calculations	
(A) = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15), adjusted for line losses	(I = Average Summer/Winter kWh /Participant Saved (17) x Number of Participants (19) for Project Life (15)
(B) = Avg. System Marginal Energy Cost (2), escalated	(L = [(J) + (K)] x 1-Inverse of Tax Rate (21)
(C) = (C) x (D)	(M = Program Admin Costs (13)
(D) = System Variable O&M Savings (6), escalated	(N = Incentive/Participant (20) x Number of Participants (19)
(E) = (C) x (F)	(O = (L) + (M) + (N)
(F) = Average Summer/Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15), adjusted for line losses	(P = (I) - (O)
(G) = System Peak Shaving Demand Cost (5), escalated + Escalated System Peak x Reserve Capacity	
(H) = (F) + (G)	
(I) = (C) + (E) + (H)	
(J) = Electric Margin (4), escalated	

**Table 2  
Utility Test**

Project: **Residential AC Cycling**  
 Program Years: **2016 - 2018**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2016	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2017	1,113	0	0	1,113	8,549	8,549	(7,436)
2018	2,326	0	0	2,326	9,481	9,481	(7,155)
2019	2,385	0	0	2,385	2,116	2,116	269
2020	2,534	0	0	2,534	2,211	2,211	323
2021	2,666	0	0	2,666	2,310	2,310	356
2022	2,850	0	0	2,850	2,414	2,414	436
2023	2,952	0	0	2,952	2,523	2,523	429
2024	3,143	0	0	3,143	2,637	2,637	506
2025	3,237	0	0	3,237	2,755	2,755	482
2026	3,334	0	0	3,334	2,879	2,879	455
2027	3,434	0	0	3,434	3,009	3,009	425
2028	3,537	0	0	3,537	3,144	3,144	393
2029	3,643	0	0	3,643	3,286	3,286	357
2030	3,753	0	0	3,753	3,434	3,434	319
2031	3,865	0	0	3,865	3,588	3,588	277
2032	2,020	0	0	2,020	1,903	1,903	117
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0

Total = \$46,792 \$56,239 (\$9,447)  
 NPV = \$21,670 \$32,064 (10,394)

Total NPV = (\$10,394)  
 Benefit/Cost Ratio = 0.68

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = Table 1 (I)
(E) = Table 1 (M) + Table 1 (N)
(F) = (E)
(G) = (D) - (F)

**Table 3**  
**Societal Cost Test**

Project: **Residential AC Cycling**  
Program Years: **2016 - 2018**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2016	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2017	1,113	0	0	362	1,475	8,549	4,000	12,549	(11,074)
2018	2,326	0	0	780	3,106	9,481	4,120	13,601	(10,495)
2019	2,385	0	0	824	3,209	2,116	0	2,116	1,093
2020	2,534	0	0	902	3,436	2,211	0	2,211	1,225
2021	2,666	0	0	977	3,643	2,310	0	2,310	1,333
2022	2,850	0	0	1,076	3,926	2,414	0	2,414	1,512
2023	2,952	0	0	1,148	4,100	2,523	0	2,523	1,577
2024	3,143	0	0	1,259	4,402	2,637	0	2,637	1,765
2025	3,237	0	0	1,336	4,573	2,755	0	2,755	1,818
2026	3,334	0	0	1,417	4,751	2,879	0	2,879	1,872
2027	3,434	0	0	1,503	4,937	3,009	0	3,009	1,928
2028	3,537	0	0	1,595	5,132	3,144	0	3,144	1,988
2029	3,643	0	0	1,692	5,335	3,286	0	3,286	2,049
2030	3,753	0	0	1,795	5,548	3,434	0	3,434	2,114
2031	3,865	0	0	1,904	5,769	3,588	0	3,588	2,181
2032	2,020	0	0	1,025	3,045	1,903	0	1,903	1,142
2033	0	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0	0
Total =					\$66,387			\$64,359	\$2,028
				NPV =	\$49,243			\$52,677	(3,434)
Total NPV =									(\$3,434)
Benefit/Cost Ratio =									<u>0.93</u>

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) = [(A) + (C)] x Environmental Damage Factor (7), escalated
(E) = (A) + (B) + (C) + (D)
(F) = Table 2 (E)
(G) = [Direct Participant Costs (14) x Number of Participants (19)] - Table 1 (N)
(H) = (F) + (G)
(I) = (E) - (H)

**Table 4  
Participant Test**

Project: **Residential AC Cycling**  
 Program Years: **2016 - 2018**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2016	\$0	\$0.09427	\$0.08963	0	0	0	\$0	0	0	\$0.000	\$0.000	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2017	6,000	0.09851	0.09366	26,000	0	26,000	2,561	0	0	0.000	0.000	0	0	8,561	\$10,349	0	10,349	(1,788)
2018	6,180	0.10294	0.09788	52,780	0	52,780	5,433	0	0	0.000	0.000	0	0	11,613	\$10,844	0	10,844	769
2019	0	0.10758	0.10228	52,780	0	52,780	5,678	0	0	0.000	0.000	0	0	5,678	\$0	0	0	5,678
2020	0	0.11242	0.10689	52,780	0	52,780	5,934	0	0	0.000	0.000	0	0	5,934	\$0	0	0	5,934
2021	0	0.11748	0.11169	52,780	0	52,780	6,201	0	0	0.000	0.000	0	0	6,201	\$0	0	0	6,201
2022	0	0.12276	0.11672	52,780	0	52,780	6,479	0	0	0.000	0.000	0	0	6,479	\$0	0	0	6,479
2023	0	0.12829	0.12197	52,780	0	52,780	6,771	0	0	0.000	0.000	0	0	6,771	\$0	0	0	6,771
2024	0	0.13406	0.12746	52,780	0	52,780	7,076	0	0	0.000	0.000	0	0	7,076	\$0	0	0	7,076
2025	0	0.14009	0.13320	52,780	0	52,780	7,394	0	0	0.000	0.000	0	0	7,394	\$0	0	0	7,394
2026	0	0.14640	0.13919	52,780	0	52,780	7,727	0	0	0.000	0.000	0	0	7,727	\$0	0	0	7,727
2027	0	0.15299	0.14546	52,780	0	52,780	8,075	0	0	0.000	0.000	0	0	8,075	\$0	0	0	8,075
2028	0	0.15987	0.15200	52,780	0	52,780	8,438	0	0	0.000	0.000	0	0	8,438	\$0	0	0	8,438
2029	0	0.16706	0.15884	52,780	0	52,780	8,817	0	0	0.000	0.000	0	0	8,817	\$0	0	0	8,817
2030	0	0.17458	0.16599	52,780	0	52,780	9,214	0	0	0.000	0.000	0	0	9,214	\$0	0	0	9,214
2031	0	0.18244	0.17346	52,780	0	52,780	9,629	0	0	0.000	0.000	0	0	9,629	\$0	0	0	9,629
2032	0	0.19065	0.18126	26,780	0	26,780	5,106	0	0	0.000	0.000	0	0	5,106	\$0	0	0	5,106
2033	0	0.19923	0.18942	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
2034	0	0.20819	0.19795	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
2035	0	0.21756	0.20685	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
Total =				791,700	0			0	0					\$122,713			\$21,193	\$101,520
														NPV = \$59,243			\$18,316	40,928

Total NPV = \$40,928  
 Benefit/Cost Ratio = 3.23

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

**Table 5**  
**Total Resource Cost Test**

Company: **Residential AC Cycling**  
Project: **2016 - 2018**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2016	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2017	1,113	0	1,113	8,549	4,000	12,549	(11,436)
2018	2,326	0	2,326	9,481	4,120	13,601	(11,275)
2019	2,385	0	2,385	2,116	0	2,116	269
2020	2,534	0	2,534	2,211	0	2,211	323
2021	2,666	0	2,666	2,310	0	2,310	356
2022	2,850	0	2,850	2,414	0	2,414	436
2023	2,952	0	2,952	2,523	0	2,523	429
2024	3,143	0	3,143	2,637	0	2,637	506
2025	3,237	0	3,237	2,755	0	2,755	482
2026	3,334	0	3,334	2,879	0	2,879	455
2027	3,434	0	3,434	3,009	0	3,009	425
2028	3,537	0	3,537	3,144	0	3,144	393
2029	3,643	0	3,643	3,286	0	3,286	357
2030	3,753	0	3,753	3,434	0	3,434	319
2031	3,865	0	3,865	3,588	0	3,588	277
2032	2,020	0	2,020	1,903	0	1,903	117
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$46,792			\$64,359	(\$17,567)
NPV =			\$21,670			\$39,143	(17,473)
Total NPV =			(\$17,473)				
Benefit/Cost Ratio =			<u>0.55</u>				

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (H)
(C) = (A) + (B)
(D) = Table 2 (E)
(E) = Table 3 (G)
(F) = (D) + (E)
(G) = (C) - (F)

**Appendix B**

**DSM Technical Reference**

**Manual (TRM)**

## Electric AC Table - Replacement

**Energy Savings** kwh/yr

Choose Energy Savings or Demand Reduction from Drop-Down Menu to the left

### Calculator

AC Size (Tons)

3

Building Type

Single Family Choose Building Type from Drop-Down Menu to the left

SEER

16.5

EER

14.4

**Savings (kwh/yr)**

**298.3**

AC Size (Tonnes)	SEER 14.5	SEER 15.0	SEER 15.5	SEER 16.0	SEER 16.5	SEER 17.0	SEER 17.5	SEER 18.0	SEER 18.5	SEER 19.0	SEER 19.5	SEER 20.0
1.0	48.5	62.5	75.6	87.9	99.4	110.3	120.5	130.2	139.4	148.0	156.2	164.1
1.5	72.7	93.7	113.4	131.8	149.1	165.4	180.8	195.3	209.0	222.0	234.4	246.1
2.0	97.0	125.0	151.2	175.8	198.9	220.6	241.1	260.4	278.7	296.0	312.5	328.1
2.5	121.2	156.2	189.0	219.7	248.6	275.7	301.3	325.5	348.4	370.1	390.6	410.1
3.0	145.5	187.5	226.8	263.7	298.3	330.9	361.6	390.6	418.1	444.1	468.7	492.2
3.5	169.7	218.7	264.6	307.6	348.0	386.0	421.9	455.7	487.7	518.1	546.9	574.2
4.0	194.0	250.0	302.4	351.6	397.7	441.2	482.1	520.8	557.4	592.1	625.0	656.2
4.5	218.2	281.2	340.2	395.5	447.4	496.3	542.4	585.9	627.1	666.1	703.1	738.3
5.0	242.5	312.5	378.0	439.4	497.1	551.5	602.7	651.0	696.8	740.1	781.2	820.3
5.5	266.7	343.7	415.8	483.4	546.9	606.6	662.9	716.1	766.5	814.1	859.4	902.3

Annual Savings = Size \* EFLCH \* (12/SEER\_Base - 12/SEER\_Eff)

**Where:**

Size = Unit Capacity in tons (1 ton = 12,000 btu/hour)

EFLCH = Effective Full Load Cooling Hours

SEER\_Base = SEER of baseline or existing unit provided by customer/contractor, or use SEER = EER / 0.875 if EER is provided. SEER\_Base equals 13 if unknown.

EER\_Base = EER of baseline or existing unit provided by customer/contractor, or use EER = SEER \* 0.875 if SEER is provided. EER\_Base equals 11.4 if unknown.

SEER\_EFF = SEER of new high efficiency unit provided by customer/contractor, or use SEER = EER / 0.875 if EER is provided.

EER\_Eff = SEER of new high efficiency unit provided by customer/contractor, or use EER = SEER \* 0.875 if SEER is provided

CF = Coincidence factor = 0.9

Source: State of Minnesota Technical Reference Manual for Energy Conservation Improvement Programs Version 1.2

## Electric AC Tune-up

### Calculator

AC Size (Tons)	3
Building Type	<b>Single Family</b>
SEER	10
EER	9.2
<b>Energy Savings (kwh/yr)</b>	<b>91.4</b>
<b>Demand Reduction (kw)</b>	<b>0.07</b>

**Choose Building Type from Drow-Down Menu to the left**

Annual Savings = (EFLCH \* CAP \* (1/SEER))/1000 \* MFe

Demand Reduction = CAP \* (1/EER)/1000 \* MFd \* CF

**Where:**

- CAP = Cooling capacity of AC system in BTU/h (1 ton equals 12,000 BTU/h, default = 2.5 ton unit)
- EFLCH = Effective Full Load Cooling Hours
- SEER = Nameplate efficiency of equipment, default = 10
- EER =Efficiency of equipment, EER = SEER \* 0.875, default = 9.2
- CF = Coincidence factor = 0.9
- MFe = Maintenance energy saving factor, MFe = 5%
- MFd = Maintenance demand saving factor, MFd = 2%

**Source: State of Minnesota Technical Reference Manual for Energy Conservation Improvement Programs Version 1.2**

## Electric AC Table - Replacement

### Calculator

<b>Window Unit</b>		Choose Unit Type from Drop-Down Menu to the left
<b>AC Size (BTU)</b>	<b>25,000</b>	Select Unit Size from Drop-Down Menu to the left
<b>Building Type</b>	<b>Single Family</b>	Select Building Type from Drop-Down Menu to the left
<b>Savings (kwh/yr)</b>	<b>136.4</b>	
<b>Demand Reduction (k</b>	<b>0.20</b>	

Annual Savings =  $\Delta kW \times Hrs$

Demand Reduction =  $CF \times \Delta kW$

**Where:**

$$\Delta kW = Btuh * (1/EER\_Base - 1/EER\_Eff) / 1000$$

Btuh = Colling capacity of air-conditioner in Btu/h, provided by customer. (1 ton equals 12,000 BTU/hour)

EER\_Base = Federal minimum standard energy efficiency ratio (EER) of air-conditioner. Refer to Table 1.

EER\_Eff = EER of new A/C. Refer to Table 1 for ENERGY STAR Standards

Hrs = Equivalent full load cooling hours

CF = Peak coincident factor = 0.9

**Source: State of Minnesota Technical Reference Manual for Energy Conservation Improvement Programs Version 1.2**

# Residential Lighting Calculator

Incandescent Bulb Wattage **43**  
 Replacement Bulb Wattage **17**  
**Energy Saved from Lightbulb (kwh/yr) 26.2**  
**Demand Reduction (kw) 0.00308256**

## Algorithms (impacts per unit)

Electrical Energy Savings (kWh/yr) = ( kW\_EE - kW\_Base ) x Hrs x HVAC\_cooling\_kWhsavings\_factor

Electrical Demand Savings (kW) = ( kW\_EE - kW\_Base ) x CF x HVAC\_cooling\_kWhsavings\_factor

Natural Gas Savings (MCF) = ( kW\_EE - kW\_Base ) x Hrs x HVAC\_heating\_penalty\_factor

Where:

kW\_EE = Deemed average wattage efficient luminaire per Table 3

kW\_Base = Deemed average wattage of baseline luminaire per Table 3

Hrs = Deemed annual operating hours from Table 2 based on building type

HVAC\_cooling\_kWhsavings\_factor = Cooling system energy savings factor resulting from efficient lighting from Table 1. Reduction in lighting energy results in a reduction in cooling energy, if the customer has air conditioning.

CF = Coincidence Factor, the probability that peak demand of the lights will coincide with peak utility system demand. CF will be determined based on customer provided building type in Table 2.

HVAC\_cooling\_kWhsavings\_factor = Cooling system demand savings factor resulting from efficient lighting from Table 1. Reduction in lighting demand results in a reduction in cooling demand, if the customer has air conditioning.

HVAC\_heating\_penalty\_factor = Heating system penalty factor resulting from efficient lighting.

**Source: State of Minnesota Technical Reference Manual for Energy Conservation Improvement Programs Version 1.2**

## Input Assumptions for Typical Applications

Space Type	HVAC Cooling KW Savings Factor		HVAC Cooling kWh Savings Factor		HVAC Heating Penalty Factor (Dth/kWh)
	HVAC System: Heating Only	HVAC System: Heating & Cooling	HVAC System: Heating Only	HVAC System: Heating & Cooling	HVAC System: Heating Only or Heating & Cooling
Interior Living Quarters	1.00	1.248	1.00	1.075	-0.0029
Multifamily Common Areas	1.00	1.248	1.00	1.075	-0.0029
Exterior/Unconditioned Space	1.00	1.00	1.00	1.00	0.00
Interior Living Quarters - Cooling Unknown	1.00	1.16	1.00	1.048	-0.0019
Multifamily Common Areas - Cooling Unknown	1.00	1.11	1.00	1.034	-0.0013
Space Type	CF	Hrs			

Table 2: Deemed Peak Demand Coincidence Factors and Annual Operating Hours by Space Type

Space Type	CF	Hrs
Interior Living Quarters	9.50%	938
Multifamily Common Areas	75%	5,950
Exterior/Unconditioned Space	0%	1,825

Table 3: Approved Baseline Wattages

Lumen Bin	Typical Incandescent Wattage	EISA Compliant Halogen	2012	2013	2014	2015	2016+
1490-2600	100W	72W	90.5W	80.5W	76.0W	72.0W	72.0W
1050-1489	75W	53W	72.0W	64.0W	57.5W	53.0W	53.0W
750-1049	60W	43W	58.5W	55.0W	48.5W	46.1W	43.0W
310-749	40W	29W	39.0W	37.0W	33.0W	31.4W	29.0W

## Electric Motors Table

**Office HVAC Pump**  
**Retrofit to Enhanced NEMA Premium**

**Choose Motor Type from Drop-Down Menu to the left**  
**Choose Motor Type from Drop-Down Menu to the left**

RPM	Enclosure	Horsepower	EPACT Efficiency	NEMA Premium Efficiency	Enhanced NEMA Premium Efficiency	Energy Savings	Demand Reduction	IC: EPACT to NEMA Premium	IC: NEMA Premium to Enhanced	IC: EPACT to Enhanced
1200	ODP	1	80.0%	82.5%	83.5%	58.6	0.02	\$826.86	\$311.97	\$1,138.83
1200	ODP	1.5	84.0%	86.5%	87.5%	79.9	0.03	\$821.85	\$308.62	\$1,130.47
1200	ODP	10	90.2%	91.7%	92.7%	334.6	0.13	\$1,475.12	\$745.15	\$2,220.27
1200	ODP	100	94.1%	95.0%	96.0%	2,353.5	0.92	\$8,402.69	\$4,412.08	\$12,814.77
1200	ODP	125	94.1%	95.0%	96.0%	2,941.9	1.15	\$10,323.06	\$5,695.32	\$16,018.38
1200	ODP	15	90.2%	91.7%	92.7%	501.9	0.20	\$2,541.29	\$976.47	\$3,517.75
1200	ODP	150	94.5%	95.4%	96.4%	3,500.8	1.37	\$10,693.62	\$5,942.94	\$16,636.56
1200	ODP	2	85.5%	87.5%	88.5%	88.7	0.03	\$907.18	\$365.64	\$1,272.82
1200	ODP	20	91.0%	92.4%	93.4%	632.0	0.25	\$2,861.24	\$1,190.27	\$4,051.52
1200	ODP	200	94.5%	95.4%	96.4%	4,667.7	1.82	\$12,801.47	\$7,351.45	\$20,152.92
1200	ODP	25	91.7%	93.0%	94.0%	746.5	0.29	\$3,261.14	\$1,457.50	\$4,718.64
1200	ODP	250	95.4%	95.4%	96.4%	3,041.9	1.19	\$15,888.00	\$9,413.95	\$25,301.95
1200	ODP	3	86.5%	88.5%	89.5%	130.1	0.05	\$953.05	\$396.29	\$1,349.34
1200	ODP	30	92.4%	93.6%	94.6%	844.9	0.33	\$3,513.58	\$1,626.18	\$5,139.75
1200	ODP	300	95.4%	95.4%	96.4%	3,650.3	1.42	\$20,204.33	\$12,298.23	\$32,502.56
1200	ODP	350	95.4%	95.4%	96.4%	4,258.7	1.66	\$29,220.28	\$18,322.91	\$47,543.19
1200	ODP	40	93.0%	94.1%	95.1%	1,062.8	0.41	\$4,222.09	\$2,099.62	\$6,321.70
1200	ODP	400	95.8%	95.8%	96.8%	4,826.7	1.88	\$32,992.47	\$20,843.58	\$53,836.05
1200	ODP	450	96.2%	96.2%	97.2%	5,385.2	2.10	\$56,915.81	\$36,829.75	\$93,745.56
1200	ODP	5	87.5%	89.5%	90.5%	212.0	0.08	\$976.06	\$411.67	\$1,387.72
1200	ODP	50	93.0%	94.1%	95.1%	1,328.5	0.52	\$4,628.91	\$2,371.47	\$7,000.39
1200	ODP	500	96.2%	96.2%	97.2%	5,983.5	2.33	\$59,663.64	\$38,665.92	\$98,329.55
1200	ODP	60	93.6%	94.5%	95.5%	1,427.1	0.56	\$5,831.16	\$3,174.84	\$9,006.00
1200	ODP	7.5	88.5%	90.2%	91.2%	280.7	0.11	\$1,323.26	\$643.67	\$1,966.93
1200	ODP	75	93.6%	94.5%	95.5%	1,783.9	0.70	\$6,697.92	\$3,754.03	\$10,451.95
1200	TEFC	1	80.0%	82.5%	83.5%	58.6	0.02	\$826.86	\$311.97	\$1,138.83
1200	TEFC	1.5	85.5%	87.5%	88.5%	66.5	0.03	\$821.85	\$308.62	\$1,130.47
1200	TEFC	10	89.5%	91.0%	92.0%	339.7	0.13	\$1,475.12	\$745.15	\$2,220.27
1200	TEFC	100	94.1%	95.0%	96.0%	2,353.5	0.92	\$8,402.69	\$4,412.08	\$12,814.77
1200	TEFC	125	94.1%	95.0%	96.0%	2,941.9	1.15	\$10,323.06	\$5,695.31	\$16,018.38
1200	TEFC	15	90.2%	91.7%	92.7%	501.9	0.20	\$2,541.29	\$976.47	\$3,517.75
1200	TEFC	150	95.0%	95.8%	96.8%	3,285.5	1.28	\$10,693.62	\$5,942.94	\$16,636.56
1200	TEFC	2	86.5%	88.5%	89.5%	86.7	0.03	\$907.18	\$365.64	\$1,272.82
1200	TEFC	20	90.2%	91.7%	92.7%	669.1	0.26	\$2,861.24	\$1,190.27	\$4,051.52
1200	TEFC	200	95.0%	95.8%	96.8%	4,380.6	1.71	\$12,801.47	\$7,351.45	\$20,152.92
1200	TEFC	25	91.7%	93.0%	94.0%	746.5	0.29	\$3,261.14	\$1,457.50	\$4,718.64
1200	TEFC	250	95.0%	95.8%	96.8%	5,475.8	2.14	\$15,888.00	\$9,413.95	\$25,301.95
1200	TEFC	3	87.5%	89.5%	90.5%	127.2	0.05	\$953.05	\$396.29	\$1,349.34
1200	TEFC	30	91.7%	93.0%	94.0%	895.7	0.35	\$3,513.58	\$1,626.18	\$5,139.75
1200	TEFC	300	95.0%	95.8%	96.8%	6,570.9	2.56	\$20,204.33	\$12,298.23	\$32,502.56
1200	TEFC	350	95.0%	95.8%	96.8%	7,666.1	2.99	\$29,220.28	\$18,322.91	\$47,543.19
1200	TEFC	40	93.0%	94.1%	95.1%	1,062.8	0.41	\$4,222.09	\$2,099.62	\$6,321.70
1200	TEFC	400	95.0%	95.8%	96.8%	8,761.2	3.42	\$32,992.47	\$20,843.58	\$53,836.05
1200	TEFC	450	95.0%	95.8%	96.8%	9,856.4	3.84	\$56,915.81	\$36,829.75	\$93,745.56
1200	TEFC	5	87.5%	89.5%	90.5%	212.0	0.08	\$976.06	\$411.67	\$1,387.72
1200	TEFC	50	93.0%	94.1%	95.1%	1,328.5	0.52	\$4,628.91	\$2,371.47	\$7,000.39
1200	TEFC	500	95.0%	95.8%	96.8%	10,951.5	4.27	\$59,663.64	\$38,665.92	\$98,329.55
1200	TEFC	60	93.6%	94.5%	95.5%	1,427.1	0.56	\$5,831.16	\$3,174.84	\$9,006.00
1200	TEFC	7.5	89.5%	91.0%	92.0%	254.8	0.10	\$1,323.26	\$643.67	\$1,966.93
1200	TEFC	75	93.6%	94.5%	95.5%	1,783.9	0.70	\$6,697.92	\$3,754.03	\$10,451.95
1800	ODP	1	82.5%	85.5%	86.5%	62.7	0.02	\$826.86	\$311.97	\$1,138.83
1800	ODP	1.5	84.0%	86.5%	87.5%	79.9	0.03	\$821.85	\$308.62	\$1,130.47
1800	ODP	10	89.5%	91.7%	92.7%	431.6	0.17	\$1,475.12	\$745.15	\$2,220.27
1800	ODP	100	94.1%	95.4%	96.4%	2,837.2	1.11	\$8,402.69	\$4,412.08	\$12,814.77
1800	ODP	125	94.5%	95.4%	96.4%	2,917.3	1.14	\$10,323.06	\$5,695.32	\$16,018.38
1800	ODP	15	91.0%	93.0%	94.0%	588.7	0.23	\$2,541.29	\$976.47	\$3,517.75
1800	ODP	150	95.0%	95.8%	96.8%	3,285.5	1.28	\$10,693.62	\$5,942.94	\$16,636.56
1800	ODP	2	84.0%	86.5%	87.5%	106.6	0.04	\$907.18	\$365.64	\$1,272.82
1800	ODP	20	91.0%	93.0%	94.0%	784.9	0.31	\$2,861.24	\$1,190.27	\$4,051.52
1800	ODP	200	95.0%	95.8%	96.8%	4,380.6	1.71	\$12,801.47	\$7,351.45	\$20,152.92
1800	ODP	25	91.7%	93.6%	94.6%	935.2	0.36	\$3,261.14	\$1,457.50	\$4,718.64
1800	ODP	250	95.4%	95.8%	96.8%	4,241.1	1.65	\$15,888.00	\$9,413.95	\$25,301.95
1800	ODP	3	86.5%	89.5%	90.5%	171.5	0.07	\$953.05	\$396.29	\$1,349.34
1800	ODP	30	92.4%	94.1%	95.1%	1,031.5	0.40	\$3,513.58	\$1,626.18	\$5,139.75
1800	ODP	300	95.4%	95.8%	96.8%	5,089.3	1.98	\$20,204.33	\$12,298.23	\$32,502.56
1800	ODP	350	95.4%	95.8%	96.8%	5,937.5	2.32	\$29,220.28	\$18,322.91	\$47,543.19
1800	ODP	40	93.0%	94.1%	95.1%	1,062.8	0.41	\$4,222.09	\$2,099.62	\$6,321.70
1800	ODP	400	95.4%	95.8%	96.8%	6,785.7	2.65	\$32,992.47	\$20,843.58	\$53,836.05

RPM	Enclosure	Horsepower	EPACT Efficiency	NEMA Premium Efficiency	Enhanced NEMA Premium Efficiency	Energy Savings	Demand Reduction	IC: EPACT to NEMA Premium	IC: NEMA Premium to Enhanced	IC: EPACT to Enhanced
1800	ODP	450	95.8%	96.2%	97.2%	7,570.7	2.95	\$56,915.81	\$36,829.75	\$93,745.56
1800	ODP	5	87.5%	89.5%	90.5%	212.0	0.08	\$976.06	\$411.67	\$1,387.72
1800	ODP	50	93.0%	94.5%	95.5%	1,574.9	0.61	\$4,628.91	\$2,371.47	\$7,000.39
1800	ODP	500	95.8%	96.2%	97.2%	8,411.9	3.28	\$59,663.64	\$38,665.92	\$98,329.55
1800	ODP	60	93.6%	95.0%	96.0%	1,793.3	0.70	\$5,831.16	\$3,174.84	\$9,006.00
1800	ODP	7.5	88.5%	91.0%	92.0%	360.8	0.14	\$1,323.26	\$643.67	\$1,966.93
1800	ODP	75	94.1%	95.0%	96.0%	1,765.2	0.69	\$6,697.92	\$3,754.03	\$10,451.95
1800	TEFC	1	82.5%	85.5%	86.5%	62.7	0.02	\$826.86	\$311.97	\$1,138.83
1800	TEFC	1.5	84.0%	86.5%	87.5%	79.9	0.03	\$821.85	\$308.62	\$1,130.47
1800	TEFC	10	89.5%	91.7%	92.7%	431.6	0.17	\$1,475.12	\$745.15	\$2,220.27
1800	TEFC	100	94.5%	95.4%	96.4%	2,333.9	0.91	\$8,402.69	\$4,412.08	\$12,814.77
1800	TEFC	125	94.5%	95.4%	96.4%	2,917.3	1.14	\$10,323.06	\$5,695.32	\$16,018.38
1800	TEFC	15	91.0%	92.4%	93.4%	474.0	0.18	\$2,541.29	\$976.47	\$3,517.75
1800	TEFC	150	95.0%	95.8%	96.8%	3,285.5	1.28	\$10,693.62	\$5,942.94	\$16,636.56
1800	TEFC	2	84.0%	86.5%	87.5%	106.6	0.04	\$907.18	\$365.64	\$1,272.82
1800	TEFC	20	91.0%	93.0%	94.0%	784.9	0.31	\$2,861.24	\$1,190.27	\$4,051.52
1800	TEFC	200	95.0%	96.2%	97.2%	5,332.0	2.08	\$12,801.47	\$7,351.45	\$20,152.92
1800	TEFC	25	92.4%	93.6%	94.6%	704.1	0.27	\$3,261.14	\$1,457.50	\$4,718.64
1800	TEFC	250	95.0%	96.2%	97.2%	6,665.0	2.60	\$15,888.00	\$9,413.95	\$25,301.95
1800	TEFC	3	87.5%	89.5%	90.5%	127.2	0.05	\$953.05	\$396.29	\$1,349.34
1800	TEFC	30	92.4%	93.6%	94.6%	844.9	0.33	\$3,513.58	\$1,626.18	\$5,139.75
1800	TEFC	300	95.4%	96.2%	97.2%	6,516.4	2.54	\$20,204.33	\$12,298.23	\$32,502.56
1800	TEFC	350	95.4%	96.2%	97.2%	7,602.5	2.96	\$29,220.28	\$18,322.91	\$47,543.19
1800	TEFC	40	93.0%	94.1%	95.1%	1,062.8	0.41	\$4,222.09	\$2,099.62	\$6,321.70
1800	TEFC	400	95.4%	96.2%	97.2%	8,688.6	3.39	\$32,992.47	\$20,843.58	\$53,836.05
1800	TEFC	450	95.4%	96.2%	97.2%	9,774.6	3.81	\$56,915.81	\$36,829.75	\$93,745.56
1800	TEFC	5	87.5%	89.5%	90.5%	212.0	0.08	\$976.06	\$411.67	\$1,387.72
1800	TEFC	50	93.0%	94.5%	95.5%	1,574.9	0.61	\$4,628.91	\$2,371.47	\$7,000.39
1800	TEFC	500	95.8%	96.2%	97.2%	8,411.9	3.28	\$59,663.64	\$38,665.92	\$98,329.55
1800	TEFC	60	93.6%	95.0%	96.0%	1,793.3	0.70	\$5,831.16	\$3,174.84	\$9,006.00
1800	TEFC	7.5	89.5%	91.7%	92.7%	323.7	0.13	\$1,323.26	\$643.67	\$1,966.93
1800	TEFC	75	94.1%	95.4%	96.4%	2,127.9	0.83	\$6,697.92	\$3,754.03	\$10,451.95
3600	ODP	1	76.3%	77.0%	78.0%	32.0	0.01	\$826.86	\$311.97	\$1,138.83
3600	ODP	1.5	82.5%	84.0%	85.0%	59.8	0.02	\$821.85	\$308.62	\$1,130.47
3600	ODP	10	88.5%	89.5%	90.5%	279.4	0.11	\$1,475.12	\$745.15	\$2,220.27
3600	ODP	100	93.0%	93.6%	94.6%	2,035.1	0.79	\$8,402.69	\$4,412.08	\$12,814.77
3600	ODP	125	93.6%	94.1%	95.1%	2,357.1	0.92	\$10,323.06	\$5,695.32	\$16,018.38
3600	ODP	15	89.5%	90.2%	91.2%	349.6	0.14	\$2,541.29	\$976.47	\$3,517.75
3600	ODP	150	93.6%	94.1%	95.1%	2,828.5	1.10	\$10,693.62	\$5,942.94	\$16,636.56
3600	ODP	2	84.0%	85.5%	86.5%	77.0	0.03	\$907.18	\$365.64	\$1,272.82
3600	ODP	20	90.2%	91.0%	92.0%	485.4	0.19	\$2,861.24	\$1,190.27	\$4,051.52
3600	ODP	200	94.5%	95.0%	96.0%	3,700.4	1.44	\$12,801.47	\$7,351.45	\$20,152.92
3600	ODP	25	91.0%	91.7%	92.7%	563.8	0.22	\$3,261.14	\$1,457.50	\$4,718.64
3600	ODP	250	94.5%	95.0%	96.0%	4,625.5	1.80	\$15,888.00	\$9,413.95	\$25,301.95
3600	ODP	3	84.0%	85.5%	86.5%	115.5	0.05	\$953.05	\$396.29	\$1,349.34
3600	ODP	30	91.0%	91.7%	92.7%	676.5	0.26	\$3,513.58	\$1,626.18	\$5,139.75
3600	ODP	300	95.0%	95.4%	96.4%	5,131.9	2.00	\$20,204.33	\$12,298.23	\$32,502.56
3600	ODP	350	95.0%	95.4%	96.4%	5,987.2	2.34	\$29,220.28	\$18,322.91	\$47,543.19
3600	ODP	40	91.7%	92.4%	93.4%	888.4	0.35	\$4,222.09	\$2,099.62	\$6,321.70
3600	ODP	400	95.4%	95.8%	96.8%	6,785.7	2.65	\$32,992.47	\$20,843.58	\$53,836.05
3600	ODP	450	95.8%	95.8%	96.8%	5,430.0	2.12	\$56,915.81	\$36,829.75	\$93,745.56
3600	ODP	5	85.5%	86.5%	87.5%	149.6	0.06	\$976.06	\$411.67	\$1,387.72
3600	ODP	50	92.4%	93.0%	94.0%	1,030.7	0.40	\$4,628.91	\$2,371.47	\$7,000.39
3600	ODP	500	95.8%	95.8%	96.8%	6,033.4	2.35	\$59,663.64	\$38,665.92	\$98,329.55
3600	ODP	60	93.0%	93.6%	94.6%	1,221.0	0.48	\$5,831.16	\$3,174.84	\$9,006.00
3600	ODP	7.5	87.5%	88.5%	89.5%	214.3	0.08	\$1,323.26	\$643.67	\$1,966.93
3600	ODP	75	93.0%	93.6%	94.6%	1,526.3	0.60	\$6,697.92	\$3,754.03	\$10,451.95
3600	TEFC	1	75.5%	77.0%	78.0%	47.5	0.02	\$826.86	\$311.97	\$1,138.83
3600	TEFC	1.5	82.5%	84.0%	85.0%	59.8	0.02	\$821.85	\$308.62	\$1,130.47
3600	TEFC	10	89.5%	90.2%	91.2%	233.1	0.09	\$1,475.12	\$745.15	\$2,220.27
3600	TEFC	100	93.6%	94.1%	95.1%	1,885.7	0.74	\$8,402.69	\$4,412.08	\$12,814.77
3600	TEFC	125	94.5%	95.0%	96.0%	2,312.7	0.90	\$10,323.06	\$5,695.32	\$16,018.38
3600	TEFC	15	90.2%	91.0%	92.0%	364.1	0.14	\$2,541.29	\$976.47	\$3,517.75
3600	TEFC	150	94.5%	95.0%	96.0%	2,775.3	1.08	\$10,693.62	\$5,942.94	\$16,636.56
3600	TEFC	2	84.0%	85.5%	86.5%	77.0	0.03	\$907.18	\$365.64	\$1,272.82
3600	TEFC	20	90.2%	91.0%	92.0%	485.4	0.19	\$2,861.24	\$1,190.27	\$4,051.52
3600	TEFC	200	95.0%	95.4%	96.4%	3,421.3	1.33	\$12,801.47	\$7,351.45	\$20,152.92
3600	TEFC	25	91.0%	91.7%	92.7%	563.8	0.22	\$3,261.14	\$1,457.50	\$4,718.64
3600	TEFC	250	95.4%	95.8%	96.8%	4,241.1	1.65	\$15,888.00	\$9,413.95	\$25,301.95
3600	TEFC	3	85.5%	86.5%	87.5%	89.7	0.04	\$953.05	\$396.29	\$1,349.34
3600	TEFC	30	91.0%	91.7%	92.7%	676.5	0.26	\$3,513.58	\$1,626.18	\$5,139.75
3600	TEFC	300	95.4%	95.8%	96.8%	5,089.3	1.98	\$20,204.33	\$12,298.23	\$32,502.56
3600	TEFC	350	95.4%	95.8%	96.8%	5,937.5	2.32	\$29,220.28	\$18,322.91	\$47,543.19

RPM	Enclosure	Horsepower	EPACT Efficiency	NEMA Premium Efficiency	Enhanced NEMA Premium Efficiency	Energy Savings	Demand Reduction	IC: EPACT to NEMA Premium	IC: NEMA Premium to Enhanced	IC: EPACT to Enhanced
3600	TEFC	40	91.7%	92.4%	93.4%	888.4	0.35	\$4,222.09	\$2,099.62	\$6,321.70
3600	TEFC	400	95.4%	95.8%	96.8%	6,785.7	2.65	\$32,992.47	\$20,843.58	\$53,836.05
3600	TEFC	450	95.4%	95.8%	96.8%	7,633.9	2.98	\$56,915.81	\$36,829.75	\$93,745.56
3600	TEFC	5	87.5%	88.5%	89.5%	142.9	0.06	\$976.06	\$411.67	\$1,387.72
3600	TEFC	50	92.4%	93.0%	94.0%	1,030.7	0.40	\$4,628.91	\$2,371.47	\$7,000.39
3600	TEFC	500	95.4%	95.8%	96.8%	8,482.1	3.31	\$59,663.64	\$38,665.92	\$98,329.55
3600	TEFC	60	93.0%	93.6%	94.6%	1,221.0	0.48	\$5,831.16	\$3,174.84	\$9,006.00
3600	TEFC	7.5	88.5%	89.5%	90.5%	209.6	0.08	\$1,323.26	\$643.67	\$1,966.93
3600	TEFC	75	93.0%	93.6%	94.6%	1,526.3	0.60	\$6,697.92	\$3,754.03	\$10,451.95

Source: State of Minnesota Technical Reference Manual for Energy Conservation Improvement Programs Version 1.2

## Electric VSDs - Energy Savings Table

### Calculator

Motor Size (HP)	25
Motor Application Type	HVAC Fan - Fan Average (unknown type)
Motor Efficiency	0.91
Energy Savings (kwh/yr)	20,764
	13842.89077

Motor Efficiencies (if unknown)	
Horsepower (Hp)	Motor Efficiency
5	0.87
7.5	0.88
10.0	0.9
15.0	0.9
20.0	0.91
25.0	0.91
30.0	0.92
40.0	0.92
50.0	0.93
60.0	0.93
75.0	0.93
100.0	0.93

**Source: State of Minnesota Technical Reference Manual for Energy Conservation Improvement Programs Version 1.2**

## Climate Data for Deemed Database

For Adjustments for Heating Degree Days:

Billings - Population 89847 - 6930 HDD - 85% Weight

Miles City: Population 8487 - 7618 HDD - 5% Weight

Sidney: Population 4774 - 8455 HDD - 5% Weight

Glendive: Population 4729 - 7906 HDD - 5% Weight

Total HDD =  $(6930*85\%)+(7618*5\%)+(8455*5\%)+(7906*5\%) = 7090$  HDD

Minneapolis HDD = **7981 HDD**

For Adjustments for Cooling Degree Days:

Miles City: Population 8487 - 748 CDD - 50% Weight

Sidney: Population 4774 - 447 CDD - 25% Weight

Glendive: Population 4729 - 721 CDD - 25% Weight

Total CDD =  $(748*50\%)+(447*25\%)+(721*25\%) = 666$  CDD

Minneapolis CDD = **682 CDD**

Bismarck: 520 CDD (from NOAA)

Mobridge: 644 CDD (From NOAA)