Integrated Resource Plan 2017

Submitted to the
North Dakota Public Service Commission
July 1, 2017

Volume III: Attachment B

Montana-Dakota Utilities Co.
2017 Integrated Resource Plan

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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 defined 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

In the 2013 IRP Montana-Dakota provided the results of the Nexant Energy Efficiency Potential Study that was completed for the Montana service territory, which also included an energy efficiency attitudes survey of customers. In addition, Montana-Dakota provided the results of the Nexant Program Planning Study for the Montana Service territory in the 2015 IRP. Montana-Dakota continues to use the key findings of both studies in our DSM planning process for the 2017 IRP.

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 1.73% of demand (MW) savings in 2035.

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)

YEAR	Residential Sales (MWh)	Achievable EE %	Achievable MWh	Small C&I Sales (MWh)	Achievable EE %	Achievable MWh	Large C&I Sales (MWh)	Achievable EE %	Achievable MWh	Street Lighting Sales (MWh)	Achievable EE %	Miscellaneous Sales (MWh)	Achievable EE %	Total Sales Sales (MWh)	Achievable EE %	Achievable MWh
2017	204,325	0.10%	204	143,011	0.10%	143	473,630	0.10%	474	7,108	0.00%	7,948	0.00%	836,022	0.10%	821
2018	207,692	0.10%	208	147,364	0.10%	147	478,400	0.10%	478	7,108	0.00%	7,963	0.00%	848,527	0.10%	833
2019	211,073	0.20%	422	151,963	0.20%	304	482,578	0.10%	483	7,108	0.00%	7,979	0.00%	860,701	0.14%	1,209
2020	214,470	0.20%	429	156,666	0.20%	313	487,471	0.20%	975	7,108	0.00%	7,995	0.00%	873,710	0.20%	1,717
2021	217,881	0.20%	436	161,468	0.20%	323	492,407	0.20%	985	7,108	0.00%	8,011	0.00%	886,875	0.20%	1,744
2022	220,857	0.30%	663	166,179	0.20%	332	496,701	0.20%	993	7,108	0.00%	8,027	0.00%	898,872	0.22%	1,988
2023	223,833	0.30%	671	171,172	0.30%	514	501,717	0.30%	1,505	7,108	0.00%	8,043	0.00%	911,873	0.30%	2,690
2024	226,313	0.30%	679	175,754	0.30%	527	506,778	0.30%	1,520	7,108	0.00%	8,058	0.00%	924,011	0.30%	2,727
2025	228,793	0.30%	686	180,424	0.30%	541	511,884	0.30%	1,536	7,108	0.00%	8,074	0.00%	936,283	0.30%	2,763
2026	230,777	0.30%	692	184,652	0.30%	554	517,037	0.30%	1,551	7,108	0.00%	8,090	0.00%	947,664	0.30%	2,797
2027	232,761	0.30%	698	188,960	0.30%	567	522,237	0.30%	1,567	7,108	0.00%	8,106	0.00%	959,172	0.30%	2,832
2028	233,753	0.30%	701	192,240	0.30%	577	527,484	0.30%	1,582	7,108	0.00%	8,122	0.00%	968,707	0.30%	2,860
2029	234,745	0.30%	704	195,571	0.30%	587	532,780	0.30%	1,598	7,108	0.00%	8,138	0.00%	978,342	0.30%	2,889
2030	235,737	0.30%	707	198,951	0.30%	597	538,126	0.30%	1,614	7,108	0.00%	8,153	0.00%	988,075	0.30%	2,918
2031	236,729	0.30%	710	202,382	0.30%	607	543,522	0.30%	1,631	7,108	0.00%	8,169	0.00%	997,910	0.30%	2,948
2032	237,721	0.30%	713	205,858	0.30%	618	548,969	0.30%	1,647	7,108	0.00%	8,185	0.00%	1,007,841	0.30%	2,978
2033	238,217	0.30%	715	208,797	0.30%	626	554,469	0.30%	1,663	7,108	0.00%	8,201	0.00%	1,016,792	0.30%	3,004
2034	238,713	0.30%	716	211,794	0.30%	635	560,021	0.30%	1,680	7,108	0.00%	8,217	0.00%	1,025,853	0.30%	3,032
2035	239,209	0.30%	718	214,835	0.30%	645	565,652	0.30%	1,697	7,108	0.00%	8,232	0.00%	1,035,036	0.30%	3,059
Cumulative														**17,902,266**	**0.26%**	**45,810**

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

YEAR	Residential Sales (MWh)	Achievable EE %	Achievable MWh	Small C&I Sales (MWh)	Achievable EE %	Achievable MWh	Large C&I Sales (MWh)	Achievable EE %	Achievable MWh	Street Lighting Sales (MWh)	Achievable EE %	Miscellaneous Sales (MWh)	Achievable EE %	Total Sales (MWh)	Achievable EE %	Achievable MWh
2017	871,765	0.15%	1,308	692,738	0.15%	1,039	663,948	0.15%	996	20,015	0.00%	52,218	0.00%	2,300,684	0.15%	3,343
2018	897,092	0.15%	1,346	732,901	0.15%	1,099	674,720	0.15%	1,012	20,015	0.00%	52,694	0.00%	2,377,422	0.15%	3,457
2019	922,539	0.20%	1,845	775,000	0.20%	1,550	686,070	0.20%	1,372	20,015	0.00%	53,170	0.00%	2,456,794	0.19%	4,767
2020	937,402	0.20%	1,875	803,404	0.20%	1,607	696,753	0.20%	1,394	20,015	0.00%	53,647	0.00%	2,511,221	0.19%	4,875
2021	952,330	0.30%	2,857	833,501	0.30%	2,501	708,446	0.30%	2,125	20,015	0.00%	54,123	0.00%	2,568,415	0.29%	7,483
2022	965,204	0.30%	2,896	863,347	0.30%	2,590	717,858	0.30%	2,154	20,015	0.00%	54,599	0.00%	2,621,023	0.29%	7,639
2023	973,788	0.40%	3,895	888,890	0.40%	3,556	728,306	0.40%	2,913	20,015	0.00%	55,075	0.00%	2,666,074	0.39%	10,364
2024	982,371	0.40%	3,929	913,847	0.40%	3,655	738,065	0.40%	2,952	20,015	0.00%	55,551	0.00%	2,709,849	0.39%	10,537
2025	989,881	0.50%	4,949	938,826	0.50%	4,694	748,882	0.50%	3,744	20,015	0.00%	56,027	0.00%	2,753,631	0.49%	13,388
2026	997,391	0.50%	4,987	964,292	0.50%	4,821	759,894	0.50%	3,799	20,015	0.00%	56,503	0.00%	2,798,095	0.49%	13,608
2027	1,004,902	0.50%	5,025	990,245	0.50%	4,951	771,104	0.50%	3,856	20,015	0.00%	56,980	0.00%	2,843,246	0.49%	13,831
2028	1,012,412	0.50%	5,062	1,016,687	0.50%	5,083	782,515	0.50%	3,913	20,015	0.00%	57,456	0.00%	2,889,085	0.49%	14,058
2029	1,019,922	0.50%	5,100	1,043,624	0.50%	5,218	794,131	0.50%	3,971	20,015	0.00%	57,932	0.00%	2,935,624	0.49%	14,288
2030	1,027,433	0.50%	5,137	1,071,063	0.50%	5,355	805,955	0.50%	4,030	20,015	0.00%	58,408	0.00%	2,982,874	0.49%	14,522
2031	1,034,943	0.50%	5,175	1,099,013	0.50%	5,495	817,992	0.50%	4,090	20,015	0.00%	58,884	0.00%	3,030,847	0.49%	14,760
2032	1,042,453	0.50%	5,212	1,127,475	0.50%	5,637	830,244	0.50%	4,151	20,015	0.00%	59,360	0.00%	3,079,547	0.49%	15,001
2033	1,049,964	0.50%	5,250	1,156,452	0.50%	5,782	842,717	0.50%	4,214	20,015	0.00%	59,836	0.00%	3,128,984	0.49%	15,246
2034	1,057,474	0.50%	5,287	1,185,949	0.50%	5,930	855,413	0.50%	4,277	20,015	0.00%	60,312	0.00%	3,179,163	0.49%	15,494
2035	1,064,984	0.50%	5,325	1,216,227	0.50%	6,081	868,385	0.50%	4,342	20,015	0.00%	60,789	0.00%	3,230,400	0.49%	15,748
Cumulative														**53,062,978**	**0.40%**	**212,409**

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

YEAR	Residential Sales (MWh)	Achievable EE %	Achievable MWh	Small C&I Sales (MWh)	Achievable EE %	Achievable MWh	Large C&I Sales (MWh)	Achievable EE %	Achievable MWh	Street Lighting Sales (MWh)	Achievable EE %	Miscellaneous Sales (MWh)	Achievable EE %	Total Sales Sales (MWh)	Achievable EE %	Achievable MWh
2017	72,602	0.05%	36	38,505	0.05%	19	39,718	0.05%	20	2,651	0.00%	1,753	0.00%	155,229	0.05%	75
2018	72,609	0.10%	73	38,988	0.10%	39	40,895	0.10%	41	2,651	0.00%	1,753	0.00%	156,896	0.10%	152
2019	72,616	0.10%	73	39,438	0.10%	39	42,106	0.10%	42	2,651	0.00%	1,753	0.00%	158,564	0.10%	154
2020	72,623	0.20%	145	39,932	0.20%	80	43,306	0.10%	43	2,651	0.00%	1,753	0.00%	160,265	0.17%	268
2021	72,630	0.20%	145	40,432	0.20%	81	44,462	0.20%	89	2,651	0.00%	1,753	0.00%	161,928	0.19%	315
2022	72,626	0.20%	145	40,938	0.20%	82	45,649	0.20%	91	2,651	0.00%	1,753	0.00%	163,617	0.19%	318
2023	72,648	0.30%	218	41,410	0.20%	83	46,817	0.20%	94	2,651	0.00%	1,753	0.00%	165,279	0.24%	394
2024	72,659	0.30%	218	41,929	0.30%	126	48,067	0.30%	144	2,651	0.00%	1,753	0.00%	167,059	0.29%	488
2025	72,670	0.30%	218	42,454	0.30%	127	49,352	0.30%	148	2,651	0.00%	1,753	0.00%	168,880	0.29%	493
2026	72,681	0.30%	218	42,987	0.30%	129	50,525	0.30%	152	2,651	0.00%	1,753	0.00%	170,597	0.29%	499
2027	72,692	0.30%	218	43,525	0.30%	131	51,727	0.30%	155	2,651	0.00%	1,753	0.00%	172,348	0.29%	504
2028	72,703	0.30%	218	44,070	0.30%	132	52,958	0.30%	159	2,651	0.00%	1,753	0.00%	174,135	0.29%	509
2029	72,703	0.30%	218	44,622	0.30%	134	54,216	0.30%	163	2,651	0.00%	1,753	0.00%	175,945	0.29%	515
2030	72,703	0.30%	218	45,181	0.30%	136	55,505	0.30%	167	2,651	0.00%	1,753	0.00%	177,793	0.29%	520
2031	72,703	0.30%	218	45,747	0.30%	137	56,825	0.30%	170	2,651	0.00%	1,753	0.00%	179,679	0.29%	526
2032	72,703	0.30%	218	46,320	0.30%	139	58,177	0.30%	175	2,651	0.00%	1,753	0.00%	181,604	0.29%	532
2033	72,692	0.30%	218	46,900	0.30%	141	59,560	0.30%	179	2,651	0.00%	1,753	0.00%	183,556	0.29%	537
2034	72,692	0.30%	218	47,488	0.30%	142	60,976	0.30%	183	2,651	0.00%	1,753	0.00%	185,560	0.29%	543
2035	72,681	0.30%	218	48,082	0.30%	144	62,426	0.30%	187	2,651	0.00%	1,753	0.00%	187,593	0.29%	550
2036	72,681	0.30%	218	48,686	0.30%	146	63,915	0.30%	192	2,651	0.00%	1,753	0.00%	189,686	0.29%	556
Cumulative														**3,436,213**	**0.25%**	**8,450**

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 at year end 2016 combine to offer approximately 24.9 MW of demand response to Montana-Dakota's integrated system. The demand response goal from the two programs is 35 MW by 2019 or 4.8 percent of the total forecasted Integrated System peak demand in 2019.

Montana-Dakota is also planning, pending PSC Commission approvals, to implement a Wi-Fi Thermostat (A/C Cycling) Demand Response program as part of the current Demand Response portfolio, which will add an additional 10MW of demand response by 2022. The A/C Cycling program would use a programmable Wi-Fi thermostat to control a customer's air conditioner during a demand response event initiated by Montana-Dakota. 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.

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 the portfolio of DSM measures 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. As discussed in Chapter 3 of the 2017 Main report many of the existing EE programs are proposed to be closed and therefore are not included in this overview.

Residential LED Lighting Program

This program would offer rebates to Montana-Dakota residential customers when they install LED lighting versus incandescent and compact fluorescent lighting (CFL) in single family dwellings. This program would be available to existing customers and new construction.

The program would provide a rebate on a per bulb basis and would be available as a point-of-sale rebate on the MDU Marketplace which is to be implemented as part of the A/C Cycling Program or mail-in rebate application.

Program Incentive:

Measure	Incentive Level
Residential LED Lighting	50% of bulb or package cost not to exceed $10 per bulb

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

- Website and social media
- Bill inserts
- Email marketing
- Direct mail
- Online marketing channels
- Traditional marketing channels

Commercial Lighting Program

The Commercial Lighting program will be re-designed and will include additional prescriptive rebates to capture most of the common retrofit lighting applications. The prescriptive rebate levels will be individually designed to maximize customer participation and cost effectiveness. The program will also include rebates for lighting controls and occupancy sensors that will minimize runtimes. A custom lighting efficiency options will also be offered for projects that are non-prescriptive, however the majority of applications should be prescriptive.

This program will also have a direct install incentive that will be provided to a Preferred Trade Ally (PTA) that provides a customer with a turnkey lighting solution. Montana-Dakota plans to select two to four PTA's through a Request for Proposals (RFP) process. The PTA's will receive an incentive based on the first year energy savings delivered from a participating customer.

This program would be available to Montana-Dakota's commercial customers that are served under a general service electric tariff.

The incentive levels will be specific to the prescriptive application and first year energy savings for both the PTA incentive and custom efficiency projects. The benefit cost modeling for this program assumes the average customer rebate level will be $0.04 per kWh saved and the average PTA incentive will be $0.02 per kWh saved.

Montana-Dakota will market the program through the following:

- Company Website and MDU Marketplace
- Key account representatives
- Preferred Trade Allies

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 and online marketing channels
- Key account representatives
- Preferred Trade Allies
- 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.

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
- 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

The A/C Cycling Demand Response program would be offered to residential customers is all states, and would be operated as a Bring Your Own Thermostat (BYOT) program. Montana-Dakota plans to use a vendor to provide the overall program administration, demand response management software, marketing support and design, and a standalone customer service and support center. In addition, Montana-Dakota expects to contract with a separate vendor to provide a Company branded online marketplace (MDU Marketplace) for customers to purchase the Wi-Fi Thermostat and receive a point-of-sale rebate.

The program would use a programmable Wi-Fi thermostat to control a customer's air conditioner when a demand response event is initiated by Montana-Dakota. 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.

A/C Cycling Program Incentives:

Measure	Incentive Level
Wi-Fi Programmable Thermostat Rebate	$60-75 one-time rebate

Residential Demand Response Capacity Payment	$40 per year

Program Rules:

- Customer would be required to have central A/C and Wi-Fi
- June 1 – September 30 is program year
- Maximum 4 hour event duration and 10 events per season
- 12-8pm Monday-Friday and no major holidays
- Two opt-outs per season
- Annual test (event can serve as the test)
- One hour notification (SMS, T-Stat, App, & Email notification)

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

- Company Website, social media
- MDU Marketplace
- Bill inserts
- Email marketing
- In app marketing
- Direct mail
- Online marketing channels
- Traditional marketing channels
- 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:

Net Benefit = Total Annual Benefits – Total Annual Costs

where

Total Annual Benefits = Energy Savings (kWh)
+ Demand Savings (kW)
+ Incentive
+ Other Savings
Total Annual Costs = Direct Costs + Other Costs

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:

Net Benefit = Annual Cost of Energy Saved – Annual Project Costs

where

*Annual Cost of Energy Saved = Energy Savings (kWh)**
*+ Peak Demand Savings (kW)**
+ O&M Savings
Annual Project Costs = Total Project Costs + Lost Margin

**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_2). 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:

Net Benefit = Annual Cost of Energy Saved – Annual Project Costs

where

*Annual Cost of Energy Saved = Energy Savings (kWh)**
*+ Demand Savings (kW)**
+ O&M Savings
+ Avoided Environmental Damage
Annual Project Costs = Total Project Costs

**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:

Net Benefit = Annual Cost of Energy Saved – Annual Project Costs

where

*Annual Cost of Energy Saved = Energy Savings (kWh)**
*+ Demand Savings (kW)**
+ O&M Savings
Annual Project Costs = Total Project

**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:

Net Benefit = Annual Cost of Energy Saved – Annual Project Costs

where

*Annual Cost of Energy Saved = Energy Savings (kWh)**
*+ Demand Savings (kW)**
+ O&M Savings

Annual Project Costs = *Total Project Costs net of incentive costs*

**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	$0.10241	$0.08063	$0.09894	$0.10281	$0.10859	$0.09178
	Retail Rate (Winter)	System average retail rate for customer class based	$0.07909	0.05624	$0.08728	0.08724	$0.09604	0.0826
	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	$0.00000	$0.00000	$0.00000	$0.00000	$0.00000	$0.00000
	Fuel Escalation Rate		2.80%	2.80%	2.80%	2.80%	2.80%	2.80%
2	System Marginal Energy Costs	Actual costs for years 1 through 10						
	Escalation Rate (after Yr. 10)	Escalation factor applied after year 10	3.00000%	3.00000%	3.00000%	3.00000%	3.00000%	3.00000%
3	Retail Summer Demand Cost ($/kW/season)	Seasonal demand cost based on program availability	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
3a	Retail Winter Demand Cost ($/kW/season)	Seasonal demand cost based on program availability	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
	Escalation Rate		4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
4	Electric Margin ($/KWh)	Average margin applicable to customer class	$0.06573	$0.06007	$0.06564	$0.06643	$0.08337	$0.07799
	Escalation Rate		4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
5	Avoided Capacity Costs ($/kW/yr.)	Demand cost based on estimated levalized cost of combustion turbine	$98.46	$98.46	$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	$30 / ton Carbon Cost	30.7%	30.7%	30.7%	30.7%	30.7%	30.7%
	Escalation Rate		3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
8	Participation Discount Rate	Federal Reserve Consumer Credit Interest rate 12 Months ended December 31, 2016	9.69%	9.69%	9.69%	9.69%	9.69%	9.69%
9	Utility Discount Rate	Montana-Dakota's authorized average cost of capital	7.296%	7.296%	7.364%	7.364%	7.216%	7.216%
10	Societal Discount Rate	Equal to the 30 year T-Bill rate average for 12 Months ended March 31, 2017	2.68%	2.68%	2.68%	2.68%	2.68%	2.68%
11	General Input Data Year	2017	2017	2017	2017	2017	2017	2017
12	Project Analysis Yr. 1	Year(s) program will be implemented	2018	2018	2018	2018	2018	2018
	Yr. 2		2019	2019	2019	2019	2019	2019
	Yr. 3		2020	2020	2020	2020	2020	2020
13	Utility Project Costs	Total direct cost to the utility caused by implementing the program(s)						
	Admin Costs	Administration costs						
	Promo Costs	Promotional costs						
14	Direct Participant Project Costs ($/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	1.08%	1.08%	1.08%	1.08%	1.08%	1.08%
	Yr. 2	Consumer Price Index based on 3 yr. average	1.08%	1.08%	1.08%	1.08%	1.08%	1.08%
	Yr. 3	Consumer Price Index based on 3 yr. average	1.08%	1.08%	1.08%	1.08%	1.08%	1.08%
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%	37.80%	37.80%	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 Maginal Energy Cost Yr. 1	Need to change the hard entry in the 14.5 SEER CostBen Tab	$0.02987	$0.02987	$0.02597	$0.02597	$0.02597	$0.02597
	Yr. 2		$0.03164	$0.03164	$0.02751	$0.02751	$0.02751	$0.02751
	Yr. 3		$0.03271	$0.03271	$0.02844	$0.02844	$0.02844	$0.02844
	Yr. 4		$0.03432	$0.03432	$0.02984	$0.02984	$0.02984	$0.02984
	Yr. 5		$0.03616	$0.03616	$0.03144	$0.03144	$0.03144	$0.03144
	Yr. 6		$0.03780	$0.03780	$0.03287	$0.03287	$0.03287	$0.03287
	Yr. 7		$0.03996	$0.03996	$0.03475	$0.03475	$0.03475	$0.03475
	Yr. 8		$0.04202	$0.04202	$0.03654	$0.03654	$0.03654	$0.03654
	Yr. 9		$0.04383	$0.04383	$0.03811	$0.03811	$0.03811	$0.03811

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		2.14	2.56	3.76	6.45	2.59
Residential Programs						
Residential Lighting	Residential	1.05	3.13	2.63	2.57	1.61
Demand Response						
Residential AC Cycling	Residential	1.38	1.41	3.03	3.47	1.99
Commercial Programs						
Commerical Lighting	Commerical	1.50	6.33	7.12	4.13	3.76
Commercial Partnership Program (Custom)	Commerical	1.40	6.14	5.28	3.48	3.15
Demand Response						
Commercial Demand Response Program	Commercial	2.58	2.58	3.53	40.52	2.54
Interruptible Rate DR Program	Commercial	3.44	3.53	4.47	10.81	3.22

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		1.81	2.02	3.03	6.12	2.12
Residential Programs						
Residential Lighting	Residential	0.98	2.97	2.47	2.67	1.52
Demand Response						
Residential AC Cycling	Residential	1.20	1.23	2.64	3.46	1.73
Commercial Programs						
Commerical Lighting	Commerical	1.29	5.87	6.57	5.69	3.47
Commercial Partnership Program (Custom)	Commercial	1.21	5.78	4.94	4.64	2.95
Demand Response						
Commercial Demand Response Program	Commercial	1.79	1.79	2.36	12.50	1.69
Interruptible Rate DR Program	Commercial	3.44	3.53	4.47	10.81	3.22

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		1.18	1.89	3.27	4.07	2.06
Residential Programs						
Residential Lighting	Residential	0.80	2.48	2.26	2.89	1.39
Demand Response						
Residential AC Cycling	Residential	1.20	1.23	2.64	3.49	1.73
Commercial Programs						
Commerical Lighting	Commerical	1.10	5.25	6.18	5.36	3.26
Commercial Partnership Program (Custom)	Commercial	1.02	4.71	4.41	4.27	2.64
Demand Response						
Commercial Demand Response Program	Commercial	2.85	2.85	3.08	2.48	2.13

The overall results show that the programs are cost effective at the measure, segment, and portfolio level in each state based on the TRC test. However, the residential lighting program does not pass the RIM test in North Dakota and South Dakota. This can be attributed to the environmental adder that is required in Montana and included in the Montana benefit cost analysis.

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.

Appendix A

DSM Benefit/Cost Analysis

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		2.14	2.56	3.76	6.45	2.59
Residential Programs						
Residential Lighting	Residential	1.05	3.13	2.63	2.57	1.61
Demand Response						
Residential AC Cycling	Residential	1.38	1.41	3.03	3.47	1.99
Commercial Programs						
Commerical Lighting	Commerical	1.50	6.33	7.12	4.13	3.76
Commercial Partnership Program (Custom)	Commerical	1.40	6.14	5.28	3.48	3.15
Demand Response						
Commercial Demand Response Program	Commercial	2.58	2.58	3.53	40.52	2.54
Interruptible Rate DR Program	Commercial	3.44	3.53	4.47	10.81	3.22

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		1.81	2.02	3.03	6.12	2.12
Residential Programs						
Residential Lighting	Residential	0.98	2.97	2.47	2.67	1.52
Demand Response						
Residential AC Cycling	Residential	1.20	1.23	2.64	3.46	1.73
Commercial Programs						
Commerical Lighting	Commerical	1.29	5.87	6.57	5.69	3.47
Commercial Partnership Program (Custom)	Commercial	1.21	5.78	4.94	4.64	2.95
Demand Response						
Commercial Demand Response Program	Commercial	1.79	1.79	2.36	12.50	1.69
Interruptible Rate DR Program	Commercial	3.44	3.53	4.47	10.81	3.22

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		1.18	1.89	3.27	4.07	2.06
Residential Programs						
Residential Lighting	Residential	0.80	2.48	2.26	2.89	1.39
Demand Response						
Residential AC Cycling	Residential	1.20	1.23	2.64	3.49	1.73
Commercial Programs						
Commerical Lighting	Commerical	1.10	5.25	6.18	5.36	3.26
Commercial Partnership Program (Custom)	Commercial	1.02	4.71	4.41	4.27	2.64
Demand Response						
Commercial Demand Response Program	Commercial	2.85	2.85	3.08	2.48	2.13
Interruptible Rate DR Program	Commercial	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Montana-Dakota Utilities Co.
Electric Utility - Montana
Demand-Side Management and Conservation Portfolio
2018 - 2020 Program Years

Program	Participants	Lifetime Energy Reduction	2020 Demand Reduction	Total Cost	Lifetime Cost/Kwh	2020 Cost/KW
Residential Programs						
Residential Lighting	9,000	2,617,965	82	47,823	0.018	583.21
Total	9,000	2,617,965	82	$47,823	$0.018	$583.21
Demand Response						
Residential AC Cycling	1,236	1,148,459	1,356	$462,810	NA	$341.31
Total Residential	10,236	3,766,424	1,438	$510,633	$0.136	$355.10
Commercial Programs						
Commerical Lighting	45	20,725,517	524	$199,757	$0.010	$381.22
Commercial Partnership Program (Custom)	10	10,773,502	338	105,626	0.010	312.50
Total Commercial	55	31,499,019	862	$305,383	$0.010	$354.27
Demand Response						
Commercial Demand Response Program	8	1,928,460	8,089	$974,895	$0.506	$120.52
Interruptible Rate DR Program	1	691,390	2,900	222,490	0.322	76.72
	9	2,619,850	10,989	$1,197,385	$0.457	$108.96
Total Commercial	64	34,118,869	11,851	$1,502,768	$0.044	$126.81
Education and Outreach				$41,600		
Total Programs without DR	9,055	34,116,984	944	$394,806	$0.012	$418.23
Total Demand Response	1,245	3,768,309	12,345	$1,660,195	$0.441	$134.48
Total Programs	10,300	37,885,293	13,289	$2,055,001	$0.054	$154.64

Montana-Dakota Utilities Co.
Electric Utility - North Dakota
Demand-Side Management and Conservation Portfolio
2018 - 2020 Program Years

Program	Participants	Lifetime Energy Reduction	2020 Demand Reduction	Total Cost	Lifetime Cost/Kwh	2020 Cost/KW
Residential Programs						
Residential Lighting	30,000	8,726,535	2,444	156,715	0.018	64.12
Total	30,000	8,726,535	2,444	$156,715	$0.018	$64.12
Demand Response						
Residential AC Cycling	4,636	1,148,459	5,084	$1,735,539	NA	$341.37
Total Residential	34,636	9,874,994	7,528	$1,892,254	$0.192	$251.36
Commercial Programs						
Commerical Lighting	30	13,817,025	350	$132,078	$0.010	$377.37
Commercial Partnership Program (Custom)	22	23,701,702	746	229,424	0.010	307.54
Total Commercial	52	37,518,727	1,096	$361,502	$0.010	$329.84
Demand Response						
Commercial Demand Response Program	37	2,142,580	8,988	$1,393,596	$0.650	$155.05
Interruptible Rate DR Program	6	4,148,340	17,401	2,002,410	0.483	115.07
	43	6,290,920	26,389	$3,396,006	$0.540	$128.69
Total Commercial	95	43,809,647	27,485	$3,757,508	$0.086	$136.71
Education and Outreach				$70,000		
Total Programs without DR	30,052	46,245,262	3,540	$588,217	$0.013	$166.16
Total Demand Response	4,679	7,439,379	31,473	$5,131,545	$0.690	$163.05
Total Programs	34,731	53,684,641	35,013	$5,719,762	$0.107	$163.36

Montana-Dakota Utilities Co.
Electric Utility - South Dakota
Demand-Side Management and Conservation Portfolio
2018 - 2020 Program Years

Program	Participants	Lifetime Energy Reduction	2020 Demand Reduction	Total Cost	Lifetime Cost/Kwh	2020 Cost/KW
Residential Programs						
Residential Lighting	3,000	872,658	252	18,993	0.022	75.37
Total	3,000	872,658	252	$18,993	$0.022	$75.37
Demand Response						
Residential AC Cycling	309	287,117	339	$115,703	NA	$341.31
Total Residential	3,309	1,159,775	591	$134,696	$0.116	$227.91
Commercial Programs						
Commerical Lighting	10	4,605,674	116	$49,569	$0.011	$427.32
Commercial Partnership Program (Custom)	3	3,232,060	102	37,986	0.012	372.41
Total Commercial	13	7,837,734	218	$87,555	$0.011	$401.63
Demand Response						
Commercial Demand Response Program	2	26,930	113	$9,015	$0.335	$79.78
Interruptible Rate DR Program	0	0	0	0	#DIV/0!	#DIV/0!
	2	26,930	113	$9,015	$0.335	$79.78
Total Commercial	15	7,864,664	331	$96,570	$0.012	$291.75
Education and Outreach				$22,850		
Total Programs without DR	3,013	8,710,392	470	$129,398	$0.015	$275.31
Total Demand Response	311	314,047	452	$124,718	$0.397	$275.92
Total Programs	3,324	9,024,439	922	$254,116	$0.028	$275.61

Montana-Dakota Utilities Co.
Electric Utility - Integrated System Total
Demand-Side Management and Conservation Portfolio
2018 - 2020 Program Years

Program	Participants	Lifetime Energy Reduction	2020 Demand Reduction	Total Cost	Lifetime Cost/Kwh	2020 Cost/KW
Residential Programs						
Residential Lighting	42,000	12,217,158	2,778	223,531	0.018	80.46
Total	42,000	12,217,158	2,778	$223,531	$0.018	$80.46
Demand Response						
Residential AC Cycling	6,182	2,584,035	6,779	$2,314,052	NA	$341.36
Total Residential	48,182	14,801,193	9,557	$2,537,583	$0.171	$265.52
Commercial Programs						
Commerical Lighting	85	39,148,216	990	$381,404	$0.010	$385.26
Commercial Partnership Program (Custom)	35	37,707,264	1,186	373,036	0.010	314.53
Total Commercial	120	76,855,480	2,176	$754,440	$0.010	$346.71
Demand Response						
Commercial Demand Response Program	47	4,097,970	17,190	$2,377,506	$0.580	$138.31
Interruptible Rate DR Program	7	4,839,730	20,301	$2,224,900	0.460	109.60
	54	8,937,700	37,491	$4,602,406	$0.515	$122.76
Total Commercial	174	85,793,180	39,667	$5,356,846	$0.062	$135.05
Education and Outreach				$134,450		
Total Programs without DR	42,120	89,072,638	4,954	$1,112,421	$0.012	$224.55
Total Demand Response	6,236	11,521,735	44,270	$6,916,458	$0.600	$156.23
Total Programs	48,356	100,594,373	49,224	$8,028,879	$0.080	$163.11

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	$0.10241	$0.08063	$0.09894	$0.10281	$0.10859	$0.09178
	Retail Rate (Winter)	System average retail rate for customer class based	$0.07909	0.05624	$0.08728	0.08724	$0.09604	0.0826
	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	$0.00000	$0.00000	$0.00000	$0.00000	$0.00000	$0.00000
	Fuel Escalation Rate		2.80%	2.80%	2.80%	2.80%	2.80%	2.80%
2	System Marginal Energy Costs	Actual costs for years 1 through 10						
	Escalation Rate (after Yr. 10)	Escalation factor applied after year 10	3.00000%	3.00000%	3.00000%	3.00000%	3.00000%	3.00000%
3	Retail Summer Demand Cost ($/kW/season)	Seasonal demand cost based on program availability	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
3a	Retail Winter Demand Cost ($/kW/season)	Seasonal demand cost based on program availability	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
	Escalation Rate		4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
4	Electric Margin ($/KWh)	Average margin applicable to customer class	$0.06573	$0.06007	$0.06564	$0.06643	$0.08337	$0.07799
	Escalation Rate		4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
5	Avoided Capacity Costs ($/kW/yr.)	Demand cost based on estimated levalized cost of combustion turbine	$98.46	$98.46	$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 December 31, 2016	9.69%	9.69%	9.69%	9.69%	9.69%	9.69%
9	Utility Discount Rate	Montana-Dakota's authorized average cost of capital	7.296%	7.296%	7.364%	7.364%	7.216%	7.216%
10	Societal Discount Rate	Equal to the 30 year T-Bill rate average for 12 Months ended March 31, 2017	2.68%	2.68%	2.68%	2.68%	2.68%	2.68%
11	General Input Data Year	2017	2017	2017	2017	2017	2017	2017

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
12	Project Analysis Yr. 1	Year(s) program will be implemented	2018	2018	2018	2018	2018	2018
	Yr. 2		2019	2019	2019	2019	2019	2019
	Yr. 3		2020	2020	2020	2020	2020	2020
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	1.08%	1.08%	1.08%	1.08%	1.08%	1.08%
	Yr. 2	Consumer Price Index based on 3 yr. average	1.08%	1.08%	1.08%	1.08%	1.08%	1.08%
	Yr. 3	Consumer Price Index based on 3 yr. average	1.08%	1.08%	1.08%	1.08%	1.08%	1.08%
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						

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
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%	37.80%	37.80%	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

		Participation Assumptions			Technical Assumptions											Cost Assumptions			
2018 - 2020 Program Years	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
Residential Programs																			
Residential Lighting	Residential	3,000	3,000	3,000	9	43.0	10.0	10	20	0.0036	0.0036	1.0000	0.0036	0.0036	0.00	NA	NA	10	5
Demand Response																			
Residential AC Cycling	Residential	400	412	424	15	NA	NA	41	0	3.6000	0.0000	0.2800	1.0000	0.0000	0.00	NA	NA	0	50
Commercial Programs																			
Commerical Lighting	Commerical	10	15	20	15	NA	NA	9,500	19,000	5.1500	5.1500	1.0000	5.1500	5.1500	0.00	NA	NA	5,883	2,850
Commercial Partnership Program (Custom)	Commerical	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
Demand Response																			
Commercial Demand Response Program	Commercial	5	6	8	10	NA	NA	22,375	0	895.0000	0.0000	1.0000	895.0000	0.0000	0.00	NA	NA	0	37,930
Interruptible Rate DR Program	Commercial	0	1	1	10	NA	NA	64,175	0	2567.0000	0.0000	1.0000	2567.0000	0.0000	0.00	NA	NA	0	111,245
Totals	**10,312**	**3,417**	**3,437**	**3,458**															
Total Less Demand Response		3,412	3,431	3,025															

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

		Participation Assumptions			Technical Assumptions											Cost Assumptions			
2018 - 2020 Program Years	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
Residential Programs																			
Residential Lighting	Residential	10,000	10,000	10,000	9	43.0	10.0	10	20	0.0036	0.0036	1.0000	0.0036	0.0036	0.00	NA	NA	10	5
Demand Response																			
Residential AC Cycling	Residential	1,500	1,545	1,591	15	NA	NA	41	0	3.60	0.00	0.28	1.00	0.00	0.00	NA	NA	0	50
Commercial Programs																			
Commerical Lighting	Commerical	10	10	10	15	NA	NA	9,500	19,000	5.1500	5.1500	1.0000	5.1500	5.1500	0.00	NA	NA	5,883	2,850
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
Demand Response																			
Commercial Demand Response Program	Commercial	23	30	37	10	NA	NA	5,375	0	215.00	0.00	1.00	215.00	0.00	0.00	NA	NA	0	11,322
Interruptible Rate DR Program	Commercial	6	6	6	10	NA	NA	64,175	0	2567.00	0.00	1.00	2567.00	0.00	0.00	NA	NA	0	111,245
Totals	**34,796**	**11,544**	**11,598**	**11,654**															
Total Less Demand Response		10,015	10,017	10,020															

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

South Dakota Electric DSM Programs
Technical Assumptions

		Participation Assumptions			Technical Assumptions											Cost Assumptions			
2018 - 2020 Program Years	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
Residential Programs																			
Residential Lighting	Residential	1,000	1,000	1,000	9	43.0	10.0	10	20	0.0036	0.0036	1.0000	0.0036	0.0036	0.00	NA	NA	10	5
Demand Response																			
Residential AC Cycling	Residential	100	103	106	15	NA	NA	41	0	3.60	0.00	0.28	1.00	0.00	0.00	NA	NA	0	50
Commercial Programs																			
Commerical Lighting	Commerical	2	3	5	15	NA	NA	9,500	19,000	5.1500	5.1500	1.0000	5.1500	5.1500	0.00	NA	NA	5,883	2,850
Commercial Partnership Program (Custom)	Commercial	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
Demand Response																			
Commercial Demand Response Program	Commercial	1	1	2	10	NA	NA	1,250	0	50.00	0.00	1.00	50.00	0.00	0.00	NA	NA	0	1,690
Interruptible Rate DR Program	Commercial	0	0	0	10	NA	NA	64,175	0	2567.00	0.00	1.00	2567.00	0.00	0.00	NA	NA	0	111,245
Totals	**3,326**	**1,104**	**1,108**	**1,114**															
Total Less Demand Response		1,003	1,004	1,006															

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

Air Conditioning Cycling Program

Prgogram will be a 100% Wi-Fi Thermostate 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%
Total	**102,178**	**18,438**		**72,370**	**10,000**	**13.8%**	

As of December 2014

Program Costs	$/Unit	Year 0 2017	Year 1 2018	Year 2 2019	Year 3 2020	Year 4 2021	Year 5 2022	Year 6 2023	Year 7 2024	Year 8 2025	Year 9 2026	Year 10 2027	Year 11 2028	Year 12 2029	Year 13 2030	Year 14 2031	Year 15 2032	Total
Program Management, M&V	Annual Fee	$ -	$ 87,220	$ 93,328	$ 95,194	$ 97,098	$ 99,040	$100,110	$101,191	$102,284	$103,388	$104,505	$105,634	$ 106,774	$ 107,928	$ 109,093	$ 110,271	
T-Stat Annual licensing Fee	$20.55	$ -	$ 41,107	$ 82,214	$123,321	$ 164,428	$ 205,535	$207,755	$209,999	$212,267	$214,559	$216,876	$219,218	$ 221,586	$ 223,979	$ 226,398	$ 228,843	
Honeywell T-Stat Enrollment Fee	$33.33		$ 54,996	$ 41,196	$ 42,432	$ 43,705	$ 45,016	$ 1,350	$ 1,350	$ 1,350	$ 1,350	$ 1,350	$ 1,350	$ 1,350	$ 1,350	$ 1,350	$ 1,350	
IntelliSOURCE SaaS		$ -	$ 74,512	$ 47,684	$ 57,306	$ 65,000	$ 71,766	$ 72,541	$ 73,325	$ 74,116	$ 74,917	$ 75,726	$ 76,544	$ 77,370	$ 78,206	$ 79,051	$ 79,904	
Simple Energy Set Up Fee	One Time Fee	$ -	$ 50,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Simple Energy License Fee	Annual Fee	$ -	$ 100,000	$ 100,000	$100,000	$ 100,000	$ 100,000	$101,080	$102,172	$103,275	$104,390	$105,518	$106,657	$ 107,809	$ 108,974	$ 110,151	$ 111,340	
Comverge Marketing		$ -	$ 40,541	$ 20,270	$ 20,270	$ 20,270	$ 20,270	$20,878	$21,504	$22,150	$22,814	$23,498	$24,203	$24,930	$25,677	$26,448	$27,241	
MDU Marketing			$ 40,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	
MDU Admin Costs			$ 10,000	$ 10,108	$ 10,217	$ 10,328	$ 10,439	$ 10,552	$ 10,666	$ 10,781	$ 10,897	$ 11,015	$ 11,134	$ 11,254	$ 11,376	$ 11,499	$ 11,623	
Simple Energy Marketing Fees			$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$10,300	$10,609	$10,927	$11,255	$11,593	$11,941	$12,299	$12,668	$13,048	$13,439	
Comverge Call Center			$ 19,047	$ 15,931	$ 16,250	$ 16,575	$ 16,906	$17,413	$17,936	$18,474	$19,028	$19,599	$20,187	$20,792	$21,416	$22,058	$22,720	
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	
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	
Total Cost		**$ -**	**$ 727,423**	**$ 724,331**	**$862,298**	**$ 998,530**	**$ 1,134,033**	**$956,031**	**$962,803**	**$969,675**	**$976,651**	**$983,732**	**$990,920**	**$ 998,217**	**$1,005,626**	**$1,013,148**	**$1,020,785**	**$14,324,205**
Cost per kW			$ 364	$ 181.08	$ 143.72	$ 124.82	$ 113.40	$ 95.60	$ 96.28	$ 96.97	$ 97.67	$ 98.37	$ 99.09	$ 99.82	$ 100.56	$ 101.31	$ 102.08	**$ 1,432.42**
Percentage of Dollars going to Customers			27.5%	39.2%	42.6%	45.2%	47.2%	42.3%	42.0%	41.7%	41.4%	41.1%	40.8%	40.5%	40.2%	39.9%	39.6%	
MT Cost		$ -	$ 145,485	$ 144,866	$172,460	$ 199,706	$ 226,807	$191,206	$192,561	$193,935	$195,330	$196,746	$198,184	$ 199,643	$ 201,125	$ 202,630	$ 204,157	**$ 2,864,841**
ND Cost		$ -	$ 545,567	$ 543,248	$646,723	$ 748,898	$ 850,525	$717,023	$722,102	$727,257	$732,489	$737,799	$743,190	$ 748,663	$ 754,219	$ 759,861	$ 765,589	**$10,743,153**
SD Cost		$ -	$ 36,371	$ 36,217	$ 43,115	$ 49,927	$ 56,702	$ 47,802	$ 48,140	$ 48,484	$ 48,833	$ 49,187	$ 49,546	$ 49,911	$ 50,281	$ 50,657	$ 51,039	**$ 716,210**
Participation																		
Montana		0	400	412	424	437	450	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	
South Dakota		0	100	103	106	109	113	3	3	3	3	3	3	3	3	3	3	
Total Particpation		0	2,000	2,060	2,122	2,185	2,251	68	68	68	68	68	68	68	68	68	68	
Cumulative Total			**2,000**	**4,000**	**6,000**	**8,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	
Cumulative MW Total			**2,000**	**4,000**	**6,000**	**8,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	

By State Breakdown	Total Particpation	$kW	Total Cost	kW	kWh Annual	kWh Lifetime (10yrs)
Montana	2,000	$1,432.42	$ 2,864,841	2,000	82,080	820,800
North Dakota	7,500	$1,432.42	$10,743,153	7,500	307,800	3,078,000
South Dakota	500	$1,432.42	$ 716,210	500	20,520	205,200

Data Input

Churn Rate	3.0%
kW per particpate (all States)	1.0
MT kWh saved per participant	41
ND kWh saved per participant	41
SD kWh saved per participant	41
Inflation Rate	1.1%
Program Life (Years)	15
Thermostat Incremental Cost	$110
Upfront Rebate Level	$60

Kwh Savings

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

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**

Input Data

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 = 9.69%

9) Utility Discount Rate = 7.30%

10) Societal Discount Rate = 2.68%

11) General Input Data Year = 2017

12) Project Analysis Year 1 = 2018
Project Analysis Year 2 = 2019
Project Analysis Year 3 = 2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$88,948	$108,266	$143,032
Incentive Costs =	277,150	451,295	562,147
Total Utility Project Costs =	$366,098	$559,561	$705,179
14) Direct Participant Costs ($/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 =	3,417	3,437	3,458
20) Incentive/Participant =			
21) Effective Federal & State Income Tax Rate =			
22) Annual Summer Kwh Saved	353,275	537,817	730,574
Annual Winter Kwh Saved	350,000	495,000	690,000
23) Annual Summer KW Saved	4,969	8,483	10,341
Annual Winter KW Saved	94	134	190

Test Results	NPV	B/C
Ratepayer Impact Measure Test	$7,914,462	2.14
Utility Cost Test	$9,040,947	2.56
Societal Test	$19,392,942	3.76
Participant Test	$4,554,952	6.45
Total Resource Cost Test	$9,116,303	2.59

Table 1
Ratepayer Impact Test

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

		Benefits											Costs						Annual
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)	Benefits Less Costs (P)
1	2018	380,602	377,073	757,675		$22,631		$0	5,720		$663,064	$685,695		703,275	$27,138	$88,948	$293,150	$103,485	$512,721	$172,974
2	2019	838,960	910,361	1,749,321		55,349		0	10,385		1,239,970	1,295,319		1,623,725	65,359	108,266	483,295	86,125	743,044	552,275
3	2020	1,411,195	1,653,732	3,064,927		100,254		0	13,289		1,634,281	1,734,535		2,844,875	119,454	143,032	610,147	96,955	969,588	764,947
4	2021	1,428,863	1,653,732	3,082,595		105,795		0	13,741		1,740,572	1,846,367		2,861,275	125,601	109,108	504,910	107,415	847,034	999,333
5	2022	1,446,532	1,653,732	3,100,264		112,104		0	14,193		1,851,761	1,963,865		2,877,675	132,078	109,130	521,697	117,707	880,612	1,083,253
6	2023	1,446,532	1,653,732	3,100,264		117,189		0	14,193		1,907,255	2,024,444		2,877,675	138,025	109,152	495,495	108,285	850,958	1,173,486
7	2024	1,446,532	1,653,732	3,100,264		123,887		0	14,193		1,964,454	2,088,341		2,877,675	144,235	109,175	495,495	109,617	858,523	1,229,818
8	2025	1,446,532	1,653,732	3,100,264		130,272		0	14,193		2,023,497	2,153,769		2,877,675	150,725	109,198	495,495	110,969	866,387	1,287,382
9	2026	1,446,532	1,653,732	3,100,264		135,883		0	14,193		2,084,100	2,219,983		2,877,675	157,502	109,221	495,495	112,340	874,559	1,345,424
10	2027	1,414,211	1,589,091	3,003,302		135,570		0	14,165		2,142,457	2,278,027		2,787,675	159,026	109,245	495,495	113,733	877,499	1,400,528
11	2028	1,153,627	1,416,715	2,570,342		119,495		0	9,017		1,404,758	1,524,253		2,385,800	141,924	42,368	305,845	115,147	605,284	918,969
12	2029	866,460	1,190,472	2,056,932		98,486		0	4,976		798,449	896,935		1,909,250	118,365	29,011	156,670	116,582	420,628	476,307
13	2030	548,910	921,134	1,470,044		72,502		0	2,784		460,111	532,613		1,364,500	88,547	2,275	80,810	118,040	289,672	242,941
14	2031	548,910	921,134	1,470,044		74,678		0	2,784		473,921	548,599		1,364,500	92,531	2,300	80,810	119,519	295,161	253,438
15	2032	548,910	921,134	1,470,044		76,913		0	2,784		488,146	565,059		1,364,500	96,691	2,325	80,810	121,022	300,848	264,211
16	2033	358,219	716,438	1,074,657		57,913		0	408		73,685	131,598		997,500	73,448	0	0	0	73,448	58,150
17	2034	204,697	409,393	614,090		34,088		0	232		43,157	77,245		570,000	43,860	0	0	0	43,860	33,385
18	2035	0	0	0		0		0	0		0	0		0	0	0	0	0	0	0
19	2036	0	0	0		0		0	0		0	0		0	0	0	0	0	0	0
20	2037	0	0	0		0		0	0		0	0		0	0	0	0	0	0	0
Total =				37,885,293					151,250			$22,566,647		35,165,250					$10,309,826	$12,256,821
											NPV =	$14,853,553							$6,939,091	7,914,462

Total NPV = $7,914,462
Benefit/Cost Ratio = 2.14

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 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)
(C = (L) + (M) + (N)
(P = (I) - (O)

Table 2
Utility Test

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

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$22,631	$0	$663,064	$685,695	$485,583	$485,583	$200,112
2019	55,349	0	1,239,970	1,295,319	677,685	677,685	617,634
2020	100,254	0	1,634,281	1,734,535	850,134	850,134	884,401
2021	105,795	0	1,740,572	1,846,367	721,433	721,433	1,124,934
2022	112,104	0	1,851,761	1,963,865	748,534	748,534	1,215,331
2023	117,189	0	1,907,255	2,024,444	712,933	712,933	1,311,511
2024	123,887	0	1,964,454	2,088,341	714,288	714,288	1,374,053
2025	130,272	0	2,023,497	2,153,769	715,662	715,662	1,438,107
2026	135,883	0	2,084,100	2,219,983	717,057	717,057	1,502,926
2027	135,570	0	2,142,457	2,278,027	718,473	718,473	1,559,554
2028	119,495	0	1,404,758	1,524,253	463,360	463,360	1,060,893
2029	98,486	0	798,449	896,935	302,263	302,263	594,672
2030	72,502	0	460,111	532,613	201,125	201,125	331,488
2031	74,678	0	473,921	548,599	202,630	202,630	345,969
2032	76,913	0	488,146	565,059	204,157	204,157	360,902
2033	57,913	0	73,685	131,598	0	0	131,598
2034	34,088	0	43,157	77,245	0	0	77,245
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$22,566,647		$8,435,317	$14,131,330
			NPV =	$14,853,553		$5,812,606	9,040,947

Total NPV = $9,040,947
Benefit/Cost Ratio = 2.56

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**

	Benefits					Costs			
Year	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)	Annual Benefits Less Costs (I)
2018	$22,631	$0	$663,064	$216,824	$902,519	$489,839	$84,330	$574,169	$328,350
2019	55,349	0	1,239,970	421,881	1,717,200	683,023	108,005	791,028	926,172
2020	100,254	0	1,634,281	581,881	2,316,416	857,571	133,788	991,359	1,325,057
2021	105,795	0	1,740,572	637,977	2,484,344	729,205	(31,235)	697,970	1,786,374
2022	112,104	0	1,851,761	698,934	2,662,799	756,656	(46,580)	710,076	1,952,723
2023	117,189	0	1,907,255	742,109	2,766,553	721,421	(68,415)	653,006	2,113,547
2024	123,887	0	1,964,454	788,498	2,876,839	723,158	(68,415)	654,743	2,222,096
2025	130,272	0	2,023,497	837,597	2,991,366	724,931	(68,415)	656,516	2,334,850
2026	135,883	0	2,084,100	889,249	3,109,232	726,742	(68,415)	658,327	2,450,905
2027	135,570	0	2,142,457	939,874	3,217,901	728,595	(68,415)	660,180	2,557,721
2028	119,495	0	1,404,758	647,745	2,171,998	467,326	(68,415)	398,911	1,773,087
2029	98,486	0	798,449	392,596	1,289,531	305,026	(79,325)	225,701	1,063,830
2030	72,502	0	460,111	240,124	772,737	201,125	(79,325)	121,800	650,937
2031	74,678	0	473,921	254,751	803,350	202,630	(79,325)	123,305	680,045
2032	76,913	0	488,146	270,265	835,324	204,157	(79,325)	124,832	710,492
2033	57,913	0	73,685	64,831	196,429	0	0	0	196,429
2034	34,088	0	43,157	39,196	116,441	0	0	0	116,441
2035	0	0	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$31,230,979			$8,041,923	$23,189,056
				NPV =	$26,428,039			$7,035,097	19,392,942

Total NPV = $19,392,942
Benefit/Cost Ratio = 3.76

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**

	Benefits												Costs			Annual
Year	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)	Benefits Less Costs (P)
2018	$293,150			703,275	$52,826	4,969	94			$0	$0	$345,976	$189,696	$0	$189,696	$156,280
2019	483,295			1,623,725	125,668	8,965	228			0	0	608,963	257,329	0	257,329	351,634
2020	610,147			2,844,875	227,191	11,345	418			0	0	837,338	338,890	0	338,890	498,448
2021	504,910			2,861,275	239,421	11,745	418			0	0	744,331	61,101	0	61,101	683,230
2022	521,697			2,877,675	252,293	12,145	418			0	0	773,990	63,165	0	63,165	710,825
2023	495,495			2,877,675	263,639	12,145	418			0	0	759,134	12,495	0	12,495	746,639
2024	495,495			2,877,675	275,502	12,145	418			0	0	770,997	12,512	0	12,512	758,485
2025	495,495			2,877,675	287,896	12,145	418			0	0	783,391	12,529	0	12,529	770,862
2026	495,495			2,877,675	300,855	12,145	418			0	0	796,350	12,546	0	12,546	783,804
2027	495,495			2,787,675	302,259	12,133	406			0	0	797,754	12,564	0	12,564	785,190
2028	305,845			2,385,800	266,317	7,616	364			0	0	572,162	12,582	0	12,582	559,580
2029	156,670			1,909,250	218,397	4,097	307			0	0	375,067	1,690	0	1,690	373,377
2030	80,810			1,364,500	161,185	2,232	232			0	0	241,995	1,708	0	1,708	240,287
2031	80,810			1,364,500	168,435	2,232	232			0	0	249,245	1,727	0	1,727	247,518
2032	80,810			1,364,500	176,017	2,232	232			0	0	256,827	1,745	0	1,745	255,082
2033	0			997,500	129,855	180	180			0	0	129,855	0	0	0	129,855
2034	0			570,000	77,543	103	103			0	0	77,543	0	0	0	77,543
2035	0			0	0	0	0			0	0	0	0	0	0	0
2036	0			0	0	0	0			0	0	0	0	0	0	0
2037	0			0	0	0	0			0	0	0	0	0	0	0
Total =						128,574	5,304					$9,120,918			$992,279	$8,128,639
											NPV =	$5,391,055			$836,103	4,554,952

Total NPV = $4,554,952
Benefit/Cost Ratio = 6.45

Worksheet Calculations

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

Table 5
Total Resource Cost Test

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

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$22,631	$663,064	$685,695	$489,839	$84,330	$574,169	$111,526
2019	55,349	1,239,970	1,295,319	683,023	108,005	791,028	504,291
2020	100,254	1,634,281	1,734,535	857,571	133,788	991,359	743,176
2021	105,795	1,740,572	1,846,367	729,205	(31,235)	697,970	1,148,397
2022	112,104	1,851,761	1,963,865	756,656	(46,580)	710,076	1,253,789
2023	117,189	1,907,255	2,024,444	721,421	(68,415)	653,006	1,371,438
2024	123,887	1,964,454	2,088,341	723,158	(68,415)	654,743	1,433,598
2025	130,272	2,023,497	2,153,769	724,931	(68,415)	656,516	1,497,253
2026	135,883	2,084,100	2,219,983	726,742	(68,415)	658,327	1,561,656
2027	135,570	2,142,457	2,278,027	728,595	(68,415)	660,180	1,617,847
2028	119,495	1,404,758	1,524,253	467,326	(68,415)	398,911	1,125,342
2029	98,486	798,449	896,935	305,026	(79,325)	225,701	671,234
2030	72,502	460,111	532,613	201,125	(79,325)	121,800	410,813
2031	74,678	473,921	548,599	202,630	(79,325)	123,305	425,294
2032	76,913	488,146	565,059	204,157	(79,325)	124,832	440,227
2033	57,913	73,685	131,598	0	0	0	131,598
2034	34,088	43,157	77,245	0	0	0	77,245
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$22,566,647			$8,041,923	$14,524,724
		NPV =	$14,853,553			$5,737,250	9,116,303

Total NPV = $9,116,303
Benefit/Cost Ratio = 2.59

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
NORTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS

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

Input Data

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 = 9.69%

9) Utility Discount Rate = 7.36%

10) Societal Discount Rate = 2.68%

11) General Input Data Year = 2017

12) Project Analysis Year 1 = 2018
Project Analysis Year 2 = 2019
Project Analysis Year 3 = 2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$124,604	$152,831	$182,642
Incentive Costs =	$1,146,376	$1,248,330	$1,360,365
Total Utility Project Costs =	$1,270,980	$1,401,161	$1,543,007
14) Direct Participant Costs ($/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 =	11,544	11,598	11,654
20) Incentive/Participant =			
21) Effective Federal & State Income Tax Rate =			
22) Annual Summer Kwh Saved	1,015,175	1,154,645	1,344,170
Annual Winter Kwh Saved	640,000	740,000	890,000
23) Annual Summer KW Saved	22,014	23,594	25,190
Annual Winter KW Saved	167	197	242

Test Results	NPV	B/C
Ratepayer Impact Measure Test	$14,755,092	1.81
Utility Cost Test	$16,642,279	2.02
Societal Test	$38,630,157	3.03
Participant Test	$11,870,579	6.12
Total Resource Cost Test	$17,363,598	2.12

Table 1
Ratepayer Impact Test

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

		Benefits											Costs						Annual
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)	Benefits Less Costs (P)
1	2018	1,093,699	689,505	1,783,204		$53,263		$0	25,059		$2,525,948	$2,579,211		1,655,175	$69,464	$124,604	$1,206,376	$388,067	$1,788,511	$790,700
2	2019	1,787,648	1,486,743	3,274,391		103,602		0	28,895		2,999,879	3,103,481		3,039,300	133,256	152,831	1,368,330	322,967	1,977,384	1,126,097
3	2020	2,643,198	2,445,585	5,088,783		166,453		0	32,841		3,512,017	3,678,470		4,723,425	216,451	182,642	1,540,365	363,580	2,303,037	1,375,433
4	2021	2,709,455	2,445,585	5,155,040		176,920		0	34,536		3,804,141	3,981,061		4,784,925	229,106	161,755	1,424,729	402,807	2,218,397	1,762,664
5	2022	2,775,712	2,445,585	5,221,297		188,801		0	36,231		4,110,407	4,299,208		4,846,425	242,453	161,838	1,487,680	441,400	2,333,371	1,965,837
6	2023	2,775,712	2,445,585	5,221,297		197,365		0	36,231		4,233,593	4,430,958		4,846,425	253,372	161,923	1,389,423	406,070	2,210,788	2,220,170
7	2024	2,775,712	2,445,585	5,221,297		208,644		0	36,231		4,360,764	4,569,408		4,846,425	264,771	162,008	1,389,423	411,064	2,227,266	2,342,142
8	2025	2,775,712	2,445,585	5,221,297		219,399		0	36,231		4,491,558	4,710,957		4,846,425	276,690	162,095	1,389,423	416,132	2,244,340	2,466,617
9	2026	2,775,712	2,445,585	5,221,297		228,849		0	36,231		4,626,338	4,855,187		4,846,425	289,138	162,182	1,389,423	421,277	2,262,020	2,593,167
10	2027	2,667,977	2,230,115	4,898,092		221,100		0	36,139		4,753,002	4,974,102		4,546,425	283,606	162,270	1,389,423	426,499	2,261,798	2,712,304
11	2028	1,742,884	1,745,308	3,488,192		162,166		0	12,891		1,746,344	1,908,510		3,237,750	211,100	66,625	461,547	431,801	1,171,072	737,438
12	2029	1,217,540	1,152,765	2,370,305		113,491		0	10,863		1,515,715	1,629,206		2,200,125	149,988	37,578	382,293	437,184	1,007,042	622,164
13	2030	638,330	614,090	1,252,420		61,769		0	8,824		1,268,185	1,329,954		1,162,500	82,694	8,532	303,039	442,649	836,913	493,041
14	2031	638,330	614,090	1,252,420		63,623		0	8,824		1,306,217	1,369,840		1,162,500	86,411	8,624	303,039	448,198	846,272	523,568
15	2032	638,330	614,090	1,252,420		65,527		0	8,824		1,345,396	1,410,923		1,162,500	90,301	8,717	303,039	453,833	855,890	555,033
16	2033	204,697	409,393	614,090		33,093		0	232		36,433	69,526		570,000	46,417	0	0	0	46,417	23,109
17	2034	102,348	204,697	307,045		17,044		0	116		18,763	35,807		285,000	24,252	0	0	0	24,252	11,555
18	2035	0	0	0		0		0	0		0	0		0	0	0	0	0	0	0
19	2036	0	0	0		0		0	0		0	0		0	0	0	0	0	0	0
20	2037	0	0	0		0		0	0		0	0		0	0	0	0	0	0	0
Total =				56,842,887					389,199			$48,935,809		52,761,750					$26,614,770	$22,321,039
											NPV =	$32,901,358							$18,146,266	14,755,092

Total NPV = $14,755,092
Benefit/Cost Ratio = 1.81

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 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)
(C = (L) + (M) + (N)
(P = (I) - (O)

Table 2
Utility Test

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

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$53,263	$0	$2,525,948	$2,579,211	$1,719,047	$1,719,047	$860,164
2019	103,602	0	2,999,879	3,103,481	1,844,128	1,844,128	1,259,353
2020	166,453	0	3,512,017	3,678,470	2,086,586	2,086,586	1,591,884
2021	176,920	0	3,804,141	3,981,061	1,989,291	1,989,291	1,991,770
2022	188,801	0	4,110,407	4,299,208	2,090,918	2,090,918	2,208,290
2023	197,365	0	4,233,593	4,430,958	1,957,416	1,957,416	2,473,542
2024	208,644	0	4,360,764	4,569,408	1,962,495	1,962,495	2,606,913
2025	219,399	0	4,491,558	4,710,957	1,967,650	1,967,650	2,743,307
2026	228,849	0	4,626,338	4,855,187	1,972,882	1,972,882	2,882,305
2027	221,100	0	4,753,002	4,974,102	1,978,192	1,978,192	2,995,910
2028	162,166	0	1,746,344	1,908,510	959,972	959,972	948,538
2029	113,491	0	1,515,715	1,629,206	857,054	857,054	772,152
2030	61,769	0	1,268,185	1,329,954	754,219	754,219	575,735
2031	63,623	0	1,306,217	1,369,840	759,861	759,861	609,979
2032	65,527	0	1,345,396	1,410,923	765,589	765,589	645,334
2033	33,093	0	36,433	69,526	0	0	69,526
2034	17,044	0	18,763	35,807	0	0	35,807
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$48,935,809		$23,665,300	$25,270,509
			NPV =	$32,901,358		$16,259,079	16,642,279

Total NPV = $16,642,279
Benefit/Cost Ratio = 2.02

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**

	Benefits					Costs			Annual
Year	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)	Benefits Less Costs (I)
2018	$53,263	$0	$2,525,948	$815,571	$3,394,782	$1,724,249	$279,789	$2,004,038	$1,390,744
2019	103,602	0	2,999,879	1,010,793	4,114,274	1,851,218	263,039	2,114,257	2,000,017
2020	166,453	0	3,512,017	1,234,006	4,912,476	2,095,724	256,356	2,352,080	2,560,396
2021	176,920	0	3,804,141	1,375,582	5,356,643	1,998,840	(92,586)	1,906,254	3,450,389
2022	188,801	0	4,110,407	1,530,075	5,829,283	2,100,897	(150,128)	1,950,769	3,878,514
2023	197,365	0	4,233,593	1,624,274	6,055,232	1,967,844	(232,009)	1,735,835	4,319,397
2024	208,644	0	4,360,764	1,725,277	6,294,685	1,973,392	(232,009)	1,741,383	4,553,302
2025	219,399	0	4,491,558	1,832,083	6,543,040	1,979,038	(232,009)	1,747,029	4,796,011
2026	228,849	0	4,626,338	1,944,820	6,800,007	1,984,782	(232,009)	1,752,773	5,047,234
2027	221,100	0	4,753,002	2,052,227	7,026,329	1,990,627	(232,009)	1,758,618	5,267,711
2028	162,166	0	1,746,344	811,041	2,719,551	964,889	(297,468)	667,421	2,052,130
2029	113,491	0	1,515,715	713,119	2,342,325	859,623	(297,468)	562,155	1,780,170
2030	61,769	0	1,268,185	599,596	1,929,550	754,219	(297,468)	456,751	1,472,799
2031	63,623	0	1,306,217	636,106	2,005,946	759,861	(297,468)	462,393	1,543,553
2032	65,527	0	1,345,396	674,839	2,085,762	765,589	(297,468)	468,121	1,617,641
2033	33,093	0	36,433	34,252	103,778	0	0	0	103,778
2034	17,044	0	18,763	18,169	53,976	0	0	0	53,976
2035	0	0	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$67,567,639			$21,679,877	$45,887,762
				NPV =	$57,619,317			$18,989,160	38,630,157

Total NPV = $38,630,157
Benefit/Cost Ratio = 3.03

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**

	Benefits												Costs			Annual
Year	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)	Benefits Less Costs (P)
2018	$1,206,376			1,655,175	$166,773	22,014	167			$14,434	$0	$1,387,583	$562,866	$0	$562,866	$824,717
2019	1,368,330			3,039,300	316,413	25,215	363			18,828	0	1,703,571	634,420	0	634,420	1,069,151
2020	1,540,365			4,723,425	511,724	28,462	605			23,221	0	2,075,310	727,823	0	727,823	1,347,487
2021	1,424,729			4,784,925	542,008	29,962	605			23,221	0	1,989,958	253,675	0	253,675	1,736,283
2022	1,487,680			4,846,425	573,989	31,462	605			23,221	0	2,084,890	261,415	0	261,415	1,823,475
2023	1,389,423			4,846,425	599,819	31,462	605			23,221	0	2,012,463	71,401	0	71,401	1,941,062
2024	1,389,423			4,846,425	626,797	31,462	605			23,221	0	2,039,441	71,465	0	71,465	1,967,976
2025	1,389,423			4,846,425	655,004	31,462	605			23,221	0	2,067,648	71,530	0	71,530	1,996,118
2026	1,389,423			4,846,425	684,495	31,462	605			23,221	0	2,097,139	71,596	0	71,596	2,025,543
2027	1,389,423			4,546,425	672,803	31,422	565			23,221	0	2,085,447	71,662	0	71,662	2,013,785
2028	461,547			3,237,750	496,734	10,960	450			8,786	0	967,067	6,270	0	6,270	960,797
2029	382,293			2,200,125	353,326	9,310	305			4,393	0	740,012	6,338	0	6,338	733,674
2030	303,039			1,162,500	193,972	7,655	155			0	0	497,011	6,406	0	6,406	490,605
2031	303,039			1,162,500	202,696	7,655	155			0	0	505,735	6,475	0	6,475	499,260
2032	303,039			1,162,500	211,820	7,655	155			0	0	514,859	6,545	0	6,545	508,314
2033	0			570,000	106,548	103	103			0	0	106,548	0	0	0	106,548
2034	0			285,000	55,672	52	52			0	0	55,672	0	0	0	55,672
2035	0			0	0	0	0			0	0	0	0	0	0	0
2036	0			0	0	0	0			0	0	0	0	0	0	0
2037	0			0	0	0	0			0	0	0	0	0	0	0
Total =						337,775	6,705					$22,930,354			$2,829,887	$20,100,467
											NPV =	$14,188,916			$2,318,336	11,870,579

Total NPV = ##########
Benefit/Cost Ratio = 6.12

Worksheet Calculations

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

Table 5
Total Resource Cost Test

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

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$53,263	$2,525,948	$2,579,211	$1,724,249	$279,789	$2,004,038	$575,173
2019	103,602	2,999,879	3,103,481	1,851,218	263,039	2,114,257	989,224
2020	166,453	3,512,017	3,678,470	2,095,724	256,356	2,352,080	1,326,390
2021	176,920	3,804,141	3,981,061	1,998,840	(92,586)	1,906,254	2,074,807
2022	188,801	4,110,407	4,299,208	2,100,897	(150,128)	1,950,769	2,348,439
2023	197,365	4,233,593	4,430,958	1,967,844	(232,009)	1,735,835	2,695,123
2024	208,644	4,360,764	4,569,408	1,973,392	(232,009)	1,741,383	2,828,025
2025	219,399	4,491,558	4,710,957	1,979,038	(232,009)	1,747,029	2,963,928
2026	228,849	4,626,338	4,855,187	1,984,782	(232,009)	1,752,773	3,102,414
2027	221,100	4,753,002	4,974,102	1,990,627	(232,009)	1,758,618	3,215,484
2028	162,166	1,746,344	1,908,510	964,889	(297,468)	667,421	1,241,089
2029	113,491	1,515,715	1,629,206	859,623	(297,468)	562,155	1,067,051
2030	61,769	1,268,185	1,329,954	754,219	(297,468)	456,751	873,203
2031	63,623	1,306,217	1,369,840	759,861	(297,468)	462,393	907,447
2032	65,527	1,345,396	1,410,923	765,589	(297,468)	468,121	942,802
2033	33,093	36,433	69,526	0	0	0	69,526
2034	17,044	18,763	35,807	0	0	0	35,807
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$48,935,809			$21,679,877	$27,255,932
		NPV =	$32,901,358			$15,537,759	17,363,598

Total NPV =	$17,363,598
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**

Input Data

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 = 9.69%

9) Utility Discount Rate = 7.22%

10) Societal Discount Rate = 2.68%

11) General Input Data Year = 2017

12) Project Analysis Year 1 = 2018
Project Analysis Year 2 = 2019
Project Analysis Year 3 = 2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$11,773	$10,773	$14,273
Incentive Costs =	$28,390	$31,420	$38,995
Total Utility Project Costs =	$40,163	$42,193	$53,268
14) Direct Participant Costs ($/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 =	1,104	1,108	1,114
20) Incentive/Participant =			
21) Effective Federal & State Income Tax Rate =			
22) Annual Summer Kwh Saved	84,350	93,973	114,350
Annual Winter Kwh Saved	108,000	127,000	165,000
23) Annual Summer KW Saved	179	187	251
Annual Winter KW Saved	29	34	45

Test Results	NPV	B/C
Ratepayer Impact Measure Test	$164,373	1.18
Utility Cost Test	$513,824	1.89
Societal Test	$1,446,243	3.27
Participant Test	$614,921	4.07
Total Resource Cost Test	$562,529	2.06

Table 1
Ratepayer Impact Test

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

		Benefits											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	2018	90,876	116,354	207,230		$6,189		$0	237		$23,889	$30,078		192,350	$9,619	$11,773	$32,390	$25,871	$79,653	($49,575)
2	2019	190,637	253,177	443,814		14,042		0	426		44,228	58,270		411,950	21,509	10,773	39,420	21,531	93,234	(34,964)
3	2020	312,216	430,941	743,157		24,308		0	698		74,644	98,952		689,800	37,592	14,273	50,995	24,239	127,099	(28,147)
4	2021	316,634	430,941	747,575		25,656		0	811		89,331	114,987		693,900	39,528	1,643	25,936	26,854	93,962	21,025
5	2022	321,051	430,941	751,992		27,192		0	924		104,828	132,020		698,000	41,567	1,649	30,133	29,427	102,776	29,244
6	2023	321,051	430,941	751,992		28,425		0	924		107,970	136,395		698,000	43,437	1,655	23,583	27,071	95,746	40,649
7	2024	321,051	430,941	751,992		30,051		0	924		111,213	141,264		698,000	45,391	1,660	23,583	27,404	98,038	43,226
8	2025	321,051	430,941	751,992		31,598		0	924		114,549	146,147		698,000	47,436	1,666	23,583	27,742	100,427	45,720
9	2026	321,051	430,941	751,992		32,960		0	924		117,985	150,945		698,000	49,571	1,672	23,583	28,085	102,911	48,034
10	2027	310,277	409,394	719,671		32,487		0	914		120,209	152,696		668,000	49,449	1,678	23,583	28,433	103,143	49,553
11	2028	244,289	333,979	578,268		26,885		0	816		110,545	137,430		536,750	41,444	1,120	21,893	28,787	93,243	44,187
12	2029	179,648	258,565	438,213		20,980		0	772		107,716	128,696		406,750	32,721	1,126	21,893	29,146	84,885	43,811
13	2030	124,434	204,697	329,131		16,232		0	681		97,874	114,106		305,500	25,711	569	20,203	29,510	75,992	38,114
14	2031	124,434	204,697	329,131		16,720		0	681		100,808	117,528		305,500	26,869	575	20,203	29,880	77,526	40,002
15	2032	124,434	204,697	329,131		17,221		0	681		103,833	121,054		305,500	28,077	581	20,203	30,256	79,116	41,938
16	2033	81,879	163,757	245,636		13,237		0	94		14,762	27,999		228,000	21,796	0	0	0	21,796	6,203
17	2034	51,174	102,348	153,522		8,522		0	58		9,382	17,904		142,500	14,236	0	0	0	14,236	3,668
18	2035	0	0	0		0		0	0		0	0		0	0	0	0	0	0	0
19	2036	0	0	0		0		0	0		0	0		0	0	0	0	0	0	0
20	2037	0	0	0		0		0	0		0	0		0	0	0	0	0	0	0
Total =				9,024,439					11,489			$1,826,471		8,376,500					$1,443,783	$382,688
											NPV =	$1,091,790							$927,417	164,373

Total NPV = $164,373
Benefit/Cost Ratio = 1.18

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 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)
(C = (L) + (M) + (N)
(P = (I) - (O)

Table 2
Utility Test

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

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$6,189	$0	$23,889	$30,078	$70,034	$70,034	($39,956)
2019	14,042	0	44,228	58,270	71,725	71,725	(13,455)
2020	24,308	0	74,644	98,952	89,507	89,507	9,445
2021	25,656	0	89,331	114,987	54,434	54,434	60,553
2022	27,192	0	104,828	132,020	61,209	61,209	70,811
2023	28,425	0	107,970	136,395	52,309	52,309	84,086
2024	30,051	0	111,213	141,264	52,647	52,647	88,617
2025	31,598	0	114,549	146,147	52,991	52,991	93,156
2026	32,960	0	117,985	150,945	53,340	53,340	97,605
2027	32,487	0	120,209	152,696	53,694	53,694	99,002
2028	26,885	0	110,545	137,430	51,799	51,799	85,631
2029	20,980	0	107,716	128,696	52,164	52,164	76,532
2030	16,232	0	97,874	114,106	50,281	50,281	63,825
2031	16,720	0	100,808	117,528	50,657	50,657	66,871
2032	17,221	0	103,833	121,054	51,039	51,039	70,015
2033	13,237	0	14,762	27,999	0	0	27,999
2034	8,522	0	9,382	17,904	0	0	17,904
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$1,826,471		$867,830	$958,641
			NPV =	$1,091,790		$577,966	513,824

Total NPV =	$513,824
Benefit/Cost Ratio =	1.89

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**

	Benefits					Costs			
Year	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)	Annual Benefits Less Costs (I)
2018	$6,189	$0	$23,889	$9,511	$39,589	$70,096	$25,066	$95,162	($55,573)
2019	14,042	0	44,228	18,979	77,249	71,790	24,249	96,039	(18,790)
2020	24,308	0	74,644	33,195	132,147	89,642	29,469	119,111	13,036
2021	25,656	0	89,331	39,733	154,720	54,575	(10,536)	44,039	110,681
2022	27,192	0	104,828	46,985	179,005	61,356	(14,372)	46,984	132,021
2023	28,425	0	107,970	49,999	186,394	52,463	(19,831)	32,632	153,762
2024	30,051	0	111,213	53,337	194,601	52,808	(19,831)	32,977	161,624
2025	31,598	0	114,549	56,836	202,983	53,159	(19,831)	33,328	169,655
2026	32,960	0	117,985	60,463	211,408	53,516	(19,831)	33,685	177,723
2027	32,487	0	120,209	62,999	215,695	53,878	(19,831)	34,047	181,648
2028	26,885	0	110,545	58,403	195,833	51,895	(19,831)	32,064	163,769
2029	20,980	0	107,716	56,331	185,027	52,264	(19,831)	32,433	152,594
2030	16,232	0	97,874	51,443	165,549	50,281	(19,831)	30,450	135,099
2031	16,720	0	100,808	54,576	172,104	50,657	(19,831)	30,826	141,278
2032	17,221	0	103,833	57,899	178,953	51,039	(19,831)	31,208	147,745
2033	13,237	0	14,762	13,794	41,793	0	0	0	41,793
2034	8,522	0	9,382	9,085	26,989	0	0	0	26,989
2035	0	0	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$2,560,039			$724,985	$1,835,054
				NPV =	$2,083,816			$637,573	1,446,243

Total NPV = $1,446,243
Benefit/Cost Ratio = 3.27

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

	Benefits												Costs			Annual
Year	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)	Benefits Less Costs (P)
2018	$32,390			192,350	$17,941	179	29			$146	$0	$50,477	$56,336	$0	$56,336	($5,859)
2019	39,420			413,200	40,163	314	64			146	0	79,729	63,259	0	63,259	16,470
2020	50,995			692,300	70,052	509	109			292	0	121,339	79,413	0	79,413	41,926
2021	25,936			696,400	73,734	609	109			292	0	99,962	12,548	0	12,548	87,414
2022	30,133			700,500	77,603	709	109			292	0	108,028	13,064	0	13,064	94,964
2023	23,583			700,500	81,101	709	109			292	0	104,976	396	0	396	104,580
2024	23,583			700,500	84,749	709	109			292	0	108,624	400	0	400	108,224
2025	23,583			700,500	88,565	709	109			292	0	112,440	405	0	405	112,035
2026	23,583			700,500	92,546	709	109			292	0	116,421	409	0	409	116,012
2027	23,583			670,500	92,045	705	105			292	0	115,920	414	0	414	115,506
2028	21,893			539,250	76,972	636	86			146	0	99,011	418	0	418	98,593
2029	21,893			408,000	60,353	617	67			146	0	82,392	423	0	423	81,969
2030	20,203			305,500	47,209	552	52			0	0	67,412	427	0	427	66,985
2031	20,203			305,500	49,334	552	52			0	0	69,537	432	0	432	69,105
2032	20,203			305,500	51,553	552	52			0	0	71,756	436	0	436	71,320
2033	0			228,000	39,498	41	41			0	0	39,498	0	0	0	39,498
2034	0			142,500	25,797	26	26			0	0	25,797	0	0	0	25,797
2035	0			0	0	0	0			0	0	0	0	0	0	0
2036	0			0	0	0	0			0	0	0	0	0	0	0
2037	0			0	0	0	0			0	0	0	0	0	0	0
Total =						8,837	1,337					$1,473,319			$228,780	$1,244,539
											NPV =	$815,237			$200,316	614,921

Total NPV = $614,921
Benefit/Cost Ratio = 4.07

Worksheet Calculations

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

Table 5
Total Resource Cost Test

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

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$6,189	$23,889	$30,078	$70,096	$25,066	$95,162	($65,084)
2019	14,042	44,228	58,270	71,790	24,249	96,039	(37,769)
2020	24,308	74,644	98,952	89,642	29,469	119,111	(20,159)
2021	25,656	89,331	114,987	54,575	(10,536)	44,039	70,948
2022	27,192	104,828	132,020	61,356	(14,372)	46,984	85,036
2023	28,425	107,970	136,395	52,463	(19,831)	32,632	103,763
2024	30,051	111,213	141,264	52,808	(19,831)	32,977	108,287
2025	31,598	114,549	146,147	53,159	(19,831)	33,328	112,819
2026	32,960	117,985	150,945	53,516	(19,831)	33,685	117,260
2027	32,487	120,209	152,696	53,878	(19,831)	34,047	118,649
2028	26,885	110,545	137,430	51,895	(19,831)	32,064	105,366
2029	20,980	107,716	128,696	52,264	(19,831)	32,433	96,263
2030	16,232	97,874	114,106	50,281	(19,831)	30,450	83,656
2031	16,720	100,808	117,528	50,657	(19,831)	30,826	86,702
2032	17,221	103,833	121,054	51,039	(19,831)	31,208	89,846
2033	13,237	14,762	27,999	0	0	0	27,999
2034	8,522	9,382	17,904	0	0	0	17,904
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$1,826,471			$724,985	$1,101,486
		NPV =	$1,091,790			$529,261	562,529

Total NPV =	$562,529
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
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS

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

Input Data

1) Retail Rate Summer ($/kWh) =	$0.10241
Retail Rate Winter ($/kWh) =	$0.07909
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.00000
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost ($/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) =	$0.06573
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/kW/yr)	$98.46
Reserve Capacity=	14.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.69%
9) Utility Discount Rate =	7.30%
10) Societal Discount Rate =	2.68%
11) General Input Data Year =	2017
12) Project Analysis Year 1 =	2018
Project Analysis Year 2 =	2019
Project Analysis Year 3 =	2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$1,369	$784	$670
Incentive Costs =	15,000	15,000	15,000
Total Utility Project Costs =	$16,369	$15,784	$15,670
14) Direct Participant Costs ($/Part.) =	$10	$10	$10
Escalation Rate =	1.08%	1.08%	1.08%
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 =	0.004	0.004	0.004
16a) Avg Winter kW/part Saved =	0.004	0.004	0.004
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 =	$5	$5	$5
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	12	12	12

Test Results	NPV	B/C
Ratepayer Impact Measure Test	$6,440	1.05
Utility Cost Test	$95,324	3.13
Societal Test	$147,520	2.63
Participant Test	$131,723	2.57
Total Resource Cost Test	$53,315	1.61

Table 1
Ratepayer Impact Test

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

t	Year	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)	Annual Benefits Less Costs (P)
																Costs					
1	2018	96,962	$0.02987	$2,896	$0.00000	$0	14	14	28	$115.92	$3,246	$6,142	$0.06869	30,000	60,000	90,000	$3,747	$1,369	$15,000	$20,116	($13,974)
2	2019	193,923	0.03164	6,136	0.00000	0	27	27	54	119.40	6,448	12,584	0.07178	60,000	120,000	180,000	7,831	784	15,000	23,615	(11,031)
3	2020	290,885	0.03271	9,515	0.00000	0	41	41	82	122.98	10,084	19,599	0.07501	90,000	180,000	270,000	12,276	670	15,000	27,946	(8,347)
4	2021	290,885	0.03432	9,983	0.00000	0	41	41	82	126.67	10,387	20,370	0.07838	90,000	180,000	270,000	12,827	0	0	12,827	7,543
5	2022	290,885	0.03616	10,518	0.00000	0	41	41	82	130.47	10,699	21,217	0.08191	90,000	180,000	270,000	13,405	0	0	13,405	7,812
6	2023	290,885	0.03780	10,995	0.00000	0	41	41	82	134.38	11,019	22,014	0.08560	90,000	180,000	270,000	14,009	0	0	14,009	8,005
7	2024	290,885	0.03996	11,624	0.00000	0	41	41	82	138.41	11,350	22,974	0.08945	90,000	180,000	270,000	14,639	0	0	14,639	8,335
8	2025	290,885	0.04202	12,223	0.00000	0	41	41	82	142.57	11,691	23,914	0.09347	90,000	180,000	270,000	15,297	0	0	15,297	8,617
9	2026	290,885	0.04383	12,749	0.00000	0	41	41	82	146.84	12,041	24,790	0.09768	90,000	180,000	270,000	15,986	0	0	15,986	8,804
10	2027	193,923	0.04514	8,754	0.00000	0	27	27	54	151.25	8,168	16,922	0.10208	60,000	120,000	180,000	11,137	0	0	11,137	5,785
11	2028	96,962	0.04649	4,508	0.00000	0	14	14	28	155.79	4,362	8,870	0.10667	30,000	60,000	90,000	5,819	0	0	5,819	3,051
12	2029	0	0.04788	0	0.00000	0	0	0	0	160.46	0	0	0.11147	0	0	0	0	0	0	0	0
13	2030	0	0.04932	0	0.00000	0	0	0	0	165.27	0	0	0.11649	0	0	0	0	0	0	0	0
14	2031	0	0.05080	0	0.00000	0	0	0	0	170.23	0	0	0.12173	0	0	0	0	0	0	0	0
15	2032	0	0.05232	0	0.00000	0	0	0	0	175.34	0	0	0.12721	0	0	0	0	0	0	0	0
16	2033	0	0.05389	0	0.00000	0	0	0	0	180.60	0	0	0.13293	0	0	0	0	0	0	0	0
17	2034	0	0.05551	0	0.00000	0	0	0	0	186.02	0	0	0.13891	0	0	0	0	0	0	0	0
18	2035	0	0.05718	0	0.00000	0	0	0	0	191.60	0	0	0.14516	0	0	0	0	0	0	0	0
19	2036	0	0.05890	0	0.00000	0	0	0	0	197.35	0	0	0.15170	0	0	0	0	0	0	0	0
20	2037	0	0.06067	0	0.00000	0	0	0	0	203.27	0	0	0.15852	0	0	0	0	0	0	0	0
	Total =	2,617,965							738			$199,396				2,430,000				$174,796	$24,600
											NPV =	$140,015								$133,575	6,440

Total NPV = $6,440
Benefit/Cost Ratio = 1.05

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

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$2,896	$0	$3,246	$6,142	$16,369	$16,369	($10,227)
2019	6,136	0	6,448	12,584	15,784	15,784	(3,200)
2020	9,515	0	10,084	19,599	15,670	15,670	3,929
2021	9,983	0	10,387	20,370	0	0	20,370
2022	10,518	0	10,699	21,217	0	0	21,217
2023	10,995	0	11,019	22,014	0	0	22,014
2024	11,624	0	11,350	22,974	0	0	22,974
2025	12,223	0	11,691	23,914	0	0	23,914
2026	12,749	0	12,041	24,790	0	0	24,790
2027	8,754	0	8,168	16,922	0	0	16,922
2028	4,508	0	4,362	8,870	0	0	8,870
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$199,396		$47,823	$151,573
			NPV =	$140,015		$44,691	95,324

Total NPV = $95,324
Benefit/Cost Ratio = 3.13

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

	Benefits					Costs			Annual
Year	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)	Benefits Less Costs (I)
2018	$2,896	$0	$3,246	$1,942	$8,084	$16,369	$15,000	$31,369	($23,285)
2019	6,136	0	6,448	4,099	16,683	15,784	15,000	30,784	(14,101)
2020	9,515	0	10,084	6,575	26,174	15,670	15,000	30,670	(4,496)
2021	9,983	0	10,387	7,038	27,408	0	0	0	27,408
2022	10,518	0	10,699	7,551	28,768	0	0	0	28,768
2023	10,995	0	11,019	8,070	30,084	0	0	0	30,084
2024	11,624	0	11,350	8,674	31,648	0	0	0	31,648
2025	12,223	0	11,691	9,300	33,214	0	0	0	33,214
2026	12,749	0	12,041	9,930	34,720	0	0	0	34,720
2027	8,754	0	8,168	6,982	23,904	0	0	0	23,904
2028	4,508	0	4,362	3,769	12,639	0	0	0	12,639
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
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$273,326			$92,823	$180,503
				NPV =	$237,959			$90,439	147,520

Total NPV = $147,520
Benefit/Cost Ratio = 2.63

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**

	Benefits														Costs			Annual
Year	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)	Benefits Less Costs (P)
2018	$15,000	$0.10702	$0.08265	30,000	60,000	90,000	$8,170	12	12	$0.000	$0.000	$0	$0	$23,170	$30,324	$0	$30,324	($7,154)
2019	15,000	0.11183	0.08637	60,000	120,000	180,000	17,074	24	24	0.000	0.000	0	0	32,074	30,651	0	30,651	1,423
2020	15,000	0.11687	0.09025	90,000	180,000	270,000	26,763	36	36	0.000	0.000	0	0	41,763	30,983	0	30,983	10,780
2021	0	0.12213	0.09432	90,000	180,000	270,000	27,969	36	36	0.000	0.000	0	0	27,969	0	0	0	27,969
2022	0	0.12762	0.09856	90,000	180,000	270,000	29,227	36	36	0.000	0.000	0	0	29,227	0	0	0	29,227
2023	0	0.13336	0.10300	90,000	180,000	270,000	30,542	36	36	0.000	0.000	0	0	30,542	0	0	0	30,542
2024	0	0.13937	0.10763	90,000	180,000	270,000	31,917	36	36	0.000	0.000	0	0	31,917	0	0	0	31,917
2025	0	0.14564	0.11247	90,000	180,000	270,000	33,352	36	36	0.000	0.000	0	0	33,352	0	0	0	33,352
2026	0	0.15219	0.11754	90,000	180,000	270,000	34,854	36	36	0.000	0.000	0	0	34,854	0	0	0	34,854
2027	0	0.15904	0.12282	60,000	120,000	180,000	24,281	24	24	0.000	0.000	0	0	24,281	0	0	0	24,281
2028	0	0.16620	0.12835	30,000	60,000	90,000	12,687	12	12	0.000	0.000	0	0	12,687	0	0	0	12,687
2029	0	0.17368	0.13413	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2030	0	0.18149	0.14016	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2031	0	0.18966	0.14647	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2032	0	0.19819	0.15306	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.20711	0.15995	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.21643	0.16715	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.22617	0.17467	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.23635	0.18253	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.24698	0.19074	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				810,000	1,620,000			324	324					$321,836			$91,958	$229,878
													NPV =	$215,741			$84,018	131,723

Total NPV = $131,723
Benefit/Cost Ratio = 2.57

Worksheet Calculations

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

Table 5
Total Resource Cost Test

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

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$2,896	$3,246	$6,142	$16,369	$15,000	$31,369	($25,227)
2019	6,136	6,448	12,584	15,784	15,000	30,784	(18,200)
2020	9,515	10,084	19,599	15,670	15,000	30,670	(11,071)
2021	9,983	10,387	20,370	0	0	0	20,370
2022	10,518	10,699	21,217	0	0	0	21,217
2023	10,995	11,019	22,014	0	0	0	22,014
2024	11,624	11,350	22,974	0	0	0	22,974
2025	12,223	11,691	23,914	0	0	0	23,914
2026	12,749	12,041	24,790	0	0	0	24,790
2027	8,754	8,168	16,922	0	0	0	16,922
2028	4,508	4,362	8,870	0	0	0	8,870
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$199,396			$92,823	$106,573
		NPV =	$140,015			$86,700	53,315

Total NPV = $53,315
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 Lighting**
Program Years: **2016 - 2018**

Input Data

1) Retail Rate Summer ($/kWh) =	$0.09894
Retail Rate Winter ($/kWh) =	$0.08728
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.00000
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost ($/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) =	$0.06564
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/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 =	9.69%
9) Utility Discount Rate =	7.36%
10) Societal Discount Rate =	2.68%
11) General Input Data Year =	2017
12) Project Analysis Year 1 =	2018
Project Analysis Year 2 =	2019
Project Analysis Year 3 =	2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$2,770	$2,063	$1,882
Incentive Costs =	50,000	50,000	50,000
Total Utility Project Costs =	$52,770	$52,063	$51,882
14) Direct Participant Costs ($/Part.) =	$10	$10	$10
Escalation Rate =	1.08%	1.08%	1.08%
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 =	0.004	0.004	0.004
16a) Avg Winter kW/part Saved =	0.004	0.004	0.004
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 =	10,000	10,000	10,000
20) Incentive/Participant =	$5	$5	$5
21) Effective Federal & State Income Tax Rate =			39.39%
22) Annual Summer Kwh Saved	100,000	100,000	100,000
Annual Winter Kwh Saved	200,000	200,000	200,000
23) Annual Summer KW Saved	40	40	40
Annual Winter KW Saved	40	40	40

Test Results	NPV	B/C
Ratepayer Impact Measure Test	($7,360)	0.98
Utility Cost Test	$288,518	2.97
Societal Test	$440,463	2.47
Participant Test	$467,908	2.67
Total Resource Cost Test	$148,486	1.52

Table 1
Ratepayer Impact Test

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

t	Year	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2018	323,205	$0.02987	$9,654	$0.00000	$0	45	45	90	$100.80	$9,072	$18,726	$0.06859	100,000	200,000	300,000	$12,472	$2,770	$50,000	$65,242	($46,516)
2	2019	646,410	0.03164	20,452	0.00000	0	90	90	180	103.82	18,688	39,140	0.07168	200,000	400,000	600,000	26,068	2,063	50,000	78,131	(38,991)
3	2020	969,615	0.03271	31,716	0.00000	0	136	136	272	106.94	29,088	60,804	0.07491	300,000	600,000	900,000	40,864	1,882	50,000	92,746	(31,942)
4	2021	969,615	0.03432	33,277	0.00000	0	136	136	272	110.15	29,961	63,238	0.07828	300,000	600,000	900,000	42,703	0	0	42,703	20,535
5	2022	969,615	0.03616	35,061	0.00000	0	136	136	272	113.45	30,858	65,919	0.08180	300,000	600,000	900,000	44,623	0	0	44,623	21,296
6	2023	969,615	0.03780	36,651	0.00000	0	136	136	272	116.85	31,783	68,434	0.08548	300,000	600,000	900,000	46,630	0	0	46,630	21,804
7	2024	969,615	0.03996	38,746	0.00000	0	136	136	272	120.36	32,738	71,484	0.08933	300,000	600,000	900,000	48,731	0	0	48,731	22,753
8	2025	969,615	0.04202	40,743	0.00000	0	136	136	272	123.97	33,720	74,463	0.09335	300,000	600,000	900,000	50,924	0	0	50,924	23,539
9	2026	969,615	0.04383	42,498	0.00000	0	136	136	272	127.69	34,732	77,230	0.09755	300,000	600,000	900,000	53,215	0	0	53,215	24,015
10	2027	646,410	0.04514	29,179	0.00000	0	90	90	180	131.52	23,674	52,853	0.10194	200,000	400,000	600,000	37,073	0	0	37,073	15,780
11	2028	323,205	0.04649	15,026	0.00000	0	45	45	90	135.47	12,192	27,218	0.10652	100,000	200,000	300,000	19,369	0	0	19,369	7,849
12	2029	0	0.04788	0	0.00000	0	0	0	0	139.53	0	0	0.11132	0	0	0	0	0	0	0	0
13	2030	0	0.04932	0	0.00000	0	0	0	0	143.72	0	0	0.11633	0	0	0	0	0	0	0	0
14	2031	0	0.05080	0	0.00000	0	0	0	0	148.03	0	0	0.12156	0	0	0	0	0	0	0	0
15	2032	0	0.05232	0	0.00000	0	0	0	0	152.47	0	0	0.12703	0	0	0	0	0	0	0	0
16	2033	0	0.05389	0	0.00000	0	0	0	0	157.04	0	0	0.13275	0	0	0	0	0	0	0	0
17	2034	0	0.05551	0	0.00000	0	0	0	0	161.75	0	0	0.13872	0	0	0	0	0	0	0	0
18	2035	0	0.05718	0	0.00000	0	0	0	0	166.61	0	0	0.14496	0	0	0	0	0	0	0	0
19	2036	0	0.05890	0	0.00000	0	0	0	0	171.60	0	0	0.15149	0	0	0	0	0	0	0	0
20	2037	0	0.06067	0	0.00000	0	0	0	0	176.75	0	0	0.15830	0	0	0	0	0	0	0	0
Total =		8,726,535							2,444			$619,509				8,100,000				$579,387	$40,122
											NPV =	$434,877								$442,237	(7,360)

Total NPV = ($7,360)
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
(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 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: **Residential Lighting**
Program Years: **2016 - 2018**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$9,654	$0	$9,072	$18,726	$52,770	$52,770	($34,044)
2019	20,452	0	18,688	39,140	52,063	52,063	(12,923)
2020	31,716	0	29,088	60,804	51,882	51,882	8,922
2021	33,277	0	29,961	63,238	0	0	63,238
2022	35,061	0	30,858	65,919	0	0	65,919
2023	36,651	0	31,783	68,434	0	0	68,434
2024	38,746	0	32,738	71,484	0	0	71,484
2025	40,743	0	33,720	74,463	0	0	74,463
2026	42,498	0	34,732	77,230	0	0	77,230
2027	29,179	0	23,674	52,853	0	0	52,853
2028	15,026	0	12,192	27,218	0	0	27,218
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$619,509		$156,715	$462,794
			NPV =	$434,877		$146,359	288,518

Total NPV = $288,518
Benefit/Cost Ratio = 2.97

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**

	Benefits					Costs			Annual
Year	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)	Benefits Less Costs (I)
2018	$9,654	$0	$9,072	$5,921	$24,647	$52,770	$50,000	$102,770	($78,123)
2019	20,452	0	18,688	12,748	51,888	52,063	50,000	102,063	(50,175)
2020	31,716	0	29,088	20,398	81,202	51,882	50,000	101,882	(20,680)
2021	33,277	0	29,961	21,851	85,089	0	0	0	85,089
2022	35,061	0	30,858	23,460	89,379	0	0	0	89,379
2023	36,651	0	31,783	25,086	93,520	0	0	0	93,520
2024	38,746	0	32,738	26,990	98,474	0	0	0	98,474
2025	40,743	0	33,720	28,959	103,422	0	0	0	103,422
2026	42,498	0	34,732	30,936	108,166	0	0	0	108,166
2027	29,179	0	23,674	21,806	74,659	0	0	0	74,659
2028	15,026	0	12,192	11,567	38,785	0	0	0	38,785
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
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$849,231			$306,715	$542,516
				NPV =	$739,265			$298,802	440,463

Total NPV = $440,463
Benefit/Cost Ratio = 2.47

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**

	Benefits													Costs			Annual
Year	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)	Benefits Less Costs (P)
2018	$50,000	$0.10339	$0.09121	100,000	200,000	300,000	$28,581	40	40	$0.000	$0.000	$0	$0	$78,581	$101,080	$0	$101,080	($22,499)
2019	50,000	0.10804	0.09531	200,000	400,000	600,000	59,732	80	80	0.000	0.000	0	0	109,732	102,172	0	102,172	7,560
2020	50,000	0.11291	0.09960	300,000	600,000	900,000	93,633	120	120	0.000	0.000	0	0	143,633	103,275	0	103,275	40,358
2021	0	0.11799	0.10408	300,000	600,000	900,000	97,845	120	120	0.000	0.000	0	0	97,845	0	0	0	97,845
2022	0	0.12330	0.10877	300,000	600,000	900,000	102,252	120	120	0.000	0.000	0	0	102,252	0	0	0	102,252
2023	0	0.12885	0.11366	300,000	600,000	900,000	106,851	120	120	0.000	0.000	0	0	106,851	0	0	0	106,851
2024	0	0.13464	0.11878	300,000	600,000	900,000	111,660	120	120	0.000	0.000	0	0	111,660	0	0	0	111,660
2025	0	0.14070	0.12412	300,000	600,000	900,000	116,682	120	120	0.000	0.000	0	0	116,682	0	0	0	116,682
2026	0	0.14703	0.12971	300,000	600,000	900,000	121,935	120	120	0.000	0.000	0	0	121,935	0	0	0	121,935
2027	0	0.15365	0.13554	200,000	400,000	600,000	84,946	80	80	0.000	0.000	0	0	84,946	0	0	0	84,946
2028	0	0.16057	0.14164	100,000	200,000	300,000	44,385	40	40	0.000	0.000	0	0	44,385	0	0	0	44,385
2029	0	0.16779	0.14802	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2030	0	0.17534	0.15468	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2031	0	0.18323	0.16164	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2032	0	0.19148	0.16891	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.20009	0.17651	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.20910	0.18446	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.21851	0.19276	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.22834	0.20143	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.23861	0.21049	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				2,700,000	5,400,000			1,080	1,080					$1,118,502			$306,527	$811,975
													NPV =	$747,968			$280,060	467,908

Total NPV = $467,908
Benefit/Cost Ratio = 2.67

Worksheet Calculations

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

Table 5
Total Resource Cost Test

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

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$9,654	$9,072	$18,726	$52,770	$50,000	$102,770	($84,044)
2019	20,452	18,688	39,140	52,063	50,000	102,063	(62,923)
2020	31,716	29,088	60,804	51,882	50,000	101,882	(41,078)
2021	33,277	29,961	63,238	0	0	0	63,238
2022	35,061	30,858	65,919	0	0	0	65,919
2023	36,651	31,783	68,434	0	0	0	68,434
2024	38,746	32,738	71,484	0	0	0	71,484
2025	40,743	33,720	74,463	0	0	0	74,463
2026	42,498	34,732	77,230	0	0	0	77,230
2027	29,179	23,674	52,853	0	0	0	52,853
2028	15,026	12,192	27,218	0	0	0	27,218
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$619,509			$306,715	$312,794
		NPV =	$434,877			$286,390	148,486

Total NPV = $148,486
Benefit/Cost Ratio = 1.52

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

Input Data

1) Retail Rate Summer ($/kWh) =	$0.10859
Retail Rate Winter ($/kWh) =	$0.09604
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.00000
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost ($/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) =	$0.08337
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/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 =	9.69%
9) Utility Discount Rate =	7.22%
10) Societal Discount Rate =	2.68%
11) General Input Data Year =	2017
12) Project Analysis Year 1 =	2018
Project Analysis Year 2 =	2019
Project Analysis Year 3 =	2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$1,898	$1,153	$942
Incentive Costs =	5,000	5,000	5,000
Total Utility Project Costs =	$6,898	$6,153	$5,942
14) Direct Participant Costs ($/Part.) =	$10	$10	$10
Escalation Rate =	1.08%	1.08%	1.08%
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 =	0.004	0.004	0.004
16a) Avg Winter kW/part Saved =	0.004	0.004	0.004
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 =	1,000	1,000	1,000
20) Incentive/Participant =	$5	$5	$5
21) Effective Federal & State Income Tax Rate =			39.39%
22) Annual Summer Kwh Saved	10,000	10,000	10,000
Annual Winter Kwh Saved	20,000	20,000	20,000
23) Annual Summer KW Saved	4	4	4
Annual Winter KW Saved	4	4	4

Test Results	NPV	B/C
Ratepayer Impact Measure Test	($11,256)	0.80
Utility Cost Test	$26,323	2.48
Societal Test	$41,853	2.26
Participant Test	$52,860	2.89
Total Resource Cost Test	$12,320	1.39

Table 1
Ratepayer Impact Test

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

t	Year	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2018	32,321	$0.02987	$965	$0.00000	$0	5	5	10	$100.80	$1,008	$1,973	$0.08712	10,000	20,000	30,000	$1,584	$1,898	$5,000	$8,482	($6,509)
2	2019	64,641	0.03164	2,045	0.00000	0	9	9	18	103.82	1,869	3,914	0.09104	20,000	40,000	60,000	3,311	1,153	5,000	9,464	(5,550)
3	2020	96,962	0.03271	3,172	0.00000	0	14	14	28	106.94	2,994	6,166	0.09514	30,000	60,000	90,000	5,190	942	5,000	11,132	(4,966)
4	2021	96,962	0.03432	3,328	0.00000	0	14	14	28	110.15	3,084	6,412	0.09942	30,000	60,000	90,000	5,423	0	0	5,423	989
5	2022	96,962	0.03616	3,506	0.00000	0	14	14	28	113.45	3,177	6,683	0.10389	30,000	60,000	90,000	5,667	0	0	5,667	1,016
6	2023	96,962	0.03780	3,665	0.00000	0	14	14	28	116.85	3,272	6,937	0.10857	30,000	60,000	90,000	5,923	0	0	5,923	1,014
7	2024	96,962	0.03996	3,875	0.00000	0	14	14	28	120.36	3,370	7,245	0.11346	30,000	60,000	90,000	6,189	0	0	6,189	1,056
8	2025	96,962	0.04202	4,074	0.00000	0	14	14	28	123.97	3,471	7,545	0.11856	30,000	60,000	90,000	6,468	0	0	6,468	1,077
9	2026	96,962	0.04383	4,250	0.00000	0	14	14	28	127.69	3,575	7,825	0.12390	30,000	60,000	90,000	6,759	0	0	6,759	1,066
10	2027	64,641	0.04514	2,918	0.00000	0	9	9	18	131.52	2,367	5,285	0.12947	20,000	40,000	60,000	4,709	0	0	4,709	576
11	2028	32,321	0.04649	1,503	0.00000	0	5	5	10	135.47	1,355	2,858	0.13530	10,000	20,000	30,000	2,460	0	0	2,460	398
12	2029	0	0.04788	0	0.00000	0	0	0	0	139.53	0	0	0.14139	0	0	0	0	0	0	0	0
13	2030	0	0.04932	0	0.00000	0	0	0	0	143.72	0	0	0.14775	0	0	0	0	0	0	0	0
14	2031	0	0.05080	0	0.00000	0	0	0	0	148.03	0	0	0.15440	0	0	0	0	0	0	0	0
15	2032	0	0.05232	0	0.00000	0	0	0	0	152.47	0	0	0.16134	0	0	0	0	0	0	0	0
16	2033	0	0.05389	0	0.00000	0	0	0	0	157.04	0	0	0.16860	0	0	0	0	0	0	0	0
17	2034	0	0.05551	0	0.00000	0	0	0	0	161.75	0	0	0.17619	0	0	0	0	0	0	0	0
18	2035	0	0.05718	0	0.00000	0	0	0	0	166.61	0	0	0.18412	0	0	0	0	0	0	0	0
19	2036	0	0.05890	0	0.00000	0	0	0	0	171.60	0	0	0.19241	0	0	0	0	0	0	0	0
20	2037	0	0.06067	0	0.00000	0	0	0	0	203.27	0	0	0.20106	0	0	0	0	0	0	0	0
Total =		872,658							252			$62,843				810,000				$72,676	($9,833)
											NPV =	$44,117								$55,373	(11,256)

Total NPV = ($11,256)
Benefit/Cost Ratio = 0.80

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

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$965	$0	$1,008	$1,973	$6,898	$6,898	($4,925)
2019	2,045	0	1,869	3,914	6,153	6,153	(2,239)
2020	3,172	0	2,994	6,166	5,942	5,942	224
2021	3,328	0	3,084	6,412	0	0	6,412
2022	3,506	0	3,177	6,683	0	0	6,683
2023	3,665	0	3,272	6,937	0	0	6,937
2024	3,875	0	3,370	7,245	0	0	7,245
2025	4,074	0	3,471	7,545	0	0	7,545
2026	4,250	0	3,575	7,825	0	0	7,825
2027	2,918	0	2,367	5,285	0	0	5,285
2028	1,503	0	1,355	2,858	0	0	2,858
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$62,843		$18,993	$43,850
			NPV =	$44,117		$17,794	26,323

Total NPV =	$26,323
Benefit/Cost Ratio =	2.48

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**

	Benefits					Costs			
Year	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)	Annual Benefits Less Costs (I)
2018	$965	$0	$1,008	$624	$2,597	$6,898	$5,000	$11,898	($9,301)
2019	2,045	0	1,869	1,275	5,189	6,153	5,000	11,153	(5,964)
2020	3,172	0	2,994	2,068	8,234	5,942	5,000	10,942	(2,708)
2021	3,328	0	3,084	2,216	8,628	0	0	0	8,628
2022	3,506	0	3,177	2,378	9,061	0	0	0	9,061
2023	3,665	0	3,272	2,543	9,480	0	0	0	9,480
2024	3,875	0	3,370	2,736	9,981	0	0	0	9,981
2025	4,074	0	3,471	2,934	10,479	0	0	0	10,479
2026	4,250	0	3,575	3,134	10,959	0	0	0	10,959
2027	2,918	0	2,367	2,180	7,465	0	0	0	7,465
2028	1,503	0	1,355	1,215	4,073	0	0	0	4,073
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
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$86,146			$33,993	$52,153
				NPV =	$74,991			$33,138	41,853

Total NPV = $41,853
Benefit/Cost Ratio = 2.26

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**

	Benefits													Costs			Annual
Year	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)	Benefits Less Costs (P)
2018	$5,000	$0.11348	$0.10036	10,000	20,000	30,000	$3,142	4	4	$0.000	$0.000	$0	$0	$8,142	$10,108	$0	$10,108	($1,966)
2019	5,000	0.11858	0.10488	20,000	40,000	60,000	6,567	8	8	0.000	0.000	0	0	11,567	10,217	0	10,217	1,350
2020	5,000	0.12392	0.10960	30,000	60,000	90,000	10,294	12	12	0.000	0.000	0	0	15,294	10,328	0	10,328	4,966
2021	0	0.12950	0.11453	30,000	60,000	90,000	10,757	12	12	0.000	0.000	0	0	10,757	0	0	0	10,757
2022	0	0.13532	0.11968	30,000	60,000	90,000	11,240	12	12	0.000	0.000	0	0	11,240	0	0	0	11,240
2023	0	0.14141	0.12507	30,000	60,000	90,000	11,747	12	12	0.000	0.000	0	0	11,747	0	0	0	11,747
2024	0	0.14778	0.13070	30,000	60,000	90,000	12,275	12	12	0.000	0.000	0	0	12,275	0	0	0	12,275
2025	0	0.15443	0.13658	30,000	60,000	90,000	12,828	12	12	0.000	0.000	0	0	12,828	0	0	0	12,828
2026	0	0.16138	0.14272	30,000	60,000	90,000	13,405	12	12	0.000	0.000	0	0	13,405	0	0	0	13,405
2027	0	0.16864	0.14915	20,000	40,000	60,000	9,339	8	8	0.000	0.000	0	0	9,339	0	0	0	9,339
2028	0	0.17623	0.15586	10,000	20,000	30,000	4,880	4	4	0.000	0.000	0	0	4,880	0	0	0	4,880
2029	0	0.18416	0.16287	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2030	0	0.19244	0.17020	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2031	0	0.20110	0.17786	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2032	0	0.21015	0.18586	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.21961	0.19423	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.22949	0.20297	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.23982	0.21210	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.25061	0.22165	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.26189	0.23162	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				270,000	540,000			108	108					$121,474			$30,653	$90,821
													NPV =	$80,866			$28,006	52,860

Total NPV = $52,860
Benefit/Cost Ratio = 2.89

Worksheet Calculations

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

Table 5
Total Resource Cost Test

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

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$965	$1,008	$1,973	$6,898	$5,000	$11,898	($9,925)
2019	2,045	1,869	3,914	6,153	5,000	11,153	(7,239)
2020	3,172	2,994	6,166	5,942	5,000	10,942	(4,776)
2021	3,328	3,084	6,412	0	0	0	6,412
2022	3,506	3,177	6,683	0	0	0	6,683
2023	3,665	3,272	6,937	0	0	0	6,937
2024	3,875	3,370	7,245	0	0	0	7,245
2025	4,074	3,471	7,545	0	0	0	7,545
2026	4,250	3,575	7,825	0	0	0	7,825
2027	2,918	2,367	5,285	0	0	0	5,285
2028	1,503	1,355	2,858	0	0	0	2,858
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$62,843			$33,993	$28,850
		NPV =	$44,117			$31,797	12,320

Total NPV = $12,320
Benefit/Cost Ratio = 1.39

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: **Air Conditioning Cycling Program**
Program Years: **2018-2022**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.10241
Retail Rate Winter ($/kWh) =	$0.07909
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.00000
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost ($/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) =	$0.06573
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/kW/yr)	$98.46
Reserve Capacity=	14.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.69%
9) Utility Discount Rate =	7.30%
10) Societal Discount Rate =	2.68%
11) General Input Data Year =	2017
12) Project Analysis Year 1 =	2018
Project Analysis Year 2 =	2019
Project Analysis Year 3 =	2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$2,000	$2,022	$2,043
Incentive Costs =	24,000	24,720	25,462
Direct Program Costs =	119,485	118,125	144,954
Total Utility Project Costs =	$145,485	$144,866	$172,460
14) Direct Participant Costs ($/Part.) =	$110	$110	$110
Escalation Rate =	1.08%	1.08%	1.08%
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 =	1.000	1.000	1.000
16a) Avg Winter kW/part Saved =	0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =	41	41	41
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 =	400	412	424
20) Incentive/Participant =	$60	$60	$60
21) Effective Federal & State Income Tax Rate =			39.39%
22) Annual Summer Kwh Saved	16,400	16,892	17,399
Annual Winter Kwh Saved	0	0	0
23) Annual Summer KW Saved	400	412	424
Annual Winter KW Saved	0	0	0

Test Results	**NPV**	**B/C**
Ratepayer Impact Measure Test	$695,309	1.38
Utility Cost Test	$731,503	1.41
Societal Test	$3,317,412	3.03
Participant Test	$513,768	3.47
Total Resource Cost Test	$1,253,567	1.99

Table 1
Ratepayer Impact Test

Project: **Air Conditioning Cycling Program**
Program Years: **2018-2022**

t	Year	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Direct Program Costs (O)	Costs: Total Project Costs (P)	Annual Benefits Less Costs (Q)
1	2018	17,669	$0.02987	$528	$0.00000	$0	452	0	452	115.92	52396	$52,924	0.06869	16,400	0	16,400	$683	$2,000	$40,000	$103,485	$146,168	($93,244)
2	2019	35,337	$0.03164	1,118	0.00000	0	904	0	904	$119.40	$107,938	$109,056	$0.07178	32,800	0	32,800	$1,427	2,022	56,720	86,125	146,293	($37,237)
3	2020	53,006	$0.03271	1,734	0.00000	0	1,356	0	1,356	$122.98	166,761	168,495	0.07501	49,200	0	49,200	$2,237	2,043	73,462	96,955	174,697	($6,202)
4	2021	70,674	$0.03432	2,426	0.00000	0	1,808	0	1,808	$126.67	229,019	231,445	0.07838	65,600	0	65,600	$3,117	2,066	90,225	107,415	202,823	$28,622
5	2022	88,343	$0.03616	3,194	0.00000	0	2,260	0	2,260	$130.47	294,862	298,056	0.08191	82,000	0	82,000	$4,071	2,088	107,012	117,707	230,878	$67,178
6	2023	88,343	$0.03780	3,339	0.00000	0	2,260	0	2,260	$134.38	303,699	307,038	0.08560	82,000	0	82,000	$4,255	2,110	80,810	108,285	195,461	$111,577
7	2024	88,343	$0.03996	3,530	0.00000	0	2,260	0	2,260	$138.41	312,807	316,337	0.08945	82,000	0	82,000	$4,446	2,133	80,810	109,617	197,007	$119,330
8	2025	88,343	$0.04202	3,712	0.00000	0	2,260	0	2,260	$142.57	322,208	325,920	0.09347	82,000	0	82,000	$4,646	2,156	80,810	110,969	198,581	$127,339
9	2026	88,343	$0.04383	3,872	0.00000	0	2,260	0	2,260	$146.84	331,858	335,730	0.09768	82,000	0	82,000	$4,855	2,179	80,810	112,340	200,185	$135,545
10	2027	88,343	$0.04514	3,988	0.00000	0	2,260	0	2,260	$151.25	341,825	345,813	0.10208	82,000	0	82,000	$5,074	2,203	80,810	113,733	201,820	$143,993
11	2028	88,343	$0.04649	4,107	0.00000	0	2,260	0	2,260	$155.79	352,085	356,192	0.10667	82,000	0	82,000	$5,302	2,227	80,810	115,147	203,486	$152,706
12	2029	88,343	$0.04788	4,230	0.00000	0	2,260	0	2,260	$160.46	362,640	366,870	0.11147	82,000	0	82,000	$5,540	2,251	80,810	116,582	205,183	$161,687
13	2030	88,343	$0.04932	4,357	0.00000	0	2,260	0	2,260	$165.27	373,510	377,867	0.11649	82,000	0	82,000	$5,790	2,275	80,810	118,040	206,915	$170,952
14	2031	88,343	$0.05080	4,488	0.00000	0	2,260	0	2,260	$170.23	384,720	389,208	0.12173	82,000	0	82,000	$6,050	2,300	80,810	119,519	208,680	$180,528
15	2032	88,343	$0.05232	4,622	0.00000	0	2,260	0	2,260	$175.34	396,268	400,890	0.12721	82,000	0	82,000	$6,323	2,325	80,810	121,022	210,480	$190,410
16	2033	0	$0.05389	0	0.00000	0	0	0	0	$180.60	0	0	0.13293	0	0	0	$0	0	0	0	0	$0
17	2034	0	$0.05551	0	0.00000	0	0	0	0	$186.02	0	0	0.13891	0	0	0	$0	0	0	0	0	$0
18	2035	0	$0.05718	0	0.00000	0	0	0	0	$191.60	0	0	0.14516	0	0	0	$0	0	0	0	0	$0
19	2036	0	$0.05890	0	0.00000	0	0	0	0	$197.35	0	0	0.15170	0	0	0	$0	0	0	0	0	$0
20	2037	0	$0.06067	0	0.00000	0	0	0	0	$203.27	0	0	0.15852	0	0	0	$0	0	0	0	0	$0
	Total =	1,148,459							29,380			$4,381,841				1,066,000					$2,928,657	$1,453,184
											NPV =	$2,523,008									$1,827,699	695,309

Total NPV = $695,309
Benefit/Cost Ratio = 1.38

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 x Reserve Capacity
(H) #NAME?
(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) #NAME?
(P) #NAME?

Table 2
Utility Test

Project: **Air Conditioning Cycling Program**
Program Years: **2018-2022**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$528	$0	$52,396	$52,924	$145,485	$145,485	($92,561)
2019	1,118	0	107,938	109,056	144,866	144,866	(35,810)
2020	1,734	0	166,761	168,495	172,460	172,460	(3,965)
2021	2,426	0	229,019	231,445	199,706	199,706	31,739
2022	3,194	0	294,862	298,056	226,807	226,807	71,249
2023	3,339	0	303,699	307,038	191,206	191,206	115,832
2024	3,530	0	312,807	316,337	192,561	192,561	123,776
2025	3,712	0	322,208	325,920	193,935	193,935	131,985
2026	3,872	0	331,858	335,730	195,330	195,330	140,400
2027	3,988	0	341,825	345,813	196,746	196,746	149,067
2028	4,107	0	352,085	356,192	198,184	198,184	158,008
2029	4,230	0	362,640	366,870	199,643	199,643	167,227
2030	4,357	0	373,510	377,867	201,125	201,125	176,742
2031	4,488	0	384,720	389,208	202,630	202,630	186,578
2032	4,622	0	396,268	400,890	204,157	204,157	196,733
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$4,381,841		$2,864,841	$1,517,000
			NPV =	$2,523,008		$1,791,505	731,503

Total NPV = $731,503
Benefit/Cost Ratio = 1.41

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) #NAME?
(G) #NAME?

Table 3
Societal Cost Test

Project: **Air Conditioning Cycling Program**
Program Years: **2018-2022**

	Benefits					Costs			Annual
Year	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)	Benefits Less Costs (I)
2018	$528	$0	$52,396	$16,735	$69,659	$145,485	$4,000	$149,485	($79,826)
2019	1,118	0	107,938	35,519	144,575	144,866	(11,400)	133,466	11,109
2020	1,734	0	166,761	56,525	225,020	172,460	(26,782)	145,678	79,342
2021	2,426	0	229,019	79,971	311,416	199,706	(42,145)	157,561	153,855
2022	3,194	0	294,862	106,077	404,133	226,807	(57,490)	169,317	234,816
2023	3,339	0	303,699	112,552	419,590	191,206	(79,325)	111,881	307,709
2024	3,530	0	312,807	119,440	435,777	192,561	(79,325)	113,236	322,541
2025	3,712	0	322,208	126,750	452,670	193,935	(79,325)	114,610	338,060
2026	3,872	0	331,858	134,482	470,212	195,330	(79,325)	116,005	354,207
2027	3,988	0	341,825	142,676	488,489	196,746	(79,325)	117,421	371,068
2028	4,107	0	352,085	151,367	507,559	198,184	(79,325)	118,859	388,700
2029	4,230	0	362,640	160,582	527,452	199,643	(79,325)	120,318	407,134
2030	4,357	0	373,510	170,358	548,225	201,125	(79,325)	121,800	426,425
2031	4,488	0	384,720	180,735	569,943	202,630	(79,325)	123,305	446,638
2032	4,622	0	396,268	191,744	592,634	204,157	(79,325)	124,832	467,802
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
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$6,167,354			$1,937,774	$4,229,580
				NPV =	$4,952,729			$1,635,317	3,317,412

Total NPV = $3,317,412
Benefit/Cost Ratio = 3.03

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) ######
(I) ######

Table 4
Participant Test

Project: **Air Conditioning Cycling Program**
Program Years: **2018-2022**

	Benefits													Costs			Annual
Year	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)	Benefits Less Costs (P)
2018	$40,000	$0.10702	$0.08265	16,400	0	16,400	$1,755	400	0	$0.000	$0.000	$0	$0	$41,755	$44,475	$0	$44,475	($2,720)
2019	56,720	0.11183	0.08637	32,800	0	32,800	3,668	800	0	0.000	0.000	0	0	60,388	46,304	0	46,304	14,084
2020	73,462	0.11687	0.09025	49,200	0	49,200	5,750	1,200	0	0.000	0.000	0	0	79,212	48,208	0	48,208	31,004
2021	90,225	0.12213	0.09432	65,600	0	65,600	8,012	1,600	0	0.000	0.000	0	0	98,237	50,191	0	50,191	48,046
2022	107,012	0.12762	0.09856	82,000	0	82,000	10,465	2,000	0	0.000	0.000	0	0	117,477	52,255	0	52,255	65,222
2023	80,810	0.13336	0.10300	82,000	0	82,000	10,936	2,000	0	0.000	0.000	0	0	91,746	1,585	0	1,585	90,161
2024	80,810	0.13937	0.10763	82,000	0	82,000	11,428	2,000	0	0.000	0.000	0	0	92,238	1,602	0	1,602	90,636
2025	80,810	0.14564	0.11247	82,000	0	82,000	11,942	2,000	0	0.000	0.000	0	0	92,752	1,619	0	1,619	91,133
2026	80,810	0.15219	0.11754	82,000	0	82,000	12,480	2,000	0	0.000	0.000	0	0	93,290	1,636	0	1,636	91,654
2027	80,810	0.15904	0.12282	82,000	0	82,000	13,041	2,000	0	0.000	0.000	0	0	93,851	1,654	0	1,654	92,197
2028	80,810	0.16620	0.12835	82,000	0	82,000	13,628	2,000	0	0.000	0.000	0	0	94,438	1,672	0	1,672	92,766
2029	80,810	0.17368	0.13413	82,000	0	82,000	14,242	2,000	0	0.000	0.000	0	0	95,052	1,690	0	1,690	93,362
2030	80,810	0.18149	0.14016	82,000	0	82,000	14,882	2,000	0	0.000	0.000	0	0	95,692	1,708	0	1,708	93,984
2031	80,810	0.18966	0.14647	82,000	0	82,000	15,552	2,000	0	0.000	0.000	0	0	96,362	1,727	0	1,727	94,635
2032	80,810	0.19819	0.15306	82,000	0	82,000	16,252	2,000	0	0.000	0.000	0	0	97,062	1,745	0	1,745	95,317
2033	0	0.20711	0.15995	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.21643	0.16715	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.22617	0.17467	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.23635	0.18253	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.24698	0.19074	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				1,066,000	0			26,000	0					$1,339,552			$258,071	$1,081,481
													NPV =	$721,749			$207,981	513,768

Total NPV = $513,768
Benefit/Cost Ratio = 3.47

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Air Conditioning Cycling Program**
Project: **2018-2022**

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$528	$52,396	$52,924	$145,485	$4,000	$149,485	($96,561)
2019	1,118	107,938	109,056	144,866	(11,400)	133,466	(24,410)
2020	1,734	166,761	168,495	172,460	(26,782)	145,678	22,817
2021	2,426	229,019	231,445	199,706	(42,145)	157,561	73,884
2022	3,194	294,862	298,056	226,807	(57,490)	169,317	128,739
2023	3,339	303,699	307,038	191,206	(79,325)	111,881	195,157
2024	3,530	312,807	316,337	192,561	(79,325)	113,236	203,101
2025	3,712	322,208	325,920	193,935	(79,325)	114,610	211,310
2026	3,872	331,858	335,730	195,330	(79,325)	116,005	219,725
2027	3,988	341,825	345,813	196,746	(79,325)	117,421	228,392
2028	4,107	352,085	356,192	198,184	(79,325)	118,859	237,333
2029	4,230	362,640	366,870	199,643	(79,325)	120,318	246,552
2030	4,357	373,510	377,867	201,125	(79,325)	121,800	256,067
2031	4,488	384,720	389,208	202,630	(79,325)	123,305	265,903
2032	4,622	396,268	400,890	204,157	(79,325)	124,832	276,058
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$4,381,841			$1,937,774	$2,444,067
		NPV =	$2,523,008			$1,269,440	1,253,567

Total NPV =	$1,253,567
Benefit/Cost Ratio =	1.99

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

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

Company: **Montana-Dakota Utilities Co.**
Project: **Air Conditioning Cycling Program**
Program Years: **2018-2022**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.09894
Retail Rate Winter ($/kWh) =	$0.08728
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.00000
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost ($/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) =	$0.06564
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/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 =	9.69%
9) Utility Discount Rate =	7.36%
10) Societal Discount Rate =	2.68%
11) General Input Data Year =	2017
12) Project Analysis Year 1 =	2018
Project Analysis Year 2 =	2019
Project Analysis Year 3 =	2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$7,500	$7,581	$7,663
Incentive Costs =	90,000	92,700	95,481
Direct Program Costs =	448,067	442,967	543,580
Total Utility Project Costs =	$545,567	$543,248	$646,723
14) Direct Participant Costs ($/Part.) =	$110	$110	$110
Escalation Rate =	1.08%	1.08%	1.08%
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 =	1.000	1.000	1.000
16a) Avg Winter kW/part Saved =	0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =	41	41	41
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 =	1,500	1,545	1,591
20) Incentive/Participant =	$60	$60	$60
21) Effective Federal & State Income Tax Rate =			39.39%
22) Annual Summer Kwh Saved	61,500	63,345	65,245
Annual Winter Kwh Saved	0	0	0
23) Annual Summer KW Saved	1,500	1,545	1,591
Annual Winter KW Saved	0	0	0

Test Results	**NPV**	**B/C**
Ratepayer Impact Measure Test	$1,386,212	1.20
Utility Cost Test	$1,521,751	1.23
Societal Test	$10,042,967	2.64
Participant Test	$1,916,583	3.46
Total Resource Cost Test	$3,479,491	1.73

Table 1
Ratepayer Impact Test

Project: **Air Conditioning Cycling Program**
Program Years: **2018-2022**

t	Year	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Direct Program Costs (O)	Costs: Total Project Costs (P)	Annual Benefits Less Costs (Q)
1	2018	66,257	$0.02987	$1,979	$0.00000	$0	1,695	0	1,695	$100.80	$170,856	$172,835	$0.06859	61,500	0	61,500	$2,557	$7,500	$150,000	$388,067	$548,124	($375,289)
2	2019	132,514	$0.03164	4,193	0.00000	0	3,389	0	3,389	103.82	351,846	356,039	0.07168	123,000	0	123,000	5,344	7,581	212,700	322,967	548,592	(192,553)
3	2020	198,771	$0.03271	6,502	0.00000	0	5,084	0	5,084	106.94	543,683	550,185	0.07491	184,500	0	184,500	8,377	7,663	275,481	363,580	655,100	(104,915)
4	2021	265,028	$0.03432	9,096	0.00000	0	6,779	0	6,779	110.15	746,707	755,803	0.07828	246,000	0	246,000	11,672	7,746	338,345	402,807	760,570	(4,767)
5	2022	331,285	$0.03616	11,979	0.00000	0	8,474	0	8,474	113.45	961,375	973,354	0.08180	307,500	0	307,500	15,246	7,829	401,296	441,400	865,771	107,583
6	2023	331,285	$0.03780	12,523	0.00000	0	8,474	0	8,474	116.85	990,187	1,002,710	0.08548	307,500	0	307,500	15,932	7,914	303,039	406,070	732,955	269,755
7	2024	331,285	$0.03996	13,238	0.00000	0	8,474	0	8,474	120.36	1,019,931	1,033,169	0.08933	307,500	0	307,500	16,650	7,999	303,039	411,064	738,752	294,417
8	2025	331,285	$0.04202	13,921	0.00000	0	8,474	0	8,474	123.97	1,050,522	1,064,443	0.09335	307,500	0	307,500	17,399	8,086	303,039	416,132	744,656	319,787
9	2026	331,285	$0.04383	14,520	0.00000	0	8,474	0	8,474	127.69	1,082,045	1,096,565	0.09755	307,500	0	307,500	18,182	8,173	303,039	421,277	750,671	345,894
10	2027	331,285	$0.04514	14,954	0.00000	0	8,474	0	8,474	131.52	1,114,500	1,129,454	0.10194	307,500	0	307,500	19,000	8,261	303,039	426,499	756,799	372,655
11	2028	331,285	$0.04649	15,401	0.00000	0	8,474	0	8,474	135.47	1,147,973	1,163,374	0.10652	307,500	0	307,500	19,854	8,351	303,039	431,801	763,044	400,330
12	2029	331,285	$0.04788	15,862	0.00000	0	8,474	0	8,474	139.53	1,182,377	1,198,239	0.11132	307,500	0	307,500	20,748	8,441	303,039	437,184	769,411	428,828
13	2030	331,285	$0.04932	16,339	0.00000	0	8,474	0	8,474	143.72	1,217,883	1,234,222	0.11633	307,500	0	307,500	21,682	8,532	303,039	442,649	775,901	458,321
14	2031	331,285	$0.05080	16,829	0.00000	0	8,474	0	8,474	148.03	1,254,406	1,271,235	0.12156	307,500	0	307,500	22,657	8,624	303,039	448,198	782,518	488,717
15	2032	331,285	$0.05232	17,333	0.00000	0	8,474	0	8,474	152.47	1,292,031	1,309,364	0.12703	307,500	0	307,500	23,676	8,717	303,039	453,833	789,265	520,099
16	2033	0	$0.05389	0	0.00000	0	0	0	0	157.04	0	0	0.13275	0	0	0	0	0	0	0	0	0
17	2034	0	$0.05551	0	0.00000	0	0	0	0	161.75	0	0	0.13872	0	0	0	0	0	0	0	0	0
18	2035	0	$0.05718	0	0.00000	0	0	0	0	166.61	0	0	0.14496	0	0	0	0	0	0	0	0	0
19	2036	0	$0.05890	0	0.00000	0	0	0	0	171.60	0	0	0.15149	0	0	0	0	0	0	0	0	0
20	2037	0	$0.06067	0	0.00000	0	0	0	0	176.75	0	0	0.15830	0	0	0	0	0	0	0	0	0
Total =		4,306,705							110,161			$14,310,991				3,997,500					$10,982,129	$3,328,862
											NPV =	$8,239,893									$6,853,681	1,386,212

Total NPV = $1,386,212
Benefit/Cost Ratio = 1.20

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 x Reserve Capacity
(H) #NAME?
(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) #NAME?
(P) #NAME?

Table 2
Utility Test

Project: **Air Conditioning Cycling Program**
Program Years: **2018-2022**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$1,979	$0	$170,856	$172,835	$545,567	$545,567	($372,732)
2019	4,193	0	351,846	356,039	543,248	543,248	(187,209)
2020	6,502	0	543,683	550,185	646,723	646,723	(96,538)
2021	9,096	0	746,707	755,803	748,898	748,898	6,905
2022	11,979	0	961,375	973,354	850,525	850,525	122,829
2023	12,523	0	990,187	1,002,710	717,023	717,023	285,687
2024	13,238	0	1,019,931	1,033,169	722,102	722,102	311,067
2025	13,921	0	1,050,522	1,064,443	727,257	727,257	337,186
2026	14,520	0	1,082,045	1,096,565	732,489	732,489	364,076
2027	14,954	0	1,114,500	1,129,454	737,799	737,799	391,655
2028	15,401	0	1,147,973	1,163,374	743,190	743,190	420,184
2029	15,862	0	1,182,377	1,198,239	748,663	748,663	449,576
2030	16,339	0	1,217,883	1,234,222	754,219	754,219	480,003
2031	16,829	0	1,254,406	1,271,235	759,861	759,861	511,374
2032	17,333	0	1,292,031	1,309,364	765,589	765,589	543,775
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$14,310,991		$10,743,153	$3,567,838
			NPV =	$8,239,893		$6,718,142	1,521,751

Total NPV = $1,521,751
Benefit/Cost Ratio = 1.23

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) #NAME?
(G) #NAME?

Table 3
Societal Cost Test

Project: **Air Conditioning Cycling Program**
Program Years: **2018-2022**

	Benefits					Costs			Annual
Year	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)	Benefits Less Costs (I)
2018	$1,979	$0	$170,856	$54,652	$227,487	$545,567	$15,000	$560,567	($333,080)
2019	4,193	0	351,846	115,961	472,000	543,248	(42,750)	500,498	(28,498)
2020	6,502	0	543,683	184,569	734,754	646,723	(100,433)	546,290	188,464
2021	9,096	0	746,707	261,154	1,016,957	748,898	(158,045)	590,853	426,104
2022	11,979	0	961,375	346,414	1,319,768	850,525	(215,587)	634,938	684,830
2023	12,523	0	990,187	367,567	1,370,277	717,023	(297,468)	419,555	950,722
2024	13,238	0	1,019,931	390,095	1,423,264	722,102	(297,468)	424,634	998,630
2025	13,921	0	1,050,522	413,960	1,478,403	727,257	(297,468)	429,789	1,048,614
2026	14,520	0	1,082,045	439,246	1,535,811	732,489	(297,468)	435,021	1,100,790
2027	14,954	0	1,114,500	465,993	1,595,447	737,799	(297,468)	440,331	1,155,116
2028	15,401	0	1,147,973	494,387	1,657,761	743,190	(297,468)	445,722	1,212,039
2029	15,862	0	1,182,377	524,480	1,722,719	748,663	(297,468)	451,195	1,271,524
2030	16,339	0	1,217,883	556,436	1,790,658	754,219	(297,468)	456,751	1,333,907
2031	16,829	0	1,254,406	590,317	1,861,552	759,861	(297,468)	462,393	1,399,159
2032	17,333	0	1,292,031	626,264	1,935,628	765,589	(297,468)	468,121	1,467,507
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
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$20,142,486			$7,266,658	$12,875,828
				NPV =	$16,175,408			$6,132,441	10,042,967

Total NPV = $10,042,967
Benefit/Cost Ratio = 2.64

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) ######
(I) ######

Table 4
Participant Test

Project: **Air Conditioning Cycling Program**
Program Years: **2018-2022**

	Benefits														Costs			Annual
Year	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)	Benefits Less Costs (P)
2018	$150,000	$0.10339	$0.09121	61,500	0	61,500	$6,358	1,500	0	$0.000	$0.000	$0	$0	$156,358	$166,782	$0	$166,782	($10,424)
2019	212,700	0.10804	0.09531	123,000	0	123,000	13,289	3,000	0	0.000	0.000	0	0	225,989	$173,641	0	173,641	52,348
2020	275,481	0.11291	0.09960	184,500	0	184,500	20,832	4,500	0	0.000	0.000	0	0	296,313	$180,782	0	180,782	115,531
2021	338,345	0.11799	0.10408	246,000	0	246,000	29,026	6,000	0	0.000	0.000	0	0	367,371	$188,216	0	188,216	179,155
2022	401,296	0.12330	0.10877	307,500	0	307,500	37,915	7,500	0	0.000	0.000	0	0	439,211	$195,956	0	195,956	243,255
2023	303,039	0.12885	0.11366	307,500	0	307,500	39,621	7,500	0	0.000	0.000	0	0	342,660	$5,942	0	5,942	336,718
2024	303,039	0.13464	0.11878	307,500	0	307,500	41,402	7,500	0	0.000	0.000	0	0	344,441	$6,006	0	6,006	338,435
2025	303,039	0.14070	0.12412	307,500	0	307,500	43,265	7,500	0	0.000	0.000	0	0	346,304	$6,071	0	6,071	340,233
2026	303,039	0.14703	0.12971	307,500	0	307,500	45,212	7,500	0	0.000	0.000	0	0	348,251	$6,137	0	6,137	342,114
2027	303,039	0.15365	0.13554	307,500	0	307,500	47,247	7,500	0	0.000	0.000	0	0	350,286	$6,203	0	6,203	344,083
2028	303,039	0.16057	0.14164	307,500	0	307,500	49,375	7,500	0	0.000	0.000	0	0	352,414	$6,270	0	6,270	346,144
2029	303,039	0.16779	0.14802	307,500	0	307,500	51,595	7,500	0	0.000	0.000	0	0	354,634	$6,338	0	6,338	348,296
2030	303,039	0.17534	0.15468	307,500	0	307,500	53,917	7,500	0	0.000	0.000	0	0	356,956	$6,406	0	6,406	350,550
2031	303,039	0.18323	0.16164	307,500	0	307,500	56,343	7,500	0	0.000	0.000	0	0	359,382	$6,475	0	6,475	352,907
2032	303,039	0.19148	0.16891	307,500	0	307,500	58,880	7,500	0	0.000	0.000	0	0	361,919	$6,545	0	6,545	355,374
2033	0	0.20009	0.17651	0	0	0	0	0	0	0.000	0.000	0	0	0	$0	0	0	0
2034	0	0.20910	0.18446	0	0	0	0	0	0	0.000	0.000	0	0	0	$0	0	0	0
2035	0	0.21851	0.19276	0	0	0	0	0	0	0.000	0.000	0	0	0	$0	0	0	0
2036	0	0.22834	0.20143	0	0	0	0	0	0	0.000	0.000	0	0	0	$0	0	0	0
2037	0	0.23861	0.21049	0	0	0	0	0	0	0.000	0.000	0	0	0	$0	0	0	0
Total =				3,997,500	0			97,500	0					$5,002,489			$967,770	$4,034,719
													NPV =	$2,696,513			$779,930	1,916,583

Total NPV = $1,916,583
Benefit/Cost Ratio = 3.46

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Air Conditioning Cycling Program**
Project: **2018-2022**

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$1,979	$170,856	$172,835	$545,567	$15,000	$560,567	($387,732)
2019	4,193	351,846	356,039	543,248	(42,750)	500,498	(144,459)
2020	6,502	543,683	550,185	646,723	(100,433)	546,290	3,895
2021	9,096	746,707	755,803	748,898	(158,045)	590,853	164,950
2022	11,979	961,375	973,354	850,525	(215,587)	634,938	338,416
2023	12,523	990,187	1,002,710	717,023	(297,468)	419,555	583,155
2024	13,238	1,019,931	1,033,169	722,102	(297,468)	424,634	608,535
2025	13,921	1,050,522	1,064,443	727,257	(297,468)	429,789	634,654
2026	14,520	1,082,045	1,096,565	732,489	(297,468)	435,021	661,544
2027	14,954	1,114,500	1,129,454	737,799	(297,468)	440,331	689,123
2028	15,401	1,147,973	1,163,374	743,190	(297,468)	445,722	717,652
2029	15,862	1,182,377	1,198,239	748,663	(297,468)	451,195	747,044
2030	16,339	1,217,883	1,234,222	754,219	(297,468)	456,751	777,471
2031	16,829	1,254,406	1,271,235	759,861	(297,468)	462,393	808,842
2032	17,333	1,292,031	1,309,364	765,589	(297,468)	468,121	841,243
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$14,310,991			$7,266,658	$7,044,333
		NPV =	$8,239,893			$4,760,402	3,479,491

Total NPV = $3,479,491
Benefit/Cost Ratio = 1.73

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

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

Company: **Montana-Dakota Utilities Co.**
Project: **Air Conditioning Cycling Program**
Program Years: **2018-2022**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.10859
Retail Rate Winter ($/kWh) =	$0.09604
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.00000
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost ($/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) =	$0.08337
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/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 =	9.69%
9) Utility Discount Rate =	7.22%
10) Societal Discount Rate =	2.68%
11) General Input Data Year =	2017
12) Project Analysis Year 1 =	2018
Project Analysis Year 2 =	2019
Project Analysis Year 3 =	2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$500	$505	$511
Incentive Costs =	6,000	6,180	6,365
Direct Program Costs =	29,871	29,531	36,239
Total Utility Project Costs =	$36,371	$36,217	$43,115
14) Direct Participant Costs ($/Part.) =	$110	$110	$110
Escalation Rate =	1.08%	1.08%	1.08%
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 =	1.000	1.000	1.000
16a) Avg Winter kW/part Saved =	0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =	41	41	41
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	103	106
20) Incentive/Participant =	$60	$60	$60
21) Effective Federal & State Income Tax Rate =			39.39%
22) Annual Summer Kwh Saved	4,100	4,223	4,350
Annual Winter Kwh Saved	0	0	0
23) Annual Summer KW Saved	100	103	106
Annual Winter KW Saved	0	0	0

Test Results	**NPV**	**B/C**
Ratepayer Impact Measure Test	$90,041	1.20
Utility Cost Test	$101,520	1.23
Societal Test	$669,662	2.64
Participant Test	$129,635	3.49
Total Resource Cost Test	$232,034	1.73

Table 1
Ratepayer Impact Test

Project: **Air Conditioning Cycling Program**
Program Years: **2018-2022**

t	Year	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Direct Program Costs (O)	Costs: Total Project Costs (P)	Annual Benefits Less Costs (Q)
1	2018	4,417	$0.02987	$132	$0.00000	$0	113	0	113	$100.80	$11,390	$11,522	$0.08712	4,100	0	4,100	$217	$500	$10,000	$25,871	$36,588	($25,066)
2	2019	8,834	0.03164	280	0.00000	0	226	0	226	103.82	23,463	23,743	0.09104	8,200	0	8,200	452	505	14,180	21,531	36,669	(12,926)
3	2020	13,251	0.03271	433	0.00000	0	339	0	339	106.94	36,253	36,686	0.09514	12,300	0	12,300	709	511	18,365	24,239	43,824	(7,138)
4	2021	17,669	0.03432	606	0.00000	0	452	0	452	110.15	49,788	50,394	0.09942	16,400	0	16,400	988	516	22,556	26,854	50,915	(521)
5	2022	22,086	0.03616	799	0.00000	0	565	0	565	113.45	64,099	64,898	0.10389	20,500	0	20,500	1,291	522	26,753	29,427	57,993	6,905
6	2023	22,086	0.03780	835	0.00000	0	565	0	565	116.85	66,020	66,855	0.10857	20,500	0	20,500	1,349	528	20,203	27,071	49,151	17,704
7	2024	22,086	0.03996	883	0.00000	0	565	0	565	120.36	68,003	68,886	0.11346	20,500	0	20,500	1,410	533	20,203	27,404	49,550	19,336
8	2025	22,086	0.04202	928	0.00000	0	565	0	565	123.97	70,043	70,971	0.11856	20,500	0	20,500	1,473	539	20,203	27,742	49,957	21,014
9	2026	22,086	0.04383	968	0.00000	0	565	0	565	127.69	72,145	73,113	0.12390	20,500	0	20,500	1,540	545	20,203	28,085	50,373	22,740
10	2027	22,086	0.04514	997	0.00000	0	565	0	565	131.52	74,309	75,306	0.12947	20,500	0	20,500	1,609	551	20,203	28,433	50,796	24,510
11	2028	22,086	0.04649	1,027	0.00000	0	565	0	565	135.47	76,541	77,568	0.13530	20,500	0	20,500	1,681	557	20,203	28,787	51,227	26,341
12	2029	22,086	0.04788	1,057	0.00000	0	565	0	565	139.53	78,834	79,891	0.14139	20,500	0	20,500	1,757	563	20,203	29,146	51,668	28,223
13	2030	22,086	0.04932	1,089	0.00000	0	565	0	565	143.72	81,202	82,291	0.14775	20,500	0	20,500	1,836	569	20,203	29,510	52,117	30,174
14	2031	22,086	0.05080	1,122	0.00000	0	565	0	565	148.03	83,637	84,759	0.15440	20,500	0	20,500	1,919	575	20,203	29,880	52,576	32,183
15	2032	22,086	0.05232	1,156	0.00000	0	565	0	565	152.47	86,146	87,302	0.16134	20,500	0	20,500	2,005	581	20,203	30,256	53,044	34,258
16	2033	0	0.05389	0	0.00000	0	0	0	0	157.04	0	0	0.16860	0	0	0	0	0	0		0	0
17	2034	0	0.05551	0	0.00000	0	0	0	0	161.75	0	0	0.17619	0	0	0	0	0	0	0	0	0
18	2035	0	0.05718	0	0.00000	0	0	0	0	166.61	0	0	0.18412	0	0	0	0	0	0	0	0	0
19	2036	0	0.05890	0	0.00000	0	0	0	0	171.60	0	0	0.19241	0	0	0	0	0	0	0	0	0
20	2037	0	0.06067	0	0.00000	0	0	0	0	203.27	0	0	0.20106	0	0	0	0	0	0	0	0	0
Total =		287,117							7,345			$954,185				266,500					$736,448	$217,737
											NPV =	$549,396									$459,355	90,041

Total NPV = $90,041
Benefit/Cost Ratio = 1.20

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 x Reserve Capacity
(H) #NAME?
(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) #NAME?
(P) #NAME?

Table 2
Utility Test

Project: **Air Conditioning Cycling Program**
Program Years: **2018-2022**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$132	$0	$11,390	$11,522	$36,371	$36,371	($24,849)
2019	280	0	23,463	23,743	36,217	36,217	(12,474)
2020	433	0	36,253	36,686	43,115	43,115	(6,429)
2021	606	0	49,788	50,394	49,927	49,927	467
2022	799	0	64,099	64,898	56,702	56,702	8,196
2023	835	0	66,020	66,855	47,802	47,802	19,053
2024	883	0	68,003	68,886	48,140	48,140	20,746
2025	928	0	70,043	70,971	48,484	48,484	22,487
2026	968	0	72,145	73,113	48,833	48,833	24,280
2027	997	0	74,309	75,306	49,187	49,187	26,119
2028	1,027	0	76,541	77,568	49,546	49,546	28,022
2029	1,057	0	78,834	79,891	49,911	49,911	29,980
2030	1,089	0	81,202	82,291	50,281	50,281	32,010
2031	1,122	0	83,637	84,759	50,657	50,657	34,102
2032	1,156	0	86,146	87,302	51,039	51,039	36,263
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$954,185		$716,210	$237,973
			NPV =	$549,396		$447,876	101,520

Total NPV = $101,520
Benefit/Cost Ratio = 1.23

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) #NAME?
(G) #NAME?

Table 3
Societal Cost Test

Project: **Air Conditioning Cycling Program**
Program Years: **2018-2022**

	Benefits					Costs			Annual
Year	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)	Benefits Less Costs (I)
2018	$132	$0	$11,390	$3,643	$15,165	$36,371	$1,000	$37,371	($22,206)
2019	280	0	23,463	7,733	31,476	36,217	(2,850)	33,367	(1,891)
2020	433	0	36,253	12,307	48,993	43,115	(6,696)	36,419	12,574
2021	606	0	49,788	17,413	67,807	49,927	(10,536)	39,391	28,416
2022	799	0	64,099	23,097	87,995	56,702	(14,372)	42,330	45,665
2023	835	0	66,020	24,507	91,362	47,802	(19,831)	27,971	63,391
2024	883	0	68,003	26,009	94,895	48,140	(19,831)	28,309	66,586
2025	928	0	70,043	27,601	98,572	48,484	(19,831)	28,653	69,919
2026	968	0	72,145	29,287	102,400	48,833	(19,831)	29,002	73,398
2027	997	0	74,309	31,070	106,376	49,187	(19,831)	29,356	77,020
2028	1,027	0	76,541	32,963	110,531	49,546	(19,831)	29,715	80,816
2029	1,057	0	78,834	34,969	114,860	49,911	(19,831)	30,080	84,780
2030	1,089	0	81,202	37,100	119,391	50,281	(19,831)	30,450	88,941
2031	1,122	0	83,637	39,359	124,118	50,657	(19,831)	30,826	93,292
2032	1,156	0	86,146	41,756	129,058	51,039	(19,831)	31,208	97,850
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
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$1,342,999			$484,448	$858,551
				NPV =	$1,078,495			$408,833	669,662

Total NPV =	$669,662
Benefit/Cost Ratio =	2.64

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) ######
(I) ######

Table 4
Participant Test

Project: **Air Conditioning Cycling Program**
Program Years: **2018-2022**

	Benefits														Costs			Annual
Year	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)	Benefits Less Costs (P)
2018	$10,000	$0.11348	$0.10036	4,100	0	4,100	$465	100	0	$0.000	$0.000	$0	$0	$10,465	$11,119	$0	$11,119	($654)
2019	14,180	0.11858	0.10488	8,200	0	8,200	972	200	0	0.000	0.000	0	0	15,152	$11,576	0	11,576	3,576
2020	18,365	0.12392	0.10960	12,300	0	12,300	1,524	300	0	0.000	0.000	0	0	19,889	$12,052	0	12,052	7,837
2021	22,556	0.12950	0.11453	16,400	0	16,400	2,124	400	0	0.000	0.000	0	0	24,680	$12,548	0	12,548	12,132
2022	26,753	0.13532	0.11968	20,500	0	20,500	2,774	500	0	0.000	0.000	0	0	29,527	$13,064	0	13,064	16,463
2023	20,203	0.14141	0.12507	20,500	0	20,500	2,899	500	0	0.000	0.000	0	0	23,102	$396	0	396	22,706
2024	20,203	0.14778	0.13070	20,500	0	20,500	3,029	500	0	0.000	0.000	0	0	23,232	$400	0	400	22,832
2025	20,203	0.15443	0.13658	20,500	0	20,500	3,166	500	0	0.000	0.000	0	0	23,369	$405	0	405	22,964
2026	20,203	0.16138	0.14272	20,500	0	20,500	3,308	500	0	0.000	0.000	0	0	23,511	$409	0	409	23,102
2027	20,203	0.16864	0.14915	20,500	0	20,500	3,457	500	0	0.000	0.000	0	0	23,660	$414	0	414	23,246
2028	20,203	0.17623	0.15586	20,500	0	20,500	3,613	500	0	0.000	0.000	0	0	23,816	$418	0	418	23,398
2029	20,203	0.18416	0.16287	20,500	0	20,500	3,775	500	0	0.000	0.000	0	0	23,978	$423	0	423	23,555
2030	20,203	0.19244	0.17020	20,500	0	20,500	3,945	500	0	0.000	0.000	0	0	24,148	$427	0	427	23,721
2031	20,203	0.20110	0.17786	20,500	0	20,500	4,123	500	0	0.000	0.000	0	0	24,326	$432	0	432	23,894
2032	20,203	0.21015	0.18586	20,500	0	20,500	4,308	500	0	0.000	0.000	0	0	24,511	$436	0	436	24,075
2033	0	0.21961	0.19423	0	0	0	0	0	0	0.000	0.000	0	0	0	$0	0	0	0
2034	0	0.22949	0.20297	0	0	0	0	0	0	0.000	0.000	0	0	0	$0	0	0	0
2035	0	0.23982	0.21210	0	0	0	0	0	0	0.000	0.000	0	0	0	$0	0	0	0
2036	0	0.25061	0.22165	0	0	0	0	0	0	0.000	0.000	0	0	0	$0	0	0	0
2037	0	0.26189	0.23162	0	0	0	0	0	0	0.000	0.000	0	0	0	$0	0	0	0
Total =				266,500	0			6,500	0					$337,366			$64,519	$272,847
													NPV =	$181,631			$51,996	129,635

Total NPV = $129,635
Benefit/Cost Ratio = 3.49

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Air Conditioning Cycling Program**
Project: **2018-2022**

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$132	$11,390	$11,522	$36,371	$1,000	$37,371	($25,849)
2019	280	23,463	23,743	36,217	(2,850)	33,367	(9,624)
2020	433	36,253	36,686	43,115	(6,696)	36,419	267
2021	606	49,788	50,394	49,927	(10,536)	39,391	11,003
2022	799	64,099	64,898	56,702	(14,372)	42,330	22,568
2023	835	66,020	66,855	47,802	(19,831)	27,971	38,884
2024	883	68,003	68,886	48,140	(19,831)	28,309	40,577
2025	928	70,043	70,971	48,484	(19,831)	28,653	42,318
2026	968	72,145	73,113	48,833	(19,831)	29,002	44,111
2027	997	74,309	75,306	49,187	(19,831)	29,356	45,950
2028	1,027	76,541	77,568	49,546	(19,831)	29,715	47,853
2029	1,057	78,834	79,891	49,911	(19,831)	30,080	49,811
2030	1,089	81,202	82,291	50,281	(19,831)	30,450	51,841
2031	1,122	83,637	84,759	50,657	(19,831)	30,826	53,933
2032	1,156	86,146	87,302	51,039	(19,831)	31,208	56,094
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$954,185			$484,448	$469,737
		NPV =	$549,396			$317,363	232,034

Total NPV = $232,034
Benefit/Cost Ratio = 1.73

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

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.08063
Retail Rate Winter ($/kWh) =	$0.05624
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.00000
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost ($/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) =	$0.06007
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/kW/yr)	$98.46
Reserve Capacity=	14.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.69%
9) Utility Discount Rate =	7.30%
10) Societal Discount Rate =	2.68%
11) General Input Data Year =	2017
12) Project Analysis Year 1 =	2018
Project Analysis Year 2 =	2019
Project Analysis Year 3 =	2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$16,852	$23,610	$31,045
Incentive Costs =	28,500	42,750	57,000
Total Utility Project Costs =	$45,352	$66,360	$88,045
14) Direct Participant Costs ($/Part.) =	$5,883	$5,883	$5,883
Escalation Rate =	1.08%	1.08%	1.08%
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 =	5.150	5.150	5.150
16a) Avg Winter kW/part Saved =	5.150	5.150	5.150
17) Avg. Summer kWh/Part. Saved =	9,500	9,500	9,500
17a) Avg. Winter kWh/Part. Saved =	19,000	19,000	19,000
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 =	10	15	20
20) Incentive/Participant =	$2,850	$2,850	$2,850
21) Effective Federal & State Income Tax Rate =			39.39%
22) Annual Summer Kwh Saved	95,000	142,500	190,000
Annual Winter Kwh Saved	190,000	285,000	380,000
23) Annual Summer KW Saved	52	77	103
Annual Winter KW Saved	52	77	103

Test Results	**NPV**	**B/C**
Ratepayer Impact Measure Test	$385,576	1.50
Utility Cost Test	$978,662	6.33
Societal Test	$1,994,530	7.12
Participant Test	$760,709	4.13
Total Resource Cost Test	$853,240	3.76

Table 1
Ratepayer Impact Test

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

t	Year	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2018	307,045	$0.02987	$9,171	$0.00000	$0	58	58	116	$115.92	$13,447	$22,618	$0.06277	95,000	190,000	285,000	$10,843	$16,852	$28,500	$56,195	($33,577)
2	2019	767,612	0.03164	24,287	0.00000	0	145	145	290	119.40	34,626	58,913	0.06560	237,500	475,000	712,500	28,330	23,610	42,750	94,690	(35,777)
3	2020	1,381,701	0.03271	45,195	0.00000	0	262	262	524	122.98	64,442	109,637	0.06855	427,500	855,000	1,282,500	53,288	31,045	57,000	141,333	(31,696)
4	2021	1,381,701	0.03432	47,420	0.00000	0	262	262	524	126.67	66,375	113,795	0.07163	427,500	855,000	1,282,500	55,682	0	0	55,682	58,113
5	2022	1,381,701	0.03616	49,962	0.00000	0	262	262	524	130.47	68,366	118,328	0.07486	427,500	855,000	1,282,500	58,193	0	0	58,193	60,135
6	2023	1,381,701	0.03780	52,228	0.00000	0	262	262	524	134.38	70,415	122,643	0.07823	427,500	855,000	1,282,500	60,813	0	0	60,813	61,830
7	2024	1,381,701	0.03996	55,213	0.00000	0	262	262	524	138.41	72,527	127,740	0.08175	427,500	855,000	1,282,500	63,549	0	0	63,549	64,191
8	2025	1,381,701	0.04202	58,059	0.00000	0	262	262	524	142.57	74,707	132,766	0.08543	427,500	855,000	1,282,500	66,409	0	0	66,409	66,357
9	2026	1,381,701	0.04383	60,560	0.00000	0	262	262	524	146.84	76,944	137,504	0.08927	427,500	855,000	1,282,500	69,395	0	0	69,395	68,109
10	2027	1,381,701	0.04514	62,370	0.00000	0	262	262	524	151.25	79,255	141,625	0.09329	427,500	855,000	1,282,500	72,519	0	0	72,519	69,106
11	2028	1,381,701	0.04649	64,235	0.00000	0	262	262	524	155.79	81,634	145,869	0.09748	427,500	855,000	1,282,500	75,777	0	0	75,777	70,092
12	2029	1,381,701	0.04788	66,156	0.00000	0	262	262	524	160.46	84,081	150,237	0.10187	427,500	855,000	1,282,500	79,189	0	0	79,189	71,048
13	2030	1,381,701	0.04932	68,145	0.00000	0	262	262	524	165.27	86,601	154,746	0.10646	427,500	855,000	1,282,500	82,757	0	0	82,757	71,989
14	2031	1,381,701	0.05080	70,190	0.00000	0	262	262	524	170.23	89,201	159,391	0.11125	427,500	855,000	1,282,500	86,481	0	0	86,481	72,910
15	2032	1,381,701	0.05232	72,291	0.00000	0	262	262	524	175.34	91,878	164,169	0.11625	427,500	855,000	1,282,500	90,368	0	0	90,368	73,801
16	2033	1,074,657	0.05389	57,913	0.00000	0	204	204	408	180.60	73,685	131,598	0.12148	332,500	665,000	997,500	73,448	0	0	73,448	58,150
17	2034	614,090	0.05551	34,088	0.00000	0	116	116	232	186.02	43,157	77,245	0.12695	190,000	380,000	570,000	43,860	0	0	43,860	33,385
18	2035	0	0.05718	0	0.00000	0	0	0	0	191.60	0	0	0.13266	0	0	0	0	0	0	0	0
19	2036	0	0.05890	0	0.00000	0	0	0	0	197.35	0	0	0.13863	0	0	0	0	0	0	0	0
20	2037	0	0.06067	0	0.00000	0	0	0	0	203.27	0	0	0.14487	0	0	0	0	0	0	0	0
Total =		20,725,517							7,858			$2,068,824				19,237,500				$1,270,658	$798,166
											NPV =	$1,162,340								$776,764	385,576

Total NPV = $385,576
Benefit/Cost Ratio = 1.50

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

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$9,171	$0	$13,447	$22,618	$45,352	$45,352	($22,734)
2019	24,287	0	34,626	58,913	66,360	66,360	(7,447)
2020	45,195	0	64,442	109,637	88,045	88,045	21,592
2021	47,420	0	66,375	113,795	0	0	113,795
2022	49,962	0	68,366	118,328	0	0	118,328
2023	52,228	0	70,415	122,643	0	0	122,643
2024	55,213	0	72,527	127,740	0	0	127,740
2025	58,059	0	74,707	132,766	0	0	132,766
2026	60,560	0	76,944	137,504	0	0	137,504
2027	62,370	0	79,255	141,625	0	0	141,625
2028	64,235	0	81,634	145,869	0	0	145,869
2029	66,156	0	84,081	150,237	0	0	150,237
2030	68,145	0	86,601	154,746	0	0	154,746
2031	70,190	0	89,201	159,391	0	0	159,391
2032	72,291	0	91,878	164,169	0	0	164,169
2033	57,913	0	73,685	131,598	0	0	131,598
2034	34,088	0	43,157	77,245	0	0	77,245
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$2,068,824		$199,757	$1,869,067
			NPV =	$1,162,340		$183,678	978,662

Total NPV =	$978,662
Benefit/Cost Ratio =	6.33

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**

	Benefits					Costs			Annual
Year	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)	Benefits Less Costs (I)
2018	$9,171	$0	$13,447	$7,152	$29,770	$45,352	$30,330	$75,682	($45,912)
2019	24,287	0	34,626	19,188	78,101	66,360	45,495	111,855	(33,754)
2020	45,195	0	64,442	36,780	146,417	88,045	60,660	148,705	(2,288)
2021	47,420	0	66,375	39,320	153,115	0	0	0	153,115
2022	49,962	0	68,366	42,113	160,441	0	0	0	160,441
2023	52,228	0	70,415	44,958	167,601	0	0	0	167,601
2024	55,213	0	72,527	48,231	175,971	0	0	0	175,971
2025	58,059	0	74,707	51,632	184,398	0	0	0	184,398
2026	60,560	0	76,944	55,079	192,583	0	0	0	192,583
2027	62,370	0	79,255	58,432	200,057	0	0	0	200,057
2028	64,235	0	81,634	61,988	207,857	0	0	0	207,857
2029	66,156	0	84,081	65,760	215,997	0	0	0	215,997
2030	68,145	0	86,601	69,766	224,512	0	0	0	224,512
2031	70,190	0	89,201	74,016	233,407	0	0	0	233,407
2032	72,291	0	91,878	78,521	242,690	0	0	0	242,690
2033	57,913	0	73,685	64,831	196,429	0	0	0	196,429
2034	34,088	0	43,157	39,196	116,441	0	0	0	116,441
2035	0	0	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$2,925,787			$336,242	$2,589,545
				NPV =	$2,320,191			$325,661	1,994,530

Total NPV =	$1,994,530
Benefit/Cost Ratio =	7.12

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**

	Benefits														Costs			Annual
Year	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)	Benefits Less Costs (P)
2018	$28,500	$0.08426	$0.05877	95,000	190,000	285,000	$19,171	52	52	$0.000	$0.000	$0	$0	$47,671	$59,465	$0	$59,465	($11,794)
2019	42,750	0.08805	0.06142	237,500	475,000	712,500	50,086	129	129	0.000	0.000	0	0	92,836	90,161	0	90,161	2,675
2020	57,000	0.09201	0.06418	427,500	855,000	1,282,500	94,208	232	232	0.000	0.000	0	0	151,208	121,514	0	121,514	29,694
2021	0	0.09615	0.06707	427,500	855,000	1,282,500	98,449	232	232	0.000	0.000	0	0	98,449	0	0	0	98,449
2022	0	0.10048	0.07009	427,500	855,000	1,282,500	102,882	232	232	0.000	0.000	0	0	102,882	0	0	0	102,882
2023	0	0.10500	0.07324	427,500	855,000	1,282,500	107,508	232	232	0.000	0.000	0	0	107,508	0	0	0	107,508
2024	0	0.10973	0.07653	427,500	855,000	1,282,500	112,343	232	232	0.000	0.000	0	0	112,343	0	0	0	112,343
2025	0	0.11466	0.07998	427,500	855,000	1,282,500	117,400	232	232	0.000	0.000	0	0	117,400	0	0	0	117,400
2026	0	0.11982	0.08358	427,500	855,000	1,282,500	122,684	232	232	0.000	0.000	0	0	122,684	0	0	0	122,684
2027	0	0.12522	0.08734	427,500	855,000	1,282,500	128,207	232	232	0.000	0.000	0	0	128,207	0	0	0	128,207
2028	0	0.13085	0.09127	427,500	855,000	1,282,500	133,974	232	232	0.000	0.000	0	0	133,974	0	0	0	133,974
2029	0	0.13674	0.09538	427,500	855,000	1,282,500	140,006	232	232	0.000	0.000	0	0	140,006	0	0	0	140,006
2030	0	0.14289	0.09967	427,500	855,000	1,282,500	146,303	232	232	0.000	0.000	0	0	146,303	0	0	0	146,303
2031	0	0.14932	0.10415	427,500	855,000	1,282,500	152,883	232	232	0.000	0.000	0	0	152,883	0	0	0	152,883
2032	0	0.15604	0.10884	427,500	855,000	1,282,500	159,765	232	232	0.000	0.000	0	0	159,765	0	0	0	159,765
2033	0	0.16306	0.11374	332,500	665,000	997,500	129,855	180	180	0.000	0.000	0	0	129,855	0	0	0	129,855
2034	0	0.17040	0.11886	190,000	380,000	570,000	77,543	103	103	0.000	0.000	0	0	77,543	0	0	0	77,543
2035	0	0.17807	0.12420	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.18608	0.12979	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.19446	0.13563	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				6,412,500	12,825,000			3,480	3,480					$2,021,517			$271,140	$1,750,377
													NPV =	$1,003,363			$242,654	760,709

Total NPV = $760,709
Benefit/Cost Ratio = 4.13

Worksheet Calculations

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

Table 5
Total Resource Cost Test

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

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$9,171	$13,447	$22,618	$45,352	$30,330	$75,682	($53,064)
2019	24,287	34,626	58,913	66,360	45,495	111,855	(52,942)
2020	45,195	64,442	109,637	88,045	60,660	148,705	(39,068)
2021	47,420	66,375	113,795	0	0	0	113,795
2022	49,962	68,366	118,328	0	0	0	118,328
2023	52,228	70,415	122,643	0	0	0	122,643
2024	55,213	72,527	127,740	0	0	0	127,740
2025	58,059	74,707	132,766	0	0	0	132,766
2026	60,560	76,944	137,504	0	0	0	137,504
2027	62,370	79,255	141,625	0	0	0	141,625
2028	64,235	81,634	145,869	0	0	0	145,869
2029	66,156	84,081	150,237	0	0	0	150,237
2030	68,145	86,601	154,746	0	0	0	154,746
2031	70,190	89,201	159,391	0	0	0	159,391
2032	72,291	91,878	164,169	0	0	0	164,169
2033	57,913	73,685	131,598	0	0	0	131,598
2034	34,088	43,157	77,245	0	0	0	77,245
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$2,068,824			$336,242	$1,732,582
		NPV =	$1,162,340			$309,100	853,240

Total NPV = $853,240
Benefit/Cost Ratio = 3.76

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
NORTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS

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

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.10281
Retail Rate Winter ($/kWh) =	$0.08724
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.00000
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost ($/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) =	$0.06643
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/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 =	9.69%
9) Utility Discount Rate =	7.36%
10) Societal Discount Rate =	2.68%
11) General Input Data Year =	2017
12) Project Analysis Year 1 =	2018
Project Analysis Year 2 =	2019
Project Analysis Year 3 =	2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$15,829	$15,426	$15,323
Incentive Costs =	28,500	28,500	28,500
Total Utility Project Costs =	$44,329	$43,926	$43,823
14) Direct Participant Costs ($/Part.) =	$5,883	$5,883	$5,883
Escalation Rate =	1.08%	1.08%	1.08%
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 =	5.150	5.150	5.150
16a) Avg Winter kW/part Saved =	5.150	5.150	5.150
17) Avg. Summer kWh/Part. Saved =	9,500	9,500	9,500
17a) Avg. Winter kWh/Part. Saved =	19,000	19,000	19,000
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 =	10	10	10
20) Incentive/Participant =	$2,850	$2,850	$2,850
21) Effective Federal & State Income Tax Rate =			39.39%
22) Annual Summer Kwh Saved	95,000	95,000	95,000
Annual Winter Kwh Saved	190,000	190,000	190,000
23) Annual Summer KW Saved	52	52	52
Annual Winter KW Saved	52	52	52

Test Results	**NPV**	**B/C**
Ratepayer Impact Measure Test	$160,594	1.29
Utility Cost Test	$600,425	5.87
Societal Test	$1,211,265	6.57
Participant Test	$773,227	5.69
Total Resource Cost Test	$515,482	3.47

Table 1
Ratepayer Impact Test

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

t	Year	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2018	307,045	$0.02987	$9,171	$0.00000	$0	58	58	116	$100.80	$11,693	$20,864	$0.06942	95,000	190,000	285,000	$11,992	$15,829	$28,500	$56,321	($35,457)
2	2019	614,090	0.03164	19,430	0.00000	0	116	116	232	103.82	24,086	43,516	0.07254	190,000	380,000	570,000	25,062	15,426	28,500	68,988	(25,472)
3	2020	921,135	0.03271	30,130	0.00000	0	175	175	350	106.94	37,429	67,559	0.07581	285,000	570,000	855,000	39,288	15,323	28,500	83,111	(15,552)
4	2021	921,135	0.03432	31,613	0.00000	0	175	175	350	110.15	38,553	70,166	0.07922	285,000	570,000	855,000	41,055	0	0	41,055	29,111
5	2022	921,135	0.03616	33,308	0.00000	0	175	175	350	113.45	39,708	73,016	0.08278	285,000	570,000	855,000	42,900	0	0	42,900	30,116
6	2023	921,135	0.03780	34,819	0.00000	0	175	175	350	116.85	40,898	75,717	0.08651	285,000	570,000	855,000	44,833	0	0	44,833	30,884
7	2024	921,135	0.03996	36,809	0.00000	0	175	175	350	120.36	42,126	78,935	0.09040	285,000	570,000	855,000	46,849	0	0	46,849	32,086
8	2025	921,135	0.04202	38,706	0.00000	0	175	175	350	123.97	43,390	82,096	0.09447	285,000	570,000	855,000	48,958	0	0	48,958	33,138
9	2026	921,135	0.04383	40,373	0.00000	0	175	175	350	127.69	44,692	85,065	0.09872	285,000	570,000	855,000	51,160	0	0	51,160	33,905
10	2027	921,135	0.04514	41,580	0.00000	0	175	175	350	131.52	46,032	87,612	0.10316	285,000	570,000	855,000	53,461	0	0	53,461	34,151
11	2028	921,135	0.04649	42,824	0.00000	0	175	175	350	135.47	47,415	90,239	0.10781	285,000	570,000	855,000	55,871	0	0	55,871	34,368
12	2029	921,135	0.04788	44,104	0.00000	0	175	175	350	139.53	48,836	92,940	0.11266	285,000	570,000	855,000	58,385	0	0	58,385	34,555
13	2030	921,135	0.04932	45,430	0.00000	0	175	175	350	143.72	50,302	95,732	0.11773	285,000	570,000	855,000	61,012	0	0	61,012	34,720
14	2031	921,135	0.05080	46,794	0.00000	0	175	175	350	148.03	51,811	98,605	0.12302	285,000	570,000	855,000	63,754	0	0	63,754	34,851
15	2032	921,135	0.05232	48,194	0.00000	0	175	175	350	152.47	53,365	101,559	0.12856	285,000	570,000	855,000	66,625	0	0	66,625	34,934
16	2033	614,090	0.05389	33,093	0.00000	0	116	116	232	157.04	36,433	69,526	0.13435	190,000	380,000	570,000	46,417	0	0	46,417	23,109
17	2034	307,045	0.05551	17,044	0.00000	0	58	58	116	161.75	18,763	35,807	0.14039	95,000	190,000	285,000	24,252	0	0	24,252	11,555
18	2035	0	0.05718	0	0.00000	0	0	0	0	166.61	0	0	0.14671	0	0	0	0	0	0	0	0
19	2036	0	0.05890	0	0.00000	0	0	0	0	171.60	0	0	0.15331	0	0	0	0	0	0	0	0
20	2037	0	0.06067	0	0.00000	0	0	0	0	176.75	0	0	0.16021	0	0	0	0	0	0	0	0
	Total =	13,817,025							5,246		NPV =	$1,268,954				12,825,000				$913,952	$355,002
												$723,759								$563,165	160,594

Total NPV = $160,594
Benefit/Cost Ratio = 1.29

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

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$9,171	$0	$11,693	$20,864	$44,329	$44,329	($23,465)
2019	19,430	0	24,086	43,516	43,926	43,926	(410)
2020	30,130	0	37,429	67,559	43,823	43,823	23,736
2021	31,613	0	38,553	70,166	0	0	70,166
2022	33,308	0	39,708	73,016	0	0	73,016
2023	34,819	0	40,898	75,717	0	0	75,717
2024	36,809	0	42,126	78,935	0	0	78,935
2025	38,706	0	43,390	82,096	0	0	82,096
2026	40,373	0	44,692	85,065	0	0	85,065
2027	41,580	0	46,032	87,612	0	0	87,612
2028	42,824	0	47,415	90,239	0	0	90,239
2029	44,104	0	48,836	92,940	0	0	92,940
2030	45,430	0	50,302	95,732	0	0	95,732
2031	46,794	0	51,811	98,605	0	0	98,605
2032	48,194	0	53,365	101,559	0	0	101,559
2033	33,093	0	36,433	69,526	0	0	69,526
2034	17,044	0	18,763	35,807	0	0	35,807
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$1,268,954		$132,078	$1,136,876
			NPV =	$723,759		$123,334	600,425

Total NPV = $600,425
Benefit/Cost Ratio = 5.87

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**

	Benefits					Costs			Annual
Year	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)	Benefits Less Costs (I)
2018	$9,171	$0	$11,693	$6,597	$27,461	$44,329	$30,330	$74,659	($47,198)
2019	19,430	0	24,086	14,173	57,689	43,926	30,330	74,256	(16,567)
2020	30,130	0	37,429	22,664	90,223	43,823	30,330	74,153	16,070
2021	31,613	0	38,553	24,245	94,411	0	0	0	94,411
2022	33,308	0	39,708	25,986	99,002	0	0	0	99,002
2023	34,819	0	40,898	27,756	103,473	0	0	0	103,473
2024	36,809	0	42,126	29,804	108,739	0	0	0	108,739
2025	38,706	0	43,390	31,927	114,023	0	0	0	114,023
2026	40,373	0	44,692	34,074	119,139	0	0	0	119,139
2027	41,580	0	46,032	36,147	123,759	0	0	0	123,759
2028	42,824	0	47,415	38,348	128,587	0	0	0	128,587
2029	44,104	0	48,836	40,681	133,621	0	0	0	133,621
2030	45,430	0	50,302	43,160	138,892	0	0	0	138,892
2031	46,794	0	51,811	45,789	144,394	0	0	0	144,394
2032	48,194	0	53,365	48,575	150,134	0	0	0	150,134
2033	33,093	0	36,433	34,252	103,778	0	0	0	103,778
2034	17,044	0	18,763	18,169	53,976	0	0	0	53,976
2035	0	0	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$1,791,301			$223,068	$1,568,233
				NPV =	$1,428,575			$217,310	1,211,265

Total NPV = $1,211,265
Benefit/Cost Ratio = 6.57

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

	Benefits													Costs			Annual
Year	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)	Benefits Less Costs (P)
2018	$28,500	$0.10744	$0.09117	95,000	190,000	285,000	$27,529	52	52	$0.000	$0.000	$0	$0	$56,029	$59,465	$0	$59,465	($3,436)
2019	28,500	0.11227	0.09527	190,000	380,000	570,000	57,534	103	103	0.000	0.000	0	0	86,034	60,108	0	60,108	25,926
2020	28,500	0.11732	0.09956	285,000	570,000	855,000	90,185	155	155	0.000	0.000	0	0	118,685	60,757	0	60,757	57,928
2021	0	0.12260	0.10404	285,000	570,000	855,000	94,244	155	155	0.000	0.000	0	0	94,244	0	0	0	94,244
2022	0	0.12812	0.10872	285,000	570,000	855,000	98,485	155	155	0.000	0.000	0	0	98,485	0	0	0	98,485
2023	0	0.13389	0.11361	285,000	570,000	855,000	102,916	155	155	0.000	0.000	0	0	102,916	0	0	0	102,916
2024	0	0.13991	0.11872	285,000	570,000	855,000	107,545	155	155	0.000	0.000	0	0	107,545	0	0	0	107,545
2025	0	0.14621	0.12406	285,000	570,000	855,000	112,384	155	155	0.000	0.000	0	0	112,384	0	0	0	112,384
2026	0	0.15279	0.12965	285,000	570,000	855,000	117,446	155	155	0.000	0.000	0	0	117,446	0	0	0	117,446
2027	0	0.15966	0.13548	285,000	570,000	855,000	122,727	155	155	0.000	0.000	0	0	122,727	0	0	0	122,727
2028	0	0.16685	0.14158	285,000	570,000	855,000	128,253	155	155	0.000	0.000	0	0	128,253	0	0	0	128,253
2029	0	0.17435	0.14795	285,000	570,000	855,000	134,021	155	155	0.000	0.000	0	0	134,021	0	0	0	134,021
2030	0	0.18220	0.15461	285,000	570,000	855,000	140,055	155	155	0.000	0.000	0	0	140,055	0	0	0	140,055
2031	0	0.19040	0.16156	285,000	570,000	855,000	146,353	155	155	0.000	0.000	0	0	146,353	0	0	0	146,353
2032	0	0.19897	0.16883	285,000	570,000	855,000	152,940	155	155	0.000	0.000	0	0	152,940	0	0	0	152,940
2033	0	0.20792	0.17643	190,000	380,000	570,000	106,548	103	103	0.000	0.000	0	0	106,548	0	0	0	106,548
2034	0	0.21728	0.18437	95,000	190,000	285,000	55,672	52	52	0.000	0.000	0	0	55,672	0	0	0	55,672
2035	0	0.22705	0.19267	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.23727	0.20134	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.24795	0.21040	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				4,275,000	8,550,000			2,325	2,325					$1,880,337			$180,330	$1,700,007
													NPV =	$937,987			$164,760	773,227

Total NPV = $773,227
Benefit/Cost Ratio = 5.69

Worksheet Calculations

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

Table 5
Total Resource Cost Test

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

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$9,171	$11,693	$20,864	$44,329	$30,330	$74,659	($53,795)
2019	19,430	24,086	43,516	43,926	30,330	74,256	(30,740)
2020	30,130	37,429	67,559	43,823	30,330	74,153	(6,594)
2021	31,613	38,553	70,166	0	0	0	70,166
2022	33,308	39,708	73,016	0	0	0	73,016
2023	34,819	40,898	75,717	0	0	0	75,717
2024	36,809	42,126	78,935	0	0	0	78,935
2025	38,706	43,390	82,096	0	0	0	82,096
2026	40,373	44,692	85,065	0	0	0	85,065
2027	41,580	46,032	87,612	0	0	0	87,612
2028	42,824	47,415	90,239	0	0	0	90,239
2029	44,104	48,836	92,940	0	0	0	92,940
2030	45,430	50,302	95,732	0	0	0	95,732
2031	46,794	51,811	98,605	0	0	0	98,605
2032	48,194	53,365	101,559	0	0	0	101,559
2033	33,093	36,433	69,526	0	0	0	69,526
2034	17,044	18,763	35,807	0	0	0	35,807
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$1,268,954			$223,068	$1,045,886
		NPV =	$723,759			$208,277	515,482

Total NPV = $515,482
Benefit/Cost Ratio = 3.47

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**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.09178
Retail Rate Winter ($/kWh) =	$0.08260
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.00000
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost ($/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) =	$0.07799
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/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 =	9.69%
9) Utility Discount Rate =	7.22%
10) Societal Discount Rate =	2.68%
11) General Input Data Year =	2017
12) Project Analysis Year 1 =	2018
Project Analysis Year 2 =	2019
Project Analysis Year 3 =	2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$5,014	$6,246	$9,809
Incentive Costs =	5,700	8,550	14,250
Total Utility Project Costs =	$10,714	$14,796	$24,059
14) Direct Participant Costs ($/Part.) =	$5,883	$5,883	$5,883
Escalation Rate =	1.08%	1.08%	1.08%
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 =	5.150	5.150	5.150
16a) Avg Winter kW/part Saved =	5.150	5.150	5.150
17) Avg. Summer kWh/Part. Saved =	9,500	9,500	9,500
17a) Avg. Winter kWh/Part. Saved =	19,000	19,000	19,000
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 =	$2,850	$2,850	$2,850
21) Effective Federal & State Income Tax Rate =			39.39%
22) Annual Summer Kwh Saved	19,000	28,500	47,500
Annual Winter Kwh Saved	38,000	57,000	95,000
23) Annual Summer KW Saved	10	15	26
Annual Winter KW Saved	10	15	26

Test Results	**NPV**	**B/C**
Ratepayer Impact Measure Test	$21,986	1.10
Utility Cost Test	$192,744	5.25
Societal Test	$400,176	6.18
Participant Test	$233,520	5.36
Total Resource Cost Test	$165,024	3.26

Table 1
Ratepayer Impact Test

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

t	Year	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2018	61,409	$0.02987	$1,834	$0.00000	$0	12	12	24	$100.80	$2,419	$4,253	$0.08150	19,000	38,000	57,000	$2,816	$5,014	$5,700	$13,530	($9,277)
2	2019	153,522	0.03164	4,857	0.00000	0	29	29	58	103.82	6,022	10,879	0.08517	47,500	95,000	142,500	7,356	6,246	8,550	22,152	(11,273)
3	2020	307,045	0.03271	10,043	0.00000	0	58	58	116	106.94	12,405	22,448	0.08900	95,000	190,000	285,000	15,374	9,809	14,250	39,433	(16,985)
4	2021	307,045	0.03432	10,538	0.00000	0	58	58	116	110.15	12,777	23,315	0.09300	95,000	190,000	285,000	16,065	0	0	16,065	7,250
5	2022	307,045	0.03616	11,103	0.00000	0	58	58	116	113.45	13,160	24,263	0.09719	95,000	190,000	285,000	16,789	0	0	16,789	7,474
6	2023	307,045	0.03780	11,606	0.00000	0	58	58	116	116.85	13,555	25,161	0.10156	95,000	190,000	285,000	17,544	0	0	17,544	7,617
7	2024	307,045	0.03996	12,270	0.00000	0	58	58	116	120.36	13,962	26,232	0.10613	95,000	190,000	285,000	18,333	0	0	18,333	7,899
8	2025	307,045	0.04202	12,902	0.00000	0	58	58	116	123.97	14,381	27,283	0.11091	95,000	190,000	285,000	19,159	0	0	19,159	8,124
9	2026	307,045	0.04383	13,458	0.00000	0	58	58	116	127.69	14,812	28,270	0.11590	95,000	190,000	285,000	20,021	0	0	20,021	8,249
10	2027	307,045	0.04514	13,860	0.00000	0	58	58	116	131.52	15,256	29,116	0.12112	95,000	190,000	285,000	20,923	0	0	20,923	8,193
11	2028	307,045	0.04649	14,275	0.00000	0	58	58	116	135.47	15,715	29,990	0.12657	95,000	190,000	285,000	21,864	0	0	21,864	8,126
12	2029	307,045	0.04788	14,701	0.00000	0	58	58	116	139.53	16,185	30,886	0.13226	95,000	190,000	285,000	22,847	0	0	22,847	8,039
13	2030	307,045	0.04932	15,143	0.00000	0	58	58	116	143.72	16,672	31,815	0.13821	95,000	190,000	285,000	23,875	0	0	23,875	7,940
14	2031	307,045	0.05080	15,598	0.00000	0	58	58	116	148.03	17,171	32,769	0.14443	95,000	190,000	285,000	24,950	0	0	24,950	7,819
15	2032	307,045	0.05232	16,065	0.00000	0	58	58	116	152.47	17,687	33,752	0.15093	95,000	190,000	285,000	26,072	0	0	26,072	7,680
16	2033	245,636	0.05389	13,237	0.00000	0	47	47	94	157.04	14,762	27,999	0.15772	76,000	152,000	228,000	21,796	0	0	21,796	6,203
17	2034	153,522	0.05551	8,522	0.00000	0	29	29	58	161.75	9,382	17,904	0.16482	47,500	95,000	142,500	14,236	0	0	14,236	3,668
18	2035	0	0.05718	0	0.00000	0	0	0	0	166.61	0	0	0.17224	0	0	0	0	0	0	0	0
19	2036	0	0.05890	0	0.00000	0	0	0	0	171.60	0	0	0.17999	0	0	0	0	0	0	0	0
20	2037	0	0.06067	0	0.00000	0	0	0	0	203.27	0	0	0.18809	0	0	0	0	0	0	0	0
	Total =	4,605,674							1,742		NPV =	$426,335				4,275,000				$359,589	$66,746
												$238,146								$216,160	21,986

Total NPV = $21,986
Benefit/Cost Ratio = 1.10

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

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$1,834	$0	$2,419	$4,253	$10,714	$10,714	($6,461)
2019	4,857	0	6,022	10,879	14,796	14,796	(3,917)
2020	10,043	0	12,405	22,448	24,059	24,059	(1,611)
2021	10,538	0	12,777	23,315	0	0	23,315
2022	11,103	0	13,160	24,263	0	0	24,263
2023	11,606	0	13,555	25,161	0	0	25,161
2024	12,270	0	13,962	26,232	0	0	26,232
2025	12,902	0	14,381	27,283	0	0	27,283
2026	13,458	0	14,812	28,270	0	0	28,270
2027	13,860	0	15,256	29,116	0	0	29,116
2028	14,275	0	15,715	29,990	0	0	29,990
2029	14,701	0	16,185	30,886	0	0	30,886
2030	15,143	0	16,672	31,815	0	0	31,815
2031	15,598	0	17,171	32,769	0	0	32,769
2032	16,065	0	17,687	33,752	0	0	33,752
2033	13,237	0	14,762	27,999	0	0	27,999
2034	8,522	0	9,382	17,904	0	0	17,904
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$426,335		$49,569	$376,766
			NPV =	$238,146		$45,402	192,744

Total NPV = $192,744
Benefit/Cost Ratio = 5.25

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**

	Benefits					Costs			Annual
Year	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)	Benefits Less Costs (I)
2018	$1,834	$0	$2,419	$1,345	$5,598	$10,714	$6,066	$16,780	($11,182)
2019	4,857	0	6,022	3,543	14,422	14,796	9,099	23,895	(9,473)
2020	10,043	0	12,405	7,531	29,979	24,059	15,165	39,224	(9,245)
2021	10,538	0	12,777	8,056	31,371	0	0	0	31,371
2022	11,103	0	13,160	8,635	32,898	0	0	0	32,898
2023	11,606	0	13,555	9,223	34,384	0	0	0	34,384
2024	12,270	0	13,962	9,904	36,136	0	0	0	36,136
2025	12,902	0	14,381	10,610	37,893	0	0	0	37,893
2026	13,458	0	14,812	11,324	39,594	0	0	0	39,594
2027	13,860	0	15,256	12,013	41,129	0	0	0	41,129
2028	14,275	0	15,715	12,745	42,735	0	0	0	42,735
2029	14,701	0	16,185	13,519	44,405	0	0	0	44,405
2030	15,143	0	16,672	14,343	46,158	0	0	0	46,158
2031	15,598	0	17,171	15,217	47,986	0	0	0	47,986
2032	16,065	0	17,687	16,143	49,895	0	0	0	49,895
2033	13,237	0	14,762	13,794	41,793	0	0	0	41,793
2034	8,522	0	9,382	9,085	26,989	0	0	0	26,989
2035	0	0	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$603,365			$79,899	$523,466
				NPV =	$477,431			$77,255	400,176

Total NPV = $400,176
Benefit/Cost Ratio = 6.18

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**

	Benefits													Costs			Annual
Year	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)	Benefits Less Costs (P)
2018	$5,700	$0.09591	$0.08632	19,000	38,000	57,000	$5,102	10	10	$0.000	$0.000	$0	$0	$10,802	$11,893	$0	$11,893	($1,091)
2019	8,550	0.10023	0.09020	47,500	95,000	142,500	13,330	26	26	0.000	0.000	0	0	21,880	18,032	0	18,032	3,848
2020	14,250	0.10474	0.09426	95,000	190,000	285,000	27,860	52	52	0.000	0.000	0	0	42,110	30,378	0	30,378	11,732
2021	0	0.10945	0.09850	95,000	190,000	285,000	29,113	52	52	0.000	0.000	0	0	29,113	0	0	0	29,113
2022	0	0.11437	0.10293	95,000	190,000	285,000	30,422	52	52	0.000	0.000	0	0	30,422	0	0	0	30,422
2023	0	0.11952	0.10757	95,000	190,000	285,000	31,793	52	52	0.000	0.000	0	0	31,793	0	0	0	31,793
2024	0	0.12490	0.11241	95,000	190,000	285,000	33,223	52	52	0.000	0.000	0	0	33,223	0	0	0	33,223
2025	0	0.13052	0.11747	95,000	190,000	285,000	34,719	52	52	0.000	0.000	0	0	34,719	0	0	0	34,719
2026	0	0.13639	0.12275	95,000	190,000	285,000	36,280	52	52	0.000	0.000	0	0	36,280	0	0	0	36,280
2027	0	0.14253	0.12828	95,000	190,000	285,000	37,914	52	52	0.000	0.000	0	0	37,914	0	0	0	37,914
2028	0	0.14895	0.13405	95,000	190,000	285,000	39,620	52	52	0.000	0.000	0	0	39,620	0	0	0	39,620
2029	0	0.15565	0.14008	95,000	190,000	285,000	41,402	52	52	0.000	0.000	0	0	41,402	0	0	0	41,402
2030	0	0.16265	0.14638	95,000	190,000	285,000	43,264	52	52	0.000	0.000	0	0	43,264	0	0	0	43,264
2031	0	0.16997	0.15297	95,000	190,000	285,000	45,211	52	52	0.000	0.000	0	0	45,211	0	0	0	45,211
2032	0	0.17762	0.15985	95,000	190,000	285,000	47,245	52	52	0.000	0.000	0	0	47,245	0	0	0	47,245
2033	0	0.18561	0.16705	76,000	152,000	228,000	39,498	41	41	0.000	0.000	0	0	39,498	0	0	0	39,498
2034	0	0.19397	0.17456	47,500	95,000	142,500	25,797	26	26	0.000	0.000	0	0	25,797	0	0	0	25,797
2035	0	0.20269	0.18242	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.21182	0.19063	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.22135	0.19921	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				1,425,000	2,850,000			779	779					$590,293			$60,303	$529,990
													NPV =	$287,100			$53,580	233,520

Total NPV = $233,520
Benefit/Cost Ratio = 5.36

Worksheet Calculations

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

Table 5
Total Resource Cost Test

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

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$1,834	$2,419	$4,253	$10,714	$6,066	$16,780	($12,527)
2019	4,857	6,022	10,879	14,796	9,099	23,895	(13,016)
2020	10,043	12,405	22,448	24,059	15,165	39,224	(16,776)
2021	10,538	12,777	23,315	0	0	0	23,315
2022	11,103	13,160	24,263	0	0	0	24,263
2023	11,606	13,555	25,161	0	0	0	25,161
2024	12,270	13,962	26,232	0	0	0	26,232
2025	12,902	14,381	27,283	0	0	0	27,283
2026	13,458	14,812	28,270	0	0	0	28,270
2027	13,860	15,256	29,116	0	0	0	29,116
2028	14,275	15,715	29,990	0	0	0	29,990
2029	14,701	16,185	30,886	0	0	0	30,886
2030	15,143	16,672	31,815	0	0	0	31,815
2031	15,598	17,171	32,769	0	0	0	32,769
2032	16,065	17,687	33,752	0	0	0	33,752
2033	13,237	14,762	27,999	0	0	0	27,999
2034	8,522	9,382	17,904	0	0	0	17,904
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$426,335			$79,899	$346,436
		NPV =	$238,146			$73,121	165,024

Total NPV = $165,024
Benefit/Cost Ratio = 3.26

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**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.08063
Retail Rate Winter ($/kWh) =	$0.05624
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.00000
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost ($/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) =	$0.06007
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/kW/yr)	$98.46
Reserve Capacity=	14.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.69%
9) Utility Discount Rate =	7.30%
10) Societal Discount Rate =	2.68%
11) General Input Data Year =	2017
12) Project Analysis Year 1 =	2018
Project Analysis Year 2 =	2019
Project Analysis Year 3 =	2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$1,826	$1,568	$2,232
Incentive Costs =	20,000	30,000	50,000
Total Utility Project Costs =	$21,826	$31,568	$52,232
14) Direct Participant Costs ($/Part.) =	$20,000	$20,000	$20,000
Escalation Rate =	1.08%	1.08%	1.08%
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

Test Results	**NPV**	**B/C**
Ratepayer Impact Measure Test	$168,843	1.40
Utility Cost Test	$496,313	6.14
Societal Test	$850,741	5.28
Participant Test	$452,279	3.48
Total Resource Cost Test	$404,922	3.15

Table 1
Ratepayer Impact Test

Project: **Commercial Partnership Program (Custom)**
Program Years: **2016 - 2018**

t	Year	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2018	215,470	$0.02987	$6,436	$0.00000	$0	34	34	68	$115.92	$7,883	$14,319	$0.06277	100,000	100,000	200,000	$7,609	$1,826	$20,000	$29,435	($15,116)
2	2019	538,676	0.03164	17,044	0.00000	0	85	85	170	119.40	20,298	37,342	0.06560	250,000	250,000	500,000	19,881	1,568	30,000	51,449	(14,107)
3	2020	1,077,350	0.03271	35,240	0.00000	0	169	169	338	122.98	41,567	76,807	0.06855	500,000	500,000	1,000,000	41,550	2,232	50,000	93,782	(16,975)
4	2021	1,077,350	0.03432	36,975	0.00000	0	169	169	338	126.67	42,814	79,789	0.07163	500,000	500,000	1,000,000	43,417	0	0	43,417	36,372
5	2022	1,077,350	0.03616	38,957	0.00000	0	169	169	338	130.47	44,099	83,056	0.07486	500,000	500,000	1,000,000	45,375	0	0	45,375	37,681
6	2023	1,077,350	0.03780	40,724	0.00000	0	169	169	338	134.38	45,420	86,144	0.07823	500,000	500,000	1,000,000	47,417	0	0	47,417	38,727
7	2024	1,077,350	0.03996	43,051	0.00000	0	169	169	338	138.41	46,783	89,834	0.08175	500,000	500,000	1,000,000	49,551	0	0	49,551	40,283
8	2025	1,077,350	0.04202	45,270	0.00000	0	169	169	338	142.57	48,189	93,459	0.08543	500,000	500,000	1,000,000	51,781	0	0	51,781	41,678
9	2026	1,077,350	0.04383	47,220	0.00000	0	169	169	338	146.84	49,632	96,852	0.08927	500,000	500,000	1,000,000	54,109	0	0	54,109	42,743
10	2027	1,077,350	0.04514	48,632	0.00000	0	169	169	338	151.25	51,123	99,755	0.09329	500,000	500,000	1,000,000	56,545	0	0	56,545	43,210
11	2028	861,880	0.04649	40,069	0.00000	0	136	136	272	155.79	42,375	82,444	0.09748	400,000	400,000	800,000	47,268	0	0	47,268	35,176
12	2029	538,676	0.04788	25,792	0.00000	0	85	85	170	160.46	27,278	53,070	0.10187	250,000	250,000	500,000	30,873	0	0	30,873	22,197
13	2030	0	0.04932	0	0.00000	0	0	0	0	165.27	0	0	0.10646	0	0	0	0	0	0	0	0
14	2031	0	0.05080	0	0.00000	0	0	0	0	170.23	0	0	0.11125	0	0	0	0	0	0	0	0
15	2032	0	0.05232	0	0.00000	0	0	0	0	175.34	0	0	0.11625	0	0	0	0	0	0	0	0
16	2033	0	0.05389	0	0.00000	0	0	0	0	180.60	0	0	0.12148	0	0	0	0	0	0	0	0
17	2034	0	0.05551	0	0.00000	0	0	0	0	186.02	0	0	0.12695	0	0	0	0	0	0	0	0
18	2035	0	0.05718	0	0.00000	0	0	0	0	191.60	0	0	0.13266	0	0	0	0	0	0	0	0
19	2036	0	0.05890	0	0.00000	0	0	0	0	197.35	0	0	0.13863	0	0	0	0	0	0	0	0
20	2037	0	0.06067	0	0.00000	0	0	0	0	203.27	0	0	0.14487	0	0	0	0	0	0	0	0
Total =		10,773,502							3,384			$892,871				10,000,000				$601,002	$291,869
											NPV =	$592,930								$424,087	168,843

Total NPV = $168,843
Benefit/Cost Ratio = 1.40

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 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 Partnership Program (Custom)**
Program Years: **2016 - 2018**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$6,436	$0	$7,883	$14,319	$21,826	$21,826	($7,507)
2019	17,044	0	20,298	37,342	31,568	31,568	5,774
2020	35,240	0	41,567	76,807	52,232	52,232	24,575
2021	36,975	0	42,814	79,789	0	0	79,789
2022	38,957	0	44,099	83,056	0	0	83,056
2023	40,724	0	45,420	86,144	0	0	86,144
2024	43,051	0	46,783	89,834	0	0	89,834
2025	45,270	0	48,189	93,459	0	0	93,459
2026	47,220	0	49,632	96,852	0	0	96,852
2027	48,632	0	51,123	99,755	0	0	99,755
2028	40,069	0	42,375	82,444	0	0	82,444
2029	25,792	0	27,278	53,070	0	0	53,070
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$892,871		$105,626	$787,245
			NPV =	$592,930		$96,617	496,313

Total NPV = $496,313
Benefit/Cost Ratio = 6.14

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**

	Benefits					Costs			
Year	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)	Annual Benefits Less Costs (I)
2018	$6,436	$0	$7,883	$4,528	$18,847	$21,826	$20,000	$41,826	($22,979)
2019	17,044	0	20,298	12,162	49,504	31,568	30,000	61,568	(12,064)
2020	35,240	0	41,567	25,766	102,573	52,232	50,000	102,232	341
2021	36,975	0	42,814	27,570	107,359	0	0	0	107,359
2022	38,957	0	44,099	29,559	112,615	0	0	0	112,615
2023	40,724	0	45,420	31,578	117,722	0	0	0	117,722
2024	43,051	0	46,783	33,919	123,753	0	0	0	123,753
2025	45,270	0	48,189	36,346	129,805	0	0	0	129,805
2026	47,220	0	49,632	38,796	135,648	0	0	0	135,648
2027	48,632	0	51,123	41,157	140,912	0	0	0	140,912
2028	40,069	0	42,375	35,035	117,479	0	0	0	117,479
2029	25,792	0	27,278	23,229	76,299	0	0	0	76,299
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
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$1,232,516			$205,626	$1,026,890
				NPV =	$1,049,493			$198,752	850,741

Total NPV =	$850,741
Benefit/Cost Ratio =	5.28

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**

	Benefits														Costs			
Year	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)	Annual Benefits Less Costs (P)
2018	$20,000	$0.08426	$0.05877	100,000	100,000	200,000	$14,303	30	30	$0.000	$0.000	$0	$0	$34,303	$40,432	$0	$40,432	($6,129)
2019	30,000	0.08805	0.06142	250,000	250,000	500,000	37,368	75	75	0.000	0.000	0	0	67,368	61,303	0	61,303	6,065
2020	50,000	0.09201	0.06418	500,000	500,000	1,000,000	78,095	150	150	0.000	0.000	0	0	128,095	103,275	0	103,275	24,820
2021	0	0.09615	0.06707	500,000	500,000	1,000,000	81,610	150	150	0.000	0.000	0	0	81,610	0	0	0	81,610
2022	0	0.10048	0.07009	500,000	500,000	1,000,000	85,285	150	150	0.000	0.000	0	0	85,285	0	0	0	85,285
2023	0	0.10500	0.07324	500,000	500,000	1,000,000	89,120	150	150	0.000	0.000	0	0	89,120	0	0	0	89,120
2024	0	0.10973	0.07653	500,000	500,000	1,000,000	93,130	150	150	0.000	0.000	0	0	93,130	0	0	0	93,130
2025	0	0.11466	0.07998	500,000	500,000	1,000,000	97,320	150	150	0.000	0.000	0	0	97,320	0	0	0	97,320
2026	0	0.11982	0.08358	500,000	500,000	1,000,000	101,700	150	150	0.000	0.000	0	0	101,700	0	0	0	101,700
2027	0	0.12522	0.08734	500,000	500,000	1,000,000	106,280	150	150	0.000	0.000	0	0	106,280	0	0	0	106,280
2028	0	0.13085	0.09127	400,000	400,000	800,000	88,848	120	120	0.000	0.000	0	0	88,848	0	0	0	88,848
2029	0	0.13674	0.09538	250,000	250,000	500,000	58,030	75	75	0.000	0.000	0	0	58,030	0	0	0	58,030
2030	0	0.14289	0.09967	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2031	0	0.14932	0.10415	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2032	0	0.15604	0.10884	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.16306	0.11374	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.17040	0.11886	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.17807	0.12420	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.18608	0.12979	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.19446	0.13563	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				5,000,000	5,000,000			1,500	1,500					$1,031,089			$205,010	$826,079
													NPV =	$634,433			$182,154	452,279

Total NPV = $452,279
Benefit/Cost Ratio = 3.48

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Commercial Partnership Program (Custom)**
Project: **2016 - 2018**

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$6,436	$7,883	$14,319	$21,826	$20,000	$41,826	($27,507)
2019	17,044	20,298	37,342	31,568	30,000	61,568	(24,226)
2020	35,240	41,567	76,807	52,232	50,000	102,232	(25,425)
2021	36,975	42,814	79,789	0	0	0	79,789
2022	38,957	44,099	83,056	0	0	0	83,056
2023	40,724	45,420	86,144	0	0	0	86,144
2024	43,051	46,783	89,834	0	0	0	89,834
2025	45,270	48,189	93,459	0	0	0	93,459
2026	47,220	49,632	96,852	0	0	0	96,852
2027	48,632	51,123	99,755	0	0	0	99,755
2028	40,069	42,375	82,444	0	0	0	82,444
2029	25,792	27,278	53,070	0	0	0	53,070
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$892,871			$205,626	$687,245
		NPV =	$592,930			$188,009	404,922

Total NPV =	$404,922
Benefit/Cost Ratio =	3.15

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**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.10281
Retail Rate Winter ($/kWh) =	$0.08724
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.00000
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost ($/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) =	$0.06643
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/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 =	9.69%
9) Utility Discount Rate =	7.36%
10) Societal Discount Rate =	2.68%
11) General Input Data Year =	2017
12) Project Analysis Year 1 =	2018
Project Analysis Year 2 =	2019
Project Analysis Year 3 =	2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$2,770	$2,889	$3,765
Incentive Costs =	50,000	70,000	100,000
Total Utility Project Costs =	$52,770	$72,889	$103,765
14) Direct Participant Costs ($/Part.) =	$20,000	$20,000	$20,000
Escalation Rate =	1.08%	1.08%	1.08%
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

Test Results	**NPV**	**B/C**
Ratepayer Impact Measure Test	$210,037	1.21
Utility Cost Test	$1,008,273	5.78
Societal Test	$1,714,925	4.94
Participant Test	$1,466,181	4.64
Total Resource Cost Test	$806,171	2.95

Table 1
Ratepayer Impact Test

Project: **Commercial Partnership Program (Custom)**
Program Years: **2016 - 2018**

t	Year	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2018	538,676	$0.02987	$16,090	$0.00000	$0	85	85	170	$100.80	$17,136	$33,226	$0.06942	250,000	250,000	500,000	$21,039	$2,770	$50,000	$73,809	($40,583)
2	2019	1,292,820	0.03164	40,905	0.00000	0	203	203	406	103.82	42,151	83,056	0.07254	600,000	600,000	1,200,000	52,762	2,889	70,000	125,651	(42,595)
3	2020	2,370,170	0.03271	77,528	0.00000	0	373	373	746	106.94	79,777	157,305	0.07581	1,100,000	1,100,000	2,200,000	101,091	3,765	100,000	204,856	(47,551)
4	2021	2,370,170	0.03432	81,344	0.00000	0	373	373	746	110.15	82,172	163,516	0.07922	1,100,000	1,100,000	2,200,000	105,638	0	0	105,638	57,878
5	2022	2,370,170	0.03616	85,705	0.00000	0	373	373	746	113.45	84,634	170,339	0.08278	1,100,000	1,100,000	2,200,000	110,385	0	0	110,385	59,954
6	2023	2,370,170	0.03780	89,592	0.00000	0	373	373	746	116.85	87,170	176,762	0.08651	1,100,000	1,100,000	2,200,000	115,359	0	0	115,359	61,403
7	2024	2,370,170	0.03996	94,712	0.00000	0	373	373	746	120.36	89,789	184,501	0.09040	1,100,000	1,100,000	2,200,000	120,546	0	0	120,546	63,955
8	2025	2,370,170	0.04202	99,595	0.00000	0	373	373	746	123.97	92,482	192,077	0.09447	1,100,000	1,100,000	2,200,000	125,973	0	0	125,973	66,104
9	2026	2,370,170	0.04383	103,885	0.00000	0	373	373	746	127.69	95,257	199,142	0.09872	1,100,000	1,100,000	2,200,000	131,641	0	0	131,641	67,501
10	2027	2,370,170	0.04514	106,989	0.00000	0	373	373	746	131.52	98,114	205,103	0.10316	1,100,000	1,100,000	2,200,000	137,561	0	0	137,561	67,542
11	2028	1,831,496	0.04649	85,146	0.00000	0	288	288	576	135.47	78,031	163,177	0.10781	850,000	850,000	1,700,000	111,089	0	0	111,089	52,088
12	2029	1,077,350	0.04788	51,584	0.00000	0	169	169	338	139.53	47,161	98,745	0.11266	500,000	500,000	1,000,000	68,286	0	0	68,286	30,459
13	2030	0	0.04932	0	0.00000	0	0	0	0	143.72	0	0	0.11773	0	0	0	0	0	0	0	0
14	2031	0	0.05080	0	0.00000	0	0	0	0	148.03	0	0	0.12302	0	0	0	0	0	0	0	0
15	2032	0	0.05232	0	0.00000	0	0	0	0	152.47	0	0	0.12856	0	0	0	0	0	0	0	0
16	2033	0	0.05389	0	0.00000	0	0	0	0	157.04	0	0	0.13435	0	0	0	0	0	0	0	0
17	2034	0	0.05551	0	0.00000	0	0	0	0	161.75	0	0	0.14039	0	0	0	0	0	0	0	0
18	2035	0	0.05718	0	0.00000	0	0	0	0	166.61	0	0	0.14671	0	0	0	0	0	0	0	0
19	2036	0	0.05890	0	0.00000	0	0	0	0	171.60	0	0	0.15331	0	0	0	0	0	0	0	0
20	2037	0	0.06067	0	0.00000	0	0	0	0	176.75	0	0	0.16021	0	0	0	0	0	0	0	0
Total =		23,701,702							7,458			$1,826,949				22,000,000				$1,430,794	$396,155
											NPV =	$1,219,109								$1,009,072	210,037

Total NPV = $210,037
Benefit/Cost Ratio = 1.21

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 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 Partnership Program (Custom)**
Program Years: **2016 - 2018**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$16,090	$0	$17,136	$33,226	$52,770	$52,770	($19,544)
2019	40,905	0	42,151	83,056	72,889	72,889	10,167
2020	77,528	0	79,777	157,305	103,765	103,765	53,540
2021	81,344	0	82,172	163,516	0	0	163,516
2022	85,705	0	84,634	170,339	0	0	170,339
2023	89,592	0	87,170	176,762	0	0	176,762
2024	94,712	0	89,789	184,501	0	0	184,501
2025	99,595	0	92,482	192,077	0	0	192,077
2026	103,885	0	95,257	199,142	0	0	199,142
2027	106,989	0	98,114	205,103	0	0	205,103
2028	85,146	0	78,031	163,177	0	0	163,177
2029	51,584	0	47,161	98,745	0	0	98,745
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$1,826,949		$229,424	$1,597,525
			NPV =	$1,219,109		$210,836	1,008,273

Total NPV = $1,008,273
Benefit/Cost Ratio = 5.78

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**

	Benefits					Costs			
Year	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)	Annual Benefits Less Costs (I)
2018	$16,090	$0	$17,136	$10,506	$43,732	$52,770	$50,000	$102,770	($59,038)
2019	40,905	0	42,151	27,051	110,107	72,889	70,000	142,889	(32,782)
2020	77,528	0	79,777	52,771	210,076	103,765	100,000	203,765	6,311
2021	81,344	0	82,172	56,500	220,016	0	0	0	220,016
2022	85,705	0	84,634	60,623	230,962	0	0	0	230,962
2023	89,592	0	87,170	64,796	241,558	0	0	0	241,558
2024	94,712	0	89,789	69,662	254,163	0	0	0	254,163
2025	99,595	0	92,482	74,698	266,775	0	0	0	266,775
2026	103,885	0	95,257	79,769	278,911	0	0	0	278,911
2027	106,989	0	98,114	84,622	289,725	0	0	0	289,725
2028	85,146	0	78,031	69,344	232,521	0	0	0	232,521
2029	51,584	0	47,161	43,222	141,967	0	0	0	141,967
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
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$2,520,513			$449,424	$2,071,089
				NPV =	$2,150,122			$435,197	1,714,925

Total NPV = $1,714,925
Benefit/Cost Ratio = 4.94

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**

	Benefits													Costs			Annual
Year	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)	Benefits Less Costs (P)
2018	$50,000	$0.10744	$0.09117	250,000	250,000	500,000	$49,653	75	75	$0.000	$0.000	$0	$0	$99,653	$101,080	$0	$101,080	($1,427)
2019	70,000	0.11227	0.09527	600,000	600,000	1,200,000	124,524	180	180	0.000	0.000	0	0	194,524	143,040	0	143,040	51,484
2020	100,000	0.11732	0.09956	1,100,000	1,100,000	2,200,000	238,568	330	330	0.000	0.000	0	0	338,568	206,550	0	206,550	132,018
2021	0	0.12260	0.10404	1,100,000	1,100,000	2,200,000	249,304	330	330	0.000	0.000	0	0	249,304	0	0	0	249,304
2022	0	0.12812	0.10872	1,100,000	1,100,000	2,200,000	260,524	330	330	0.000	0.000	0	0	260,524	0	0	0	260,524
2023	0	0.13389	0.11361	1,100,000	1,100,000	2,200,000	272,250	330	330	0.000	0.000	0	0	272,250	0	0	0	272,250
2024	0	0.13991	0.11872	1,100,000	1,100,000	2,200,000	284,493	330	330	0.000	0.000	0	0	284,493	0	0	0	284,493
2025	0	0.14621	0.12406	1,100,000	1,100,000	2,200,000	297,297	330	330	0.000	0.000	0	0	297,297	0	0	0	297,297
2026	0	0.15279	0.12965	1,100,000	1,100,000	2,200,000	310,684	330	330	0.000	0.000	0	0	310,684	0	0	0	310,684
2027	0	0.15966	0.13548	1,100,000	1,100,000	2,200,000	324,654	330	330	0.000	0.000	0	0	324,654	0	0	0	324,654
2028	0	0.16685	0.14158	850,000	850,000	1,700,000	262,166	255	255	0.000	0.000	0	0	262,166	0	0	0	262,166
2029	0	0.17435	0.14795	500,000	500,000	1,000,000	161,150	150	150	0.000	0.000	0	0	161,150	0	0	0	161,150
2030	0	0.18220	0.15461	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2031	0	0.19040	0.16156	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2032	0	0.19897	0.16883	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.20792	0.17643	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.21728	0.18437	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.22705	0.19267	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.23727	0.20134	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.24795	0.21040	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				11,000,000	11,000,000			3,300	3,300					$3,055,267			$450,670	$2,604,597
													NPV =	$1,869,334			$403,153	1,466,181

Total NPV = $1,466,181
Benefit/Cost Ratio = 4.64

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Commercial Partnership Program (Custom)**
Project: **2016 - 2018**

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$16,090	$17,136	$33,226	$52,770	$50,000	$102,770	($69,544)
2019	40,905	42,151	83,056	72,889	70,000	142,889	(59,833)
2020	77,528	79,777	157,305	103,765	100,000	203,765	(46,460)
2021	81,344	82,172	163,516	0	0	0	163,516
2022	85,705	84,634	170,339	0	0	0	170,339
2023	89,592	87,170	176,762	0	0	0	176,762
2024	94,712	89,789	184,501	0	0	0	184,501
2025	99,595	92,482	192,077	0	0	0	192,077
2026	103,885	95,257	199,142	0	0	0	199,142
2027	106,989	98,114	205,103	0	0	0	205,103
2028	85,146	78,031	163,177	0	0	0	163,177
2029	51,584	47,161	98,745	0	0	0	98,745
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$1,826,949			$449,424	$1,377,525
		NPV =	$1,219,109			$412,938	806,171

Total NPV = $806,171
Benefit/Cost Ratio = 2.95

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
SOUTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS

Company: **Montana-Dakota Utilities Co.**
Project: **Commercial Partnership Program (Custom)**
Program Years: **2016 - 2018**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.09178
Retail Rate Winter ($/kWh) =	$0.08260
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.00000
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost ($/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) =	$0.07799
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/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 =	9.69%
9) Utility Discount Rate =	7.22%
10) Societal Discount Rate =	2.68%
11) General Input Data Year =	2017
12) Project Analysis Year 1 =	2018
Project Analysis Year 2 =	2019
Project Analysis Year 3 =	2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$3,797	$2,305	$1,884
Incentive Costs =	10,000	10,000	10,000
Total Utility Project Costs =	$13,797	$12,305	$11,884
14) Direct Participant Costs ($/Part.) =	$20,000	$20,000	$20,000
Escalation Rate =	1.08%	1.08%	1.08%
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

Test Results	**NPV**	**B/C**
Ratepayer Impact Measure Test	$3,621	1.02
Utility Cost Test	$132,185	4.71
Societal Test	$226,171	4.41
Participant Test	$182,995	4.27
Total Resource Cost Test	$104,179	2.64

Table 1
Ratepayer Impact Test

Project: **Commercial Partnership Program (Custom)**
Program Years: **2016 - 2018**

t	Year	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)	Costs: Summer Energy Reduction (K1)	Costs: Winter Energy Reduction (K2)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2018	107,736	$0.02987	$3,218	$0.00000	$0	17	17	34	$100.80	$3,427	$6,645	$0.08150	50,000	50,000	100,000	$4,940	$3,797	$10,000	$18,737	($12,092)
2	2019	215,470	0.03164	6,817	0.00000	0	34	34	68	103.82	7,060	13,877	0.08517	100,000	100,000	200,000	10,325	2,305	10,000	22,630	(8,753)
3	2020	323,206	0.03271	10,572	0.00000	0	51	51	102	106.94	10,908	21,480	0.08900	150,000	150,000	300,000	16,184	1,884	10,000	28,068	(6,588)
4	2021	323,206	0.03432	11,092	0.00000	0	51	51	102	110.15	11,235	22,327	0.09300	150,000	150,000	300,000	16,911	0	0	16,911	5,416
5	2022	323,206	0.03616	11,687	0.00000	0	51	51	102	113.45	11,572	23,259	0.09719	150,000	150,000	300,000	17,673	0	0	17,673	5,586
6	2023	323,206	0.03780	12,217	0.00000	0	51	51	102	116.85	11,919	24,136	0.10156	150,000	150,000	300,000	18,467	0	0	18,467	5,669
7	2024	323,206	0.03996	12,915	0.00000	0	51	51	102	120.36	12,277	25,192	0.10613	150,000	150,000	300,000	19,298	0	0	19,298	5,894
8	2025	323,206	0.04202	13,581	0.00000	0	51	51	102	123.97	12,645	26,226	0.11091	150,000	150,000	300,000	20,168	0	0	20,168	6,058
9	2026	323,206	0.04383	14,166	0.00000	0	51	51	102	127.69	13,024	27,190	0.11590	150,000	150,000	300,000	21,075	0	0	21,075	6,115
10	2027	323,206	0.04514	14,590	0.00000	0	51	51	102	131.52	13,415	28,005	0.12112	150,000	150,000	300,000	22,024	0	0	22,024	5,981
11	2028	215,470	0.04649	10,017	0.00000	0	34	34	68	135.47	9,212	19,229	0.12657	100,000	100,000	200,000	15,343	0	0	15,343	3,886
12	2029	107,736	0.04788	5,158	0.00000	0	17	17	34	139.53	4,744	9,902	0.13226	50,000	50,000	100,000	8,017	0	0	8,017	1,885
13	2030	0	0.04932	0	0.00000	0	0	0	0	143.72	0	0	0.13821	0	0	0	0	0	0	0	0
14	2031	0	0.05080	0	0.00000	0	0	0	0	148.03	0	0	0.14443	0	0	0	0	0	0	0	0
15	2032	0	0.05232	0	0.00000	0	0	0	0	152.47	0	0	0.15093	0	0	0	0	0	0	0	0
16	2033	0	0.05389	0	0.00000	0	0	0	0	157.04	0	0	0.15772	0	0	0	0	0	0	0	0
17	2034	0	0.05551	0	0.00000	0	0	0	0	161.75	0	0	0.16482	0	0	0	0	0	0	0	0
18	2035	0	0.05718	0	0.00000	0	0	0	0	166.61	0	0	0.17224	0	0	0	0	0	0	0	0
19	2036	0	0.05890	0	0.00000	0	0	0	0	171.60	0	0	0.17999	0	0	0	0	0	0	0	0
20	2037	0	0.06067	0	0.00000	0	0	0	0	203.27	0	0	0.18809	0	0	0	0	0	0	0	0
	Total =	3,232,060							1,020			$247,468				3,000,000				$228,411	$19,057
											NPV =	$167,773								$164,152	3,621

Total NPV = $3,621
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) = (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 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 Partnership Program (Custom)**
Program Years: **2016 - 2018**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$3,218	$0	$3,427	$6,645	$13,797	$13,797	($7,152)
2019	6,817	0	7,060	13,877	12,305	12,305	1,572
2020	10,572	0	10,908	21,480	11,884	11,884	9,596
2021	11,092	0	11,235	22,327	0	0	22,327
2022	11,687	0	11,572	23,259	0	0	23,259
2023	12,217	0	11,919	24,136	0	0	24,136
2024	12,915	0	12,277	25,192	0	0	25,192
2025	13,581	0	12,645	26,226	0	0	26,226
2026	14,166	0	13,024	27,190	0	0	27,190
2027	14,590	0	13,415	28,005	0	0	28,005
2028	10,017	0	9,212	19,229	0	0	19,229
2029	5,158	0	4,744	9,902	0	0	9,902
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$247,468		$37,986	$209,482
			NPV =	$167,773		$35,588	132,185

Total NPV = $132,185
Benefit/Cost Ratio = 4.71

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**

	Benefits					Costs			Annual
Year	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)	Benefits Less Costs (I)
2018	$3,218	$0	$3,427	$2,101	$8,746	$13,797	$10,000	$23,797	($15,051)
2019	6,817	0	7,060	4,520	18,397	12,305	10,000	22,305	(3,908)
2020	10,572	0	10,908	7,206	28,686	11,884	10,000	21,884	6,802
2021	11,092	0	11,235	7,715	30,042	0	0	0	30,042
2022	11,687	0	11,572	8,278	31,537	0	0	0	31,537
2023	12,217	0	11,919	8,848	32,984	0	0	0	32,984
2024	12,915	0	12,277	9,512	34,704	0	0	0	34,704
2025	13,581	0	12,645	10,199	36,425	0	0	0	36,425
2026	14,166	0	13,024	10,891	38,081	0	0	0	38,081
2027	14,590	0	13,415	11,554	39,559	0	0	0	39,559
2028	10,017	0	9,212	8,172	27,401	0	0	0	27,401
2029	5,158	0	4,744	4,334	14,236	0	0	0	14,236
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
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$340,798			$67,986	$272,812
				NPV =	$292,447			$66,276	226,171

Total NPV = $226,171
Benefit/Cost Ratio = 4.41

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**

	Benefits														Costs			Annual
Year	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)	Benefits Less Costs (P)
2018	$10,000	$0.09591	$0.08632	50,000	50,000	100,000	$9,112	15	15	$0.000	$0.000	$0	$0	$19,112	$20,216	$0	$20,216	($1,104)
2019	10,000	0.10023	0.09020	100,000	100,000	200,000	19,043	30	30	0.000	0.000	0	0	29,043	20,434	0	20,434	8,609
2020	10,000	0.10474	0.09426	150,000	150,000	300,000	29,850	45	45	0.000	0.000	0	0	39,850	20,655	0	20,655	19,195
2021	0	0.10945	0.09850	150,000	150,000	300,000	31,193	45	45	0.000	0.000	0	0	31,193	0	0	0	31,193
2022	0	0.11437	0.10293	150,000	150,000	300,000	32,595	45	45	0.000	0.000	0	0	32,595	0	0	0	32,595
2023	0	0.11952	0.10757	150,000	150,000	300,000	34,064	45	45	0.000	0.000	0	0	34,064	0	0	0	34,064
2024	0	0.12490	0.11241	150,000	150,000	300,000	35,597	45	45	0.000	0.000	0	0	35,597	0	0	0	35,597
2025	0	0.13052	0.11747	150,000	150,000	300,000	37,199	45	45	0.000	0.000	0	0	37,199	0	0	0	37,199
2026	0	0.13639	0.12275	150,000	150,000	300,000	38,871	45	45	0.000	0.000	0	0	38,871	0	0	0	38,871
2027	0	0.14253	0.12828	150,000	150,000	300,000	40,622	45	45	0.000	0.000	0	0	40,622	0	0	0	40,622
2028	0	0.14895	0.13405	100,000	100,000	200,000	28,300	30	30	0.000	0.000	0	0	28,300	0	0	0	28,300
2029	0	0.15565	0.14008	50,000	50,000	100,000	14,787	15	15	0.000	0.000	0	0	14,787	0	0	0	14,787
2030	0	0.16265	0.14638	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2031	0	0.16997	0.15297	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2032	0	0.17762	0.15985	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.18561	0.16705	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.19397	0.17456	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.20269	0.18242	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.21182	0.19063	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.22135	0.19921	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				1,500,000	1,500,000			450	450					$381,233			$61,305	$319,928
													NPV =	$239,006			$56,012	182,995

Total NPV = $182,995
Benefit/Cost Ratio = 4.27

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Commercial Partnership Program (Custom)**
Project: **2016 - 2018**

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$3,218	$3,427	$6,645	$13,797	$10,000	$23,797	($17,152)
2019	6,817	7,060	13,877	12,305	10,000	22,305	(8,428)
2020	10,572	10,908	21,480	11,884	10,000	21,884	(404)
2021	11,092	11,235	22,327	0	0	0	22,327
2022	11,687	11,572	23,259	0	0	0	23,259
2023	12,217	11,919	24,136	0	0	0	24,136
2024	12,915	12,277	25,192	0	0	0	25,192
2025	13,581	12,645	26,226	0	0	0	26,226
2026	14,166	13,024	27,190	0	0	0	27,190
2027	14,590	13,415	28,005	0	0	0	28,005
2028	10,017	9,212	19,229	0	0	0	19,229
2029	5,158	4,744	9,902	0	0	0	9,902
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$247,468			$67,986	$179,482
		NPV =	$167,773			$63,594	104,179

Total NPV = $104,179
Benefit/Cost Ratio = 2.64

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**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.08063
Retail Rate Winter ($/kWh) =	$0.05624
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.00000
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost ($/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) =	$0.06007
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/kW/yr)	$98.46
Reserve Capacity=	14.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.69%
9) Utility Discount Rate =	7.30%
10) Societal Discount Rate =	2.68%
11) General Input Data Year =	2017
12) Project Analysis Year 1 =	2018
Project Analysis Year 2 =	2019
Project Analysis Year 3 =	2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$66,901	$80,282	$107,042
Incentive Costs =	189,650	227,580	303,440
Direct Program Costs =	0	0	0
Total Utility Project Costs =	$256,551	$307,862	$410,482
14) Direct Participant Costs ($/Part.) =	$0	$0	$0
Escalation Rate =	1.08%	1.08%	1.08%
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 =	895.000	895.000	895.000
16a) Avg Winter kW/part Saved =	0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =	22,375	22,375	22,375
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	6	8
20) Incentive/Participant =	$37,930	$37,930	$37,930
21) Effective Federal & State Income Tax Rate =			39.39%
22) Annual Summer Kwh Saved	111,875	134,250	179,000
Annual Winter Kwh Saved	0	0	0
23) Annual Summer KW Saved	4,475	5,370	7,160
Annual Winter KW Saved	0	0	0

Test Results	**NPV**	**B/C**
Ratepayer Impact Measure Test	$4,728,447	2.58
Utility Cost Test	$4,728,447	2.58
Societal Test	$9,412,434	3.53
Participant Test	$2,029,841	40.52
Total Resource Cost Test	$4,675,824	2.54

Table 1
Ratepayer Impact Test

Project: **Commercial Demand Response Program**
Program Years: **2016 - 2018**

t	Year	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Direct Program Costs (O)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
0	2017																					
1	2018	120,529	$0.02987	$3,600	$0.00000	$0	5,056	0	5,056	$115.92	$586,092	$589,692	$0.06277	111,875	0	111,875	$4,256	$66,901	$189,650	$0	$260,807	$328,885
2	2019	144,634	0.03164	4,576	0.00000	0	6,067	0	6,067	119.40	724,400	728,976	0.06560	134,250	0	134,250	5,338	80,282	227,580	0	313,200	415,776
3	2020	192,846	0.03271	6,308	0.00000	0	8,089	0	8,089	122.98	994,785	1,001,093	0.06855	179,000	0	179,000	7,437	107,042	303,440	0	417,919	583,174
4	2021	192,846	0.03432	6,618	0.00000	0	8,089	0	8,089	126.67	1,024,634	1,031,252	0.07163	179,000	0	179,000	7,772	107,042	303,440	0	418,254	612,998
5	2022	192,846	0.03616	6,973	0.00000	0	8,089	0	8,089	130.47	1,055,372	1,062,345	0.07486	179,000	0	179,000	8,122	107,042	303,440	0	418,604	643,741
6	2023	192,846	0.03780	7,290	0.00000	0	8,089	0	8,089	134.38	1,087,000	1,094,290	0.07823	179,000	0	179,000	8,488	107,042	303,440	0	418,970	675,320
7	2024	192,846	0.03996	7,706	0.00000	0	8,089	0	8,089	138.41	1,119,598	1,127,304	0.08175	179,000	0	179,000	8,870	107,042	303,440	0	419,352	707,952
8	2025	192,846	0.04202	8,103	0.00000	0	8,089	0	8,089	142.57	1,153,249	1,161,352	0.08543	179,000	0	179,000	9,269	107,042	303,440	0	419,751	741,601
9	2026	192,846	0.04383	8,452	0.00000	0	8,089	0	8,089	146.84	1,187,789	1,196,241	0.08927	179,000	0	179,000	9,685	107,042	303,440	0	420,167	776,074
10	2027	192,846	0.04514	8,705	0.00000	0	8,089	0	8,089	151.25	1,223,461	1,232,166	0.09329	179,000	0	179,000	10,122	107,042	303,440	0	420,604	811,562
11	2028	72,317	0.04649	3,362	0.00000	0	3,033	0	3,033	155.79	472,511	475,873	0.09748	67,125	0	67,125	3,966	40,141	113,790	0	157,897	317,976
12	2029	48,212	0.04788	2,308	0.00000	0	2,022	0	2,022	160.46	324,450	326,758	0.10187	44,750	0	44,750	2,763	26,760	75,860	0	105,383	221,375
13	2030	0	0.04932	0	0.00000	0	0	0	0	165.27	0	0	0.10646	0	0	0	0	0	0	0	0	0
14	2031	0	0.05080	0	0.00000	0	0	0	0	170.23	0	0	0.11125	0	0	0	0	0	0	0	0	0
15	2032	0	0.05232	0	0.00000	0	0	0	0	175.34	0	0	0.11625	0	0	0	0	0	0	0	0	0
16	2033	0	0.05389	0	0.00000	0	0	0	0	180.60	0	0	0.12148	0	0	0	0	0	0	0	0	0
17	2034	0	0.05551	0	0.00000	0	0	0	0	186.02	0	0	0.12695	0	0	0	0	0	0	0	0	0
18	2035	0	0.05718	0	0.00000	0	0	0	0	191.60	0	0	0.13266	0	0	0	0	0	0	0	0	0
19	2036	0	0.05890	0	0.00000	0	0	0	0	197.35	0	0	0.13863	0	0	0	0	0	0	0	0	0
20	2037	0	0.06067	0	0.00000	0	0	0	0	203.27	0	0	0.14487	0	0	0	0	0	0	0	0	0
Total =		1,928,460							80,890			$11,027,342				1,790,000					$4,190,908	$6,836,434
											NPV =	$7,713,476									$2,985,029	4,728,447

Total NPV = $4,728,447
Benefit/Cost Ratio = 2.58

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 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 Demand Response Program**
Program Years: **2016 - 2018**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$3,600	$0	$586,092	$589,692	$260,807	$260,807	$328,885
2019	4,576	0	724,400	728,976	313,200	313,200	415,776
2020	6,308	0	994,785	1,001,093	417,919	417,919	583,174
2021	6,618	0	1,024,634	1,031,252	418,254	418,254	612,998
2022	6,973	0	1,055,372	1,062,345	418,604	418,604	643,741
2023	7,290	0	1,087,000	1,094,290	418,970	418,970	675,320
2024	7,706	0	1,119,598	1,127,304	419,352	419,352	707,952
2025	8,103	0	1,153,249	1,161,352	419,751	419,751	741,601
2026	8,452	0	1,187,789	1,196,241	420,167	420,167	776,074
2027	8,705	0	1,223,461	1,232,166	420,604	420,604	811,562
2028	3,362	0	472,511	475,873	157,897	157,897	317,976
2029	2,308	0	324,450	326,758	105,383	105,383	221,375
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$11,027,342		$4,190,908	$6,836,434
			NPV =	$7,713,476		$2,985,029	4,728,447

Total NPV = $4,728,447
Benefit/Cost Ratio = 2.58

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**

	Benefits					Costs			Annual
Year	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)	Benefits Less Costs (I)
2018	$3,600	$0	$586,092	$186,467	$776,159	$260,807	$15,000	$275,807	$500,352
2019	4,576	0	724,400	237,425	966,401	313,200	18,000	331,200	635,201
2020	6,308	0	994,785	335,834	1,336,927	417,919	24,000	441,919	895,008
2021	6,618	0	1,024,634	356,330	1,387,582	418,254	0	418,254	969,328
2022	6,973	0	1,055,372	378,086	1,440,431	418,604	0	418,604	1,021,827
2023	7,290	0	1,087,000	401,138	1,495,428	418,970	0	418,970	1,076,458
2024	7,706	0	1,119,598	425,638	1,552,942	419,352	0	419,352	1,133,590
2025	8,103	0	1,153,249	451,648	1,613,000	419,751	0	419,751	1,193,249
2026	8,452	0	1,187,789	479,173	1,675,414	420,167	0	420,167	1,255,247
2027	8,705	0	1,223,461	508,370	1,740,536	420,604	0	420,604	1,319,932
2028	3,362	0	472,511	202,227	678,100	157,897	0	157,897	520,203
2029	2,308	0	324,450	143,025	469,783	105,383	0	105,383	364,400
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
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$15,132,703			$4,247,908	$10,884,795
				NPV =	$13,138,129			$3,725,695	9,412,434

Total NPV = $9,412,434
Benefit/Cost Ratio = 3.53

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**

	Benefits													Costs			Annual
Year	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)	Benefits Less Costs (P)
				0														
2018	$189,650	$0.08426	$0.05877	111,875	0	111,875	$9,427	4,475	0	$0.000	$0.000	$0	$0	$199,077	$15,000	$0	$15,000	$184,077
2019	227,580	0.08805	0.06142	134,250	0	134,250	11,821	5,370	0	0.000	0.000	0	0	239,401	18,000	0	18,000	221,401
2020	303,440	0.09201	0.06418	179,000	0	179,000	16,470	7,160	0	0.000	0.000	0	0	319,910	24,000	0	24,000	295,910
2021	303,440	0.09615	0.06707	179,000	0	179,000	17,211	7,160	0	0.000	0.000	0	0	320,651	0	0	0	320,651
2022	303,440	0.10048	0.07009	179,000	0	179,000	17,986	7,160	0	0.000	0.000	0	0	321,426	0	0	0	321,426
2023	303,440	0.10500	0.07324	179,000	0	179,000	18,795	7,160	0	0.000	0.000	0	0	322,235	0	0	0	322,235
2024	303,440	0.10973	0.07653	179,000	0	179,000	19,642	7,160	0	0.000	0.000	0	0	323,082	0	0	0	323,082
2025	303,440	0.11466	0.07998	179,000	0	179,000	20,524	7,160	0	0.000	0.000	0	0	323,964	0	0	0	323,964
2026	303,440	0.11982	0.08358	179,000	0	179,000	21,448	7,160	0	0.000	0.000	0	0	324,888	0	0	0	324,888
2027	303,440	0.12522	0.08734	179,000	0	179,000	22,414	7,160	0	0.000	0.000	0	0	325,854	0	0	0	325,854
2028	113,790	0.13085	0.09127	67,125	0	67,125	8,783	2,685	0	0.000	0.000	0	0	122,573	0	0	0	122,573
2029	75,860	0.13674	0.09538	44,750	0	44,750	6,119	1,790	0	0.000	0.000	0	0	81,979	0	0	0	81,979
2030	0	0.14289	0.09967	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2031	0	0.14932	0.10415	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2032	0	0.15604	0.10884	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.16306	0.11374	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.17040	0.11886	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.17807	0.12420	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.18608	0.12979	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.19446	0.13563	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				1,790,000	0			71,600	0					$3,225,040			$57,000	$3,168,040
													NPV =	$2,081,198			$51,357	2,029,841

Total NPV = $2,029,841
Benefit/Cost Ratio = 40.52

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Commercial Demand Response Program**
Project: **2016 - 2018**

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$3,600	$586,092	$589,692	$260,807	$15,000	$275,807	$313,885
2019	4,576	724,400	728,976	313,200	18,000	331,200	397,776
2020	6,308	994,785	1,001,093	417,919	24,000	441,919	559,174
2021	6,618	1,024,634	1,031,252	418,254	0	418,254	612,998
2022	6,973	1,055,372	1,062,345	418,604	0	418,604	643,741
2023	7,290	1,087,000	1,094,290	418,970	0	418,970	675,320
2024	7,706	1,119,598	1,127,304	419,352	0	419,352	707,952
2025	8,103	1,153,249	1,161,352	419,751	0	419,751	741,601
2026	8,452	1,187,789	1,196,241	420,167	0	420,167	776,074
2027	8,705	1,223,461	1,232,166	420,604	0	420,604	811,562
2028	3,362	472,511	475,873	157,897	0	157,897	317,976
2029	2,308	324,450	326,758	105,383	0	105,383	221,375
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$11,027,342			$4,247,908	$6,779,434
		NPV =	$7,713,476			$3,037,652	4,675,824

Total NPV =	$4,675,824
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
NORTH DAKOTA ELECTRIC COST-EFFECTIVENESS ANALYSIS

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

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.10281
Retail Rate Winter ($/kWh) =	$0.08724
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.00000
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost ($/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) =	$0.06643
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/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 =	9.69%
9) Utility Discount Rate =	7.36%
10) Societal Discount Rate =	2.68%
11) General Input Data Year =	2017
12) Project Analysis Year 1 =	2018
Project Analysis Year 2 =	2019
Project Analysis Year 3 =	2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$95,735	$124,872	$154,009
Incentive Costs =	260,406	339,660	418,914
Direct Program Costs =	0	0	0
Total Utility Project Costs =	$356,141	$464,532	$572,923
14) Direct Participant Costs ($/Part.) =	$0	$0	$0
Escalation Rate =	1.08%	1.08%	1.08%
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 =	215.000	215.000	215.000
16a) Avg Winter kW/part Saved =	0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =	5,375	5,375	5,375
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 =	23	30	37
20) Incentive/Participant =	$11,322	$11,322	$11,322
21) Effective Federal & State Income Tax Rate =			39.39%
22) Annual Summer Kwh Saved	123,625	161,250	198,875
Annual Winter Kwh Saved	0	0	0
23) Annual Summer KW Saved	4,945	6,450	7,955
Annual Winter KW Saved	0	0	0

Test Results	**NPV**	**B/C**
Ratepayer Impact Measure Test	$3,305,087	1.79
Utility Cost Test	$3,305,087	1.79
Societal Test	$7,318,799	2.36
Participant Test	$2,798,690	12.50
Total Resource Cost Test	$3,055,790	1.69

Table 1
Ratepayer Impact Test

Project: **Commercial Demand Response Program**
Program Years: **2016 - 2018**

t	Year	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Direct Program Costs (O)	Costs: Total Project Costs (P)	Annual Benefits Less Costs (Q)
1	2018	133,187	$0.02987	$3,978	$0.00000	$0	5,587	0	5,587	$100.80	$563,170	$567,148	$0.06942	123,625	0	123,625	$5,202	$95,735	$260,406	$0	$361,343	$205,805
2	2019	173,723	0.03164	5,497	0.00000	0	7,287	0	7,287	103.82	756,536	762,033	0.07254	161,250	0	161,250	7,090	124,872	339,660	0	471,622	290,411
3	2020	214,258	0.03271	7,008	0.00000	0	8,988	0	8,988	106.94	961,177	968,185	0.07581	198,875	0	198,875	9,138	154,009	418,914	0	582,061	386,124
4	2021	214,258	0.03432	7,353	0.00000	0	8,988	0	8,988	110.15	990,028	997,381	0.07922	198,875	0	198,875	9,549	154,009	418,914	0	582,472	414,909
5	2022	214,258	0.03616	7,748	0.00000	0	8,988	0	8,988	113.45	1,019,689	1,027,437	0.08278	198,875	0	198,875	9,979	154,009	418,914	0	582,902	444,535
6	2023	214,258	0.03780	8,099	0.00000	0	8,988	0	8,988	116.85	1,050,248	1,058,347	0.08651	198,875	0	198,875	10,428	154,009	418,914	0	583,351	474,996
7	2024	214,258	0.03996	8,562	0.00000	0	8,988	0	8,988	120.36	1,081,796	1,090,358	0.09040	198,875	0	198,875	10,897	154,009	418,914	0	583,820	506,538
8	2025	214,258	0.04202	9,003	0.00000	0	8,988	0	8,988	123.97	1,114,242	1,123,245	0.09447	198,875	0	198,875	11,388	154,009	418,914	0	584,311	538,934
9	2026	214,258	0.04383	9,391	0.00000	0	8,988	0	8,988	127.69	1,147,678	1,157,069	0.09872	198,875	0	198,875	11,900	154,009	418,914	0	584,823	572,246
10	2027	214,258	0.04514	9,672	0.00000	0	8,988	0	8,988	131.52	1,182,102	1,191,774	0.10316	198,875	0	198,875	12,435	154,009	418,914	0	585,358	606,416
11	2028	81,071	0.04649	3,769	0.00000	0	3,401	0	3,401	135.47	460,733	464,502	0.10781	75,250	0	75,250	4,917	58,274	158,508	0	221,699	242,803
12	2029	40,535	0.04788	1,941	0.00000	0	1,701	0	1,701	139.53	237,341	239,282	0.11266	37,625	0	37,625	2,569	29,137	79,254	0	110,960	128,322
13	2030	0	0.04932	0	0.00000	0	0	0	0	143.72	0	0	0.11773	0	0	0	0	0	0	0	0	0
14	2031	0	0.05080	0	0.00000	0	0	0	0	148.03	0	0	0.12302	0	0	0	0	0	0	0	0	0
15	2032	0	0.05232	0	0.00000	0	0	0	0	152.47	0	0	0.12856	0	0	0	0	0	0	0	0	0
16	2033	0	0.05389	0	0.00000	0	0	0	0	157.04	0	0	0.13435	0	0	0	0	0	0	0	0	0
17	2034	0	0.05551	0	0.00000	0	0	0	0	161.75	0	0	0.14039	0	0	0	0	0	0	0	0	0
18	2035	0	0.05718	0	0.00000	0	0	0	0	166.61	0	0	0.14671	0	0	0	0	0	0	0	0	0
19	2036	0	0.05890	0	0.00000	0	0	0	0	171.60	0	0	0.15331	0	0	0	0	0	0	0	0	0
20	2037	0	0.06067	0	0.00000	0	0	0	0	176.75	0	0	0.16021	0	0	0	0	0	0	0	0	0
Total =		2,142,580							89,880			$10,646,761				1,988,750					$5,834,722	$4,812,039
											NPV =	$7,476,962									$4,171,875	3,305,087

Total NPV = $3,305,087
Benefit/Cost Ratio = 1.79

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 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 Demand Response Program**
Program Years: **2016 - 2018**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$3,978	$0	$563,170	$567,148	$361,343	$361,343	$205,805
2019	5,497	0	756,536	762,033	471,622	471,622	290,411
2020	7,008	0	961,177	968,185	582,061	582,061	386,124
2021	7,353	0	990,028	997,381	582,472	582,472	414,909
2022	7,748	0	1,019,689	1,027,437	582,902	582,902	444,535
2023	8,099	0	1,050,248	1,058,347	583,351	583,351	474,996
2024	8,562	0	1,081,796	1,090,358	583,820	583,820	506,538
2025	9,003	0	1,114,242	1,123,245	584,311	584,311	538,934
2026	9,391	0	1,147,678	1,157,069	584,823	584,823	572,246
2027	9,672	0	1,182,102	1,191,774	585,358	585,358	606,416
2028	3,769	0	460,733	464,502	221,699	221,699	242,803
2029	1,941	0	237,341	239,282	110,960	110,960	128,322
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$10,646,761		$5,834,722	$4,812,039
			NPV =	$7,476,962		$4,171,875	3,305,087

Total NPV =	$3,305,087
Benefit/Cost Ratio =	1.79

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**

	Benefits					Costs			Annual
Year	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)	Benefits Less Costs (I)
2018	$3,978	$0	$563,170	$179,338	$746,486	$361,343	$69,000	$430,343	$316,143
2019	5,497	0	756,536	248,191	1,010,224	471,622	90,000	561,622	448,602
2020	7,008	0	961,177	324,794	1,292,979	582,061	111,000	693,061	599,918
2021	7,353	0	990,028	344,626	1,342,007	582,472	0	582,472	759,535
2022	7,748	0	1,019,689	365,662	1,393,099	582,902	0	582,902	810,197
2023	8,099	0	1,050,248	387,963	1,446,310	583,351	0	583,351	862,959
2024	8,562	0	1,081,796	411,688	1,502,046	583,820	0	583,820	918,226
2025	9,003	0	1,114,242	436,828	1,560,073	584,311	0	584,311	975,762
2026	9,391	0	1,147,678	463,482	1,620,551	584,823	0	584,823	1,035,728
2027	9,672	0	1,182,102	491,705	1,683,479	585,358	0	585,358	1,098,121
2028	3,769	0	460,733	197,395	661,897	221,699	0	221,699	440,198
2029	1,941	0	237,341	104,736	344,018	110,960	0	110,960	233,058
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
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$14,603,169			$6,104,722	$8,498,447
				NPV =	$12,698,499			$5,379,700	7,318,799

Total NPV = $7,318,799
Benefit/Cost Ratio = 2.36

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**

	Benefits														Costs			Annual
Year	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)	Benefits Less Costs (P)
				0														
2018	$260,406	$0.10744	$0.09117	123,625	0	123,625	$13,282	4,945	0	$2.919	$0.000	$14,434	$0	$288,122	$69,000	$0	$69,000	$219,122
2019	339,660	0.11227	0.09527	161,250	0	161,250	18,104	6,450	0	2.919	0.000	18,828	0	376,592	90,000	0	90,000	286,592
2020	418,914	0.11732	0.09956	198,875	0	198,875	23,332	7,955	0	2.919	0.000	23,221	0	465,467	111,000	0	111,000	354,467
2021	418,914	0.12260	0.10404	198,875	0	198,875	24,382	7,955	0	2.919	0.000	23,221	0	466,517	0	0	0	466,517
2022	418,914	0.12812	0.10872	198,875	0	198,875	25,480	7,955	0	2.919	0.000	23,221	0	467,615	0	0	0	467,615
2023	418,914	0.13389	0.11361	198,875	0	198,875	26,627	7,955	0	2.919	0.000	23,221	0	468,762	0	0	0	468,762
2024	418,914	0.13991	0.11872	198,875	0	198,875	27,825	7,955	0	2.919	0.000	23,221	0	469,960	0	0	0	469,960
2025	418,914	0.14621	0.12406	198,875	0	198,875	29,078	7,955	0	2.919	0.000	23,221	0	471,213	0	0	0	471,213
2026	418,914	0.15279	0.12965	198,875	0	198,875	30,386	7,955	0	2.919	0.000	23,221	0	472,521	0	0	0	472,521
2027	418,914	0.15966	0.13548	198,875	0	198,875	31,752	7,955	0	2.919	0.000	23,221	0	473,887	0	0	0	473,887
2028	158,508	0.16685	0.14158	75,250	0	75,250	12,555	3,010	0	2.919	0.000	8,786	0	179,849	0	0	0	179,849
2029	79,254	0.17435	0.14795	37,625	0	37,625	6,560	1,505	0	2.919	0.000	4,393	0	90,207	0	0	0	90,207
2030	0	0.18220	0.15461	0	0	0	0	0	0	2.919	0.000	0	0	0	0	0	0	0
2031	0	0.19040	0.16156	0	0	0	0	0	0	2.919	0.000	0	0	0	0	0	0	0
2032	0	0.19897	0.16883	0	0	0	0	0	0	2.919	0.000	0	0	0	0	0	0	0
2033	0	0.20792	0.17643	0	0	0	0	0	0	2.919	0.000	0	0	0	0	0	0	0
2034	0	0.21728	0.18437	0	0	0	0	0	0	2.919	0.000	0	0	0	0	0	0	0
2035	0	0.22705	0.19267	0	0	0	0	0	0	2.919	0.000	0	0	0	0	0	0	0
2036	0	0.23727	0.20134	0	0	0	0	0	0	2.919	0.000	0	0	0	0	0	0	0
2037	0	0.24795	0.21040	0	0	0	0	0	0	2.919	0.000	0	0	0	0	0	0	0
Total =				1,988,750	0			79,550	0					$4,690,712			$270,000	$4,420,712
													NPV =	$3,041,994			$243,304	2,798,690

Total NPV = $2,798,690
Benefit/Cost Ratio = 12.50

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Commercial Demand Response Program**
Project: **2016 - 2018**

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$3,978	$563,170	$567,148	$361,343	$69,000	$430,343	$136,805
2019	5,497	756,536	762,033	471,622	90,000	561,622	200,411
2020	7,008	961,177	968,185	582,061	111,000	693,061	275,124
2021	7,353	990,028	997,381	582,472	0	582,472	414,909
2022	7,748	1,019,689	1,027,437	582,902	0	582,902	444,535
2023	8,099	1,050,248	1,058,347	583,351	0	583,351	474,996
2024	8,562	1,081,796	1,090,358	583,820	0	583,820	506,538
2025	9,003	1,114,242	1,123,245	584,311	0	584,311	538,934
2026	9,391	1,147,678	1,157,069	584,823	0	584,823	572,246
2027	9,672	1,182,102	1,191,774	585,358	0	585,358	606,416
2028	3,769	460,733	464,502	221,699	0	221,699	242,803
2029	1,941	237,341	239,282	110,960	0	110,960	128,322
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$10,646,761			$6,104,722	$4,542,039
		NPV =	$7,476,962			$4,421,172	3,055,790

Total NPV = $3,055,790
Benefit/Cost Ratio = 1.69

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**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.09178
Retail Rate Winter ($/kWh) =	$0.08260
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.00000
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost ($/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) =	$0.07799
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/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 =	9.69%
9) Utility Discount Rate =	7.22%
10) Societal Discount Rate =	2.68%
11) General Input Data Year =	2017
12) Project Analysis Year 1 =	2018
Project Analysis Year 2 =	2019
Project Analysis Year 3 =	2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$564	$564	$1,127
Incentive Costs =	1,690	1,690	3,380
Direct Program Costs =	0	0	0
Total Utility Project Costs =	$2,254	$2,254	$4,507
14) Direct Participant Costs ($/Part.) =	$0	$0	$0
Escalation Rate =	1.08%	1.08%	1.08%
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 =	50.000	50.000	50.000
16a) Avg Winter kW/part Saved =	0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =	1,250	1,250	1,250
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	2
20) Incentive/Participant =	$1,690	$1,690	$1,690
21) Effective Federal & State Income Tax Rate =			39.39%
22) Annual Summer Kwh Saved	1,250	1,250	2,500
Annual Winter Kwh Saved	0	0	0
23) Annual Summer KW Saved	50	50	100
Annual Winter KW Saved	0	0	0

Test Results	**NPV**	**B/C**
Ratepayer Impact Measure Test	$59,980	2.85
Utility Cost Test	$59,980	2.85
Societal Test	$108,381	3.08
Participant Test	$15,912	2.48
Total Resource Cost Test	$48,972	2.13

Table 1
Ratepayer Impact Test

Project: **Commercial Demand Response Program**
Program Years: **2016 - 2018**

t	Year	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Direct Program Costs (O)	Costs: Total Project Costs (P)	Annual Benefits Less Costs (Q)
1	2018	1,347	$0.02987	$40	$0.00000	$0	56	0	56	$100.80	$5,645	$5,685	$0.08150	1,250	0	1,250	$62	$564	$1,690	$0	$2,316	$3,369
2	2019	1,347	0.03164	43	0.00000	0	56	0	56	103.82	5,814	5,857	0.08517	1,250	0	1,250	65	564	1,690	0	2,319	3,538
3	2020	2,693	0.03271	88	0.00000	0	113	0	113	106.94	12,084	12,172	0.08900	2,500	0	2,500	135	1,127	3,380	0	4,642	7,530
4	2021	2,693	0.03432	92	0.00000	0	113	0	113	110.15	12,447	12,539	0.09300	2,500	0	2,500	141	1,127	3,380	0	4,648	7,891
5	2022	2,693	0.03616	97	0.00000	0	113	0	113	113.45	12,820	12,917	0.09719	2,500	0	2,500	147	1,127	3,380	0	4,654	8,263
6	2023	2,693	0.03780	102	0.00000	0	113	0	113	116.85	13,204	13,306	0.10156	2,500	0	2,500	154	1,127	3,380	0	4,661	8,645
7	2024	2,693	0.03996	108	0.00000	0	113	0	113	120.36	13,601	13,709	0.10613	2,500	0	2,500	161	1,127	3,380	0	4,668	9,041
8	2025	2,693	0.04202	113	0.00000	0	113	0	113	123.97	14,009	14,122	0.11091	2,500	0	2,500	168	1,127	3,380	0	4,675	9,447
9	2026	2,693	0.04383	118	0.00000	0	113	0	113	127.69	14,429	14,547	0.11590	2,500	0	2,500	176	1,127	3,380	0	4,683	9,864
10	2027	2,693	0.04514	122	0.00000	0	113	0	113	131.52	14,862	14,984	0.12112	2,500	0	2,500	184	1,127	3,380	0	4,691	10,293
11	2028	1,346	0.04649	63	0.00000	0	57	0	57	135.47	7,722	7,785	0.12657	1,250	0	1,250	96	563	1,690	0	2,349	5,436
12	2029	1,346	0.04788	64	0.00000	0	57	0	57	139.53	7,953	8,017	0.13226	1,250	0	1,250	100	563	1,690	0	2,353	5,664
13	2030	0	0.04932	0	0.00000	0	0	0	0	143.72	0	0	0.13821	0	0	0	0	0	0	0	0	0
14	2031	0	0.05080	0	0.00000	0	0	0	0	148.03	0	0	0.14443	0	0	0	0	0	0	0	0	0
15	2032	0	0.05232	0	0.00000	0	0	0	0	152.47	0	0	0.15093	0	0	0	0	0	0	0	0	0
16	2033	0	0.05389	0	0.00000	0	0	0	0	157.04	0	0	0.15772	0	0	0	0	0	0	0	0	0
17	2034	0	0.05551	0	0.00000	0	0	0	0	161.75	0	0	0.16482	0	0	0	0	0	0	0	0	0
18	2035	0	0.05718	0	0.00000	0	0	0	0	166.61	0	0	0.17224	0	0	0	0	0	0	0	0	0
19	2036	0	0.05890	0	0.00000	0	0	0	0	171.60	0	0	0.17999	0	0	0	0	0	0	0	0	0
20	2037	0	0.06067	0	0.00000	0	0	0	0	203.27	0	0	0.18809	0	0	0	0	0	0	0	0	0
Total =		26,930							1,130			$135,640				25,000					$46,659	$88,981
											NPV =	$92,357									$32,377	59,980

Total NPV = $59,980
Benefit/Cost Ratio = 2.85

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 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 Demand Response Program**
Program Years: **2016 - 2018**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$40	$0	$5,645	$5,685	$2,316	$2,316	$3,369
2019	43	0	5,814	5,857	2,319	2,319	3,538
2020	88	0	12,084	12,172	4,642	4,642	7,530
2021	92	0	12,447	12,539	4,648	4,648	7,891
2022	97	0	12,820	12,917	4,654	4,654	8,263
2023	102	0	13,204	13,306	4,661	4,661	8,645
2024	108	0	13,601	13,709	4,668	4,668	9,041
2025	113	0	14,009	14,122	4,675	4,675	9,447
2026	118	0	14,429	14,547	4,683	4,683	9,864
2027	122	0	14,862	14,984	4,691	4,691	10,293
2028	63	0	7,722	7,785	2,349	2,349	5,436
2029	64	0	7,953	8,017	2,353	2,353	5,664
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$135,640		$46,659	$88,981
			NPV =	$92,357		$32,377	59,980

Total NPV = $59,980
Benefit/Cost Ratio = 2.85

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**

	Benefits					Costs			Annual
Year	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)	Benefits Less Costs (I)
2018	$40	$0	$5,645	$1,798	$7,483	$2,316	$3,000	$5,316	$2,167
2019	43	0	5,814	1,908	7,765	2,319	3,000	5,319	2,446
2020	88	0	12,084	4,083	16,255	4,642	6,000	10,642	5,613
2021	92	0	12,447	4,333	16,872	4,648	0	4,648	12,224
2022	97	0	12,820	4,597	17,514	4,654	0	4,654	12,860
2023	102	0	13,204	4,878	18,184	4,661	0	4,661	13,523
2024	108	0	13,601	5,176	18,885	4,668	0	4,668	14,217
2025	113	0	14,009	5,492	19,614	4,675	0	4,675	14,939
2026	118	0	14,429	5,827	20,374	4,683	0	4,683	15,691
2027	122	0	14,862	6,182	21,166	4,691	0	4,691	16,475
2028	63	0	7,722	3,308	11,093	2,349	0	2,349	8,744
2029	64	0	7,953	3,509	11,526	2,353	0	2,353	9,173
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
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$186,731			$58,659	$128,072
				NPV =	$160,452			$52,071	108,381

Total NPV = $108,381
Benefit/Cost Ratio = 3.08

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**

	Benefits													Costs			Annual
Year	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)	Benefits Less Costs (P)
2018	$1,690	$0.09591	$0.08632	1,250	0	1,250	$120	50	0	$2.919	$0.000	$146	$0	$1,956	$3,000	$0	$3,000	($1,044)
2019	1,690	0.10023	0.09020	2,500	0	2,500	251	50	0	2.919	0.000	146	0	2,087	3,000	0	3,000	(913)
2020	3,380	0.10474	0.09426	5,000	0	5,000	524	100	0	2.919	0.000	292	0	4,196	6,000	0	6,000	(1,804)
2021	3,380	0.10945	0.09850	5,000	0	5,000	547	100	0	2.919	0.000	292	0	4,219	0	0	0	4,219
2022	3,380	0.11437	0.10293	5,000	0	5,000	572	100	0	2.919	0.000	292	0	4,244	0	0	0	4,244
2023	3,380	0.11952	0.10757	5,000	0	5,000	598	100	0	2.919	0.000	292	0	4,270	0	0	0	4,270
2024	3,380	0.12490	0.11241	5,000	0	5,000	625	100	0	2.919	0.000	292	0	4,297	0	0	0	4,297
2025	3,380	0.13052	0.11747	5,000	0	5,000	653	100	0	2.919	0.000	292	0	4,325	0	0	0	4,325
2026	3,380	0.13639	0.12275	5,000	0	5,000	682	100	0	2.919	0.000	292	0	4,354	0	0	0	4,354
2027	3,380	0.14253	0.12828	5,000	0	5,000	713	100	0	2.919	0.000	292	0	4,385	0	0	0	4,385
2028	1,690	0.14895	0.13405	3,750	0	3,750	559	50	0	2.919	0.000	146	0	2,395	0	0	0	2,395
2029	1,690	0.15565	0.14008	2,500	0	2,500	389	50	0	2.919	0.000	146	0	2,225	0	0	0	2,225
2030	0	0.16265	0.14638	0	0	0	0	0	0	2.919	0.000	0	0	0	0	0	0	0
2031	0	0.16997	0.15297	0	0	0	0	0	0	2.919	0.000	0	0	0	0	0	0	0
2032	0	0.17762	0.15985	0	0	0	0	0	0	2.919	0.000	0	0	0	0	0	0	0
2033	0	0.18561	0.16705	0	0	0	0	0	0	2.919	0.000	0	0	0	0	0	0	0
2034	0	0.19397	0.17456	0	0	0	0	0	0	2.919	0.000	0	0	0	0	0	0	0
2035	0	0.20269	0.18242	0	0	0	0	0	0	2.919	0.000	0	0	0	0	0	0	0
2036	0	0.21182	0.19063	0	0	0	0	0	0	2.919	0.000	0	0	0	0	0	0	0
2037	0	0.22135	0.19921	0	0	0	0	0	0	2.919	0.000	0	0	0	0	0	0	0
Total =				50,000	0			1,000	0					$42,953			$12,000	$30,953
													NPV =	$26,633			$10,722	15,912

Total NPV = $15,912
Benefit/Cost Ratio = 2.48

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Commercial Demand Response Program**
Project: **2016 - 2018**

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$40	$5,645	$5,685	$2,316	$3,000	$5,316	$369
2019	43	5,814	5,857	2,319	3,000	5,319	538
2020	88	12,084	12,172	4,642	6,000	10,642	1,530
2021	92	12,447	12,539	4,648	0	4,648	7,891
2022	97	12,820	12,917	4,654	0	4,654	8,263
2023	102	13,204	13,306	4,661	0	4,661	8,645
2024	108	13,601	13,709	4,668	0	4,668	9,041
2025	113	14,009	14,122	4,675	0	4,675	9,447
2026	118	14,429	14,547	4,683	0	4,683	9,864
2027	122	14,862	14,984	4,691	0	4,691	10,293
2028	63	7,722	7,785	2,349	0	2,349	5,436
2029	64	7,953	8,017	2,353	0	2,353	5,664
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$135,640			$58,659	$76,981
		NPV =	$92,357			$43,385	48,972

Total NPV = $48,972
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
MONTANA ELECTRIC COST-EFFECTIVENESS ANALYSIS

Company: **Montana-Dakota Utilities Co.**
Project: **Interruptible Rate DR Program**
Program Years: **2016 - 2018**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.08063
Retail Rate Winter ($/kWh) =	$0.05624
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.00000
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost ($/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) =	$0.06007
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/kW/yr)	$98.46
Reserve Capacity=	14.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.69%
9) Utility Discount Rate =	7.30%
10) Societal Discount Rate =	2.68%
11) General Input Data Year =	2017
12) Project Analysis Year 1 =	2018
Project Analysis Year 2 =	2019
Project Analysis Year 3 =	2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$0	$0	$0
Incentive Costs =	0	111,245	111,245
Total Utility Project Costs =	$0	$111,245	$111,245
14) Direct Participant Costs ($/Part.) =	$0	$0	$0
Escalation Rate =	1.08%	1.08%	1.08%
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 =	2,567.000	2,567.000	2,567.000
16a) Avg Winter kW/part Saved =	0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =	64,175	64,175	64,175
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	1
20) Incentive/Participant =	$111,245	$111,245	$111,245
21) Effective Federal & State Income Tax Rate =			39.39%
22) Annual Summer Kwh Saved	0	64,175	64,175
Annual Winter Kwh Saved	0	0	0
23) Annual Summer KW Saved	0	2,567	2,567
Annual Winter KW Saved	0	0	0

Test Results	**NPV**	**B/C**
Ratepayer Impact Measure Test	$1,929,848	3.44
Utility Cost Test	$1,951,025	3.53
Societal Test	$3,670,305	4.47
Participant Test	$666,632	10.81
Total Resource Cost Test	$1,875,435	3.22

Table 1
Ratepayer Impact Test

Project: **Interruptible Rate DR Program**
Program Years: **2016 - 2018**

t	Year	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2018	0	$0.02987	$0	$0.00000	$0	0	0	0	$115.92	$0	$0	$0.06277	0	0	0	$0	$0	$0	$0	$0
2	2019	69,139	0.03164	2,188	0.00000	0	2,900	0	2,900	119.40	346,260	348,448	0.06560	64,175	0	64,175	2,552	0	111,245	113,797	234,651
3	2020	69,139	0.03271	2,262	0.00000	0	2,900	0	2,900	122.98	356,642	358,904	0.06855	64,175	0	64,175	2,666	0	111,245	113,911	244,993
4	2021	69,139	0.03432	2,373	0.00000	0	2,900	0	2,900	126.67	367,343	369,716	0.07163	64,175	0	64,175	2,786	0	111,245	114,031	255,685
5	2022	69,139	0.03616	2,500	0.00000	0	2,900	0	2,900	130.47	378,363	380,863	0.07486	64,175	0	64,175	2,912	0	111,245	114,157	266,706
6	2023	69,139	0.03780	2,613	0.00000	0	2,900	0	2,900	134.38	389,702	392,315	0.07823	64,175	0	64,175	3,043	0	111,245	114,288	278,027
7	2024	69,139	0.03996	2,763	0.00000	0	2,900	0	2,900	138.41	401,389	404,152	0.08175	64,175	0	64,175	3,180	0	111,245	114,425	289,727
8	2025	69,139	0.04202	2,905	0.00000	0	2,900	0	2,900	142.57	413,453	416,358	0.08543	64,175	0	64,175	3,323	0	111,245	114,568	301,790
9	2026	69,139	0.04383	3,030	0.00000	0	2,900	0	2,900	146.84	425,836	428,866	0.08927	64,175	0	64,175	3,472	0	111,245	114,717	314,149
10	2027	69,139	0.04514	3,121	0.00000	0	2,900	0	2,900	151.25	438,625	441,746	0.09329	64,175	0	64,175	3,629	0	111,245	114,874	326,872
11	2028	69,139	0.04649	3,214	0.00000	0	2,900	0	2,900	155.79	451,791	455,005	0.09748	64,175	0	64,175	3,792	0	111,245	115,037	339,968
12	2029	0	0.04788	0	0.00000	0	0	0	0	160.46	0	0	0.10187	0	0	0	0	0	0	0	0
13	2030	0	0.04932	0	0.00000	0	0	0	0	165.27	0	0	0.10646	0	0	0	0	0	0	0	0
14	2031	0	0.05080	0	0.00000	0	0	0	0	170.23	0	0	0.11125	0	0	0	0	0	0	0	0
15	2032	0	0.05232	0	0.00000	0	0	0	0	175.34	0	0	0.11625	0	0	0	0	0	0	0	0
16	2033	0	0.05389	0	0.00000	0	0	0	0	180.60	0	0	0.12148	0	0	0	0	0	0	0	0
17	2034	0	0.05551	0	0.00000	0	0	0	0	186.02	0	0	0.12695	0	0	0	0	0	0	0	0
18	2035	0	0.05718	0	0.00000	0	0	0	0	191.60	0	0	0.13266	0	0	0	0	0	0	0	0
19	2036	0	0.05890	0	0.00000	0	0	0	0	197.35	0	0	0.13863	0	0	0	0	0	0	0	0
20	2037	0	0.06067	0	0.00000	0	0	0	0	203.27	0	0	0.14487	0	0	0	0	0	0	0	0
Total =		691,390							29,000			$3,996,373				641,750				$1,143,805	$2,852,568
											NPV =	$2,721,784								$791,936	1,929,848

Total NPV = $1,929,848
Benefit/Cost Ratio = 3.44

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 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**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$0	$0	$0	$0	$0	$0	$0
2019	2,188	0	346,260	348,448	111,245	111,245	237,203
2020	2,262	0	356,642	358,904	111,245	111,245	247,659
2021	2,373	0	367,343	369,716	111,245	111,245	258,471
2022	2,500	0	378,363	380,863	111,245	111,245	269,618
2023	2,613	0	389,702	392,315	111,245	111,245	281,070
2024	2,763	0	401,389	404,152	111,245	111,245	292,907
2025	2,905	0	413,453	416,358	111,245	111,245	305,113
2026	3,030	0	425,836	428,866	111,245	111,245	317,621
2027	3,121	0	438,625	441,746	111,245	111,245	330,501
2028	3,214	0	451,791	455,005	111,245	111,245	343,760
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$3,996,373		$1,112,450	$2,883,923
			NPV =	$2,721,784		$770,759	1,951,025

Total NPV = $1,951,025
Benefit/Cost Ratio = 3.53

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**

	Benefits					Costs			Annual
Year	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)	Benefits Less Costs (I)
2018	$0	$0	$0	$0	$0	$0	$0	$0	$0
2019	2,188	0	346,260	113,488	461,936	111,245	10,910	122,155	339,781
2020	2,262	0	356,642	120,401	479,305	111,245	10,910	122,155	357,150
2021	2,373	0	367,343	127,748	497,464	111,245	10,910	122,155	375,309
2022	2,500	0	378,363	135,548	516,411	111,245	10,910	122,155	394,256
2023	2,613	0	389,702	143,813	536,128	111,245	10,910	122,155	413,973
2024	2,763	0	401,389	152,596	556,748	111,245	10,910	122,155	434,593
2025	2,905	0	413,453	161,921	578,279	111,245	10,910	122,155	456,124
2026	3,030	0	425,836	171,789	600,655	111,245	10,910	122,155	478,500
2027	3,121	0	438,625	182,257	624,003	111,245	10,910	122,155	501,848
2028	3,214	0	451,791	193,359	648,364	111,245	10,910	122,155	526,209
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
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$5,499,293			$1,221,550	$4,277,743
				NPV =	$4,729,538			$1,059,233	3,670,305

Total NPV = $3,670,305
Benefit/Cost Ratio = 4.47

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**

	Benefits													Costs			Annual
Year	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)	Benefits Less Costs (P)
2018	$0	$0.08426	$0.05877	0	0	0	$0	0	0	$0.000	$0.000	$0	$0	$0	$0	$0	$0	$0
2019	111,245	0.08805	0.06142	64,175	0	64,175	5,651	2,567	0	0.000	0.000	0	0	116,896	10,910	0	10,910	105,986
2020	111,245	0.09201	0.06418	64,175	0	64,175	5,905	2,567	0	0.000	0.000	0	0	117,150	10,910	0	10,910	106,240
2021	111,245	0.09615	0.06707	64,175	0	64,175	6,170	2,567	0	0.000	0.000	0	0	117,415	10,910	0	10,910	106,505
2022	111,245	0.10048	0.07009	64,175	0	64,175	6,448	2,567	0	0.000	0.000	0	0	117,693	10,910	0	10,910	106,783
2023	111,245	0.10500	0.07324	64,175	0	64,175	6,738	2,567	0	0.000	0.000	0	0	117,983	10,910	0	10,910	107,073
2024	111,245	0.10973	0.07653	64,175	0	64,175	7,042	2,567	0	0.000	0.000	0	0	118,287	10,910	0	10,910	107,377
2025	111,245	0.11466	0.07998	64,175	0	64,175	7,358	2,567	0	0.000	0.000	0	0	118,603	10,910	0	10,910	107,693
2026	111,245	0.11982	0.08358	64,175	0	64,175	7,689	2,567	0	0.000	0.000	0	0	118,934	10,910	0	10,910	108,024
2027	111,245	0.12522	0.08734	64,175	0	64,175	8,036	2,567	0	0.000	0.000	0	0	119,281	10,910	0	10,910	108,371
2028	111,245	0.13085	0.09127	64,175	0	64,175	8,397	2,567	0	0.000	0.000	0	0	119,642	10,910	0	10,910	108,732
2029	0	0.13674	0.09538	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2030	0	0.14289	0.09967	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2031	0	0.14932	0.10415	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2032	0	0.15604	0.10884	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.16306	0.11374	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.17040	0.11886	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.17807	0.12420	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.18608	0.12979	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.19446	0.13563	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				641,750	0			25,670	0					$1,181,884			$109,100	$1,072,784
													NPV =	$734,572			$67,939	666,632

Total NPV = $666,632
Benefit/Cost Ratio = 10.81

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Interruptible Rate DR Program**
Project: **2016 - 2018**

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$0	$0	$0	$0	$0	$0	$0
2019	2,188	346,260	348,448	111,245	10,910	122,155	226,293
2020	2,262	356,642	358,904	111,245	10,910	122,155	236,749
2021	2,373	367,343	369,716	111,245	10,910	122,155	247,561
2022	2,500	378,363	380,863	111,245	10,910	122,155	258,708
2023	2,613	389,702	392,315	111,245	10,910	122,155	270,160
2024	2,763	401,389	404,152	111,245	10,910	122,155	281,997
2025	2,905	413,453	416,358	111,245	10,910	122,155	294,203
2026	3,030	425,836	428,866	111,245	10,910	122,155	306,711
2027	3,121	438,625	441,746	111,245	10,910	122,155	319,591
2028	3,214	451,791	455,005	111,245	10,910	122,155	332,850
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$3,996,373			$1,221,550	$2,774,823
		NPV =	$2,721,784			$846,348	1,875,435

Total NPV =	$1,875,435
Benefit/Cost Ratio =	3.22

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**

Input Data

1) Retail Rate Summer ($/kWh) =	$0.10281
Retail Rate Winter ($/kWh) =	$0.08724
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.00000
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost ($/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) =	$0.06643
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/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 =	9.69%
9) Utility Discount Rate =	7.36%
10) Societal Discount Rate =	2.68%
11) General Input Data Year =	2017
12) Project Analysis Year 1 =	2018
Project Analysis Year 2 =	2019
Project Analysis Year 3 =	2020

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$0	$0	$0
Incentive Costs =	667,470	667,470	667,470
Total Utility Project Costs =	$667,470	$667,470	$667,470
14) Direct Participant Costs ($/Part.) =	$0	$0	$0
Escalation Rate =	1.08%	1.08%	1.08%
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 =	2,567.000	2,567.000	2,567.000
16a) Avg Winter kW/part Saved =	0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =	64,175	64,175	64,175
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 =	6	6	6
20) Incentive/Participant =	$111,245	$111,245	$111,245
21) Effective Federal & State Income Tax Rate =			39.39%
22) Annual Summer Kwh Saved	385,050	385,050	385,050
Annual Winter Kwh Saved	0	0	0
23) Annual Summer KW Saved	15,402	15,402	15,402
Annual Winter KW Saved	0	0	0

Test Results	NPV	B/C
Ratepayer Impact Measure Test	$9,700,522	2.90
Utility Cost Test	$9,844,800	2.98
Societal Test	$17,901,737	3.74
Participant Test	$4,447,991	10.95
Total Resource Cost Test	$9,358,179	2.72

Table 1
Ratepayer Impact Test

Project: **Interruptible Rate DR Program**
Program Years: **2016 - 2018**

t	Year	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
0	2017																				
1	2018	414,834	$0.02987	$12,391	$0.00000	$0	17,401	0	17,401	$100.80	$1,754,021	$1,766,412	$0.06942	385,050	0	385,050	$16,202	$0	$667,470	$683,672	$1,082,740
2	2019	414,834	0.03164	13,125	0.00000	0	17,401	0	17,401	103.82	1,806,572	1,819,697	0.07254	385,050	0	385,050	16,930	0	667,470	684,400	1,135,297
3	2020	414,834	0.03271	13,569	0.00000	0	17,401	0	17,401	106.94	1,860,863	1,874,432	0.07581	385,050	0	385,050	17,693	0	667,470	685,163	1,189,269
4	2021	414,834	0.03432	14,237	0.00000	0	17,401	0	17,401	110.15	1,916,720	1,930,957	0.07922	385,050	0	385,050	18,489	0	667,470	685,959	1,244,998
5	2022	414,834	0.03616	15,000	0.00000	0	17,401	0	17,401	113.45	1,974,143	1,989,143	0.08278	385,050	0	385,050	19,320	0	667,470	686,790	1,302,353
6	2023	414,834	0.03780	15,681	0.00000	0	17,401	0	17,401	116.85	2,033,307	2,048,988	0.08651	385,050	0	385,050	20,190	0	667,470	687,660	1,361,328
7	2024	414,834	0.03996	16,577	0.00000	0	17,401	0	17,401	120.36	2,094,384	2,110,961	0.09040	385,050	0	385,050	21,098	0	667,470	688,568	1,422,393
8	2025	414,834	0.04202	17,431	0.00000	0	17,401	0	17,401	123.97	2,157,202	2,174,633	0.09447	385,050	0	385,050	22,048	0	667,470	689,518	1,485,115
9	2026	414,834	0.04383	18,182	0.00000	0	17,401	0	17,401	127.69	2,221,934	2,240,116	0.09872	385,050	0	385,050	23,040	0	667,470	690,510	1,549,606
10	2027	414,834	0.04514	18,726	0.00000	0	17,401	0	17,401	131.52	2,288,580	2,307,306	0.10316	385,050	0	385,050	24,076	0	667,470	691,546	1,615,760
11	2028	0	0.04649	0	0.00000	0	0	0	0	135.47	0	0	0.10781	0	0	0	0	0	0	0	0
12	2029	0	0.04788	0	0.00000	0	0	0	0	139.53	0	0	0.11266	0	0	0	0	0	0	0	0
13	2030	0	0.04932	0	0.00000	0	0	0	0	143.72	0	0	0.11773	0	0	0	0	0	0	0	0
14	2031	0	0.05080	0	0.00000	0	0	0	0	148.03	0	0	0.12302	0	0	0	0	0	0	0	0
15	2032	0	0.05232	0	0.00000	0	0	0	0	152.47	0	0	0.12856	0	0	0	0	0	0	0	0
16	2033	0	0.05389	0	0.00000	0	0	0	0	157.04	0	0	0.13435	0	0	0	0	0	0	0	0
17	2034	0	0.05551	0	0.00000	0	0	0	0	161.75	0	0	0.14039	0	0	0	0	0	0	0	0
18	2035	0	0.05718	0	0.00000	0	0	0	0	166.61	0	0	0.14671	0	0	0	0	0	0	0	0
19	2036	0	0.05890	0	0.00000	0	0	0	0	171.60	0	0	0.15331	0	0	0	0	0	0	0	0
20	2037	0	0.06067	0	0.00000	0	0	0	0	176.75	0	0	0.16021	0	0	0	0	0	0	0	0
Total =		4,148,340							174,010			$20,262,645				3,850,500				$6,873,786	$13,388,859
											NPV =	$14,806,759								$5,106,237	9,700,522

Total NPV = $9,700,522
Benefit/Cost Ratio = 2.90

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 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**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2018	$12,391	$0	$1,754,021	$1,766,412	$667,470	$667,470	$1,098,942
2019	13,125	0	1,806,572	1,819,697	667,470	667,470	1,152,227
2020	13,569	0	1,860,863	1,874,432	667,470	667,470	1,206,962
2021	14,237	0	1,916,720	1,930,957	667,470	667,470	1,263,487
2022	15,000	0	1,974,143	1,989,143	667,470	667,470	1,321,673
2023	15,681	0	2,033,307	2,048,988	667,470	667,470	1,381,518
2024	16,577	0	2,094,384	2,110,961	667,470	667,470	1,443,491
2025	17,431	0	2,157,202	2,174,633	667,470	667,470	1,507,163
2026	18,182	0	2,221,934	2,240,116	667,470	667,470	1,572,646
2027	18,726	0	2,288,580	2,307,306	667,470	667,470	1,639,836
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
Total =				$20,262,645		$6,674,700	$13,587,945
			NPV =	$14,806,759		$4,961,959	9,844,800

Total NPV = $9,844,800
Benefit/Cost Ratio = 2.98

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**

	Benefits					Costs			Annual
Year	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)	Benefits Less Costs (I)
2018	$12,391	$0	$1,754,021	$558,557	$2,324,969	$667,470	$65,459	$732,929	$1,592,040
2019	13,125	0	1,806,572	592,669	2,412,366	667,470	65,459	732,929	1,679,437
2020	13,569	0	1,860,863	628,810	2,503,242	667,470	65,459	732,929	1,770,313
2021	14,237	0	1,916,720	667,206	2,598,163	667,470	65,459	732,929	1,865,234
2022	15,000	0	1,974,143	707,930	2,697,073	667,470	65,459	732,929	1,964,144
2023	15,681	0	2,033,307	751,106	2,800,094	667,470	65,459	732,929	2,067,165
2024	16,577	0	2,094,384	797,038	2,907,999	667,470	65,459	732,929	2,175,070
2025	17,431	0	2,157,202	845,711	3,020,344	667,470	65,459	732,929	2,287,415
2026	18,182	0	2,221,934	897,313	3,137,429	667,470	65,459	732,929	2,404,500
2027	18,726	0	2,288,580	951,954	3,259,260	667,470	65,459	732,929	2,526,331
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
2036	0	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0	0
Total =					$27,660,939			$7,329,290	$20,331,649
				NPV =	$24,427,448			$6,525,711	17,901,737

Total NPV = $17,901,737
Benefit/Cost Ratio = 3.74

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**

	Benefits													Costs			Annual
Year	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)	Benefits Less Costs (P)
2018	$667,470	$0.10744	$0.09117	385,050	0	385,050	$41,370	15,402	0	$0.000	$0.000	$0	$0	$708,840	$65,459	$0	$65,459	$643,381
2019	667,470	0.11227	0.09527	385,050	0	385,050	43,230	15,402	0	0.000	0.000	0	0	710,700	65,459	0	65,459	645,241
2020	667,470	0.11732	0.09956	385,050	0	385,050	45,174	15,402	0	0.000	0.000	0	0	712,644	65,459	0	65,459	647,185
2021	667,470	0.12260	0.10404	385,050	0	385,050	47,207	15,402	0	0.000	0.000	0	0	714,677	65,459	0	65,459	649,218
2022	667,470	0.12812	0.10872	385,050	0	385,050	49,333	15,402	0	0.000	0.000	0	0	716,803	65,459	0	65,459	651,344
2023	667,470	0.13389	0.11361	385,050	0	385,050	51,554	15,402	0	0.000	0.000	0	0	719,024	65,459	0	65,459	653,565
2024	667,470	0.13991	0.11872	385,050	0	385,050	53,872	15,402	0	0.000	0.000	0	0	721,342	65,459	0	65,459	655,883
2025	667,470	0.14621	0.12406	385,050	0	385,050	56,298	15,402	0	0.000	0.000	0	0	723,768	65,459	0	65,459	658,309
2026	667,470	0.15279	0.12965	385,050	0	385,050	58,832	15,402	0	0.000	0.000	0	0	726,302	65,459	0	65,459	660,843
2027	667,470	0.15966	0.13548	385,050	0	385,050	61,477	15,402	0	0.000	0.000	0	0	728,947	65,459	0	65,459	663,488
2028	0	0.16685	0.14158	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2029	0	0.17435	0.14795	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2030	0	0.18220	0.15461	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2031	0	0.19040	0.16156	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2032	0	0.19897	0.16883	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.20792	0.17643	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.21728	0.18437	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.22705	0.19267	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.23727	0.20134	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.24795	0.21040	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				3,850,500	0			154,020	0					$7,183,047			$654,590	$6,528,457
													NPV =	$4,895,120			$447,129	4,447,991

Total NPV = ########
Benefit/Cost Ratio = 10.95

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Interruptible Rate DR Program**
Project: **2016 - 2018**

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
2018	$12,391	$1,754,021	$1,766,412	$667,470	$65,459	$732,929	$1,033,483
2019	13,125	1,806,572	1,819,697	667,470	65,459	732,929	1,086,768
2020	13,569	1,860,863	1,874,432	667,470	65,459	732,929	1,141,503
2021	14,237	1,916,720	1,930,957	667,470	65,459	732,929	1,198,028
2022	15,000	1,974,143	1,989,143	667,470	65,459	732,929	1,256,214
2023	15,681	2,033,307	2,048,988	667,470	65,459	732,929	1,316,059
2024	16,577	2,094,384	2,110,961	667,470	65,459	732,929	1,378,032
2025	17,431	2,157,202	2,174,633	667,470	65,459	732,929	1,441,704
2026	18,182	2,221,934	2,240,116	667,470	65,459	732,929	1,507,187
2027	18,726	2,288,580	2,307,306	667,470	65,459	732,929	1,574,377
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
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
		Total =	$20,262,645			$7,329,290	$12,933,355
		NPV =	$14,806,759			$5,448,580	9,358,179

Total NPV = $9,358,179
Benefit/Cost Ratio = 2.72

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**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.09178
Retail Rate Winter ($/kWh) =	$0.08260
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.00000
Fuel Escalation Rate =	2.80%
2) Avg. System Marginal Energy Cost ($/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) =	$0.07799
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/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 =	9.69%
9) Utility Discount Rate =	7.22%
10) Societal Discount Rate =	2.68%
11) General Input Data Year =	2017
12) Project Analysis Year 1 =	2018
Project Analysis Year 2 =	2019
Project Analysis Year 3 =	2020

	First Year	Second Year	Third Year
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 =	1.08%	1.08%	1.08%
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 =	2,567.000	2,567.000	2,567.000
16a) Avg Winter kW/part Saved =	0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =	64,175	64,175	64,175
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 =	$111,245	$111,245	$111,245
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

Test Results	**NPV**	**B/C**
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	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2018	0	$0.02987	$0	$0.00000	$0	0	0	0	$100.80	$0	$0	$0.08150	0	0	0	$0	$0	$0	$0	$0
2	2019	0	0.03164	0	0.00000	0	0	0	0	103.82	0	0	0.08517	0	0	0	0	0	0	0	0
3	2020	0	0.03271	0	0.00000	0	0	0	0	106.94	0	0	0.08900	0	0	0	0	0	0	0	0
4	2021	0	0.03432	0	0.00000	0	0	0	0	110.15	0	0	0.09300	0	0	0	0	0	0	0	0
5	2022	0	0.03616	0	0.00000	0	0	0	0	113.45	0	0	0.09719	0	0	0	0	0	0	0	0
6	2023	0	0.03780	0	0.00000	0	0	0	0	116.85	0	0	0.10156	0	0	0	0	0	0	0	0
7	2024	0	0.03996	0	0.00000	0	0	0	0	120.36	0	0	0.10613	0	0	0	0	0	0	0	0
8	2025	0	0.04202	0	0.00000	0	0	0	0	123.97	0	0	0.11091	0	0	0	0	0	0	0	0
9	2026	0	0.04383	0	0.00000	0	0	0	0	127.69	0	0	0.11590	0	0	0	0	0	0	0	0
10	2027	0	0.04514	0	0.00000	0	0	0	0	131.52	0	0	0.12112	0	0	0	0	0	0	0	0
11	2028	0	0.04649	0	0.00000	0	0	0	0	135.47	0	0	0.12657	0	0	0	0	0	0	0	0
12	2029	0	0.04788	0	0.00000	0	0	0	0	139.53	0	0	0.13226	0	0	0	0	0	0	0	0
13	2030	0	0.04932	0	0.00000	0	0	0	0	143.72	0	0	0.13821	0	0	0	0	0	0	0	0
14	2031	0	0.05080	0	0.00000	0	0	0	0	148.03	0	0	0.14443	0	0	0	0	0	0	0	0
15	2032	0	0.05232	0	0.00000	0	0	0	0	152.47	0	0	0.15093	0	0	0	0	0	0	0	0
16	2033	0	0.05389	0	0.00000	0	0	0	0	157.04	0	0	0.15772	0	0	0	0	0	0	0	0
17	2034	0	0.05551	0	0.00000	0	0	0	0	161.75	0	0	0.16482	0	0	0	0	0	0	0	0
18	2035	0	0.05718	0	0.00000	0	0	0	0	166.61	0	0	0.17224	0	0	0	0	0	0	0	0
19	2036	0	0.05890	0	0.00000	0	0	0	0	171.60	0	0	0.17999	0	0	0	0	0	0	0	0
20	2037	0	0.06067	0	0.00000	0	0	0	0	203.27	0	0	0.18809	0	0	0	0	0	0	0	0
Total =		0							0			$0				0				$0	$0
											NPV =	$0								$0	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
(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 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**

	Benefits				Costs		
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Annual Benefits Less Costs (G)
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
2036	0	0	0	0	0	0	0
2037	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**

	Benefits					Costs			
Year	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)	Annual Benefits Less Costs (I)
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
2036	0	0	0	0	0	0	0	0	0
2037	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**

	Benefits													Costs			
Year	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)	Annual Benefits Less Costs (P)
2018	$0	$0.09591	$0.08632	0	0	0	$0	0	0	$0.000	$0.000	$0	$0	$0	$0	$0	$0	$0
2019	0	0.10023	0.09020	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2020	0	0.10474	0.09426	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2021	0	0.10945	0.09850	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2022	0	0.11437	0.10293	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2023	0	0.11952	0.10757	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2024	0	0.12490	0.11241	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2025	0	0.13052	0.11747	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2026	0	0.13639	0.12275	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2027	0	0.14253	0.12828	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2028	0	0.14895	0.13405	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2029	0	0.15565	0.14008	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2030	0	0.16265	0.14638	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2031	0	0.16997	0.15297	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2032	0	0.17762	0.15985	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.18561	0.16705	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.19397	0.17456	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.20269	0.18242	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.21182	0.19063	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.22135	0.19921	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				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)
(B) = Retail Summer Rate, escalated.
(C) = Retail Winter Rate, escalated.
(D) = Table 1 (K)
(E) = [Retail Rate (B) or (C)] x (D)
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)
(H) = Retail Summer Demand Rate, escalated.
(I) = Retail Winter Demand Rate, escalated.
(J) = (A) + (D) + (I) + (J)
(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(O) = (L) + (M)
(P) = (K) - (N)

Table 5
Total Resource Cost Test

Company: **Interruptible Rate DR Program**
Project: **2016 - 2018**

	Benefits			Costs			
Year	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)	Benefits Less Costs (G)
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
2036	0	0	0	0	0	0	0
2037	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)