



Integrated Resource Plan 2019



Submitted to the
North Dakota Public Service
Commission July 1, 2019

Volume III: Attachment B

Montana-Dakota Utilities Co.
2019 Integrated Resource Plan

Submitted to the North Dakota Public Service Commission

July 1, 2019

Volume III
Attachment B



**MONTANA-DAKOTA
UTILITIES CO.**

A Subsidiary of MDU Resources Group, Inc.

Attachment B

DEMAND-SIDE ANALYSIS DOCUMENTATION

Demand-Side Analysis

TABLE OF CONTENTS

Overview	1
Energy Efficiency	1
Demand Response	6
DSM Program Overview	6
Residential LED Lighting Program	6
Company-owned Lighting LED Conversion	7
Commercial Lighting Program	7
Commercial Partnership Program.....	8
Commercial Demand Response Program	8
Interruptible Demand Response Rate	9
DSM Methodology	10
Benefit/Cost Analysis	10
Participant Test	11
Ratepayer Test	11
Societal Cost Test	12
Utility Test	12
Total Resource Cost Test (TRC)	13
DSM Model Input Data	13
DSM Model Results	17
Technical Reference Manual (TRM)	18

Appendix A - DSM Analysis Results

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 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.

Energy Efficiency

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.

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 2019 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 1.70% of demand (MW) savings in 2037.

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 0.26 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 0.40 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			Small C&I			Large C&I			Street Lighting		Miscellaneous		Total Sales		
	Sales (MWh)	Achievable EE %	Achievable MWh	Sales (MWh)	Achievable EE %	Achievable MWh	Sales (MWh)	Achievable EE %	Achievable MWh	Sales (MWh)	Achievable EE %	Sales (MWh)	Achievable EE %	Sales (MWh)	Achievable EE %	Achievable MWh
2019	187,248	0.10%	187	139,558	0.10%	140	481,274	0.10%	481	2,486	0.00%	7,579	0.00%	818,145	0.10%	808
2020	188,345	0.10%	188	142,213	0.10%	142	483,294	0.10%	483	2,486	0.00%	7,600	0.00%	823,938	0.10%	814
2021	189,447	0.20%	379	144,909	0.20%	290	512,589	0.10%	513	2,486	0.00%	7,620	0.00%	857,050	0.14%	1,181
2022	190,568	0.20%	381	147,648	0.20%	295	575,812	0.20%	1,152	2,486	0.00%	7,641	0.00%	924,154	0.20%	1,828
2023	191,034	0.20%	382	150,044	0.20%	300	619,331	0.20%	1,239	2,486	0.00%	7,662	0.00%	970,557	0.20%	1,921
2024	191,499	0.30%	574	152,648	0.20%	305	621,994	0.20%	1,244	2,486	0.00%	7,682	0.00%	976,308	0.22%	2,124
2025	191,965	0.30%	576	155,292	0.30%	466	624,699	0.30%	1,874	2,486	0.00%	7,703	0.00%	982,145	0.30%	2,916
2026	192,430	0.30%	577	157,977	0.30%	474	627,449	0.30%	1,882	2,486	0.00%	7,724	0.00%	988,066	0.30%	2,934
2027	192,896	0.30%	579	160,703	0.30%	482	630,243	0.30%	1,891	2,486	0.00%	7,745	0.00%	994,073	0.30%	2,952
2028	193,361	0.30%	580	163,474	0.30%	490	633,084	0.30%	1,899	2,486	0.00%	7,765	0.00%	1,000,170	0.30%	2,970
2029	193,827	0.30%	581	166,281	0.30%	499	635,970	0.30%	1,908	2,486	0.00%	7,786	0.00%	1,006,350	0.30%	2,988
2030	194,292	0.30%	583	169,137	0.30%	507	638,903	0.30%	1,917	2,486	0.00%	7,807	0.00%	1,012,625	0.30%	3,007
2031	194,758	0.30%	584	172,030	0.30%	516	641,883	0.30%	1,926	2,486	0.00%	7,827	0.00%	1,018,983	0.30%	3,026
2032	195,223	0.30%	586	174,966	0.30%	525	644,911	0.30%	1,935	2,486	0.00%	7,848	0.00%	1,025,434	0.30%	3,045
2033	195,689	0.30%	587	177,950	0.30%	534	647,989	0.30%	1,944	2,486	0.00%	7,869	0.00%	1,031,982	0.30%	3,065
2034	196,154	0.30%	588	180,977	0.30%	543	651,117	0.30%	1,953	2,486	0.00%	7,889	0.00%	1,038,622	0.30%	3,085
2035	196,620	0.30%	590	184,043	0.30%	552	654,295	0.30%	1,963	2,486	0.00%	7,910	0.00%	1,045,354	0.30%	3,105
2036	197,085	0.30%	591	187,172	0.30%	562	657,542	0.30%	1,973	2,486	0.00%	7,931	0.00%	1,052,216	0.30%	3,125
2037	197,551	0.30%	593	190,341	0.30%	571	660,841	0.30%	1,983	2,486	0.00%	7,951	0.00%	1,059,170	0.30%	3,146
Cumulative														18,625,346	0.26%	48,039

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

YEAR	Residential Achievable			Small C&I Achievable			Large C&I Achievable			Street Lighting Achievable		Miscellaneous Achievable		Total Sales Achievable		
	Sales (MWh)	EE %	MWh	Sales (MWh)	EE %	MWh	Sales (MWh)	EE %	MWh	Sales (MWh)	EE %	Sales (MWh)	EE %	Sales (MWh)	EE %	MWh
2019	795,141	0.15%	1,193	641,770	0.15%	963	645,758	0.15%	969	13,863	0.00%	51,473	0.00%	2,148,006	0.15%	3,124
2020	800,577	0.15%	1,201	657,294	0.15%	986	655,815	0.15%	984	7,339	0.00%	52,111	0.00%	2,173,137	0.15%	3,171
2021	806,032	0.20%	1,612	672,236	0.20%	1,344	686,803	0.20%	1,374	7,339	0.00%	52,749	0.00%	2,225,160	0.19%	4,330
2022	811,566	0.20%	1,623	688,239	0.20%	1,376	718,678	0.20%	1,437	7,339	0.00%	53,386	0.00%	2,279,209	0.19%	4,437
2023	815,096	0.30%	2,445	703,620	0.30%	2,111	728,546	0.30%	2,186	7,339	0.00%	54,024	0.00%	2,308,626	0.29%	6,742
2024	818,625	0.30%	2,456	720,128	0.30%	2,160	739,324	0.30%	2,218	7,339	0.00%	54,662	0.00%	2,340,078	0.29%	6,834
2025	822,155	0.40%	3,289	735,960	0.40%	2,944	749,542	0.40%	2,998	7,339	0.00%	55,300	0.00%	2,370,296	0.39%	9,231
2026	825,685	0.40%	3,303	752,964	0.40%	3,012	760,693	0.40%	3,043	7,339	0.00%	55,937	0.00%	2,402,618	0.39%	9,357
2027	829,215	0.50%	4,146	770,233	0.50%	3,851	772,043	0.50%	3,860	7,339	0.00%	56,575	0.00%	2,435,405	0.49%	11,857
2028	832,744	0.50%	4,164	787,764	0.50%	3,939	783,596	0.50%	3,918	7,339	0.00%	57,213	0.00%	2,468,656	0.49%	12,021
2029	836,274	0.50%	4,181	805,569	0.50%	4,028	795,355	0.50%	3,977	7,339	0.00%	57,851	0.00%	2,502,388	0.49%	12,186
2030	839,804	0.50%	4,199	823,641	0.50%	4,118	807,324	0.50%	4,037	7,339	0.00%	58,488	0.00%	2,536,596	0.49%	12,354
2031	843,334	0.50%	4,217	841,980	0.50%	4,210	819,506	0.50%	4,098	7,339	0.00%	59,126	0.00%	2,571,285	0.49%	12,524
2032	846,863	0.50%	4,234	860,601	0.50%	4,303	831,905	0.50%	4,160	7,339	0.00%	59,764	0.00%	2,606,472	0.49%	12,697
2033	850,393	0.50%	4,252	879,494	0.50%	4,397	844,526	0.50%	4,223	7,339	0.00%	60,402	0.00%	2,642,154	0.49%	12,872
2034	853,923	0.50%	4,270	898,666	0.50%	4,493	857,372	0.50%	4,287	7,339	0.00%	61,039	0.00%	2,678,340	0.49%	13,050
2035	857,453	0.50%	4,287	918,114	0.50%	4,591	870,447	0.50%	4,352	7,339	0.00%	61,677	0.00%	2,715,030	0.49%	13,230
2036	860,982	0.50%	4,305	938,000	0.50%	4,690	883,821	0.50%	4,419	7,339	0.00%	62,315	0.00%	2,752,458	0.49%	13,414
2037	864,512	0.50%	4,323	958,175	0.50%	4,791	897,434	0.50%	4,487	7,339	0.00%	62,953	0.00%	2,790,413	0.49%	13,601
Cumulative														46,946,325	0.40%	187,031

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

YEAR	Residential			Small C&I			Large C&I			Street Lighting		Miscellaneous		Total Sales		
	Sales (MWh)	Achievable EE %	Achievable MWh	Sales (MWh)	Achievable EE %	Achievable MWh	Sales (MWh)	Achievable EE %	Achievable MWh	Sales (MWh)	EE %	Sales (MWh)	EE %	Sales (MWh)	Achievable EE %	Achievable MWh
2019	68,139	0.05%	34	38,570	0.05%	19	39,724	0.05%	20	2,517	0.00%	1,703	0.00%	150,653	0.05%	73
2020	68,146	0.10%	68	39,025	0.10%	39	40,660	0.10%	41	2,517	0.00%	1,703	0.00%	152,051	0.10%	148
2021	68,152	0.10%	68	39,485	0.10%	39	41,663	0.10%	42	906	0.00%	1,703	0.00%	151,909	0.10%	149
2022	68,162	0.20%	136	39,951	0.20%	80	42,682	0.10%	43	906	0.00%	1,703	0.00%	153,405	0.17%	259
2023	68,162	0.20%	136	40,381	0.20%	81	43,676	0.20%	87	906	0.00%	1,703	0.00%	154,828	0.20%	304
2024	68,162	0.20%	136	40,858	0.20%	82	44,726	0.20%	89	906	0.00%	1,703	0.00%	156,355	0.20%	307
2025	68,152	0.30%	204	41,340	0.20%	83	45,804	0.20%	92	906	0.00%	1,703	0.00%	157,906	0.24%	379
2026	68,152	0.30%	204	41,827	0.30%	125	46,893	0.30%	141	906	0.00%	1,703	0.00%	159,481	0.30%	471
2027	68,142	0.30%	204	42,322	0.30%	127	48,003	0.30%	144	906	0.00%	1,703	0.00%	161,076	0.30%	475
2028	68,131	0.30%	204	42,821	0.30%	128	49,132	0.30%	147	906	0.00%	1,703	0.00%	162,694	0.30%	480
2029	68,121	0.30%	204	43,326	0.30%	130	50,287	0.30%	151	906	0.00%	1,703	0.00%	164,344	0.30%	485
2030	68,110	0.30%	204	43,838	0.30%	132	51,456	0.30%	154	906	0.00%	1,703	0.00%	166,012	0.30%	490
2031	68,100	0.30%	204	44,355	0.30%	133	52,649	0.30%	158	906	0.00%	1,703	0.00%	167,714	0.30%	495
2032	68,079	0.30%	204	44,878	0.30%	135	53,860	0.30%	162	906	0.00%	1,703	0.00%	169,427	0.30%	500
2033	68,069	0.30%	204	45,408	0.30%	136	55,112	0.30%	165	906	0.00%	1,703	0.00%	171,198	0.30%	506
2034	68,048	0.30%	204	45,944	0.30%	138	56,418	0.30%	169	906	0.00%	1,703	0.00%	173,019	0.30%	511
2035	68,027	0.30%	204	46,486	0.30%	139	57,767	0.30%	173	906	0.00%	1,703	0.00%	174,889	0.30%	517
2036	68,006	0.30%	204	47,036	0.30%	141	59,153	0.30%	177	906	0.00%	1,703	0.00%	176,804	0.30%	523
2037	67,996	0.30%	204	47,593	0.30%	143	60,563	0.30%	182	906	0.00%	1,703	0.00%	178,761	0.30%	528
2038	67,996	0.30%	204	47,593	0.30%	143	60,563	0.30%	182	906	0.00%	1,703	0.00%	178,761	0.30%	528
Cumulative														3,281,287	0.25%	8,131

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 2018 combine to offer approximately 40.4 MW of demand response to Montana-Dakota's integrated system. The demand response goal from the two programs is 45 MW by 2021 or 7.1 percent of the total forecasted Integrated System peak demand in 2021.

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

Residential LED Lighting Program

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

The program provides a rebate on a per bulb basis and is available as a mail-in rebate application form.

Program Incentive:

Measure	Incentive Level
Residential LED Lighting (A-line, 40W, 60W 75W and 100W equivalent)	50% of bulb or package cost not to exceed \$5 per bulb
Residential LED Lighting (Globe, Indoor Flood and Outdoor Flood)	50% of bulb or package cost not to exceed \$7 per bulb

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

- Website and social media
- Bill inserts
- Traditional marketing channels

Company-owned Lighting LED Conversion

In 2018, Montana-Dakota began a LED conversion project of its company-owned streetlights. Street Lighting conversion projects have been completed in the company's Montana and North Dakota service territory. Conversion of the company-owned streetlights in the South Dakota service territory will take place in 2020. To date, the completed projects have resulted in an estimated energy savings of 9,340,000 kWh. In addition to the street lighting conversion projects, Montana-Dakota is currently in the process of a LED conversion project for all company-owned flood lights and planning to implement a LED yard light conversion project in 2020.

Commercial Lighting Program

The Commercial Lighting program offers an array of prescriptive rebates to capture most of the common retrofit lighting applications. The prescriptive rebate levels are individually designed to maximize customer participation and cost effectiveness. The program also includes rebates for lighting controls and occupancy sensors that will minimize runtimes. A custom lighting efficiency option also offers rebates for projects that are non-prescriptive, however most applications should be covered in the prescriptive program.

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

Incentive levels are specific to the prescriptive application and first year energy savings for the custom efficiency projects and customer rebates are capped at 50% of the equipment cost. The benefit cost modeling for this program assumes the average customer rebate level will be \$0.04 per kWh saved.

Montana-Dakota will market the program through the following:

- Company Website
- Key account representatives

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 electric 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
- 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.

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

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

where

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

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

Ratepayer Test

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

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

where

$$\begin{aligned} \text{Annual Cost of Energy Saved} &= \text{Energy Savings (kWh)} * \\ &+ \text{Peak Demand Savings (kW)} * \end{aligned}$$

$$\begin{aligned} \text{Annual Project Costs} & \quad + \text{O\&M Savings} \\ & = \text{Total Project Costs} + \text{Lost Margin} \end{aligned}$$

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

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

Societal Cost Test

The Societal Cost Test measures the net costs of a DSM program as a resource option based on the total costs of the program (both the participants' costs and the utility's costs). This test also includes a factor for environmental externalities, which for this analysis is based on a \$30/ton cost of carbon dioxide (CO₂). This test is a summation of the benefit and cost terms in the Participant Test and the Ratepayer Test. The NPV calculation is based on the societal discount rate. The total cost net benefit is calculated by the following equation:

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

where

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

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

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

Utility Test

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

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

where

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

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

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

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

Total Resource Cost Test (TRC)

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

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

where

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

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

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

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

DSM Model Input Data

Montana-Dakota's DSM Model is dependent on the input data to determine the cost-benefit of each program. Recent Company operational and financial data is used for the general model data inputs, and estimated supply cost avoidance is used based on marginal energy costs and capacity costs of adding the next supply resource including reserve requirements and losses. Program specific data is also used for each program being evaluated. The operational, financial, and

program data inputs used for each program model run are provided in Appendix A to this Attachment, and sources of the data are shown in Table B-4.

Also shown in Table B-4 are the inputs for avoided system energy costs and capacity costs applicable to the DSM measures. Avoided energy costs are based on the system marginal energy cost that is projected for the next 10 years and escalated by 0.06 percent annually thereafter. The avoided capacity costs are based on the estimated levelized cost of a combustion turbine. These costs are the same across all three states in Montana-Dakota's Integrated System. The retail energy rate and demand costs vary across the states and are based on the average cost for much 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	\$0.12435	\$0.09800	\$0.11367	\$0.08927	\$0.12455	\$0.09297
	Retail Rate (Winter)	System average retail rate for customer class based	\$0.10438	0.08074	\$0.10201	0.08074	\$0.11323	0.09107
	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, 2019	\$0.02542	\$0.02538	\$0.02536	\$0.02521	\$0.02524	\$0.02524
	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, See Input 24						
	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	\$50.42	\$0.00	\$51.05	\$0.00	\$33.00
3a	Retail Winter Demand Cost (\$/kW/season)	Seasonal demand cost based on program availability	\$0.00	\$89.97	\$0.00	\$78.02	\$0.00	\$58.00
	Escalation Rate		4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
4	Electric Margin (\$/KWh)	Average margin applicable to customer class	\$0.08571	\$0.07001	\$0.08037	\$0.05843	\$0.08975	\$0.02524
	Escalation Rate		4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
5	Avoided Capacity Costs (\$/kW/yr.)	Demand cost based on estimated levelized cost of combustion turbine	\$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	10.32%	10.32%	10.32%	10.32%	10.32%	10.32%
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 December 31, 2018	3.11%	3.11%	3.11%	3.11%	3.11%	3.11%
11	General Input Data Year	2019	2019	2019	2019	2019	2019	2019
12	Project Analysis Yr. 1	Year(s) program will be implemented	2020	2020	2020	2020	2020	2020
	Yr. 2		2021	2021	2021	2021	2021	2021
	Yr. 3		2022	2022	2022	2022	2022	2022
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 (January 2016-December 2018)	1.94%	1.94%	1.94%	1.94%	1.94%	1.94%
	Yr. 2	Consumer Price Index based on 3 yr. average (January 2016-December 2018)	1.94%	1.94%	1.94%	1.94%	1.94%	1.94%
	Yr. 3	Consumer Price Index based on 3 yr. average (January 2016-December 2018)	1.94%	1.94%	1.94%	1.94%	1.94%	1.94%
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	11.900%	11.900%	11.900%	11.900%	11.900%	11.900%
	Yr. 2		11.900%	11.900%	11.900%	11.900%	11.900%	11.900%
	Yr. 3		11.900%	11.900%	11.900%	11.900%	11.900%	11.900%
18b	System Energy Line Loss Factor Yr. 1	Historical energy line loss factor	8.1730%	8.1730%	8.1730%	8.1730%	8.1730%	8.1730%
	Yr. 2		8.1730%	8.1730%	8.1730%	8.1730%	8.1730%	8.1730%
	Yr. 3		8.1730%	8.1730%	8.1730%	8.1730%	8.1730%	8.1730%
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	26.3325%	26.3325%	24.4049%	24.4049%	21.00%	21.00%
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	\$0.03133	\$0.03133	\$0.02724	\$0.02724	\$0.02724	\$0.02724
	Yr. 2		\$0.03227	\$0.03227	\$0.02806	\$0.02806	\$0.02806	\$0.02806
	Yr. 3		\$0.03323	\$0.03323	\$0.02890	\$0.02890	\$0.02890	\$0.02890
	Yr. 4		\$0.03423	\$0.03423	\$0.02977	\$0.02977	\$0.02977	\$0.02977
	Yr. 5		\$0.03526	\$0.03526	\$0.03066	\$0.03066	\$0.03066	\$0.03066
	Yr. 6		\$0.03632	\$0.03632	\$0.03158	\$0.03158	\$0.03158	\$0.03158
	Yr. 7		\$0.03740	\$0.03740	\$0.03253	\$0.03253	\$0.03253	\$0.03253
	Yr. 8		\$0.03853	\$0.03853	\$0.03350	\$0.03350	\$0.03350	\$0.03350
	Yr. 9		\$0.03968	\$0.03968	\$0.03451	\$0.03451	\$0.03451	\$0.03451

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		1.87	2.27	3.40	5.64	2.38
Residential Programs						
Residential Lighting	Residential	0.70	2.55	2.28	3.04	1.43
Demand Response						
Residential AC Cycling	Residential	1.33	1.38	2.91	3.38	1.93
Commercial Programs						
Commercial Lighting	Commercial	0.81	5.07	6.22	6.09	3.18
Commercial Partnership Program (Custom)	Commercial	1.00	5.07	4.61	5.11	2.82
Demand Response						
Commercial Demand Response Program	Commercial	2.41	2.41	3.31	80.19	2.41
Interruptible Rate DR Program	Commercial	3.21	3.29	4.28	17.06	3.10

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		1.69	1.98	3.10	6.47	2.16
Residential Programs						
Residential Lighting	Residential	0.65	2.35	2.05	2.92	1.28
Demand Response						
Residential AC Cycling	Residential	1.16	1.20	2.53	3.35	1.68
Commercial Programs						
Commercial Lighting	Commercial	1.18	6.68	8.04	6.82	4.11
Commercial Partnership Program (Custom)	Commercial	1.01	4.62	4.10	4.85	2.51
Demand Response						
Commercial Demand Response Program	Commercial	2.11	2.11	2.88	23.16	2.09
Interruptible Rate DR Program	Commercial	3.21	3.29	4.28	17.06	3.10

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		1.59	1.92	3.08	4.74	2.05
Residential Programs						
Residential Lighting	Residential	0.57	2.03	1.88	3.18	1.17
Demand Response						
Residential AC Cycling	Residential	1.16	1.20	2.54	3.39	1.68
Commercial Programs						
Commercial Lighting	Commercial	2.14	6.02	7.58	6.88	3.86
Commercial Partnership Program (Custom)	Commercial	1.72	3.98	3.76	4.88	2.30
Demand Response						
Commercial Demand Response Program	Commercial	2.18	2.18	2.94	4.95	2.11
Interruptible Rate DR Program	Commercial					

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. Much 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.

Montana-Dakota's prescriptive lighting program utilizes Wisconsin's TRM. Wisconsin's TRM was developed for the state by The Cadmus Group, Inc. and is used in Wisconsin's Focus on Energy conservation programs. Montana-Dakota chose to use Wisconsin's TRM to support our prescriptive lighting program because the Wisconsin TRM has a robust catalog of lighting measures and really focuses on providing baseline values for many of the variables in the algorithms. Montana-Dakota felt the more robust Wisconsin TRM lighting algorithms would result in a more accurate energy savings calculation than the lighting measures in the Minnesota TRM.

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		1.87	2.27	3.40	5.64	2.38
Residential Programs						
Residential Lighting	Residential	0.70	2.55	2.28	3.04	1.43
Demand Response						
Residential AC Cycling	Residential	1.33	1.38	2.91	3.38	1.93
Commercial Programs						
Commerical Lighting	Commerical	0.81	5.07	6.22	6.09	3.18
Commercial Partnership Program (Custom)	Commerical	1.00	5.07	4.61	5.11	2.82
Demand Response						
Commercial Demand Response Program	Commercial	2.41	2.41	3.31	80.19	2.41
Interruptible Rate DR Program	Commercial	3.21	3.29	4.28	17.06	3.10

**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		1.69	1.98	3.10	6.47	2.16
Residential Programs						
Residential Lighting	Residential	0.65	2.35	2.05	2.92	1.28
Demand Response						
Residential AC Cycling	Residential	1.16	1.20	2.53	3.35	1.68
Commercial Programs						
Commerical Lighting	Commerical	1.18	6.68	8.04	6.82	4.11
Commercial Partnership Program (Custom)	Commercial	1.01	4.62	4.10	4.85	2.51
Demand Response						
Commercial Demand Response Program	Commercial	2.11	2.11	2.88	23.16	2.09
Interruptible Rate DR Program	Commercial	3.21	3.29	4.28	17.06	3.10

**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		1.59	1.92	3.08	4.74	2.05
Residential Programs						
Residential Lighting	Residential	0.57	2.03	1.88	3.18	1.17
Demand Response						
Residential AC Cycling	Residential	1.16	1.20	2.54	3.39	1.68
Commercial Programs						
Commerical Lighting	Commerical	2.14	6.02	7.58	6.88	3.86
Commercial Partnership Program (Custom)	Commercial	1.72	3.98	3.76	4.88	2.30
Demand Response						
Commercial Demand Response Program	Commercial	2.18	2.18	2.94	4.95	2.11
Interruptible Rate DR Program	Commercial					

**Montana-Dakota Utilities Co.
Electric Utility - Montana
Demand-Side Management and Conservation Portfolio
2020 - 2022 Program Years**

Program	Participants	Lifetime Energy Reduction	2022 Demand Reduction	Total Cost	Lifetime Cost/Kwh	2022 Cost/KW
Residential Programs						
Residential Lighting	9,000	2,628,605	80	56,987	0.022	712.34
Total	<u>9,000</u>	<u>2,628,605</u>	<u>80</u>	<u>\$56,987</u>	<u>\$0.022</u>	<u>\$712.34</u>
Demand Response						
Residential AC Cycling	1,236	1,153,125	1,343	\$462,810	NA	\$344.61
Total Residential	<u>10,236</u>	<u>3,781,730</u>	<u>1,423</u>	<u>\$519,797</u>	<u>\$0.137</u>	<u>\$365.28</u>
Commercial Programs						
Commerical Lighting	20	9,653,400	107	\$76,941	\$0.008	\$719.07
Commercial Partnership Program (Custom)	10	10,817,302	336	124,648	0.012	370.98
Total Commercial	<u>30</u>	<u>20,470,702</u>	<u>443</u>	<u>\$201,589</u>	<u>\$0.010</u>	<u>\$455.05</u>
Demand Response						
Commercial Demand Response Program	2	1,636,124	7,274	\$1,143,916	\$0.699	\$157.26
Interruptible Rate DR Program	2	281,250	17,900	17,877	0.064	1.00
	<u>4</u>	<u>1,917,374</u>	<u>25,174</u>	<u>\$1,161,793</u>	<u>\$0.606</u>	<u>\$46.15</u>
Total Commercial	<u>34</u>	<u>22,388,076</u>	<u>25,617</u>	<u>\$1,363,382</u>	<u>\$0.061</u>	<u>\$53.22</u>
Education and Outreach				\$41,600		
Total Programs without DR	<u>9,030</u>	<u>23,099,307</u>	<u>523</u>	<u>\$300,176</u>	<u>\$0.013</u>	<u>\$573.95</u>
Total Demand Response	1,240	3,070,499	26,517	\$1,624,603	\$0.529	\$61.27
Total Programs	<u>10,270</u>	<u>26,169,806</u>	<u>27,040</u>	<u>\$1,924,779</u>	<u>\$0.074</u>	<u>\$71.18</u>

**Montana-Dakota Utilities Co.
Electric Utility - North Dakota
Demand-Side Management and Conservation Portfolio
2020 - 2022 Program Years**

Program	Participants	Lifetime Energy Reduction	2022 Demand Reduction	Total Cost	Lifetime Cost/Kwh	2022 Cost/KW
Residential Programs						
Residential Lighting	30,000	8,762,013	2,416	179,652	0.021	74.36
Total	30,000	8,762,013	2,416	\$179,652	\$0.021	\$74.36
Demand Response						
Residential AC Cycling	4,636	1,153,125	5,036	\$1,735,539	NA	\$344.63
Total Residential	<u>34,636</u>	<u>9,915,138</u>	<u>7,452</u>	<u>\$1,915,191</u>	\$0.193	\$257.00
Commercial Programs						
Commercial Lighting	60	28,960,200	644	\$218,455	\$0.008	\$339.22
Commercial Partnership Program (Custom)	22	23,798,062	738	261,224	0.011	353.96
Total Commercial	82	52,758,262	1,382	\$479,679	\$0.009	\$347.09
Demand Response						
Commercial Demand Response Program	8	1,933,593	8,617	\$94,489	\$0.049	\$10.97
Interruptible Rate DR Program	0	3,026,545	145,022	186,438	0.062	1.29
	8	4,960,138	153,639	\$280,927	\$0.057	\$1.83
Total Commercial	<u>90</u>	<u>57,718,400</u>	<u>155,021</u>	<u>\$760,606</u>	\$0.013	\$4.91
Education and Outreach				\$70,000		
Total Programs without DR	<u>30,082</u>	<u>61,520,275</u>	<u>3,798</u>	<u>\$729,331</u>	\$0.012	\$192.03
Total Demand Response	4,644	6,113,263	158,675	\$2,016,466	\$0.330	\$12.71
Total Programs	<u>34,726</u>	<u>67,633,538</u>	<u>162,473</u>	<u>\$2,745,797</u>	\$0.041	\$16.90

**Montana-Dakota Utilities Co.
Electric Utility - South Dakota
Demand-Side Management and Conservation Portfolio
2020 - 2022 Program Years**

Program	Participants	Lifetime Energy Reduction	2022 Demand Reduction	Total Cost	Lifetime Cost/Kwh	2022 Cost/KW
Residential Programs						
Residential Lighting	3,000	876,204	234	20,429	0.023	87.30
Total	3,000	876,204	234	\$20,429	\$0.023	\$87.30
Demand Response						
Residential AC Cycling	309	288,275	336	\$115,703	NA	\$344.35
Total Residential	<u>3,309</u>	<u>1,164,479</u>	<u>570</u>	<u>\$136,132</u>	\$0.117	\$238.83
Commercial Programs						
Commercial Lighting	10	4,826,700	108	\$40,731	\$0.008	\$377.14
Commercial Partnership Program (Custom)	3	3,245,200	100	40,860	0.013	408.60
Total Commercial	<u>13</u>	<u>8,071,900</u>	<u>208</u>	<u>\$81,591</u>	\$0.010	\$392.26
Demand Response						
Commercial Demand Response Program	4	216,349	895	\$8,466	\$0.039	\$9.46
Interruptible Rate DR Program	0	0	0	0	#DIV/0!	#DIV/0!
	<u>4</u>	<u>216,349</u>	<u>895</u>	<u>\$8,466</u>	\$0.039	\$9.46
Total Commercial	<u>17</u>	<u>8,288,249</u>	<u>1,103</u>	<u>\$90,057</u>	\$0.011	\$81.65
Education and Outreach				\$22,850		
Total Programs without DR	<u>3,013</u>	<u>8,948,104</u>	<u>442</u>	<u>\$124,870</u>	\$0.014	\$282.51
Total Demand Response	313	504,624	1,231	\$124,169	\$0.246	\$100.87
Total Programs	<u>3,326</u>	<u>9,452,728</u>	<u>1,673</u>	<u>\$249,039</u>	\$0.026	\$148.86

Montana-Dakota Utilities Co.
Electric Utility - Integrated System Total
Demand-Side Management and Conservation Portfolio
2020 - 2022 Program Years

Program	Participants	Lifetime Energy Reduction	2022 Demand Reduction	Total Cost	Lifetime Cost/Kwh	2022 Cost/KW
Residential Programs						
Residential Lighting	42,000	12,266,822	2,730	257,068	0.021	94.16
Total	<u>42,000</u>	<u>12,266,822</u>	<u>2,730</u>	<u>\$257,068</u>	<u>\$0.021</u>	<u>\$94.16</u>
Demand Response						
Residential AC Cycling	6,182	2,594,525	6,715	\$2,314,052	NA	\$344.61
Total Residential	<u>48,182</u>	<u>14,861,347</u>	<u>9,445</u>	<u>\$2,571,120</u>	<u>\$0.173</u>	<u>\$272.22</u>
Commercial Programs						
Commerical Lighting	90	43,440,300	859	\$336,127	\$0.008	\$391.30
Commercial Partnership Program (Custom)	35	37,860,564	1,174	426,732	0.011	363.49
Total Commercial	<u>125</u>	<u>81,300,864</u>	<u>2,033</u>	<u>\$762,859</u>	<u>\$0.009</u>	<u>\$375.24</u>
Demand Response						
Commercial Demand Response Program	14	3,786,066	16,786	\$1,246,871	\$0.329	\$74.28
Interruptible Rate DR Program	2	3,307,795	162,922	\$204,315	0.062	1.25
	<u>16</u>	<u>7,093,861</u>	<u>179,708</u>	<u>\$1,451,186</u>	<u>\$0.205</u>	<u>\$8.08</u>
Total Commercial	<u>141</u>	<u>88,394,725</u>	<u>181,741</u>	<u>\$2,214,045</u>	<u>\$0.025</u>	<u>\$12.18</u>
Education and Outreach				\$134,450		
Total Programs without DR	<u>42,125</u>	<u>93,567,686</u>	<u>4,763</u>	<u>\$1,154,377</u>	<u>\$0.012</u>	<u>\$242.36</u>
Total Demand Response	6,198	9,688,386	186,423	\$3,765,238	\$0.389	\$20.20
Total Programs	<u>48,323</u>	<u>103,256,072</u>	<u>191,186</u>	<u>\$4,919,615</u>	<u>\$0.048</u>	<u>\$25.73</u>

**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	\$0.12435	\$0.09800	\$0.11367	\$0.08927	\$0.12455	\$0.09297
	Retail Rate (Winter)	System average retail rate for customer class based	\$0.10438	0.08074	\$0.10201	0.08074	\$0.11323	0.09107
	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, 2019	\$0.02542	\$0.02538	\$0.02536	\$0.02521	\$0.02524	\$0.02524
	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, See Input 24						
	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	\$50.42	\$0.00	\$51.05	\$0.00	\$33.00
3a	Retail Winter Demand Cost (\$/kW/season)	Seasonal demand cost based on program availability	\$0.00	\$89.97	\$0.00	\$78.02	\$0.00	\$58.00
	Escalation Rate		4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
4	Electric Margin (\$/KWh)	Average margin applicable to customer class	\$0.08571	\$0.07001	\$0.08037	\$0.05843	\$0.08975	\$0.02524
	Escalation Rate		4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
5	Avoided Capacity Costs (\$/kW/yr.)	Demand cost based on estimated levelized cost of combustion turbine	\$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	10.32%	10.32%	10.32%	10.32%	10.32%	10.32%
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 December 31, 2018	3.11%	3.11%	3.11%	3.11%	3.11%	3.11%

**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
11	General Input Data Year	2019	2019	2019	2019	2019	2019	2019
12	Project Analysis Yr. 1	Year(s) program will be implemented	2020	2020	2020	2020	2020	2020
	Yr. 2		2021	2021	2021	2021	2021	2021
	Yr. 3		2022	2022	2022	2022	2022	2022
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 (January 2016-December 2018)	1.94%	1.94%	1.94%	1.94%	1.94%	1.94%
	Yr. 2	Consumer Price Index based on 3 yr. average (January 2016-December 2018)	1.94%	1.94%	1.94%	1.94%	1.94%	1.94%
	Yr. 3	Consumer Price Index based on 3 yr. average (January 2016-December 2018)	1.94%	1.94%	1.94%	1.94%	1.94%	1.94%
14a	Other Participant Costs (Annual \$/Part.) Yr. 1		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Yr. 2		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Yr. 3		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Escalation Rate Yr. 1		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Yr. 2		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Yr. 3		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
14b	Other Participant Savings (Annual \$/Part.) Yr. 1		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Yr. 2		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Yr. 3		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Escalation Rate Yr. 1		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Yr. 2		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Yr. 3		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
15	Project Life	Based on the estimated useful life of the energy saving equipment						
16	Avg. Summer Demand Reduction	Avg demand reduction (kW) caused by the DSM program						

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

Table B-4

Input No.	Input Data Description	Information Source	Montana Residential	Montana Commercial	North Dakota Residential	North Dakota Commercial	South Dakota Residential	South Dakota Commercial
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	11.900%	11.900%	11.900%	11.900%	11.900%	11.900%
	Yr. 2		11.900%	11.900%	11.900%	11.900%	11.900%	11.900%
	Yr. 3		11.900%	11.900%	11.900%	11.900%	11.900%	11.900%
18b	System Energy Line Loss Factor Yr. 1	Historical energy line loss factor	8.1730%	8.1730%	8.1730%	8.1730%	8.1730%	8.1730%
	Yr. 2		8.1730%	8.1730%	8.1730%	8.1730%	8.1730%	8.1730%
	Yr. 3		8.1730%	8.1730%	8.1730%	8.1730%	8.1730%	8.1730%
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	26.3325%	26.3325%	24.4049%	24.4049%	21.00%	21.00%
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

2020 - 2022 Program Years	Participation Assumptions			Technical Assumptions											Cost Assumptions				
	Customer Class	Number of Participants Year 1	Number of Participants Year 2	Number of Participants Year 3	Project Life	Baseline Efficiency	Average High Efficiency	Average Summer kWh Saved / part	Average Winter kWh Saved / part	Average Summer kW Saved / part	Average Winter kW Saved / part	Average Peak Load Factor of Measure	coincident Summer Peak Avg kW Saved / Part	coincident Winter Peak Avg kW Saved / Part	Average Non-Energy Benefits / Part	Cost Std Equip	Cost High Eff Equip	incremental Cost	Average Incentive / Part
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																			
Commercial Lighting	Commercial	5	10	5	18	T-12	T-8	8,263	16,526	4,8000	4,8000	1.0000	4,8000	4,8000	0.00	NA	NA	5,345	3,060
Commercial Partnership Program (Custom)	Commercial	2	3	5	10	NA	NA	50,000	50,000	20,0000	20,0000	0.7500	15,0000	15,0000	0.00	NA	NA	20,000	10,000
Demand Response																			
Commercial Demand Response Program	Commercial	0	3	5	10	NA	NA	10,000	0	400.0000	0.0000	1.0000	400.0000	0.0000	0.00	NA	NA	0	0
Interruptible Rate DR Program	Commercial	0	0	0		NA	NA	10,000	0	400.0000	0.0000	1.0000	400.0000	0.0000	0.00	NA	NA	0	0
Totals		10,274	3,407	3,428	3,439														
Total Less Demand Response			3,407	3,425	3,010														

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

2020 - 2022 Program Years	Participation Assumptions			Technical Assumptions											Cost Assumptions				
	Customer Class	Number of Participants Year 1	Number of Participants Year 2	Number of Participants Year 3	Project Life	Baseline Efficiency	Average High Efficiency	Average Summer kWh Saved / part	Average Winter kWh Saved / part	Average Summer kW Saved / part	Average Winter kW Saved / part	Average Peak Load Factor of Measure	coincident Summer Peak Avg kW Saved / Part	coincident Winter Peak Avg kW Saved / Part	Average Non-Energy Benefits / Part	Cost Std Equip	Cost High Eff Equip	incremental Cost	Average Incentive / Part
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	15	20	25	18	T-12	T-8	8,263	16,526	4,8000	4,8000	1.0000	4,8000	4,8000	0.00	NA	NA	5,345	3,060
Commercial 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	0	9	18	10	NA	NA	10,000	0	400.00	0.00	1.00	400.00	0.00	0.00	NA	NA	0	0
Interruptible Rate DR Program	Commercial	0	0	0		NA	NA	10,000	0	1333.00	0.00	1.00	1333.00	0.00	0.00	NA	NA	0	0
Totals		34,745	11,520	11,581			11,644												
Total Less Demand Response			10,020	10,027			10,035												

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

2020 - 2022 Program Years	Participation Assumptions			Technical Assumptions											Cost Assumptions				
	Customer Class	Number of Participants Year 1	Number of Participants Year 2	Number of Participants Year 3	Project Life	Baseline Efficiency	Average High Efficiency	Average Summer kWh Saved / part	Average Winter kWh Saved / part	Average Summer kW Saved / part	Average Winter kW Saved / part	Average Peak Load Factor of Measure	coincident Summer Peak Avg kW Saved / Part	coincident Winter Peak Avg kW Saved / Part	Average Non-Energy Benefits / Part	Cost Std Equip	Cost High Eff Equip	incremental Cost	Average Incentive / Part
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	18	T-12	T-8	8,263	16,526	4,8000	4,8000	1.0000	4,8000	4,8000	0.00	NA	NA	5,345	3,060
Commercial 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	0	1	2	10	NA	NA	10,000	0	400.00	0.00	1.00	400.00	0.00	0.00	NA	NA	0	0
Interruptible Rate DR Program	Commercial																		
Totals		3,325	1,103	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

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

	Residential Customers	Sm Commercial Customers	AC Saturation	Total Available	Goal	Saturation	State %
Montana	20,114	5,056	60%	15,102	2,000	13.2%	20%
North Dakota	75,508	11,555	60%	52,238	7,500	14.4%	75%
South Dakota	6,556	1,827	60%	5,030	500	9.9%	5%
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	\$ 100,961	\$ 102,920	\$ 104,917	\$ 106,952	\$ 109,027	\$ 111,142	\$ 113,298	\$ 115,496	\$ 117,737	\$ 120,021	
T-Stat Annual licensing Fee	\$20.55	\$ -	\$ 41,107	\$ 82,214	\$ 123,321	\$ 164,428	\$ 205,535	\$ 209,522	\$ 213,587	\$ 217,731	\$ 221,955	\$ 226,261	\$ 230,650	\$ 235,125	\$ 239,686	\$ 244,336	\$ 249,076	
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	\$ 73,158	\$ 74,578	\$ 76,024	\$ 77,499	\$ 79,003	\$ 80,535	\$ 82,098	\$ 83,690	\$ 85,314	\$ 86,969	
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	\$ 101,940	\$ 103,918	\$ 105,934	\$ 107,989	\$ 110,084	\$ 112,219	\$ 114,396	\$ 116,616	\$ 118,878	\$ 121,184	
Converge Marketing	\$ -	\$ -	\$ 40,541	\$ 20,270	\$ 20,270	\$ 20,270	\$ 20,270	\$ 20,270	\$ 20,270	\$ 20,270	\$ 20,270	\$ 20,270	\$ 20,270	\$ 20,270	\$ 20,270	\$ 20,270	\$ 20,270	
MDU Marketing	\$ -	\$ -	\$ 40,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	
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	
Converge 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	\$ -	\$ -	\$ 724,423	\$ 862,298	\$ 998,530	\$ 1,134,033	\$ 960,127	\$ 971,119	\$ 982,339	\$ 993,791	\$ 1,005,481	\$ 1,017,414	\$ 1,029,594	\$ 1,042,028	\$ 1,054,720	\$ 1,067,676	\$ 1,080,707	\$ 1,457,090
Cost per kW		\$ 364	\$ 181.08	\$ 143.72	\$ 124.82	\$ 113.40	\$ 96.01	\$ 97.11	\$ 98.23	\$ 99.38	\$ 100.55	\$ 101.74	\$ 102.96	\$ 104.20	\$ 105.47	\$ 106.77	\$ 108.11	
Percentage of Dollars going to Customers			27.5%	39.2%	42.6%	45.2%	47.2%	42.1%	41.6%	41.1%	40.7%	40.2%	39.7%	39.2%	38.8%	38.3%	37.8%	
MT Cost	\$ -	\$ -	\$ 145,485	\$ 144,866	\$ 172,460	\$ 199,706	\$ 226,807	\$ 192,025	\$ 194,224	\$ 196,468	\$ 198,758	\$ 201,096	\$ 203,483	\$ 205,919	\$ 208,406	\$ 210,944	\$ 213,535	\$ 2,914,181
ND Cost	\$ -	\$ -	\$ 545,567	\$ 543,248	\$ 646,723	\$ 748,898	\$ 850,525	\$ 720,096	\$ 728,340	\$ 736,754	\$ 745,344	\$ 754,111	\$ 763,060	\$ 772,196	\$ 781,521	\$ 791,040	\$ 800,757	\$ 10,928,179
SD Cost	\$ -	\$ -	\$ 36,371	\$ 36,217	\$ 43,115	\$ 49,927	\$ 56,702	\$ 48,006	\$ 48,556	\$ 49,117	\$ 49,690	\$ 50,274	\$ 50,871	\$ 51,480	\$ 52,101	\$ 52,736	\$ 53,384	\$ 728,545
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 Participation		0	2,000	2,060	2,122	2,185	2,251	68	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	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	10,000

By State Breakdown	Total Participation	\$kW	Total Cost	kW	kWh Annual	kWh Lifetime (10yrs)
Montana	2,000	\$1,457.09	\$ 2,914,181	2,000	82,080	820,800
North Dakota	7,500	\$1,457.09	\$ 10,928,179	7,500	307,800	3,078,000
South Dakota	500	\$1,457.09	\$ 728,545	500	20,520	205,200

Data Input	
Churn Rate	3.0%
kW per participate (all States)	1.0
MT kWh saved per participant	41
ND kWh saved per participant	41
SD kWh saved per participant	41
Inflation Rate	1.9%
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 Thermostat

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

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

Company: **Montana-Dakota Utilities Co.**
 Project: **Air Conditioning Cycling Program**
 Program Years: **2020-2022**

Input Data		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.12435			
Retail Rate Winter (\$/kWh) =	\$0.10438			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.02542			
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) =	\$0.08571			
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 =	10.32%			
9) Utility Discount Rate =	7.30%			
10) Societal Discount Rate =	3.11%			
11) General Input Data Year =	2019			
12) Project Analysis Year 1 =	2020			
Project Analysis Year 2 =	2021			
Project Analysis Year 3 =	2022			
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 =		1.94%	1.94%	1.94%
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		11.9000%	11.9000%	11.9000%
18b) System Energy Line Loss Factor		8.1730%	8.1730%	8.1730%
19) Number of Participants =		400	412	424
20) Incentive/Participant =		\$60	\$60	\$60
21) Effective Federal & State Income Tax Rate =				26.33%
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	\$625,311	1.33
Utility Cost Test	\$682,671	1.38
Societal Test	\$3,109,826	2.91
Participant Test	\$503,081	3.38
Total Resource Cost Test	\$1,204,735	1.93

**Table 1
Ratepayer Impact Test**

Project: **Air Conditioning Cycling Program**
 Program Years: **2020-2022**

t	Year											Costs							Annual Benefits Less Costs (Q)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)	Program Admin Costs (M)		Incentive Costs (N)	Direct Program Costs (O)	Total Project Costs (P)	
1	2020	17,740	\$0.03133	\$556	\$0.00000	\$0	448	0	448	115.92	51932	\$52,488	0.08957	16,400	0	16,400	\$1,082	\$2,000	\$40,000	\$103,485	\$146,567	(\$94,079)	
2	2021	35,481	\$0.03227	1,145	0.00000	0	895	0	895	\$119.40	\$106,863	\$108,008	\$0.09360	32,800	0	32,800	\$2,262	2,022	56,720	86,125	147,128	(\$39,120)	
3	2022	53,221	\$0.03323	1,769	0.00000	0	1,343	0	1,343	\$122.98	165,162	166,931	0.09781	49,200	0	49,200	\$3,545	2,043	73,462	96,955	176,005	(\$9,074)	
4	2023	70,961	\$0.03423	2,429	0.00000	0	1,790	0	1,790	\$126.67	226,739	229,168	0.10221	65,600	0	65,600	\$4,939	2,066	90,225	107,415	204,645	\$24,523	
5	2024	88,702	\$0.03526	3,128	0.00000	0	2,238	0	2,238	\$130.47	291,992	295,120	0.10681	82,000	0	82,000	\$6,452	2,088	107,012	117,707	233,259	\$61,861	
6	2025	88,702	\$0.03632	3,222	0.00000	0	2,238	0	2,238	\$134.38	300,742	303,964	0.11162	82,000	0	82,000	\$6,743	2,110	80,810	109,105	198,768	\$105,196	
7	2026	88,702	\$0.03740	3,317	0.00000	0	2,238	0	2,238	\$138.41	309,762	313,079	0.11664	82,000	0	82,000	\$7,046	2,133	80,810	111,280	201,270	\$111,809	
8	2027	88,702	\$0.03853	3,418	0.00000	0	2,238	0	2,238	\$142.57	319,072	322,490	0.12189	82,000	0	82,000	\$7,363	2,156	80,810	113,501	203,831	\$118,659	
9	2028	88,702	\$0.03968	3,520	0.00000	0	2,238	0	2,238	\$146.84	328,628	332,148	0.12737	82,000	0	82,000	\$7,694	2,179	80,810	115,768	206,452	\$125,696	
10	2029	88,702	\$0.04087	3,625	0.00000	0	2,238	0	2,238	\$151.25	338,498	342,123	0.13311	82,000	0	82,000	\$8,041	2,203	80,810	118,083	209,137	\$132,986	
11	2030	88,702	\$0.04210	3,734	0.00000	0	2,238	0	2,238	\$155.79	348,658	352,392	0.13909	82,000	0	82,000	\$8,402	2,227	80,810	120,446	211,885	\$140,507	
12	2031	88,702	\$0.04336	3,846	0.00000	0	2,238	0	2,238	\$160.46	359,109	362,955	0.14535	82,000	0	82,000	\$8,780	2,251	80,810	122,858	214,699	\$148,256	
13	2032	88,702	\$0.04466	3,961	0.00000	0	2,238	0	2,238	\$165.27	369,874	373,835	0.15189	82,000	0	82,000	\$9,175	2,275	80,810	125,320	217,581	\$156,254	
14	2033	88,702	\$0.04600	4,080	0.00000	0	2,238	0	2,238	\$170.23	380,975	385,055	0.15873	82,000	0	82,000	\$9,588	2,300	80,810	127,834	220,532	\$164,523	
15	2034	88,702	\$0.04738	4,203	0.00000	0	2,238	0	2,238	\$175.34	392,411	396,614	0.16587	82,000	0	82,000	\$10,020	2,325	80,810	130,400	223,555	\$173,059	
16	2035	0	\$0.04880	0	0.00000	0	0	0	0	\$180.60	0	0	0.17334	0	0	0	\$0	0	0	0	0	\$0	
17	2036	0	\$0.05026	0	0.00000	0	0	0	0	\$186.02	0	0	0.18114	0	0	0	\$0	0	0	0	0	\$0	
18	2037	0	\$0.05177	0	0.00000	0	0	0	0	\$191.60	0	0	0.18929	0	0	0	\$0	0	0	0	0	\$0	
19	2038	0	\$0.05332	0	0.00000	0	0	0	0	\$197.35	0	0	0.19781	0	0	0	\$0	0	0	0	0	\$0	
20	2039	0	\$0.05492	0	0.00000	0	0	0	0	\$203.27	0	0	0.20671	0	0	0	\$0	0	0	0	0	\$0	
Total =		1,153,125							29,094			\$4,336,370				1,066,000					\$3,015,314	\$1,321,056	
												NPV = \$2,497,115										\$1,871,804	625,311
Total NPV =			\$625,311																				
Benefit/Cost Ratio =			1.33																				

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

**Table 2
Utility Test**

Project: **Air Conditioning Cycling Program**
 Program Years: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2020	\$556	\$0	\$51,932	\$52,488	\$145,485	\$145,485	(\$92,997)
2021	1,145	0	106,863	108,008	144,866	144,866	(36,858)
2022	1,769	0	165,162	166,931	172,460	172,460	(5,529)
2023	2,429	0	226,739	229,168	199,706	199,706	29,462
2024	3,128	0	291,992	295,120	226,807	226,807	68,313
2025	3,222	0	300,742	303,964	192,025	192,025	111,939
2026	3,317	0	309,762	313,079	194,224	194,224	118,855
2027	3,418	0	319,072	322,490	196,468	196,468	126,022
2028	3,520	0	328,628	332,148	198,758	198,758	133,390
2029	3,625	0	338,498	342,123	201,096	201,096	141,027
2030	3,734	0	348,658	352,392	203,483	203,483	148,909
2031	3,846	0	359,109	362,955	205,919	205,919	157,036
2032	3,961	0	369,874	373,835	208,406	208,406	165,429
2033	4,080	0	380,975	385,055	210,944	210,944	174,111
2034	4,203	0	392,411	396,614	213,535	213,535	183,079
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =				\$4,336,370		\$2,914,181	\$1,422,188
				NPV = \$2,497,115		\$1,814,444	682,671
Total NPV =		\$682,671					
Benefit/Cost Ratio =		1.38					

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: **2020-2022**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2020	\$556	\$0	\$51,932	\$16,597	\$69,085	\$145,485	\$4,000	\$149,485	(\$80,400)
2021	1,145	0	106,863	35,178	143,186	144,866	(11,400)	133,466	9,720
2022	1,769	0	165,162	56,000	222,931	172,460	(26,782)	145,678	77,253
2023	2,429	0	226,739	79,185	308,353	199,706	(42,145)	157,561	150,792
2024	3,128	0	291,992	105,032	400,152	226,807	(57,490)	169,317	230,835
2025	3,222	0	300,742	111,425	415,389	192,025	(79,325)	112,700	302,689
2026	3,317	0	309,762	118,210	431,289	194,224	(79,325)	114,899	316,390
2027	3,418	0	319,072	125,416	447,906	196,468	(79,325)	117,143	330,763
2028	3,520	0	328,628	133,047	465,195	198,758	(79,325)	119,433	345,762
2029	3,625	0	338,498	141,154	483,277	201,096	(79,325)	121,771	361,506
2030	3,734	0	348,658	149,752	502,144	203,483	(79,325)	124,158	377,986
2031	3,846	0	359,109	158,869	521,824	205,919	(79,325)	126,594	395,230
2032	3,961	0	369,874	168,540	542,375	208,406	(79,325)	129,081	413,294
2033	4,080	0	380,975	178,806	563,861	210,944	(79,325)	131,619	432,242
2034	4,203	0	392,411	189,699	586,313	213,535	(79,325)	134,210	452,103
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
2038	0	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0	0
Total =					\$6,103,280			\$1,987,115	\$4,116,165
					NPV = \$4,739,040			\$1,629,214	3,109,826
Total NPV =		\$3,109,826							
Benefit/Cost Ratio =		<u>2.91</u>							

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

**Table 4
Participant Test**

Project: **Air Conditioning Cycling Program**
 Program Years: **2020-2022**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2020	\$40,000	\$0.12995	\$0.10908	16,400	0	16,400	\$2,131	400	0	\$0.000	\$0.000	\$0	\$0	\$42,131	\$44,854	\$0	\$44,854	(\$2,723)
2021	56,720	0.13579	0.11399	32,800	0	32,800	4,454	800	0	0.000	0.000	0	0	61,174	47,095	0	47,095	14,079
2022	73,462	0.14190	0.11911	49,200	0	49,200	6,981	1,200	0	0.000	0.000	0	0	80,443	49,449	0	49,449	30,994
2023	90,225	0.14829	0.12448	65,600	0	65,600	9,728	1,600	0	0.000	0.000	0	0	99,953	51,921	0	51,921	48,032
2024	107,012	0.15496	0.13008	82,000	0	82,000	12,707	2,000	0	0.000	0.000	0	0	119,719	54,516	0	54,516	65,203
2025	80,810	0.16194	0.13593	82,000	0	82,000	13,279	2,000	0	0.000	0.000	0	0	94,089	1,667	0	1,667	92,422
2026	80,810	0.16922	0.14205	82,000	0	82,000	13,876	2,000	0	0.000	0.000	0	0	94,686	1,700	0	1,700	92,986
2027	80,810	0.17684	0.14844	82,000	0	82,000	14,501	2,000	0	0.000	0.000	0	0	95,311	1,733	0	1,733	93,578
2028	80,810	0.18480	0.15512	82,000	0	82,000	15,154	2,000	0	0.000	0.000	0	0	95,964	1,766	0	1,766	94,198
2029	80,810	0.19311	0.16210	82,000	0	82,000	15,835	2,000	0	0.000	0.000	0	0	96,645	1,800	0	1,800	94,845
2030	80,810	0.20180	0.16939	82,000	0	82,000	16,548	2,000	0	0.000	0.000	0	0	97,358	1,835	0	1,835	95,523
2031	80,810	0.21088	0.17702	82,000	0	82,000	17,292	2,000	0	0.000	0.000	0	0	98,102	1,871	0	1,871	96,231
2032	80,810	0.22037	0.18498	82,000	0	82,000	18,070	2,000	0	0.000	0.000	0	0	98,880	1,907	0	1,907	96,973
2033	80,810	0.23029	0.19331	82,000	0	82,000	18,884	2,000	0	0.000	0.000	0	0	99,694	1,944	0	1,944	97,750
2034	80,810	0.24065	0.20200	82,000	0	82,000	19,733	2,000	0	0.000	0.000	0	0	100,543	1,982	0	1,982	98,561
2035	0	0.25148	0.21109	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.26280	0.22059	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.27462	0.23052	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2038	0	0.28698	0.24089	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2039	0	0.29990	0.25173	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					\$1,374,692			\$266,040	\$1,108,652
														NPV = \$714,066			\$210,985	503,081
Total NPV =			\$503,081															
Benefit/Cost Ratio =			<u>3.38</u>															

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

**Table 5
Total Resource Cost Test**

Company: **Air Conditioning Cycling Program**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2020	\$556	\$51,932	\$52,488	\$145,485	\$4,000	\$149,485	(\$96,997)
2021	1,145	106,863	108,008	144,866	(11,400)	133,466	(25,458)
2022	1,769	165,162	166,931	172,460	(26,782)	145,678	21,253
2023	2,429	226,739	229,168	199,706	(42,145)	157,561	71,607
2024	3,128	291,992	295,120	226,807	(57,490)	169,317	125,803
2025	3,222	300,742	303,964	192,025	(79,325)	112,700	191,264
2026	3,317	309,762	313,079	194,224	(79,325)	114,899	198,180
2027	3,418	319,072	322,490	196,468	(79,325)	117,143	205,347
2028	3,520	328,628	332,148	198,758	(79,325)	119,433	212,715
2029	3,625	338,498	342,123	201,096	(79,325)	121,771	220,352
2030	3,734	348,658	352,392	203,483	(79,325)	124,158	228,234
2031	3,846	359,109	362,955	205,919	(79,325)	126,594	236,361
2032	3,961	369,874	373,835	208,406	(79,325)	129,081	244,754
2033	4,080	380,975	385,055	210,944	(79,325)	131,619	253,436
2034	4,203	392,411	396,614	213,535	(79,325)	134,210	262,404
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =			\$4,336,370			\$1,987,115	\$2,349,255
NPV =			\$2,497,115			\$1,292,380	1,204,735

Total NPV = \$1,204,735
Benefit/Cost Ratio = 1.93

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: **2020-2022**

Input Data		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.11367			
Retail Rate Winter (\$/kWh) =	\$0.10201			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.02536			
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) =	\$0.08037			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.32%			
9) Utility Discount Rate =	7.36%			
10) Societal Discount Rate =	3.11%			
11) General Input Data Year =	2019			
12) Project Analysis Year 1 =	2020			
Project Analysis Year 2 =	2021			
Project Analysis Year 3 =	2022			
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 =		1.94%	1.94%	1.94%
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		11.9000%	11.9000%	11.9000%
18b) System Energy Line Loss Factor		8.1730%	8.1730%	8.1730%
19) Number of Participants =		1,500	1,545	1,591
20) Incentive/Participant =		\$60	\$60	\$60
21) Effective Federal & State Income Tax Rate =				26.33%
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		\$1,150,333	1.16	
Utility Cost Test		\$1,352,027	1.20	
Societal Test		\$9,369,367	2.53	
Participant Test		\$1,856,871	3.35	
Total Resource Cost Test		\$3,309,768	1.68	

Table 1
Ratepayer Impact Test

Project: **Air Conditioning Cycling Program**
Program Years: **2020-2022**

t	Year											Costs							Annual Benefits Less Costs (Q)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)	Program Admin Costs (M)		Incentive Costs (N)	Direct Program Costs (O)	Total Project Costs (P)	
1	2020	66,526	\$0.03133	\$2,084	\$0.00000	\$0	1,679	0	1,679	\$100.80	\$169,243	\$171,327	\$0.08399	61,500	0	61,500	\$3,805	\$7,500	#####	\$388,067	\$549,372	(\$378,045)	
2	2021	133,053	\$0.03227	4,294	0.00000	0	3,357	0	3,357	103.82	348,524	352,818	0.08777	123,000	0	123,000	7,953	7,581	212,700	322,967	551,201	(198,383)	
3	2022	199,579	\$0.03323	6,632	0.00000	0	5,036	0	5,036	106.94	538,550	545,182	0.09172	184,500	0	184,500	12,466	7,663	275,481	363,580	659,189	(114,007)	
4	2023	266,106	\$0.03423	9,109	0.00000	0	6,714	0	6,714	110.15	739,547	748,656	0.09584	246,000	0	246,000	17,368	7,746	338,345	402,807	766,266	(17,610)	
5	2024	332,632	\$0.03526	11,729	0.00000	0	8,393	0	8,393	113.45	952,186	963,915	0.10016	307,500	0	307,500	22,689	7,829	401,296	441,400	873,214	90,701	
6	2025	332,632	\$0.03632	12,081	0.00000	0	8,393	0	8,393	116.85	980,722	992,803	0.10466	307,500	0	307,500	23,708	7,914	303,039	409,143	743,804	248,999	
7	2026	332,632	\$0.03740	12,440	0.00000	0	8,393	0	8,393	120.36	1,010,181	1,022,621	0.10937	307,500	0	307,500	24,775	7,999	303,039	417,301	753,115	269,506	
8	2027	332,632	\$0.03853	12,816	0.00000	0	8,393	0	8,393	123.97	1,040,480	1,053,296	0.11429	307,500	0	307,500	25,890	8,086	303,039	425,630	762,644	290,652	
9	2028	332,632	\$0.03968	13,199	0.00000	0	8,393	0	8,393	127.69	1,071,702	1,084,901	0.11944	307,500	0	307,500	27,056	8,173	303,039	434,132	772,400	312,501	
10	2029	332,632	\$0.04087	13,595	0.00000	0	8,393	0	8,393	131.52	1,103,847	1,117,442	0.12481	307,500	0	307,500	28,273	8,261	303,039	442,811	782,384	335,058	
11	2030	332,632	\$0.04210	14,004	0.00000	0	8,393	0	8,393	135.47	1,137,000	1,151,004	0.13043	307,500	0	307,500	29,546	8,351	303,039	451,671	792,606	358,398	
12	2031	332,632	\$0.04336	14,423	0.00000	0	8,393	0	8,393	139.53	1,171,075	1,185,498	0.13630	307,500	0	307,500	30,876	8,441	303,039	460,716	803,072	382,426	
13	2032	332,632	\$0.04466	14,855	0.00000	0	8,393	0	8,393	143.72	1,206,242	1,221,097	0.14243	307,500	0	307,500	32,264	8,532	303,039	469,950	813,785	407,312	
14	2033	332,632	\$0.04600	15,301	0.00000	0	8,393	0	8,393	148.03	1,242,416	1,257,717	0.14884	307,500	0	307,500	33,716	8,624	303,039	479,377	824,756	432,961	
15	2034	332,632	\$0.04738	15,760	0.00000	0	8,393	0	8,393	152.47	1,279,681	1,295,441	0.15554	307,500	0	307,500	35,234	8,717	303,039	489,001	835,991	459,450	
16	2035	0	\$0.04880	0	0.00000	0	0	0	0	157.04	0	0	0.16254	0	0	0	0	0	0	0	0	0	
17	2036	0	\$0.05026	0	0.00000	0	0	0	0	161.75	0	0	0.16985	0	0	0	0	0	0	0	0	0	
18	2037	0	\$0.05177	0	0.00000	0	0	0	0	166.61	0	0	0.17750	0	0	0	0	0	0	0	0	0	
19	2038	0	\$0.05332	0	0.00000	0	0	0	0	171.60	0	0	0.18548	0	0	0	0	0	0	0	0	0	
20	2039	0	\$0.05492	0	0.00000	0	0	0	0	176.75	0	0	0.19383	0	0	0	0	0	0	0	0	0	
Total =		4,324,216							109,109			\$14,163,718				3,997,500					\$11,283,799	\$2,879,919	
												NPV = \$8,156,194										\$7,005,861	1,150,333
Total NPV =			\$1,150,333																				
Benefit/Cost Ratio =			1.16																				

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

**Table 2
Utility Test**

Project: **Air Conditioning Cycling Program**
 Program Years: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2020	\$2,084	\$0	\$169,243	\$171,327	\$545,567	\$545,567	(\$374,240)
2021	4,294	0	348,524	352,818	543,248	543,248	(190,430)
2022	6,632	0	538,550	545,182	646,723	646,723	(101,541)
2023	9,109	0	739,547	748,656	748,898	748,898	(242)
2024	11,729	0	952,186	963,915	850,525	850,525	113,390
2025	12,081	0	980,722	992,803	720,096	720,096	272,707
2026	12,440	0	1,010,181	1,022,621	728,340	728,340	294,281
2027	12,816	0	1,040,480	1,053,296	736,754	736,754	316,542
2028	13,199	0	1,071,702	1,084,901	745,344	745,344	339,557
2029	13,595	0	1,103,847	1,117,442	754,111	754,111	363,331
2030	14,004	0	1,137,000	1,151,004	763,060	763,060	387,944
2031	14,423	0	1,171,075	1,185,498	772,196	772,196	413,302
2032	14,855	0	1,206,242	1,221,097	781,521	781,521	439,576
2033	15,301	0	1,242,416	1,257,717	791,040	791,040	466,677
2034	15,760	0	1,279,681	1,295,441	800,757	800,757	494,684
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =				\$14,163,718	\$10,928,179	\$3,235,538	
NPV =				\$8,156,194	\$6,804,167	1,352,027	
Total NPV =				\$1,352,027			
Benefit/Cost Ratio =				1.20			

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: **2020-2022**

Year	Benefits				Costs			Annual Benefits Less Costs (I)	
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)		Annual Total Increase (H)
2020	\$2,084	\$0	\$169,243	\$54,175	\$225,502	\$545,567	\$15,000	\$560,567	(\$335,065)
2021	4,294	0	348,524	114,912	467,730	543,248	(42,750)	500,498	(32,768)
2022	6,632	0	538,550	182,891	728,073	646,723	(100,433)	546,290	181,783
2023	9,109	0	739,547	258,684	1,007,340	748,898	(158,045)	590,853	416,487
2024	11,729	0	952,186	343,055	1,306,970	850,525	(215,587)	634,938	672,032
2025	12,081	0	980,722	363,936	1,356,739	720,096	(297,468)	422,628	934,111
2026	12,440	0	1,010,181	386,112	1,408,733	728,340	(297,468)	430,872	977,861
2027	12,816	0	1,040,480	409,625	1,462,921	736,754	(297,468)	439,286	1,023,635
2028	13,199	0	1,071,702	434,574	1,519,475	745,344	(297,468)	447,876	1,071,599
2029	13,595	0	1,103,847	461,037	1,578,479	754,111	(297,468)	456,643	1,121,836
2030	14,004	0	1,137,000	489,130	1,640,134	763,060	(297,468)	465,592	1,174,542
2031	14,423	0	1,171,075	518,903	1,704,401	772,196	(297,468)	474,728	1,229,673
2032	14,855	0	1,206,242	550,519	1,771,616	781,521	(297,468)	484,053	1,287,563
2033	15,301	0	1,242,416	584,040	1,841,757	791,040	(297,468)	493,572	1,348,185
2034	15,760	0	1,279,681	619,604	1,915,045	800,757	(297,468)	503,289	1,411,756
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
2038	0	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0	0
Total =					\$19,934,915		\$7,451,685	\$12,483,230	
					NPV = \$15,478,922		\$6,109,555	9,369,367	
Total NPV =		\$9,369,367							
Benefit/Cost Ratio =		<u>2.53</u>							

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

**Table 4
Participant Test**

Project: **Air Conditioning Cycling Program**
 Program Years: **2020-2022**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2020	\$150,000	\$0.11879	\$0.10660	61,500	0	61,500	\$7,306	1,500	0	\$0.000	\$0.000	\$0	\$0	\$157,306	\$168,201	\$0	\$168,201	(\$10,895)
2021	212,700	0.12413	0.11140	123,000	0	123,000	15,268	3,000	0	0.000	0.000	0	0	227,968	\$176,608	0	176,608	51,360
2022	275,481	0.12972	0.11641	184,500	0	184,500	23,933	4,500	0	0.000	0.000	0	0	299,414	\$185,435	0	185,435	113,979
2023	338,345	0.13555	0.12165	246,000	0	246,000	33,345	6,000	0	0.000	0.000	0	0	371,690	\$194,704	0	194,704	176,986
2024	401,296	0.14165	0.12712	307,500	0	307,500	43,557	7,500	0	0.000	0.000	0	0	444,853	\$204,435	0	204,435	240,418
2025	303,039	0.14803	0.13284	307,500	0	307,500	45,519	7,500	0	0.000	0.000	0	0	348,558	\$6,252	0	6,252	342,306
2026	303,039	0.15469	0.13882	307,500	0	307,500	47,567	7,500	0	0.000	0.000	0	0	350,606	\$6,373	0	6,373	344,233
2027	303,039	0.16165	0.14507	307,500	0	307,500	49,707	7,500	0	0.000	0.000	0	0	352,746	\$6,497	0	6,497	346,249
2028	303,039	0.16892	0.15160	307,500	0	307,500	51,943	7,500	0	0.000	0.000	0	0	354,982	\$6,623	0	6,623	348,359
2029	303,039	0.17653	0.15842	307,500	0	307,500	54,283	7,500	0	0.000	0.000	0	0	357,322	\$6,752	0	6,752	350,570
2030	303,039	0.18447	0.16555	307,500	0	307,500	56,725	7,500	0	0.000	0.000	0	0	359,764	\$6,882	0	6,882	352,882
2031	303,039	0.19277	0.17300	307,500	0	307,500	59,277	7,500	0	0.000	0.000	0	0	362,316	\$7,016	0	7,016	355,300
2032	303,039	0.20145	0.18078	307,500	0	307,500	61,946	7,500	0	0.000	0.000	0	0	364,985	\$7,152	0	7,152	357,833
2033	303,039	0.21051	0.18892	307,500	0	307,500	64,732	7,500	0	0.000	0.000	0	0	367,771	\$7,291	0	7,291	360,480
2034	303,039	0.21998	0.19742	307,500	0	307,500	67,644	7,500	0	0.000	0.000	0	0	370,683	\$7,432	0	7,432	363,251
2035	0	0.22988	0.20630	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
2036	0	0.24023	0.21559	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
2037	0	0.25104	0.22529	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
2038	0	0.26233	0.23542	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
2039	0	0.27414	0.24602	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					\$5,090,964			\$997,653	\$4,093,311
														NPV = \$2,648,066			\$791,195	1,856,871

Total NPV = \$1,856,871
 Benefit/Cost Ratio = 3.35

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

Table 5
Total Resource Cost Test

Company: **Air Conditioning Cycling Program**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2020	\$2,084	\$169,243	\$171,327	\$545,567	\$15,000	\$560,567	(\$389,240)
2021	4,294	348,524	352,818	543,248	(42,750)	500,498	(147,680)
2022	6,632	538,550	545,182	646,723	(100,433)	546,290	(1,108)
2023	9,109	739,547	748,656	748,898	(158,045)	590,853	157,803
2024	11,729	952,186	963,915	850,525	(215,587)	634,938	328,977
2025	12,081	980,722	992,803	720,096	(297,468)	422,628	570,175
2026	12,440	1,010,181	1,022,621	728,340	(297,468)	430,872	591,749
2027	12,816	1,040,480	1,053,296	736,754	(297,468)	439,286	614,010
2028	13,199	1,071,702	1,084,901	745,344	(297,468)	447,876	637,025
2029	13,595	1,103,847	1,117,442	754,111	(297,468)	456,643	660,799
2030	14,004	1,137,000	1,151,004	763,060	(297,468)	465,592	685,412
2031	14,423	1,171,075	1,185,498	772,196	(297,468)	474,728	710,770
2032	14,855	1,206,242	1,221,097	781,521	(297,468)	484,053	737,044
2033	15,301	1,242,416	1,257,717	791,040	(297,468)	493,572	764,145
2034	15,760	1,279,681	1,295,441	800,757	(297,468)	503,289	792,152
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =			\$14,163,718			\$7,451,685	\$6,712,033
NPV =			\$8,156,194			\$4,846,426	3,309,768
Total NPV =			\$3,309,768				
Benefit/Cost Ratio =			1.68				

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: **2020-2022**

Input Data		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.12455			
Retail Rate Winter (\$/kWh) =	\$0.11323			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.02524			
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) =	\$0.08975			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.32%			
9) Utility Discount Rate =	7.22%			
10) Societal Discount Rate =	3.11%			
11) General Input Data Year =	2019			
12) Project Analysis Year 1 =	2020			
Project Analysis Year 2 =	2021			
Project Analysis Year 3 =	2022			
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 =	1.94%	1.94%	1.94%	
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	11.9000%	11.9000%	11.9000%	
18b) System Energy Line Loss Factor	8.1730%	8.1730%	8.1730%	
19) Number of Participants =	100	103	106	
20) Incentive/Participant =	\$60	\$60	\$60	
21) Effective Federal & State Income Tax Rate =			26.33%	
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	\$75,565	1.16		
Utility Cost Test	\$90,582	1.20		
Societal Test	\$625,470	2.54		
Participant Test	\$125,809	3.39		
Total Resource Cost Test	\$221,096	1.68		

**Table 1
Ratepayer Impact Test**

Project: **Air Conditioning Cycling Program**
 Program Years: **2020-2022**

t	Year											Costs							Annual Benefits Less Costs (Q)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)	Program Admin Costs (M)		Incentive Costs (N)	Direct Program Costs (O)	Total Project Costs (P)	
1	2020	4,435	\$0.03133	\$139	\$0.00000	\$0	112	0	112	\$100.80	\$11,290	\$11,429	\$0.09379	4,100	0	4,100	\$283	\$500	\$10,000	\$25,871	\$36,654	(\$25,225)	
2	2021	8,870	0.03227	286	0.00000	0	224	0	224	103.82	23,256	23,542	0.09801	8,200	0	8,200	592	505	14,180	21,531	36,809	(13,267)	
3	2022	13,305	0.03323	442	0.00000	0	336	0	336	106.94	35,932	36,374	0.10242	12,300	0	12,300	928	511	18,365	24,239	44,043	(7,669)	
4	2023	17,740	0.03423	607	0.00000	0	448	0	448	110.15	49,347	49,954	0.10703	16,400	0	16,400	1,293	516	22,556	26,854	51,220	(1,266)	
5	2024	22,175	0.03526	782	0.00000	0	560	0	560	113.45	63,532	64,314	0.11184	20,500	0	20,500	1,689	522	26,753	29,427	58,391	5,923	
6	2025	22,175	0.03632	805	0.00000	0	560	0	560	116.85	65,436	66,241	0.11688	20,500	0	20,500	1,765	528	20,203	27,276	49,771	16,470	
7	2026	22,175	0.03740	829	0.00000	0	560	0	560	120.36	67,402	68,231	0.12214	20,500	0	20,500	1,845	533	20,203	27,820	50,401	17,830	
8	2027	22,175	0.03853	854	0.00000	0	560	0	560	123.97	69,423	70,277	0.12763	20,500	0	20,500	1,927	539	20,203	28,375	51,044	19,233	
9	2028	22,175	0.03968	880	0.00000	0	560	0	560	127.69	71,506	72,386	0.13338	20,500	0	20,500	2,014	545	20,203	28,942	51,704	20,682	
10	2029	22,175	0.04087	906	0.00000	0	560	0	560	131.52	73,651	74,557	0.13938	20,500	0	20,500	2,105	551	20,203	29,521	52,379	22,178	
11	2030	22,175	0.04210	934	0.00000	0	560	0	560	135.47	75,863	76,797	0.14565	20,500	0	20,500	2,200	557	20,203	30,111	53,071	23,726	
12	2031	22,175	0.04336	962	0.00000	0	560	0	560	139.53	78,137	79,099	0.15221	20,500	0	20,500	2,299	563	20,203	30,714	53,779	25,320	
13	2032	22,175	0.04466	990	0.00000	0	560	0	560	143.72	80,483	81,473	0.15905	20,500	0	20,500	2,402	569	20,203	31,330	54,503	26,970	
14	2033	22,175	0.04600	1,020	0.00000	0	560	0	560	148.03	82,897	83,917	0.16621	20,500	0	20,500	2,510	575	20,203	31,958	55,246	28,671	
15	2034	22,175	0.04738	1,051	0.00000	0	560	0	560	152.47	85,383	86,434	0.17369	20,500	0	20,500	2,623	581	20,203	32,600	56,007	30,427	
16	2035	0	0.04880	0	0.00000	0	0	0	0	157.04	0	0	0.18151	0	0	0	0	0	0	0	0	0	
17	2036	0	0.05026	0	0.00000	0	0	0	0	161.75	0	0	0.18968	0	0	0	0	0	0	0	0	0	
18	2037	0	0.05177	0	0.00000	0	0	0	0	166.61	0	0	0.19821	0	0	0	0	0	0	0	0	0	
19	2038	0	0.05332	0	0.00000	0	0	0	0	171.60	0	0	0.20713	0	0	0	0	0	0	0	0	0	
20	2039	0	0.05492	0	0.00000	0	0	0	0	203.27	0	0	0.21645	0	0	0	0	0	0	0	0	0	
Total =		288,275						7,280				\$945,025				266,500				\$755,022	\$755,022	\$190,003	
												NPV =	\$544,193								\$468,628	\$468,628	75,565
Total NPV =												\$75,565											
Benefit/Cost Ratio =												1.16											

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

**Table 2
Utility Test**

Project: **Air Conditioning Cycling Program**
 Program Years: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2020	\$139	\$0	\$11,290	\$11,429	\$36,371	\$36,371	(\$24,942)
2021	286	0	23,256	23,542	36,217	36,217	(12,675)
2022	442	0	35,932	36,374	43,115	43,115	(6,741)
2023	607	0	49,347	49,954	49,927	49,927	27
2024	782	0	63,532	64,314	56,702	56,702	7,612
2025	805	0	65,436	66,241	48,006	48,006	18,235
2026	829	0	67,402	68,231	48,556	48,556	19,675
2027	854	0	69,423	70,277	49,117	49,117	21,160
2028	880	0	71,506	72,386	49,690	49,690	22,696
2029	906	0	73,651	74,557	50,274	50,274	24,283
2030	934	0	75,863	76,797	50,871	50,871	25,926
2031	962	0	78,137	79,099	51,480	51,480	27,619
2032	990	0	80,483	81,473	52,101	52,101	29,372
2033	1,020	0	82,897	83,917	52,736	52,736	31,181
2034	1,051	0	85,383	86,434	53,384	53,384	33,050
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =				\$945,025	\$728,545	\$216,478	
NPV =				\$544,193	\$453,611	90,582	
Total NPV =				\$90,582			
Benefit/Cost Ratio =				1.20			

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: **2020-2022**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2020	\$139	\$0	\$11,290	\$3,614	\$15,043	\$36,371	\$1,000	\$37,371	(\$22,328)
2021	286	0	23,256	7,668	31,210	36,217	(2,850)	33,367	(2,157)
2022	442	0	35,932	12,202	48,576	43,115	(6,696)	36,419	12,157
2023	607	0	49,347	17,261	67,215	49,927	(10,536)	39,391	27,824
2024	782	0	63,532	22,889	87,203	56,702	(14,372)	42,330	44,873
2025	805	0	65,436	24,282	90,523	48,006	(19,831)	28,175	62,348
2026	829	0	67,402	25,762	93,993	48,556	(19,831)	28,725	65,268
2027	854	0	69,423	27,331	97,608	49,117	(19,831)	29,286	68,322
2028	880	0	71,506	28,995	101,381	49,690	(19,831)	29,859	71,522
2029	906	0	73,651	30,761	105,318	50,274	(19,831)	30,443	74,875
2030	934	0	75,863	32,636	109,433	50,871	(19,831)	31,040	78,393
2031	962	0	78,137	34,622	113,721	51,480	(19,831)	31,649	82,072
2032	990	0	80,483	36,731	118,204	52,101	(19,831)	32,270	85,934
2033	1,020	0	82,897	38,968	122,885	52,736	(19,831)	32,905	89,980
2034	1,051	0	85,383	41,341	127,775	53,384	(19,831)	33,553	94,222
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
2038	0	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0	0
Total =					\$1,330,088		\$496,783	\$833,305	
NPV =					\$1,032,777		\$407,307	625,470	
Total NPV =		\$625,470							
Benefit/Cost Ratio =		2.54							

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: **2020-2022**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2020	\$10,000	\$0.13015	\$0.11833	4,100	0	4,100	\$534	100	0	\$0.000	\$0.000	\$0	\$0	\$10,534	\$11,213	\$0	\$11,213	(\$679)
2021	14,180	0.13601	0.12365	8,200	0	8,200	1,115	200	0	0.000	0.000	0	0	15,295	\$11,774	0	11,774	3,521
2022	18,365	0.14213	0.12921	12,300	0	12,300	1,748	300	0	0.000	0.000	0	0	20,113	\$12,362	0	12,362	7,751
2023	22,556	0.14853	0.13503	16,400	0	16,400	2,436	400	0	0.000	0.000	0	0	24,992	\$12,980	0	12,980	12,012
2024	26,753	0.15521	0.14111	20,500	0	20,500	3,182	500	0	0.000	0.000	0	0	29,935	\$13,629	0	13,629	16,306
2025	20,203	0.16220	0.14745	20,500	0	20,500	3,325	500	0	0.000	0.000	0	0	23,528	\$417	0	417	23,111
2026	20,203	0.16950	0.15409	20,500	0	20,500	3,475	500	0	0.000	0.000	0	0	23,678	\$425	0	425	23,253
2027	20,203	0.17712	0.16102	20,500	0	20,500	3,631	500	0	0.000	0.000	0	0	23,834	\$433	0	433	23,401
2028	20,203	0.18509	0.16827	20,500	0	20,500	3,794	500	0	0.000	0.000	0	0	23,997	\$442	0	442	23,555
2029	20,203	0.19342	0.17584	20,500	0	20,500	3,965	500	0	0.000	0.000	0	0	24,168	\$450	0	450	23,718
2030	20,203	0.20213	0.18376	20,500	0	20,500	4,144	500	0	0.000	0.000	0	0	24,347	\$459	0	459	23,888
2031	20,203	0.21122	0.19202	20,500	0	20,500	4,330	500	0	0.000	0.000	0	0	24,533	\$468	0	468	24,065
2032	20,203	0.22073	0.20067	20,500	0	20,500	4,525	500	0	0.000	0.000	0	0	24,728	\$477	0	477	24,251
2033	20,203	0.23066	0.20970	20,500	0	20,500	4,729	500	0	0.000	0.000	0	0	24,932	\$486	0	486	24,446
2034	20,203	0.24104	0.21913	20,500	0	20,500	4,941	500	0	0.000	0.000	0	0	25,144	\$495	0	495	24,649
2035	0	0.25189	0.22899	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
2036	0	0.26322	0.23930	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
2037	0	0.27507	0.25007	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
2038	0	0.28744	0.26132	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
2039	0	0.30038	0.27308	0	0	0	0	0	0	0.000	0.000	0	0	0	\$0	0	0	0
Total =				266,500	0			6,500	0					\$343,758			\$66,510	\$277,248
														NPV = \$178,555			\$52,746	125,809

Total NPV = \$125,809
 Benefit/Cost Ratio = 3.39

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

Table 5
Total Resource Cost Test

Company: **Air Conditioning Cycling Program**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2020	\$139	\$11,290	\$11,429	\$36,371	\$1,000	\$37,371	(\$25,942)
2021	286	23,256	23,542	36,217	(2,850)	33,367	(9,825)
2022	442	35,932	36,374	43,115	(6,696)	36,419	(45)
2023	607	49,347	49,954	49,927	(10,536)	39,391	10,563
2024	782	63,532	64,314	56,702	(14,372)	42,330	21,984
2025	805	65,436	66,241	48,006	(19,831)	28,175	38,066
2026	829	67,402	68,231	48,556	(19,831)	28,725	39,506
2027	854	69,423	70,277	49,117	(19,831)	29,286	40,991
2028	880	71,506	72,386	49,690	(19,831)	29,859	42,527
2029	906	73,651	74,557	50,274	(19,831)	30,443	44,114
2030	934	75,863	76,797	50,871	(19,831)	31,040	45,757
2031	962	78,137	79,099	51,480	(19,831)	31,649	47,450
2032	990	80,483	81,473	52,101	(19,831)	32,270	49,203
2033	1,020	82,897	83,917	52,736	(19,831)	32,905	51,012
2034	1,051	85,383	86,434	53,384	(19,831)	33,553	52,881
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =			\$945,025			\$496,783	\$448,242
NPV =			\$544,193			\$323,098	221,096

Total NPV = \$221,096
Benefit/Cost Ratio = 1.68

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: **Total Program with Demand Response**
 Program Years: **2020-2022**

<u>Input Data</u>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =				
Retail Rate Winter (\$/kWh) =				
Retail Escalation Rate =				
1a) Power Supply Cost Adjustment				
Fuel Escalation Rate =				
2) Avg. System Marginal Energy Cost (\$/kWh) =				
Escalation Rate =				
3) Retail Summer Demand Rate (\$/kW/season) =				
3a) Retail Winter Demand Rate (\$/kW/season) =				
Escalation Rate =				
4) Electric Margin (\$/kWh) =				
Escalation Rate =				
5) System Peak Shaving Demand Cost (\$/kW/yr)				
Reserve Capacity=				
Escalation Rate =				
6) System Variable O&M (\$/kWh) =				
Escalation Rate =				
7) Environmental Damage Factor =				
Escalation Rate =				
8) Participant Discount Rate =	10.32%			
9) Utility Discount Rate =	7.30%			
10) Societal Discount Rate =	3.11%			
11) General Input Data Year =	2019			
12) Project Analysis Year 1 =	2020			
Project Analysis Year 2 =	2021			
Project Analysis Year 3 =	2022			
13) Utility Project Costs				
Admin & Promotion Costs =		\$50,715	\$53,094	\$51,935
Incentive Costs =		74,300	100,320	105,762
Total Utility Project Costs =		\$125,015	\$153,414	\$157,697
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 =		3,409	3,427	3,434
20) Incentive/Participant =				
21) Effective Federal & State Income Tax Rate =				
22) Annual Summer Kwh Saved		228,965	314,272	338,714
Annual Winter Kwh Saved		242,630	375,260	392,630
23) Annual Summer KW Saved		2,466	2,117	535
Annual Winter KW Saved		42	57	87
Test Results		NPV	B/C	
Ratepayer Impact Measure Test		\$5,566,130	1.87	
Utility Cost Test		\$6,691,313	2.27	
Societal Test		\$14,277,733	3.40	
Participant Test		\$2,857,939	5.64	
Total Resource Cost Test		\$6,926,614	2.38	

**Table 1
Ratepayer Impact Test**

Project: **Total Program with Demand Response**
Program Yea **2020-2022**

t	Year									Costs						Annual Benefits Less Costs (P)	
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	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)
1	2020	631,833		\$19,796		\$0	7,843	\$909,161	\$928,957		584,095	\$32,767	\$91,105	\$90,300	\$419,955	\$634,127	\$294,830
2	2021	1,377,191		44,442		0	10,262	1,225,283	1,269,725		1,273,135	74,390	118,627	132,320	460,135	785,471	484,254
3	2022	2,167,225		72,017		0	10,930	1,344,171	1,416,188		2,003,480	122,125	117,639	153,762	470,965	864,491	551,697
4	2023	2,184,965		74,792		0	11,377	1,441,125	1,515,917		2,019,880	128,861	74,258	90,225	481,425	774,769	741,148
5	2024	2,202,706		77,668		0	11,825	1,542,808	1,620,476		2,036,280	135,954	74,280	107,012	491,717	808,963	811,513
6	2025	2,202,706		80,002		0	11,825	1,589,043	1,669,045		2,036,280	142,065	74,302	80,810	483,115	780,292	888,753
7	2026	2,202,706		82,381		0	11,825	1,636,699	1,719,080		2,036,280	148,454	74,325	80,810	485,290	788,880	930,200
8	2027	2,202,706		84,871		0	11,825	1,685,891	1,770,762		2,036,280	155,137	74,348	80,810	487,511	797,807	972,955
9	2028	2,202,706		87,403		0	11,825	1,736,383	1,823,786		2,036,280	162,118	74,371	80,810	489,778	807,078	1,016,708
10	2029	1,983,656		81,072		0	6,763	1,022,906	1,103,978		1,833,780	151,578	74,395	80,810	233,163	539,946	564,032
11	2030	1,625,332		68,427		0	4,429	689,995	758,422		1,502,530	128,991	29,299	80,810	177,986	417,086	341,336
12	2031	1,165,868		50,552		0	2,513	403,235	453,787		1,077,780	95,877	2,251	80,810	122,858	301,796	151,991
13	2032	625,002		27,912		0	2,345	387,558	415,470		577,780	54,489	2,275	80,810	125,320	262,895	152,575
14	2033	625,002		28,750		0	2,345	399,190	427,940		577,780	56,940	2,300	80,810	127,834	267,884	160,056
15	2034	625,002		29,613		0	2,345	411,172	440,785		577,780	59,505	2,325	80,810	130,400	273,040	167,745
16	2035	536,300		26,171		0	107	19,324	45,495		495,780	51,713	0	0	0	51,713	(6,218)
17	2036	536,300		26,954		0	107	19,904	46,858		495,780	54,039	0	0	0	54,039	(7,181)
18	2037	536,300		27,764		0	107	20,501	48,265		495,780	56,472	0	0	0	56,472	(8,207)
19	2038	402,225		21,447		0	81	15,985	37,432		371,835	44,258	0	0	0	44,258	(6,826)
20	2039	134,075		7,363		0	27	5,488	12,851		123,945	15,416	0	0	0	15,416	(2,565)
Total =		26,169,806					120,706		\$17,525,219		24,192,540				\$9,326,423	\$8,198,796	
									NPV = \$11,956,251						\$6,390,121	5,566,130	
Total NPV =				\$5,566,130													
Benefit/Cost Ratio =				<u>1.87</u>													

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

**Table 2
Utility Test**

Project: **Total Program with Demand Response**
 Program Years: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2020	\$19,796	\$0	\$909,161	\$928,957	\$601,360	\$601,360	\$327,597
2021	44,442	0	1,225,283	1,269,725	711,081	711,081	558,644
2022	72,017	0	1,344,171	1,416,188	742,366	742,366	673,822
2023	74,792	0	1,441,125	1,515,917	645,908	645,908	870,009
2024	77,668	0	1,542,808	1,620,476	673,009	673,009	947,467
2025	80,002	0	1,589,043	1,669,045	638,227	638,227	1,030,818
2026	82,381	0	1,636,699	1,719,080	640,426	640,426	1,078,654
2027	84,871	0	1,685,891	1,770,762	642,670	642,670	1,128,092
2028	87,403	0	1,736,383	1,823,786	644,960	644,960	1,178,826
2029	81,072	0	1,022,906	1,103,978	388,368	388,368	715,610
2030	68,427	0	689,995	758,422	288,095	288,095	470,327
2031	50,552	0	403,235	453,787	205,919	205,919	247,868
2032	27,912	0	387,558	415,470	208,406	208,406	207,064
2033	28,750	0	399,190	427,940	210,944	210,944	216,996
2034	29,613	0	411,172	440,785	213,535	213,535	227,250
2035	26,171	0	19,324	45,495	0	0	45,495
2036	26,954	0	19,904	46,858	0	0	46,858
2037	27,764	0	20,501	48,265	0	0	48,265
2038	21,447	0	15,985	37,432	0	0	37,432
2039	7,363	0	5,488	12,851	0	0	12,851
Total =				\$17,525,219		\$7,455,274	\$10,069,945
				NPV = \$11,956,251		\$5,264,938	6,691,313
Total NPV =		\$6,691,313					
Benefit/Cost Ratio =		<u>2.27</u>					

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

**Table 3
Societal Cost Test**

Project: **Total Program with Demand Response**
 Program Years: **2020-2022**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2020	\$19,796	\$0	\$909,161	\$293,745	\$1,222,702	\$608,771	\$56,188	\$664,959	\$557,743
2021	44,442	0	1,225,283	413,544	1,683,269	720,233	63,870	784,103	899,166
2022	72,017	0	1,344,171	475,085	1,891,273	751,930	54,063	805,993	1,085,280
2023	74,792	0	1,441,125	523,797	2,039,714	655,903	(37,725)	618,178	1,421,536
2024	77,668	0	1,542,808	576,722	2,197,198	683,454	(53,070)	630,384	1,566,814
2025	80,002	0	1,589,043	611,828	2,280,873	649,141	(74,905)	574,236	1,706,637
2026	82,381	0	1,636,699	649,076	2,368,156	651,831	(74,905)	576,926	1,791,230
2027	84,871	0	1,685,891	688,647	2,459,409	654,588	(74,905)	579,683	1,879,726
2028	87,403	0	1,736,383	730,546	2,554,332	657,415	(74,905)	582,510	1,971,822
2029	81,072	0	1,022,906	455,483	1,559,461	392,373	(74,905)	317,468	1,241,993
2030	68,427	0	689,995	322,298	1,080,720	290,188	(77,667)	212,521	868,199
2031	50,552	0	403,235	198,626	652,413	205,919	(79,325)	126,594	525,819
2032	27,912	0	387,558	187,311	602,781	208,406	(79,325)	129,081	473,700
2033	28,750	0	399,190	198,720	626,660	210,944	(79,325)	131,619	495,041
2034	29,613	0	411,172	210,826	651,611	213,535	(79,325)	134,210	517,401
2035	26,171	0	19,324	22,413	67,908	0	0	0	67,908
2036	26,954	0	19,904	23,777	70,635	0	0	0	70,635
2037	27,764	0	20,501	25,226	73,491	0	0	0	73,491
2038	21,447	0	15,985	20,151	57,583	0	0	0	57,583
2039	7,363	0	5,488	7,126	19,977	0	0	0	19,977
Total =					\$24,160,166			\$6,868,465	\$17,291,701
NPV =					\$20,232,422			\$5,954,689	14,277,733
Total NPV =		\$14,277,733							
Benefit/Cost Ratio =		<u>3.40</u>							

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

**Table 4
Participant Test**

Project: **Total Program with Demand Response**
 Program Years: **2020-2022**

Year	Benefits											Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
	2020	\$90,300			584,095	\$58,200	6,966	42			\$66,841	\$28,875	\$244,216	\$149,218		\$0
2021	132,320			1,273,135	130,373	9,071	99			106,628	34,125	403,446	203,585	0	203,585	199,861
2022	153,762			2,003,480	213,192	9,582	186			120,721	34,125	521,800	219,894	0	219,894	301,906
2023	90,225			2,019,880	225,222	9,982	186			122,050	34,125	471,622	56,341	0	56,341	415,281
2024	107,012			2,036,280	237,904	10,382	186			123,440	34,125	502,481	58,936	0	58,936	443,545
2025	80,810			2,036,280	248,598	10,382	186			124,892	34,125	488,425	6,087	0	6,087	482,338
2026	80,810			2,036,280	259,790	10,382	186			126,410	34,125	501,135	6,120	0	6,120	495,015
2027	80,810			2,036,280	271,486	10,382	186			127,996	34,125	514,417	6,153	0	6,153	508,264
2028	80,810			2,036,280	283,705	10,382	186			129,654	34,125	528,294	6,186	0	6,186	522,108
2029	80,810			1,833,780	263,826	5,870	174			118,250	10,500	473,386	6,220	0	6,220	467,166
2030	80,810			1,502,530	223,911	3,828	132			65,185	5,250	375,156	3,493	0	3,493	371,663
2031	80,810			1,077,780	165,799	2,171	75			26,065	0	272,674	1,871	0	1,871	270,803
2032	80,810			577,780	94,066	2,096	0			8,578	0	183,454	1,907	0	1,907	181,547
2033	80,810			577,780	98,300	2,096	0			8,964	0	188,074	1,944	0	1,944	186,130
2034	80,810			577,780	102,720	2,096	0			9,367	0	192,897	1,982	0	1,982	190,915
2035	0			495,780	86,723	96	0			9,789	0	96,512	0	0	0	96,512
2036	0			495,780	90,624	96	0			10,229	0	100,853	0	0	0	100,853
2037	0			495,780	94,702	96	0			10,690	0	105,392	0	0	0	105,392
2038	0			371,835	74,224	72	0			8,378	0	82,602	0	0	0	82,602
2039	0			123,945	25,855	24	0			2,918	0	28,773	0	0	0	28,773
Total =						106,052	1,824					\$6,275,609			\$729,937	\$5,545,672
												NPV = \$3,473,303			\$615,365	2,857,939
Total NPV =				\$2,857,939												
Benefit/Cost Ratio =				<u>5.64</u>												

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

Table 5
Total Resource Cost Test

Company: **Total Program with Demand Response**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2020	\$19,796	\$909,161	\$928,957	\$608,771	\$56,188	\$664,959	\$263,998
2021	44,442	1,225,283	1,269,725	720,233	63,870	784,103	485,622
2022	72,017	1,344,171	1,416,188	751,930	54,063	805,993	610,195
2023	74,792	1,441,125	1,515,917	655,903	(37,725)	618,178	897,739
2024	77,668	1,542,808	1,620,476	683,454	(53,070)	630,384	990,092
2025	80,002	1,589,043	1,669,045	649,141	(74,905)	574,236	1,094,809
2026	82,381	1,636,699	1,719,080	651,831	(74,905)	576,926	1,142,154
2027	84,871	1,685,891	1,770,762	654,588	(74,905)	579,683	1,191,079
2028	87,403	1,736,383	1,823,786	657,415	(74,905)	582,510	1,241,276
2029	81,072	1,022,906	1,103,978	392,373	(74,905)	317,468	786,510
2030	68,427	689,995	758,422	290,188	(77,667)	212,521	545,901
2031	50,552	403,235	453,787	205,919	(79,325)	126,594	327,193
2032	27,912	387,558	415,470	208,406	(79,325)	129,081	286,389
2033	28,750	399,190	427,940	210,944	(79,325)	131,619	296,321
2034	29,613	411,172	440,785	213,535	(79,325)	134,210	306,575
2035	26,171	19,324	45,495	0	0	0	45,495
2036	26,954	19,904	46,858	0	0	0	46,858
2037	27,764	20,501	48,265	0	0	0	48,265
2038	21,447	15,985	37,432	0	0	0	37,432
2039	7,363	5,488	12,851	0	0	0	12,851
Total =			\$17,525,219			\$6,868,465	\$10,656,754
NPV =			\$11,956,251			\$5,029,637	6,926,614

Total NPV = \$6,926,614
Benefit/Cost Ratio = 2.38

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

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

Company: **Montana-Dakota Utilities Co.**
 Project: **Total Program with Demand Response**
 Program Years: **2020-2022**

Input Data		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =				
Retail Rate Winter (\$/kWh) =				
Retail Escalation Rate =				
1a) Power Supply Cost Adjustment				
Fuel Escalation Rate =				
2) Avg. System Marginal Energy Cost (\$/kWh) =				
Escalation Rate =				
3) Retail Summer Demand Rate (\$/kW/season) =				
3a) Retail Winter Demand Rate (\$/kW/season) =				
Escalation Rate =				
4) Electric Margin (\$/kWh) =				
Escalation Rate =				
5) System Peak Shaving Demand Cost (\$/kW/yr)				
Reserve Capacity=				
Escalation Rate =				
6) System Variable O&M (\$/kWh) =				
Escalation Rate =				
7) Environmental Damage Factor =				
Escalation Rate =				
8) Participant Discount Rate =	10.32%			
9) Utility Discount Rate =	7.36%			
10) Societal Discount Rate =	3.11%			
11) General Input Data Year =	2019			
12) Project Analysis Year 1 =	2020			
Project Analysis Year 2 =	2021			
Project Analysis Year 3 =	2022			
13) Utility Project Costs				
Admin & Promotion Costs =		\$143,736	\$132,363	\$133,303
Incentive Costs =		\$235,900	\$273,900	\$321,981
Total Utility Project Costs =		\$379,636	\$406,263	\$455,284
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 =		11,524	11,576	11,626
20) Incentive/Participant =				
21) Effective Federal & State Income Tax Rate =				
22) Annual Summer Kwh Saved		562,945	706,105	871,820
Annual Winter Kwh Saved		697,890	880,520	1,113,150
23) Annual Summer KW Saved		2,787	2,886	1,901
Annual Winter KW Saved		187	241	310
Test Results		NPV	B/C	
Ratepayer Impact Measure Test		\$12,454,808	1.69	
Utility Cost Test		\$15,077,520	1.98	
Societal Test		\$34,987,345	3.10	
Participant Test		\$10,404,591	6.47	
Total Resource Cost Test		\$16,361,925	2.16	

**Table 1
Ratepayer Impact Test**

Project: **Total Program with Demand Response**
Program Year **2020-2022**

t	Year	Benefits								Costs						Annual Benefits Less Costs (P)	
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	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)
1	2020	1,512,622		\$50,636		\$0	9,485	\$2,580,339	\$2,630,975		1,709,210	\$82,990	\$762,327	\$295,900	\$767,831	\$1,909,048	\$721,927
2	2021	3,226,925		100,533		0	12,932	3,015,515	3,116,048		3,293,990	167,603	759,134	393,900	766,025	2,086,662	1,029,386
3	2022	5,370,075		165,772		0	15,303	3,359,691	3,525,463		5,275,215	279,131	761,612	501,981	806,638	2,349,361	1,176,102
4	2023	5,436,602		173,023		0	16,981	3,645,371	3,818,394		5,336,715	296,026	694,449	338,345	845,865	2,174,685	1,643,709
5	2024	5,503,128		180,560		0	18,660	3,945,066	4,125,626		5,398,215	313,874	694,532	401,296	884,458	2,294,160	1,831,466
6	2025	5,503,128		185,978		0	18,660	4,063,294	4,249,272		5,398,215	328,003	694,617	303,039	852,201	2,177,860	2,071,412
7	2026	5,503,128		191,554		0	18,660	4,185,350	4,376,904		5,398,215	342,782	694,702	303,039	860,359	2,200,883	2,176,021
8	2027	5,503,128		197,303		0	18,660	4,310,883	4,508,186		5,398,215	358,181	694,789	303,039	868,688	2,224,696	2,283,490
9	2028	5,503,128		203,220		0	18,660	4,440,241	4,643,461		5,398,215	374,306	694,876	303,039	877,190	2,249,411	2,394,050
10	2029	5,029,871		180,534		0	12,417	1,633,084	1,813,618		4,649,840	333,601	8,261	303,039	569,399	1,214,300	599,318
11	2030	4,134,741		153,200		0	10,928	1,480,417	1,633,617		3,822,340	282,933	8,351	303,039	514,965	1,109,287	524,330
12	2031	3,023,262		115,887		0	9,373	1,307,814	1,423,701		2,794,840	212,445	8,441	303,039	460,716	984,641	439,060
13	2032	1,941,532		77,345		0	9,037	1,298,798	1,376,143		1,794,840	145,722	8,532	303,039	469,950	927,243	448,900
14	2033	1,941,532		79,673		0	9,037	1,337,747	1,417,420		1,794,840	152,280	8,624	303,039	479,377	943,320	474,100
15	2034	1,941,532		82,063		0	9,037	1,377,872	1,459,935		1,794,840	159,134	8,717	303,039	489,001	959,891	500,044
16	2035	1,608,900		68,298		0	644	101,134	169,432		1,487,340	129,477	0	0	0	129,477	39,955
17	2036	1,608,900		70,341		0	644	104,167	174,508		1,487,340	135,295	0	0	0	135,295	39,213
18	2037	1,608,900		72,449		0	644	107,297	179,746		1,487,340	141,387	0	0	0	141,387	38,359
19	2038	1,206,675		55,966		0	484	83,054	139,020		1,115,505	110,815	0	0	0	110,815	28,205
20	2039	670,375		32,024		0	268	47,369	79,393		619,725	64,335	0	0	0	64,335	15,058
Total =		67,778,084					210,514		\$44,860,862		65,454,995				\$26,386,757	\$18,474,105	
									NPV = \$30,414,552						\$17,959,744	12,454,808	

Total NPV = \$12,454,808
Benefit/Cost Ratio = 1.69

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

**Table 2
Utility Test**

Project: **Total Program with Demand Response**
 Program Years: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2020	\$50,636	\$0	\$2,580,339	\$2,630,975	\$1,826,058	\$1,826,058	\$804,917
2021	100,533	0	3,015,515	3,116,048	1,919,059	1,919,059	1,196,989
2022	165,772	0	3,359,691	3,525,463	2,070,230	2,070,230	1,455,233
2023	173,023	0	3,645,371	3,818,394	1,878,659	1,878,659	1,939,735
2024	180,560	0	3,945,066	4,125,626	1,980,286	1,980,286	2,145,340
2025	185,978	0	4,063,294	4,249,272	1,849,857	1,849,857	2,399,415
2026	191,554	0	4,185,350	4,376,904	1,858,101	1,858,101	2,518,803
2027	197,303	0	4,310,883	4,508,186	1,866,515	1,866,515	2,641,671
2028	203,220	0	4,440,241	4,643,461	1,875,105	1,875,105	2,768,356
2029	180,534	0	1,633,084	1,813,618	880,699	880,699	932,919
2030	153,200	0	1,480,417	1,633,617	826,354	826,354	807,263
2031	115,887	0	1,307,814	1,423,701	772,196	772,196	651,505
2032	77,345	0	1,298,798	1,376,143	781,521	781,521	594,622
2033	79,673	0	1,337,747	1,417,420	791,040	791,040	626,380
2034	82,063	0	1,377,872	1,459,935	800,757	800,757	659,178
2035	68,298	0	101,134	169,432	0	0	169,432
2036	70,341	0	104,167	174,508	0	0	174,508
2037	72,449	0	107,297	179,746	0	0	179,746
2038	55,966	0	83,054	139,020	0	0	139,020
2039	32,024	0	47,369	79,393	0	0	79,393
Total =				\$44,860,862	\$21,976,437	\$22,884,425	
NPV =				\$30,414,552	\$15,337,032	15,077,520	
Total NPV =		\$15,077,520					
Benefit/Cost Ratio =		1.98					

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: **Total Program with Demand Response**
 Program Years: **2020-2022**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2020	\$50,636	\$0	\$2,580,339	\$831,940	\$3,462,915	\$1,833,480	\$177,149	\$2,010,629	\$1,452,286
2021	100,533	0	3,015,515	1,014,886	4,130,934	1,928,108	150,824	2,078,932	2,052,002
2022	165,772	0	3,359,691	1,182,678	4,708,141	2,079,686	122,566	2,202,252	2,505,889
2023	173,023	0	3,645,371	1,319,374	5,137,768	1,888,540	(142,171)	1,746,369	3,391,399
2024	180,560	0	3,945,066	1,468,300	5,593,926	1,990,611	(199,713)	1,790,898	3,803,028
2025	185,978	0	4,063,294	1,557,674	5,806,946	1,860,647	(281,594)	1,579,053	4,227,893
2026	191,554	0	4,185,350	1,652,592	6,029,496	1,869,378	(281,594)	1,587,784	4,441,712
2027	197,303	0	4,310,883	1,753,225	6,261,411	1,878,298	(281,594)	1,596,704	4,664,707
2028	203,220	0	4,440,241	1,860,010	6,503,471	1,887,418	(281,594)	1,605,824	4,897,647
2029	180,534	0	1,633,084	748,267	2,561,885	884,376	(297,468)	586,908	1,974,977
2030	153,200	0	1,480,417	694,222	2,327,839	828,275	(297,468)	530,807	1,797,032
2031	115,887	0	1,307,814	623,167	2,046,868	772,196	(297,468)	474,728	1,572,140
2032	77,345	0	1,298,798	620,420	1,996,563	781,521	(297,468)	484,053	1,512,510
2033	79,673	0	1,337,747	658,200	2,075,620	791,040	(297,468)	493,572	1,582,048
2034	82,063	0	1,377,872	698,281	2,158,216	800,757	(297,468)	503,289	1,654,927
2035	68,298	0	101,134	83,470	252,902	0	0	0	252,902
2036	70,341	0	104,167	88,550	263,058	0	0	0	263,058
2037	72,449	0	107,297	93,944	273,690	0	0	0	273,690
2038	55,966	0	83,054	74,838	213,858	0	0	0	213,858
2039	32,024	0	47,369	44,022	123,415	0	0	0	123,415
Total =					\$61,928,922			\$19,271,802	\$42,657,120
					NPV = \$51,654,363			\$16,667,018	34,987,345
Total NPV =		\$34,987,345							
Benefit/Cost Ratio =		<u>3.10</u>							

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

**Table 4
Participant Test**

Project: **Total Program with Demand Response**
 Program Years: **2020-2022**

Year	Benefits											Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2020	\$295,900			1,709,210	\$161,792	22,687	187			\$688,820	\$34,650	\$1,181,162	\$481,685	\$0	\$481,685	\$699,477
2021	393,900			3,293,990	324,317	25,528	428			721,253	40,425	1,479,895	564,973	0	564,973	914,922
2022	501,981			5,275,215	539,252	27,338	738			763,228	40,425	1,844,886	660,664	0	660,664	1,184,222
2023	338,345			5,336,715	571,852	28,838	738			767,324	40,425	1,717,946	210,578	0	210,578	1,507,368
2024	401,296			5,398,215	606,308	30,338	738			771,605	40,425	1,819,634	220,309	0	220,309	1,599,325
2025	303,039			5,398,215	633,565	30,338	738			776,077	40,425	1,753,106	22,126	0	22,126	1,730,980
2026	303,039			5,398,215	662,092	30,338	738			780,752	40,425	1,786,308	22,247	0	22,247	1,764,061
2027	303,039			5,398,215	691,885	30,338	738			785,637	40,425	1,820,986	22,371	0	22,371	1,798,615
2028	303,039			5,398,215	723,019	30,338	738			790,740	40,425	1,857,223	22,497	0	22,497	1,834,726
2029	303,039			4,649,840	644,066	10,398	698			130,293	11,550	1,088,948	6,752	0	6,752	1,082,196
2030	303,039			3,822,340	548,529	9,183	583			116,947	5,775	974,290	6,882	0	6,882	967,408
2031	303,039			2,794,840	414,267	7,938	438			95,872	0	813,178	7,016	0	7,016	806,162
2032	303,039			1,794,840	282,261	7,788	288			65,875	0	651,175	7,152	0	7,152	644,023
2033	303,039			1,794,840	294,962	7,788	288			68,840	0	666,841	7,291	0	7,291	659,550
2034	303,039			1,794,840	308,226	7,788	288			71,938	0	683,203	7,432	0	7,432	675,771
2035	0			1,487,340	251,420	288	288			75,175	0	326,595	0	0	0	326,595
2036	0			1,487,340	262,724	288	288			78,558	0	341,282	0	0	0	341,282
2037	0			1,487,340	274,548	288	288			82,093	0	356,641	0	0	0	356,641
2038	0			1,115,505	215,181	216	216			64,340	0	279,521	0	0	0	279,521
2039	0			619,725	124,922	120	120			37,353	0	162,275	0	0	0	162,275

Total = 308,164 9,564 \$21,605,095 \$2,269,975 \$19,335,120
 NPV = \$12,308,058 \$1,903,467 10,404,591

Total NPV = #####
 Benefit/Cost Ratio = 6.47

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

Table 5
Total Resource Cost Test

Company: **Total Program with Demand Response**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2020	\$50,636	\$2,580,339	\$2,630,975	\$1,833,480	\$177,149	\$2,010,629	\$620,346
2021	100,533	3,015,515	3,116,048	1,928,108	150,824	2,078,932	1,037,116
2022	165,772	3,359,691	3,525,463	2,079,686	122,566	2,202,252	1,323,211
2023	173,023	3,645,371	3,818,394	1,888,540	(142,171)	1,746,369	2,072,025
2024	180,560	3,945,066	4,125,626	1,990,611	(199,713)	1,790,898	2,334,728
2025	185,978	4,063,294	4,249,272	1,860,647	(281,594)	1,579,053	2,670,219
2026	191,554	4,185,350	4,376,904	1,869,378	(281,594)	1,587,784	2,789,120
2027	197,303	4,310,883	4,508,186	1,878,298	(281,594)	1,596,704	2,911,482
2028	203,220	4,440,241	4,643,461	1,887,418	(281,594)	1,605,824	3,037,637
2029	180,534	1,633,084	1,813,618	884,376	(297,468)	586,908	1,226,710
2030	153,200	1,480,417	1,633,617	828,275	(297,468)	530,807	1,102,810
2031	115,887	1,307,814	1,423,701	772,196	(297,468)	474,728	948,973
2032	77,345	1,298,798	1,376,143	781,521	(297,468)	484,053	892,090
2033	79,673	1,337,747	1,417,420	791,040	(297,468)	493,572	923,848
2034	82,063	1,377,872	1,459,935	800,757	(297,468)	503,289	956,646
2035	68,298	101,134	169,432	0	0	0	169,432
2036	70,341	104,167	174,508	0	0	0	174,508
2037	72,449	107,297	179,746	0	0	0	179,746
2038	55,966	83,054	139,020	0	0	0	139,020
2039	32,024	47,369	79,393	0	0	0	79,393
Total =			\$44,860,862			\$19,271,802	\$25,589,060
NPV =			\$30,414,552			\$14,052,627	16,361,925

Total NPV = \$16,361,925
Benefit/Cost Ratio = 2.16

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: **2020-2022**

<u>Input Data</u>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =				
Retail Rate Winter (\$/kWh) =				
Retail Escalation Rate =				
1a) Power Supply Cost Adjustment				
Fuel Escalation Rate =				
2) Avg. System Marginal Energy Cost (\$/kWh) =				
Escalation Rate =				
3) Retail Summer Demand Rate (\$/kW/season) =				
3a) Retail Winter Demand Rate (\$/kW/season) =				
Escalation Rate =				
4) Electric Margin (\$/kWh) =				
Escalation Rate =				
5) System Peak Shaving Demand Cost (\$/kW/yr)				
Reserve Capacity=				
Escalation Rate =				
6) System Variable O&M (\$/kWh) =				
Escalation Rate =				
7) Environmental Damage Factor =				
Escalation Rate =				
8) Participant Discount Rate =	10.32%			
9) Utility Discount Rate =	7.22%			
10) Societal Discount Rate =	3.11%			
11) General Input Data Year =	2019			
12) Project Analysis Year 1 =	2020			
Project Analysis Year 2 =	2021			
Project Analysis Year 3 =	2022			
13) Utility Project Costs				
Admin & Promotion Costs =		\$12,797	\$11,584	\$12,021
Incentive Costs =		\$27,120	\$30,360	\$36,665
Total Utility Project Costs =		\$39,917	\$41,944	\$48,686
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 =		1,105	1,109	1,112
20) Incentive/Participant =				
21) Effective Federal & State Income Tax Rate =				
22) Annual Summer Kwh Saved		90,626	99,012	105,665
Annual Winter Kwh Saved		103,052	119,578	152,630
23) Annual Summer KW Saved		529	536	149
Annual Winter KW Saved		29	33	43

Test Results	NPV	B/C
Ratepayer Impact Measure Test	\$633,636	1.59
Utility Cost Test	\$819,377	1.92
Societal Test	\$2,063,119	3.08
Participant Test	\$742,206	4.74
Total Resource Cost Test	\$871,992	2.05

**Table 1
Ratepayer Impact Test**

Project: **Total Program with Demand Response**
Program Yea **2020-2022**

t	Year										Costs						Annual Benefits Less Costs (P)
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	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)	
1	2020	209,508		\$5,726		\$0	624	\$62,899	\$68,625		193,678	\$5,456	\$12,797	\$31,120	\$48,887	\$98,260	(\$29,635)
2	2021	445,830		12,546		0	1,259	130,710	143,256		412,145	11,907	11,584	38,360	67,563	129,415	13,841
3	2022	724,966		21,007		0	1,465	156,667	177,674		670,190	19,767	12,021	48,665	70,271	150,724	26,950
4	2023	729,401		21,791		0	1,577	173,706	195,497		674,290	20,981	516	22,556	72,886	116,940	78,557
5	2024	733,836		22,600		0	1,689	191,618	214,218		678,390	22,261	522	26,753	75,459	124,995	89,223
6	2025	733,836		23,278		0	1,689	197,360	220,638		678,390	23,265	528	20,203	73,308	117,303	103,335
7	2026	733,836		23,977		0	1,689	203,288	227,265		678,390	24,313	533	20,203	73,852	118,901	108,364
8	2027	733,836		24,696		0	1,689	209,385	234,081		678,390	25,404	539	20,203	74,407	120,553	113,528
9	2028	733,836		25,437		0	1,689	215,669	241,106		678,390	26,550	545	20,203	74,974	122,272	118,834
10	2029	701,384		25,045		0	1,681	221,084	246,129		648,390	24,665	551	20,203	75,553	120,971	125,158
11	2030	549,940		20,255		0	1,192	161,481	181,736		508,390	19,236	557	20,203	53,127	93,123	88,613
12	2031	398,499		15,153		0	702	97,950	113,103		368,390	13,268	563	20,203	30,714	64,748	48,355
13	2032	290,325		11,405		0	668	96,005	107,410		268,390	10,570	569	20,203	31,330	62,671	44,739
14	2033	290,325		11,749		0	668	98,884	110,633		268,390	11,045	575	20,203	31,958	63,781	46,852
15	2034	290,325		12,101		0	668	101,850	113,951		268,390	11,544	581	20,203	32,600	64,928	49,023
16	2035	268,150		11,383		0	108	16,960	28,343		247,890	9,321	0	0	0	9,321	19,022
17	2036	268,150		11,724		0	108	17,469	29,193		247,890	9,741	0	0	0	9,741	19,452
18	2037	268,150		12,075		0	108	17,994	30,069		247,890	10,179	0	0	0	10,179	19,890
19	2038	214,520		9,949		0	86	14,758	24,707		198,312	8,510	0	0	0	8,510	16,197
20	2039	134,075		6,405		0	54	10,977	17,382		123,945	5,558	0	0	0	5,558	11,824
Total =		9,452,728					19,413		\$2,725,016		8,738,520				\$1,612,894	\$1,112,122	
									NPV = \$1,706,151						\$1,072,515	633,636	
Total NPV =			\$633,636														
Benefit/Cost Ratio =			1.59														

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

**Table 2
Utility Test**

Project: **Total Program with Demand Response**
 Program Years: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2020	\$5,726	\$0	\$62,899	\$68,625	\$92,804	\$92,804	(\$24,179)
2021	12,546	0	130,710	143,256	117,508	117,508	25,748
2022	21,007	0	156,667	177,674	130,957	130,957	46,717
2023	21,791	0	173,706	195,497	95,959	95,959	99,538
2024	22,600	0	191,618	214,218	102,734	102,734	111,484
2025	23,278	0	197,360	220,638	94,038	94,038	126,600
2026	23,977	0	203,288	227,265	94,588	94,588	132,677
2027	24,696	0	209,385	234,081	95,149	95,149	138,932
2028	25,437	0	215,669	241,106	95,722	95,722	145,384
2029	25,045	0	221,084	246,129	96,306	96,306	149,823
2030	20,255	0	161,481	181,736	73,887	73,887	107,849
2031	15,153	0	97,950	113,103	51,480	51,480	61,623
2032	11,405	0	96,005	107,410	52,101	52,101	55,309
2033	11,749	0	98,884	110,633	52,736	52,736	57,897
2034	12,101	0	101,850	113,951	53,384	53,384	60,567
2035	11,383	0	16,960	28,343	0	0	28,343
2036	11,724	0	17,469	29,193	0	0	29,193
2037	12,075	0	17,994	30,069	0	0	30,069
2038	9,949	0	14,758	24,707	0	0	24,707
2039	6,405	0	10,977	17,382	0	0	17,382
Total =				\$2,725,016		\$1,299,353	\$1,425,663
NPV =				\$1,706,151		\$886,774	819,377
Total NPV =		\$819,377					
Benefit/Cost Ratio =		1.92					

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: **2020-2022**

Year	Benefits				Annual Total Decrease (E)	Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)		Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2020	\$5,726	\$0	\$62,899	\$21,700	\$90,325	\$92,998	\$26,570	\$119,568	(\$29,243)
2021	12,546	0	130,710	46,658	189,914	117,914	25,005	142,919	46,995
2022	21,007	0	156,667	59,603	237,277	131,381	19,729	151,110	86,167
2023	21,791	0	173,706	67,550	263,047	96,402	(10,536)	85,866	177,181
2024	22,600	0	191,618	76,239	290,457	103,197	(14,372)	88,825	201,632
2025	23,278	0	197,360	80,880	301,518	94,522	(19,831)	74,691	226,827
2026	23,977	0	203,288	85,809	313,074	95,094	(19,831)	75,263	237,811
2027	24,696	0	209,385	91,033	325,114	95,678	(19,831)	75,847	249,267
2028	25,437	0	215,669	96,578	337,684	96,275	(19,831)	76,444	261,240
2029	25,045	0	221,084	101,548	347,677	96,884	(19,831)	77,053	270,624
2030	20,255	0	161,481	77,231	258,967	74,189	(19,831)	54,358	204,609
2031	15,153	0	97,950	49,506	162,609	51,480	(19,831)	31,649	130,960
2032	11,405	0	96,005	48,424	155,834	52,101	(19,831)	32,270	123,564
2033	11,749	0	98,884	51,374	162,007	52,736	(19,831)	32,905	129,102
2034	12,101	0	101,850	54,502	168,453	53,384	(19,831)	33,553	134,900
2035	11,383	0	16,960	13,963	42,306	0	0	0	42,306
2036	11,724	0	17,469	14,813	44,006	0	0	0	44,006
2037	12,075	0	17,994	15,715	45,784	0	0	0	45,784
2038	9,949	0	14,758	13,300	38,007	0	0	0	38,007
2039	6,405	0	10,977	9,638	27,020	0	0	0	27,020
Total =					\$3,801,080			\$1,152,321	\$2,648,759
NPV =					\$3,055,501			\$992,382	2,063,119
Total NPV =		\$2,063,119							
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: **Total Program with Demand Response**
 Program Years: **2020-2022**

Year	Benefits											Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2020	\$31,120			193,678	\$19,541	529	29			\$3,545	\$2,100	\$56,306	\$58,692	\$0	\$58,692	(\$2,386)
2021	38,360			412,145	43,322	1,062	62			7,701	4,200	93,583	65,613	0	65,613	27,970
2022	48,665			670,190	73,332	1,205	105			11,993	4,200	138,190	72,453	0	72,453	65,737
2023	22,556			674,290	77,240	1,305	105			12,427	4,200	116,423	12,980	0	12,980	103,443
2024	26,753			678,390	81,354	1,405	105			12,881	4,200	125,188	13,629	0	13,629	111,559
2025	20,203			678,390	85,014	1,405	105			13,356	4,200	122,773	417	0	417	122,356
2026	20,203			678,390	88,838	1,405	105			13,852	4,200	127,093	425	0	425	126,668
2027	20,203			678,390	92,835	1,405	105			14,370	4,200	131,608	433	0	433	131,175
2028	20,203			678,390	97,013	1,405	105			14,912	4,200	136,328	442	0	442	135,886
2029	20,203			648,390	95,930	1,401	101			15,477	4,200	135,810	450	0	450	135,360
2030	20,203			508,390	78,108	982	82			12,687	2,100	113,098	459	0	459	112,639
2031	20,203			368,390	58,487	563	63			9,723	0	88,413	468	0	468	87,945
2032	20,203			268,390	44,810	548	48			7,741	0	72,754	477	0	477	72,277
2033	20,203			268,390	46,829	548	48			8,089	0	75,121	486	0	486	74,635
2034	20,203			268,390	48,935	548	48			8,453	0	77,591	495	0	495	77,096
2035	0			247,890	45,974	48	48			8,834	0	54,808	0	0	0	54,808
2036	0			247,890	48,043	48	48			9,231	0	57,274	0	0	0	57,274
2037	0			247,890	50,204	48	48			9,647	0	59,851	0	0	0	59,851
2038	0			198,312	41,971	38	38			7,981	0	49,952	0	0	0	49,952
2039	0			123,945	27,412	24	24			5,267	0	32,679	0	0	0	32,679
Total =						15,922	1,422					\$1,864,843			\$227,919	\$1,636,924
												NPV = \$940,608			\$198,402	742,206
Total NPV =				\$742,206												
Benefit/Cost Ratio =				<u>4.74</u>												

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

**Table 5
Total Resource Cost Test**

Company: **Total Program with Demand Response**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2020	\$5,726	\$62,899	\$68,625	\$92,998	\$26,570	\$119,568	(\$50,943)
2021	12,546	130,710	143,256	117,914	25,005	142,919	337
2022	21,007	156,667	177,674	131,381	19,729	151,110	26,564
2023	21,791	173,706	195,497	96,402	(10,536)	85,866	109,631
2024	22,600	191,618	214,218	103,197	(14,372)	88,825	125,393
2025	23,278	197,360	220,638	94,522	(19,831)	74,691	145,947
2026	23,977	203,288	227,265	95,094	(19,831)	75,263	152,002
2027	24,696	209,385	234,081	95,678	(19,831)	75,847	158,234
2028	25,437	215,669	241,106	96,275	(19,831)	76,444	164,662
2029	25,045	221,084	246,129	96,884	(19,831)	77,053	169,076
2030	20,255	161,481	181,736	74,189	(19,831)	54,358	127,378
2031	15,153	97,950	113,103	51,480	(19,831)	31,649	81,454
2032	11,405	96,005	107,410	52,101	(19,831)	32,270	75,140
2033	11,749	98,884	110,633	52,736	(19,831)	32,905	77,728
2034	12,101	101,850	113,951	53,384	(19,831)	33,553	80,398
2035	11,383	16,960	28,343	0	0	0	28,343
2036	11,724	17,469	29,193	0	0	0	29,193
2037	12,075	17,994	30,069	0	0	0	30,069
2038	9,949	14,758	24,707	0	0	0	24,707
2039	6,405	10,977	17,382	0	0	0	17,382
Total =			\$2,725,016			\$1,152,321	\$1,572,695
NPV =			\$1,706,151			\$834,159	871,992

Total NPV = \$871,992
Benefit/Cost Ratio = 2.05

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: **2020-2022**

Input Data		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.12435			
Retail Rate Winter (\$/kWh) =	\$0.10438			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.02542			
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) =	\$0.08571			
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 =	10.32%			
9) Utility Discount Rate =	7.30%			
10) Societal Discount Rate =	3.11%			
11) General Input Data Year =	2019			
12) Project Analysis Year 1 =	2020			
Project Analysis Year 2 =	2021			
Project Analysis Year 3 =	2022			
13) Utility Project Costs				
Admin & Promotion Costs =		\$5,359	\$3,444	\$3,184
Incentive Costs =		15,000	15,000	15,000
Total Utility Project Costs =		\$20,359	\$18,444	\$18,184
14) Direct Participant Costs (\$/Part.) =		\$10	\$10	\$10
Escalation Rate =		1.94%	1.94%	1.94%
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		11.9000%	11.9000%	11.9000%
18b) System Energy Line Loss Factor		8.1730%	8.1730%	8.1730%
19) Number of Participants =		3,000	3,000	3,000
20) Incentive/Participant =		\$5	\$5	\$5
21) Effective Federal & State Income Tax Rate =				26.33%
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		(\$58,217)	0.70	
Utility Cost Test		\$82,650	2.55	
Societal Test		\$126,552	2.28	
Participant Test		\$173,325	3.04	
Total Resource Cost Test		\$40,641	1.43	

**Table 1
Ratepayer Impact Test**

Project: **Residential Lighting**
Program Years: **2020-2022**

t	Year											Costs						Annual Benefits Less Costs (P)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2020	97,356	\$0.03133	\$3,050	\$0.00000	\$0	13	13	26	\$115.92	\$3,014	\$6,064	\$0.08957	30,000	60,000	90,000	\$5,939	\$5,359	\$15,000	\$26,298	(\$20,234)	
2	2021	194,712	0.03227	6,283	0.00000	0	27	27	54	119.40	6,448	12,731	0.09360	60,000	120,000	180,000	12,412	3,444	15,000	30,856	(18,125)	
3	2022	292,067	0.03323	9,705	0.00000	0	40	40	80	122.98	9,838	19,543	0.09781	90,000	180,000	270,000	19,455	3,184	15,000	37,639	(18,096)	
4	2023	292,067	0.03423	9,997	0.00000	0	40	40	80	126.67	10,134	20,131	0.10221	90,000	180,000	270,000	20,330	0	0	20,330	(199)	
5	2024	292,067	0.03526	10,298	0.00000	0	40	40	80	130.47	10,438	20,736	0.10681	90,000	180,000	270,000	21,245	0	0	21,245	(509)	
6	2025	292,067	0.03632	10,608	0.00000	0	40	40	80	134.38	10,750	21,358	0.11162	90,000	180,000	270,000	22,201	0	0	22,201	(843)	
7	2026	292,067	0.03740	10,923	0.00000	0	40	40	80	138.41	11,073	21,996	0.11664	90,000	180,000	270,000	23,200	0	0	23,200	(1,204)	
8	2027	292,067	0.03853	11,253	0.00000	0	40	40	80	142.57	11,406	22,659	0.12189	90,000	180,000	270,000	24,244	0	0	24,244	(1,585)	
9	2028	292,067	0.03968	11,589	0.00000	0	40	40	80	146.84	11,747	23,336	0.12737	90,000	180,000	270,000	25,334	0	0	25,334	(1,998)	
10	2029	194,712	0.04087	7,958	0.00000	0	27	27	54	151.25	8,168	16,126	0.13311	60,000	120,000	180,000	17,651	0	0	17,651	(1,525)	
11	2030	97,356	0.04210	4,099	0.00000	0	13	13	26	155.79	4,051	8,150	0.13909	30,000	60,000	90,000	9,222	0	0	9,222	(1,072)	
12	2031	0	0.04336	0	0.00000	0	0	0	0	160.46	0	0	0.14535	0	0	0	0	0	0	0	0	
13	2032	0	0.04466	0	0.00000	0	0	0	0	165.27	0	0	0.15189	0	0	0	0	0	0	0	0	
14	2033	0	0.04600	0	0.00000	0	0	0	0	170.23	0	0	0.15873	0	0	0	0	0	0	0	0	
15	2034	0	0.04738	0	0.00000	0	0	0	0	175.34	0	0	0.16587	0	0	0	0	0	0	0	0	
16	2035	0	0.04880	0	0.00000	0	0	0	0	180.60	0	0	0.17334	0	0	0	0	0	0	0	0	
17	2036	0	0.05026	0	0.00000	0	0	0	0	186.02	0	0	0.18114	0	0	0	0	0	0	0	0	
18	2037	0	0.05177	0	0.00000	0	0	0	0	191.60	0	0	0.18929	0	0	0	0	0	0	0	0	
19	2038	0	0.05332	0	0.00000	0	0	0	0	197.35	0	0	0.19781	0	0	0	0	0	0	0	0	
20	2039	0	0.05492	0	0.00000	0	0	0	0	203.27	0	0	0.20671	0	0	0	0	0	0	0	0	
Total =		2,628,605						720				\$192,830				2,430,000				\$258,220	(\$65,390)	
												NPV = \$135,994									\$194,211	(58,217)
Total NPV =																						
Benefit/Cost Ratio =																						

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

**Table 2
Utility Test**

Project: **Residential Lighting**
 Program Years: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2020	\$3,050	\$0	\$3,014	\$6,064	\$20,359	\$20,359	(\$14,295)
2021	6,283	0	6,448	12,731	18,444	18,444	(5,713)
2022	9,705	0	9,838	19,543	18,184	18,184	1,359
2023	9,997	0	10,134	20,131	0	0	20,131
2024	10,298	0	10,438	20,736	0	0	20,736
2025	10,608	0	10,750	21,358	0	0	21,358
2026	10,923	0	11,073	21,996	0	0	21,996
2027	11,253	0	11,406	22,659	0	0	22,659
2028	11,589	0	11,747	23,336	0	0	23,336
2029	7,958	0	8,168	16,126	0	0	16,126
2030	4,099	0	4,051	8,150	0	0	8,150
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
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =				\$192,830		\$56,987	\$135,843
				NPV = \$135,994		\$53,344	82,650
Total NPV =				\$82,650			
Benefit/Cost Ratio =				<u>2.55</u>			

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

**Table 3
Societal Cost Test**

Project: **Residential Lighting**
Program Years: **2020-2022**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2020	\$3,050	\$0	\$3,014	\$1,917	\$7,981	\$20,359	\$15,000	\$35,359	(\$27,378)
2021	6,283	0	6,448	4,146	16,877	18,444	15,000	33,444	(16,567)
2022	9,705	0	9,838	6,556	26,099	18,184	15,000	33,184	(7,085)
2023	9,997	0	10,134	6,956	27,087	0	0	0	27,087
2024	10,298	0	10,438	7,380	28,116	0	0	0	28,116
2025	10,608	0	10,750	7,829	29,187	0	0	0	29,187
2026	10,923	0	11,073	8,305	30,301	0	0	0	30,301
2027	11,253	0	11,406	8,812	31,471	0	0	0	31,471
2028	11,589	0	11,747	9,348	32,684	0	0	0	32,684
2029	7,958	0	8,168	6,653	22,779	0	0	0	22,779
2030	4,099	0	4,051	3,463	11,613	0	0	0	11,613
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
2038	0	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0	0
Total =					\$264,195			\$101,987	\$162,208
					NPV = \$225,559			\$99,007	126,552
Total NPV =									\$126,552
Benefit/Cost Ratio =									<u>2.28</u>

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

**Table 4
Participant Test**

Project: **Residential Lighting**
Program Years: **2020-2022**

Year	Benefits													Costs			Annual Benefits Less Costs (P)	
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)		Total Annual Costs (O)
2020	\$15,000	\$0.12995	\$0.10908	30,000	60,000	90,000	\$10,443	12	12	\$0.000	\$0.000	\$0	\$0	\$25,443	\$30,582	\$0	\$30,582	(\$5,139)
2021	15,000	0.13579	0.11399	60,000	120,000	180,000	21,826	24	24	0.000	0.000	0	0	36,826	31,175	0	31,175	5,651
2022	15,000	0.14190	0.11911	90,000	180,000	270,000	34,211	36	36	0.000	0.000	0	0	49,211	31,780	0	31,780	17,431
2023	0	0.14829	0.12448	90,000	180,000	270,000	35,753	36	36	0.000	0.000	0	0	35,753	0	0	0	35,753
2024	0	0.15496	0.13008	90,000	180,000	270,000	37,361	36	36	0.000	0.000	0	0	37,361	0	0	0	37,361
2025	0	0.16194	0.13593	90,000	180,000	270,000	39,042	36	36	0.000	0.000	0	0	39,042	0	0	0	39,042
2026	0	0.16922	0.14205	90,000	180,000	270,000	40,799	36	36	0.000	0.000	0	0	40,799	0	0	0	40,799
2027	0	0.17684	0.14844	90,000	180,000	270,000	42,635	36	36	0.000	0.000	0	0	42,635	0	0	0	42,635
2028	0	0.18480	0.15512	90,000	180,000	270,000	44,554	36	36	0.000	0.000	0	0	44,554	0	0	0	44,554
2029	0	0.19311	0.16210	60,000	120,000	180,000	31,039	24	24	0.000	0.000	0	0	31,039	0	0	0	31,039
2030	0	0.20180	0.16939	30,000	60,000	90,000	16,217	12	12	0.000	0.000	0	0	16,217	0	0	0	16,217
2031	0	0.21088	0.17702	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2032	0	0.22037	0.18498	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2033	0	0.23029	0.19331	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.24065	0.20200	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.25148	0.21109	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.26280	0.22059	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.27462	0.23052	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2038	0	0.28698	0.24089	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2039	0	0.29990	0.25173	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					\$398,880			\$93,537	\$305,343
														NPV = \$258,278			\$84,953	173,325
Total NPV =																		\$173,325
Benefit/Cost Ratio =																		3.04

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

**Table 5
Total Resource Cost Test**

Company: **Residential Lighting**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2020	\$3,050	\$3,014	\$6,064	\$20,359	\$15,000	\$35,359	(\$29,295)
2021	6,283	6,448	12,731	18,444	15,000	33,444	(20,713)
2022	9,705	9,838	19,543	18,184	15,000	33,184	(13,641)
2023	9,997	10,134	20,131	0	0	0	20,131
2024	10,298	10,438	20,736	0	0	0	20,736
2025	10,608	10,750	21,358	0	0	0	21,358
2026	10,923	11,073	21,996	0	0	0	21,996
2027	11,253	11,406	22,659	0	0	0	22,659
2028	11,589	11,747	23,336	0	0	0	23,336
2029	7,958	8,168	16,126	0	0	0	16,126
2030	4,099	4,051	8,150	0	0	0	8,150
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
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =			\$192,830		\$101,987	\$90,843	
NPV =			\$135,994		\$95,353	40,641	
Total NPV =			\$40,641				
Benefit/Cost Ratio =			1.43				

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 Lighting**
 Program Years: **2020-2022**

Input Data		First Year	Second Year	Third Year	
1) Retail Rate Summer (\$/kWh) =	\$0.09800				
Retail Rate Winter (\$/kWh) =	\$0.08074				
Retail Escalation Rate =	4.50%				
1a) Power Supply Cost Adjustment	\$0.02538				
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) =	\$50.42				
3a) Retail Winter Demand Rate (\$/kW/season) =	\$89.97				
Escalation Rate =	4.50%				
4) Electric Margin (\$/kWh) =	\$0.07001				
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 =	10.32%				
9) Utility Discount Rate =	7.30%				
10) Societal Discount Rate =	3.11%				
11) General Input Data Year =	2019				
12) Project Analysis Year 1 =	2020				
Project Analysis Year 2 =	2021				
Project Analysis Year 3 =	2022				
		13) Utility Project Costs			
		Admin & Promotion Costs =	\$5,466	\$7,027	\$3,248
		Incentive Costs =	15,300	30,600	15,300
		Total Utility Project Costs =	\$20,766	\$37,627	\$18,548
		14) Direct Participant Costs (\$/Part.) =	\$5,345	\$5,345	\$5,345
		Escalation Rate =	1.94%	1.94%	1.94%
		14a) Other Participant Costs (Annual \$/Part.) =	\$0	\$0	\$0
		Escalation Rate =	0.00%	0.00%	0.00%
		14b) Other Participant Savings (Annual \$/Part.) =	\$0	\$0	\$0
		Escalation Rate =	0%	0%	0%
		15) Project Life (Years) =	18	18	18
		16) Avg Summer kW/part. Saved =	4.800	4.800	4.800
		16a) Avg Winter kW/part Saved =	0.000	0.000	0.000
		17) Avg. Summer kWh/Part. Saved =	8,263	8,263	8,263
		17a) Avg. Winter kWh/Part. Saved =	16,526	16,526	16,526
		18a) System Demand Line Loss Factor	11.9000%	11.9000%	11.9000%
		18b) System Energy Line Loss Factor	8.1730%	8.1730%	8.1730%
		19) Number of Participants =	5	10	5
		20) Incentive/Participant =	\$3,060	\$3,060	\$3,060
		21) Effective Federal & State Income Tax Rate =			26.33%
		22) Annual Summer Kwh Saved	41,315	82,630	41,315
		Annual Winter Kwh Saved	82,630	165,260	82,630
		23) Annual Summer KW Saved	24	48	24
		Annual Winter KW Saved	0	0	0
		Test Results	NPV	B/C	
		Ratepayer Impact Measure Test	(\$84,865)	0.81	
		Utility Cost Test	\$292,982	5.07	
		Societal Test	\$621,962	6.22	
		Participant Test	\$513,035	6.09	
		Total Resource Cost Test	\$250,337	3.18	

**Table 1
Ratepayer Impact Test**

Project: **Commerical Lighting**
Program Years: **2020-2022**

t	Year											Electric Margin (J)	Costs					Annual Benefits Less Costs (P)			
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)		Total Savings (I)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)
1	2020	134,075	\$0.03133	\$4,201	\$0.00000	\$0	27	0	27	\$115.92	\$3,130	\$7,331	\$0.07316	41,315	82,630	123,945	\$6,680	\$5,466	\$15,300	\$27,446	(\$20,115)
2	2021	402,225	0.03227	12,980	0.00000	0	81	0	81	119.40	9,671	22,651	0.07645	123,945	247,890	371,835	20,941	7,027	30,600	58,568	(35,917)
3	2022	536,300	0.03323	17,821	0.00000	0	107	0	107	122.98	13,159	30,980	0.07989	165,260	330,520	495,780	29,178	3,248	15,300	47,726	(16,746)
4	2023	536,300	0.03423	18,358	0.00000	0	107	0	107	126.67	13,554	31,912	0.08349	165,260	330,520	495,780	30,493	0	0	30,493	1,419
5	2024	536,300	0.03526	18,910	0.00000	0	107	0	107	130.47	13,960	32,870	0.08725	165,260	330,520	495,780	31,866	0	0	31,866	1,004
6	2025	536,300	0.03632	19,478	0.00000	0	107	0	107	134.38	14,379	33,857	0.09117	165,260	330,520	495,780	33,298	0	0	33,298	559
7	2026	536,300	0.03740	20,058	0.00000	0	107	0	107	138.41	14,810	34,868	0.09527	165,260	330,520	495,780	34,795	0	0	34,795	73
8	2027	536,300	0.03853	20,664	0.00000	0	107	0	107	142.57	15,255	35,919	0.09956	165,260	330,520	495,780	36,362	0	0	36,362	(443)
9	2028	536,300	0.03968	21,280	0.00000	0	107	0	107	146.84	15,712	36,992	0.10404	165,260	330,520	495,780	37,998	0	0	37,998	(1,006)
10	2029	536,300	0.04087	21,919	0.00000	0	107	0	107	151.25	16,184	38,103	0.10872	165,260	330,520	495,780	39,708	0	0	39,708	(1,605)
11	2030	536,300	0.04210	22,578	0.00000	0	107	0	107	155.79	16,670	39,248	0.11362	165,260	330,520	495,780	41,497	0	0	41,497	(2,249)
12	2031	536,300	0.04336	23,254	0.00000	0	107	0	107	160.46	17,169	40,423	0.11873	165,260	330,520	495,780	43,364	0	0	43,364	(2,941)
13	2032	536,300	0.04466	23,951	0.00000	0	107	0	107	165.27	17,684	41,635	0.12407	165,260	330,520	495,780	45,314	0	0	45,314	(3,679)
14	2033	536,300	0.04600	24,670	0.00000	0	107	0	107	170.23	18,215	42,885	0.12965	165,260	330,520	495,780	47,352	0	0	47,352	(4,467)
15	2034	536,300	0.04738	25,410	0.00000	0	107	0	107	175.34	18,761	44,171	0.13549	165,260	330,520	495,780	49,485	0	0	49,485	(5,314)
16	2035	536,300	0.04880	26,171	0.00000	0	107	0	107	180.60	19,324	45,495	0.14159	165,260	330,520	495,780	51,713	0	0	51,713	(6,218)
17	2036	536,300	0.05026	26,954	0.00000	0	107	0	107	186.02	19,904	46,858	0.14796	165,260	330,520	495,780	54,039	0	0	54,039	(7,181)
18	2037	536,300	0.05177	27,764	0.00000	0	107	0	107	191.60	20,501	48,265	0.15462	165,260	330,520	495,780	56,472	0	0	56,472	(8,207)
19	2038	402,225	0.05332	21,447	0.00000	0	81	0	81	197.35	15,985	37,432	0.16157	123,945	247,890	371,835	44,258	0	0	44,258	(6,826)
20	2039	134,075	0.05492	7,363	0.00000	0	27	0	27	203.27	5,488	12,851	0.16884	41,315	82,630	123,945	15,416	0	0	15,416	(2,565)
Total =		9,653,400							1,928			\$704,746			8,924,040				\$827,170	(\$122,424)	
												NPV = \$364,928								\$449,793	(84,865)
Total NPV =																				(\$84,865)	
Benefit/Cost Ratio =																				0.81	

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

**Table 2
Utility Test**

Project: **Commerical Lighting**
 Program Years: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2020	\$4,201	\$0	\$3,130	\$7,331	\$20,766	\$20,766	(\$13,435)
2021	12,980	0	9,671	22,651	37,627	37,627	(14,976)
2022	17,821	0	13,159	30,980	18,548	18,548	12,432
2023	18,358	0	13,554	31,912	0	0	31,912
2024	18,910	0	13,960	32,870	0	0	32,870
2025	19,478	0	14,379	33,857	0	0	33,857
2026	20,058	0	14,810	34,868	0	0	34,868
2027	20,664	0	15,255	35,919	0	0	35,919
2028	21,280	0	15,712	36,992	0	0	36,992
2029	21,919	0	16,184	38,103	0	0	38,103
2030	22,578	0	16,670	39,248	0	0	39,248
2031	23,254	0	17,169	40,423	0	0	40,423
2032	23,951	0	17,684	41,635	0	0	41,635
2033	24,670	0	18,215	42,885	0	0	42,885
2034	25,410	0	18,761	44,171	0	0	44,171
2035	26,171	0	19,324	45,495	0	0	45,495
2036	26,954	0	19,904	46,858	0	0	46,858
2037	27,764	0	20,501	48,265	0	0	48,265
2038	21,447	0	15,985	37,432	0	0	37,432
2039	7,363	0	5,488	12,851	0	0	12,851
Total =				\$704,746		\$76,941	\$627,805
NPV =				\$364,928		\$71,946	292,982
Total NPV =		\$292,982					
Benefit/Cost Ratio =		<u>5.07</u>					

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

**Table 3
Societal Cost Test**

Project: **Commerical Lighting**
Program Years: **2020-2022**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2020	\$4,201	\$0	\$3,130	\$2,318	\$9,649	\$20,766	\$11,425	\$32,191	(\$22,542)
2021	12,980	0	9,671	7,377	30,028	37,627	22,850	60,477	(30,449)
2022	17,821	0	13,159	10,393	41,373	18,548	11,425	29,973	11,400
2023	18,358	0	13,554	11,027	42,939	0	0	0	42,939
2024	18,910	0	13,960	11,698	44,568	0	0	0	44,568
2025	19,478	0	14,379	12,411	46,268	0	0	0	46,268
2026	20,058	0	14,810	13,165	48,033	0	0	0	48,033
2027	20,664	0	15,255	13,969	49,888	0	0	0	49,888
2028	21,280	0	15,712	14,818	51,810	0	0	0	51,810
2029	21,919	0	16,184	15,721	53,824	0	0	0	53,824
2030	22,578	0	16,670	16,679	55,927	0	0	0	55,927
2031	23,254	0	17,169	17,693	58,116	0	0	0	58,116
2032	23,951	0	17,684	18,771	60,406	0	0	0	60,406
2033	24,670	0	18,215	19,914	62,799	0	0	0	62,799
2034	25,410	0	18,761	21,127	65,298	0	0	0	65,298
2035	26,171	0	19,324	22,413	67,908	0	0	0	67,908
2036	26,954	0	19,904	23,777	70,635	0	0	0	70,635
2037	27,764	0	20,501	25,226	73,491	0	0	0	73,491
2038	21,447	0	15,985	20,151	57,583	0	0	0	57,583
2039	7,363	0	5,488	7,126	19,977	0	0	0	19,977
Total =					\$1,010,520			\$122,641	\$887,879
					NPV = \$740,998			\$119,036	621,962
Total NPV =		\$621,962							
Benefit/Cost Ratio =		<u>6.22</u>							

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

**Table 4
Participant Test**

Project: **Commerical Lighting**
 Program Years: **2020-2022**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2020	\$15,300	\$0.10241	\$0.08437	41,315	82,630	123,945	\$11,203	24	0	\$52,689	\$94,017	\$1,265	\$0	\$27,768	\$27,243	\$0	\$27,243	\$525
2021	30,600	0.10702	0.08817	123,945	247,890	371,835	35,121	72	0	55,060	98,247	3,964	0	69,685	55,544	0	55,544	14,141
2022	15,300	0.11183	0.09214	165,260	330,520	495,780	48,935	96	0	57,538	102,668	5,524	0	69,759	28,311	0	28,311	41,448
2023	0	0.11687	0.09628	165,260	330,520	495,780	51,136	96	0	60.127	107.289	5,772	0	56,908	0	0	0	56,908
2024	0	0.12213	0.10062	165,260	330,520	495,780	53,440	96	0	62.832	112.116	6,032	0	59,472	0	0	0	59,472
2025	0	0.12762	0.10514	165,260	330,520	495,780	55,841	96	0	65.660	117.162	6,303	0	62,144	0	0	0	62,144
2026	0	0.13336	0.10988	165,260	330,520	495,780	58,357	96	0	68.615	122.434	6,587	0	64,944	0	0	0	64,944
2027	0	0.13937	0.11482	165,260	330,520	495,780	60,983	96	0	71.702	127.944	6,883	0	67,866	0	0	0	67,866
2028	0	0.14564	0.11999	165,260	330,520	495,780	63,728	96	0	74.929	133.701	7,193	0	70,921	0	0	0	70,921
2029	0	0.15219	0.12539	165,260	330,520	495,780	66,595	96	0	78.301	139.718	7,517	0	74,112	0	0	0	74,112
2030	0	0.15904	0.13103	165,260	330,520	495,780	69,591	96	0	81.824	146.005	7,855	0	77,446	0	0	0	77,446
2031	0	0.16620	0.13693	165,260	330,520	495,780	72,724	96	0	85.506	152.575	8,209	0	80,933	0	0	0	80,933
2032	0	0.17368	0.14309	165,260	330,520	495,780	75,996	96	0	89.354	159.441	8,578	0	84,574	0	0	0	84,574
2033	0	0.18149	0.14953	165,260	330,520	495,780	79,416	96	0	93.375	166.616	8,964	0	88,380	0	0	0	88,380
2034	0	0.18966	0.15625	165,260	330,520	495,780	82,987	96	0	97.577	174.113	9,367	0	92,354	0	0	0	92,354
2035	0	0.19819	0.16329	165,260	330,520	495,780	86,723	96	0	101.968	181.949	9,789	0	96,512	0	0	0	96,512
2036	0	0.20711	0.17063	165,260	330,520	495,780	90,624	96	0	106.556	190.136	10,229	0	100,853	0	0	0	100,853
2037	0	0.21643	0.17831	165,260	330,520	495,780	94,702	96	0	111.351	198.692	10,690	0	105,392	0	0	0	105,392
2038	0	0.22617	0.18634	123,945	247,890	371,835	74,224	72	0	116.362	207.634	8,378	0	82,602	0	0	0	82,602
2039	0	0.23635	0.19472	41,315	82,630	123,945	25,855	24	0	121.599	216.977	2,918	0	28,773	0	0	0	28,773
Total =				2,974,680	5,949,360			1,728	0					\$1,461,398			\$111,098	\$1,350,300
														NPV = \$613,888			\$100,853	513,035
Total NPV =			\$513,035															
Benefit/Cost Ratio =			<u>6.09</u>															

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

**Table 5
Total Resource Cost Test**

Company: **Commerical Lighting**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2020	\$4,201	\$3,130	\$7,331	\$20,766	\$11,425	\$32,191	(\$24,860)
2021	12,980	9,671	22,651	37,627	22,850	60,477	(37,826)
2022	17,821	13,159	30,980	18,548	11,425	29,973	1,007
2023	18,358	13,554	31,912	0	0	0	31,912
2024	18,910	13,960	32,870	0	0	0	32,870
2025	19,478	14,379	33,857	0	0	0	33,857
2026	20,058	14,810	34,868	0	0	0	34,868
2027	20,664	15,255	35,919	0	0	0	35,919
2028	21,280	15,712	36,992	0	0	0	36,992
2029	21,919	16,184	38,103	0	0	0	38,103
2030	22,578	16,670	39,248	0	0	0	39,248
2031	23,254	17,169	40,423	0	0	0	40,423
2032	23,951	17,684	41,635	0	0	0	41,635
2033	24,670	18,215	42,885	0	0	0	42,885
2034	25,410	18,761	44,171	0	0	0	44,171
2035	26,171	19,324	45,495	0	0	0	45,495
2036	26,954	19,904	46,858	0	0	0	46,858
2037	27,764	20,501	48,265	0	0	0	48,265
2038	21,447	15,985	37,432	0	0	0	37,432
2039	7,363	5,488	12,851	0	0	0	12,851
Total =			\$704,746			\$122,641	\$582,105
NPV =			\$364,928			\$114,591	250,337

Total NPV = \$250,337
Benefit/Cost Ratio = 3.18

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: **2020-2022**

Input Data		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.08927			
Retail Rate Winter (\$/kWh) =	\$0.08074			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.02521			
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) =	\$51.05			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$78.02			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05843			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.32%			
9) Utility Discount Rate =	7.36%			
10) Societal Discount Rate =	3.11%			
11) General Input Data Year =	2019			
12) Project Analysis Year 1 =	2020			
Project Analysis Year 2 =	2021			
Project Analysis Year 3 =	2022			
13) Utility Project Costs				
Admin & Promotion Costs =		\$11,610	\$11,079	\$12,166
Incentive Costs =		45,900	61,200	76,500
Total Utility Project Costs =		\$57,510	\$72,279	\$88,666
14) Direct Participant Costs (\$/Part.) =		\$5,345	\$5,345	\$5,345
Escalation Rate =		1.94%	1.94%	1.94%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		18	18	18
16) Avg Summer kW/part. Saved =		4,800	4,800	4,800
16a) Avg Winter kW/part Saved =		4,800	4,800	4,800
17) Avg. Summer kWh/Part. Saved =		8,263	8,263	8,263
17a) Avg. Winter kWh/Part. Saved =		16,526	16,526	16,526
18a) System Demand Line Loss Factor		11.9000%	11.9000%	11.9000%
18b) System Energy Line Loss Factor		8.1730%	8.1730%	8.1730%
19) Number of Participants =		15	20	25
20) Incentive/Participant =		\$3,060	\$3,060	\$3,060
21) Effective Federal & State Income Tax Rate =				26.33%
22) Annual Summer Kwh Saved		123,945	165,260	206,575
Annual Winter Kwh Saved		247,890	330,520	413,150
23) Annual Summer KW Saved		72	96	120
Annual Winter KW Saved		72	96	120
Test Results		NPV	B/C	
Ratepayer Impact Measure Test		\$205,535	1.18	
Utility Cost Test		\$1,147,477	6.68	
Societal Test		\$2,418,638	8.04	
Participant Test		\$1,738,077	6.82	
Total Resource Cost Test		\$1,020,989	4.11	

**Table 1
Ratepayer Impact Test**

Project: **Commerical Lighting**
Program Years: **2020-2022**

t	Year											Costs						Annual Benefits Less Costs (P)			
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)
1	2020	402,225	\$0.02724	\$10,957	\$0.00000	\$0	81	81	162	\$100.80	\$16,330	\$27,287	\$0.06106	123,945	247,890	371,835	\$16,726	\$11,610	\$45,900	\$74,236	(\$46,949)
2	2021	938,525	0.02806	26,332	0.00000	0	188	188	376	103.82	39,036	65,368	0.06381	289,205	578,410	867,615	40,784	11,079	61,200	113,063	(47,695)
3	2022	1,608,900	0.02890	46,495	0.00000	0	322	322	644	106.94	68,869	115,364	0.06668	495,780	991,560	1,487,340	73,060	12,166	76,500	161,726	(46,362)
4	2023	1,608,900	0.02977	47,890	0.00000	0	322	322	644	110.15	70,937	118,827	0.06968	495,780	991,560	1,487,340	76,347	0	0	76,347	42,480
5	2024	1,608,900	0.03066	49,327	0.00000	0	322	322	644	113.45	73,062	122,389	0.07281	495,780	991,560	1,487,340	79,777	0	0	79,777	42,612
6	2025	1,608,900	0.03158	50,807	0.00000	0	322	322	644	116.85	75,251	126,058	0.07609	495,780	991,560	1,487,340	83,371	0	0	83,371	42,687
7	2026	1,608,900	0.03253	52,331	0.00000	0	322	322	644	120.36	77,512	129,843	0.07952	495,780	991,560	1,487,340	87,129	0	0	87,129	42,714
8	2027	1,608,900	0.03350	53,901	0.00000	0	322	322	644	123.97	79,837	133,738	0.08309	495,780	991,560	1,487,340	91,041	0	0	91,041	42,697
9	2028	1,608,900	0.03451	55,518	0.00000	0	322	322	644	127.69	82,232	137,750	0.08683	495,780	991,560	1,487,340	95,138	0	0	95,138	42,612
10	2029	1,608,900	0.03554	57,180	0.00000	0	322	322	644	131.52	84,699	141,879	0.09074	495,780	991,560	1,487,340	99,423	0	0	99,423	42,456
11	2030	1,608,900	0.03661	58,902	0.00000	0	322	322	644	135.47	87,243	146,145	0.09482	495,780	991,560	1,487,340	103,893	0	0	103,893	42,252
12	2031	1,608,900	0.03771	60,672	0.00000	0	322	322	644	139.53	89,857	150,529	0.09909	495,780	991,560	1,487,340	108,572	0	0	108,572	41,957
13	2032	1,608,900	0.03884	62,490	0.00000	0	322	322	644	143.72	92,556	155,046	0.10355	495,780	991,560	1,487,340	113,458	0	0	113,458	41,588
14	2033	1,608,900	0.04001	64,372	0.00000	0	322	322	644	148.03	95,331	159,703	0.10821	495,780	991,560	1,487,340	118,564	0	0	118,564	41,139
15	2034	1,608,900	0.04121	66,303	0.00000	0	322	322	644	152.47	98,191	164,494	0.11308	495,780	991,560	1,487,340	123,900	0	0	123,900	40,594
16	2035	1,608,900	0.04245	68,298	0.00000	0	322	322	644	157.04	101,134	169,432	0.11817	495,780	991,560	1,487,340	129,477	0	0	129,477	39,955
17	2036	1,608,900	0.04372	70,341	0.00000	0	322	322	644	161.75	104,167	174,508	0.12348	495,780	991,560	1,487,340	135,295	0	0	135,295	39,213
18	2037	1,608,900	0.04503	72,449	0.00000	0	322	322	644	166.61	107,297	179,746	0.12904	495,780	991,560	1,487,340	141,387	0	0	141,387	38,359
19	2038	1,206,675	0.04638	55,966	0.00000	0	242	242	484	171.60	83,054	139,020	0.13485	371,835	743,670	1,115,505	110,815	0	0	110,815	28,205
20	2039	670,375	0.04777	32,024	0.00000	0	134	134	268	176.75	47,369	79,393	0.14092	206,575	413,150	619,725	64,335	0	0	64,335	15,058

Total = 28,960,200 11,594 \$2,636,519 NPV = \$1,349,369 26,772,120 \$2,110,947 \$1,143,834 \$525,572 205,535

Total NPV = \$205,535
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 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: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2020	\$10,957	\$0	\$16,330	\$27,287	\$57,510	\$57,510	(\$30,223)
2021	26,332	0	39,036	65,368	72,279	72,279	(6,911)
2022	46,495	0	68,869	115,364	88,666	88,666	26,698
2023	47,890	0	70,937	118,827	0	0	118,827
2024	49,327	0	73,062	122,389	0	0	122,389
2025	50,807	0	75,251	126,058	0	0	126,058
2026	52,331	0	77,512	129,843	0	0	129,843
2027	53,901	0	79,837	133,738	0	0	133,738
2028	55,518	0	82,232	137,750	0	0	137,750
2029	57,180	0	84,699	141,879	0	0	141,879
2030	58,902	0	87,243	146,145	0	0	146,145
2031	60,672	0	89,857	150,529	0	0	150,529
2032	62,490	0	92,556	155,046	0	0	155,046
2033	64,372	0	95,331	159,703	0	0	159,703
2034	66,303	0	98,191	164,494	0	0	164,494
2035	68,298	0	101,134	169,432	0	0	169,432
2036	70,341	0	104,167	174,508	0	0	174,508
2037	72,449	0	107,297	179,746	0	0	179,746
2038	55,966	0	83,054	139,020	0	0	139,020
2039	32,024	0	47,369	79,393	0	0	79,393
Total =				\$2,636,519		\$218,455	\$2,418,064
NPV =				\$1,349,369		\$201,892	1,147,477
Total NPV =				\$1,147,477			
Benefit/Cost Ratio =				<u>6.68</u>			

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

**Table 3
Societal Cost Test**

Project: **Commerical Lighting**
Program Years: **2020-2022**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2020	\$10,957	\$0	\$16,330	\$8,628	\$35,915	\$57,510	\$34,275	\$91,785	(\$55,870)
2021	26,332	0	39,036	21,290	86,658	72,279	45,700	117,979	(31,321)
2022	46,495	0	68,869	38,701	154,065	88,666	57,125	145,791	8,274
2023	47,890	0	70,937	41,058	159,885	0	0	0	159,885
2024	49,327	0	73,062	43,558	165,947	0	0	0	165,947
2025	50,807	0	75,251	46,210	172,268	0	0	0	172,268
2026	52,331	0	77,512	49,025	178,868	0	0	0	178,868
2027	53,901	0	79,837	52,010	185,748	0	0	0	185,748
2028	55,518	0	82,232	55,178	192,928	0	0	0	192,928
2029	57,180	0	84,699	58,537	200,416	0	0	0	200,416
2030	58,902	0	87,243	62,106	208,251	0	0	0	208,251
2031	60,672	0	89,857	65,888	216,417	0	0	0	216,417
2032	62,490	0	92,556	69,901	224,947	0	0	0	224,947
2033	64,372	0	95,331	74,160	233,863	0	0	0	233,863
2034	66,303	0	98,191	78,677	243,171	0	0	0	243,171
2035	68,298	0	101,134	83,470	252,902	0	0	0	252,902
2036	70,341	0	104,167	88,550	263,058	0	0	0	263,058
2037	72,449	0	107,297	93,944	273,690	0	0	0	273,690
2038	55,966	0	83,054	74,838	213,858	0	0	0	213,858
2039	32,024	0	47,369	44,022	123,415	0	0	0	123,415
Total =					\$3,786,270		\$355,555	\$3,430,715	
					NPV = \$2,761,972		\$343,334	2,418,638	
Total NPV =		\$2,418,638							
Benefit/Cost Ratio =		<u>8.04</u>							

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

**Table 4
Participant Test**

Project: **Commerical Lighting**
 Program Years: **2020-2022**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2020	\$45,900	\$0.09329	\$0.08437	123,945	247,890	371,835	\$32,477	72	72	\$53.349	\$81.527	\$9,711	\$0	\$88,088	\$81,730	\$0	\$81,730	\$6,358
2021	61,200	0.09749	0.08817	289,205	578,410	867,615	79,193	168	168	55.750	85.195	23,679	0	164,072	111,088	0	111,088	52,984
2022	76,500	0.10187	0.09214	495,780	991,560	1,487,340	141,867	288	288	58.259	89.029	42,419	0	260,786	141,554	0	141,554	119,232
2023	0	0.10646	0.09628	495,780	991,560	1,487,340	148,248	288	288	60.880	93.036	44,328	0	192,576	0	0	0	192,576
2024	0	0.11125	0.10062	495,780	991,560	1,487,340	154,926	288	288	63.620	97.222	46,323	0	201,249	0	0	0	201,249
2025	0	0.11625	0.10514	495,780	991,560	1,487,340	161,887	288	288	66.483	101.597	48,407	0	210,294	0	0	0	210,294
2026	0	0.12148	0.10988	495,780	991,560	1,487,340	169,180	288	288	69.475	106.169	50,585	0	219,765	0	0	0	219,765
2027	0	0.12695	0.11482	495,780	991,560	1,487,340	176,790	288	288	72.601	110.947	52,862	0	229,652	0	0	0	229,652
2028	0	0.13266	0.11999	495,780	991,560	1,487,340	184,747	288	288	75.868	115.939	55,240	0	239,987	0	0	0	239,987
2029	0	0.13863	0.12539	495,780	991,560	1,487,340	193,062	288	288	79.282	121.156	57,726	0	250,788	0	0	0	250,788
2030	0	0.14487	0.13103	495,780	991,560	1,487,340	201,748	288	288	82.850	126.609	60,324	0	262,072	0	0	0	262,072
2031	0	0.15139	0.13693	495,780	991,560	1,487,340	210,830	288	288	86.578	132.306	63,039	0	273,869	0	0	0	273,869
2032	0	0.15820	0.14309	495,780	991,560	1,487,340	220,315	288	288	90.474	138.260	65,875	0	286,190	0	0	0	286,190
2033	0	0.16532	0.14953	495,780	991,560	1,487,340	230,230	288	288	94.545	144.481	68,840	0	299,070	0	0	0	299,070
2034	0	0.17276	0.15625	495,780	991,560	1,487,340	240,582	288	288	98.800	150.983	71,938	0	312,520	0	0	0	312,520
2035	0	0.18054	0.16329	495,780	991,560	1,487,340	251,420	288	288	103.246	157.777	75,175	0	326,595	0	0	0	326,595
2036	0	0.18866	0.17063	495,780	991,560	1,487,340	262,724	288	288	107.892	164.877	78,558	0	341,282	0	0	0	341,282
2037	0	0.19715	0.17831	495,780	991,560	1,487,340	274,548	288	288	112.747	172.297	82,093	0	356,641	0	0	0	356,641
2038	0	0.20602	0.18634	371,835	743,670	1,115,505	215,181	216	216	117.821	180.050	64,340	0	279,521	0	0	0	279,521
2039	0	0.21529	0.19472	206,575	413,150	619,725	124,922	120	120	123.123	188.152	37,353	0	162,275	0	0	0	162,275
Total =				8,924,040	17,848,080			5,184	5,184					\$4,957,292			\$334,372	\$4,622,920
														NPV =	\$2,036,812		\$298,735	1,738,077

Total NPV = \$1,738,077
 Benefit/Cost Ratio = 6.82

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

Table 5
Total Resource Cost Test

Company: **Commerical Lighting**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2020	\$10,957	\$16,330	\$27,287	\$57,510	\$34,275	\$91,785	(\$64,498)
2021	26,332	39,036	65,368	72,279	45,700	117,979	(52,611)
2022	46,495	68,869	115,364	88,666	57,125	145,791	(30,427)
2023	47,890	70,937	118,827	0	0	0	118,827
2024	49,327	73,062	122,389	0	0	0	122,389
2025	50,807	75,251	126,058	0	0	0	126,058
2026	52,331	77,512	129,843	0	0	0	129,843
2027	53,901	79,837	133,738	0	0	0	133,738
2028	55,518	82,232	137,750	0	0	0	137,750
2029	57,180	84,699	141,879	0	0	0	141,879
2030	58,902	87,243	146,145	0	0	0	146,145
2031	60,672	89,857	150,529	0	0	0	150,529
2032	62,490	92,556	155,046	0	0	0	155,046
2033	64,372	95,331	159,703	0	0	0	159,703
2034	66,303	98,191	164,494	0	0	0	164,494
2035	68,298	101,134	169,432	0	0	0	169,432
2036	70,341	104,167	174,508	0	0	0	174,508
2037	72,449	107,297	179,746	0	0	0	179,746
2038	55,966	83,054	139,020	0	0	0	139,020
2039	32,024	47,369	79,393	0	0	0	79,393
Total =			\$2,636,519			\$355,555	\$2,280,964
NPV =			\$1,349,369			\$328,379	1,020,989

Total NPV = \$1,020,989
Benefit/Cost Ratio = 4.11

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

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

Company: **Montana-Dakota Utilities Co.**
 Project: **Commerical Lighting**
 Program Years: **2020-2022**

Input Data		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09297			
Retail Rate Winter (\$/kWh) =	\$0.09107			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.02524			
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) =	\$33.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$58.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.02524			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.32%			
9) Utility Discount Rate =	7.22%			
10) Societal Discount Rate =	3.11%			
11) General Input Data Year =	2019			
12) Project Analysis Year 1 =	2020			
Project Analysis Year 2 =	2021			
Project Analysis Year 3 =	2022			
13) Utility Project Costs				
Admin & Promotion Costs =		\$3,015	\$2,942	\$4,174
Incentive Costs =		6,120	9,180	15,300
Total Utility Project Costs =		\$9,135	\$12,122	\$19,474
14) Direct Participant Costs (\$/Part.) =		\$5,345	\$5,345	\$5,345
Escalation Rate =		1.94%	1.94%	1.94%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		18	18	18
16) Avg Summer kW/part. Saved =		4,800	4,800	4,800
16a) Avg Winter kW/part Saved =		4,800	4,800	4,800
17) Avg. Summer kWh/Part. Saved =		8,263	8,263	8,263
17a) Avg. Winter kWh/Part. Saved =		16,526	16,526	16,526
18a) System Demand Line Loss Factor		11.9000%	11.9000%	11.9000%
18b) System Energy Line Loss Factor		8.1730%	8.1730%	8.1730%
19) Number of Participants =		2	3	5
20) Incentive/Participant =		\$3,060	\$3,060	\$3,060
21) Effective Federal & State Income Tax Rate =				26.33%
22) Annual Summer Kwh Saved		16,526	24,789	41,315
Annual Winter Kwh Saved		33,052	49,578	82,630
23) Annual Summer KW Saved		10	14	24
Annual Winter KW Saved		10	14	24
Test Results		NPV	B/C	
Ratepayer Impact Measure Test		\$119,946	2.14	
Utility Cost Test		\$187,520	6.02	
Societal Test		\$402,530	7.58	
Participant Test		\$289,747	6.88	
Total Resource Cost Test		\$166,637	3.86	

**Table 1
Ratepayer Impact Test**

Project: **Commerical Lighting**
Program Years: **2020-2022**

t	Year											Costs					Annual Benefits Less Costs (P)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)		Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)
1	2020	53,630	\$0.02724	\$1,461	\$0.00000	\$0	11	11	22	\$100.80	\$2,218	\$3,679	\$0.02638	16,526	33,052	49,578	\$963	\$3,015	\$6,120	\$10,098	(\$6,419)
2	2021	134,075	0.02806	3,762	0.00000	0	27	27	54	103.82	5,606	9,368	0.02756	41,315	82,630	123,945	2,516	2,942	9,180	14,638	(5,270)
3	2022	268,150	0.02890	7,749	0.00000	0	54	54	108	106.94	11,550	19,299	0.02880	82,630	165,260	247,890	5,259	4,174	15,300	24,733	(5,434)
4	2023	268,150	0.02977	7,982	0.00000	0	54	54	108	110.15	11,896	19,878	0.03010	82,630	165,260	247,890	5,497	0	0	5,497	14,381
5	2024	268,150	0.03066	8,221	0.00000	0	54	54	108	113.45	12,253	20,474	0.03145	82,630	165,260	247,890	5,743	0	0	5,743	14,731
6	2025	268,150	0.03158	8,468	0.00000	0	54	54	108	116.85	12,620	21,088	0.03287	82,630	165,260	247,890	6,003	0	0	6,003	15,085
7	2026	268,150	0.03253	8,722	0.00000	0	54	54	108	120.36	12,999	21,721	0.03435	82,630	165,260	247,890	6,273	0	0	6,273	15,448
8	2027	268,150	0.03350	8,983	0.00000	0	54	54	108	123.97	13,389	22,372	0.03589	82,630	165,260	247,890	6,554	0	0	6,554	15,818
9	2028	268,150	0.03451	9,253	0.00000	0	54	54	108	127.69	13,791	23,044	0.03751	82,630	165,260	247,890	6,850	0	0	6,850	16,194
10	2029	268,150	0.03554	9,530	0.00000	0	54	54	108	131.52	14,204	23,734	0.03920	82,630	165,260	247,890	7,158	0	0	7,158	16,576
11	2030	268,150	0.03661	9,817	0.00000	0	54	54	108	135.47	14,631	24,448	0.04096	82,630	165,260	247,890	7,480	0	0	7,480	16,968
12	2031	268,150	0.03771	10,112	0.00000	0	54	54	108	139.53	15,069	25,181	0.04280	82,630	165,260	247,890	7,816	0	0	7,816	17,365
13	2032	268,150	0.03884	10,415	0.00000	0	54	54	108	143.72	15,522	25,937	0.04473	82,630	165,260	247,890	8,168	0	0	8,168	17,769
14	2033	268,150	0.04001	10,729	0.00000	0	54	54	108	148.03	15,987	26,716	0.04674	82,630	165,260	247,890	8,535	0	0	8,535	18,181
15	2034	268,150	0.04121	11,050	0.00000	0	54	54	108	152.47	16,467	27,517	0.04885	82,630	165,260	247,890	8,921	0	0	8,921	18,596
16	2035	268,150	0.04245	11,383	0.00000	0	54	54	108	157.04	16,960	28,343	0.05104	82,630	165,260	247,890	9,321	0	0	9,321	19,022
17	2036	268,150	0.04372	11,724	0.00000	0	54	54	108	161.75	17,469	29,193	0.05334	82,630	165,260	247,890	9,741	0	0	9,741	19,452
18	2037	268,150	0.04503	12,075	0.00000	0	54	54	108	166.61	17,994	30,069	0.05574	82,630	165,260	247,890	10,179	0	0	10,179	19,890
19	2038	214,520	0.04638	9,949	0.00000	0	43	43	86	171.60	14,758	24,707	0.05825	66,104	132,208	198,312	8,510	0	0	8,510	16,197
20	2039	134,075	0.04777	6,405	0.00000	0	27	27	54	203.27	10,977	17,382	0.06087	41,315	82,630	123,945	5,558	0	0	5,558	11,824

Total = 4,826,700 1,944 \$444,150 NPV = \$224,868 4,462,020 \$177,776 \$266,374
\$104,922 119,946

Total NPV = \$119,946
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 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: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2020	\$1,461	\$0	\$2,218	\$3,679	\$9,135	\$9,135	(\$5,456)
2021	3,762	0	5,606	9,368	12,122	12,122	(2,754)
2022	7,749	0	11,550	19,299	19,474	19,474	(175)
2023	7,982	0	11,896	19,878	0	0	19,878
2024	8,221	0	12,253	20,474	0	0	20,474
2025	8,468	0	12,620	21,088	0	0	21,088
2026	8,722	0	12,999	21,721	0	0	21,721
2027	8,983	0	13,389	22,372	0	0	22,372
2028	9,253	0	13,791	23,044	0	0	23,044
2029	9,530	0	14,204	23,734	0	0	23,734
2030	9,817	0	14,631	24,448	0	0	24,448
2031	10,112	0	15,069	25,181	0	0	25,181
2032	10,415	0	15,522	25,937	0	0	25,937
2033	10,729	0	15,987	26,716	0	0	26,716
2034	11,050	0	16,467	27,517	0	0	27,517
2035	11,383	0	16,960	28,343	0	0	28,343
2036	11,724	0	17,469	29,193	0	0	29,193
2037	12,075	0	17,994	30,069	0	0	30,069
2038	9,949	0	14,758	24,707	0	0	24,707
2039	6,405	0	10,977	17,382	0	0	17,382
Total =				\$444,150		\$40,731	\$403,419
NPV =				\$224,868		\$37,348	187,520
Total NPV =				\$187,520			
Benefit/Cost Ratio =				6.02			

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: **Commerical Lighting**
Program Years: **2020-2022**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2020	\$1,461	\$0	\$2,218	\$1,163	\$4,842	\$9,135	\$4,570	\$13,705	(\$8,863)
2021	3,762	0	5,606	3,051	12,419	12,122	6,855	18,977	(6,558)
2022	7,749	0	11,550	6,474	25,773	19,474	11,425	30,899	(5,126)
2023	7,982	0	11,896	6,868	26,746	0	0	0	26,746
2024	8,221	0	12,253	7,287	27,761	0	0	0	27,761
2025	8,468	0	12,620	7,730	28,818	0	0	0	28,818
2026	8,722	0	12,999	8,201	29,922	0	0	0	29,922
2027	8,983	0	13,389	8,700	31,072	0	0	0	31,072
2028	9,253	0	13,791	9,231	32,275	0	0	0	32,275
2029	9,530	0	14,204	9,792	33,526	0	0	0	33,526
2030	9,817	0	14,631	10,389	34,837	0	0	0	34,837
2031	10,112	0	15,069	11,022	36,203	0	0	0	36,203
2032	10,415	0	15,522	11,693	37,630	0	0	0	37,630
2033	10,729	0	15,987	12,406	39,122	0	0	0	39,122
2034	11,050	0	16,467	13,161	40,678	0	0	0	40,678
2035	11,383	0	16,960	13,963	42,306	0	0	0	42,306
2036	11,724	0	17,469	14,813	44,006	0	0	0	44,006
2037	12,075	0	17,994	15,715	45,784	0	0	0	45,784
2038	9,949	0	14,758	13,300	38,007	0	0	0	38,007
2039	6,405	0	10,977	9,638	27,020	0	0	0	27,020
Total =					\$638,747		\$63,581	\$575,166	
NPV =					\$463,703		\$61,173	402,530	
Total NPV =		\$402,530							
Benefit/Cost Ratio =		<u>7.58</u>							

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

**Table 4
Participant Test**

Project: **Commerical Lighting**
 Program Years: **2020-2022**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2020	\$6,120	\$0.09715	\$0.09517	16,526	33,052	49,578	\$4,751	10	10	\$34.485	\$60.610	\$951	\$0	\$11,822	\$10,897	\$0	\$10,897	\$925
2021	9,180	0.10153	0.09945	41,315	82,630	123,945	12,412	24	24	36.037	63.337	2,385	0	23,977	16,663	0	16,663	7,314
2022	15,300	0.10609	0.10393	82,630	165,260	247,890	25,942	48	48	37.658	66.188	4,985	0	46,227	28,311	0	28,311	17,916
2023	0	0.11087	0.10860	82,630	165,260	247,890	27,108	48	48	39.353	69.166	5,209	0	32,317	0	0	0	32,317
2024	0	0.11586	0.11349	82,630	165,260	247,890	28,329	48	48	41.124	72.279	5,443	0	33,772	0	0	0	33,772
2025	0	0.12107	0.11860	82,630	165,260	247,890	29,604	48	48	42.975	75.531	5,688	0	35,292	0	0	0	35,292
2026	0	0.12652	0.12393	82,630	165,260	247,890	30,935	48	48	44.908	78.930	5,944	0	36,879	0	0	0	36,879
2027	0	0.13221	0.12951	82,630	165,260	247,890	32,327	48	48	46.929	82.482	6,212	0	38,539	0	0	0	38,539
2028	0	0.13816	0.13534	82,630	165,260	247,890	33,782	48	48	49.041	86.194	6,491	0	40,273	0	0	0	40,273
2029	0	0.14438	0.14143	82,630	165,260	247,890	35,303	48	48	51.248	90.072	6,783	0	42,086	0	0	0	42,086
2030	0	0.15088	0.14779	82,630	165,260	247,890	36,891	48	48	53.554	94.125	7,089	0	43,980	0	0	0	43,980
2031	0	0.15767	0.15444	82,630	165,260	247,890	38,551	48	48	55.964	98.361	7,408	0	45,959	0	0	0	45,959
2032	0	0.16476	0.16139	82,630	165,260	247,890	40,285	48	48	58.482	102.787	7,741	0	48,026	0	0	0	48,026
2033	0	0.17218	0.16866	82,630	165,260	247,890	42,100	48	48	61.114	107.413	8,089	0	50,189	0	0	0	50,189
2034	0	0.17992	0.17625	82,630	165,260	247,890	43,994	48	48	63.864	112.246	8,453	0	52,447	0	0	0	52,447
2035	0	0.18802	0.18418	82,630	165,260	247,890	45,974	48	48	66.738	117.297	8,834	0	54,808	0	0	0	54,808
2036	0	0.19648	0.19247	82,630	165,260	247,890	48,043	48	48	69.741	122.576	9,231	0	57,274	0	0	0	57,274
2037	0	0.20532	0.20113	82,630	165,260	247,890	50,204	48	48	72.880	128.092	9,647	0	59,851	0	0	0	59,851
2038	0	0.21456	0.21018	66,104	132,208	198,312	41,971	38	38	76.159	133.856	7,981	0	49,952	0	0	0	49,952
2039	0	0.22422	0.21963	41,315	82,630	123,945	27,412	24	24	79.587	139.879	5,267	0	32,679	0	0	0	32,679
Total =				1,487,340	2,974,680			864	864					\$836,349			\$55,871	\$780,478
														NPV = \$339,010			\$49,263	289,747

Total NPV = \$289,747
 Benefit/Cost Ratio = 6.88

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

Table 5
Total Resource Cost Test

Company: **Commerical Lighting**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2020	\$1,461	\$2,218	\$3,679	\$9,135	\$4,570	\$13,705	(\$10,026)
2021	3,762	5,606	9,368	12,122	6,855	18,977	(9,609)
2022	7,749	11,550	19,299	19,474	11,425	30,899	(11,600)
2023	7,982	11,896	19,878	0	0	0	19,878
2024	8,221	12,253	20,474	0	0	0	20,474
2025	8,468	12,620	21,088	0	0	0	21,088
2026	8,722	12,999	21,721	0	0	0	21,721
2027	8,983	13,389	22,372	0	0	0	22,372
2028	9,253	13,791	23,044	0	0	0	23,044
2029	9,530	14,204	23,734	0	0	0	23,734
2030	9,817	14,631	24,448	0	0	0	24,448
2031	10,112	15,069	25,181	0	0	0	25,181
2032	10,415	15,522	25,937	0	0	0	25,937
2033	10,729	15,987	26,716	0	0	0	26,716
2034	11,050	16,467	27,517	0	0	0	27,517
2035	11,383	16,960	28,343	0	0	0	28,343
2036	11,724	17,469	29,193	0	0	0	29,193
2037	12,075	17,994	30,069	0	0	0	30,069
2038	9,949	14,758	24,707	0	0	0	24,707
2039	6,405	10,977	17,382	0	0	0	17,382
Total =			\$444,150			\$63,581	\$380,569
NPV =			\$224,868			\$58,231	166,637

Total NPV = \$166,637
Benefit/Cost Ratio = 3.86

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: **2020-2022**

Input Data		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09800			
Retail Rate Winter (\$/kWh) =	\$0.08074			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.02538			
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) =	\$50.42			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$89.97			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.07001			
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 =	10.32%			
9) Utility Discount Rate =	7.30%			
10) Societal Discount Rate =	3.11%			
11) General Input Data Year =	2019			
12) Project Analysis Year 1 =	2020			
Project Analysis Year 2 =	2021			
Project Analysis Year 3 =	2022			
13) Utility Project Costs				
Admin & Promotion Costs =		\$7,145	\$6,889	\$10,614
Incentive Costs =		20,000	30,000	50,000
Total Utility Project Costs =		\$27,145	\$36,889	\$60,614
14) Direct Participant Costs (\$/Part.) =		\$20,000	\$20,000	\$20,000
Escalation Rate =		1.94%	1.94%	1.94%
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		11.9000%	11.9000%	11.9000%
18b) System Energy Line Loss Factor		8.1730%	8.1730%	8.1730%
19) Number of Participants =		2	3	5
20) Incentive/Participant =		\$10,000	\$10,000	\$10,000
21) Effective Federal & State Income Tax Rate =				26.33%
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		\$927	1.00	
Utility Cost Test		\$464,780	5.07	
Societal Test		\$780,469	4.61	
Participant Test		\$757,668	5.11	
Total Resource Cost Test		\$373,389	2.82	

**Table 2
Utility Test**

Project: **Commercial Partnership Program (Custom)**
 Program Years: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2020	\$6,778	\$0	\$7,883	\$14,661	\$27,145	\$27,145	(\$12,484)
2021	17,454	0	20,059	37,513	36,889	36,889	624
2022	35,946	0	41,321	77,267	60,614	60,614	16,653
2023	37,028	0	42,561	79,589	0	0	79,589
2024	38,142	0	43,838	81,980	0	0	81,980
2025	39,288	0	45,152	84,440	0	0	84,440
2026	40,457	0	46,506	86,963	0	0	86,963
2027	41,679	0	47,904	89,583	0	0	89,583
2028	42,923	0	49,338	92,261	0	0	92,261
2029	44,210	0	50,820	95,030	0	0	95,030
2030	36,433	0	41,752	78,185	0	0	78,185
2031	23,452	0	26,957	50,409	0	0	50,409
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
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =				\$867,881		\$124,648	\$743,233
			NPV =	\$578,957		\$114,177	464,780
Total NPV =		\$464,780					
Benefit/Cost Ratio =		<u>5.07</u>					

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

**Table 3
Societal Cost Test**

Project: **Commercial Partnership Program (Custom)**
 Program Years: **2020-2022**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2020	\$6,778	\$0	\$7,883	\$4,636	\$19,297	\$27,145	\$20,000	\$47,145	(\$27,848)
2021	17,454	0	20,059	12,218	49,731	36,889	30,000	66,889	(17,158)
2022	35,946	0	41,321	25,921	103,188	60,614	50,000	110,614	(7,426)
2023	37,028	0	42,561	27,500	107,089	0	0	0	107,089
2024	38,142	0	43,838	29,176	111,156	0	0	0	111,156
2025	39,288	0	45,152	30,954	115,394	0	0	0	115,394
2026	40,457	0	46,506	32,835	119,798	0	0	0	119,798
2027	41,679	0	47,904	34,839	124,422	0	0	0	124,422
2028	42,923	0	49,338	36,957	129,218	0	0	0	129,218
2029	44,210	0	50,820	39,208	134,238	0	0	0	134,238
2030	36,433	0	41,752	33,225	111,410	0	0	0	111,410
2031	23,452	0	26,957	22,064	72,473	0	0	0	72,473
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
2038	0	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0	0
Total =					\$1,197,414			\$224,648	\$972,766
					NPV = \$996,527			\$216,058	780,469
Total NPV =		\$780,469							
Benefit/Cost Ratio =		<u>4.61</u>							

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

**Table 4
Participant Test**

Project: **Commercial Partnership Program (Custom)**
 Program Years: **2020-2022**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2020	\$20,000	\$0.10241	\$0.08437	100,000	100,000	200,000	\$18,678	30	30	\$52.689	\$94.017	\$4,401	\$0	\$43,079	\$40,776	\$0	\$40,776	\$2,303
2021	30,000	0.10702	0.08817	250,000	250,000	500,000	48,798	75	75	55.060	98.247	11,498	0	90,296	62,351	0	62,351	27,945
2022	50,000	0.11183	0.09214	500,000	500,000	1,000,000	101,985	150	150	57.538	102.668	24,031	0	176,016	105,934	0	105,934	70,082
2023	0	0.11687	0.09628	500,000	500,000	1,000,000	106,575	150	150	60.127	107.289	25,112	0	131,687	0	0	0	131,687
2024	0	0.12213	0.10062	500,000	500,000	1,000,000	111,375	150	150	62.832	112.116	26,242	0	137,617	0	0	0	137,617
2025	0	0.12762	0.10514	500,000	500,000	1,000,000	116,380	150	150	65.660	117.162	27,423	0	143,803	0	0	0	143,803
2026	0	0.13336	0.10988	500,000	500,000	1,000,000	121,620	150	150	68.615	122.434	28,657	0	150,277	0	0	0	150,277
2027	0	0.13937	0.11482	500,000	500,000	1,000,000	127,095	150	150	71.702	127.944	29,947	0	157,042	0	0	0	157,042
2028	0	0.14564	0.11999	500,000	500,000	1,000,000	132,815	150	150	74.929	133.701	31,295	0	164,110	0	0	0	164,110
2029	0	0.15219	0.12539	500,000	500,000	1,000,000	138,790	150	150	78.301	139.718	32,703	0	171,493	0	0	0	171,493
2030	0	0.15904	0.13103	400,000	400,000	800,000	116,028	120	120	81.824	146.005	27,339	0	143,367	0	0	0	143,367
2031	0	0.16620	0.13693	250,000	250,000	500,000	75,783	75	75	85.506	152.575	17,856	0	93,639	0	0	0	93,639
2032	0	0.17368	0.14309	0	0	0	0	0	0	89.354	159.441	0	0	0	0	0	0	0
2033	0	0.18149	0.14953	0	0	0	0	0	0	93.375	166.616	0	0	0	0	0	0	0
2034	0	0.18966	0.15625	0	0	0	0	0	0	97.577	174.113	0	0	0	0	0	0	0
2035	0	0.19819	0.16329	0	0	0	0	0	0	101.968	181.949	0	0	0	0	0	0	0
2036	0	0.20711	0.17063	0	0	0	0	0	0	106.556	190.136	0	0	0	0	0	0	0
2037	0	0.21643	0.17831	0	0	0	0	0	0	111.351	198.692	0	0	0	0	0	0	0
2038	0	0.22617	0.18634	0	0	0	0	0	0	116.362	207.634	0	0	0	0	0	0	0
2039	0	0.23635	0.19472	0	0	0	0	0	0	121.599	216.977	0	0	0	0	0	0	0
Total =				5,000,000	5,000,000			1,500	1,500					\$1,602,426			\$209,061	\$1,393,365
														NPV = \$942,004			\$184,336	757,668

Total NPV = \$757,668
 Benefit/Cost Ratio = 5.11

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

**Table 5
Total Resource Cost Test**

Company: **Commercial Partnership Program (Custom)**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2020	\$6,778	\$7,883	\$14,661	\$27,145	\$20,000	\$47,145	(\$32,484)
2021	17,454	20,059	37,513	36,889	30,000	66,889	(29,376)
2022	35,946	41,321	77,267	60,614	50,000	110,614	(33,347)
2023	37,028	42,561	79,589	0	0	0	79,589
2024	38,142	43,838	81,980	0	0	0	81,980
2025	39,288	45,152	84,440	0	0	0	84,440
2026	40,457	46,506	86,963	0	0	0	86,963
2027	41,679	47,904	89,583	0	0	0	89,583
2028	42,923	49,338	92,261	0	0	0	92,261
2029	44,210	50,820	95,030	0	0	0	95,030
2030	36,433	41,752	78,185	0	0	0	78,185
2031	23,452	26,957	50,409	0	0	0	50,409
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
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =			\$867,881			\$224,648	\$643,233
NPV =			\$578,957			\$205,568	373,389

Total NPV = \$373,389
Benefit/Cost Ratio = 2.82

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

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

Company: **Montana-Dakota Utilities Co.**
 Project: **Commercial Partnership Program (Custom)**
 Program Years: **2020-2022**

Input Data		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.08927			
Retail Rate Winter (\$/kWh) =	\$0.08074			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.02521			
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) =	\$51.05			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$78.02			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05843			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.32%			
9) Utility Discount Rate =	7.36%			
10) Societal Discount Rate =	3.11%			
11) General Input Data Year =	2019			
12) Project Analysis Year 1 =	2020			
Project Analysis Year 2 =	2021			
Project Analysis Year 3 =	2022			
13) Utility Project Costs				
Admin & Promotion Costs =		\$12,648	\$12,672	\$15,904
Incentive Costs =		50,000	70,000	100,000
Total Utility Project Costs =		\$62,648	\$82,672	\$115,904
14) Direct Participant Costs (\$/Part.) =		\$20,000	\$20,000	\$20,000
Escalation Rate =		1.94%	1.94%	1.94%
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		11.9000%	11.9000%	11.9000%
18b) System Energy Line Loss Factor		8.1730%	8.1730%	8.1730%
19) Number of Participants =		5	7	10
20) Incentive/Participant =		\$10,000	\$10,000	\$10,000
21) Effective Federal & State Income Tax Rate =				26.33%
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		\$16,145	1.01	
Utility Cost Test		\$869,476	4.62	
Societal Test		\$1,440,008	4.10	
Participant Test		\$1,569,854	4.85	
Total Resource Cost Test		\$667,373	2.51	

**Table 1
Ratepayer Impact Test**

Project: **Commercial Partnership Program (Custom)**
Program Years: **2020-2022**

t	Year												Costs					Annual Benefits Less Costs (P)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2020	540,866	\$0.02724	\$14,733	\$0.00000	\$0	84	84	168	\$100.80	\$16,934	\$31,667	\$0.06106	250,000	250,000	500,000	\$22,491	\$12,648	\$50,000	\$85,139	(\$53,472)	
2	2021	1,298,076	0.02806	36,420	0.00000	0	201	201	402	103.82	41,736	78,156	0.06381	600,000	600,000	1,200,000	56,409	12,672	70,000	139,081	(60,925)	
3	2022	2,379,806	0.02890	68,774	0.00000	0	369	369	738	106.94	78,922	147,696	0.06668	1,100,000	1,100,000	2,200,000	108,067	15,904	100,000	223,971	(76,275)	
4	2023	2,379,806	0.02977	70,837	0.00000	0	369	369	738	110.15	81,291	152,128	0.06968	1,100,000	1,100,000	2,200,000	112,929	0	0	112,929	39,199	
5	2024	2,379,806	0.03066	72,962	0.00000	0	369	369	738	113.45	83,726	156,688	0.07281	1,100,000	1,100,000	2,200,000	118,002	0	0	118,002	38,686	
6	2025	2,379,806	0.03158	75,151	0.00000	0	369	369	738	116.85	86,235	161,386	0.07609	1,100,000	1,100,000	2,200,000	123,318	0	0	123,318	38,068	
7	2026	2,379,806	0.03253	77,406	0.00000	0	369	369	738	120.36	88,826	166,232	0.07952	1,100,000	1,100,000	2,200,000	128,877	0	0	128,877	37,355	
8	2027	2,379,806	0.03350	79,728	0.00000	0	369	369	738	123.97	91,490	171,218	0.08309	1,100,000	1,100,000	2,200,000	134,663	0	0	134,663	36,555	
9	2028	2,379,806	0.03451	82,120	0.00000	0	369	369	738	127.69	94,235	176,355	0.08683	1,100,000	1,100,000	2,200,000	140,724	0	0	140,724	35,631	
10	2029	2,379,806	0.03554	84,578	0.00000	0	369	369	738	131.52	97,062	181,640	0.09074	1,100,000	1,100,000	2,200,000	147,061	0	0	147,061	34,579	
11	2030	1,838,942	0.03661	67,324	0.00000	0	285	285	570	135.47	77,218	144,542	0.09482	850,000	850,000	1,700,000	118,748	0	0	118,748	25,794	
12	2031	1,081,730	0.03771	40,792	0.00000	0	168	168	336	139.53	46,882	87,674	0.09909	500,000	500,000	1,000,000	72,997	0	0	72,997	14,677	
13	2032	0	0.03884	0	0.00000	0	0	0	0	143.72	0	0	0.10355	0	0	0	0	0	0	0	0	
14	2033	0	0.04001	0	0.00000	0	0	0	0	148.03	0	0	0.10821	0	0	0	0	0	0	0	0	
15	2034	0	0.04121	0	0.00000	0	0	0	0	152.47	0	0	0.11308	0	0	0	0	0	0	0	0	
16	2035	0	0.04245	0	0.00000	0	0	0	0	157.04	0	0	0.11817	0	0	0	0	0	0	0	0	
17	2036	0	0.04372	0	0.00000	0	0	0	0	161.75	0	0	0.12348	0	0	0	0	0	0	0	0	
18	2037	0	0.04503	0	0.00000	0	0	0	0	166.61	0	0	0.12904	0	0	0	0	0	0	0	0	
19	2038	0	0.04638	0	0.00000	0	0	0	0	171.60	0	0	0.13485	0	0	0	0	0	0	0	0	
20	2039	0	0.04777	0	0.00000	0	0	0	0	176.75	0	0	0.14092	0	0	0	0	0	0	0	0	
Total =		23,798,062							7,380			\$1,655,382				22,000,000				\$1,545,510	\$109,872	
												NPV =									\$1,093,707	16,145

Total NPV = \$16,145
Benefit/Cost Ratio = 1.01

Worksheet Calculations

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

**Table 2
Utility Test**

Project: **Commercial Partnership Program (Custom)**
 Program Years: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2020	\$14,733	\$0	\$16,934	\$31,667	\$62,648	\$62,648	(\$30,981)
2021	36,420	0	41,736	78,156	82,672	82,672	(4,516)
2022	68,774	0	78,922	147,696	115,904	115,904	31,792
2023	70,837	0	81,291	152,128	0	0	152,128
2024	72,962	0	83,726	156,688	0	0	156,688
2025	75,151	0	86,235	161,386	0	0	161,386
2026	77,406	0	88,826	166,232	0	0	166,232
2027	79,728	0	91,490	171,218	0	0	171,218
2028	82,120	0	94,235	176,355	0	0	176,355
2029	84,578	0	97,062	181,640	0	0	181,640
2030	67,324	0	77,218	144,542	0	0	144,542
2031	40,792	0	46,882	87,674	0	0	87,674
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
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =				\$1,655,382		\$261,224	\$1,394,158
NPV =				\$1,109,852		\$240,376	869,476
Total NPV =		\$869,476					
Benefit/Cost Ratio =		4.62					

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

**Table 3
Societal Cost Test**

Project: **Commercial Partnership Program (Custom)**
 Program Years: **2020-2022**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2020	\$14,733	\$0	\$16,934	\$10,013	\$41,680	\$62,648	\$50,000	\$112,648	(\$70,968)
2021	36,420	0	41,736	25,455	103,611	82,672	70,000	152,672	(49,061)
2022	68,774	0	78,922	49,547	197,243	115,904	100,000	215,904	(18,661)
2023	70,837	0	81,291	52,565	204,693	0	0	0	204,693
2024	72,962	0	83,726	55,765	212,453	0	0	0	212,453
2025	75,151	0	86,235	59,160	220,546	0	0	0	220,546
2026	77,406	0	88,826	62,764	228,996	0	0	0	228,996
2027	79,728	0	91,490	66,586	237,804	0	0	0	237,804
2028	82,120	0	94,235	70,642	246,997	0	0	0	246,997
2029	84,578	0	97,062	74,941	256,581	0	0	0	256,581
2030	67,324	0	77,218	61,425	205,967	0	0	0	205,967
2031	40,792	0	46,882	38,376	126,050	0	0	0	126,050
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
2038	0	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0	0
Total =					\$2,282,621			\$481,224	\$1,801,397
					NPV = \$1,903,799			\$463,791	1,440,008
Total NPV =		\$1,440,008							
Benefit/Cost Ratio =		<u>4.10</u>							

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

**Table 4
Participant Test**

Project: **Commercial Partnership Program (Custom)**
 Program Years: **2020-2022**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2020	\$50,000	\$0.09329	\$0.08437	250,000	250,000	500,000	\$44,415	75	75	\$53.349	\$81.527	\$10,116	\$0	\$104,531	\$101,940	\$0	\$101,940	\$2,591
2021	70,000	0.09749	0.08817	600,000	600,000	1,200,000	111,396	180	180	55.750	85.195	25,370	0	206,766	145,485	0	145,485	61,281
2022	100,000	0.10187	0.09214	1,100,000	1,100,000	2,200,000	213,411	330	330	58.259	89.029	48,605	0	362,016	211,867	0	211,867	150,149
2023	0	0.10646	0.09628	1,100,000	1,100,000	2,200,000	223,014	330	330	60.880	93.036	50,792	0	273,806	0	0	0	273,806
2024	0	0.11125	0.10062	1,100,000	1,100,000	2,200,000	233,057	330	330	63.620	97.222	53,078	0	286,135	0	0	0	286,135
2025	0	0.11625	0.10514	1,100,000	1,100,000	2,200,000	243,529	330	330	66.483	101.597	55,466	0	298,995	0	0	0	298,995
2026	0	0.12148	0.10988	1,100,000	1,100,000	2,200,000	254,496	330	330	69.475	106.169	57,963	0	312,459	0	0	0	312,459
2027	0	0.12695	0.11482	1,100,000	1,100,000	2,200,000	265,947	330	330	72.601	110.947	60,571	0	326,518	0	0	0	326,518
2028	0	0.13266	0.11999	1,100,000	1,100,000	2,200,000	277,915	330	330	75.868	115.939	63,296	0	341,211	0	0	0	341,211
2029	0	0.13863	0.12539	1,100,000	1,100,000	2,200,000	290,422	330	330	79.282	121.156	66,145	0	356,567	0	0	0	356,567
2030	0	0.14487	0.13103	850,000	850,000	1,700,000	234,515	255	255	82.850	126.609	53,412	0	287,927	0	0	0	287,927
2031	0	0.15139	0.13693	500,000	500,000	1,000,000	144,160	150	150	86.578	132.306	32,833	0	176,993	0	0	0	176,993
2032	0	0.15820	0.14309	0	0	0	0	0	0	90.474	138.260	0	0	0	0	0	0	0
2033	0	0.16532	0.14953	0	0	0	0	0	0	94.545	144.481	0	0	0	0	0	0	0
2034	0	0.17276	0.15625	0	0	0	0	0	0	98.800	150.983	0	0	0	0	0	0	0
2035	0	0.18054	0.16329	0	0	0	0	0	0	103.246	157.777	0	0	0	0	0	0	0
2036	0	0.18866	0.17063	0	0	0	0	0	0	107.892	164.877	0	0	0	0	0	0	0
2037	0	0.19715	0.17831	0	0	0	0	0	0	112.747	172.297	0	0	0	0	0	0	0
2038	0	0.20602	0.18634	0	0	0	0	0	0	117.821	180.050	0	0	0	0	0	0	0
2039	0	0.21529	0.19472	0	0	0	0	0	0	123.123	188.152	0	0	0	0	0	0	0
Total =				11,000,000	11,000,000			3,300	3,300					\$3,333,924			\$459,292	\$2,874,632
														NPV = \$1,977,752			\$407,898	1,569,854

Total NPV = \$1,569,854
 Benefit/Cost Ratio = 4.85

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

Table 5
Total Resource Cost Test

Company: **Commercial Partnership Program (Custom)**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2020	\$14,733	\$16,934	\$31,667	\$62,648	\$50,000	\$112,648	(\$80,981)
2021	36,420	41,736	78,156	82,672	70,000	152,672	(74,516)
2022	68,774	78,922	147,696	115,904	100,000	215,904	(68,208)
2023	70,837	81,291	152,128	0	0	0	152,128
2024	72,962	83,726	156,688	0	0	0	156,688
2025	75,151	86,235	161,386	0	0	0	161,386
2026	77,406	88,826	166,232	0	0	0	166,232
2027	79,728	91,490	171,218	0	0	0	171,218
2028	82,120	94,235	176,355	0	0	0	176,355
2029	84,578	97,062	181,640	0	0	0	181,640
2030	67,324	77,218	144,542	0	0	0	144,542
2031	40,792	46,882	87,674	0	0	0	87,674
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
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =			\$1,655,382			\$481,224	\$1,174,158
NPV =			\$1,109,852			\$442,478	667,373

Total NPV = \$667,373
Benefit/Cost Ratio = 2.51

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: **2020-2022**

Input Data		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09297			
Retail Rate Winter (\$/kWh) =	\$0.09107			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.02524			
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) =	\$33.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$58.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.02524			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.32%			
9) Utility Discount Rate =	7.22%			
10) Societal Discount Rate =	3.11%			
11) General Input Data Year =	2019			
12) Project Analysis Year 1 =	2020			
Project Analysis Year 2 =	2021			
Project Analysis Year 3 =	2022			
13) Utility Project Costs				
Admin & Promotion Costs =		\$4,927	\$3,205	\$2,728
Incentive Costs =		10,000	10,000	10,000
Total Utility Project Costs =		\$14,927	\$13,205	\$12,728
14) Direct Participant Costs (\$/Part.) =		\$20,000	\$20,000	\$20,000
Escalation Rate =		1.94%	1.94%	1.94%
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		11.9000%	11.9000%	11.9000%
18b) System Energy Line Loss Factor		8.1730%	8.1730%	8.1730%
19) Number of Participants =		1	1	1
20) Incentive/Participant =		\$10,000	\$10,000	\$10,000
21) Effective Federal & State Income Tax Rate =				26.33%
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		\$63,714	1.72	
Utility Cost Test		\$114,282	3.98	
Societal Test		\$190,061	3.76	
Participant Test		\$219,764	4.88	
Total Resource Cost Test		\$86,276	2.30	

**Table 1
Ratepayer Impact Test**

Project: **Commercial Partnership Program (Custom)**
 Program Years: **2020-2022**

t	Year											Costs					Annual Benefits Less Costs (P)					
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)		Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2020	108,174	\$0.02724	\$2,947	\$0.00000	\$0	17	17	34	\$100.80	\$3,427	\$6,374	\$0.02638	50,000	50,000	100,000	\$1,943	\$4,927	\$10,000	\$16,870	(\$10,496)	
2	2021	216,346	0.02806	6,070	0.00000	0	34	34	68	103.82	7,060	13,130	0.02756	100,000	100,000	200,000	4,061	3,205	10,000	17,266	(4,136)	
3	2022	324,520	0.02890	9,378	0.00000	0	50	50	100	106.94	10,694	20,072	0.02880	150,000	150,000	300,000	6,365	2,728	10,000	19,093	979	
4	2023	324,520	0.02977	9,660	0.00000	0	50	50	100	110.15	11,015	20,675	0.03010	150,000	150,000	300,000	6,652	0	0	6,652	14,023	
5	2024	324,520	0.03066	9,949	0.00000	0	50	50	100	113.45	11,345	21,294	0.03145	150,000	150,000	300,000	6,951	0	0	6,951	14,343	
6	2025	324,520	0.03158	10,248	0.00000	0	50	50	100	116.85	11,685	21,933	0.03287	150,000	150,000	300,000	7,264	0	0	7,264	14,669	
7	2026	324,520	0.03253	10,555	0.00000	0	50	50	100	120.36	12,036	22,591	0.03435	150,000	150,000	300,000	7,591	0	0	7,591	15,000	
8	2027	324,520	0.03350	10,872	0.00000	0	50	50	100	123.97	12,397	23,269	0.03589	150,000	150,000	300,000	7,932	0	0	7,932	15,337	
9	2028	324,520	0.03451	11,198	0.00000	0	50	50	100	127.69	12,769	23,967	0.03751	150,000	150,000	300,000	8,290	0	0	8,290	15,677	
10	2029	324,520	0.03554	11,533	0.00000	0	50	50	100	131.52	13,152	24,685	0.03920	150,000	150,000	300,000	8,663	0	0	8,663	16,022	
11	2030	216,346	0.03661	7,920	0.00000	0	34	34	68	135.47	9,212	17,132	0.04096	100,000	100,000	200,000	6,035	0	0	6,035	11,097	
12	2031	108,174	0.03771	4,079	0.00000	0	17	17	34	139.53	4,744	8,823	0.04280	50,000	50,000	100,000	3,153	0	0	3,153	5,670	
13	2032	0	0.03884	0	0.00000	0	0	0	0	143.72	0	0	0.04473	0	0	0	0	0	0	0	0	
14	2033	0	0.04001	0	0.00000	0	0	0	0	148.03	0	0	0.04674	0	0	0	0	0	0	0	0	
15	2034	0	0.04121	0	0.00000	0	0	0	0	152.47	0	0	0.04885	0	0	0	0	0	0	0	0	
16	2035	0	0.04245	0	0.00000	0	0	0	0	157.04	0	0	0.05104	0	0	0	0	0	0	0	0	
17	2036	0	0.04372	0	0.00000	0	0	0	0	161.75	0	0	0.05334	0	0	0	0	0	0	0	0	
18	2037	0	0.04503	0	0.00000	0	0	0	0	166.61	0	0	0.05574	0	0	0	0	0	0	0	0	
19	2038	0	0.04638	0	0.00000	0	0	0	0	171.60	0	0	0.05825	0	0	0	0	0	0	0	0	
20	2039	0	0.04777	0	0.00000	0	0	0	0	203.27	0	0	0.06087	0	0	0	0	0	0	0	0	
Total =		3,245,200							1,004			\$223,945				3,000,000				\$115,760	\$108,185	
												NPV = \$152,572									\$88,858	63,714
Total NPV =			\$63,714																			
Benefit/Cost Ratio =			<u>1.72</u>																			

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

**Table 2
Utility Test**

Project: **Commercial Partnership Program (Custom)**
 Program Years: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2020	\$2,947	\$0	\$3,427	\$6,374	\$14,927	\$14,927	(\$8,553)
2021	6,070	0	7,060	13,130	13,205	13,205	(75)
2022	9,378	0	10,694	20,072	12,728	12,728	7,344
2023	9,660	0	11,015	20,675	0	0	20,675
2024	9,949	0	11,345	21,294	0	0	21,294
2025	10,248	0	11,685	21,933	0	0	21,933
2026	10,555	0	12,036	22,591	0	0	22,591
2027	10,872	0	12,397	23,269	0	0	23,269
2028	11,198	0	12,769	23,967	0	0	23,967
2029	11,533	0	13,152	24,685	0	0	24,685
2030	7,920	0	9,212	17,132	0	0	17,132
2031	4,079	0	4,744	8,823	0	0	8,823
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
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =				\$223,945		\$40,860	\$183,085
				NPV = \$152,572		\$38,290	114,282

Total NPV = \$114,282
 Benefit/Cost Ratio = 3.98

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: **Commercial Partnership Program (Custom)**
 Program Years: **2020-2022**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2020	\$2,947	\$0	\$3,427	\$2,016	\$8,390	\$14,927	\$10,000	\$24,927	(\$16,537)
2021	6,070	0	7,060	4,276	17,406	13,205	10,000	23,205	(5,799)
2022	9,378	0	10,694	6,733	26,805	12,728	10,000	22,728	4,077
2023	9,660	0	11,015	7,144	27,819	0	0	0	27,819
2024	9,949	0	11,345	7,578	28,872	0	0	0	28,872
2025	10,248	0	11,685	8,040	29,973	0	0	0	29,973
2026	10,555	0	12,036	8,530	31,121	0	0	0	31,121
2027	10,872	0	12,397	9,049	32,318	0	0	0	32,318
2028	11,198	0	12,769	9,600	33,567	0	0	0	33,567
2029	11,533	0	13,152	10,185	34,870	0	0	0	34,870
2030	7,920	0	9,212	7,280	24,412	0	0	0	24,412
2031	4,079	0	4,744	3,862	12,685	0	0	0	12,685
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
2038	0	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0	0
Total =					\$308,238			\$70,860	\$237,378
					NPV = \$258,871			\$68,810	190,061
Total NPV =		\$190,061							
Benefit/Cost Ratio =		<u>3.76</u>							

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

**Table 4
Participant Test**

Project: **Commercial Partnership Program (Custom)**
 Program Years: **2020-2022**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2020	\$10,000	\$0.09715	\$0.09517	50,000	50,000	100,000	\$9,616	15	15	\$34.485	\$60.610	\$1,426	\$0	\$21,042	\$20,388	\$0	\$20,388	\$654
2021	10,000	0.10153	0.09945	100,000	100,000	200,000	20,098	30	30	36.037	63.337	2,981	0	33,079	20,784	0	20,784	12,295
2022	10,000	0.10609	0.10393	150,000	150,000	300,000	31,503	45	45	37.658	66.188	4,673	0	46,176	21,187	0	21,187	24,989
2023	0	0.11087	0.10860	150,000	150,000	300,000	32,921	45	45	39.353	69.166	4,883	0	37,804	0	0	0	37,804
2024	0	0.11586	0.11349	150,000	150,000	300,000	34,403	45	45	41.124	72.279	5,103	0	39,506	0	0	0	39,506
2025	0	0.12107	0.11860	150,000	150,000	300,000	35,951	45	45	42.975	75.531	5,333	0	41,284	0	0	0	41,284
2026	0	0.12652	0.12393	150,000	150,000	300,000	37,568	45	45	44.908	78.930	5,573	0	43,141	0	0	0	43,141
2027	0	0.13221	0.12951	150,000	150,000	300,000	39,258	45	45	46.929	82.482	5,823	0	45,081	0	0	0	45,081
2028	0	0.13816	0.13534	150,000	150,000	300,000	41,025	45	45	49.041	86.194	6,086	0	47,111	0	0	0	47,111
2029	0	0.14438	0.14143	150,000	150,000	300,000	42,872	45	45	51.248	90.072	6,359	0	49,231	0	0	0	49,231
2030	0	0.15088	0.14779	100,000	100,000	200,000	29,867	30	30	53.554	94.125	4,430	0	34,297	0	0	0	34,297
2031	0	0.15767	0.15444	50,000	50,000	100,000	15,606	15	15	55.964	98.361	2,315	0	17,921	0	0	0	17,921
2032	0	0.16476	0.16139	0	0	0	0	0	0	58.482	102.787	0	0	0	0	0	0	0
2033	0	0.17218	0.16866	0	0	0	0	0	0	61.114	107.413	0	0	0	0	0	0	0
2034	0	0.17992	0.17625	0	0	0	0	0	0	63.864	112.246	0	0	0	0	0	0	0
2035	0	0.18802	0.18418	0	0	0	0	0	0	66.738	117.297	0	0	0	0	0	0	0
2036	0	0.19648	0.19247	0	0	0	0	0	0	69.741	122.576	0	0	0	0	0	0	0
2037	0	0.20532	0.20113	0	0	0	0	0	0	72.880	128.092	0	0	0	0	0	0	0
2038	0	0.21456	0.21018	0	0	0	0	0	0	76.159	133.856	0	0	0	0	0	0	0
2039	0	0.22422	0.21963	0	0	0	0	0	0	79.587	139.879	0	0	0	0	0	0	0
Total =				1,500,000	1,500,000			450	450					\$455,673			\$62,359	\$393,314
														NPV = \$276,400			\$56,636	219,764
Total NPV =			\$219,764															
Benefit/Cost Ratio =			<u>4.88</u>															

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

**Table 5
Total Resource Cost Test**

Company: **Commercial Partnership Program (Custom)**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2020	\$2,947	\$3,427	\$6,374	\$14,927	\$10,000	\$24,927	(\$18,553)
2021	6,070	7,060	13,130	13,205	10,000	23,205	(10,075)
2022	9,378	10,694	20,072	12,728	10,000	22,728	(2,656)
2023	9,660	11,015	20,675	0	0	0	20,675
2024	9,949	11,345	21,294	0	0	0	21,294
2025	10,248	11,685	21,933	0	0	0	21,933
2026	10,555	12,036	22,591	0	0	0	22,591
2027	10,872	12,397	23,269	0	0	0	23,269
2028	11,198	12,769	23,967	0	0	0	23,967
2029	11,533	13,152	24,685	0	0	0	24,685
2030	7,920	9,212	17,132	0	0	0	17,132
2031	4,079	4,744	8,823	0	0	0	8,823
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
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =			\$223,945			\$70,860	\$153,085
NPV =			\$152,572			\$66,296	86,276

Total NPV = \$86,276
Benefit/Cost Ratio = 2.30

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: **2020-2022**

Input Data		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09800			
Retail Rate Winter (\$/kWh) =	\$0.08074			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.02538			
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) =	\$50.42			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$89.97			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.07001			
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 =	10.32%			
9) Utility Discount Rate =	7.30%			
10) Societal Discount Rate =	3.11%			
11) General Input Data Year =	2019			
12) Project Analysis Year 1 =	2020			
Project Analysis Year 2 =	2021			
Project Analysis Year 3 =	2022			
13) Utility Project Costs				
Admin & Promotion Costs =		\$26,015	\$27,053	\$26,358
Incentive Costs =		0	0	0
Direct Program Costs =		316,470	374,010	374,010
Total Utility Project Costs =		\$342,485	\$401,063	\$400,368
14) Direct Participant Costs (\$/Part.) =		\$0	\$0	\$0
Escalation Rate =		1.94%	1.94%	1.94%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		10	10	10
16) Avg Summer kW/part. Saved =		1,000.000	1,000.000	1,000.000
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		25,000	25,000	25,000
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		11.9000%	11.9000%	11.9000%
18b) System Energy Line Loss Factor		8.1730%	8.1730%	8.1730%
19) Number of Participants =		1	1	0
20) Incentive/Participant =		\$0	\$0	\$0
21) Effective Federal & State Income Tax Rate =				26.33%
22) Annual Summer Kwh Saved		25,000	25,000	0
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		1,000	1,000	0
Annual Winter KW Saved		0	0	0
Test Results		NPV	B/C	
Ratepayer Impact Measure Test		\$3,898,777	2.41	
Utility Cost Test		\$3,898,777	2.41	
Societal Test		\$7,468,748	3.31	
Participant Test		\$452,869	80.19	
Total Resource Cost Test		\$3,892,981	2.41	

**Table 1
Ratepayer Impact Test**

Project: **Commercial Demand Response Program**
Program Years: **2020-2022**

t	Year											Costs							Annual Benefits Less Costs (P)				
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)	Program Admin Costs (M)		Incentive Costs (N)	Direct Program Costs (O)	Total Project Costs (O)	
0	2015						5,036							112,500							\$258,930		
1	2020	148,738	\$0.03133	\$4,660	\$0.00000	\$0	6,155	0	6,155	\$115.92	\$713,488	\$718,148	\$0.07316	137,500	0	137,500	\$7,411	\$26,015	\$0	\$316,470	\$349,896	\$368,252	
2	2021	175,782	0.03227	5,672	0.00000	0	7,274	0	7,274	119.40	868,516	874,188	0.07645	162,500	0	162,500	9,152	27,053	0	374,010	410,215	463,973	
3	2022	175,782	0.03323	5,841	0.00000	0	7,274	0	7,274	122.98	894,557	900,398	0.07989	162,500	0	162,500	9,564	26,358	0	374,010	409,932	490,466	
4	2023	175,782	0.03423	6,017	0.00000	0	7,274	0	7,274	126.67	921,398	927,415	0.08349	162,500	0	162,500	9,995	0	0	374,010	384,005	543,410	
5	2024	175,782	0.03526	6,198	0.00000	0	7,274	0	7,274	130.47	949,039	955,237	0.08725	162,500	0	162,500	10,445	0	0	374,010	384,455	570,782	
6	2025	175,782	0.03632	6,384	0.00000	0	7,274	0	7,274	134.38	977,480	983,864	0.09117	162,500	0	162,500	10,914	0	0	374,010	384,924	598,940	
7	2026	175,782	0.03740	6,574	0.00000	0	7,274	0	7,274	138.41	1,006,794	1,013,368	0.09527	162,500	0	162,500	11,405	0	0	374,010	385,415	627,953	
8	2027	175,782	0.03853	6,773	0.00000	0	7,274	0	7,274	142.57	1,037,054	1,043,827	0.09956	162,500	0	162,500	11,918	0	0	374,010	385,928	657,899	
9	2028	175,782	0.03968	6,975	0.00000	0	7,274	0	7,274	146.84	1,068,114	1,075,089	0.10404	162,500	0	162,500	12,455	0	0	374,010	386,465	688,624	
10	2029	54,087	0.04087	2,211	0.00000	0	2,238	0	2,238	151.25	338,498	340,709	0.10872	50,000	0	50,000	4,005	0	0	115,080	119,085	221,624	
11	2030	27,043	0.04210	1,139	0.00000	0	1,119	0	1,119	155.79	174,329	175,468	0.11362	25,000	0	25,000	2,093	0	0	57,540	59,633	115,835	
12	2031	0	0.04336	0	0.00000	0	0	0	0	160.46	0	0	0.11873	0	0	0	0	0	0	0	0	0	
13	2032	0	0.04466	0	0.00000	0	0	0	0	165.27	0	0	0.12407	0	0	0	0	0	0	0	0	0	
14	2033	0	0.04600	0	0.00000	0	0	0	0	170.23	0	0	0.12965	0	0	0	0	0	0	0	0	0	
15	2034	0	0.04738	0	0.00000	0	0	0	0	175.34	0	0	0.13549	0	0	0	0	0	0	0	0	0	
16	2035	0	0.04880	0	0.00000	0	0	0	0	180.60	0	0	0.14159	0	0	0	0	0	0	0	0	0	
17	2036	0	0.05026	0	0.00000	0	0	0	0	186.02	0	0	0.14796	0	0	0	0	0	0	0	0	0	
18	2037	0	0.05177	0	0.00000	0	0	0	0	191.60	0	0	0.15462	0	0	0	0	0	0	0	0	0	
19	2038	0	0.05332	0	0.00000	0	0	0	0	197.35	0	0	0.16157	0	0	0	0	0	0	0	0	0	
20	2039	0	0.05492	0	0.00000	0	0	0	0	203.27	0	0	0.16884	0	0	0	0	0	0	0	0	0	
Total =		1,636,124							67,704			\$9,007,711				1,512,500				\$3,659,953	\$5,347,758		
												NPV =									\$2,760,938	3,898,777	
Total NPV =			\$3,898,777																				
Benefit/Cost Ratio =			<u>2.41</u>																				

Worksheet Calculations

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

**Table 2
Utility Test**

Project: **Commercial Demand Response Program**
 Program Years: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2020	\$4,660	\$0	\$713,488	\$718,148	\$349,896	\$349,896	\$368,252
2021	5,672	0	868,516	874,188	410,215	410,215	463,973
2022	5,841	0	894,557	900,398	409,932	409,932	490,466
2023	6,017	0	921,398	927,415	384,005	384,005	543,410
2024	6,198	0	949,039	955,237	384,455	384,455	570,782
2025	6,384	0	977,480	983,864	384,924	384,924	598,940
2026	6,574	0	1,006,794	1,013,368	385,415	385,415	627,953
2027	6,773	0	1,037,054	1,043,827	385,928	385,928	657,899
2028	6,975	0	1,068,114	1,075,089	386,465	386,465	688,624
2029	2,211	0	338,498	340,709	119,085	119,085	221,624
2030	1,139	0	174,329	175,468	59,633	59,633	115,835
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
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =				\$9,007,711		\$3,659,953	\$5,347,758
NPV =				\$6,659,715		\$2,760,938	3,898,777
Total NPV =		\$3,898,777					
Benefit/Cost Ratio =		<u>2.41</u>					

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

**Table 3
Societal Cost Test**

Project: **Commercial Demand Response Program**
 Program Years: **2020-2022**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2020	\$4,660	\$0	\$713,488	\$227,086	\$945,234	\$349,896	\$3,000	\$352,896	\$592,338
2021	5,672	0	868,516	284,720	1,158,908	410,215	3,000	413,215	745,693
2022	5,841	0	894,557	302,054	1,202,452	409,932	0	409,932	792,520
2023	6,017	0	921,398	320,451	1,247,866	384,005	0	384,005	863,861
2024	6,198	0	949,039	339,966	1,295,203	384,455	0	384,455	910,748
2025	6,384	0	977,480	360,659	1,344,523	384,924	0	384,924	959,599
2026	6,574	0	1,006,794	382,619	1,395,987	385,415	0	385,415	1,010,572
2027	6,773	0	1,037,054	405,943	1,449,770	385,928	0	385,928	1,063,842
2028	6,975	0	1,068,114	430,643	1,505,732	386,465	0	386,465	1,119,267
2029	2,211	0	338,498	140,571	481,280	119,085	0	119,085	362,195
2030	1,139	0	174,329	74,567	250,035	59,633	0	59,633	190,402
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
2038	0	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0	0
Total =					\$12,276,990			\$3,665,953	\$8,611,037
					NPV = \$10,697,627			\$3,228,879	7,468,748

Total NPV = \$7,468,748
 Benefit/Cost Ratio = 3.31

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: **2020-2022**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2020	\$0	\$0.10241	\$0.08437	112,500	0	137,500	\$14,081	4,500	0	\$2.919	\$94.017	\$16,055	\$28,875	\$59,011	\$3,000	\$0	\$3,000	\$56,011
2021	0	0.10702	0.08817	162,500	0	162,500	17,391	6,500	0	2.919	98.247	18,974	34,125	70,490	3,000	0	3,000	67,490
2022	0	0.11183	0.09214	162,500	0	162,500	18,172	6,500	0	2.919	102.668	18,974	34,125	71,271	0	0	0	71,271
2023	0	0.11687	0.09628	162,500	0	162,500	18,991	6,500	0	2.919	107.289	18,974	34,125	72,090	0	0	0	72,090
2024	0	0.12213	0.10062	162,500	0	162,500	19,846	6,500	0	2.919	112.116	18,974	34,125	72,945	0	0	0	72,945
2025	0	0.12762	0.10514	162,500	0	162,500	20,738	6,500	0	2.919	117.162	18,974	34,125	73,837	0	0	0	73,837
2026	0	0.13336	0.10988	162,500	0	162,500	21,671	6,500	0	2.919	122.434	18,974	34,125	74,770	0	0	0	74,770
2027	0	0.13937	0.11482	162,500	0	162,500	22,648	6,500	0	2.919	127.944	18,974	34,125	75,747	0	0	0	75,747
2028	0	0.14564	0.11999	162,500	0	162,500	23,667	6,500	0	2.919	133.701	18,974	34,125	76,766	0	0	0	76,766
2029	0	0.15219	0.12539	50,000	0	50,000	7,610	2,000	0	2.919	139.718	5,838	10,500	23,948	0	0	0	23,948
2030	0	0.15904	0.13103	25,000	0	25,000	3,976	1,000	0	2.919	146.005	2,919	5,250	12,145	0	0	0	12,145
2031	0	0.16620	0.13693	0	0	0	0	0	0	2.919	152.575	0	0	0	0	0	0	0
2032	0	0.17368	0.14309	0	0	0	0	0	0	2.919	159.441	0	0	0	0	0	0	0
2033	0	0.18149	0.14953	0	0	0	0	0	0	2.919	166.616	0	0	0	0	0	0	0
2034	0	0.18966	0.15625	0	0	0	0	0	0	2.919	174.113	0	0	0	0	0	0	0
2035	0	0.19819	0.16329	0	0	0	0	0	0	2.919	181.949	0	0	0	0	0	0	0
2036	0	0.20711	0.17063	0	0	0	0	0	0	2.919	190.136	0	0	0	0	0	0	0
2037	0	0.21643	0.17831	0	0	0	0	0	0	2.919	198.692	0	0	0	0	0	0	0
2038	0	0.22617	0.18634	0	0	0	0	0	0	2.919	207.634	0	0	0	0	0	0	0
2039	0	0.23635	0.19472	0	0	0	0	0	0	2.919	216.977	0	0	0	0	0	0	0
Total =				1,512,500	0			60,500	0					\$683,020			\$6,000	\$677,020
														NPV = \$458,589			\$5,719	452,869

Total NPV = \$452,869
 Benefit/Cost Ratio = 80.19

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

**Table 5
Total Resource Cost Test**

Company: **Commercial Demand Response Program**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2020	\$4,660	\$713,488	\$718,148	\$349,896	\$3,000	\$352,896	\$365,252
2021	5,672	868,516	874,188	410,215	3,000	413,215	460,973
2022	5,841	894,557	900,398	409,932	0	409,932	490,466
2023	6,017	921,398	927,415	384,005	0	384,005	543,410
2024	6,198	949,039	955,237	384,455	0	384,455	570,782
2025	6,384	977,480	983,864	384,924	0	384,924	598,940
2026	6,574	1,006,794	1,013,368	385,415	0	385,415	627,953
2027	6,773	1,037,054	1,043,827	385,928	0	385,928	657,899
2028	6,975	1,068,114	1,075,089	386,465	0	386,465	688,624
2029	2,211	338,498	340,709	119,085	0	119,085	221,624
2030	1,139	174,329	175,468	59,633	0	59,633	115,835
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
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =			\$9,007,711			\$3,665,953	\$5,341,758
NPV =			\$6,659,715			\$2,766,734	3,892,981

Total NPV = \$3,892,981
Benefit/Cost Ratio = 2.41

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: **2020-2022**

<u>Input Data</u>		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.08927			
Retail Rate Winter (\$/kWh) =	\$0.08074			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.02521			
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) =	\$51.05			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$78.02			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05843			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.32%			
9) Utility Discount Rate =	7.36%			
10) Societal Discount Rate =	3.11%			
11) General Input Data Year =	2019			
12) Project Analysis Year 1 =	2020			
Project Analysis Year 2 =	2021			
Project Analysis Year 3 =	2022			
13) Utility Project Costs				
Admin & Promotion Costs =		\$31,218	\$32,047	\$31,224
Incentive Costs =		0	0	0
Direct Program Costs =		0	0	0
Total Utility Project Costs =		\$31,218	\$32,047	\$31,224
14) Direct Participant Costs (\$/Part.) =		\$0	\$0	\$0
Escalation Rate =		1.94%	1.94%	1.94%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		10	10	10
16) Avg Summer kW/part. Saved =		275.000	275.000	275.000
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		6,875	6,875	6,875
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		11.9000%	11.9000%	11.9000%
18b) System Energy Line Loss Factor		8.1730%	8.1730%	8.1730%
19) Number of Participants =		4	4	0
20) Incentive/Participant =		\$0	\$0	\$0
21) Effective Federal & State Income Tax Rate =				26.33%
22) Annual Summer Kwh Saved		27,500	27,500	0
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		1,100	1,100	0
Annual Winter KW Saved		0	0	0
Test Results		NPV	B/C	
Ratepayer Impact Measure Test		\$3,596,214	2.11	
Utility Cost Test		\$3,596,214	2.11	
Societal Test		\$7,173,206	2.88	
Participant Test		\$507,003	23.16	
Total Resource Cost Test		\$3,573,030	2.09	

**Table 1
Ratepayer Impact Test**

Project: **Commercial Demand Response Program**
Program Years: **2020-2022**

t	Year											Electric Margin (J)	Costs					Annual Benefits Less Costs (Q)						
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)		Total Savings (I)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)		Program Admin Costs (M)	Incentive Costs (N)	Direct Program Costs (O)	Total Project Costs (P)		
1	2020	178,486	\$0.02724	\$4,862	\$0.00000	\$0	6,155	7,386	0	7,386	\$100.80	\$744,509	\$749,371	\$0.06106	137,500	165,000	0	165,000	\$7,422	\$31,218	\$0	\$379,764	\$418,404	\$330,967
2	2021	208,233	0.02806	5,842	0.00000	0	8,617	0	8,617	103.82	894,617	900,459	0.06381	192,500	0	192,500	9,049	32,047	0	443,058	484,154	416,305		
3	2022	208,233	0.02890	6,018	0.00000	0	8,617	0	8,617	106.94	921,502	927,520	0.06668	192,500	0	192,500	9,456	31,224	0	443,058	483,738	443,782		
4	2023	208,233	0.02977	6,198	0.00000	0	8,617	0	8,617	110.15	949,163	955,361	0.06968	192,500	0	192,500	9,881	0	0	443,058	452,939	502,422		
5	2024	208,233	0.03066	6,384	0.00000	0	8,617	0	8,617	113.45	977,599	983,983	0.07281	192,500	0	192,500	10,325	0	0	443,058	453,383	530,600		
6	2025	208,233	0.03158	6,576	0.00000	0	8,617	0	8,617	116.85	1,006,896	1,013,472	0.07609	192,500	0	192,500	10,790	0	0	443,058	453,848	559,624		
7	2026	208,233	0.03253	6,773	0.00000	0	8,617	0	8,617	120.36	1,037,142	1,043,915	0.07952	192,500	0	192,500	11,277	0	0	443,058	454,335	589,580		
8	2027	208,233	0.03350	6,976	0.00000	0	8,617	0	8,617	123.97	1,068,249	1,075,225	0.08309	192,500	0	192,500	11,783	0	0	443,058	454,841	620,384		
9	2028	208,233	0.03451	7,185	0.00000	0	8,617	0	8,617	127.69	1,100,305	1,107,490	0.08683	192,500	0	192,500	12,313	0	0	443,058	455,371	652,119		
10	2029	59,495	0.03554	2,114	0.00000	0	2,462	0	2,462	131.52	323,802	325,916	0.09074	55,000	0	55,000	3,677	0	0	126,588	130,265	195,651		
11	2030	29,748	0.03661	1,089	0.00000	0	1,231	0	1,231	135.47	166,764	167,853	0.09482	27,500	0	27,500	1,921	0	0	63,294	65,215	102,638		
12	2031	0	0.03771	0	0.00000	0	0	0	0	139.53	0	0	0.09909	0	0	0	0	0	0	0	0	0		
13	2032	0	0.03884	0	0.00000	0	0	0	0	143.72	0	0	0.10355	0	0	0	0	0	0	0	0	0		
14	2033	0	0.04001	0	0.00000	0	0	0	0	148.03	0	0	0.10821	0	0	0	0	0	0	0	0	0	0	
15	2034	0	0.04121	0	0.00000	0	0	0	0	152.47	0	0	0.11308	0	0	0	0	0	0	0	0	0	0	
16	2035	0	0.04245	0	0.00000	0	0	0	0	157.04	0	0	0.11817	0	0	0	0	0	0	0	0	0	0	
17	2036	0	0.04372	0	0.00000	0	0	0	0	161.75	0	0	0.12348	0	0	0	0	0	0	0	0	0	0	
18	2037	0	0.04503	0	0.00000	0	0	0	0	166.61	0	0	0.12904	0	0	0	0	0	0	0	0	0	0	
19	2038	0	0.04638	0	0.00000	0	0	0	0	171.60	0	0	0.13485	0	0	0	0	0	0	0	0	0	0	
20	2039	0	0.04777	0	0.00000	0	0	0	0	176.75	0	0	0.14092	0	0	0	0	0	0	0	0	0	0	
Total =		1,933,593						80,015					\$9,250,565			1,787,500					\$4,306,493	\$4,944,072		
													NPV =									\$3,253,931	3,596,214	
Total NPV =			\$3,596,214																					
Benefit/Cost Ratio =			2.11																					

Worksheet Calculations

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

**Table 2
Utility Test**

Project: **Commercial Demand Response Program**
 Program Years: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2020	\$4,862	\$0	\$744,509	\$749,371	\$418,404	\$418,404	\$330,967
2021	5,842	0	894,617	900,459	484,154	484,154	416,305
2022	6,018	0	921,502	927,520	483,738	483,738	443,782
2023	6,198	0	949,163	955,361	452,939	452,939	502,422
2024	6,384	0	977,599	983,983	453,383	453,383	530,600
2025	6,576	0	1,006,896	1,013,472	453,848	453,848	559,624
2026	6,773	0	1,037,142	1,043,915	454,335	454,335	589,580
2027	6,976	0	1,068,249	1,075,225	454,841	454,841	620,384
2028	7,185	0	1,100,305	1,107,490	455,371	455,371	652,119
2029	2,114	0	323,802	325,916	130,265	130,265	195,651
2030	1,089	0	166,764	167,853	65,215	65,215	102,638
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
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =				\$9,250,565		\$4,306,493	\$4,944,072
				NPV = \$6,850,145		\$3,253,931	3,596,214
Total NPV =		\$3,596,214					
Benefit/Cost Ratio =		<u>2.11</u>					

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

**Table 3
Societal Cost Test**

Project: **Commercial Demand Response Program**
 Program Years: **2020-2022**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2020	\$4,862	\$0	\$744,509	\$236,959	\$986,330	\$418,404	\$12,000	\$430,404	\$555,926
2021	5,842	0	894,617	293,276	1,193,735	484,154	12,000	496,154	697,581
2022	6,018	0	921,502	311,153	1,238,673	483,738	0	483,738	754,935
2023	6,198	0	949,163	330,107	1,285,468	452,939	0	452,939	832,529
2024	6,384	0	977,599	350,197	1,334,180	453,383	0	453,383	880,797
2025	6,576	0	1,006,896	371,513	1,384,985	453,848	0	453,848	931,137
2026	6,773	0	1,037,142	394,152	1,438,067	454,335	0	454,335	983,732
2027	6,976	0	1,068,249	418,153	1,493,378	454,841	0	454,841	1,038,537
2028	7,185	0	1,100,305	443,622	1,551,112	455,371	0	455,371	1,095,741
2029	2,114	0	323,802	134,467	460,383	130,265	0	130,265	330,118
2030	1,089	0	166,764	71,331	239,184	65,215	0	65,215	173,969
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
2038	0	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0	0
Total =					\$12,605,495			\$4,330,493	\$8,275,002
					NPV = \$10,991,947			\$3,818,741	7,173,206
Total NPV =	\$7,173,206								
Benefit/Cost Ratio =	<u>2.88</u>								

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

**Table 4
Participant Test**

Project: **Commercial Demand Response Program**
 Program Years: **2020-2022**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2020	\$0	\$0.09329	\$0.08437	137,500	0	165,000	\$15,393	6,600	0	\$2.919	\$81.527	\$19,265	\$34,650	\$69,308	\$12,000	\$0	\$12,000	\$57,308
2021	0	0.09749	0.08817	192,500	0	192,500	18,767	7,700	0	2.919	85.195	22,476	40,425	81,668	12,000	0	12,000	69,668
2022	0	0.10187	0.09214	192,500	0	192,500	19,610	7,700	0	2.919	89.029	22,476	40,425	82,511	0	0	0	82,511
2023	0	0.10646	0.09628	192,500	0	192,500	20,494	7,700	0	2.919	93.036	22,476	40,425	83,395	0	0	0	83,395
2024	0	0.11125	0.10062	192,500	0	192,500	21,416	7,700	0	2.919	97.222	22,476	40,425	84,317	0	0	0	84,317
2025	0	0.11625	0.10514	192,500	0	192,500	22,378	7,700	0	2.919	101.597	22,476	40,425	85,279	0	0	0	85,279
2026	0	0.12148	0.10988	192,500	0	192,500	23,385	7,700	0	2.919	106.169	22,476	40,425	86,286	0	0	0	86,286
2027	0	0.12695	0.11482	192,500	0	192,500	24,438	7,700	0	2.919	110.947	22,476	40,425	87,339	0	0	0	87,339
2028	0	0.13266	0.11999	192,500	0	192,500	25,537	7,700	0	2.919	115.939	22,476	40,425	88,438	0	0	0	88,438
2029	0	0.13863	0.12539	55,000	0	55,000	7,625	2,200	0	2.919	121.156	6,422	11,550	25,597	0	0	0	25,597
2030	0	0.14487	0.13103	27,500	0	27,500	3,984	1,100	0	2.919	126.609	3,211	5,775	12,970	0	0	0	12,970
2031	0	0.15139	0.13693	0	0	0	0	0	0	2.919	132.306	0	0	0	0	0	0	0
2032	0	0.15820	0.14309	0	0	0	0	0	0	2.919	138.260	0	0	0	0	0	0	0
2033	0	0.16532	0.14953	0	0	0	0	0	0	2.919	144.481	0	0	0	0	0	0	0
2034	0	0.17276	0.15625	0	0	0	0	0	0	2.919	150.983	0	0	0	0	0	0	0
2035	0	0.18054	0.16329	0	0	0	0	0	0	2.919	157.777	0	0	0	0	0	0	0
2036	0	0.18866	0.17063	0	0	0	0	0	0	2.919	164.877	0	0	0	0	0	0	0
2037	0	0.19715	0.17831	0	0	0	0	0	0	2.919	172.297	0	0	0	0	0	0	0
2038	0	0.20602	0.18634	0	0	0	0	0	0	2.919	180.050	0	0	0	0	0	0	0
2039	0	0.21529	0.19472	0	0	0	0	0	0	2.919	188.152	0	0	0	0	0	0	0
Total =				1,787,500	0			71,500	0					\$787,108			\$24,000	\$763,108
														NPV = \$529,880			\$22,877	507,003

Total NPV = \$507,003
 Benefit/Cost Ratio = 23.16

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

**Table 5
Total Resource Cost Test**

Company: **Commercial Demand Response Program**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2020	\$4,862	\$744,509	\$749,371	\$418,404	\$12,000	\$430,404	\$318,967
2021	5,842	894,617	900,459	484,154	12,000	496,154	404,305
2022	6,018	921,502	927,520	483,738	0	483,738	443,782
2023	6,198	949,163	955,361	452,939	0	452,939	502,422
2024	6,384	977,599	983,983	453,383	0	453,383	530,600
2025	6,576	1,006,896	1,013,472	453,848	0	453,848	559,624
2026	6,773	1,037,142	1,043,915	454,335	0	454,335	589,580
2027	6,976	1,068,249	1,075,225	454,841	0	454,841	620,384
2028	7,185	1,100,305	1,107,490	455,371	0	455,371	652,119
2029	2,114	323,802	325,916	130,265	0	130,265	195,651
2030	1,089	166,764	167,853	65,215	0	65,215	102,638
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
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =			\$9,250,565			\$4,330,493	\$4,920,072
NPV =			\$6,850,145			\$3,277,115	3,573,030
Total NPV =		\$3,573,030					
Benefit/Cost Ratio =		<u>2.09</u>					

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

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

Company: **Montana-Dakota Utilities Co.**
 Project: **Commercial Demand Response Program**
 Program Years: **2020-2022**

Input Data		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09297			
Retail Rate Winter (\$/kWh) =	\$0.09107			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.02524			
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) =	\$33.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$58.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.02524			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.32%			
9) Utility Discount Rate =	7.22%			
10) Societal Discount Rate =	3.11%			
11) General Input Data Year =	2019			
12) Project Analysis Year 1 =	2020			
Project Analysis Year 2 =	2021			
Project Analysis Year 3 =	2022			
13) Utility Project Costs				
Admin & Promotion Costs =		\$1,892	\$3,330	\$3,244
Incentive Costs =		0	0	0
Direct Program Costs =		0	0	0
Total Utility Project Costs =		\$1,892	\$3,330	\$3,244
14) Direct Participant Costs (\$/Part.) =		\$0	\$0	\$0
Escalation Rate =		1.94%	1.94%	1.94%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		10	10	10
16) Avg Summer kW/part. Saved =		200.000	200.000	200.000
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		5,000	5,000	5,000
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		11.9000%	11.9000%	11.9000%
18b) System Energy Line Loss Factor		8.1730%	8.1730%	8.1730%
19) Number of Participants =		2	2	0
20) Incentive/Participant =		\$0	\$0	\$0
21) Effective Federal & State Income Tax Rate =				26.33%
22) Annual Summer Kwh Saved		10,000	10,000	0
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		400	400	0
Annual Winter KW Saved		0	0	0
Test Results		NPV	B/C	
Ratepayer Impact Measure Test		\$403,802	2.18	
Utility Cost Test		\$403,802	2.18	
Societal Test		\$814,907	2.94	
Participant Test		\$45,219	4.95	
Total Resource Cost Test		\$392,209	2.11	

**Table 2
Utility Test**

Project: **Commercial Demand Response Program**
 Program Years: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2020	\$295	\$0	\$45,158	\$45,453	\$25,102	\$25,102	\$20,351
2021	607	0	92,919	93,526	49,768	49,768	43,758
2022	625	0	95,711	96,336	49,700	49,700	46,636
2023	644	0	98,584	99,228	46,475	46,475	52,753
2024	663	0	101,538	102,201	46,495	46,495	55,706
2025	683	0	104,581	105,264	46,516	46,516	58,748
2026	704	0	107,722	108,426	46,538	46,538	61,888
2027	725	0	110,953	111,678	46,561	46,561	65,117
2028	747	0	114,283	115,030	46,585	46,585	68,445
2029	769	0	117,710	118,479	46,610	46,610	71,869
2030	396	0	60,691	61,087	23,318	23,318	37,769
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
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =				\$1,056,708	\$473,668	\$583,040	
				NPV = \$745,596	\$341,794	403,802	
Total NPV =	\$403,802						
Benefit/Cost Ratio =	<u>2.18</u>						

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

**Table 3
Societal Cost Test**

Project: **Commercial Demand Response Program**
 Program Years: **2020-2022**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2020	\$295	\$0	\$45,158	\$14,373	\$59,826	\$25,102	\$6,000	\$31,102	\$28,724
2021	607	0	92,919	30,461	123,987	49,768	6,000	55,768	68,219
2022	625	0	95,711	32,318	128,654	49,700	0	49,700	78,954
2023	644	0	98,584	34,286	133,514	46,475	0	46,475	87,039
2024	663	0	101,538	36,373	138,574	46,495	0	46,495	92,079
2025	683	0	104,581	38,587	143,851	46,516	0	46,516	97,335
2026	704	0	107,722	40,939	149,365	46,538	0	46,538	102,827
2027	725	0	110,953	43,431	155,109	46,561	0	46,561	108,548
2028	747	0	114,283	46,077	161,107	46,585	0	46,585	114,522
2029	769	0	117,710	48,882	167,361	46,610	0	46,610	120,751
2030	396	0	60,691	25,960	87,047	23,318	0	23,318	63,729
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
2038	0	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0	0
Total =					\$1,448,395			\$485,668	\$962,727
					NPV = \$1,235,595			\$420,688	814,907
Total NPV =	\$814,907								
Benefit/Cost Ratio =	<u>2.94</u>								

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

**Table 4
Participant Test**

Project: **Commercial Demand Response Program**
 Program Years: **2020-2022**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2020	\$0	\$0.09715	\$0.09517	10,000	0	10,000	\$972	400	0	\$2.919	\$60.610	\$1,168	\$2,100	\$4,240	\$6,000	\$0	\$6,000	(\$1,760)
2021	0	0.10153	0.09945	20,000	0	20,000	2,031	800	0	2.919	63.337	2,335	4,200	8,566	6,000	0	6,000	2,566
2022	0	0.10609	0.10393	20,000	0	20,000	2,122	800	0	2.919	66.188	2,335	4,200	8,657	0	0	0	8,657
2023	0	0.11087	0.10860	20,000	0	20,000	2,217	800	0	2.919	69.166	2,335	4,200	8,752	0	0	0	8,752
2024	0	0.11586	0.11349	20,000	0	20,000	2,317	800	0	2.919	72.279	2,335	4,200	8,852	0	0	0	8,852
2025	0	0.12107	0.11860	20,000	0	20,000	2,421	800	0	2.919	75.531	2,335	4,200	8,956	0	0	0	8,956
2026	0	0.12652	0.12393	20,000	0	20,000	2,530	800	0	2.919	78.930	2,335	4,200	9,065	0	0	0	9,065
2027	0	0.13221	0.12951	20,000	0	20,000	2,644	800	0	2.919	82.482	2,335	4,200	9,179	0	0	0	9,179
2028	0	0.13816	0.13534	20,000	0	20,000	2,763	800	0	2.919	86.194	2,335	4,200	9,298	0	0	0	9,298
2029	0	0.14438	0.14143	20,000	0	20,000	2,888	800	0	2.919	90.072	2,335	4,200	9,423	0	0	0	9,423
2030	0	0.15088	0.14779	10,000	0	10,000	1,509	400	0	2.919	94.125	1,168	2,100	4,777	0	0	0	4,777
2031	0	0.15767	0.15444	0	0	0	0	0	0	2.919	98.361	0	0	0	0	0	0	0
2032	0	0.16476	0.16139	0	0	0	0	0	0	2.919	102.787	0	0	0	0	0	0	0
2033	0	0.17218	0.16866	0	0	0	0	0	0	2.919	107.413	0	0	0	0	0	0	0
2034	0	0.17992	0.17625	0	0	0	0	0	0	2.919	112.246	0	0	0	0	0	0	0
2035	0	0.18802	0.18418	0	0	0	0	0	0	2.919	117.297	0	0	0	0	0	0	0
2036	0	0.19648	0.19247	0	0	0	0	0	0	2.919	122.576	0	0	0	0	0	0	0
2037	0	0.20532	0.20113	0	0	0	0	0	0	2.919	128.092	0	0	0	0	0	0	0
2038	0	0.21456	0.21018	0	0	0	0	0	0	2.919	133.856	0	0	0	0	0	0	0
2039	0	0.22422	0.21963	0	0	0	0	0	0	2.919	139.879	0	0	0	0	0	0	0
Total =				200,000	0			8,000	0					\$89,765			\$12,000	\$77,765
														NPV = \$56,657			\$11,439	45,219

Total NPV = \$45,219
 Benefit/Cost Ratio = 4.95

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

Table 5
Total Resource Cost Test

Company: **Commercial Demand Response Program**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2020	\$295	\$45,158	\$45,453	\$25,102	\$6,000	\$31,102	\$14,351
2021	607	92,919	93,526	49,768	6,000	55,768	37,758
2022	625	95,711	96,336	49,700	0	49,700	46,636
2023	644	98,584	99,228	46,475	0	46,475	52,753
2024	663	101,538	102,201	46,495	0	46,495	55,706
2025	683	104,581	105,264	46,516	0	46,516	58,748
2026	704	107,722	108,426	46,538	0	46,538	61,888
2027	725	110,953	111,678	46,561	0	46,561	65,117
2028	747	114,283	115,030	46,585	0	46,585	68,445
2029	769	117,710	118,479	46,610	0	46,610	71,869
2030	396	60,691	61,087	23,318	0	23,318	37,769
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
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =			\$1,056,708			\$485,668	\$571,040
NPV =			\$745,596			\$353,386	392,209

Total NPV = \$392,209
Benefit/Cost Ratio = 2.11

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

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

Company: **Montana-Dakota Utilities Co.**
 Project: **Interruptible Rate DR Program**
 Program Years: **2020-2022**

Input Data		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09800			
Retail Rate Winter (\$/kWh) =	\$0.08074			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.02538			
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) =	\$50.42			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$89.97			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.07001			
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 =	10.32%			
9) Utility Discount Rate =	7.30%			
10) Societal Discount Rate =	3.11%			
11) General Input Data Year =	2019			
12) Project Analysis Year 1 =	2020			
Project Analysis Year 2 =	2021			
Project Analysis Year 3 =	2022			
13) Utility Project Costs				
Admin & Promotion Costs =		\$4,730	\$6,659	\$6,488
Incentive Costs =		0	0	0
Total Utility Project Costs =		\$4,730	\$6,659	\$6,488
14) Direct Participant Costs (\$/Part.) =		\$0	\$0	\$0
Escalation Rate =		1.94%	1.94%	1.94%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		10	10	10
16) Avg Summer kW/part. Saved =		1,000.000	600.000	1,000.000
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		16,250	9,750	16,250
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		11.9000%	11.9000%	11.9000%
18b) System Energy Line Loss Factor		8.1730%	8.1730%	8.1730%
19) Number of Participants =		1	1	0
20) Incentive/Participant =		\$0	\$0	\$0
21) Effective Federal & State Income Tax Rate =				26.33%
22) Annual Summer Kwh Saved		16,250	9,750	0
Annual Winter Kwh Saved		0	0	0
23) Annual Summer KW Saved		1,000	600	0
Annual Winter KW Saved		0	0	0
Test Results		NPV	B/C	
Ratepayer Impact Measure Test		\$1,184,196	3.21	
Utility Cost Test		\$1,196,552	3.29	
Societal Test		\$2,170,176	4.28	
Participant Test		\$457,961	17.06	
Total Resource Cost Test		\$1,164,531	3.10	

**Table 1
Ratepayer Impact Test**

Project: **Interruptible Rate DR Program**
 Program Years: **2020-2022**

t	Year											Costs							Annual Benefits Less Costs (P)			
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)	Program Admin Costs (M)		Incentive Costs (N)	Total Project Costs (O)	
1	2020	17,578	\$0.03133	\$551	\$0.00000	\$0	1,119	0	1,119	\$115.92	\$129,714	\$130,265	\$0.07316	16,250	0	16,250	\$876	\$45,120	\$0	\$45,996	\$84,269	
2	2021	28,125	0.03227	908	0.00000	0	1,790	0	1,790	119.40	213,726	214,634	0.07645	26,000	0	26,000	1,464	72,192	0	73,656	140,978	
3	2022	28,125	0.03323	935	0.00000	0	1,790	0	1,790	122.98	220,134	221,069	0.07989	26,000	0	26,000	1,530	72,192	0	73,722	147,347	
4	2023	28,125	0.03423	963	0.00000	0	1,790	0	1,790	126.67	226,739	227,702	0.08349	26,000	0	26,000	1,599	72,192	0	73,791	153,911	
5	2024	28,125	0.03526	992	0.00000	0	1,790	0	1,790	130.47	233,541	234,533	0.08725	26,000	0	26,000	1,671	72,192	0	73,863	160,670	
6	2025	28,125	0.03632	1,022	0.00000	0	1,790	0	1,790	134.38	240,540	241,562	0.09117	26,000	0	26,000	1,746	72,192	0	73,938	167,624	
7	2026	28,125	0.03740	1,052	0.00000	0	1,790	0	1,790	138.41	247,754	248,806	0.09527	26,000	0	26,000	1,825	72,192	0	74,017	174,789	
8	2027	28,125	0.03853	1,084	0.00000	0	1,790	0	1,790	142.57	255,200	256,284	0.09956	26,000	0	26,000	1,907	72,192	0	74,099	182,185	
9	2028	28,125	0.03968	1,116	0.00000	0	1,790	0	1,790	146.84	262,844	263,960	0.10404	26,000	0	26,000	1,993	72,192	0	74,185	189,775	
10	2029	28,125	0.04087	1,149	0.00000	0	1,790	0	1,790	151.25	270,738	271,887	0.10872	26,000	0	26,000	2,082	72,192	0	74,274	197,613	
11	2030	10,547	0.04210	444	0.00000	0	671	0	671	155.79	104,535	104,979	0.11362	9,750	0	9,750	816	27,072	0	27,888	77,091	
12	2031	0	0.04336	0	0.00000	0	0	0	0	160.46	0	0	0.11873	0	0	0	0	0	0	0	0	
13	2032	0	0.04466	0	0.00000	0	0	0	0	165.27	0	0	0.12407	0	0	0	0	0	0	0	0	
14	2033	0	0.04600	0	0.00000	0	0	0	0	170.23	0	0	0.12965	0	0	0	0	0	0	0	0	
15	2034	0	0.04738	0	0.00000	0	0	0	0	175.34	0	0	0.13549	0	0	0	0	0	0	0	0	
16	2035	0	0.04880	0	0.00000	0	0	0	0	180.60	0	0	0.14159	0	0	0	0	0	0	0	0	
17	2036	0	0.05026	0	0.00000	0	0	0	0	186.02	0	0	0.14796	0	0	0	0	0	0	0	0	
18	2037	0	0.05177	0	0.00000	0	0	0	0	191.60	0	0	0.15462	0	0	0	0	0	0	0	0	
19	2038	0	0.05332	0	0.00000	0	0	0	0	197.35	0	0	0.16157	0	0	0	0	0	0	0	0	
20	2039	0	0.05492	0	0.00000	0	0	0	0	203.27	0	0	0.16884	0	0	0	0	0	0	0	0	
Total =		281,250							17,900			\$2,415,681			260,000					\$739,429	\$1,676,252	
												NPV = \$1,719,541									\$535,345	1,184,196
Total NPV =			\$1,184,196																			
Benefit/Cost Ratio =			<u>3.21</u>																			

Worksheet Calculations

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

**Table 2
Utility Test**

Project: **Interruptible Rate DR Program**
 Program Years: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2020	\$551	\$0	\$129,714	\$130,265	\$45,120	\$45,120	\$85,145
2021	908	0	213,726	214,634	72,192	72,192	142,442
2022	935	0	220,134	221,069	72,192	72,192	148,877
2023	963	0	226,739	227,702	72,192	72,192	155,510
2024	992	0	233,541	234,533	72,192	72,192	162,341
2025	1,022	0	240,540	241,562	72,192	72,192	169,370
2026	1,052	0	247,754	248,806	72,192	72,192	176,614
2027	1,084	0	255,200	256,284	72,192	72,192	184,092
2028	1,116	0	262,844	263,960	72,192	72,192	191,768
2029	1,149	0	270,738	271,887	72,192	72,192	199,695
2030	444	0	104,535	104,979	27,072	27,072	77,907
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
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =				\$2,415,681		\$721,920	\$1,693,761
				NPV = \$1,719,541		\$522,989	1,196,552
Total NPV =		\$1,196,552					
Benefit/Cost Ratio =		<u>3.29</u>					

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

**Table 3
Societal Cost Test**

Project: **Interruptible Rate DR Program**
 Program Years: **2020-2022**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2020	\$551	\$0	\$129,714	\$41,191	\$171,456	\$45,120	\$2,763	\$47,883	\$123,573
2021	908	0	213,726	69,905	284,539	72,192	4,420	76,612	207,927
2022	935	0	220,134	74,161	295,230	72,192	4,420	76,612	218,618
2023	963	0	226,739	78,678	306,380	72,192	4,420	76,612	229,768
2024	992	0	233,541	83,470	318,003	72,192	4,420	76,612	241,391
2025	1,022	0	240,540	88,550	330,112	72,192	4,420	76,612	253,500
2026	1,052	0	247,754	93,942	342,748	72,192	4,420	76,612	266,136
2027	1,084	0	255,200	99,668	355,952	72,192	4,420	76,612	279,340
2028	1,116	0	262,844	105,733	369,693	72,192	4,420	76,612	293,081
2029	1,149	0	270,738	112,176	384,063	72,192	4,420	76,612	307,451
2030	444	0	104,535	44,612	149,591	27,072	1,658	28,730	120,861
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
2038	0	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0	0
Total =					\$3,307,767			\$766,121	\$2,541,646
					NPV = \$2,832,671			\$662,495	2,170,176
Total NPV =		\$2,170,176							
Benefit/Cost Ratio =		<u>4.28</u>							

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

**Table 4
Participant Test**

Project: **Interruptible Rate DR Program**
 Program Years: **2020-2022**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2020	\$0	\$0.10241	\$0.08437	16,250	0	16,250	\$1,664	1,000	0	\$52,689	\$94,017	\$45,120	\$0	\$46,784	\$2,763	\$0	\$2,763	\$44,021
2021	0	0.10702	0.08817	26,000	0	26,000	2,783	1,600	0	55,060	98,247	72,192	0	74,975	4,420	0	4,420	70,555
2022	0	0.11183	0.09214	26,000	0	26,000	2,908	1,600	0	57,538	102,668	72,192	0	75,100	4,420	0	4,420	70,680
2023	0	0.11687	0.09628	26,000	0	26,000	3,039	1,600	0	60,127	107,289	72,192	0	75,231	4,420	0	4,420	70,811
2024	0	0.12213	0.10062	26,000	0	26,000	3,175	1,600	0	62,832	112,116	72,192	0	75,367	4,420	0	4,420	70,947
2025	0	0.12762	0.10514	26,000	0	26,000	3,318	1,600	0	65,660	117,162	72,192	0	75,510	4,420	0	4,420	71,090
2026	0	0.13336	0.10988	26,000	0	26,000	3,467	1,600	0	68,615	122,434	72,192	0	75,659	4,420	0	4,420	71,239
2027	0	0.13937	0.11482	26,000	0	26,000	3,624	1,600	0	71,702	127,944	72,192	0	75,816	4,420	0	4,420	71,396
2028	0	0.14564	0.11999	26,000	0	26,000	3,787	1,600	0	74,929	133,701	72,192	0	75,979	4,420	0	4,420	71,559
2029	0	0.15219	0.12539	26,000	0	26,000	3,957	1,600	0	78,301	139,718	72,192	0	76,149	4,420	0	4,420	71,729
2030	0	0.15904	0.13103	9,750	0	9,750	1,551	600	0	81,824	146,005	27,072	0	28,623	1,658	0	1,658	26,965
2031	0	0.16620	0.13693	0	0	0	0	0	0	85,506	152,575	0	0	0	0	0	0	0
2032	0	0.17368	0.14309	0	0	0	0	0	0	89,354	159,441	0	0	0	0	0	0	0
2033	0	0.18149	0.14953	0	0	0	0	0	0	93,375	166,616	0	0	0	0	0	0	0
2034	0	0.18966	0.15625	0	0	0	0	0	0	97,577	174,113	0	0	0	0	0	0	0
2035	0	0.19819	0.16329	0	0	0	0	0	0	101,968	181,949	0	0	0	0	0	0	0
2036	0	0.20711	0.17063	0	0	0	0	0	0	106,556	190,136	0	0	0	0	0	0	0
2037	0	0.21643	0.17831	0	0	0	0	0	0	111,351	198,692	0	0	0	0	0	0	0
2038	0	0.22617	0.18634	0	0	0	0	0	0	116,362	207,634	0	0	0	0	0	0	0
2039	0	0.23635	0.19472	0	0	0	0	0	0	121,599	216,977	0	0	0	0	0	0	0
Total =				260,000	0			16,000	0					\$755,193			\$44,201	\$710,992
														NPV = \$486,479			\$28,518	457,961

Total NPV = \$457,961
 Benefit/Cost Ratio = 17.06

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

**Table 5
Total Resource Cost Test**

Company: **Interruptible Rate DR Program**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2020	\$551	\$129,714	\$130,265	\$45,120	\$2,763	\$47,883	\$82,382
2021	908	213,726	214,634	72,192	4,420	76,612	138,022
2022	935	220,134	221,069	72,192	4,420	76,612	144,457
2023	963	226,739	227,702	72,192	4,420	76,612	151,090
2024	992	233,541	234,533	72,192	4,420	76,612	157,921
2025	1,022	240,540	241,562	72,192	4,420	76,612	164,950
2026	1,052	247,754	248,806	72,192	4,420	76,612	172,194
2027	1,084	255,200	256,284	72,192	4,420	76,612	179,672
2028	1,116	262,844	263,960	72,192	4,420	76,612	187,348
2029	1,149	270,738	271,887	72,192	4,420	76,612	195,275
2030	444	104,535	104,979	27,072	1,658	28,730	76,249
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
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =			\$2,415,681			\$766,121	\$1,649,560
NPV =			\$1,719,541			\$555,010	1,164,531

Total NPV = \$1,164,531
Benefit/Cost Ratio = 3.10

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: **2020-2022**

Input Data		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.08927			
Retail Rate Winter (\$/kWh) =	\$0.08074			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.02521			
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) =	\$51.05			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$78.02			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.05843			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.32%			
9) Utility Discount Rate =	7.36%			
10) Societal Discount Rate =	3.11%			
11) General Input Data Year =	2019			
12) Project Analysis Year 1 =	2020			
Project Analysis Year 2 =	2021			
Project Analysis Year 3 =	2022			
13) Utility Project Costs				
Admin & Promotion Costs =		\$68,112	\$59,932	\$58,394
Incentive Costs =		0	0	0
Total Utility Project Costs =		\$68,112	\$59,932	\$58,394
14) Direct Participant Costs (\$/Part.) =		\$0	\$0	\$0
Escalation Rate =		1.94%	1.94%	1.94%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		10	10	10
16) Avg Summer kW/part. Saved =		1,000,000	1,000,000	1,000,000
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		16,250	16,250	16,250
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		11.9000%	11.9000%	11.9000%
18b) System Energy Line Loss Factor		8.1730%	8.1730%	8.1730%
19) Number of Participants =		0	0	0
20) Incentive/Participant =		\$0	\$0	\$0
21) Effective Federal & State Income Tax Rate =				26.33%
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		\$7,699,387	2.59	
Utility Cost Test		\$7,812,888	2.65	
Societal Test		\$14,250,083	3.54	
Participant Test		\$4,188,583	43.06	
Total Resource Cost Test		\$7,703,303	2.59	

**Table 2
Utility Test**

Project: **Interruptible Rate DR Program**
 Program Years: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
2020	\$9,160	\$0	\$1,624,251	\$1,633,411	\$686,703	\$686,703	\$946,708
2021	9,435	0	1,672,914	1,682,349	686,703	686,703	995,646
2022	9,718	0	1,723,188	1,732,906	686,703	686,703	1,046,203
2023	10,010	0	1,774,913	1,784,923	686,703	686,703	1,098,220
2024	10,310	0	1,828,088	1,838,398	686,703	686,703	1,151,695
2025	10,619	0	1,882,874	1,893,493	686,703	686,703	1,206,790
2026	10,938	0	1,939,433	1,950,371	686,703	686,703	1,263,668
2027	11,266	0	1,997,603	2,008,869	686,703	686,703	1,322,166
2028	11,604	0	2,057,546	2,069,150	686,703	686,703	1,382,447
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
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =				\$16,593,870	\$6,180,327	\$6,180,327	\$10,413,543
				NPV = \$12,553,476	\$4,740,588	\$4,740,588	7,812,888
Total NPV =				\$7,812,888			
Benefit/Cost Ratio =				<u>2.65</u>			

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

**Table 3
Societal Cost Test**

Project: **Interruptible Rate DR Program**
 Program Years: **2020-2022**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
2020	\$9,160	\$0	\$1,624,251	\$516,501	\$2,149,912	\$686,703	\$15,874	\$702,577	\$1,447,335
2021	9,435	0	1,672,914	547,935	2,230,284	686,703	15,874	702,577	1,527,707
2022	9,718	0	1,723,188	581,333	2,314,239	686,703	15,874	702,577	1,611,662
2023	10,010	0	1,774,913	616,747	2,401,670	686,703	15,874	702,577	1,699,093
2024	10,310	0	1,828,088	654,281	2,492,679	686,703	15,874	702,577	1,790,102
2025	10,619	0	1,882,874	694,105	2,587,598	686,703	15,874	702,577	1,885,021
2026	10,938	0	1,939,433	736,404	2,686,775	686,703	15,874	702,577	1,984,198
2027	11,266	0	1,997,603	781,246	2,790,115	686,703	15,874	702,577	2,087,538
2028	11,604	0	2,057,546	828,830	2,897,980	686,703	15,874	702,577	2,195,403
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
2038	0	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0	0
Total =					\$22,551,252		\$6,323,193	\$16,228,059	
					NPV = \$19,861,729		\$5,611,646	14,250,083	
Total NPV =		\$14,250,083							
Benefit/Cost Ratio =		3.54							

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: **2020-2022**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2020	\$0	\$0.09329	\$0.08437	310,875	0	310,875	\$29,002	14,400	0	\$53.349	\$81.527	\$649,728	\$0	\$678,730	\$15,874	\$0	\$15,874	\$662,856
2021	0	0.09749	0.08817	310,875	0	310,875	30,307	14,400	0	55.750	85.195	\$649,728	0	680,035	15,874	0	15,874	664,161
2022	0	0.10187	0.09214	310,875	0	310,875	31,669	14,400	0	58.259	89.029	\$649,728	0	681,397	15,874	0	15,874	665,523
2023	0	0.10646	0.09628	310,875	0	310,875	33,096	14,400	0	60.880	93.036	\$649,728	0	682,824	15,874	0	15,874	666,950
2024	0	0.11125	0.10062	310,875	0	310,875	34,585	14,400	0	63.620	97.222	\$649,728	0	684,313	15,874	0	15,874	668,439
2025	0	0.11625	0.10514	310,875	0	310,875	36,139	14,400	0	66.483	101.597	\$649,728	0	685,867	15,874	0	15,874	669,993
2026	0	0.12148	0.10988	310,875	0	310,875	37,765	14,400	0	69.475	106.169	\$649,728	0	687,493	15,874	0	15,874	671,619
2027	0	0.12695	0.11482	310,875	0	310,875	39,466	14,400	0	72.601	110.947	\$649,728	0	689,194	15,874	0	15,874	673,320
2028	0	0.13266	0.11999	310,875	0	310,875	41,241	14,400	0	75.868	115.939	\$649,728	0	690,969	15,874	0	15,874	675,095
2029	0	0.13863	0.12539	0	0	0	0	0	0	79.282	121.156	0	0	0	0	0	0	0
2030	0	0.14487	0.13103	0	0	0	0	0	0	82.850	126.609	0	0	0	0	0	0	0
2031	0	0.15139	0.13693	0	0	0	0	0	0	86.578	132.306	0	0	0	0	0	0	0
2032	0	0.15820	0.14309	0	0	0	0	0	0	90.474	138.260	0	0	0	0	0	0	0
2033	0	0.16532	0.14953	0	0	0	0	0	0	94.545	144.481	0	0	0	0	0	0	0
2034	0	0.17276	0.15625	0	0	0	0	0	0	98.800	150.983	0	0	0	0	0	0	0
2035	0	0.18054	0.16329	0	0	0	0	0	0	103.246	157.777	0	0	0	0	0	0	0
2036	0	0.18866	0.17063	0	0	0	0	0	0	107.892	164.877	0	0	0	0	0	0	0
2037	0	0.19715	0.17831	0	0	0	0	0	0	112.747	172.297	0	0	0	0	0	0	0
2038	0	0.20602	0.18634	0	0	0	0	0	0	117.821	180.050	0	0	0	0	0	0	0
2039	0	0.21529	0.19472	0	0	0	0	0	0	123.123	188.152	0	0	0	0	0	0	0
Total =				2,797,875	0			129,600	0					\$6,160,822			\$142,866	\$6,017,956
														NPV = \$4,288,166			\$99,583	4,188,583

Total NPV = #####
 Benefit/Cost Ratio = 43.06

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

Table 5
Total Resource Cost Test

Company: **Interruptible Rate DR Program**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
2020	\$9,160	\$1,624,251	\$1,633,411	\$686,703	\$15,874	\$702,577	\$930,834
2021	9,435	1,672,914	1,682,349	686,703	15,874	702,577	979,772
2022	9,718	1,723,188	1,732,906	686,703	15,874	702,577	1,030,329
2023	10,010	1,774,913	1,784,923	686,703	15,874	702,577	1,082,346
2024	10,310	1,828,088	1,838,398	686,703	15,874	702,577	1,135,821
2025	10,619	1,882,874	1,893,493	686,703	15,874	702,577	1,190,916
2026	10,938	1,939,433	1,950,371	686,703	15,874	702,577	1,247,794
2027	11,266	1,997,603	2,008,869	686,703	15,874	702,577	1,306,292
2028	11,604	2,057,546	2,069,150	686,703	15,874	702,577	1,366,573
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
2038	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0
Total =			\$16,593,870		\$6,323,193	\$10,270,677	
NPV =			\$12,553,476		\$4,850,173	7,703,303	
Total NPV =			\$7,703,303				
Benefit/Cost Ratio =			<u>2.59</u>				

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

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

Company: **Montana-Dakota Utilities Co.**
 Project: **Interruptible Rate DR Program**
 Program Years: **2020-2022**

Input Data		First Year	Second Year	Third Year
1) Retail Rate Summer (\$/kWh) =	\$0.09297			
Retail Rate Winter (\$/kWh) =	\$0.09107			
Retail Escalation Rate =	4.50%			
1a) Power Supply Cost Adjustment	\$0.02524			
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) =	\$33.00			
3a) Retail Winter Demand Rate (\$/kW/season) =	\$58.00			
Escalation Rate =	4.50%			
4) Electric Margin (\$/kWh) =	\$0.02524			
Escalation Rate =	4.50%			
5) System Peak Shaving Demand Cost (\$/kW/yr)	\$85.62			
Reserve Capacity=	14.3%			
Escalation Rate =	3.00%			
6) System Variable O&M (\$/kWh) =	\$0.00000			
Escalation Rate =	0.00%			
7) Environmental Damage Factor =	31%			
Escalation Rate =	3.00%			
8) Participant Discount Rate =	10.32%			
9) Utility Discount Rate =	7.22%			
10) Societal Discount Rate =	3.11%			
11) General Input Data Year =	2019			
12) Project Analysis Year 1 =	2020			
Project Analysis Year 2 =	2021			
Project Analysis Year 3 =	2022			
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 =		1.94%	1.94%	1.94%
14a) Other Participant Costs (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0.00%	0.00%	0.00%
14b) Other Participant Savings (Annual \$/Part.) =		\$0	\$0	\$0
Escalation Rate =		0%	0%	0%
15) Project Life (Years) =		0	0	0
16) Avg Summer kW/part. Saved =		0.000	0.000	0.000
16a) Avg Winter kW/part Saved =		0.000	0.000	0.000
17) Avg. Summer kWh/Part. Saved =		0	0	0
17a) Avg. Winter kWh/Part. Saved =		0	0	0
18a) System Demand Line Loss Factor		11.9000%	11.9000%	11.9000%
18b) System Energy Line Loss Factor		8.1730%	8.1730%	8.1730%
19) Number of Participants =		0	0	0
20) Incentive/Participant =		\$0	\$0	\$0
21) Effective Federal & State Income Tax Rate =				26.33%
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: **2020-2022**

t	Year	Benefits										Costs					Annual Benefits Less Costs (P)					
		Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)		Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	
1	2020	0	\$0.02724	\$0	0.00000	\$0	0	0	0	\$100.80	\$0	\$0	\$0.02638	0	0	0	\$0	\$0	\$0	\$0	\$0	\$0
2	2021	0	0.02806	0	0.00000	0	0	0	0	103.82	0	0	0.02756	0	0	0	0	0	0	0	0	0
3	2022	0	0.02890	0	0.00000	0	0	0	0	106.94	0	0	0.02880	0	0	0	0	0	0	0	0	0
4	2023	0	0.02977	0	0.00000	0	0	0	0	110.15	0	0	0.03010	0	0	0	0	0	0	0	0	0
5	2024	0	0.03066	0	0.00000	0	0	0	0	113.45	0	0	0.03145	0	0	0	0	0	0	0	0	0
6	2025	0	0.03158	0	0.00000	0	0	0	0	116.85	0	0	0.03287	0	0	0	0	0	0	0	0	0
7	2026	0	0.03253	0	0.00000	0	0	0	0	120.36	0	0	0.03435	0	0	0	0	0	0	0	0	0
8	2027	0	0.03350	0	0.00000	0	0	0	0	123.97	0	0	0.03589	0	0	0	0	0	0	0	0	0
9	2028	0	0.03451	0	0.00000	0	0	0	0	127.69	0	0	0.03751	0	0	0	0	0	0	0	0	0
10	2029	0	0.03554	0	0.00000	0	0	0	0	131.52	0	0	0.03920	0	0	0	0	0	0	0	0	0
11	2030	0	0.03661	0	0.00000	0	0	0	0	135.47	0	0	0.04096	0	0	0	0	0	0	0	0	0
12	2031	0	0.03771	0	0.00000	0	0	0	0	139.53	0	0	0.04280	0	0	0	0	0	0	0	0	0
13	2032	0	0.03884	0	0.00000	0	0	0	0	143.72	0	0	0.04473	0	0	0	0	0	0	0	0	0
14	2033	0	0.04001	0	0.00000	0	0	0	0	148.03	0	0	0.04674	0	0	0	0	0	0	0	0	0
15	2034	0	0.04121	0	0.00000	0	0	0	0	152.47	0	0	0.04885	0	0	0	0	0	0	0	0	0
16	2035	0	0.04245	0	0.00000	0	0	0	0	157.04	0	0	0.05104	0	0	0	0	0	0	0	0	0
17	2036	0	0.04372	0	0.00000	0	0	0	0	161.75	0	0	0.05334	0	0	0	0	0	0	0	0	0
18	2037	0	0.04503	0	0.00000	0	0	0	0	166.61	0	0	0.05574	0	0	0	0	0	0	0	0	0
19	2038	0	0.04638	0	0.00000	0	0	0	0	171.60	0	0	0.05825	0	0	0	0	0	0	0	0	0
20	2039	0	0.04777	0	0.00000	0	0	0	0	203.27	0	0	0.06087	0	0	0	0	0	0	0	0	0

Total = 0 NPV = \$0

Total NPV = \$0
 Benefit/Cost Ratio = #DIV/0!

Worksheet Calculations

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

**Table 2
Utility Test**

Project: **Interruptible Rate DR Program**
 Program Years: **2020-2022**

Year	Benefits				Costs		Annual Benefits Less Costs (G)
	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	
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
2038	0	0	0	0	0	0	0
2039	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: **2020-2022**

Year	Benefits					Costs			Annual Benefits Less Costs (I)
	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	
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
2038	0	0	0	0	0	0	0	0	0
2039	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: **2020-2022**

Year	Benefits														Costs			Annual Benefits Less Costs (P)
	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	
2020	\$0	\$0.09715	\$0.09517	0	0	0	\$0	0	0	\$34.485	\$60.610	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2021	0	0.10153	0.09945	0	0	0	0	0	0	36.037	63.337	0	0	0	0	0	0	0
2022	0	0.10609	0.10393	0	0	0	0	0	0	37.658	66.188	0	0	0	0	0	0	0
2023	0	0.11087	0.10860	0	0	0	0	0	0	39.353	69.166	0	0	0	0	0	0	0
2024	0	0.11586	0.11349	0	0	0	0	0	0	41.124	72.279	0	0	0	0	0	0	0
2025	0	0.12107	0.11860	0	0	0	0	0	0	42.975	75.531	0	0	0	0	0	0	0
2026	0	0.12652	0.12393	0	0	0	0	0	0	44.908	78.930	0	0	0	0	0	0	0
2027	0	0.13221	0.12951	0	0	0	0	0	0	46.929	82.482	0	0	0	0	0	0	0
2028	0	0.13816	0.13534	0	0	0	0	0	0	49.041	86.194	0	0	0	0	0	0	0
2029	0	0.14438	0.14143	0	0	0	0	0	0	51.248	90.072	0	0	0	0	0	0	0
2030	0	0.15088	0.14779	0	0	0	0	0	0	53.554	94.125	0	0	0	0	0	0	0
2031	0	0.15767	0.15444	0	0	0	0	0	0	55.964	98.361	0	0	0	0	0	0	0
2032	0	0.16476	0.16139	0	0	0	0	0	0	58.482	102.787	0	0	0	0	0	0	0
2033	0	0.17218	0.16866	0	0	0	0	0	0	61.114	107.413	0	0	0	0	0	0	0
2034	0	0.17992	0.17625	0	0	0	0	0	0	63.864	112.246	0	0	0	0	0	0	0
2035	0	0.18802	0.18418	0	0	0	0	0	0	66.738	117.297	0	0	0	0	0	0	0
2036	0	0.19648	0.19247	0	0	0	0	0	0	69.741	122.576	0	0	0	0	0	0	0
2037	0	0.20532	0.20113	0	0	0	0	0	0	72.880	128.092	0	0	0	0	0	0	0
2038	0	0.21456	0.21018	0	0	0	0	0	0	76.159	133.856	0	0	0	0	0	0	0
2039	0	0.22422	0.21963	0	0	0	0	0	0	79.587	139.879	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)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(D) = Table 1 (K)	(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(E) = [Retail Rate (B) or (C)] x (D)	(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(O) = (L) + (M)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)	(P) = (K) - (N)
(H) = Retail Summer Demand Rate, escalated.	

Table 5
Total Resource Cost Test

Company: **Interruptible Rate DR Program**
Project: **2020-2022**

Year	Benefits			Costs			Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	
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
2038	0	0	0	0	0	0	0
2039	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)