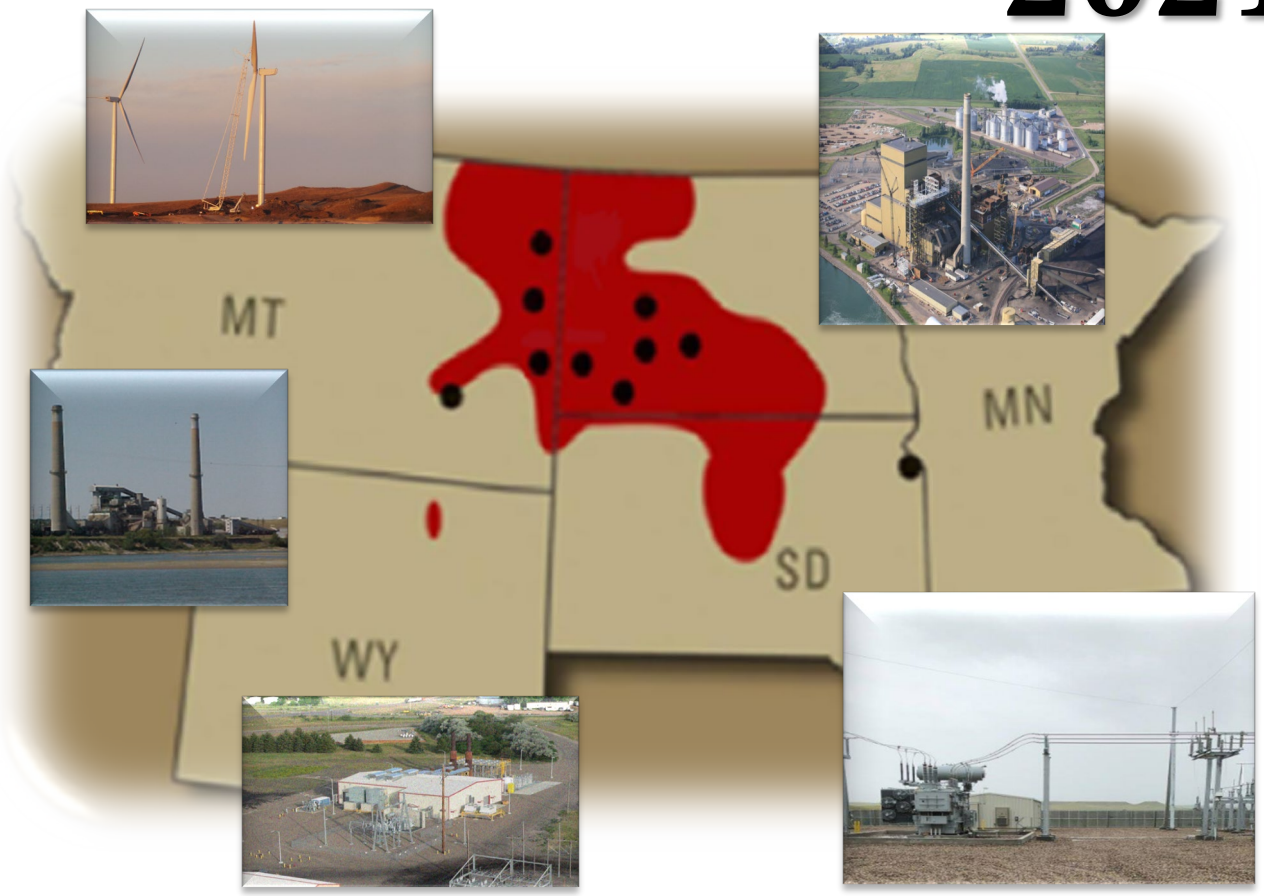
Integrated Resource Plan 2021



Submitted to the
North Dakota Public Service Commission
July 1, 2021

Volume III: Attachment B

Montana-Dakota Utilities Co.

2021 Integrated Resource Plan

Submitted to the North Dakota Public Service Commission

July 1, 2021

Volume III

Attachment B

MONTANA-DAKOTA UTILITIES CO.

A Subsidiary of MDU Resources Group, Inc.

Attachment B

DEMAND-SIDE ANALYSIS DOCUMENTATION

Demand-Side Analysis

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DEMAND-SIDE ANALYSIS

Overview

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

Montana-Dakota's 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 2021 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 0.34 percent of annual energy sales (MWh) and 1.78% of demand (MW) savings in 2040.

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

The Montana service territory achievable potential identified in the Nexant Study was used as a basis to project the savings that could be achievable in North Dakota. The achievable potential is estimated to be 0.38 percent of energy sales in North Dakota over the IRP planning period. Table B-2 below contains the estimated achievable potential for the North Dakota service territory.

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

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

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

YEAR	Residential Sales (MWh)	Achievable EE %	Achievable MWh	Small C&I Sales (MWh)	Achievable EE %	Achievable MWh	Large C&I Sales (MWh)	Achievable EE %	Achievable MWh	Street Lighting Sales (MWh)	Achievable EE %	Miscellaneous Sales (MWh)	Achievable EE %	Total Sales Sales (MWh)	Achievable EE %	Achievable MWh
2021	182,940	0.05%	91	135,502	0.05%	68	473,461	0.05%	237	3,049	0.00%	6,146	0.00%	801,097	0.05%	396
2022	182,940	0.10%	183	137,702	0.10%	138	519,099	0.10%	519	3,049	0.00%	6,134	0.00%	848,924	0.10%	840
2023	182,940	0.10%	183	139,950	0.10%	140	538,543	0.10%	539	3,049	0.00%	6,121	0.00%	870,603	0.10%	861
2024	182,940	0.20%	366	142,180	0.20%	284	552,244	0.10%	552	3,049	0.00%	6,109	0.00%	886,521	0.14%	1,202
2025	182,940	0.20%	366	144,350	0.20%	289	559,081	0.20%	1,118	3,049	0.00%	6,096	0.00%	895,516	0.20%	1,773
2026	182,940	0.20%	366	146,317	0.20%	293	560,017	0.20%	1,120	3,049	0.00%	6,084	0.00%	898,407	0.20%	1,779
2027	182,940	0.30%	549	148,492	0.20%	297	561,652	0.20%	1,123	3,049	0.00%	6,071	0.00%	902,203	0.22%	1,969
2028	182,940	0.30%	549	150,607	0.30%	452	563,286	0.30%	1,690	3,049	0.00%	6,059	0.00%	905,941	0.30%	2,690
2029	182,940	0.30%	549	152,664	0.30%	458	564,920	0.30%	1,695	3,049	0.00%	6,047	0.00%	909,619	0.30%	2,702
2030	182,940	0.30%	549	154,731	0.30%	464	566,553	0.30%	1,700	3,049	0.00%	6,034	0.00%	913,307	0.30%	2,713
2031	182,940	0.30%	549	156,791	0.30%	470	568,187	0.30%	1,705	3,049	0.00%	6,022	0.00%	916,988	0.30%	2,724
2032	182,940	0.30%	549	158,817	0.30%	476	569,821	0.30%	1,709	3,049	0.00%	6,009	0.00%	920,635	0.30%	2,735
2033	182,940	0.30%	549	160,818	0.30%	482	571,454	0.30%	1,714	3,049	0.00%	5,997	0.00%	924,257	0.30%	2,746
2034	182,940	0.30%	549	162,818	0.30%	488	573,087	0.30%	1,719	3,049	0.00%	5,985	0.00%	927,879	0.30%	2,757
2035	182,940	0.30%	549	164,796	0.30%	494	574,720	0.30%	1,724	3,049	0.00%	5,972	0.00%	931,477	0.30%	2,767
2036	182,940	0.30%	549	166,733	0.30%	500	576,353	0.30%	1,729	3,049	0.00%	5,960	0.00%	935,035	0.30%	2,778
2037	182,940	0.30%	549	168,696	0.30%	506	577,986	0.30%	1,734	3,049	0.00%	5,947	0.00%	938,618	0.30%	2,789
2038	182,940	0.30%	549	170,648	0.30%	512	579,619	0.30%	1,739	3,049	0.00%	5,935	0.00%	942,190	0.30%	2,800
2039	182,940	0.30%	549	172,560	0.30%	518	581,261	0.30%	1,744	3,049	0.00%	5,922	0.00%	945,732	0.30%	2,810
2040	182,940	0.30%	549	174,495	0.30%	523	582,903	0.30%	1,749	3,049	0.00%	5,910	0.00%	949,296	0.30%	2,821
Cumulative														**18,164,246**	**0.25%**	**44,651**

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

YEAR	Residential Sales (MWh)	Achievable EE %	Achievable MWh	Small C&I Sales (MWh)	Achievable EE %	Achievable MWh	Large C&I Sales (MWh)	Achievable EE %	Achievable MWh	Street Lighting Sales (MWh)	Achievable EE %	Miscellaneous Sales (MWh)	Achievable EE %	Total Sales Sales (MWh)	Achievable EE %	Achievable MWh
2021	774,857	0.10%	775	594,489	0.10%	594	708,604	0.10%	709	14,499	0.00%	58,463	0.00%	2,150,912	0.10%	2,078
2022	777,307	0.15%	1,166	604,883	0.15%	907	708,351	0.15%	1,063	14,499	0.00%	59,563	0.00%	2,164,604	0.14%	3,136
2023	782,746	0.15%	1,174	615,577	0.15%	923	712,881	0.15%	1,069	14,499	0.00%	60,664	0.00%	2,186,367	0.14%	3,167
2024	788,185	0.20%	1,576	625,626	0.20%	1,251	735,185	0.20%	1,470	14,499	0.00%	60,803	0.00%	2,224,298	0.19%	4,298
2025	793,624	0.20%	1,587	636,312	0.20%	1,273	758,430	0.20%	1,517	14,499	0.00%	60,943	0.00%	2,263,808	0.19%	4,377
2026	796,074	0.30%	2,388	646,320	0.30%	1,939	764,433	0.30%	2,293	14,499	0.00%	61,083	0.00%	2,282,410	0.29%	6,620
2027	798,524	0.30%	2,396	656,991	0.30%	1,971	771,404	0.30%	2,314	14,499	0.00%	61,223	0.00%	2,302,641	0.29%	6,681
2028	800,974	0.40%	3,204	666,954	0.40%	2,668	777,529	0.40%	3,110	14,499	0.00%	61,363	0.00%	2,321,319	0.39%	8,982
2029	803,424	0.40%	3,214	677,603	0.40%	2,710	784,653	0.40%	3,139	14,499	0.00%	61,504	0.00%	2,341,683	0.39%	9,063
2030	805,874	0.50%	4,029	688,257	0.50%	3,441	791,862	0.50%	3,959	14,499	0.00%	61,646	0.00%	2,362,138	0.48%	11,430
2031	808,324	0.50%	4,042	698,910	0.50%	3,495	799,156	0.50%	3,996	14,499	0.00%	61,787	0.00%	2,382,677	0.48%	11,532
2032	810,774	0.50%	4,054	709,562	0.50%	3,548	806,538	0.50%	4,033	14,499	0.00%	61,929	0.00%	2,403,302	0.48%	11,634
2033	813,224	0.50%	4,066	720,213	0.50%	3,601	814,008	0.50%	4,070	14,499	0.00%	62,072	0.00%	2,424,016	0.48%	11,737
2034	815,674	0.50%	4,078	730,863	0.50%	3,654	821,566	0.50%	4,108	14,499	0.00%	62,214	0.00%	2,444,817	0.48%	11,841
2035	818,124	0.50%	4,091	741,507	0.50%	3,708	829,215	0.50%	4,146	14,499	0.00%	62,358	0.00%	2,465,703	0.48%	11,944
2036	820,574	0.50%	4,103	752,155	0.50%	3,761	836,955	0.50%	4,185	14,499	0.00%	62,501	0.00%	2,486,684	0.48%	12,048
2037	823,024	0.50%	4,115	762,802	0.50%	3,814	844,786	0.50%	4,224	14,499	0.00%	62,645	0.00%	2,507,756	0.48%	12,153
2038	825,474	0.50%	4,127	773,448	0.50%	3,867	852,712	0.50%	4,264	14,499	0.00%	62,789	0.00%	2,528,921	0.48%	12,258
2039	827,924	0.50%	4,140	784,174	0.50%	3,921	860,817	0.50%	4,304	14,499	0.00%	62,933	0.00%	2,550,347	0.48%	12,365
2040	830,374	0.50%	4,152	794,900	0.50%	3,975	869,019	0.50%	4,345	14,499	0.00%	63,078	0.00%	2,571,870	0.48%	12,471
Cumulative														**47,366,274**	**0.38%**	**179,815**

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

YEAR	Residential Sales (MWh)	Achievable EE %	Achievable MWh	Small C&I Sales (MWh)	Achievable EE %	Achievable MWh	Large C&I Sales (MWh)	Achievable EE %	Achievable MWh	Street Lighting Sales (MWh)	Achievable EE %	Miscellaneous Sales (MWh)	Achievable EE %	Total Sales Sales (MWh)	Achievable EE %	Achievable MWh
2021	67,970	0.05%	34	39,999	0.05%	20	38,183	0.05%	19	1,257	0.00%	1,851	0.00%	149,260	0.05%	73
2022	67,991	0.10%	68	40,311	0.10%	40	38,848	0.10%	39	1,257	0.00%	1,851	0.00%	150,259	0.10%	147
2023	68,004	0.10%	68	40,667	0.10%	41	39,485	0.10%	39	1,257	0.00%	1,851	0.00%	151,264	0.10%	148
2024	68,008	0.20%	136	41,025	0.20%	82	40,174	0.10%	40	1,257	0.00%	1,851	0.00%	152,315	0.17%	258
2025	68,008	0.20%	136	41,387	0.20%	83	40,875	0.20%	82	1,257	0.00%	1,851	0.00%	153,377	0.20%	301
2026	68,003	0.20%	136	41,709	0.20%	83	41,545	0.20%	83	1,257	0.00%	1,851	0.00%	154,365	0.20%	303
2027	67,994	0.30%	204	42,077	0.20%	84	42,269	0.20%	85	1,257	0.00%	1,851	0.00%	155,448	0.24%	373
2028	67,979	0.30%	204	42,448	0.30%	127	43,006	0.30%	129	1,257	0.00%	1,851	0.00%	156,540	0.29%	460
2029	67,961	0.30%	204	42,822	0.30%	128	43,756	0.30%	131	1,257	0.00%	1,851	0.00%	157,646	0.29%	464
2030	67,939	0.30%	204	43,199	0.30%	130	44,519	0.30%	134	1,257	0.00%	1,851	0.00%	158,765	0.29%	467
2031	67,916	0.30%	204	43,580	0.30%	131	45,295	0.30%	136	1,257	0.00%	1,851	0.00%	159,899	0.29%	470
2032	67,888	0.30%	204	43,964	0.30%	132	46,085	0.30%	138	1,257	0.00%	1,851	0.00%	161,045	0.29%	474
2033	67,857	0.30%	204	44,352	0.30%	133	46,888	0.30%	141	1,257	0.00%	1,851	0.00%	162,205	0.29%	477
2034	67,826	0.30%	203	44,743	0.30%	134	47,706	0.30%	143	1,257	0.00%	1,851	0.00%	163,382	0.29%	481
2035	67,791	0.30%	203	45,137	0.30%	135	48,537	0.30%	146	1,257	0.00%	1,851	0.00%	164,573	0.29%	484
2036	67,756	0.30%	203	45,535	0.30%	137	49,383	0.30%	148	1,257	0.00%	1,851	0.00%	165,782	0.29%	488
2037	67,721	0.30%	203	45,936	0.30%	138	50,244	0.30%	151	1,257	0.00%	1,851	0.00%	167,009	0.29%	492
2038	67,683	0.30%	203	46,341	0.30%	139	51,120	0.30%	153	1,257	0.00%	1,851	0.00%	168,252	0.29%	495
2039	67,645	0.30%	203	46,751	0.30%	140	52,015	0.30%	156	1,257	0.00%	1,851	0.00%	169,519	0.29%	499
2040	67,609	0.30%	203	47,164	0.30%	141	52,925	0.30%	159	1,257	0.00%	1,851	0.00%	170,806	0.29%	503
Cumulative														**3,191,710**	**0.25%**	**7,857**

Demand Response

As discussed later in this Attachment, Montana-Dakota continues to pursue a demand response portfolio that includes a Commercial Demand Response Resources (DRR) Program and the Company's current Interruptible Demand Response rates. These two programs at year end 2020 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 7.6 percent of the total forecasted Integrated System peak demand in 2021. In 2020 Montana-Dakota expanded the DRR program to a target enrollment of 50 MW, with an initial target enrollment of 40 MW by 2023. This brings the total demand response goal for the two programs to 60 MW by summer 2023.

DSM Program Overview

Montana-Dakota currently offers Energy Efficiency DSM Programs only in the company's Montana service territory. These programs 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 currently being offered or 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. The program is available to existing customers and new construction.

The program provides a rebate on a per bulb basis (limited to 40 bulbs per residential electric account) 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
- Online advertising and billboards

Company-owned Lighting LED Conversion

In 2017, Montana-Dakota began a LED conversion project of its company-owned lighting (streetlights, flood lights and yard lights). Street Lighting and flood lighting conversion projects have been completed across the company's service territory and the yard lighting conversion is nearing completion. The estimated annual energy savings for Montana-Dakota's integrated electric system associated with these projects is approximately 16,259,000 kWh.

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 $0.09 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
- Key account representatives
- HVAC contractor relationships

Commercial Demand Response Resources (DRR) Program

The Commercial DRR 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. In 2020, Montana-Dakota expanded the DRR program to include provisions to enroll commercial customers with a load of 25 kW or higher, and expand the target enrollment to 50 MW, with an initial target enrollment of 40 MW by 2023.

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 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 and Email.

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 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:

$$Net\ Benefit = Total\ Annual\ Benefits - Total\ Annual\ Costs$$

where

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

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:

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

where

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

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

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

Societal Cost Test

The Societal Cost Test measures the net costs of a DSM program as a resource option based on the total costs of the program (both the participants' costs and the utility's costs). This test also includes a factor for environmental externalities, which for this analysis is based on a $30/ton cost of carbon dioxide (CO_2). This test is a summation of the benefit and cost terms in the Participant Test and the Ratepayer Test. The NPV calculation is based on the societal discount rate. The total cost net benefit is calculated by the following equation:

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

where

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

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

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

Utility Test

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

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

where

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

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

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

Total Resource Cost Test (TRC)

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

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

where

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

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

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

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

DSM Model Input Data

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

Also shown in Table B-4 are the inputs for avoided system energy costs and capacity costs applicable to the DSM measures. Avoided energy costs are based on the system marginal energy cost that is projected for the next 10 years and escalated by 0.06 percent annually thereafter. The avoided capacity costs are based on the estimated levelized cost of a combustion turbine. These costs are the same across all three states in Montana-Dakota's Integrated System. The retail energy rate and demand costs vary across the states and are based on the average cost for 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	$0.11882	$0.09538	$0.11344	$0.08331	$0.11866	$0.08670
	Retail Rate (Winter)	System average retail rate for customer class based	$0.10277	0.09219	$0.10332	0.07595	$0.10399	0.08523
	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, 2021	$0.02091	$0.02142	$0.02003	$0.01972	$0.01960	$0.01951
	Fuel Escalation Rate		3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
2	System Marginal Energy Costs	Actual costs for years 1 through 10, See Input 24						
	Escalation Rate (after Yr. 10)	Escalation factor applied after year 10	3.00000%	3.00000%	3.00000%	3.00000%	3.00000%	3.00000%
3	Retail Summer Demand Cost ($/kW/season)	Seasonal demand cost based on program availability	$0.00	$50.60	$0.00	$50.00	$0.00	$33.00
3a	Retail Winter Demand Cost ($/kW/season)	Seasonal demand cost based on program availability	$0.00	$90.40	$0.00	$76.00	$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 levalized cost of combustion turbine	$90.78	$90.78	$78.94	$78.94	$78.94	$78.94
	Reserve Capacity	Based on MISO Non-Coincident Peak	18.30%	18.30%	18.30%	18.30%	18.30%	18.30%
	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	$30 / ton Carbon Cost	30.7%	30.7%	30.7%	30.7%	30.7%	30.7%
	Escalation Rate		3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
8	Participation Discount Rate	Federal Reserve Consumer Credit Interest rate 12 Months ended December 31, 2020	9.65%	9.65%	9.65%	9.65%	9.65%	9.65%
9	Utility Discount Rate	Montana-Dakota's authorized average cost of capital	7.043%	7.043%	7.364%	7.364%	7.216%	7.216%
10	Societal Discount Rate	Equal to the 30 year T-Bill rate average for 12 Months ended December 31, 2020	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%
11	General Input Data Year	2021	2021	2021	2021	2021	2021	2021
12	Project Analysis Yr. 1	Year(s) program will be implemented	2022	2022	2022	2022	2022	2022
	Yr. 2		2023	2023	2023	2023	2023	2023
	Yr. 3		2024	2024	2024	2024	2024	2024
13	Utility Project Costs	Total direct cost to the utility caused by implementing the program(s)						
	Admin Costs	Administration costs						
	Promo Costs	Promotional costs						
14	Direct Participant Project Costs ($/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 2018-December 2020)	1.83%	1.83%	1.83%	1.83%	1.83%	1.83%
	Yr. 2	Consumer Price Index based on 3 yr. average (January 2018-December 2020)	1.83%	1.83%	1.83%	1.83%	1.83%	1.83%
	Yr. 3	Consumer Price Index based on 3 yr. average (January 2018-December 2020)	1.83%	1.83%	1.83%	1.83%	1.83%	1.83%
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	11.450%	11.450%	11.450%	11.450%	11.450%	11.450%
	Yr. 2		11.450%	11.450%	11.450%	11.450%	11.450%	11.450%
	Yr. 3		11.450%	11.450%	11.450%	11.450%	11.450%	11.450%
18b	System Energy Line Loss Factor Yr. 1	Historical energy line loss factor	8.0410%	8.0410%	8.0410%	8.0410%	8.0410%	8.0410%
	Yr. 2		8.0410%	8.0410%	8.0410%	8.0410%	8.0410%	8.0410%
	Yr. 3		8.0410%	8.0410%	8.0410%	8.0410%	8.0410%	8.0410%
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	$0.02907	$0.02907	$0.02528	$0.02528	$0.02528	$0.02528
	Yr. 2		$0.02994	$0.02994	$0.02603	$0.02603	$0.02603	$0.02603
	Yr. 3		$0.03084	$0.03084	$0.02681	$0.02681	$0.02681	$0.02681
	Yr. 4		$0.03176	$0.03176	$0.02762	$0.02762	$0.02762	$0.02762
	Yr. 5		$0.03271	$0.03271	$0.02845	$0.02845	$0.02845	$0.02845
	Yr. 6		$0.03370	$0.03370	$0.02930	$0.02930	$0.02930	$0.02930
	Yr. 7		$0.03471	$0.03471	$0.03018	$0.03018	$0.03018	$0.03018
	Yr. 8		$0.03575	$0.03575	$0.03109	$0.03109	$0.03109	$0.03109
	Yr. 9		$0.03682	$0.03682	$0.03202	$0.03202	$0.03202	$0.03202

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		1.97	2.58	3.43	7.16	2.39
Residential Programs						
Residential Lighting	Residential	0.64	2.22	2.17	3.04	1.29
Commercial Programs						
Commerical Lighting	Commerical	0.75	4.46	6.35	6.76	2.88
Commercial Partnership Program (Custom)	Commerical	0.93	4.45	4.45	5.43	2.56
Demand Response						
Commercial Demand Response Program	Commercial	2.29	2.29	3.16	81.19	2.28
Interruptible Rate DR Program	Commercial	3.05	3.13	4.08	17.04	2.95

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		1.92	2.46	3.29	8.68	2.28
Residential Programs						
Residential Lighting	Residential	0.60	2.06	1.96	3.00	1.16
Commercial Programs						
Commerical Lighting	Commerical	1.10	5.94	8.28	6.76	3.76
Commercial Partnership Program (Custom)	Commercial	0.94	4.07	3.98	4.72	2.29
Demand Response						
Commercial Demand Response Program	Commercial	1.99	1.99	2.74	23.22	1.98
Interruptible Rate DR Program	Commercial	3.05	3.13	4.08	17.04	2.95

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		1.80	2.50	3.35	5.14	2.12
Residential Programs						
Residential Lighting	Residential	0.52	1.78	1.79	3.05	1.06
Commercial Programs						
Commerical Lighting	Commerical	1.96	5.31	7.73	6.82	3.50
Commercial Partnership Program (Custom)	Commercial	1.56	3.48	3.61	4.74	2.08
Demand Response						
Commercial Demand Response Program	Commercial	2.07	2.07	2.81	4.98	2.00
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		1.97	2.58	3.43	7.16	2.39
Residential Programs						
Residential Lighting	Residential	0.64	2.22	2.17	3.04	1.29
Commercial Programs						
Commerical Lighting	Commerical	0.75	4.46	6.35	6.76	2.88
Commercial Partnership Program (Custom)	Commerical	0.93	4.45	4.45	5.43	2.56
Demand Response						
Commercial Demand Response Program	Commercial	2.29	2.29	3.16	81.19	2.28
Interruptible Rate DR Program	Commercial	3.05	3.13	4.08	17.04	2.95

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		1.92	2.46	3.29	8.68	2.28
Residential Programs						
Residential Lighting	Residential	0.60	2.06	1.96	3.00	1.16
Commercial Programs						
Commerical Lighting	Commerical	1.10	5.94	8.28	6.76	3.76
Commercial Partnership Program (Custom)	Commercial	0.94	4.07	3.98	4.72	2.29
Demand Response						
Commercial Demand Response Program	Commercial	1.99	1.99	2.74	23.22	1.98
Interruptible Rate DR Program	Commercial	3.05	3.13	4.08	17.04	2.95

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		1.80	2.50	3.35	5.14	2.12
Residential Programs						
Residential Lighting	Residential	0.52	1.78	1.79	3.05	1.06
Commercial Programs						
Commerical Lighting	Commerical	1.96	5.31	7.73	6.82	3.50
Commercial Partnership Program (Custom)	Commercial	1.56	3.48	3.61	4.74	2.08
Demand Response						
Commercial Demand Response Program	Commercial	2.07	2.07	2.81	4.98	2.00
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	2024 Demand Reduction	Total Cost	Lifetime Cost/Kwh	2024 Cost/KW
Residential Programs						
Residential Lighting	9,000	2,625,399	80	62,094	0.024	776.18
Total	9,000	2,625,399	80	$62,094	$0.024	$776.18
Total Residential	9,000	2,625,399	80	$62,094	$0.024	$776.18
Commercial Programs						
Commerical Lighting	20	9,641,626	107	$83,483	$0.009	$780.21
Commercial Partnership Program (Custom)	10	10,804,102	334	134,524	0.012	402.77
Total Commercial	30	20,445,728	441	$218,007	$0.011	$494.35
Demand Response						
Commercial Demand Response Program	2	1,634,123	7,244	$1,154,373	$0.706	$159.36
Interruptible Rate DR Program	2	280,910	17,831	20,331	0.072	1.14
	4	1,915,033	25,075	$1,174,704	$0.613	$46.85
Total Commercial	34	22,360,761	25,516	$1,392,711	$0.062	$54.58
Education and Outreach				$41,600		
Total Programs without DR	9,030	23,071,127	521	$321,701	$0.014	$617.47
Total Demand Response	4	1,915,033	25,075	$1,174,704	$0.613	$46.85
Total Programs	9,034	24,986,160	25,596	$1,496,405	$0.060	$58.46

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

Program	Participants	Lifetime Energy Reduction	2024 Demand Reduction	Total Cost	Lifetime Cost/Kwh	2024 Cost/KW
Residential Programs						
Residential Lighting	30,000	8,751,321	2,412	194,429	0.022	80.61
Total	30,000	8,751,321	2,412	$194,429	$0.022	$80.61
Demand Response						
Residential AC Cycling	0	0	0	$0	NA	#DIV/0!
Total Residential	30,000	8,751,321	2,412	$194,429	$0.022	$80.61
Commercial Programs						
Commerical Lighting	60	28,924,866	642	$235,242	$0.008	$366.42
Commercial Partnership Program (Custom)	22	23,769,022	736	280,839	0.012	381.57
Total Commercial	82	52,693,888	1,378	$516,081	$0.010	$374.51
Demand Response						
Commercial Demand Response Program	8	1,931,233	8,582	$106,906	$0.055	$12.46
Interruptible Rate DR Program	0	3,022,852	144,439	210,356	0.070	1.46
	8	4,954,085	153,021	$317,262	$0.064	$2.07
Total Commercial	90	57,647,973	154,399	$833,343	$0.014	$5.40
Education and Outreach				$70,000		
Total Programs without DR	30,082	61,445,209	3,790	$780,510	$0.013	$205.94
Total Demand Response	8	4,954,085	153,021	$317,262	$0.064	$2.07
Total Programs	30,090	66,399,294	156,811	$1,097,772	$0.017	$7.00

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

Program	Participants	Lifetime Energy Reduction	2024 Demand Reduction	Total Cost	Lifetime Cost/Kwh	2024 Cost/KW
Residential Programs						
Residential Lighting	3,000	875,131	234	22,175	0.025	94.76
Total	3,000	875,131	234	$22,175	$0.025	$94.76
Demand Response						
Residential AC Cycling	0	0	0	$0	NA	#DIV/0!
Total Residential	3,000	875,131	234	$22,175	$0.025	$94.76
Commercial Programs						
Commerical Lighting	10	4,820,813	106	$43,855	$0.009	$413.73
Commercial Partnership Program (Custom)	3	3,241,240	100	44,350	0.014	443.50
Total Commercial	13	8,062,053	206	$88,205	$0.011	$428.18
Demand Response						
Commercial Demand Response Program	4	216,080	892	$9,659	$0.045	$10.83
Interruptible Rate DR Program	0	0	0	0	#DIV/0!	#DIV/0!
	4	216,080	892	$9,659	$0.045	$10.83
Total Commercial	17	8,278,133	1,098	$97,864	$0.012	$89.13
Education and Outreach				$22,850		
Total Programs without DR	3,013	8,937,184	440	$133,230	$0.015	$302.80
Total Demand Response	4	216,080	892	$9,659	$0.045	$10.83
Total Programs	3,017	9,153,264	1,332	$142,889	$0.016	$107.27

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

Program	Participants	Lifetime Energy Reduction	2024 Demand Reduction	Total Cost	Lifetime Cost/Kwh	2024 Cost/KW
Residential Programs						
Residential Lighting	42,000	12,251,851	2,726	278,698	0.023	102.24
Total	42,000	12,251,851	2,726	$278,698	$0.023	$102.24
Demand Response						
Residential AC Cycling	0	0	0	$0	NA	#DIV/0!
Total Residential	42,000	12,251,851	2,726	$278,698	$0.023	$102.24
Commercial Programs						
Commerical Lighting	90	43,387,305	855	$362,580	$0.008	$424.07
Commercial Partnership Program (Custom)	35	37,814,364	1,170	459,713	0.012	392.92
Total Commercial	125	81,201,669	2,025	$822,293	$0.010	$406.07
Demand Response						
Commercial Demand Response Program	14	3,781,436	16,718	$1,270,938	$0.336	$76.02
Interruptible Rate DR Program	2	3,303,762	162,270	$230,687	0.070	1.42
	16	7,085,198	178,988	$1,501,625	$0.212	$8.39
Total Commercial	141	88,286,867	181,013	$2,323,918	$0.026	$12.84
Education and Outreach				$134,450		
Total Programs without DR	42,125	93,453,520	4,751	$1,235,441	$0.013	$260.04
Total Demand Response	16	7,085,198	178,988	$1,501,625	$0.212	$8.39
Total Programs	42,141	100,538,718	183,739	$2,737,066	$0.027	$14.90

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	$0.11882	$0.09538	$0.11344	$0.08331	$0.11866	$0.08670
	Retail Rate (Winter)	System average retail rate for customer class based	$0.10277	0.09219	$0.10332	0.07595	$0.10399	0.08523
	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, 2021	$0.02091	$0.02142	$0.02003	$0.01972	$0.01960	$0.01951
	Fuel Escalation Rate		3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
2	System Marginal Energy Costs	Actual costs for years 1 through 10, See Input 24						
	Escalation Rate (after Yr. 10)	Escalation factor applied after year 10	3.00000%	3.00000%	3.00000%	3.00000%	3.00000%	3.00000%
3	Retail Summer Demand Cost ($/kW/season)	Seasonal demand cost based on program availability	$0.00	$50.60	$0.00	$50.00	$0.00	$33.00
3a	Retail Winter Demand Cost ($/kW/season)	Seasonal demand cost based on program availability	$0.00	$90.40	$0.00	$76.00	$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 levalized cost of combustion turbine	$90.78	$90.78	$78.94	$78.94	$78.94	$78.94
	Reserve Capacity	Based on MISO Non-Coincident Peak	18.30%	18.30%	18.30%	18.30%	18.30%	18.30%
	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, 2020	9.65%	9.65%	9.65%	9.65%	9.65%	9.65%
9	Utility Discount Rate	Montana-Dakota's authorized average cost of capital	7.043%	7.043%	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, 2020	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%
11	General Input Data Year	2021	2021	2021	2021	2021	2021	2021

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

Input No.	Input Data Description	Information Source	Montana Residential	Montana Commercial	North Dakota Residential	North Dakota Commercial	South Dakota Residential	South Dakota Commercial
12	Project Analysis Yr. 1	Year(s) program will be implemented	2022	2022	2022	2022	2022	2022
	Yr. 2		2023	2023	2023	2023	2023	2023
	Yr. 3		2024	2024	2024	2024	2024	2024
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 2018-December 2020)	1.83%	1.83%	1.83%	1.83%	1.83%	1.83%
	Yr. 2	Consumer Price Index based on 3 yr. average (January 2018-December 2020)	1.83%	1.83%	1.83%	1.83%	1.83%	1.83%
	Yr. 3	Consumer Price Index based on 3 yr. average (January 2018-December 2020)	1.83%	1.83%	1.83%	1.83%	1.83%	1.83%
14a	Other Participant Costs (Annual $/Part.) Yr. 1		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
	Yr. 2		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
	Yr. 3		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
	Escalation Rate Yr. 1		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Yr. 2		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Yr. 3		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
14b	Other Participant Savings (Annual $/Part.) Yr. 1		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
	Yr. 2		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
	Yr. 3		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
	Escalation Rate Yr. 1		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Yr. 2		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Yr. 3		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
15	Project Life	Based on the estimated useful life of the energy saving equipment						
16	Avg. Summer Demand Reduction	Avg demand reduction (kW) caused by the DSM program						
16a	Avg. Winter Demand Reduction	Avg demand reduction (kW) caused by the DSM program						

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

Input No.	Input Data Description	Information Source	Montana Residential	Montana Commercial	North Dakota Residential	North Dakota Commercial	South Dakota Residential	South Dakota Commercial
17	Avg. Winter Energy Reduction	Avg energy reduction (kWh) caused by the DSM program						
17a	Avg. Summer Energy Reduction	Avg energy reduction (kWh) caused by the DSM program						
18a	System Demand Line Loss Factor Yr. 1	Historical demand line loss factor	11.450%	11.450%	11.450%	11.450%	11.450%	11.450%
	Yr. 2		11.450%	11.450%	11.450%	11.450%	11.450%	11.450%
	Yr. 3		11.450%	11.450%	11.450%	11.450%	11.450%	11.450%
18b	System Energy Line Loss Factor Yr. 1	Historical energy line loss factor	8.0410%	8.0410%	8.0410%	8.0410%	8.0410%	8.0410%
	Yr. 2		8.0410%	8.0410%	8.0410%	8.0410%	8.0410%	8.0410%
	Yr. 3		8.0410%	8.0410%	8.0410%	8.0410%	8.0410%	8.0410%
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

		Participation Assumptions			Technical Assumptions											Cost Assumptions			
2020 - 2022 Program Years	Customer Class	Number of Participants Year 1	Number of Participants Year 2	Number of Participants Year 3	Project Life	Baseline Efficiency	Average High Efficiency	Average Summer kWh Saved / part	Average Winter kWh Saved / part	Average Summer kW Saved / part	Average Winter kW Saved / part	Average Peak Load Factor of Measure	coincident Summer Peak Avg kW Saved / Part	coincident Winter Peak Avg kW Saved / Part	Average Non-Energy Benefits / Part	Cost Std Equip	Cost High Eff Equip	incremental Cost	Average Incentive / Part
Residential Programs																			
Residential Lighting	Residential	3,000	3,000	3,000	9	43.0	10.0	10	20	0.0036	0.0036	1.0000	0.0036	0.0036	0.00	NA	NA	10	5
Commercial Programs																			
Commerical Lighting	Commerical	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)	Commerical	2	3	5	10	NA	NA	50,000	50,000	20.0000	20.0000	0.7500	15.0000	15.0000	0.00	NA	NA	20,000	10,000
Demand Response																			
Commercial Demand Response Program	Commercial	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	**9,038**	**3,007**	**3,016**	**3,015**															
Total Less Demand Response		3,007	3,013	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

		Participation Assumptions			Technical Assumptions											Cost Assumptions			
2020 - 2022 Program Years	Customer Class	Number of Participants Year 1	Number of Participants Year 2	Number of Participants Year 3	Project Life	Baseline Efficiency	Average High Efficiency	Average Summer kWh Saved / part	Average Winter kWh Saved / part	Average Summer kW Saved / part	Average Winter kW Saved / part	Average Peak Load Factor of Measure	coincident Summer Peak Avg kW Saved / Part	coincident Winter Peak Avg kW Saved / Part	Average Non-Energy Benefits / Part	Cost Std Equip	Cost High Eff Equip	incremental Cost	Average Incentive / Part
Residential Programs																			
Residential Lighting	Residential	10,000	10,000	10,000	9	43.0	10.0	10	20	0.0036	0.0036	1.0000	0.0036	0.0036	0.00	NA	NA	10	5
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	**30,109**	**10,020**	**10,036**	**10,053**															
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

		Participation Assumptions			Technical Assumptions											Cost Assumptions			
2020 - 2022 Program Years	Customer Class	Number of Participants Year 1	Number of Participants Year 2	Number of Participants Year 3	Project Life	Baseline Efficiency	Average High Efficiency	Average Summer kWh Saved / part	Average Winter kWh Saved / part	Average Summer kW Saved / part	Average Winter kW Saved / part	Average Peak Load Factor of Measure	coincident Summer Peak Avg kW Saved / Part	coincident Winter Peak Avg kW Saved / Part	Average Non-Energy Benefits / Part	Cost Std Equip	Cost High Eff Equip	incremental Cost	Average Incentive / Part
Residential Programs																			
Residential Lighting	Residential	1,000	1,000	1,000	9	43.0	10.0	10	20	0.0036	0.0036	1.0000	0.0036	0.0036	0.00	NA	NA	10	5
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	**3,016**	**1,003**	**1,005**	**1,008**															
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

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

Company: **Montana-Dakota Utilities Co.**
Project: **Total Program with Demand Response**
Program Years: **2022 - 2024**

Input Data

1) Retail Rate Summer ($/kWh) =
Retail Rate Winter ($/kWh) =
Retail Escalation Rate =
1a) Power Supply Cost Adjustment
Fuel Escalation Rate =

2) Avg. System Marginal Energy Cost ($/kWh) =
Escalation Rate =

3) Retail Summer Demand Rate ($/kW/season) =
3a) Retail Winter Demand Rate ($/kW/season) =
Escalation Rate =

4) Electric Margin ($/kWh) =
Escalation Rate =

5) System Peak Shaving Demand Cost ($/kW/yr)
Reserve Capacity=
Escalation Rate =

6) System Variable O&M ($/kWh) =
Escalation Rate =

7) Environmental Damage Factor =
Escalation Rate =

8) Participant Discount Rate = 9.65%

9) Utility Discount Rate = 7.04%

10) Societal Discount Rate = 1.56%

11) General Input Data Year = 2021

12) Project Analysis Year 1 = 2022
Project Analysis Year 2 = 2023
Project Analysis Year 3 = 2024

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$59,970	$62,019	$62,126
Incentive Costs =	50,300	75,600	80,300
Total Utility Project Costs =	$110,270	$137,619	$142,426
14) Direct Participant Costs ($/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 =	3,009	3,015	3,010
20) Incentive/Participant =			
21) Effective Federal & State Income Tax Rate =			
22) Annual Summer Kwh Saved	212,565	297,380	321,315
Annual Winter Kwh Saved	242,630	375,260	392,630
23) Annual Summer KW Saved	2,066	1,705	111
Annual Winter KW Saved	42	57	87

Test Results	NPV	B/C
Ratepayer Impact Measure Test	$4,474,693	1.97
Utility Cost Test	$5,559,069	2.58
Societal Test	$11,216,366	3.43
Participant Test	$2,506,811	7.16
Total Resource Cost Test	$5,270,793	2.39

Table 1
Ratepayer Impact Test

Project: **Total Program with Demand Response**
Program Ye **2022 - 2024**

t	Year	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Direct Program Costs (O)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2022	613,343		$17,831		$0	7,364		$814,606	$832,437		567,695	$31,685	$100,021	$50,300	$316,470	$498,476	$333,961
2	2023	1,340,072		40,122		0	9,329		1,062,852	1,102,974		1,240,335	72,128	126,693	75,600	374,010	648,431	454,543
3	2024	2,111,425		65,115		0	9,548		1,120,457	1,185,572		1,954,280	118,580	126,574	80,300	374,010	699,464	486,108
4	2025	2,111,425		67,059		0	9,548		1,154,067	1,221,126		1,954,280	123,922	72,192	0	374,010	570,124	651,002
5	2026	2,111,425		69,065		0	9,548		1,188,727	1,257,792		1,954,280	129,502	72,192	0	374,010	575,704	682,088
6	2027	2,111,425		71,156		0	9,548		1,224,340	1,295,496		1,954,280	135,322	72,192	0	374,010	581,524	713,972
7	2028	2,111,425		73,287		0	9,548		1,261,101	1,334,388		1,954,280	141,408	72,192	0	374,010	587,610	746,778
8	2029	2,111,425		75,484		0	9,548		1,298,909	1,374,393		1,954,280	147,774	72,192	0	374,010	593,976	780,417
9	2030	2,111,425		77,742		0	9,548		1,337,866	1,415,608		1,954,280	154,424	72,192	0	374,010	600,626	814,982
10	2031	1,892,642		71,768		0	4,507		650,495	722,263		1,751,780	143,537	72,192	0	115,080	330,809	391,454
11	2032	1,534,755		59,947		0	2,185		324,823	384,770		1,420,530	120,589	27,072	0	57,540	205,201	179,569
12	2033	1,075,852		43,281		0	275		42,108	85,389		995,780	87,097	0	0	0	87,097	(1,708)
13	2034	535,646		22,197		0	107		16,875	39,072		495,780	45,314	0	0	0	45,314	(6,242)
14	2035	535,646		22,861		0	107		17,381	40,242		495,780	47,352	0	0	0	47,352	(7,110)
15	2036	535,646		23,547		0	107		17,903	41,450		495,780	49,485	0	0	0	49,485	(8,035)
16	2037	535,646		24,254		0	107		18,440	42,694		495,780	51,713	0	0	0	51,713	(9,019)
17	2038	535,646		24,983		0	107		18,994	43,977		495,780	54,039	0	0	0	54,039	(10,062)
18	2039	535,646		25,732		0	107		19,563	45,295		495,780	56,472	0	0	0	56,472	(11,177)
19	2040	401,734		19,878		0	80		15,066	34,944		371,835	44,258	0	0	0	44,258	(9,314)
20	2041	133,911		6,824		0	27		5,237	12,061		123,945	15,416	0	0	0	15,416	(3,355)
	Total =	24,986,160					91,245			$12,511,943		23,126,540					$6,343,091	$6,168,852
									NPV =	$9,069,250							$4,594,557	4,474,693

Total NPV = $4,474,693
Benefit/Cost Ratio = 1.97

Worksheet Calculations

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

Table 2
Utility Test

Project: **Total Program with Demand Response**
Program Years: **2022 - 2024**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2022	$17,831	$0	$814,606	$832,437	$466,791	$466,791	$365,646
2023	40,122	0	1,062,852	1,102,974	576,303	576,303	526,671
2024	65,115	0	1,120,457	1,185,572	580,884	580,884	604,688
2025	67,059	0	1,154,067	1,221,126	446,202	446,202	774,924
2026	69,065	0	1,188,727	1,257,792	446,202	446,202	811,590
2027	71,156	0	1,224,340	1,295,496	446,202	446,202	849,294
2028	73,287	0	1,261,101	1,334,388	446,202	446,202	888,186
2029	75,484	0	1,298,909	1,374,393	446,202	446,202	928,191
2030	77,742	0	1,337,866	1,415,608	446,202	446,202	969,406
2031	71,768	0	650,495	722,263	187,272	187,272	534,991
2032	59,947	0	324,823	384,770	84,612	84,612	300,158
2033	43,281	0	42,108	85,389	0	0	85,389
2034	22,197	0	16,875	39,072	0	0	39,072
2035	22,861	0	17,381	40,242	0	0	40,242
2036	23,547	0	17,903	41,450	0	0	41,450
2037	24,254	0	18,440	42,694	0	0	42,694
2038	24,983	0	18,994	43,977	0	0	43,977
2039	25,732	0	19,563	45,295	0	0	45,295
2040	19,878	0	15,066	34,944	0	0	34,944
2041	6,824	0	5,237	12,061	0	0	12,061
Total =				$12,511,943		$4,573,074	$7,938,869
			NPV =	$9,069,250		$3,510,181	5,559,069

Total NPV =	$5,559,069
Benefit/Cost Ratio =	2.58

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

Table 3
Societal Cost Test

Project: **Total Program with Demand Response**
Program Years: **2022 - 2024**

	Benefits					Costs			Annual
Year	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	Benefits Less Costs (I)
2022	$17,831	$0	$814,606	$263,225	$1,095,662	$474,202	$52,188	$526,390	$569,272
2023	40,122	0	1,062,852	359,235	1,462,209	585,455	75,270	660,725	801,484
2024	65,115	0	1,120,457	397,720	1,583,292	590,448	80,845	671,293	911,999
2025	67,059	0	1,154,067	421,938	1,643,064	456,197	4,420	460,617	1,182,447
2026	69,065	0	1,188,727	447,646	1,705,438	456,647	4,420	461,067	1,244,371
2027	71,156	0	1,224,340	474,895	1,770,391	457,116	4,420	461,536	1,308,855
2028	73,287	0	1,261,101	503,827	1,838,215	457,607	4,420	462,027	1,376,188
2029	75,484	0	1,298,909	534,499	1,908,892	458,120	4,420	462,540	1,446,352
2030	77,742	0	1,337,866	567,044	1,982,652	458,657	4,420	463,077	1,519,575
2031	71,768	0	650,495	297,993	1,020,256	191,277	4,420	195,697	824,559
2032	59,947	0	324,823	163,512	548,282	86,705	1,658	88,363	459,919
2033	43,281	0	42,108	37,376	122,765	0	0	0	122,765
2034	22,197	0	16,875	17,615	56,687	0	0	0	56,687
2035	22,861	0	17,381	18,687	58,929	0	0	0	58,929
2036	23,547	0	17,903	19,825	61,275	0	0	0	61,275
2037	24,254	0	18,440	21,033	63,727	0	0	0	63,727
2038	24,983	0	18,994	22,315	66,292	0	0	0	66,292
2039	25,732	0	19,563	23,673	68,968	0	0	0	68,968
2040	19,878	0	15,066	18,811	53,755	0	0	0	53,755
2041	6,824	0	5,237	6,688	18,749	0	0	0	18,749
Total =					$17,129,500			$4,913,332	$12,216,168
				NPV =	$15,835,588			$4,619,222	11,216,366

Total NPV = $11,216,366
Benefit/Cost Ratio = 3.43

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: **2022 - 2024**

	Benefits												Costs			Annual
Year	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	Benefits Less Costs (P)
2022	$50,300			567,695	$57,173	6,566	42			$66,864	$28,875	$203,212	$104,261	$0	$104,261	$98,951
2023	75,600			1,240,335	129,960	8,271	99			106,692	34,125	346,377	156,178	0	156,178	190,199
2024	80,300			1,954,280	213,609	8,382	186			120,845	34,125	448,879	169,923	0	169,923	278,956
2025	0			1,954,280	223,228	8,382	186			122,181	34,125	379,534	4,420	0	4,420	375,114
2026	0			1,954,280	233,275	8,382	186			123,576	34,125	390,976	4,420	0	4,420	386,556
2027	0			1,954,280	243,772	8,382	186			125,035	34,125	402,932	4,420	0	4,420	398,512
2028	0			1,954,280	254,744	8,382	186			126,559	34,125	415,428	4,420	0	4,420	411,008
2029	0			1,954,280	266,200	8,382	186			128,151	34,125	428,476	4,420	0	4,420	424,056
2030	0			1,954,280	278,177	8,382	186			129,816	34,125	442,118	4,420	0	4,420	437,698
2031	0			1,751,780	258,924	3,870	174			118,419	10,500	387,843	4,420	0	4,420	383,423
2032	0			1,420,530	217,961	1,828	132			65,333	5,250	288,544	1,658	0	1,658	286,886
2033	0			995,780	157,927	171	75			26,172	0	184,099	0	0	0	184,099
2034	0			495,780	81,934	96	0			8,609	0	90,543	0	0	0	90,543
2035	0			495,780	85,621	96	0			8,996	0	94,617	0	0	0	94,617
2036	0			495,780	89,473	96	0			9,401	0	98,874	0	0	0	98,874
2037	0			495,780	93,499	96	0			9,824	0	103,323	0	0	0	103,323
2038	0			495,780	97,707	96	0			10,266	0	107,973	0	0	0	107,973
2039	0			495,780	102,104	96	0			10,728	0	112,832	0	0	0	112,832
2040	0			371,835	80,024	72	0			8,408	0	88,432	0	0	0	88,432
2041	0			123,945	27,876	24	0			2,929	0	30,805	0	0	0	30,805
Total =						80,052	1,824					$5,045,817			$462,960	$4,582,857
											NPV =	$2,913,601			$406,790	2,506,811

Total NPV = $2,506,811
Benefit/Cost Ratio = 7.16

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Total Program with Demand Response**
Project: **2022 - 2024**

	Benefits			Costs			
Year	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	Benefits Less Costs (G)
2022	$17,831	$814,606	$832,437	$474,202	$52,188	$526,390	$306,047
2023	40,122	1,062,852	1,102,974	585,455	75,270	660,725	442,249
2024	65,115	1,120,457	1,185,572	590,448	80,845	671,293	514,279
2025	67,059	1,154,067	1,221,126	456,197	4,420	460,617	760,509
2026	69,065	1,188,727	1,257,792	456,647	4,420	461,067	796,725
2027	71,156	1,224,340	1,295,496	457,116	4,420	461,536	833,960
2028	73,287	1,261,101	1,334,388	457,607	4,420	462,027	872,361
2029	75,484	1,298,909	1,374,393	458,120	4,420	462,540	911,853
2030	77,742	1,337,866	1,415,608	458,657	4,420	463,077	952,531
2031	71,768	650,495	722,263	191,277	4,420	195,697	526,566
2032	59,947	324,823	384,770	86,705	1,658	88,363	296,407
2033	43,281	42,108	85,389	0	0	0	85,389
2034	22,197	16,875	39,072	0	0	0	39,072
2035	22,861	17,381	40,242	0	0	0	40,242
2036	23,547	17,903	41,450	0	0	0	41,450
2037	24,254	18,440	42,694	0	0	0	42,694
2038	24,983	18,994	43,977	0	0	0	43,977
2039	25,732	19,563	45,295	0	0	0	45,295
2040	19,878	15,066	34,944	0	0	0	34,944
2041	6,824	5,237	12,061	0	0	0	12,061
		Total =	$12,511,943			$4,913,332	$7,598,611
		NPV =	$9,069,250			$3,798,457	5,270,793

Total NPV =	$5,270,793
Benefit/Cost Ratio =	2.39

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

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

Company: **Montana-Dakota Utilities Co.**
Project: **Total Program with Demand Response**
Program Years: **2022 - 2024**

Input Data

1) Retail Rate Summer ($/kWh) =
Retail Rate Winter ($/kWh) =
Retail Escalation Rate =
1a) Power Supply Cost Adjustment
Fuel Escalation Rate =

2) Avg. System Marginal Energy Cost ($/kWh) =
Escalation Rate =

3) Retail Summer Demand Rate ($/kW/season) =
3a) Retail Winter Demand Rate ($/kW/season) =
Escalation Rate =

4) Electric Margin ($/kWh) =
Escalation Rate =

5) System Peak Shaving Demand Cost ($/kW/yr)
Reserve Capacity=
Escalation Rate =

6) System Variable O&M ($/kWh) =
Escalation Rate =

7) Environmental Damage Factor =
Escalation Rate =

8) Participant Discount Rate = 9.65%

9) Utility Discount Rate = 7.36%

10) Societal Discount Rate = 1.56%

11) General Input Data Year = 2021

12) Project Analysis Year 1 = 2022
Project Analysis Year 2 = 2023
Project Analysis Year 3 = 2024

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$164,935	$152,029	$157,208
Incentive Costs =	$145,900	$181,200	$226,500
Total Utility Project Costs =	$310,835	$333,229	$383,708
14) Direct Participant Costs ($/Part.) =			
Escalation Rate =			
14a) Other Participant Costs (Annual $/Part.) =			
Escalation Rate =			
14b) Other Participant Savings (Annual $/Part.) =			
Escalation Rate =			
15) Project Life (Years) =			
16) Avg Summer kW/part. Saved =			
16a) Avg Winter kW/part Saved =			
17) Avg. Summer kWh/Part. Saved =			
17a) Avg. Winter kWh/Part. Saved =			
18a) System Demand Line Loss Factor			
18b) System Energy Line Loss Factor			
19) Number of Participants =	10,024	10,031	10,035
20) Incentive/Participant =			
21) Effective Federal & State Income Tax Rate =			
22) Annual Summer Kwh Saved	501,445	642,760	806,575
Annual Winter Kwh Saved	697,890	880,520	1,113,150
23) Annual Summer KW Saved	1,287	1,341	310
Annual Winter KW Saved	187	241	310

Test Results	NPV	B/C
Ratepayer Impact Measure Test	$10,213,794	1.92
Utility Cost Test	$12,672,908	2.46
Societal Test	$25,682,673	3.29
Participant Test	$8,594,790	8.68
Total Resource Cost Test	$11,996,706	2.28

Table 1
Ratepayer Impact Test

Project: **Total Program with Demand Response**
Program Ye **2022 - 2024**

t	Year	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Direct Program Costs (O)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2022	1,444,330		$44,995		$0	7,774		$2,291,515	$2,336,510		1,647,710	$79,185	$778,644	$145,900	$379,764	$1,383,493	$953,017
2	2023	3,090,097		89,189		0	9,536		2,534,686	2,623,875		3,170,990	159,650	771,066	181,200	443,058	1,554,974	1,068,901
3	2024	5,164,187		147,480		0	10,228		2,681,547	2,829,027		5,090,715	266,665	774,215	226,500	443,058	1,710,438	1,118,589
4	2025	5,164,187		151,904		0	10,228		2,761,954	2,913,858		5,090,715	278,658	686,703	0	443,058	1,408,419	1,505,439
5	2026	5,164,187		156,461		0	10,228		2,844,726	3,001,187		5,090,715	291,185	686,703	0	443,058	1,420,946	1,580,241
6	2027	5,164,187		161,155		0	10,228		2,930,126	3,091,281		5,090,715	304,295	686,703	0	443,058	1,434,056	1,657,225
7	2028	5,164,187		165,991		0	10,228		3,017,892	3,183,883		5,090,715	318,007	686,703	0	443,058	1,447,768	1,736,115
8	2029	5,164,187		170,970		0	10,228		3,108,546	3,279,516		5,090,715	332,291	686,703	0	443,058	1,462,052	1,817,464
9	2030	5,164,187		176,099		0	10,228		3,201,829	3,377,928		5,090,715	347,250	686,703	0	443,058	1,477,011	1,900,917
10	2031	4,691,508		154,726		0	4,008		503,004	657,730		4,342,340	305,328	0	0	126,588	431,916	225,814
11	2032	3,797,469		129,000		0	2,526		326,535	455,535		3,514,840	253,387	0	0	63,294	316,681	138,854
12	2033	2,687,347		94,031		0	976		129,954	223,985		2,487,340	181,569	0	0	0	181,569	42,416
13	2034	1,606,937		57,914		0	642		88,044	145,958		1,487,340	113,458	0	0	0	113,458	32,500
14	2035	1,606,937		59,650		0	642		90,683	150,333		1,487,340	118,564	0	0	0	118,564	31,769
15	2036	1,606,937		61,433		0	642		93,405	154,838		1,487,340	123,900	0	0	0	123,900	30,938
16	2037	1,606,937		63,281		0	642		96,210	159,491		1,487,340	129,477	0	0	0	129,477	30,014
17	2038	1,606,937		65,177		0	642		99,093	164,270		1,487,340	135,295	0	0	0	135,295	28,975
18	2039	1,606,937		67,138		0	642		102,065	169,203		1,487,340	141,387	0	0	0	141,387	27,816
19	2040	1,205,203		51,860		0	482		78,928	130,788		1,115,505	110,815	0	0	0	110,815	19,973
20	2041	669,557		29,675		0	268		45,204	74,879		619,725	64,335	0	0	0	64,335	10,544
	Total =	63,376,442					101,018			$29,124,075		61,457,495					$15,166,554	$13,957,521
									NPV =	$21,334,922							$11,121,128	10,213,794

Total NPV = $10,213,794
Benefit/Cost Ratio = 1.92

Worksheet Calculations

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

Table 2
Utility Test

Project: **Total Program with Demand Response**
Program Years: **2022 - 2024**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2022	$44,995	$0	$2,291,515	$2,336,510	$1,304,308	$1,304,308	$1,032,202
2023	89,189	0	2,534,686	2,623,875	1,395,324	1,395,324	1,228,551
2024	147,480	0	2,681,547	2,829,027	1,443,773	1,443,773	1,385,254
2025	151,904	0	2,761,954	2,913,858	1,129,761	1,129,761	1,784,097
2026	156,461	0	2,844,726	3,001,187	1,129,761	1,129,761	1,871,426
2027	161,155	0	2,930,126	3,091,281	1,129,761	1,129,761	1,961,520
2028	165,991	0	3,017,892	3,183,883	1,129,761	1,129,761	2,054,122
2029	170,970	0	3,108,546	3,279,516	1,129,761	1,129,761	2,149,755
2030	176,099	0	3,201,829	3,377,928	1,129,761	1,129,761	2,248,167
2031	154,726	0	503,004	657,730	126,588	126,588	531,142
2032	129,000	0	326,535	455,535	63,294	63,294	392,241
2033	94,031	0	129,954	223,985	0	0	223,985
2034	57,914	0	88,044	145,958	0	0	145,958
2035	59,650	0	90,683	150,333	0	0	150,333
2036	61,433	0	93,405	154,838	0	0	154,838
2037	63,281	0	96,210	159,491	0	0	159,491
2038	65,177	0	99,093	164,270	0	0	164,270
2039	67,138	0	102,065	169,203	0	0	169,203
2040	51,860	0	78,928	130,788	0	0	130,788
2041	29,675	0	45,204	74,879	0	0	74,879
Total =				$29,124,075		$11,111,853	$18,012,222
			NPV =	$21,334,922		$8,662,014	12,672,908

Total NPV =	$12,672,908
Benefit/Cost Ratio =	2.46

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: **2022 - 2024**

	Benefits					Costs			Annual
Year	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	Benefits Less Costs (I)
2022	$44,995	$0	$2,291,515	$738,827	$3,075,337	$1,311,730	$162,149	$1,473,879	$1,601,458
2023	89,189	0	2,534,686	854,587	3,478,462	1,404,373	193,574	1,597,947	1,880,515
2024	147,480	0	2,681,547	949,046	3,778,073	1,453,229	222,999	1,676,228	2,101,845
2025	151,904	0	2,761,954	1,006,830	3,920,688	1,139,642	15,874	1,155,516	2,765,172
2026	156,461	0	2,844,726	1,068,114	4,069,301	1,140,086	15,874	1,155,960	2,913,341
2027	161,155	0	2,930,126	1,133,183	4,224,464	1,140,551	15,874	1,156,425	3,068,039
2028	165,991	0	3,017,892	1,202,144	4,386,027	1,141,038	15,874	1,156,912	3,229,115
2029	170,970	0	3,108,546	1,275,399	4,554,915	1,141,544	15,874	1,157,418	3,397,497
2030	176,099	0	3,201,829	1,353,082	4,731,010	1,142,074	15,874	1,157,948	3,573,062
2031	154,726	0	503,004	271,368	929,098	130,265	0	130,265	798,833
2032	129,000	0	326,535	193,585	649,120	65,215	0	65,215	583,905
2033	94,031	0	129,954	98,040	322,025	0	0	0	322,025
2034	57,914	0	88,044	65,804	211,762	0	0	0	211,762
2035	59,650	0	90,683	69,809	220,142	0	0	0	220,142
2036	61,433	0	93,405	74,058	228,896	0	0	0	228,896
2037	63,281	0	96,210	78,572	238,063	0	0	0	238,063
2038	65,177	0	99,093	83,355	247,625	0	0	0	247,625
2039	67,138	0	102,065	88,433	257,636	0	0	0	257,636
2040	51,860	0	78,928	70,407	201,195	0	0	0	201,195
2041	29,675	0	45,204	41,519	116,398	0	0	0	116,398
Total =					$39,840,237			$11,883,713	$27,956,524
				NPV =	$36,900,138			$11,217,465	25,682,673

Total NPV = $25,682,673
Benefit/Cost Ratio = 3.29

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: **2022 - 2024**

	Benefits												Costs			Annual
Year	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	Benefits Less Costs (P)
2022	$145,900			1,647,710	$146,952	21,187	187			$688,348	$34,650	$1,015,850	$313,185	$0	$313,185	$702,665
2023	181,200			3,170,990	294,342	22,528	428			720,087	40,425	1,236,054	387,610	0	387,610	848,444
2024	226,500			5,090,715	490,423	22,838	738			761,065	40,425	1,518,413	473,788	0	473,788	1,044,625
2025	0			5,090,715	512,493	22,838	738			765,063	40,425	1,317,981	15,874	0	15,874	1,302,107
2026	0			5,090,715	535,567	22,838	738			769,241	40,425	1,345,233	15,874	0	15,874	1,329,359
2027	0			5,090,715	559,662	22,838	738			773,608	40,425	1,373,695	15,874	0	15,874	1,357,821
2028	0			5,090,715	584,839	22,838	738			778,172	40,425	1,403,436	15,874	0	15,874	1,387,562
2029	0			5,090,715	611,170	22,838	738			782,940	40,425	1,434,535	15,874	0	15,874	1,418,661
2030	0			5,090,715	638,668	22,838	738			787,923	40,425	1,467,016	15,874	0	15,874	1,451,142
2031	0			4,342,340	559,692	2,898	698			127,348	11,550	698,590	0	0	0	698,590
2032	0			3,514,840	464,602	1,683	583			114,243	5,775	584,620	0	0	0	584,620
2033	0			2,487,340	332,797	438	438			93,592	0	426,389	0	0	0	426,389
2034	0			1,487,340	206,661	288	288			64,310	0	270,971	0	0	0	270,971
2035	0			1,487,340	215,967	288	288			67,203	0	283,170	0	0	0	283,170
2036	0			1,487,340	225,674	288	288			70,227	0	295,901	0	0	0	295,901
2037	0			1,487,340	235,833	288	288			73,388	0	309,221	0	0	0	309,221
2038	0			1,487,340	246,447	288	288			76,690	0	323,137	0	0	0	323,137
2039	0			1,487,340	257,533	288	288			80,141	0	337,674	0	0	0	337,674
2040	0			1,115,505	201,843	216	216			62,811	0	264,654	0	0	0	264,654
2041	0			619,725	117,182	120	120			36,465	0	153,647	0	0	0	153,647
Total =						210,664	9,564					$16,060,187			$1,269,827	$14,790,360
											NPV =	$9,713,633			$1,118,843	8,594,790

Total NPV = $8,594,790
Benefit/Cost Ratio = 8.68

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Total Program with Demand Response**
Project: **2022 - 2024**

	Benefits			Costs			
Year	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	Benefits Less Costs (G)
2022	$44,995	$2,291,515	$2,336,510	$1,311,730	$162,149	$1,473,879	$862,631
2023	89,189	2,534,686	2,623,875	1,404,373	193,574	1,597,947	1,025,928
2024	147,480	2,681,547	2,829,027	1,453,229	222,999	1,676,228	1,152,799
2025	151,904	2,761,954	2,913,858	1,139,642	15,874	1,155,516	1,758,342
2026	156,461	2,844,726	3,001,187	1,140,086	15,874	1,155,960	1,845,227
2027	161,155	2,930,126	3,091,281	1,140,551	15,874	1,156,425	1,934,856
2028	165,991	3,017,892	3,183,883	1,141,038	15,874	1,156,912	2,026,971
2029	170,970	3,108,546	3,279,516	1,141,544	15,874	1,157,418	2,122,098
2030	176,099	3,201,829	3,377,928	1,142,074	15,874	1,157,948	2,219,980
2031	154,726	503,004	657,730	130,265	0	130,265	527,465
2032	129,000	326,535	455,535	65,215	0	65,215	390,320
2033	94,031	129,954	223,985	0	0	0	223,985
2034	57,914	88,044	145,958	0	0	0	145,958
2035	59,650	90,683	150,333	0	0	0	150,333
2036	61,433	93,405	154,838	0	0	0	154,838
2037	63,281	96,210	159,491	0	0	0	159,491
2038	65,177	99,093	164,270	0	0	0	164,270
2039	67,138	102,065	169,203	0	0	0	169,203
2040	51,860	78,928	130,788	0	0	0	130,788
2041	29,675	45,204	74,879	0	0	0	74,879
		Total =	$29,124,075			$11,883,713	$17,240,362
		NPV =	$21,334,922			$9,338,216	11,996,706

Total NPV = $11,996,706
Benefit/Cost Ratio = 2.28

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

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

Company: **Montana-Dakota Utilities Co.**
Project: **Total Program with Demand Response**
Program Years: **2022 - 2024**

Input Data

1) Retail Rate Summer ($/kWh) =
Retail Rate Winter ($/kWh) =
Retail Escalation Rate =
1a) Power Supply Cost Adjustment
Fuel Escalation Rate =

2) Avg. System Marginal Energy Cost ($/kWh) =
Escalation Rate =

3) Retail Summer Demand Rate ($/kW/season) =
3a) Retail Winter Demand Rate ($/kW/season) =
Escalation Rate =

4) Electric Margin ($/kWh) =
Escalation Rate =

5) System Peak Shaving Demand Cost ($/kW/yr)
Reserve Capacity=
Escalation Rate =

6) System Variable O&M ($/kWh) =
Escalation Rate =

7) Environmental Damage Factor =
Escalation Rate =

8) Participant Discount Rate = 9.65%

9) Utility Discount Rate = 7.22%

10) Societal Discount Rate = 1.56%

11) General Input Data Year = 2021

12) Project Analysis Year 1 = 2022
Project Analysis Year 2 = 2023
Project Analysis Year 3 = 2024

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$16,101	$13,970	$14,368
Incentive Costs =	$21,120	$24,180	$30,300
Total Utility Project Costs =	$37,221	$38,150	$44,668
14) Direct Participant Costs ($/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 =	1,005	1,006	1,006
20) Incentive/Participant =			
21) Effective Federal & State Income Tax Rate =			
22) Annual Summer Kwh Saved	86,526	94,789	101,315
Annual Winter Kwh Saved	103,052	119,578	152,630
23) Annual Summer KW Saved	429	433	43
Annual Winter KW Saved	29	33	43

Test Results	NPV	B/C
Ratepayer Impact Measure Test	$493,884	1.80
Utility Cost Test	$667,313	2.50
Societal Test	$1,478,087	3.35
Participant Test	$604,903	5.14
Total Resource Cost Test	$589,205	2.12

Table 1
Ratepayer Impact Test

Project: **Total Program with Demand Response**
Program Ye **2022 - 2024**

t	Year	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)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Direct Program Costs (O)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2022	204,823		$5,177		$0	510		$49,057	$54,234		189,578	$5,173	$16,101	$21,120	$23,016	$65,410	($11,176)
2	2023	436,425		11,362		0	1,030		102,042	113,404		403,945	11,315	13,970	24,180	46,032	95,497	17,907
3	2024	710,792		19,058		0	1,124		114,704	133,762		657,890	18,839	14,368	30,300	46,032	109,539	24,223
4	2025	710,792		19,632		0	1,124		118,144	137,776		657,890	19,688	0	0	46,032	65,720	72,056
5	2026	710,792		20,220		0	1,124		121,685	141,905		657,890	20,572	0	0	46,032	66,604	75,301
6	2027	710,792		20,826		0	1,124		125,337	146,163		657,890	21,500	0	0	46,032	67,532	78,631
7	2028	710,792		21,452		0	1,124		129,091	150,543		657,890	22,468	0	0	46,032	68,500	82,043
8	2029	710,792		22,095		0	1,124		132,970	155,065		657,890	23,477	0	0	46,032	69,509	85,556
9	2030	710,792		22,758		0	1,124		136,959	159,717		657,890	24,536	0	0	46,032	70,568	89,149
10	2031	678,379		22,374		0	1,116		140,058	162,432		627,890	22,560	0	0	46,032	68,592	93,840
11	2032	527,121		17,906		0	626		80,923	98,829		487,890	17,036	0	0	23,016	40,052	58,777
12	2033	375,865		13,151		0	140		18,641	31,792		347,890	10,969	0	0	0	10,969	20,823
13	2034	267,823		9,652		0	106		14,537	24,189		247,890	8,168	0	0	0	8,168	16,021
14	2035	267,823		9,942		0	106		14,973	24,915		247,890	8,535	0	0	0	8,535	16,380
15	2036	267,823		10,239		0	106		15,422	25,661		247,890	8,921	0	0	0	8,921	16,740
16	2037	267,823		10,547		0	106		15,885	26,432		247,890	9,321	0	0	0	9,321	17,111
17	2038	267,823		10,863		0	106		16,361	27,224		247,890	9,741	0	0	0	9,741	17,483
18	2039	267,823		11,190		0	106		16,852	28,042		247,890	10,179	0	0	0	10,179	17,863
19	2040	214,258		9,220		0	86		14,083	23,303		198,312	8,510	0	0	0	8,510	14,793
20	2041	133,911		5,935		0	54		10,474	16,409		123,945	5,558	0	0	0	5,558	10,851
Total =		9,153,264					12,066			$1,681,797		8,472,020					$867,425	$814,372
									NPV =	$1,113,188							$619,304	493,884

Total NPV = $493,884
Benefit/Cost Ratio = 1.80

Worksheet Calculations

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

Table 2
Utility Test

Project: **Total Program with Demand Response**
Program Years: **2022 - 2024**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2022	$5,177	$0	$49,057	$54,234	$60,237	$60,237	($6,003)
2023	11,362	0	102,042	113,404	84,182	84,182	29,222
2024	19,058	0	114,704	133,762	90,700	90,700	43,062
2025	19,632	0	118,144	137,776	46,032	46,032	91,744
2026	20,220	0	121,685	141,905	46,032	46,032	95,873
2027	20,826	0	125,337	146,163	46,032	46,032	100,131
2028	21,452	0	129,091	150,543	46,032	46,032	104,511
2029	22,095	0	132,970	155,065	46,032	46,032	109,033
2030	22,758	0	136,959	159,717	46,032	46,032	113,685
2031	22,374	0	140,058	162,432	46,032	46,032	116,400
2032	17,906	0	80,923	98,829	23,016	23,016	75,813
2033	13,151	0	18,641	31,792	0	0	31,792
2034	9,652	0	14,537	24,189	0	0	24,189
2035	9,942	0	14,973	24,915	0	0	24,915
2036	10,239	0	15,422	25,661	0	0	25,661
2037	10,547	0	15,885	26,432	0	0	26,432
2038	10,863	0	16,361	27,224	0	0	27,224
2039	11,190	0	16,852	28,042	0	0	28,042
2040	9,220	0	14,083	23,303	0	0	23,303
2041	5,935	0	10,474	16,409	0	0	16,409
Total =				$1,681,797		$580,359	$1,101,438
			NPV =	$1,113,188		$445,875	667,313

Total NPV =	$667,313
Benefit/Cost Ratio =	2.50

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: **2022 - 2024**

	Benefits					Costs			Annual
Year	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	Benefits Less Costs (I)
2022	$5,177	$0	$49,057	$17,149	$71,383	$60,431	$25,570	$86,001	($14,618)
2023	11,362	0	102,042	36,935	150,339	84,588	27,855	112,443	37,896
2024	19,058	0	114,704	44,873	178,635	91,124	26,425	117,549	61,086
2025	19,632	0	118,144	47,606	185,382	46,475	0	46,475	138,907
2026	20,220	0	121,685	50,503	192,408	46,495	0	46,495	145,913
2027	20,826	0	125,337	53,579	199,742	46,516	0	46,516	153,226
2028	21,452	0	129,091	56,841	207,384	46,538	0	46,538	160,846
2029	22,095	0	132,970	60,304	215,369	46,561	0	46,561	168,808
2030	22,758	0	136,959	63,978	223,695	46,585	0	46,585	177,110
2031	22,374	0	140,058	67,016	229,448	46,610	0	46,610	182,838
2032	17,906	0	80,923	41,999	140,828	23,318	0	23,318	117,510
2033	13,151	0	18,641	13,916	45,708	0	0	0	45,708
2034	9,652	0	14,537	10,905	35,094	0	0	0	35,094
2035	9,942	0	14,973	11,570	36,485	0	0	0	36,485
2036	10,239	0	15,422	12,274	37,935	0	0	0	37,935
2037	10,547	0	15,885	13,022	39,454	0	0	0	39,454
2038	10,863	0	16,361	13,814	41,038	0	0	0	41,038
2039	11,190	0	16,852	14,656	42,698	0	0	0	42,698
2040	9,220	0	14,083	12,545	35,848	0	0	0	35,848
2041	5,935	0	10,474	9,098	25,507	0	0	0	25,507
Total =					$2,334,380			$665,091	$1,669,289
				NPV =	$2,105,762			$627,675	1,478,087

Total NPV = $1,478,087
Benefit/Cost Ratio = 3.35

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: **2022 - 2024**

	Benefits												Costs			Annual
Year	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	Benefits Less Costs (P)
2022	$21,120			189,578	$17,744	429	29			$3,545	$2,100	$44,509	$47,436	$0	$47,436	($2,927)
2023	24,180			403,945	39,405	862	62			7,701	4,200	75,486	53,738	0	53,738	21,748
2024	30,300			657,890	66,841	905	105			11,993	4,200	113,334	59,902	0	59,902	53,432
2025	0			657,890	69,849	905	105			12,427	4,200	86,476	0	0	0	86,476
2026	0			657,890	72,991	905	105			12,881	4,200	90,072	0	0	0	90,072
2027	0			657,890	76,276	905	105			13,356	4,200	93,832	0	0	0	93,832
2028	0			657,890	79,711	905	105			13,852	4,200	97,763	0	0	0	97,763
2029	0			657,890	83,297	905	105			14,370	4,200	101,867	0	0	0	101,867
2030	0			657,890	87,043	905	105			14,912	4,200	106,155	0	0	0	106,155
2031	0			627,890	85,887	901	101			15,477	4,200	105,564	0	0	0	105,564
2032	0			487,890	69,095	482	82			12,687	2,100	83,882	0	0	0	83,882
2033	0			347,890	50,615	63	63			9,723	0	60,338	0	0	0	60,338
2034	0			247,890	37,657	48	48			7,741	0	45,398	0	0	0	45,398
2035	0			247,890	39,352	48	48			8,089	0	47,441	0	0	0	47,441
2036	0			247,890	41,122	48	48			8,453	0	49,575	0	0	0	49,575
2037	0			247,890	42,974	48	48			8,834	0	51,808	0	0	0	51,808
2038	0			247,890	44,907	48	48			9,231	0	54,138	0	0	0	54,138
2039	0			247,890	46,929	48	48			9,647	0	56,576	0	0	0	56,576
2040	0			198,312	39,232	38	38			7,981	0	47,213	0	0	0	47,213
2041	0			123,945	25,624	24	24			5,267	0	30,891	0	0	0	30,891
Total =						9,422	1,422					$1,442,318			$161,076	$1,281,242
											NPV =	$751,170			$146,267	604,903

Total NPV = $604,903
Benefit/Cost Ratio = 5.14

Worksheet Calculations	
(A) = Table 1 (N)	(I) = Retail Winter Demand Rate, escalated.
(B) = Retail Summer Rate, escalated.	(J) = (A) + (D) + (I) + (J)
(C) = Retail Winter Rate, escalated.	(K) = Number of Participants (20) x Other Participant Savings (14b), escalatec
(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: **2022 - 2024**

	Benefits			Costs			
Year	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	Benefits Less Costs (G)
2022	$5,177	$49,057	$54,234	$60,431	$25,570	$86,001	($31,767)
2023	11,362	102,042	113,404	84,588	27,855	112,443	961
2024	19,058	114,704	133,762	91,124	26,425	117,549	16,213
2025	19,632	118,144	137,776	46,475	0	46,475	91,301
2026	20,220	121,685	141,905	46,495	0	46,495	95,410
2027	20,826	125,337	146,163	46,516	0	46,516	99,647
2028	21,452	129,091	150,543	46,538	0	46,538	104,005
2029	22,095	132,970	155,065	46,561	0	46,561	108,504
2030	22,758	136,959	159,717	46,585	0	46,585	113,132
2031	22,374	140,058	162,432	46,610	0	46,610	115,822
2032	17,906	80,923	98,829	23,318	0	23,318	75,511
2033	13,151	18,641	31,792	0	0	0	31,792
2034	9,652	14,537	24,189	0	0	0	24,189
2035	9,942	14,973	24,915	0	0	0	24,915
2036	10,239	15,422	25,661	0	0	0	25,661
2037	10,547	15,885	26,432	0	0	0	26,432
2038	10,863	16,361	27,224	0	0	0	27,224
2039	11,190	16,852	28,042	0	0	0	28,042
2040	9,220	14,083	23,303	0	0	0	23,303
2041	5,935	10,474	16,409	0	0	0	16,409
		Total =	$1,681,797			$665,091	$1,016,706
		NPV =	$1,113,188			$523,983	589,205

Total NPV =	$589,205
Benefit/Cost Ratio =	2.12

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

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

Company: **Montana-Dakota Utilities Co.**
Project: **Residential Lighting**
Program Years: **2022 - 2024**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.11882
Retail Rate Winter ($/kWh) =	$0.10277
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.02091
Fuel Escalation Rate =	3.00%
2) Avg. System Marginal Energy Cost ($/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)	$90.78
Reserve Capacity=	18.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.65%
9) Utility Discount Rate =	7.04%
10) Societal Discount Rate =	1.56%
11) General Input Data Year =	2021
12) Project Analysis Year 1 =	2022
Project Analysis Year 2 =	2023
Project Analysis Year 3 =	2024

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$8,058	$4,754	$4,282
Incentive Costs =	15,000	15,000	15,000
Total Utility Project Costs =	$23,058	$19,754	$19,282
14) Direct Participant Costs ($/Part.) =	$10	$10	$10
Escalation Rate =	1.83%	1.83%	1.83%
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	11.4500%	11.4500%	11.4500%
18b) System Energy Line Loss Factor	8.0410%	8.0410%	8.0410%
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	($71,473)	0.64
Utility Cost Test	$71,005	2.22
Societal Test	$123,701	2.17
Participant Test	$173,581	3.04
Total Resource Cost Test	$28,901	1.29

Table 1
Ratepayer Impact Test

Project: **Residential Lighting**
Program Years: **2022 - 2024**

t	Year	Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Costs: Summer Energy Reduction (K1)	Costs: Winter Energy Reduction (K2)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2022	97,237	$0.02907	$2,827	$0.00000	$0	13	13	26	$110.62	$2,876	$5,703	$0.08957	30,000	60,000	90,000	$5,939	$8,058	$15,000	$28,997	($23,294)
2	2023	194,474	0.02994	5,823	0.00000	0	27	27	54	113.93	6,152	11,975	0.09360	60,000	120,000	180,000	12,412	4,754	15,000	32,166	(20,191)
3	2024	291,711	0.03084	8,996	0.00000	0	40	40	80	117.35	9,388	18,384	0.09781	90,000	180,000	270,000	19,455	4,282	15,000	38,737	(20,353)
4	2025	291,711	0.03176	9,265	0.00000	0	40	40	80	120.87	9,670	18,935	0.10221	90,000	180,000	270,000	20,330	0	0	20,330	(1,395)
5	2026	291,711	0.03271	9,542	0.00000	0	40	40	80	124.50	9,960	19,502	0.10681	90,000	180,000	270,000	21,245	0	0	21,245	(1,743)
6	2027	291,711	0.03370	9,831	0.00000	0	40	40	80	128.23	10,258	20,089	0.11162	90,000	180,000	270,000	22,201	0	0	22,201	(2,112)
7	2028	291,711	0.03471	10,125	0.00000	0	40	40	80	132.08	10,566	20,691	0.11664	90,000	180,000	270,000	23,200	0	0	23,200	(2,509)
8	2029	291,711	0.03575	10,429	0.00000	0	40	40	80	136.04	10,883	21,312	0.12189	90,000	180,000	270,000	24,244	0	0	24,244	(2,932)
9	2030	291,711	0.03682	10,741	0.00000	0	40	40	80	140.12	11,210	21,951	0.12737	90,000	180,000	270,000	25,334	0	0	25,334	(3,383)
10	2031	194,474	0.03792	7,374	0.00000	0	27	27	54	144.33	7,794	15,168	0.13311	60,000	120,000	180,000	17,651	0	0	17,651	(2,483)
11	2032	97,237	0.03906	3,798	0.00000	0	13	13	26	148.66	3,865	7,663	0.13909	30,000	60,000	90,000	9,222	0	0	9,222	(1,559)
12	2033	0	0.04023	0	0.00000	0	0	0	0	153.12	0	0	0.14535	0	0	0	0	0	0	0	0
13	2034	0	0.04144	0	0.00000	0	0	0	0	157.71	0	0	0.15189	0	0	0	0	0	0	0	0
14	2035	0	0.04268	0	0.00000	0	0	0	0	162.44	0	0	0.15873	0	0	0	0	0	0	0	0
15	2036	0	0.04396	0	0.00000	0	0	0	0	167.32	0	0	0.16587	0	0	0	0	0	0	0	0
16	2037	0	0.04528	0	0.00000	0	0	0	0	172.34	0	0	0.17334	0	0	0	0	0	0	0	0
17	2038	0	0.04664	0	0.00000	0	0	0	0	177.51	0	0	0.18114	0	0	0	0	0	0	0	0
18	2039	0	0.04804	0	0.00000	0	0	0	0	182.83	0	0	0.18929	0	0	0	0	0	0	0	0
19	2040	0	0.04948	0	0.00000	0	0	0	0	188.32	0	0	0.19781	0	0	0	0	0	0	0	0
20	2041	0	0.05096	0	0.00000	0	0	0	0	193.97	0	0	0.20671	0	0	0	0	0	0	0	0
Total =		2,625,399							720			$181,373				2,430,000				$263,327	($81,954)
											NPV =	$129,345								$200,818	(71,473)

Total NPV = ($71,473)
Benefit/Cost Ratio = 0.64

Worksheet Calculations

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

Table 2
Utility Test

Project: **Residential Lighting**
Program Years: **2022 - 2024**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2022	$2,827	$0	$2,876	$5,703	$23,058	$23,058	($17,355)
2023	5,823	0	6,152	11,975	19,754	19,754	(7,779)
2024	8,996	0	9,388	18,384	19,282	19,282	(898)
2025	9,265	0	9,670	18,935	0	0	18,935
2026	9,542	0	9,960	19,502	0	0	19,502
2027	9,831	0	10,258	20,089	0	0	20,089
2028	10,125	0	10,566	20,691	0	0	20,691
2029	10,429	0	10,883	21,312	0	0	21,312
2030	10,741	0	11,210	21,951	0	0	21,951
2031	7,374	0	7,794	15,168	0	0	15,168
2032	3,798	0	3,865	7,663	0	0	7,663
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
Total =				$181,373		$62,094	$119,279
			NPV =	$129,345		$58,340	71,005

Total NPV =	$71,005
Benefit/Cost Ratio =	2.22

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: **2022 - 2024**

	Benefits					Costs			Annual
Year	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	Benefits Less Costs (I)
2022	$2,827	$0	$2,876	$1,803	$7,506	$23,058	$15,000	$38,058	($30,552)
2023	5,823	0	6,152	3,900	15,875	19,754	15,000	34,754	(18,879)
2024	8,996	0	9,388	6,167	24,551	19,282	15,000	34,282	(9,731)
2025	9,265	0	9,670	6,543	25,478	0	0	0	25,478
2026	9,542	0	9,960	6,941	26,443	0	0	0	26,443
2027	9,831	0	10,258	7,364	27,453	0	0	0	27,453
2028	10,125	0	10,566	7,812	28,503	0	0	0	28,503
2029	10,429	0	10,883	8,288	29,600	0	0	0	29,600
2030	10,741	0	11,210	8,793	30,744	0	0	0	30,744
2031	7,374	0	7,794	6,258	21,426	0	0	0	21,426
2032	3,798	0	3,865	3,256	10,919	0	0	0	10,919
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
2040	0	0	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0	0	0
Total =					$248,498			$107,094	$141,404
				NPV =	$229,216			$105,515	123,701

Total NPV = $123,701
Benefit/Cost Ratio = 2.17

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: **2022 - 2024**

	Benefits														Costs			Annual
Year	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	Benefits Less Costs (P)
2022	$15,000	$0.12417	$0.10739	30,000	60,000	90,000	$10,169	12	12	$0.000	$0.000	$0	$0	$25,169	$30,550	$0	$30,550	($5,381)
2023	15,000	0.12975	0.11223	60,000	120,000	180,000	21,253	24	24	0.000	0.000	0	0	36,253	31,110	0	31,110	5,143
2024	15,000	0.13559	0.11728	90,000	180,000	270,000	33,314	36	36	0.000	0.000	0	0	48,314	31,680	0	31,680	16,634
2025	0	0.14170	0.12256	90,000	180,000	270,000	34,814	36	36	0.000	0.000	0	0	34,814	0	0	0	34,814
2026	0	0.14807	0.12807	90,000	180,000	270,000	36,379	36	36	0.000	0.000	0	0	36,379	0	0	0	36,379
2027	0	0.15473	0.13383	90,000	180,000	270,000	38,015	36	36	0.000	0.000	0	0	38,015	0	0	0	38,015
2028	0	0.16170	0.13986	90,000	180,000	270,000	39,728	36	36	0.000	0.000	0	0	39,728	0	0	0	39,728
2029	0	0.16897	0.14615	90,000	180,000	270,000	41,514	36	36	0.000	0.000	0	0	41,514	0	0	0	41,514
2030	0	0.17658	0.15273	90,000	180,000	270,000	43,384	36	36	0.000	0.000	0	0	43,384	0	0	0	43,384
2031	0	0.18452	0.15960	60,000	120,000	180,000	30,223	24	24	0.000	0.000	0	0	30,223	0	0	0	30,223
2032	0	0.19283	0.16678	30,000	60,000	90,000	15,792	12	12	0.000	0.000	0	0	15,792	0	0	0	15,792
2033	0	0.20150	0.17429	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.21057	0.18213	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.22005	0.19032	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.22995	0.19889	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.24030	0.20784	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2038	0	0.25111	0.21719	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2039	0	0.26241	0.22697	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2040	0	0.27422	0.23718	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2041	0	0.28656	0.24785	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					$389,585			$93,340	$296,245
													NPV =	$258,853			$85,271	173,581

Total NPV = $173,581
Benefit/Cost Ratio = 3.04

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Residential Lighting**
Project: **2022 - 2024**

	Benefits			Costs			
Year	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	Benefits Less Costs (G)
2022	$2,827	$2,876	$5,703	$23,058	$15,000	$38,058	($32,355)
2023	5,823	6,152	11,975	19,754	15,000	34,754	(22,779)
2024	8,996	9,388	18,384	19,282	15,000	34,282	(15,898)
2025	9,265	9,670	18,935	0	0	0	18,935
2026	9,542	9,960	19,502	0	0	0	19,502
2027	9,831	10,258	20,089	0	0	0	20,089
2028	10,125	10,566	20,691	0	0	0	20,691
2029	10,429	10,883	21,312	0	0	0	21,312
2030	10,741	11,210	21,951	0	0	0	21,951
2031	7,374	7,794	15,168	0	0	0	15,168
2032	3,798	3,865	7,663	0	0	0	7,663
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
		Total =	$181,373			$107,094	$74,279
		NPV =	$129,345			$100,445	28,901

Total NPV = $28,901
Benefit/Cost Ratio = 1.29

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

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

Company: **Montana-Dakota Utilities Co.**
Project: **Residential Lighting**
Program Years: **2022 - 2024**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.11344
Retail Rate Winter ($/kWh) =	$0.10332
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.02003
Fuel Escalation Rate =	3.00%
2) Avg. System Marginal Energy Cost ($/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)	$78.94
Reserve Capacity=	18.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.65%
9) Utility Discount Rate =	7.36%
10) Societal Discount Rate =	1.56%
11) General Input Data Year =	2021
12) Project Analysis Year 1 =	2022
Project Analysis Year 2 =	2023
Project Analysis Year 3 =	2024

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$20,043	$13,295	$11,091
Incentive Costs =	50,000	50,000	50,000
Total Utility Project Costs =	$70,043	$63,295	$61,091
14) Direct Participant Costs ($/Part.) =	$10	$10	$10
Escalation Rate =	1.83%	1.83%	1.83%
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	11.4500%	11.4500%	11.4500%
18b) System Energy Line Loss Factor	8.0410%	8.0410%	8.0410%
19) Number of Participants =	10,000	10,000	10,000
20) Incentive/Participant =	$5	$5	$5
21) Effective Federal & State Income Tax Rate =			26.33%
22) Annual Summer Kwh Saved	100,000	100,000	100,000
Annual Winter Kwh Saved	200,000	200,000	200,000
23) Annual Summer KW Saved	40	40	40
Annual Winter KW Saved	40	40	40

Test Results	**NPV**	**B/C**
Ratepayer Impact Measure Test	($251,950)	0.60
Utility Cost Test	$193,382	2.06
Societal Test	$326,794	1.96
Participant Test	$569,021	3.00
Total Resource Cost Test	$53,035	1.16

Table 1
Ratepayer Impact Test

Project: **Residential Lighting**
Program Years: **2022 - 2024**

t	Year	Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2022	324,123	$0.02528	$8,192	$0.00000	$0	45	45	90	$96.19	$8,657	$16,849	$0.08399	100,000	200,000	300,000	$18,562	$20,043	$50,000	$88,605	($71,756)
2	2023	648,246	0.02603	16,876	0.00000	0	89	89	178	99.07	17,634	34,510	0.08777	200,000	400,000	600,000	38,795	13,295	50,000	102,090	(67,580)
3	2024	972,369	0.02681	26,073	0.00000	0	134	134	268	102.05	27,349	53,422	0.09172	300,000	600,000	900,000	60,811	11,091	50,000	121,902	(68,480)
4	2025	972,369	0.02762	26,856	0.00000	0	134	134	268	105.11	28,169	55,025	0.09584	300,000	600,000	900,000	63,543	0	0	63,543	(8,518)
5	2026	972,369	0.02845	27,661	0.00000	0	134	134	268	108.26	29,014	56,675	0.10016	300,000	600,000	900,000	66,407	0	0	66,407	(9,732)
6	2027	972,369	0.02930	28,491	0.00000	0	134	134	268	111.51	29,885	58,376	0.10466	300,000	600,000	900,000	69,390	0	0	69,390	(11,014)
7	2028	972,369	0.03018	29,346	0.00000	0	134	134	268	114.85	30,780	60,126	0.10937	300,000	600,000	900,000	72,513	0	0	72,513	(12,387)
8	2029	972,369	0.03109	30,226	0.00000	0	134	134	268	118.30	31,704	61,930	0.11429	300,000	600,000	900,000	75,775	0	0	75,775	(13,845)
9	2030	972,369	0.03202	31,133	0.00000	0	134	134	268	121.85	32,656	63,789	0.11944	300,000	600,000	900,000	79,190	0	0	79,190	(15,401)
10	2031	648,246	0.03298	21,379	0.00000	0	89	89	178	125.50	22,339	43,718	0.12481	200,000	400,000	600,000	55,167	0	0	55,167	(11,449)
11	2032	324,123	0.03397	11,010	0.00000	0	45	45	90	129.27	11,634	22,644	0.13043	100,000	200,000	300,000	28,825	0	0	28,825	(6,181)
12	2033	0	0.03499	0	0.00000	0	0	0	0	133.15	0	0	0.13630	0	0	0	0	0	0	0	0
13	2034	0	0.03604	0	0.00000	0	0	0	0	137.14	0	0	0.14243	0	0	0	0	0	0	0	0
14	2035	0	0.03712	0	0.00000	0	0	0	0	141.25	0	0	0.14884	0	0	0	0	0	0	0	0
15	2036	0	0.03823	0	0.00000	0	0	0	0	145.49	0	0	0.15554	0	0	0	0	0	0	0	0
16	2037	0	0.03938	0	0.00000	0	0	0	0	149.86	0	0	0.16254	0	0	0	0	0	0	0	0
17	2038	0	0.04056	0	0.00000	0	0	0	0	154.35	0	0	0.16985	0	0	0	0	0	0	0	0
18	2039	0	0.04178	0	0.00000	0	0	0	0	158.98	0	0	0.17750	0	0	0	0	0	0	0	0
19	2040	0	0.04303	0	0.00000	0	0	0	0	163.75	0	0	0.18548	0	0	0	0	0	0	0	0
20	2041	0	0.04432	0	0.00000	0	0	0	0	168.67	0	0	0.19383	0	0	0	0	0	0	0	0
Total =		8,751,321							2,412			$527,064				8,100,000				$823,407	########
											NPV =	$375,872								$627,822	(251,950)

Total NPV = ($251,950)
Benefit/Cost Ratio = 0.60

Worksheet Calculations

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

Table 2
Utility Test

Project: **Residential Lighting**
Program Years: **2022 - 2024**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2022	$8,192	$0	$8,657	$16,849	$70,043	$70,043	($53,194)
2023	16,876	0	17,634	34,510	63,295	63,295	(28,785)
2024	26,073	0	27,349	53,422	61,091	61,091	(7,669)
2025	26,856	0	28,169	55,025	0	0	55,025
2026	27,661	0	29,014	56,675	0	0	56,675
2027	28,491	0	29,885	58,376	0	0	58,376
2028	29,346	0	30,780	60,126	0	0	60,126
2029	30,226	0	31,704	61,930	0	0	61,930
2030	31,133	0	32,656	63,789	0	0	63,789
2031	21,379	0	22,339	43,718	0	0	43,718
2032	11,010	0	11,634	22,644	0	0	22,644
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
Total =				$527,064		$194,429	$332,635
			NPV =	$375,872		$182,490	193,382

Total NPV = $193,382
Benefit/Cost Ratio = 2.06

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: **2022 - 2024**

	Benefits					Costs			Annual
Year	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	Benefits Less Costs (I)
2022	$8,192	$0	$8,657	$5,328	$22,177	$70,043	$50,000	$120,043	($97,866)
2023	16,876	0	17,634	11,240	45,750	63,295	50,000	113,295	(67,545)
2024	26,073	0	27,349	17,921	71,343	61,091	50,000	111,091	(39,748)
2025	26,856	0	28,169	19,013	74,038	0	0	0	74,038
2026	27,661	0	29,014	20,170	76,845	0	0	0	76,845
2027	28,491	0	29,885	21,399	79,775	0	0	0	79,775
2028	29,346	0	30,780	22,702	82,828	0	0	0	82,828
2029	30,226	0	31,704	24,084	86,014	0	0	0	86,014
2030	31,133	0	32,656	25,552	89,341	0	0	0	89,341
2031	21,379	0	22,339	18,037	61,755	0	0	0	61,755
2032	11,010	0	11,634	9,623	32,267	0	0	0	32,267
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
2040	0	0	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0	0	0
Total =					$722,133			$344,429	$377,704
				NPV =	$666,096			$339,302	326,794

Total NPV = $326,794
Benefit/Cost Ratio = 1.96

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: **2022 - 2024**

	Benefits														Costs			Annual
Year	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	Benefits Less Costs (P)
2022	$50,000	$0.11854	$0.10797	100,000	200,000	300,000	$33,448	40	40	$0.000	$0.000	$0	$0	$83,448	$101,833	$0	$101,833	($18,385)
2023	50,000	0.12388	0.11283	200,000	400,000	600,000	69,908	80	80	0.000	0.000	0	0	119,908	103,700	0	103,700	16,208
2024	50,000	0.12945	0.11791	300,000	600,000	900,000	109,581	120	120	0.000	0.000	0	0	159,581	105,601	0	105,601	53,980
2025	0	0.13528	0.12321	300,000	600,000	900,000	114,510	120	120	0.000	0.000	0	0	114,510	0	0	0	114,510
2026	0	0.14137	0.12876	300,000	600,000	900,000	119,667	120	120	0.000	0.000	0	0	119,667	0	0	0	119,667
2027	0	0.14773	0.13455	300,000	600,000	900,000	125,049	120	120	0.000	0.000	0	0	125,049	0	0	0	125,049
2028	0	0.15438	0.14060	300,000	600,000	900,000	130,674	120	120	0.000	0.000	0	0	130,674	0	0	0	130,674
2029	0	0.16132	0.14693	300,000	600,000	900,000	136,554	120	120	0.000	0.000	0	0	136,554	0	0	0	136,554
2030	0	0.16858	0.15354	300,000	600,000	900,000	142,698	120	120	0.000	0.000	0	0	142,698	0	0	0	142,698
2031	0	0.17617	0.16045	200,000	400,000	600,000	99,414	80	80	0.000	0.000	0	0	99,414	0	0	0	99,414
2032	0	0.18410	0.16767	100,000	200,000	300,000	51,944	40	40	0.000	0.000	0	0	51,944	0	0	0	51,944
2033	0	0.19238	0.17522	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.20104	0.18310	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.21008	0.19134	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.21954	0.19995	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.22942	0.20895	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2038	0	0.23974	0.21835	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2039	0	0.25053	0.22818	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2040	0	0.26180	0.23845	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2041	0	0.27358	0.24918	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				2,700,000	5,400,000			1,080	1,080					$1,283,447			$311,134	$972,313
													NPV =	$853,259			$284,238	569,021

Total NPV = $569,021
Benefit/Cost Ratio = 3.00

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Residential Lighting**
Project: **2022 - 2024**

	Benefits			Costs			
Year	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	Benefits Less Costs (G)
2022	$8,192	$8,657	$16,849	$70,043	$50,000	$120,043	($103,194)
2023	16,876	17,634	34,510	63,295	50,000	113,295	(78,785)
2024	26,073	27,349	53,422	61,091	50,000	111,091	(57,669)
2025	26,856	28,169	55,025	0	0	0	55,025
2026	27,661	29,014	56,675	0	0	0	56,675
2027	28,491	29,885	58,376	0	0	0	58,376
2028	29,346	30,780	60,126	0	0	0	60,126
2029	30,226	31,704	61,930	0	0	0	61,930
2030	31,133	32,656	63,789	0	0	0	63,789
2031	21,379	22,339	43,718	0	0	0	43,718
2032	11,010	11,634	22,644	0	0	0	22,644
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
		Total =	$527,064			$344,429	$182,635
		NPV =	$375,872			$322,837	53,035

Total NPV = $53,035
Benefit/Cost Ratio = 1.16

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: **Residential Lighting**
Program Years: **2022 - 2024**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.11866
Retail Rate Winter ($/kWh) =	$0.10399
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.01960
Fuel Escalation Rate =	3.00%
2) Avg. System Marginal Energy Cost ($/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)	$78.94
Reserve Capacity=	18.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.65%
9) Utility Discount Rate =	7.22%
10) Societal Discount Rate =	1.56%
11) General Input Data Year =	2021
12) Project Analysis Year 1 =	2022
Project Analysis Year 2 =	2023
Project Analysis Year 3 =	2024

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$3,332	$2,111	$1,732
Incentive Costs =	5,000	5,000	5,000
Total Utility Project Costs =	$8,332	$7,111	$6,732
14) Direct Participant Costs ($/Part.) =	$10	$10	$10
Escalation Rate =	1.83%	1.83%	1.83%
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	11.4500%	11.4500%	11.4500%
18b) System Energy Line Loss Factor	8.0410%	8.0410%	8.0410%
19) Number of Participants =	1,000	1,000	1,000
20) Incentive/Participant =	$5	$5	$5
21) Effective Federal & State Income Tax Rate =			26.33%
22) Annual Summer Kwh Saved	10,000	10,000	10,000
Annual Winter Kwh Saved	20,000	20,000	20,000
23) Annual Summer KW Saved	4	4	4
Annual Winter KW Saved	4	4	4

Test Results	**NPV**	**B/C**
Ratepayer Impact Measure Test	($33,568)	0.52
Utility Cost Test	$16,163	1.78
Societal Test	$28,960	1.79
Participant Test	$58,371	3.05
Total Resource Cost Test	$2,127	1.06

Table 1
Ratepayer Impact Test

Project: **Residential Lighting**
Program Years: **2022 - 2024**

t	Year	Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2022	32,412	$0.02528	$819	$0.00000	$0	4	4	8	$96.19	$770	$1,589	$0.09379	10,000	20,000	30,000	$2,073	$3,332	$5,000	$10,405	($8,816)
2	2023	64,824	0.02603	1,688	0.00000	0	9	9	18	99.07	1,783	3,471	0.09801	20,000	40,000	60,000	4,332	2,111	5,000	11,443	(7,972)
3	2024	97,237	0.02681	2,607	0.00000	0	13	13	26	102.05	2,653	5,260	0.10242	30,000	60,000	90,000	6,791	1,732	5,000	13,523	(8,263)
4	2025	97,237	0.02762	2,686	0.00000	0	13	13	26	105.11	2,733	5,419	0.10703	30,000	60,000	90,000	7,096	0	0	7,096	(1,677)
5	2026	97,237	0.02845	2,766	0.00000	0	13	13	26	108.26	2,815	5,581	0.11184	30,000	60,000	90,000	7,415	0	0	7,415	(1,834)
6	2027	97,237	0.02930	2,849	0.00000	0	13	13	26	111.51	2,899	5,748	0.11688	30,000	60,000	90,000	7,749	0	0	7,749	(2,001)
7	2028	97,237	0.03018	2,935	0.00000	0	13	13	26	114.85	2,986	5,921	0.12214	30,000	60,000	90,000	8,098	0	0	8,098	(2,177)
8	2029	97,237	0.03109	3,023	0.00000	0	13	13	26	118.30	3,076	6,099	0.12763	30,000	60,000	90,000	8,462	0	0	8,462	(2,363)
9	2030	97,237	0.03202	3,113	0.00000	0	13	13	26	121.85	3,168	6,281	0.13338	30,000	60,000	90,000	8,843	0	0	8,843	(2,562)
10	2031	64,824	0.03298	2,138	0.00000	0	9	9	18	125.50	2,259	4,397	0.13938	20,000	40,000	60,000	6,161	0	0	6,161	(1,764)
11	2032	32,412	0.03397	1,101	0.00000	0	4	4	8	129.27	1,034	2,135	0.14565	10,000	20,000	30,000	3,219	0	0	3,219	(1,084)
12	2033	0	0.03499	0	0.00000	0	0	0	0	133.15	0	0	0.15221	0	0	0	0	0	0	0	0
13	2034	0	0.03604	0	0.00000	0	0	0	0	137.14	0	0	0.15905	0	0	0	0	0	0	0	0
14	2035	0	0.03712	0	0.00000	0	0	0	0	141.25	0	0	0.16621	0	0	0	0	0	0	0	0
15	2036	0	0.03823	0	0.00000	0	0	0	0	145.49	0	0	0.17369	0	0	0	0	0	0	0	0
16	2037	0	0.03938	0	0.00000	0	0	0	0	149.86	0	0	0.18151	0	0	0	0	0	0	0	0
17	2038	0	0.04056	0	0.00000	0	0	0	0	154.35	0	0	0.18968	0	0	0	0	0	0	0	0
18	2039	0	0.04178	0	0.00000	0	0	0	0	158.98	0	0	0.19821	0	0	0	0	0	0	0	0
19	2040	0	0.04303	0	0.00000	0	0	0	0	163.75	0	0	0.20713	0	0	0	0	0	0	0	0
20	2041	0	0.04432	0	0.00000	0	0	0	0	193.97	0	0	0.21645	0	0	0	0	0	0	0	0
Total =		875,131							234			$51,901				810,000				$92,414	($40,513)
											NPV =	$37,013								$70,581	(33,568)

Total NPV = ($33,568)
Benefit/Cost Ratio = 0.52

Worksheet Calculations

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

Table 2
Utility Test

Project: **Residential Lighting**
Program Years: **2022 - 2024**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2022	$819	$0	$770	$1,589	$8,332	$8,332	($6,743)
2023	1,688	0	1,783	3,471	7,111	7,111	(3,640)
2024	2,607	0	2,653	5,260	6,732	6,732	(1,472)
2025	2,686	0	2,733	5,419	0	0	5,419
2026	2,766	0	2,815	5,581	0	0	5,581
2027	2,849	0	2,899	5,748	0	0	5,748
2028	2,935	0	2,986	5,921	0	0	5,921
2029	3,023	0	3,076	6,099	0	0	6,099
2030	3,113	0	3,168	6,281	0	0	6,281
2031	2,138	0	2,259	4,397	0	0	4,397
2032	1,101	0	1,034	2,135	0	0	2,135
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
Total =				$51,901		$22,175	$29,726
			NPV =	$37,013		$20,850	16,163

Total NPV = $16,163
Benefit/Cost Ratio = 1.78

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

Table 3
Societal Cost Test

Project: **Residential Lighting**
Program Years: **2022 - 2024**

	Benefits					Costs			Annual
Year	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	Benefits Less Costs (I)
2022	$819	$0	$770	$502	$2,091	$8,332	$5,000	$13,332	($11,241)
2023	1,688	0	1,783	1,130	4,601	7,111	5,000	12,111	(7,510)
2024	2,607	0	2,653	1,765	7,025	6,732	5,000	11,732	(4,707)
2025	2,686	0	2,733	1,872	7,291	0	0	0	7,291
2026	2,766	0	2,815	1,986	7,567	0	0	0	7,567
2027	2,849	0	2,899	2,107	7,855	0	0	0	7,855
2028	2,935	0	2,986	2,236	8,157	0	0	0	8,157
2029	3,023	0	3,076	2,372	8,471	0	0	0	8,471
2030	3,113	0	3,168	2,516	8,797	0	0	0	8,797
2031	2,138	0	2,259	1,814	6,211	0	0	0	6,211
2032	1,101	0	1,034	907	3,042	0	0	0	3,042
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
2040	0	0	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0	0	0
Total =					$71,108			$37,175	$33,933
				NPV =	$65,591			$36,631	28,960

Total NPV =	$28,960
Benefit/Cost Ratio =	1.79

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: **2022 - 2024**

	Benefits														Costs			Annual
Year	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	Benefits Less Costs (P)
2022	$5,000	$0.12400	$0.10867	10,000	20,000	30,000	$3,413	4	4	$0.000	$0.000	$0	$0	$8,413	$10,183	$0	$10,183	($1,770)
2023	5,000	0.12958	0.11356	20,000	40,000	60,000	7,134	8	8	0.000	0.000	0	0	12,134	10,370	0	10,370	1,764
2024	5,000	0.13541	0.11867	30,000	60,000	90,000	11,183	12	12	0.000	0.000	0	0	16,183	10,560	0	10,560	5,623
2025	0	0.14150	0.12401	30,000	60,000	90,000	11,686	12	12	0.000	0.000	0	0	11,686	0	0	0	11,686
2026	0	0.14787	0.12959	30,000	60,000	90,000	12,212	12	12	0.000	0.000	0	0	12,212	0	0	0	12,212
2027	0	0.15453	0.13542	30,000	60,000	90,000	12,761	12	12	0.000	0.000	0	0	12,761	0	0	0	12,761
2028	0	0.16148	0.14152	30,000	60,000	90,000	13,336	12	12	0.000	0.000	0	0	13,336	0	0	0	13,336
2029	0	0.16875	0.14788	30,000	60,000	90,000	13,935	12	12	0.000	0.000	0	0	13,935	0	0	0	13,935
2030	0	0.17634	0.15454	30,000	60,000	90,000	14,563	12	12	0.000	0.000	0	0	14,563	0	0	0	14,563
2031	0	0.18428	0.16149	20,000	40,000	60,000	10,145	8	8	0.000	0.000	0	0	10,145	0	0	0	10,145
2032	0	0.19257	0.16876	10,000	20,000	30,000	5,301	4	4	0.000	0.000	0	0	5,301	0	0	0	5,301
2033	0	0.20123	0.17635	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2034	0	0.21029	0.18429	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2035	0	0.21975	0.19258	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2036	0	0.22964	0.20125	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2037	0	0.23997	0.21031	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2038	0	0.25077	0.21977	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2039	0	0.26206	0.22966	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2040	0	0.27385	0.23999	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
2041	0	0.28617	0.25079	0	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Total =				270,000	540,000			108	108					$130,669			$31,113	$99,556
													NPV =	$86,794			$28,423	58,371

Total NPV = $58,371
Benefit/Cost Ratio = 3.05

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Residential Lighting**
Project: **2022 - 2024**

	Benefits			Costs			
Year	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	Benefits Less Costs (G)
2022	$819	$770	$1,589	$8,332	$5,000	$13,332	($11,743)
2023	1,688	1,783	3,471	7,111	5,000	12,111	(8,640)
2024	2,607	2,653	5,260	6,732	5,000	11,732	(6,472)
2025	2,686	2,733	5,419	0	0	0	5,419
2026	2,766	2,815	5,581	0	0	0	5,581
2027	2,849	2,899	5,748	0	0	0	5,748
2028	2,935	2,986	5,921	0	0	0	5,921
2029	3,023	3,076	6,099	0	0	0	6,099
2030	3,113	3,168	6,281	0	0	0	6,281
2031	2,138	2,259	4,397	0	0	0	4,397
2032	1,101	1,034	2,135	0	0	0	2,135
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
		Total =	$51,901			$37,175	$14,726
		NPV =	$37,013			$34,885	2,127

Total NPV =	$2,127
Benefit/Cost Ratio =	1.06

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

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

Company: **Montana-Dakota Utilities Co.**
Project: **Commerical Lighting**
Program Years: **2022 - 2024**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.09538
Retail Rate Winter ($/kWh) =	$0.09219
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.02142
Fuel Escalation Rate =	3.00%
2) Avg. System Marginal Energy Cost ($/kWh) =	$0.00000
Escalation Rate =	3.00%
3) Retail Summer Demand Rate ($/kW/season) =	$50.60
3a) Retail Winter Demand Rate ($/kW/season) =	$90.40
Escalation Rate =	4.50%
4) Electric Margin ($/kWh) =	$0.07001
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/kW/yr)	$90.78
Reserve Capacity=	18.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.65%
9) Utility Discount Rate =	7.04%
10) Societal Discount Rate =	1.56%
11) General Input Data Year =	2021
12) Project Analysis Year 1 =	2022
Project Analysis Year 2 =	2023
Project Analysis Year 3 =	2024

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$8,219	$9,697	$4,367
Incentive Costs =	15,300	30,600	15,300
Total Utility Project Costs =	$23,519	$40,297	$19,667
14) Direct Participant Costs ($/Part.) =	$5,345	$5,345	$5,345
Escalation Rate =	1.83%	1.83%	1.83%
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	11.4500%	11.4500%	11.4500%
18b) System Energy Line Loss Factor	8.0410%	8.0410%	8.0410%
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	($114,946)	0.75
Utility Cost Test	$270,842	4.46
Societal Test	$680,465	6.35
Participant Test	$582,673	6.76
Total Resource Cost Test	$228,100	2.88

Table 1
Ratepayer Impact Test

Project: **Commerical Lighting**
Program Years: **2022 - 2024**

t	Year	Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2022	133,911	$0.02907	$3,893	$0.00000	$0	27	0	27	$110.62	$2,987	$6,880	$0.07316	41,315	82,630	123,945	$6,680	$8,219	$15,300	$30,199	($23,319)
2	2023	401,734	0.02994	12,028	0.00000	0	80	0	80	113.93	9,114	21,142	0.07645	123,945	247,890	371,835	20,941	9,697	30,600	61,238	(40,096)
3	2024	535,646	0.03084	16,519	0.00000	0	107	0	107	117.35	12,556	29,075	0.07989	165,260	330,520	495,780	29,178	4,367	15,300	48,845	(19,770)
4	2025	535,646	0.03176	17,012	0.00000	0	107	0	107	120.87	12,933	29,945	0.08349	165,260	330,520	495,780	30,493	0	0	30,493	(548)
5	2026	535,646	0.03271	17,521	0.00000	0	107	0	107	124.50	13,322	30,843	0.08725	165,260	330,520	495,780	31,866	0	0	31,866	(1,023)
6	2027	535,646	0.03370	18,051	0.00000	0	107	0	107	128.23	13,721	31,772	0.09117	165,260	330,520	495,780	33,298	0	0	33,298	(1,526)
7	2028	535,646	0.03471	18,592	0.00000	0	107	0	107	132.08	14,133	32,725	0.09527	165,260	330,520	495,780	34,795	0	0	34,795	(2,070)
8	2029	535,646	0.03575	19,149	0.00000	0	107	0	107	136.04	14,556	33,705	0.09956	165,260	330,520	495,780	36,362	0	0	36,362	(2,657)
9	2030	535,646	0.03682	19,722	0.00000	0	107	0	107	140.12	14,993	34,715	0.10404	165,260	330,520	495,780	37,998	0	0	37,998	(3,283)
10	2031	535,646	0.03792	20,312	0.00000	0	107	0	107	144.33	15,443	35,755	0.10872	165,260	330,520	495,780	39,708	0	0	39,708	(3,953)
11	2032	535,646	0.03906	20,922	0.00000	0	107	0	107	148.66	15,907	36,829	0.11362	165,260	330,520	495,780	41,497	0	0	41,497	(4,668)
12	2033	535,646	0.04023	21,549	0.00000	0	107	0	107	153.12	16,384	37,933	0.11873	165,260	330,520	495,780	43,364	0	0	43,364	(5,431)
13	2034	535,646	0.04144	22,197	0.00000	0	107	0	107	157.71	16,875	39,072	0.12407	165,260	330,520	495,780	45,314	0	0	45,314	(6,242)
14	2035	535,646	0.04268	22,861	0.00000	0	107	0	107	162.44	17,381	40,242	0.12965	165,260	330,520	495,780	47,352	0	0	47,352	(7,110)
15	2036	535,646	0.04396	23,547	0.00000	0	107	0	107	167.32	17,903	41,450	0.13549	165,260	330,520	495,780	49,485	0	0	49,485	(8,035)
16	2037	535,646	0.04528	24,254	0.00000	0	107	0	107	172.34	18,440	42,694	0.14159	165,260	330,520	495,780	51,713	0	0	51,713	(9,019)
17	2038	535,646	0.04664	24,983	0.00000	0	107	0	107	177.51	18,994	43,977	0.14796	165,260	330,520	495,780	54,039	0	0	54,039	(10,062)
18	2039	535,646	0.04804	25,732	0.00000	0	107	0	107	182.83	19,563	45,295	0.15462	165,260	330,520	495,780	56,472	0	0	56,472	(11,177)
19	2040	401,734	0.04948	19,878	0.00000	0	80	0	80	188.32	15,066	34,944	0.16157	123,945	247,890	371,835	44,258	0	0	44,258	(9,314)
20	2041	133,911	0.05096	6,824	0.00000	0	27	0	27	193.97	5,237	12,061	0.16884	41,315	82,630	123,945	15,416	0	0	15,416	(3,355)
Total =		9,641,626							1,926			$661,054				8,924,040				$833,712	($172,658)
											NPV =	$349,171								$464,117	(114,946)

Total NPV = ($114,946)
Benefit/Cost Ratio = 0.75

Worksheet Calculations

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

Table 2
Utility Test

Project: **Commerical Lighting**
Program Years: **2022 - 2024**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2022	$3,893	$0	$2,987	$6,880	$23,519	$23,519	($16,639)
2023	12,028	0	9,114	21,142	40,297	40,297	(19,155)
2024	16,519	0	12,556	29,075	19,667	19,667	9,408
2025	17,012	0	12,933	29,945	0	0	29,945
2026	17,521	0	13,322	30,843	0	0	30,843
2027	18,051	0	13,721	31,772	0	0	31,772
2028	18,592	0	14,133	32,725	0	0	32,725
2029	19,149	0	14,556	33,705	0	0	33,705
2030	19,722	0	14,993	34,715	0	0	34,715
2031	20,312	0	15,443	35,755	0	0	35,755
2032	20,922	0	15,907	36,829	0	0	36,829
2033	21,549	0	16,384	37,933	0	0	37,933
2034	22,197	0	16,875	39,072	0	0	39,072
2035	22,861	0	17,381	40,242	0	0	40,242
2036	23,547	0	17,903	41,450	0	0	41,450
2037	24,254	0	18,440	42,694	0	0	42,694
2038	24,983	0	18,994	43,977	0	0	43,977
2039	25,732	0	19,563	45,295	0	0	45,295
2040	19,878	0	15,066	34,944	0	0	34,944
2041	6,824	0	5,237	12,061	0	0	12,061
Total =				$661,054		$83,483	$577,571
			NPV =	$349,171		$78,329	270,842

Total NPV = $270,842
Benefit/Cost Ratio = 4.46

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: **2022 - 2024**

	Benefits					Costs			Annual
Year	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	Benefits Less Costs (I)
2022	$3,893	$0	$2,987	$2,176	$9,056	$23,519	$11,425	$34,944	($25,888)
2023	12,028	0	9,114	6,886	28,028	40,297	22,850	63,147	(35,119)
2024	16,519	0	12,556	9,754	38,829	19,667	11,425	31,092	7,737
2025	17,012	0	12,933	10,347	40,292	0	0	0	40,292
2026	17,521	0	13,322	10,977	41,820	0	0	0	41,820
2027	18,051	0	13,721	11,647	43,419	0	0	0	43,419
2028	18,592	0	14,133	12,356	45,081	0	0	0	45,081
2029	19,149	0	14,556	13,108	46,813	0	0	0	46,813
2030	19,722	0	14,993	13,906	48,621	0	0	0	48,621
2031	20,312	0	15,443	14,752	50,507	0	0	0	50,507
2032	20,922	0	15,907	15,651	52,480	0	0	0	52,480
2033	21,549	0	16,384	16,604	54,537	0	0	0	54,537
2034	22,197	0	16,875	17,615	56,687	0	0	0	56,687
2035	22,861	0	17,381	18,687	58,929	0	0	0	58,929
2036	23,547	0	17,903	19,825	61,275	0	0	0	61,275
2037	24,254	0	18,440	21,033	63,727	0	0	0	63,727
2038	24,983	0	18,994	22,315	66,292	0	0	0	66,292
2039	25,732	0	19,563	23,673	68,968	0	0	0	68,968
2040	19,878	0	15,066	18,811	53,755	0	0	0	53,755
2041	6,824	0	5,237	6,688	18,749	0	0	0	18,749
Total =					$947,865			$129,183	$818,682
				NPV =	$807,730			$127,265	680,465

Total NPV = $680,465
Benefit/Cost Ratio = 6.35

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) =[(A) + (C)] x Environmental Damage Factor (7), escalatec
(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: **2022 - 2024**

	Benefits														Costs			Annual
Year	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	Benefits Less Costs (P)
2022	$15,300	$0.09967	$0.09634	41,315	82,630	123,945	$12,078	24	0	$52.877	$94.468	$1,269	$0	$28,647	$27,215	$0	$27,215	$1,432
2023	30,600	0.10416	0.10067	123,945	247,890	371,835	37,865	72	0	55.256	98.719	3,978	0	72,443	55,428	0	55,428	17,015
2024	15,300	0.10884	0.10520	165,260	330,520	495,780	52,758	96	0	57.743	103.161	5,543	0	73,601	28,222	0	28,222	45,379
2025	0	0.11374	0.10994	165,260	330,520	495,780	55,134	96	0	60.341	107.804	5,793	0	60,927	0	0	0	60,927
2026	0	0.11886	0.11489	165,260	330,520	495,780	57,616	96	0	63.057	112.655	6,053	0	63,669	0	0	0	63,669
2027	0	0.12421	0.12006	165,260	330,520	495,780	60,209	96	0	65.894	117.724	6,326	0	66,535	0	0	0	66,535
2028	0	0.12980	0.12546	165,260	330,520	495,780	62,918	96	0	68.860	123.022	6,611	0	69,529	0	0	0	69,529
2029	0	0.13564	0.13110	165,260	330,520	495,780	65,747	96	0	71.958	128.558	6,908	0	72,655	0	0	0	72,655
2030	0	0.14174	0.13700	165,260	330,520	495,780	68,705	96	0	75.196	134.343	7,219	0	75,924	0	0	0	75,924
2031	0	0.14812	0.14317	165,260	330,520	495,780	71,799	96	0	78.580	140.388	7,544	0	79,343	0	0	0	79,343
2032	0	0.15479	0.14961	165,260	330,520	495,780	75,030	96	0	82.116	146.706	7,883	0	82,913	0	0	0	82,913
2033	0	0.16175	0.15634	165,260	330,520	495,780	78,404	96	0	85.812	153.308	8,238	0	86,642	0	0	0	86,642
2034	0	0.16903	0.16338	165,260	330,520	495,780	81,934	96	0	89.673	160.207	8,609	0	90,543	0	0	0	90,543
2035	0	0.17664	0.17073	165,260	330,520	495,780	85,621	96	0	93.708	167.416	8,996	0	94,617	0	0	0	94,617
2036	0	0.18459	0.17841	165,260	330,520	495,780	89,473	96	0	97.925	174.950	9,401	0	98,874	0	0	0	98,874
2037	0	0.19289	0.18644	165,260	330,520	495,780	93,499	96	0	102.332	182.822	9,824	0	103,323	0	0	0	103,323
2038	0	0.20157	0.19483	165,260	330,520	495,780	97,707	96	0	106.937	191.049	10,266	0	107,973	0	0	0	107,973
2039	0	0.21064	0.20360	165,260	330,520	495,780	102,104	96	0	111.749	199.646	10,728	0	112,832	0	0	0	112,832
2040	0	0.22012	0.21276	123,945	247,890	371,835	80,024	72	0	116.778	208.631	8,408	0	88,432	0	0	0	88,432
2041	0	0.23003	0.22234	41,315	82,630	123,945	27,876	24	0	122.033	218.019	2,929	0	30,805	0	0	0	30,805
Total =				2,974,680	5,949,360			1,728	0					$1,560,227			$110,865	$1,449,362
													NPV =	$683,912			$101,238	582,673

Total NPV = $582,673
Benefit/Cost Ratio = 6.76

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Commerical Lighting**
Project: **2022 - 2024**

	Benefits			Costs			
Year	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	Benefits Less Costs (G)
2022	$3,893	$2,987	$6,880	$23,519	$11,425	$34,944	($28,064)
2023	12,028	9,114	21,142	40,297	22,850	63,147	(42,005)
2024	16,519	12,556	29,075	19,667	11,425	31,092	(2,017)
2025	17,012	12,933	29,945	0	0	0	29,945
2026	17,521	13,322	30,843	0	0	0	30,843
2027	18,051	13,721	31,772	0	0	0	31,772
2028	18,592	14,133	32,725	0	0	0	32,725
2029	19,149	14,556	33,705	0	0	0	33,705
2030	19,722	14,993	34,715	0	0	0	34,715
2031	20,312	15,443	35,755	0	0	0	35,755
2032	20,922	15,907	36,829	0	0	0	36,829
2033	21,549	16,384	37,933	0	0	0	37,933
2034	22,197	16,875	39,072	0	0	0	39,072
2035	22,861	17,381	40,242	0	0	0	40,242
2036	23,547	17,903	41,450	0	0	0	41,450
2037	24,254	18,440	42,694	0	0	0	42,694
2038	24,983	18,994	43,977	0	0	0	43,977
2039	25,732	19,563	45,295	0	0	0	45,295
2040	19,878	15,066	34,944	0	0	0	34,944
2041	6,824	5,237	12,061	0	0	0	12,061
		Total =	$661,054			$129,183	$531,871
		NPV =	$349,171			$121,071	228,100

Total NPV =	$228,100
Benefit/Cost Ratio =	2.88

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: **2022 - 2024**

Input Data

1) Retail Rate Summer ($/kWh) =	$0.08331
Retail Rate Winter ($/kWh) =	$0.07595
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustmen	$0.01972
Fuel Escalation Rate =	3.00%
2) Avg. System Marginal Energy Cost ($/kWh) =	$0.00000
Escalation Rate =	3.00%
3) Retail Summer Demand Rate ($/kW/season) =	$50.00
3a) Retail Winter Demand Rate ($/kW/season) =	$76.00
Escalation Rate =	4.50%
4) Electric Margin ($/kWh) =	$0.05843
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/kW/yr)	$78.94
Reserve Capacity=	18.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.65%
9) Utility Discount Rate =	7.36%
10) Societal Discount Rate =	1.56%
11) General Input Data Year =	2021
12) Project Analysis Year 1 =	2022
Project Analysis Year 2 =	2023
Project Analysis Year 3 =	2024

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$18,399	$16,273	$16,970
Incentive Costs =	45,900	61,200	76,500
Total Utility Project Costs =	$64,299	$77,473	$93,470
14) Direct Participant Costs ($/Part.) =	$5,345	$5,345	$5,345
Escalation Rate =	1.83%	1.83%	1.83%
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	11.4500%	11.4500%	11.4500%
18b) System Energy Line Loss Factor	8.0410%	8.0410%	8.0410%
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	$115,701	1.10
Utility Cost Test	$1,077,812	5.94
Societal Test	$2,663,193	8.28
Participant Test	$1,729,913	6.76
Total Resource Cost Test	$950,988	3.76

Table 1
Ratepayer Impact Test

Project: **Commerical Lighting**
Program Years: **2022 - 2024**

t	Year	Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2022	401,734	$0.02528	$10,154	$0.00000	$0	80	80	160	$96.19	$15,390	$25,544	$0.06106	123,945	247,890	371,835	$16,726	$18,399	$45,900	$81,025	($55,481)
2	2023	937,380	0.02603	24,403	0.00000	0	187	187	374	99.07	37,052	61,455	0.06381	289,205	578,410	867,615	40,784	16,273	61,200	118,257	(56,802)
3	2024	1,606,937	0.02681	43,089	0.00000	0	321	321	642	102.05	65,516	108,605	0.06668	495,780	991,560	1,487,340	73,060	16,970	76,500	166,530	(57,925)
4	2025	1,606,937	0.02762	44,381	0.00000	0	321	321	642	105.11	67,481	111,862	0.06968	495,780	991,560	1,487,340	76,347	0	0	76,347	35,515
5	2026	1,606,937	0.02845	45,713	0.00000	0	321	321	642	108.26	69,503	115,216	0.07281	495,780	991,560	1,487,340	79,777	0	0	79,777	35,439
6	2027	1,606,937	0.02930	47,084	0.00000	0	321	321	642	111.51	71,589	118,673	0.07609	495,780	991,560	1,487,340	83,371	0	0	83,371	35,302
7	2028	1,606,937	0.03018	48,497	0.00000	0	321	321	642	114.85	73,734	122,231	0.07952	495,780	991,560	1,487,340	87,129	0	0	87,129	35,102
8	2029	1,606,937	0.03109	49,952	0.00000	0	321	321	642	118.30	75,949	125,901	0.08309	495,780	991,560	1,487,340	91,041	0	0	91,041	34,860
9	2030	1,606,937	0.03202	51,450	0.00000	0	321	321	642	121.85	78,228	129,678	0.08683	495,780	991,560	1,487,340	95,138	0	0	95,138	34,540
10	2031	1,606,937	0.03298	52,997	0.00000	0	321	321	642	125.50	80,571	133,568	0.09074	495,780	991,560	1,487,340	99,423	0	0	99,423	34,145
11	2032	1,606,937	0.03397	54,588	0.00000	0	321	321	642	129.27	82,991	137,579	0.09482	495,780	991,560	1,487,340	103,893	0	0	103,893	33,686
12	2033	1,606,937	0.03499	56,227	0.00000	0	321	321	642	133.15	85,482	141,709	0.09909	495,780	991,560	1,487,340	108,572	0	0	108,572	33,137
13	2034	1,606,937	0.03604	57,914	0.00000	0	321	321	642	137.14	88,044	145,958	0.10355	495,780	991,560	1,487,340	113,458	0	0	113,458	32,500
14	2035	1,606,937	0.03712	59,650	0.00000	0	321	321	642	141.25	90,683	150,333	0.10821	495,780	991,560	1,487,340	118,564	0	0	118,564	31,769
15	2036	1,606,937	0.03823	61,433	0.00000	0	321	321	642	145.49	93,405	154,838	0.11308	495,780	991,560	1,487,340	123,900	0	0	123,900	30,938
16	2037	1,606,937	0.03938	63,281	0.00000	0	321	321	642	149.86	96,210	159,491	0.11817	495,780	991,560	1,487,340	129,477	0	0	129,477	30,014
17	2038	1,606,937	0.04056	65,177	0.00000	0	321	321	642	154.35	99,093	164,270	0.12348	495,780	991,560	1,487,340	135,295	0	0	135,295	28,975
18	2039	1,606,937	0.04178	67,138	0.00000	0	321	321	642	158.98	102,065	169,203	0.12904	495,780	991,560	1,487,340	141,387	0	0	141,387	27,816
19	2040	1,205,203	0.04303	51,860	0.00000	0	241	241	482	163.75	78,928	130,788	0.13485	371,835	743,670	1,115,505	110,815	0	0	110,815	19,973
20	2041	669,557	0.04432	29,675	0.00000	0	134	134	268	168.67	45,204	74,879	0.14092	206,575	413,150	619,725	64,335	0	0	64,335	10,544
Total =		28,924,866							11,556			$2,481,781				26,772,120				$2,127,734	$354,047
											NPV =	$1,296,061								$1,180,360	115,701

Total NPV = $115,701
Benefit/Cost Ratio = 1.10

Worksheet Calculations

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

Table 2
Utility Test

Project: **Commerical Lighting**
Program Years: **2022 - 2024**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2022	$10,154	$0	$15,390	$25,544	$64,299	$64,299	($38,755)
2023	24,403	0	37,052	61,455	77,473	77,473	(16,018)
2024	43,089	0	65,516	108,605	93,470	93,470	15,135
2025	44,381	0	67,481	111,862	0	0	111,862
2026	45,713	0	69,503	115,216	0	0	115,216
2027	47,084	0	71,589	118,673	0	0	118,673
2028	48,497	0	73,734	122,231	0	0	122,231
2029	49,952	0	75,949	125,901	0	0	125,901
2030	51,450	0	78,228	129,678	0	0	129,678
2031	52,997	0	80,571	133,568	0	0	133,568
2032	54,588	0	82,991	137,579	0	0	137,579
2033	56,227	0	85,482	141,709	0	0	141,709
2034	57,914	0	88,044	145,958	0	0	145,958
2035	59,650	0	90,683	150,333	0	0	150,333
2036	61,433	0	93,405	154,838	0	0	154,838
2037	63,281	0	96,210	159,491	0	0	159,491
2038	65,177	0	99,093	164,270	0	0	164,270
2039	67,138	0	102,065	169,203	0	0	169,203
2040	51,860	0	78,928	130,788	0	0	130,788
2041	29,675	0	45,204	74,879	0	0	74,879
Total =				$2,481,781		$235,242	$2,246,539
			NPV =	$1,296,061		$218,249	1,077,812

Total NPV =	$1,077,812
Benefit/Cost Ratio =	5.94

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: **2022 - 2024**

	Benefits					Costs			Annual
Year	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	Benefits Less Costs (I)
2022	$10,154	$0	$15,390	$8,077	$33,621	$64,299	$34,275	$98,574	($64,953)
2023	24,403	0	37,052	20,016	81,471	77,473	45,700	123,173	(41,702)
2024	43,089	0	65,516	36,433	145,038	93,470	57,125	150,595	(5,557)
2025	44,381	0	67,481	38,652	150,514	0	0	0	150,514
2026	45,713	0	69,503	41,005	156,221	0	0	0	156,221
2027	47,084	0	71,589	43,502	162,175	0	0	0	162,175
2028	48,497	0	73,734	46,151	168,382	0	0	0	168,382
2029	49,952	0	75,949	48,963	174,864	0	0	0	174,864
2030	51,450	0	78,228	51,945	181,623	0	0	0	181,623
2031	52,997	0	80,571	55,108	188,676	0	0	0	188,676
2032	54,588	0	82,991	58,466	196,045	0	0	0	196,045
2033	56,227	0	85,482	62,027	203,736	0	0	0	203,736
2034	57,914	0	88,044	65,804	211,762	0	0	0	211,762
2035	59,650	0	90,683	69,809	220,142	0	0	0	220,142
2036	61,433	0	93,405	74,058	228,896	0	0	0	228,896
2037	63,281	0	96,210	78,572	238,063	0	0	0	238,063
2038	65,177	0	99,093	83,355	247,625	0	0	0	247,625
2039	67,138	0	102,065	88,433	257,636	0	0	0	257,636
2040	51,860	0	78,928	70,407	201,195	0	0	0	201,195
2041	29,675	0	45,204	41,519	116,398	0	0	0	116,398
Total =					$3,564,083			$372,342	$3,191,741
				NPV =	$3,029,052			$365,859	2,663,193

Total NPV = $2,663,193
Benefit/Cost Ratio = 8.28

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) =[(A) + (C)] x Environmental Damage Factor (7), escalatec
(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: **2022 - 2024**

	Benefits														Costs			Annual
Year	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	Benefits Less Costs (P)
2022	$45,900	$0.08706	$0.07937	123,945	247,890	371,835	$30,466	72	72	$52.250	$79.420	$9,480	$0	$85,846	$81,645	$0	$81,645	$4,201
2023	61,200	0.09098	0.08294	289,205	578,410	867,615	74,285	168	168	54.601	82.994	23,116	0	158,601	110,856	0	110,856	47,745
2024	76,500	0.09507	0.08667	495,780	991,560	1,487,340	133,072	288	288	57.058	86.729	41,411	0	250,983	141,110	0	141,110	109,873
2025	0	0.09935	0.09057	495,780	991,560	1,487,340	139,061	288	288	59.626	90.631	43,274	0	182,335	0	0	0	182,335
2026	0	0.10382	0.09465	495,780	991,560	1,487,340	145,323	288	288	62.309	94.710	45,221	0	190,544	0	0	0	190,544
2027	0	0.10849	0.09891	495,780	991,560	1,487,340	151,862	288	288	65.113	98.972	47,256	0	199,118	0	0	0	199,118
2028	0	0.11337	0.10336	495,780	991,560	1,487,340	158,694	288	288	68.043	103.425	49,383	0	208,077	0	0	0	208,077
2029	0	0.11848	0.10801	495,780	991,560	1,487,340	165,838	288	288	71.105	108.080	51,605	0	217,443	0	0	0	217,443
2030	0	0.12381	0.11287	495,780	991,560	1,487,340	173,300	288	288	74.305	112.943	53,927	0	227,227	0	0	0	227,227
2031	0	0.12938	0.11795	495,780	991,560	1,487,340	181,099	288	288	77.648	118.026	56,354	0	237,453	0	0	0	237,453
2032	0	0.13520	0.12326	495,780	991,560	1,487,340	189,249	288	288	81.143	123.337	58,890	0	248,139	0	0	0	248,139
2033	0	0.14128	0.12880	495,780	991,560	1,487,340	197,757	288	288	84.794	128.887	61,540	0	259,297	0	0	0	259,297
2034	0	0.14764	0.13460	495,780	991,560	1,487,340	206,661	288	288	88.610	134.687	64,310	0	270,971	0	0	0	270,971
2035	0	0.15429	0.14066	495,780	991,560	1,487,340	215,967	288	288	92.597	140.748	67,203	0	283,170	0	0	0	283,170
2036	0	0.16123	0.14698	495,780	991,560	1,487,340	225,674	288	288	96.764	147.081	70,227	0	295,901	0	0	0	295,901
2037	0	0.16848	0.15360	495,780	991,560	1,487,340	235,833	288	288	101.119	153.700	73,388	0	309,221	0	0	0	309,221
2038	0	0.17607	0.16051	495,780	991,560	1,487,340	246,447	288	288	105.669	160.617	76,690	0	323,137	0	0	0	323,137
2039	0	0.18399	0.16773	495,780	991,560	1,487,340	257,533	288	288	110.424	167.844	80,141	0	337,674	0	0	0	337,674
2040	0	0.19227	0.17528	371,835	743,670	1,115,505	201,843	216	216	115.393	175.397	62,811	0	264,654	0	0	0	264,654
2041	0	0.20092	0.18317	206,575	413,150	619,725	117,182	120	120	120.586	183.290	36,465	0	153,647	0	0	0	153,647
Total =				8,924,040	17,848,080			5,184	5,184					$4,703,438			$333,611	$4,369,827
													NPV =	$2,030,023			$300,110	1,729,913

Total NPV = $1,729,913
Benefit/Cost Ratio = 6.76

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Commerical Lighting**
Project: **2022 - 2024**

	Benefits			Costs			
Year	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	Benefits Less Costs (G)
2022	$10,154	$15,390	$25,544	$64,299	$34,275	$98,574	($73,030)
2023	24,403	37,052	61,455	77,473	45,700	123,173	(61,718)
2024	43,089	65,516	108,605	93,470	57,125	150,595	(41,990)
2025	44,381	67,481	111,862	0	0	0	111,862
2026	45,713	69,503	115,216	0	0	0	115,216
2027	47,084	71,589	118,673	0	0	0	118,673
2028	48,497	73,734	122,231	0	0	0	122,231
2029	49,952	75,949	125,901	0	0	0	125,901
2030	51,450	78,228	129,678	0	0	0	129,678
2031	52,997	80,571	133,568	0	0	0	133,568
2032	54,588	82,991	137,579	0	0	0	137,579
2033	56,227	85,482	141,709	0	0	0	141,709
2034	57,914	88,044	145,958	0	0	0	145,958
2035	59,650	90,683	150,333	0	0	0	150,333
2036	61,433	93,405	154,838	0	0	0	154,838
2037	63,281	96,210	159,491	0	0	0	159,491
2038	65,177	99,093	164,270	0	0	0	164,270
2039	67,138	102,065	169,203	0	0	0	169,203
2040	51,860	78,928	130,788	0	0	0	130,788
2041	29,675	45,204	74,879	0	0	0	74,879
		Total =	$2,481,781			$372,342	$2,109,439
		NPV =	$1,296,061			$345,073	950,988

Total NPV =	$950,988
Benefit/Cost Ratio =	3.76

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

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

Company: **Montana-Dakota Utilities Co.**
Project: **Commerical Lighting**
Program Years: **2022 - 2024**

Input Data

1) Retail Rate Summer ($/kWh) =	$0.08670
Retail Rate Winter ($/kWh) =	$0.08523
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustmen	$0.01951
Fuel Escalation Rate =	3.00%
2) Avg. System Marginal Energy Cost ($/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)	$78.94
Reserve Capacity=	18.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.65%
9) Utility Discount Rate =	7.22%
10) Societal Discount Rate =	1.56%
11) General Input Data Year =	2021
12) Project Analysis Year 1 =	2022
Project Analysis Year 2 =	2023
Project Analysis Year 3 =	2024

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$4,078	$3,877	$5,300
Incentive Costs =	6,120	9,180	15,300
Total Utility Project Costs =	$10,198	$13,057	$20,600
14) Direct Participant Costs ($/Part.) =	$5,345	$5,345	$5,345
Escalation Rate =	1.83%	1.83%	1.83%
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	11.4500%	11.4500%	11.4500%
18b) System Energy Line Loss Factor	8.0410%	8.0410%	8.0410%
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	$104,928	1.96
Utility Cost Test	$173,971	5.31
Societal Test	$440,338	7.73
Participant Test	$288,119	6.82
Total Resource Cost Test	$153,026	3.50

Table 1
Ratepayer Impact Test

Project: **Commerical Lighting**
Program Years: **2022 - 2024**

t	Year	Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2022	53,565	$0.02528	$1,354	$0.00000	$0	11	11	22	$96.19	$2,116	$3,470	$0.02638	16,526	33,052	49,578	$963	$4,078	$6,120	$11,161	($7,691)
2	2023	133,911	0.02603	3,486	0.00000	0	27	27	54	99.07	5,350	8,836	0.02756	41,315	82,630	123,945	2,516	3,877	9,180	15,573	(6,737)
3	2024	267,823	0.02681	7,181	0.00000	0	53	53	106	102.05	10,817	17,998	0.02880	82,630	165,260	247,890	5,259	5,300	15,300	25,859	(7,861)
4	2025	267,823	0.02762	7,397	0.00000	0	53	53	106	105.11	11,142	18,539	0.03010	82,630	165,260	247,890	5,497	0	0	5,497	13,042
5	2026	267,823	0.02845	7,619	0.00000	0	53	53	106	108.26	11,476	19,095	0.03145	82,630	165,260	247,890	5,743	0	0	5,743	13,352
6	2027	267,823	0.02930	7,847	0.00000	0	53	53	106	111.51	11,820	19,667	0.03287	82,630	165,260	247,890	6,003	0	0	6,003	13,664
7	2028	267,823	0.03018	8,083	0.00000	0	53	53	106	114.85	12,174	20,257	0.03435	82,630	165,260	247,890	6,273	0	0	6,273	13,984
8	2029	267,823	0.03109	8,325	0.00000	0	53	53	106	118.30	12,540	20,865	0.03589	82,630	165,260	247,890	6,554	0	0	6,554	14,311
9	2030	267,823	0.03202	8,575	0.00000	0	53	53	106	121.85	12,916	21,491	0.03751	82,630	165,260	247,890	6,850	0	0	6,850	14,641
10	2031	267,823	0.03298	8,833	0.00000	0	53	53	106	125.50	13,303	22,136	0.03920	82,630	165,260	247,890	7,158	0	0	7,158	14,978
11	2032	267,823	0.03397	9,098	0.00000	0	53	53	106	129.27	13,703	22,801	0.04096	82,630	165,260	247,890	7,480	0	0	7,480	15,321
12	2033	267,823	0.03499	9,371	0.00000	0	53	53	106	133.15	14,114	23,485	0.04280	82,630	165,260	247,890	7,816	0	0	7,816	15,669
13	2034	267,823	0.03604	9,652	0.00000	0	53	53	106	137.14	14,537	24,189	0.04473	82,630	165,260	247,890	8,168	0	0	8,168	16,021
14	2035	267,823	0.03712	9,942	0.00000	0	53	53	106	141.25	14,973	24,915	0.04674	82,630	165,260	247,890	8,535	0	0	8,535	16,380
15	2036	267,823	0.03823	10,239	0.00000	0	53	53	106	145.49	15,422	25,661	0.04885	82,630	165,260	247,890	8,921	0	0	8,921	16,740
16	2037	267,823	0.03938	10,547	0.00000	0	53	53	106	149.86	15,885	26,432	0.05104	82,630	165,260	247,890	9,321	0	0	9,321	17,111
17	2038	267,823	0.04056	10,863	0.00000	0	53	53	106	154.35	16,361	27,224	0.05334	82,630	165,260	247,890	9,741	0	0	9,741	17,483
18	2039	267,823	0.04178	11,190	0.00000	0	53	53	106	158.98	16,852	28,042	0.05574	82,630	165,260	247,890	10,179	0	0	10,179	17,863
19	2040	214,258	0.04303	9,220	0.00000	0	43	43	86	163.75	14,083	23,303	0.05825	66,104	132,208	198,312	8,510	0	0	8,510	14,793
20	2041	133,911	0.04432	5,935	0.00000	0	27	27	54	193.97	10,474	16,409	0.06087	41,315	82,630	123,945	5,558	0	0	5,558	10,851
Total =		4,820,813							1,912			$414,815				4,462,020				$180,900	$233,915
											NPV =	$214,345								$109,417	104,928

Total NPV = $104,928
Benefit/Cost Ratio = 1.96

Worksheet Calculations

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

Table 2
Utility Test

Project: **Commerical Lighting**
Program Years: **2022 - 2024**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2022	$1,354	$0	$2,116	$3,470	$10,198	$10,198	($6,728)
2023	3,486	0	5,350	8,836	13,057	13,057	(4,221)
2024	7,181	0	10,817	17,998	20,600	20,600	(2,602)
2025	7,397	0	11,142	18,539	0	0	18,539
2026	7,619	0	11,476	19,095	0	0	19,095
2027	7,847	0	11,820	19,667	0	0	19,667
2028	8,083	0	12,174	20,257	0	0	20,257
2029	8,325	0	12,540	20,865	0	0	20,865
2030	8,575	0	12,916	21,491	0	0	21,491
2031	8,833	0	13,303	22,136	0	0	22,136
2032	9,098	0	13,703	22,801	0	0	22,801
2033	9,371	0	14,114	23,485	0	0	23,485
2034	9,652	0	14,537	24,189	0	0	24,189
2035	9,942	0	14,973	24,915	0	0	24,915
2036	10,239	0	15,422	25,661	0	0	25,661
2037	10,547	0	15,885	26,432	0	0	26,432
2038	10,863	0	16,361	27,224	0	0	27,224
2039	11,190	0	16,852	28,042	0	0	28,042
2040	9,220	0	14,083	23,303	0	0	23,303
2041	5,935	0	10,474	16,409	0	0	16,409
Total =				$414,815		$43,855	$370,960
			NPV =	$214,345		$40,374	173,971

Total NPV =	$173,971
Benefit/Cost Ratio =	5.31

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: **2022 - 2024**

	Benefits					Costs			Annual
Year	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	Benefits Less Costs (I)
2022	$1,354	$0	$2,116	$1,097	$4,567	$10,198	$4,570	$14,768	($10,201)
2023	3,486	0	5,350	2,878	11,714	13,057	6,855	19,912	(8,198)
2024	7,181	0	10,817	6,038	24,036	20,600	11,425	32,025	(7,989)
2025	7,397	0	11,142	6,406	24,945	0	0	0	24,945
2026	7,619	0	11,476	6,796	25,891	0	0	0	25,891
2027	7,847	0	11,820	7,209	26,876	0	0	0	26,876
2028	8,083	0	12,174	7,648	27,905	0	0	0	27,905
2029	8,325	0	12,540	8,114	28,979	0	0	0	28,979
2030	8,575	0	12,916	8,609	30,100	0	0	0	30,100
2031	8,833	0	13,303	9,133	31,269	0	0	0	31,269
2032	9,098	0	13,703	9,690	32,491	0	0	0	32,491
2033	9,371	0	14,114	10,280	33,765	0	0	0	33,765
2034	9,652	0	14,537	10,905	35,094	0	0	0	35,094
2035	9,942	0	14,973	11,570	36,485	0	0	0	36,485
2036	10,239	0	15,422	12,274	37,935	0	0	0	37,935
2037	10,547	0	15,885	13,022	39,454	0	0	0	39,454
2038	10,863	0	16,361	13,814	41,038	0	0	0	41,038
2039	11,190	0	16,852	14,656	42,698	0	0	0	42,698
2040	9,220	0	14,083	12,545	35,848	0	0	0	35,848
2041	5,935	0	10,474	9,098	25,507	0	0	0	25,507
Total =					$596,597			$66,705	$529,892
				NPV =	$505,761			$65,423	440,338

Total NPV = $440,338
Benefit/Cost Ratio = 7.73

Worksheet Calculations
(A) = Table 1 (C)
(B) = Table 1 (E)
(C) = Table 1 (H)
(D) =[(A) + (C)] x Environmental Damage Factor (7), escalatec
(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: **2022 - 2024**

	Benefits														Costs			Annual
Year	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	Benefits Less Costs (P)
2022	$6,120	$0.09060	$0.08907	16,526	33,052	49,578	$4,441	10	10	$34.485	$60.610	$951	$0	$11,512	$10,886	$0	$10,886	$626
2023	9,180	0.09468	0.09307	41,315	82,630	123,945	11,602	24	24	36.037	63.337	2,385	0	23,167	16,628	0	16,628	6,539
2024	15,300	0.09894	0.09726	82,630	165,260	247,890	24,249	48	48	37.658	66.188	4,985	0	44,534	28,222	0	28,222	16,312
2025	0	0.10339	0.10164	82,630	165,260	247,890	25,340	48	48	39.353	69.166	5,209	0	30,549	0	0	0	30,549
2026	0	0.10804	0.10621	82,630	165,260	247,890	26,480	48	48	41.124	72.279	5,443	0	31,923	0	0	0	31,923
2027	0	0.11291	0.11099	82,630	165,260	247,890	27,672	48	48	42.975	75.531	5,688	0	33,360	0	0	0	33,360
2028	0	0.11799	0.11599	82,630	165,260	247,890	28,918	48	48	44.908	78.930	5,944	0	34,862	0	0	0	34,862
2029	0	0.12330	0.12121	82,630	165,260	247,890	30,219	48	48	46.929	82.482	6,212	0	36,431	0	0	0	36,431
2030	0	0.12884	0.12666	82,630	165,260	247,890	31,578	48	48	49.041	86.194	6,491	0	38,069	0	0	0	38,069
2031	0	0.13464	0.13236	82,630	165,260	247,890	32,999	48	48	51.248	90.072	6,783	0	39,782	0	0	0	39,782
2032	0	0.14070	0.13832	82,630	165,260	247,890	34,485	48	48	53.554	94.125	7,089	0	41,574	0	0	0	41,574
2033	0	0.14703	0.14454	82,630	165,260	247,890	36,036	48	48	55.964	98.361	7,408	0	43,444	0	0	0	43,444
2034	0	0.15365	0.15104	82,630	165,260	247,890	37,657	48	48	58.482	102.787	7,741	0	45,398	0	0	0	45,398
2035	0	0.16056	0.15784	82,630	165,260	247,890	39,352	48	48	61.114	107.413	8,089	0	47,441	0	0	0	47,441
2036	0	0.16779	0.16494	82,630	165,260	247,890	41,122	48	48	63.864	112.246	8,453	0	49,575	0	0	0	49,575
2037	0	0.17534	0.17237	82,630	165,260	247,890	42,974	48	48	66.738	117.297	8,834	0	51,808	0	0	0	51,808
2038	0	0.18323	0.18012	82,630	165,260	247,890	44,907	48	48	69.741	122.576	9,231	0	54,138	0	0	0	54,138
2039	0	0.19148	0.18823	82,630	165,260	247,890	46,929	48	48	72.880	128.092	9,647	0	56,576	0	0	0	56,576
2040	0	0.20009	0.19670	66,104	132,208	198,312	39,232	38	38	76.159	133.856	7,981	0	47,213	0	0	0	47,213
2041	0	0.20910	0.20555	41,315	82,630	123,945	25,624	24	24	79.587	139.879	5,267	0	30,891	0	0	0	30,891
Total =				1,487,340	2,974,680			864	864					$792,247			$55,736	$736,511
													NPV =	$337,643			$49,524	288,119

Total NPV = $288,119
Benefit/Cost Ratio = 6.82

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Commerical Lighting**
Project: **2022 - 2024**

	Benefits			Costs			
Year	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	Benefits Less Costs (G)
2022	$1,354	$2,116	$3,470	$10,198	$4,570	$14,768	($11,298)
2023	3,486	5,350	8,836	13,057	6,855	19,912	(11,076)
2024	7,181	10,817	17,998	20,600	11,425	32,025	(14,027)
2025	7,397	11,142	18,539	0	0	0	18,539
2026	7,619	11,476	19,095	0	0	0	19,095
2027	7,847	11,820	19,667	0	0	0	19,667
2028	8,083	12,174	20,257	0	0	0	20,257
2029	8,325	12,540	20,865	0	0	0	20,865
2030	8,575	12,916	21,491	0	0	0	21,491
2031	8,833	13,303	22,136	0	0	0	22,136
2032	9,098	13,703	22,801	0	0	0	22,801
2033	9,371	14,114	23,485	0	0	0	23,485
2034	9,652	14,537	24,189	0	0	0	24,189
2035	9,942	14,973	24,915	0	0	0	24,915
2036	10,239	15,422	25,661	0	0	0	25,661
2037	10,547	15,885	26,432	0	0	0	26,432
2038	10,863	16,361	27,224	0	0	0	27,224
2039	11,190	16,852	28,042	0	0	0	28,042
2040	9,220	14,083	23,303	0	0	0	23,303
2041	5,935	10,474	16,409	0	0	0	16,409
		Total =	$414,815			$66,705	$348,110
		NPV =	$214,345			$61,319	153,026

Total NPV = $153,026
Benefit/Cost Ratio = 3.50

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

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

Company: **Montana-Dakota Utilities Co.**
Project: **Commercial Partnership Program (Custom)**
Program Years: **2022 - 2024**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.09538
Retail Rate Winter ($/kWh) =	$0.09219
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.02142
Fuel Escalation Rate =	3.00%
2) Avg. System Marginal Energy Cost ($/kWh) =	$0.00000
Escalation Rate =	3.00%
3) Retail Summer Demand Rate ($/kW/season) =	$50.60
3a) Retail Winter Demand Rate ($/kW/season) =	$90.40
Escalation Rate =	4.50%
4) Electric Margin ($/kWh) =	$0.07001
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/kW/yr)	$90.78
Reserve Capacity=	18.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.65%
9) Utility Discount Rate =	7.04%
10) Societal Discount Rate =	1.56%
11) General Input Data Year =	2021
12) Project Analysis Year 1 =	2022
Project Analysis Year 2 =	2023
Project Analysis Year 3 =	2024

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$10,744	$9,507	$14,273
Incentive Costs =	20,000	30,000	50,000
Total Utility Project Costs =	$30,744	$39,507	$64,273
14) Direct Participant Costs ($/Part.) =	$20,000	$20,000	$20,000
Escalation Rate =	1.83%	1.83%	1.83%
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	11.4500%	11.4500%	11.4500%
18b) System Energy Line Loss Factor	8.0410%	8.0410%	8.0410%
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	($43,293)	0.93
Utility Cost Test	$426,707	4.45
Societal Test	$793,413	4.45
Participant Test	$821,628	5.43
Total Resource Cost Test	$335,044	2.56

Table 1
Ratepayer Impact Test

Project: **Commercial Partnership Program (Custom)**
Program Years: **2022 - 2024**

t	Year	Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2022	216,082	$0.02907	$6,282	$0.00000	$0	33	33	66	$110.62	$7,301	$13,583	$0.07316	100,000	100,000	200,000	$10,779	$10,744	$20,000	$41,523	($27,940)
2	2023	540,206	0.02994	16,174	0.00000	0	84	84	168	113.93	19,140	35,314	0.07645	250,000	250,000	500,000	28,159	9,507	30,000	67,666	(32,352)
3	2024	1,080,410	0.03084	33,320	0.00000	0	167	167	334	117.35	39,195	72,515	0.07989	500,000	500,000	1,000,000	58,853	14,273	50,000	123,126	(50,611)
4	2025	1,080,410	0.03176	34,314	0.00000	0	167	167	334	120.87	40,371	74,685	0.08349	500,000	500,000	1,000,000	61,505	0	0	61,505	13,180
5	2026	1,080,410	0.03271	35,340	0.00000	0	167	167	334	124.50	41,583	76,923	0.08725	500,000	500,000	1,000,000	64,275	0	0	64,275	12,648
6	2027	1,080,410	0.03370	36,410	0.00000	0	167	167	334	128.23	42,829	79,239	0.09117	500,000	500,000	1,000,000	67,163	0	0	67,163	12,076
7	2028	1,080,410	0.03471	37,501	0.00000	0	167	167	334	132.08	44,115	81,616	0.09527	500,000	500,000	1,000,000	70,183	0	0	70,183	11,433
8	2029	1,080,410	0.03575	38,625	0.00000	0	167	167	334	136.04	45,437	84,062	0.09956	500,000	500,000	1,000,000	73,343	0	0	73,343	10,719
9	2030	1,080,410	0.03682	39,781	0.00000	0	167	167	334	140.12	46,800	86,581	0.10404	500,000	500,000	1,000,000	76,644	0	0	76,644	9,937
10	2031	1,080,410	0.03792	40,969	0.00000	0	167	167	334	144.33	48,206	89,175	0.10872	500,000	500,000	1,000,000	80,091	0	0	80,091	9,084
11	2032	864,328	0.03906	33,761	0.00000	0	134	134	268	148.66	39,841	73,602	0.11362	400,000	400,000	800,000	66,961	0	0	66,961	6,641
12	2033	540,206	0.04023	21,732	0.00000	0	84	84	168	153.12	25,724	47,456	0.11873	250,000	250,000	500,000	43,733	0	0	43,733	3,723
13	2034	0	0.04144	0	0.00000	0	0	0	0	157.71	0	0	0.12407	0	0	0	0	0	0	0	0
14	2035	0	0.04268	0	0.00000	0	0	0	0	162.44	0	0	0.12965	0	0	0	0	0	0	0	0
15	2036	0	0.04396	0	0.00000	0	0	0	0	167.32	0	0	0.13549	0	0	0	0	0	0	0	0
16	2037	0	0.04528	0	0.00000	0	0	0	0	172.34	0	0	0.14159	0	0	0	0	0	0	0	0
17	2038	0	0.04664	0	0.00000	0	0	0	0	177.51	0	0	0.14796	0	0	0	0	0	0	0	0
18	2039	0	0.04804	0	0.00000	0	0	0	0	182.83	0	0	0.15462	0	0	0	0	0	0	0	0
19	2040	0	0.04948	0	0.00000	0	0	0	0	188.32	0	0	0.16157	0	0	0	0	0	0	0	0
20	2041	0	0.05096	0	0.00000	0	0	0	0	193.97	0	0	0.16884	0	0	0	0	0	0	0	0
Total =		10,804,102							3,342			$814,751				10,000,000				$836,213	($21,462)
											NPV =	$550,452								$593,745	(43,293)

Total NPV = ($43,293)
Benefit/Cost Ratio = 0.93

Worksheet Calculations

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

Table 2
Utility Test

Project: **Commercial Partnership Program (Custom)**
Program Years: **2022 - 2024**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2022	$6,282	$0	$7,301	$13,583	$30,744	$30,744	($17,161)
2023	16,174	0	19,140	35,314	39,507	39,507	(4,193)
2024	33,320	0	39,195	72,515	64,273	64,273	8,242
2025	34,314	0	40,371	74,685	0	0	74,685
2026	35,340	0	41,583	76,923	0	0	76,923
2027	36,410	0	42,829	79,239	0	0	79,239
2028	37,501	0	44,115	81,616	0	0	81,616
2029	38,625	0	45,437	84,062	0	0	84,062
2030	39,781	0	46,800	86,581	0	0	86,581
2031	40,969	0	48,206	89,175	0	0	89,175
2032	33,761	0	39,841	73,602	0	0	73,602
2033	21,732	0	25,724	47,456	0	0	47,456
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
Total =				$814,751		$134,524	$680,227
			NPV =	$550,452		$123,745	426,707

Total NPV = $426,707
Benefit/Cost Ratio = 4.45

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: **2022 - 2024**

	Benefits					Costs			Annual
Year	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	Benefits Less Costs (I)
2022	$6,282	$0	$7,301	$4,295	$17,878	$30,744	$20,000	$50,744	($32,866)
2023	16,174	0	19,140	11,502	46,816	39,507	30,000	69,507	(22,691)
2024	33,320	0	39,195	24,326	96,841	64,273	50,000	114,273	(17,432)
2025	34,314	0	40,371	25,806	100,491	0	0	0	100,491
2026	35,340	0	41,583	27,377	104,300	0	0	0	104,300
2027	36,410	0	42,829	29,047	108,286	0	0	0	108,286
2028	37,501	0	44,115	30,816	112,432	0	0	0	112,432
2029	38,625	0	45,437	32,692	116,754	0	0	0	116,754
2030	39,781	0	46,800	34,681	121,262	0	0	0	121,262
2031	40,969	0	48,206	36,792	125,967	0	0	0	125,967
2032	33,761	0	39,841	31,278	104,880	0	0	0	104,880
2033	21,732	0	25,724	20,772	68,228	0	0	0	68,228
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
2040	0	0	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0	0	0
Total =					$1,124,135			$234,524	$889,611
				NPV =	$1,023,386			$229,973	793,413

Total NPV = $793,413
Benefit/Cost Ratio = 4.45

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: **2022 - 2024**

	Benefits														Costs			Annual
Year	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	Benefits Less Costs (P)
2022	$20,000	$0.09967	$0.09634	100,000	100,000	200,000	$19,601	30	30	$52.877	$94.468	$4,420	$0	$44,021	$40,733	$0	$40,733	$3,288
2023	30,000	0.10416	0.10067	250,000	250,000	500,000	51,208	75	75	55.256	98.719	11,548	0	92,756	62,220	0	62,220	30,536
2024	50,000	0.10884	0.10520	500,000	500,000	1,000,000	107,020	150	150	57.743	103.161	24,136	0	181,156	105,601	0	105,601	75,555
2025	0	0.11374	0.10994	500,000	500,000	1,000,000	111,840	150	150	60.341	107.804	25,222	0	137,062	0	0	0	137,062
2026	0	0.11886	0.11489	500,000	500,000	1,000,000	116,875	150	150	63.057	112.655	26,357	0	143,232	0	0	0	143,232
2027	0	0.12421	0.12006	500,000	500,000	1,000,000	122,135	150	150	65.894	117.724	27,543	0	149,678	0	0	0	149,678
2028	0	0.12980	0.12546	500,000	500,000	1,000,000	127,630	150	150	68.860	123.022	28,782	0	156,412	0	0	0	156,412
2029	0	0.13564	0.13110	500,000	500,000	1,000,000	133,370	150	150	71.958	128.558	30,077	0	163,447	0	0	0	163,447
2030	0	0.14174	0.13700	500,000	500,000	1,000,000	139,370	150	150	75.196	134.343	31,431	0	170,801	0	0	0	170,801
2031	0	0.14812	0.14317	500,000	500,000	1,000,000	145,645	150	150	78.580	140.388	32,845	0	178,490	0	0	0	178,490
2032	0	0.15479	0.14961	400,000	400,000	800,000	121,760	120	120	82.116	146.706	27,459	0	149,219	0	0	0	149,219
2033	0	0.16175	0.15634	250,000	250,000	500,000	79,523	75	75	85.812	153.308	17,934	0	97,457	0	0	0	97,457
2034	0	0.16903	0.16338	0	0	0	0	0	0	89.673	160.207	0	0	0	0	0	0	0
2035	0	0.17664	0.17073	0	0	0	0	0	0	93.708	167.416	0	0	0	0	0	0	0
2036	0	0.18459	0.17841	0	0	0	0	0	0	97.925	174.950	0	0	0	0	0	0	0
2037	0	0.19289	0.18644	0	0	0	0	0	0	102.332	182.822	0	0	0	0	0	0	0
2038	0	0.20157	0.19483	0	0	0	0	0	0	106.937	191.049	0	0	0	0	0	0	0
2039	0	0.21064	0.20360	0	0	0	0	0	0	111.749	199.646	0	0	0	0	0	0	0
2040	0	0.22012	0.21276	0	0	0	0	0	0	116.778	208.631	0	0	0	0	0	0	0
2041	0	0.23003	0.22234	0	0	0	0	0	0	122.033	218.019	0	0	0	0	0	0	0
Total =				5,000,000	5,000,000			1,500	1,500					$1,663,731			$208,554	$1,455,177
													NPV =	$1,006,937			$185,309	821,628

Total NPV = $821,628
Benefit/Cost Ratio = 5.43

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Commercial Partnership Program (Custom)**
Project: **2022 - 2024**

	Benefits			Costs			
Year	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	Benefits Less Costs (G)
2022	$6,282	$7,301	$13,583	$30,744	$20,000	$50,744	($37,161)
2023	16,174	19,140	35,314	39,507	30,000	69,507	(34,193)
2024	33,320	39,195	72,515	64,273	50,000	114,273	(41,758)
2025	34,314	40,371	74,685	0	0	0	74,685
2026	35,340	41,583	76,923	0	0	0	76,923
2027	36,410	42,829	79,239	0	0	0	79,239
2028	37,501	44,115	81,616	0	0	0	81,616
2029	38,625	45,437	84,062	0	0	0	84,062
2030	39,781	46,800	86,581	0	0	0	86,581
2031	40,969	48,206	89,175	0	0	0	89,175
2032	33,761	39,841	73,602	0	0	0	73,602
2033	21,732	25,724	47,456	0	0	0	47,456
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
		Total =	$814,751			$234,524	$580,227
		NPV =	$550,452			$215,408	335,044

Total NPV = $335,044
Benefit/Cost Ratio = 2.56

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: **2022 - 2024**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.08331
Retail Rate Winter ($/kWh) =	$0.07595
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.01972
Fuel Escalation Rate =	3.00%
2) Avg. System Marginal Energy Cost ($/kWh) =	$0.00000
Escalation Rate =	3.00%
3) Retail Summer Demand Rate ($/kW/season) =	$50.00
3a) Retail Winter Demand Rate ($/kW/season) =	$76.00
Escalation Rate =	4.50%
4) Electric Margin ($/kWh) =	$0.05843
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/kW/yr)	$78.94
Reserve Capacity=	18.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.65%
9) Utility Discount Rate =	7.36%
10) Societal Discount Rate =	1.56%
11) General Input Data Year =	2021
12) Project Analysis Year 1 =	2022
Project Analysis Year 2 =	2023
Project Analysis Year 3 =	2024

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$20,043	$18,613	$22,183
Incentive Costs =	50,000	70,000	100,000
Total Utility Project Costs =	$70,043	$88,613	$122,183
14) Direct Participant Costs ($/Part.) =	$20,000	$20,000	$20,000
Escalation Rate =	1.83%	1.83%	1.83%
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	11.4500%	11.4500%	11.4500%
18b) System Energy Line Loss Factor	8.0410%	8.0410%	8.0410%
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	($67,248)	0.94
Utility Cost Test	$797,242	4.07
Societal Test	$1,464,034	3.98
Participant Test	$1,524,555	4.72
Total Resource Cost Test	$594,574	2.29

Table 1
Ratepayer Impact Test

Project: **Commercial Partnership Program (Custom)**
Program Years: **2022 - 2024**

t	Year	Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2022	540,206	$0.02528	$13,654	$0.00000	$0	84	84	168	$96.19	$16,160	$29,814	$0.06106	250,000	250,000	500,000	$22,491	$20,043	$50,000	$92,534	($62,720)
2	2023	1,296,492	0.02603	33,752	0.00000	0	201	201	402	99.07	39,826	73,578	0.06381	600,000	600,000	1,200,000	56,409	18,613	70,000	145,022	(71,444)
3	2024	2,376,902	0.02681	63,735	0.00000	0	368	368	736	102.05	75,109	138,844	0.06668	1,100,000	1,100,000	2,200,000	108,067	22,183	100,000	230,250	(91,406)
4	2025	2,376,902	0.02762	65,647	0.00000	0	368	368	736	105.11	77,361	143,008	0.06968	1,100,000	1,100,000	2,200,000	112,929	0	0	112,929	30,079
5	2026	2,376,902	0.02845	67,616	0.00000	0	368	368	736	108.26	79,679	147,295	0.07281	1,100,000	1,100,000	2,200,000	118,002	0	0	118,002	29,293
6	2027	2,376,902	0.02930	69,645	0.00000	0	368	368	736	111.51	82,071	151,716	0.07609	1,100,000	1,100,000	2,200,000	123,318	0	0	123,318	28,398
7	2028	2,376,902	0.03018	71,734	0.00000	0	368	368	736	114.85	84,530	156,264	0.07952	1,100,000	1,100,000	2,200,000	128,877	0	0	128,877	27,387
8	2029	2,376,902	0.03109	73,886	0.00000	0	368	368	736	118.30	87,069	160,955	0.08309	1,100,000	1,100,000	2,200,000	134,663	0	0	134,663	26,292
9	2030	2,376,902	0.03202	76,103	0.00000	0	368	368	736	121.85	89,682	165,785	0.08683	1,100,000	1,100,000	2,200,000	140,724	0	0	140,724	25,061
10	2031	2,376,902	0.03298	78,390	0.00000	0	368	368	736	125.50	92,368	170,758	0.09074	1,100,000	1,100,000	2,200,000	147,061	0	0	147,061	23,697
11	2032	1,836,698	0.03397	62,393	0.00000	0	284	284	568	129.27	73,425	135,818	0.09482	850,000	850,000	1,700,000	118,748	0	0	118,748	17,070
12	2033	1,080,410	0.03499	37,804	0.00000	0	167	167	334	133.15	44,472	82,276	0.09909	500,000	500,000	1,000,000	72,997	0	0	72,997	9,279
13	2034	0	0.03604	0	0.00000	0	0	0	0	137.14	0	0	0.10355	0	0	0	0	0	0	0	0
14	2035	0	0.03712	0	0.00000	0	0	0	0	141.25	0	0	0.10821	0	0	0	0	0	0	0	0
15	2036	0	0.03823	0	0.00000	0	0	0	0	145.49	0	0	0.11308	0	0	0	0	0	0	0	0
16	2037	0	0.03938	0	0.00000	0	0	0	0	149.86	0	0	0.11817	0	0	0	0	0	0	0	0
17	2038	0	0.04056	0	0.00000	0	0	0	0	154.35	0	0	0.12348	0	0	0	0	0	0	0	0
18	2039	0	0.04178	0	0.00000	0	0	0	0	158.98	0	0	0.12904	0	0	0	0	0	0	0	0
19	2040	0	0.04303	0	0.00000	0	0	0	0	163.75	0	0	0.13485	0	0	0	0	0	0	0	0
20	2041	0	0.04432	0	0.00000	0	0	0	0	168.67	0	0	0.14092	0	0	0	0	0	0	0	0
Total =		23,769,022							7,360			$1,556,111				22,000,000				$1,565,125	($9,014)
											NPV =	$1,056,701								$1,123,949	(67,248)

Total NPV = ($67,248)
Benefit/Cost Ratio = 0.94

Worksheet Calculations

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

Table 2
Utility Test

Project: **Commercial Partnership Program (Custom)**
Program Years: **2022 - 2024**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2022	$13,654	$0	$16,160	$29,814	$70,043	$70,043	($40,229)
2023	33,752	0	39,826	73,578	88,613	88,613	(15,035)
2024	63,735	0	75,109	138,844	122,183	122,183	16,661
2025	65,647	0	77,361	143,008	0	0	143,008
2026	67,616	0	79,679	147,295	0	0	147,295
2027	69,645	0	82,071	151,716	0	0	151,716
2028	71,734	0	84,530	156,264	0	0	156,264
2029	73,886	0	87,069	160,955	0	0	160,955
2030	76,103	0	89,682	165,785	0	0	165,785
2031	78,390	0	92,368	170,758	0	0	170,758
2032	62,393	0	73,425	135,818	0	0	135,818
2033	37,804	0	44,472	82,276	0	0	82,276
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
Total =				$1,556,111		$280,839	$1,275,272
			NPV =	$1,056,701		$259,459	797,242

Total NPV =	$797,242
Benefit/Cost Ratio =	4.07

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: **2022 - 2024**

	Benefits					Costs			Annual
Year	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	Benefits Less Costs (I)
2022	$13,654	$0	$16,160	$9,427	$39,241	$70,043	$50,000	$120,043	($80,802)
2023	33,752	0	39,826	23,964	97,542	88,613	70,000	158,613	(61,071)
2024	63,735	0	75,109	46,578	185,422	122,183	100,000	222,183	(36,761)
2025	65,647	0	77,361	49,414	192,422	0	0	0	192,422
2026	67,616	0	79,679	52,422	199,717	0	0	0	199,717
2027	69,645	0	82,071	55,615	207,331	0	0	0	207,331
2028	71,734	0	84,530	59,001	215,265	0	0	0	215,265
2029	73,886	0	87,069	62,595	223,550	0	0	0	223,550
2030	76,103	0	89,682	66,408	232,193	0	0	0	232,193
2031	78,390	0	92,368	70,452	241,210	0	0	0	241,210
2032	62,393	0	73,425	57,717	193,535	0	0	0	193,535
2033	37,804	0	44,472	36,013	118,289	0	0	0	118,289
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
2040	0	0	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0	0	0
Total =					$2,145,717			$500,839	$1,644,878
				NPV =	$1,955,663			$491,629	1,464,034

Total NPV = $1,464,034
Benefit/Cost Ratio = 3.98

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: **2022 - 2024**

	Benefits													Costs			Annual
Year	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	Benefits Less Costs (P)
2022	$50,000	$0.08706	$0.07937	250,000	250,000	500,000	$41,608	75	75	$52.250	$79.420	$9,875	$0	$101,483	$101,833	$0	$101,833	($350)
2023	70,000	0.09098	0.08294	600,000	600,000	1,200,000	104,352	180	180	54.601	82.994	24,767	0	199,119	145,180	0	145,180	53,939
2024	100,000	0.09507	0.08667	1,100,000	1,100,000	2,200,000	199,914	330	330	57.058	86.729	47,450	0	347,364	211,203	0	211,203	136,161
2025	0	0.09935	0.09057	1,100,000	1,100,000	2,200,000	208,912	330	330	59.626	90.631	49,585	0	258,497	0	0	0	258,497
2026	0	0.10382	0.09465	1,100,000	1,100,000	2,200,000	218,317	330	330	62.309	94.710	51,816	0	270,133	0	0	0	270,133
2027	0	0.10849	0.09891	1,100,000	1,100,000	2,200,000	228,140	330	330	65.113	98.972	54,148	0	282,288	0	0	0	282,288
2028	0	0.11337	0.10336	1,100,000	1,100,000	2,200,000	238,403	330	330	68.043	103.425	56,585	0	294,988	0	0	0	294,988
2029	0	0.11848	0.10801	1,100,000	1,100,000	2,200,000	249,139	330	330	71.105	108.080	59,131	0	308,270	0	0	0	308,270
2030	0	0.12381	0.11287	1,100,000	1,100,000	2,200,000	260,348	330	330	74.305	112.943	61,792	0	322,140	0	0	0	322,140
2031	0	0.12938	0.11795	1,100,000	1,100,000	2,200,000	272,063	330	330	77.648	118.026	64,572	0	336,635	0	0	0	336,635
2032	0	0.13520	0.12326	850,000	850,000	1,700,000	219,691	255	255	81.143	123.337	52,142	0	271,833	0	0	0	271,833
2033	0	0.14128	0.12880	500,000	500,000	1,000,000	135,040	150	150	84.794	128.887	32,052	0	167,092	0	0	0	167,092
2034	0	0.14764	0.13460	0	0	0	0	0	0	88.610	134.687	0	0	0	0	0	0	0
2035	0	0.15429	0.14066	0	0	0	0	0	0	92.597	140.748	0	0	0	0	0	0	0
2036	0	0.16123	0.14698	0	0	0	0	0	0	96.764	147.081	0	0	0	0	0	0	0
2037	0	0.16848	0.15360	0	0	0	0	0	0	101.119	153.700	0	0	0	0	0	0	0
2038	0	0.17607	0.16051	0	0	0	0	0	0	105.669	160.617	0	0	0	0	0	0	0
2039	0	0.18399	0.16773	0	0	0	0	0	0	110.424	167.844	0	0	0	0	0	0	0
2040	0	0.19227	0.17528	0	0	0	0	0	0	115.393	175.397	0	0	0	0	0	0	0
2041	0	0.20092	0.18317	0	0	0	0	0	0	120.586	183.290	0	0	0	0	0	0	0
Total =				11,000,000	11,000,000			3,300	3,300					$3,159,842			$458,216	$2,701,626
													NPV =	$1,934,456			$409,900	1,524,555

Total NPV = $1,524,555
Benefit/Cost Ratio = 4.72

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Commercial Partnership Program (Custom)**
Project: **2022 - 2024**

	Benefits			Costs			
Year	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	Benefits Less Costs (G)
2022	$13,654	$16,160	$29,814	$70,043	$50,000	$120,043	($90,229)
2023	33,752	39,826	73,578	88,613	70,000	158,613	(85,035)
2024	63,735	75,109	138,844	122,183	100,000	222,183	(83,339)
2025	65,647	77,361	143,008	0	0	0	143,008
2026	67,616	79,679	147,295	0	0	0	147,295
2027	69,645	82,071	151,716	0	0	0	151,716
2028	71,734	84,530	156,264	0	0	0	156,264
2029	73,886	87,069	160,955	0	0	0	160,955
2030	76,103	89,682	165,785	0	0	0	165,785
2031	78,390	92,368	170,758	0	0	0	170,758
2032	62,393	73,425	135,818	0	0	0	135,818
2033	37,804	44,472	82,276	0	0	0	82,276
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
		Total =	$1,556,111			$500,839	$1,055,272
		NPV =	$1,056,701			$462,127	594,574

Total NPV = $594,574
Benefit/Cost Ratio = 2.29

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: **2022 - 2024**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.08670
Retail Rate Winter ($/kWh) =	$0.08523
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.01951
Fuel Escalation Rate =	3.00%
2) Avg. System Marginal Energy Cost ($/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)	$78.94
Reserve Capacity=	18.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.65%
9) Utility Discount Rate =	7.22%
10) Societal Discount Rate =	1.56%
11) General Input Data Year =	2021
12) Project Analysis Year 1 =	2022
Project Analysis Year 2 =	2023
Project Analysis Year 3 =	2024

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$6,663	$4,223	$3,464
Incentive Costs =	10,000	10,000	10,000
Total Utility Project Costs =	$16,663	$14,223	$13,464
14) Direct Participant Costs ($/Part.) =	$20,000	$20,000	$20,000
Escalation Rate =	1.83%	1.83%	1.83%
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	11.4500%	11.4500%	11.4500%
18b) System Energy Line Loss Factor	8.0410%	8.0410%	8.0410%
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	$52,173	1.56
Utility Cost Test	$103,374	3.48
Societal Test	$191,567	3.61
Participant Test	$212,764	4.74
Total Resource Cost Test	$75,305	2.08

Table 1
Ratepayer Impact Test

Project: **Commercial Partnership Program (Custom)**
Program Years: **2022 - 2024**

t	Year	Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2022	108,042	$0.02528	$2,731	$0.00000	$0	17	17	34	$96.19	$3,270	$6,001	$0.02638	50,000	50,000	100,000	$1,943	$6,663	$10,000	$18,606	($12,605)
2	2023	216,082	0.02603	5,625	0.00000	0	33	33	66	99.07	6,539	12,164	0.02756	100,000	100,000	200,000	4,061	4,223	10,000	18,284	(6,120)
3	2024	324,124	0.02681	8,691	0.00000	0	50	50	100	102.05	10,205	18,896	0.02880	150,000	150,000	300,000	6,365	3,464	10,000	19,829	(933)
4	2025	324,124	0.02762	8,952	0.00000	0	50	50	100	105.11	10,511	19,463	0.03010	150,000	150,000	300,000	6,652	0	0	6,652	12,811
5	2026	324,124	0.02845	9,220	0.00000	0	50	50	100	108.26	10,826	20,046	0.03145	150,000	150,000	300,000	6,951	0	0	6,951	13,095
6	2027	324,124	0.02930	9,497	0.00000	0	50	50	100	111.51	11,151	20,648	0.03287	150,000	150,000	300,000	7,264	0	0	7,264	13,384
7	2028	324,124	0.03018	9,782	0.00000	0	50	50	100	114.85	11,485	21,267	0.03435	150,000	150,000	300,000	7,591	0	0	7,591	13,676
8	2029	324,124	0.03109	10,075	0.00000	0	50	50	100	118.30	11,830	21,905	0.03589	150,000	150,000	300,000	7,932	0	0	7,932	13,973
9	2030	324,124	0.03202	10,378	0.00000	0	50	50	100	121.85	12,185	22,563	0.03751	150,000	150,000	300,000	8,290	0	0	8,290	14,273
10	2031	324,124	0.03298	10,690	0.00000	0	50	50	100	125.50	12,550	23,240	0.03920	150,000	150,000	300,000	8,663	0	0	8,663	14,577
11	2032	216,082	0.03397	7,340	0.00000	0	33	33	66	129.27	8,532	15,872	0.04096	100,000	100,000	200,000	6,035	0	0	6,035	9,837
12	2033	108,042	0.03499	3,780	0.00000	0	17	17	34	133.15	4,527	8,307	0.04280	50,000	50,000	100,000	3,153	0	0	3,153	5,154
13	2034	0	0.03604	0	0.00000	0	0	0	0	137.14	0	0	0.04473	0	0	0	0	0	0	0	0
14	2035	0	0.03712	0	0.00000	0	0	0	0	141.25	0	0	0.04674	0	0	0	0	0	0	0	0
15	2036	0	0.03823	0	0.00000	0	0	0	0	145.49	0	0	0.04885	0	0	0	0	0	0	0	0
16	2037	0	0.03938	0	0.00000	0	0	0	0	149.86	0	0	0.05104	0	0	0	0	0	0	0	0
17	2038	0	0.04056	0	0.00000	0	0	0	0	154.35	0	0	0.05334	0	0	0	0	0	0	0	0
18	2039	0	0.04178	0	0.00000	0	0	0	0	158.98	0	0	0.05574	0	0	0	0	0	0	0	0
19	2040	0	0.04303	0	0.00000	0	0	0	0	163.75	0	0	0.05825	0	0	0	0	0	0	0	0
20	2041	0	0.04432	0	0.00000	0	0	0	0	193.97	0	0	0.06087	0	0	0	0	0	0	0	0
Total =		3,241,240							1,000			$210,372				3,000,000				$119,250	$91,122
											NPV =	$145,075								$92,902	52,173

Total NPV = $52,173
Benefit/Cost Ratio = 1.56

Worksheet Calculations

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

Table 2
Utility Test

Project: **Commercial Partnership Program (Custom)**
Program Years: **2022 - 2024**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2022	$2,731	$0	$3,270	$6,001	$16,663	$16,663	($10,662)
2023	5,625	0	6,539	12,164	14,223	14,223	(2,059)
2024	8,691	0	10,205	18,896	13,464	13,464	5,432
2025	8,952	0	10,511	19,463	0	0	19,463
2026	9,220	0	10,826	20,046	0	0	20,046
2027	9,497	0	11,151	20,648	0	0	20,648
2028	9,782	0	11,485	21,267	0	0	21,267
2029	10,075	0	11,830	21,905	0	0	21,905
2030	10,378	0	12,185	22,563	0	0	22,563
2031	10,690	0	12,550	23,240	0	0	23,240
2032	7,340	0	8,532	15,872	0	0	15,872
2033	3,780	0	4,527	8,307	0	0	8,307
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
Total =				$210,372		$44,350	$166,022
			NPV =	$145,075		$41,701	103,374

Total NPV = $103,374
Benefit/Cost Ratio = 3.48

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

Table 3
Societal Cost Test

Project: **Commercial Partnership Program (Custom)**
Program Years: **2022 - 2024**

	Benefits					Costs			Annual
Year	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	Benefits Less Costs (I)
2022	$2,731	$0	$3,270	$1,898	$7,899	$16,663	$10,000	$26,663	($18,764)
2023	5,625	0	6,539	3,962	16,126	14,223	10,000	24,223	(8,097)
2024	8,691	0	10,205	6,339	25,235	13,464	10,000	23,464	1,771
2025	8,952	0	10,511	6,725	26,188	0	0	0	26,188
2026	9,220	0	10,826	7,134	27,180	0	0	0	27,180
2027	9,497	0	11,151	7,569	28,217	0	0	0	28,217
2028	9,782	0	11,485	8,030	29,297	0	0	0	29,297
2029	10,075	0	11,830	8,519	30,424	0	0	0	30,424
2030	10,378	0	12,185	9,038	31,601	0	0	0	31,601
2031	10,690	0	12,550	9,588	32,828	0	0	0	32,828
2032	7,340	0	8,532	6,745	22,617	0	0	0	22,617
2033	3,780	0	4,527	3,636	11,943	0	0	0	11,943
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
2040	0	0	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0	0	0
Total =					$289,555			$74,350	$215,205
				NPV =	$264,830			$73,263	191,567

Total NPV = $191,567
Benefit/Cost Ratio = 3.61

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: **2022 - 2024**

	Benefits													Costs			Annual
Year	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	Benefits Less Costs (P)
2022	$10,000	$0.09060	$0.08907	50,000	50,000	100,000	$8,984	15	15	$34.485	$60.610	$1,426	$0	$20,410	$20,367	$0	$20,367	$43
2023	10,000	0.09468	0.09307	100,000	100,000	200,000	18,775	30	30	36.037	63.337	2,981	0	31,756	20,740	0	20,740	11,016
2024	10,000	0.09894	0.09726	150,000	150,000	300,000	29,430	45	45	37.658	66.188	4,673	0	44,103	21,120	0	21,120	22,983
2025	0	0.10339	0.10164	150,000	150,000	300,000	30,755	45	45	39.353	69.166	4,883	0	35,638	0	0	0	35,638
2026	0	0.10804	0.10621	150,000	150,000	300,000	32,138	45	45	41.124	72.279	5,103	0	37,241	0	0	0	37,241
2027	0	0.11291	0.11099	150,000	150,000	300,000	33,585	45	45	42.975	75.531	5,333	0	38,918	0	0	0	38,918
2028	0	0.11799	0.11599	150,000	150,000	300,000	35,097	45	45	44.908	78.930	5,573	0	40,670	0	0	0	40,670
2029	0	0.12330	0.12121	150,000	150,000	300,000	36,677	45	45	46.929	82.482	5,823	0	42,500	0	0	0	42,500
2030	0	0.12884	0.12666	150,000	150,000	300,000	38,325	45	45	49.041	86.194	6,086	0	44,411	0	0	0	44,411
2031	0	0.13464	0.13236	150,000	150,000	300,000	40,050	45	45	51.248	90.072	6,359	0	46,409	0	0	0	46,409
2032	0	0.14070	0.13832	100,000	100,000	200,000	27,902	30	30	53.554	94.125	4,430	0	32,332	0	0	0	32,332
2033	0	0.14703	0.14454	50,000	50,000	100,000	14,579	15	15	55.964	98.361	2,315	0	16,894	0	0	0	16,894
2034	0	0.15365	0.15104	0	0	0	0	0	0	58.482	102.787	0	0	0	0	0	0	0
2035	0	0.16056	0.15784	0	0	0	0	0	0	61.114	107.413	0	0	0	0	0	0	0
2036	0	0.16779	0.16494	0	0	0	0	0	0	63.864	112.246	0	0	0	0	0	0	0
2037	0	0.17534	0.17237	0	0	0	0	0	0	66.738	117.297	0	0	0	0	0	0	0
2038	0	0.18323	0.18012	0	0	0	0	0	0	69.741	122.576	0	0	0	0	0	0	0
2039	0	0.19148	0.18823	0	0	0	0	0	0	72.880	128.092	0	0	0	0	0	0	0
2040	0	0.20009	0.19670	0	0	0	0	0	0	76.159	133.856	0	0	0	0	0	0	0
2041	0	0.20910	0.20555	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					$431,282			$62,227	$369,055
													NPV =	$269,612			$56,848	212,764

Total NPV = $212,764
Benefit/Cost Ratio = 4.74

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Commercial Partnership Program (Custom)**
Project: **2022 - 2024**

	Benefits			Costs			
Year	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	Benefits Less Costs (G)
2022	$2,731	$3,270	$6,001	$16,663	$10,000	$26,663	($20,662)
2023	5,625	6,539	12,164	14,223	10,000	24,223	(12,059)
2024	8,691	10,205	18,896	13,464	10,000	23,464	(4,568)
2025	8,952	10,511	19,463	0	0	0	19,463
2026	9,220	10,826	20,046	0	0	0	20,046
2027	9,497	11,151	20,648	0	0	0	20,648
2028	9,782	11,485	21,267	0	0	0	21,267
2029	10,075	11,830	21,905	0	0	0	21,905
2030	10,378	12,185	22,563	0	0	0	22,563
2031	10,690	12,550	23,240	0	0	0	23,240
2032	7,340	8,532	15,872	0	0	0	15,872
2033	3,780	4,527	8,307	0	0	0	8,307
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
		Total =	$210,372			$74,350	$136,022
		NPV =	$145,075			$69,770	75,305

Total NPV = $75,305
Benefit/Cost Ratio = 2.08

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: **2022 - 2024**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.09538
Retail Rate Winter ($/kWh) =	$0.09219
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.02142
Fuel Escalation Rate =	3.00%
2) Avg. System Marginal Energy Cost ($/kWh) =	$0.00000
Escalation Rate =	3.00%
3) Retail Summer Demand Rate ($/kW/season) =	$50.60
3a) Retail Winter Demand Rate ($/kW/season) =	$90.40
Escalation Rate =	4.50%
4) Electric Margin ($/kWh) =	$0.07001
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/kW/yr)	$90.78
Reserve Capacity=	18.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.65%
9) Utility Discount Rate =	7.04%
10) Societal Discount Rate =	1.56%
11) General Input Data Year =	2021
12) Project Analysis Year 1 =	2022
Project Analysis Year 2 =	2023
Project Analysis Year 3 =	2024

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$27,880	$30,543	$31,460
Incentive Costs =	0	0	0
Direct Program Costs =	316,470	374,010	374,010
Total Utility Project Costs =	$344,350	$404,553	$405,470
14) Direct Participant Costs ($/Part.) =	$0	$0	$0
Escalation Rate =	1.83%	1.83%	1.83%
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	11.4500%	11.4500%	11.4500%
18b) System Energy Line Loss Factor	8.0410%	8.0410%	8.0410%
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	$3,593,273	2.29
Utility Cost Test	$3,593,273	2.29
Societal Test	$7,425,928	3.16
Participant Test	$459,966	81.19
Total Resource Cost Test	$3,587,471	2.28

Table 1
Ratepayer Impact Test

Project: **Commercial Demand Response Program**
Program Years: **2022 - 2024**

t	Year	Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Direct Program Costs (O)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
0	2015						5,015							112,500						$258,930		
1	2022	148,556	$0.02907	$4,319	$0.00000	$0	6,130	0	6,130	$110.62	$678,101	$682,420	$0.07316	137,500	0	137,500	$7,411	$27,880	$0	$316,470	$351,761	$330,659
2	2023	175,567	0.02994	5,256	0.00000	0	7,244	0	7,244	113.93	825,309	830,565	0.07645	162,500	0	162,500	9,152	30,543	0	374,010	413,705	416,860
3	2024	175,567	0.03084	5,414	0.00000	0	7,244	0	7,244	117.35	850,083	855,497	0.07989	162,500	0	162,500	9,564	31,460	0	374,010	415,034	440,463
4	2025	175,567	0.03176	5,576	0.00000	0	7,244	0	7,244	120.87	875,582	881,158	0.08349	162,500	0	162,500	9,995	0	0	374,010	384,005	497,153
5	2026	175,567	0.03271	5,743	0.00000	0	7,244	0	7,244	124.50	901,878	907,621	0.08725	162,500	0	162,500	10,445	0	0	374,010	384,455	523,166
6	2027	175,567	0.03370	5,917	0.00000	0	7,244	0	7,244	128.23	928,898	934,815	0.09117	162,500	0	162,500	10,914	0	0	374,010	384,924	549,891
7	2028	175,567	0.03471	6,094	0.00000	0	7,244	0	7,244	132.08	956,788	962,882	0.09527	162,500	0	162,500	11,405	0	0	374,010	385,415	577,467
8	2029	175,567	0.03575	6,277	0.00000	0	7,244	0	7,244	136.04	985,474	991,751	0.09956	162,500	0	162,500	11,918	0	0	374,010	385,928	605,823
9	2030	175,567	0.03682	6,464	0.00000	0	7,244	0	7,244	140.12	1,015,029	1,021,493	0.10404	162,500	0	162,500	12,455	0	0	374,010	386,465	635,028
10	2031	54,021	0.03792	2,048	0.00000	0	2,229	0	2,229	144.33	321,712	323,760	0.10872	50,000	0	50,000	4,005	0	0	115,080	119,085	204,675
11	2032	27,010	0.03906	1,055	0.00000	0	1,115	0	1,115	148.66	165,756	166,811	0.11362	25,000	0	25,000	2,093	0	0	57,540	59,633	107,178
12	2033	0	0.04023	0	0.00000	0	0	0	0	153.12	0	0	0.11873	0	0	0	0	0	0	0	0	0
13	2034	0	0.04144	0	0.00000	0	0	0	0	157.71	0	0	0.12407	0	0	0	0	0	0	0	0	0
14	2035	0	0.04268	0	0.00000	0	0	0	0	162.44	0	0	0.12965	0	0	0	0	0	0	0	0	0
15	2036	0	0.04396	0	0.00000	0	0	0	0	167.32	0	0	0.13549	0	0	0	0	0	0	0	0	0
16	2037	0	0.04528	0	0.00000	0	0	0	0	172.34	0	0	0.14159	0	0	0	0	0	0	0	0	0
17	2038	0	0.04664	0	0.00000	0	0	0	0	177.51	0	0	0.14796	0	0	0	0	0	0	0	0	0
18	2039	0	0.04804	0	0.00000	0	0	0	0	182.83	0	0	0.15462	0	0	0	0	0	0	0	0	0
19	2040	0	0.04948	0	0.00000	0	0	0	0	188.32	0	0	0.16157	0	0	0	0	0	0	0	0	0
20	2041	0	0.05096	0	0.00000	0	0	0	0	193.97	0	0	0.16884	0	0	0	0	0	0	0	0	0
Total =		1,634,123							67,426			$8,558,773				1,512,500					$3,670,410	$4,888,363
											NPV =	$6,388,341									$2,795,068	3,593,273

Total NPV = $3,593,273
Benefit/Cost Ratio = 2.29

Worksheet Calculations

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

Table 2
Utility Test

Project: **Commercial Demand Response Program**
Program Years: **2022 - 2024**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2022	$4,319	$0	$678,101	$682,420	$351,761	$351,761	$330,659
2023	5,256	0	825,309	830,565	413,705	413,705	416,860
2024	5,414	0	850,083	855,497	415,034	415,034	440,463
2025	5,576	0	875,582	881,158	384,005	384,005	497,153
2026	5,743	0	901,878	907,621	384,455	384,455	523,166
2027	5,917	0	928,898	934,815	384,924	384,924	549,891
2028	6,094	0	956,788	962,882	385,415	385,415	577,467
2029	6,277	0	985,474	991,751	385,928	385,928	605,823
2030	6,464	0	1,015,029	1,021,493	386,465	386,465	635,028
2031	2,048	0	321,712	323,760	119,085	119,085	204,675
2032	1,055	0	165,756	166,811	59,633	59,633	107,178
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
Total =				$8,558,773		$3,670,410	$4,888,363
			NPV =	$6,388,341		$2,795,068	3,593,273

Total NPV = $3,593,273
Benefit/Cost Ratio = 2.29

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: **2022 - 2024**

	Benefits					Costs			Annual
Year	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	Benefits Less Costs (I)
2022	$4,319	$0	$678,101	$215,788	$898,208	$351,761	$3,000	$354,761	$543,447
2023	5,256	0	825,309	270,512	1,101,077	413,705	3,000	416,705	684,372
2024	5,414	0	850,083	286,991	1,142,488	415,034	0	415,034	727,454
2025	5,576	0	875,582	304,468	1,185,626	384,005	0	384,005	801,621
2026	5,743	0	901,878	323,020	1,230,641	384,455	0	384,455	846,186
2027	5,917	0	928,898	342,679	1,277,494	384,924	0	384,924	892,570
2028	6,094	0	956,788	363,557	1,326,439	385,415	0	385,415	941,024
2029	6,277	0	985,474	385,690	1,377,441	385,928	0	385,928	991,513
2030	6,464	0	1,015,029	409,175	1,430,668	386,465	0	386,465	1,044,203
2031	2,048	0	321,712	133,578	457,338	119,085	0	119,085	338,253
2032	1,055	0	165,756	70,888	237,699	59,633	0	59,633	178,066
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
2040	0	0	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0	0	0
Total =					$11,665,119			$3,676,410	$7,988,709
				NPV =	$10,871,240			$3,445,312	7,425,928

Total NPV = $7,425,928
Benefit/Cost Ratio = 3.16

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: **2022 - 2024**

	Benefits													Costs			Annual
Year	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	Benefits Less Costs (P)
				112,500				4,500										
2022	$0	$0.09967	$0.09634	137,500	0	137,500	$13,705	5,500	0	$2.919	$94.468	$16,055	$28,875	$58,635	$3,000	$0	$3,000	$55,635
2023	0	0.10416	0.10067	162,500	0	162,500	16,926	6,500	0	2.919	98.719	18,974	34,125	70,025	3,000	0	3,000	67,025
2024	0	0.10884	0.10520	162,500	0	162,500	17,687	6,500	0	2.919	103.161	18,974	34,125	70,786	0	0	0	70,786
2025	0	0.11374	0.10994	162,500	0	162,500	18,483	6,500	0	2.919	107.804	18,974	34,125	71,582	0	0	0	71,582
2026	0	0.11886	0.11489	162,500	0	162,500	19,315	6,500	0	2.919	112.655	18,974	34,125	72,414	0	0	0	72,414
2027	0	0.12421	0.12006	162,500	0	162,500	20,184	6,500	0	2.919	117.724	18,974	34,125	73,283	0	0	0	73,283
2028	0	0.12980	0.12546	162,500	0	162,500	21,093	6,500	0	2.919	123.022	18,974	34,125	74,192	0	0	0	74,192
2029	0	0.13564	0.13110	162,500	0	162,500	22,042	6,500	0	2.919	128.558	18,974	34,125	75,141	0	0	0	75,141
2030	0	0.14174	0.13700	162,500	0	162,500	23,033	6,500	0	2.919	134.343	18,974	34,125	76,132	0	0	0	76,132
2031	0	0.14812	0.14317	50,000	0	50,000	7,406	2,000	0	2.919	140.388	5,838	10,500	23,744	0	0	0	23,744
2032	0	0.15479	0.14961	25,000	0	25,000	3,870	1,000	0	2.919	146.706	2,919	5,250	12,039	0	0	0	12,039
2033	0	0.16175	0.15634	0	0	0	0	0	0	2.919	153.308	0	0	0	0	0	0	0
2034	0	0.16903	0.16338	0	0	0	0	0	0	2.919	160.207	0	0	0	0	0	0	0
2035	0	0.17664	0.17073	0	0	0	0	0	0	2.919	167.416	0	0	0	0	0	0	0
2036	0	0.18459	0.17841	0	0	0	0	0	0	2.919	174.950	0	0	0	0	0	0	0
2037	0	0.19289	0.18644	0	0	0	0	0	0	2.919	182.822	0	0	0	0	0	0	0
2038	0	0.20157	0.19483	0	0	0	0	0	0	2.919	191.049	0	0	0	0	0	0	0
2039	0	0.21064	0.20360	0	0	0	0	0	0	2.919	199.646	0	0	0	0	0	0	0
2040	0	0.22012	0.21276	0	0	0	0	0	0	2.919	208.631	0	0	0	0	0	0	0
2041	0	0.23003	0.22234	0	0	0	0	0	0	2.919	218.019	0	0	0	0	0	0	0
Total =				1,512,500	0			60,500	0					$677,973			$6,000	$671,973
													NPV =	$465,702			$5,736	459,966

Total NPV = $459,966
Benefit/Cost Ratio = 81.19

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Commercial Demand Response Program**
Project: **2022 - 2024**

	Benefits			Costs			
Year	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	Benefits Less Costs (G)
2022	$4,319	$678,101	$682,420	$351,761	$3,000	$354,761	$327,659
2023	5,256	825,309	830,565	413,705	3,000	416,705	413,860
2024	5,414	850,083	855,497	415,034	0	415,034	440,463
2025	5,576	875,582	881,158	384,005	0	384,005	497,153
2026	5,743	901,878	907,621	384,455	0	384,455	523,166
2027	5,917	928,898	934,815	384,924	0	384,924	549,891
2028	6,094	956,788	962,882	385,415	0	385,415	577,467
2029	6,277	985,474	991,751	385,928	0	385,928	605,823
2030	6,464	1,015,029	1,021,493	386,465	0	386,465	635,028
2031	2,048	321,712	323,760	119,085	0	119,085	204,675
2032	1,055	165,756	166,811	59,633	0	59,633	107,178
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
		Total =	$8,558,773			$3,676,410	$4,882,363
		NPV =	$6,388,341			$2,800,871	3,587,471

Total NPV =	$3,587,471
Benefit/Cost Ratio =	2.28

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

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

Company: **Montana-Dakota Utilities Co.**
Project: **Commercial Demand Response Program**
Program Years: **2022 - 2024**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.08331
Retail Rate Winter ($/kWh) =	$0.07595
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.01972
Fuel Escalation Rate =	3.00%
2) Avg. System Marginal Energy Cost ($/kWh) =	$0.00000
Escalation Rate =	3.00%
3) Retail Summer Demand Rate ($/kW/season) =	$50.00
3a) Retail Winter Demand Rate ($/kW/season) =	$76.00
Escalation Rate =	4.50%
4) Electric Margin ($/kWh) =	$0.05843
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/kW/yr)	$78.94
Reserve Capacity=	18.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.65%
9) Utility Discount Rate =	7.36%
10) Societal Discount Rate =	1.56%
11) General Input Data Year =	2021
12) Project Analysis Year 1 =	2022
Project Analysis Year 2 =	2023
Project Analysis Year 3 =	2024

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$33,456	$36,182	$37,268
Incentive Costs =	0	0	0
Direct Program Costs =	0	0	0
Total Utility Project Costs =	$33,456	$36,182	$37,268
14) Direct Participant Costs ($/Part.) =	$0	$0	$0
Escalation Rate =	1.83%	1.83%	1.83%
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	11.4500%	11.4500%	11.4500%
18b) System Energy Line Loss Factor	8.0410%	8.0410%	8.0410%
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	$3,277,102	1.99
Utility Cost Test	$3,277,102	1.99
Societal Test	$7,094,766	2.74
Participant Test	$509,865	23.22
Total Resource Cost Test	$3,253,891	1.98

Table 1
Ratepayer Impact Test

Project: **Commercial Demand Response Program**
Program Years: **2022 - 2024**

t	Year	Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Direct Program Costs (O)	Costs: Total Project Costs (P)	Annual Benefits Less Costs (Q)
							6,130							137,500						$316,470		
1	2022	178,267	$0.02528	$4,506	$0.00000	$0	7,356	0	7,356	$96.19	$707,574	$712,080	$0.06106	165,000	0	165,000	$7,422	$33,456	$0	$379,764	$420,642	$291,438
2	2023	207,979	0.02603	5,414	0.00000	0	8,582	0	8,582	99.07	850,219	855,633	0.06381	192,500	0	192,500	9,049	36,182	0	443,058	488,289	367,344
3	2024	207,979	0.02681	5,577	0.00000	0	8,582	0	8,582	102.05	875,793	881,370	0.06668	192,500	0	192,500	9,456	37,268	0	443,058	489,782	391,588
4	2025	207,979	0.02762	5,744	0.00000	0	8,582	0	8,582	105.11	902,054	907,798	0.06968	192,500	0	192,500	9,881	0	0	443,058	452,939	454,859
5	2026	207,979	0.02845	5,916	0.00000	0	8,582	0	8,582	108.26	929,087	935,003	0.07281	192,500	0	192,500	10,325	0	0	443,058	453,383	481,620
6	2027	207,979	0.02930	6,094	0.00000	0	8,582	0	8,582	111.51	956,979	963,073	0.07609	192,500	0	192,500	10,790	0	0	443,058	453,848	509,225
7	2028	207,979	0.03018	6,277	0.00000	0	8,582	0	8,582	114.85	985,643	991,920	0.07952	192,500	0	192,500	11,277	0	0	443,058	454,335	537,585
8	2029	207,979	0.03109	6,465	0.00000	0	8,582	0	8,582	118.30	1,015,251	1,021,716	0.08309	192,500	0	192,500	11,783	0	0	443,058	454,841	566,875
9	2030	207,979	0.03202	6,659	0.00000	0	8,582	0	8,582	121.85	1,045,717	1,052,376	0.08683	192,500	0	192,500	12,313	0	0	443,058	455,371	597,005
10	2031	59,423	0.03298	1,960	0.00000	0	2,452	0	2,452	125.50	307,726	309,686	0.09074	55,000	0	55,000	3,677	0	0	126,588	130,265	179,421
11	2032	29,711	0.03397	1,009	0.00000	0	1,226	0	1,226	129.27	158,485	159,494	0.09482	27,500	0	27,500	1,921	0	0	63,294	65,215	94,279
12	2033	0	0.03499	0	0.00000	0	0	0	0	133.15	0	0	0.09909	0	0	0	0	0	0	0	0	0
13	2034	0	0.03604	0	0.00000	0	0	0	0	137.14	0	0	0.10355	0	0	0	0	0	0	0	0	0
14	2035	0	0.03712	0	0.00000	0	0	0	0	141.25	0	0	0.10821	0	0	0	0	0	0	0	0	0
15	2036	0	0.03823	0	0.00000	0	0	0	0	145.49	0	0	0.11308	0	0	0	0	0	0	0	0	0
16	2037	0	0.03938	0	0.00000	0	0	0	0	149.86	0	0	0.11817	0	0	0	0	0	0	0	0	0
17	2038	0	0.04056	0	0.00000	0	0	0	0	154.35	0	0	0.12348	0	0	0	0	0	0	0	0	0
18	2039	0	0.04178	0	0.00000	0	0	0	0	158.98	0	0	0.12904	0	0	0	0	0	0	0	0	0
19	2040	0	0.04303	0	0.00000	0	0	0	0	163.75	0	0	0.13485	0	0	0	0	0	0	0	0	0
20	2041	0	0.04432	0	0.00000	0	0	0	0	168.67	0	0	0.14092	0	0	0	0	0	0	0	0	0
	Total =	1,931,233							79,690			$8,790,149				1,787,500					$4,318,910	$4,471,239
											NPV =	$6,571,179									$3,294,077	3,277,102

Total NPV = $3,277,102
Benefit/Cost Ratio = 1.99

Worksheet Calculations

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

Table 2
Utility Test

Project: **Commercial Demand Response Program**
Program Years: **2022 - 2024**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2022	$4,506	$0	$707,574	$712,080	$420,642	$420,642	$291,438
2023	5,414	0	850,219	855,633	488,289	488,289	367,344
2024	5,577	0	875,793	881,370	489,782	489,782	391,588
2025	5,744	0	902,054	907,798	452,939	452,939	454,859
2026	5,916	0	929,087	935,003	453,383	453,383	481,620
2027	6,094	0	956,979	963,073	453,848	453,848	509,225
2028	6,277	0	985,643	991,920	454,335	454,335	537,585
2029	6,465	0	1,015,251	1,021,716	454,841	454,841	566,875
2030	6,659	0	1,045,717	1,052,376	455,371	455,371	597,005
2031	1,960	0	307,726	309,686	130,265	130,265	179,421
2032	1,009	0	158,485	159,494	65,215	65,215	94,279
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
Total =				$8,790,149		$4,318,910	$4,471,239
			NPV =	$6,571,179		$3,294,077	3,277,102

Total NPV = $3,277,102
Benefit/Cost Ratio = 1.99

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: **2022 - 2024**

	Benefits					Costs			Annual
Year	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	Benefits Less Costs (I)
2022	$4,506	$0	$707,574	$225,167	$937,247	$420,642	$12,000	$432,642	$504,605
2023	5,414	0	850,219	278,677	1,134,310	488,289	12,000	500,289	634,021
2024	5,577	0	875,793	295,671	1,177,041	489,782	0	489,782	687,259
2025	5,744	0	902,054	313,673	1,221,471	452,939	0	452,939	768,532
2026	5,916	0	929,087	332,765	1,267,768	453,383	0	453,383	814,385
2027	6,094	0	956,979	353,038	1,316,111	453,848	0	453,848	862,263
2028	6,277	0	985,643	374,521	1,366,441	454,335	0	454,335	912,106
2029	6,465	0	1,015,251	397,344	1,419,060	454,841	0	454,841	964,219
2030	6,659	0	1,045,717	421,545	1,473,921	455,371	0	455,371	1,018,550
2031	1,960	0	307,726	127,771	437,457	130,265	0	130,265	307,192
2032	1,009	0	158,485	67,779	227,273	65,215	0	65,215	162,058
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
2040	0	0	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0	0	0
Total =					$11,978,100			$4,342,910	$7,635,190
				NPV =	$11,167,146			$4,072,380	7,094,766

Total NPV = $7,094,766
Benefit/Cost Ratio = 2.74

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

Table 4
Participant Test

Project: **Commercial Demand Response Program**
Program Years: **2022 - 2024**

	Benefits														Costs			Annual
Year	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	Benefits Less Costs (P)
				137,500				5,500										
2022	$0	$0.08706	$0.07937	165,000	0	165,000	$14,365	6,600	0	$2.919	$79.420	$19,265	$34,650	$68,280	$12,000	$0	$12,000	$56,280
2023	0	0.09098	0.08294	192,500	0	192,500	17,514	7,700	0	2.919	82.994	22,476	40,425	80,415	12,000	0	12,000	68,415
2024	0	0.09507	0.08667	192,500	0	192,500	18,301	7,700	0	2.919	86.729	22,476	40,425	81,202	0	0	0	81,202
2025	0	0.09935	0.09057	192,500	0	192,500	19,125	7,700	0	2.919	90.631	22,476	40,425	82,026	0	0	0	82,026
2026	0	0.10382	0.09465	192,500	0	192,500	19,985	7,700	0	2.919	94.710	22,476	40,425	82,886	0	0	0	82,886
2027	0	0.10849	0.09891	192,500	0	192,500	20,884	7,700	0	2.919	98.972	22,476	40,425	83,785	0	0	0	83,785
2028	0	0.11337	0.10336	192,500	0	192,500	21,824	7,700	0	2.919	103.425	22,476	40,425	84,725	0	0	0	84,725
2029	0	0.11848	0.10801	192,500	0	192,500	22,807	7,700	0	2.919	108.080	22,476	40,425	85,708	0	0	0	85,708
2030	0	0.12381	0.11287	192,500	0	192,500	23,833	7,700	0	2.919	112.943	22,476	40,425	86,734	0	0	0	86,734
2031	0	0.12938	0.11795	55,000	0	55,000	7,116	2,200	0	2.919	118.026	6,422	11,550	25,088	0	0	0	25,088
2032	0	0.13520	0.12326	27,500	0	27,500	3,718	1,100	0	2.919	123.337	3,211	5,775	12,704	0	0	0	12,704
2033	0	0.14128	0.12880	0	0	0	0	0	0	2.919	128.887	0	0	0	0	0	0	0
2034	0	0.14764	0.13460	0	0	0	0	0	0	2.919	134.687	0	0	0	0	0	0	0
2035	0	0.15429	0.14066	0	0	0	0	0	0	2.919	140.748	0	0	0	0	0	0	0
2036	0	0.16123	0.14698	0	0	0	0	0	0	2.919	147.081	0	0	0	0	0	0	0
2037	0	0.16848	0.15360	0	0	0	0	0	0	2.919	153.700	0	0	0	0	0	0	0
2038	0	0.17607	0.16051	0	0	0	0	0	0	2.919	160.617	0	0	0	0	0	0	0
2039	0	0.18399	0.16773	0	0	0	0	0	0	2.919	167.844	0	0	0	0	0	0	0
2040	0	0.19227	0.17528	0	0	0	0	0	0	2.919	175.397	0	0	0	0	0	0	0
2041	0	0.20092	0.18317	0	0	0	0	0	0	2.919	183.290	0	0	0	0	0	0	0
Total =				1,787,500	0			71,500	0					$773,553			$24,000	$749,553
													NPV =	$532,809			$22,944	509,865

Total NPV = $509,865
Benefit/Cost Ratio = 23.22

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Commercial Demand Response Program**
Project: **2022 - 2024**

	Benefits			Costs			
Year	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	Benefits Less Costs (G)
2022	$4,506	$707,574	$712,080	$420,642	$12,000	$432,642	$279,438
2023	5,414	850,219	855,633	488,289	12,000	500,289	355,344
2024	5,577	875,793	881,370	489,782	0	489,782	391,588
2025	5,744	902,054	907,798	452,939	0	452,939	454,859
2026	5,916	929,087	935,003	453,383	0	453,383	481,620
2027	6,094	956,979	963,073	453,848	0	453,848	509,225
2028	6,277	985,643	991,920	454,335	0	454,335	537,585
2029	6,465	1,015,251	1,021,716	454,841	0	454,841	566,875
2030	6,659	1,045,717	1,052,376	455,371	0	455,371	597,005
2031	1,960	307,726	309,686	130,265	0	130,265	179,421
2032	1,009	158,485	159,494	65,215	0	65,215	94,279
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
		Total =	$8,790,149			$4,342,910	$4,447,239
		NPV =	$6,571,179			$3,317,288	3,253,891

Total NPV = $3,253,891
Benefit/Cost Ratio = 1.98

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

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

Company: **Montana-Dakota Utilities Co.**
Project: **Commercial Demand Response Program**
Program Years: **2022 - 2024**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.08670
Retail Rate Winter ($/kWh) =	$0.08523
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.01951
Fuel Escalation Rate =	3.00%
2) Avg. System Marginal Energy Cost ($/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)	$78.94
Reserve Capacity=	18.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.65%
9) Utility Discount Rate =	7.22%
10) Societal Discount Rate =	1.56%
11) General Input Data Year =	2021
12) Project Analysis Year 1 =	2022
Project Analysis Year 2 =	2023
Project Analysis Year 3 =	2024

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$2,028	$3,759	$3,872
Incentive Costs =	0	0	0
Direct Program Costs =	0	0	0
Total Utility Project Costs =	$2,028	$3,759	$3,872
14) Direct Participant Costs ($/Part.) =	$0	$0	$0
Escalation Rate =	1.83%	1.83%	1.83%
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	11.4500%	11.4500%	11.4500%
18b) System Energy Line Loss Factor	8.0410%	8.0410%	8.0410%
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	$370,352	2.07
Utility Cost Test	$370,352	2.07
Societal Test	$817,221	2.81
Participant Test	$45,649	4.98
Total Resource Cost Test	$358,747	2.00

Table 1
Ratepayer Impact Test

Project: **Commercial Demand Response Program**
Program Years: **2022 - 2024**

t	Year	Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Direct Program Costs (O)	Costs: Total Project Costs (P)	Annual Benefits Less Costs (Q)
1	2022	10,804	$0.02528	$273	$0.00000	$0	446	0	446	$96.19	$42,901	$43,174	$0.02638	10,000	0	10,000	$194	$2,028	$0	$23,016	$25,238	$17,936
2	2023	21,608	0.02603	563	0.00000	0	892	0	892	99.07	88,370	88,933	0.02756	20,000	0	20,000	406	3,759	0	46,032	50,197	38,736
3	2024	21,608	0.02681	579	0.00000	0	892	0	892	102.05	91,029	91,608	0.02880	20,000	0	20,000	424	3,872	0	46,032	50,328	41,280
4	2025	21,608	0.02762	597	0.00000	0	892	0	892	105.11	93,758	94,355	0.03010	20,000	0	20,000	443	0	0	46,032	46,475	47,880
5	2026	21,608	0.02845	615	0.00000	0	892	0	892	108.26	96,568	97,183	0.03145	20,000	0	20,000	463	0	0	46,032	46,495	50,688
6	2027	21,608	0.02930	633	0.00000	0	892	0	892	111.51	99,467	100,100	0.03287	20,000	0	20,000	484	0	0	46,032	46,516	53,584
7	2028	21,608	0.03018	652	0.00000	0	892	0	892	114.85	102,446	103,098	0.03435	20,000	0	20,000	506	0	0	46,032	46,538	56,560
8	2029	21,608	0.03109	672	0.00000	0	892	0	892	118.30	105,524	106,196	0.03589	20,000	0	20,000	529	0	0	46,032	46,561	59,635
9	2030	21,608	0.03202	692	0.00000	0	892	0	892	121.85	108,690	109,382	0.03751	20,000	0	20,000	553	0	0	46,032	46,585	62,797
10	2031	21,608	0.03298	713	0.00000	0	892	0	892	125.50	111,946	112,659	0.03920	20,000	0	20,000	578	0	0	46,032	46,610	66,049
11	2032	10,804	0.03397	367	0.00000	0	446	0	446	129.27	57,654	58,021	0.04096	10,000	0	10,000	302	0	0	23,016	23,318	34,703
12	2033	0	0.03499	0	0.00000	0	0	0	0	133.15	0	0	0.04280	0	0	0	0	0	0	0	0	0
13	2034	0	0.03604	0	0.00000	0	0	0	0	137.14	0	0	0.04473	0	0	0	0	0	0	0	0	0
14	2035	0	0.03712	0	0.00000	0	0	0	0	141.25	0	0	0.04674	0	0	0	0	0	0	0	0	0
15	2036	0	0.03823	0	0.00000	0	0	0	0	145.49	0	0	0.04885	0	0	0	0	0	0	0	0	0
16	2037	0	0.03938	0	0.00000	0	0	0	0	149.86	0	0	0.05104	0	0	0	0	0	0	0	0	0
17	2038	0	0.04056	0	0.00000	0	0	0	0	154.35	0	0	0.05334	0	0	0	0	0	0	0	0	0
18	2039	0	0.04178	0	0.00000	0	0	0	0	158.98	0	0	0.05574	0	0	0	0	0	0	0	0	0
19	2040	0	0.04303	0	0.00000	0	0	0	0	163.75	0	0	0.05825	0	0	0	0	0	0	0	0	0
20	2041	0	0.04432	0	0.00000	0	0	0	0	193.97	0	0	0.06087	0	0	0	0	0	0	0	0	0
	Total =	216,080							8,920			$1,004,709				200,000					$474,861	$529,848
											NPV =	$716,755									$346,403	370,352

Total NPV = $370,352
Benefit/Cost Ratio = 2.07

Worksheet Calculations

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

Table 2
Utility Test

Project: **Commercial Demand Response Program**
Program Years: **2022 - 2024**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2022	$273	$0	$42,901	$43,174	$25,238	$25,238	$17,936
2023	563	0	88,370	88,933	50,197	50,197	38,736
2024	579	0	91,029	91,608	50,328	50,328	41,280
2025	597	0	93,758	94,355	46,475	46,475	47,880
2026	615	0	96,568	97,183	46,495	46,495	50,688
2027	633	0	99,467	100,100	46,516	46,516	53,584
2028	652	0	102,446	103,098	46,538	46,538	56,560
2029	672	0	105,524	106,196	46,561	46,561	59,635
2030	692	0	108,690	109,382	46,585	46,585	62,797
2031	713	0	111,946	112,659	46,610	46,610	66,049
2032	367	0	57,654	58,021	23,318	23,318	34,703
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
Total =				$1,004,709		$474,861	$529,848
			NPV =	$716,755		$346,403	370,352

Total NPV = $370,352
Benefit/Cost Ratio = 2.07

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: **2022 - 2024**

	Benefits					Costs			Annual
Year	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	Benefits Less Costs (I)
2022	$273	$0	$42,901	$13,652	$56,826	$25,238	$6,000	$31,238	$25,588
2023	563	0	88,370	28,965	117,898	50,197	6,000	56,197	61,701
2024	579	0	91,029	30,731	122,339	50,328	0	50,328	72,011
2025	597	0	93,758	32,603	126,958	46,475	0	46,475	80,483
2026	615	0	96,568	34,587	131,770	46,495	0	46,495	85,275
2027	633	0	99,467	36,694	136,794	46,516	0	46,516	90,278
2028	652	0	102,446	38,927	142,025	46,538	0	46,538	95,487
2029	672	0	105,524	41,299	147,495	46,561	0	46,561	100,934
2030	692	0	108,690	43,815	153,197	46,585	0	46,585	106,612
2031	713	0	111,946	46,481	159,140	46,610	0	46,610	112,530
2032	367	0	57,654	24,657	82,678	23,318	0	23,318	59,360
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
2040	0	0	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0	0	0
Total =					$1,377,120			$486,861	$890,259
				NPV =	$1,269,579			$452,358	817,221

Total NPV = $817,221
Benefit/Cost Ratio = 2.81

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: **2022 - 2024**

	Benefits													Costs			Annual
Year	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	Benefits Less Costs (P)
2022	$0	$0.09060	$0.08907	10,000	0	10,000	$906	400	0	$2.919	$60.610	$1,168	$2,100	$4,174	$6,000	$0	$6,000	($1,826)
2023	0	0.09468	0.09307	20,000	0	20,000	1,894	800	0	2.919	63.337	2,335	4,200	8,429	6,000	0	6,000	2,429
2024	0	0.09894	0.09726	20,000	0	20,000	1,979	800	0	2.919	66.188	2,335	4,200	8,514	0	0	0	8,514
2025	0	0.10339	0.10164	20,000	0	20,000	2,068	800	0	2.919	69.166	2,335	4,200	8,603	0	0	0	8,603
2026	0	0.10804	0.10621	20,000	0	20,000	2,161	800	0	2.919	72.279	2,335	4,200	8,696	0	0	0	8,696
2027	0	0.11291	0.11099	20,000	0	20,000	2,258	800	0	2.919	75.531	2,335	4,200	8,793	0	0	0	8,793
2028	0	0.11799	0.11599	20,000	0	20,000	2,360	800	0	2.919	78.930	2,335	4,200	8,895	0	0	0	8,895
2029	0	0.12330	0.12121	20,000	0	20,000	2,466	800	0	2.919	82.482	2,335	4,200	9,001	0	0	0	9,001
2030	0	0.12884	0.12666	20,000	0	20,000	2,577	800	0	2.919	86.194	2,335	4,200	9,112	0	0	0	9,112
2031	0	0.13464	0.13236	20,000	0	20,000	2,693	800	0	2.919	90.072	2,335	4,200	9,228	0	0	0	9,228
2032	0	0.14070	0.13832	10,000	0	10,000	1,407	400	0	2.919	94.125	1,168	2,100	4,675	0	0	0	4,675
2033	0	0.14703	0.14454	0	0	0	0	0	0	2.919	98.361	0	0	0	0	0	0	0
2034	0	0.15365	0.15104	0	0	0	0	0	0	2.919	102.787	0	0	0	0	0	0	0
2035	0	0.16056	0.15784	0	0	0	0	0	0	2.919	107.413	0	0	0	0	0	0	0
2036	0	0.16779	0.16494	0	0	0	0	0	0	2.919	112.246	0	0	0	0	0	0	0
2037	0	0.17534	0.17237	0	0	0	0	0	0	2.919	117.297	0	0	0	0	0	0	0
2038	0	0.18323	0.18012	0	0	0	0	0	0	2.919	122.576	0	0	0	0	0	0	0
2039	0	0.19148	0.18823	0	0	0	0	0	0	2.919	128.092	0	0	0	0	0	0	0
2040	0	0.20009	0.19670	0	0	0	0	0	0	2.919	133.856	0	0	0	0	0	0	0
2041	0	0.20910	0.20555	0	0	0	0	0	0	2.919	139.879	0	0	0	0	0	0	0
Total =				200,000	0			8,000	0					$88,120			$12,000	$76,120
													NPV =	$57,121			$11,472	45,649

Total NPV = $45,649
Benefit/Cost Ratio = 4.98

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Commercial Demand Response Program**
Project: **2022 - 2024**

	Benefits			Costs			
Year	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	Benefits Less Costs (G)
2022	$273	$42,901	$43,174	$25,238	$6,000	$31,238	$11,936
2023	563	88,370	88,933	50,197	6,000	56,197	32,736
2024	579	91,029	91,608	50,328	0	50,328	41,280
2025	597	93,758	94,355	46,475	0	46,475	47,880
2026	615	96,568	97,183	46,495	0	46,495	50,688
2027	633	99,467	100,100	46,516	0	46,516	53,584
2028	652	102,446	103,098	46,538	0	46,538	56,560
2029	672	105,524	106,196	46,561	0	46,561	59,635
2030	692	108,690	109,382	46,585	0	46,585	62,797
2031	713	111,946	112,659	46,610	0	46,610	66,049
2032	367	57,654	58,021	23,318	0	23,318	34,703
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
		Total =	$1,004,709			$486,861	$517,848
		NPV =	$716,755			$358,008	358,747

Total NPV = $358,747
Benefit/Cost Ratio = 2.00

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: **2022 - 2024**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.09538
Retail Rate Winter ($/kWh) =	$0.09219
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.02142
Fuel Escalation Rate =	3.00%
2) Avg. System Marginal Energy Cost ($/kWh) =	$0.00000
Escalation Rate =	3.00%
3) Retail Summer Demand Rate ($/kW/season) =	$50.60
3a) Retail Winter Demand Rate ($/kW/season) =	$90.40
Escalation Rate =	4.50%
4) Electric Margin ($/kWh) =	$0.07001
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/kW/yr)	$90.78
Reserve Capacity=	18.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.65%
9) Utility Discount Rate =	7.04%
10) Societal Discount Rate =	1.56%
11) General Input Data Year =	2021
12) Project Analysis Year 1 =	2022
Project Analysis Year 2 =	2023
Project Analysis Year 3 =	2024

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$5,069	$7,518	$7,744
Incentive Costs =	0	0	0
Total Utility Project Costs =	$5,069	$7,518	$7,744
14) Direct Participant Costs ($/Part.) =	$0	$0	$0
Escalation Rate =	1.83%	1.83%	1.83%
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	11.4500%	11.4500%	11.4500%
18b) System Energy Line Loss Factor	8.0410%	8.0410%	8.0410%
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	$1,111,133	3.05
Utility Cost Test	$1,123,626	3.13
Societal Test	$2,192,859	4.08
Participant Test	$468,961	17.04
Total Resource Cost Test	$1,091,279	2.95

Table 1
Ratepayer Impact Test

Project: **Interruptible Rate DR Program**
Program Years: **2022 - 2024**

t	Year	Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Costs: Summer Energy Reduction (K1)	Costs: Winter Energy Reduction (K2)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2022	17,557	$0.02907	$510	$0.00000	$0	1,115	0	1,115	$110.62	$123,341	$123,851	$0.07316	16,250	0	16,250	$876	$45,120	$0	$45,996	$77,855
2	2023	28,091	0.02994	841	0.00000	0	1,783	0	1,783	113.93	203,137	203,978	0.07645	26,000	0	26,000	1,464	72,192	0	73,656	130,322
3	2024	28,091	0.03084	866	0.00000	0	1,783	0	1,783	117.35	209,235	210,101	0.07989	26,000	0	26,000	1,530	72,192	0	73,722	136,379
4	2025	28,091	0.03176	892	0.00000	0	1,783	0	1,783	120.87	215,511	216,403	0.08349	26,000	0	26,000	1,599	72,192	0	73,791	142,612
5	2026	28,091	0.03271	919	0.00000	0	1,783	0	1,783	124.50	221,984	222,903	0.08725	26,000	0	26,000	1,671	72,192	0	73,863	149,040
6	2027	28,091	0.03370	947	0.00000	0	1,783	0	1,783	128.23	228,634	229,581	0.09117	26,000	0	26,000	1,746	72,192	0	73,938	155,643
7	2028	28,091	0.03471	975	0.00000	0	1,783	0	1,783	132.08	235,499	236,474	0.09527	26,000	0	26,000	1,825	72,192	0	74,017	162,457
8	2029	28,091	0.03575	1,004	0.00000	0	1,783	0	1,783	136.04	242,559	243,563	0.09956	26,000	0	26,000	1,907	72,192	0	74,099	169,464
9	2030	28,091	0.03682	1,034	0.00000	0	1,783	0	1,783	140.12	249,834	250,868	0.10404	26,000	0	26,000	1,993	72,192	0	74,185	176,683
10	2031	28,091	0.03792	1,065	0.00000	0	1,783	0	1,783	144.33	257,340	258,405	0.10872	26,000	0	26,000	2,082	72,192	0	74,274	184,131
11	2032	10,534	0.03906	411	0.00000	0	669	0	669	148.66	99,454	99,865	0.11362	9,750	0	9,750	816	27,072	0	27,888	71,977
12	2033	0	0.04023	0	0.00000	0	0	0	0	153.12	0	0	0.11873	0	0	0	0	0	0	0	0
13	2034	0	0.04144	0	0.00000	0	0	0	0	157.71	0	0	0.12407	0	0	0	0	0	0	0	0
14	2035	0	0.04268	0	0.00000	0	0	0	0	162.44	0	0	0.12965	0	0	0	0	0	0	0	0
15	2036	0	0.04396	0	0.00000	0	0	0	0	167.32	0	0	0.13549	0	0	0	0	0	0	0	0
16	2037	0	0.04528	0	0.00000	0	0	0	0	172.34	0	0	0.14159	0	0	0	0	0	0	0	0
17	2038	0	0.04664	0	0.00000	0	0	0	0	177.51	0	0	0.14796	0	0	0	0	0	0	0	0
18	2039	0	0.04804	0	0.00000	0	0	0	0	182.83	0	0	0.15462	0	0	0	0	0	0	0	0
19	2040	0	0.04948	0	0.00000	0	0	0	0	188.32	0	0	0.16157	0	0	0	0	0	0	0	0
20	2041	0	0.05096	0	0.00000	0	0	0	0	193.97	0	0	0.16884	0	0	0	0	0	0	0	0
Total =		280,910							17,831			$2,295,992				260,000				$739,429	$1,556,563
											NPV =	$1,651,941								$540,808	1,111,133

Total NPV = $1,111,133
Benefit/Cost Ratio = 3.05

Worksheet Calculations

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

Table 2
Utility Test

Project: **Interruptible Rate DR Program**
Program Years: **2022 - 2024**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2022	$510	$0	$123,341	$123,851	$45,120	$45,120	$78,731
2023	841	0	203,137	203,978	72,192	72,192	131,786
2024	866	0	209,235	210,101	72,192	72,192	137,909
2025	892	0	215,511	216,403	72,192	72,192	144,211
2026	919	0	221,984	222,903	72,192	72,192	150,711
2027	947	0	228,634	229,581	72,192	72,192	157,389
2028	975	0	235,499	236,474	72,192	72,192	164,282
2029	1,004	0	242,559	243,563	72,192	72,192	171,371
2030	1,034	0	249,834	250,868	72,192	72,192	178,676
2031	1,065	0	257,340	258,405	72,192	72,192	186,213
2032	411	0	99,454	99,865	27,072	27,072	72,793
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
Total =				$2,295,992		$721,920	$1,574,072
			NPV =	$1,651,941		$528,315	1,123,626

Total NPV = $1,123,626
Benefit/Cost Ratio = 3.13

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

Table 3
Societal Cost Test

Project: **Interruptible Rate DR Program**
Program Years: **2022 - 2024**

	Benefits					Costs			Annual
Year	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	Benefits Less Costs (I)
2022	$510	$0	$123,341	$39,163	$163,014	$45,120	$2,763	$47,883	$115,131
2023	841	0	203,137	66,435	270,413	72,192	4,420	76,612	193,801
2024	866	0	209,235	70,482	280,583	72,192	4,420	76,612	203,971
2025	892	0	215,511	74,774	291,177	72,192	4,420	76,612	214,565
2026	919	0	221,984	79,331	302,234	72,192	4,420	76,612	225,622
2027	947	0	228,634	84,158	313,739	72,192	4,420	76,612	237,127
2028	975	0	235,499	89,286	325,760	72,192	4,420	76,612	249,148
2029	1,004	0	242,559	94,721	338,284	72,192	4,420	76,612	261,672
2030	1,034	0	249,834	100,489	351,357	72,192	4,420	76,612	274,745
2031	1,065	0	257,340	106,613	365,018	72,192	4,420	76,612	288,406
2032	411	0	99,454	42,439	142,304	27,072	1,658	28,730	113,574
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
2040	0	0	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0	0	0
Total =					$3,143,883			$766,121	$2,377,762
				NPV =	$2,904,016			$711,157	2,192,859

Total NPV = $2,192,859
Benefit/Cost Ratio = 4.08

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: **Interruptible Rate DR Program**
Program Years: **2022 - 2024**

	Benefits													Costs			Annual
Year	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	Benefits Less Costs (P)
2022	$0	$0.09967	$0.09634	16,250	0	16,250	$1,620	1,000	0	$52.877	$94.468	$45,120	$0	$46,740	$2,763	$0	$2,763	$43,977
2023	0	0.10416	0.10067	26,000	0	26,000	2,708	1,600	0	55.256	98.719	72,192	0	74,900	4,420	0	4,420	70,480
2024	0	0.10884	0.10520	26,000	0	26,000	2,830	1,600	0	57.743	103.161	72,192	0	75,022	4,420	0	4,420	70,602
2025	0	0.11374	0.10994	26,000	0	26,000	2,957	1,600	0	60.341	107.804	72,192	0	75,149	4,420	0	4,420	70,729
2026	0	0.11886	0.11489	26,000	0	26,000	3,090	1,600	0	63.057	112.655	72,192	0	75,282	4,420	0	4,420	70,862
2027	0	0.12421	0.12006	26,000	0	26,000	3,229	1,600	0	65.894	117.724	72,192	0	75,421	4,420	0	4,420	71,001
2028	0	0.12980	0.12546	26,000	0	26,000	3,375	1,600	0	68.860	123.022	72,192	0	75,567	4,420	0	4,420	71,147
2029	0	0.13564	0.13110	26,000	0	26,000	3,527	1,600	0	71.958	128.558	72,192	0	75,719	4,420	0	4,420	71,299
2030	0	0.14174	0.13700	26,000	0	26,000	3,685	1,600	0	75.196	134.343	72,192	0	75,877	4,420	0	4,420	71,457
2031	0	0.14812	0.14317	26,000	0	26,000	3,851	1,600	0	78.580	140.388	72,192	0	76,043	4,420	0	4,420	71,623
2032	0	0.15479	0.14961	9,750	0	9,750	1,509	600	0	82.116	146.706	27,072	0	28,581	1,658	0	1,658	26,923
2033	0	0.16175	0.15634	0	0	0	0	0	0	85.812	153.308	0	0	0	0	0	0	0
2034	0	0.16903	0.16338	0	0	0	0	0	0	89.673	160.207	0	0	0	0	0	0	0
2035	0	0.17664	0.17073	0	0	0	0	0	0	93.708	167.416	0	0	0	0	0	0	0
2036	0	0.18459	0.17841	0	0	0	0	0	0	97.925	174.950	0	0	0	0	0	0	0
2037	0	0.19289	0.18644	0	0	0	0	0	0	102.332	182.822	0	0	0	0	0	0	0
2038	0	0.20157	0.19483	0	0	0	0	0	0	106.937	191.049	0	0	0	0	0	0	0
2039	0	0.21064	0.20360	0	0	0	0	0	0	111.749	199.646	0	0	0	0	0	0	0
2040	0	0.22012	0.21276	0	0	0	0	0	0	116.778	208.631	0	0	0	0	0	0	0
2041	0	0.23003	0.22234	0	0	0	0	0	0	122.033	218.019	0	0	0	0	0	0	0
Total =				260,000	0			16,000	0					$754,301			$44,201	$710,100
													NPV =	$498,197			$29,236	468,961

Total NPV = $468,961
Benefit/Cost Ratio = 17.04

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Interruptible Rate DR Program**
Project: **2022 - 2024**

	Benefits			Costs			
Year	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	Benefits Less Costs (G)
2022	$510	$123,341	$123,851	$45,120	$2,763	$47,883	$75,968
2023	841	203,137	203,978	72,192	4,420	76,612	127,366
2024	866	209,235	210,101	72,192	4,420	76,612	133,489
2025	892	215,511	216,403	72,192	4,420	76,612	139,791
2026	919	221,984	222,903	72,192	4,420	76,612	146,291
2027	947	228,634	229,581	72,192	4,420	76,612	152,969
2028	975	235,499	236,474	72,192	4,420	76,612	159,862
2029	1,004	242,559	243,563	72,192	4,420	76,612	166,951
2030	1,034	249,834	250,868	72,192	4,420	76,612	174,256
2031	1,065	257,340	258,405	72,192	4,420	76,612	181,793
2032	411	99,454	99,865	27,072	1,658	28,730	71,135
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
		Total =	$2,295,992			$766,121	$1,529,871
		NPV =	$1,651,941			$560,663	1,091,279

Total NPV = $1,091,279
Benefit/Cost Ratio = 2.95

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

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

Company: **Montana-Dakota Utilities Co.**
Project: **Interruptible Rate DR Program**
Program Years: **2022 - 2024**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.08331
Retail Rate Winter ($/kWh) =	$0.07595
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.01972
Fuel Escalation Rate =	3.00%
2) Avg. System Marginal Energy Cost ($/kWh) =	$0.00000
Escalation Rate =	3.00%
3) Retail Summer Demand Rate ($/kW/season) =	$50.00
3a) Retail Winter Demand Rate ($/kW/season) =	$76.00
Escalation Rate =	4.50%
4) Electric Margin ($/kWh) =	$0.05843
Escalation Rate =	4.50%
5) System Peak Shaving Demand Cost ($/kW/yr)	$78.94
Reserve Capacity=	18.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.65%
9) Utility Discount Rate =	7.36%
10) Societal Discount Rate =	1.56%
11) General Input Data Year =	2021
12) Project Analysis Year 1 =	2022
Project Analysis Year 2 =	2023
Project Analysis Year 3 =	2024

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$72,994	$67,666	$69,696
Incentive Costs =	0	0	0
Total Utility Project Costs =	$72,994	$67,666	$69,696
14) Direct Participant Costs ($/Part.) =	$0	$0	$0
Escalation Rate =	1.83%	1.83%	1.83%
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	11.4500%	11.4500%	11.4500%
18b) System Energy Line Loss Factor	8.0410%	8.0410%	8.0410%
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	$7,140,190	2.46
Utility Cost Test	$7,254,723	2.52
Societal Test	$14,133,885	3.38
Participant Test	$4,261,436	42.92
Total Resource Cost Test	$7,144,218	2.46

Table 1
Ratepayer Impact Test

Project: **Interruptible Rate DR Program**
Program Years: **2022 - 2024**

t	Year	Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Total Energy Reduction (K)	Lost Margin (L)	Program Admin Costs (M)	Incentive Costs (N)	Total Project Costs (O)	Annual Benefits Less Costs (P)
																Costs					
0	2015	335,872							16,049					310,875				$0			
1	2022	335,872	$0.02528	$8,489	$0.00000	$0	0	0	16,049	$96.19	$1,543,734	$1,552,223	$0.06106	310,875	0	310,875	$13,984	$686,703	$0	$700,687	$851,536
2	2023	335,872	0.02603	8,744	0.00000	0	0	0	16,049	99.07	1,589,955	1,598,699	0.06381	310,875	0	310,875	14,613	$686,703	0	701,316	897,383
3	2024	335,872	0.02681	9,006	0.00000	0	0	0	16,049	102.05	1,637,780	1,646,786	0.06668	310,875	0	310,875	15,271	$686,703	0	701,974	944,812
4	2025	335,872	0.02762	9,276	0.00000	0	0	0	16,049	105.11	1,686,889	1,696,165	0.06968	310,875	0	310,875	15,958	$686,703	0	702,661	993,504
5	2026	335,872	0.02845	9,555	0.00000	0	0	0	16,049	108.26	1,737,443	1,746,998	0.07281	310,875	0	310,875	16,674	$686,703	0	703,377	1,043,621
6	2027	335,872	0.02930	9,841	0.00000	0	0	0	16,049	111.51	1,789,602	1,799,443	0.07609	310,875	0	310,875	17,426	$686,703	0	704,129	1,095,314
7	2028	335,872	0.03018	10,137	0.00000	0	0	0	16,049	114.85	1,843,205	1,853,342	0.07952	310,875	0	310,875	18,211	$686,703	0	704,914	1,148,428
8	2029	335,872	0.03109	10,441	0.00000	0	0	0	16,049	118.30	1,898,573	1,909,014	0.08309	310,875	0	310,875	19,029	$686,703	0	705,732	1,203,282
9	2030	335,872	0.03202	10,754	0.00000	0	0	0	16,049	121.85	1,955,546	1,966,300	0.08683	310,875	0	310,875	19,885	$686,703	0	706,588	1,259,712
10	2031	0	0.03298	0	0.00000	0	0	0	0	125.50	0	0	0.09074	0	0	0	0	0	0	0	0
11	2032	0	0.03397	0	0.00000	0	0	0	0	129.27	0	0	0.09482	0	0	0	0	0	0	0	0
12	2033	0	0.03499	0	0.00000	0	0	0	0	133.15	0	0	0.09909	0	0	0	0	0	0	0	0
13	2034	0	0.03604	0	0.00000	0	0	0	0	137.14	0	0	0.10355	0	0	0	0	0	0	0	0
14	2035	0	0.03712	0	0.00000	0	0	0	0	141.25	0	0	0.10821	0	0	0	0	0	0	0	0
15	2036	0	0.03823	0	0.00000	0	0	0	0	145.49	0	0	0.11308	0	0	0	0	0	0	0	0
16	2037	0	0.03938	0	0.00000	0	0	0	0	149.86	0	0	0.11817	0	0	0	0	0	0	0	0
17	2038	0	0.04056	0	0.00000	0	0	0	0	154.35	0	0	0.12348	0	0	0	0	0	0	0	0
18	2039	0	0.04178	0	0.00000	0	0	0	0	158.98	0	0	0.12904	0	0	0	0	0	0	0	0
19	2040	0	0.04303	0	0.00000	0	0	0	0	163.75	0	0	0.13485	0	0	0	0	0	0	0	0
20	2041	0	0.04432	0	0.00000	0	0	0	0	168.67	0	0	0.14092	0	0	0	0	0	0	0	0
Total =		3,022,852							144,439			$15,768,970				2,797,875				$6,331,378	$9,437,592
											NPV =	$12,035,110								$4,894,920	7,140,190

Total NPV = $7,140,190
Benefit/Cost Ratio = 2.46

Worksheet Calculations

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

Table 2
Utility Test

Project: **Interruptible Rate DR Program**
Program Years: **2022 - 2024**

	Benefits				Costs		Annual
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Benefits Less Costs (G)
2022	$8,489	$0	$1,543,734	$1,552,223	$686,703	$686,703	$865,520
2023	8,744	0	1,589,955	1,598,699	686,703	686,703	911,996
2024	9,006	0	1,637,780	1,646,786	686,703	686,703	960,083
2025	9,276	0	1,686,889	1,696,165	686,703	686,703	1,009,462
2026	9,555	0	1,737,443	1,746,998	686,703	686,703	1,060,295
2027	9,841	0	1,789,602	1,799,443	686,703	686,703	1,112,740
2028	10,137	0	1,843,205	1,853,342	686,703	686,703	1,166,639
2029	10,441	0	1,898,573	1,909,014	686,703	686,703	1,222,311
2030	10,754	0	1,955,546	1,966,300	686,703	686,703	1,279,597
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
Total =				$15,768,970		$6,180,327	$9,588,643
			NPV =	$12,035,110		$4,780,387	7,254,723

Total NPV = $7,254,723
Benefit/Cost Ratio = 2.52

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: **2022 - 2024**

	Benefits					Costs			Annual
Year	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	Benefits Less Costs (I)
2022	$8,489	$0	$1,543,734	$490,828	$2,043,051	$686,703	$15,874	$702,577	$1,340,474
2023	8,744	0	1,589,955	520,690	2,119,389	686,703	15,874	702,577	1,416,812
2024	9,006	0	1,637,780	552,443	2,199,229	686,703	15,874	702,577	1,496,652
2025	9,276	0	1,686,889	586,078	2,282,243	686,703	15,874	702,577	1,579,666
2026	9,555	0	1,737,443	621,752	2,368,750	686,703	15,874	702,577	1,666,173
2027	9,841	0	1,789,602	659,629	2,459,072	686,703	15,874	702,577	1,756,495
2028	10,137	0	1,843,205	699,769	2,553,111	686,703	15,874	702,577	1,850,534
2029	10,441	0	1,898,573	742,413	2,651,427	686,703	15,874	702,577	1,948,850
2030	10,754	0	1,955,546	787,632	2,753,932	686,703	15,874	702,577	2,051,355
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
2040	0	0	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0	0	0
Total =					$21,430,204			$6,323,193	$15,107,011
				NPV =	$20,082,180			$5,948,295	14,133,885

Total NPV = $14,133,885
Benefit/Cost Ratio = 3.38

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: **2022 - 2024**

	Benefits													Costs			
Year	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	Annual Benefits Less Costs (P)
				310,875				14,400										
2022	$0	$0.08706	$0.07937	310,875	0	310,875	$27,065	14,400	0	$52.250	$79.420	$649,728	$0	$676,793	$15,874	$0	$15,874	$660,919
2023	0	0.09098	0.08294	310,875	0	310,875	28,283	14,400	0	54.601	82.994	$649,728	0	678,011	15,874	0	15,874	662,137
2024	0	0.09507	0.08667	310,875	0	310,875	29,555	14,400	0	57.058	86.729	$649,728	0	679,283	15,874	0	15,874	663,409
2025	0	0.09935	0.09057	310,875	0	310,875	30,885	14,400	0	59.626	90.631	$649,728	0	680,613	15,874	0	15,874	664,739
2026	0	0.10382	0.09465	310,875	0	310,875	32,275	14,400	0	62.309	94.710	$649,728	0	682,003	15,874	0	15,874	666,129
2027	0	0.10849	0.09891	310,875	0	310,875	33,727	14,400	0	65.113	98.972	$649,728	0	683,455	15,874	0	15,874	667,581
2028	0	0.11337	0.10336	310,875	0	310,875	35,244	14,400	0	68.043	103.425	$649,728	0	684,972	15,874	0	15,874	669,098
2029	0	0.11848	0.10801	310,875	0	310,875	36,832	14,400	0	71.105	108.080	$649,728	0	686,560	15,874	0	15,874	670,686
2030	0	0.12381	0.11287	310,875	0	310,875	38,489	14,400	0	74.305	112.943	$649,728	0	688,217	15,874	0	15,874	672,343
2031	0	0.12938	0.11795	0	0	0	0	0	0	77.648	118.026	0	0	0	0	0	0	0
2032	0	0.13520	0.12326	0	0	0	0	0	0	81.143	123.337	0	0	0	0	0	0	0
2033	0	0.14128	0.12880	0	0	0	0	0	0	84.794	128.887	0	0	0	0	0	0	0
2034	0	0.14764	0.13460	0	0	0	0	0	0	88.610	134.687	0	0	0	0	0	0	0
2035	0	0.15429	0.14066	0	0	0	0	0	0	92.597	140.748	0	0	0	0	0	0	0
2036	0	0.16123	0.14698	0	0	0	0	0	0	96.764	147.081	0	0	0	0	0	0	0
2037	0	0.16848	0.15360	0	0	0	0	0	0	101.119	153.700	0	0	0	0	0	0	0
2038	0	0.17607	0.16051	0	0	0	0	0	0	105.669	160.617	0	0	0	0	0	0	0
2039	0	0.18399	0.16773	0	0	0	0	0	0	110.424	167.844	0	0	0	0	0	0	0
2040	0	0.19227	0.17528	0	0	0	0	0	0	115.393	175.397	0	0	0	0	0	0	0
2041	0	0.20092	0.18317	0	0	0	0	0	0	120.586	183.290	0	0	0	0	0	0	0
Total =				2,797,875	0			129,600	0					$6,139,907			$142,866	$5,997,041
													NPV =	$4,363,087			$101,651	4,261,436

Total NPV = ########
Benefit/Cost Ratio = 42.92

Worksheet Calculations

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

Table 5
Total Resource Cost Test

Company: **Interruptible Rate DR Program**
Project: **2022 - 2024**

	Benefits			Costs			
Year	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	Benefits Less Costs (G)
2022	$8,489	$1,543,734	$1,552,223	$686,703	$15,874	$702,577	$849,646
2023	8,744	1,589,955	1,598,699	686,703	15,874	702,577	896,122
2024	9,006	1,637,780	1,646,786	686,703	15,874	702,577	944,209
2025	9,276	1,686,889	1,696,165	686,703	15,874	702,577	993,588
2026	9,555	1,737,443	1,746,998	686,703	15,874	702,577	1,044,421
2027	9,841	1,789,602	1,799,443	686,703	15,874	702,577	1,096,866
2028	10,137	1,843,205	1,853,342	686,703	15,874	702,577	1,150,765
2029	10,441	1,898,573	1,909,014	686,703	15,874	702,577	1,206,437
2030	10,754	1,955,546	1,966,300	686,703	15,874	702,577	1,263,723
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
2040	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
		Total =	$15,768,970			$6,323,193	$9,445,777
		NPV =	$12,035,110			$4,890,892	7,144,218

Total NPV = $7,144,218
Benefit/Cost Ratio = 2.46

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: **2022 - 2024**

Input Data	
1) Retail Rate Summer ($/kWh) =	$0.08670
Retail Rate Winter ($/kWh) =	$0.08523
Retail Escalation Rate =	4.50%
1a) Power Supply Cost Adjustment	$0.01951
Fuel Escalation Rate =	3.00%
2) Avg. System Marginal Energy Cost ($/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)	$78.94
Reserve Capacity=	18.3%
Escalation Rate =	3.00%
6) System Variable O&M ($/kWh) =	$0.00000
Escalation Rate =	0.00%
7) Environmental Damage Factor =	31%
Escalation Rate =	3.00%
8) Participant Discount Rate =	9.65%
9) Utility Discount Rate =	7.22%
10) Societal Discount Rate =	1.56%
11) General Input Data Year =	2021
12) Project Analysis Year 1 =	2022
Project Analysis Year 2 =	2023
Project Analysis Year 3 =	2024

	First Year	Second Year	Third Year
13) Utility Project Costs			
Admin & Promotion Costs =	$0	$0	$0
Incentive Costs =	0	0	0
Total Utility Project Costs =	$0	$0	$0
14) Direct Participant Costs ($/Part.) =	$0	$0	$0
Escalation Rate =	1.83%	1.83%	1.83%
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	11.4500%	11.4500%	11.4500%
18b) System Energy Line Loss Factor	8.0410%	8.0410%	8.0410%
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: **2022 - 2024**

t	Year	Total Energy Reduction (A)	Energy Cost (B)	Energy Savings (C)	Variable O&M Sav. /kWh (D)	Variable O&M Savings (E)	Summer Demand Reduction (F1)	Winter Demand Reduction (F2)	Total Demand Reduction (F)	Demand Savings/ kW (G)	Demand Savings (H)	Total Savings (I)	Electric Margin (J)	Summer Energy Reduction (K1)	Winter Energy Reduction (K2)	Costs: Total Energy Reduction (K)	Costs: Lost Margin (L)	Costs: Program Admin Costs (M)	Costs: Incentive Costs (N)	Costs: Total Project Costs (O)	Annual Benefits Less Costs (P)
1	2022	0	$0.02528	$0	$0.00000	$0	0	0	0	$96.19	$0	$0	$0.02638	0	0	0	$0	$0	$0	$0	$0
2	2023	0	0.02603	0	0.00000	0	0	0	0	99.07	0	0	0.02756	0	0	0	0	0	0	0	0
3	2024	0	0.02681	0	0.00000	0	0	0	0	102.05	0	0	0.02880	0	0	0	0	0	0	0	0
4	2025	0	0.02762	0	0.00000	0	0	0	0	105.11	0	0	0.03010	0	0	0	0	0	0	0	0
5	2026	0	0.02845	0	0.00000	0	0	0	0	108.26	0	0	0.03145	0	0	0	0	0	0	0	0
6	2027	0	0.02930	0	0.00000	0	0	0	0	111.51	0	0	0.03287	0	0	0	0	0	0	0	0
7	2028	0	0.03018	0	0.00000	0	0	0	0	114.85	0	0	0.03435	0	0	0	0	0	0	0	0
8	2029	0	0.03109	0	0.00000	0	0	0	0	118.30	0	0	0.03589	0	0	0	0	0	0	0	0
9	2030	0	0.03202	0	0.00000	0	0	0	0	121.85	0	0	0.03751	0	0	0	0	0	0	0	0
10	2031	0	0.03298	0	0.00000	0	0	0	0	125.50	0	0	0.03920	0	0	0	0	0	0	0	0
11	2032	0	0.03397	0	0.00000	0	0	0	0	129.27	0	0	0.04096	0	0	0	0	0	0	0	0
12	2033	0	0.03499	0	0.00000	0	0	0	0	133.15	0	0	0.04280	0	0	0	0	0	0	0	0
13	2034	0	0.03604	0	0.00000	0	0	0	0	137.14	0	0	0.04473	0	0	0	0	0	0	0	0
14	2035	0	0.03712	0	0.00000	0	0	0	0	141.25	0	0	0.04674	0	0	0	0	0	0	0	0
15	2036	0	0.03823	0	0.00000	0	0	0	0	145.49	0	0	0.04885	0	0	0	0	0	0	0	0
16	2037	0	0.03938	0	0.00000	0	0	0	0	149.86	0	0	0.05104	0	0	0	0	0	0	0	0
17	2038	0	0.04056	0	0.00000	0	0	0	0	154.35	0	0	0.05334	0	0	0	0	0	0	0	0
18	2039	0	0.04178	0	0.00000	0	0	0	0	158.98	0	0	0.05574	0	0	0	0	0	0	0	0
19	2040	0	0.04303	0	0.00000	0	0	0	0	163.75	0	0	0.05825	0	0	0	0	0	0	0	0
20	2041	0	0.04432	0	0.00000	0	0	0	0	193.97	0	0	0.06087	0	0	0	0	0	0	0	0
Total =		0							0			$0				0				$0	$0
											NPV =	$0								$0	0

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

Worksheet Calculations

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

Table 2
Utility Test

Project: **Interruptible Rate DR Program**
Program Years: **2022 - 2024**

	Benefits				Costs		
Year	Energy Savings (A)	O & M Savings (B)	Demand Savings (C)	Total Savings (D)	Total Project Costs (E)	Total Project Costs (F)	Annual Benefits Less Costs (G)
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
2040	0	0	0	0	0	0	0
2041	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: **2022 - 2024**

	Benefits					Costs			Annual
Year	Total Energy Savings (A)	Variable O & M Savings (B)	System Demand Savings (C)	Avoided Environmental Damage Costs (D)	Annual Total Decrease (E)	Utility Project Costs (F)	Participants' Costs Net of Rebates (G)	Annual Total Increase (H)	Benefits Less Costs (I)
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
2040	0	0	0	0	0	0	0	0	0
2041	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: **2022 - 2024**

	Benefits													Costs			
Year	Incentives Received (A)	Summer Retail Rate (B)	Winter Retail Rate (C)	Summer Energy Reduction (D1)	Winter Energy Reduction (D2)	Total Energy Reduction (D)	Energy Savings Bill (E)	Summer Demand Reduction (F)	Winter Demand Reduction (G)	Summer Demand Rate (H)	Winter Demand Rate (I)	Demand Savings Bill (J)	Other Participant Savings (K)	Total Annual Benefits (L)	Direct Part. Costs (M)	Other Part. Costs (N)	Total Annual Costs (O)	Annual Benefits Less Costs (P)
2022	$0	$0.09060	$0.08907	0	0	0	$0	0	0	$34.485	$60.610	$0	$0	$0	$0	$0	$0	$0
2023	0	0.09468	0.09307	0	0	0	0	0	0	36.037	63.337	0	0	0	0	0	0	0
2024	0	0.09894	0.09726	0	0	0	0	0	0	37.658	66.188	0	0	0	0	0	0	0
2025	0	0.10339	0.10164	0	0	0	0	0	0	39.353	69.166	0	0	0	0	0	0	0
2026	0	0.10804	0.10621	0	0	0	0	0	0	41.124	72.279	0	0	0	0	0	0	0
2027	0	0.11291	0.11099	0	0	0	0	0	0	42.975	75.531	0	0	0	0	0	0	0
2028	0	0.11799	0.11599	0	0	0	0	0	0	44.908	78.930	0	0	0	0	0	0	0
2029	0	0.12330	0.12121	0	0	0	0	0	0	46.929	82.482	0	0	0	0	0	0	0
2030	0	0.12884	0.12666	0	0	0	0	0	0	49.041	86.194	0	0	0	0	0	0	0
2031	0	0.13464	0.13236	0	0	0	0	0	0	51.248	90.072	0	0	0	0	0	0	0
2032	0	0.14070	0.13832	0	0	0	0	0	0	53.554	94.125	0	0	0	0	0	0	0
2033	0	0.14703	0.14454	0	0	0	0	0	0	55.964	98.361	0	0	0	0	0	0	0
2034	0	0.15365	0.15104	0	0	0	0	0	0	58.482	102.787	0	0	0	0	0	0	0
2035	0	0.16056	0.15784	0	0	0	0	0	0	61.114	107.413	0	0	0	0	0	0	0
2036	0	0.16779	0.16494	0	0	0	0	0	0	63.864	112.246	0	0	0	0	0	0	0
2037	0	0.17534	0.17237	0	0	0	0	0	0	66.738	117.297	0	0	0	0	0	0	0
2038	0	0.18323	0.18012	0	0	0	0	0	0	69.741	122.576	0	0	0	0	0	0	0
2039	0	0.19148	0.18823	0	0	0	0	0	0	72.880	128.092	0	0	0	0	0	0	0
2040	0	0.20009	0.19670	0	0	0	0	0	0	76.159	133.856	0	0	0	0	0	0	0
2041	0	0.20910	0.20555	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)
(B) = Retail Summer Rate, escalated.
(C) = Retail Winter Rate, escalated.
(D) = Table 1 (K)
(E) = [Retail Rate (B) or (C)] x (D)
(F) = Average Summer kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)
(G) = Average Winter kW /Participant Saved (16) x Number of Participants (19) for Project Life (15)
(H) = Retail Summer Demand Rate, escalated.
(I) = Retail Winter Demand Rate, escalated.
(J) = (A) + (D) + (I) + (J)
(K) = Number of Participants (20) x Other Participant Savings (14b), escalated
(M) = Number of Participants (20) x Direct Participant Costs (14), escalated
(N) = Number of Participants (20) x Other Participants Costs (11a), escalated
(O) = (L) + (M)
(P) = (K) - (N)

Table 5
Total Resource Cost Test

Company: **Interruptible Rate DR Program**
Project: **2022 - 2024**

	Benefits			Costs			
Year	Total Energy Savings (A)	Total Demand Savings (B)	Total Annual Benefits (C)	Utility Program Costs (D)	Participants' Costs Net of Rebate (E)	Total Costs (F)	Benefits Less Costs (G)
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
2040	0	0	0	0	0	0	0
2041	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)