

**NATURAL GAS CONSERVATION PROGRAMS/DEMAND-SIDE MANAGEMENT
BEN/COST ANALYSIS FOR GAS CONSERVATION**

Company: **Montana-Dakota Utilities Co.**
 Project: **Residential Water Heating .67 EF**
 Program Years: **2015 - 2017**

Input Data			First Year	Second Year	Third Year
1) Retail Rate (\$/Dk) =	\$7.691	16) Utility Project Costs			
Escalation Rate =	3.50%	16a) Administrative & Operating Costs =	\$581	\$722	\$868
2) Non-Gas Fuel Retail Rate (\$/Fuel Unit) =	\$0.12640	16b) Incentive Costs =	4,000	4,800	5,600
Escalation Rate =	3.50%	16c) Total Utility Project Costs =	\$4,581	\$5,522	\$6,468
Non-Gas Fuel Units (ie. kWh,Gallons, etc) =	Kwh	17) Direct Participant Costs (\$/Part.) =	\$258	\$258	\$258
3) Commodity Cost (\$/Dk) =	\$4.187	18) Participant Non-Energy Costs (Annual \$/Part.) =	\$0	\$0	\$0
Escalation Rate =	3.50%	Escalation Rate =	0.00%	0.00%	0.00%
4) Demand Cost (\$/Unit/Yr) =	\$146.26	19) Participant Non-Energy Savings (Annual \$/Part) =	\$0	\$0	\$0
Escalation Rate =	1.00%	Escalation Rate =	0.00%	0.00%	1.40%
5) Peak Reduction Factor =	1.000%	20) Project Life (Years) =	15	15	15
6) Variable O&M (\$/Dk) =	\$0.000	21) Avg. Dk/Part. Saved =	2.100	2.100	2.100
Escalation Rate =	0.00%	22) Avg Non-Gas Fuel Units/Part. Saved =	0	0	0
7) Non-Gas Fuel Cost (\$/Fuel Unit) =	\$0.01990	22a) Avg Additional Non-Gas Fuel Units/ Part. Used =	0	0	0
Escalation Rate =	3.50%	23) Number of Participants =	40	48	56
8) Non-Gas Fuel Loss Factor	5.10%	24) Total Annual Dk Saved =	84	101	118
9) Gas Environmental Damage Factor =	\$0.350	25) Incentive/Participant =	\$100	\$100	\$100
Escalation Rate =	2.30%	26) Distribution Delivery Charge			\$1,744
10) Non Gas Fuel Environmental Damage Factor :	\$0.000	27) Effective Income Tax Rate =			35.000%
Escalation Rate =	0.00%	(Federal & State Taxes)			
11) Participant Discount Rate =	10.00%				
12) Utility Discount Rate =	7.60%				
13) Societal Discount Rate =	3.56%				
14) General Input Data Year =	2014				
15) Project Analysis Year 1 =	2015				
Project Analysis Year 2 =	2016				
Project Analysis Year 3 =	2017				

Test Results	NPV	B/C
Ratepayer Impact Measure Test	(\$558)	0.97
Utility Cost Test	\$3,381	1.22
Societal Test	(\$11,351)	0.70
Participant Test	\$2,277	1.07
Total Resource Cost Test	(\$17,629)	0.51

**Table 1
Ratepayer Impact Measure Test**

Company: **Montana-Dakota Utilities Co.**
Project: **Residential Water Heating .67 EF**

t	Year	Benefits										Costs			Annual Benefits Less Costs (P)		
		Total Energy Reduction (A)	Gas Commodity Cost/Dk (B)	Gas Commodity Savings (C)	Variable O & M Cost/Dk (D)	Variable O & M Savings (E)	Total Energy Savings (F)	Peak Dk Demand Reduction (G)	Demand Savings Per Unit (H)	Total Demand Savings (I)	Total Savings (J)	Distribution Delivery Charge (K)	Lost Margin (L)	Program Admin Costs (M)		Incentive Costs (N)	Total Program Costs (O)
1	2015	84	\$4,334	\$364	\$0.000	\$0	\$364	0.8	\$148	\$118	\$482	\$1,805	\$99	\$581	\$4,000	\$4,680	(\$4,198)
2	2016	185	4,485	830	0.000	0	830	1.9	149	283	1,113	1,868	225	722	4,800	5,747	(4,634)
3	2017	302	4,642	1,402	0.000	0	1,402	3.0	151	453	1,855	1,934	380	868	5,600	6,848	(4,993)
4	2018	302	4,805	1,451	0.000	0	1,451	3.0	152	456	1,907	2,001	393	0	0	693	1,514
5	2019	302	4,973	1,502	0.000	0	1,502	3.0	154	462	1,964	2,071	407	0	0	407	1,557
6	2020	302	5,147	1,554	0.000	0	1,554	3.0	155	465	2,019	2,144	421	0	0	421	1,598
7	2021	302	5,327	1,609	0.000	0	1,609	3.0	157	471	2,080	2,219	436	0	0	436	1,644
8	2022	302	5,513	1,665	0.000	0	1,665	3.0	158	474	2,139	2,297	451	0	0	451	1,688
9	2023	302	5,706	1,723	0.000	0	1,723	3.0	160	480	2,203	2,377	467	0	0	467	1,736
10	2024	302	5,906	1,784	0.000	0	1,784	3.0	162	486	2,270	2,460	483	0	0	483	1,787
11	2025	302	6,113	1,846	0.000	0	1,846	3.0	163	489	2,335	2,546	500	0	0	500	1,835
12	2026	302	6,327	1,911	0.000	0	1,911	3.0	165	495	2,406	2,635	517	0	0	517	1,889
13	2027	302	6,548	1,977	0.000	0	1,977	3.0	166	498	2,475	2,728	536	0	0	536	1,939
14	2028	302	6,777	2,047	0.000	0	2,047	3.0	168	504	2,551	2,823	554	0	0	554	1,997
15	2029	302	7,015	2,119	0.000	0	2,119	3.0	170	510	2,629	2,922	574	0	0	574	2,055
16	2030	218	7,260	1,583	0.000	0	1,583	2.2	172	378	1,961	3,024	429	0	0	429	1,532
17	2031	118	7,514	887	0.000	0	887	1.2	173	208	1,095	3,130	240	0	0	240	855
18	2032	0	7,777	0	0.000	0	0	0.0	175	0	0	3,239	0	0	0	0	0
19	2033	0	8,050	0	0.000	0	0	0.0	177	0	0	3,353	0	0	0	0	0
20	2034	0	8,331	0	0.000	0	0	0.0	178	0	0	3,470	0	0	0	0	0
21	2035	0	8,623	0	0.000	0	0	0.0	180	0	0	3,592	0	0	0	0	0
Total =		4,531									\$33,484					\$23,683	\$9,801
NPV =											\$18,681					\$19,238	(\$558)
Total NPV =																	(\$558)
Benefit/Cost Ratio =																	0.97

Worksheet Calculations	
(A) = Average Dk/Participant Saved (21) x Number of Participants (23) for Project Life (20)	(I) = (G) x (H)
(B) = Commodity Cost (3) escalated	(J) = (F) + (I)
(C) = (A) x (B)	(K) = Distribution Delivery Charge (26) escalated.
(D) = Variable O&M Cost (6), escalated	(L) = (A) x (K) x (1-Inverse of Tax Rate (27))
(E) = (A) x (D)	(M) = Admin & Operating Costs (16a)
(F) = (C) + (E)	(N) = Incentive Costs (16b)
(G) = (A) x Peak Reduction Factor (5)	(O) = (L) + (M) + (N)
(H) = Demand Cost (4) escalated.	(P) = (J) - (O)

**Table 2
Utility Cost Test**

Company: **Montana-Dakota Utilities Co.**
Project: **Residential Water Heating .67 EF**

Year	Benefits			Costs			Annual Benefits Less Costs (G)
	Total Energy Savings (A)	Total Demand Savings (B)	Annual Total Savings (C)	Program Admin Costs (D)	Utility Incentive Costs (E)	Utility Program Costs (F)	
2015	\$364	\$118	\$482	\$581	\$4,000	\$4,581	(\$4,099)
2016	830	283	1,113	722	4,800	5,522	(4,409)
2017	1,402	453	1,855	868	5,600	6,468	(4,613)
2018	1,451	456	1,907	0	0	0	1,907
2019	1,502	462	1,964	0	0	0	1,964
2020	1,554	465	2,019	0	0	0	2,019
2021	1,609	471	2,080	0	0	0	2,080
2022	1,665	474	2,139	0	0	0	2,139
2023	1,723	480	2,203	0	0	0	2,203
2024	1,784	486	2,270	0	0	0	2,270
2025	1,846	489	2,335	0	0	0	2,335
2026	1,911	495	2,406	0	0	0	2,406
2027	1,977	498	2,475	0	0	0	2,475
2028	2,047	504	2,551	0	0	0	2,551
2029	2,119	510	2,629	0	0	0	2,629
2030	1,583	378	1,961	0	0	0	1,961
2031	887	208	1,095	0	0	0	1,095
2032	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0
Total =			\$33,484		\$16,571	\$16,913	
NPV =			\$18,681		\$15,300	\$3,381	
Total NPV =			\$3,381				
Benefit/Cost Ratio =			<u>1.22</u>				

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

**Table 3
Societal Test**

Company: **Montana-Dakota Utilities Co.**
Project: **Residential Water Heating .67 EF**

Year	Benefits							Costs			Annual Benefits Less Costs (K)
	Total Energy Savings (A)	Total Demand Savings (B)	Non-Gas Energy Savings (\$/Part.) (C)	Non-Gas Energy Savings (D)	Environmental Damage Savings/Dk (E)	Environmental Damage Savings (F)	Annual Total Savings (G)	Utility Program Costs (H)	Participants' Costs Net of Rebate (I)	Annual Total Costs (J)	
2015	\$364	\$118	\$0.022	\$0	\$0.358	\$30	\$512	\$4,581	\$6,320	\$10,901	(\$10,389)
2016	830	283	0.022	0	0.366	68	1,181	5,522	7,584	13,106	(11,925)
2017	1,402	453	0.023	0	0.375	113	1,968	6,468	8,848	15,316	(13,348)
2018	1,451	456	0.024	0	0.383	116	2,023	0	0	0	2,023
2019	1,502	462	0.025	0	0.392	118	2,082	0	0	0	2,082
2020	1,554	465	0.026	0	0.401	121	2,140	0	0	0	2,140
2021	1,609	471	0.027	0	0.410	124	2,204	0	0	0	2,204
2022	1,665	474	0.028	0	0.420	127	2,266	0	0	0	2,266
2023	1,723	480	0.029	0	0.429	130	2,333	0	0	0	2,333
2024	1,784	486	0.030	0	0.439	133	2,403	0	0	0	2,403
2025	1,846	489	0.031	0	0.449	136	2,471	0	0	0	2,471
2026	1,911	495	0.032	0	0.460	139	2,545	0	0	0	2,545
2027	1,977	498	0.033	0	0.470	142	2,617	0	0	0	2,617
2028	2,047	504	0.034	0	0.481	145	2,696	0	0	0	2,696
2029	2,119	510	0.035	0	0.492	149	2,778	0	0	0	2,778
2030	1,583	378	0.036	0	0.504	110	2,071	0	0	0	2,071
2031	887	208	0.038	0	0.515	61	1,156	0	0	0	1,156
2032	0	0	0.039	0	0.527	0	0	0	0	0	0
2033	0	0	0.040	0	0.539	0	0	0	0	0	0
2034	0	0	0.042	0	0.552	0	0	0	0	0	0
2035	0	0	0.043	0	0.564	0	0	0	0	0	0

Total = \$35,446 \$39,323 (\$3,877)
 NPV = \$26,487 \$37,838 (\$11,351)

Total NPV = (\$11,351)
 Benefit/Cost Ratio = 0.70

Worksheet Calculations	
(A) = Table 1 (F)	(H) = Table 2 (F)
(G) = Table 1 (I)	(I) = Direct Part. Costs (17) x No. of Part. (23) - Table 1 (N)
(C) = Non-Gas Fuel Cost (7), adjusted for losses (8), escalated.	(J) = (H) + (I)
(D) = (C) x [Avg. Non-Gas Fuel Units/Part.Saved (22) x No. of Part. (23)]	(K) = (G) - (J)
(E) = Gas Environmental Damage Factor (9), escalated	
(F) = Table 1 (A) x (E)	
(G) = (A) + (B) + (D) + (F)	

**Table 4
Participant Test**

Company: **Montana-Dakota Utilities Co.**
Project: **Residential Water Heating .67 EF**

Year	Benefits						Costs		Annual Benefits Less Costs (I)
	Incentives Received (A)	Total Energy Reduction (B)	Retail Rate (C)	Gas Bill Savings (D)	Non-Gas Fuel Retail Rate (E)	Non-Gas Energy Savings (F)	Total Annual Benefits (G)	Direct Participant Costs (H)	
2015	\$4,000	84	\$7.960	\$669	\$0.131	\$0	\$4,669	\$10,320	(\$5,651)
2016	4,800	185	8.239	1,524	0.135	0	6,324	12,384	(6,060)
2017	5,600	302	8.527	2,575	0.140	0	8,175	14,448	(6,273)
2018	0	302	8.826	2,665	0.145	0	2,665	0	2,665
2019	0	302	9.134	2,758	0.150	0	2,758	0	2,758
2020	0	302	9.454	2,855	0.155	0	2,855	0	2,855
2021	0	302	9.785	2,955	0.161	0	2,955	0	2,955
2022	0	302	10.128	3,059	0.166	0	3,059	0	3,059
2023	0	302	10.482	3,166	0.172	0	3,166	0	3,166
2024	0	302	10.849	3,276	0.178	0	3,276	0	3,276
2025	0	302	11.229	3,391	0.185	0	3,391	0	3,391
2026	0	302	11.622	3,510	0.191	0	3,510	0	3,510
2027	0	302	12.028	3,632	0.198	0	3,632	0	3,632
2028	0	302	12.449	3,760	0.205	0	3,760	0	3,760
2029	0	302	12.885	3,891	0.212	0	3,891	0	3,891
2030	0	218	13.336	2,907	0.219	0	2,907	0	2,907
2031	0	118	13.803	1,629	0.227	0	1,629	0	1,629
2032	0	0	14.286	0	0.235	0	0	0	0
2033	0	0	14.786	0	0.243	0	0	0	0
2034	0	0	15.303	0	0.252	0	0	0	0
2035	0	0	15.839	0	0.260	0	0	0	0
Total =		4,531					\$62,622	\$37,152	\$25,470
						NPV =	\$35,796	\$33,519	2,277
Total NPV =		\$2,277							
Benefit/Cost Ratio =		<u>1.07</u>							

Worksheet Calculations
(A) = Table 1 (N)
(B) = Table 1 (A)
(C) = Retail Rate (1) escalated.
(D) = (B) x (C)
(E) = Non-Gas Fuel Retail Rate (2), escalated.
(F) = (C) x [Avg. Non-Gas Fuel Units/Part.Saved (22) x No. of Part. (23)]
(G) = (A) + (D) + (F)
(H) = Direct Participant Costs (17) x Number of Participants (23)
(I) = (G) - (H)

**Table 5
Total Resource Cost Test**

Compa Montana-Dakota Utilities Co.
Project Residential Water Heating .67 EF

Year	Benefits				Costs			Annual Benefits Less Costs (H)
	Total Energy Savings (A)	Total Demand Savings (B)	Non-Gas Energy Savings (C)	Total Annual Benefits (D)	Utility Program Costs (E)	Participants' Costs Net of Rebate (F)	Total Costs (G)	
2015	\$364	\$118	\$0	\$482	\$4,581	\$6,320	\$10,901	(\$10,419)
2016	830	283	0	1,113	5,522	7,584	13,106	(11,993)
2017	1,402	453	0	1,855	6,468	8,848	15,316	(13,461)
2018	1,451	456	0	1,907	0	0	0	1,907
2019	1,502	462	0	1,964	0	0	0	1,964
2020	1,554	465	0	2,019	0	0	0	2,019
2021	1,609	471	0	2,080	0	0	0	2,080
2022	1,665	474	0	2,139	0	0	0	2,139
2023	1,723	480	0	2,203	0	0	0	2,203
2024	1,784	486	0	2,270	0	0	0	2,270
2025	1,846	489	0	2,335	0	0	0	2,335
2026	1,911	495	0	2,406	0	0	0	2,406
2027	1,977	498	0	2,475	0	0	0	2,475
2028	2,047	504	0	2,551	0	0	0	2,551
2029	2,119	510	0	2,629	0	0	0	2,629
2030	1,583	378	0	1,961	0	0	0	1,961
2031	887	208	0	1,095	0	0	0	1,095
2032	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0
			Total =	\$33,484			\$39,323	(\$5,839)
			NPV =	\$18,681			\$36,310	(17,629)

Total NPV = (\$17,629)
Benefit/Cost Ratio = 0.51

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