

From: Hopkins, Asa [Asa.Hopkins@state.vt.us]
Sent: Monday, April 20, 2015 4:53 PM
To: Dan Tukey (dtukey@us.ibm.com); dzwicky@vpirg.org; Johanna Miller (jmiller@vnrc.org); Mark Whitworth (mark@energizevermont.org); Christopher Bray (CBray@leg.state.vt.us)
CC: Springer, Darren
Subject: the model as you saw it today
Attachments: H 40 consolidated model 20150420 Copy.xlsx

Thanks for the discussion this afternoon. This model continues to see tweaks; suggestions are welcome.
Best,
Asa

Asa S. Hopkins, PhD
Director of Energy Policy and Planning
Planning and Energy Resources Division
Vermont Public Service Department

802-828-4082
asa.hopkins@state.vt.us

YELLOW: INPUTS
GREY: CALCULATED

electric rate cost:	39
tier 3 savings:	429
net savings	390
emissions avoided	12.6

Generation required to meet Vermont load (base case)		DG tier	El tier	
2014	6109		0.0%	0.0%
2015	6067		0.0%	0.0%
2016	6021		0.0%	0.0%
2017	5986		1.0%	2.0%
2018	5961		1.6%	2.7%
2019	5950		2.2%	3.3%
2020	5942		2.8%	4.0%
2021	5969		3.4%	4.7%
2022	6002		4.0%	5.3%
2023	6043		4.6%	6.0%
2024	6089		5.2%	6.7%
2025	6141		5.8%	7.3%
2026	6198		6.4%	8.0%
2027	6259		7.0%	8.7%
2028	6324		7.6%	9.3%
2029	6393		8.2%	10.0%
2030	6466		8.8%	10.7%
2031	6542		9.4%	11.3%
2032	6617		10.0%	12.0%

3% real discount rate

1.7% inflation

15% net metering capacity factor
 15 MW of net metered solar per year after 2016
 100% % of counted net metering with RECs to utility

18% larger DG capacity factor

875	2014 premium RECs sold (thousands of MWh)
2000	GWh of old-hydro RECs already in portfolio

2016	"new" date for DG Tier
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	generation	5860369
	sales	5494000
losses		6.67%

50%	% of residential heat pumps leased
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5:reference	oil price forecast	\$2.87 <- 2017 oil price in this scenari
reference	electric price	
PSD	source of REC price forecast	

10%	bioheat fraction of fuel oil
7%	ethanol fraction of gasoline

0%	annual real cost decrease for tier 3 measures
0%	annual performance increase for HPs and EVs
0%	annual increase in % of home load covered by HP

million tons by 2032

Combined	Tier 2 target
0.0%	0.0%
0.0%	0.0%
0.0%	0.0%
3.0%	55.0%
4.3%	56.3%
5.5%	57.7%
6.8%	59.0%
8.1%	60.3%
9.3%	61.7%
10.6%	63.0%
11.9%	64.3%
13.1%	65.7%
14.4%	67.0%
15.7%	68.3%
16.9%	69.7%
18.2%	71.0%
19.5%	72.3%
20.7%	73.7%
22.0%	75.0%

Net metered MW	Std Offer MW	build rate
0	56.6	6.6
0	60.0	6.6
15	65.0	6.6
30	72.5	8.8
45	80.0	8.8
60	87.5	8.8
75	97.5	11.0
90	107.5	11.0
105	117.5	9.3
120	127.5	0.0
135	127.5	0.0
150	127.5	0.0
165	127.5	0.0
180	127.5	0.0
195	127.5	0.0
210	127.5	0.0
225	127.5	0.0
240	127.5	0.0
255	127.5	0.0

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Premium RECs	Tier 2 RECs	Tier 1 premium	PSD	PSD
\$55.00	\$1.00	\$54.00	\$55.00	\$1.00
\$54.08	\$1.00	\$53.08	\$54.08	\$1.00
\$53.18	\$1.00	\$52.18	\$53.18	\$1.00
\$52.29	\$1.00	\$51.29	\$52.29	\$1.00
\$51.41	\$1.25	\$50.16	\$51.41	\$1.25
\$50.55	\$1.50	\$49.05	\$50.55	\$1.50
\$49.71	\$1.75	\$47.96	\$49.71	\$1.75
\$48.88	\$2.00	\$46.88	\$48.88	\$2.00
\$48.06	\$2.00	\$46.06	\$48.06	\$2.00
\$47.26	\$2.00	\$45.26	\$47.26	\$2.00
\$46.47	\$2.00	\$44.47	\$46.47	\$2.00
\$45.69	\$2.00	\$43.69	\$45.69	\$2.00
\$44.93	\$2.00	\$42.93	\$44.93	\$2.00
\$44.18	\$2.00	\$42.18	\$44.18	\$2.00
\$43.44	\$2.00	\$41.44	\$43.44	\$2.00
\$42.71	\$2.00	\$40.71	\$42.71	\$2.00
\$42.00	\$2.00	\$40.00	\$42.00	\$2.00
\$41.30	\$2.00	\$39.30	\$41.30	\$2.00
\$40.61	\$2.00	\$38.61	\$40.61	\$2.00

GMP:	nominal	real	real	nominal	
	\$ 1.00	\$1.02		\$61.71 \$ 60.68	
	\$ 1.00	\$1.00		\$54.39 \$ 54.39	
	\$ 1.00	\$0.98		\$46.13 \$ 46.91	PSD
	\$ 1.00	\$0.97		\$34.90 \$ 36.10	GMP
	\$ 1.00	\$0.95		\$28.52 \$ 30.00	
	\$ 1.00	\$0.93		\$28.04 \$ 30.00	
	\$ 2.00	\$1.84		\$22.98 \$ 25.00	
	\$ 3.00	\$2.71		\$22.60 \$ 25.00	
	\$ 4.00	\$3.55		\$22.22 \$ 25.00	
	\$ 5.00	\$4.37		\$21.85 \$ 25.00	
	\$ 5.00	\$4.30		\$21.48 \$ 25.00	
	\$ 5.00	\$4.22		\$21.12 \$ 25.00	
	\$ 5.00	\$4.15		\$20.77 \$ 25.00	
	\$ 5.00	\$4.08		\$20.42 \$ 25.00	

\$	5.00	\$4.02	\$20.08	\$	25.00
\$	5.00	\$3.95	\$19.74	\$	25.00
\$	5.00	\$3.88	\$19.41	\$	25.00
\$	5.00	\$3.82	\$19.09	\$	25.00
\$	5.00	\$3.75	\$18.77	\$	25.00

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Present value cost (millions of \$2014)

Current policy risk \$529

RPS \$99

EIP **\$39**

		Tier 1 cost	Tier 2 (DG only)	Tier 2 and 3 (EIP)	Total (DG+TE)
1.00	2014	0.0	0.0	0.0	0.0
0.97	2015	0.0	0.0	0.0	0.0
0.94	2016	0.0	0.0	0.0	0.0
0.91	2017	1.1	0.8	2.8	1.9
0.89	2018	1.4	1.5	4.1	2.9
0.86	2019	1.8	2.1	5.4	3.9
0.83	2020	2.2	2.7	6.6	4.9
0.81	2021	2.7	3.3	7.9	6.1
0.78	2022	2.9	4.0	9.2	6.9
0.76	2023	3.1	4.6	10.6	7.7
0.74	2024	3.3	5.3	11.9	8.6
0.72	2025	3.5	5.9	13.3	9.4
0.69	2026	3.8	6.6	14.7	10.3
0.67	2027	4.0	7.3	16.2	11.3
0.65	2028	4.2	8.0	17.6	12.2
0.63	2029	4.5	8.7	19.1	13.2
0.61	2030	4.7	9.4	20.7	14.1
0.60	2031	5.0	10.2	22.2	15.2
0.58	2032	5.3	10.9	23.7	16.2

GHG emissions avoided due to EIP:
12,617,949

Total (EIP)	EIP incl usage	Rate % (DG+TE)	Rate % (EIP)	Rate% (EIP incre	EIP combined
0.0	0.0	0.0%	0.00%	0.00%	0.00%
0.0	0.0	0.0%	0.00%	0.00%	0.00%
0.0	0.0	0.0%	0.00%	0.00%	0.00%
3.9	3.2	0.2%	0.49%	-0.08%	0.4%
5.5	4.0	0.4%	0.69%	-0.19%	0.5%
7.2	4.7	0.5%	0.91%	-0.32%	0.6%
8.8	5.1	0.6%	1.12%	-0.47%	0.6%
10.6	5.5	0.8%	1.34%	-0.65%	0.7%
12.1	5.4	0.9%	1.52%	-0.84%	0.7%
13.7	5.2	1.0%	1.70%	-1.05%	0.6%
15.2	4.8	1.1%	1.89%	-1.29%	0.6%
16.8	4.4	1.2%	2.07%	-1.53%	0.5%
18.5	3.7	1.3%	2.25%	-1.79%	0.5%
20.2	3.0	1.4%	2.43%	-2.06%	0.4%
21.9	2.2	1.5%	2.60%	-2.35%	0.3%
23.6	1.2	1.6%	2.78%	-2.64%	0.1%
25.4	0.2	1.6%	2.96%	-2.94%	0.0%
27.2	-0.9	1.7%	3.13%	-3.24%	-0.1%
29.0	-2.2	1.8%	3.30%	-3.55%	-0.2%

0.69%

	2017	2024	2032
Total RE tier	0.1%	0.4%	0.6%
DG tier	0.1%	0.7%	1.2%
Transformation tie	0.2%	-0.5%	-2.1%
Combined	0.4%	0.6%	-0.2%

Present value of EIP customer savings
429 \$ millions

net VT cost: **-\$390**

434 total DG RECs counted in VT in 2032
419

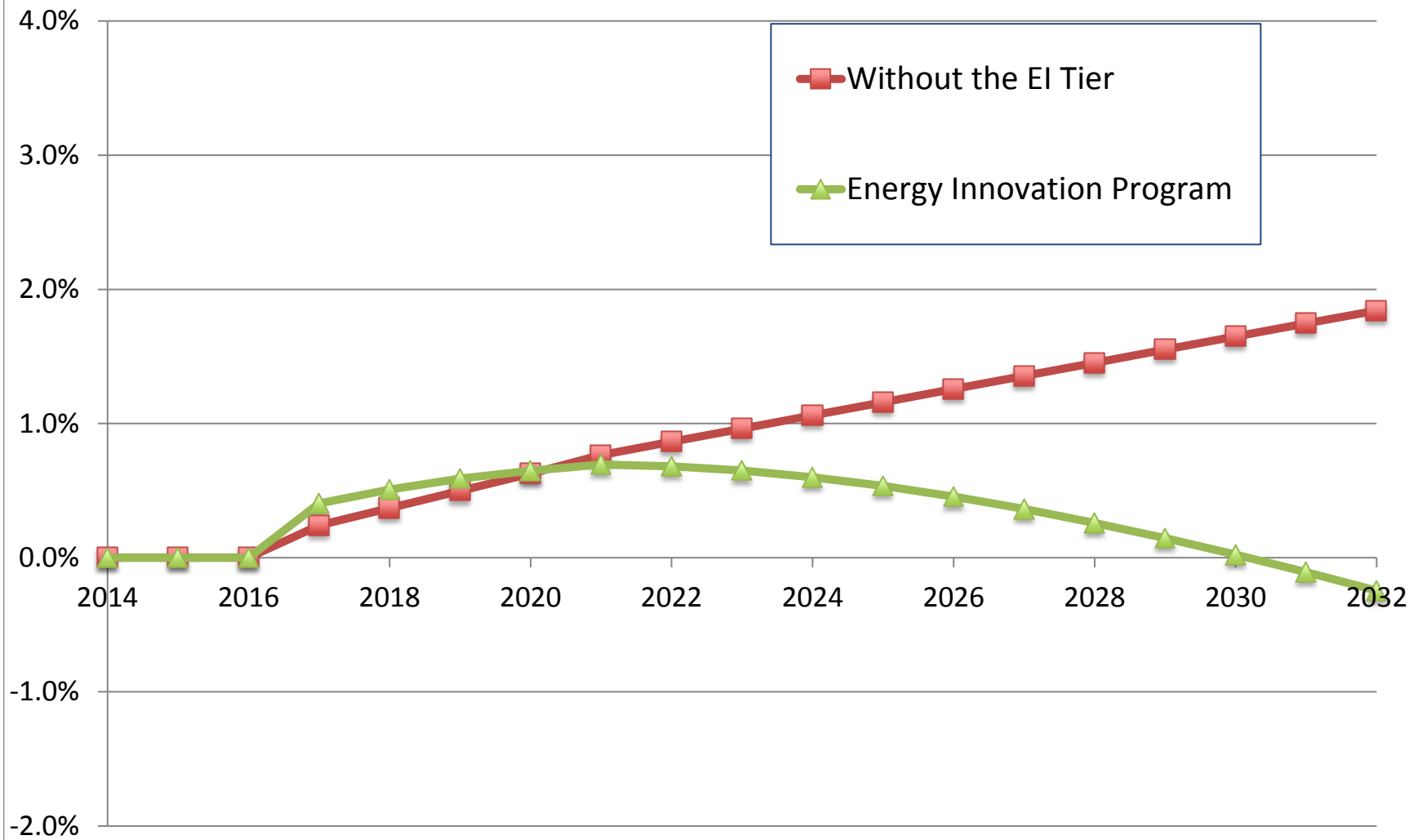
EIP participant	EIP net cost	net impact as % of rate		
0	0.0	0.0%		
0	0.0	0.0%		
0	0.0	0.0%		
8	-4.8	-0.6%	0.1%	0.1%
11	-6.6	-0.8%		
13	-8.8	-1.1%		
16	-11.3	-1.4%		
20	-14.2	-1.8%		
23	-17.9	-2.3%		
27	-22.2	-2.8%		
32	-27.1	-3.4%	0.4%	0.7%
37	-32.7	-4.0%		
43	-39.0	-4.7%		
49	-45.9	-5.5%		
56	-53.5	-6.4%		
63	-61.8	-7.3%		
71	-70.9	-8.3%		
80	-80.8	-9.3%		
89	-91.4	-10.4%	0.6%	1.2%

0.2%

-0.5%

-2.1%

Cumulative rate impacts of different policy options



	Generation
Credits (in MWh)	1
Cost/measure	54
Cost/credit	\$54
measure life	1
GHG impact	0.240
\$/ton	\$225
tons/credit	0.240
Customer lifetime savings without "sweetener"	

		net metering	DG RECs
1.0%	2017	70.6%	29.4%
1.6%	2018	66.4%	33.6%
2.2%	2019	64.5%	35.5%
2.8%	2020	63.5%	36.5%
3.4%	2021	62.4%	37.6%
4.0%	2022	61.6%	38.4%
4.6%	2023	60.8%	39.2%
5.2%	2024	60.0%	40.0%
5.8%	2025	59.3%	40.7%
6.4%	2026	58.6%	41.4%
7.0%	2027	57.8%	42.2%
7.6%	2028	57.1%	42.9%
8.2%	2029	56.4%	43.6%
8.8%	2030	55.7%	44.3%
9.4%	2031	54.9%	45.1%

10.0%	2032	54.3%	45.7%
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2017
2018
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2031
2032

res heat pump	cmml HP	EV	weatherization (TEPF)	100% bioheat
47	94	21	49	10
\$300	\$2,000	\$1,000	2000	200
\$6	\$21	\$47	\$41	\$20
15	15	9	20	1
42.7	85.4	15.7	32.1	6.6
\$7	\$23	\$64	\$62	\$30
0.91	0.91	0.74	0.65	0.66
3392	9207	3141	5076	0
\$3,392	\$9,207	\$3,141	\$5,076	\$0

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sales impact per unit	sales impact per unit	sales impact per unit
(\$207)	(\$414)	(\$238)

lease profit:

(\$156) per lease
(\$78) weighted average

res heat pump	cmml HP	EV	weatherization (TEPF)	100% bioheat
42.0%	8.0%	15.0%	2.0%	0.0%
42.0%	8.0%	14.0%	3.0%	0.0%
42.0%	8.0%	13.0%	4.0%	0.0%
42.0%	8.0%	12.0%	5.0%	0.0%
42.0%	8.0%	11.0%	6.0%	0.0%
42.0%	8.0%	10.0%	7.0%	0.0%
42.0%	8.0%	9.0%	8.0%	0.0%
42.0%	8.0%	8.0%	9.0%	0.0%
42.0%	8.0%	7.0%	10.0%	0.0%
42.0%	8.0%	6.0%	11.0%	0.0%
42.0%	8.0%	5.0%	12.0%	0.0%
42.0%	8.0%	4.0%	13.0%	0.0%
42.0%	8.0%	3.0%	14.0%	0.0%
42.0%	8.0%	2.0%	15.0%	0.0%
42.0%	8.0%	1.0%	16.0%	0.0%

42.0%	8.0%	0.0%	17.0%	0.0%
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Credits by year:

res HP

46	91	24	51	10
46	93	23	51	10
46	93	23	51	10
46	93	23	50	10
46	93	22	50	10
46	93	22	50	10
46	93	22	50	10
47	93	22	50	10
47	94	21	49	10
47	94	21	49	10
47	95	20	49	10
47	95	20	48	10
48	95	20	48	10
48	96	19	48	10
48	96	19	47	10
48	97	19	47	10

customer savings by year of installation

res heat pump	cmml HP	EV	weatherization (TEPF)	100% bioheat
(\$1,665.22)	(\$5,752.75)	(\$3,467.96)	(\$4,366.58)	0
(\$1,733.43)	(\$5,889.17)	(\$3,400.53)	(\$4,369.12)	0
(\$1,826.04)	(\$6,074.39)	(\$3,346.57)	(\$4,386.87)	0
(\$1,938.48)	(\$6,299.28)	(\$3,304.55)	(\$4,416.98)	0
(\$2,075.28)	(\$6,572.87)	(\$3,267.95)	(\$4,462.26)	0
(\$2,231.78)	(\$6,885.87)	(\$3,233.09)	(\$4,519.82)	0
(\$2,408.85)	(\$7,240.02)	(\$3,202.81)	(\$4,590.20)	0
(\$2,620.03)	(\$7,662.38)	(\$3,176.79)	(\$4,681.83)	0
(\$2,868.91)	(\$8,160.13)	(\$3,153.03)	(\$4,796.95)	0
(\$3,122.93)	(\$8,668.18)	(\$3,131.77)	(\$4,915.28)	0
(\$3,383.76)	(\$9,189.84)	(\$3,112.34)	(\$5,037.85)	0
(\$3,653.62)	(\$9,729.55)	(\$3,096.19)	(\$5,166.04)	0
(\$3,930.29)	(\$10,282.88)	(\$3,085.02)	(\$5,298.48)	0
(\$4,214.11)	(\$10,850.54)	(\$3,079.47)	(\$5,435.38)	0
(\$4,505.13)	(\$11,432.58)	(\$3,075.21)	(\$5,576.76)	0
(\$4,803.41)	(\$12,029.13)	(\$3,070.74)	(\$5,722.66)	0

bioCHP (one year)	HP+Wx	pellet boiler
3911	74	150
\$50,000	\$1,300	4000
\$13	\$18	\$27
1	18	15
4000.0	72.4	99.2
\$13	\$18	\$40
1.02	0.98	0.66
0	7455	0
\$0	\$7,455	\$0

Value to customer:

HP alone	HP lease	Hp + Wx
-\$4,604	-\$2,181	-\$8,666
	\$2,422 lease + Wx:	
		-\$6,243
\$1,000 low oil price "sweetener" H		
3: low		
4: mid-low	< \$500 extra incentive for H	

sales impact
per unit

(\$207)

lease profit:

(\$156) per lease

(\$78) weighted average

bioCHP (one year)	HP+Wx	pellet boiler	avg cost/cred	avg measure life	
0.0%	33.0%	0.0%	\$18.09	15.19	25.0%
0.0%	33.0%	0.0%	\$18.03	15.3	25.0%
0.0%	33.0%	0.0%	\$17.96	15.41	25.0%
0.0%	33.0%	0.0%	\$17.89	15.52	25.0%
0.0%	33.0%	0.0%	\$17.83	15.63	25.0%
0.0%	33.0%	0.0%	\$17.76	15.74	25.0%
0.0%	33.0%	0.0%	\$17.70	15.85	25.0%
0.0%	33.0%	0.0%	\$17.63	15.96	25.0%
0.0%	33.0%	0.0%	\$17.56	16.07	25.0%
0.0%	33.0%	0.0%	\$17.50	16.18	25.0%
0.0%	33.0%	0.0%	\$17.43	16.29	25.0%
0.0%	33.0%	0.0%	\$17.37	16.4	25.0%
0.0%	33.0%	0.0%	\$17.30	16.51	25.0%
0.0%	33.0%	0.0%	\$17.24	16.62	25.0%
0.0%	33.0%	0.0%	\$17.17	16.73	25.0%

0.0%	33.0%	0.0%
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\$17.10

16.84

25.0%

HP + Wx

3911	74	150
3911	75	150
3911	74	150
3911	74	150
3911	74	150
3911	74	150
3911	73	150
3911	73	150
3911	73	150
3911	73	150
3911	73	150
3911	73	150
3911	73	150
3911	73	150
3911	73	150
3911	73	150

bioCHP (one year) HP+Wx pellet boiler

0	(\$6,219.00)	0
0	(\$6,296.33)	0
0	(\$6,411.88)	0
0	(\$6,558.51)	0
0	(\$6,743.30)	0
0	(\$6,958.95)	0
0	(\$7,206.85)	0
0	(\$7,508.18)	0
0	(\$7,868.57)	0
0	(\$8,237.04)	0
0	(\$8,616.16)	0
0	(\$9,009.43)	0
0	(\$9,413.37)	0
0	(\$9,828.53)	0
0	#####	0
0	#####	0

Wx EV
-\$5,076 -\$3,141

P incentive

IPs

8.0%	15.0%	2.0%	0.0%	0.0%	50.0%	0.0%
8.0%	14.0%	3.0%	0.0%	0.0%	50.0%	0.0%
8.0%	13.0%	4.0%	0.0%	0.0%	50.0%	0.0%
8.0%	12.0%	5.0%	0.0%	0.0%	50.0%	0.0%
8.0%	11.0%	6.0%	0.0%	0.0%	50.0%	0.0%
8.0%	10.0%	7.0%	0.0%	0.0%	50.0%	0.0%
8.0%	9.0%	8.0%	0.0%	0.0%	50.0%	0.0%
8.0%	8.0%	9.0%	0.0%	0.0%	50.0%	0.0%
8.0%	7.0%	10.0%	0.0%	0.0%	50.0%	0.0%
8.0%	6.0%	11.0%	0.0%	0.0%	50.0%	0.0%
8.0%	5.0%	12.0%	0.0%	0.0%	50.0%	0.0%
8.0%	4.0%	13.0%	0.0%	0.0%	50.0%	0.0%
8.0%	3.0%	14.0%	0.0%	0.0%	50.0%	0.0%
8.0%	2.0%	15.0%	0.0%	0.0%	50.0%	0.0%
8.0%	1.0%	16.0%	0.0%	0.0%	50.0%	0.0%

8.0%	0.0%	17.0%	0.0%	0.0%	50.0%	0.0%
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	sales	generation	sales after			DG + EI
	GWh	GWh	NM	DG tier	EI tier	distributed
2014	5701	6109	5701	0.0%	0.0%	0.00%
2015	5662	6067	5662	0.0%	0.0%	0.00%
2016	5620	6021	5600	0.0%	0.0%	0.00%
2017	5587	5986	5547	1.0%	2.0%	3.00%
2018	5563	5961	5504	1.6%	2.7%	4.27%
2019	5553	5950	5474	2.2%	3.3%	5.53%
2020	5546	5942	5447	2.8%	4.0%	6.80%
2021	5571	5969	5452	3.4%	4.7%	8.07%
2022	5602	6002	5464	4.0%	5.3%	9.33%
2023	5640	6043	5482	4.6%	6.0%	10.60%
2024	5683	6089	5506	5.2%	6.7%	11.87%
2025	5731	6141	5534	5.8%	7.3%	13.13%
2026	5784	6198	5568	6.4%	8.0%	14.40%
2027	5842	6259	5605	7.0%	8.7%	15.67%
2028	5902	6324	5646	7.6%	9.3%	16.93%
2029	5967	6393	5691	8.2%	10.0%	18.20%
2030	6035	6466	5739	8.8%	10.7%	19.47%
2031	6105	6542	5790	9.4%	11.3%	20.73%
2032	6176	6617	5841	10.0%	12.0%	22.00%
2033						
2034						
2035						
2036						
2037						
2038						
2039						
2040						
2041						
2042						
2043						
2044						
2045						
2046						

2047

2048

2049

2050

all renewable	Requirements		DG NM GWh	Addl GWh to be acquired		
	DG+EI	Total RE		DG only	DG + EI	EI only
0.00%	0	0	0		0	
0.00%	0	0	0		0	
0.00%	0	0	20		0	
55.00%	168	3073	39	16	128	112
56.33%	237	3134	59	30	178	148
57.67%	307	3202	79	43	228	185
59.00%	377	3272	99	57	279	222
60.33%	449	3361	118	71	331	260
61.67%	523	3455	138	86	385	299
63.00%	598	3553	158	102	440	338
64.33%	674	3656	177	118	497	379
65.67%	753	3764	197	135	556	420
67.00%	833	3876	217	153	616	463
68.33%	915	3992	237	172	679	506
69.67%	999	4112	256	192	743	551
71.00%	1086	4237	276	213	810	597
72.33%	1175	4365	296	235	879	644
73.67%	1266	4498	315	259	951	692
75.00%	1359	4632	335	283	1,024	741

Total RE	Net cost (\$millions)			EI equivalencies	heat pumps	cmml HPs
	Total RE	DG only	DG + EI (gener Total			
0	0.0	0.0	0.0	0.0	0	0
0	0.0	0.0	0.0	0.0	0	0
0	0.0	0.0	0.0	0.0	0	0
1,073	1.1	0.8	6.6	7.6	2444	1222
1,134	1.4	1.5	8.9	10.4	3202	1601
1,202	1.8	2.1	11.2	13.0	3992	1996
1,272	2.2	2.7	13.4	15.6	4781	2391
1,361	2.7	3.3	15.5	18.2	5600	2800
1,455	2.9	4.0	17.7	20.6	6433	3216
1,553	3.1	4.6	19.9	23.0	7282	3641
1,656	3.3	5.3	22.1	25.4	8137	4069
1,764	3.5	5.9	24.3	27.8	8981	4490
1,876	3.8	6.6	26.4	30.2	9839	4919
1,992	4.0	7.3	28.6	32.6	10713	5356
2,112	4.2	8.0	30.8	35.0	11603	5802
2,237	4.5	8.7	33.0	37.5	12512	6256
2,365	4.7	9.4	35.2	39.9	13441	6720
2,498	5.0	10.2	37.4	42.3	14389	7194
2,632	5.3	10.9	39.5	44.8	15351	7675

EV	DG + EI deployment:					
	weatherization	bioheat	bioCHP	HP+Wx	pellets	DG MWs
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
4744	2195	11189	29	1501	746	10.4
6385	2923	14856	38	1985	990	19.0
8073	3659	18536	47	2485	1236	27.5
9800	4399	22214	57	2988	1481	36.0
11628	5172	26032	66	3514	1735	45.1
13527	5964	29919	76	4053	1995	54.6
15501	6777	33886	87	4607	2259	64.5
17552	7622	37939	97	5169	2529	74.9
19844	8511	42088	107	5731	2806	85.8
22261	9432	46338	118	6307	3089	97.3
24811	10388	50696	129	6897	3380	109.3
27499	11380	55165	141	7503	3678	122.0
30331	12409	59751	153	8125	3983	135.3
33314	13478	64459	165	8764	4297	149.3
36453	14587	69290	177	9420	4619	164.0
39735	15732	74215	190	10090	4948	179.2

incremental REC-ret:	
15 MW/yr of NM	
2016	10.4
2017	8.5
2018	8.5
2019	8.5
2020	9.1
2021	9.5
2022	9.9
2023	10.4
2024	10.9
2025	11.5
2026	12.0

2027	12.7
2028	13.3
2029	14.0
2030	14.7
2031	15.2

Scaled by utility:

DG MWs

2017	8
2018	15
2019	21
2020	28
2021	35
2022	42
2023	50
2024	58
2025	66
2026	75
2027	84
2028	94
2029	104
2030	115
2031	127
2032	138

S

heat pumps	cmml HPs	EV	weatherization	bioheat	bioCHP	HP+Wx	pellets	cumulative HPs
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
1027	98	712	44	0	0	495	0	1027
1345	128	894	88	0	0	655	0	2371
1677	160	1049	146	0	0.0	820	0	4048
2008	191	1176	220	0	0.0	986	0	6056
2352	224	1279	310	0	0.0	1160	0	8408
2702	257	1353	417	0	0.0	1338	0	11110
3059	291	1395	542	0	0.0	1520	0	14169
3418	325	1404	686	0	0.0	1706	0	17586
3772	359	1389	851	0	0.0	1891	0	21358
4132	394	1336	1038	0	0.0	2081	0	25491
4499	429	1241	1247	0	0.0	2276	0	29990
4873	464	1100	1479	0	0.0	2476	0	34863
5255	500	910	1737	0	0.0	2681	0	40119
5645	538	666	2022	0	0.0	2892	0	45764
6043	576	365	2334	0	0.0	3109	0	51807
6447	614	0	2674	0	0.0	3330	0	58254

ained deployment BEYOND:

NM + Std Offer

3.8

-0.3

-0.3

-0.3

-1.9

-1.5

0.6

10.4

10.9

11.5

12.0

weatherized:

HPs:

103506

45252

93218

12.7
13.3
14.0
14.7
15.2

GMP 77.2%

heat pumps	cmml HPs	EV	weatherization	bioheat	bioCHP	HP+Wx	pellets	cumulative HPs
792	75	549	34	0	0	382	0	792
1038	99	690	68	0	0	505	0	1830
1294	123	810	113	0	0	633	0	3124
1550	148	907	170	0	0	761	0	4673
1815	173	987	239	0	0	895	0	6488
2085	199	1044	322	0	0	1032	0	8573
2360	225	1076	418	0	0	1173	0	10933
2637	251	1083	529	0	0	1316	0	13570
2910	277	1072	657	0	0	1459	0	16480
3189	304	1031	801	0	0	1606	0	19669
3472	331	957	962	0	0	1756	0	23140
3760	358	849	1141	0	0	1910	0	26901
4055	386	702	1340	0	0	2069	0	30956
4356	415	514	1560	0	0	2231	0	35311
4663	444	281	1801	0	0	2399	0	39974
4975	474	0	2064	0	0	2569	0	44949

DG + EI net cost (w/ flexibility)

cum cmml HPs	cum EVs	cum HP+ ¹ DG RECs	heat pumps	cmml HPs	EVs
0	0	0	\$0.0	\$0.0	\$0.0
0	0	0	\$0.0	\$0.0	\$0.0
0	0	0	\$0.0	\$0.0	\$0.0
98	712	495	\$0.8	\$0.3	\$0.7
226	1605	1150	\$1.5	\$0.4	\$0.9
386	2655	1971	\$2.1	\$0.5	\$1.0
577	3831	2957	\$2.7	\$0.6	\$1.2
801	5110	4116	\$3.3	\$0.7	\$1.3
1058	6463	5454	\$4.0	\$0.8	\$1.4
1349	7858	6974	\$4.6	\$0.9	\$1.4
1675	9262	8680	\$5.3	\$1.0	\$1.4
2034	10651	10571	\$5.9	\$1.1	\$1.4
2428	11987	12653	\$6.6	\$1.2	\$1.3
2856	13227	14929	\$7.3	\$1.3	\$1.2
3320	14327	17405	\$8.0	\$1.5	\$1.1
3821	15237	20086	\$8.7	\$1.6	\$0.9
4358	15903	22978	\$9.4	\$1.7	\$0.7
4934	16268	26086	\$10.2	\$1.8	\$0.4
5548	16268	29416	\$10.9	\$1.9	\$0.0

shifts from increased usage

\$0	\$0	\$0
\$0	\$0	\$0
\$0	\$0	\$0
(\$0)	(\$0)	(\$0)
(\$1)	(\$0)	(\$0)
(\$1)	(\$0)	(\$1)
(\$2)	(\$0)	(\$1)
(\$2)	(\$0)	(\$1)
(\$3)	(\$0)	(\$2)
(\$4)	(\$1)	(\$2)
(\$5)	(\$1)	(\$2)
(\$6)	(\$1)	(\$3)
(\$7)	(\$1)	(\$3)

(\$9)	(\$1)	(\$3)
(\$10)	(\$1)	(\$3)
(\$11)	(\$2)	(\$4)
(\$13)	(\$2)	(\$4)
(\$15)	(\$2)	(\$4)
(\$17)	(\$2)	(\$4)

cum cmml HPs cum EVs

75	549
174	1239
297	2048
445	2956
618	3943
816	4987
1041	6063
1292	7147
1570	8218
1873	9249
2204	10206
2562	11055
2948	11757
3363	12271
3807	12552
4281	12552

					credit costs only
					DG+EI total net cost
weatherization	bioheat	bioCHP	HP+Wx	pellets	with flexibility
\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
\$0.1	\$0.0	\$0.0	\$0.6	\$0.0	\$2.8
\$0.2	\$0.0	\$0.0	\$0.9	\$0.0	\$4.1
\$0.3	\$0.0	\$0.0	\$1.1	\$0.0	\$5.4
\$0.4	\$0.0	\$0.0	\$1.3	\$0.0	\$6.6
\$0.6	\$0.0	\$0.0	\$1.5	\$0.0	\$7.9
\$0.8	\$0.0	\$0.0	\$1.7	\$0.0	\$9.2
\$1.1	\$0.0	\$0.0	\$2.0	\$0.0	\$10.6
\$1.4	\$0.0	\$0.0	\$2.2	\$0.0	\$11.9
\$1.7	\$0.0	\$0.0	\$2.5	\$0.0	\$13.3
\$2.1	\$0.0	\$0.0	\$2.7	\$0.0	\$14.7
\$2.5	\$0.0	\$0.0	\$3.0	\$0.0	\$16.2
\$3.0	\$0.0	\$0.0	\$3.2	\$0.0	\$17.6
\$3.5	\$0.0	\$0.0	\$3.5	\$0.0	\$19.1
\$4.0	\$0.0	\$0.0	\$3.8	\$0.0	\$20.7
\$4.7	\$0.0	\$0.0	\$4.0	\$0.0	\$22.2
\$5.3	\$0.0	\$0.0	\$4.3	\$0.0	\$23.7

fixed cost savings	
\$0	\$0.0
\$0	\$0.0
\$0	\$0.0
(\$0)	-\$0.6
(\$0)	-\$1.5
(\$1)	-\$2.5
(\$1)	-\$3.7
(\$1)	-\$5.1
(\$2)	-\$6.7
(\$2)	-\$8.5
(\$2)	-\$10.4
(\$3)	-\$12.5
(\$4)	-\$14.7

(\$4)	-\$17.1
(\$5)	-\$19.7
(\$6)	-\$22.4
(\$7)	-\$25.2
(\$7)	-\$28.1
(\$8)	-\$31.2

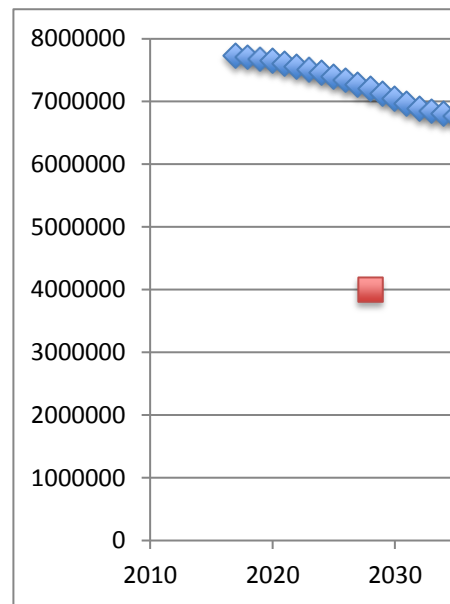
DG+EI	present value of			
CO2 emissions reductions	Customer savings			
0	0.0	0	0	
0	0.0	0	0	
0	0.0	0	0	
358042	8.0	257442	100600	8383
404769	10.6	272158	132611	19434
454309	13.4	288559	165750	33247
504272	16.4	305306	198966	49827
560148	19.7	326631	233517	69287
617900	23.4	349127	268773	91685
677576	27.4	372761	304815	117086
738744	31.9	397478	341266	145525
801053	37.1	423284	377770	177006
865130	42.7	450135	414995	211589
931006	48.9	478024	452983	249337
998639	55.7	506895	491744	290316
1068105	63.1	536780	531325	334593
1139370	71.1	567639	571731	382237
1212417	79.8	599450	612967	433318
1286468	89.3	631713	654755	479497
		631713	654755	523009
		631713	654755	563760
		631713	654755	601742
		631713	654755	636845
		631713	654755	669010
		631713	654755	698172
		631713	654755	724296
		631713	654755	747378
		631713	654755	767358
		631713	654755	784172
		631713	654755	797757
		631713	654755	808042
		631713	654755	814961
		631713	654755	818443

631713	654755	818443
631713	654755	818443
631713	654755	818443
631713	654755	818443

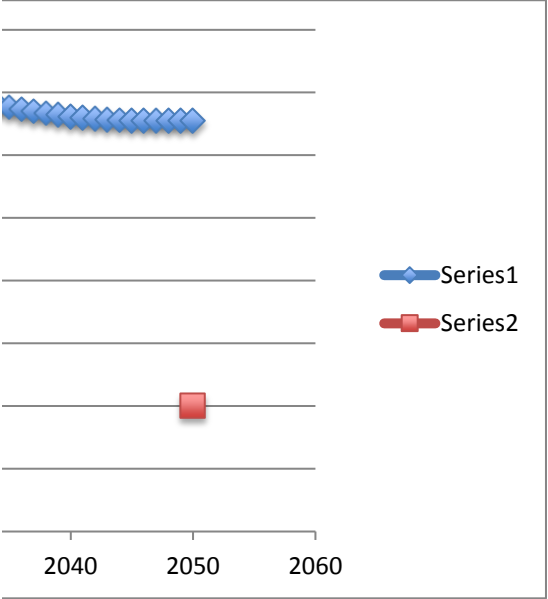
265825	7734175
291592	7708408
321806	7678194
355134	7644866
395918	7604082
440812	7559188
489847	7510153
543003	7456997
600289	7399711
661724	7338276
727361	7272639
797210	7202790
871373	7128627
949876	7050124
1032767	6967233
1111210	6888790
1154722	6845278
1195472	6804528
1233455	6766545
1268558	6731442
1300723	6699277
1329885	6670115
1356009	6643991
1379091	6620909
1399071	6600929
1415885	6584115
1429469	6570531
1439755	6560245
1446674	6553326
1450156	6549844

4000000 0.19930259

0.30836372



1450156	6549844		
1450156	6549844		
1450156	6549844		
1450156	6549844	2000000	0.2416927



	sales	generation	sales after		
	GWh	GWh	NM	new RECs	total REC sales
2014	5701	6109	5701	4	879
2015	5662	6067	5662	9	884
2016	5620	6021	5600	17	892
2017	5587	5986	5547	29	904
2018	5563	5961	5504	41	916
2019	5553	5950	5474	53	928
2020	5546	5942	5447	69	944
2021	5571	5969	5452	84	959
2022	5602	6002	5464	100	975
2023	5640	6043	5482	116	991
2024	5683	6089	5506	116	991
2025	5731	6141	5534	116	991
2026	5784	6198	5568	116	991
2027	5842	6259	5605	116	991
2028	5902	6324	5646	116	991
2029	5967	6393	5691	116	991
2030	6035	6466	5739	116	991
2031	6105	6542	5790	116	991
2032	6176	6617	5841	116	991

4,942,959

\$ value

of lost sales

cents/kWh

% of rates

GHG impact

0	0.00	0.0%	0
0	0.00	0.0%	0
0	0.00	0.0%	0
47	0.85	6.0%	287691
47	0.86	6.0%	291454
47	0.86	6.0%	295216
47	0.86	6.1%	300233
47	0.86	6.0%	305251
47	0.86	6.0%	310268
47	0.85	6.0%	315285
46	0.84	5.9%	315285
45	0.82	5.8%	315285
45	0.80	5.6%	315285
44	0.78	5.5%	315285
43	0.76	5.4%	315285
42	0.74	5.2%	315285
42	0.73	5.1%	315285
41	0.71	5.0%	315285
40	0.69	4.8%	315285

rate with underlying trajectory

0.00%
0.00%
0.00%
6.11%
6.02%
6.03%
6.06%
6.05%
6.03%
6.01%
6.57%
5.75%
5.62%
5.49%
5.36%
5.23%
5.10%
4.97%
6.15%

start cost	start % displaced			perf increase		
	3500	50%				
	real cost decrease/year	annual incr	annual gallon decrease	0%	85%	
	0%	0%	5			
HP cost	% displaced	baseline fuel	fuel displaced	COP	MMBTU of heat	
2017	3500	50%	800	400	2.4	47
2018	3500	50%	795	398	2.4	47
2019	3500	50%	790	395	2.4	46
2020	3500	50%	785	393	2.4	46
2021	3500	50%	780	390	2.4	46
2022	3500	50%	775	388	2.4	45
2023	3500	50%	770	385	2.4	45
2024	3500	50%	765	383	2.4	45
2025	3500	50%	760	380	2.4	45
2026	3500	50%	755	378	2.4	44
2027	3500	50%	750	375	2.4	44
2028	3500	50%	745	373	2.4	44
2029	3500	50%	740	370	2.4	43
2030	3500	50%	735	368	2.4	43
2031	3500	50%	730	365	2.4	43
2032	3500	50%	725	363	2.4	43

	\$/gallon	BTU/gallon	\$/MMBTU
FO:	3.08	138200	22.28654124
propane:	3.06	91600	33.40611354
			1.498936653

0
1
2

#N/A

incentive:

\$0

3%

MWh elec	PV of op savings		NPV		propane %
	propane	FO	propane	FO	
5.73	(\$7,840.01)	(\$4,912.74)	(\$4,340.01)	(\$1,412.74)	50%
5.69	(\$7,899.32)	(\$5,154.54)	(\$4,399.32)	(\$1,654.54)	47%
5.66	(\$7,956.49)	(\$5,422.04)	(\$4,456.49)	(\$1,922.04)	44%
5.62	(\$8,012.80)	(\$5,702.35)	(\$4,512.80)	(\$2,202.35)	41%
5.59	(\$8,074.92)	(\$5,996.72)	(\$4,574.92)	(\$2,496.72)	38%
5.55	(\$8,140.35)	(\$6,298.17)	(\$4,640.35)	(\$2,798.17)	35%
5.51	(\$8,209.00)	(\$6,607.55)	(\$4,709.00)	(\$3,107.55)	32%
5.48	(\$8,278.40)	(\$6,925.24)	(\$4,778.40)	(\$3,425.24)	30%
5.44	(\$8,351.23)	(\$7,249.57)	(\$4,851.23)	(\$3,749.57)	30%
5.41	(\$8,428.03)	(\$7,579.54)	(\$4,928.03)	(\$4,079.54)	30%
5.37	(\$8,518.18)	(\$7,913.52)	(\$5,018.18)	(\$4,413.52)	30%
5.34	(\$8,625.05)	(\$8,253.23)	(\$5,125.05)	(\$4,753.23)	30%
5.30	(\$8,750.22)	(\$8,594.82)	(\$5,250.22)	(\$5,094.82)	30%
5.26	(\$8,892.62)	(\$8,939.27)	(\$5,392.62)	(\$5,439.27)	30%
5.23	(\$9,053.47)	(\$9,286.07)	(\$5,553.47)	(\$5,786.07)	30%
5.19	(\$9,230.71)	(\$9,636.22)	(\$5,730.71)	(\$6,136.22)	30%

10,300

-4603.5807

FO %	weighted average NPV	% RE	lifetime % FF BTU->MWh	FF elec
50%	(\$2,876.38)	55.0%	64.3%	5.09 2.04362055
53%	(\$2,944.59)	56.3%	65.7%	5.04 1.95492838
56%	(\$3,037.20)	57.7%	66.3%	5.00 1.9049122
59%	(\$3,149.64)	59.0%	67.0%	4.95 1.8553735
62%	(\$3,286.44)	60.3%	67.7%	4.90 1.80631228
65%	(\$3,442.94)	61.7%	68.3%	4.85 1.75772854
68%	(\$3,620.01)	63.0%	69.0%	4.81 1.70962229
70%	(\$3,831.19)	64.3%	69.7%	4.77 1.66199352
70%	(\$4,080.07)	65.7%	70.3%	4.73 1.61484222
70%	(\$4,334.09)	67.0%	71.0%	4.70 1.56816841
70%	(\$4,594.92)	68.3%	71.7%	4.67 1.52197208
70%	(\$4,864.78)	69.7%	72.3%	4.64 1.47625324
70%	(\$5,141.44)	71.0%	73.0%	4.61 1.43101187
70%	(\$5,425.27)	72.3%	73.7%	4.58 1.38624799
70%	(\$5,716.29)	73.7%	74.3%	4.55 1.34196158
70%	(\$6,014.57)	75.0%	75.0%	4.52 1.29815266

47.273

20.2 pounds CO2/gallon of F

net MWh	MWh credits	Tier 3 GWh	HPs to meet	GHG avoided
3.05	45.71	112	2,444	45.0
3.09	46.33	148	3,202	44.8
3.09	46.36	185	3,992	44.5
3.09	46.40	222	4,781	44.2
3.09	46.42	260	5,600	43.9
3.10	46.45	299	6,433	43.6
3.10	46.47	338	7,282	43.3
3.10	46.56	379	8,137	43.0
3.12	46.80	420	8,981	42.9
3.14	47.03	463	9,839	42.7
3.15	47.26	506	10,713	42.6
3.17	47.48	551	11,603	42.4
3.18	47.69	597	12,512	42.2
3.19	47.89	644	13,441	42.1
3.21	48.09	692	14,389	41.9
3.22	48.28	741	15,351	41.8

	start cost	start % displaced		
	5922.314342	50%		
	real cost decrease/year	annual incr	annual gallon decrease	
	0%	0%	5	
HP cost		% displaced	baseline fuel	fuel displaced
2017	5922	50%	800	400
2018	5922	50%	795	398
2019	5922	50%	790	395
2020	5922	50%	785	393
2021	5922	50%	780	390
2022	5922	50%	775	388
2023	5922	50%	770	385
2024	5922	50%	765	383
2025	5922	50%	760	380
2026	5922	50%	755	378
2027	5922	50%	750	375
2028	5922	50%	745	373
2029	5922	50%	740	370
2030	5922	50%	735	368
2031	5922	50%	730	365
2032	5922	50%	725	363

	\$/gallon	BTU/gallon	\$/MMBTU
FO:	3.08	138200	22.28654124
propane:	3.06	91600	33.40611354
			1.498936653

	5922	
1	545	1.00
2	535	0.97
3	524	0.94
4	514	0.92
5	504	0.89
6	494	0.86
7	484	0.84
8	475	0.81
9	465	0.79
10	456	0.77
11	447	0.74
12	439	0.72
13	430	0.70
14	422	0.68
15	413	0.66

perf increase

0%

85%

COP

MMBTU of heat MWh elec

PV of op savings

propane

FO

2.4	47	5.73	(\$7,840.01)	(\$4,912.74)
2.4	47	5.69	(\$7,899.32)	(\$5,154.54)
2.4	46	5.66	(\$7,956.49)	(\$5,422.04)
2.4	46	5.62	(\$8,012.80)	(\$5,702.35)
2.4	46	5.59	(\$8,074.92)	(\$5,996.72)
2.4	45	5.55	(\$8,140.35)	(\$6,298.17)
2.4	45	5.51	(\$8,209.00)	(\$6,607.55)
2.4	45	5.48	(\$8,278.40)	(\$6,925.24)
2.4	45	5.44	(\$8,351.23)	(\$7,249.57)
2.4	44	5.41	(\$8,428.03)	(\$7,579.54)
2.4	44	5.37	(\$8,518.18)	(\$7,913.52)
2.4	44	5.34	(\$8,625.05)	(\$8,253.23)
2.4	43	5.30	(\$8,750.22)	(\$8,594.82)
2.4	43	5.26	(\$8,892.62)	(\$8,939.27)
2.4	43	5.23	(\$9,053.47)	(\$9,286.07)
2.4	43	5.19	(\$9,230.71)	(\$9,636.22)

incentive:

\$0

3%

-2181.2664

NPV

propane	FO	propane %	FO %	weighted average NPV
(\$1,917.70)	\$1,009.57	50%	50%	(\$454.06)
(\$1,977.01)	\$767.78	47%	53%	(\$522.27)
(\$2,034.18)	\$500.28	44%	56%	(\$614.88)
(\$2,090.49)	\$219.96	41%	59%	(\$727.32)
(\$2,152.61)	(\$74.40)	38%	62%	(\$864.12)
(\$2,218.04)	(\$375.86)	35%	65%	(\$1,020.62)
(\$2,286.69)	(\$685.23)	32%	68%	(\$1,197.70)
(\$2,356.08)	(\$1,002.93)	30%	70%	(\$1,408.87)
(\$2,428.92)	(\$1,327.25)	30%	70%	(\$1,657.75)
(\$2,505.72)	(\$1,657.23)	30%	70%	(\$1,911.78)
(\$2,595.86)	(\$1,991.21)	30%	70%	(\$2,172.60)
(\$2,702.73)	(\$2,330.92)	30%	70%	(\$2,442.46)
(\$2,827.91)	(\$2,672.51)	30%	70%	(\$2,719.13)
(\$2,970.30)	(\$3,016.95)	30%	70%	(\$3,002.96)
(\$3,131.15)	(\$3,363.76)	30%	70%	(\$3,293.98)
(\$3,308.40)	(\$3,713.90)	30%	70%	(\$3,592.25)

10,300

% RE	lifetime % FF BTU->MWh	FF elec		net MWh	MWh crec
55.0%	64.3%	5.09	2.04362055	3.05	45.71
56.3%	65.7%	5.04	1.95492838	3.09	46.33
57.7%	66.3%	5.00	1.9049122	3.09	46.36
59.0%	67.0%	4.95	1.8553735	3.09	46.40
60.3%	67.7%	4.90	1.80631228	3.09	46.42
61.7%	68.3%	4.85	1.75772854	3.10	46.45
63.0%	69.0%	4.81	1.70962229	3.10	46.47
64.3%	69.7%	4.77	1.66199352	3.10	46.56
65.7%	70.3%	4.73	1.61484222	3.12	46.80
67.0%	71.0%	4.70	1.56816841	3.14	47.03
68.3%	71.7%	4.67	1.52197208	3.15	47.26
69.7%	72.3%	4.64	1.47625324	3.17	47.48
71.0%	73.0%	4.61	1.43101187	3.18	47.69
72.3%	73.7%	4.58	1.38624799	3.19	47.89
73.7%	74.3%	4.55	1.34196158	3.21	48.09
75.0%	75.0%	4.52	1.29815266	3.22	48.28

20.2

lits	Tier 3 GWh	HPs to meet	GHG avoided
	112	2,444	45.0
	148	3,202	44.8
	185	3,992	44.5
	222	4,781	44.2
	260	5,600	43.9
	299	6,433	43.6
	338	7,282	43.3
	379	8,137	43.0
	420	8,981	42.9
	463	9,839	42.7
	506	10,713	42.6
	551	11,603	42.4
	597	12,512	42.2
	644	13,441	42.1
	692	14,389	41.9
	741	15,351	41.8

	start cost	start % displaced
	9500	60%
	real cost decrease/year	annual increase
	0%	0%
	HP+Wx cost	% displaced
2017	9500	60%
2018	9500	60%
2019	9500	60%
2020	9500	60%
2021	9500	60%
2022	9500	60%
2023	9500	60%
2024	9500	60%
2025	9500	60%
2026	9500	60%
2027	9500	60%
2028	9500	60%
2029	9500	60%
2030	9500	60%
2031	9500	60%
2032	9500	60%

	\$/gallon	BTU/gallon	\$/MMBTU
FO:	3.08	138200	22.28654124
propane:	3.06	91600	33.40611354
			1.498936653

6728 avg cost per project
25.1 avg MMBTU savings
21.335 avg MMBTU of heat demand

5918.496

weatherization:

20% perf increase

FO system effic:

0%

85%

MMBTU of heat from:

baseline fuel use	fuel displaced	COP	weatherization	HP	MWh elec
800	544	2.4	18.8	45	5.50
795	541	2.4	18.7	45	5.47
790	537	2.4	18.5	44	5.43
785	534	2.4	18.4	44	5.40
780	530	2.4	18.3	44	5.36
775	527	2.4	18.2	44	5.33
770	524	2.4	18.1	43	5.29
765	520	2.4	17.9	43	5.26
760	517	2.4	17.8	43	5.23
755	513	2.4	17.7	43	5.19
750	510	2.4	17.6	42	5.16
745	507	2.4	17.5	42	5.12
740	503	2.4	17.4	42	5.09
735	500	2.4	17.2	41	5.05
730	496	2.4	17.1	41	5.02
725	493	2.4	17.0	41	4.98

savings

incentive:
\$1,000

3%

PV of op savings		NPV		3%	
propane	FO	propane	FO	propane %	FO %
(\$17,012.28)	(\$12,425.73)	(\$8,512.28)	(\$3,925.73)	50%	50%
(\$17,075.66)	(\$12,775.03)	(\$8,575.66)	(\$4,275.03)	47%	53%
(\$17,135.68)	(\$13,164.61)	(\$8,635.68)	(\$4,664.61)	44%	56%
(\$17,194.36)	(\$13,574.27)	(\$8,694.36)	(\$5,074.27)	41%	59%
(\$17,262.14)	(\$14,005.94)	(\$8,762.14)	(\$5,505.94)	38%	62%
(\$17,335.10)	(\$14,448.72)	(\$8,835.10)	(\$5,948.72)	35%	65%
(\$17,413.12)	(\$14,903.90)	(\$8,913.12)	(\$6,403.90)	32%	68%
(\$17,492.30)	(\$15,372.12)	(\$8,992.30)	(\$6,872.12)	30%	70%
(\$17,576.86)	(\$15,850.74)	(\$9,076.86)	(\$7,350.74)	30%	70%
(\$17,667.64)	(\$16,338.21)	(\$9,167.64)	(\$7,838.21)	30%	70%
(\$17,779.33)	(\$16,831.94)	(\$9,279.33)	(\$8,331.94)	30%	70%
(\$17,917.23)	(\$17,334.66)	(\$9,417.23)	(\$8,834.66)	30%	70%
(\$18,083.81)	(\$17,840.32)	(\$9,583.81)	(\$9,340.32)	30%	70%
(\$18,277.36)	(\$18,350.46)	(\$9,777.36)	(\$9,850.46)	30%	70%
(\$18,499.84)	(\$18,864.29)	(\$9,999.84)	#####	30%	70%
(\$18,748.01)	(\$19,383.37)	(\$10,248.01)	#####	30%	70%

diff from HP alone:

(\$4,172.27) (\$2,512.99)
 (\$4,176.34) (\$2,620.50)
 (\$4,179.19) (\$2,742.57)
 (\$4,181.56) (\$2,871.91)
 (\$4,187.22) (\$3,009.22)
 (\$4,194.75) (\$3,150.54)
 (\$4,204.12) (\$3,296.35)
 (\$4,213.90) (\$3,446.88)
 (\$4,225.63) (\$3,601.17)
 (\$4,239.61) (\$3,758.66)
 (\$4,261.16) (\$3,918.42)
 (\$4,292.19) (\$4,081.43)
 (\$4,333.59) (\$4,245.50)
 (\$4,384.75) (\$4,411.19)
 (\$4,446.37) (\$4,578.22)
 (\$4,517.29) (\$4,747.15)

10,300

-8665.7378

weighted average NPV	% RE	lifetime %RE	FF BTU->MWh	FF elec
(\$6,219.00)		55.0%	64.3%	6.92 1.96188
(\$6,296.33)		56.3%	65.7%	6.86 1.87673
(\$6,411.88)		57.7%	66.3%	6.79 1.82872
(\$6,558.51)		59.0%	67.0%	6.73 1.78116
(\$6,743.30)		60.3%	67.7%	6.67 1.73406
(\$6,958.95)		61.7%	68.3%	6.60 1.68742
(\$7,206.85)		63.0%	69.0%	6.54 1.64124
(\$7,508.18)		64.3%	69.7%	6.48 1.59551
(\$7,868.57)		65.7%	70.3%	6.44 1.55025
(\$8,237.04)		67.0%	71.0%	6.40 1.50544
(\$8,616.16)		68.3%	71.7%	6.35 1.46109
(\$9,009.43)		69.7%	72.3%	6.31 1.4172
(\$9,413.37)		71.0%	73.0%	6.27 1.37377
(\$9,828.53)		72.3%	73.7%	6.23 1.3308
#####		73.7%	74.3%	6.19 1.28828
#####		75.0%	75.0%	6.14 1.24623

73.5576522

20.2

net MWh	MWh credits	Tier 3 GWh	Jobs to meet	GHG avoided
4.96	74.43	112	1,501	76.9
4.98	74.74	148	1,985	76.5
4.97	74.48	185	2,485	75.9
4.95	74.23	222	2,988	75.3
4.93	73.98	260	3,514	74.7
4.91	73.72	299	4,053	74.1
4.90	73.45	338	4,607	73.6
4.89	73.29	379	5,169	73.1
4.89	73.34	420	5,731	72.7
4.89	73.37	463	6,307	72.4
4.89	73.40	506	6,897	72.1
4.90	73.43	551	7,503	71.7
4.90	73.44	597	8,125	71.4
4.90	73.45	644	8,764	71.1
4.90	73.45	692	9,420	70.7
4.90	73.45	741	10,090	70.4

	start cost		start % displaced
	7500		0%
	real cost decrease/year		annual increase
	0%		0%
	project cost		% displaced
2017	7500		0%
2018	7500		0%
2019	7500		0%
2020	7500		0%
2021	7500		0%
2022	7500		0%
2023	7500		0%
2024	7500		0%
2025	7500		0%
2026	7500		0%
2027	7500		0%
2028	7500		0%
2029	7500		0%
2030	7500		0%
2031	7500		0%
2032	7500		0%

	\$/gallon	BTU/gallon	\$/MMBTU
FO:	3.08	138200	22.28654124
propane:	3.06	91600	33.40611354
			1.498936653

6728 avg cost per project
25.1 avg MMBTU savings
21.335 avg MMBTU of heat demand
7398.12

weatherization:			FO system effic:			
25% perf increase			85%			
0%						
			MMBTU of heat from:			
baseline fuel use	fuel displaced	COP	weatherization	HP	MWh elec	
800	200	2.4	23.5	-	-	
795	199	2.4	23.3	-	-	
790	198	2.4	23.2	-	-	
785	196	2.4	23.0	-	-	
780	195	2.4	22.9	-	-	
775	194	2.4	22.7	-	-	
770	193	2.4	22.6	-	-	
765	191	2.4	22.4	-	-	
760	190	2.4	22.3	-	-	
755	189	2.4	22.1	-	-	
750	188	2.4	22.0	-	-	
745	186	2.4	21.8	-	-	
740	185	2.4	21.7	-	-	
735	184	2.4	21.6	-	-	
730	183	2.4	21.4	-	-	
725	181	2.4	21.3	-	-	

savings

incentive:
\$1,500

3%

PV of op savings		NPV			
propane	FO	propane	FO	propane %	FO %
(\$11,278.59)	(\$9,454.56)	(\$5,278.59)	(\$3,454.56)	50%	50%
(\$11,275.59)	(\$9,565.27)	(\$5,275.59)	(\$3,565.27)	47%	53%
(\$11,271.26)	(\$9,691.99)	(\$5,271.26)	(\$3,691.99)	44%	56%
(\$11,266.39)	(\$9,826.71)	(\$5,266.39)	(\$3,826.71)	41%	59%
(\$11,265.14)	(\$9,970.17)	(\$5,265.14)	(\$3,970.17)	38%	62%
(\$11,265.95)	(\$10,118.06)	(\$5,265.95)	(\$4,118.06)	35%	65%
(\$11,268.77)	(\$10,270.87)	(\$5,268.77)	(\$4,270.87)	32%	68%
(\$11,272.05)	(\$10,428.88)	(\$5,272.05)	(\$4,428.88)	30%	70%
(\$11,277.48)	(\$10,591.01)	(\$5,277.48)	(\$4,591.01)	30%	70%
(\$11,285.37)	(\$10,756.67)	(\$5,285.37)	(\$4,756.67)	30%	70%
(\$11,301.59)	(\$10,924.82)	(\$5,301.59)	(\$4,924.82)	30%	70%
(\$11,328.22)	(\$11,096.54)	(\$5,328.22)	(\$5,096.54)	30%	70%
(\$11,366.26)	(\$11,269.43)	(\$5,366.26)	(\$5,269.43)	30%	70%
(\$11,415.03)	(\$11,444.10)	(\$5,415.03)	(\$5,444.10)	30%	70%
(\$11,475.30)	(\$11,620.24)	(\$5,475.30)	(\$5,620.24)	30%	70%
(\$11,545.79)	(\$11,798.47)	(\$5,545.79)	(\$5,798.47)	30%	70%

10,300

-5075.9175

weighted average NPV	% RE	lifetime %RE	FF BTU->MWh	FF elec	
(\$4,366.58)		55.0%	64.3%	2.55	0
(\$4,369.12)		56.3%	65.7%	2.54	0
(\$4,386.87)		57.7%	66.3%	2.53	0
(\$4,416.98)		59.0%	67.0%	2.52	0
(\$4,462.26)		60.3%	67.7%	2.51	0
(\$4,519.82)		61.7%	68.3%	2.51	0
(\$4,590.20)		63.0%	69.0%	2.50	0
(\$4,681.83)		64.3%	69.7%	2.49	0
(\$4,796.95)		65.7%	70.3%	2.47	0
(\$4,915.28)		67.0%	71.0%	2.45	0
(\$5,037.85)		68.3%	71.7%	2.44	0
(\$5,166.04)		69.7%	72.3%	2.42	0
(\$5,298.48)		71.0%	73.0%	2.40	0
(\$5,435.38)		72.3%	73.7%	2.39	0
(\$5,576.76)		73.7%	74.3%	2.37	0
(\$5,722.66)		75.0%	75.0%	2.36	0

48.7307218

20.2

net MWh	MWh credits	Tier 3 GWh	Jobs to meet	GHG avoided
2.55	50.91	112	2,195	34.9
2.54	50.75	148	2,923	34.6
2.53	50.59	185	3,659	34.2
2.52	50.43	222	4,399	33.9
2.51	50.27	260	5,172	33.6
2.51	50.10	299	5,964	33.3
2.50	49.93	338	6,777	32.9
2.49	49.71	379	7,622	32.7
2.47	49.39	420	8,511	32.4
2.45	49.06	463	9,432	32.2
2.44	48.74	506	10,388	32.0
2.42	48.41	551	11,380	31.8
2.40	48.09	597	12,409	31.6
2.39	47.76	644	13,478	31.4
2.37	47.44	692	14,587	31.2
2.36	47.11	741	15,732	31.0

	start cost	start % displaced
	10000	100%
	real cost decrease/year	annual increase
	0%	0%
	EV cost	% displaced
2017	10000	100%
2018	10000	100%
2019	10000	100%
2020	10000	100%
2021	10000	100%
2022	10000	100%
2023	10000	100%
2024	10000	100%
2025	10000	100%
2026	10000	100%
2027	10000	100%
2028	10000	100%
2029	10000	100%
2030	10000	100%
2031	10000	100%
2032	10000	100%

	\$/gallon	BTU/gallon	\$/MMBTU
FO:	3.08	138200	22.28654124
propane:	3.06	91600	33.40611354
			1.498936653

	perf increase		miles/kWh	MMBTU of fuel	MWh elec
	2%	0%			
baseline fuel use	fuel displaced				
364	364	3.2	42	2.86	
357	357	3.2	41	2.86	
350	350	3.2	40	2.86	
343	343	3.2	39	2.86	
337	337	3.2	38	2.86	
330	330	3.2	38	2.86	
324	324	3.2	37	2.86	
317	317	3.2	36	2.86	
311	311	3.2	35	2.86	
305	305	3.2	35	2.86	
299	299	3.2	34	2.86	
293	293	3.2	33	2.86	
287	287	3.2	33	2.86	
282	282	3.2	32	2.86	
276	276	3.2	31	2.86	
271	271	3.2	31	2.86	

incentive:
\$8,500

-3140.7847

NPV		weighted average NPV	% RE	lifetime %RE
fuel savings PV	gasoline			
(\$4,967.96)	(\$3,467.96)	(\$3,467.96)	55.0%	60.3%
(\$4,900.53)	(\$3,400.53)	(\$3,400.53)	56.3%	61.7%
(\$4,846.57)	(\$3,346.57)	(\$3,346.57)	57.7%	63.0%
(\$4,804.55)	(\$3,304.55)	(\$3,304.55)	59.0%	64.3%
(\$4,767.95)	(\$3,267.95)	(\$3,267.95)	60.3%	65.7%
(\$4,733.09)	(\$3,233.09)	(\$3,233.09)	61.7%	67.0%
(\$4,702.81)	(\$3,202.81)	(\$3,202.81)	63.0%	68.3%
(\$4,676.79)	(\$3,176.79)	(\$3,176.79)	64.3%	69.7%
(\$4,653.03)	(\$3,153.03)	(\$3,153.03)	65.7%	70.3%
(\$4,631.77)	(\$3,131.77)	(\$3,131.77)	67.0%	71.0%
(\$4,612.34)	(\$3,112.34)	(\$3,112.34)	68.3%	71.7%
(\$4,596.19)	(\$3,096.19)	(\$3,096.19)	69.7%	72.3%
(\$4,585.02)	(\$3,085.02)	(\$3,085.02)	71.0%	73.0%
(\$4,579.47)	(\$3,079.47)	(\$3,079.47)	72.3%	73.7%
(\$4,575.21)	(\$3,075.21)	(\$3,075.21)	73.7%	74.3%
(\$4,570.74)	(\$3,070.74)	(\$3,070.74)	75.0%	75.0%

10,300

20.3970355

FF BTU->MWh	FF elec	net MWh	MWh credits	Tier 3 GWh	EVs to meet
3.75	1.13333	2.62	23.56	112	4,744
3.68	1.09524	2.58	23.24	148	6,385
3.60	1.05714	2.55	22.93	185	8,073
3.53	1.01905	2.52	22.64	222	9,800
3.46	0.98095	2.48	22.36	260	11,628
3.40	0.94286	2.45	22.09	299	13,527
3.33	0.90476	2.43	21.83	338	15,501
3.27	0.86667	2.40	21.59	379	17,552
3.20	0.84762	2.35	21.18	420	19,844
3.14	0.82857	2.31	20.79	463	22,261
3.08	0.80952	2.27	20.41	506	24,811
3.02	0.79048	2.23	20.03	551	27,499
2.96	0.77143	2.19	19.67	597	30,331
2.90	0.75238	2.15	19.32	644	33,314
2.84	0.73333	2.11	18.98	692	36,453
2.79	0.71429	2.07	18.65	741	39,735

18

GHG avoided

19.3

18.9

18.5

18.1

17.7

17.3

16.9

16.5

16.2

15.9

15.6

15.3

15.0

14.7

14.4

14.1

Summary:

Credits:

HP alone	HP lease	Hp + Wx	Wx	EV	fuel cost
45.71	45.71	74.43	50.91	23.56	5:referenc
46.33	46.33	74.74	50.75	23.24	
46.36	46.36	74.48	50.59	22.93	fuel cost
46.40	46.40	74.23	50.43	22.64	3.18
46.42	46.42	73.98	50.27	22.36	3.23
46.45	46.45	73.72	50.10	22.09	3.30
46.47	46.47	73.45	49.93	21.83	3.37
46.56	46.56	73.29	49.71	21.59	3.44
46.80	46.80	73.34	49.39	21.18	3.51
47.03	47.03	73.37	49.06	20.79	3.59
47.26	47.26	73.40	48.74	20.41	3.67
47.48	47.48	73.43	48.41	20.03	3.75
47.69	47.69	73.44	48.09	19.67	3.83
47.89	47.89	73.45	47.76	19.32	3.92
48.09	48.09	73.45	47.44	18.98	4.00
48.28	48.28	73.45	47.11	18.65	4.09

Value to customer:

HP alone	HP lease	Hp + Wx	Wx	EV	
-\$4,604	-\$2,181	-\$8,666	-\$5,076	-\$3,141	4.38
	\$2,422	lease + Wx:			
		-\$6,243			

elec cost	reference	0.15
0.15	high	0.17

elec cost	propane price	multi	gasoline
0.15	1.19293		2.93
0.15	1.17881		2.96
0.15	1.16295		3.00
0.15	1.14651		3.05
0.15	1.12988		3.09
0.15	1.11345		3.14
0.15	1.09716		3.19
0.15	1.08085		3.24
0.15	1.06482		3.30
0.15	1.04915		3.36
0.15	1.03449		3.42
0.15	1.02088		3.48
0.15	1.00859		3.54
0.15	0.99746		3.61
0.15	0.98753		3.68
0.15	0.97858		3.75

1: high
2: mid-high
3: low
4: mid-low
5:reference

	fuel oil					propane r
	high	mid-high	low	mid-low	reference	
2012	3.769	3.769	3.769	3.769	3.769	1.04545
2013	3.759	3.759	3.759	3.759	3.759	1.0162
2014	3.616	3.616	3.616	3.616	3.616	1.07652
2015	4.017	3.3025	2.256	2.422	2.588	1.31722
2016	4.359	3.5945	2.257	2.5435	2.83	1.27133
2017	4.488	3.6805	2.27	2.5715	2.873	1.27398
2018	4.594	3.734	2.29	2.582	2.874	1.2821
2019	4.677	3.794	2.335	2.623	2.911	1.27507
2020	4.751	3.8485	2.384	2.665	2.946	1.2639
2021	4.857	3.9285	2.421	2.7105	3	1.24645
2022	4.961	4.0085	2.467	2.7615	3.056	1.22849
2023	5.057	4.087	2.498	2.8075	3.117	1.21225
2024	5.193	4.186	2.534	2.8565	3.179	1.19507
2025	5.321	4.2815	2.566	2.904	3.242	1.1781
2026	5.447	4.379	2.6	2.9555	3.311	1.16192
2027	5.578	4.4775	2.631	3.004	3.377	1.14505
2028	5.707	4.581	2.641	3.048	3.455	1.12472
2029	5.832	4.682	2.658	3.095	3.532	1.10705
2030	5.959	4.7855	2.664	3.138	3.612	1.08893
2031	6.083	4.887	2.682	3.1865	3.691	1.07399
2032	6.211	4.9915	2.688	3.23	3.772	1.06056
2033	6.383	5.1195	2.708	3.282	3.856	1.04503
2034	6.53	5.237	2.718	3.331	3.944	1.02957
2035	6.632	5.3325	2.73	3.3815	4.033	1.01441
2036	6.783	5.453	2.748	3.4355	4.123	0.99987
2037	6.931	5.575	2.76	3.4895	4.219	0.98373
2038	7.087	5.7055	2.771	3.5475	4.324	0.96677
2039	7.231	5.827	2.788	3.6055	4.423	0.95416
2040	7.398	5.9585	2.802	3.6605	4.519	0.94338
2041	7.56886	6.09297	2.81607	3.71634	4.61708	0.94338
2042	7.74366	6.23047	2.83021	3.77303	4.7173	0.94338
2043	7.9225	6.37108	2.84442	3.83059	4.81968	0.94338
2044	8.10547	6.51485	2.85871	3.88902	4.92429	0.94338
2045	8.29267	6.66188	2.87306	3.94834	5.03117	0.94338
2046	8.48418	6.81222	2.88749	4.00857	5.14037	0.94338
2047	8.68013	6.96595	2.90199	4.06972	5.25194	0.94338

15-year levelized prices

	fuel oil					propane	
2017	5.17	4.17	2.49	2.83	3.18	1.19	6.17
2018	5.28	4.26	2.52	2.88	3.23	1.18	6.23
2019	5.40	4.35	2.55	2.92	3.30	1.16	6.28

2020	5.52	4.44	2.58	2.97	3.37	1.15	6.33
2021	5.64	4.54	2.60	3.02	3.44	1.13	6.38
2022	5.77	4.64	2.62	3.07	3.51	1.11	6.43
2023	5.90	4.74	2.65	3.12	3.59	1.10	6.47
2024	6.04	4.85	2.66	3.16	3.67	1.08	6.52
2025	6.17	4.96	2.68	3.21	3.75	1.06	6.57
2026	6.31	5.07	2.70	3.26	3.83	1.05	6.62
2027	6.45	5.18	2.71	3.31	3.92	1.03	6.67
2028	6.59	5.30	2.73	3.37	4.00	1.02	6.73
2029	6.74	5.42	2.74	3.42	4.09	1.01	6.79
2030	6.89	5.54	2.75	3.47	4.19	1.00	6.87
2031	7.04	5.66	2.77	3.52	4.28	0.99	6.95
2032	7.20	5.79	2.78	3.58	4.38	0.98	7.04

ratio (raw)	gasoline				
	high	mid-high	low	mid-low	reference
3.17748	2012	3.777	3.777	3.777	3.777
	2013	3.605	3.605	3.605	3.605
	2014	3.403	3.403	3.403	3.403
	2015	3.777	3.0685	2.333	2.3465
	2016	4.037	3.362	2.288	2.4875
	2017	4.116	3.467	2.29	2.554
	2018	4.172	3.495	2.332	2.575
	2019	4.239	3.5315	2.401	2.6125
	2020	4.297	3.575	2.45	2.6515
	2021	4.382	3.6405	2.476	2.6875
	2022	4.459	3.699	2.494	2.7165
	2023	4.534	3.758	2.509	2.7455
	2024	4.614	3.821	2.52	2.774
	2025	4.69	3.883	2.527	2.8015
	2026	4.778	3.9525	2.539	2.833
	2027	4.871	4.0225	2.558	2.866
	2028	4.978	4.0995	2.561	2.891
	2029	5.083	4.177	2.569	2.92
	2030	5.179	4.252	2.575	2.95
	2031	5.282	4.334	2.592	2.989
	2032	5.399	4.4255	2.598	3.025
	2033	5.528	4.5245	2.616	3.0685
	2034	5.657	4.621	2.625	3.105
	2035	5.768	4.7105	2.64	3.1465
	2036	5.902	4.812	2.658	3.19
	2037	6.016	4.9045	2.67	3.2315
	2038	6.171	5.022	2.685	3.279
	2039	6.304	5.1325	2.702	3.3315
	2040	6.472	5.252	2.721	3.3765
	2041	6.64448	5.37428	2.74013	3.42211
	2042	6.82155	5.49941	2.7594	3.46833
	2043	7.00334	5.62745	2.77881	3.51518
	2044	7.18998	5.75848	2.79835	3.56266
	2045	7.38159	5.89255	2.81802	3.61078
	2046	7.57831	6.02975	2.83784	3.65956
	2047	7.78027	6.17014	2.85779	3.70899

10-year average prices				
gasoline				
4.98	2.98	3.39	3.79	4.41
5.02	2.98	3.40	3.82	4.48
5.06	2.98	3.41	3.84	4.56
				3.67
				3.72
				3.78
				2.45
				2.48
				2.50
				2.69
				2.72
				2.75
				2.93
				2.96
				3.00

5.09	2.97	3.41	3.86	4.65	3.85	2.52	2.78	3.05
5.13	2.95	3.42	3.88	4.73	3.91	2.53	2.81	3.09
5.17	2.93	3.42	3.91	4.82	3.98	2.54	2.84	3.14
5.21	2.92	3.43	3.94	4.92	4.05	2.55	2.87	3.19
5.24	2.89	3.43	3.96	5.01	4.13	2.56	2.90	3.24
5.28	2.87	3.43	3.99	5.12	4.21	2.57	2.94	3.30
5.32	2.84	3.43	4.02	5.22	4.29	2.58	2.97	3.36
5.36	2.82	3.43	4.05	5.34	4.38	2.60	3.01	3.42
5.41	2.79	3.44	4.09	5.45	4.46	2.61	3.04	3.48
5.46	2.77	3.45	4.13	5.57	4.55	2.62	3.08	3.54
5.52	2.76	3.47	4.18	5.69	4.65	2.63	3.12	3.61
5.59	2.74	3.48	4.23	5.82	4.75	2.65	3.16	3.68
5.66	2.73	3.50	4.28	5.95	4.85	2.66	3.21	3.75

1.00
0.97
0.94
0.91
0.89
0.86
0.83
0.81
0.78
0.76
0.74
0.72
0.69
0.67
0.65
0.63
0.61
0.60
0.58

\$606,454,000 GMP revenue requirement
 30% fraction that is fixed costs
 \$182,300,072 non-energy GMP revenue requirement
 7.5% GMP rate of return
 \$3,500 heat pump capital cost
 13.5% HP rate of return
 (\$45) monthly lease payment
 \$545 annual revenue
 (\$32) GMP ROR
 \$389 annual GMP profit
\$156 annual \$ that counts toward reducing net revenue requirement

4348322 GMP annual MWh sales
 5.5 MWh heating from HP
 0.2 MWh annual cooling from HP $< = N19 * 2 \text{ (capacity) } *$

10000 total HPs
 56,612 HP MWh increase

1.30% GMP sales increase %

\$41.92 fixed \$ per MWh
 \$41.39 fixed \$ per MWh after HP increment
 \$254,511 incremental HP energy cost
 \$179,957,163 effective revenue from non-HP customers
 \$1,559,486 HP lease revenue
 \$178,668,960 remaining revenue from non-HP customers
 \$602,822,887 net effective GMP revenue for rates from non-participants
-0.5987%
 \$3,631,113 total HP savings
\$363.11 savings per HP

\$207.16 impact from sales, per HP

with NO impact on peak

\$74.69 fixed \$ per MWh
 \$73.73 fixed \$ per MWh after HP increment
 \$254,511 incremental HP energy cost
 \$320,582,371.40 effective revenue from non-HP customers
 \$1,559,486 HP lease revenue
 \$319,022,885.44 remaining revenue from non-HP customers
 \$600,720,768.44 net effective GMP revenue for rates from non-participants
-0.9454%

\$5,733,232 total HP savings
\$573.32 savings per HP
\$417.37 impact from sales, per HP

ent

		window AC			22
		base	Estar	Tier 1	
		9.8	10.8	11.3	
1.5 (convenience/cmml)	D Annual MWh		0.0166	0.0234	
	ratio	1	0.9074074	0.867257	0.4454545
	annual MWh	0.17778	0.1613189	0.154181	0.0718602
			0.0165	0.0236	

\$64.78	energy portion	\$32.76	T&D portior
6.9% increment higher prices for HPs than annual average			
\$	4.50	additional energy cost for HP timing (per HP MWh)	\$139.47
\$281,697,883.00	\$3,667,498.29		
	0.089%		

0.17928 0.17628

1

4.100 20 year levelized		peak	off-peak	
0.106	0.079	10.43	354	390
0.101	0.077	10.43	320	377
0.077	0.059	10.43	354	390
0.065	0.049	10.43	171	189
0.067	0.048	10.43	0	0
0.077	0.057	11.31	0	0
0.098	0.062	11.31	50	0
0.082	0.058	11.31	0	0
0.068	0.051	11.31	0	0
0.065	0.049	11.31	177	195
0.071	0.055	11.31	343	377
0.087	0.067	11.31	354	390
0.0803333	0.05925		4171	4589

68.341714	
61.36	
50.273143	
20.382857	
0	
0	
4.9	0.0740981
0	
0	
21.062286	
45.085714	
56.933714	
0.0692897	1.0693964

\$606,454,000 GMP revenue requirement
30% fraction that is fixed costs
18230007240% fixed cost GMP revenue requirement
\$324,756,117 non-energy GMP revenue requirement

4348322 GMP annual MWh sales
2.9 MWh annual; per EV

10000 total EVs
28,571 EV MWh increase

0.66% GMP sales increase %

\$41.92 fixed \$ per MWh
\$41.65 fixed \$ per MWh after HP increment
-\$261,117 incremental Ev energy cost
\$322,636,178 effective revenue from non-EV customers

\$322,376,765 remaining revenue from non-EV customers
\$604,074,648 net effective GMP revenue for rates from non-participants
-0.3923%
\$2,379,352 total EV savings
\$237.94 savings per EV

		23.49%
\$64.78	energy portion	\$32.76
	-14.1% increment higher prices for HPs than annual average	T&D portior
\$	(9.14) additional energy cost for HP timing (per HP MWh)	\$32.55 fixed \$ per l
\$281,697,883.00	\$1,850,946.40	\$139.47
	-0.092%	

1

VWh after HP increment		4.100	20 year levelized	peak	off-peak	
	0.106	0.079	10.43	4	248	
	0.101	0.077	10.43	4	224	
	0.077	0.059	10.43	4	248	
	0.065	0.049	10.43	4	240	
	0.067	0.048	10.43	4	248	
	0.077	0.057	11.31	4	240	
	0.098	0.062	11.31	4	248	
	0.082	0.058	11.31	4	248	
	0.068	0.051	11.31	4	240	
	0.065	0.049	11.31	4	248	
	0.071	0.055	11.31	4	240	
	0.087	0.067	11.31	4	248	
	0.0803333	0.05925		4171	4589	

20.016

17.652

14.94

12.02

12.172

13.988

15.768 0.0595148

14.712

12.512

12.412

13.484

16.964

0.0692897

0.8589277

developing a credit for switch to bioheat

800	gallons of FO used per year
138700	BTU/gallon
110960000	BTU in fuel
85%	efficiency of FO system
94316000	BTU of heat delivered
0%	weatherization savings
0	BTU demand reduction
100%	new bioheat %
99,864,000	fossil BTU demand reduction
10000	BTU/kWh
9986	"kWh" savings
9.99	REC equivalents per year

1 measure life in years
9.9864 REC equivalents earned

6.6 lifetime CO2 reduction

developing a credit for switch

800	gallons of FO
138700	BTU/gallon
110960000	BTU in fuel
85%	efficiency of F
94316000	BTU of heat d
0%	weatherizatio
0	BTU demand
100%	new pellet %
99,864,000	fossil BTU der
10000	BTU/kWh
9986	"kWh" saving
9.99	REC equivaler

15 measure life i
149.796 REC equivaler

99.2 lifetime CO2 r

to pellets	developing an EIP credit for a commercial CHP system http://info.ornl.gov/sites/publications/files/Pub13655.pdf		
	0.20	MW nominal (electrical) capacity	
used per year	0.9 ktons CO2		
	117 lb/MMBTU		
CO system	16314	MMBTU	81568.125 ccf/year
delivered	80%	efficiency	0.8435
	3412	BTU/kWh	\$ 70,117 \$/year VGS bill
in savings	3.83 GWh		
reduction	8500 hours		
	0.45 MW		
mand reduction	power plant		
	0.5 kTons		
s	700 lb/MWh		
its per year	17000 MMBTU		
	34% efficiency		
	3412 BTU/kWh		
	1.7	GWh	\$ 169,600 \$/year GMP bill
n years	8500 hours		
its earned	0.20 MW		
reduction	electric impacts of replacing grid power with CHP-generated power		
	reduce grid kWh by		
	1.7 GWh		
	reduce renewable kWh by		
	1.1 GWh		
	reduce fossil/nuclear kWh by		
	0.6 GWh		
	5950 MMBTU		
	combustion impacts		
	50%	renewable CHP fuel	
	increase fossil combusted directly by		
	3625 MMBTU		
	2325 net fossil/nuclear MMBTU improvement		
	10000 BTU/kWh		
	232.475 REC-equivalents per year		



operating savings:
\$ 136,461 per year

developing an EIP credit for a commercial biomass CHP system

0.0 ktons CO2	
0 lb/MMBTU	
84764 MMBTU	0 ccf/year
85% efficiency	0.8435
3412 BTU/kWh	\$ 1,314 \$/year VGS bill
21.18 GWh	
5648 hours	
3.75 MW	

power plant

1.2 kTons	
700 lb/MWh	
38260 MMBTU	
34% efficiency	
3412 BTU/kWh	
3.8 GWh	\$ 418,407 \$/year GMP bill
5648 hours	\$ 109.74
0.68 MW	

electric impacts of replacing grid power with CHP-generated power
reduce grid kWh by

3.8 GWh

reduce renewable kWh by

2.5 GWh

example from reduce fossil/nuclear kWh by

187.6



1.3 GWh

40.2

13344 MMBTU

700

4707

13.4 combustion impacts
 5500  100% renewable CHP fuel
 increase fossil combusted directly by
 3712.5 0 MMBTU
 16500
 13344 net fossil/nuclear MMBTU improvement
 696465 3412 BTU/kWh
 663300 **3911** REC-equivalents per year or

 1359765
 317672
 operating savings:
 \$1,042,093 \$ 548,765 per year vs. natural gas
 \$ 1,414,322 per year vs. fuel oil
 7
 \$7,294,648

example from Prodesa (CHP-7) used to calculate prices:

120 \$/MWh	electric value	fuel oil:
30 \$/MWh	heat value	\$30 \$/MMBTU
30 \$/ton		3412 BTU/kWh
2800 kcal/kg	fuel price	\$102.36 \$/MWh
10.2 \$/MWh	7.8 months	
8000 hours/year		natural gas:
5400 electric MWh		0.8435 \$/ccf
24000 thermal MWh		8.435 \$/MMBTU
		28.78 \$/MWh
648000 electric \$		
720000 thermal \$		
1368000 revenue		
350672 fuel cost		
\$1,017,328 net operating profit		
9 payback time (years)		

\$9,155,951 upfront cost

\$5 \$/MMBTU for wood chips
\$ 40,784 \$/year wood chips

\$ 110,901

boiler

0.5 kTons
117 lb/MMBTU (natural gas)
9063 MMBTU 90631.25 ccf/year
80% efficiency 0.8435
3412 BTU/kWh \$ 77,761 \$/year VGS bill
2.1 GWh
8500 hours
0.25 MW

ower:

\$5 \$/MMBTU for wood chips
\$ 423,820 \$/year wood chips

\$ 425,134

boiler

3.5 kTons
117 lb/MMBTU (natural gas)
65700 MMBTU 656998.3247 ccf/year
88% efficiency 0.8435
3412 BTU/kWh \$ 555,492 \$/year VGS bill
16.9 GWh 473683.0026 gallons of oil
5648 hours \$3.00 \$/gallon
3.00 MW \$1,421,049.01

ower:

lb/MMBTU
tons avoided

3813 electric premium RECs	\$	190,630
and		
98 EIP credits	\$	1,967
	\$	192,596

4.100 20 year levelized		peak	
0.106	0.079	10.43	354
0.101	0.077	10.43	320
0.077	0.059	10.43	354
0.065	0.049	10.43	257
0.067	0.048	10.43	221
0.077	0.057	11.31	214
0.098	0.062	11.31	221
0.082	0.058	11.31	221
0.068	0.051	11.31	214
0.065	0.049	11.31	266
0.071	0.055	11.31	343
0.087	0.067	11.31	354

utility sales in 2013:

BARTON #####
BURLINGTON #####
CENTRAL V 0
ENOSBURG #####
GMP (see I #####
HARDWICK #####
HYDE PARK #####
JACKSONV 4,867,849
JOHNSON #####
LUDLOW #####
LYNDONVI #####
MORRISVII #####
NORTHFIELD #####
ORLEANS #####
STOWE #####
SWANTON #####
VEC #####
WEC #####

BED	342	6.1%
GMP	4,348	77.2%
Stowe	74	1.3%
VEC	443	7.9%
VPPSA	358	6.4%
WEC	69	1.2%

6847

86966

1477

8863

7165

1390