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Modulating Gas Valve for Commercial Dryer Study

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Executive Summary

Standard commercial gas-fired dryers only have one firing rate. This is normally a high firing rate designed to heat up the clothes and drive off moisture during the initial stages of drying. In the later stages of drying not as much moisture remains in the clothes, not as much heat is needed and more energy is being wasted and lost out the flue. A modulating gas dryer allows the firing rate to change for the changing demand in heat needed. The Bio-Therm technology offered by EZ-Efficiency is an affordable post-OEM retrofit kit to change standard non-modulating dryers to modulating dryers. This technology allows a site to change a standard dryer to a modulating dryer at an installed cost around $1150 per dryer. At this cost, it is estimated a typical user would have a simple payback of 4-5 years.

GTI Energy has completed a demonstration of 4 test sites (8 dryers) in the Chicago area as well as 5 sites (12 dryers) in Minnesota using the modulating dryer technology across 20 total dryers. Initial demonstrations in the Chicago area indicate average savings of 14% on natural gas used for drying[1]. The additional Minnesota study found 12% savings on natural gas use[2]. GTI analyzed this data across 20 dryers and two field demos to see what the savings and payback periods would look like for the 4 states in NEEA territory and the results are presented below in Table 1. Montana had a payback in as little as 3.94 years with higher natural gas costs and Idaho took 6.59 years with lower natural gas costs.

Table 1: Summary Savings and Payback Periods across NEEA States

State	Annual Baseline Gas Use (Therm))	Annual MV Gas Use (Therm)	% Savings	Annual Savings (Therm)	Annual Cost Savings ($)	Payback Period (Years)
Idaho	1,930	1,701	12.88%	229	$174.50	6.59
Montana	1,936	1,706	12.93%	230	$291.66	3.94
Oregon	1,922	1,694	12.85%	229	$253.25	4.54
Washington	1,921	1,693	12.83%	228	$246.26	4.67
Average	**1,927**	**1,699**	**12.87%**	**229**	**241**	**4.94**

The target market for this new technology is in the commercial sector, specifically laundromats, dry cleaners, hospitality, and healthcare facilities. Additionally, any other facilities with on premise laundry (OPL) may be a suitable fit, such as a gym, university, or even multi-family housing with large laundromat size dryers. These facilities often have commercial dryers sized between 30 and 250 lbs. and typically without modulating capabilities.

NEEA provide GTI with some market data pulled from CBSA 4 2019 data. According to this data there are an estimated 50,171 commercial gas dryers across NEEA member utilities in Idaho, Montana, Oregon, and Washington. Applying these energy savings and assumed market

1 Scott, S., Kosar, D., Cushman, G. "Nicor Gas Emerging Technology Program 1036: Commercial Dryer Modulation Retrofit Public Project Report." September 2014

2 Scott, S. "Advanced Commercial Clothes Dryer Technologies Field Test." Conservation Applied Research and Development (CARD) Final Report, January 2018

penetration rates provide the potential impact of this technology on energy efficiency programs and the potential therms savings that could be generated by the technology. Table 2 provides the summary of potential annual savings of this technology as it achieves market penetration across the 4 NEEA states. The Technology at only 10% market penetration would achieve over 1 million therms of annual savings and at 40% penetration would achieve over 4.5 million therms of annual savings. Providing rebates on the technology through energy efficiency programs would reduce the annual payback times and help to increase that market penetration rate and the overall therm savings that can be achieved.

Table 2: Annual Therm Savings Estimates with Varying Market Penetration Rates

State	Commercial Gas Dryers	Adoption Rate Annual Energy Savings (Therms)				
		10%	20%	40%	60%	80%
Idaho	6,274	143,675	287,349	574,698	862,048	1,149,397
Montana	4,188	96,324	192,648	385,296	577,944	770,592
Oregon	14,311	327,722	655,444	1,310,888	1,966,331	2,621,775
Washington	25,399	579,097	1,158,194	2,316,389	3,474,583	4,632,778
Average	**50,171**	**1,148,916**	**2,297,832**	**4,595,664**	**6,893,495**	**9,191,327**

Introduction

Standard commercial gas-fired dryers only have one firing rate. This is normally a high firing rate designed to heat up the clothes and drive off moisture during the initial stages of drying. In the later stages of drying not as much moisture remains in the clothes, not as much heat is needed and more energy is being wasted and lost out the flue. A modulating gas dryer allows the firing rate to change for the changing demand in heat needed. There are modulating dryers available directly from manufacturers, but they are relatively costly and would require a large capital expense from users to replace already installed non-modulating dryers. The Bio-Therm technology offered by EZ-Efficiency is an affordable post-OEM retrofit kit to change standard non-modulating dryers to modulating dryers (Figure 1).

Figure 1: EZ-Efficiency Bio-Therm Modulating Valve Controller

This technology allows a site to change a standard dryer to a modulating dryer at an installed cost around $1150 per dryer. At this cost, it is estimated a typical user would have a simple payback of 4-5 years. The biggest barrier to the adaption of this technology will be its newness. Most commercial consumers will be unfamiliar with this technology and may be hesitant to adopt it. An additional potential barrier is that the installation of this technology would likely void any original manufacturer warranty on the dryer. Therefore, its installation would be preferred for appliances that are no longer under warranty coverage, which tends to be any dryer over three years old. However, The manufacturer has installed thousands of these units in CA now and many were installed on brand new dryers. At this time, EZ-Efficiency is the only manufacturer offering this technology. Gas modulation is a very mature technology, having been around for decades in various other appliances such as boilers and furnaces. However, its application in dryers is more recent.

The target market for this new technology is in the commercial sector, specifically laundromats, dry cleaners, hospitality, and healthcare facilities. Additionally, any other facilities with on premise laundry (OPL) may be a suitable fit, such as a gym, university, or even multi-family housing with large laundromat size dryers. These facilities often have commercial dryers sized between 30 and 250 lbs. and typically without modulating capabilities.

NEEA provide GTI with some market data pulled from CBSA data. According to this data there are an estimated 50,171 commercial gas dryers across NEEA member utilities in Idaho, Montana, Oregon, and Washington. A Summary of commercial gas dryers by state is provided in the Table below. These are estimated by CBSA across Lodging, Hospitals, Assembly, Mixed Commercial, Residential Care, and Retail.

Table 3: CBSA Commercial Gas Dryer Market for NEEA Utilities

	Commercial Gas Dryers
Idaho	6,274
Montana	4,188
Oregon	14,311
Washington	25,399
Total	50,171

GTI Energy has completed a demonstration of 4 test sites (8 dryers) in the Chicago area as well as 5 sites (12 dryers) in Minnesota using the modulating dryer technology across 20 total dryers. Initial demonstrations in the Chicago area indicate average savings of 14% on natural gas used for drying[3]. The additional Minnesota study found 12% savings on natural gas use[4]. MN Pilot sites included two hotels (2 - 75 lb. dryers, 2 – 120lb dryers), one healthcare facility (2 - 75 lb. dryer), one university (1 - 75 lb. dryers), one dry cleaner (1- 50 lb. dryer) and one laundromat (2 - 45 lb. dryers, 2-30 lb. dryers). Chicago pilot sites included two hotels (1 - 75 lb. dryer, 1 – 170lb dryer), one healthcare facility (2 - 75 lb. dryer), and one laundromat (2 - 45 lb. dryers, 2-30 lb. dryers).

Figure 2: Bio-Therm Modulating valve and controller installed at Site in MN

3 Scott, S., Kosar, D., Cushman, G. “Nicor Gas Emerging Technology Program 1036: Commercial Dryer Modulation Retrofit Public Project Report.” September 2014

4 Scott, S. “Advanced Commercial Clothes Dryer Technologies Field Test.” Conservation Applied Research and Development (CARD) Final Report, January 2018

Both data sets can be used along with makeup air temperature monitoring conducted during all of the demos to apply the results to specific regions of the country. The make up air (outdoor temperature) does have a large effect on the total energy use of the dryer if the dryer back room was designed properly and supplied with enough makeup air. GTI will look at average temperatures across all 4 states (Idaho, Montana, Oregon, Washington) in NEEA territory and expected year-round outdoor temperature to modify the expected savings compared to MN and IL. Those studies will be adapted by this project to provide analysis for member territories. Analysis includes State specific baseline, installed cost, climate affects, and energy costs and payback periods. Local relevant data on air temperatures, and energy costs will all be used to modify the data sets and provide relevant energy savings and payback periods for the specific territory. For details on how each of those previous studies was conducted, equipment monitored and how savings numbers were achieved please refer to each of the final reports. For this NEEA report we will focus on how the results from those other studies can be applied to NEEA territory and how the combined data set of all 20 dryers shows estimated savings and payback periods for NEEA territory states.

Data Analysis Approach

Weather Correction for NEEA Territory

GTI did a deep dive into the twenty dryers that were monitored in the two IL and MN field demonstrations of the BIO-Therm modulating dryer technology. Most commercial dryers are installed so that their front is exposed in the laundry room and provides access for putting clothes in the dryer, running the dryer and removing clothes from the dryer (Figure 3). The back of the dryer is then accessible through a small access room behind the dryer where makeup air is provided that is used for combustion and drying the clothes before it is exhausted outside (Figure 4). If the dryer access room behind the dryers is designed with enough makeup air the temperature in that room will approach outdoor temperatures, which has a large effect on how much energy the dryer uses. If the dryer is heating from 70 °F up to 160 °F for instance it will use a lot less energy than heating from 20 °F to 160 °F for drying. What GTI found in digging into this data though is that a lot of the dryer access rooms did not have enough makeup air and did not then have a traceable effect on the energy use pattern of the dryer.

Figure 3: Front of Hotel Dryers in IL

Figure 4: MN Laundromat Back Access Room

GTI Energy analyzed the data for all 20 dryers to look at how the makeup air temp effected the results and how that would change the results for NEEA territory. An example of how the makeup air temp influences the energy use of the dryers is shown in Figure 5 for Hotel #1 in the Chicago area. It shows a clear trend where energy use changes with makeup air temp. For average weather trends GTI Energy used Weather spark data[5]. For Idaho, Montana, Oregon, and Washington GTI used the average of a few cities in each state, which was directly how weather spark calculated state averages. The average temperatures used for those states can be seen in Table 4. GTI Energy for the Chicago area sites analysis used weather spark temperatures for Chicago and looked at how much above those outdoor temperatures the air being used for drying was in the small dryer room. That temperature difference was considered the increase above outdoor that occurred from the heat gain around the dryer in the small makeup air temp room. If this hotel was to be moved to a location in Oregon, that same heat gain was assumed and added to the outdoor temperature from weather spark for Oregon to calculate how much energy would be used for this same hotel in Oregon. The energy use trend lines as shown in Figure 5 were then used with the average expected monthly temps to calculate the monthly and then annual energy use. Table 5 shows how temperatures for the 4 NEEA territory states would be altered based on how far off from outdoor temperature this one Chicago area site was. For details of each site you can look at the data analysis that was conducted for each site in the summary excel spreadsheets provided to NEEA. In the end only 6 of 20 dryers were found to have their energy use varied by outdoor temperature. The other 14 sites energy savings could be applied directly to new locations.

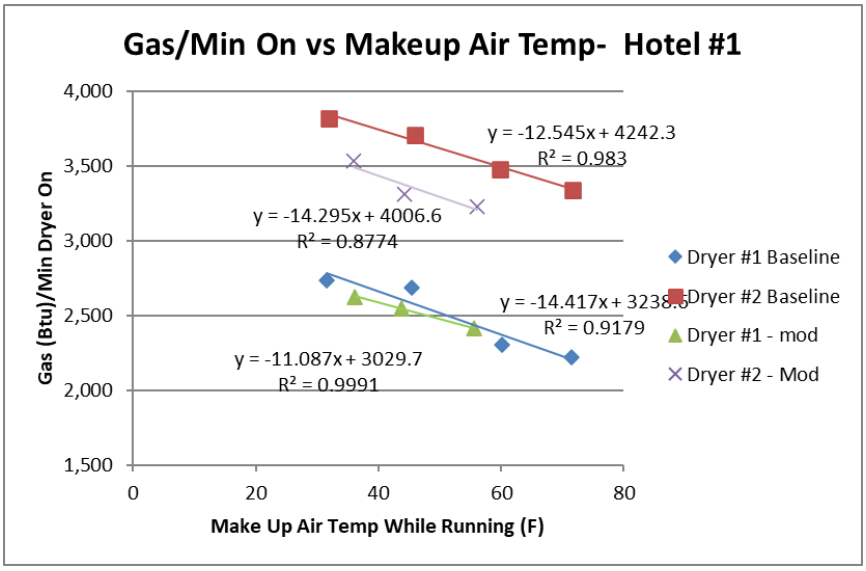

Figure 5: Chicago Area Illinois Hotel #1 energy use versus makeup Air Temp

5 https://weatherspark.com/y/14091/Average-Weather-in-Chicago-Illinois-United-States-Year-Round

Table 4: NEEA Territory State Average Monthly Temp From Weather Spark

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Oregon												
Portland	40	43	47	51	57	62	68	68	63	54	46	40
Eugene	41	43	47	50	56	61	67	68	62	53	45	40
Bend	32	34	39	43	51	58	66	65	57	47	37	31
Avg	**38**	**40**	**44**	**48**	**55**	**60**	**67**	**67**	**61**	**51**	**43**	**37**
Idaho												
Sandpoint	29	32	37	45	53	59	65	65	56	45	35	29
Idaho Falls	21	25	36	45	54	62	69	68	58	46	33	22
Boise	31	36	44	51	59	68	76	75	65	53	40	31
Avg	**27**	**31**	**39**	**47**	**55**	**63**	**70**	**69**	**60**	**48**	**36**	**27**
Montana												
Billings	28	31	39	48	57	66	74	73	62	50	37	28
Bozeman	22	25	33	41	50	58	66	65	55	43	30	21
Missoula	25	29	37	45	53	60	68	67	57	44	32	24
Avg	**25**	**28**	**36**	**45**	**53**	**61**	**69**	**68**	**58**	**46**	**33**	**24**
Washington												
Spokane	31	34	41	48	56	63	71	70	61	49	38	30
Seattle	42	44	47	51	57	62	66	67	62	53	46	41
Avg	**37**	**39**	**44**	**50**	**57**	**63**	**69**	**69**	**62**	**51**	**42**	**36**

Table 5: Chicago Site Hotel #1 Temp Correction Modifications

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chicago Site #1 Makeup Temp	32	38	47	59	70	80	84	83	76	64	49	37
Weather spark Chicago data	27	30	39	49	59	70	76	75	67	55	43	32
Difference Between Makeup temp and Weather spark data	5	8	8	10	11	10	8	8	9	9	6	5
Oregon Weather spark data	38	40	44	48	55	60	67	67	61	51	43	37
Idaho Weather spark data	27	31	39	47	55	63	70	69	60	48	36	27
Montana Weather spark data	25	28	36	45	53	61	69	68	58	46	33	24
Washington Weather spark data	37	39	44	50	57	63	69	69	62	51	42	36
Oregon (Corrected)	**43**	**48**	**52**	**58**	**66**	**70**	**75**	**75**	**70**	**60**	**49**	**42**
Idaho (Corrected)	**32**	**39**	**47**	**57**	**66**	**73**	**78**	**77**	**69**	**57**	**42**	**32**
Montana (Corrected)	**30**	**36**	**44**	**55**	**64**	**71**	**77**	**76**	**67**	**55**	**39**	**29**
Washington (Corrected)	**42**	**47**	**52**	**60**	**68**	**73**	**77**	**77**	**71**	**60**	**48**	**41**

Cost and Number of Dryers in NEEA Territory

The approach explained above was how each hotel was essentially moved from MN or Illinois to each of the 4 NEEA states to determine how much energy use each location would have in baseline and modulating mode in the 4 NEEA states. The other question is how much each state's energy rates would affect the savings and payback periods for each state and what is the potential impact in terms of customers and potential therm savings in each state. The energy costs used for each state were obtained from EIA average commercial natural gas prices from

each state for the last 6 months[6]. Energy costs were converted to a cost per therm and the average of the 6 months was used for calculations. The energy cost rates used are provided in Table 6. A detailed table with the number of estimated commercial dryers in each state and utility was obtained by NEEA using CBSA 4 2019 and is provided in Appendix A: Commercial Dryer Market Estimate From CBSA 4 2019. A summary of the overall natural gas commercial dryers by sector across the 4 NEEA states is provided in Table 7.

Table 6: EIA commercial Natural Gas Princes

	22-Jul ($/therm)	22-Aug ($/therm)	22-Sep ($/therm)	22-Oct ($/therm)	22-Nov ($/therm)	22-Dec ($/therm)	Average ($/therm)
Idaho	$0.73	$0.75	$0.80	$0.75	$0.75	$0.78	$0.76
Montana	$1.40	$1.41	$1.38	$1.29	$1.10	$1.02	$1.27
Oregon	$1.13	$1.12	$1.08	$1.01	$1.14	$1.16	$1.11
Washington	$1.09	$1.06	$1.10	$1.00	$1.08	$1.15	$1.08

Table 7. Commercial Natural Gas Dryers across 4 NEEA States

Building Type	Number of Natural Gas Dryers
Assembly	3,451
Hospital	172
Lodging	7,796
Mixed Commercial	34,073
Office	27
Other	25
Residential Care	1,506
Retail/Service	3,121
Region	**50,171**

6 https://www.eia.gov/dnav/ng/ng_pri_sum_dcu_SMT_m.htm

Results and Discussions

Results of the energy savings and payback periods for all 20 dryers from the previous Illinois and Minnesota studies applied to all 4 NEEA states are provided in Table 10 - Table 13. A summary of the average savings for the 4 states are shown in Table 8. The average therms savings only had a small variance with the changing weather data of the 4 states. The payback period and savings varied the most from state to state based on the large difference between natural gas prices between the states with Montana paying back the quickest at 3.94 years and $291 in annual gas savings and Idaho with the lowest gas prices paying back in 6.59 years with $175 in annual gas savings. All of the savings are with an estimated Modulating dryer valve kit installed cost of $1150, which is the latest cost data we had from the manufacturer EZ Efficiency.

Table 8: Summary Annual Therm and Cost savings for 4 NEEA States

State	Annual Baseline Gas Use (Therm))	Annual MV Gas Use (Therm)	% Savings	Annual Savings (Therm)	Annual Cost Savings ($)	Payback Period (Years)
Idaho	1,930	1,701	12.88%	229	$174.50	6.59
Montana	1,936	1,706	12.93%	230	$291.66	3.94
Oregon	1,922	1,694	12.85%	229	$253.25	4.54
Washington	1,921	1,693	12.83%	228	$246.26	4.67
Average	**1,927**	**1,699**	**12.87%**	**229**	**241**	**4.94**

The savings estimates can be applied across the expected numbers of dryers for each state to arrive at a maximum potential therms savings for each state and for NEEA territory as a whole. The CBSA 4 2019 data obtained for NEEA was used to estimate the number of commercial dryers for each state in NEEA territory, which shows over 50,000 commercial dryers across the 4 states. An adoption rate can then be assumed to determine the potential therm savings of the technology as it becomes more adopted in each state and across NEEA territory as a whole. Table 9 provides the number of dryers in NEEA territory as well as the estimated annual therm savings with varying adoption rates. With just a 10% adoption rate across the 4 states the technology has the potential for over 1 million therms of savings and up to over 4.5 million therms of savings at a 40% adoptions rate across the 4 states.

Table 9: Statewide Annual Energy Saving Estimates

State	Commercial Gas Dryers	Adoption Rate Annual Energy Savings (Therms)				
		10%	20%	40%	60%	80%
Idaho	6,274	143,675	287,349	574,698	862,048	1,149,397
Montana	4,188	96,324	192,648	385,296	577,944	770,592
Oregon	14,311	327,722	655,444	1,310,888	1,966,331	2,621,775
Washington	25,399	579,097	1,158,194	2,316,389	3,474,583	4,632,778
Average	**50,171**	**1,148,916**	**2,297,832**	**4,595,664**	**6,893,495**	**9,191,327**

Table 10: Idaho State Modulating Valve Savings and Payback Period

Modulating Valve Long Term Monitoring Savings - Idaho						
MN Sites	**Annual Baseline Gas Use (Therm)**	**Annual MV Gas Use (Therm)**	**% Savings**	**Annual Savings (Therm)**	**Annual Cost Savings ($)**	**Payback Period (Years)**
Laundromat						
Dryer#1 (30 lb)	1,522	1,291	15.19%	231	$175.86	6.54
Dryer #2 (30 lb)	688	600	12.76%	88	$66.78	17.22
Dryer #3 (45 lb)	1,672	1,352	19.16%	320	$243.64	4.72
Dryer #4 (45 lb)	604	452	25.08%	151	$115.17	9.98
Dry Cleaner						
Dryer #1 (50 lb)	781	794	-1.75%	-14	-$10.40	-110.54
University						
Dryer #1 (75 lb)	496	457	7.76%	38	$29.27	39.29
Hotel #1						
Dryer #1 (75 lb)	1,516	1,232	18.70%	283	$215.56	5.34
Dryer #2 (75 lb)	1,865	1,588	14.84%	277	$210.54	5.46
HealthCare						
Dryer #1 (75 lb)	1,511	1,259	16.65%	252	$191.37	6.01
Dryer #2 (75 lb)	1,191	1,037	12.93%	154	$117.17	9.81
Hotel #2						
Dryer #1 (120 lb)	1,989	1,928	3.07%	61	$46.46	24.75
Dryer #2 (120 lb)	3,038	2,941	3.20%	97	$73.89	15.56
IL Sites						
Laundromat						
Dryer#1 (30 lb)	1,903	1,697	10.80%	205	$156.29	7.36
Dryer #2 (30 lb)	1,163	1,007	13.36%	155	$118.16	9.73
Dryer #3 (45 lb)	2,035	1,321	35.09%	714	$543.17	2.12
Dryer #4 (45 lb)	1,320	1,070	18.90%	249	$189.68	6.06
Hotel #1						
Dryer #1 (170 lb)	4,070	3,687	9.41%	383	$291.36	3.95
Hotel #2						
Dryer #1 (75 lb)	1,990	1,908	4.11%	82	$62.15	18.50
HealthCare						
Dryer #1 (75 lb)	4,738	4,176	11.86%	562	$427.34	2.69
Dryer #2 (75 lb)	4,519	4,222	6.59%	298	$226.55	5.08
Average	**1,930**	**1,701**	**12.88%**	**229**	**$174.50**	**6.59**

Table 11: Montana State Modulating Valve Savings and Payback Period

Modulating Valve Long Term Monitoring Savings - Montana						
MN Sites	**Annual Baseline Gas Use (Therm)**	**Annual MV Gas Use (Therm)**	**% Savings**	**Annual Savings (Therm)**	**Annual Cost Savings ($)**	**Payback Period (Years)**
Laundromat						
Dryer#1 (30 lb)	1,522	1,291	15.19%	231	$292.72	3.93
Dryer #2 (30 lb)	688	600	12.76%	88	$111.15	10.35
Dryer #3 (45 lb)	1,672	1,352	19.16%	320	$405.54	2.84
Dryer #4 (45 lb)	604	452	25.08%	151	$191.71	6.00
Dry Cleaner						
Dryer #1 (50 lb)	781	794	-1.75%	-14	-$17.32	-66.41
University						
Dryer #1 (75 lb)	503	464	7.62%	38	$48.48	23.72
Hotel #1						
Dryer #1 (75 lb)	1,516	1,232	18.70%	283	$358.79	3.21
Dryer #2 (75 lb)	1,865	1,588	14.84%	277	$350.43	3.28
HealthCare						
Dryer #1 (75 lb)	1,535	1,267	17.44%	268	$339.04	3.39
Dryer #2 (75 lb)	1,191	1,037	12.93%	154	$195.03	5.90
Hotel #2						
Dryer #1 (120 lb)	2,007	1,937	3.48%	70	$88.44	13.00
Dryer #2 (120 lb)	3,067	2,976	2.97%	91	$115.23	9.98
IL Sites						
Laundromat						
Dryer#1 (30 lb)	1,903	1,697	10.80%	205	$260.14	4.42
Dryer #2 (30 lb)	1,163	1,007	13.36%	155	$196.68	5.85
Dryer #3 (45 lb)	2,035	1,321	35.09%	714	$904.10	1.27
Dryer #4 (45 lb)	1,320	1,070	18.90%	249	$315.71	3.64
Hotel #1						
Dryer #1 (170 lb)	4,100	3,721	9.24%	379	$479.66	2.40
Hotel #2						
Dryer #1 (75 lb)	2,001	1,915	4.31%	86	$109.22	10.53
HealthCare						
Dryer #1 (75 lb)	4,738	4,176	11.86%	562	$711.30	1.62
Dryer #2 (75 lb)	4,519	4,222	6.59%	298	$377.10	3.05
Average	**1,936**	**1,706**	**12.93%**	**230**	**$291.66**	**3.94**

Table 12: Oregon State Modulating Valve Savings and Payback Period

Modulating Valve Long Term Monitoring Savings - Oregon						
MN Sites	**Annual Baseline Gas Use (Therm)**	**Annual MV Gas Use (Therm)**	**% Savings**	**Annual Savings (Therm)**	**Annual Cost Savings ($)**	**Payback Period (Years)**
Laundromat						
Dryer#1 (30 lb)	1,522	1,291	15.19%	231	$256.08	4.49
Dryer #2 (30 lb)	688	600	12.76%	88	$97.24	11.83
Dryer #3 (45 lb)	1,672	1,352	19.16%	320	$354.78	3.24
Dryer #4 (45 lb)	604	452	25.08%	151	$167.71	6.86
Dry Cleaner						
Dryer #1 (50 lb)	781	794	-1.75%	-14	-$15.15	-75.91
University						
Dryer #1 (75 lb)	486	447	7.97%	39	$42.94	26.78
Hotel #1						
Dryer #1 (75 lb)	1,516	1,232	18.70%	283	$313.88	3.66
Dryer #2 (75 lb)	1,865	1,588	14.84%	277	$306.57	3.75
HealthCare						
Dryer #1 (75 lb)	1,487	1,252	15.85%	236	$261.03	4.41
Dryer #2 (75 lb)	1,191	1,037	12.93%	154	$170.62	6.74
Hotel #2						
Dryer #1 (120 lb)	1,969	1,918	2.62%	52	$57.17	20.11
Dryer #2 (120 lb)	2,990	2,883	3.59%	107	$118.91	9.67
IL Sites						
Laundromat						
Dryer#1 (30 lb)	1,903	1,697	10.80%	205	$227.58	5.05
Dryer #2 (30 lb)	1,163	1,007	13.36%	155	$172.07	6.68
Dryer #3 (45 lb)	2,035	1,321	35.09%	714	$790.95	1.45
Dryer #4 (45 lb)	1,320	1,070	18.90%	249	$276.20	4.16
Hotel #1						
Dryer #1 (170 lb)	4,024	3,635	9.68%	389	$431.32	2.67
Hotel #2						
Dryer #1 (75 lb)	1,973	1,898	3.79%	75	$82.84	13.88
HealthCare						
Dryer #1 (75 lb)	4,738	4,176	11.86%	562	$622.28	1.85
Dryer #2 (75 lb)	4,519	4,222	6.59%	298	$329.90	3.49
Average	**1,922**	**1,694**	**12.85%**	**229**	**$253.25**	**4.54**

Table 13: Washington State Modulating Valve Savings and Payback Period

Modulating Valve Long Term Monitoring Savings - Washington						
MN Sites	Annual Baseline Gas Use (Therm)	Annual MV Gas Use (Therm)	% Savings	Annual Savings (Therm)	Annual Cost Savings ($)	Payback Period (Years)
Laundromat						
Dryer#1 (30 lb)	1,522	1,291	15.19%	231	$249.40	4.61
Dryer #2 (30 lb)	688	600	12.76%	88	$94.70	12.14
Dryer #3 (45 lb)	1,672	1,352	19.16%	320	$345.52	3.33
Dryer #4 (45 lb)	604	452	25.08%	151	$163.33	7.04
Dry Cleaner						
Dryer #1 (50 lb)	781	794	-1.75%	-14	-$14.75	-77.95
University						
Dryer #1 (75 lb)	485	446	8.00%	39	$41.85	27.48
Hotel #1						
Dryer #1 (75 lb)	1,516	1,232	18.70%	283	$305.69	3.76
Dryer #2 (75 lb)	1,865	1,588	14.84%	277	$298.57	3.85
HealthCare						
Dryer #1 (75 lb)	1,480	1,249	15.61%	231	$249.26	4.61
Dryer #2 (75 lb)	1,191	1,037	12.93%	154	$166.16	6.92
Hotel #2						
Dryer #1 (120 lb)	1,963	1,915	2.48%	49	$52.45	21.93
Dryer #2 (120 lb)	2,987	2,879	3.62%	108	$116.66	9.86
IL Sites						
Laundromat						
Dryer#1 (30 lb)	1,903	1,697	10.80%	205	$221.63	5.19
Dryer #2 (30 lb)	1,163	1,007	13.36%	155	$167.57	6.86
Dryer #3 (45 lb)	2,035	1,321	35.09%	714	$770.29	1.49
Dryer #4 (45 lb)	1,320	1,070	18.90%	249	$268.98	4.28
Hotel #1						
Dryer #1 (170 lb)	4,019	3,629	9.71%	390	$420.84	2.73
Hotel #2						
Dryer #1 (75 lb)	1,971	1,897	3.75%	74	$79.82	14.41
HealthCare						
Dryer #1 (75 lb)	4,738	4,176	11.86%	562	$606.03	1.90
Dryer #2 (75 lb)	4,519	4,222	6.59%	298	$321.28	3.58
Average	**1,921**	**1,693**	**12.83%**	**228**	**$246.26**	**4.67**

Conclusions

GTI Energy has previously completed a demonstration of 4 test sites (8 dryers) in the Chicago area as well as 5 sites (12 dryers) in Minnesota using the modulating dryer technology across 20 total dryers. Initial demonstrations in the Chicago area indicate average savings of 14% on natural gas used for drying. The additional Minnesota study found 12% savings on natural gas use. GTI analyzed this data across 20 dryers and two field demos to see what the savings and payback periods would look like if the results were applied to the 4 states in NEEA territory. The results showed an average annual savings of 229 therms per dryer. The average payback period across the 4 states was 4.94 years with Montana having a payback in as little as 3.94 years with higher natural gas costs and Idaho taking 6.59 years with lower natural gas costs.

If these annual savings are applied to the 4 NEEA states, they have the potential to provide large annual therm savings across the more than 50,000 commercial dryers believed to be installed in NEEA territory. The Technology at only 10% market penetration would achieve over 1 million therms of annual savings and at 40% penetration would achieve over 4.5 million therms of annual savings. Providing rebates on the technology through energy efficiency programs would reduce the annual payback times and help to increase that market penetration rate and the overall therm savings that can be achieved.

Appendix A: Commercial Dryer Market Estimate From CBSA 4 2019

Area	Company	2020 RES NG Customers	Gas Dryers - Commercial (Region)	Assembly	Grocery	Hospital	Lodging	Mixed Commercial	Office	Other	Residential Care	Restaurant	Retail/ Service	School	Warehouse
Idaho	**Total of All Companies (ID)**	**428,374**	**6,274**	**431**	**0**	**21**	**975**	**4,261**	**4**	**4**	**189**	**0**	**391**	**0**	**0**
Idaho	17606391ID (INTERMOUNTAIN GAS COMPANY)	347,807	5,094	350	0	17	791	3,459	3	3	153	0	317	0	0
Idaho	17611024ID (QUESTAR GAS COMPANY)	2,066	30	2	0	0	5	21	0	0	1	0	2	0	0
Idaho	17614616ID (AVISTA UTILITIES)	78,501	1,150	79	0	4	179	781	1	1	35	0	72	0	0
Montana	**Total of All Companies (MT)**	**283,469**	**4,188**	**287**	**0**	**14**	**651**	**2,844**	**2**	**2**	**126**	**0**	**261**	**0**	**0**
Montana	17603147MT (CUT BANK GAS CO)	1,257	19	1	0	0	3	13	0	0	1	0	1	0	0
Montana	17605164MT (ENERGY WEST MONTANA INC)	26,721	395	27	0	1	61	268	0	0	12	0	25	0	0
Montana	17609755MT (NORTHWESTERN ENERGY)	176,890	2,613	180	0	9	406	1,775	1	1	78	0	163	0	0
Montana	17611861MT (SACO MUNICIPAL GAS SVC)	129	2	0	0	0	0	1	0	0	0	0	0	0	0
Montana	17612243MT (SHELBY GAS ASSOCIATION)	1,129	17	1	0	0	3	11	0	0	1	0	1	0	0
Montana	17627001MT (MONTANA DAKOTA UTILITIES CO)	76,917	1,136	78	0	4	177	772	1	1	34	0	71	0	0
Montana	17674356MT (ENERGY WEST WEST YELLOWSTONE)	426	6	0	0	0	1	4	0	0	0	0	0	0	0
Oregon	**Total of All Companies (OR)**	**776,811**	**14,311**	**985**	**0**	**49**	**2,223**	**9,720**	**8**	**8**	**429**	**0**	**890**	**0**	**0**
Oregon	17601966OR (CASCADE NAT GAS CORP)	67,590	1,245	86	0	4	193	846	1	1	37	0	77	0	0
Oregon	17610351OR (NORTHWEST NATURAL GAS CO)	616,999	11,367	782	0	39	1,766	7,720	6	6	341	0	707	0	0
Oregon	17611125OR (AVISTA UTILITIES)	92,222	1,699	117	0	6	264	1,154	1	1	51	0	106	0	0
Washington	**Total of All Companies (WA)**	**1,232,852**	**25,399**	**1,748**	**0**	**87**	**3,947**	**17,250**	**14**	**13**	**762**	**0**	**1,581**	**0**	**0**
Washington	17602004WA (CASCADE NAT GAS CORP)	195,229	4,022	277	0	14	625	2,732	2	2	121	0	250	0	0
Washington	17603907WA (ELLENSBURG CITY OF)	3,988	82	6	0	0	13	56	0	0	2	0	5	0	0
Washington	17603995WA (ENUMCLAW CITY OF)	4,552	94	6	0	0	15	64	0	0	3	0	6	0	0
Washington	17614608WA (PUGET SOUND ENERGY)	791,612	16,309	1,122	0	56	2,534	11,076	9	8	490	0	1,015	0	0
Washington	17616582WA (NORTHWEST NATURAL GAS CO)	81,564	1,680	116	0	6	261	1,141	1	1	50	0	105	0	0
Washington	17616595WA (AVISTA UTILITIES)	155,907	3,212	221	0	11	499	2,181	2	2	96	0	200	0	0
Total Region		**2,721,506**	**50,171**	**3,451**	**0**	**172**	**7,796**	**34,073**	**27**	**25**	**1,506**	**0**	**3,121**	**0**	**0**

END OF REPORT