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Residential Ozone Laundry Field Demonstration

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Table of Contents

Table of Figures

List of Tables

Executive Summary

Background

The residential ozone washer system saves gas by using cold water and ozone to wash and sanitize clothes rather than the hot water and detergents traditionally used. Ozone is most effective when used with cold water so natural gas is saved by not using hot or warm water cycles on the washer. The primary benefits of a residential ozone system include:

- Reduced hot water use
- Reduced natural gas consumption
- Eliminates the need for detergent or fabric softener

Some qualitative benefits of ozone cannot be measured at all, though some can sometimes be established, such as:

- Increased fabric softness, fluffiness, and brightness
- Improved fabric and washer smell
- Ability to mix white and colored linens
- Potentially shorter drying times
- Improved washer smell

GTI targeted a demonstration of 3 residential ozone system types in 12 single-family homes as well as on 6 washers in 3 multifamily laundry rooms (18 washers in all). GTI selected 3 manufacturers of residential ozone systems for the demonstration including Purewash Pro, O3 Pure, and EcoWash. Six of each system were installed across the 18 washers. The single family homes were a mix of front load washers and top load washers to achieve a range of approximately 10 to 40 gallons of water consumption per load. The homes were also selected to reflect a range of family size and number of washer loads per week. Additional considerations for selection were the types of cycles (including water temperature) normally used on the washer, as well as the location of the washer for ease of monitoring. A survey form and field test agreement was utilized to secure participating homes. GTI selected 3 newer front load sites (2010-2014 washers), 2 older front load (2004-2007), 3 new top load (2010-2016), 3 older top load (2004-2013, one 2013 chosen based on high energy use rating), and 1 extremely old top load from 1990s for the study. The sites indicated they used a variety of loads per week from 2 up to 15 loads per week. For multifamily, 3 separate laundry rooms from 3 buildings was selected for the demo with 2 washer being monitored at each. They were all top load coin machines as are typically seen in multifamily laundry rooms with ages from 1997 to 2016.

The pilot duration was four months: one month of baseline monitoring and three months of ozone system monitoring. The hot and cold water use along with temperatures of cold and hot water were monitored. In addition the electric use of the ozone and washing machine were recorded. Water use monitoring will be used to determine gas savings based on the temperature setting and a standard efficiency water heater.

Results

Results from the demonstration in single family are provided in Table 1. The data shows the hot water savings were lower than initially anticipated. It appears most homeowners tend to use warm and cold settings the majority of the time and even the hot setting still tends to use a good deal of cold water. The payback period on average across all 12 sites was 5.8 years, but the payback was driven primarily by detergent savings. GTI conducted a quick survey of amazon.com and Jet.com prices with a variety of detergent brands and sizes. The average cost of detergent was $0.16 per load, which was used for detergent cost savings calculations. The hot water energy savings averaged 14.5 therms per home.

Table 1: Single Family Ozone Testing Results

Site	Type	Year	Loads / week	Annual Gas Energy Savings (Therms)	Annual Gas Cost Savings	Annual Detergent Savings	Annual Ozone Electric Cost	Payback Period
Peoples-RO-1	Top load	2011	7.6	9.1	$6.97	$62.86	$0.04	4.30
Peoples-RO-2	Top load	1990s	2.7	0.7	$0.56	$22.58	$0.12	13.03
Peoples-RO-3	Top Load	2016	16.8	26.7	$20.54	$139.63	$0.76	1.88
Peoples-RO-4	Top load	2004	3.7	16.4	$12.59	$30.51	$0.23	7.00
Peoples-RO-5	Front load	2014	7.2	3.5	$2.69	$59.69	$0.21	4.83
Peoples-RO-6	front load	2004	3.9	12.0	$9.23	$32.24	$0.06	7.24
Peoples-RO-7	Top load	2013	2.0	8.1	$6.23	$16.64	$0.09	13.17
Peoples-RO-8	Top Load	2007	15.5	24.8	$19.11	$128.96	$0.24	2.03
Peoples-RO-9	Top load	2010	13.2	34.3	$26.40	$110.14	$0.71	2.21
Peoples-RO-10	Front load	2014	10.5	22.4	$17.26	$86.98	$0.37	2.89
Peoples-RO-11	Top load	2011	4.0	12.2	$9.36	$32.92	$0.06	7.11
Peoples-RO-12	Front load	2010	9.0	14.0	$10.79	$75.28	$0.08	3.49
		Summary	**7.3**	**14.5**	**$11.15**	**$60.86**	**$0.25**	**5.8**

This technology probably doesn't make as much sense for small homes with two or less occupants, but savings looks pretty good for families with 4+ in the home as increased cycles and laundry use take place, driven by larger detergent savings. The payback was not driven by the age of the washer as much as anticipated, but more by the occupants' laundry habits and how many cycles they run in general and how many hot and warm cycles they run. Figure 1 below

shows the trend line of payback versus loads run in a week. Homes with over 6 loads of laundry a week are going to pay back in less than 6 years and would be a good fit for this technology.

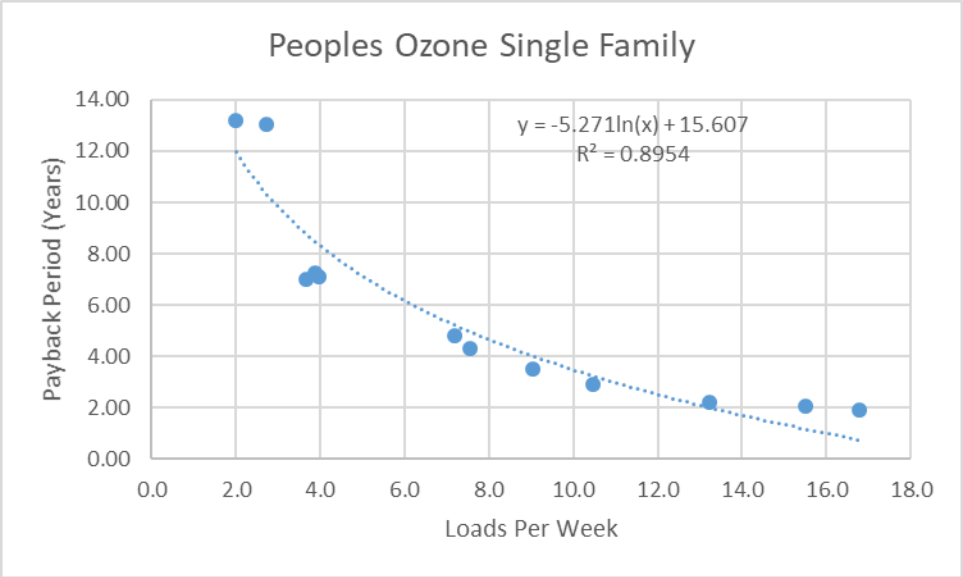

Figure 1: Peoples Single Family Payback versus Loads Trend

Results for multifamily testing are provided in Table 2 below. Multifamily sites saved an average of 49.7 therms per washer. When combined with the detergent savings this would result in a 2.6 year payback. Unless a unit is a condo building where the owner and user are the same though, the savings to the owner who is buying the ozone system would only be from gas therms savings. With only gas savings the average payback period is 10.1 years. Figure 2 shows the trend of payback period versus number of loads for building owners who were to implement ozone systems on their laundry room washers. The payback begins to become reasonable at under 5 years as the loads are increased to over 14 loads per week. This would be a good fit for busy laundry rooms with 15 or more loads per week per washer. It also could be a good fit for low income housing as the residents would receive the benefit of not needing to pay for detergent and the building owner would receive the gas savings.

Table 2: Multifamily Ozone Testing Results

Site	Year	Ozone Installed	Loads / week	Annual Gas Energy Savings (Therms)	Annual Gas Cost Savings	Annual Detergent Savings	Annual Ozone Electric Cost	Payback Period	Owner Payback Period
Peoples-ROMF-1-Washer 1	2001	EcoWash	12.12	90.9	$70.02	$100.84	$0.25	1.76	4.30
Peoples-ROMF-1-Washer 2	2016	Purewash	8.8	41.2	$31.75	$73.22	$0.14	2.86	9.49

Site	Year	Ozone Installed	Loads / week	Annual Gas Energy Savings (Therms)	Annual Gas Cost Savings	Annual Detergent Savings	Annual Ozone Electric Cost	Payback Period	Owner Payback Period
Peoples-ROMF-2-Washer 1	2001	O3 Pure	12.4	60.0	$46.22	$103.17	$0.08	2.01	6.50
Peoples-ROMF-2-Washer 2	2001	PureWash	15.52	49.2	$37.92	$129.13	$0.06	1.80	7.92
Peoples-ROMF-3-Washer 1	1997	O3 Pure	8.44	39.2	$30.20	$70.22	$0.05	2.99	9.95
Peoples-ROMF-3-Washer 2	1997	EcoWash	6.44	17.5	$13.49	$53.58	$0.09	4.48	22.40
	Summary		**10.6**	**49.7**	**$38.26**	**$88.36**	**$0.11**	**2.6**	**10.1**

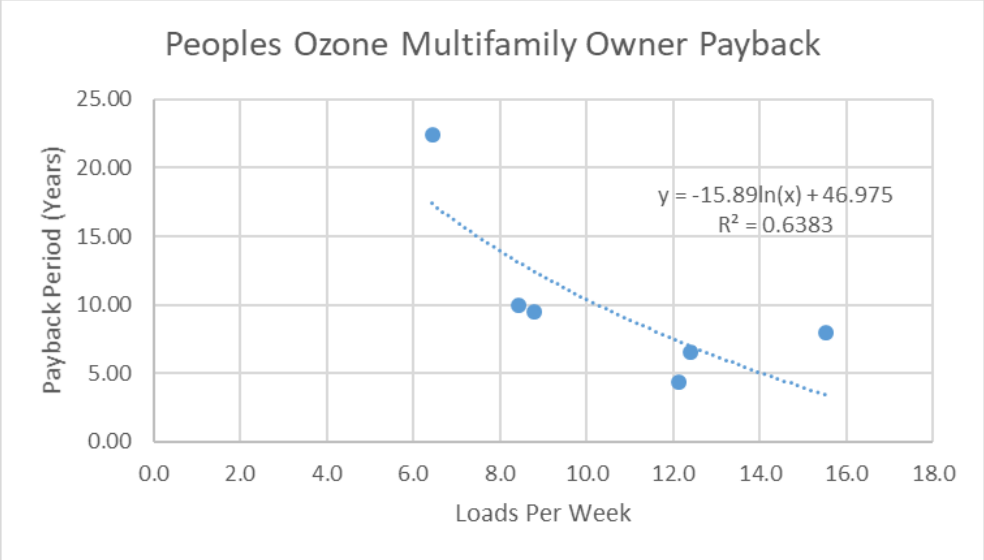

Figure 2: Multifamily Owner Payback Period

Project Background

Project Overview

Residential ozone washer systems save gas by using cold water and ozone to wash and sanitize clothes rather than the hot water and detergents traditionally used. Ozone is most effective when used with cold water so natural gas is saved by not using hot or warm water cycles on the washer. The primary benefits of a residential ozone system include:

- Reduce hot water and gas use

- Eliminates the need for detergent or fabric softener

Some qualitative benefits of ozone cannot be measured at all, though some can sometimes be established, such as:

- Increased fabric softness, fluffiness, and brightness
- Improved fabric and washer smell
- Ability to mix white and colored linens
- Potentially shorter drying times
- Improved washer smell

GTI targeted a demonstration of 3 residential ozone system types in 12 single-family homes as well as on 6 washers in 3 multifamily laundry rooms (18 washers in all). GTI selected 3 manufacturers of residential ozone systems for the demonstration including Purewash Pro, O3 Pure, and EcoWash (Figure 3). Six of each system were installed across the 18 washers. The single family homes were a mix of front load washers and top load washers to achieve a range of approximately 10 to 40 gallons of water consumption per load. The homes were also selected to reflect a range of family size and number of washer loads per week. Additional considerations for selection were the types of cycles (including water temperature) normally used on the washer, as well as the location of the washer for ease of monitoring. A survey form and field test agreement was utilized to secure participating homes. GTI selected 3 newer front load sites (2010-2014 washers), 2 older front load (2004-2007), 3 new top load (2010-2016), 3 older top load (2004-2013, one 2013 chosen based on high energy use rating), and 1 extremely old top load from 1990s for the study. The sites indicated they used a variety of loads per week from 2 up to 15 loads per week.

The pilot duration was four months: one month of baseline monitoring and three months of ozone system monitoring. The hot and cold water use along with temperatures of cold and hot water were monitored. In addition the electric use of the ozone and washing machine were recorded. Water use monitoring will be used to determine gas savings based on the temperature setting and a standard efficiency water heater.

Figure 3: Demonstration Residential Ozone Systems

Previous Study Results

Consumer reports conducted a study in 2014 to validate the cleaning effectiveness of both the Wash It (now out of business) and Pure Wash ozone laundry systems. Their study looked at stain removal effectiveness and found that the ozone systems did not perform as well as regular washing and detergent. The key in GTI's opinion is that the ozone manufacturers do not claim to be built for stain removing. The ozone systems are setup to clean and kill bacteria on normally soiled laundry. They recommend using a stain remover as you always would if you get a specific stain that needs removing like the blood, grass, and mud that was used for the consumer reports study. The ozone systems are primarily to clean every day laundry without stains, which is the majority of most laundry people run in their washer. In this instance the ozone system would get rid of odors and eliminate any bacteria. GTI felt that a better laboratory study would have been to look at the bacteria-killing capability along with odor removal of the ozone machines.

GTI conducted a very similar study for another gas utility in 2016 where 12 single family homes had Wash It ozone laundry systems installed and 6 multifamily ozone washers that had already been installed were monitored for a behavioral study. Wash It has since gone out of business, which probably explains the majority of the issues that were encountered in that study.

Technology and Market Overview

Traditionally residential customers use a washing machine with hot water and detergents to clean clothes. Ozone technology allows the homeowner to use cold water and ozone to clean clothes, kill bacteria and remove odor. This saves on hot water heating costs as well as detergent costs. Ozone technology has been around for decades in the commercial markets and is just starting to be applied to the residential market.

Although ozone technologies have been around for decades, the biggest obstacle to further adoption will be educating the residential consumer on the technology. Consumers are used to washing their laundry with hot water and laundry detergent. One of the manufacturers, Wash It, indicated that it takes a one-on-one demonstration in a lot of cases to show them the unit simply attaches to their existing washing machine and cleans their laundry and sanitizes and disinfects their clothes better than their traditional hot water and detergent. Once a consumer has been educated on the benefits and cost savings of the technology, it should be capable of fairly wide adoption due to the relatively short payback period.

There are dozens of manufacturers in the commercial market with ozone laundry products that have been in the marketplace for 20 years or longer. The application to the residential market is relatively new and it will take education of residential consumers to make them aware of the benefits. The residential ozone product was available from seven manufacturers, Wash It, O3 Pure, Pure Wash, Eco Washer, LaundryPure, Naturwash, and Scent Crusher. Wash It systems were used exclusively for the other utility demonstration however they went out of business in 2016. The other six manufacturers (Figure 4) are still producing residential ozone systems. Prices vary from $250-$350 per system depending on the manufacturer and retailer of the product.

For the three systems demonstrated the EcoWash and O3 Pure systems do not require regular maintenance. The PureWash system does have a desiccant to dry out incoming air. This is

recommended to be replaced regularly by the manufacturer, and it may be possible to regenerate the desiccant as well through heating it. The O3 Pure unit does have the ability to set the ozone production to two different levels of high and low as well as completely off. The Pure Wash provides an additional tap to dispense ozonated water for other cleaning purposes as well.

Figure 4: Residential Ozone Manufacturing models

The amount of energy saved per site will vary widely with the washer type and age, the number of loads washed in a week and what types of setting the homeowner uses on their washer. Table 3 provides potential annual energy savings numbers based on a 0.58 energy factor (EF) gas water heater and varying number of loads and hot water use per load.

Before the pilot, GTI estimated a residential ozone system retrofit could save 209 therms per residential site with 10 hot water loads per week. Since implementing the field demo it became clear that the rough estimate used above is not a good estimate for today's more water efficient washing machines and the number of hot loads people tend to run in a week. The actual usage patterns tend to be more in the Top left section of Table 3.

Table 3: Energy Savings for Varying Washers and Loads per Week

Res Ozone Annual Therms Saved with Varying Loads and Gallons of HW per Load							
		Loads Per Week					
Gal HW/Load		2	4	6	8	10	12
	10	10	21	31	42	52	63
	15	16	31	47	63	78	94
	20	21	42	63	84	105	125
	25	26	52	78	105	131	157
	30	31	63	94	125	157	188
	35	37	73	110	146	183	220
	40	42	84	125	167	209	251

Objectives

The objectives for this pilot were:

- validate gas savings
- determine cost-effectiveness with estimated simple paybacks
- establish a dataset for generation of deemed savings value
- identify and potentially help overcome key market acceptance barriers
- demonstrate the product in the field for the local market

Methodology

Experimental Design and Procedure

GTI targeted a demonstration of 3 manufacturer's residential ozone system in 12 single-family homes as well as 6 multifamily laundry room washers. These homes were a mix of front load washers and top load washers to achieve a range of approximately 10 to 40 gallons of water consumption per load. The homes were also selected to achieve a range of family size and number of washer loads/week. Additional considerations for selection were the types of cycles (including water temperature) normally used on the washer, as well as the location of the washer for ease of monitoring. A survey form and field test agreement was utilized to secure those participating homes.

The data was collected by a Logic Beach data logger, which recorded the energy usage, cycle count, and temperature at minute intervals. GTI accessed the data remotely with a cell modem to download datasets and look at sensor readings in real time. GTI monitored the cold and hot water use and the hot and cold water temperatures, which together with standard water heater efficiency ratings were used to determine the natural gas use. GTI also monitored the electricity use of the washer and ozone system. Data was collected at each site for one month to determine the baseline energy usage before the ozone systems were installed, and then energy usage monitoring continued for at least three months after the ozone systems had become operational.

Site, Installation, and Commissioning Requirements

A list of the single family sites is provided in Table 4 along with the year make and model of their washer and how many loads a week they estimated to have before the demo. The selected sites were required to meet the following criteria:

- site is representative of the target markets for this technology
- site has a gas-fired water heater
- homeowner will allow ozone and data collection equipment installation for baseline and modulating dryer monitoring periods

Table 4: Single Family Site List

Site	Year	Manufac.	Model	Loads/ week	Energy Guide (kWh/yr)
New Front Load					
Site 5	2014	LG	LG True Balance	7	unknown
Site 10	2014	Whirlpool	GHW925OMWI	6	unknown
Site 12	2010	Frigidaire	affinity	10	99
Older Front Load					
Site 1	2007	GE	GE WCVH6800JWW	10	144
Site 6	2004	Whirlpool	GHW9150PWI	5	177
New Top Load					
Site 3	2004	LG	WT5270CW	15	113
Site 9	-	Maytag	MVWX500XWO	5	122
Site 11	2013	whirlpool		7	unknown
Older Top Load					
Site 4	2007	Kenmore	90 Series	3	unknown
Site 8	2004	GE	GCWP1000M0WW	10	427
Site 7	2004	Whirlpool	WTW5200	2	289
Extremely Old Top Load					
Site 2	1990's	Speed Queen	SWT220LA	6	unknown

Three different multifamily laundry room sites were selected with the model numbers shown in Table 5. All of these units are typical coin top load machines with ages from 1997 up to one unit from 2016. They are very typical of what would be expected in most small multifamily laundry rooms.

Table 5: Multifamily Site List

Site	Washer	Year	Manufac.	Model	Style
Site MF-1	#1	2001	Speed Queen	SWT221WA	Top Load
Site MF-1	#2	2016	Speed Queen	SWNSX2PP112TW01	Top Load
Site MF-2	#1	2001	Speed Queen	SWT221WA	Top Load
Site MF-2	#2	2001	Speed Queen	SWT221WA	Top Load
Site MF-3	#1	1997	Speed Queen	EA1220W	Top Load
Site MF-3	#2	1997	Speed Queen	EA1221WG	Top Load

Analytical Methods

A diagram of the monitoring equipment is provided in Figure 5 and a list of the instrumentation is provided in Table 6 . Referring to Figure 5, a flow meter with integrated RTD temperature sensor was installed on both the hot and cold inlet lines to the washing machine. Electric meters were also installed for both the washing machine and the ozone generator.

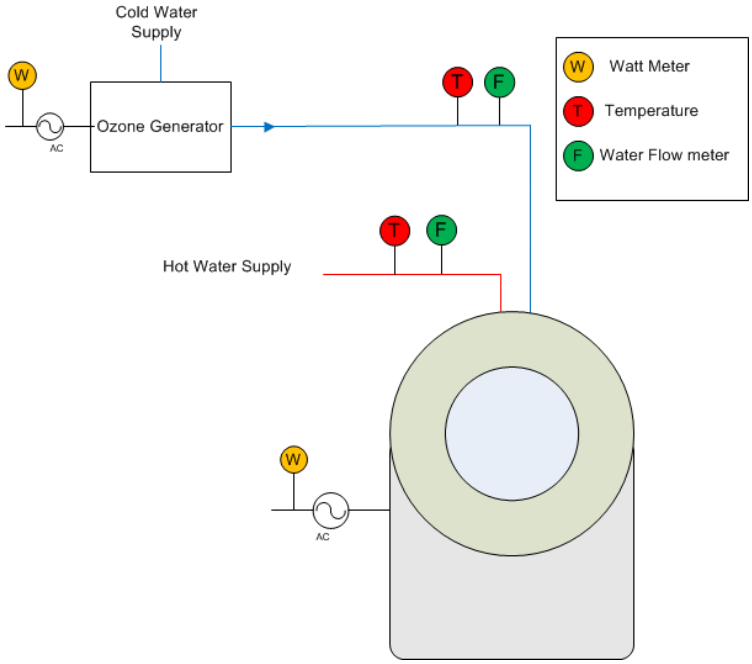

Figure 5: Data Collection Monitoring Diagram

Table 6: Data Collection Monitoring Equipment

Sensor	Description	Equipment	Manufacturer/ Model	Accuracy	Webpage link
F	Cold and hot water flow	RTD	Sika / VVXAAEP1R RRP251C0	± 2%	*http://sika-usa.com/sturteverant/wp-content/uploads/DS_Vortex_USA_0317.pdf*
T	Cold and hot water temperature	RTD	Sika / VVXAAEP1R RRP251C0	± 2%	*http://sika-usa.com/sturteverant/wp-content/uploads/DS_Vortex_USA_0317.pdf*
W	Ozone and Washer electric use	Watthour Meter	Continental Controls/	± 0.5%	*http://www.ccontrolsys.com/w/Advanced_Pulse_WattNode*

			WNB-3Y-208-P		
Ozone	Ambient Ozone Monitor	Ozone Transmitter	ATI / B12 Transmitter	± 5%	*http://www.ozonesolutions.com/products/Ozone-Monitors/Ambient-Ozone/B12_Ozone_Transmitter*
Data Logger	Records and sends data for dryers	Intellilogger	Logic Beach / IL-80		*http://www.logicbeach.com/*
Cell Modem	Connects logger to internet	Cell Modem	Sierra Wireless / Raven XE		*http://www.sierrawireless.com/*

The data logger recorded values every one minute unless cold or hot water flow occurred or electric use occurred by the washer or ozone at which point the logger would record every five seconds. The data allows for a complete picture of water and energy use before and after the ozone installation took place along with the number of loads that were washed which can determine detergent cost savings as well. Single family site 1 and site 3 as well as all multifamily sites had the ambient ozone levels monitored by an additional sensor, an ATI ozone transmitter to determine if ambient ozone levels rose and if so to what levels in the immediate ambient air around the washing machines.

Results

Installation and Commissioning

GTI staff installed all of the data collection equipment, sensors and ozone systems at all 12 single family homes and 6 multifamily washers. Some example installation pictures are provided in Figure 6 - Figure 10. Ozone systems were installed according to the manufacturer's instructions. The cold water supply line was split to provide water to both the washer cold and hot water inlet, so that only cold water would be used even if the homeowner selected a hot water cycle.

Figure 6: Peoples-RO-1 O3 Pure Ozone System

Figure 7: Peoples RO-3 Pure Wash Ozone System

Figure 8: Peoples RO-5 Eco Wash Ozone System

Figure 9: Peoples RO-3 Temp and Flow Meters and Ambient Ozone

Figure 10: Peoples MF-3 Site Washers

Energy Savings and Economic Performance

Single Family

Table 7 shows the annualized results from the long term monitoring of the 12 single family sites. The data shows the hot water savings were lower than initially anticipated. It appears most homeowners tend to use warm and cold settings the majority of the time. Most sites were able to complete one month of baseline and three months of ozone monitoring or more, with a few exceptions. The payback period on average across all 12 sites was 5.8 years, but the payback was driven primarily by detergent savings. GTI conducted a quick survey of amazon.com and Jet.com prices with a variety of detergent brands and sizes. The average cost of detergent was $0.16 per load, which was used for detergent cost savings calculations. The hot water energy savings averaged 14.5 therms per home. For the other utility demo it is important to note that a lot of the homes still used some hot water with ozone. For this demo the ozone systems were setup with a split tee hose from the ozone outlet that fed into both the cold and hot inlet of the washer so only cold ozone water was used. Even if a homeowner selected hot water only cold water would be used.

This technology probably doesn't make as much sense for small homes with two or less occupants, but savings looks pretty good for families with 4+ in the home as increased cycles and laundry use take place, driven by with correspondingly larger detergent savings usage. The payback was not driven by the age of the washer as much as anticipated but more by the occupants' laundry habits - how many cycles they run in general and how many hot and warm cycles they run. Figure 11 shows the trend for how payback period varying with number of loads run. Homes with less than 6 loads a week result in a payback over 6 years, but homes with over 10 loads a week are generally going to payback in less than 3 years.

The spreadsheet showing complete results for each test site is provided in Appendix A: Supporting Data Spreadsheets and Tables along with tables of data from each test site.

Table 7: Single Family Long-Term Monitoring Annualized Results

Site	Type	Year	Ozone Installed	Loads / week	Annual Gas Energy Savings (Therms)	Annual Gas Cost Savings	Annual Detergent Savings	Annual Ozone Electric Cost	Payback Period
Peoples-RO-1	Top load	2011	O3 Pure	7.6	9.1	$6.97	$62.86	$0.04	4.30
Peoples-RO-2	Top load	1990s	Pure Wash	2.7	0.7	$0.56	$22.58	$0.12	13.03
Peoples-RO-3	Top Load	2016	PureWash	16.8	26.7	$20.54	$139.63	$0.76	1.88
Peoples-RO-4	Top load	2004	Eco Wash	3.7	16.4	$12.59	$30.51	$0.23	7.00
Peoples-RO-5	Front load	2014	Eco Wash	7.2	3.5	$2.69	$59.69	$0.21	4.83
Peoples-RO-6	front load	2004	EcoWash	3.9	12.0	$9.23	$32.24	$0.06	7.24
Peoples-RO-7	Top load	2013	Pure Wash	2.0	8.1	$6.23	$16.64	$0.09	13.17

Site	Type	Year	Ozone Installed	Loads / week	Annual Gas Energy Savings (Therms)	Annual Gas Cost Savings	Annual Detergent Savings	Annual Ozone Electric Cost	Payback Period
Peoples-RO-8	Top Load	2007	O3 Pure	15.5	24.8	$19.11	$128.96	$0.24	2.03
Peoples-RO-9	Top load	2010	EcoWash	13.2	34.3	$26.40	$110.14	$0.71	2.21
Peoples-RO-10	Front load	2014	Pure Wash	10.5	22.4	$17.26	$86.98	$0.37	2.89
Peoples-RO-11	Top load	2011	O3 Pure	4.0	12.2	$9.36	$32.92	$0.06	7.11
Peoples-RO-12	Front load	2010	O3 Pure	9.0	14.0	$10.79	$75.28	$0.08	3.49
		Summary		**7.3**	**14.5**	**$11.15**	**$60.86**	**$0.25**	**5.8**

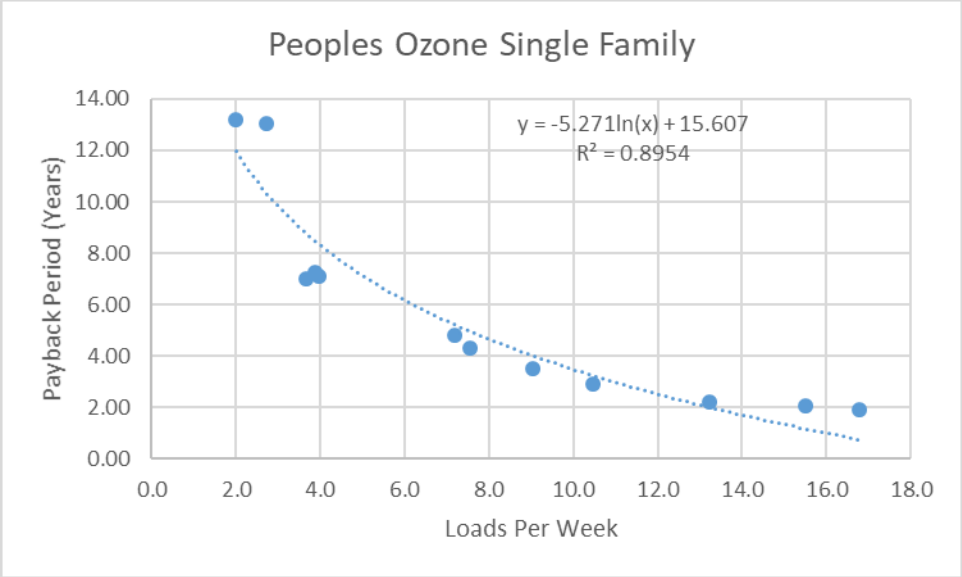

Figure 11: Peoples Single Family Payback versus Loads Trend

Multifamily

Table 8 shows the annualized results from the long term monitoring of the 6 multifamily washers. These sites were setup to only use cold water even if hot water was selected just like single family sites. We did witness hot and warm water cycles still being selected, but only cold water was hooked up to both inlets. The multifamily sites become somewhat complicated in that the payback is again driven primarily by detergent savings and not gas savings, so the purchaser of the ozone system might not see the payback from detergent savings but only gas therm savings. The tenants would receive the detergent cost savings in a rental situation. If the building is a condo then the savings would come back to the building owners who are also purchasing the ozone systems and the standard payback calculation can be used. An additional payback column labeled as owner payback period was added to the summary table to show savings excluding detergent savings. If detergent and gas savings are taken into account the payback period is only

2.6 years on average across the multifamily sites. That average gas savings was 49.7 therms per year. If payback is only from gas savings the payback increases to 10.1 years. Figure 12 provides a graph showing the payback period versus number of loads run at the facility each week. Anything over 8 loads per week will payback in under 3 years and would be worth adopting to sites where the owner and users are the same such as multifamily condos. If the building is rented and the owner only sees a payback on gas saving then the payback trend is shown in Figure 13. The measure probably only becomes practical for high usage sites with over 15 loads per week.

Table 8: Multifamily Long-Term Monitoring Annualized Results

Site	Year	Ozone Installed	Loads / week	Annual Gas Energy Savings (Therms)	Annual Gas Cost Savings	Annual Detergent Savings	Annual Ozone Electric Cost	Payback Period	Owner Payback Period
Peoples-ROMF-1-Washer 1	2001	EcoWash	12.12	90.9	$70.02	$100.84	$0.25	1.76	4.30
Peoples-ROMF-1-Washer 2	2016	Purewash	8.8	41.2	$31.75	$73.22	$0.14	2.86	9.49
Peoples-ROMF-2-Washer 1	2001	O3 Pure	12.4	60.0	$46.22	$103.17	$0.08	2.01	6.50
Peoples-ROMF-2-Washer 2	2001	PureWash	15.52	49.2	$37.92	$129.13	$0.06	1.80	7.92
Peoples-ROMF-3-Washer 1	1997	O3 Pure	8.44	39.2	$30.20	$70.22	$0.05	2.99	9.95
Peoples-ROMF-3-Washer 2	1997	EcoWash	6.44	17.5	$13.49	$53.58	$0.09	4.48	22.40
	Summary		**10.6**	**49.7**	**$38.26**	**$88.36**	**$0.11**	**2.6**	**10.1**

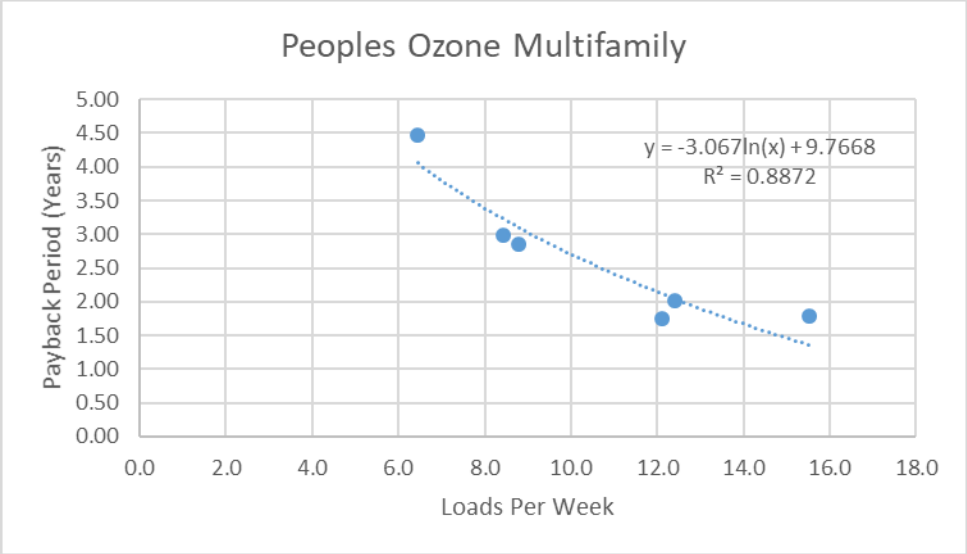

Figure 12: Peoples Multifamily Payback versus Loads Trend

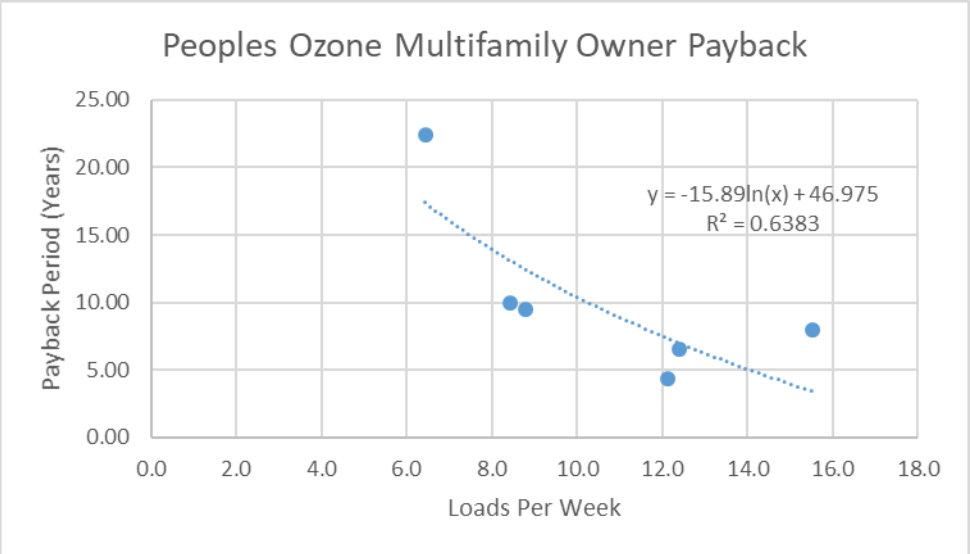

Figure 13: Peoples Multifamily - Owner Payback versus Loads Trend

Issues Encountered and Stakeholder Acceptance

Single Family

There were a great deal of issues encountered with the Wash IT system in the previous utility ozone testing. With this demonstration of 3 separate manufactures, only one issue with the ozone systems was encountered. One site had the plastic hose that comes with the ozone system leak, they found it right away before any damage occurred. The sensor and meter fittings installed by GTI had very small leak issues that caused some minor damage that was quickly repaired in two homes, but the ozone systems themselves did not cause any complaints or issues.

Overall most of the participants in the demonstration seemed to really enjoy the technology and felt that it cleaned well. There were several sites that indicated softer clothes and several that

indicated the ozone system cleaned their clothes much better and they smelled much better. One site indicated the system cleaned much worse than standard washing, Six sites indicated the ozone cleaned just as well, three indicated the ozone cleaned better, and two sites indicated the ozone cleaned much better than normal laundry. The general impression is that the technology works pretty well. In the end all 12 single family sites decided to keep their ozone systems at the end of the demo. Completed end user surveys are in Appendix B: End User Survey and Results.

Multifamily

The 6 ozone systems at the multifamily sites performed well without issues. The building manager indicated that he received no complaints on the systems and a few people gave him positive response including one lady saying "I love it." They did elect to keep the systems at the end of the demo as well. GTI also provided surveys for tenants of the buildings to fil in if they wished. Five surveys were received and three indicated positive experience with the systems and wanting to keep the systems after the demo. One was slightly negative but mostly neutral and one indicated really not liking the system and wanting to have the equipment removed. Their problem seemed to be primarily the belief that only hot water kills bed bugs and germs and with the smell of the ozone system. This does bring up the issue that in multifamily you will have a variety of people using the machines along with opinions on how laundry should be done. For the most part the feedback was positive overall. The surveys from both the building manager and the tenants are provided in Appendix B: End User Survey and Results.

It is also worth pointing out that two laundry rooms were located in one large multifamily building in separate areas and one building just had one laundry room. Both of those buildings had at least 1 washer that was not retrofitted with an ozone machine, so tenants can choose to not use the ozone washer if they would like. Looking at the number of loads completed on each machine before and after ozone installation showed that all 6 washers had higher loads per week after ozone installation with 21% higher loads per week on average across the 6 washing machines. There are a lot of variables that are not known including occupancy and total loads done on the non-ozone machines, but the data seems to indicate more people were choosing to wash with the ozone machines. This may have also been them just wanting to try it, but monitoring for 3 months you would only expect a small increase if they didn't like to continue using the ozone machines.

Safety of the Ozone Washer

Single Family

There were questions about whether ambient level of ozone would increase to harmful levels in the home with the use of the ozone washing device. GTI installed an ambient ozone monitor at sites 1 and 3 to verify if any harmful levels are reached. The monitors were connected to the washing machine to provide ambient levels close to the washer. According to OSHA the 8 hour time weighted average for ozone should not exceed 0.1 ppm. Figure 14 below shows the ambient ozone levels monitored at site #1. The ozone was almost always below the recommended 0.1 ppm level and they were always below for an 8 hour average. However, there were several peaks of high ozone usage during high usage times. Generally the ozone would only be high for a few minutes at most (which would happen during ozone system power use) and then the level would come back down to normal levels. Even with these peak days the 8 hour time weighted average

stayed below the recommended 0.1 ppm level. The sensor did appear to drift off from zero a little, but not enough to make actual numbers above 0.1 ppm

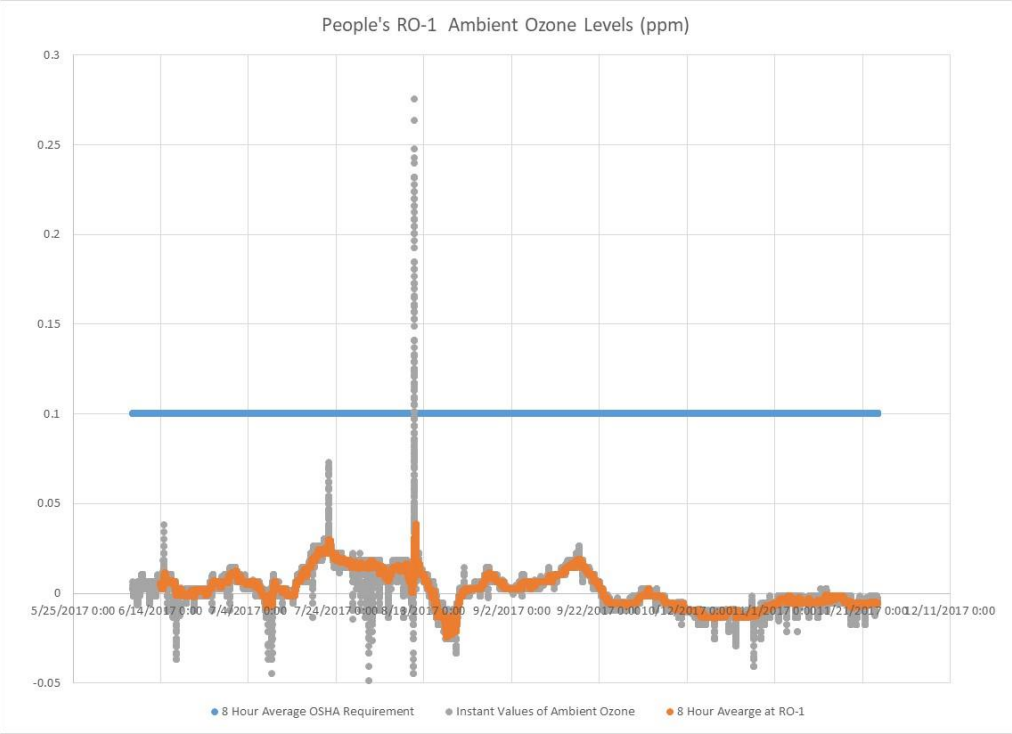

Figure 14: Peoples RO-1 Ambient Ozone Levels

Data for ambient ozone levels at site #3 is provided in Figure 15 below. The ozone was almost always below the recommended 0.1 ppm level and the ozone level was always below for an 8 hour average. However, there were a lot of peaks of high ozone usage that reached over 0.75 ppm for very short times. As in site 1 the ozone would only stay high for very short periods of time while the ozone machine was running and would quickly drop to levels below 0.1 ppm. Even with short peaks above 1 ppm the overall 8 hour average always stayed below the OSHA recommended level of 0.1 ppm. It is also important to note that for both test sites the ozone monitor was installed right next to the washing machine. The 8 hour average next to the washing machine was always below 0.1 ppm, but it would be expected to be even lower at locations in the home further away from the washing machine as the life is very short lived.

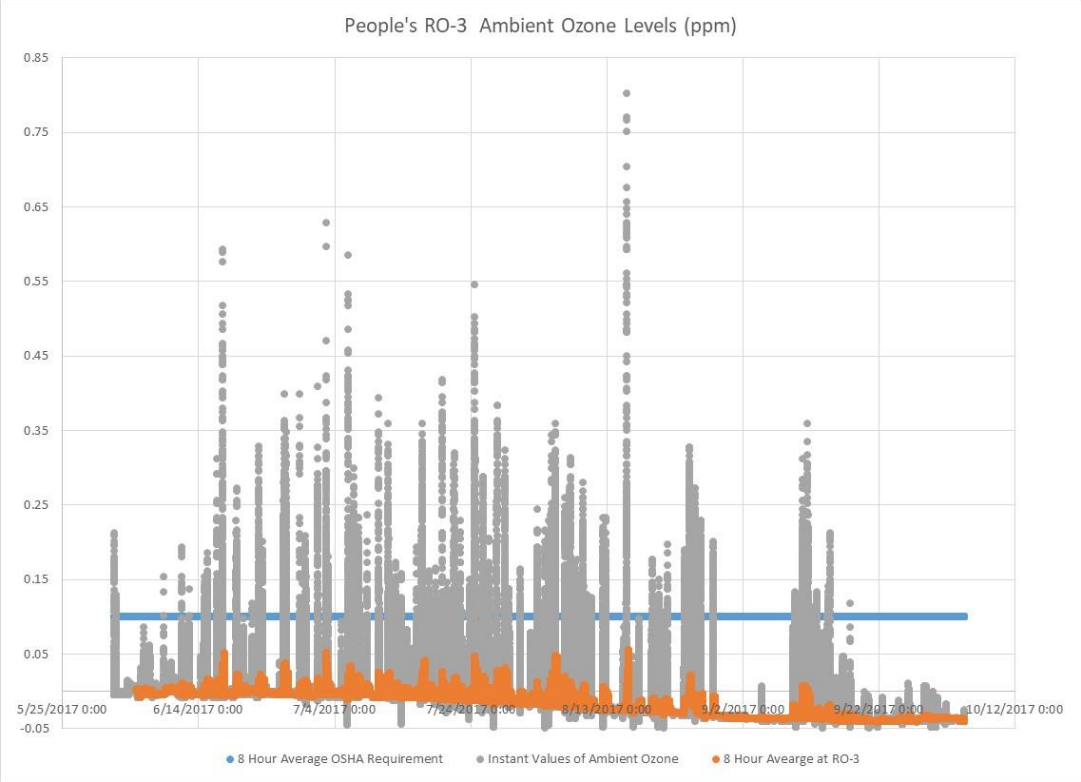

Figure 15: Peoples RO-3 Ambient Ozone Levels

Multifamily

There are more questions about whether ambient ozone levels could built up more in a laundry room with several washers and ozone machines working at the same time. GTI installed ambient ozone level monitors at all 3 multifamily laundry rooms near the washers. According to OSHA the 8 hour time weighted average for ozone should not exceed 0.1 ppm. Figure 16 - Figure 18 below shows the ambient ozone levels monitored at multifamily site #1-3. The ozone was usually below the recommended 0.1 ppm level and they were always below for an 8 hour average, with one very brief exception. Site ROMF-02 in general had higher ambient ozone levels. However, there were several peaks of high ozone usage during high usage times. One time led to the 8 hour average ozone level going above 0.1 ppm for 4 hours reaching as high as 0.108 ppm at its peak. It barely exceed the 0.1 ppm level, but it did exceed it on this one instance. All the remainder of the time ambient ozone was monitored at the 3 multifamily sites the ambient ozone stayed below 0.1 ppm for the 8 hour average. The ambient ozone monitor at multifamily site #3 did drift from zero, but it drifted upward and would have only lead to higher ozone readings. Even with the higher readings the levels stayed well below the 0.1 ppm OSHA 8 hour average.

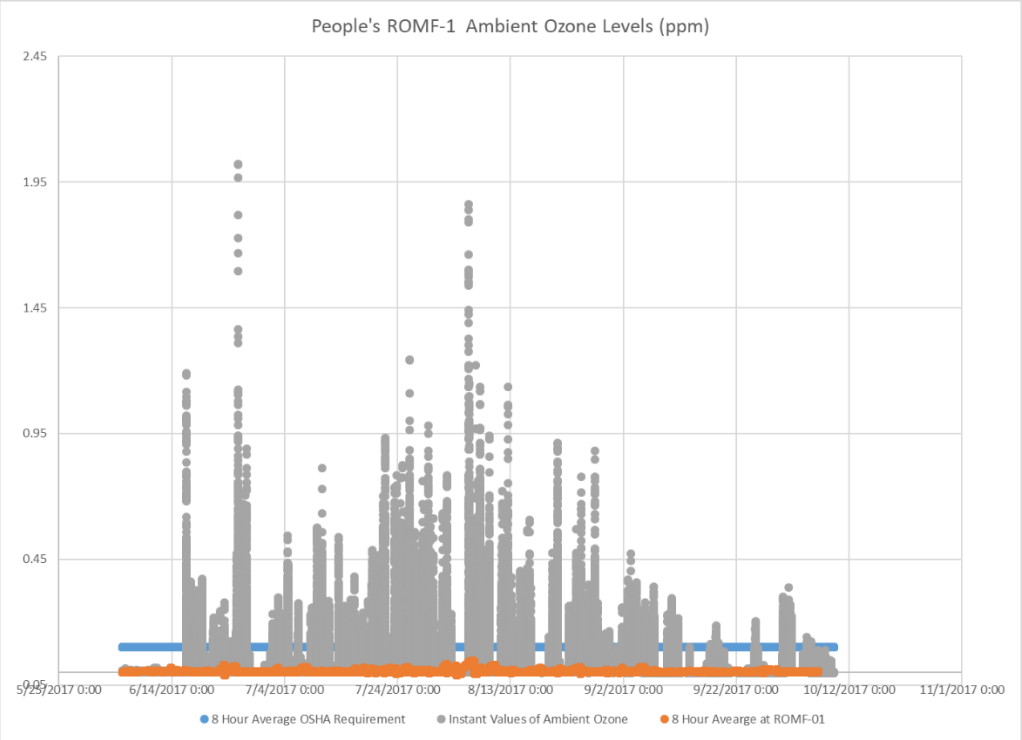

Figure 16: Peoples ROMF-1 Ambient Ozone Levels

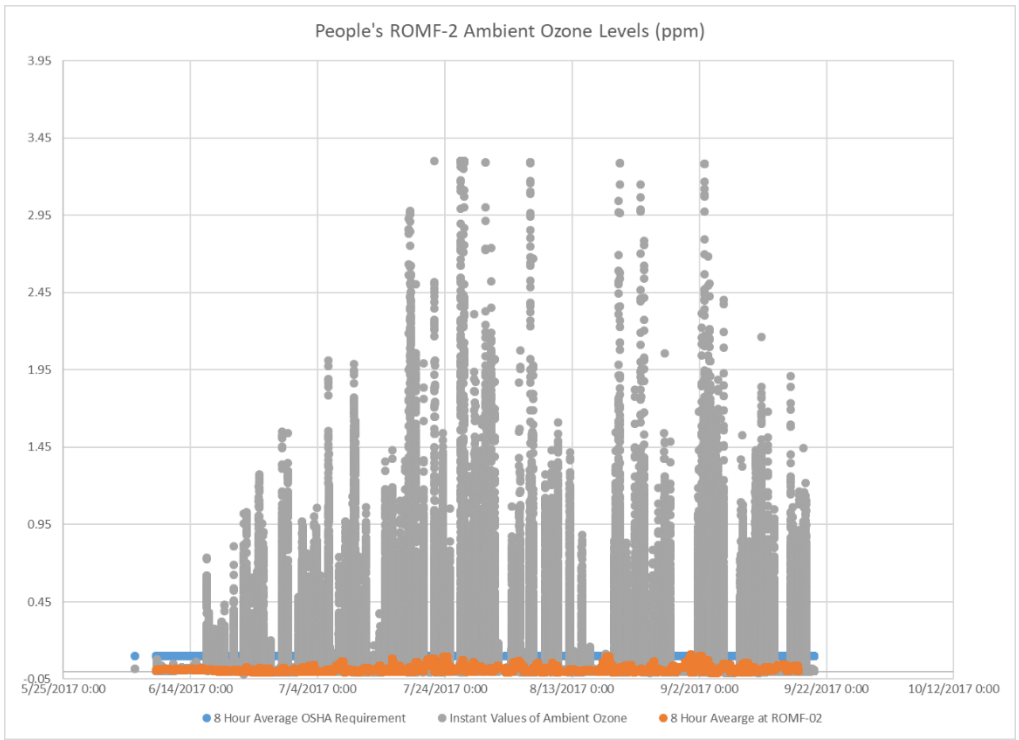

Figure 17: Peoples ROMF-2 Ambient Ozone Levels

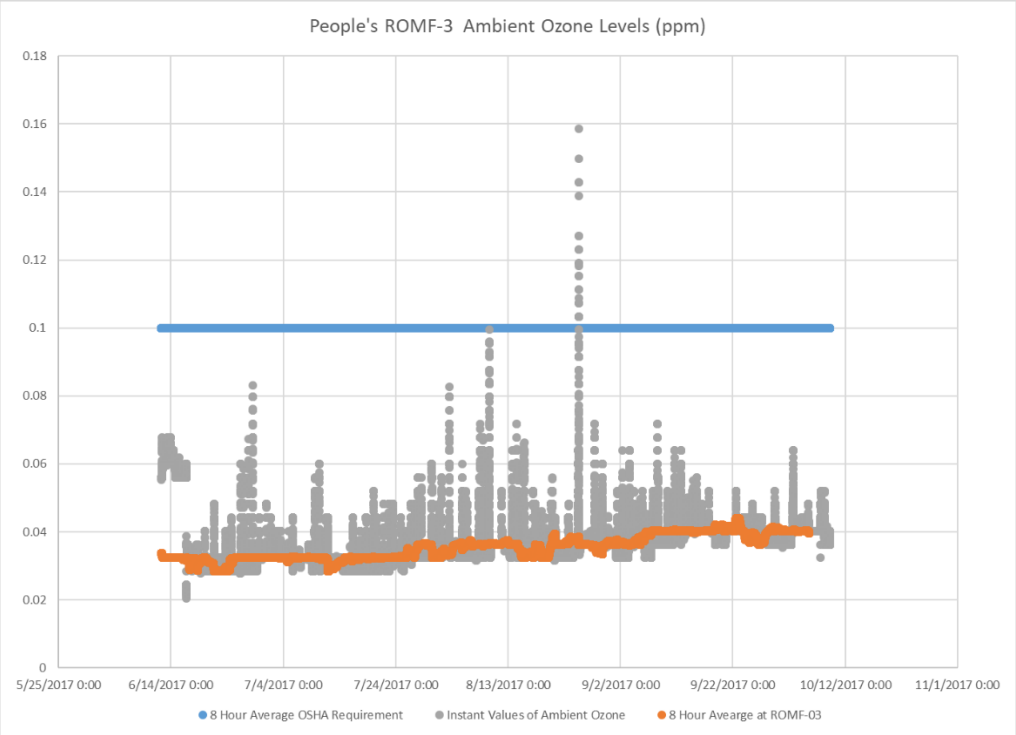

Figure 18: Peoples ROMF-3 Ambient Ozone Levels

Discussion and Conclusions

Implications for People and North Shore Gas Energy Efficiency Programs

The pilot demonstrated an average of 14.5 therms of annualized gas savings for each ozone system based on these 12 single family homes. The cost savings for the consumer are largely based on the detergent savings, but they still result in natural gas savings as well. Although these therm savings are relatively small per home, when multiplied across People and North Shore Gas territory, they can add up if widely adopted. There are approximately 1,000,000 customers in People and North Shore Gas territory. If GTI assumes that 70% of them are in a single family situation, and a market penetration rate of 0.3, then 210,000 sites could potentially adopt a residential ozone system. This would translate to 3,045,000 therms of gas savings potential in Peoples and North Shore Gas service territory. For multifamily the calculations are a little more complicated as we don't know how many multifamily buildings have laundry rooms and how many units are in one multifamily building for sites that do have laundry rooms. Assuming 30% or 300,000 customers live in multifamily residences, 50% of those buildings have laundry rooms, and 6 customer accounts per washer in a laundry room would result in 25,000 washers in laundry rooms that could use this technology. Average savings at the multifamily sites were 49.7 therms per washer, which would translate to 1,242,500 therms of potential savings in the territory. A 30% market penetration rate would produce 372,750 therms of savings at multifamily sites.

Lessons Learned

It appears from the amount of issues encountered throughout the test with the other utility Wash It system demo, and the fact that they went out of business in 2016, there were some design

problems with that specific manufacturer's ozone model. The three manufacturers systems tested under this demonstration appeared to all work very well, with only a cheap hose pointed to as a failed part from one unit. Specific manufacturer models do have some features that stand out on their own. The Pure Wash Pro has a desiccant dryer cartridge that needs to be periodically replaced, which some homeowners pointed out as something they would prefer not to have to do. The Pure Wash Pro also has a spout for homeowners to collected ozone water and use for household cleaning, and one site indicated they would like this to be something other than a hose fitting.

Recommendations for Further Study

In addition to field demonstrations, it would be very helpful to conduct a lab study that looked at both the short- and long-term effectiveness of ozone systems from all the available manufacturers. The systems could be set up in the lab to determine what levels of ozone they are actually producing, how it varies across different manufacturers and if it produces less ozone over time as we appeared to see with the Wash it systems. All of the manufacturers could also be tested for effectiveness at cleaning and killing bacteria. The safety of each of the systems could also be tested with ambient ozone monitoring in an environmental chamber with repeated washing.

In addition, it would be helpful to conduct both a market penetration study to look at how many of these systems are in use already and what would the potential market look like with incentives. That could be combined with a behavior change study to look at what could lead to deeper market penetration. What interventions could help change behaviors? For multifamily, would it be helpful to provide the option to use or not use the system? Would it be possible to charge more for use of the ozone system to help the payback for the site owner? Is there messaging and marketing pointing out a greener technology and saving the environment that could lead to greater adoption? A study to look at all of these aspects would be very beneficial for the technology adoption and effectiveness of incentives.

References

United States Census Bureau, 2012 County Business Patterns: https://www.census.gov/programs-surveys/cbp/data/tables.html

Ozone Solutions Website
http://www.ozonesolutions.com/info/osha-and-ozone

OSHA Ozone Levels
https://www.osha.gov/dts/chemicalsampling/data/CH_259300.html

Appendix A: Supporting Data Spreadsheets and Tables

The complete summaries of the monitoring datasets for the 12 single family pilot sites are contained in the Excel workbook "**Peoples-Residential Ozone Summary Calcs -2017-12-21.xlsx**" that has been provided as a companion electronic deliverable with this report. The complete summaries of the monitoring datasets for the 3 multifamily pilot sites are contained in the Excel workbook "**Peoples-Residential Ozone Summary Calcs -2018-02-19.xlsx**" that has been provided as a companion electronic deliverable with this report.

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Appendix B: End User Surveys

Thank you for your participation in the Peoples and North Shore Gas Emerging Technology Program's pilot of the residential ozone system for laundry. In addition to the important data we've been collecting about energy use of the system, we'd like to hear from you about your experience. A first-hand account of your impressions and opinions will provide us with extremely valuable information about how individuals and families may respond to this technology.

Part I. Your Original Laundry System

Before you began using the ozone system…

1. What laundry detergent brand(s) did you most often use?
   All, Gain, Member's Mark (Sam's).

2. Did you use fabric softener? If so, which brands did you most often use?
   Snuggle and Bounce

3. Did you use stain remover? If so, which brands did you most often use?

   Oxi-Clean

Please respond to the below questions on a scale of 1 to 5.

4. What was the average noise level of your washing machine prior to ozone installation?	**1** Very Quiet	**2**	**3** Noticeable, but not intrusive	**4**	**5** Very Loud
Additional comments:					
5. Did your washing machine have an unwanted odor prior to ozone installation?	**1** No Odor	**2**	**3** Light odor	**4**	**5** Strong
Additional comments:					

Part II. Experience with the Ozone System for Laundry

On a scale of 1 to 5, please indicate how the ozone laundry system performed as compared to your original laundry system in the following categories:

6. The ozone system cleaned my clothes: Comments: Whites and colors were dull	**1** Much Worse	**2**	**3** Just as well	**4**	**5** Much Better
7. Clothes washed with the ozone system felt (softer, similar or rougher): Comments:	**1** Rougher	**2**	**3** Similar	**4**	**5** Softer
8. The time it took the wash cycle to complete was faster, similar or longer with the ozone system: Comments:	**1** Longer	**2**	**3** Similar	**4**	**5** Faster
9. Clothes smelled better, similar or worse when cleaned with the ozone system: Comments:	**1** Worse	**2**	**3** Similar	**4**	**5** Better
10. How much noise did the washing cycle with the ozone system make when compared to your original laundry system? Comments:	**1** Quieter	**2**	**3** Similar	**4**	**5** Louder

11. After the ozone system was installed, did you continue to use stain remover? **YES**

    a. If so, did you notice any difference in the performance of your stain remover? Please explain. **NO**

12. After the ozone system was installed, did you continue to use detergent? **MOSTLY NOT, IT WAS DEPENEDENT UPON ON WHO WASHED THE CLOTHES. LATER IN THE FIELD EVALAUTION MY WIFE STARTED TO USE DETERGENT BASED ON THE OUTCOME OF THE WASH.**

    a. If so, why did you choose to continue to use detergent? **WIFE FELT THE CLOTHES WERE NOT GETTING CLEAN ON OZONE ALONE**

13. Did you use only cold water cycles with your ozone? **YES**

    a. If not, why did you choose to use warm or hot settings?

b. What percentage of the time did you use cycles other than cold?

14. Would you like to keep your ozone system at no cost to you or would you like it removed?

I WOULD LIKE TO KEEP IT AND CONTINUE TO EVALAUTE THE PERFORMANCE

15. Would you recommend an ozone system to others? Why?

I KNOW THAT MY WIFE WOULD NOT RECOOMEND THE DEVICE BASED ON DULLER LOOKING COLORS AND WHITES. I HAVE NOT YET MADCE A DETERMINATION.

16. Given your experience, would you be willing to recommend that another customer pay the retail price of $250 for an ozone laundry system?

NOT AT THIS TIME

17. Were any problems or issues encountered with the ozone system or your washer during the field trial? If yes, please provide details.

THE PLASTIC CONNECTION ON THE HOSE CRACKED CAUSING WATER TO LEAK - FORTUNATELY I WAS HOME AT THE TIME AND HEARD NOISE OF WATER LEAKING AND WAS ABLE TO TURN OFF THE WATER BEFORE IT COULD DO EXTENSIVE DAMAGE.

18. Did the performance of the ozone system change throughout the field demo? If so, please provide additional details on how the performance changed throughout the test.

COULD NOT DETERMINE ANY NOTICIABLE CHANGE IN PERFORMANCE

19. Did you receive any additional unexpected benefits from the ozone system that were not noted above?

OUR WASHER, A FRONT LOADER HAS MOLD GROWING UNDER THE SEAL OF THE DOOR, I WAS HOPING IT WOULD CLEAR THAT UP -BUT IT HAD NO EFFECT.

20. Do you have any other feedback on the ozone system?

THE PLASTIC CONNECTION ON THE HOSE SHOULD BE REPLACED WITH METAL

Thank you for your participation in the Peoples and North Shore Gas Emerging Technology Program's pilot of the residential ozone system for laundry. In addition to the important data we've been collecting about energy use of the system, we'd like to hear from you about your experience. A first-hand account of your impressions and opinions will provide us with extremely valuable information about how individuals and families may respond to this technology.

Part I. Your Original Laundry System

Before you began using the ozone system…

1. What laundry detergent brand(s) did you most often use?

Tide

2. Did you use fabric softener? If so, which brands did you most often use?

No

3. Did you use stain remover? If so, which brands did you most often use?

Occasionally. Shout

Please respond to the below questions on a scale of 1 to 5.

4. What was the average noise level of your washing machine prior to ozone installation?	**1** Very Quiet	**2**	**3** Noticeable, but not intrusive	**4**	**5** Very Loud
Additional comments:					
5. Did your washing machine have an unwanted odor prior to ozone installation?	**1** No Odor	**2**	**3** Light odor	**4**	**5** Strong Odor
Additional comments:					

Part II. Experience with the Ozone System for Laundry

On a scale of 1 to 5, please indicate how the ozone laundry system performed as compared to your original laundry system in the following categories:

6. The ozone system cleaned my clothes: Comments:	**1** Much Worse	**2**	**3** Just as well	**4**	**5** Much Better
7. Clothes washed with the ozone system felt (softer, similar or rougher): Comments:	**1** Rougher	**2**	**3** Similar	**4**	**5** Softer
8. The time it took the wash cycle to complete was faster, similar or longer with the ozone system: Comments:	**1** Longer	**2**	**3** Similar	**4**	**5** Faster My water pressure isn't very good. I think the ozone system caused a slightly longer time to fill but it was acceptable.
9. Clothes smelled better, similar or worse when cleaned with the ozone system: Comments:	**1** Worse	**2**	**3** Similar	**4**	**5** Better
10. How much noise did the washing cycle with the ozone system make when compared to your original laundry system? Comments:	**1** Quieter	**2**	**3** Similar	**4**	**5** Louder

11. After the ozone system was installed, did you continue to use stain remover?

Rarely

a. If so, did you notice any difference in the performance of your stain remover? Please explain.

Didn't notice

12. After the ozone system was installed, did you continue to use detergent?

Yes

a. If so, why did you choose to continue to use detergent?

I used only a drop of detergent in each load just for the smell.

13. Did you use only cold water cycles with your ozone? I did. Roommate used hot water on some loads.

a. If not, why did you choose to use warm or hot settings? Roommate wouldn't wash socks in anything but hot water.

b. What percentage of the time did you use cycles other than cold? Me: 0% Roommate: 20%

14. Would you like to keep your ozone system at no cost to you or would you like it removed? Keep

15. Would you recommend an ozone system to others? Why? Yes. I love not using detergent.

16. Given your experience, would you be willing to recommend that another customer pay the retail price of $250 for an ozone laundry system? Yes, as long as any consumables needed by the system were reasonably priced.

17. Were any problems or issues encountered with the ozone system or your washer during the field trial? If yes, please provide details.

No issues.

18. Did the performance of the ozone system change throughout the field demo? If so, please provide additional details on how the performance changed throughout the test.

Same throughout.

19. Did you receive any additional unexpected benefits from the ozone system that were not noted above?

No.

20. Do you have any other feedback on the ozone system?

I really like it. I use 1/30th of the detergent I would have used without it. I believe my clothes are clean.

Thank you for your participation in the Peoples and North Shore Gas Emerging Technology Program's pilot of the residential ozone system for laundry. In addition to the important data we've been collecting about energy use of the system, we'd like to hear from you about your experience. A first-hand account of your impressions and opinions will provide us with extremely valuable information about how individuals and families may respond to this technology.

Part I. Your Original Laundry System

Before you began using the ozone system…

1. What laundry detergent brand(s) did you most often use?
   Kirkland – Environmental Friendly

2. Did you use fabric softener? If so, which brands did you most often use?
   Downy

3. Did you use stain remover? If so, which brands did you most often use?
   Oxi

Please respond to the below questions on a scale of 1 to 5.

4. What was the average noise level of your washing machine prior to ozone installation?	**1** Very Quiet	**2**	**3** Noticeable, but not intrusive	**4**	**5** Very Loud
Additional comments:					
5. Did your washing machine have an unwanted odor prior to ozone installation?	**1** No Odor	**2**	**3** Light odor	**4**	**5** Strong Odor
Additional comments:					

Part II. Experience with the Ozone System for Laundry

On a scale of 1 to 5, please indicate how the ozone laundry system performed as compared to your original laundry system in the following categories:

6. The ozone system cleaned my clothes: Comments:	**1** Much Worse	**2**	**3** Just as well	**4**	**5** Much Better
7. Clothes washed with the ozone system felt (softer, similar or rougher): Comments:	**1** Rougher	**2**	**3** Similar	**4**	**5** Softer
8. The time it took the wash cycle to complete was faster, similar or longer with the ozone system: Comments: It's a smart washer so it basically weighs the load and determines the length of time.	**1** Longer	**2**	**3** Similar	**4**	**5** Faster
9. Clothes smelled better, similar or worse when cleaned with the ozone system: Comments:	**1** Worse	**2**	**3** Similar	**4**	**5** Better
10. How much noise did the washing cycle with the ozone system make when compared to your original laundry system? Comments: This was a little hard to answer because it's in the basement. I set it and come back when it's done.	**1** Quieter	**2**	**3** Similar	**4**	**5** Louder

11. After the ozone system was installed, did you continue to use stain remover?

    No

    a. If so, did you notice any difference in the performance of your stain remover? Please explain.

12. After the ozone system was installed, did you continue to use detergent?

    At first I did not, but my husband didn't like that idea. So I used a little.

    a. If so, why did you choose to continue to use detergent?

    I used like a 4th of what I normally would

13. Did you use only cold water cycles with your ozone?

    Yes

a. If not, why did you choose to use warm or hot settings?

b. What percentage of the time did you use cycles other than cold?

None – because the hose to the hot water was not installed.

14. Would you like to keep your ozone system at no cost to you or would you like it removed?

Yes keep it.

15. Would you recommend an ozone system to others? Why?

Sure – it saves on the hot water and detergent.

16. Given your experience, would you be willing to recommend that another customer pay the retail price of $250 for an ozone laundry system?

Sure

17. Were any problems or issues encountered with the ozone system or your washer during the field trial? If yes, please provide details.

None.

18. Did the performance of the ozone system change throughout the field demo? If so, please provide additional details on how the performance changed throughout the test.

No.

19. Did you receive any additional unexpected benefits from the ozone system that were not noted above?

No.

20. Do you have any other feedback on the ozone system?

It was funny to see the reaction of my family to instruct them not to use detergent. That was the biggest change.

Thank you for your participation in the Peoples and North Shore Gas Emerging Technology Program's pilot of the residential ozone system for laundry. In addition to the important data we've been collecting about energy use of the system, we'd like to hear from you about your experience. A first-hand account of your impressions and opinions will provide us with extremely valuable information about how individuals and families may respond to this technology.

Part I. Your Original Laundry System

Before you began using the ozone system…

1. What laundry detergent brand(s) did you most often use?

Tide

2. Did you use fabric softener? If so, which brands did you most often use?

Yes, Suavital

3. Did you use stain remover? If so, which brands did you most often use?

None

Please respond to the below questions on a scale of 1 to 5.

4. What was the average noise level of your washing machine prior to ozone installation?	**1** Very Quiet	**2**	**3** Noticeable, but not intrusive	**4**	**5** Very Loud
Additional comments:					
5. Did your washing machine have an unwanted odor prior to ozone installation?	**1** No Odor	**2**	**3** Light odor	**4**	**5** Strong Odor
Additional comments:					

Part II. Experience with the Ozone System for Laundry

On a scale of 1 to 5, please indicate how the ozone laundry system performed as compared to your original laundry system in the following categories:

6. The ozone system cleaned my clothes: Comments:	**1** Much Worse	**2**	**3** Just as well	**4**	**5** Much Better
7. Clothes washed with the ozone system felt (softer, similar or rougher): Comments:	**1** Rougher	**2**	**3** Similar	**4**	**5** Softer
8. The time it took the wash cycle to complete was faster, similar or longer with the ozone system: Comments:	**1** Longer	**2**	**3** Similar	**4**	**5** Faster
9. Clothes smelled better, similar or worse when cleaned with the ozone system: Comments:	**1** Worse	**2**	**3** Similar	**4**	**5** Better
10. How much noise did the washing cycle with the ozone system make when compared to your original laundry system? Comments:	**1** Quieter	**2**	**3** Similar	**4**	**5** Louder

11. After the ozone system was installed, did you continue to use stain remover?

No.

a. If so, did you notice any difference in the performance of your stain remover? Please explain.

12. After the ozone system was installed, did you continue to use detergent?

Only with heavily soiled items.

a. If so, why did you choose to continue to use detergent?

13. Did you use only cold water cycles with your ozone? Yes.

a. If not, why did you choose to use warm or hot settings?

b. What percentage of the time did you use cycles other than cold?

14. Would you like to keep your ozone system at no cost to you or would you like it removed?

Yes, Keep it.

15. Would you recommend an ozone system to others? Why?

Yes. It seems like the benefit of not having hot water and detergent are worth it.

16. Given your experience, would you be willing to recommend that another customer pay the retail price of $250 for an ozone laundry system? Yes.

17. Were any problems or issues encountered with the ozone system or your washer during the field trial? If yes, please provide details.

No.

18. Did the performance of the ozone system change throughout the field demo? If so, please provide additional details on how the performance changed throughout the test.

No.

19. Did you receive any additional unexpected benefits from the ozone system that were not noted above?

No.

20. Do you have any other feedback on the ozone system?

No.

Thank you for your participation in the Peoples and North Shore Gas Emerging Technology Program's pilot of the residential ozone system for laundry. In addition to the important data we've been collecting about energy use of the system, we'd like to hear from you about your experience. A first-hand account of your impressions and opinions will provide us with extremely valuable information about how individuals and families may respond to this technology.

Part I. Your Original Laundry System

Before you began using the ozone system…

1. What laundry detergent brand(s) did you most often use? Tide

2. Did you use fabric softener? If so, which brands did you most often use? Yes, Downy

3. Did you use stain remover? If so, which brands did you most often use? No

Please respond to the below questions on a scale of 1 to 5.

4. What was the average noise level of your washing machine prior to ozone installation?	**1** Very Quiet	**2**	**3** Noticeable, but not intrusive	**4**	**5** Very Loud
Additional comments:					
5. Did your washing machine have an unwanted odor prior to ozone installation?	**1** No Odor	**2**	**3** Light odor	**4**	**5** Strong Odor
Additional comments:					

Part II. Experience with the Ozone System for Laundry

On a scale of 1 to 5, please indicate how the ozone laundry system performed as compared to your original laundry system in the following categories:

6. The ozone system cleaned my clothes: Comments:	**1** Much Worse	**2**	**3** Just as well	**4**	**5** Much Better
7. Clothes washed with the ozone system felt (softer, similar or rougher): Comments:	**1** Rougher	**2**	**3** Similar	**4**	**5** Softer
8. The time it took the wash cycle to complete was faster, similar or longer with the ozone system: Comments:	**1** Longer	**2**	**3** Similar	**4**	**5** Faster
9. Clothes smelled better, similar or worse when cleaned with the ozone system: Comments:	**1** Worse	**2**	**3** Similar	**4**	**5** Better
10. How much noise did the washing cycle with the ozone system make when compared to your original laundry system? Comments:	**1** Quieter	**2**	**3** Similar	**4**	**5** Louder

11. After the ozone system was installed, did you continue to use stain remover? No

    a. If so, did you notice any difference in the performance of your stain remover? Please explain.

12. After the ozone system was installed, did you continue to use detergent? Sometime

    a. If so, why did you choose to continue to use detergent? For the clean smell

13. Did you use only cold water cycles with your ozone? Yes

    a. If not, why did you choose to use warm or hot settings?

    b. What percentage of the time did you use cycles other than cold?

14. Would you like to keep your ozone system at no cost to you or would you like it removed? Yes

15. Would you recommend an ozone system to others? Why? Yes, no need for detergent, and smells great.

16. Given your experience, would you be willing to recommend that another customer pay the retail price of $250 for an ozone laundry system? Yes

17. Were any problems or issues encountered with the ozone system or your washer during the field trial? If yes, please provide details.
    Had a leak at the ozone and hose connector, that leaked to my basement, but tech came out and fixed.

18. Did the performance of the ozone system change throughout the field demo? If so, please provide additional details on how the performance changed throughout the test.
    No

19. Did you receive any additional unexpected benefits from the ozone system that were not noted above?

    No

20. Do you have any other feedback on the ozone system?
    No

Thank you for your participation in the Peoples and North Shore Gas Emerging Technology Program's pilot of the residential ozone system for laundry. In addition to the important data we've been collecting about energy use of the system, we'd like to hear from you about your experience. A first-hand account of your impressions and opinions will provide us with extremely valuable information about how individuals and families may respond to this technology.

Part I. Your Original Laundry System

Before you began using the ozone system…

1. What laundry detergent brand(s) did you most often use? Laundry detergent was used only on heavily soiled clothing, when used the main detergent was Wisk.

2. Did you use fabric softener? If so, which brands did you most often use? Bounce fabric sheets were used.

3. Did you use stain remover? If so, which brands did you most often use? Stain remover was used occasionally. Shout and Oxy were used

Please respond to the below questions on a scale of 1 to 5.

4. What was the average noise level of your washing machine prior to ozone installation?	**1**	**2**	**3**	**4**	**5**
	Very Quiet		Noticeable, but not intrusive		Very Loud
Additional comments:					
5. Did your washing machine have an unwanted odor prior to ozone installation?	**1**	**2**	**3**	**4**	**5**
	No Odor		Light odor		Strong Odor
Additional comments:					

Part II. Experience with the Ozone System for Laundry

On a scale of 1 to 5, please indicate how the ozone laundry system performed as compared to your original laundry system in the following categories:

6. The ozone system cleaned my clothes: Comments: just as well on regular loads. Needed detergent on heavily soiled or smelly clothes (baseball uniform/gym uniform)	**1** Much Worse	**2**	**3** Just as well	**4**	**5** Much Better
7. Clothes washed with the ozone system felt (softer, similar or rougher): Comments: this was most noticeable on sweatshirts and pants, the lining pilled and was hard	**1** Rougher	**2**	**3** Similar	**4**	**5** Softer
8. The time it took the wash cycle to complete was faster, similar or longer with the ozone system: Comments: it was faster, I image due to little or no detergent the front loader would turn off if too much detergent was added prior to the study. No such issue while using ozone equipment	**1** Longer	**2**	**3** Similar	**4**	**5** Faster
9. Clothes smelled better, similar or worse when cleaned with the ozone system: Comments: the kids commented that the clothes didn't smell clean anymore. I did notice that some odors returned faster, such as older t-shirts felt clean but had an unlaundered smell, not dirty or body order. I usually use a fragrance free detergent and clothes had a different odor than clothes after using fragrance free detergent. It was the smell I would detect when the ozone equipment was in operation.	**1** Worse	**2**	**3** Similar	**4**	**5** Better
10. How much noise did the washing cycle with the ozone system make when compared to your original laundry system? Comments: not much difference	**1** Quieter	**2**	**3** Similar	**4**	**5** Louder

11. After the ozone system was installed, did you continue to use stain remover? Yes on heavily soiled items

    a. If so, did you notice any difference in the performance of your stain remover? Please explain. I did not notice if there was a difference

12. After the ozone system was installed, did you continue to use detergent? occasionally

    a. If so, why did you choose to continue to use detergent? Once kids started to complain that the cloths didn't smell clean I started to add a small amount of detergent. I did use detergent on heavily stained items just because they were stained and wanted to make sure I would get them clean in one wash.

13. Did you use only cold water cycles with your ozone? Only cold. If I could have figured out how to use the hot I may have tried. I wasn't there at installation so my daughter (who was) told me it had to be cold only.
    a. If not, why did you choose to use warm or hot settings?

    b. What percentage of the time did you use cycles other than cold?

14. Would you like to keep your ozone system at no cost to you or would you like it removed? I will keep it.

15. Would you recommend an ozone system to others? Why? I would recommend because there was cost savings on detergent and softener side. I didn't notice much of a change in gas usage, although I honestly didn't look closely. I will have to compare overall usage.

16. Given your experience, would you be willing to recommend that another customer pay the retail price of $250 for an ozone laundry system? Given that my family was not completely satisfied with the way the clothes felt and smelled I would probably not recommend to people with children. For adults that aren't as picky about these things I would advocate for the product.

17. Were any problems or issues encountered with the ozone system or your washer during the field trial? If yes, please provide details. none

18. Did the performance of the ozone system change throughout the field demo? If so, please provide additional details on how the performance changed throughout the test. I didn't notice a change.

19. Did you receive any additional unexpected benefits from the ozone system that were not noted above? Not that I am aware of.

20. Do you have any other feedback on the ozone system? Not at this time.

Thank you for your participation in the Peoples and North Shore Gas Emerging Technology Program's pilot of the residential ozone system for laundry. In addition to the important data we've been collecting about energy use of the system, we'd like to hear from you about your experience. A first-hand account of your impressions and opinions will provide us with extremely valuable information about how individuals and families may respond to this technology.

Part I. Your Original Laundry System

Before you began using the ozone system…

1. What laundry detergent brand(s) did you most often use? Costco Brand Pods

2. Did you use fabric softener? If so, which brands did you most often use? N/A

3. Did you use stain remover? If so, which brands did you most often use? Spray and Wash

Please respond to the below questions on a scale of 1 to 5.

4. What was the average noise level of your washing machine prior to ozone installation?	**1** Very Quiet	**2**	**3** Noticeable, but not intrusive	**4**	**5** Very Loud
Additional comments:					
5. Did your washing machine have an unwanted odor prior to ozone installation?	**1** No Odor	**2**	**3** Light odor	**4**	**5** Strong Odor
Additional comments:					

Part II. Experience with the Ozone System for Laundry

On a scale of 1 to 5, please indicate how the ozone laundry system performed as compared to your original laundry system in the following categories:

6. The ozone system cleaned my clothes: Comments: Except for Bedding	**1** Much Worse	**2**	**3** Just as well	**4**	**5** Much Better
7. Clothes washed with the ozone system felt (softer, similar or rougher): Comments:	**1** Rougher	**2**	**3** Similar	**4**	**5** Softer
8. The time it took the wash cycle to complete was faster, similar or longer with the ozone system: Comments:	**1** Longer	**2**	**3** Similar	**4**	**5** Faster
9. Clothes smelled better, similar or worse when cleaned with the ozone system: Comments:	**1** Worse	**2**	**3** Similar	**4**	**5** Better
10. How much noise did the washing cycle with the ozone system make when compared to your original laundry system? Comments:	**1** Quieter	**2**	**3** Similar	**4**	**5** Louder

11. After the ozone system was installed, did you continue to use stain remover? Only if needed

    a. If so, did you notice any difference in the performance of your stain remover? Please explain. I didn't really have a before/after comparison, so I'm not sure.

12. After the ozone system was installed, did you continue to use detergent? Only with bedding

    a. If so, why did you choose to continue to use detergent? The ozone machine didn't do a great job at getting the body oil marks off things like the pillow case.

13. Did you use only cold water cycles with your ozone? Yes
    a. If not, why did you choose to use warm or hot settings?

b. What percentage of the time did you use cycles other than cold?

14. Would you like to keep your ozone system at no cost to you or would you like it removed? I plan to continue using it.

15. Would you recommend an ozone system to others? Why? Yes, it saved both time and money and is much more environmentally friendly.

16. Given your experience, would you be willing to recommend that another customer pay the retail price of $250 for an ozone laundry system? Yes, because of the product, but with the replaceable dryer cartridges, you will never see a payback from using it.

17. Were any problems or issues encountered with the ozone system or your washer during the field trial? If yes, please provide details. One time it did not want to stop running, so I just unplugged it and plugged it back in, this seemed to fix the problem.

18. Did the performance of the ozone system change throughout the field demo? If so, please provide additional details on how the performance changed throughout the test. Yes, there was a break in period. After my first few loads, I noticed nothing looked or smelled clean. I had to rewash everything multiple times for about the first 5 or 6 loads. After this the machine seemed to function very well.

19. Did you receive any additional unexpected benefits from the ozone system that were not noted above? I used the water to clean with because of the sterilizing property of ozone.

20. Do you have any other feedback on the ozone system? The system works well; I would like to see something better than the replaceable dryer cartridges. They are actually a little pricey and only seem to last about 6 months. I would also like to see a better solution to the outlet used for “at home”. Maybe a built in spigot or something other than a regular hose fitting.

Thank you for your participation in the Peoples and North Shore Gas Emerging Technology Program's pilot of the residential ozone system for laundry. In addition to the important data we've been collecting about energy use of the system, we'd like to hear from you about your experience. A first-hand account of your impressions and opinions will provide us with extremely valuable information about how individuals and families may respond to this technology.

Part I. Your Original Laundry System

Before you began using the ozone system…

1. What laundry detergent brand(s) did you most often use? Ecos

2. Did you use fabric softener? If so, which brands did you most often use? No

3. Did you use stain remover? If so, which brands did you most often use? Yes. Oxiclean and Tech.

Please respond to the below questions on a scale of 1 to 5.

4. What was the average noise level of your washing machine prior to ozone installation?	**1** Very Quiet	**2**	**3** Noticeable, but not intrusive	**4**	**5** Very Loud
Additional comments:					
5. Did your washing machine have an unwanted odor prior to ozone installation?	**1** No Odor	**2**	**3** Light odor	**4**	**5** Strong Odor
Additional comments:					

Part II. Experience with the Ozone System for Laundry

On a scale of 1 to 5, please indicate how the ozone laundry system performed as compared to your original laundry system in the following categories:

6. The ozone system cleaned my clothes: Comments:	**1** Much Worse	**2**	**3** Just as well	**4**	**5** Much Better
7. Clothes washed with the ozone system felt (softer, similar or rougher): Comments:	**1** Rougher	**2**	**3** Similar	**4**	**5** Softer
8. The time it took the wash cycle to complete was faster, similar or longer with the ozone system: Comments:	**1** Longer	**2**	**3** Similar	**4**	**5** Faster
9. Clothes smelled better, similar or worse when cleaned with the ozone system: Comments:	**1** Worse	**2**	**3** Similar	**4**	**5** Better
10. How much noise did the washing cycle with the ozone system make when compared to your original laundry system? Comments:	**1** Quieter	**2**	**3** Similar	**4**	**5** Louder

11. After the ozone system was installed, did you continue to use stain remover? Yes

    a. If so, did you notice any difference in the performance of your stain remover? Please explain. No. It seems to be working the same as before.

12. After the ozone system was installed, did you continue to use detergent? No

    a. If so, why did you choose to continue to use detergent?

13. Did you use only cold water cycles with your ozone? No

    a. If not, why did you choose to use warm or hot settings? I prefer to still use warm with towels and sometimes if the load is all undergarments. It's a mindset

b. What percentage of the time did you use cycles other than cold? 40%

14. Would you like to keep your ozone system at no cost to you or would you like it removed? Keep It

15. Would you recommend an ozone system to others? Why? Yes.

16. Given your experience, would you be willing to recommend that another customer pay the retail price of $250 for an ozone laundry system? I have not had it long enough to determine if I'm saving $250 in detergent, as I was buying detergent in bulk at half the cost that would last me over two years. If it doesn't conk out on us after a couple of years, then I'd recommend it.

17. Were any problems or issues encountered with the ozone system or your washer during the field trial? If yes, please provide details. Yes. The tubing on the back of the washer was not tightened properly and caused water to leak. By the time we noticed it and determined the cause, it had damaged the baseboard and soaked the carpet padding underneath the hallway carpet. The replacement of the padding and baseboard was around $250. Your technician also came out to fix the connection/replace tubing.

18. Did the performance of the ozone system change throughout the field demo? If so, please provide additional details on how the performance changed throughout the test. Yes, there was a break in period. After my first few loads, I noticed nothing looked or smelled clean. I had to rewash everything multiple times for about the first 5 or 6 loads. After this the machine seemed to function very well.

19. Did you receive any additional unexpected benefits from the ozone system that were not noted above? I do not believe so.

20. Do you have any other feedback on the ozone system? No.

Thank you for your participation in the Peoples and North Shore Gas Emerging Technology Program's pilot of the residential ozone system for laundry. In addition to the important data we've been collecting about energy use of the system, we'd like to hear from you about your experience. A first-hand account of your impressions and opinions will provide us with extremely valuable information about how individuals and families may respond to this technology.

Part I. Your Original Laundry System

Before you began using the ozone system…

1. What laundry detergent brand(s) did you most often use? **Costco's Kirkland Brand or Tide**

2. Did you use fabric softener? If so, which brands did you most often use? **Costco's Kirkland Brand and/or bounce sheets.**

3. Did you use stain remover? If so, which brands did you most often use? **OXY**

Please respond to the below questions on a scale of 1 to 5.

4. What was the average noise level of your washing machine prior to ozone installation?	**1** Very Quiet	**2**	**3** Noticeable, but not intrusive	**4**	**5** Very Loud
Additional comments:					
5. Did your washing machine have an unwanted odor prior to ozone installation?	**1** No Odor	**2**	**3** Light odor	**4**	**5** Strong Odor
Additional comments:					

Part II. Experience with the Ozone System for Laundry

On a scale of 1 to 5, please indicate how the ozone laundry system performed as compared to your original laundry system in the following categories:

6. The ozone system cleaned my clothes: Comments:	**1** Much Worse	**2**	**3** Just as well	**4**	**5** Much Better
7. Clothes washed with the ozone system felt (softer, similar or rougher): Comments:	**1** Rougher	**2**	**3** Similar	**4**	**5** Softer
8. The time it took the wash cycle to complete was faster, similar or longer with the ozone system: Comments:	**1** Longer	**2**	**3** Similar	**4**	**5** Faster
9. Clothes smelled better, similar or worse when cleaned with the ozone system: Comments:	**1** Worse	**2**	**3** Similar	**4**	**5** Better
10. How much noise did the washing cycle with the ozone system make when compared to your original laundry system? Comments:	**1** Quieter	**2**	**3** Similar	**4**	**5** Louder

11. After the ozone system was installed, did you continue to use stain remover? **At the beginning I did not, however, I felt that without the stain remover, the hard spots were not coming off so I started using the spray oxy on stains.**

    a. If so, did you notice any difference in the performance of your stain remover? Please explain. **The stain remover worked for the most part on tough stains.**

12. After the ozone system was installed, did you continue to use detergent? **No… I definitely tried to stick with not using detergent… have saved lots of money.**

    a. If so, why did you choose to continue to use detergent? **Only use detergent on those loads that required much heavier duty wash with stains.**

13. Did you use only cold water cycles with your ozone? **yes**
    a. If not, why did you choose to use warm or hot settings?

    b. What percentage of the time did you use cycles other than cold? **0%**

14. Would you like to keep your ozone system at no cost to you or would you like it removed? **I WOULD LIKE TO KEEP IT.. SUCH A MONEY SAVER AND I HAVE TO DO ANYTHING OTHER THAN START THE MACHINE AS I WOULD NORMALLY.**
15. Would you recommend an ozone system to others? Why? **Definitely, #1 for the savings… at the beginning, it was tough to think that I could wash without using laundry detergent. That was probably the hardest part of the transition, but as I continued to use the washer without detergent, it only got better and better for me. The savings on detergent was amazing and now It will be difficult to go back to not having this little gadget.**

16. Given your experience, would you be willing to recommend that another customer pay the retail price of $250 for an ozone laundry system? **I definitely would but would have to explain the savings in not only in gas but not having to buy detergent vs. the cost of the laundry system.**

17. Were any problems or issues encountered with the ozone system or your washer during the field trial? If yes, please provide details. **None at all.**

18. Did the performance of the ozone system change throughout the field demo? If so, please provide additional details on how the performance changed throughout the test. **I think perception of the performance changed for me…. Not the performance itself. It is so worth it.**

19. Did you receive any additional unexpected benefits from the ozone system that were not noted above? **Just a larger cost savings on the detergent portion.**

20. Do you have any other feedback on the ozone system? **No**

Thank you for your participation in the Peoples and North Shore Gas Emerging Technology Program's pilot of the residential ozone system for laundry. In addition to the important data we've been collecting about energy use of the system, we'd like to hear from you about your experience. A first-hand account of your impressions and opinions will provide us with extremely valuable information about how individuals and families may respond to this technology.

Part I. Your Original Laundry System

Before you began using the ozone system…

1. What laundry detergent brand(s) did you most often use? **Gain Power Pack**

2. Did you use fabric softener? If so, which brands did you most often use? **Suaritel**

3. Did you use stain remover? If so, which brands did you most often use? **Resolve Pretreat**

Please respond to the below questions on a scale of 1 to 5.

4. What was the average noise level of your washing machine prior to ozone installation?	**1** Very Quiet	**2**	**3** Noticeable, but not intrusive	**4**	**5** Very Loud
Additional comments:					
5. Did your washing machine have an unwanted odor prior to ozone installation?	**1** No Odor	**2**	**3** Light odor	**4**	**5** Strong Odor
Additional comments:					

Part II. Experience with the Ozone System for Laundry

On a scale of 1 to 5, please indicate how the ozone laundry system performed as compared to your original laundry system in the following categories:

6. The ozone system cleaned my clothes: Comments:	**1** Much Worse	**2**	**3** Just as well	**4**	**5** Much Better
7. Clothes washed with the ozone system felt (softer, similar or rougher): Comments:	**1** Rougher	**2**	**3** Similar	**4**	**5** Softer
8. The time it took the wash cycle to complete was faster, similar or longer with the ozone system: Comments:	**1** Longer	**2**	**3** Similar	**4**	**5** Faster
9. Clothes smelled better, similar or worse when cleaned with the ozone system: Comments: I also use baking soda in washer!	**1** Worse	**2**	**3** Similar	**4**	**5** Better
10. How much noise did the washing cycle with the ozone system make when compared to your original laundry system? Comments:	**1** Quieter	**2**	**3** Similar	**4**	**5** Louder

11. After the ozone system was installed, did you continue to use stain remover? **Sometimes when necessary. My work clothes sometimes would need stain remover.**

    a. If so, did you notice any difference in the performance of your stain remover? Please explain. **Yes! All the stains were removed from my clothes.**

12. After the ozone system was installed, did you continue to use detergent? **Yes, not as much**

    a. If so, why did you choose to continue to use detergent? **Because that's what I was used to doing, and also for the smell of the freshness**

13. Did you use only cold water cycles with your ozone? **yes**
    a. If not, why did you choose to use warm or hot settings?

b. What percentage of the time did you use cycles other than cold? **N/A**

14. Would you like to keep your ozone system at no cost to you or would you like it removed? **We are going to keep the ozone system.**

15. Would you recommend an ozone system to others? Why? **Yes! My clothes are softer, I've used less soap.**

16. Given your experience, would you be willing to recommend that another customer pay the retail price of $250 for an ozone laundry system? **Yes!**

17. Were any problems or issues encountered with the ozone system or your washer during the field trial? If yes, please provide details. **No problems at all.**

18. Did the performance of the ozone system change throughout the field demo? If so, please provide additional details on how the performance changed throughout the test. **No. All worked well.**

19. Did you receive any additional unexpected benefits from the ozone system that were not noted above? **NA**

20. Do you have any other feedback on the ozone system? **It did well, love the system and just hope it will continue to work well for me.**

Thank you for your participation in the Peoples and North Shore Gas Emerging Technology Program's pilot of the residential ozone system for laundry. In addition to the important data we've been collecting about energy use of the system, we'd like to hear from you about your experience. A first-hand account of your impressions and opinions will provide us with extremely valuable information about how individuals and families may respond to this technology.

Part I. Your Original Laundry System

Before you began using the ozone system…

1. What laundry detergent brand(s) did you most often use? **Tide Pods**

2. Did you use fabric softener? If so, which brands did you most often use? **Bounce Sheets for Dryer**

3. Did you use stain remover? If so, which brands did you most often use? **No**

Please respond to the below questions on a scale of 1 to 5.

4. What was the average noise level of your washing machine prior to ozone installation?	**1** Very Quiet	**2**	**3** Noticeable, but not intrusive	**4**	**5** Very Loud
Additional comments:					
5. Did your washing machine have an unwanted odor prior to ozone installation?	**1** No Odor	**2**	**3** Light odor	**4**	**5** Strong Odor
Additional comments:					

Part II. Experience with the Ozone System for Laundry

On a scale of 1 to 5, please indicate how the ozone laundry system performed as compared to your original laundry system in the following categories:

6. The ozone system cleaned my clothes: Comments:	**1** Much Worse	**2**	**3** Just as well	**4**	**5** Much Better
7. Clothes washed with the ozone system felt (softer, similar or rougher): Comments:	**1** Rougher	**2**	**3** Similar	**4**	**5** Softer
8. The time it took the wash cycle to complete was faster, similar or longer with the ozone system: Comments:	**1** Longer	**2**	**3** Similar	**4**	**5** Faster
9. Clothes smelled better, similar or worse when cleaned with the ozone system: Comments:	**1** Worse	**2**	**3** Similar	**4**	**5** Better
10. How much noise did the washing cycle with the ozone system make when compared to your original laundry system? Comments:	**1** Quieter	**2**	**3** Similar	**4**	**5** Louder

11. After the ozone system was installed, did you continue to use stain remover? **Never use stain remover.**

    a. If so, did you notice any difference in the performance of your stain remover? Please explain.

12. After the ozone system was installed, did you continue to use detergent? **Sometimes**

    a. If so, why did you choose to continue to use detergent? **Habit, and not use to not using detergent.**

13. Did you use only cold water cycles with your ozone? **yes**
    a. If not, why did you choose to use warm or hot settings?

    b. What percentage of the time did you use cycles other than cold? **0**

14. Would you like to keep your ozone system at no cost to you or would you like it removed? **I like to keep it.**

15. Would you recommend an ozone system to others? Why? **Possibly, because it can save money not having to buy detergent and it gets the job done.**

16. Given your experience, would you be willing to recommend that another customer pay the retail price of $250 for an ozone laundry system? **Yes**

17. Were any problems or issues encountered with the ozone system or your washer during the field trial? If yes, please provide details. **No**

18. Did the performance of the ozone system change throughout the field demo? If so, please provide additional details on how the performance changed throughout the test. **No**

19. Did you receive any additional unexpected benefits from the ozone system that were not noted above? **Not that I'm aware of.**

20. Do you have any other feedback on the ozone system? **No.**

Thank you for your participation in the Peoples and North Shore Gas Emerging Technology Program's pilot of the residential ozone system for laundry. In addition to the important data we've been collecting about energy use of the system, we'd like to hear from you about your experience. A first-hand account of your impressions and opinions will provide us with extremely valuable information about how individuals and families may respond to this technology.

Part I. Your Original Laundry System

Before you began using the ozone system…

1. What laundry detergent brand(s) did you most often use? Tide

2. Did you use fabric softener? If so, which brands did you most often use? Gains

3. Did you use stain remover? If so, which brands did you most often use? No

Please respond to the below questions on a scale of 1 to 5.

4. What was the average noise level of your washing machine prior to ozone installation?	**1** Very Quiet	**2**	**3** Noticeable, but not intrusive	**4**	**5** Very Loud
Additional comments:					
5. Did your washing machine have an unwanted odor prior to ozone installation?	**1** No Odor	**2**	**3** Light odor	**4**	**5** Strong Odor
Additional comments:					

Part II. Experience with the Ozone System for Laundry

On a scale of 1 to 5, please indicate how the ozone laundry system performed as compared to your original laundry system in the following categories:

6. The ozone system cleaned my clothes: Comments:	**1** Much Worse	**2**	**3** Just as well	**4**	**5** Much Better
7. Clothes washed with the ozone system felt (softer, similar or rougher): Comments:	**1** Rougher	**2**	**3** Similar	**4**	**5** Softer
8. The time it took the wash cycle to complete was faster, similar or longer with the ozone system: Comments:	**1** Longer	**2**	**3** Similar	**4**	**5** Faster
9. Clothes smelled better, similar or worse when cleaned with the ozone system: Comments:	**1** Worse	**2**	**3** Similar	**4**	**5** Better
10. How much noise did the washing cycle with the ozone system make when compared to your original laundry system? Comments:	**1** Quieter	**2**	**3** Similar	**4**	**5** Louder

11. After the ozone system was installed, did you continue to use stain remover? no

    a. If so, did you notice any difference in the performance of your stain remover? Please explain.

12. After the ozone system was installed, did you continue to use detergent? yes

    a. If so, why did you choose to continue to use detergent?

I used detergent during the test. I don't feel my clothes are clean without the detergent. The men in the family work outside and around oil.

13. Did you use only cold water cycles with your ozone? yes
    a. If not, why did you choose to use warm or hot settings?

b. What percentage of the time did you use cycles other than cold?

14. Would you like to keep your ozone system at no cost to you or would you like it removed? Keep it

15. Would you recommend an ozone system to others? Why? Yes, the clothes are softer and look much better.

16. Given your experience, would you be willing to recommend that another customer pay the retail price of $250 for an ozone laundry system? yes

17. Were any problems or issues encountered with the ozone system or your washer during the field trial? If yes, please provide details. no

18. Did the performance of the ozone system change throughout the field demo? If so, please provide additional details on how the performance changed throughout the test. no

19. Did you receive any additional unexpected benefits from the ozone system that were not noted above? Yes, the kids did their own washing, just to see how the system worked.

20. Do you have any other feedback on the ozone system? I really like your staff and the attitude of the installer, per my husband.

Thank you for your participation in the Peoples Gas Emerging Technology Program's pilot of the residential ozone laundry system. In addition to the important data we've been collecting about energy use of the system, we'd like to hear from you about your experience. A first-hand account of your impressions and opinions will provide us with extremely valuable information about how individuals and families may respond to this technology.

Part I. Your Original Laundry System

Please respond to the below questions on a scale of 1 to 5.

1. What was the average noise level of your washing machines prior to ozone installation?	**1** Very Quiet	**2**	**3** Noticeable, but not intrusive	**4**	**5** Very Loud
Additional comments: No Complaints on Noise					
2. Did your washing machines have an unwanted odor prior to ozone installation?	**1** No Odor	**2**	**3** Light odor	**4**	**5** Strong Odor
Additional comments:					

Part II. Experience with the Ozone Laundry System

On a scale of 1 to 5, please indicate how the ozone laundry system performed as compared to your original laundry system in the following categories:

3. The time it took the wash cycle to complete was faster, similar, or longer with the ozone system: Comments: As building manager I don't do my laundry here, so I can't give feedback on this	**1** Longer	**2**	**3** Similar	**4**	**5** Faster
4. How much noise did the washing cycle with the ozone system make when compared to your original laundry system? Comments:	**1** Quieter	**2**	**3** Similar	**4**	**5** Louder

5. Did you receive complaints from your tenants about the ozone system? No.

    a. If so, what was the nature of the complaints?

    b. Were the issues easily resolved?

6. Did you receive positive comments from your tenants about the ozone system? Yes.

    a. If so, what comments were received?

Just a couple of people gave positive comments in passing. One Woman said "I Love it."

7. Would you like to keep your ozone systems at no cost to you or would you like them removed?

Yes, would like to keep the systems.

8. Would you recommend an ozone system to others? Why?

Sure, since it worked out well.

9. Given your experience, would you be willing to recommend that another property manager or owner pay the retail price of $250 for an ozone laundry system?

    Recommending something for free is easy, but when asking someone to pay that much it's more difficult because you have to explain the system well and how it works.

10. Were any problems or issues encountered with the ozone system or your washer during the field trial? If yes, please provide details.

One. Technician from GTI came and was doing some maintenance, and forgot to reconnect the equipment. That caused an issue when tenants tried to use the washers.

11. Did you notice if one ozone system and washer performed better than another?

No. Didn't notice that.

    a. If Yes, which system performed better and in what way did it work better?

12. Did the performance of the ozone system change throughout the field demo? If so, please provide additional details on how the performance changed throughout the test.

No. Didn't notice that.

13. Did you or your tenants receive any additional unexpected benefits from the ozone system that were not noted above?

Don't need soap, not as much waste.

14. Do you have any other feedback on the ozone system?

Some people still used soap, even though it's not needed. Either they don't believe it's not necessary, or still don't understand that it's not needed, even with signage.

Thank you for your participation in the Peoples Gas Emerging Technology Program's pilot of the residential ozone laundry system. In addition to the important data we've been collecting about energy use of the system, we'd like to hear from you about your experience. A first-hand account of your impressions and opinions will provide us with extremely valuable information about how individuals and families may respond to this technology.

Please list your building address: _____Peoples-ROMF-3_____

Part I. Your Original Laundry System

Before you began using the ozone system…

1. What laundry detergent brand(s) did you most often use?

Whole Foods Organic

2. Did you use fabric softener? If so, which brands did you most often use?

No

3. Did you use stain remover? If so, which brands did you most often use?

No

Please respond to the below questions on a scale of 1 to 5.

4. What was the average noise level of your washing machine prior to ozone installation?	**1** Very Quiet	**2**	**3** Noticeable, but not intrusive	**4**	**5** Very Loud
Additional comments:					
5. Did your washing machine have an unwanted odor prior to ozone installation?	**1** No Odor	**2**	**3** Light odor	**4**	**5** Strong Odor
Additional comments:					

Part II. Experience with the Ozone Laundry System

On a scale of 1 to 5, please indicate how the ozone laundry system performed in comparison to your original laundry system in the following categories:

6. The ozone system cleaned my clothes: Comments:	**1** Much Worse	**2**	**3** Just as well	**4**	**5** Much Better
7. Clothes washed with the ozone system felt (softer, similar or rougher): Comments:	**1** Rougher	**2**	**3** Similar	**4**	**5** Softer
8. The time it took the wash cycle to complete was faster, similar, or longer with the ozone system: Comments: Approximately 10 minutes longer	**1** Longer	**2**	**3** Similar	**4**	**5** Faster
9. Clothes smelled better, similar, or worse when cleaned with the ozone system: Comments: Strange odor, which I have been complaining about to janitor	**1** Worse	**2**	**3** Similar	**4**	**5** Better
10. How much noise did the washing cycle with the Ozone System make when compared to your original laundry system? Comments: Quite Loud during spin cycle, shakes violently	**1** Quieter	**2**	**3** Similar	**4**	**5** Louder

11. After the ozone system was installed, did you continue to use stain remover?
N/A

    a. If so, did you notice any difference in the performance of your stain remover? Please explain.

12. After the ozone system was installed, did you continue to use detergent?
Yes, after first trying without.

    a. If so, why did you choose to continue to use detergent?
    Because clothes did not smell clean without it. They still have the odor even with detergent.

13. Before the ozone system installation did you use primarily hot cycles, warm cycles or cold cycles?
    a. % Hot cycles___100_____ % Warm cycles _____ % Cold cycles_____

14. Were you okay with the ozone system only using cold water cycles?
No.

a. If not, why would you prefer to use warm or hot settings?

Hot, because this is a city and you never know when bed bugs/larvae may be present. Only hot water kills them.

15. Would you like your building to keep your ozone system, or would you like it removed?

Remove Please

16. Would you recommend an ozone system to others? Why?

Obviously not.

17. Were any problems or issues encountered with the ozone system or your washer during the field trial? If yes, please provide details.

Yes, see above questions

18. Did the performance of the ozone system change throughout the field demo? If so, please provide additional details on how the performance changed throughout the test.

No.

19. Did you notice if one ozone system and washer performed better than another?

a. If Yes, which system performed better and in what way did it work better?

N/A

20. Did you receive any additional unexpected benefits from the ozone system that were not noted above?

No.

21. Do you have any other feedback on the ozone system?

No, other than to work on hot water / odor issues.

Thank you for your participation in the Peoples Gas Emerging Technology Program's pilot of the residential ozone laundry system. In addition to the important data we've been collecting about energy use of the system, we'd like to hear from you about your experience. A first-hand account of your impressions and opinions will provide us with extremely valuable information about how individuals and families may respond to this technology.

Please list your building address: _____Peoples-ROMF-2_____

Part I. Your Original Laundry System

Before you began using the ozone system…

1. What laundry detergent brand(s) did you most often use?

Tide or Cheer

2. Did you use fabric softener? If so, which brands did you most often use?

Yes, Downy

3. Did you use stain remover? If so, which brands did you most often use?

No

Please respond to the below questions on a scale of 1 to 5.

4. What was the average noise level of your washing machine prior to ozone installation?	**1** Very Quiet	**2**	**3** Noticeable, but not intrusive	**4**	**5** Very Loud
Additional comments:					
5. Did your washing machine have an unwanted odor prior to ozone installation?	**1** No Odor	**2**	**3** Light odor	**4**	**5** Strong Odor
Additional comments:					

Part II. Experience with the Ozone Laundry System

On a scale of 1 to 5, please indicate how the ozone laundry system performed in comparison to your original laundry system in the following categories:

6. The ozone system cleaned my clothes: Comments:	**1** Much Worse	**2**	**3** Just as well	**4**	**5** Much Better
7. Clothes washed with the ozone system felt (softer, similar or rougher): Comments:	**1** Rougher	**2**	**3** Similar	**4**	**5** Softer
8. The time it took the wash cycle to complete was faster, similar, or longer with the ozone system: Comments: Loading of the water	**1** Longer	**2**	**3** Similar	**4**	**5** Faster
9. Clothes smelled better, similar, or worse when cleaned with the ozone system: Comments:	**1** Worse	**2**	**3** Similar	**4**	**5** Better
10. How much noise did the washing cycle with the Ozone System make when compared to your original laundry system? Comments:	**1** Quieter	**2**	**3** Similar	**4**	**5** Louder

11. After the ozone system was installed, did you continue to use stain remover?

No

a. If so, did you notice any difference in the performance of your stain remover? Please explain.

12. After the ozone system was installed, did you continue to use detergent?

Sometimes

a. If so, why did you choose to continue to use detergent?

I like to see the soap

13. Before the ozone system installation did you use primarily hot cycles, warm cycles or cold cycles?

a. % Hot cycles_____ % Warm cycles ____50%____ % Cold cycles___50____

14. Were you okay with the ozone system only using cold water cycles?

No!!

a. If not, why would you prefer to use warm or hot settings?

White Clothes

15. Would you like your building to keep your ozone system, or would you like it removed?

It doesn't matter

16. Would you recommend an ozone system to others? Why?

Not really. I need to know if it's truly cost effective.

17. Were any problems or issues encountered with the ozone system or your washer during the field trial? If yes, please provide details.

Not to my knowledge.

18. Did the performance of the ozone system change throughout the field demo? If so, please provide additional details on how the performance changed throughout the test.

I think it sometimes ran out of detergent.

19. Did you notice if one ozone system and washer performed better than another?

a. If Yes, which system performed better and in what way did it work better?

No, not really.

20. Did you receive any additional unexpected benefits from the ozone system that were not noted above?

None

21. Do you have any other feedback on the ozone system?

Think about the use of bleach!!

Thank you for your participation in the Peoples Gas Emerging Technology Program's pilot of the residential ozone laundry system. In addition to the important data we've been collecting about energy use of the system, we'd like to hear from you about your experience. A first-hand account of your impressions and opinions will provide us with extremely valuable information about how individuals and families may respond to this technology.

Please list your building address: _____Peoples-ROMF-1_____

Part I. Your Original Laundry System

Before you began using the ozone system…

1. What laundry detergent brand(s) did you most often use?

Tide

2. Did you use fabric softener? If so, which brands did you most often use?

Kirkland

3. Did you use stain remover? If so, which brands did you most often use?

No

Please respond to the below questions on a scale of 1 to 5.

4. What was the average noise level of your washing machine prior to ozone installation?	**1** Very Quiet	**2**	**3** Noticeable, but not intrusive	**4**	**5** Very Loud
Additional comments:					
5. Did your washing machine have an unwanted odor prior to ozone installation?	**1** No Odor	**2**	**3** Light odor	**4**	**5** Strong Odor
Additional comments:					

Part II. Experience with the Ozone Laundry System

On a scale of 1 to 5, please indicate how the ozone laundry system performed in comparison to your original laundry system in the following categories:

6. The ozone system cleaned my clothes: Comments:	**1** Much Worse	**2**	**3** Just as well	**4**	**5** Much Better
7. Clothes washed with the ozone system felt (softer, similar or rougher): Comments:	**1** Rougher	**2**	**3** Similar	**4**	**5** Softer
8. The time it took the wash cycle to complete was faster, similar, or longer with the ozone system: Comments:	**1** Longer	**2**	**3** Similar	**4**	**5** Faster
9. Clothes smelled better, similar, or worse when cleaned with the ozone system: Comments:	**1** Worse	**2**	**3** Similar	**4**	**5** Better
10. How much noise did the washing cycle with the Ozone System make when compared to your original laundry system? Comments:	**1** Quieter	**2**	**3** Similar	**4**	**5** Louder

11. After the ozone system was installed, did you continue to use stain remover?

No

a. If so, did you notice any difference in the performance of your stain remover? Please explain.

12. After the ozone system was installed, did you continue to use detergent?

No

a. If so, why did you choose to continue to use detergent?

13. Before the ozone system installation did you use primarily hot cycles, warm cycles or cold cycles?

a. % Hot cycles___50_____ % Warm cycles _____ % Cold cycles___50____

14. Were you okay with the ozone system only using cold water cycles?

Yes

a. If not, why would you prefer to use warm or hot settings?

15. Would you like your building to keep your ozone system, or would you like it removed?

Keep

16. Would you recommend an ozone system to others? Why?

Yes. Dollar Savings

17. Were any problems or issues encountered with the ozone system or your washer during the field trial? If yes, please provide details.

No

18. Did the performance of the ozone system change throughout the field demo? If so, please provide additional details on how the performance changed throughout the test.

No.

19. Did you notice if one ozone system and washer performed better than another?

a. If Yes, which system performed better and in what way did it work better?

No

20. Did you receive any additional unexpected benefits from the ozone system that were not noted above?

Not Really

21. Do you have any other feedback on the ozone system?

No.

Thank you for your participation in the Peoples Gas Emerging Technology Program's pilot of the residential ozone laundry system. In addition to the important data we've been collecting about energy use of the system, we'd like to hear from you about your experience. A first-hand account of your impressions and opinions will provide us with extremely valuable information about how individuals and families may respond to this technology.

Please list your building address: _____Peoples-ROMF-1_____

Part I. Your Original Laundry System

Before you began using the ozone system…

1. What laundry detergent brand(s) did you most often use?

Tide

2. Did you use fabric softener? If so, which brands did you most often use?

Yes. Bounce.

3. Did you use stain remover? If so, which brands did you most often use?

No

Please respond to the below questions on a scale of 1 to 5.

4. What was the average noise level of your washing machine prior to ozone installation?	**1** Very Quiet	**2**	**3** Noticeable, but not intrusive	**4**	**5** Very Loud
Additional comments:					
5. Did your washing machine have an unwanted odor prior to ozone installation?	**1** No Odor	**2**	**3** Light odor	**4**	**5** Strong Odor
Additional comments:					

Part II. Experience with the Ozone Laundry System

On a scale of 1 to 5, please indicate how the ozone laundry system performed in comparison to your original laundry system in the following categories:

6. The ozone system cleaned my clothes: Comments:	**1** Much Worse	**2**	**3** Just as well	**4**	**5** Much Better
7. Clothes washed with the ozone system felt (softer, similar or rougher): Comments:	**1** Rougher	**2**	**3** Similar	**4**	**5** Softer
8. The time it took the wash cycle to complete was faster, similar, or longer with the ozone system: Comments:	**1** Longer	**2**	**3** Similar	**4**	**5** Faster
9. Clothes smelled better, similar, or worse when cleaned with the ozone system: Comments:	**1** Worse	**2**	**3** Similar	**4**	**5** Better
10. How much noise did the washing cycle with the Ozone System make when compared to your original laundry system? Comments:	**1** Quieter	**2**	**3** Similar	**4**	**5** Louder

11. After the ozone system was installed, did you continue to use stain remover?

No

a. If so, did you notice any difference in the performance of your stain remover? Please explain.

12. After the ozone system was installed, did you continue to use detergent?

No

a. If so, why did you choose to continue to use detergent?

13. Before the ozone system installation did you use primarily hot cycles, warm cycles or cold cycles?

a. % Hot cycles___33_____ % Warm cycles _____ % Cold cycles__66____

14. Were you okay with the ozone system only using cold water cycles?

Yes

a. If not, why would you prefer to use warm or hot settings?

15. Would you like your building to keep your ozone system, or would you like it removed?

Keep the system

16. Would you recommend an ozone system to others? Why?

Yes. It's much more convenient to not need detergent plus energy savings.

17. Were any problems or issues encountered with the ozone system or your washer during the field trial? If yes, please provide details.

Once system was disconnected – technician forgot to reconnect after servicing.

18. Did the performance of the ozone system change throughout the field demo? If so, please provide additional details on how the performance changed throughout the test.

No.

19. Did you notice if one ozone system and washer performed better than another?

Didn't notice

a. If Yes, which system performed better and in what way did it work better?

20. Did you receive any additional unexpected benefits from the ozone system that were not noted above?

Less wasted plastic detergent bottles.

21. Do you have any other feedback on the ozone system?

No.

Thank you for your participation in the Peoples Gas Emerging Technology Program's pilot of the residential ozone laundry system. In addition to the important data we've been collecting about energy use of the system, we'd like to hear from you about your experience. A first-hand account of your impressions and opinions will provide us with extremely valuable information about how individuals and families may respond to this technology.

Please list your building address: _____Peoples-ROMF-1_____

Part I. Your Original Laundry System

Before you began using the ozone system…

1. What laundry detergent brand(s) did you most often use?

Whatever was on sale & fragrance free

2. Did you use fabric softener? If so, which brands did you most often use?

No.

3. Did you use stain remover? If so, which brands did you most often use?

Stain Stick or Spray & Wash

Please respond to the below questions on a scale of 1 to 5.

4. What was the average noise level of your washing machine prior to ozone installation?	**1** Very Quiet	**2**	**3** Noticeable, but not intrusive	**4**	**5** Very Loud
Additional comments:					
5. Did your washing machine have an unwanted odor prior to ozone installation?	**1** No Odor	**2**	**3** Light odor	**4**	**5** Strong Odor
Additional comments:					

Part II. Experience with the Ozone Laundry System

On a scale of 1 to 5, please indicate how the ozone laundry system performed in comparison to your original laundry system in the following categories:

6. The ozone system cleaned my clothes: Comments:	**1** Much Much Worse Better	**2**	**3** Just as well	**4**	**5**
7. Clothes washed with the ozone system felt (softer, similar or rougher): Comments:	**1** Rougher Softer	**2**	**3** Similar	**4**	**5**
8. The time it took the wash cycle to complete was faster, similar, or longer with the ozone system: Comments: Slightly longer but no longer than a dryer cycle, so not a problem	**1** Longer Faster	**2**	**3** Similar	**4**	**5**
9. Clothes smelled better, similar, or worse when cleaned with the ozone system: Comments:	**1** Worse Better	**2**	**3** Similar	**4**	**5**
10. How much noise did the washing cycle with the Ozone System make when compared to your original laundry system? Comments:	**1** Quieter Louder	**2**	**3** Similar	**4**	**5**

11. After the ozone system was installed, did you continue to use stain remover?

Rarely

a. If so, did you notice any difference in the performance of your stain remover? Please explain.

No.

12. After the ozone system was installed, did you continue to use detergent?

Yes

a. If so, why did you choose to continue to use detergent?

Was apprehensive and when I realized it worked better without additional detergent I ceased using it.

13. Before the ozone system installation did you use primarily hot cycles, warm cycles or cold cycles?

a. % Hot cycles___25_____ % Warm cycles _____ % Cold cycles__75____

14. Were you okay with the ozone system only using cold water cycles?

Eventually.

a. If not, why would you prefer to use warm or hot settings?

I would prefer it sometimes for white items and towels.

15. Would you like your building to keep your ozone system, or would you like it removed?

I would like the ozone system to remain.

16. Would you recommend an ozone system to others? Why?

Sure. You save money on detergent and laundry seems to be cleaned just as effectively. Also it must have a slight fabric softener element?

17. Were any problems or issues encountered with the ozone system or your washer during the field trial? If yes, please provide details.

Only issue was a result of my reluctance to withdraw the use of my own detergent, but the fault was mine.

18. Did the performance of the ozone system change throughout the field demo? If so, please provide additional details on how the performance changed throughout the test.

Not that I noticed.

19. Did you notice if one ozone system and washer performed better than another?

Not that I noticed.

a. If Yes, which system performed better and in what way did it work better?

20. Did you receive any additional unexpected benefits from the ozone system that were not noted above?

No

21. Do you have any other feedback on the ozone system?

I like it, please keep it.

END OF REPORT