Applied Public Policy Research
APPRISE
Institute for Study and Evaluation

MEMO

DATE: April 8, 2016

TO: Participating Utility Managers

FROM: APPRISE

SUBJECT: Smart Thermostat Survey Findings

APPRISE conducted a survey with customers of two natural gas companies in the northeast to assess interest and potential use of smart thermostat technology. This memo provides a description of the research and a summary of the findings.

I. Introduction

Many utilities have added or are considering the addition of smart thermostats to their residential energy efficiency offerings. ACEEE recently reviewed studies on energy savings from smart thermostats and found that they can save from eight to 15 percent on home heating and cooling energy usage.[1]

We expect that savings from this technology will vary by household characteristics and prior thermostat usage practices. For example, factors that may affect energy savings include the following.

- Use of less advanced programmable (but not smart) thermostats
- Current use of setback practices without a smart thermostat
- Occupants who are elderly or less technologically advanced who may not make use of the internet/smart phone capabilities

The survey was designed to develop a better understanding of which households will benefit from smart thermostats and what the opportunities for energy savings may be. The survey aimed to address the following issues.

- Do households have smart thermostats? Do they use the remote features? Are they programmed for setback when they are away from home and/or asleep?

- Do households have programmable thermostats? Are they programmed for setback when they are away from home and/or asleep?

- If the household does not have programmable thermostats, do they consistently practice manual setback?

[1] Smart Thermostat Initiatives Reveal Exciting New Horizons for Energy Efficiency Programs, October 6, 2015. http://aceee.org/blog/2015/10/smart-thermostat-initiatives-reveal

- How do individuals think they would use a smart thermostat? Would they make use of remote access and other smart functions, use it as if it were a programmable thermostat without the smart functions, or use it as though it was a manual thermostat?

APPRISE partnered with New Jersey Natural Gas (NJNG) and another natural gas utility in the northeast to address these issues. The following topics were included in the survey.

- Demographics
- Use of thermostats and current setback behavior
- Use and interest in of smart thermostat capabilities
- Previous participation and knowledge of energy efficiency programs

Key findings were as follows.

- There is great opportunity for this measure, as the penetration rate of smart thermostats was very low among these utilities' customers. Only four percent of respondents had a wi-fi connected thermostat.
- A high percentage of customers had the technology needed for a smart thermostat. The survey found that 74 percent had both wi-fi and a smart phone or tablet.
- Lower income households (annual income below $50,000) were less likely to have programmable thermostats and therefore may present the greatest opportunity for savings with smart thermostat technology. Over half of these customers had the needed technology to adopt smart thermostats.
- Households show opportunities for benefitting from smart thermostats that adjust to their usage preferences, as about half of the respondents reported that they manually adjust the thermostat at least once a week or more frequently.
- Many reported that they would make extensive use of smart thermostat features if they were available. While 19 percent said they would use remote temperature change once per day or more frequently, 18 percent said they would use it at least once a week, and nine percent said they would use it at least once per month.
- Customers were less likely to practice setback on air conditioning, so those customers with thermostats that control heating and air conditioning may save more energy from smart thermostats.
- Programs and incentives could potentially have a large impact on the adoption of smart thermostats. Those who said they considered installing a smart thermostat but did not stated that this was due to cost, the fact that it the program they participated in did not offer a smart thermostat, or they were waiting to install other upgrades.

II. Methodology

Each utility randomly selected residential customers for inclusion in the study and provide their contact information to APPRISE. APPRISE removed a small number of customers whose listed address was not in the state in which the utility was located and those that appeared to be property management companies.

APPRISE sent an advance letter to the selected sample of 800 customers from each utility, for a total of 1,600 customers, to inform them of the survey and request their participation. The advance letters were sent in two waves with the first 400 customers of each utility sent letters around January 26th and February 1st and the second wave of letters sent to the

remaining customers on February 11th and February 19th. A phone number was also provided for customers to call in and complete the survey at their convenience.

Managers from APPRISE trained staff on the survey instrument and on how to use the computerized version of the survey to record responses. Training included an explanation of smart thermostat technology, the purpose of the study, an explanation of field codes included in the survey instrument, an overview of each question, and in-depth discussion of survey questions that required special attention.

Telephone surveys were conducted from January 28, 2016 to March 21, 2016. All customers were called during the day, the evening and on the weekend. Most customers who were not reached received 13 calls over the two-month period, with an average of 4 calls each during the day, evening and weekend.

Table II-1 displays the final sample disposition. Interviews were completed with 24 percent of respondents, the response rate was 29 percent, and the cooperation rate was 48 percent.

Table II-1
Sample Disposition

Final Disposition	NJNG		NE GAS UTILITY		All	
	#	%	#	%	#	%
Complete	217	27%	168	21%	385	24%
Partially Complete, Callback and Refusals	219	27%	198	25%	417	26%
Max Call Attempts Reached	191	24%	174	22%	365	23%
Non-Working Number, Wrong Number	83	10%	151	19%	234	15%
Voicemail, No Answer, Busy	68	9%	67	8%	135	8%
Hearing or Language Barrier, Ill, Deceased, Unavailable	22	3%	28	4%	50	3%
Ineligible*	0	0%	14	2%	14	1%
Total	**800**	**100%**	**800**	**100%**	**1,600**	**100%**
Cooperation Rate	**50%**		**46%**		**48%**	
Response Rate	**30%**		**27%**		**29%**	

*Respondents were classified as ineligible if they were management companies or reported that they did not have a thermostat.

III. Survey Findings

This section provides a summary of survey findings in the following areas.

- Demographic Characteristics
- Current Thermostat Characteristics
- Thermostat Programming Behaviors
- Thermostat Setback Behaviors
- Potential Smart Thermostat Use
- Energy Efficiency Upgrades

A. Demographic Characteristics

Customers were asked several questions about demographics to obtain an understanding of how thermostat usage and smart thermostat interest relate to household characteristics.

Table III-1 displays home ownership characteristics. The table shows that 87 percent of the NJNG customers and 71 percent of the NE Gas customers owned their homes.

Table III-1
Own or Rent Home

Do you own or rent your home?						
Own or Rent	**NJNG**		**NE GAS UTILITY**		**All**	
	#	**%**	**#**	**%**	**#**	**%**
Own	189	87%	119	71%	308	80%
Rent	26	12%	49	29%	75	19%
Don't Know	1	<1%	0	0%	1	<1%
Refused	1	<1%	0	0%	1	<1%
Total	**217**	**100%**	**168**	**100%**	**385**	**100%**

Table III-2 shows that 96 percent of the NJNG customers and 90 percent of the NE Gas customers said that their main heating fuel was natural gas.

Table III-2
Heating Fuel

What is the main fuel that you use to heat your home?						
Main Heating Fuel	**NJNG**		**NE GAS UTILITY**		**All**	
	#	**%**	**#**	**%**	**#**	**%**
Natural Gas	208	96%	152	90%	360	94%
Electricity	3	1%	6	4%	9	2%
Fuel Oil	2	1%	3	2%	5	1%
Other	0	0%	2	1%	2	1%
Don't Know	4	2%	5	3%	9	2%
Total	**217**	**100%**	**168**	**100%**	**385**	**100%**

Customers were asked how often they use a computer for work or personal use to assess their comfort with computers. Most customers said that they use the computer at least once per day. Eleven percent of NJNG customers and 32 percent of the NE Gas customers said that they used a computer less frequently than once per week, but 70 percent said that they use a computer at least once per day.

Table III-3
Computer Use

How often do you use a computer for either work or personal use? Do you use a computer multiple times per day, once a day, at least once a week or less frequently?						
Computer Use	**NJNG**		**NE GAS UTILITY**		**All**	
	#	**%**	**#**	**%**	**#**	**%**
Multiple Times a Day	137	63%	80	48%	217	56%
Once a Day	33	15%	22	13%	55	14%
At Least Once a Week	21	10%	10	6%	31	8%
Less Frequently	24	11%	53	32%	77	20%
Don't Know	1	<1%	2	1%	3	1%
Refused	1	<1%	1	1%	2	1%
Total	**217**	**100%**	**168**	**100%**	**385**	**100%**

Customers were asked whether they have wi-fi in their home and whether the own a smart phone or tablet to assess whether they have the tools to make full use of the smart thermostat. Table III-4 shows that about 80 percent reported that they had wi-fi, about 80 percent said they had a smart phone or tablet, and about 74 percent said that they had both.

Table III-4
Wi-Fi and Smart Phone Availability

Do you have a wi-fi connection in your home? Do you own a smart phone or a tablet?									
	NJNG	**NE GAS UTILITY**	**All**	**NJNG**	**NE GAS UTILITY**	**All**	**NJNG**	**NE GAS UTILITY**	**All**
Number of Respondents	**217**	**168**	**385**	**217**	**168**	**385**	**217**	**168**	**385**
Has Wi-Fi, Smart Phone or Tablet	**Wi-Fi**			**Smart Phone/Tablet**			**Has Both**		
	Percent of Respondents								
Yes	82%	78%	81%	80%	80%	80%	76%	73%	74%
No	15%	21%	28%	19%	20%	19%	24%	27%	26%
Don't Know	2%	2%	2%	0%	0%	0%	--	--	--
Refused	<1%	0%	<1%	1%	0%	1%	--	--	--
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Customers who have regular times when their homes are not occupied can program their thermostats to save energy, whereas customers who have irregular schedules may need a smart thermostat to make better use of setbacks. Table III-5 shows that 53 percent of NJNG customers and 63 percent of the NE Gas customers said that they were regular times during the day when no one was home and they could save energy by using less heat or air conditioning than when someone was at home. Several customers stated that they would not be able to use setback because of pets in the home at all times.

Table III-5

Home Regularly Unoccupied

Are there regular times during the day when there is no one at home and you could save energy by using less heat or air conditioning than you do when someone is home?						
Home Regularly Unoccupied	**NJNG**		**NE GAS UTILITY**		**All**	
	#	**%**	**#**	**%**	**#**	**%**
Yes	115	53%	105	63%	220	57%
No	100	46%	59	35%	159	41%
Don't Know	0	0%	4	2%	4	1%
Refused	2	1%	0	0%	2	1%
Total	**217**	**100%**	**168**	**100%**	**385**	**100%**

While 18 percent said that they did not know their income or refused to provide a range, the majority of respondents did provide income data. Table III-6 shows that nearly one quarter of the respondents reported that they had annual household income above $100,000.

Table III-6
Annual Income

What is your household annual income?						
Annual Income	**NJNG**		**NE GAS UTILITY**		**All**	
	#	**%**	**#**	**%**	**#**	**%**
≤$25,000	13	6%	56	33%	69	18%
$25,001-$50,000	29	13%	41	24%	70	18%
$50,001-$100,000	58	27%	30	18%	88	23%
$100,001-$150,000	39	18%	13	8%	52	14%
$150,001-$200,000	13	6%	2	1%	15	4%
>$200,000	15	7%	4	2%	19	5%
Don't Know	14	6%	11	7%	25	6%
Refused	36	17%	11	7%	47	12%
Total	**217**	**100%**	**168**	**100%**	**385**	**100%**

B. Current Thermostat Characteristics

This section explores the thermostat characteristics of respondents at the time of the survey. Table III-7 shows that most customers, 82 percent had only one thermostat in the home. However, 24 percent of NJNG customers and seven percent of the NE Gas utility customers reported that they had more than one thermostat.

Table III-7
Number of Thermostats in Home

How many thermostats do you have in your home?			
Number of Thermostats	**NJNG**	**NE GAS UTILITY**	**All**

How many thermostats do you have in your home?						
	#	%	#	%	#	%
1 Thermostat	163	75%	154	92%	317	82%
2 Thermostats	33	15%	8	5%	41	11%
3 Thermostats	18	8%	1	1%	19	5%
4+ Thermostats	3	1%	1	1%	4	1%
Don't Know	0	0%	4	2%	4	1%
Total	**217**	**100%**	**168**	**100%**	**385**	**100%**

Those customers who had more than one thermostat were asked to respond to the rest of the questions in the survey with respect to the thermostat that controls their main heating source.

Table III-8 shows that five percent of customers installed a new thermostat in the past year and 40 percent within the past five years. Most reported that they had their current thermostat for more than five years or that it was in the home when they moved in.

Table III-8
Age of Thermostat

How long have you had your current thermostat?						
Age of Thermostat	**NJNG**		**NE GAS UTILITY**		**All**	
	#	%	#	%	#	%
<1 Year	12	6%	7	4%	19	5%
1-5 Years	67	31%	67	40%	134	35%
6-10 Years	37	17%	23	14%	60	16%
>10 Years	29	13%	15	9%	44	11%
Already in Home	61	28%	50	30%	111	29%
Don't Know	10	5%	6	4%	16	4%
Refused	1	<1%	0	0%	1	<1%
Total	**217**	**100%**	**168**	**100%**	**385**	**100%**

While 67 percent of the NJNG customers said that they had a programmable thermostat, 42 percent of the NE Gas Utility customers stated that they had a programmable thermostat. However, only three percent said they had a remote sensor that allowed them to read and adjust the home temperature based on the temperature in a room other than where the thermostat is located.

Table III-9A
Programmable Thermostat and Remote Sensors

Do you currently have a thermostat that lets you program the temperature setting to automatically change on certain days and times, so you do not have the change the setting on the thermostat yourself? Some thermostats have a remote sensor where you can read and adjust the temperature in the home based upon the temperature in the room other than where the thermostat is. Do you have a remote sensor?						
Technology	**NJNG**		**NE GAS UTILITY**		**All**	
	#	**%**	**#**	**%**	**#**	**%**
Programmable Thermostat	146	67%	70	42%	216	56%
Remote Sensor	7	3%	5	3%	12	3%

Table III-9B displays the percent of customers who had a programmable thermostat by several household characteristics. As expected, customers who use computers more often, had wi-fi, had a smart phone or tablet, and had higher income were more likely to have a programmable thermostat. The fact that only 39 percent of households with income below $50,000 had a programmable thermostat, compared to 62 percent of those with income between $50,000 and $100,000 and 72 percent of those with income over $100,000 shows that these lower income households may have greater opportunities to achieve savings with a smart thermostat.

Table III-9B
Programmable Thermostat
By Customer Characteristics

	How Often Use Computer		**Has Wi-Fi**		**Has Smart Phone Or Tablet**		**Annual Income**		
	Once Per Day or More	**Less than Every Day**	**Yes**	**No**	**Yes**	**No**	**<$50,000**	**$50,000-$100,000**	**>$100,000**
Obs	**272**	**108**	**310**	**68**	**308**	**75**	**139**	**88**	**86**
Yes	62%	40%	61%	34%	59%	43%	39%	62%	72%
No	38%	60%	39%	66%	41%	57%	61%	38%	28%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table III-9C displays technology in the households of survey respondents, by annual household income. The table shows that households with lower annual income were less likely to use a computer at least once per day, were less likely to have wi-fi in the home, and were less likely to have a smart phone or tablet. However, the majority of the lower income customers still had these characteristics and many could potentially benefit from smart thermostat technology.

Table III-9C
Programmable Thermostat
Technology by Annual Income

Annual Income	How Often Use Computer		Has Wi-Fi		Has Smart Phone Or Tablet	
	Once Per Day or More	Less than Every Day	Yes	No	Yes	No
<$50,000	51%	49%	67%	33%	69%	31%
$50,000-$100,000	84%	16%	93%	7%	84%	16%
>$100,000	92%	8%	97%	3%	98%	2%
Total	**72%**	**28%**	**82%**	**18%**	**81%**	**19%**

Customers were asked about the features of their current thermostats that are typically considered part of smart thermostats. Only a small percent reported that they had these features. Table III-10 shows that only four percent reported that their thermostats were wi-fi connected, seven percent said that the thermostat could sense humidity and weather, and three percent said that their thermostat learns their preferences and senses occupancy.

Table III-10
Smart Thermostat Features

Does your thermostat…
- **Allow you to use a phone or computer when you are away from home to remotely change the temperature?**
- **Have the ability to sense the humidity or the outside weather and adjust the indoor temperature accordingly?**
- **Learn your preferences by sensing when you are home and remembering how and when you tend to adjust the temperature. Does your thermostat have the ability to automatically learn your preferences and adjust the indoor temperature accordingly?**

	NJNG		NE GAS UTILITY		All	
Number of Respondents	**217**		**168**		**385**	
Type of Smart Features	**#**	**%**	**#**	**%**	**#**	**%**
Wi-Fi Connected	11	5%	4	2%	15	4%
Sense Humidity and Weather	15	7%	12	7%	27	7%
Learns Preferences and Senses Occupancy	7	3%	3	2%	10	3%

Based on the responses to the previous questions, we classified 44 percent as having a manual thermostat, 51 percent as having a programmable thermostat without smart features, and five percent as having a programmable thermostat with smart features.

Table III-11
Type of Thermostat

Type of Thermostat	NJNG		NE GAS UTILITY		All	
	#	%	#	%	#	%
Manual Thermostat	71	33%	98	58%	169	44%
Programmable Thermostat Without Smart Features	134	62%	64	38%	198	51%
Programmable Thermostat With Smart Features	12	6%	6	4%	18	5%
Total	**217**	**100%**	**168**	**100%**	**385**	**100%**

Table III-12 shows that 42 percent of customers did not know the make of their current thermostat. While 39 percent said that they had a manual Honeywell thermostat, only one percent said they had a Nest and only one customer reported a Honeywell wi-fi programmable thermostat.

Table III-12
Thermostat Make and Model

What is the make and model of your current thermostat?						
Type of Thermostat	**NJNG**		**NE GAS UTILITY**		**All**	
	#	%	#	%	#	%
Honeywell, Manual	109	50%	40	24%	149	39%
Honeywell, Unspecified	7	3%	14	8%	21	5%
Carrier	5	2%	1	1%	6	2%
Lux	4	2%	2	1%	6	2%
White-Rogers	4	2%	2	1%	6	2%
Honeywell Lyric	1	<1%	3	2%	4	1%
Nest	2	1%	1	1%	3	1%
Honeywell Wi-fi Programmable	1	<1%	0	0%	1	<1%
Other	18	8%	7	4%	25	6%
Don't Know	66	30%	97	58%	163	42%
Refused	0	0%	1	1%	1	<1%
Total	**217**	**100%**	**168**	**100%**	**385**	**100%**

While 61 percent said that only one adult in the household adjusts the thermostat, 37 percent said that more than one adult adjusts the thermostat.

Table III-13
Thermostat Adjustment

Who in your household adjusts the thermostat settings and/or programming, only one adult, more than one adult, adults and children or children only?						
Adjusts Thermostat	**NJNG**		**NE GAS UTILITY**		**All**	
	#	**%**	**#**	**%**	**#**	**%**
Only One Adult	116	53%	118	70%	234	61%
More Than One Adult	97	45%	47	28%	144	37%
Adults and Children	4	2%	3	2%	7	2%
Total	**217**	**100%**	**168**	**100%**	**385**	**100%**

Table III-14 shows that 75 percent of the NJNG customers and 20 percent of the NE gas customers reported that their thermostat controls the air conditioning in the home as well as the heating.

Table III-14
Same Thermostat Controls Air Conditioning

Does this thermostat control the air conditioning in your home?						
Air Conditioning Control	**NJNG**		**NE GAS UTILITY**		**All**	
	#	**%**	**#**	**%**	**#**	**%**
Yes	163	75%	34	20%	197	51%
No	32	15%	67	40%	99	26%
Does Not Have Air Conditioning	9	4%	13	8%	22	6%
Not Asked*	13	6%	54	32%	67	17%
Total	**217**	**100%**	**168**	**100%**	**385**	**100%**

*This question was added after the survey was fielded, so 67 respondents were not asked this question.

C. Thermostat Programming Behaviors

Respondents were asked whether the thermostat came pre-programmed to automatically change temperatures at certain times of the day, either when the thermostat was purchased or when the customer moved into the current home. Table III-15 shows that 17 percent of those with a programmable thermostat said that their thermostat was pre-programmed.

Table III-15
Thermostat Was Pre-Programed

Did your thermostat come pre-programmed to automatically change temperatures at certain days and times without requiring you to put in your own settings? (Note: either when you purchased it or when you moved into your home)						
	NJNG		NE GAS UTILITY		All	
Thermostat Was Pre-Programmed	#	%	#	%	#	%
Yes	22	15%	14	20%	36	17%
No	107	73%	51	73%	158	73%
Don't Know	17	12%	5	7%	22	10%
Total	**146**	**100%**	**70**	**100%**	**216**	**100%**

Table III-16 shows that 50 percent of those with a programmable thermostat and 28 percent of all respondents stated that their thermostat is currently programmed.

Table III-16
Thermostat Currently Programmed

Is your thermostat currently programmed to change the temperature at different times of the day, for example to change to a lower heating temperature when everyone is out of the house?						
	NJNG		NE GAS UTILITY		All	
Currently Programmed	#	%	#	%	#	%
Of those with Programmable Thermostat	71	49%	37	53%	108	50%
Of All Respondents	71	33%	37	22%	108	28%

Table III-17A examines whether the thermostat is currently programmed by whether or not the customer's home is unoccupied at regular times of the day. The table shows that the percent with a programmed thermostat does not differ greatly by this factor. While 53 percent of those with a programmable thermostat who have their home unoccupied at regular times had their thermostat programmed, 47 percent with a programmable thermostat who do not have their home unoccupied at regular times had their thermostat programmed.

Table III-17A
Thermostat Currently Programmed
By House Regularly Unoccupied

Is your thermostat currently programmed to change the temperature at different times of the day, for example to change to a lower heating temperature when everyone is out of the house?						
	NJNG		NE GAS UTILITY		All	
Of Those with Programmable Thermostat	#	%	#	%		%
House Unoccupied at Regular Times	41	53%	21	51%	62	53%
House Not Unoccupied at Regular Times*	30	43%	16	55%	46	47%

Is your thermostat currently programmed to change the temperature at different times of the day, for example to change to a lower heating temperature when everyone is out of the house?						
Of All Respondents	**#**	**%**	**#**	**%**	**#**	**%**
House Unoccupied at Regular Times	41	36%	21	20%	62	28%
House Not Unoccupied at Regular Times*	30	29%	16	25%	46	29%

*Includes those who answered don't know or refuse to the question, "Are there regular times during the day when no one is home, and you could save energy by using less heat or air conditioning than you do when someone is home?"

Table III-17B displays the percent of customers who had a programmed thermostat by several household characteristics. This includes customers who did and did not have a programmable thermostat. As expected, customers who use computers more often, had wi-fi, had a smart phone or tablet, and had higher income were more likely to have a programmed thermostat.

Table III-17B
Thermostat Currently Programmed
By Customer Characteristics

	How Often Use Computer		**Has Wi-Fi**		**Has Smart Phone Or Tablet**		**Annual Income**		
	Once Per Day or More	**Less than Every Day**	**Yes**	**No**	**Yes**	**No**	**<$50,000**	**$50,000-$100,000**	**>$100,000**
Obs	272	108	310	68	308	75	139	88	86
Yes	33%	16%	33%	10%	31%	13%	17%	27%	47%
No	67%	74%	67%	90%	69%	87%	83%	73%	53%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Respondents were asked how often they program their thermostat. Table III-18 displays the responses for those customers who reported that they had a programmable thermostat that was programmed. The table shows that about one fifth of customers with a programmed thermostat re-program the thermostat four times per year, about one fifth re-program it two times per year, and about one quarter never re-program the thermostat.

Table III-18
Re-Program Thermostat Settings
For Customers with Programmed Programmable Thermostats

How often do you re-program the settings on your thermostat?						
	NJNG		**NE GAS UTILITY**		**All**	
Frequency of Re-Programming	**#**	**%**	**#**	**%**	**#**	**%**
More than Four Times per Year	3	4%	4	11%	7	6%
Seasonally / 4 Times per Year	16	23%	5	14%	21	19%
2 Times per Year	16	23%	7	19%	23	21%
Annually	2	3%	3	8%	5	5%
Every Few Years	8	11%	3	8%	11	10%
Never	19	27%	11	30%	30	28%

How often do you re-program the settings on your thermostat?						
	NJNG		NE GAS UTILITY		All	
Frequency of Re-Programming	#	%	#	%	#	%
Other	4	6%	4	11%	8	7%
Don't Know	3	4%	0	0%	3	3%
Total	**71**	**100%**	**37**	**100%**	**108**	**100%**

Table III-19 displays how often customers with programmed thermostats manually adjust the programming. The table shows that about half reported they adjust it at least once per week or more frequently. Thirty-one percent reported that they manually adjust the thermostat less than once per month.

Table III-19
Manually Adjust Programmed Thermostat Settings

How often do you manually adjust the temperature on your thermostat to temporarily change the programmed settings? Would you say you manually adjust the temperature to temporarily change the programmed settings more than once a day, once a day, at least once a week, at least once a month, or less frequently?						
Manually Adjust Settings	NJNG		NE GAS UTILITY		All	
	#	%	#	%	#	%
More Than Once a Day	2	3%	3	8%	5	5%
Once A Day	13	18%	1	3%	14	13%
At Least Once a Week	22	31%	14	38%	36	33%
At Least Once a Month	11	15%	8	22%	19	18%
Less Frequently	22	31%	11	30%	33	31%
Don't Know	1	1%	0	0%	1	1%
Refused	0	0%	0	0%	0	0%
Total	**71**	**100%**	**37**	**100%**	**108**	**100%**

D. Thermostat Setback Behaviors

This section examines setback practices used by customers with both manual and programmable thermostats. Table III-20A shows that over those customers with manual and programmed thermostats, over 60 percent turn down the heat at night or during the day when they are not at home, and over 50 percent do so with their air conditioning. Respondents with programmed thermostats were much more likely to report these behaviors.

Table III-20A
Setback Habits by Type of Thermostat

Do you adjust the …
- **heat to a cooler temperature when everyone is asleep at night in the winter? during the day if everyone is at work or school in the winter?**
- **the air conditioning to a warmer temperature when everyone is asleep at night in the summer? during the day if everyone is at work or school in the summer?**

Thermostat Type	Manual		Unprogrammed Programmable		Manual and Unprogrammed Programmable		Programmed Programmable		Total	
# with Thermostat Type	**169**		**108**		**277**		**108**		**385**	
Setback Habits	#	%	#	%	#	%	#	%	#	%
Heat Down At Night	91	54%	65	60%	156	56%	103	95%	259	67%
Heat Down During Day	90	53%	53	49%	143	52%	90	83%	233	61%
# with Thermostat Type That Also Controls Air Conditioning	**53**		**76**		**129**		**68**		**197**	
Setback Habits	#	%	#	%	#	%	#	%	#	%
A/C Up at Night	28	53%	28	37%	56	43%	47	69%	103	52%
A/C Up During Day	32	60%	30	39%	62	48%	54	79%	116	59%

Table III-20B displays the percent of customers who set back their heating and air conditioning when no one is at home and at night by several household characteristics. This includes customers who did and did not have a programmable thermostat. As expected, customers who use computers more often, had wi-fi, had a smart phone or tablet, and had higher income were more likely to set back their thermostat.

Table III-20B
Setback Habits
By Type Customer Characteristics

	How Often Use Computer		Has Wi-Fi		Has Smart Phone Or Tablet		Annual Income		
	Once Per Day or More	Less than Every Day	Yes	No	Yes	No	<$50,000	$50,000-$100,000	>$100,000
Obs	272	108	310	68	308	75	139	88	86
Heat Down At Night	72%	52%	71%	50%	70%	53%	56%	66%	77%
Heat Down During Day	69%	39%	66%	40%	65%	41%	53%	66%	72%
Obs	155	39	169	24	163	32	40	52	63
A/C Up at Night	54%	41%	54%	46%	54%	50%	45%	46%	63%
A/C Up During Day	63%	44%	62%	46%	63%	41%	48%	62%	70%

Table III-21 displays the same results only for the NJNG customers. The table shows that these customers were somewhat more likely to turn down the heat at night. The table shows that 76 percent turned down the heat at night.

Table III-21
Setback Habits by Type of Thermostat
NJNG Customers

Thermostat Type	Manual		Unprogrammed Programmable		Manual and Unprogrammed Programmable		Programmed Programmable		Total	
# with Thermostat Type	**71**		**75**		**146**		**71**		**217**	
Setback Habits	#	%	#	%	#	%	#	%	#	%
Heat Down At Night	49	69%	47	63%	96	66%	68	96%	164	76%
Heat Down During Day	42	59%	36	48%	78	53%	61	86%	139	64%
# with Thermostat Type That Also Controls Air Conditioning	**38**		**66**		**104**		**59**		**163**	
Setback Habits	#	%	#	%	#	%	#	%	#	%
A/C Up at Night	22	58%	26	39%	48	46%	41	69%	89	55%
A/C Up During Day	23	61%	27	41%	50	48%	47	80%	97	60%

Table III-22 displays the same results only for the Northeast Natural Gas Utility customers. The table shows that these customers were somewhat less likely to practice setback behavior. Most did not have air conditioning controlled by the same thermostat.

Table III-22
Setback Habits by Type of Thermostat
Northeast Natural Gas Utility Customers

Thermostat Type	Manual		Unprogrammed Programmable		Manual and Unprogrammed Programmable		Programmed Programmable		Total	
# with Thermostat Type	**98**		**33**		**131**		**37**		**168**	
Setback Habits	#	%	#	%	#	%	#	%	#	%
Heat Down At Night	42	43%	18	55%	60	46%	35	95%	95	57%
Heat Down During Day	48	49%	17	52%	65	50%	29	78%	94	56%
# with Thermostat Type That Also Controls Air Conditioning	**15**		**10**		**25**		**9**		**34**	
Setback Habits	#	%	#	%	#	%	#	%	#	%
A/C Up at Night	6	40%	2	20%	8	32%	6	67%	14	41%
A/C Up During Day	9	60%	3	30%	12	48%	7	78%	19	56%

E. Smart Thermostat Use

The earlier analysis showed that only four percent of respondents and 15 respondents in total had a wi-fi connected thermostat. These customers were asked a series of questions to understand how they used their thermostats. We found that about half had used a phone or computer to remotely change the temperature of their thermostat. Forty percent had done so when away from home and 40 percent from another room of the home.

Frequency of changing the temperature remotely varied from those who did so at least once per week to those who had only done so once.

Respondents who used the remote feature more than once per month were asked to report the circumstances under which they used the remote temperature change feature. They reported the following.

- Weather (3 respondents)
- Increase comfort from different area of home (2 respondents)
- Temporary change in daily schedule (2 customers)
- Out of town (2 customers)

When asked how easy or difficult it was to change the temperature remotely, 86 percent said that it was very or somewhat easy. They also reported the following.

- 73 percent said the temperature in the home has been more than before purchasing this thermostat.
- 40 percent said their monthly energy bills were lower
- 20 percent said they used the mobile application or website that accompanied the thermostat to identify opportunities for saving money and energy

Of the seven respondents who said their thermostat had learning features, all said that the thermostat was very or somewhat responsive to changing conditions such as indoor humidity and outside temperature and 57 percent said that the motion sensors always or frequently recognize home occupancy.

F. Potential for Smart Thermostat Use

Some smart thermostats need to be programmed initially to begin learning the user's comfort preferences. Respondents were asked how likely they would be to initially program a smart learning thermostat if they owned one. Table III-23 shows that 56 percent said they were very or somewhat likely to do so.

Table III-23
Likelihood of Initially Programming Smart Thermostat

Certain thermostats have features that learn your comfort preferences based on the way you initially program the thermostat to automatically change temperatures on certain days and times. If you owned a thermostat with these capabilities, how likely would you be to initially program the thermostat? Would you be very likely, somewhat likely, not too likely or not at all likely to program your thermostat?						
Likelihood of Initially Programming Thermostat	**NJNG**		**NE GAS UTILITY**		**All**	
	#	**%**	**#**	**%**	**#**	**%**
Very Likely	74	34%	63	38%	137	36%
Somewhat Likely	42	19%	35	21%	77	20%
Not Too Likely	32	15%	24	14%	56	15%
Not at All Likely	47	22%	35	21%	82	21%
Don't Know	10	5%	7	4%	17	4%
Refused	1	<1%	0	0%	1	<1%
Has Wi-Fi Programmable Thermostat	11	5%	4	2%	15	4%

Certain thermostats have features that learn your comfort preferences based on the way you initially program the thermostat to automatically change temperatures on certain days and times. If you owned a thermostat with these capabilities, how likely would you be to initially program the thermostat? Would you be very likely, somewhat likely, not too likely or not at all likely to program your thermostat?						
Total	**217**	**100%**	**168**	**100%**	**385**	**100%**

Table III-24 shows whether they would program their thermostat by the type of thermostat they had. The table shows that while 70 percent of those with a thermostat that is currently programmed said they would do so, 50 percent with a programmable thermostat that is not currently programmed and 56 percent of those with a manual thermostat said they would do so.

Table III-24
Likelihood of Initially Programming Smart Thermostat
By Type of Thermostat

Certain thermostats have features that learn your comfort preferences based on the way you initially program the thermostat to automatically change temperatures on certain days and times. If you owned a thermostat with these capabilities, how likely would you be to initially program the thermostat? Would you be very likely, somewhat likely, not too likely or not at all likely to program your thermostat?								
Likelihood of Initially Programming Thermostat	**Thermostat is Programmed**		**Thermostat Not Programmed**		**Manual Thermostat**		**All**	
	#	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Very Likely/Somewhat Likely	67	70%	53	50%	94	56%	214	58%
Not Too Likely/Not at all Likely	24	25%	47	45%	67	40%	138	37%
Don't Know/Refused	5	5%	5	5%	8	5%	18	5%
Total*	**96**	**100%**	**105**	**100%**	**169**	**100%**	**370**	**100%**

*Table excludes 15 customers who had a learning thermostat.

Respondents were asked how often they think they would make use of the remote adjustment feature if their thermostat had such a capability. Table III-25A shows that many respondents felt that they would use this feature on a regular basis. While 19 percent said they would use it once per day or more frequently, 18 percent said they would use it at least once a week, and nine percent said they would use it at least once per month. However, 44 percent said they would use it less frequently than once per month.

Table III-25A
Predicted Frequency of Using Wi-Fi Connected Smart Thermostat Features

Certain thermostats have features that allow you to make adjustments to thermostat settings remotely through Wi-Fi using a phone or computer. If you owned a thermostat with these capabilities, how often would you use your phone or computer to change the temperature remotely? Would you use this feature more than once a day, once a day, at least once a week, at least once a month or less frequently?						
Frequency of Use of Wi-Fi Connected Features	**NJNG**		**NE GAS UTILITY**		**All**	
	#	**%**	**#**	**%**	**#**	**%**
More Than Once a Day	10	5%	16	10%	26	7%

Certain thermostats have features that allow you to make adjustments to thermostat settings remotely through Wi-Fi using a phone or computer. If you owned a thermostat with these capabilities, how often would you use your phone or computer to change the temperature remotely? Would you use this feature more than once a day, once a day, at least once a week, at least once a month or less frequently?						
Once A Day	26	12%	22	13%	48	12%
At Least Once a Week	36	17%	33	20%	69	18%
At Least Once a Month	19	9%	15	9%	34	9%
Less Frequently	102	47%	69	41%	171	44%
Don't Know	13	6%	8	5%	21	5%
Refused	0	0%	1	1%	1	<1%
Has Wi-Fi Programmable Thermostat	11	5%	4	2%	15	4%
Total	**217**	**100%**	**168**	**100%**	**385**	**100%**

Table III-25B displays customers' projected frequency of use of remote temperature change by customer characteristics. The table shows that customers who used computers more, had wi-fi, and had a smart phone or tablet were more likely to report that they would change their temperature remotely once per day or more. However, higher income households did not appear to be more likely to do so than lower income households. This shows that if customers have the necessary technological capabilities, lower income households can be good targets for this technology.

Table III-25B
Predicted Frequency of Using Wi-Fi Connected Smart Thermostat Features
By Customer Characteristics

	How Often Use Computer		Has Wi-Fi		Has Smart Phone Or Tablet		Annual Income		
	Once Per Day or More	Less than Every Day	Yes	No	Yes	No	<$50,000	$50,000-$100,000	>$100,000
Obs	248	96	281	63	280	66	130	78	75
Once Per Day or More	23%	16%	25%	8%	24%	9%	25%	21%	27%
At Least Once Per Week	24%	10%	22%	10%	23%	6%	15%	23%	24%
Less than Once Per Week	53%	74%	53%	83%	53%	85%	60%	56%	49%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Respondents were asked to report the circumstances under which they would use the remote temperature change feature. The most common responses were as follows.

- Weather
- Out of town
- Increase comfort from a different area of the home
- Temporary change in daily schedule
- While on the way home

Table III-26
Circumstances Under Which Thermostat is Changed Remotely

Under what circumstances do you change your thermostat remotely?						
Use of Remote Features	**NJNG**		**NE GAS UTILITY**		**All**	
	#	**%**	**#**	**%**	**#**	**%**
Based on Weather	37	17%	47	28%	84	22%
Out of Town / On Vacation	56	26%	19	11%	75	19%
Increase Comfort from Different Area of Home	15	7%	20	12%	35	9%
Temporary Change in Daily Schedule	24	11%	12	7%	36	9%
When On the Way Home	15	7%	9	5%	24	6%
After Leaving the House and Forgetting to Adjust Thermostat	7	3%	8	5%	15	4%
Other Times When Not at Home	4	2%	6	4%	10	3%
If Thermostat Was Broken	2	1%	3	2%	5	1%
When Guests Are In the House	3	1%	2	1%	5	1%
Other	6	3%	1	1%	7	2%
Would Never Use Feature	35	16%	33	20%	68	18%
Has Wi-Fi Programmable Thermostat	11	5%	4	2%	15	4%
Total	**217**	**100%**	**168**	**100%**	**385**	**100%**

Respondents could provide more than one response so percentages may not sum to 100%.

G. Energy Efficiency Upgrades

Respondents were asked whether they had an energy audit on their home, and whether they participated in an energy efficiency program. Table III-27 shows that 28 percent said that they had an audit and 23 percent said that they participated in an energy efficiency program.

Table III-27
Participation in Energy Audit and Energy Efficiency Program

Have you ever had someone examine your home and conduct an energy audit to identify ways you could save energy? Have you ever participated in an energy efficiency program that provides rebates for energy efficiency upgrades or does work in your home to make it more efficient?						
	NJNG	**NE GAS UTILITY**	**All**	**NJNG**	**NE GAS UTILITY**	**All**
Number of Respondents	**217**	**168**	**385**	**217**	**168**	**385**
Participated	**Energy Audit**			**Energy Efficiency Program**		
	Percent of Respondents					
Yes	25%	30%	28%	21%	26%	23%
No	73%	69%	71%	78%	73%	76%
Don't Know	2%	1%	1%	1%	1%	1%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table III-28 shows that 38 to 47 percent of respondents reported that they replaced heating or cooling equipment, added insulation or had air sealing work done, or replaced their thermostat. Only about six percent reported that they did so as part of an energy efficiency program.

Table III-28
Energy Efficiency Upgrades

Have you ever replaced the heating or cooling equipment in your current home? Have you ever added insulation or had air sealing done in your current home? Have you ever replaced the thermostat in your current home?				Did you replace __ as part of an energy efficiency program?		
	NJNG	NE GAS UTILITY	All	NJNG	NE GAS UTILITY	All
Number of Respondents	**217**	**168**	**385**	**217**	**168**	**385**
Heating/Cooling	49%	31%	41%	9%	5%	7%
Insulation/Air Sealing	43%	32%	38%	5%	8%	6%
Thermostat	51%	42%	47%	5%	7%	6%

When asked how satisfied they were with their current thermostat, half said they were very satisfied and 37 percent said they were somewhat satisfied. Only 12 percent said they were very or somewhat dissatisfied.

Table III-29
Satisfaction with Thermostat

How satisfied are you with your current thermostat? Would you say you are very satisfied, somewhat satisfied, somewhat dissatisfied or very dissatisfied with your current thermostat?						
Satisfaction with Current Thermostat	**NJNG**		**NE GAS UTILITY**		**All**	
	#	**%**	**#**	**%**	**#**	**%**
Very Satisfied	117	54%	76	45%	193	50%
Somewhat Satisfied	76	35%	66	39%	142	37%
Somewhat Dissatisfied	18	8%	17	10%	35	9%
Very Dissatisfied	5	2%	7	4%	12	3%
Don't Know	1	<1%	2	1%	3	1%

Those who were dissatisfied were asked why. Table III-30 shows that the most common reasons were that it is difficult to adjust the temperature, it is difficult to program, that they want newer technology, and that the heat does not respond to the thermostat settings.

Table III-30
Reason for Dissatisfaction

Why are you dissatisfied with your current thermostat?						
Reason for Dissatisfaction	**NJNG**		**NE GAS UTILITY**		**All**	
	#	**%**	**#**	**%**	**#**	**%**
Difficult to Adjust Temperature	4	2%	11	7%	15	4%
Difficult to Program	5	2%	5	3%	10	3%
Wants New Technology	6	3%	6	4%	12	3%
Heat Does Not Respond to Thermostat Settings	6	3%	7	4%	13	3%
Results in High Bills/Usage	2	1%	1	1%	3	1%
Heats House Unevenly	4	2%	0	0%	4	1%
Difficult to Reach/Access	1	<1%	1	1%	2	1%
Other	2	1%	2	1%	2	1%
Satisfied with Thermostat	194	89%	144	86%	338	88%
Total	**217**	**100%**	**168**	**100%**	**385**	**100%**

Respondents could provide more than one response so percentages may not sum to 100%.

Respondents who reported that they participated in an energy efficiency program and did not report that they had a wi-fi enabled thermostat were asked whether they considered purchasing a smart thermostat as part of the energy efficiency upgrades in their home. Table III-31 shows that 24 percent reported that they had considered this purchase.

Table III-31
Considered Purchasing a Smart Thermostat

Did you think about installing a smart thermostat as part of the energy efficiency upgrades you made to your home?						
Considered a Smart Thermostat	**NJNG**		**NE GAS UTILITY**		**All**	
	#	**%**	**#**	**%**	**#**	**%**
Yes	12	29%	8	19%	20	24%
No	29	69%	33	79%	62	74%
Don't Know	1	2%	1	2%	2	2%
Total	**42**	**100%**	**42**	**100%**	**84**	**100%**

Those who reported that they considered purchasing a thermostat but had not done so were most likely to report that this was due to cost, the fact that it was not offered by the program, they were concerned about the technology, or they were waiting to install other upgrades.

IV. Summary

The Smart Thermostat survey developed an understanding of thermostat technology currently in use, programming and setbacks, and potential use of smart thermostats. This section provides a summary of the findings in this memo.

Demographic Characteristics

- Computer Use: Seventy percent of respondents reported that they use computers at least once per day or more, indicating a certain degree of readiness for this technology.
- Wi-Fi and Smart Phone/Tables: About 80 percent reported that they had wi-fi, about 80 percent said they had a smart phone or tablet, and about 74 percent said that they had both. This shows that a high percentage of these utility customers had the requisite technology for a smart thermostat.
- Away from Home: 53 percent of NJNG customers and 63 percent of the NE Natural Gas Utility customers said that there were regular times during the day when no one was home and they could save energy by using less heat or air conditioning than when someone was at home. However, several customers stated that they would not be able to use setback because of pets in the home at all times.

Current Thermostat Characteristics

- Thermostat Age: Most respondents reported that they had their current thermostat for more than five years or that it was in the home when they moved in.
- Programmable Thermostat: While 67 percent of the NJNG customers said that they had a programmable thermostat, 42 percent of the Northeast Utility Natural Gas customers stated that they had a programmable thermostat. Customers who used computers more often, had wi-fi, had a smart phone or tablet, and had higher income were more likely to have a programmable thermostat.

  The fact that only 39 percent of households with income below $50,000 had a programmable thermostat, compared to 62 percent of those with income between $50,000 and $100,000 and 72 percent of those with income over $100,000 shows that these lower income households may have greater opportunities to achieve savings with a smart thermostat. Households with lower annual income were less likely to report that they used a computer at least once per day, were less likely to have wi-fi in the home, and were less likely to have a smart phone or tablet. However, the majority of the lower income customers used these technologies and many are likely to be able to benefit from smart thermostats.

- Smart Thermostat Features: Customers were not likely to have smart thermostats. Only four percent reported that their thermostats were wi-fi connected, seven percent said that the thermostat could sense humidity and weather, and three percent said that their thermostat learns their preferences and senses occupancy. Smart thermostats are a potentially available opportunity for most of these customers who had less technologically advanced equipment at the current time.

Thermostat Programming Behaviors

- Programmed Thermostat: While 50 percent of those with a programmable thermostat said that it was currently programmed, overall 28 percent of all respondents stated that their thermostat was currently programmed. Customers who use computers more often, had wi-fi, had a smart phone or tablet, and had higher income were more likely to have a programmed thermostat.

- Programming Frequency: About one quarter of customers with a programmed thermostat re-program the thermostat four times per year or more, about one fifth re-program it two times per year, and about one quarter never re-program the thermostat.
- Manual Adjustments: While 31 percent reported that they manually adjust the thermostat less than once per month, about half of the respondents stated that they manually adjust the thermostat at least once per week or more frequently. This shows that they may benefit from a smart thermostat that adjusts to their usage preferences.
- Setbacks: Over 60 percent turn down the heat at night or during the day when they are not at home, and over 50 percent do so with their air conditioning. However, 95 percent of those with programmed programmable thermostats stated that they set back their heat at night. Customers who use computers more often, had wi-fi, had a smart phone or tablet, and had higher income were more likely to set back their thermostat.

  Because customers were less likely to practice setback with their air conditioning, smart thermostats may result in higher savings if they replace thermostats that control the air conditioning as well as heating.

<u>Smart Thermostat Use and Potential Use</u>

- Remote Temperature Change: Only four percent of respondents and 15 respondents in total had a wi-fi connected thermostat. About half had used a phone or computer to remotely change the temperature of their thermostat. Forty percent of those who changed the temperature remotely had done so when away from home and 40 percent from another room of the home.
- Potential Smart Thermostat Use: Respondents were asked how often they think they would make use of the remote adjustment feature if their thermostat had such a capability. Many respondents felt that they would use this feature on a regular basis. While 19 percent said they would use it once per day or more frequently, 18 percent said they would use it at least once a week, and nine percent said they would use it at least once per month. However, 44 percent said they would use it less frequently than once per month.

  Customers who use computers more frequently, had wi-fi, and had a smart phone or tablet were more likely to report that they would change their temperature remotely once per day or more. However, higher income households did not appear to be more likely to do so than lower income households. This shows that if customers have the necessary technological capabilities, lower income households can be good targets for this technology.

- Occasion for Remote Temperature Change: The most common circumstances under which respondents thought they may remotely change the temperature in their home were weather conditions, being out of town, increasing comfort from a different area of the home, a temporary change in the daily schedule, or while on the way home.

<u>Energy Efficiency Upgrades</u>

- Audit and Efficiency Program Participation: While 28 percent said that they had an audit, 23 percent said that they participated in an energy efficiency program.
- Efficiency Work: 41 percent said they replaced their had ever replaced the heating or cooling equipment in their current home, 38 percent insulation or air sealing work done, and 47 percent had a new thermostat installed. Only about six percent stated that this work was done as part as an energy efficiency program.

- Thermostat Satisfaction: When asked how satisfied they were with their current thermostat, half said they were very satisfied and 37 percent said they were somewhat satisfied. Only 12 percent said they were very or somewhat dissatisfied.
- Smart Thermostat Consideration: Respondents who reported that they participated in an energy efficiency program and did not report that they had a wi-fi enabled thermostat were asked whether they considered purchasing a smart thermostat as part of the energy efficiency upgrades in their home, and 24 percent reported that they had considered this purchase. Those who reported that they considered purchasing a thermostat but had not done so were most likely to report that this was due to cost, the fact that it was not offered by the program, they were concerned about the technology, or they were waiting to install other upgrades. This shows that programs and incentives could potentially have a large impact on uptake of smart thermostats.