
Encouraging sustainable practices beyond here and now: The case of programmable thermostats for low-income tenants

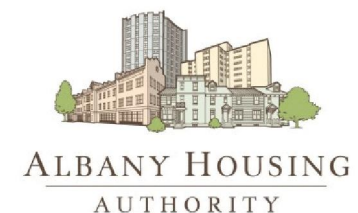


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BECC 2016
Baltimore, October 2016
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 **Fraunhofer**
USA

Field experiment | North Albany Homes



Facts.co

Albany, New York State



Multifamily Housing



Income eligible



Focus group results

Like: Comfort, health, economic impact

Dislike: Irritating, complex, controversial

Field experiment | Schedule the thermostat according to familial lifestyles



3,5 months

December 2014 – March 2015

106 days

Field experiment | Recruitment



91% participated
8% of those opted out

Theoretical framework



Adapted from the Fogg's Model of Behavior Change

Research Questions

Field experiment | Research questions



Will residents be encouraged to keep their thermostats scheduled?

Field experiment | Research questions



Will residents be encouraged to keep their thermostats scheduled?

Are those who commit to keep the schedules, more likely to use schedules?

Field experiment | Research questions



Will residents be encouraged to keep their thermostats scheduled?

Are those who commit to keep the schedules, more likely to use schedules?

Is the prompt a useful reminder to go back to using schedules?

Field experiment | Research questions



Will residents be encouraged to keep their thermostats scheduled?

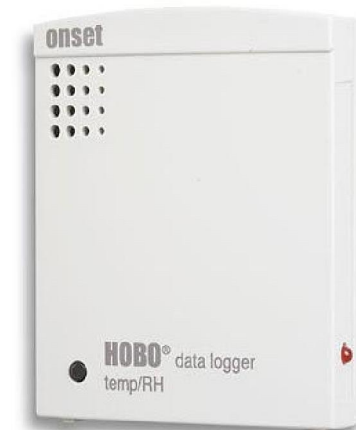
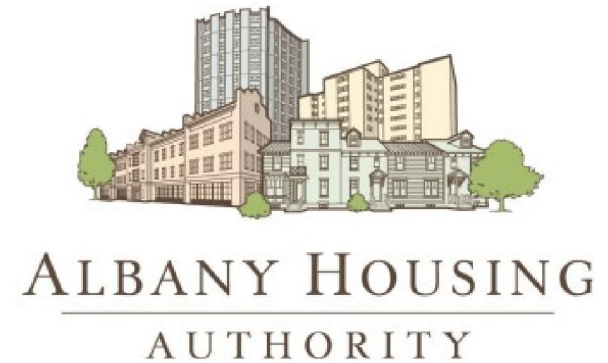
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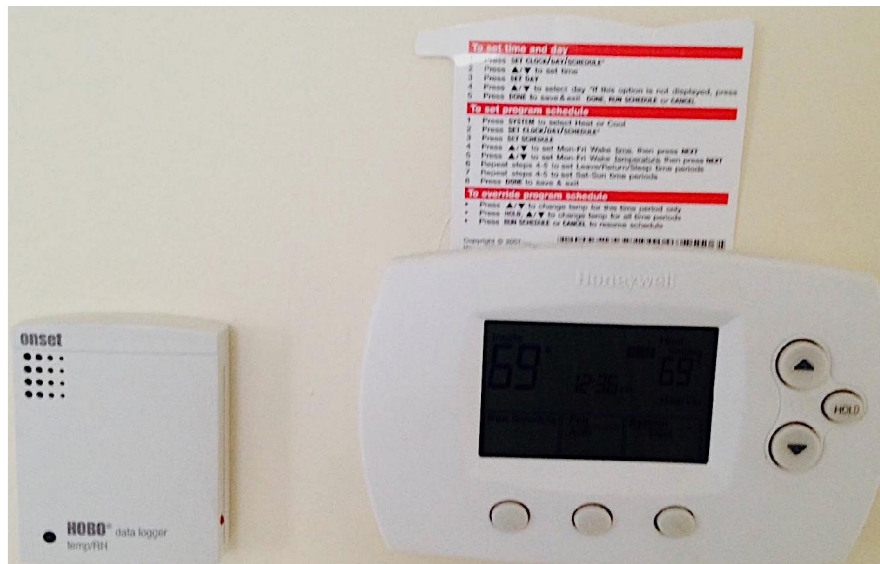
On average, do tenants save energy?

Experimental Design

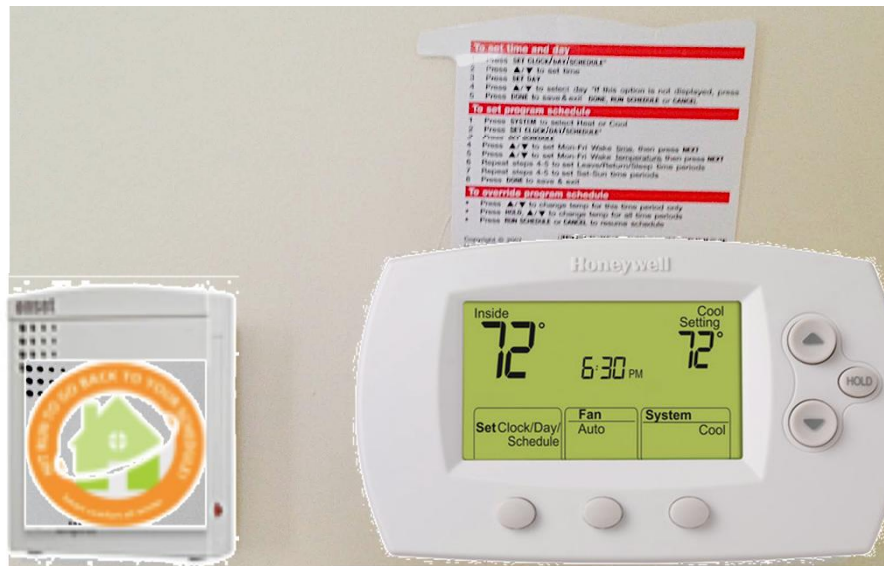
Before the field work | Activity on site



Field experiment | Control Group



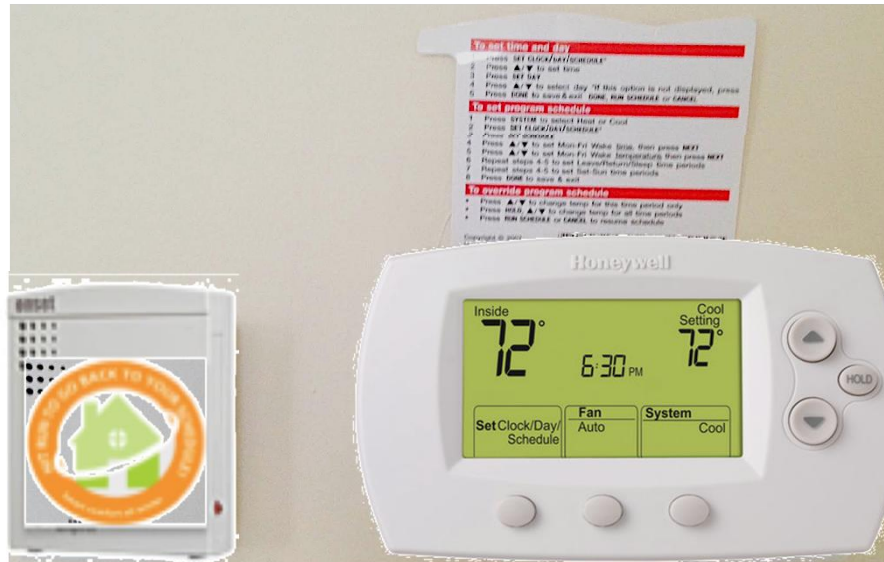
Field experiment | Prompt Group



Prompt

Programmed thermostat

Field experiment | Prompt & Commitment Group



Prompt

Programmed thermostat

Fraunhofer USA

To save money and energy in the winter, I will lower the temperature of the thermostat when we are not at home or during the night.

Monday - Friday	Period of Day	Time	Temp
	Wake	7am	74
	Leave	10am	70
	Return	2pm	74
	Sleep	11pm	70
Weekends	Period of Day	Time	Temp
	Wake	8am	74
	Leave	10am	70
	Return	2pm	74
	Sleep	11pm	70

Signature _____

Commitment

Field experiment | Randomized control trial



45



40

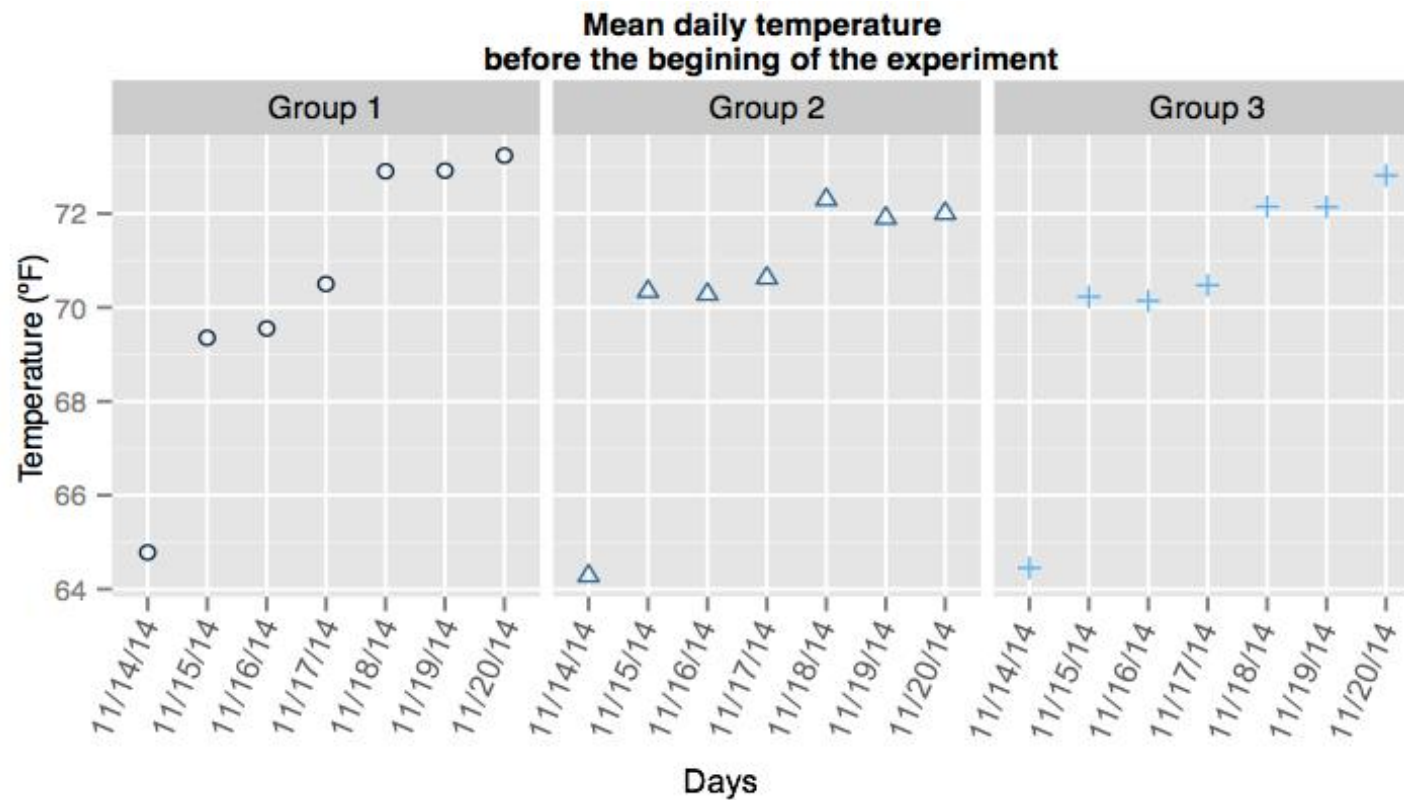


45

Analysis

Group equivalency check

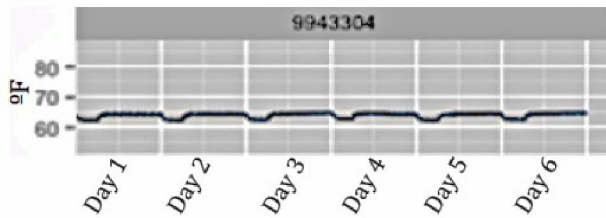
Groups were statistically similar before the beginning of the experiment



(Levene test confirms homogeneity and ANOVA p-value > 0.05)

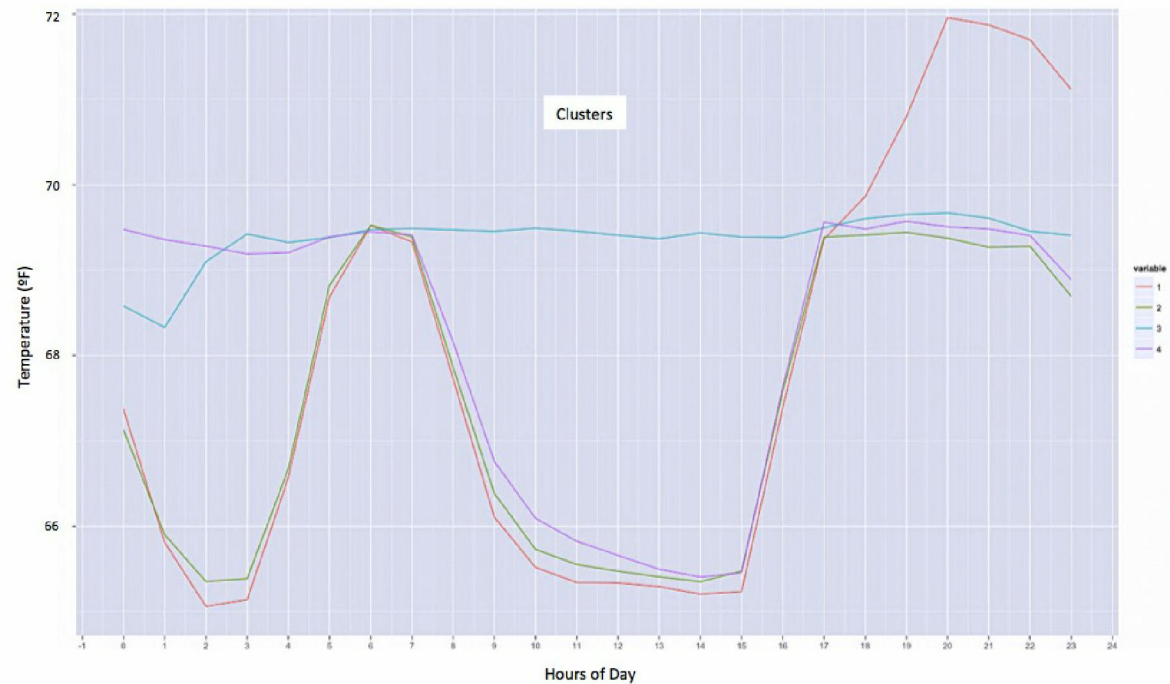
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Data Analysis | Temperature dataset



Temperature dataset for a week

Determining the number of days the schedules were used



Results

Results | Will residents be encouraged to keep their thermostats scheduled?



Control



Prompt



**Prompt &
Commitment**

**Average %
of days with
schedules**

6 %

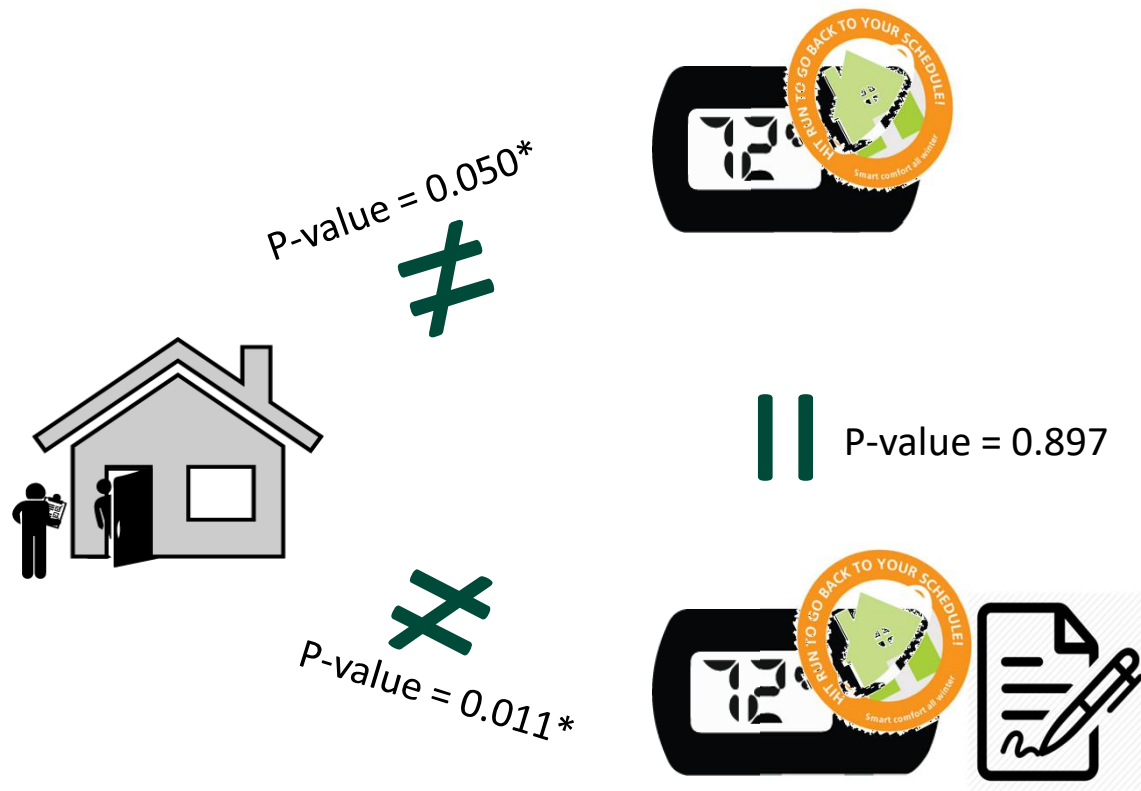
37 %

25 %

Table 5: Total number of days in the experiment and number of days in schedule

Dataset	Total number of days in the experiment per group	Number of days in schedule per group	% in schedule
Control group	5293	298	5.6%
Prompt group	3408	1248	36.6%
Prompt + Commitment group	4141	1020	24.6%

Results | Will those who commit keep more days in schedule?



*denotes statistical significance

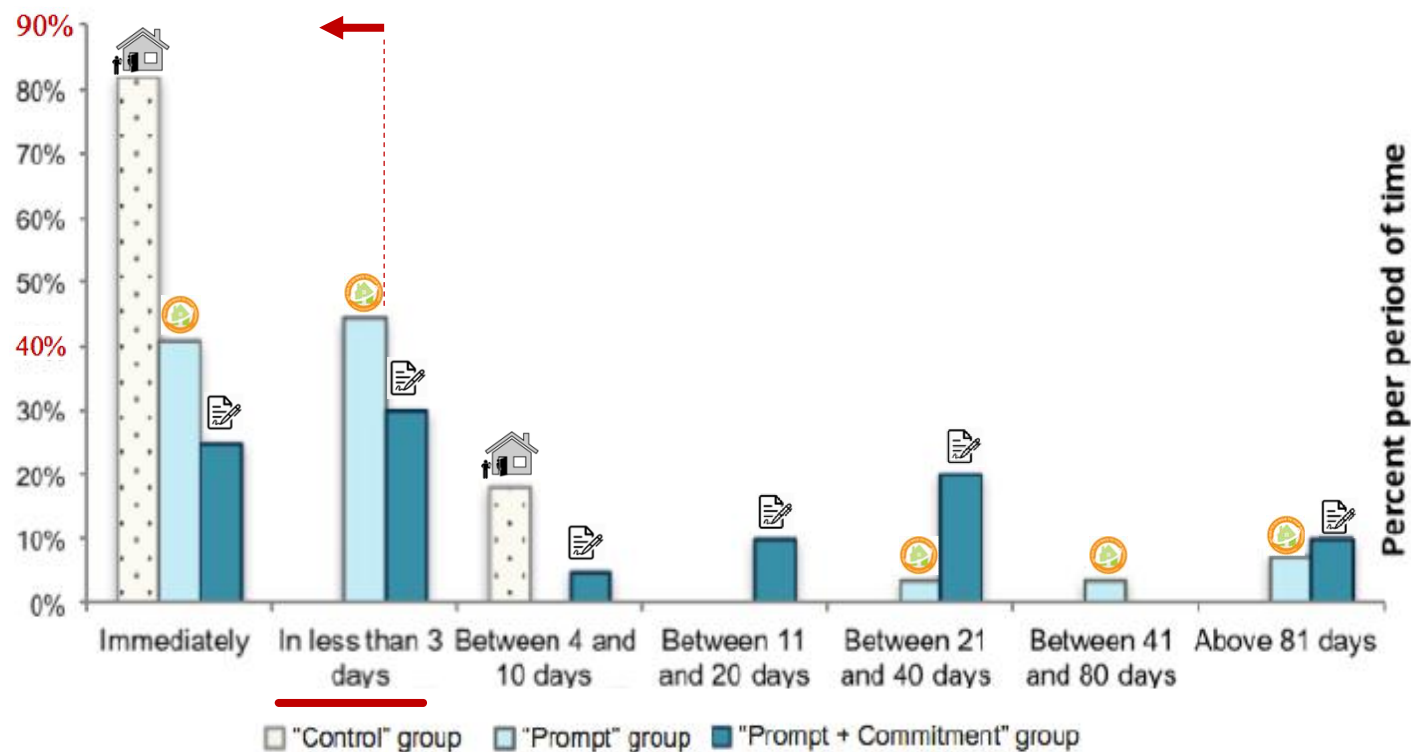
Table 8. Two by two comparison

Groups	<i>t</i>	Df	<i>p</i> -value
“Control” vs. “Prompt” groups	2.38	92	0.050*
“Control” vs. “Prompt + Commitment” groups	2.97	89	0.011*
“Prompt” group vs. “Prompt + Commitment” groups	0.44	90	0.897

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Results | Is the prompt a useful reminder to go back to using schedules?

Percentage of schedule overrides for specific periods of time



Results | Is the prompt a useful reminder to go back to using schedules?



Control



Prompt



**Prompt &
Commitment**

**Average
number of
days with
schedules**

6

39

26

Results | On average, do tenants save energy?

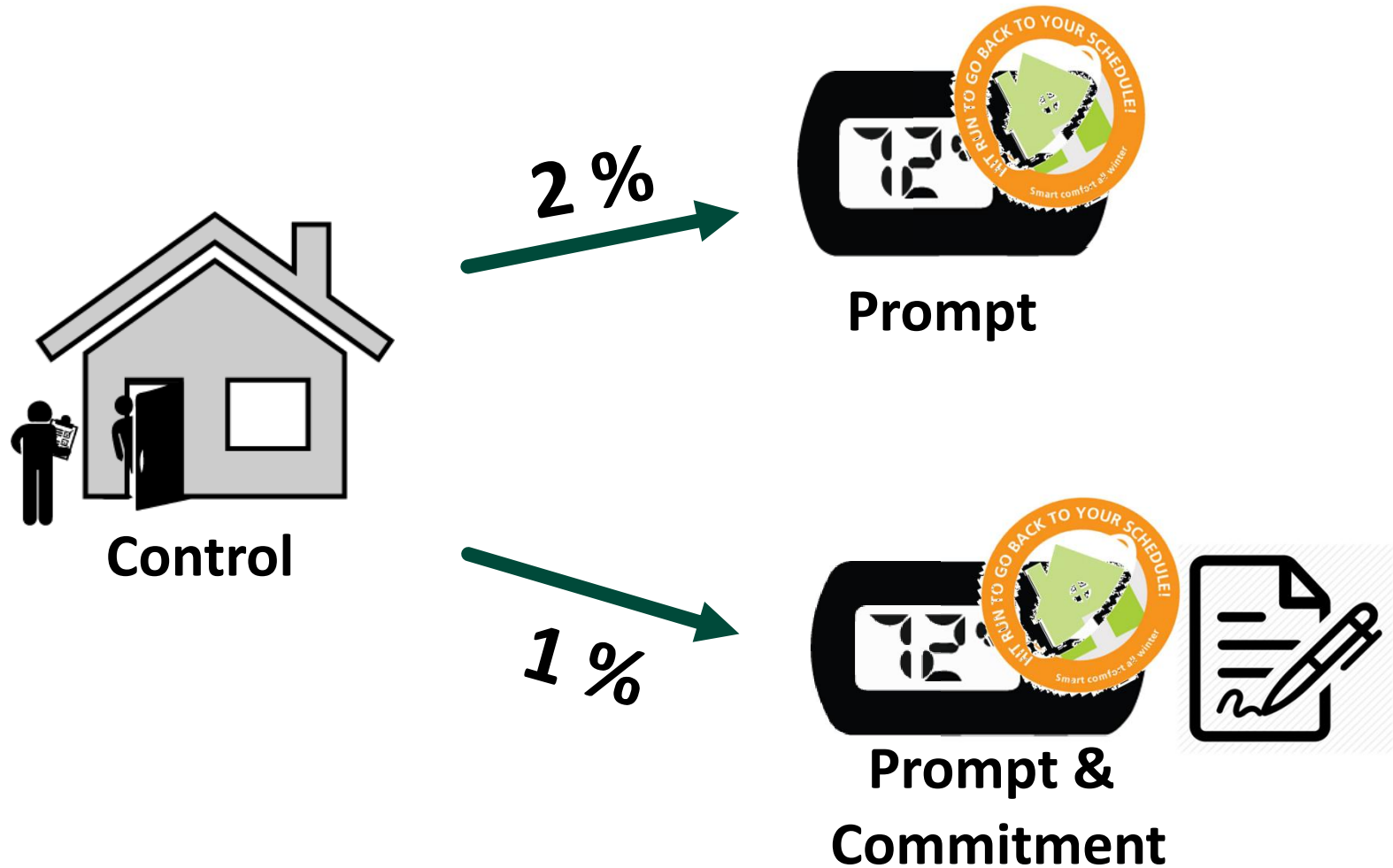


Table10: Percent savings for “Prompt” and “Prompt + Commitment”

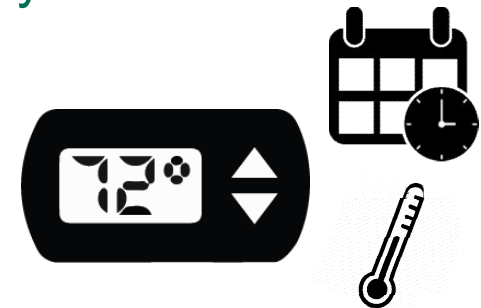
Experimental Groups	Average indoor temp daytime (°F)	Average indoor temp nighttime (°F)	Average indoor temperature (°F)	% Savings
Control	73.6	74.1	73.8	
Prompt	72.9	72.9	72.9	1.8%
Prompt + Commitment	73.3	73.3	73.3	1.1%

$$\left[1 - \frac{AveT_{indx} - AveT_{out}}{AveT_{indG1} - AveT_{out}} \right]$$

Conclusions

Conclusions

- Results indicate that scheduling the thermostats with the preferences of the occupants and providing a prompt as a reminder to go back to using schedules helps participants **save energy**
- Average daytime and nighttime indoor temperatures during the winter were significantly cooler than participants in the control group
- Voluntary **commitment** didn't result in an increased the use of programmed thermostat schedules
- However, the households that **committed** to maintain their programmed schedules **took more time to initially override their programmed thermostat settings**



Impact

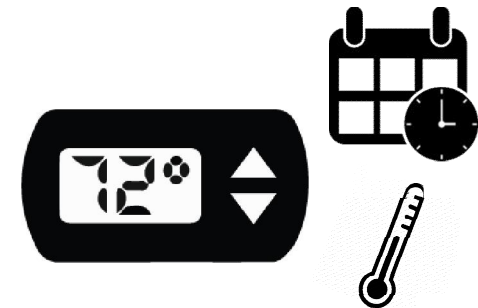
Renew Boston



EmPower New York



Application in direct install campaigns



Acknowledgements

Marsha Walton, [NYSERDA](#)

Alex Dunn, Jane Peters and Meghan Bean,
[RIA](#)

Laura Moody, [AHA](#)

Michael Zeifman, Kurt Roth, Kaitlin Lehman,
Anne Williams, Claire McIlvennie, Alliston
Watts, [Fraunhofer](#)

Thank you for your time!

Joana M. Abreu

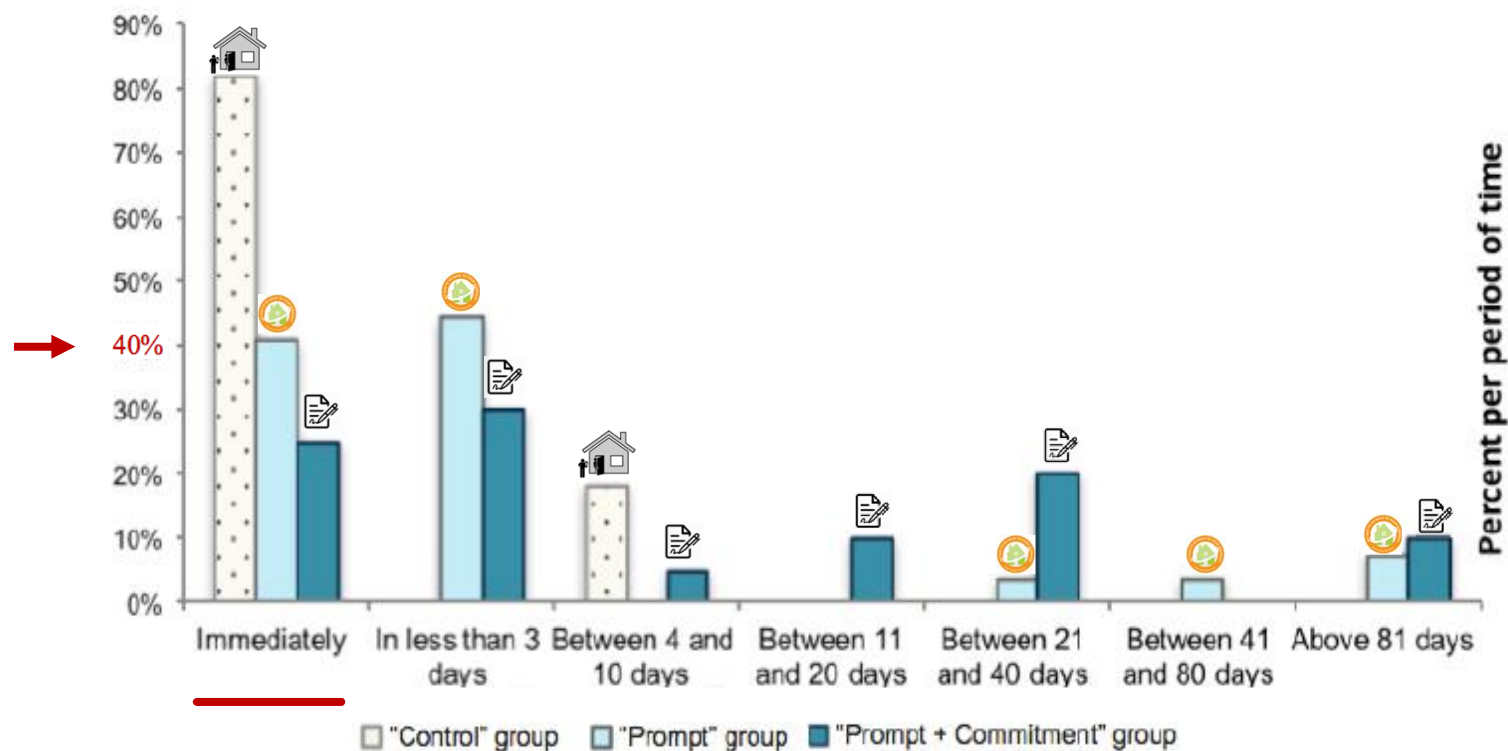
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Percentage of schedule overrides for specific periods of time



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