CLEARING UP THE UNCLEAR SAVINGS OF ADVANCED THERMOSTATS IN ILLINOIS

GETTING AGREEMENT ON EVALUATION METHODS ACROSS 15+ ENGAGED STAKEHOLDER GROUPS

Source: https://www.ecobee.com/

Presented by:

Pace Goodman

ComEd
An Exelon Company

NAVIGANT

Presented on: October 16, 2017

OUR INTERESTED AND INFORMED STAKEHOLDER GROUP

Among others…

Regulators:	Illinois Commerce Commission	Academics & Advocacy Groups:	Environmental Law & Policy Center — Protecting the Midwest's Environment and Natural Heritage; NRDC; Wisconsin — University of Wisconsin–Madison
Consultants:	NAVIGANT; Vermont Energy Investment Corporation; Opinion Dynamics; CADMUS; Future Energy Enterprises, LLC		
Implementers:	CLEAResult®	Technology Companies:	ENERGYSAVVY; nest; ecobee
Utilities:	ComEd — An Exelon Company; Nicor Gas; Ameren		

IL ENERGY EFFICIENCY (EE)

Program Administrators: utilities

Goal: encourage energy efficient behavior and purchases

Tools: rebates, home energy reports, etc.

Funding: on-bill riders or utility standard rates of return[1]

1. https://www.nrdc.org/sites/default/files/illinois-energy-efficiency-ib.pdf

MARKET TRENDS

Source: https://www.icc.illinois.gov/

Source: https://www.amazon.com/

Source: https://www.ecobee.com/

NAVIGANT

PROJECT OBJECTIVE

Estimate savings for advanced thermostats, like Nest and Ecobee

Source: https://www.icc.illinois.gov/

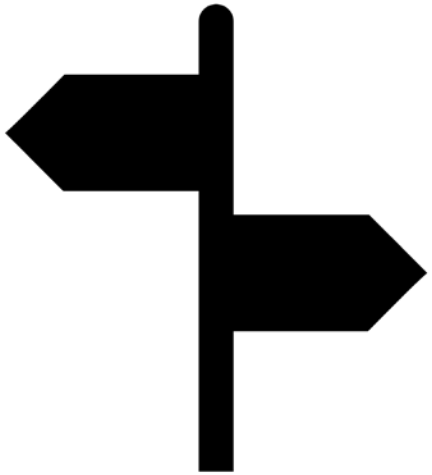
Source: https://www.amazon.com/

Source: https://www.ecobee.com/

NAVIGANT

THE CHALLENGE

"…reported energy savings falling somewhere between 1% and 15%." [1]



1. DOE report: https://energy.gov/sites/prod/files/2016/12/f34/Overview%20of%20Existing%20Future%20Residential%20Use%20Cases%20for%20CT_2016-12-16.pdf

NAVIGANT

OUR INTERESTED AND INFORMED STAKEHOLDER GROUP

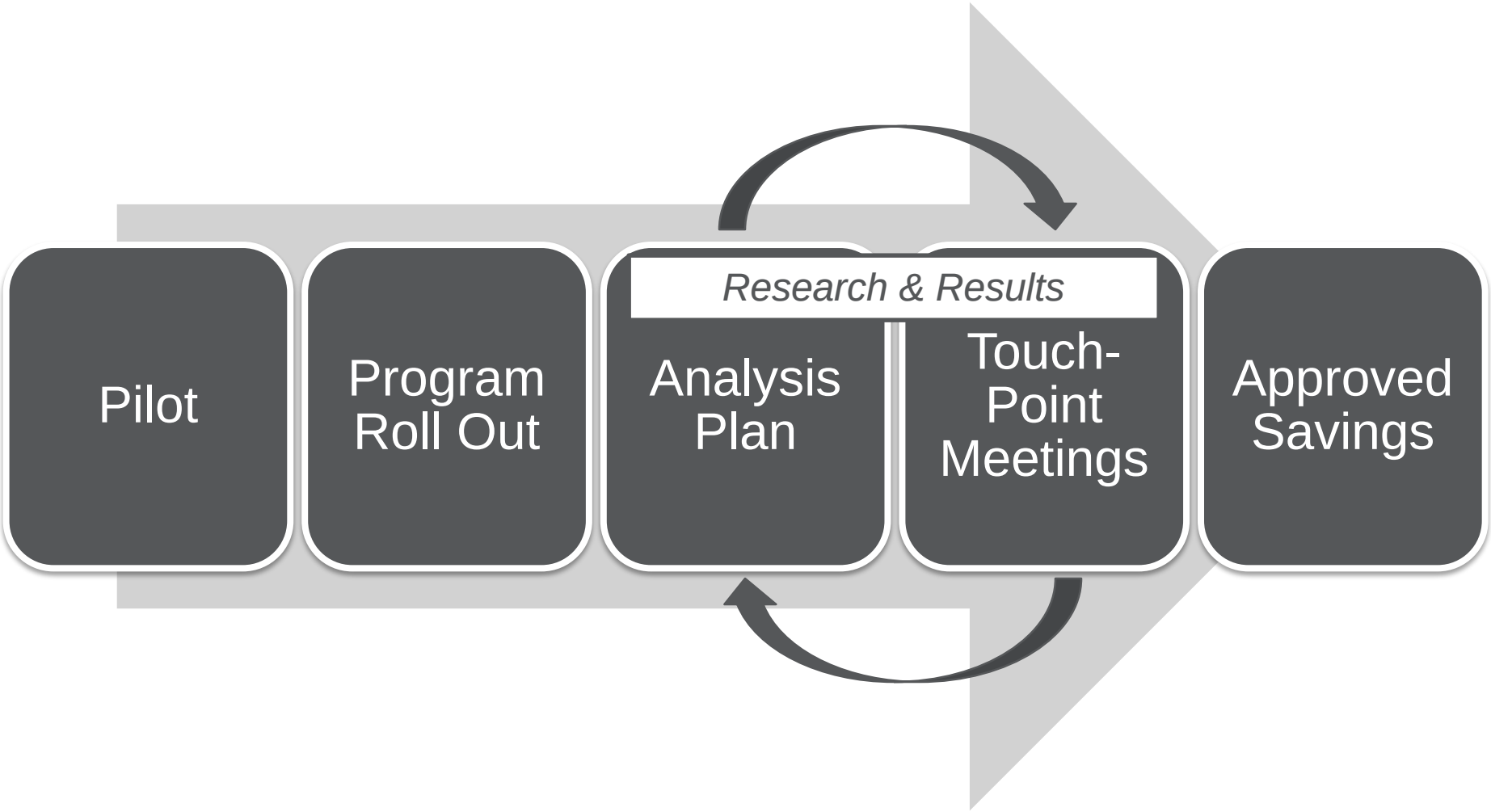
Among others…

Regulators:	Illinois Commerce Commission	Academics & Advocacy Groups:	Environmental Law & Policy Center — Protecting the Midwest's Environment and Natural Heritage; NRDC; Wisconsin — University of Wisconsin–Madison
Consultants:	Navigant; Vermont Energy Investment Corporation; Opinion Dynamics; Cadmus; Future Energy Enterprises, LLC		
Implementers:	CLEAResult®	Technology Companies:	EnergySavvy; nest; ecobee
Utilities:	ComEd — An Exelon Company; Nicor Gas; Ameren		

A PATH FORWARD

How do we coordinate with a large group on a technical project?

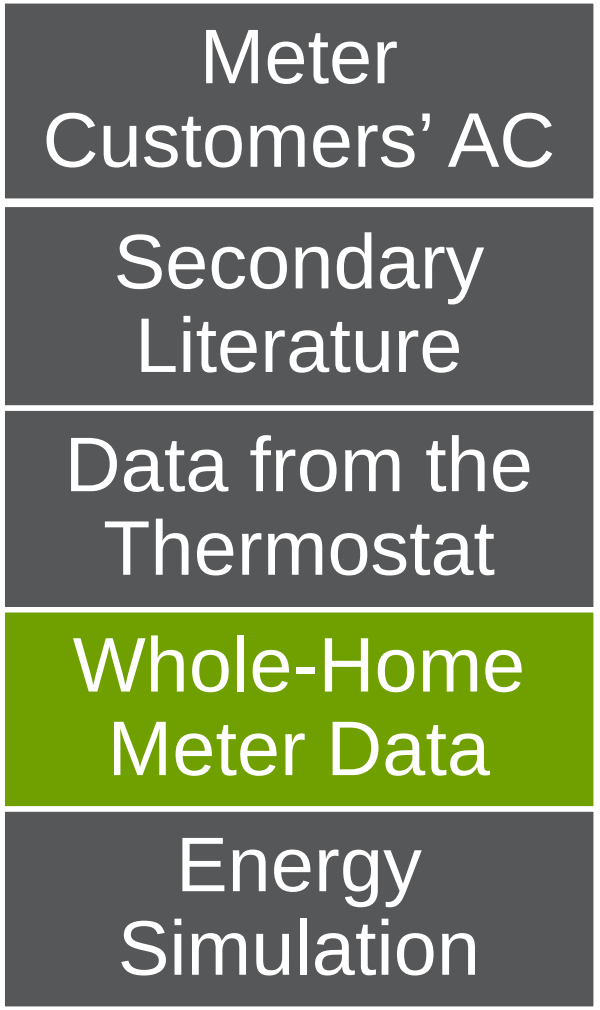
OUR PATH TO AGREED SAVINGS IN IL



NAVIGANT

THE “STORY” OF OUR MODEL

Where to start…



NAVIGANT

HEATING & COOLING

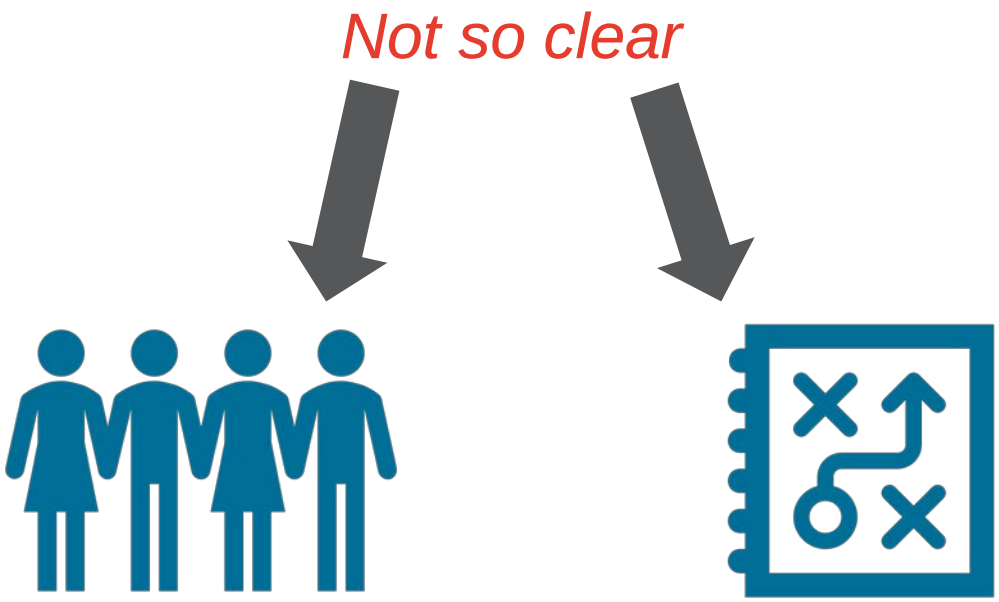
- Residential energy use is largely driven by heating and cooling

CHANGE IN HEATING & COOLING?

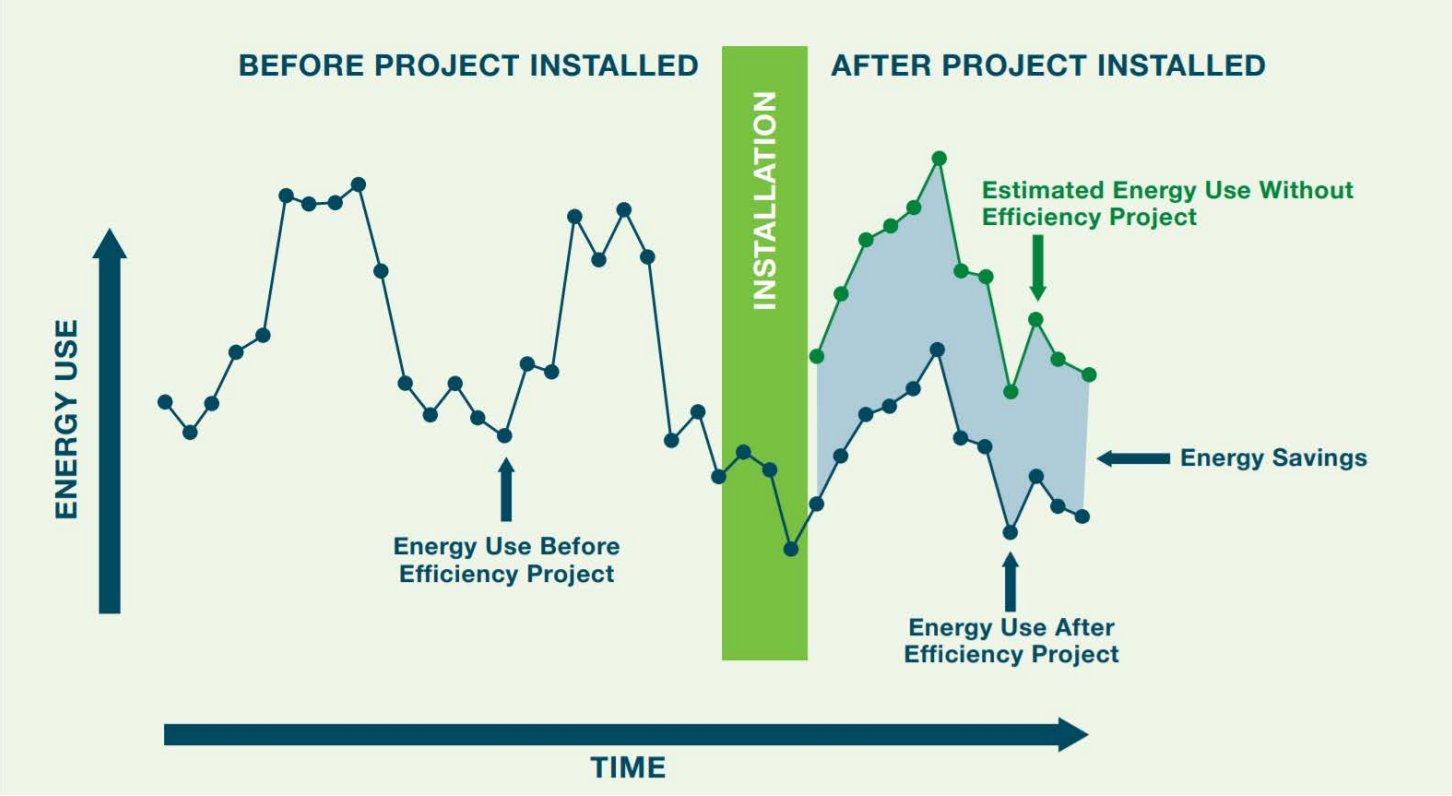
- Is savings the change in heating & cooling?

CHANGE IN HEATING & COOLING?

- Is savings the change in heating & cooling?



COMPARE USAGE TO OTHER CUSTOMERS?

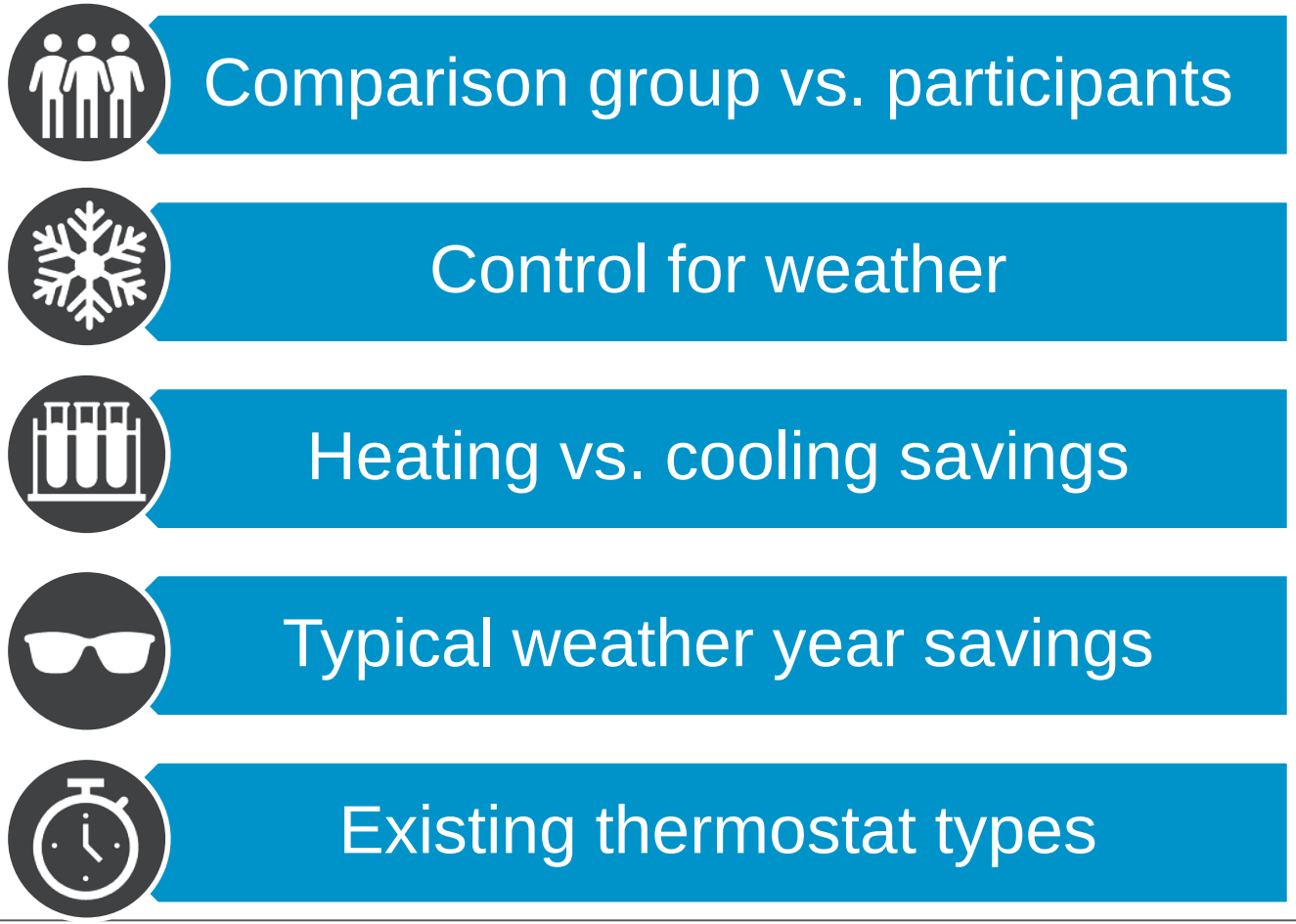


Source: https://www4.eere.energy.gov/seeaction/sites/default/files/pdfs/emv_ee_program_impact_guide_1.pdf

NAVIGANT

FINAL RESOLUTIONS

- But, it does get more complicated…



NAVIGANT

CONTACTS

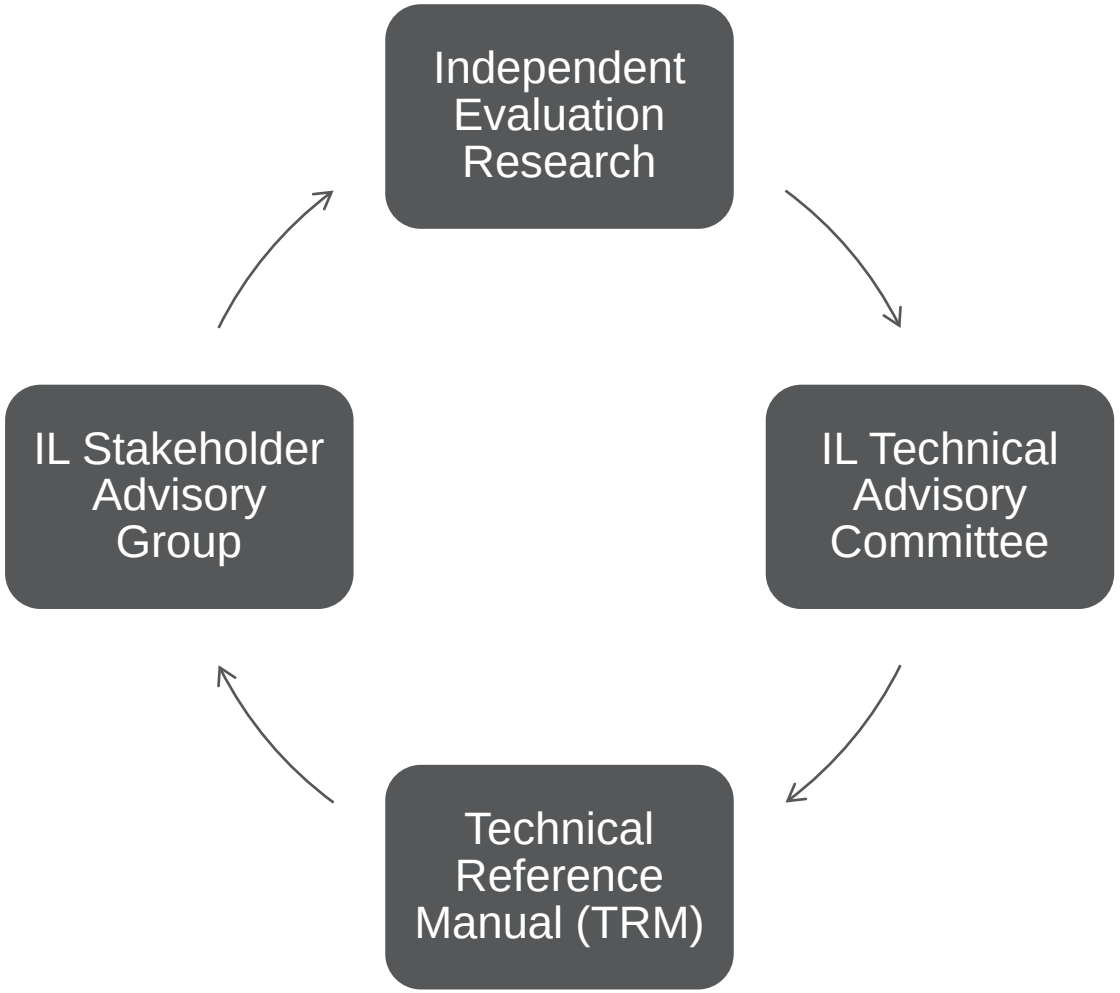
PACE GOODMAN
Navigant
360-828-4036
Pace.Goodman@Navigant.com

VINCENT GUTIERREZ
Commonwealth Edison (ComEd®)
(630) 437-2474
Vincent.Gutierrez@ComEd.com

ACKNOWLEDGMENTS

I'd like to acknowledge the valuable contribution across our interested and informed stakeholder group.

ILLINOIS'S ENERGY EFFICIENCY (EE) POLICY FRAMEWORK



NAVIGANT

RELEVANT HISTORY

2014

- Energy Independence and Security Act (EISA) affects the most common residential bulb types[1]

2015

- Chicago aims for 1 million smart thermostats[2]

2016

- The US Department of Energy acknowledges that reported savings for connected thermostats fall between 1% and 15%[3]

2017

- EnergyStar qualifies first connected thermostat[4]
- ComEd plans to increase its EE investment by 40%[5]

1. http://www.lightingfacts.com/library/content/faqs/eisa
2. http://midwestenergynews.com/2015/10/08/chicago-program-aims-for-1-million-smart-thermostats/
3. https://energy.gov/eere/buildings/downloads/overview-existing-and-future-residential-use-cases-connected-thermostats
4. https://cleantechnica.com/2017/03/09/epa-finalises-energy-star-ratings-smart-thermostats-nest-first-qualify/
5. https://www.comed.com/News/Pages/NewsReleases/2017-09-12.aspx

NAVIGANT

PRIMARY RESEARCH QUESTION

Objective: The scope of this research is to update the cooling energy savings factor for the residential advanced thermostat measure in the Illinois Technical Reference Manual (IL TRM) version 7.*

IL TRM Equation for Cooling Savings

$$\Delta kWh_{cool} = \%AC * ((FLH * Btu/hr * 1/SEER)/1000) * Cooling\_Reduction * Eff\_ISR$$

* Advanced thermostats are measure 5.3.16 in volume 3 of version 5.0 of the Illinois TRM. Available at: http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_5/Final/IL TRM_Effective_060116_v5.0_Vol_3_Res_021116_Final.pdf

CONCEPTUAL DIAGRAM FOR TIME PERIODS OF ENERGY USE DATA

2014

- **Matching Period (excluded from modeling data set):** time period of energy use used to develop the comparison group

2015

- **Pre-Treatment Period:** energy use before any participants receive a rebate to install an advanced thermostat

2016

- **Installation Period (excluded from analysis data set):** advanced thermostats are installed

2017

- **Post-Treatment Period:** energy use after treatment participants have installed their advanced thermostats and while savings accrue

AGREED-TO REGRESSION MODEL

Model to Inform IL TRM

$$ADU_{k,t} = \alpha_k + \beta_1 HDD_{60,k,t} + \beta_2 CDD_{65,k,t} + \beta_3 post_t + \beta_4 post_t * HDD_{60,k,t} + \beta_5 post_t * CDD_{65,k,t} + \beta_6 treat_k * HDD_{60,k,t} + \beta_7 treat_k * CDD_{65,k,t} + \beta_8 post_t * treat_k + \beta_9 post_t * treat_k * HDD_{60,k,t} + \beta_{10} post_t * treat_k * CDD_{65,k,t} + \beta_{11} \Phi_{k,t} + \varepsilon_{k,t}$$

Where

- α_k = Site fixed effects, which are binary variables (one for each site) that take on the value of 1 for a given site and 0 otherwise. This variable accounts for site specific conditions, such as the number of occupants.
- $HDD_{60,k,t}$ = Heating degree days for customer k during time (i.e., bill) t at a 60ºF balance temperature.
- $CDD_{65,k,t}$ = Cooling degree days for customer k during time (i.e., bill) t at a 65ºF balance temperature.
- $post_t$ = A binary variable indicating whether time period t is after the installation (taking a value of 1) or before (taking a value of 0). This variable will take values of 1 and 0 for both customers who receive a new thermostat and comparison group sites.
- $treat_k$ = A binary variable indicating whether customer k is in the treated participant group (taking a value of 1) or in the comparison group (taking a value of 0). This variable will not change over time for any customers.
- $\Phi_{k,t}$ = A vector of variables representing other ComEd energy efficiency programs
- $\varepsilon_{k,t}$ = The cluster-robust error term for customer k during date t. Cluster-robust errors account for heteroscedasticity and autocorrelation at the customer level.

REGRESSION RESULTS (1 OF 4)

- Does non-participant energy use change before and after program participation?

Model to Inform IL TRM

$$ADU_{k,t} = \alpha_k + \beta_1 HDD_{60,k,t} + \beta_2 CDD_{65,k,t} + \beta_3 post_t + \beta_4 post_t * HDD_{60,k,t} + \beta_5 post_t * CDD_{65,k,t} + \beta_6 treat_k * HDD_{60,k,t} + \beta_7 treat_k * CDD_{65,k,t} + \beta_8 post_t * treat_k + \beta_9 post_t * treat_k * HDD_{60,k,t} + \beta_{10} post_t * treat_k * CDD_{65,k,t} + \varepsilon_{k,t}$$

REGRESSION RESULTS (2 OF 4)

- Does energy use for participants and non-participants separate after the matched period, but before advanced thermostats are installed?

Model to Inform IL TRM

$$ADU_{k,t} = \alpha_k + \beta_1 HDD_{60,k,t} + \beta_2 CDD_{65,k,t} + \beta_3 post_t + \beta_4 post_t * HDD_{60,k,t} + \beta_5 post_t * CDD_{65,k,t} + \beta_6 treat_k * HDD_{60,k,t} + \beta_7 treat_k * CDD_{65,k,t} + \beta_8 post_t * treat_k + \beta_9 post_t * treat_k * HDD_{60,k,t} + \beta_{10} post_t * treat_k * CDD_{65,k,t} + \varepsilon_{k,t}$$

REGRESSION RESULTS (3 OF 4)

- What is the baseline heating and cooling load?

Model to Inform IL TRM

$$ADU_{k,t} = \alpha_k + \beta_1 HDD_{60,k,t} + \beta_2 CDD_{65,k,t} + \beta_3 post_t + \beta_4 post_t * HDD_{60,k,t} + \beta_5 post_t * CDD_{65,k,t} + \beta_6 treat_k * HDD_{60,k,t} + \beta_7 treat_k * CDD_{65,k,t} + \beta_8 post_t * treat_k + \beta_9 post_t * treat_k * HDD_{60,k,t} + \beta_{10} post_t * treat_k * CDD_{65,k,t} + \varepsilon_{k,t}$$

REGRESSION RESULTS (4 OF 4)

- What impact does installing an advanced thermostat have on heating, cooling and average energy use?

Model to Inform IL TRM

$$ADU_{k,t} = \alpha_k + \beta_1 HDD_{60,k,t} + \beta_2 CDD_{65,k,t} + \beta_3 post_t + \beta_4 post_t * HDD_{60,k,t} + \beta_5 post_t * CDD_{65,k,t} + \beta_6 treat_k * HDD_{60,k,t} + \beta_7 treat_k * CDD_{65,k,t} + \beta_8 post_t * treat_k + \beta_9 post_t * treat_k * HDD_{60,k,t} + \beta_{10} post_t * treat_k * CDD_{65,k,t} + \varepsilon_{k,t}$$

