MEASURING PERFORMANCE OF NET ZERO HOMES IN NEW YORK STATE

OVERVIEW

- Project and Program introduction
- Methods review
- Review of an example homes performance
- Observations, next steps and thoughts for discussion

This evaluation is still in progress, all data and observations are preliminary and have not been approved by NYSERDA
THE SCOPE OF THE PROJECT

- Establish the actual energy use and performance of a population of net zero homes in NY
- Examine the relationship between energy use and various independent variables
- Examine the relationship between energy use and occupant behavior

PROGRAM INTRODUCTION

- NYSERDA’s Low-Rise Residential New Construction program provides technical and financial support for the construction of net zero energy homes
- Participant homes are modeled in REM/Rate
  - HERS Index under 10 qualifies as NZE
  - NZE sub-program began 2008
PROJECT INTRODUCTION

- Program Years 2008 – 2015
- Predominantly Single-Family NC
- Size range from 756 – 4,382 SF
- Tightness range from 0.14 – 3.3 ACH\textsubscript{50}
- 1 Contractor built 50%+ of program homes
- ~75% GSHP and 25% ASHP
- Std DHW, typically preheated
- Most lighting still CFL
- All homes generate with PV

METHODS OVERVIEW

- Site Work
  - Deploy current transducers
  - Home energy inventory and interview
- Data Analysis
  - Make use of metered data and utility data
  - Establish gross and net energy use
  - Identify correlations between independent variables and energy use
METHODS - SITE WORK M&V

- MTCOOL: “meter the crap out of it”
  - Whole Home Net
  - Solar Production
  - Heat Pumps
  - Domestic Hot Water
  - ERV
  - Well Pump
  - Electric Vehicles & other

METHODS – M&V DATA AND UTILITY ANALYSIS

- Metered data is corroborated and triangulated using utility data
  - Weather normalized 8760 analysis
    - kBtu/s.f. as prime metric
  - Consumption load profiles
  - Generation load profiles
  - Peak demand period analysis
  - End-use breakdown
Look for correlations between systems/behavior and energy use
- Small sample sizes, still informative
- GSHP vs. ASHP
- Occupied vs. Unoccupied energy use
  - Impacted by temperature setbacks?
  - Impacted by occupant use of plug loads?
- Energy use vs. Occupant density

METHODS – M&V DATA AND UTILITY ANALYSIS

Built 2008-2009
- 6 years of daily kWh consumption and production data
- 3,237 s.f.
- ICF walls
- GSHP – two vertical wells
- 600 s.f. of PV, fixed southerly alignment

DURIAN HOME
DURIAN HOME

- Average daily kWh consumption vs. OAT

- Consumption over time
EXAMPLE HOME

- PV production over time

![PV Production Graph]

DURIAN HOME

- Is it a zero energy building?

<table>
<thead>
<tr>
<th>Year</th>
<th>kBtu/s.f. - consumption</th>
<th>Source energy per DOE definition</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009-2010</td>
<td>8.4</td>
<td>(27,522)</td>
<td></td>
</tr>
<tr>
<td>2010-2011</td>
<td>9.4</td>
<td>(24,516)</td>
<td></td>
</tr>
<tr>
<td>2011-2012</td>
<td>8.7</td>
<td>(35,564)</td>
<td></td>
</tr>
<tr>
<td>2012-2013</td>
<td>9.4</td>
<td>(17,459)</td>
<td></td>
</tr>
<tr>
<td>2013-2014</td>
<td>8.4</td>
<td>(30,597)</td>
<td></td>
</tr>
<tr>
<td>2014-2015</td>
<td>10.7</td>
<td>(2,688)</td>
<td>Purchased electric vehicle</td>
</tr>
</tbody>
</table>

- RECS 2009
  - Average NY home – 56 kBtu/s.f.
Net zero neighborhoods provide a natural laboratory for examining occupant impact

- Numerous participants in one neighborhood, near identical construction methods and design
- Very different occupant characteristics and attitudes
EARLY OBSERVATIONS

- 88% of metered homes report they do not set back thermostats or make an effort to turn off lights
  - Paraphrasing: “I already made my investment by buying a NZE home, why bother to set back the thermostat?”
- Jevon’s paradox/rebound effect? Or just an opportunity to improve performance?

NEXT STEPS

- Continue metering through winter 2017
  - Cold weather performance of ASHP systems and coincidence with PV generation is of interest
- Deeper dive into impact of occupant characteristics/behavior and energy use
- Delivery of performance metrics (e.g. kBtu/s.f.) of four tiers of residential performance
THOUGHTS FOR DISCUSSION

- What affect does the NZE label have on energy behaviors?
- What expectation can we have of NZE homes for achieving further savings?
- What is the role of super-efficient equipment and behavior change activities in a time of cheap PV?

---

THOUGHTS FOR DISCUSSION

- Performance is reliably achieved in “normal” looking and feeling homes
- Homes, at least those built by experienced NZE contractors, are cost competitive in the real estate market
- If we can build these homes and sell them at a competitive cost, then what is the next barrier to overcome? At least in some markets, the technical and cost barriers are pretty well breached.
THANK YOU!

Questions and discussion

Nick Collins – ncollins@ers-inc.com  Ryan Pollin – rpollin@ers-inc.com