Natural Gas EE Programs

Expanding Opportunities with Emerging Technologies

NARUC Gas Committee
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Independent, _not-for-profit_ company established by natural gas industry

Providing natural gas and energy research, development and technology deployment services to industry, consumers, and government clients

Performing contract research, program management, consulting, and training

Wellhead to the burner tip including energy conversion technologies as well as renewables and energy efficiency
Residential Natural Gas Use Carbon Footprint

Improvements in EE for natural gas technologies and tighter building envelopes continue to reduce the carbon footprint of homes using natural gas.

As a result, residential natural gas use is a shrinking and small portion of U.S. carbon dioxide emissions.

Additionally, further improvements in gas appliance efficiency and even tighter building envelopes – along with blending renewable natural gas (RNG) – is the future low cost option for continued and dramatic reductions in residential carbon emissions.
Trends In Natural Gas Customer Efficiency

![Residential Natural Gas Use Trends](image)
Carbon emissions from home electricity use have peaked and are in a decline phase.

Reductions driven by natural gas displacing coal (about 75%) and wind and solar generation (about 25%).

Even with the large increase in the number of homes using natural gas carbon emissions has been flat and recently declining.
Residential Energy Prices

<table>
<thead>
<tr>
<th>Residential Energy</th>
<th>$/MMBTU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity ($0.127/kWh)</td>
<td>36.78</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>10.06</td>
</tr>
<tr>
<td>Ratio</td>
<td>3.66</td>
</tr>
</tbody>
</table>

Residential Electric and Natural Gas Prices

Electricity ($0.127/kWh)
Natural Gas
Consumers’ Preferences

Home energy consumers have a strong preference for using natural gas.

From Energy Solutions Center Report:
As energy efficiency programs, codes & standards, and markets mature, low hanging fruit disappears. (e.g. CFLs)

Low natural gas prices make paybacks longer and efficiency gains more challenging.

High capital cost efficiency ‘upgrades’ present adoption barriers across all market sectors.

Higher measure costs during initial program launch discourage the inclusion of new measures or concepts which may provide meaningful value to ratepayers and the program.
Bridging the Gap Between R&D and EEPs with ETPs

- R&D investment creates innovations for energy efficiency programs, but the transfer to programs requires support.

- Realizing the potential of successful innovation in the marketplace requires an effective and continuous link between upstream R&D and downstream energy efficiency programs (EEP).

- To capture the full value created by R&D investments, it is necessary to invest in linkages between upstream R&D and energy efficiency programs.

ETP has a unique role to play within an energy efficiency portfolio, bridging the gap between research and development (R&D) and program implementation.
What Can ETPs Accomplish?
What is the Process?

<table>
<thead>
<tr>
<th>ETP</th>
</tr>
</thead>
<tbody>
<tr>
<td>As energy efficiency programs, regulations, and markets mature, low hanging fruit disappears. ETP helps <strong>deliver a pipeline of new technologies and program solutions</strong> enabling programs to meet tomorrow’s energy efficiency goals with <strong>less risk and more certainty</strong>. ETP is designed to help <strong>identify and evaluate the most promising products and integrated solutions</strong>, assess their suitability for future use in utility energy efficiency programs, and <strong>deliver comprehensive program guidelines for successful full scale deployment</strong>.</td>
</tr>
</tbody>
</table>

1. Identification and review of technologies and program concepts using criteria such as market readiness, market and technical potential, potential for cost-effective energy savings, and enabling market infrastructure such as distribution and service network.

2. Deployment of assessments and scaled field placements that expand technical and market understanding of performance, reliability, and serviceability help to reduce risk to energy efficiency programs and consumers. Potential for better understanding of non-energy benefits.

3. Market transformation—information and infrastructure—including training guidelines, delivery challenges, contractor relationships—needed to remove market barriers.
ETPs Growing

Many States with long-running energy efficiency programs are recognizing the value of ETP and direct a portion of their EE rate payer funding towards ETPs.

ETP Envisioned and Enabled in EEP Legislation

In 2009, IL SB 1918, an amendment to Illinois Power Agency Act, allowed Illinois energy efficiency programs to allocate up to 3% of EEP revenue for ‘demonstration of breakthrough equipment and devices.’

In 2017 new energy legislation increased the percentage to 6% of EE funds to be use for ‘demonstration of breakthrough equipment and devices.’

ETP Added to Existing EEP During EEP Plan Filing

California stakeholders, including IOUs and the CPUC, identified the need for ETPs. Based on multi-lateral discussions, it was decided that IOUs, with their lead role in energy efficiency program administration, were best positioned to address the ET function.

Beginning in late 1990s, IOUs included an ET function within their overall energy efficiency program filing. California’s ETPs have grown and matured ever since.

ETP Administered by the State, For EEPs

In States like New York and Minnesota, ETPs are administered by state agencies for the benefit of energy efficiency programs, often administered by IOUs.

Selected States with ETP-Type Approval

- California
- Illinois
- Massachusetts
- Michigan
- Minnesota
- New York
- Oregon
- Rhode Island
- Washington
- Wisconsin
Energy Efficiency Program Collaboration
Emerging Technology Program

> Gas Technology Institute led, utility supported, North American collaborative targeting residential, commercial, and industrial solutions

> ETP's principle goal is to accelerate the market acceptance of emerging energy efficient technologies
Nicor Gas Emerging Technology Program

GTI implements the Nicor Gas ETP. Nicor Gas serves more than 2.2 million gas customers across Chicagoland.

- **75+ applications**: Received more than 75 applications from manufacturers, sales representatives and contractors.
- **20+ pilot projects**: Launched more than twenty pilot projects in residential, commercial and industrial markets.
- **5 new rebates launched (2 more to be added in 2018-2019)**: Identified, evaluated and facilitated 5 emerging technologies as new rebates through energySMART, a Nicor Gas program.
Nicor Gas Emerging Technology Program (Continued)

**ETP Benefits to a Startup Company Applicant!**
Here is what - #1077: Dynamic Air Balancing System ETP Applicant had to say:

“...We made a number of improvements that have made our system much easier to install, less prone to installation mistakes, and more reliable. Working with a patient, experienced installer was extremely valuable and influential to our product design and commercialization process.”

“...studies conducted by independent third-parties are the most valuable tool we have when discussing the new technology with potential businesses and is foundational to our business development and growth.”

**Pilot #1001 - High efficiency heating rooftop units (RTU)**
The pilot is helping to transform the early market development of 100% outdoor air (OA) condensing RTUs. The pilot work is being cited by Consortium for Energy Efficiency (CEE).

“The pilot identified commercial applications that can address the adoption of condensing RTUs. 100% OA systems are emerging as the most promising early market entry point for the condensing RTUs.”
Case Study: High Efficiency Gas Rooftop Units

Collaboration with NREL, DOE, manufacturers, national accounts, and utilities

Large-scale monitoring shows diverse runtimes for RTUs and more therm use than energy models suggested

Based on monitoring results, targeted deployment of dedicated outside air systems (DOAS) as high efficiency market entry point application

Deployed condensing DOAS systems at “big box” retail accounts. Demonstrated practical and technical viability highlighted by roughly 4 year ROI w/o rebates.

Using UTD and ETP project results, GTI developed custom program calculator and technical reference manual calculation methodology to support deployment under efficiency programs

GTI lead effort to increase thermal efficiency of DOAS from 90% to 93% through lab-based R&D

Nicor Gas ETP demo pictured
> Two-stage modulating gas valve, temperature sensor, control unit.

> Industrial-sized modulating dryers are available at a high up front cost, but modulation is rare in smaller capacity dryers.

> Modulation technology is very mature but its application in dryers is more recent.

> Good fit in hospitality, laundromats, healthcare, dry cleaners, etc.

> Relatively modest installed cost of $700.

> Payback time of 2-3 years.
Modulating Dryer Technology: Nicor Gas ETP Field Demo

> 11 dryers were monitored in Nicor Gas territory:
  - Hotel (4 dryers – one 75 lb, one 120 lb, two 170 lb)
  - Laundromat (4 dryers – two 30 lb, two 45 lb)
  - Healthcare (2 dryers – two 75 lb)
  - Dry Cleaner (1 dryer – 50 lb)

> Long term monitoring is considered more accurate

<table>
<thead>
<tr>
<th></th>
<th>Long-Term Monitoring</th>
<th>Standardize Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Annual Gas Savings</td>
<td>333 therms</td>
<td>286 therms</td>
</tr>
<tr>
<td>% Annual Gas Savings</td>
<td>13.8%</td>
<td>12.4%</td>
</tr>
<tr>
<td>Average Annual Electric Savings</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>% Annual Electric Savings</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Annual Cost Savings</td>
<td>$250</td>
<td>$215</td>
</tr>
<tr>
<td>Payback Period</td>
<td>2.10 years</td>
<td>2.44 years</td>
</tr>
</tbody>
</table>
Modulating Dryer Technology: Transition to EE Programs

> Included in Illinois Technical Reference Manual, indicating the following savings numbers:

<table>
<thead>
<tr>
<th>Application</th>
<th>ΔTherms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coin-Operated Laundromats$^{762}$</td>
<td>267</td>
</tr>
<tr>
<td>Multi-family Dryers$^{763}$</td>
<td>193</td>
</tr>
<tr>
<td>On-Premise Laundromats$^{764}$</td>
<td>649</td>
</tr>
</tbody>
</table>

> Nicor now offers a $100 rebate for clothes dryer modulating controls which includes one qualifying product at this time: EZ-Efficiency BIO-Therm

> 30 to 250 lb capacity commercial dryer retrofit covered
Rheem H2AC™ Integrated Air & Water System

> **Technology:** The Rheem H2AC™ Rooftop Unit (RTU) takes the heat removed from an air conditioned space—which is typically exhausted—and transfers it to a water heater storage tank.

  - When cooling is required, it will recover the waste heat, and preheat hot water to as high as 125°F.
  - Waste heat recovery components are factory installed in the RTU, and leak checked. Minimizes installation error.

> **Proven Through Third Party M&V**

  > 3 GTI ETP project demonstrations complete.
  > 3 SoCal Gas technology assessments complete.
  > Industrial site with the California Energy Commission underway.

> **Best Applications**

  - Southern, Cooling-Dominated Climates (1,800 CDD+ year).
  - Target sites use the 15-ton system, and 1,500+ gallons hot water per day:
    > Restaurants (4,700 ft2 or larger), food processing, health clubs, hotels, assisted living.
## ETP Field Demos

<table>
<thead>
<tr>
<th>Spire Territory</th>
<th>APGA RF Territory</th>
<th>SDG&amp;E Territory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-Service Restaurant National Chain #1</td>
<td>Full-Service Restaurant National Chain #2</td>
<td>Full-Service Restaurant National Chain #3</td>
</tr>
<tr>
<td>10-Ton Unit</td>
<td>15-Ton Unit</td>
<td>10-Ton Unit</td>
</tr>
<tr>
<td>100 Gallons</td>
<td>119 Gallons</td>
<td>80 Gallons</td>
</tr>
<tr>
<td>H2AC Installed May ‘14</td>
<td>H2AC Installed Aug. ‘14</td>
<td>H2AC Installed Nov. ‘14</td>
</tr>
<tr>
<td>Monitoring Concluded</td>
<td>Monitoring Concluded</td>
<td>Monitoring Concluded</td>
</tr>
<tr>
<td>1400 Hot Water GPD</td>
<td>1750 Hot Water GPD</td>
<td>1300 Hot Water GPD</td>
</tr>
<tr>
<td>~35% hot water energy savings</td>
<td>~25% hot water energy savings</td>
<td>~30% hot water energy savings</td>
</tr>
</tbody>
</table>
Performance Conclusions

> Provided significant energy savings (25-35%).
> Simple paybacks ≤5 years under most scenarios.
> Both contractors and host sites would recommend the technology.

> Transition to programs:
  – GTI developed a performance model/calculator to estimate savings across many climates, hot water loads (based on # of meals served), and baseline water heater / RTU scenarios.

### Energy Savings and Payback

<table>
<thead>
<tr>
<th></th>
<th>Units</th>
<th>Tampa, FL 15 ton RTU</th>
<th>Birmingham, AL 15 ton RTU</th>
<th>Laguna Hills, CA 15 ton RTU</th>
<th>El Cajon, CA 15 ton RTU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incremental Cost</td>
<td>$</td>
<td>$7,500</td>
<td>$7,500</td>
<td>$7,500</td>
<td>$7,500</td>
</tr>
<tr>
<td>Adjusted Annual Gas Savings</td>
<td>Therms</td>
<td>3,314</td>
<td>2,962</td>
<td>3,602</td>
<td>3,319</td>
</tr>
<tr>
<td>Annual Gas Savings ($1.00/therm)</td>
<td>$</td>
<td>$3,314</td>
<td>$2,962</td>
<td>$3,602</td>
<td>$3,319</td>
</tr>
<tr>
<td>Annual Gas Savings ($0.70/therm)</td>
<td>$</td>
<td>$2,320</td>
<td>$2,073</td>
<td>$2,521</td>
<td>$2,323</td>
</tr>
<tr>
<td>Simple Payback ($1.00/therm)</td>
<td>Years</td>
<td>2.3</td>
<td>2.6</td>
<td>2.1</td>
<td>2.3</td>
</tr>
<tr>
<td>Simple Payback ($0.70/therm)</td>
<td>Years</td>
<td>3.2</td>
<td>3.6</td>
<td>3.0</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Figure 1: Rheem H2AC™ Energy Savings and Payback
Savings based on GTI calculator, developed with actual field results. Assumes 1,750 daily hot water use, .77 EF storage water heater, and 30 year average weather for each location. Table values should be used for discussion purposes only. Actual costs will vary by vendor, site, and contractor.
Summary

- Natural gas continues to be a low cost, low carbon fuel of choice for homeowners.
- Natural gas EE programs continue to grow in number and dollar amount across the country.
- As energy efficiency programs, codes & standards, and markets mature, low hanging fruit disappears. (e.g. CFLs)
- Low natural gas prices make paybacks longer and efficiency gains more challenging.
- High capital cost efficiency ‘upgrades’ present adoption barriers across all market sectors.
- Utilizing EE natural gas program dollars for emerging technologies is taking hold in many states and could be expanded to others.
- ETPs help deliver a pipeline of new technologies and program solutions enabling programs to meet tomorrow’s energy efficiency goals with less risk and more certainty. ETP is designed to help identify and evaluate the most promising products and integrated solutions, assess their suitability for future use in utility energy efficiency programs, and deliver comprehensive program guidelines for successful full scale deployment.
Questions?

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Natural Gas Efficiency: Progress & Opportunities

Steven Nadel, Executive Director
Presentation to NARUC Gas Committee
Feb. 13, 2018
The American Council for an Energy-Efficient Economy is a nonprofit 501(c)(3) founded in 1980. We act as a catalyst to advance energy efficiency policies, programs, technologies, investments, & behaviors.

Our research explores economic impacts, financing options, behavior changes, program design, and utility planning, as well as US national, state, & local policy.

Our work is made possible by foundation funding, contracts, government grants, and conference revenue.

aceee.org @ACEEEEdc
Normalized Natural Gas Consumption

Source: ACEEE, Nadel 2017 (based on EIA, BLS and FRED data)
Real Natural Gas Prices

Source: ACEEE, Nadel 2017 (based on EIA data)
Energy Consumption of New Homes and Buildings Meeting National Model Codes

Source: ACEEE analysis using DOE data
Savings from Appliance Efficiency Standards

Source: ACEEE, Nadel 2017 (based on ASAP data)
Utility Energy Efficiency Spending

Source: ACEEE, Berg et al. 2017
Net Incremental Savings from Gas-Utility Funded Programs

Source: ACEEE, Nadel 2017 and Berg et al. 2017
Utility Program Savings by State

Source: ACEEE, Nadel 2017 (data from Berg et al. 2016)
Incremental Net 2015 Natural Gas Savings by Utility as a % of Sales

Source: ACEEE, Nadel 2017
Total 2015 Savings from Utility-Funded Programs as a % of Sales

<table>
<thead>
<tr>
<th>State</th>
<th>Savings as % of R+C sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vermont</td>
<td>6.4</td>
</tr>
<tr>
<td>Minnesota</td>
<td>5.7</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>5.2</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>5.0</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>4.9</td>
</tr>
<tr>
<td>Michigan</td>
<td>4.4</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>4.0</td>
</tr>
<tr>
<td>Oregon</td>
<td>3.6</td>
</tr>
<tr>
<td>Iowa</td>
<td>3.5</td>
</tr>
<tr>
<td>Arizona</td>
<td>2.8</td>
</tr>
<tr>
<td>California</td>
<td>2.7</td>
</tr>
<tr>
<td>Utah</td>
<td>2.6</td>
</tr>
</tbody>
</table>

Source: ACEEE, Nadel 2017
State with Gas Decoupling and Performance Incentives

States with Natural Gas Savings Targets

Source: ACEEE, Berg et al. 2017
## Comparison of States with and without Gas Savings Targets

<table>
<thead>
<tr>
<th>Policy</th>
<th>No. of states</th>
<th>Average EE $/residential customer</th>
<th>Avg. EE savings as % of R+C sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>No target</td>
<td>33</td>
<td>$4</td>
<td>0.08%</td>
</tr>
<tr>
<td>Target</td>
<td>17</td>
<td>$33</td>
<td>0.82%</td>
</tr>
</tbody>
</table>

Detroit Edison Energy Savings Potential

Source: DTE Energy 2016
ACEEE Estimate of 2030 Savings Potential

26% potential

Perhaps half achievable

Source: ACEEE, Nadel 2017
Emerging Areas

- Combined heat and power, particularly as a resiliency strategy for hospitals and other critical infrastructure
- Transportation, particularly heavy trucks
- Coordination between gas, electric and water utilities
- Electrification, particularly vehicles and space/water heating