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Heating Electrification and Rate Design

Urban Sustainability Directors Network/Building Electrification Initiative

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Outline for Today

- Heating Electrification Economics
- Rate Design Overview and Principles
- Affordable Bills for Electric Heating
- Conclusions
1 Heating Electrification
Economics
**Beneficial Electrification (BE) - Three Conditions**

1. Saves Customers Money Over Long-Term
2. Reduces Environmental Impacts
3. Enables Better Grid Management
Consumer Economics: Key Factors

• Incremental cost of installation
  • Space cooling desired?
• Efficiency of heating options
• Cost of fuel
• Building thermal efficiency
Home temperature loss after 5 hours

With a temperature of 20°C inside and 0°C outside

- Norway: 0.9°C
- UK: 3°C
- Belgium: 2.9°C
- France: 2.5°C
- Spain: 2.2°C
- Sweden: 1.2°C
- Denmark: 1.2°C
- Netherlands: 2.4°C
- Germany: 1°C
- Austria: 1.2°C
- Italy: 1.5°C

Based on a sample of over 80,000 European homes

Source: https://www.tado.com/t/en/uk-homes-losing-heat-up-to-three-times-faster-than-european-neighbours/
2 Rate Design Principles
General Goals of Rate Design

- Efficient forward-looking price signals
- Recovery of revenue requirement
- Equitable intra-class cost allocation
- Customer understanding and acceptance
- Achievement of public policy goals

Within overarching frame of imposing pricing discipline equivalent to competitive markets
Key Terms for Rate Design

• **Customer Charge**: Fixed monthly fee to access utility service

• **Energy Charge**: Price per kWh of consumption

• **Demand charge**: A rate charged on a customer’s highest 15- or 30-minute individual peak usage
  
  • Typically defined as highest non-coincident individual peak over whole month, but sometimes during “peak window”
Key Terms for Rate Design

• **Time of use (TOU) rate**: Time-varying kWh prices with preset times and price schedules

• **Critical peak pricing (CPP)**: Higher rate for highest 50-100 hours in year

• **Peak time rebate (PTR)**: Bill discount for reductions below baseline at peak times

• **Demand response**: Program that compensates customer for reducing load in response to signal
Smart Rate Design Principles

• **Principle #1**: A customer should be allowed to connect to the grid for no more than the cost of connecting to the grid.

• **Principle #2**: Customers should pay for power supply and the grid in proportion to how much they use, and when they use it.

• **Principle #3**: Customers delivering power to the grid should receive full and fair value — no more and no less.
Rate design should make the choices the customer makes to minimize their own bill consistent with the choices they would make to minimize system costs.
## Illustrative Smart Rate Design

<table>
<thead>
<tr>
<th></th>
<th>Residential</th>
<th>Medium C&amp;I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Charge ($/mo.)</td>
<td>Multifamily: $7</td>
<td>$25</td>
</tr>
<tr>
<td></td>
<td>Small Single-Family: $10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Large Single-Family: $15</td>
<td></td>
</tr>
<tr>
<td>Site Infrastructure ($/kW)</td>
<td>N/A</td>
<td>$2</td>
</tr>
<tr>
<td>Off-peak (cents per kWh)</td>
<td>7 cents</td>
<td>5 cents</td>
</tr>
<tr>
<td>Mid-peak (cents/kWh)</td>
<td>9 cents</td>
<td>8 cents</td>
</tr>
<tr>
<td>On-peak (cents/kWh)</td>
<td>14 cents</td>
<td>13 cents</td>
</tr>
<tr>
<td>Critical peak (cents/kWh)</td>
<td>75 cents</td>
<td>75 cents</td>
</tr>
</tbody>
</table>
3 Affordable Bills for Electric Heating
The Opportunity of Time-Varying Rates

- Time-varying rates provide new electric end-uses the opportunity, but not a guarantee, of lower bills
  - Depends on ability to avoid high-cost times
- To what extent is high demand for electric heating correlated with high-cost times?
  - With extensive electrification of heating, more regions may be “winter peaking”
- Affordable battery storage will increase flexibility for all customers
Thermal Efficiency is Key

• Allows “pre-heating/cooling” in advance of high price hours without loss of comfort
• Allows efficient unit sizing
  • Reduces upfront costs and ongoing electricity costs
• Thermal storage (e.g., ceramic bricks or advanced construction materials) is another alternative, but may be costly
The Trouble with Rate Discounts

• Generous “whole house” rate structures for electric heat risk disincentivizing energy efficiency more broadly
• Separate rates for specific end-uses have additional metering and billing costs
• Efficiency of electric heating and transportation will be enormously important sooner rather than later
Grid Management Programs

- Demand response programs provide payments for curtailment at key times
  - Is it worth it for the customer? Is there a loss of comfort?
- Ancillary services markets provide payments for more granular responses to support the grid
  - Frequency regulation and voltage support
4 Conclusions
Key Takeaways

- Improved rate design can lower system costs and unlock demand-side resources
- Good rate design is typically technology-neutral
  - Opportunities to lower bills come from controlling load into low-cost times
- Thermal efficiency saves money in multiple ways
  - Lower capital costs, lower fuel costs, and increased flexibility for time-varying rates
- Specific grid programs are more sustainable than outright discounts
Resources from RAP

- Smart Rate Design for a Smart Future
- Smart Non-Residential Rate Design
- Beneficial Electrification (four-part series)
- Beneficial Electrification of Space Heating
About RAP

The Regulatory Assistance Project (RAP)® is an independent, non-partisan, non-governmental organization dedicated to accelerating the transition to a clean, reliable, and efficient energy future.

Learn more about our work at raponline.org