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Heating Electrification and Rate Design

Urban Sustainability Directors Network/Building Electrification Initiative

Mark LeBel
Associate
Regulatory Assistance Project (RAP)®

50 State Street, Suite 3
Montpelier, Vermont 05602
USA

802-498-0732
mlebel@raponline.org
raponline.org

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

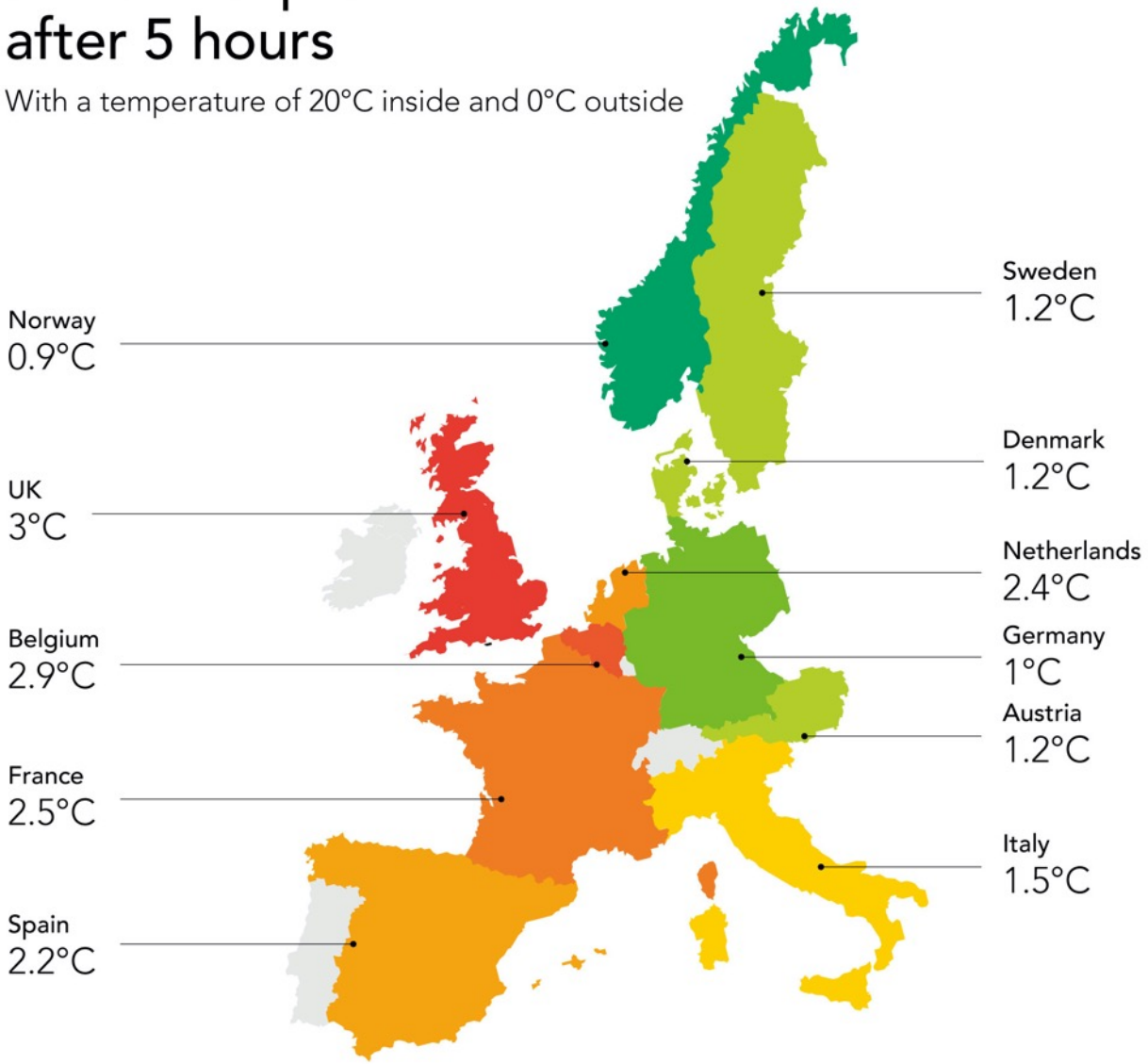
Consumer Economics: Key Factors

- Incremental cost of installation
  - Space cooling desired?
- Efficiency of heating options
- Cost of fuel
- Building thermal efficiency

Home temperature loss after 5 hours

tado°

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



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

	Residential	Medium C&I
Customer Charge ($/mo.)	Multifamily: $7 Small Single-Family: $10 Large Single-Family: $15	$25
Site Infrastructure ($/kW)	N/A	$2
Off-peak (cents per kWh)	7 cents	5 cents
Mid-peak (cents/kWh)	9 cents	8 cents
On-peak (cents/kWh)	14 cents	13 cents
Critical peak (cents/kWh)	75 cents	75 cents

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

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