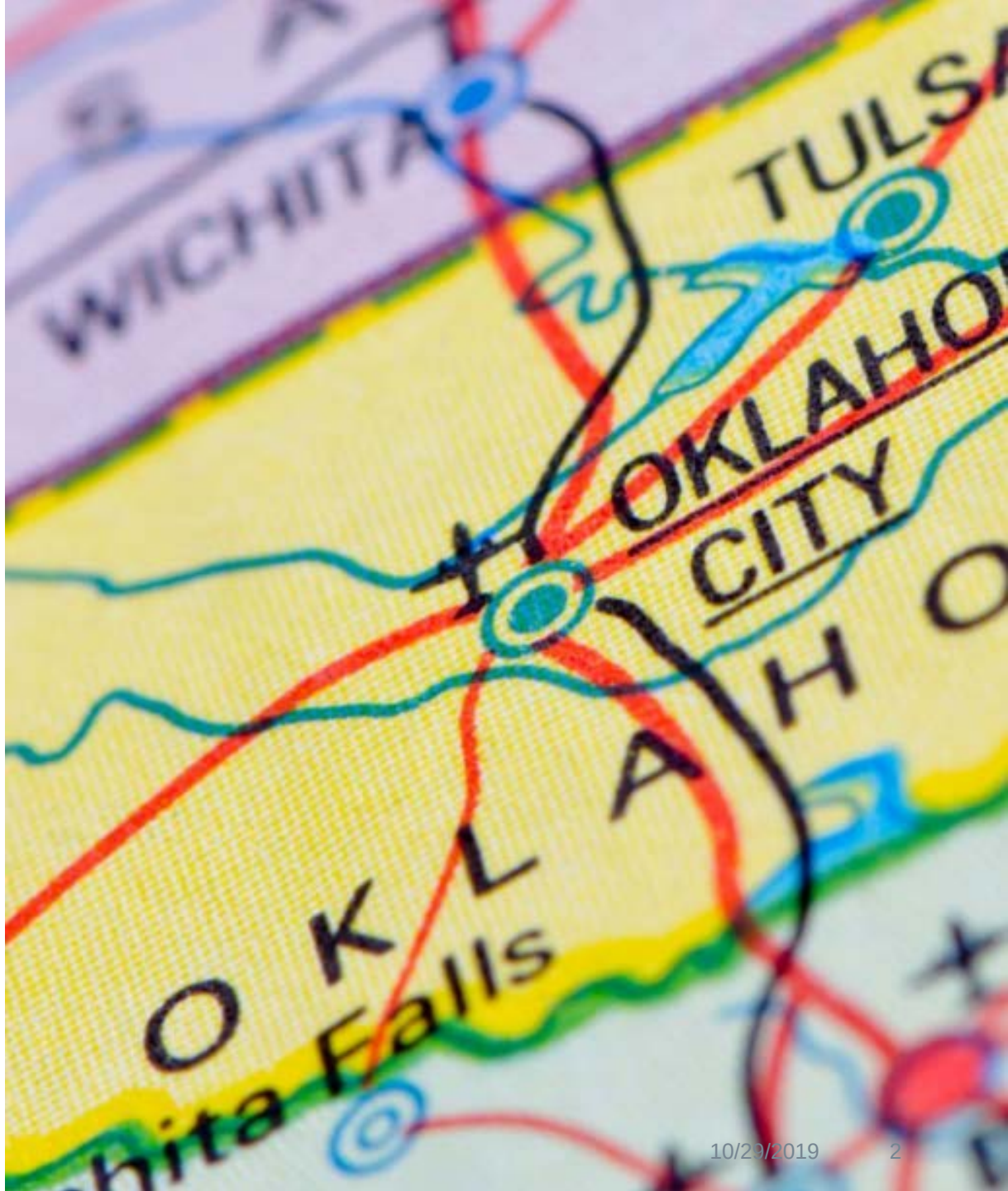
Turning Up the Heat: A Non-Wires Assessment of a Winter Peaking Feeder in the South-Central US

2019 ACEEE Energy Efficiency as a Resource Conference

David Pudleiner
DER Analytics Team

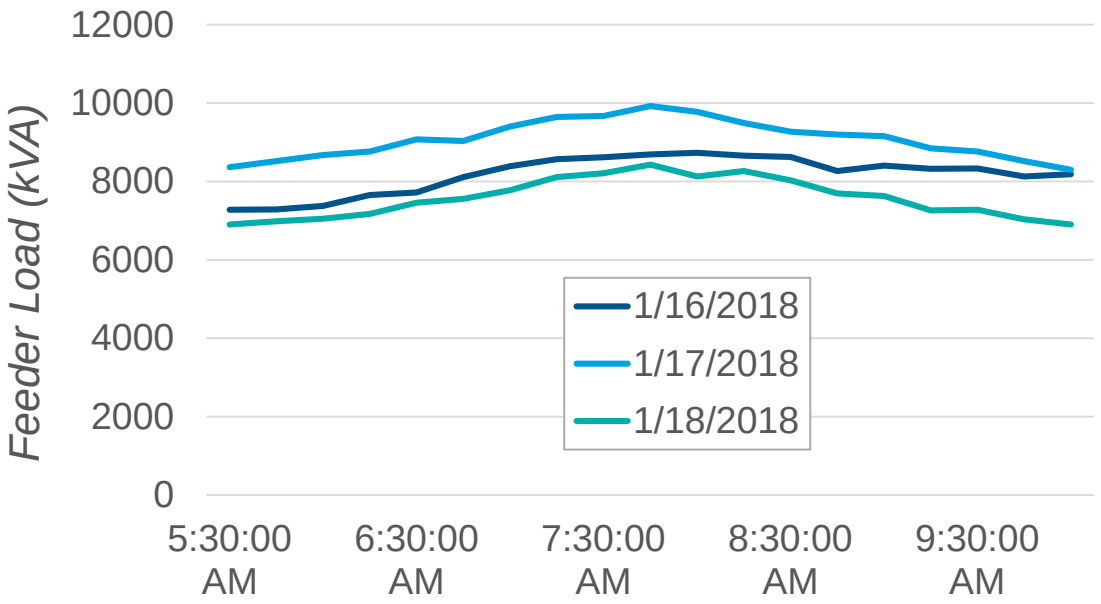
It Gets Cold in Winter, Even in Oklahoma

- **Location**: A small town in Oklahoma
- **Utility:** Public Service Company of Oklahoma (PSO)
- **Number of Customers:**
  - Residential: ~400
  - Commercial: ~60
  - Public Authority: ~20
- **Motivation for this preliminary assessment**
  - High intensity loads during the winter season
  - Opportunity to reach communities usually underserved by traditional EE programs
- **NWA Potential Deferral Costs** ~$3-5 Million
- **Desired Load Reduction** ~0.5 MW

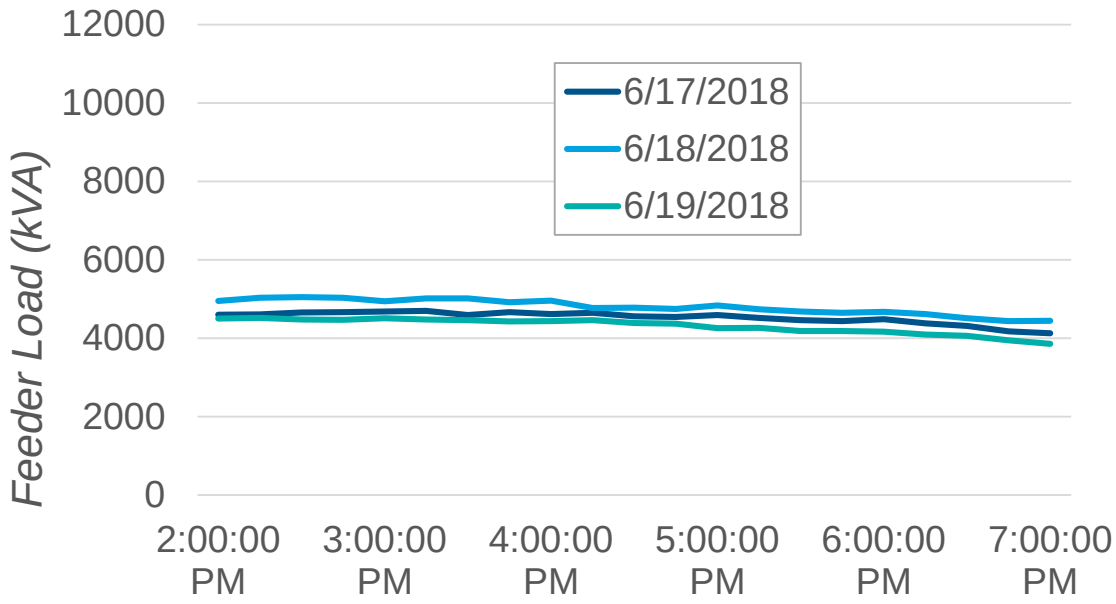


Digging into the Feeder Load Data

- **Winter Morning Peaks**
  - 60% Residential – 1882 kW
  - 25% Commercial – 790 kW
  - 13% Public Authority – 390 kW

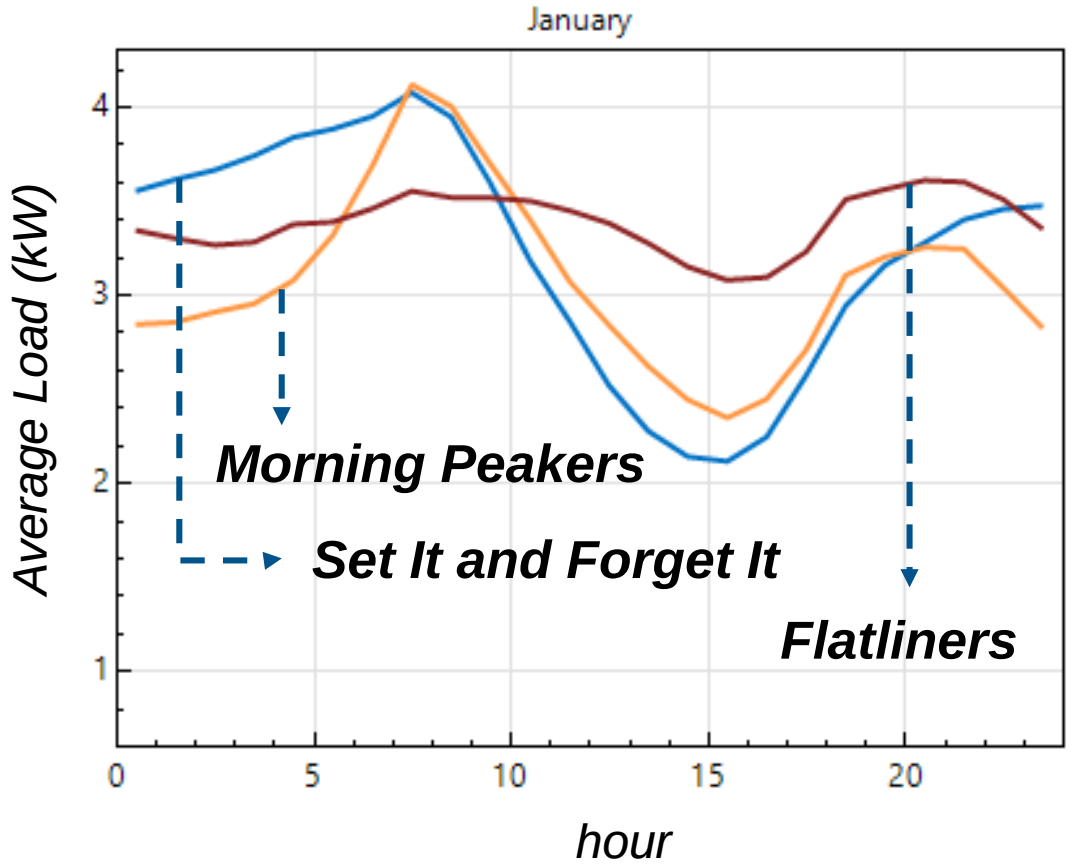


- **Equivalent Reductions per Customer**
  - Residential – 0.96 kW
  - Commercial – 2.61 kW
  - Public Authority – 3.44 kW

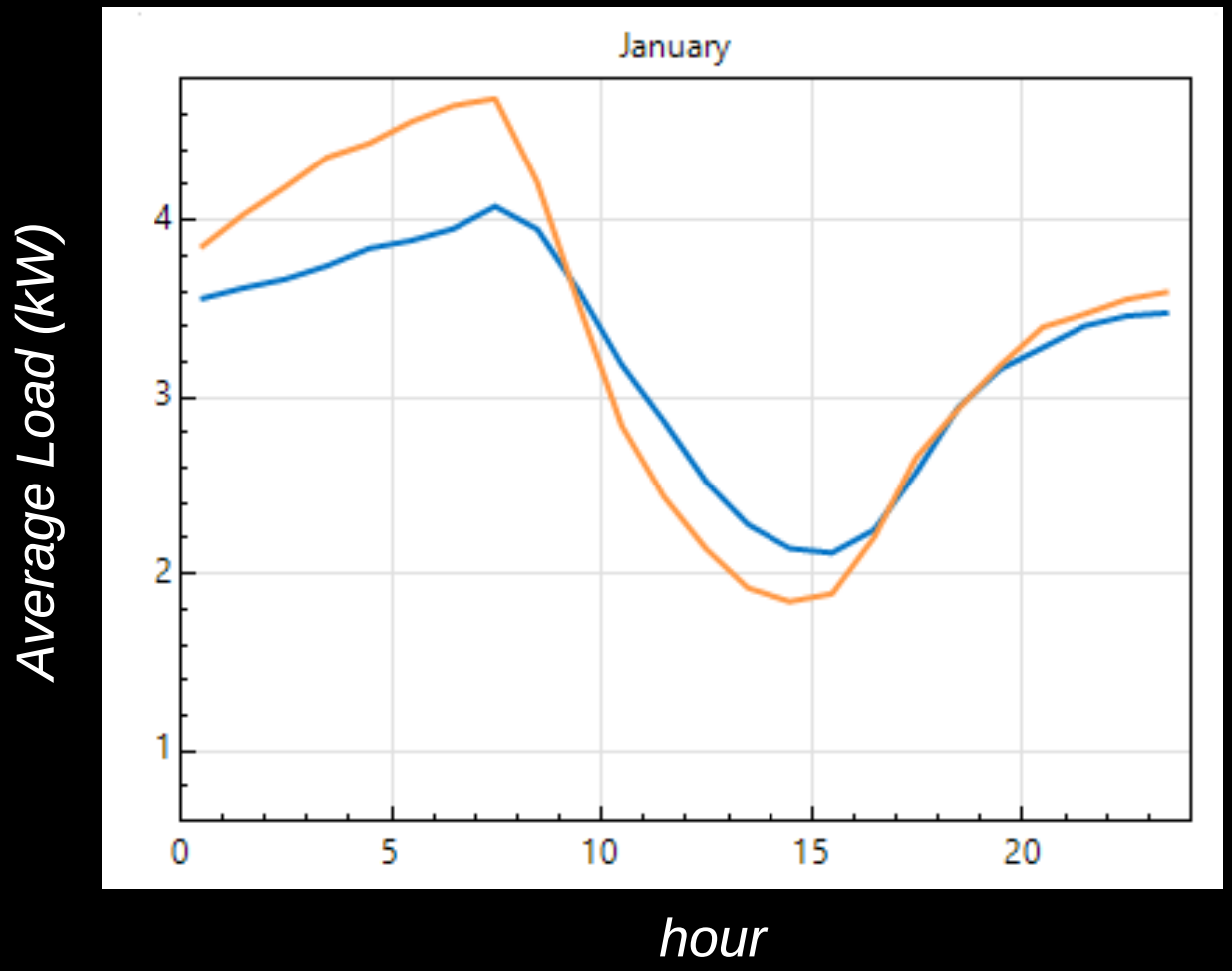


AMI Insight #1: Residential Customer Categorization

- **Average 24-hour profiles for each month revealed 3 key customer categories**
- **Morning Peakers**
  - Characterized by night setback and morning ramp up, highest burden
- **Set It and Forget It**
  - Heating consumption pattern closely matches outdoor temperature trends
- **Flatliners**
  - Consumption does not follow temperature trends as expected, indicative of manually controlled heating



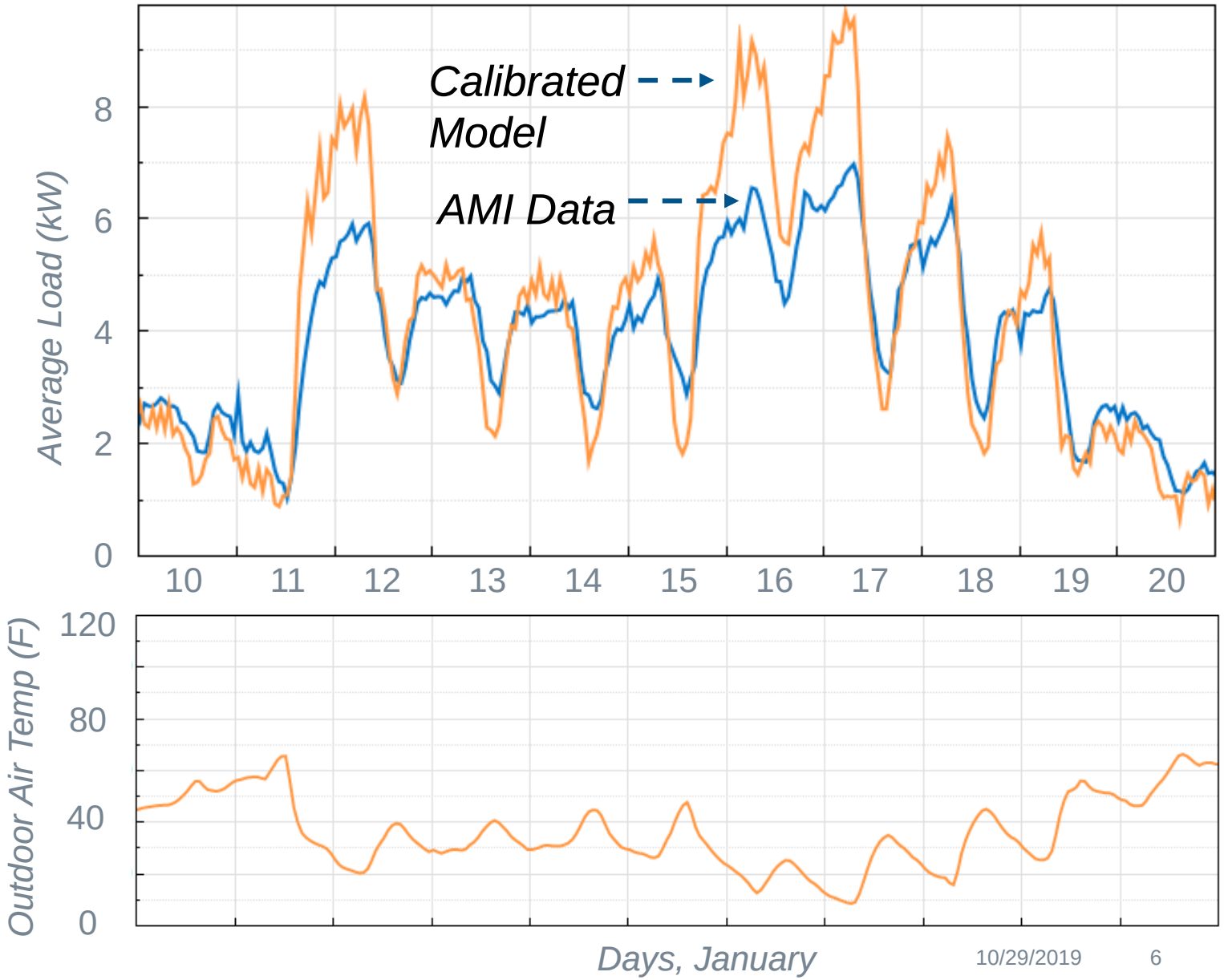
AMI Insight #2: Calibrated Energy Modeling



AMI Insight #3: The Cold Weather Gap

- **On the coldest nights, there is a significant gap between modeled and metered consumption**
- **Possible explanations**
  - Thermostat setback during the coldest nights
  - Heating system unable to keep up with demand

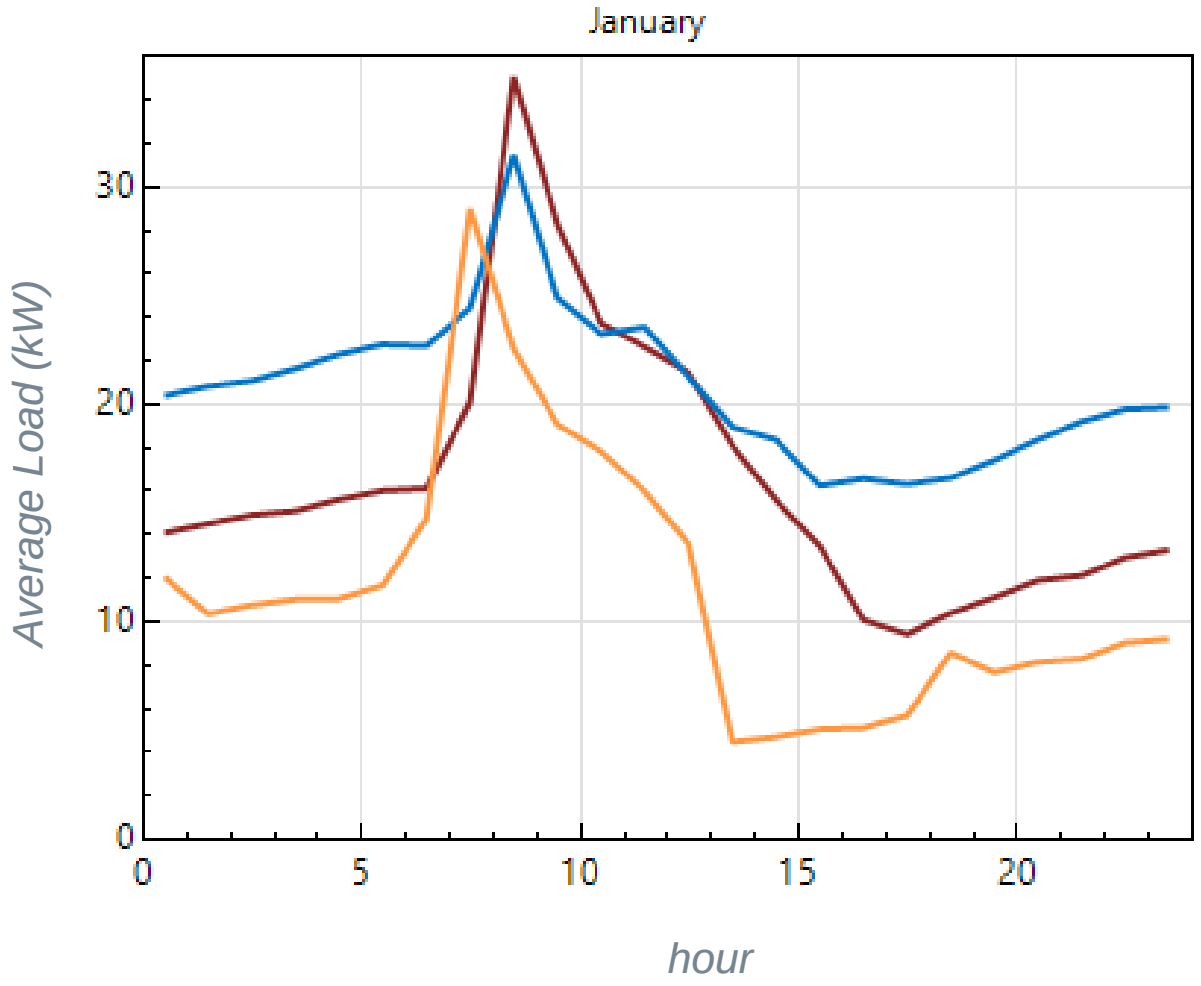
- **No matter the reason, indicates probable rebound effect**
- **BEM provides mechanism to calculate the rebound impact**



AMI Insight #4: Peak Loads from Educational and Institutional Facilities

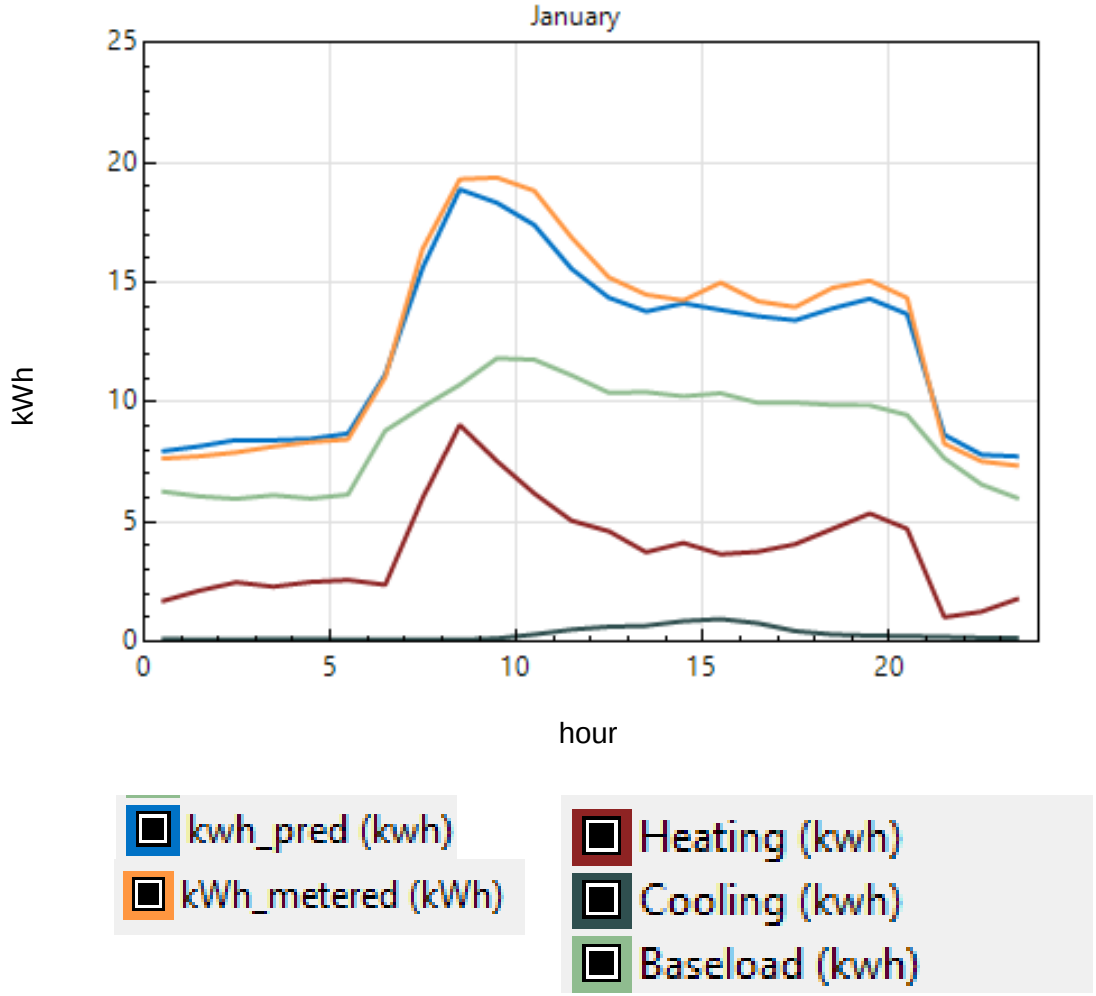
- Educational and institutional facilities have a significant morning ramp ups
- Provides an opportunity for load shifting to an earlier part of the morning, prior to aggregate town peak
- Average of 10-15 kW of load relief per customer estimated
- Extremely cost-effective measure; provides the opportunity for large incentives to help support local community centers

Average Hourly Loads for Three Educational/Institutional Customers



AMI Insight #5: Hourly Disaggregation of Non-Residential Customers to Identify Heating Loads

- Due to the diversity & sample size of commercial customers, BEM was not pursued
- Instead, utilized inverse modeling for hourly disaggregation of heating, cooling and baseload
- Conducted for top 30 influential non-residential customers, equivalent to 82% of sector peak
- Used in combination with data gained from field visits which identified existing heating equipment for commercial customers



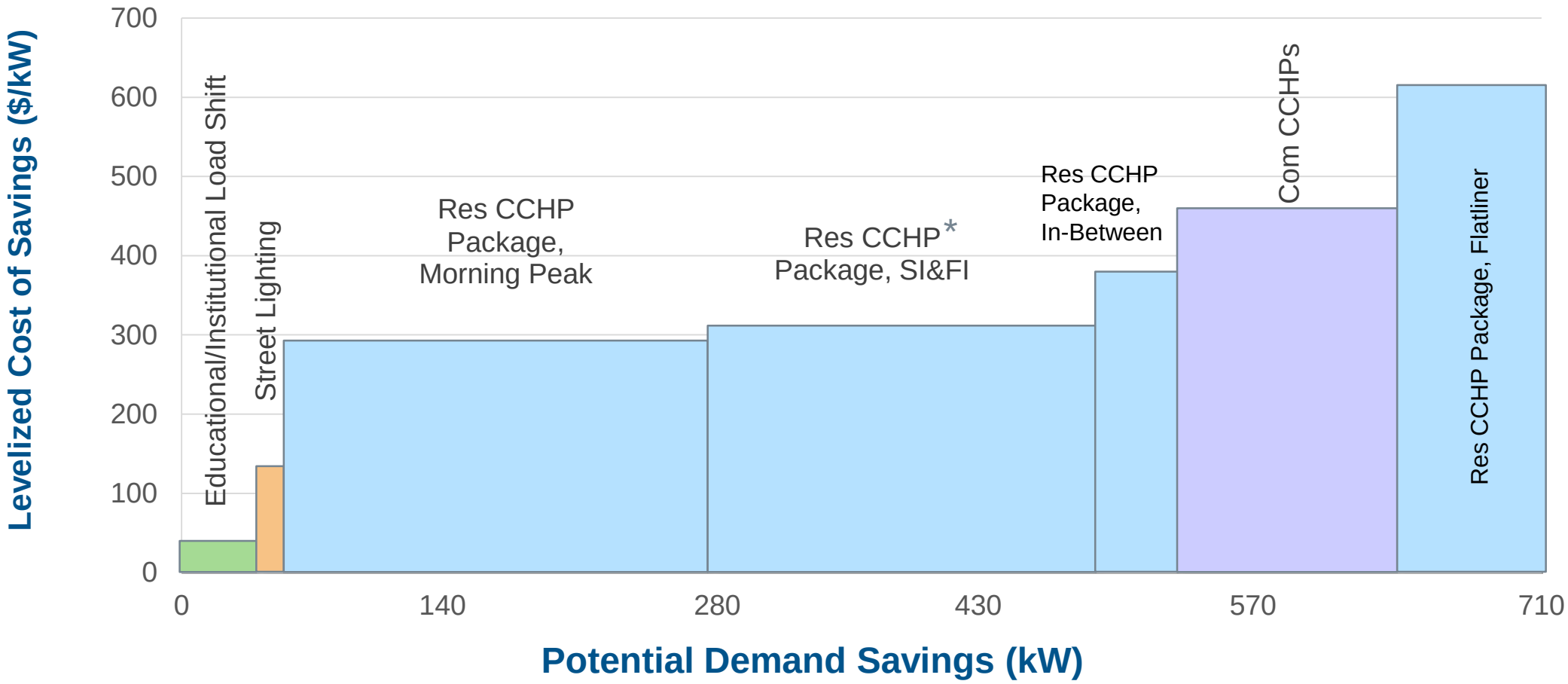
Several Challenges of the Situation . . .

- **Customer base has a very low threshold for upfront investment**
- **Minimal historical EE & DR program participation**
  - Residential customers show minimal participation on direct load control offerings
- **Typical participation rates from traditional income eligible weatherization programs is not enough**

But the good news . . .

- **Significant avoided distribution costs**
- **Non-existent to minimal foreseeable future load growth**
- **Income eligible weatherization achieving high kW per home**
  - 0.65 summer kW per home on average

Measure Supply Stack for Consideration



**Cold Climate Heat Pump*

Initial Focus Areas: Res Weatherization & HVAC, Commercial Load Shifting & Street Lighting

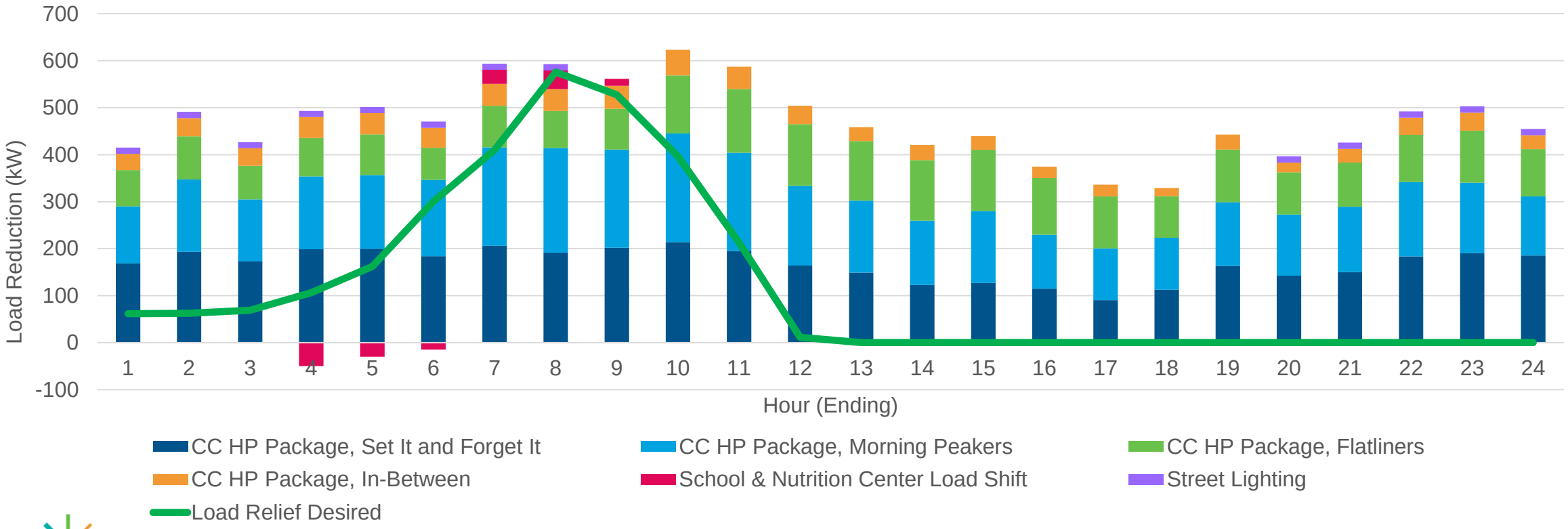
- Potentially fully incentivized weatherization + cold climate heat pumps for electrically heated homes
- Commercial load shifting for educational/institutional buildings
- Upgrading of street lighting in the town to LED

Measure	Summer kW Savings	Winter kW Savings	Annual kWh Savings	Incremental Measure Cost	Participation (% of eligible population)
Weatherization + CCHP Package, SI&FI	0.13	2.81	2,544	$10,800	85%
Weatherization + CCHP Package, MP	0.10	3.01	2,658	$10,800	85%
Weatherization + CCHP Package, FL	-0.49	1.65	2,569	$10,800	85%
Weatherization + CCHP Package, IB	-0.19	2.72	1,637	$10,800	85%
Educational/Institutional Building Load Shift	0	35	-1,717	$500	100%
Street Lighting	0	13.3	58,254	$61,537	100%

How it All Shakes Out

- Significant additional avoided energy costs from weatherization & CCHPs boost the cost effectiveness
- Savings would increase as weather becomes more extreme, especially for morning peak customers

Total Load Reduction	588 kW
TRC Cost-Effectiveness Ratio	1.24



Takeaways

- AMI provides actionable insights for non-wires program design
  - Targeted savings projections
  - Better understanding of customer base
  - Identification of unique & customer specific opportunities

- High avoided distribution costs can allow for innovative customer offerings

- Value streams other than avoided distribution costs can significantly impact NWA program cost effectiveness

Thank you!

Questions?

David Pudleiner

David.Pudleiner@icf.com