Surprising Insights
from
Electricity Customer Micro Data

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Energy Analytics

Goal today–

Generate discussion, seek feedback

and move the discussion forward.

Sagewell Introduction

- Smart meter data analytics software provider
- Strategic electrification analysis
- Utility customer sizes: from 10,000 to 4 million meters
- Started as an energy efficiency company
- Based in Woburn, MA
  - Employees in Michigan, North Carolina, New York and California

Awards

Energy Innovator of the Year
Braintree Electric Light Department - 2018
For Sagewell's use of AMI meter data in *Bring Your Own Charger®* (BYOC) program and in strategic electrification programs

"Game Changer Company" Award - Sagewell
By The Boston Globe for innovation in energy markets

Associate member of the year
Sagewell - 2017
AMI data analytics and use of data to grow strategic electrification program at public power utilities

Leading by Example Award
Belmont Light
For Sagewell's Innovative use of AMI meter data to drive strategic electrification programs (heat pumps and EVs) and energy efficiency programs

About the audience – lightning round

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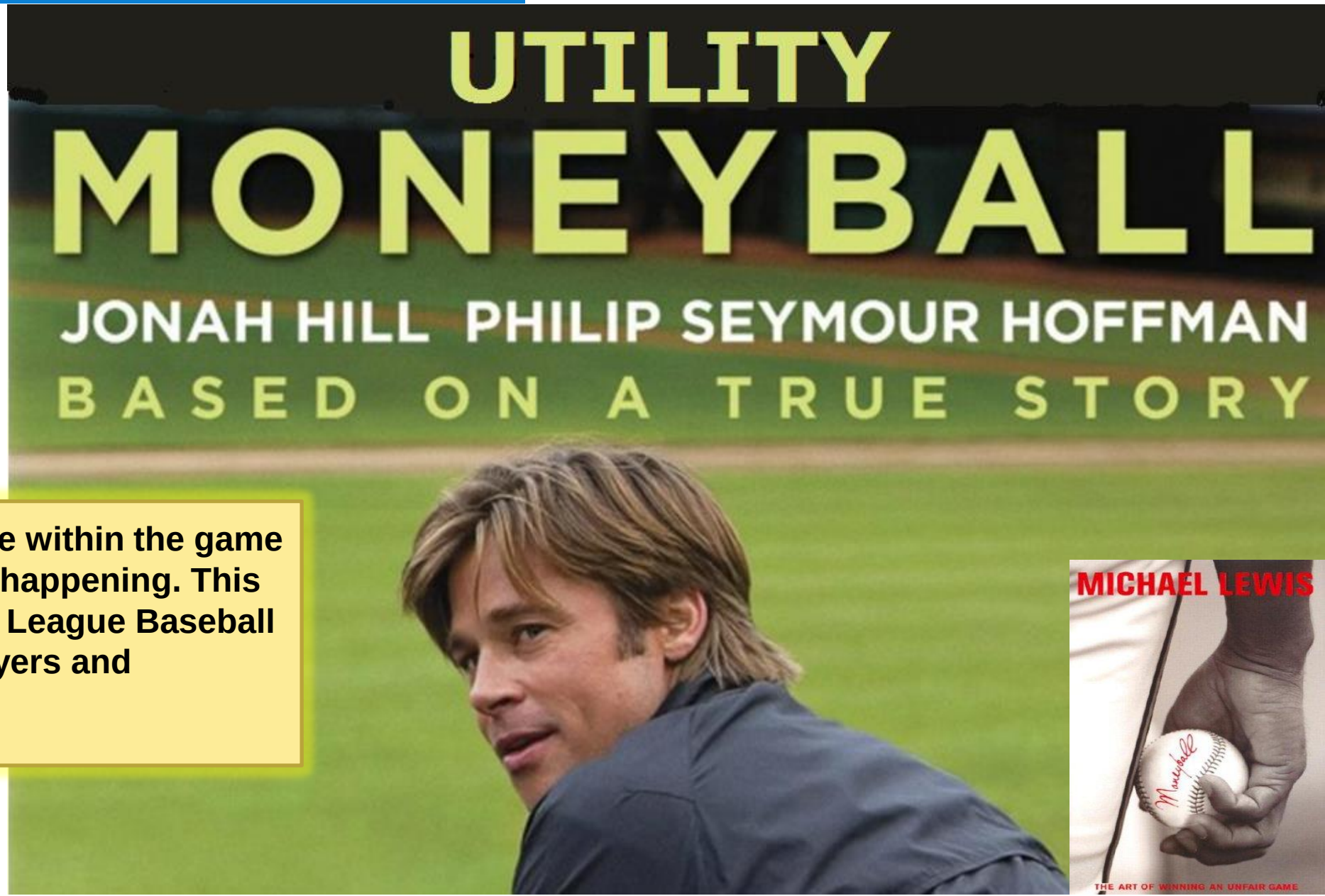
- Who has done a Mass Save® energy assessment (aka energy audit)?
- Who drives an electric vehicle?
- Who heats their home with a heat pump?
- Who has been a utility regulator?
- Who teaches utility-related classes?
- Who teaches or has taught utility accounting?
- Who has been an expert witness in utility cases?
- Who consults with utilities?
- Who has been or is currently a utility executive?
- Who has an MBA or took undergraduate business classes?
- Who has or currently runs a business?
- Who is a current student?

The game has changed

Many implications:

- M&A
- Management changes
- Regulatory changes
- Who keeps the money?



"There is an epidemic failure within the game to understand what's really happening. This leaves those who run Major League Baseball teams to misjudge their players and mismanage their teams."

- Peter Brand (Jonah Hill), Moneyball

This story is partly about

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Actual Economics vs. Regulatory ”Utility” Accounting

Compare to: Tax Accounting vs. Managerial Accounting

“Utility Accounting is ‘Imaginary’ Accounting”

“Utilities are run like faith-based initiatives”

Remember later:

1. **“Customers pay ‘real’ costs, not regulatory costs”**
2. **“Bills are paid with margins, not revenue”**
3. **Coined a term: “Activity-Based Margins”**

Many analysis and regulatory frameworks & stake holders

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- Environmental goals (e.g. CO2 reduction)
- Economic - e.g. maximize rate reduction
- Economic – e.g. Maximize utility shareholder ROI
- “fairness” / low income / etc.
- Results in significant policy advocacy & billions of dollars in capital allocation
- **But, what do we actually know about the economics of the utility business?**
- **What about environmental benefits of electrification?**
- **Have stake holders actually looked at the data on how customers use energy?**
- **What hard evidence do we have for most things beyond engineering related matters?**
- Implications: many significant decisions are not evidence-based!

Company rule

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"It is fine to speculate, just try to begin a sentence with:"

- "I suspect, although I have no data to back me up…"
- "I speculate without much evidence…"
- "Based on a spurious correlation, I infer that…"
- "I am making this stuff up…"

Telltale signs – look for the following vocabulary

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Words we hear often:

- "Cost allocation"
- "Avoided cost"
- "Regulatory cost"
- "Cost recovery"
- "Cost pass-through"
- "Decoupling"
- "Deemed savings"

- None are "reality-based"
- Remember "Moneyball"

Words we don't hear much:

- "Market prices"
- "Contribution margin"
- "Market share"
- "Product substitutes"
- "Competitive pricing"
- "Cost of customer acquisition"
- "Marketing"
- "Marginal profitability"
- "Opportunity cost"
- "Growth"

Evolution of customer analysis

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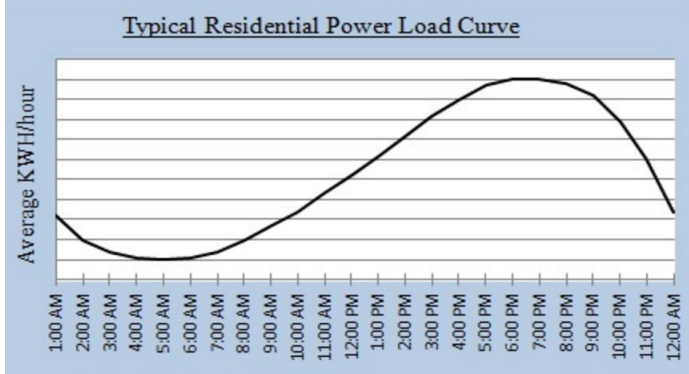
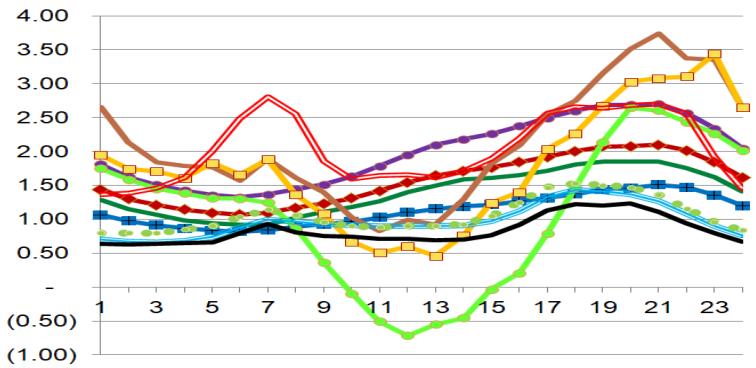
Past

1- load shape per class



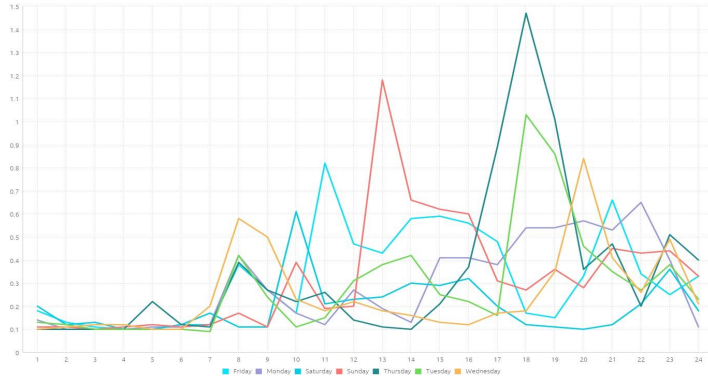
Near Past

Hundreds of load shapes per class



Present

Individual customer analysis



Principles behind analysis

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- First and foremost –a business analysis
- First evaluate actual economics without any regulatory adjustments/ distortions
- Then review regulatory frameworks and their impact on “actual” economics

Modeled vs. actual load shapes by customer class

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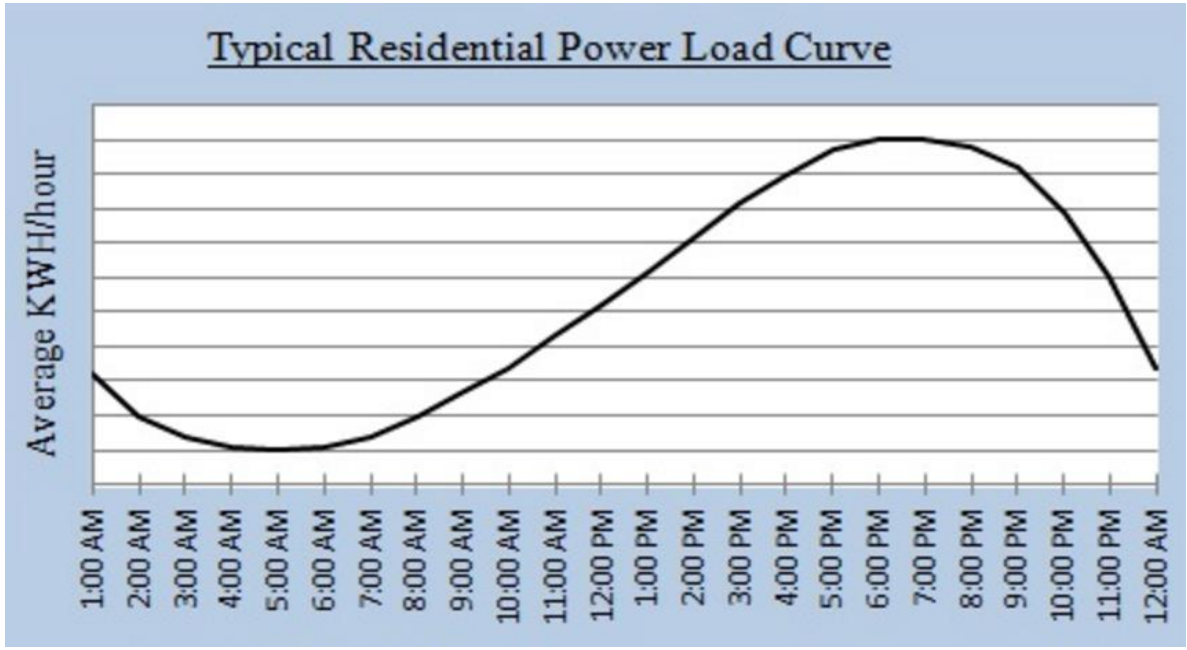
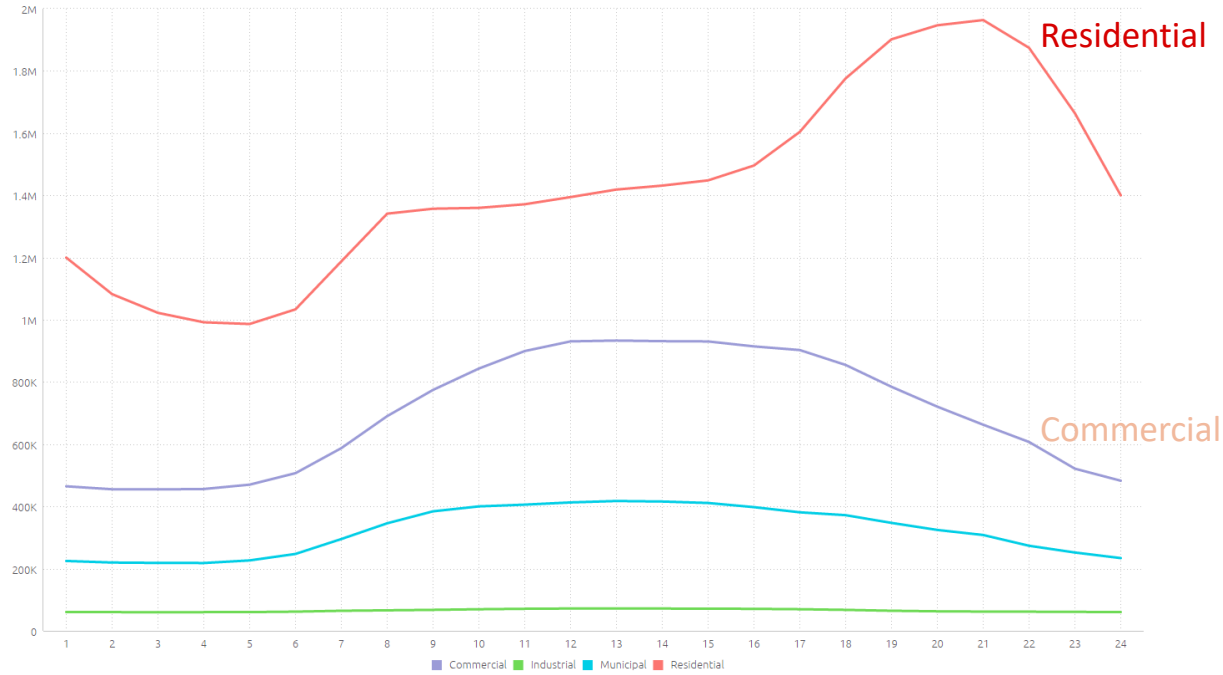
Reference load shape



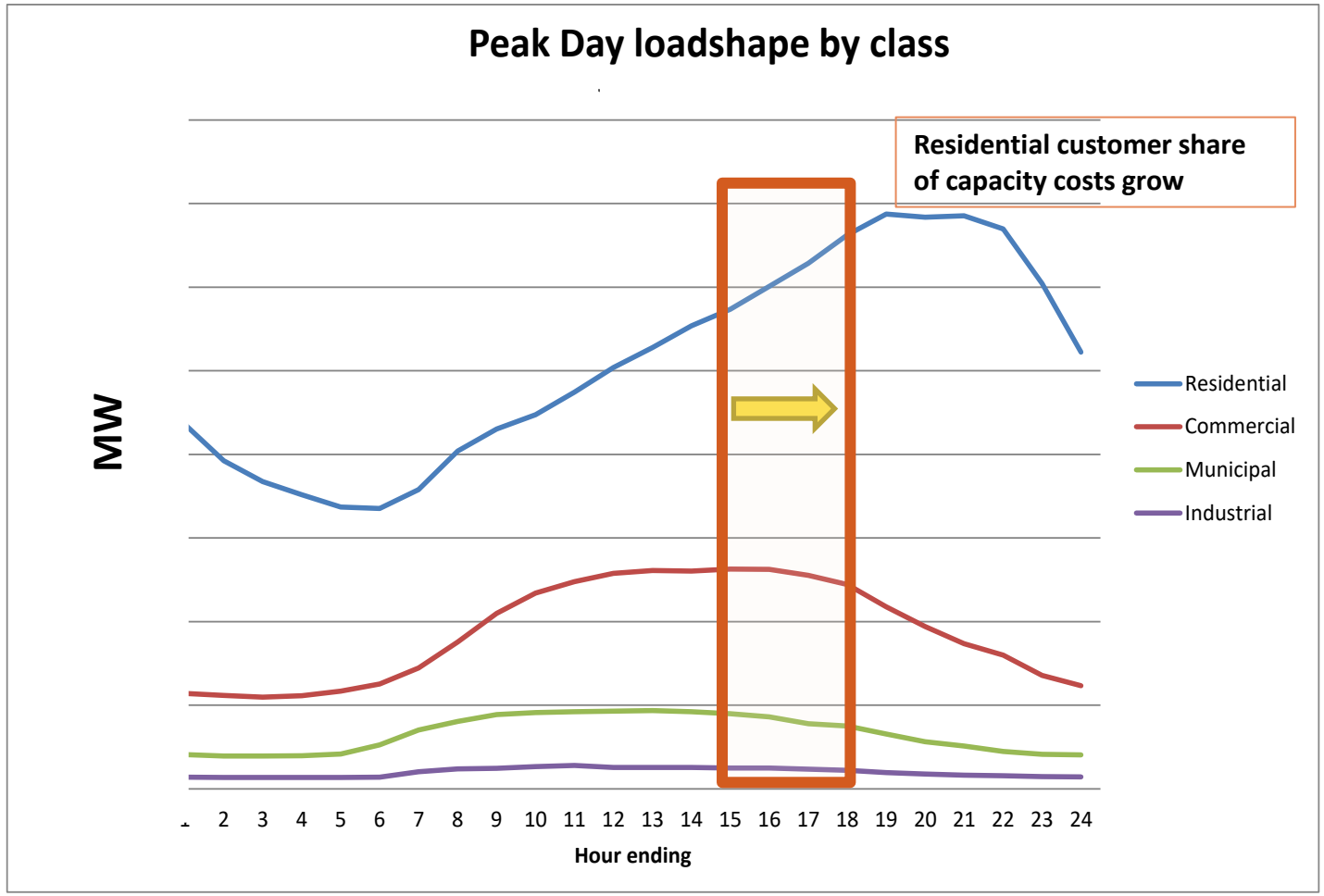
vs.

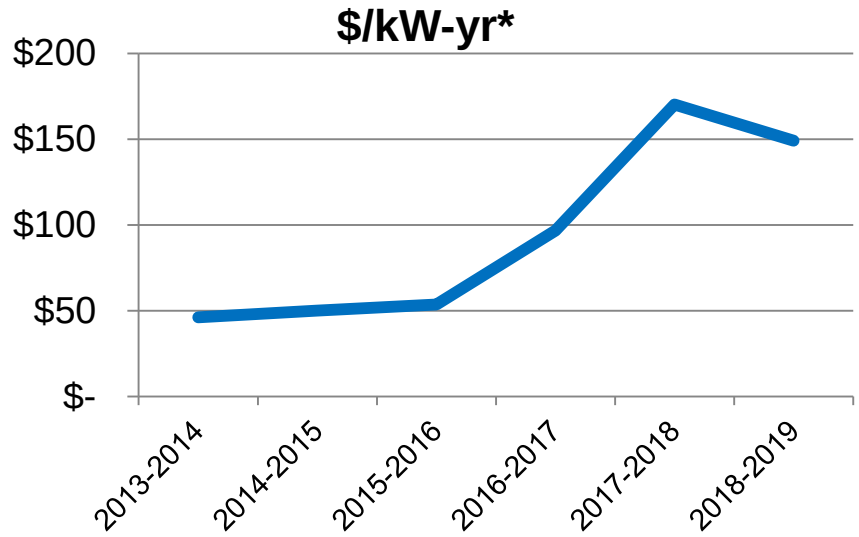
Actual peak day load shape



Data from Sagewell SageSight[SM] AMI meter data analytics software

Who is on peak – when peak shifts? Combine with cost shifts. MA Example.





- $500 million increase in capacity costs in 2 yrs
- LMP energy costs fell to 3.5 c/kWh
- **Peak capacity hour costs more than energy for the rest of the year (at LMP prices)**
- Upends distribution utility economics
- **Customers that were profitable three years ago are no longer**
- Test: "ask an expert if capacity cost is on energy or distribution portion of the bill"
  - Often heard: "I don't know, it is just a pass-through"

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What does AMI meter data analysis tell us about EE programs?

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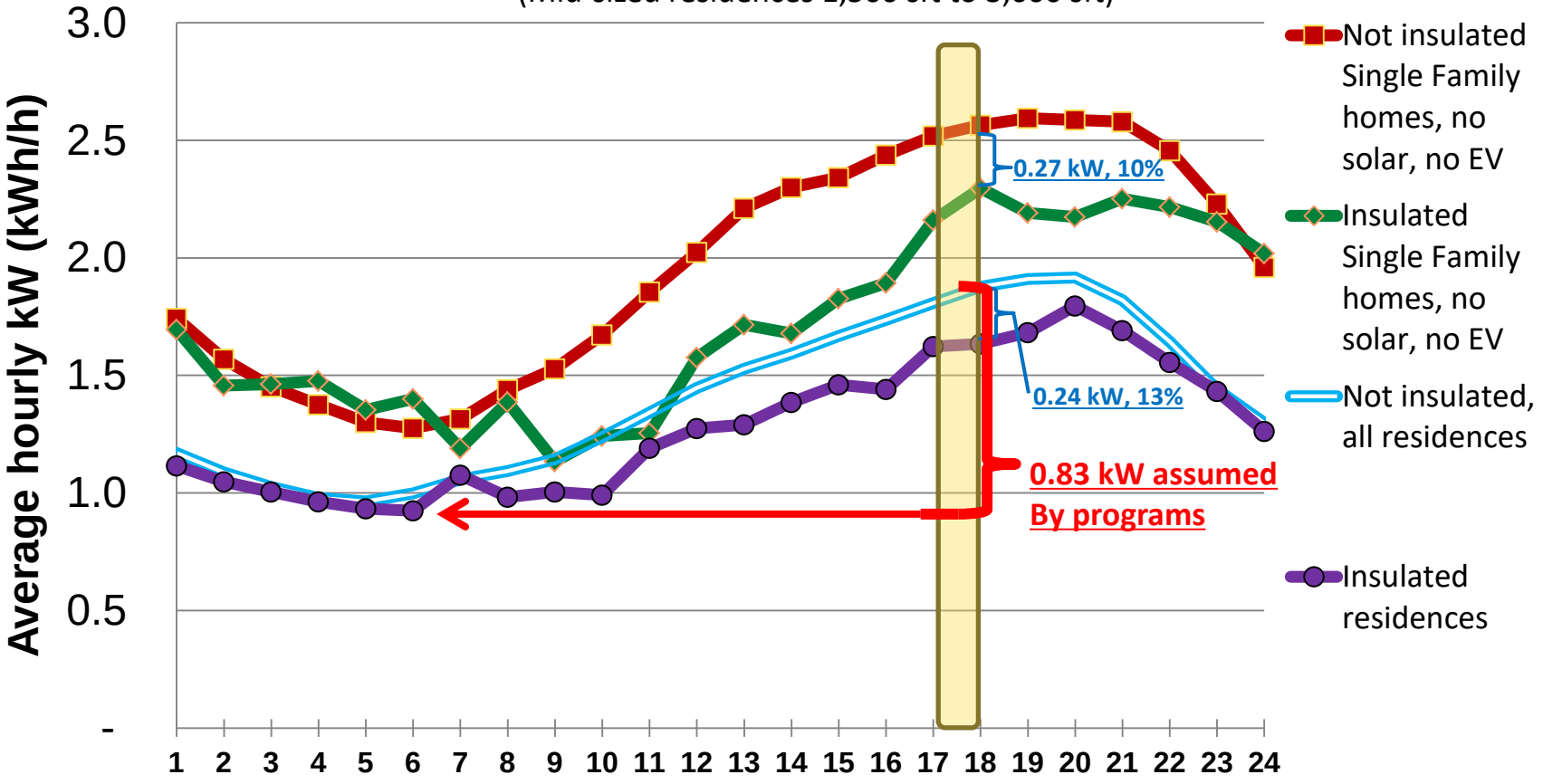
Summer peak reduction from insulation (2018 peak day)

(Mid-sized residences 1,500 sft to 3,000 sft)



- **Typical peak reduction observed in AMI data: 0.1 kW to 0.3 kW, or 5% to 15%**

Mass Save® Reported Electric Program Peak Reduction

- Mass Save® Reported peak reduction: 0.83 kW
- 3,257 kW/ 3,914 participants = 0.83 kW
- **Mass Save® reports 46% avg. peak reduction?**

Q1 2018 Electric & Gas Summary Report

*Prior to 2016, benefits were only reported in Q2 and Q4. Benefits in the other quarters are shown as zero.

As of Q1 2018	Participants	Total Expenditures	Annual MWh Savings	Lifetime MWh Savings	Summer Capacity (kW)
Electric					
Actual	2,176,665	$ 94,266,072	259,496	2,090,469	37,234
Residential	2,162,768	$ 50,001,276	168,639	1,008,729	24,080
Residential Whole House	1,190,759	$ 28,411,856	43,858	202,946	7,074
Residential New Construction	880	$ 2,194,187	3,078	31,645	523
Residential Multi-Family Retrofit	3,734	$ 858,863	595	6,338	48
Residential Home Energy Services - Measures	3,914	$ 19,065,323	19,152	143,929	3,257

Source: Masssavedata.com

Data from **Sagewell SageSight**SM AMI meter data analytics software and Sagewell's AMI meter data library
Preliminary 2018 summer peak, Aug 29, 2018, hour ending 6pm. Peak day temp 96 degrees, peak hour temp 90 degrees
Note: ISO-NE has subsequently revised the 2018 peak hour to be 5pm, however it would not change the conclusions.

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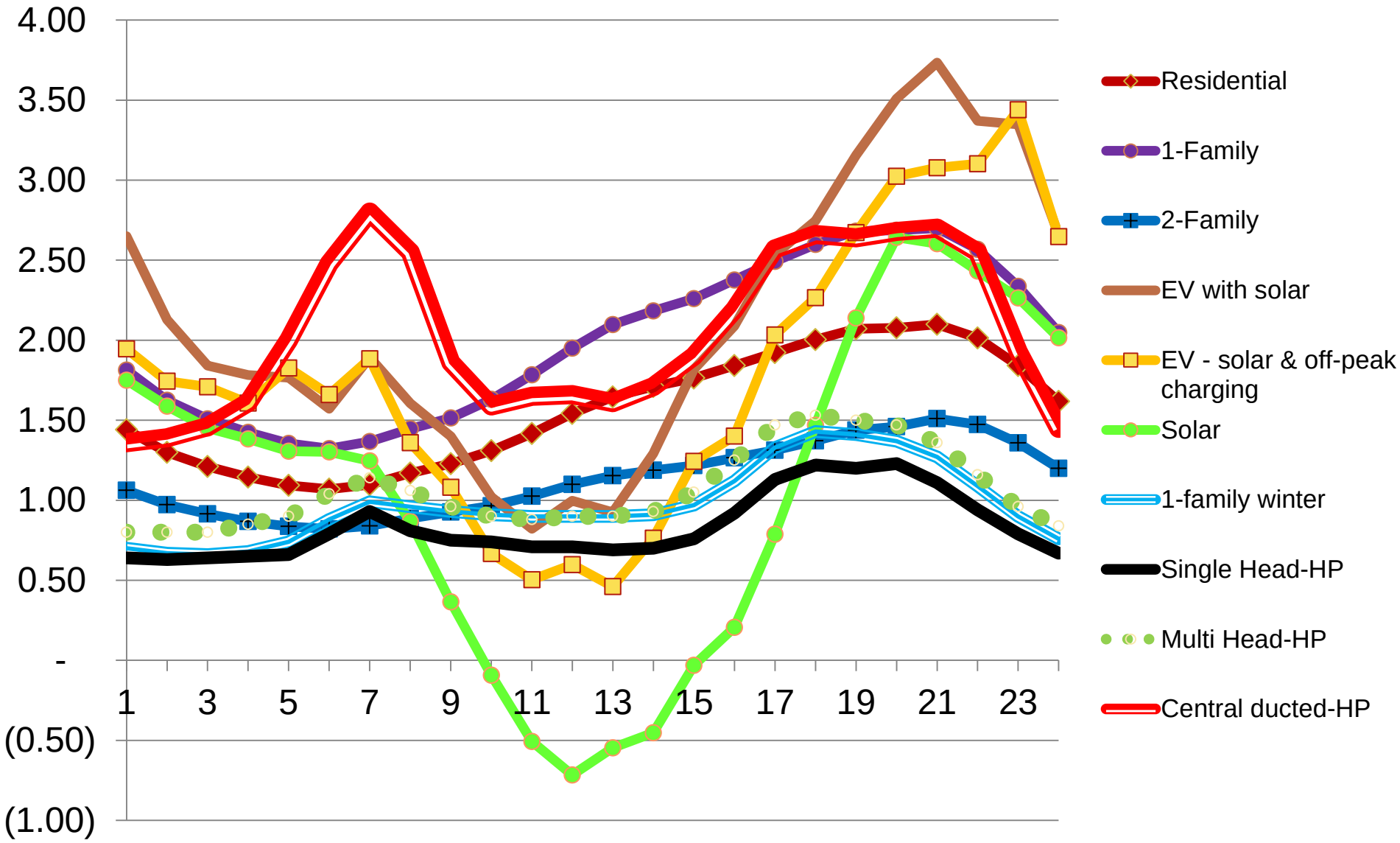
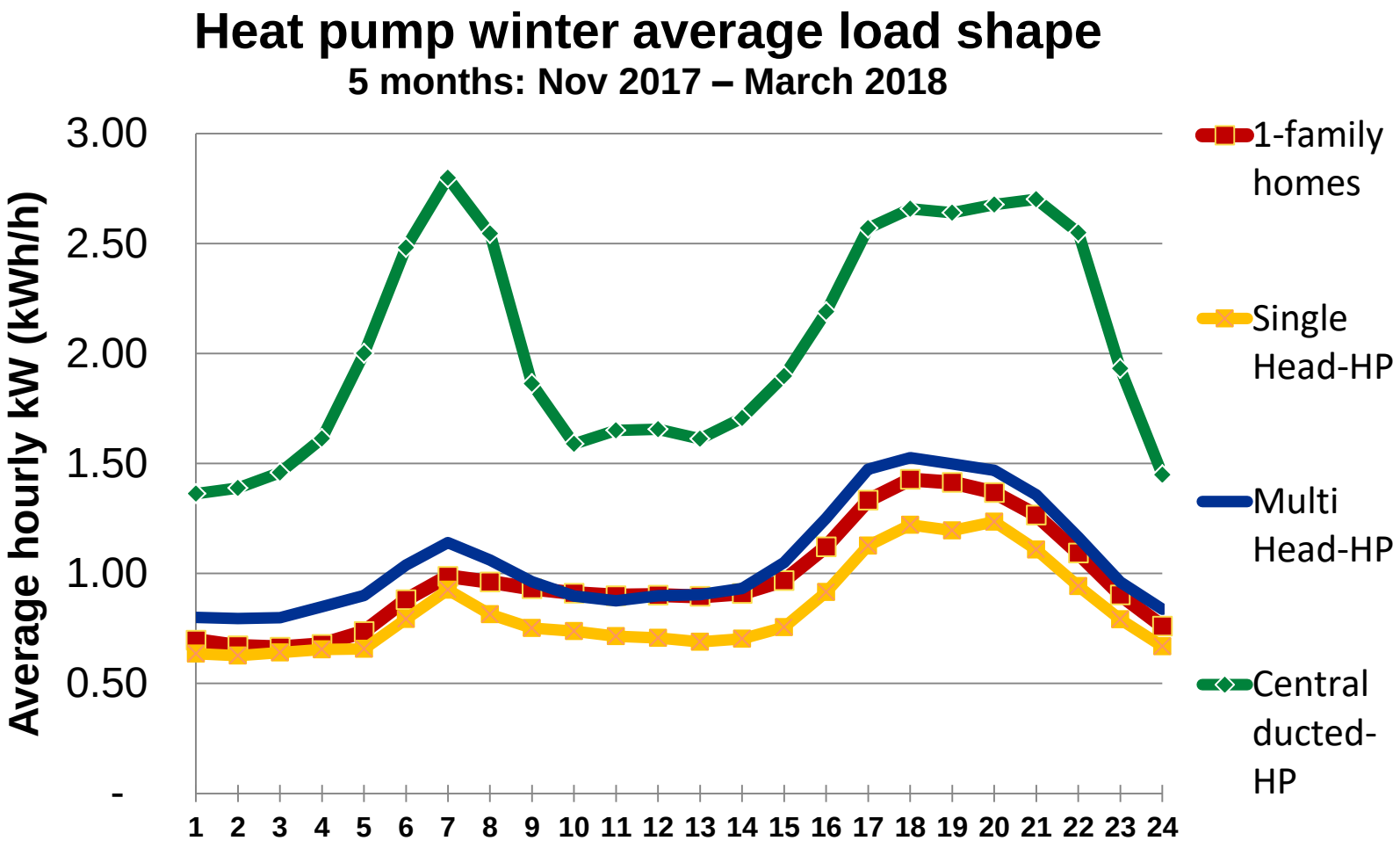
Hundreds of residential sub-class load shapes



- Does a residential customer "class" even exist?
- Sagewell models over 200 residential "sub classes"
- **Load shapes vary substantially by utility**
- Big business changes coming

Not all technologies are worth the same



- Not all heat pumps are worth the same environmentally or economically
- Best heat pumps reduce C02 by 30% to 50% over natural gas, propane and oil
  - **But most utility promoted models don't**
- Heat pumps operate down to -17F
- Heat pumps already cost less to operate than natural gas, propane and oil in large parts of the country

Data from Sagewell SageSight[SM] AMI meter data analytics software and Sagewell's AMI meter data library

Individual customer energy use is volatile:

One customer, one week

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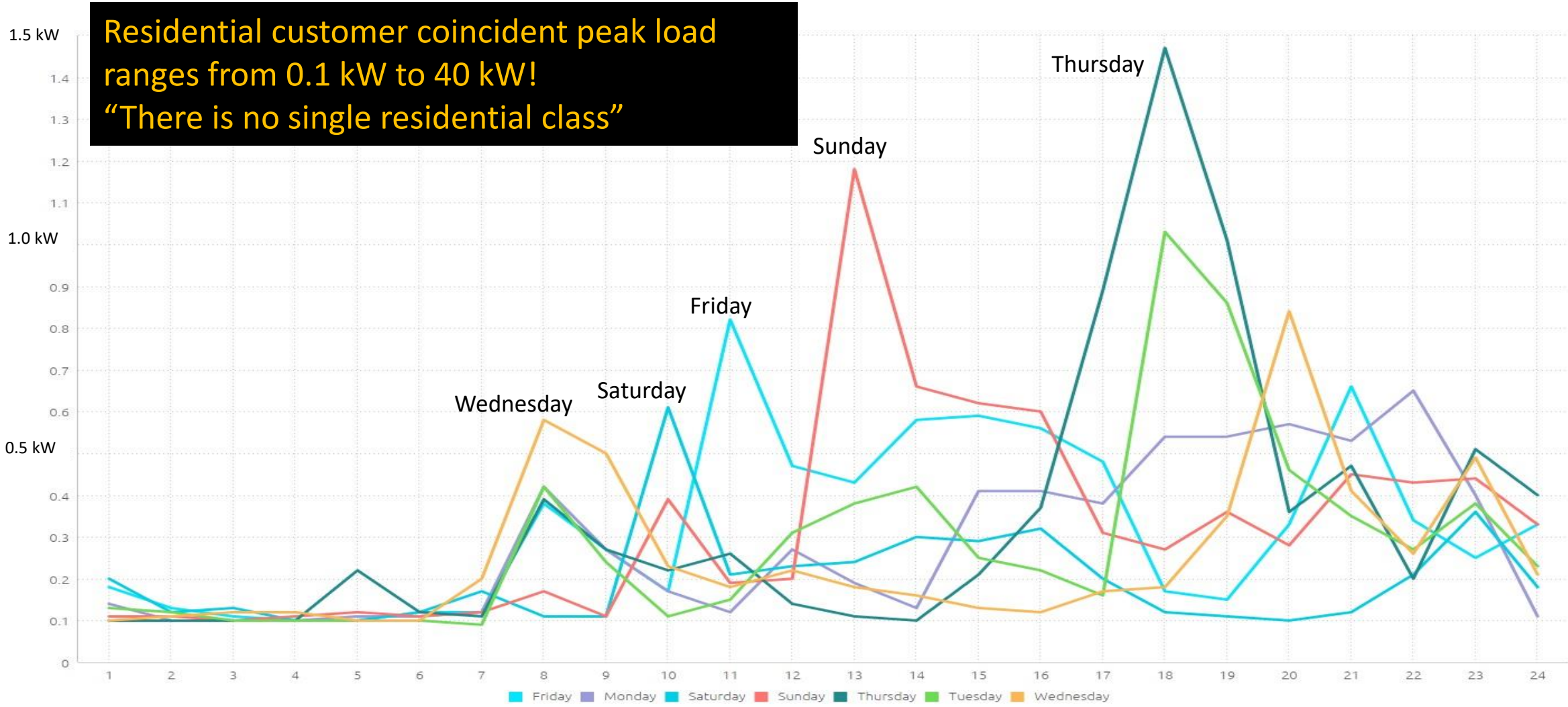
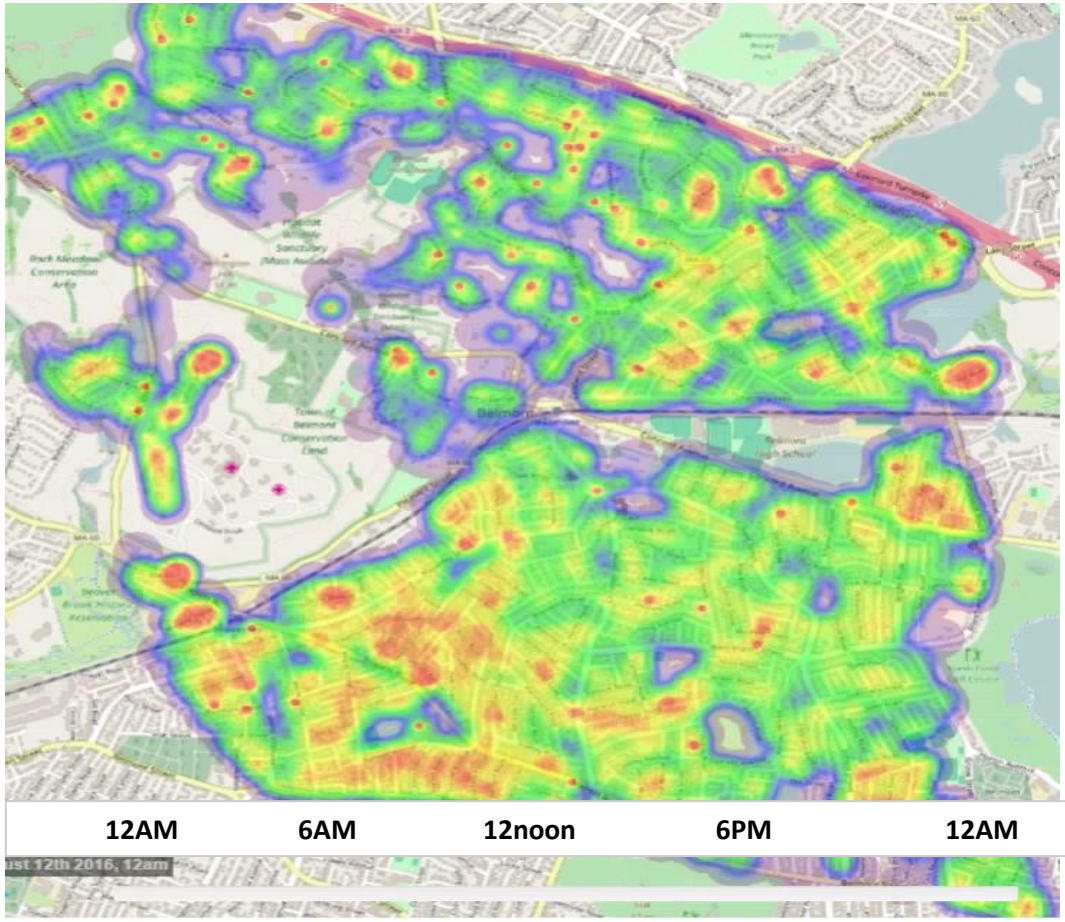


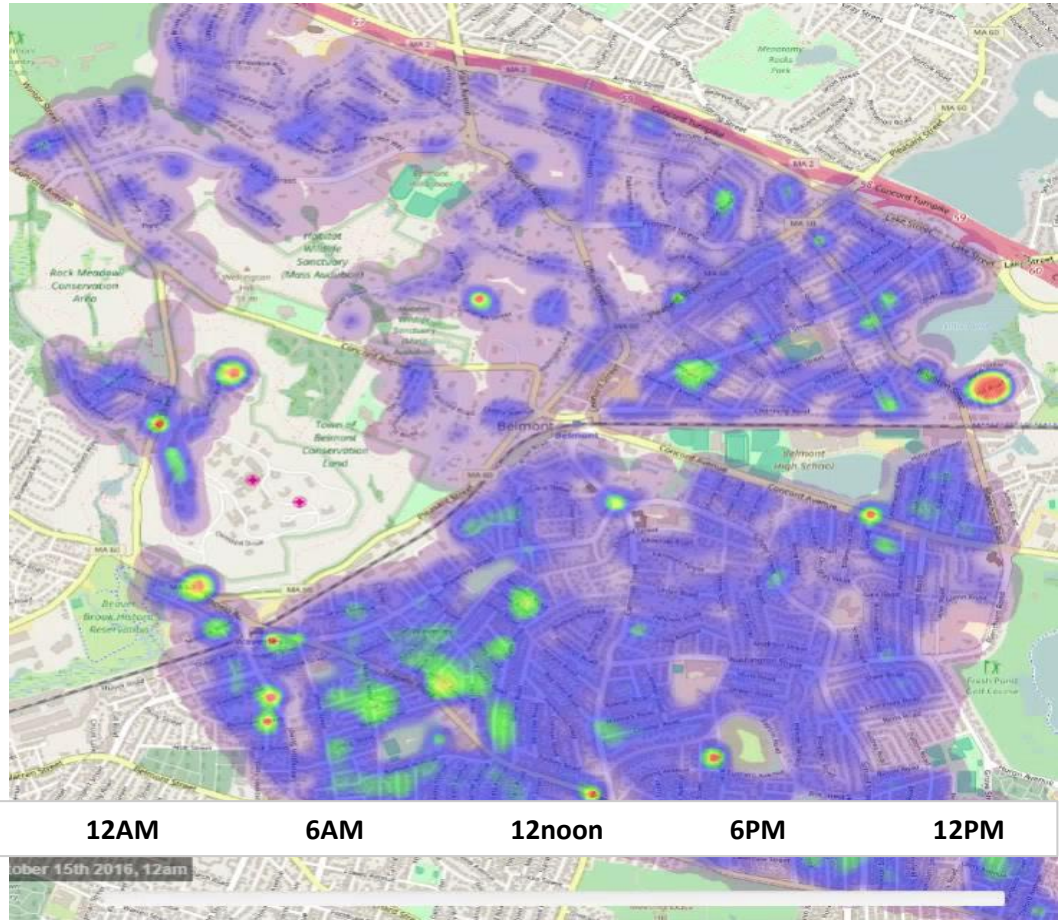
Graph from Sagewell SageSight[SM] AMI meter data analytics software

Residential peak load reduction – a game of "Whack-a-Mole"

Summer peak



Fall Saturday



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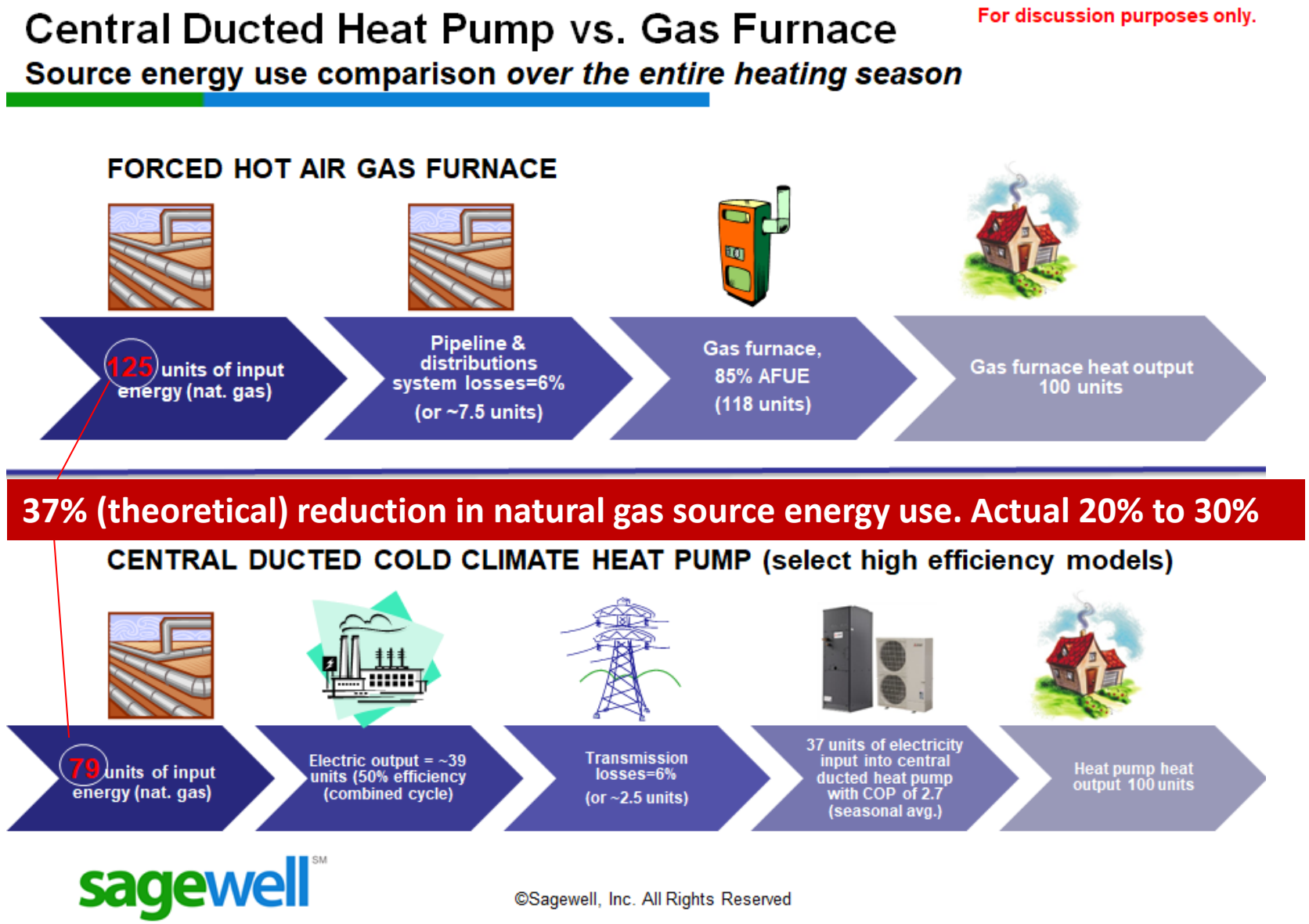
Animation from Sagewell SageSight[SM] AMI meter data analytics software

Implications:
Energy Efficiency vs. Electrification

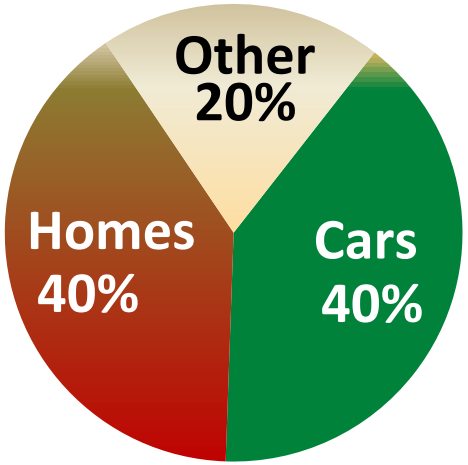
The trends have been clear for years…

- 2014 analysis of heat pump technology impacts
- Updated with 2018 high-efficiency heat pump performance data



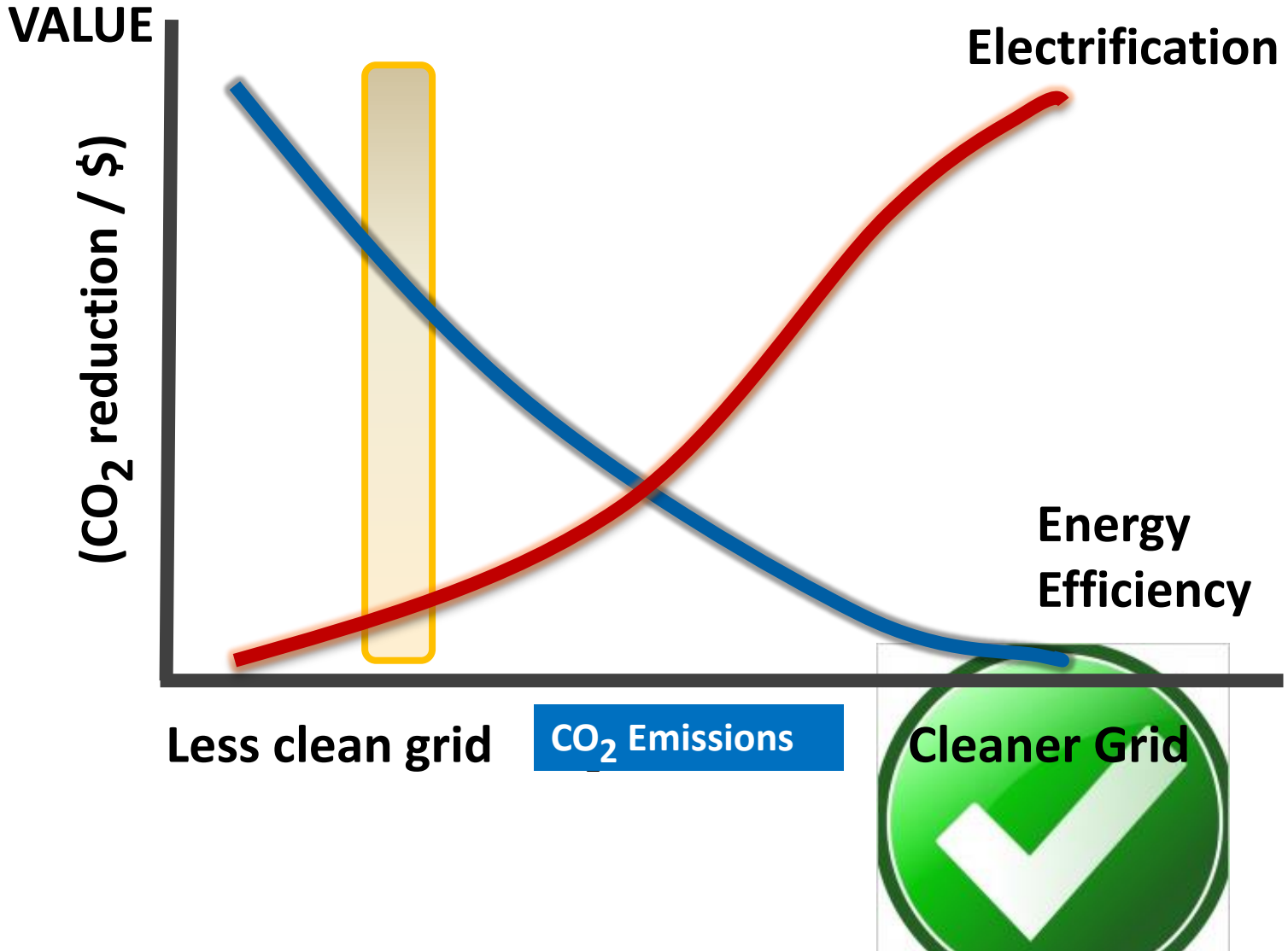
A Key Energy Efficiency Program Goal and Justification: CO_2 reduction

- 80% CO_2 reduction goals by 2050
- Residential EE program "savings" come mostly from suburbs
- Sources of (suburban) end-use emissions:

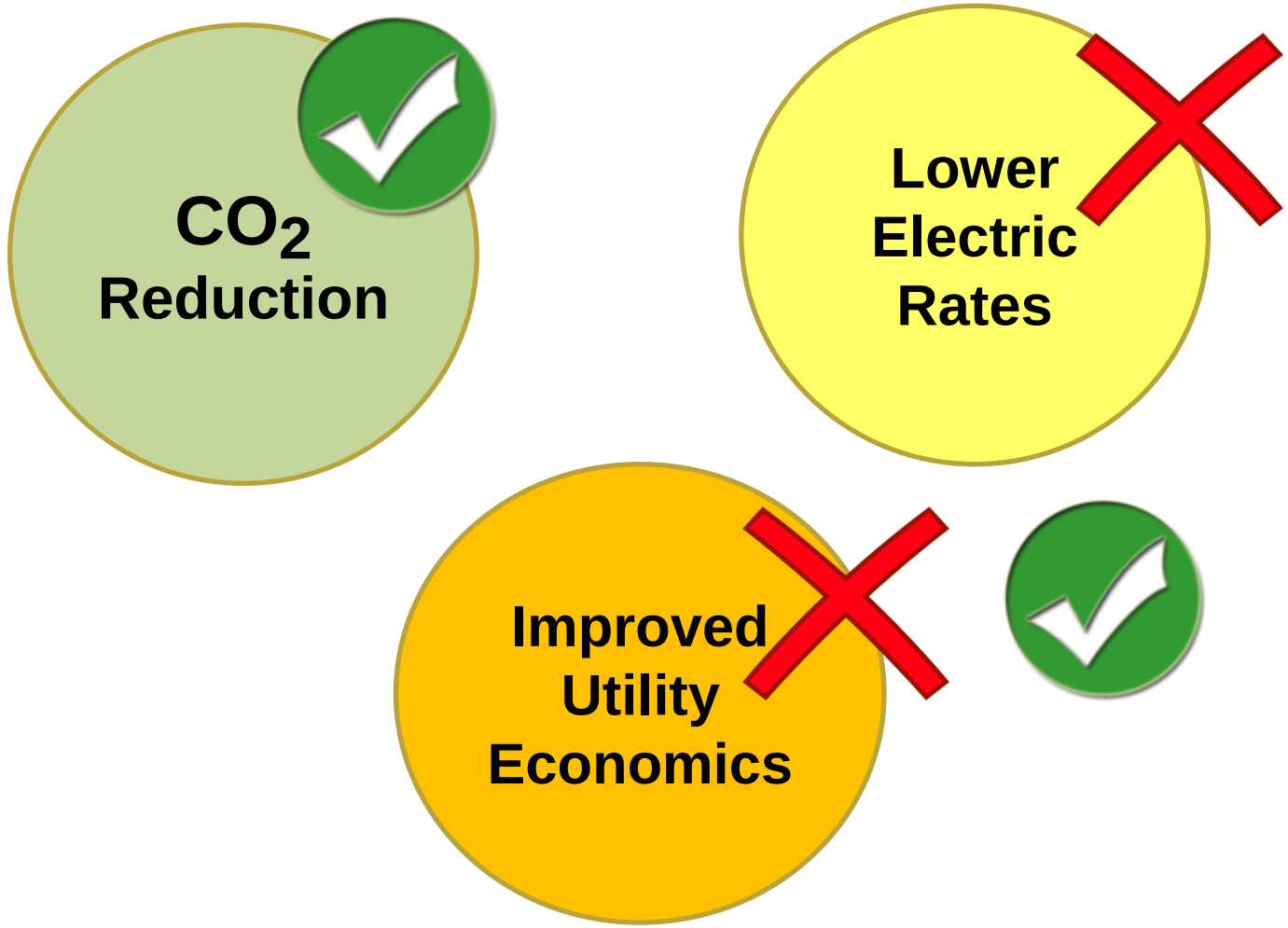


- If electrify all homes & cars – can reduce their emissions by almost half – at current NE generation mix
- Electrification can achieve most emissions goals if grid is 100% renewable.

EE Program value vs. cleaner grid



Energy Efficiency Programs



Electrification

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CO_2 Reduction

Lower Electric Rates

Improved Utility Economics

What should we do differently?

Bottom-up vs. top-down customer analysis

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- Top-down cost allocation is not necessary any more
- Top-down cost allocation should be stopped
- “Bottom up” analysis results in different conclusions from “top down” analysis
- Alternative: figure out how much each customer contributes towards fixed cost
  - “i.e. calculate contribution margin by customer
- Utilities have not even deployed Activity-Based Costing
  - Activity-based Costing concept is credited to Prof. Robert S. Kaplan, HBS, early 1980’s

Focus business on "Activity Based Margins"

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- Case study: utility with 3 million electric customers
- Heat pump contribution margin: $350/yr
- 1.3 million potential customers in the territory
  - Heat pump is already the "best available technology"
- $455/yr million in potential contribution margin

- Also, electric vehicles represent another $540 million/yr in margin
- Together: 1 Billion of potential new contribution margin
  - Would flow directly to net income (but for regulated earnings constraints)
- Can invest significant sums in marketing and customer acquisition
- **But – who gets to keep these margins?!**

Heat pump trends

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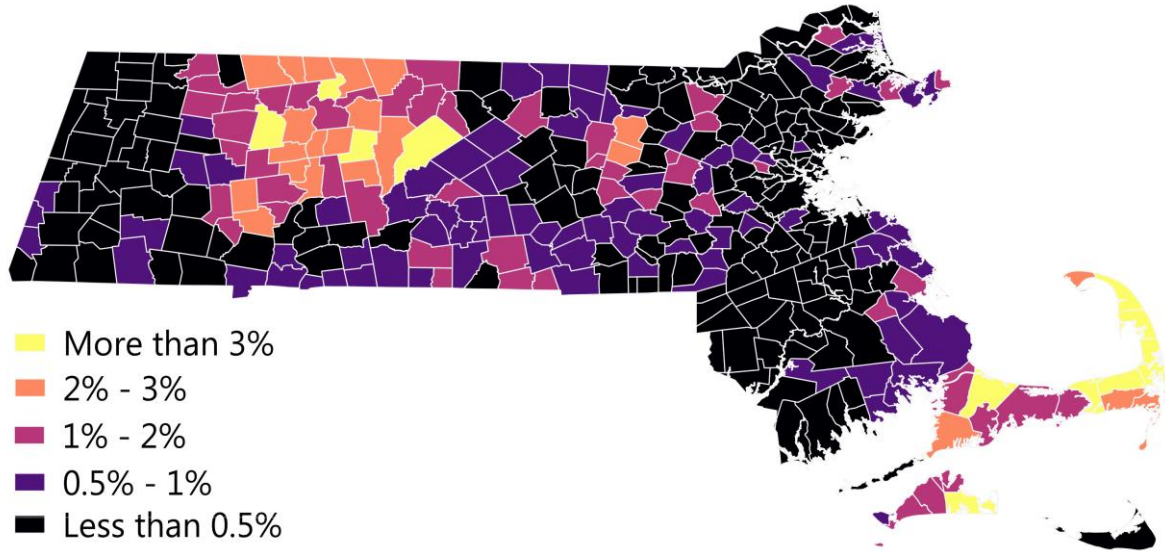
MA Heat pump sales Q4 2014 – Q3 2017

- **40% annual growth in the last two years**
- **Still: less than 10% of units sales are heat pumps**

MA Residential Heat Pump Market share



Excludes municipal utilities

- **Heat pump operating costs are competitive**
- Heat pumps will gain market share

Implications

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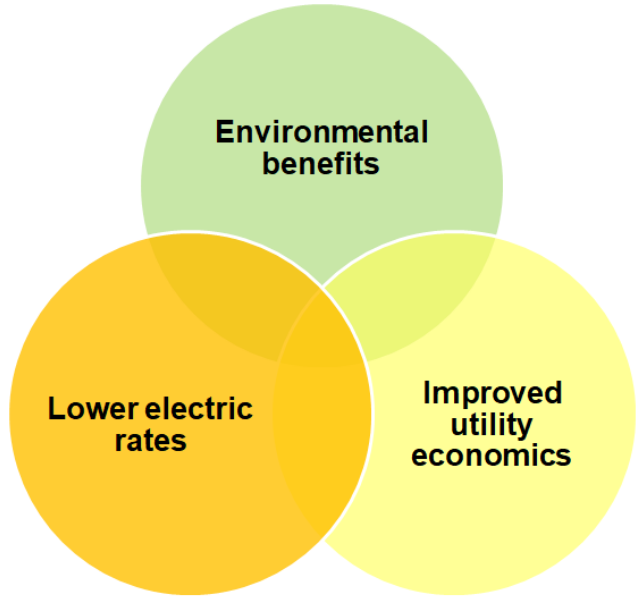
- Economics of distribution utilities are changing rapidly
  - But pricing strategies and product marketing are not keeping up
  - Significant winners and losers
  - Favorable economics and environmental benefits can be significantly accelerated
- Who will capture the changes in the energy value chain?
  - Utility customers in the form of lower rates?
  - Utility shareholders?
  - Both?
  - Other? LBO firms?
- Results in:
  - Significant changes in utility programs (e.g. electrification over energy efficiency)
  - Significant changes in regulations & regulatory strategies (for both utilities and regulators)
  - Investments by utilities
  - Mergers & Acquisitions

Final thoughts

- Every utility is unique; can't always apply AMI meter data analysis lessons from other utilities
- Benefits are best captured by those who analyze their own meter data
- Extraordinary alignment of interests from electrification
  - Environmental benefits (significant emissions reductions)
  - Utility shareholder economics (growth & higher earnings)
  - Customer economics (lower electric rates)



Q&A