

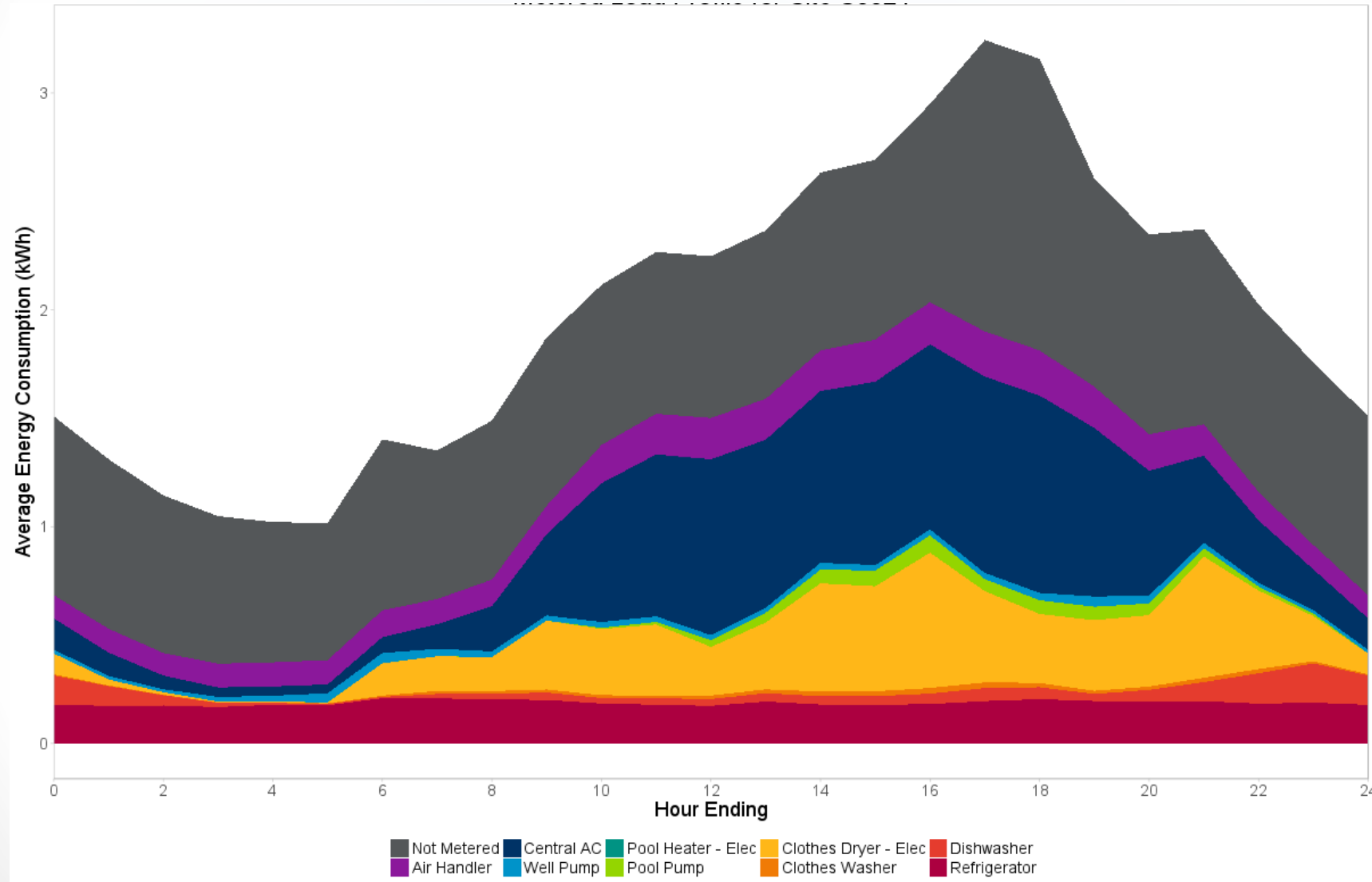
Duck hunt!

Risks and benefits of load shape disaggregation and end-use metering for determining end-use load shapes

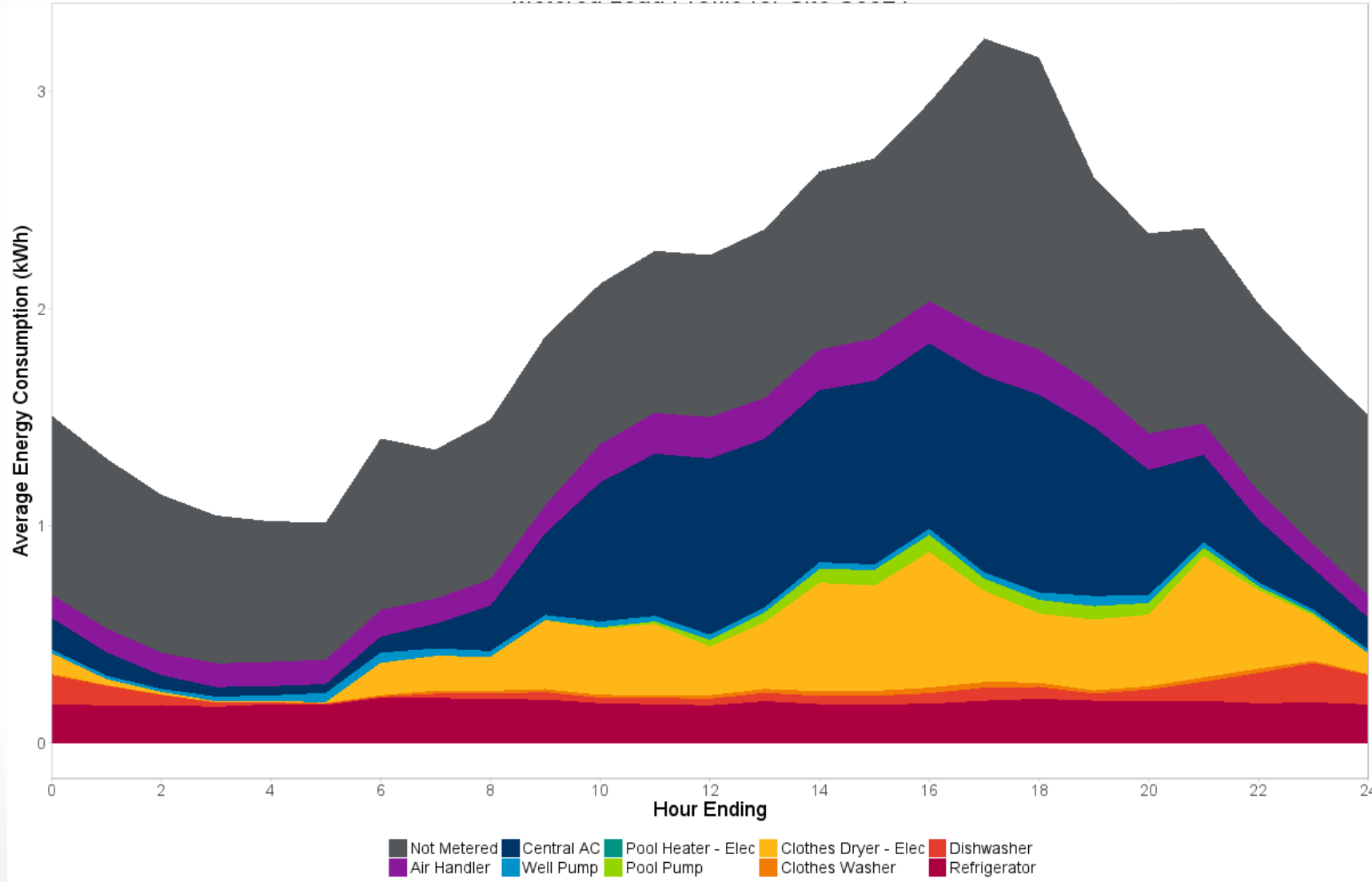
IEPEC 2017
Baltimore, MD



Let's talk about end-use load shapes.

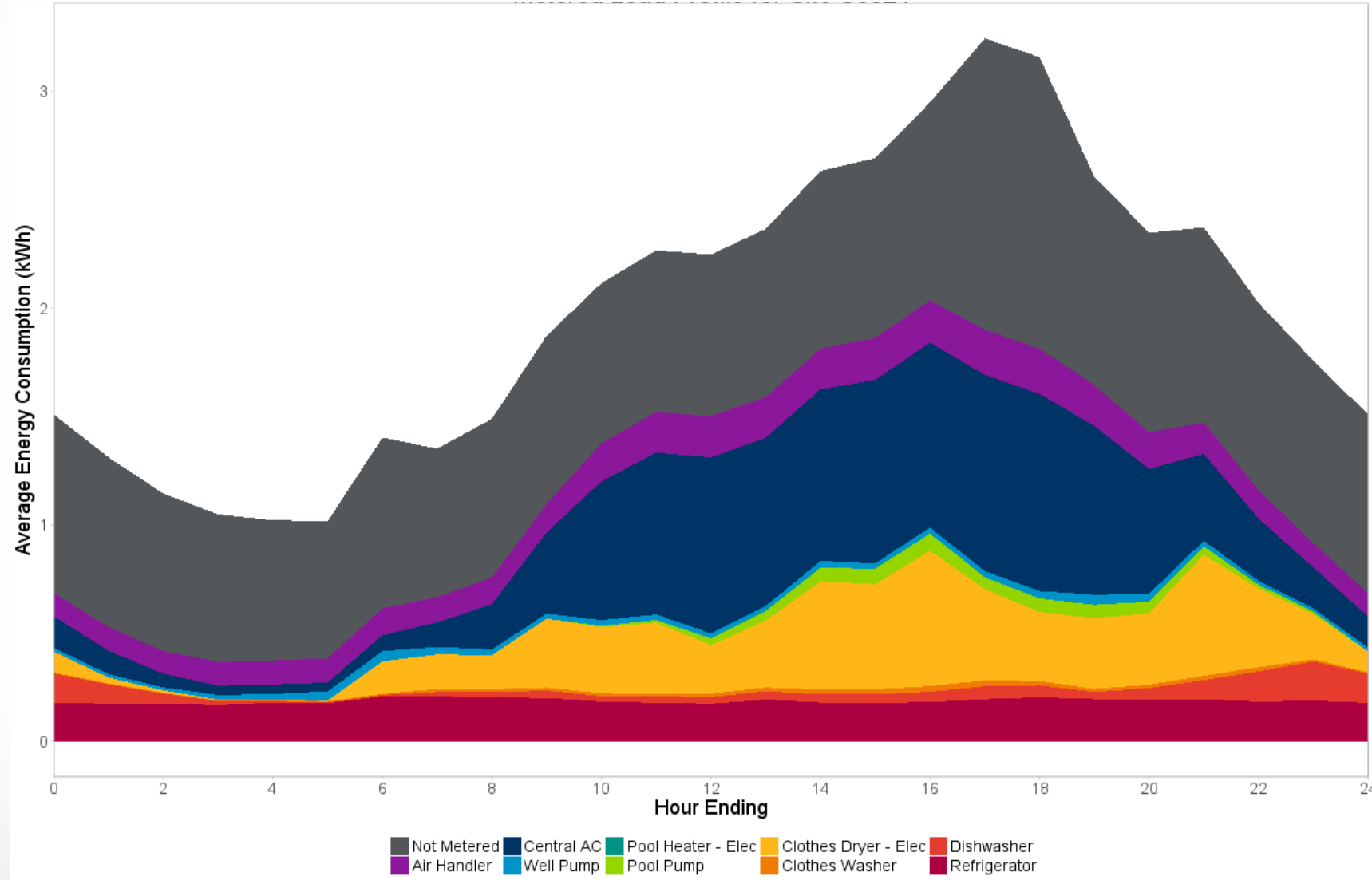


What does an end-use load shape tell you?



What does an end-use load shape tell you?

When people use electricity for different things.



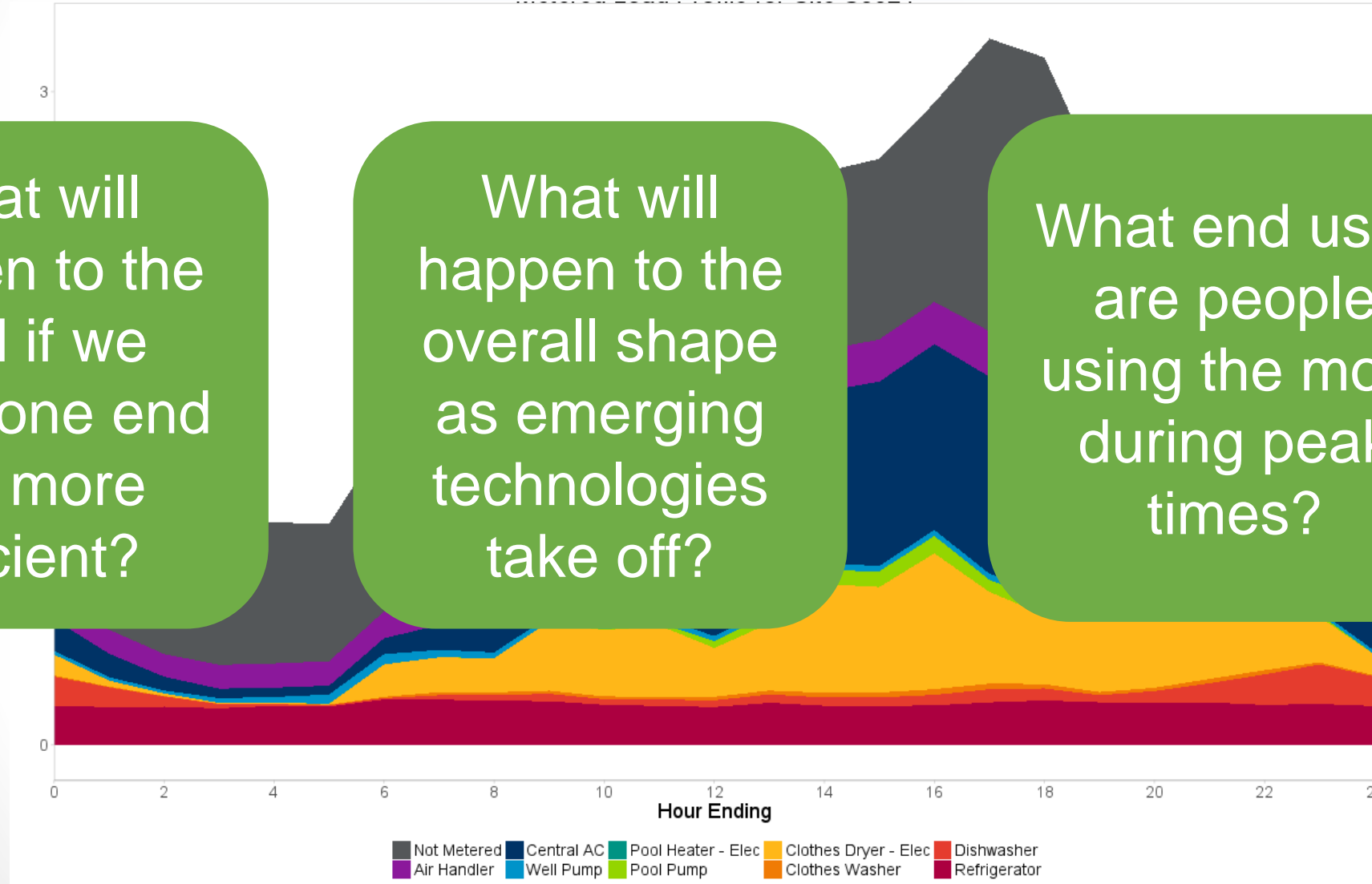
What does an end-use load shape tell you?

When people use electricity for different things.

What will happen to the load if we make one end use more efficient?

What will happen to the overall shape as emerging technologies take off?

What end uses are people using the most during peak times?



What are utilities using this data for?

All sorts of things.



EE/DR program design and evaluation



Resource planning



Transmission and distribution planning



Inform research projects (market effects, potential studies)



Rate design



Forward capacity market bidding support

Three Case Studies

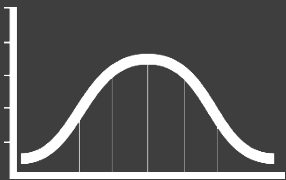
(See the paper for more details.)

Southwest Utility

Utility need: Shape DSM portfolio to mitigate Duck Curve impacts

Priority: Collect reasonable amount of data at a low cost

Tested Method(s): Remote direct measurement, leveraging disaggregated AMI data for future years



Massachusetts

Utility need: Provide foundational data set of load research

Priority: High accuracy for every major end use

Tested Method(s): Three NILM methods, two whole premise meters, remote direct measurement of 25 end uses



Southeast Utility

Utility need: Impact evaluation of demand response program

Priority: Accuracy for demand response measures

Tested Method(s): Remote and non-remote direct measurement of one to three end use per home



How do you get end-use load shapes?

There are several ways.



**Direct
Measurement**



**Leveraged Direct
Measurement**



**Disaggregate High
Frequency Data (NILM)**



**Disaggregate Low
Frequency Data (NILM)**



What is the best way?

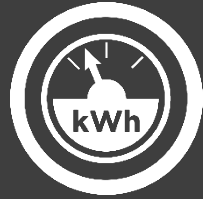
Here comes the balancing act.

What tools do you have available?

What are your specific research objectives?

What tradeoffs are you willing to make?

What does your tool box look like?



AMI Data



Time



Money



Site-level
Saturation Data



Weather Data



Building
Characteristics

NILM Hardware Options

Optical Sensor



Smart Meter



Low Frequency
NILM

Utility-side Meter + Local
Disaggregation

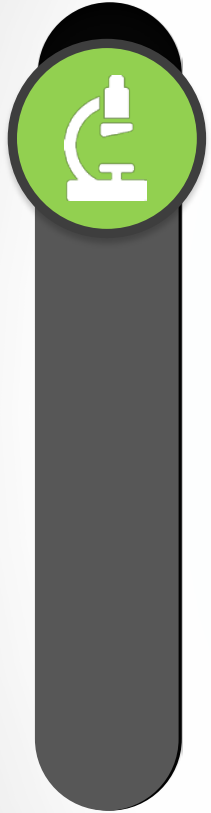


CT-Based Sensors



High Frequency
NILM

Tradeoff: Accuracy



**Direct
Measurement**



**Leveraged Direct
Measurement**

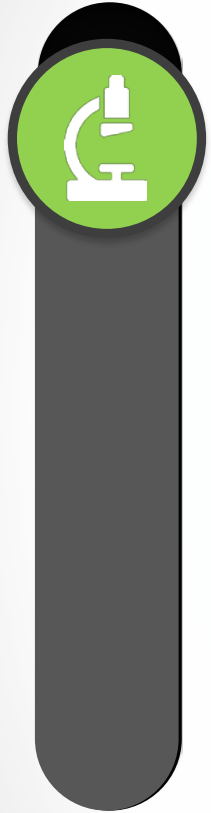


**Disaggregate High
Frequency Data (NILM)**

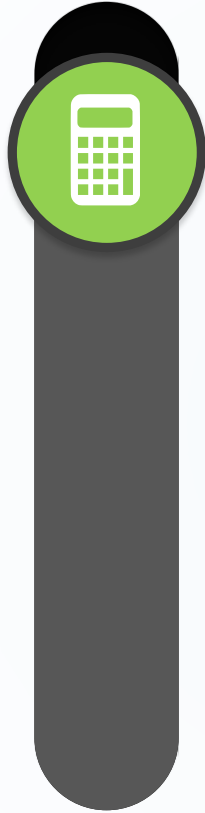


**Disaggregate Low
Frequency Data (NILM)**

Tradeoff: Customer Intrusion



**Direct
Measurement**



**Leveraged Direct
Measurement**



**Disaggregate High
Frequency Data (NILM)**



**Disaggregate Low
Frequency Data (NILM)**

Tradeoff: Red Tape



Direct Measurement



Leveraged Direct Measurement



Disaggregate High Frequency Data (NILM)



Disaggregate Low Frequency Data (NILM)

Tradeoff: Costs



**Direct
Measurement**



**Leveraged Direct
Measurement**



**Disaggregate High
Frequency Data (NILM)**



**Disaggregate Low
Frequency Data (NILM)**

Risks and Benefits Summary

For each load shape determination method

	Direct Measurement	Leveraged Direct Measurement	Disaggregate High Frequency Data (NILM)	Disaggregate Low Frequency Data (NILM)
Accuracy	10% error	15-30% error	20-50% error	50-100% error
Intrusion	High	High	High	Low
Red Tape	Low	Med/High	Med/High	Low
Per site equipment + installation cost	\$3,000	\$2,000	\$1,000	\$0

Decision Tree

(See the paper for more details.)



What level of rigor is desired?

How many end uses are needed?

Are end uses suitable for disaggregation?

Is AMI data available?

Key Takeaways

For choosing a load shape determination method



Metering is not as expensive as it used to be, and it gets you exactly what you need.



Low frequency NILM will tell you some things about your load, but probably not exactly what you need.



NILM can be considered an option for some loads, but it's somewhat limited.



If you need high accuracy, plan for metering. In this case, NILM will only be useful for leverage.



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