

# Tools, Data, and Trends Towards Advanced M&V

Public Webinar

Northeast Energy Efficiency Partnerships

Friday, March 2, 2018

Please note: This Webinar is being recorded. Recording and Slides will be available online after the fact.

# Northeast Energy Efficiency Partnerships



*“Assisting the Northeast & Mid-Atlantic Region in Reducing Total Carbon Emissions 80% by 2050”*

## Mission

Accelerate energy efficiency as an essential part of demand-side solutions that enable a sustainable regional energy system

## Vision

That the region embraces next generation energy efficiency as a core strategy to meet energy needs in a carbon-constrained world

## Approach

Overcome barriers and transform markets through  
*Collaboration, Education, and Enterprise*



# Introduction

## WELCOME

This webinar is part of US DOE grant:

**“Standardized, Sustainable and Transparent EM&V - Integrating New Approaches”**

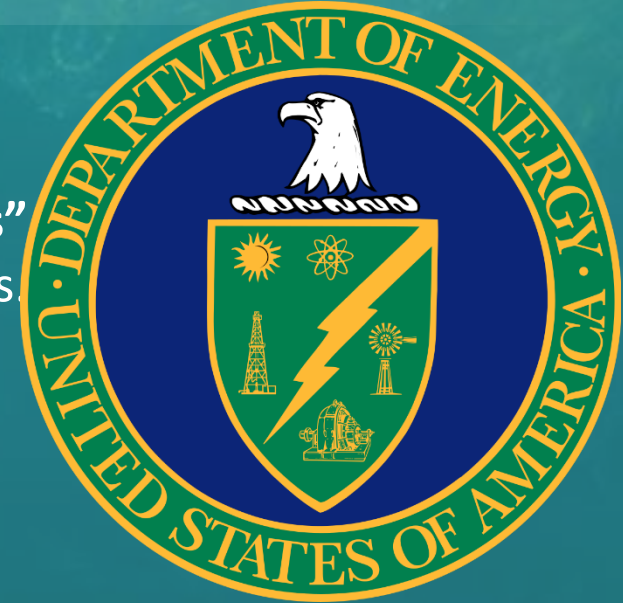
This includes a pilot project with CT DEEP, Utilities, LBNL, and several State Partners

## BACKGROUND

In follow up from great interest in December 11<sup>th</sup> Rapid Fire Webinar, we invited active and interested organization in this space.

## 2018 Outlook

- Public M&V 2.0 Workshop for November (in Vermont)
- Working with State Energy Partners on pilots and regional outreach
- (EM&V General in person meeting planning for Late spring)
- More details to come—Setting agendas for meetings now, contact Elizabeth with ideas or to get involved



# Agenda



## 4 POLLS

### Speaker Line Up

1. Pasi Miettinen, Sagewell
2. Tarik Borogovac, FirstFuel
3. Carmen Best, OpenEE

(intermission—2 polls!)

1. Bill Koran, SBW Consulting
2. Eliot Crowe, Lawrence Berkeley National Labs
3. Jeremy Eddy, Opinion Dynamics

## WRAP UP- Q&A & FINAL POLL



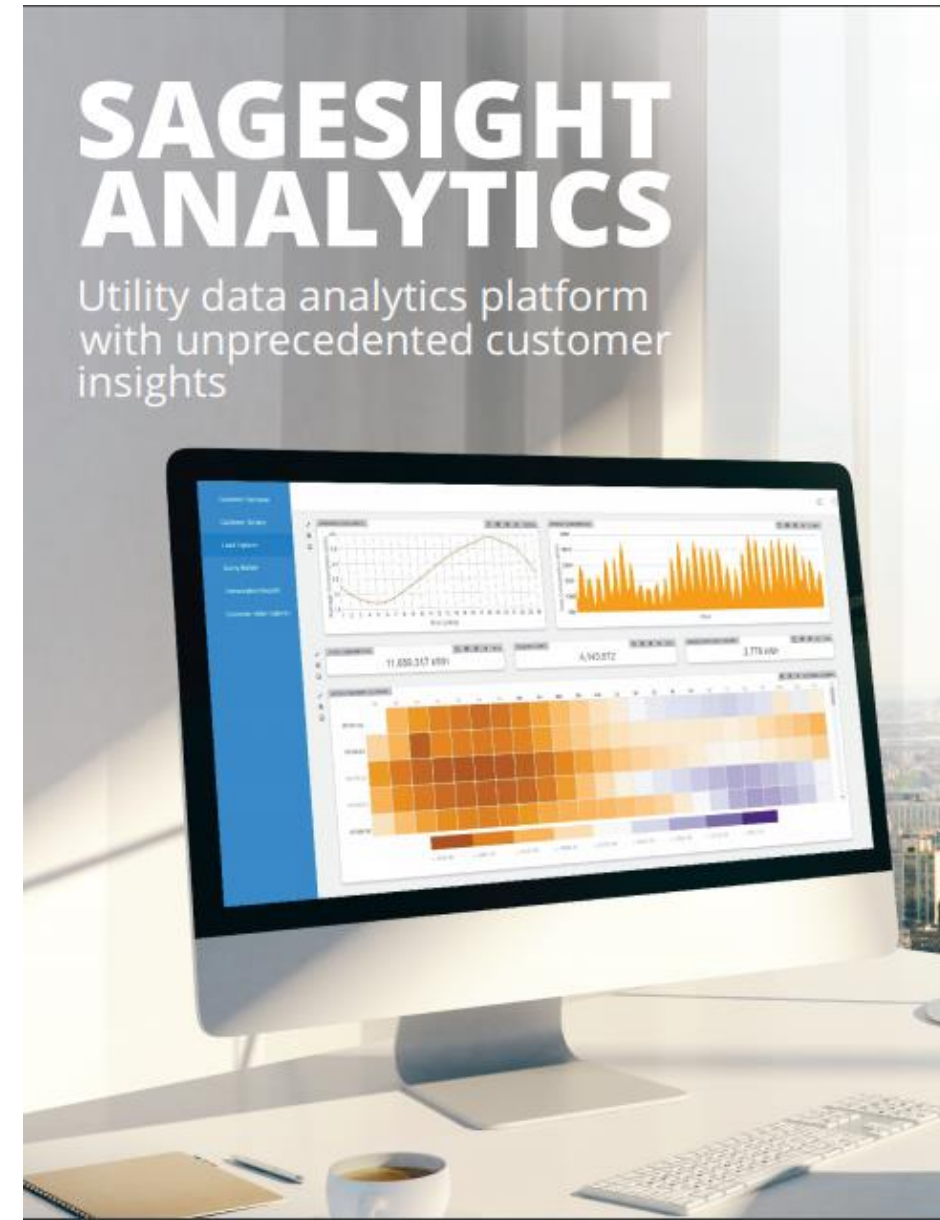




Sagewell  
Pasi Miettinen  
[pasi@sagewell.com](mailto:pasi@sagewell.com)

## “Iterative M&V” Principles:

- **Beneficial Electrification program M&V requires AMI analysis**
- Check early & check often
- Precision vs. accuracy
- Rank order relative performance – BenefitMatrix<sup>SM</sup>
- “Fail fast”
  - Look for obvious program successes – do more
  - Look for obvious program failures – stop
- Enabled by Sagewell **SageSight**<sup>SM</sup> smart meter data analytics software
  - **SageSight**<sup>SM</sup> used at utilities ranging from 10,000 to 4 million meters
- Program evaluator solutions & partnerships



# “Iterative M&V” software implications & requirements

- **Enable business users**
  - To find value from hundreds of billions of meter reads
- **Dynamic queries**
  - Each query inevitably results in multiple additional queries
- **Rapid searches**
  - Results in seconds or minutes; not in overnight batch runs
- **Continuous testing & improvement**
  - Iterate programs & test results, repeat



## Real-time Program Evaluation

**SageSight<sup>SM</sup>** is used to evaluate the effectiveness of beneficial electrification, energy efficiency and marketing programs in real time. Access to real-time meter data changes the way programs are evaluated. Powerful data integration and analysis tools make impact analysis simple, intuitive, quick, and inexpensive. Measure energy reductions, cost impacts, revenue and earnings changes precisely and in a way that makes sense. Customer-by-customer, system-by-system, hour-by-hour, program-by-program.



### Rapid searching

Search petabytes of smart meter and other data with unprecedented speed.



### Dynamic querying

No more canned over-night reports. Start exploring your data in real time, your way.



### Interactive dashboards

Use interactive dashboards instead of database specialists for your analysis.



## Program successes:

Technical, economic or customer satisfaction

- Heat pump program (central ducted)
- Finding electric vehicles (from AMI meter data) and converting to peak reduction program
- “Bring Your Own Charger<sup>®</sup>” EV peak load reduction for utilities with AMI meters

## Program failures:

Technical, economic or customer satisfaction

- Heat pump program (ductless)
- EV smart charger peak load reduction
- Thermostat peak load reduction
- Water heater peak load reduction
- Behavioral peak load reduction

**SageSight<sup>SM</sup> delivers  
on-demand insights into utility  
customers' energy use and economic value**

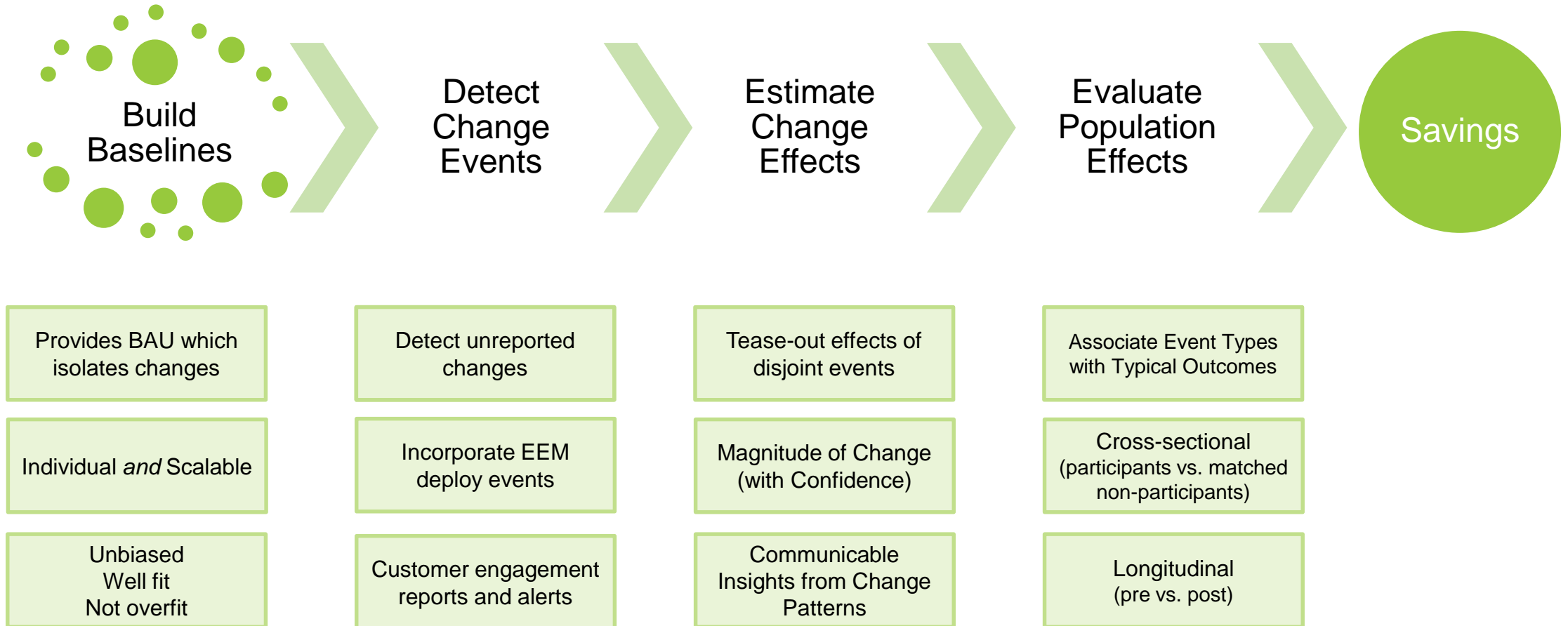


FirstFuel

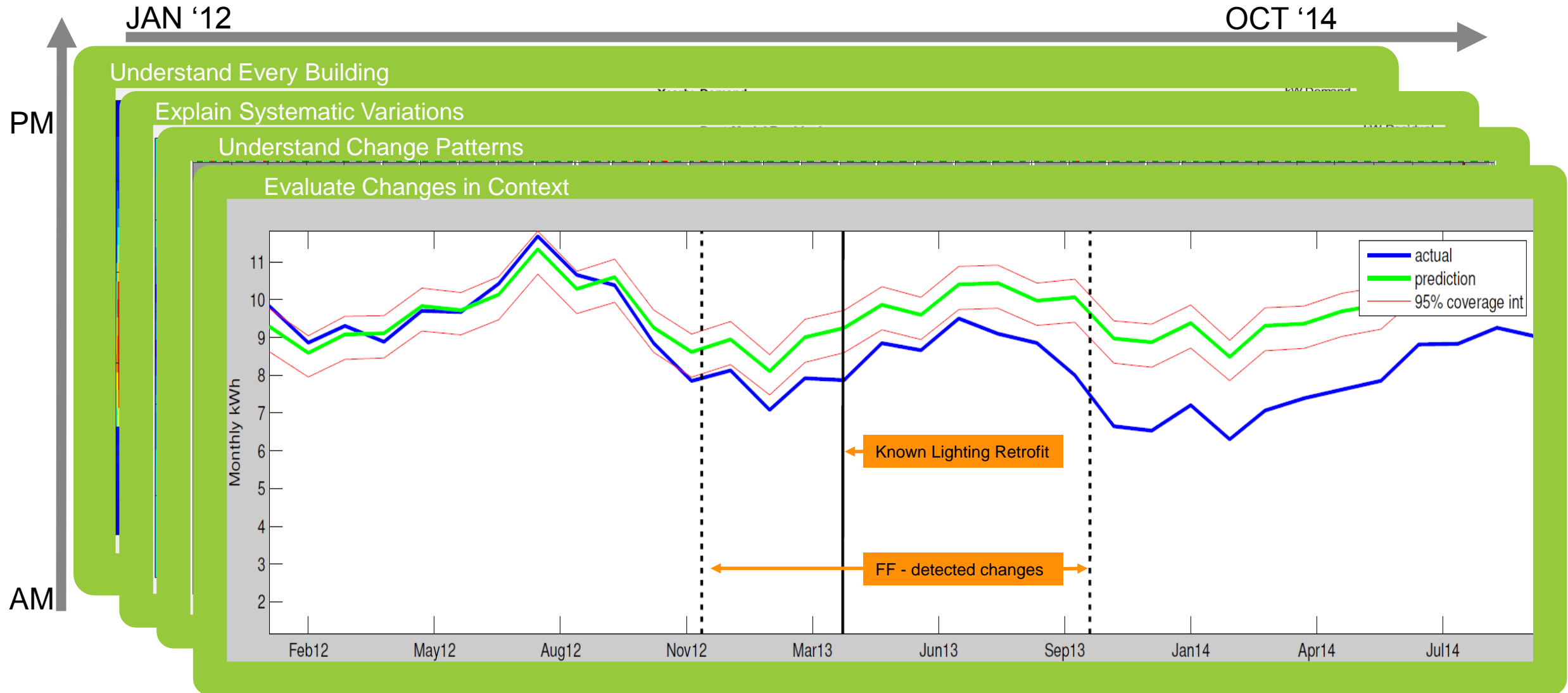
Tarik Borogovac

[tarik@firstfuel.com](mailto:tarik@firstfuel.com)

# FIRSTFUEL ANALYTICS M&V 2.0 RESOURCES



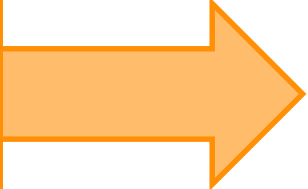
# ONE BUILDING'S JOURNEY





# ENABLED USE CASES

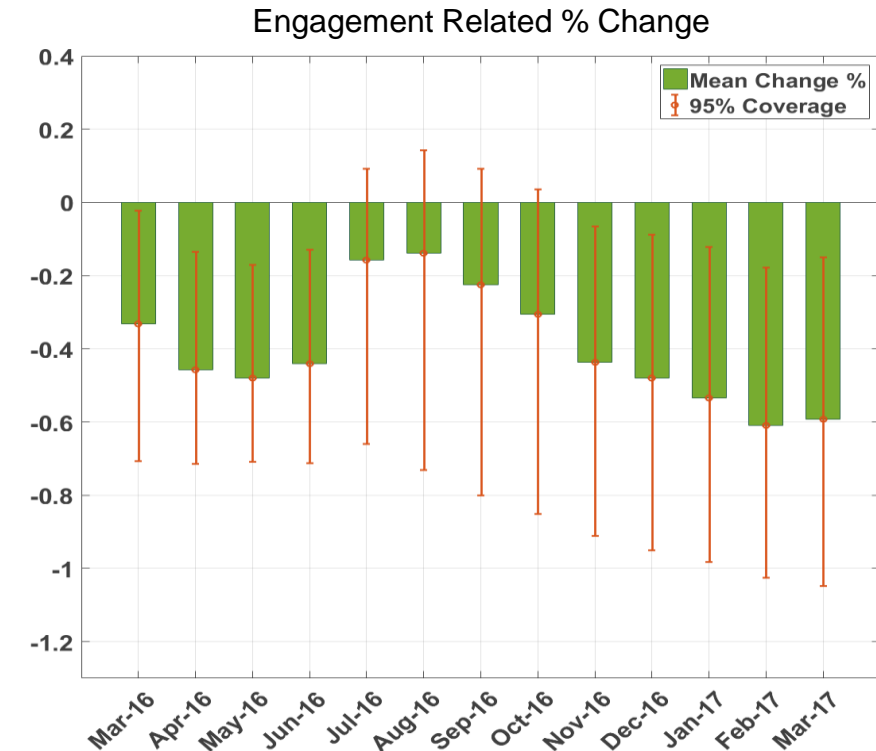
	Building / Customer Level	Program / Population Level
Retrospective	<ul style="list-style-type: none"> <li>Verify EE Measures (P4P)</li> <li>Verify Electrification Measures</li> </ul>	<ul style="list-style-type: none"> <li>Evaluate and Design Effective Programs</li> </ul>
Proactive	<ul style="list-style-type: none"> <li>Track in Near Real Time</li> <li>Forecast</li> <li>Generate Actionable Reports</li> <li>Educate, Motivate and Empower</li> </ul>	<ul style="list-style-type: none"> <li>Deliver Behavioral Savings</li> </ul>



## Clicks & kWh

Measuring Behavioral Savings from Online Engagement

- 7K Commercial Buildings (1/2 engaged, 1/2 matches)
- Users that are engaged more save more on average
- When they stop engaging, savings decay





Open Energy Efficiency

Carmen Best

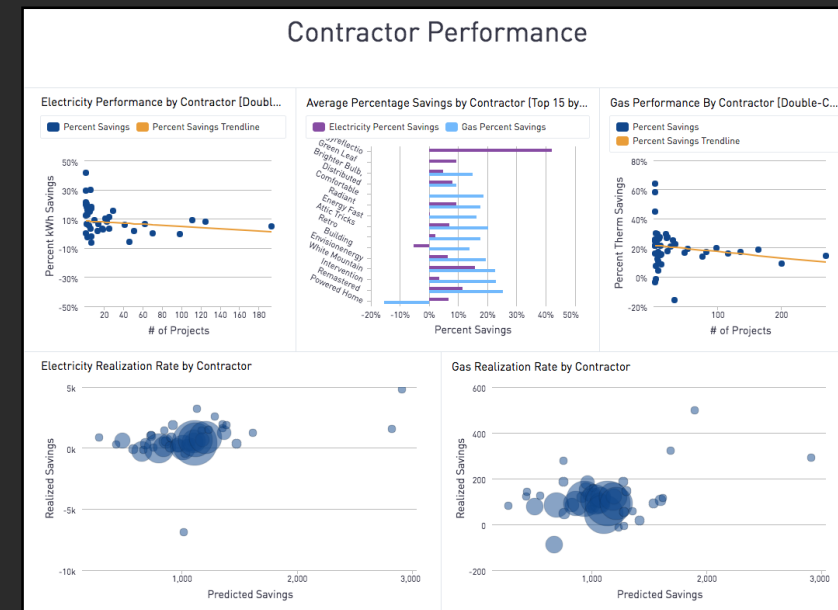
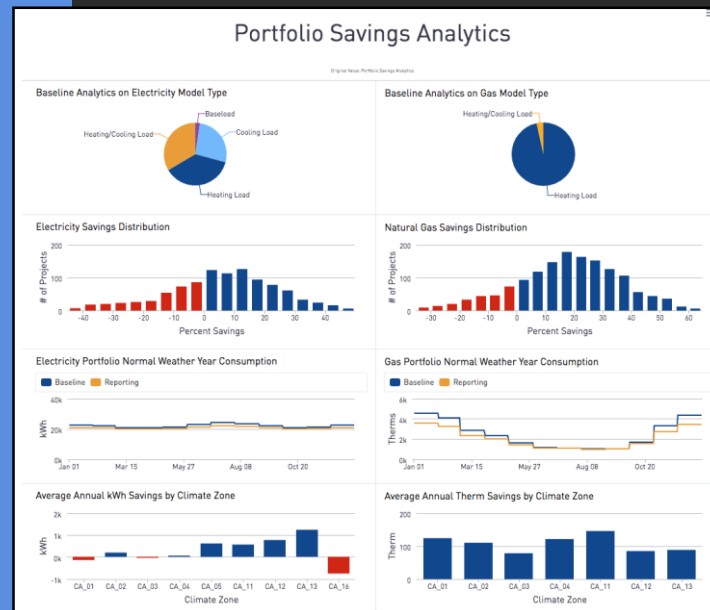
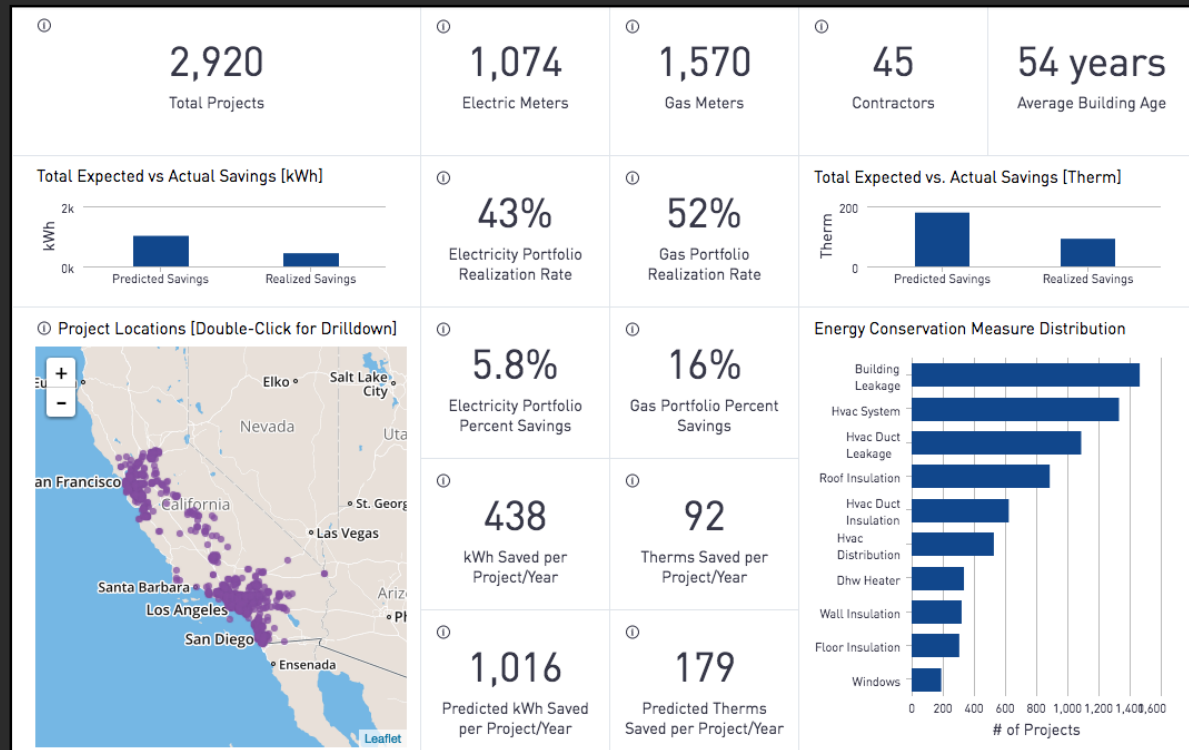
[carmen@openee.io](mailto:carmen@openee.io)

# Open Source Transparent M&V Methods

## CalTRACK Methods

- Empirically tested
- Replicable
- Transparent
- Accessible

*Create trust, enable insurance,  
finance, and growth of investment*



# M&V at Your Fingertips

Open EE Meter is available via:

*OpenEEmeter Desktop*

OR

*OpenEEmeter Online*

## OpenEEMeter Online

Open source, secure and transparent, so you can have confidence in the results.

Estimate energy savings locally without the need for servers or python experts.

An explanation of the OpenEEMeter core methods, models, and structures is available [here](#).

Project Details -

Load Sample Data

project\_id,zipcode,project\_start,project\_end

Meter Data -

Load Sample Data

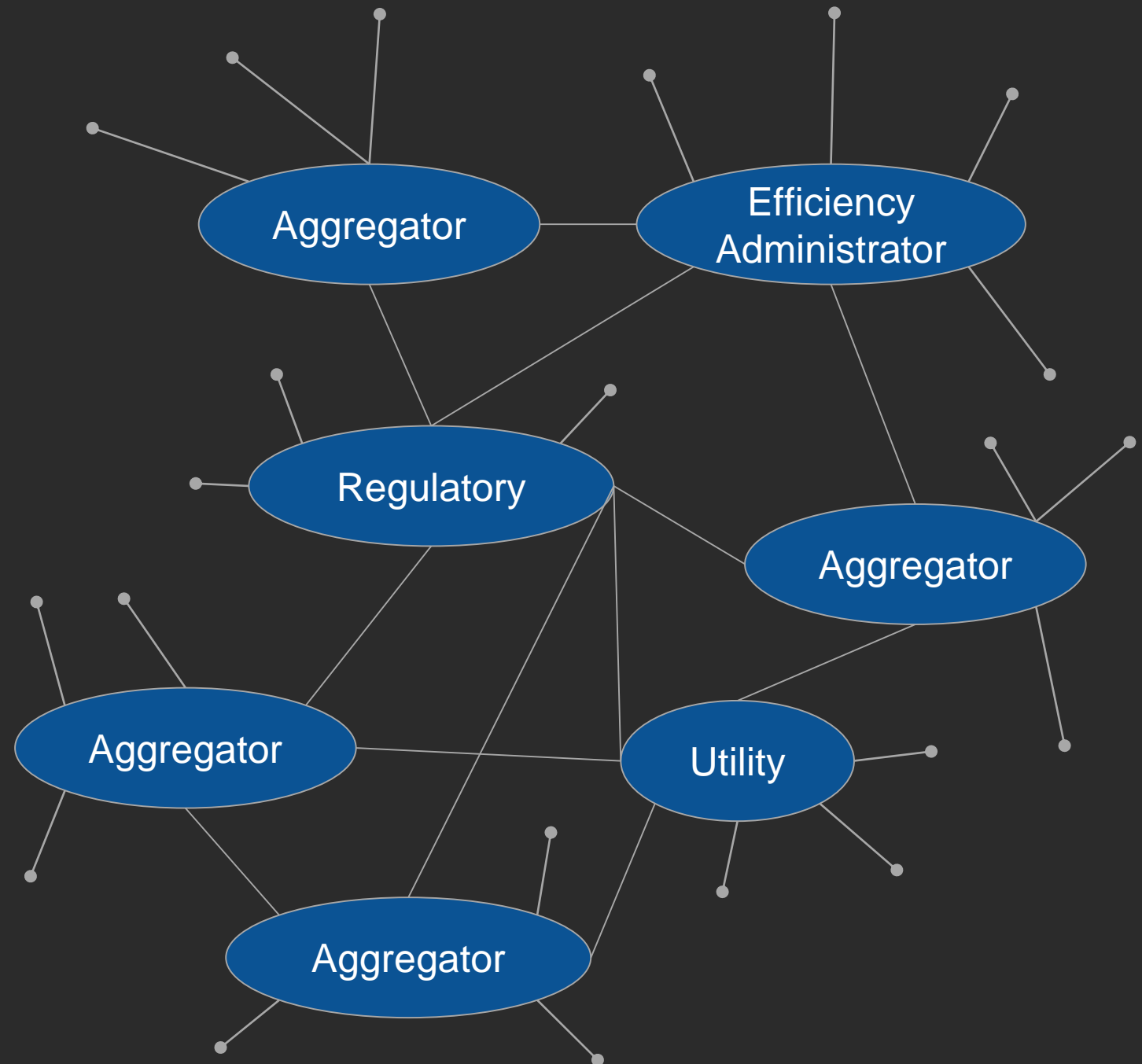
start,value,project\_id,interpretation

Submit



# Project Registry

- Immutable record of interventions
- Augment energy with other sources of data
- Provide secure access for relevant parties
- Documentation solution for project validation and ex-post EM&V



# POLLS





SBW Consulting

Bill Koran

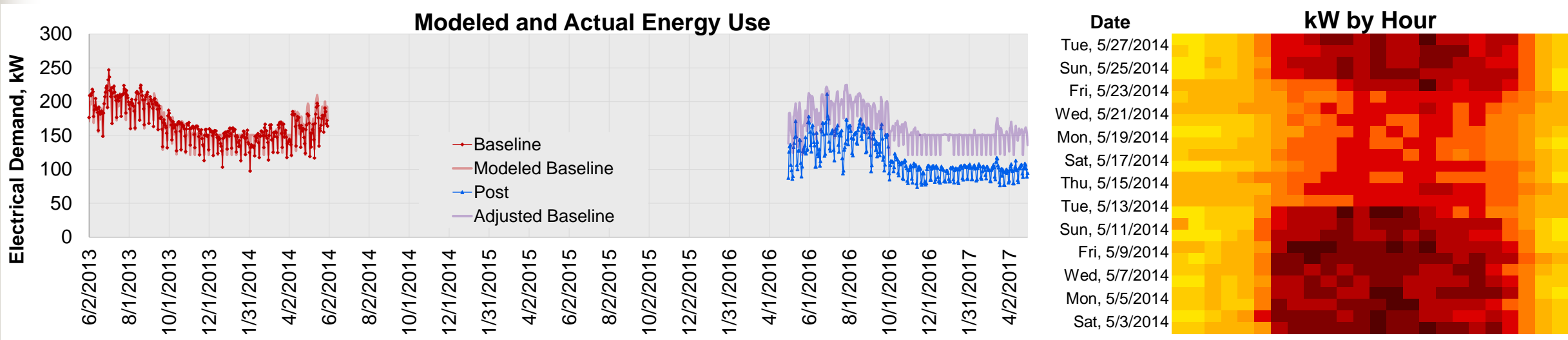
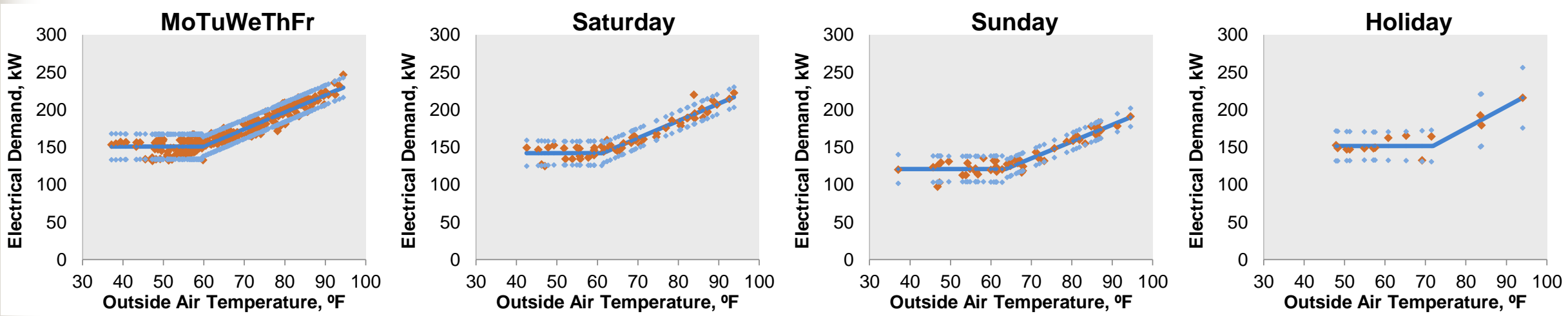
[bill.koran@sbwconsulting.com](mailto:bill.koran@sbwconsulting.com)



# ECAM Popularity: Possibly the most users?

- Bonneville Power Administration
- Users across the country, from Duke Energy (P4P program in 5 states) to Orlando Utilities Commission to Seattle City Light
- Training at PG&E 8 years running
- Many other utilities, professionals, and researchers
- Translated into French in 2017. Also users in U.K., Saudi Arabia, New Zealand, Australia, and elsewhere
- Mentioned in CA legislation appendix
- Adopted by PNNL for Building Re-tuning
- Referenced in ASHRAE work statement to update the inverse model toolkit







# ECAM Strengths

- Adherent to IPMVP and ASHRAE Guideline 14
- Useful for ALL IPMVP Options, including support for Option D calibrations
- Hourly, daily, or monthly data
- Excellent models; Custom daytypes, hourtypes, and holidays
- Physically-significant models
- XML data exchange
- Support SEM and P4P
- Automated weather data downloads
- Fantastic transparency, data visualizations and flexibility
- Support detection and quantification of non-routine events
- Coming 2<sup>nd</sup> Quarter: Batch processing



**Lawrence Berkeley National Labs: “RM&V” – Free M&V Tool**

**Eliot Crowe (Program Manager) [Ecrowe@lbl.gov](mailto:Ecrowe@lbl.gov)**

**Jessica Granderson, PhD (Principal Investigator) [jgranderson@lbl.gov](mailto:jgranderson@lbl.gov)**

**Samir Touzani (RM&V Tool Developer) [stouzani@lbl.gov](mailto:stouzani@lbl.gov)**

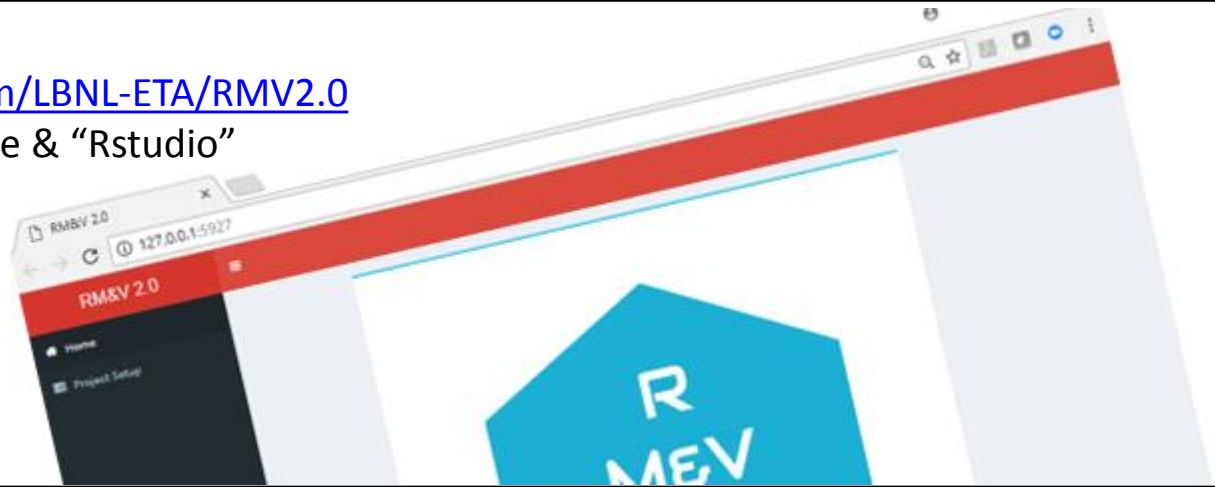
# “RM&V” – LBNL’s Free M&V Tool

## 1. Git it!

<https://github.com/LBNL-ETA/RMV2.0>

Install “R” software & “Rstudio”

Run the script



## 2. Prep your data

	A	B	C
	time	eload	temp
1	6/30/2016 0:30	21.42	69.8
2	6/30/2016 0:45	20.484	69.8
3	6/30/2016 1:00	19.98	69.3
4	6/30/2016 1:15	21.42	69.3
5	6/30/2016 1:30	19.08	69.1
6	6/30/2016 1:45	19.116	68.9
7	6/30/2016 2:00	18.864	68.2
8	6/30/2016 2:15	19.62	67.6
9	6/30/2016 2:30	18.432	67.3
10	6/30/2016 2:45	15.336	67.1
		17.784	67.1

## 3. Choose your modeling approach

A screenshot of the RM&amp;V 2.0 web interface. The browser's address bar shows the URL 'https://127.0.0.1:5927'. The page has a red header with 'RM&amp;V 2.0' and a blue sidebar with navigation links: 'Home', 'Project Setup', 'Screening Analysis', 'Input Data Overview', 'Train Baseline Models', 'Baseline Modeling Results', and 'Summary'. The main content area shows a 'Model Set Up' section with a dropdown menu for 'Select the Baseline Model' currently set to 'TOWT'. Below this, there is a 'Baseline Model Description' section and a 'TOWT Hyper-parameter Setup' section with a slider for 'timescale for weighting function (in days)'.

### Time of Week and Temperature (TOWT)

<https://drcc.lbl.gov/publications/quantifying-changes-building>

<https://drcc.lbl.gov/publications/methods-analyzing-electric-load-shape>

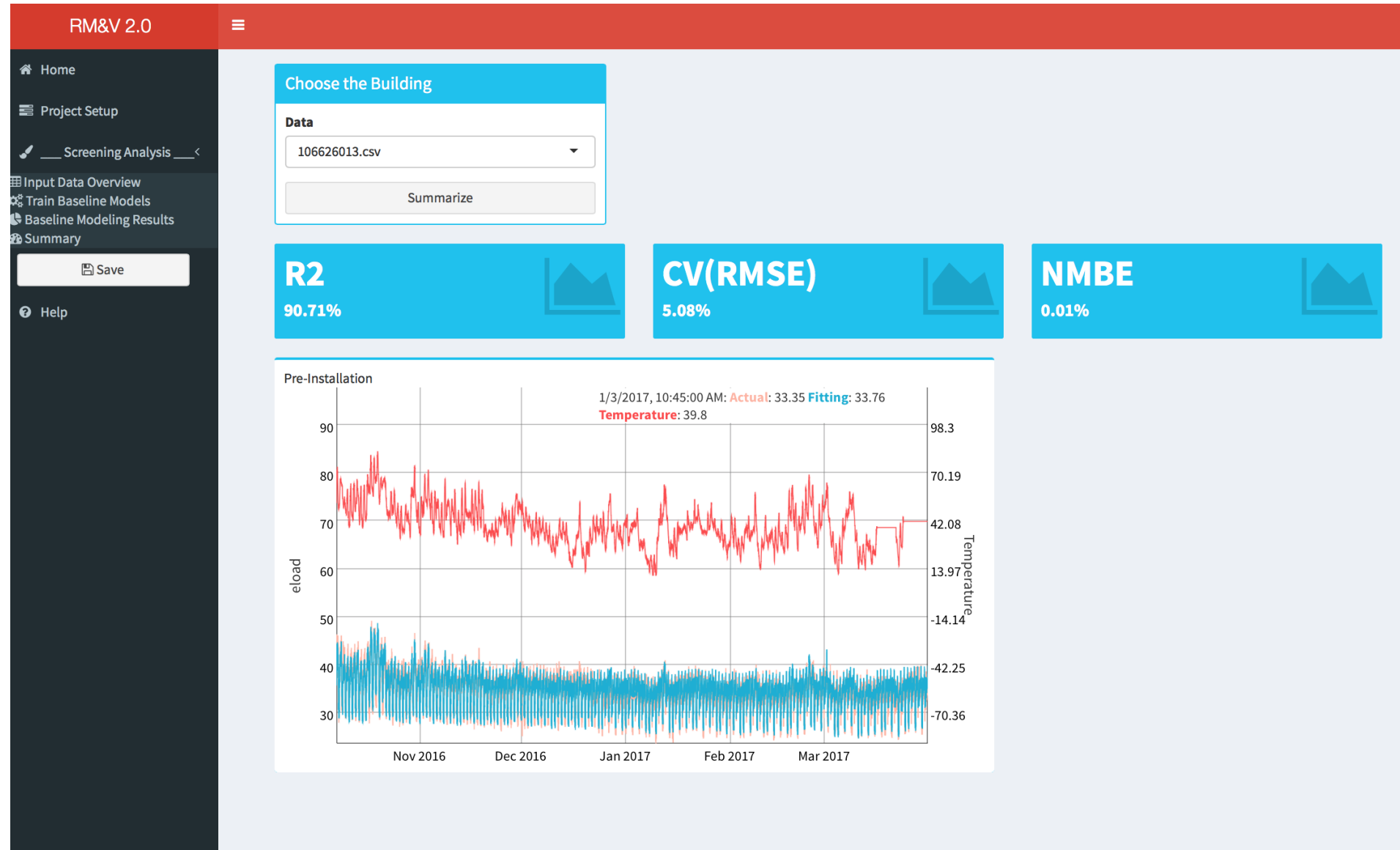
### Gradient Boosting Model

<https://www.sciencedirect.com/science/article/pii/S0378778817320844>

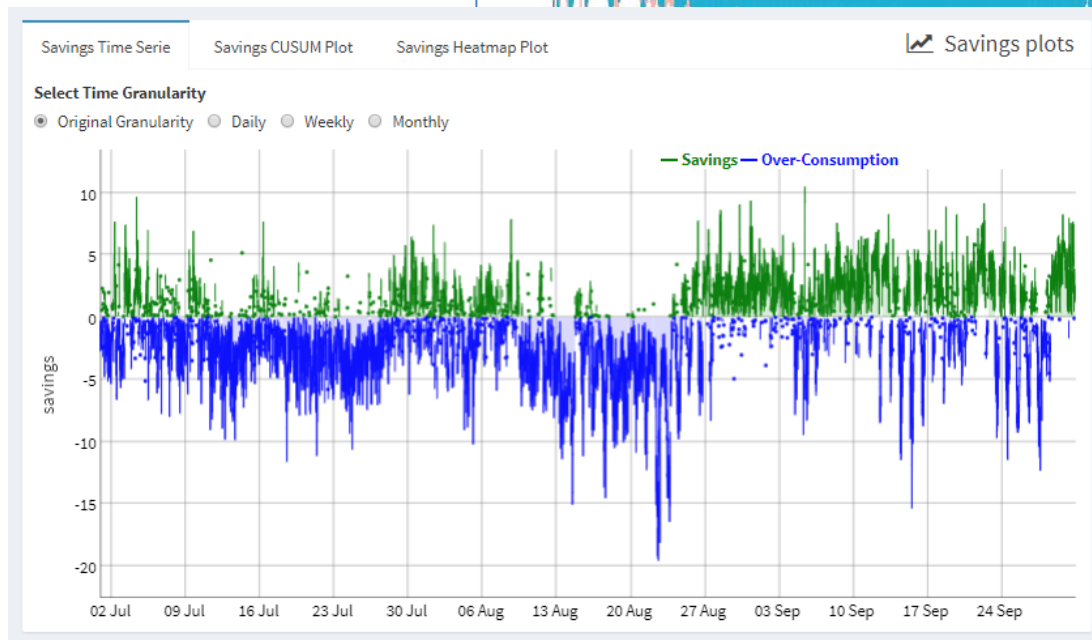
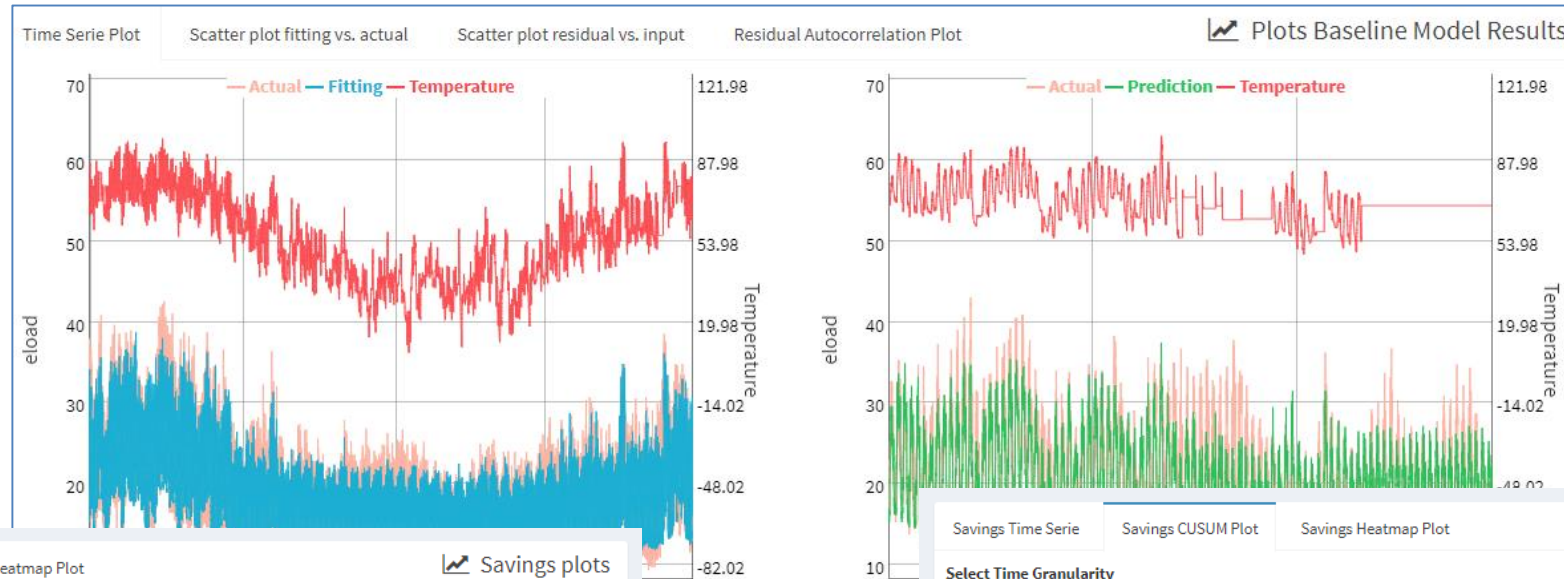
For more of LBNL’s work on automated M&V, check out: <http://eis.lbl.gov/auto-mv.html>



# Develop Baseline



# Quantify Savings





**Opinion Dynamics: Normalized Metered Energy Consumption  
(NMEC) and the commodities marketplace  
Jeremy Eddy, [jeddy@opiniondynamics.com](mailto:jeddy@opiniondynamics.com)**

# NMEC is Exciting! But...

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## NMEC is Exciting...

- Shift toward a more market-based approach to EE compensation

## ...BUT it may bring real risk of market manipulation

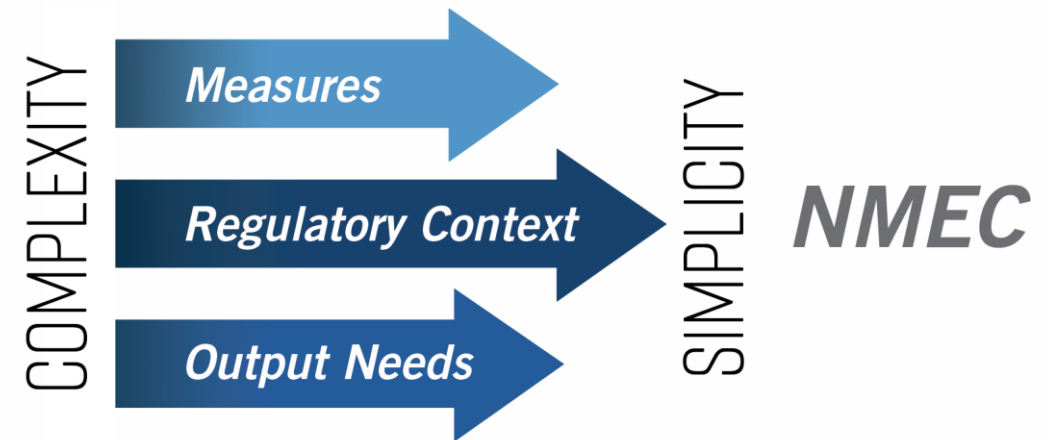
- ISO-NE: FERC vs. Competitive Energy Services, et al.: curtail on-site generation, artificially inflate baseline load
- Claiming energy savings when it's actually just a case of someone going out of business.
- The ability to establish an artificial price.



# Challenges to Standardization

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- Attribution: Whose priorities are being served?
- Signal-to-noise ratio
- Tradeoffs in accuracy for consistency: Reproducible AND Replicable
- Non-routine events:
  - How are these defined?
  - How are they dealt with?
- Increasing accuracy of savings as time accumulates post-intervention
- AMI data availability

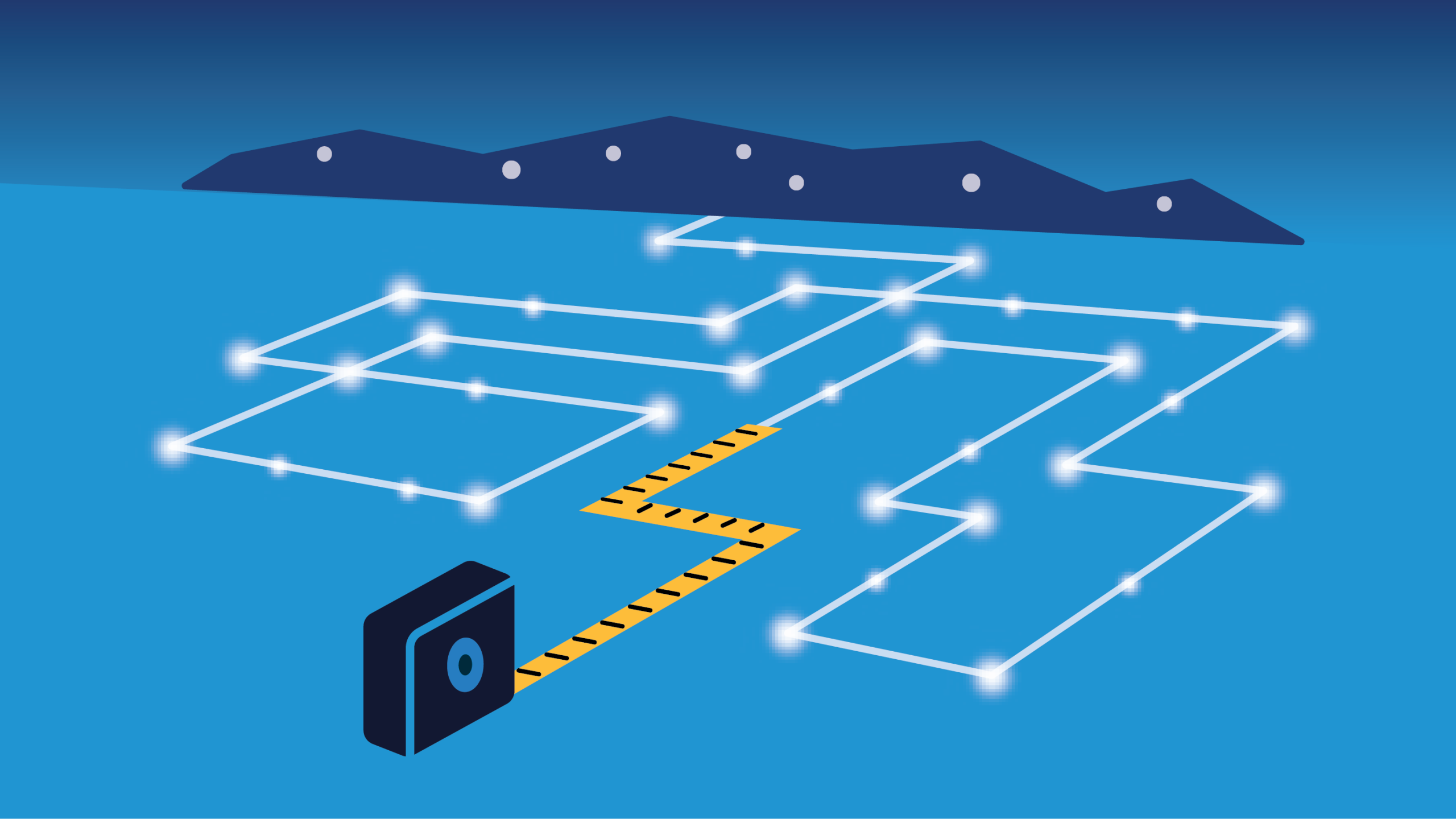




## Best Practices for Positive Results

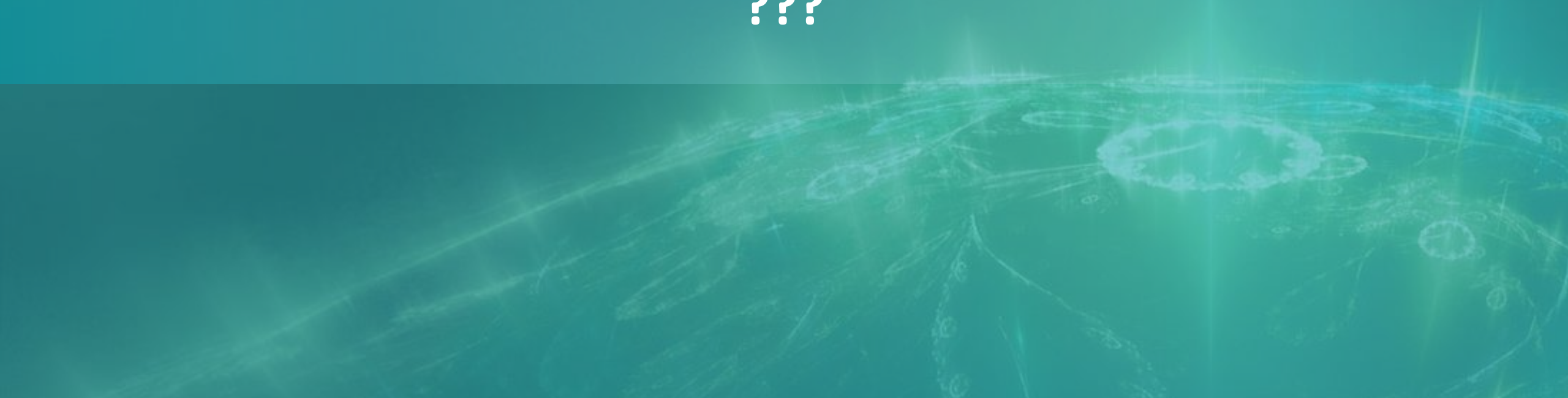
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- Agree among key stakeholders on no-regrets items
- Demonstrate success where favorable conditions are met:
- Keep 2 sets of books?
  - Clear, rigid definition of a unit of energy savings
  - More accurate, analysis-based feedback
    - Who should carry the risk of the differential between these two?
- Minimize sharks risk: Require gross receipts?





Q&A  
???



# Resource Links and Final Poll

## From NEEP:

- December 11<sup>th</sup> webinar (<http://www.neep.org/events/rapid-fire-advanced-mv-software-products-overview>)
- The Many Flavors of M&V Workshop Slides (<http://neep.org/events/2017-regional-emv-forum-fall-meeting>)
- Advanced M&V Brief: An Evolving Industry  
(<http://neep.org/sites/default/files/resources/Advanced%20Measurement%20%26%20Verification%20%28M%26V%29%20Brief%20-%20An%20Evolving%20Industry.pdf>)
- Auto M&V Industry Brief: How Fast is the EM&V Paradigm Changing? (<http://neep.org/auto-mv-industry-brief-how-fast-emv-paradigm-changing>)
- Advanced Building Analytics Tool List (<http://neep.org/initiatives/emv-forum>)

## From LBNL:

- For more of LBNL's work on automated M&V, check out: <http://eis.lbl.gov/auto-mv.html>

## Contacts

- Elizabeth Titus, [etitus@neep.org](mailto:etitus@neep.org), 781-860-9177 x111
- Claire Miziolek, [cmiziolek@neep.org](mailto:cmiziolek@neep.org), 781-860-9177 x115
- Giselle Procaccianti, [gprocaccianti@NEEP.org](mailto:gprocaccianti@NEEP.org), 781-860-9177 x156

# Upcoming Events

## NEEP webinars/Workshops:

- Strategies for Improving Energy Efficiency in Communities on 3/28 at 11AM
- 4/2-4/4: High Performance Schools Tour in Wells ME, Concord NH, and Fall Creek MA
- Mark your Calendars (more details very soon!)
  - June 18-19 Workshop as part of Air Source Heat Pump Initiative
  - October 2-3 NEEP Regional Summit

## Industry events:

- NFMT2018 – March 20-22 (*free conference*)
- GLOBALCON – March 21-22 (*reduced rates with NEEP*)
- Getting to Zero Forum – April 17-19
- HPC National- April 23-26





**THANK YOU!**

