Overview of the NMEC Procedures Manual

An SCE Emerging Technology Project

Presentation to

EM&V – NMEC Forum

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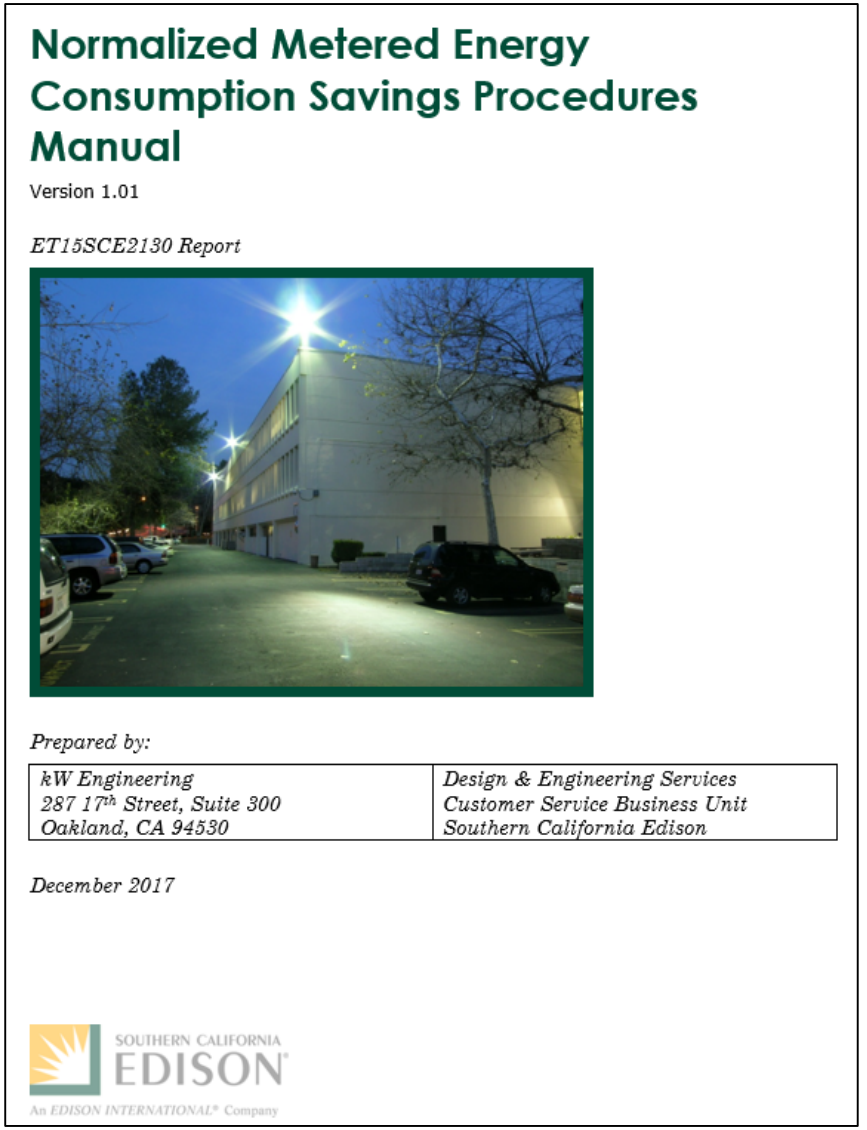
Agenda

- Background
- Purpose
- Quick Review
- Organization
- Procedures
- Issues
- Availability



Normalized Metered Energy Consumption Savings Procedures Manual

Version 1.01

ET15SCE2130 Report

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Background

- NMEC = normalized metered energy consumption Authorized under AB 802 in California (2015)
  - Enables program administrators (PAs) to provide incentives for all EE measures based on the "overall reduction in normalized metered energy consumption."
- Creates a new program 'pathway' separate from custom or deemed measures
  - Actually two EE programmatic pathways:
    - a site specific pathway
    - a population-based treatment and control group pathway
- 'Metered' not whole building
- Stakeholders are unfamiliar with 'NMEC methods'
- Past experience with a similar program (MBCx) showed that without specific guidance, PAs will get as many M&V methods are there are implementers.
- WO33 Appendix G listed a number of issues to resolve

Purpose

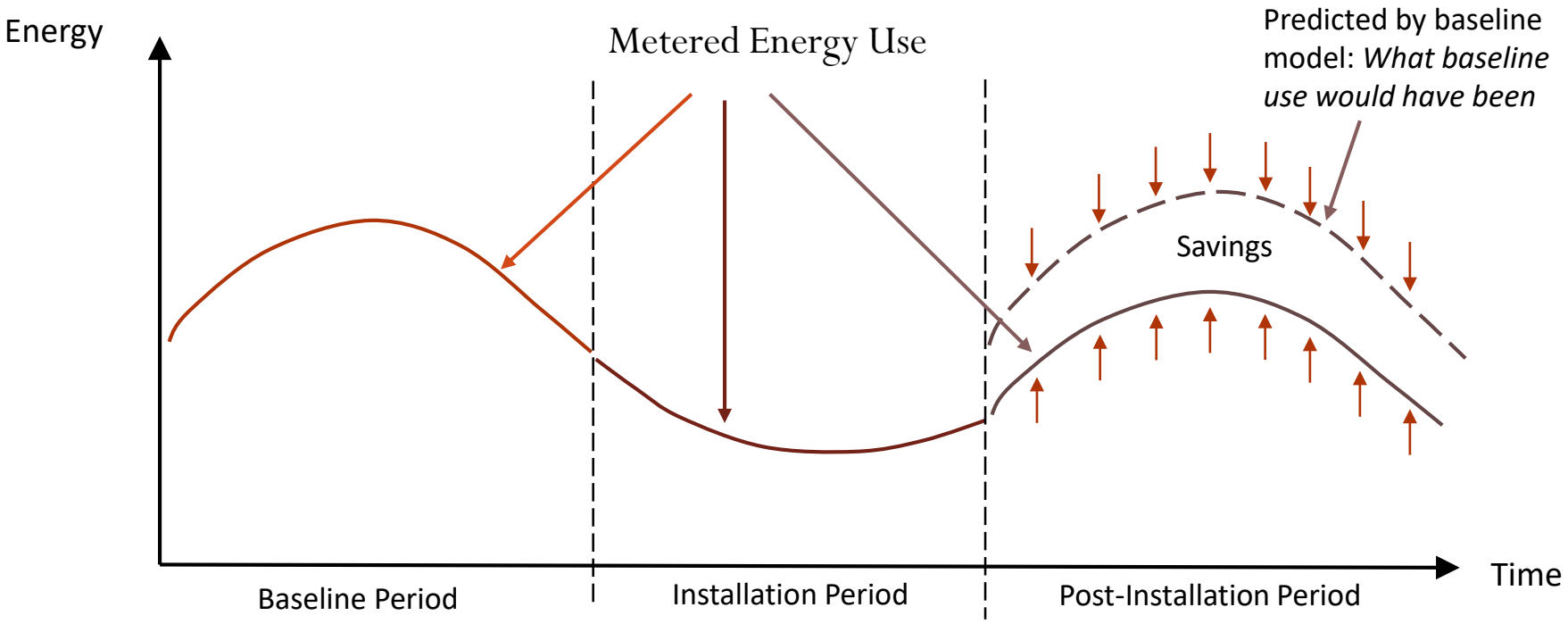
- To provide common procedures and requirements for documenting savings achieved with meter-based approaches
  - Based on industry best practices
- To establish consistency in *site-specific* NMEC savings analysis
- To document current best practices in an adaptable format
  - Enable revisions as the industry learns
- To align with CPUC guidance

Quick Review - Savings Methodology

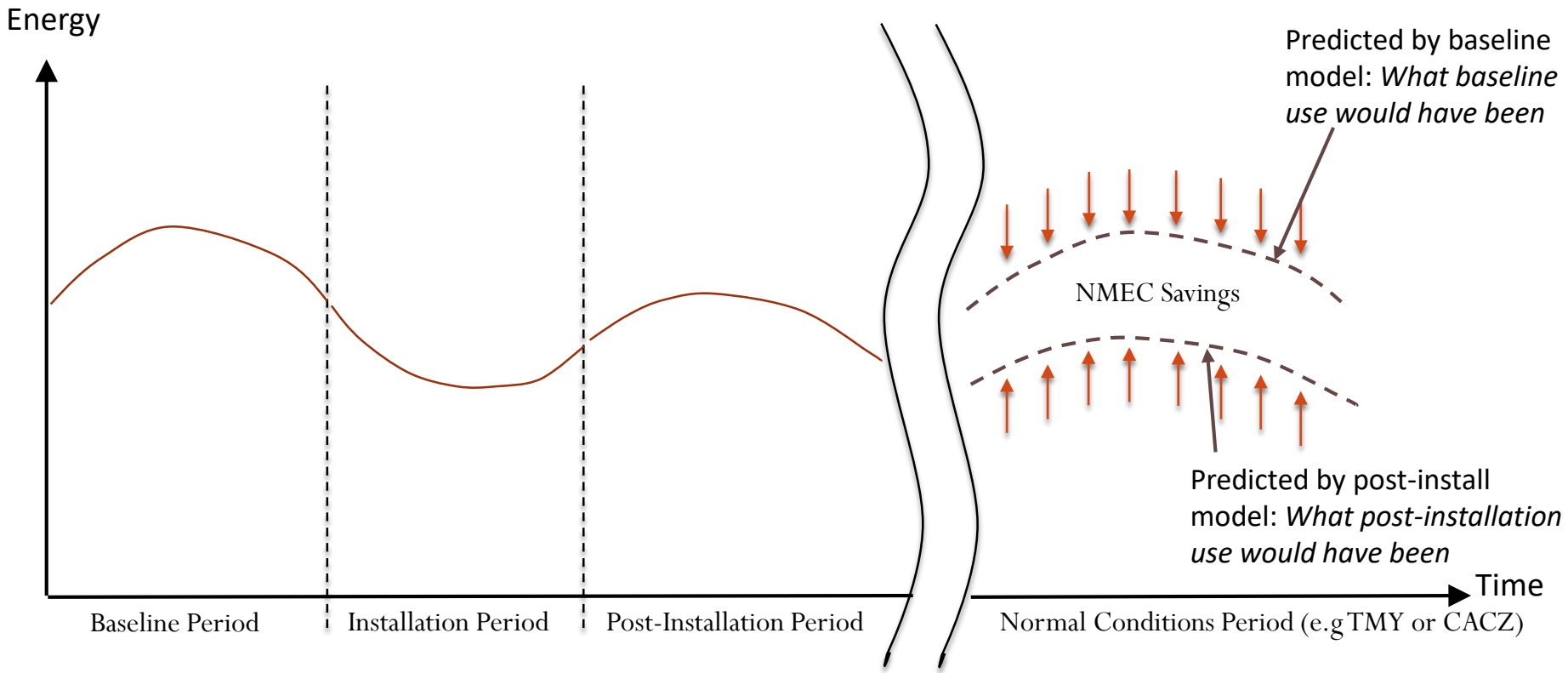
Whole Building

Building Subsystem

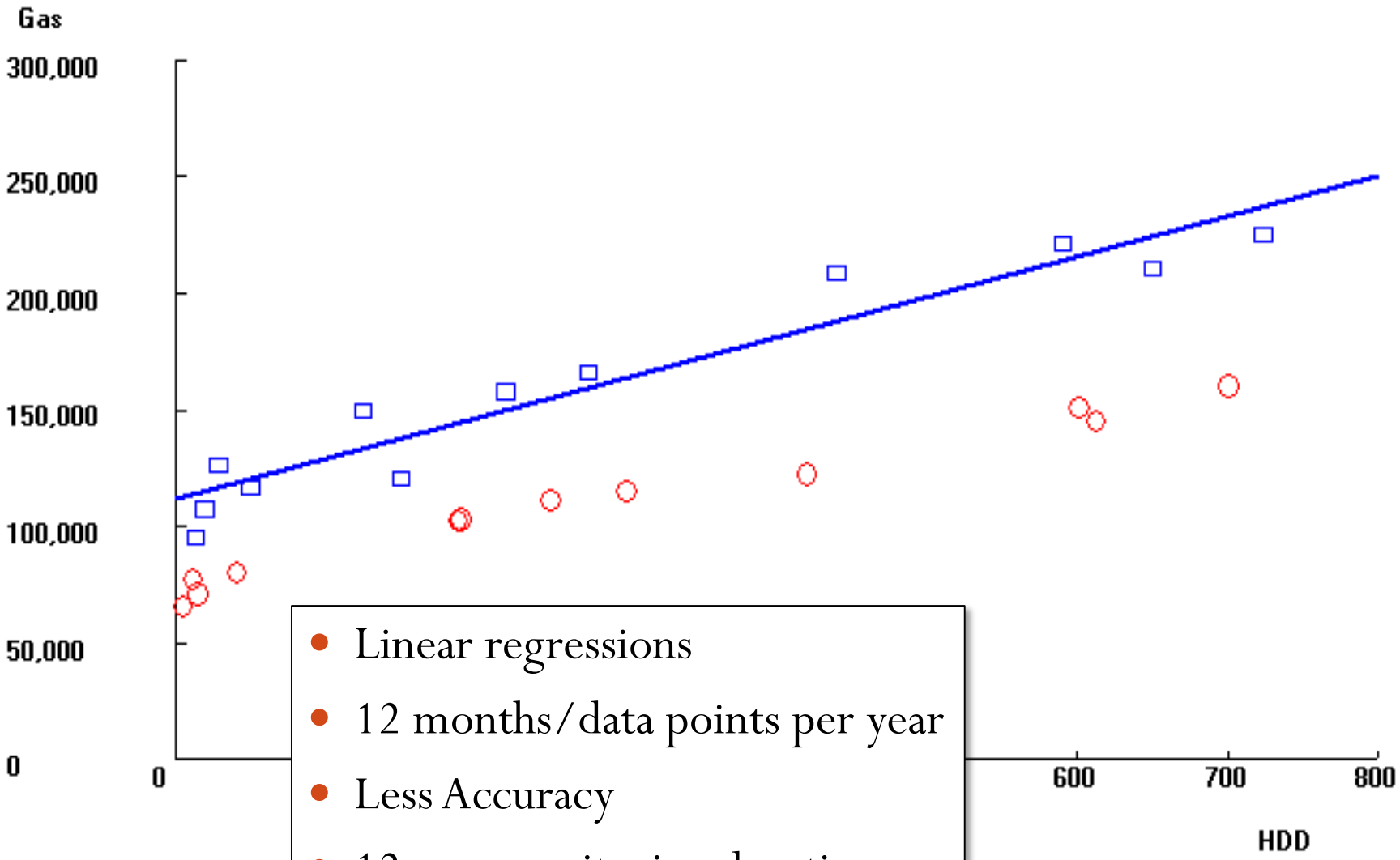
Graphical Representation of Method



Savings Based on NMEC

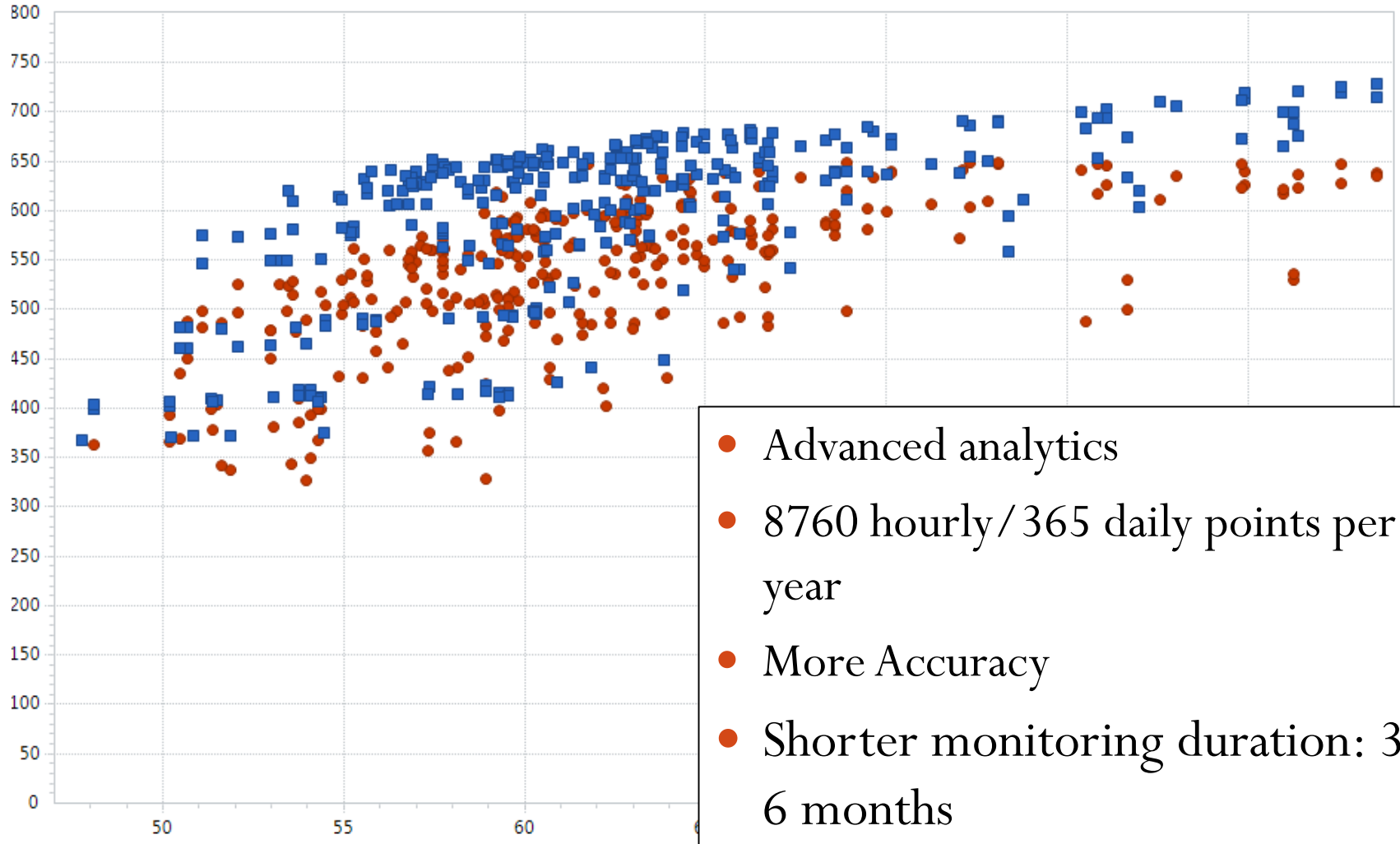


M&V 1.0 – Monthly Data



- Linear regressions
- 12 months/data points per year
- Less Accuracy
- 12 mo. monitoring duration

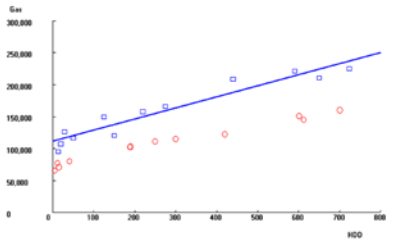
M&V 2.0 - Interval Data



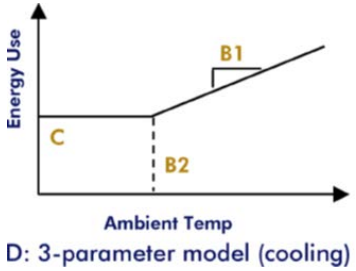
- Advanced analytics
- 8760 hourly/365 daily points per year
- More Accuracy
- Shorter monitoring duration: 3 to 6 months
- Applicable to subsystems (Option B)

Advanced Analytics

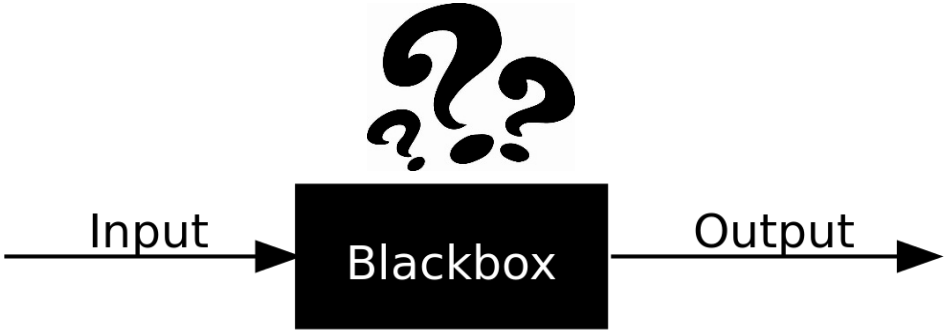
- Familiar
  - Linear OLS Regression



- More Advanced
  - ASHRAE RP1050 Change-Point Models
  - LBNL Temperature and Time-of-Week Model

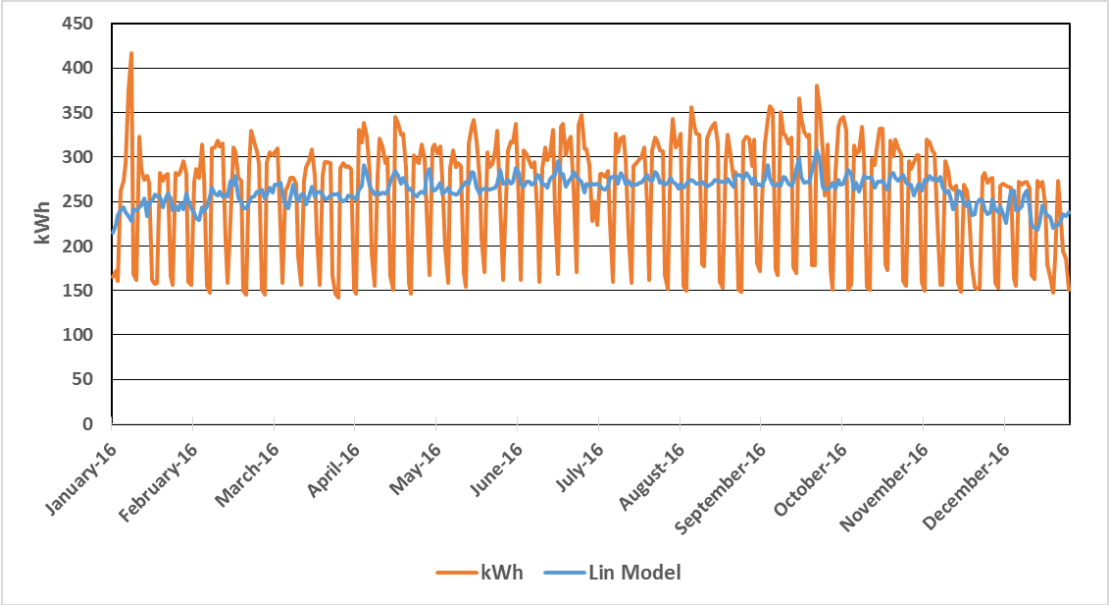


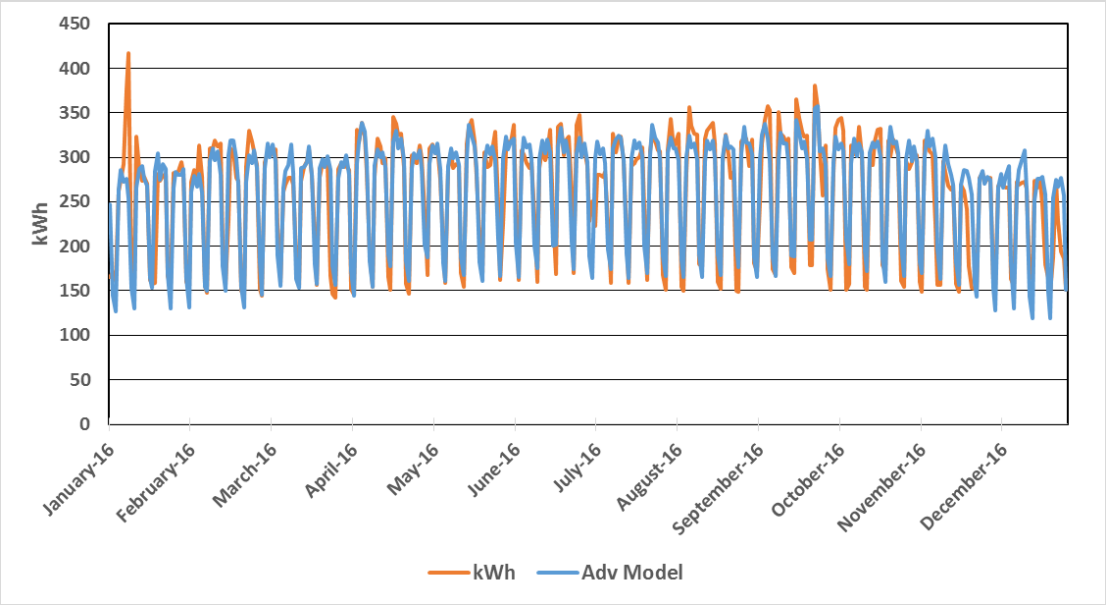
- Exotic
  - Neural Networks
  - Nearest Neighbor
  - Machine Learning
  - Much More..



Comparison

- Linear OLS Model
  - Temperature only

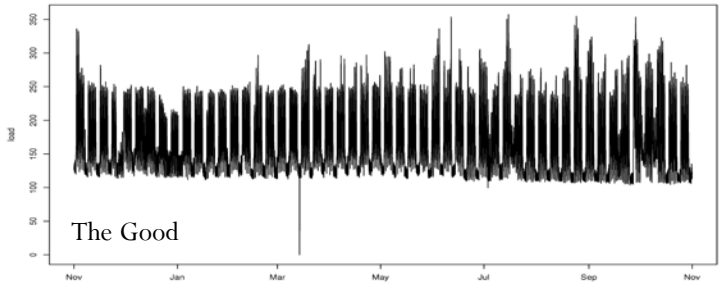




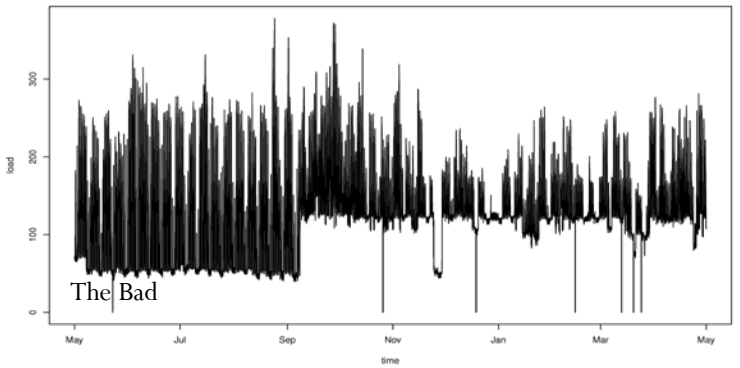
- Advanced Model
  - Temperature and Time-of-Week

Predict/Forecast

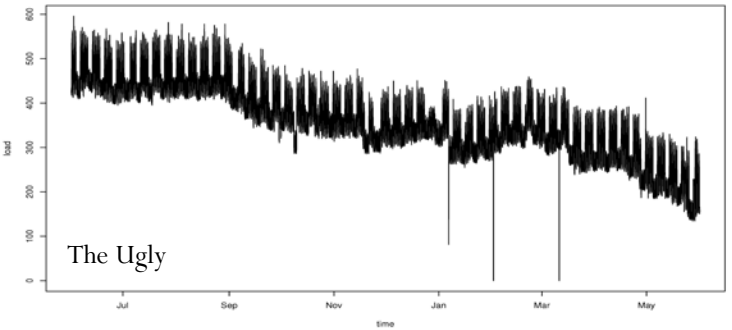
- Good buildings:
  - Predictable operation



- Bad buildings
  - Requires intervention?



- Ugly buildings
  - Cannot predict future use

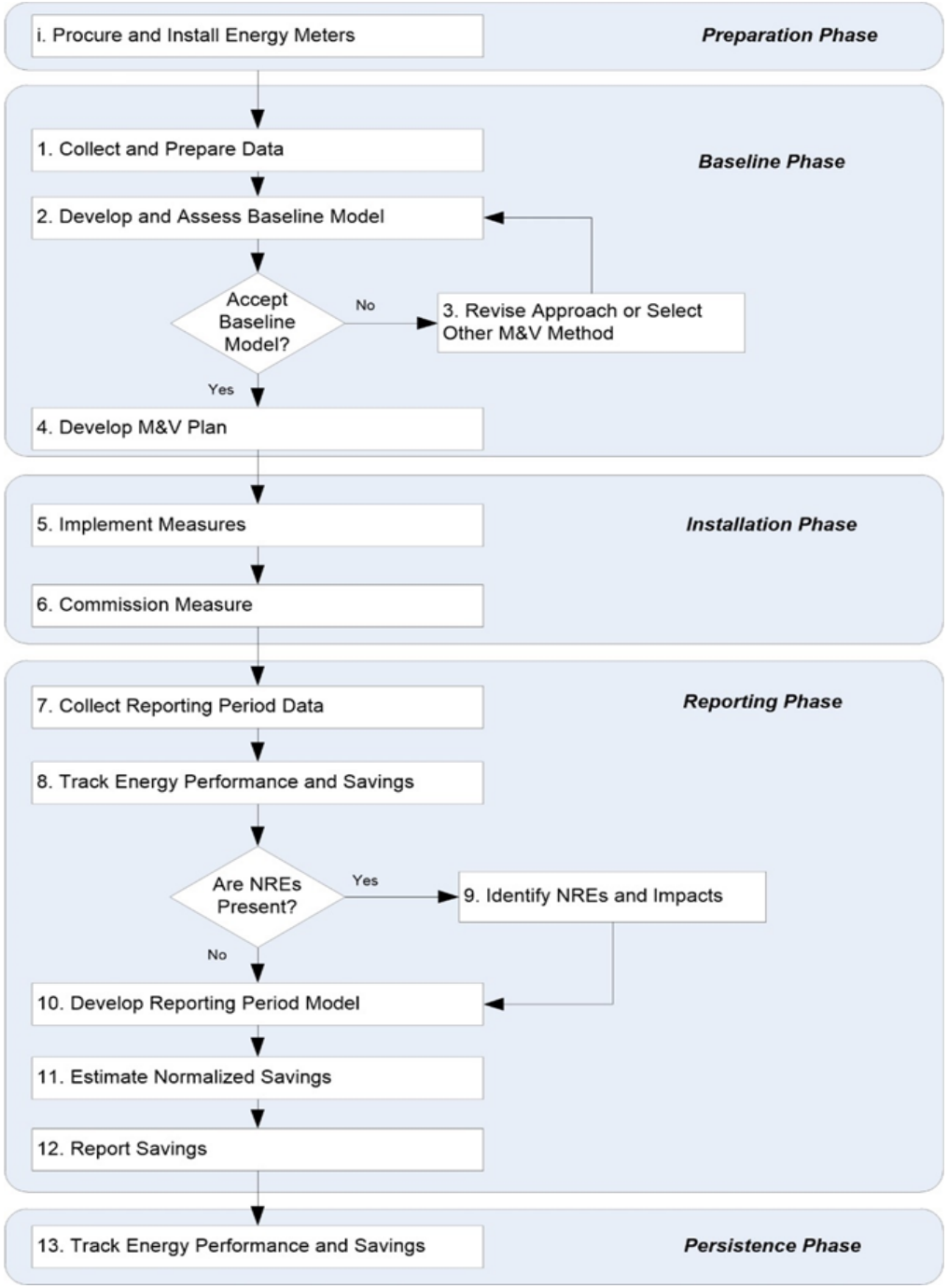


NMEC Manual Organization

- Executive Summary
- Introduction
  - Background, Method Overview, Structure of Manual
- **NMEC Procedures and Requirements**
- **Issues**
- Templates
  - M&V Plan
  - Savings Report

Procedures and Requirements

- Associated text describes each step and summarizes the step's requirements



Issues Section

- Energy Metering
- Independent Variables
- Weather Coverage
  - Does baseline weather include all anticipated conditions?
- Modeling Algorithms
  - Change-point, TTOW described, other algorithms not excluded
- Goodness-of-Fit Metrics
- Assessing Savings Uncertainty
  - ASHRAE method
- Non-Routine Events
- Normalized Savings Uncertainty
- Resources

Metering

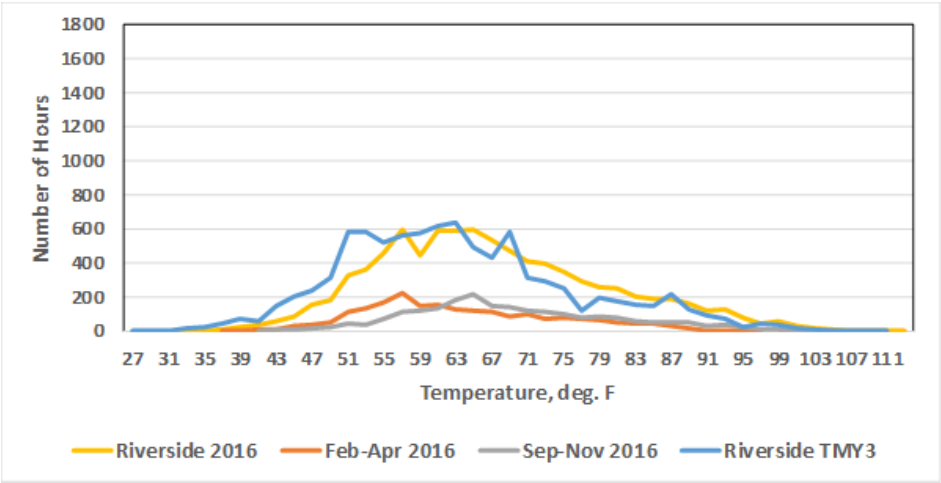
- Concern: Meter Accuracy
  - Bias Measurement Error - eliminate
  - Random Measurement Error – reduce as possible

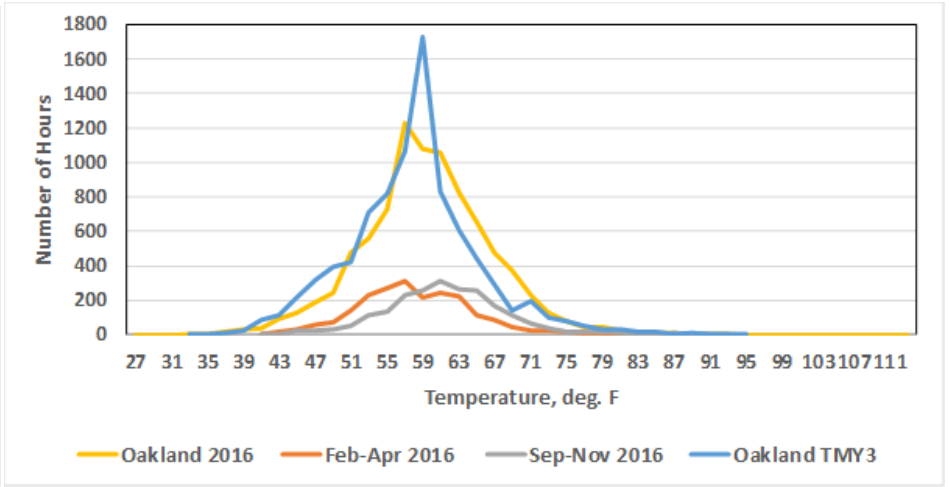
Energy Source	Type	Typical Accuracy	Common Mfgrs
Electric	Solid state	± 0.2% of reading	Square D Eaton
Natural Gas	Positive displacement	± 1 - 2% of reading	Dresser American
CHW/HHW	Temperature sensors: solid state Flow meter: turbine, electromagnetic, ultrasonic, or vortex	Temp sensors: ± 0.15°F from 32-200 °F Flow meter: ± 0.2% to ± 2.0% per flow meter Calculator accuracy: within ± 0.05%	Onicon Flexim
Steam	Flow: Vortex shedding Temperature: RTD	Mass flow: ± 2% of mass flow calculation	Rosemount Yokogawa

- Mfgr's product test results, installed meter calibration reports, should be submitted with the documentation for all meters.

Weather Coverage

- Aide in determining if enough baseline data collected (duration of baseline period)



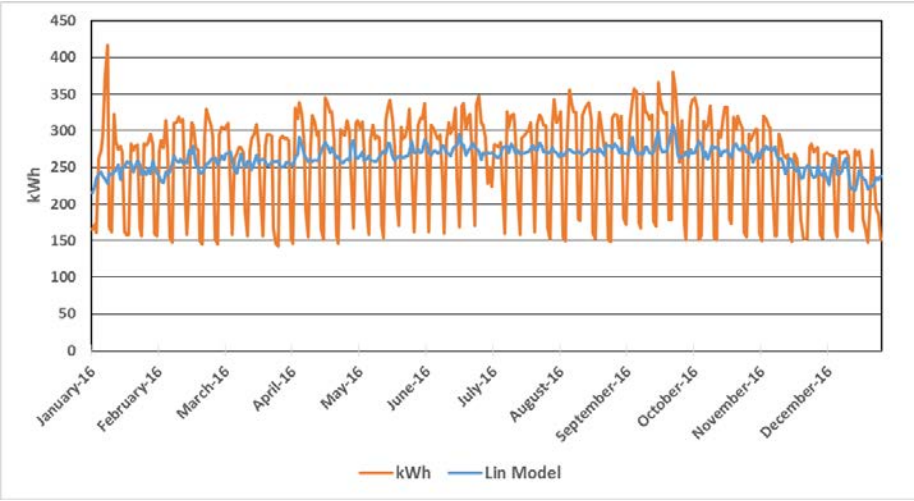


Range of Dates	Duration (Months)	Filtered Temperature Range		Extended Temperature Range		Temperature Coverage Factor	Hours Coverage Factor	Number of Hours Not Covered
		Minimum	Maximum	Minimum	Maximum			
Jan-Apr	4	39	91	33.8	96.2	72.6%	98.4%	140
Mar-Jun	4	45	99	39.6	104.4	75.3%	98.1%	169
May-Aug	4	53	109	47.4	112	75.1%	90.7%	812
Jul-Oct	4	55	105	50	110	69.8%	85.0%	1318
Sep-Dec	4	39	99	33	105	83.7%	99.8%	21
2016	12	39	103	32.6	109.4	89.3%	99.8%	16

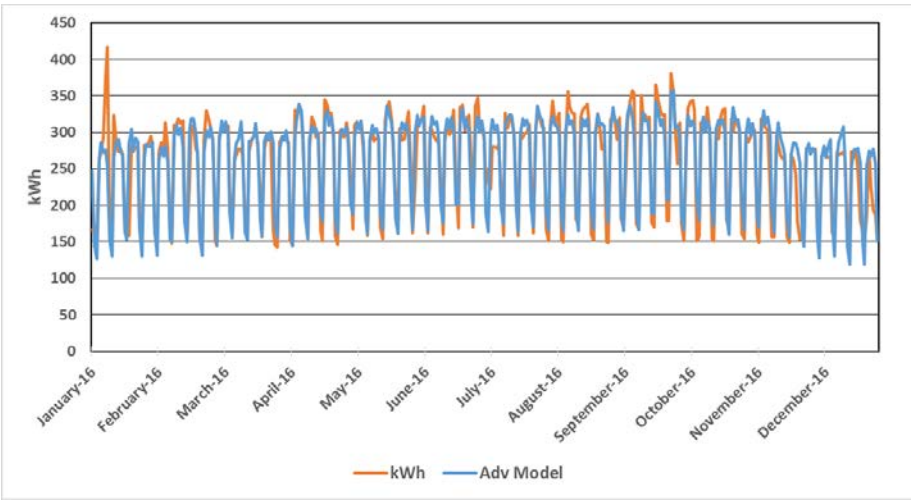
Goodness of Fit Metrics

- Baseline Models
  - NDBE (bias error) < 0.005%
  - CV(RMSE) (random error) < 25%
  - R^2 (independent variables 'explanatory power') > 0.7

Linear Model, CV = 25%



TTOW Model, CV = 11%



Non-Routine Adjustments Process

- Identify the NRE (visualize data or owner report)
- Determine if NRE Impact is Material (if not, stop)
- Assess
  - Temporary or Permanent?
  - Constant or Variable Load?
  - Added or Removed Load?
- Quantify Impact
  - Engineering calcs + assumptions (low quality/cost)
  - Engineering calcs + logged data (med-high quality/cost)
  - Analysis of before/after NRE using metered data (high quality/low cost)
- Adjust Savings Estimate

Other Elements of NMEC Manual

- Change Log
  - Track revisions by version number
- Tracking reviewer comments (Appendix A)
  - For consideration in future versions
- M&V Plan and Savings Reports
  - Evolution expected

Questions?

NMEC Procedures Manual to be available on

California Emerging Technologies Coordinating Council Website in February 2018

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M&V Documentation

- M&V Plan
  - Describe Model
    - Why chosen?
    - Mathematical form
    - Independent variables
  - Baseline Period
    - Coverage factor
    - Goodness-of-fit statistics
    - Uncertainty Assessment
  - Calculations
  - How often & how savings are reported
  - Non-routine adjustments
  - More!

Best Applications – Project Level M&V

- ‘Predictable’ buildings, systems
  - Weather sensitive, regularly scheduled
- Multiple and interactive ECMs
  - Affecting multiple building systems (HVAC, lighting, etc.)
- Deep savings projects
  - Savings are “above the noise”
- Data useful for other purposes
  - Anomaly detection, Performance drift

Risks and Issues

- Sub Meter Calibration Requirements & Frequency
- Complex Analysis Methods
  - Not simple OLS anymore!
- Unpredictable buildings
  - Prescreening may be required
- Non-Routine Events
  - Added building loads, major occupancy shifts
  - Must remove impacts from savings estimations
- Data accessibility and security (not covered)