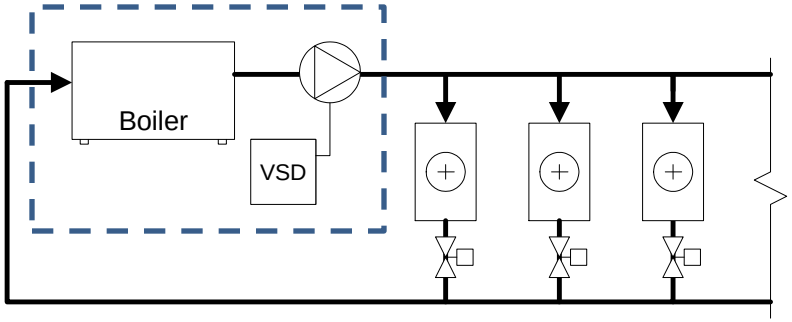
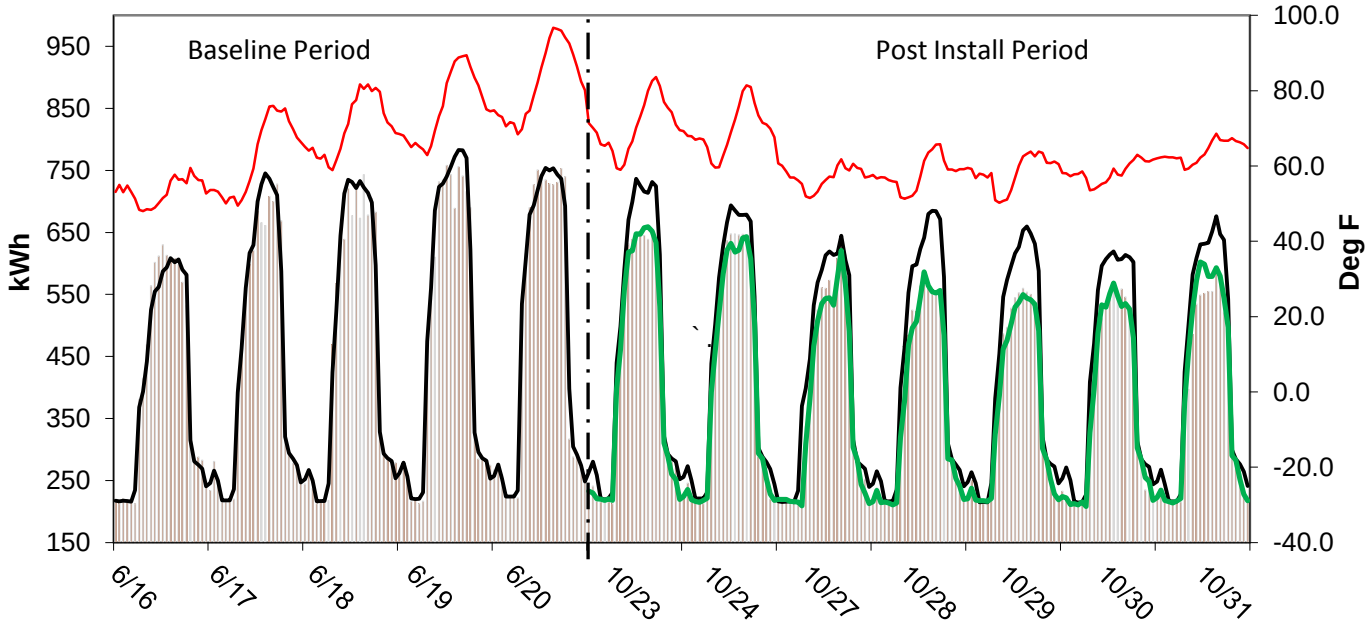
# Meter-Based Approach

Whole Building (Option C)

Building Subsystem or Submeter (Option B)

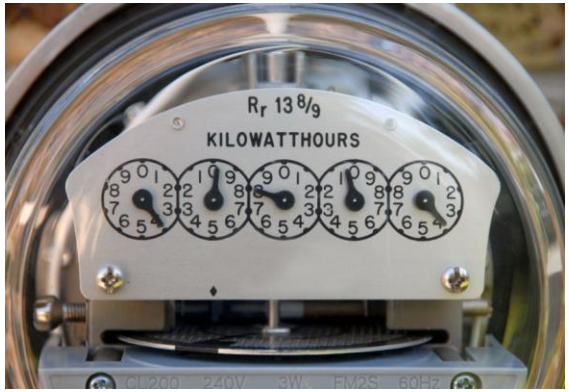


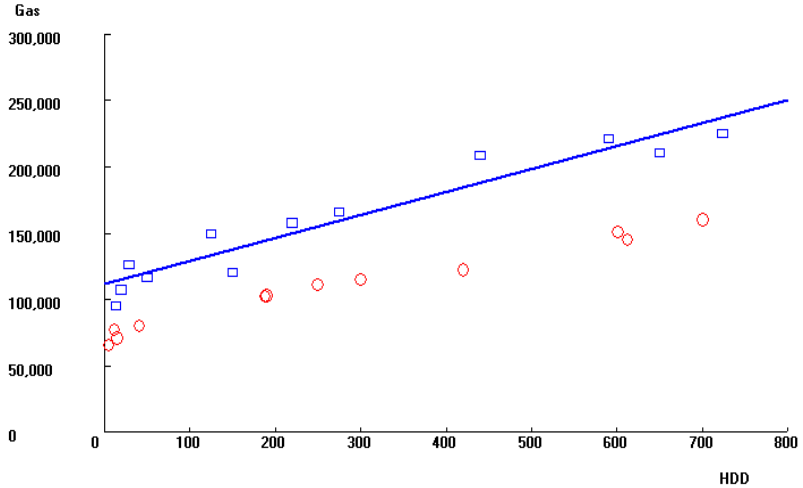

Savings Verification Method



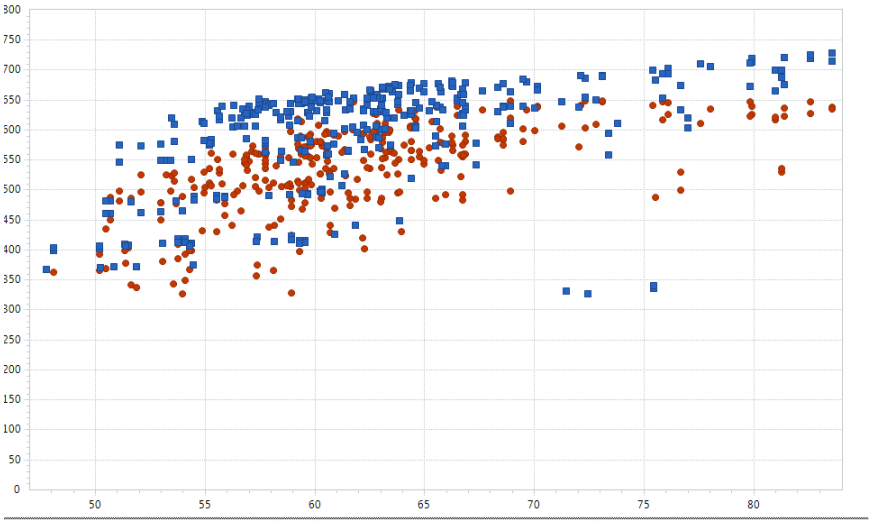
# Monthly vs. Interval Data

## M&V 1.0 - Monthly

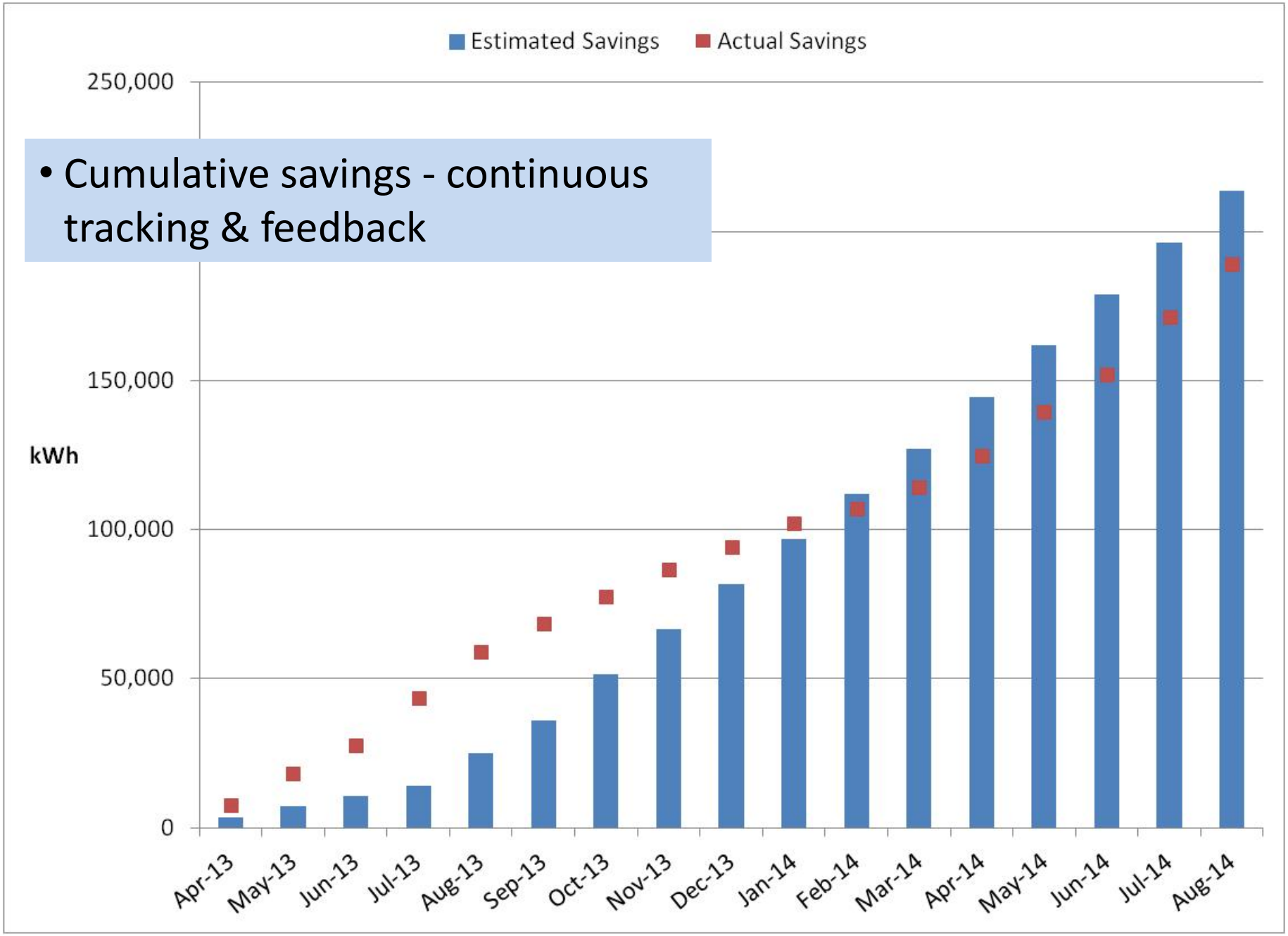



## M&V 2.0 – Hourly or Daily

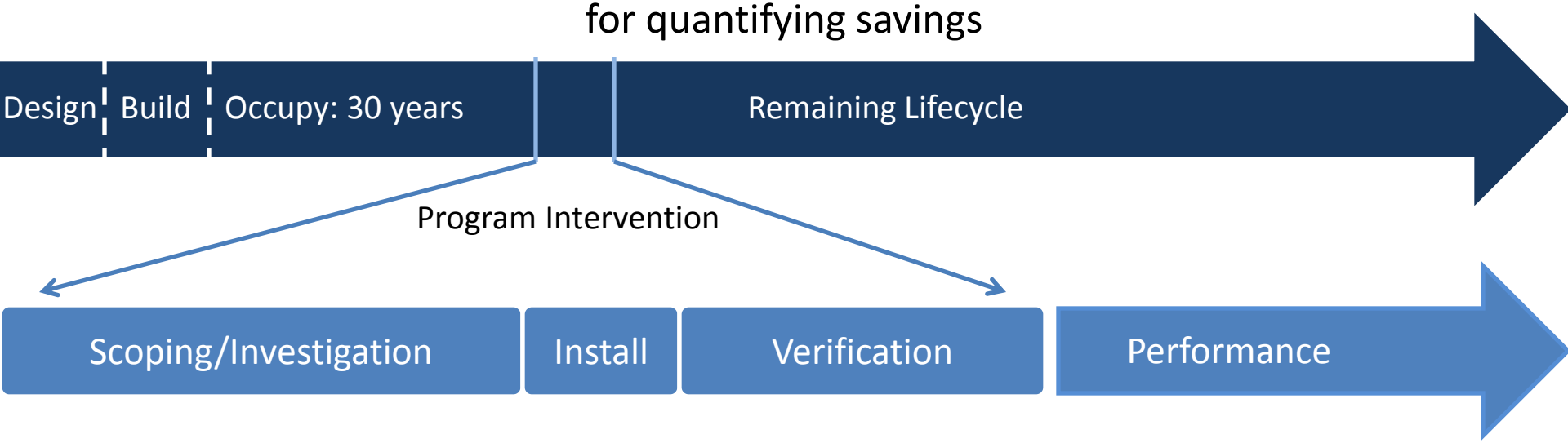


- Cumulative savings - continuous tracking & feedback



# Metered/Deemed/Calculated Approaches

for quantifying savings




| | | | |
|---|---|---|---|
| Deemed | • Eligibility check<br>• Apply deemed savings & costs | • Inspection | ?? |
| Calculated | • Data Collection<br>• Business case development<br>• Incentive Agreement | • Verify installation<br>• Collect post-install data<br>• True-up savings | ?? |
| Metered | • Pre-screening<br>• Baseline Model Development | • **Quantify Savings & Uncertainty** | • **Track performance**<br>• **Report monthly savings** |

# Meter-Based Approach Attributes

- Comprehensive: accounts for all ECM savings, including interactive effects
- Gross Savings: not net savings (no to-code/above-code capability)
- Simple: few data streams required (energy, weather), + tools available
- Accurate: Estimates savings uncertainty
- Persistence: Fast feedback on building performance
- Lower administration costs: standardization & automation reduces required time for savings analysis & technical review

# Best Applications

- <u>'Predictable' buildings</u>
  - Weather sensitive, regularly scheduled
- <u>Multiple and interactive ECMs</u>
  - Affecting multiple building systems (HVAC, lighting, etc.)
- <u>Deep savings projects</u>
  - Savings are "above the noise"
- <u>Difficult to quantify ECMs</u>
  - Duct sealing, envelope upgrades, etc.
- <u>ECMs using existing condition as baseline</u>
  - RCx, behavioral
- <u>SMB sector: other approaches not cost-effective</u>

# Questions / Discussion

- Thank you!

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# M&V 1.0 vs. 2.0

**M&V 1.0 –Monthly Data**

- Linear regressions
- 12 months/data points per year
  - High uncertainty with moderate savings
    - Ex: 10% savings, 10% CV, 95% confidence
    - ➢ 77% Uncertainty

- Monitoring duration req.
  - 12-month baseline & post

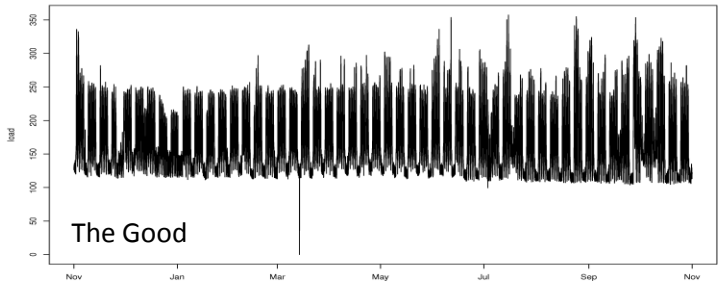
**M&V 2.0 – Interval Data**

- Nonlinear/Advanced analytics
- 8760 hourly points per year
  - 6-fold lower uncertainty with moderate savings
    - Ex: 10% savings, 10% CV, 95% confidence, high autocorrelation
    - ➢ 12% Uncertainty

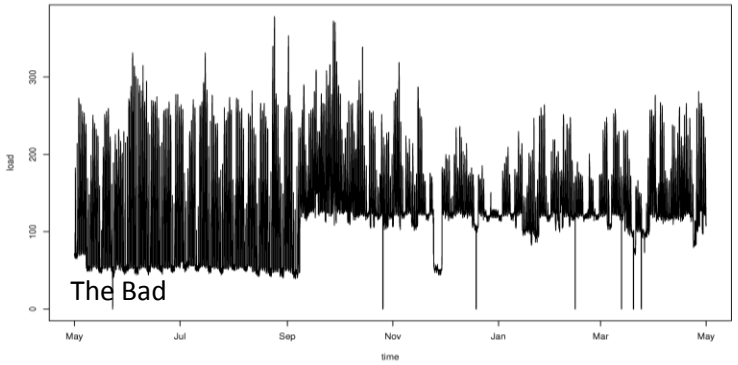
- Monitoring duration – can be much shorter
  - 3 & 6 month baseline
  - 3 & 6 month post
- Applicable to subsystem interval data

# Predict/Forecast

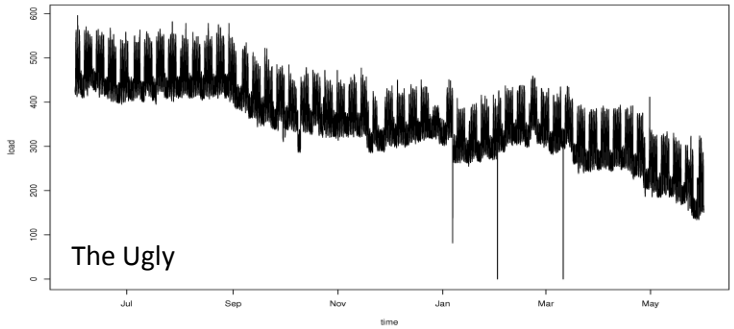
- Good buildings:
  - Predictable operation




- Bad buildings
  - Requires intervention?




- Ugly buildings
  - Cannot predict future use



# Approach Comparison

| | Savings Approach | | |
|---|---|---|---|
| **Attribute** | **Deemed** | **Calculated** | **Metered** |
| Data Requirements | low | high | low |
| Accuracy | low | low | high |
| Method Cost | low | high | low |
| Administration Cost | low | high | low |
| Comprehensiveness | by ECM | by ECM | All ECMs |
| Interactive Effects | Not Included | Not Included | Included |
| Behavioral Savings | Not Included | Not Included | Included |
| Performance Tracking | no | no | yes |

# Relationship of ‘Predictability’, Savings, and Uncertainty

| U < 10% | Uncertainty (95% CI) | | | | | |
|---|---|---|---|---|---|---|
| CV(RMSE) | 0.05 | 0.1 | 0.15 | 0.175 | 0.2 | 0.25 |
| % savings | | | | | | |
| 2% | 29% | 58% | 86% | 101% | 115% | 144% |
| 4% | 14% | 29% | 43% | 50% | 58% | 72% |
| 6% | 10% | 19% | 29% | 34% | 38% | 48% |
| 8% | 7% | 14% | 22% | 25% | 29% | 36% |
| 10% | 6% | 12% | 17% | 20% | 23% | 29% |
| 12% | 5% | 10% | 14% | 17% | 19% | 24% |
| 14% | 4% | 8% | 12% | 14% | 16% | 21% |
| 16% | 4% | 7% | 11% | 13% | 14% | 18% |
| 18% | 3% | 6% | 10% | 11% | 13% | 16% |
| 20% | 3% | 6% | 9% | 10% | 12% | 14% |