Standard Approach to Non-Standard Projects

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Outline

The Problem

The Measures

The Options

EUI Issues

Demand-side / Supply-side Efficiency

Benefits

The Goal

Determination of energy savings in large custom industrial verification projects

- Consistent – reduce cost, easier QA/QC
- Transparent
- Repeatable
- M&V Based

Challenges to Standardization

Custom resists standardization

- Unpredictable data availability
- Production dependent
  - Low granularity
  - Proprietary and confidential
  - Unclear Dependencies

To What Does it Apply?

- EE projects often affect support systems
  - Compressed Air
  - Process Cooling
- Projects typically involve an increase in a process' efficiency
- Some projects reduce a system's load

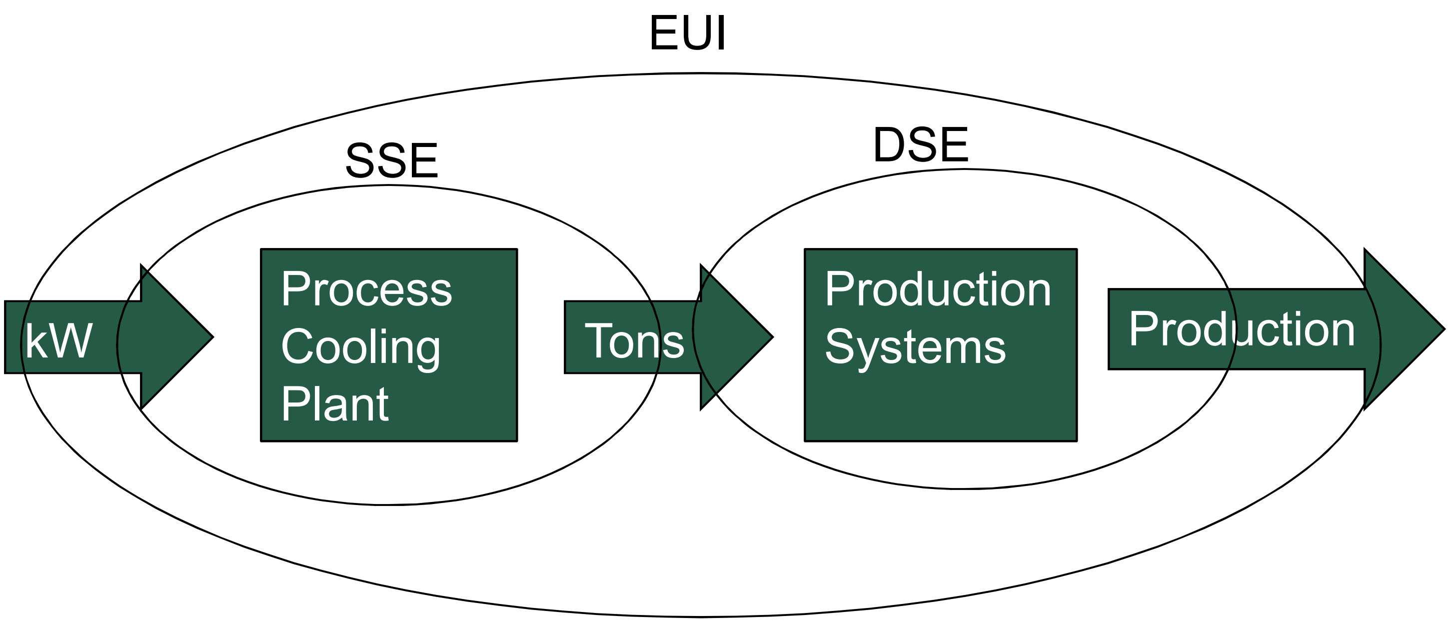
M&V Approach Options

- Verification Only
- Option D
  - Building model not usually feasible for industrial facilities
- Option C
  - Savings too small for a large industrial project
- IPMVP Option A/B
  - Retrofit Isolation

Retrofit Isolation – A&B

- Leverage short term pre-installation and post-installation data
- Normalize and annualize to production
- Methods
  - Energy Use Intensity
  - Demand-side / Supply-side Efficiency Approach

Measurement Boundaries



Example Project

- Compressed Air
    - Demand Side Measures (air knives, solenoid valves)
    - Supply Side Measures (VFD Compressor)
- Customer Monitors
    - Production (daily)
    - CFM (hourly)
- Several weeks pre-install kW and post-install kW

Energy Use Intensity Approach

- Divide energy use by production
  - Can be useful
  - Our fallback approach
  - Required data is readily available
  - Is easily misused or over-simplified
  - Doesn’t tell you much about why RR isn’t 100%

EUI Example Analysis

- Is this sufficient data?

Period	*Production*	*Energy Use (average kW)*	*EUI*
Pre-installation	1,500	750	0.5
Post-installation	2,000	900	0.45

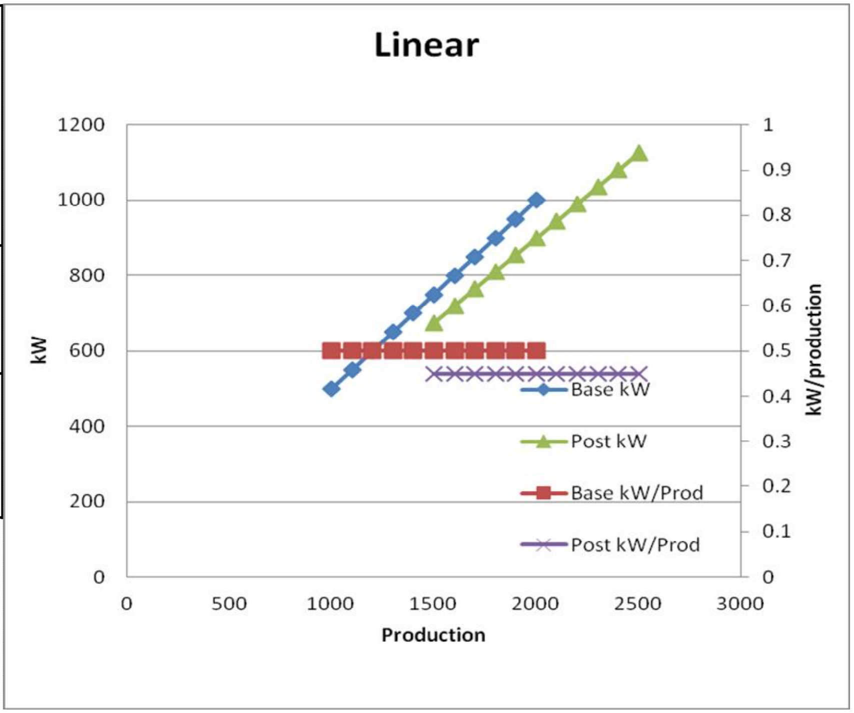
EUI Example Analysis

- Is this the savings?
- 0.5 x 2000 = 1000 kW Baseline
- Savings = 1000 – 900 = 100 kW

Period	*Production*	*Energy Use (average kW)*	*EUI*
Pre-installation	1,500	750	0.5
Post-installation	2,000	900	0.45

Beware "Production Corrected"

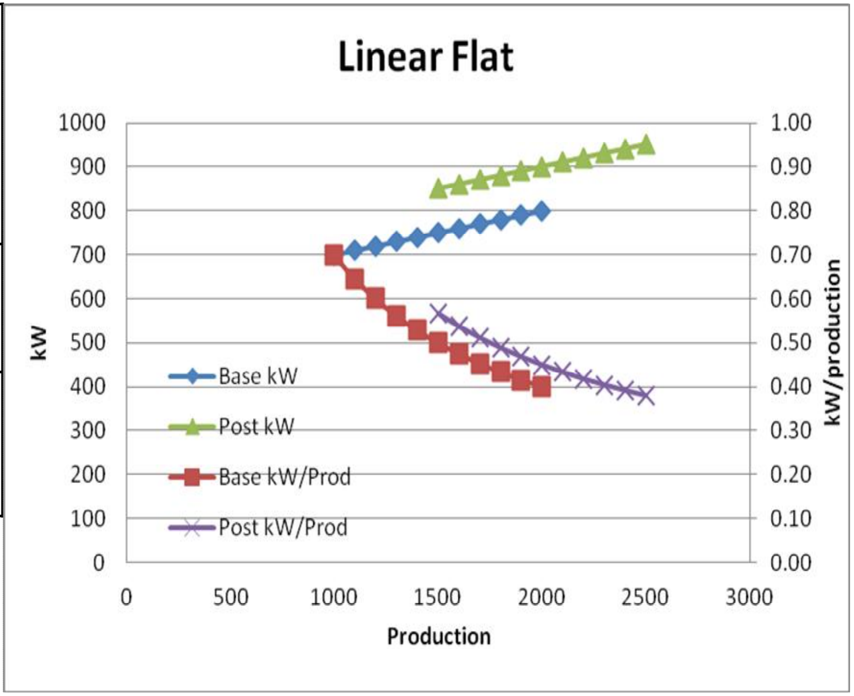
Period	*Production*	*Energy Use (average kW)*	*EUI*
Pre-installation	1,500	750	0.5
Post-installation	2,000	900	0.45



Assumes linear AND intercept = 0

More typical EUI Dependence

Period	*Production*	*Energy Use (average kW)*	*EUI*
Pre-installation	1,500	750	0.5
Post-installation	2,000	900	0.45

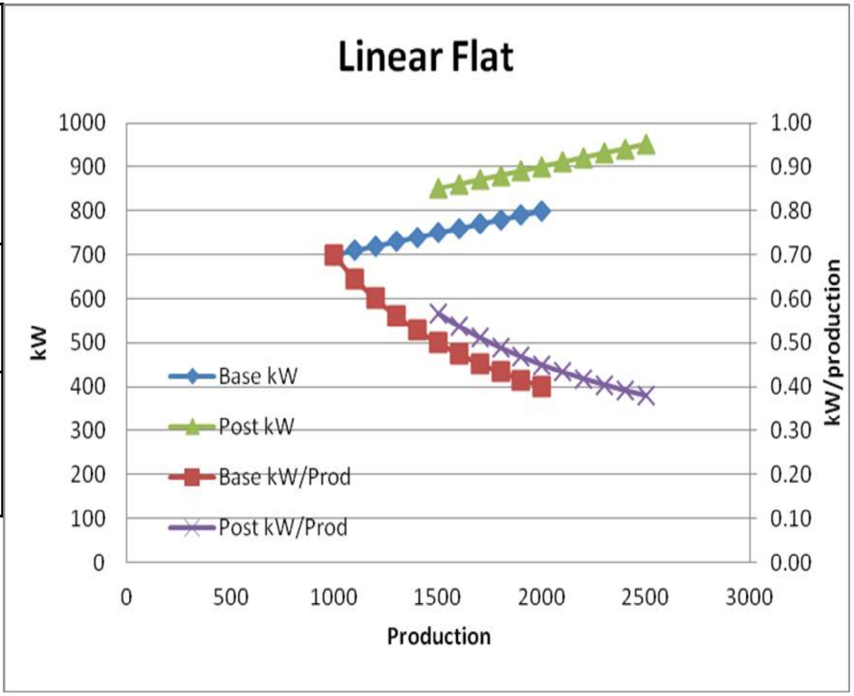


- Linear, but nonzero intercept
- At higher production, baseline would have been more efficient

Implications - typical EUI

Period	*Production*	*Energy Use (average kW)*	*EUI*
Pre-installation	1,500	750	0.5
Post-installation	2,000	900	0.45

- Baseline 800 kW at 2000 Production
- Negative savings



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The DSE/SSE Approach

Demand Side Efficiency and Supply Side Efficiency

Efficiency Type	*Typical Efficiency Units*	
	Compressed Air Measures	*Process Cooling Measures*
Supply Side (SSE)	kW/CFM	kW/Tons of Cooling
Demand Side (DSE)	CFM/Production	Tons of Cooling/Production

The Algorithm

Annual kWhsave = kWhbase - kWhpost

Where:

kWhbase = $\sum_i(SSE_{pre,i} \times DSE_{pre,i})$ x production,i x hours,i

kWhpost = $\sum_i(SSE_{post,i} \times DSE_{post,i})$ x production,i x hours,i

DSE, SSE are curves or table, not constants

Required Data

Short term (1-3 weeks) kW data pre

Short term output (CFM, tons)* data pre

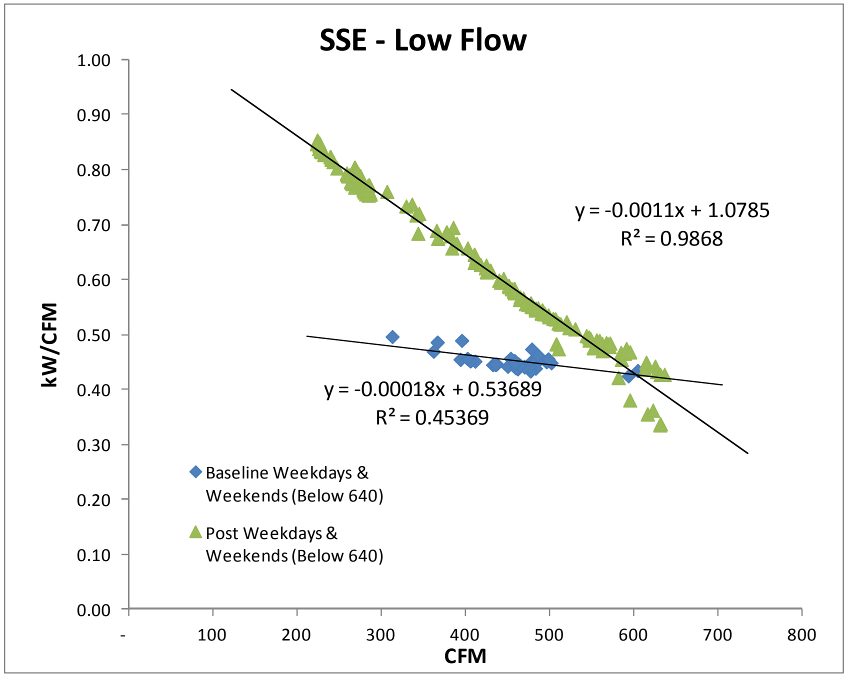
Short term (1-3 weeks) kW data post

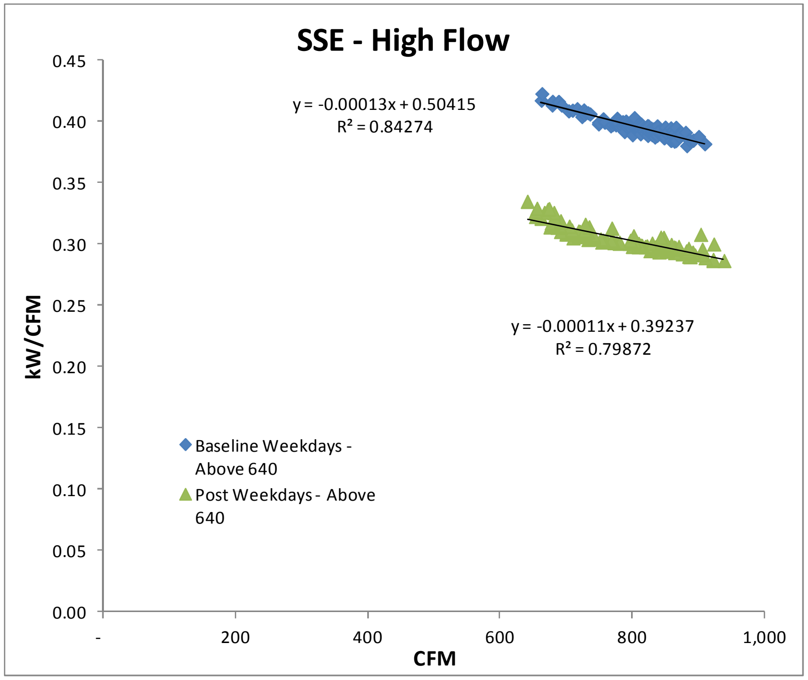
Short term output (CFM, tons)* data post

Short and long term production data

*Or ability to calculate

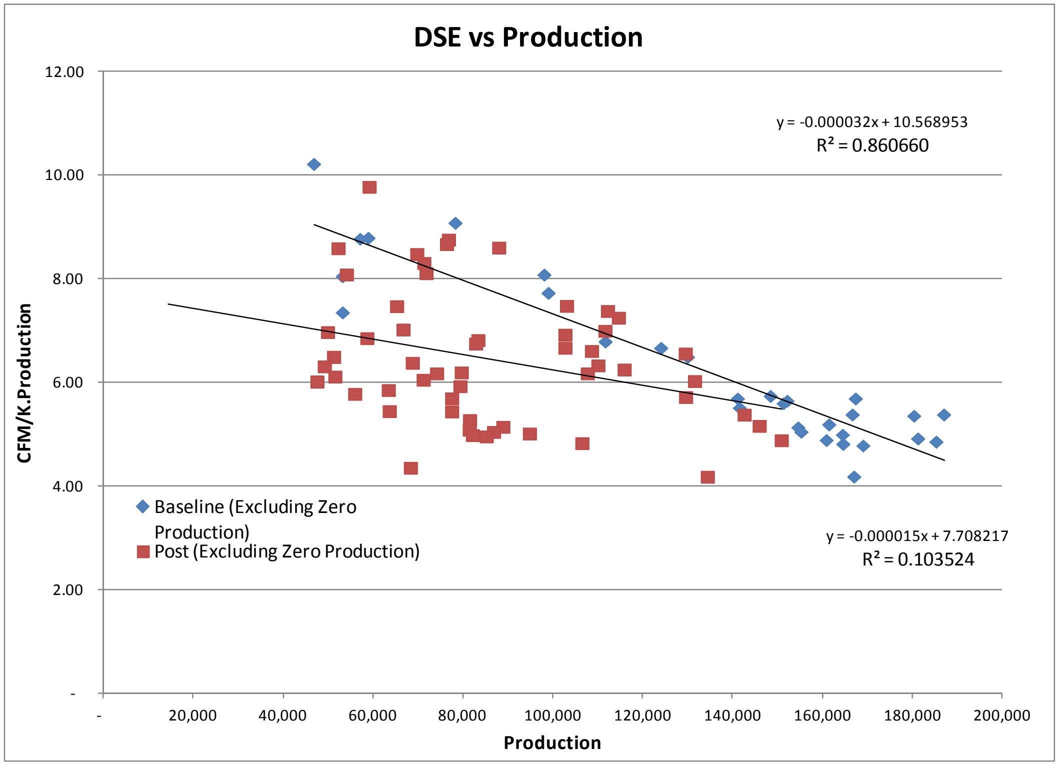
Supply Side Efficiency





Demand Side Efficiency

- Aggregate energy data to the interval of the production data
- Modes may be needed rather than regression
- Often not "pretty" but better than assuming a constant value



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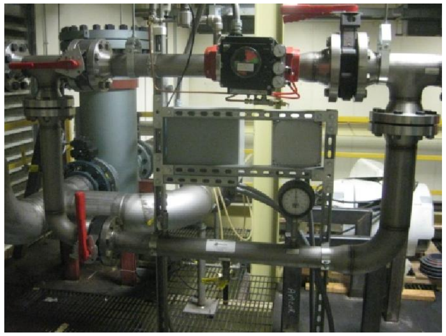
Improved Savings Isolation

- Holding one term "unchanged"

kWhbase = $\sum_i(SSE_{pre,i}$ x $DSE_{\mathbf{avg},i})$ x production,i x hours,i

kWhpost = $\sum_i(SSE_{post,i}$ x $DSE_{\mathbf{avg},i})$ x production,i x hours,I

- A main benefit of the approach
- Not holding a term constant, but "unchanged"

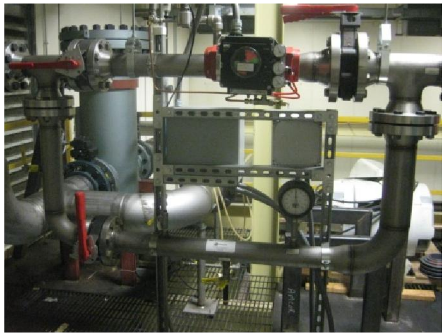


Improved Savings Isolation

- If expect there to be improvement but feel negative savings are unrealistic

kWhbase = $\sum_i(SSE_{pre,i} \times DSE_{pre,i})$ x production,i x hours,i

kWhpost = $\sum_i(SSE_{post,i} \times DSE_{\mathbf{min},i})$ x production,i x hours,I



Improved Insight into the Project

- Did the CFM increase?
- Did the SSE improve?
- How would the plant have behaved at the new production levels in the absence of the project?

Remember

- When evaluating large non-standard custom industrial projects:
  - Think in terms of DSE and SSE
  - Hold one term unchanged, but not constant, when appropriate
  - Use caution with EUI methods
  - Real-time evaluation to ensure you get the data

Thank you!

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