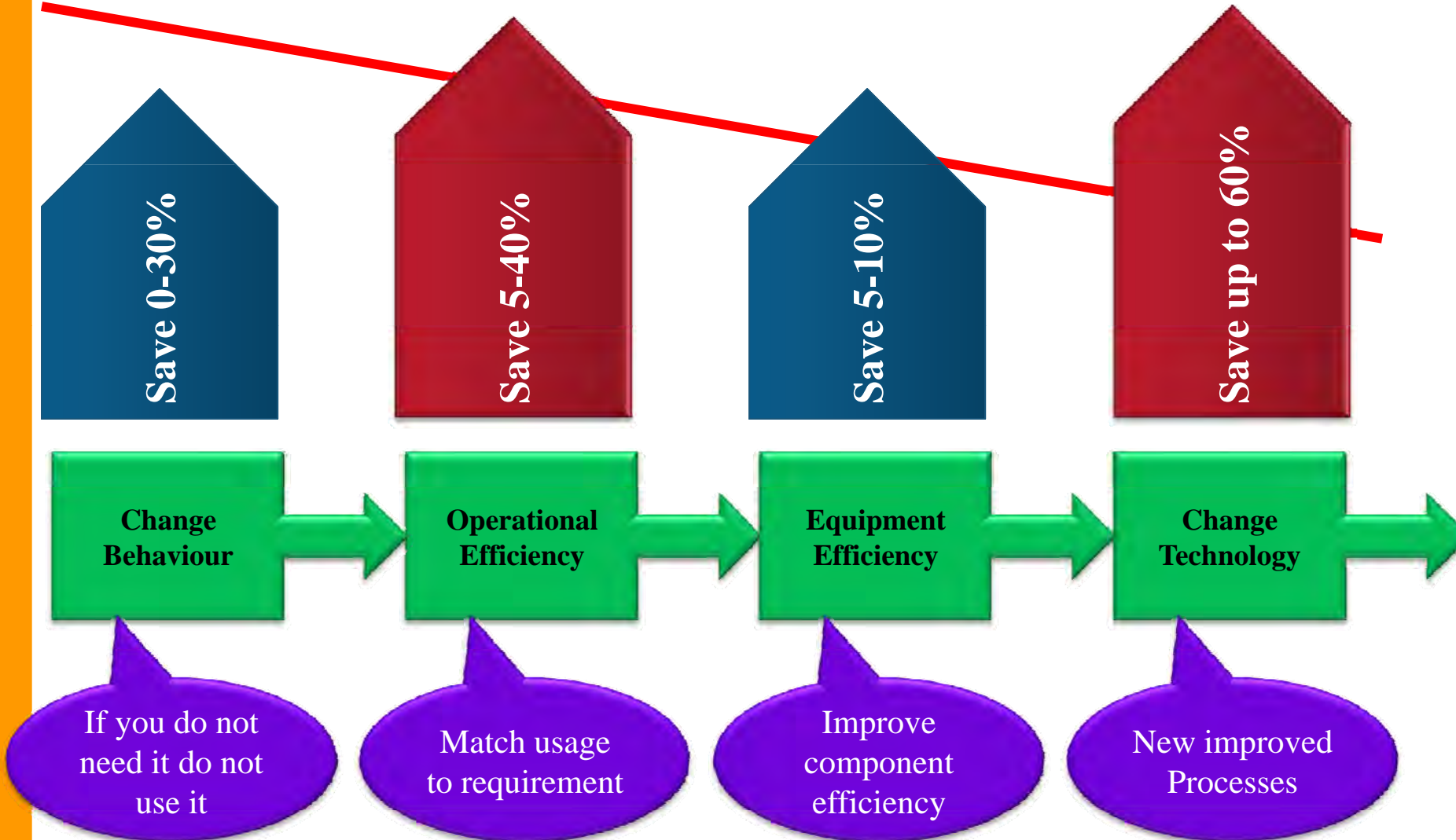


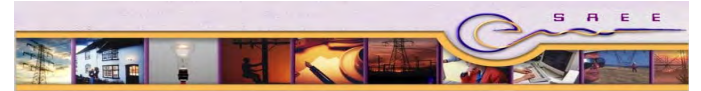
# Measurement and Verification: How to Quantify Energy Efficiency Savings?

Mining and Industrial Energy Optimisation  
2010

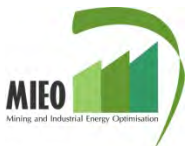


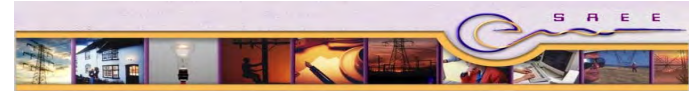
# How can you save energy?





# WHO CAN SAVE ENERGY?





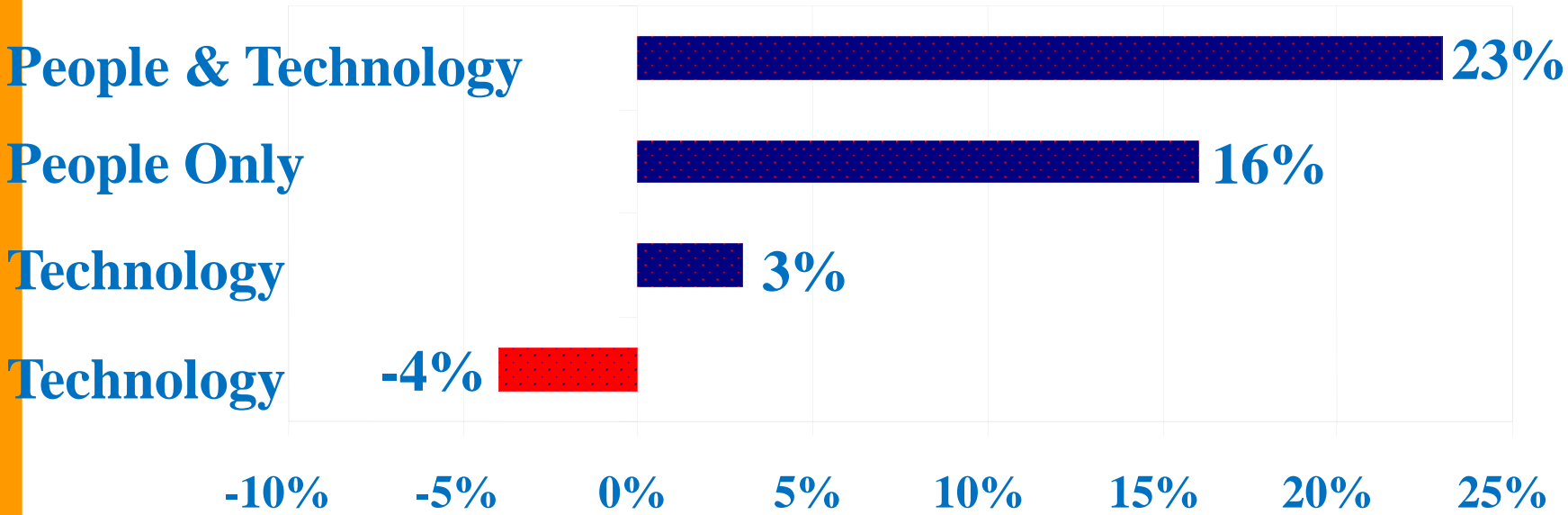
## Who can save?

- Everyone is responsible for saving energy.
- Energy Manager cannot manage the energy use.
- Energy Manager can only facilitates energy use and savings.
- It is the end users/operators/customers that cause energy use, wastage and savings.



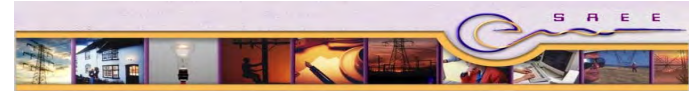
# Technology alone will not cut it!

Who  
~~What~~ creates energy savings?



Actual Savings *ETSU GPG084: Managing and Motivating Staff to Save Energy*



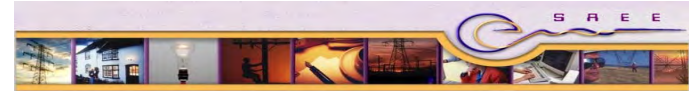


## What is needed?

- **Makes energy use visible** to everyone in an easily understood format.
- **Makes everyone responsible** for saving energy.
- **Empowers everyone** (including systems) to take action.
- **Many savings are realised** (and sustained) through **changes in behaviour**.
- Need complete **impact analysis** solution – It answers the question “**what are we saving?**” on an ongoing basis.
- Must be an **operational tool** and not another AMR or billing solution.

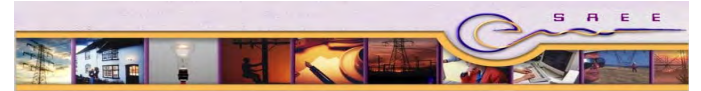


80% of CEOs and CFOs said they would not spend money to make their factories more efficient and save money in the long run if it will hurt their next quarter bottom line



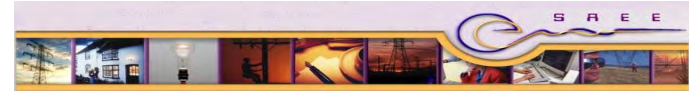
# Energy Efficiency/Saving Initiatives

- EE Tax Incentive Scheme
- Standard Offer
- EEDSM
- Solar Water Heating Initiative
- SANS 204 - EE National Building Regulation/Standard
- SATS 50010 – M&V of Energy Savings
- REFIT
- Power Conservation Programme (PCP)



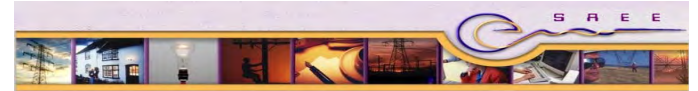
# MEASUREMENT AND VERIFICATION





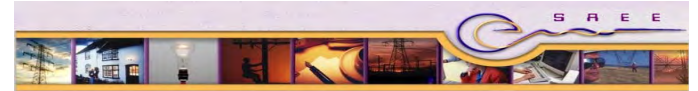
## SATS 50010:2010

- Provide standard approach towards the measurement and verification of energy savings and energy efficiency
- Intended for use in voluntary and regulatory domain
- Build on IPMVP
- Methodology used should yield conservative savings
- Guarantee that savings is at least the reported savings



## Accreditation of M&V Teams/Bodies

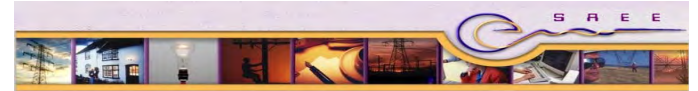
- SANAS busy to develop accreditation system for M&V Teams/Bodies
- M&V Teams will have to be accredited to issue M&V Saving reports for regulatory environment
- Requirements are currently been developed by STC
- Define training, capacity building and skill requirements



## What is M&V?

“Measurement & Verification (M&V) is the process of using measurements to reliably determine actual saving created within an individual facility by an energy management program.”

Ref: IPMVP Vol I, 2007, Section 9



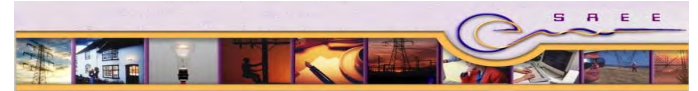
## The “M” in M&V

The **M** in M&V stands for:

*Measurement*

**Not** *Monitoring*

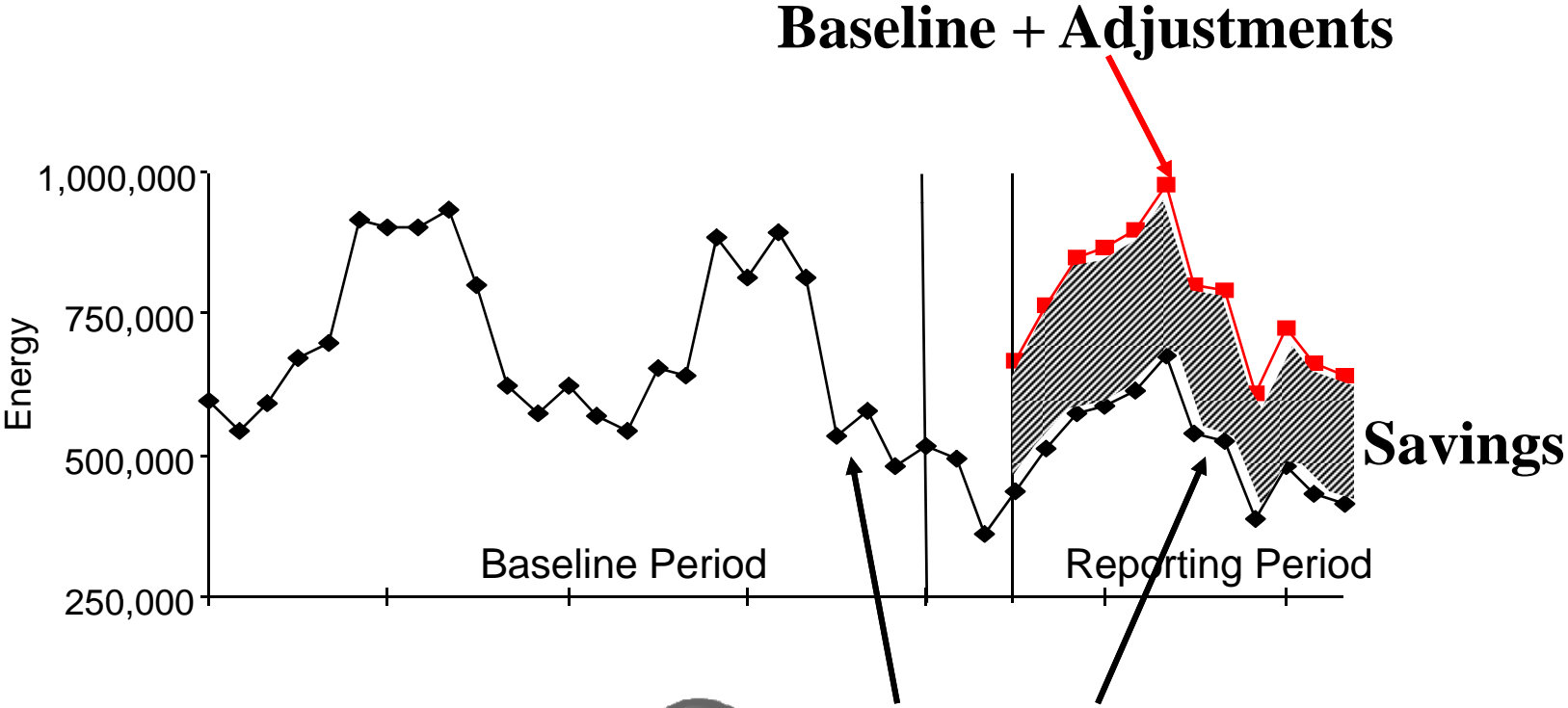
(Monitoring is an activity which takes place *after* the Measurement of savings. Monitoring is the evaluation of the savings and taking any necessary action.)



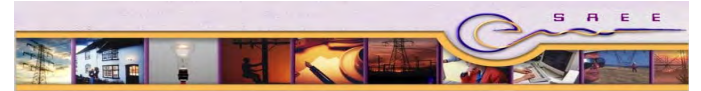
# Measure Savings?

- Savings are the absence of energy use.
- We can *not* measure what we do not have.
- We do *not* ‘measure’ savings!
  
- We *do* measure energy use.
- We *analyze* measured energy use to **determine** savings.

# A Notional Baseline

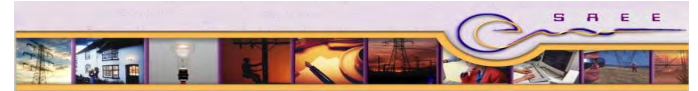


Metered Energy



# HOW MUCH ARE WE SAVING?





# Practical Example

## 2008 Figures

- Production per month = 1280 tonnes/month
- Total energy use = 6784 MWh/month
- Specific Energy Use = 5.3 MWh/tonne

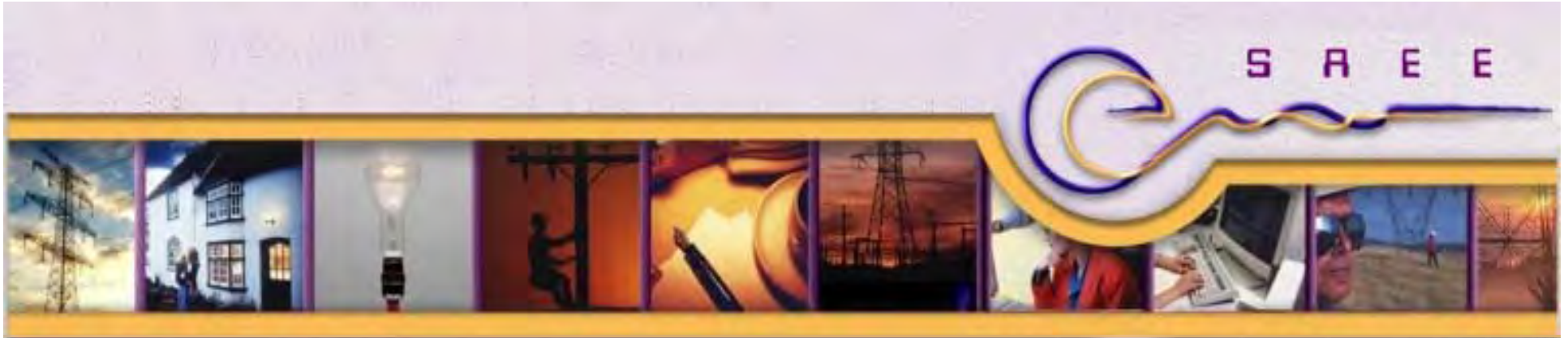
## 2009 Figures

- Production per month = 858 tonnes/month
- Total energy use = 5748.6 MWh/month
- Specific Energy Use = 6.7 MWh/tonne

## Savings??

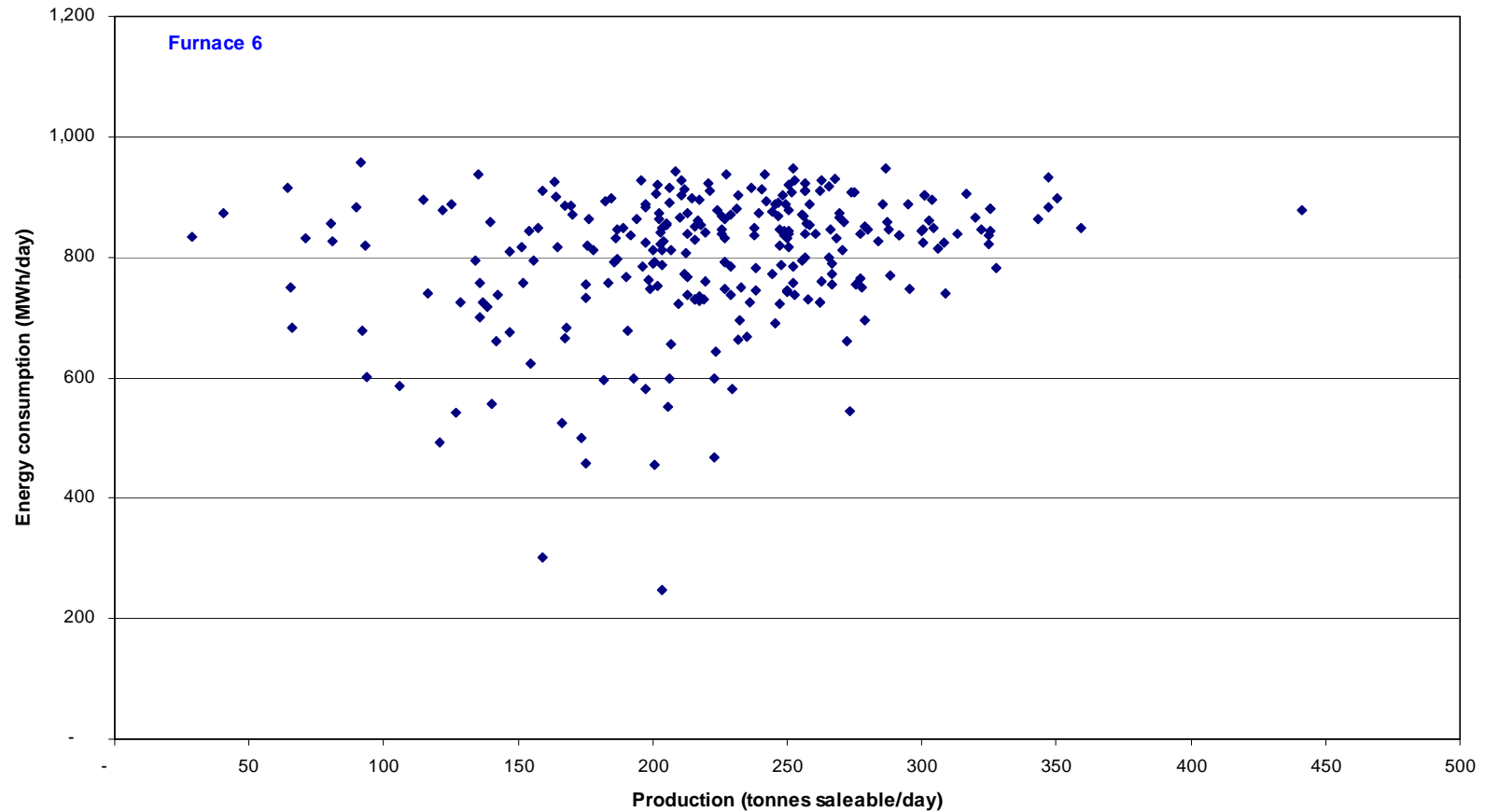
- Production = 422 tonnes/month lower
- Total energy use = 1035.4 MWh/month lower
- Specific Energy Use = 1.4 MWh/tonne increase





# How do systems an processes perform?

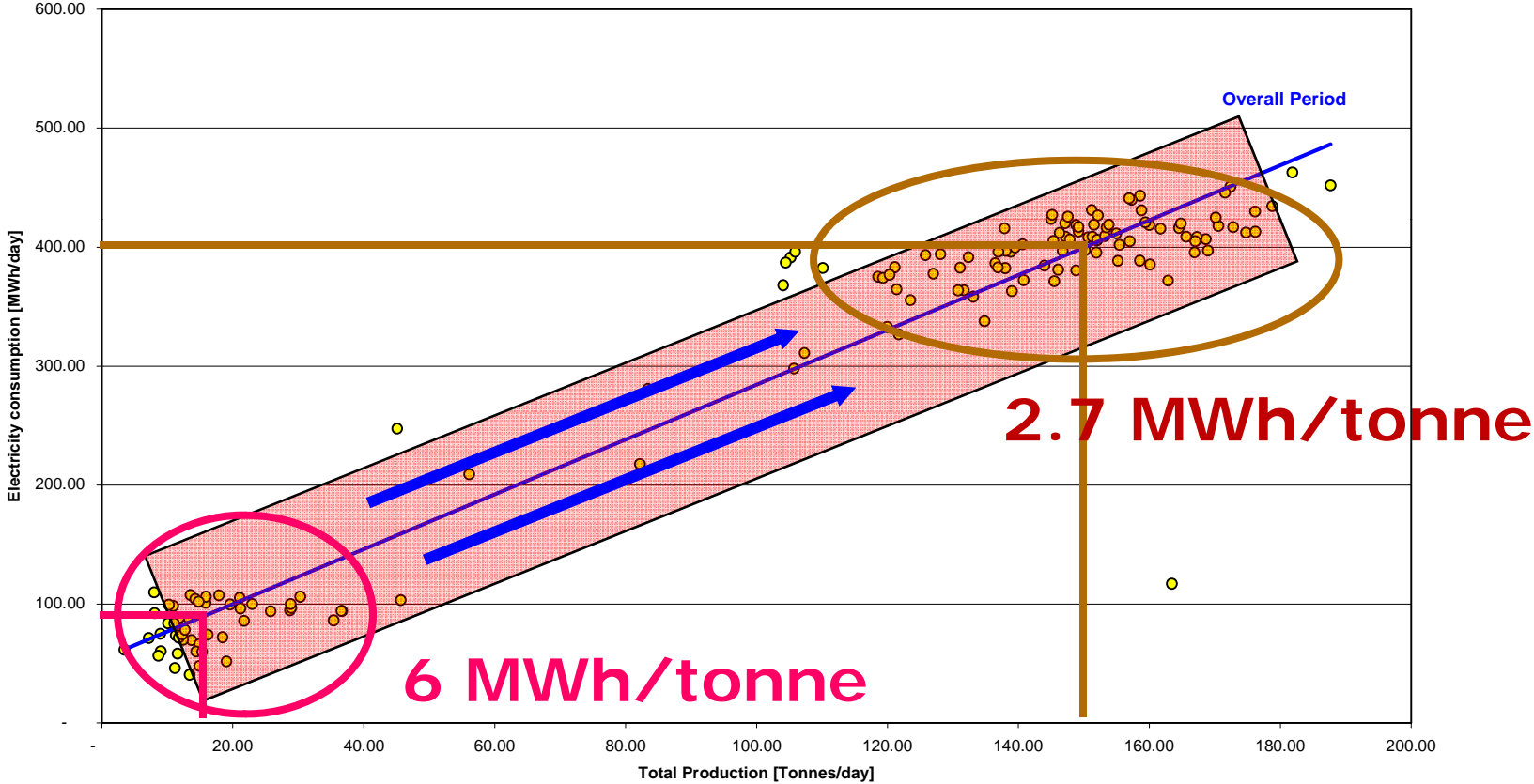
# Poor Furnaces Performance





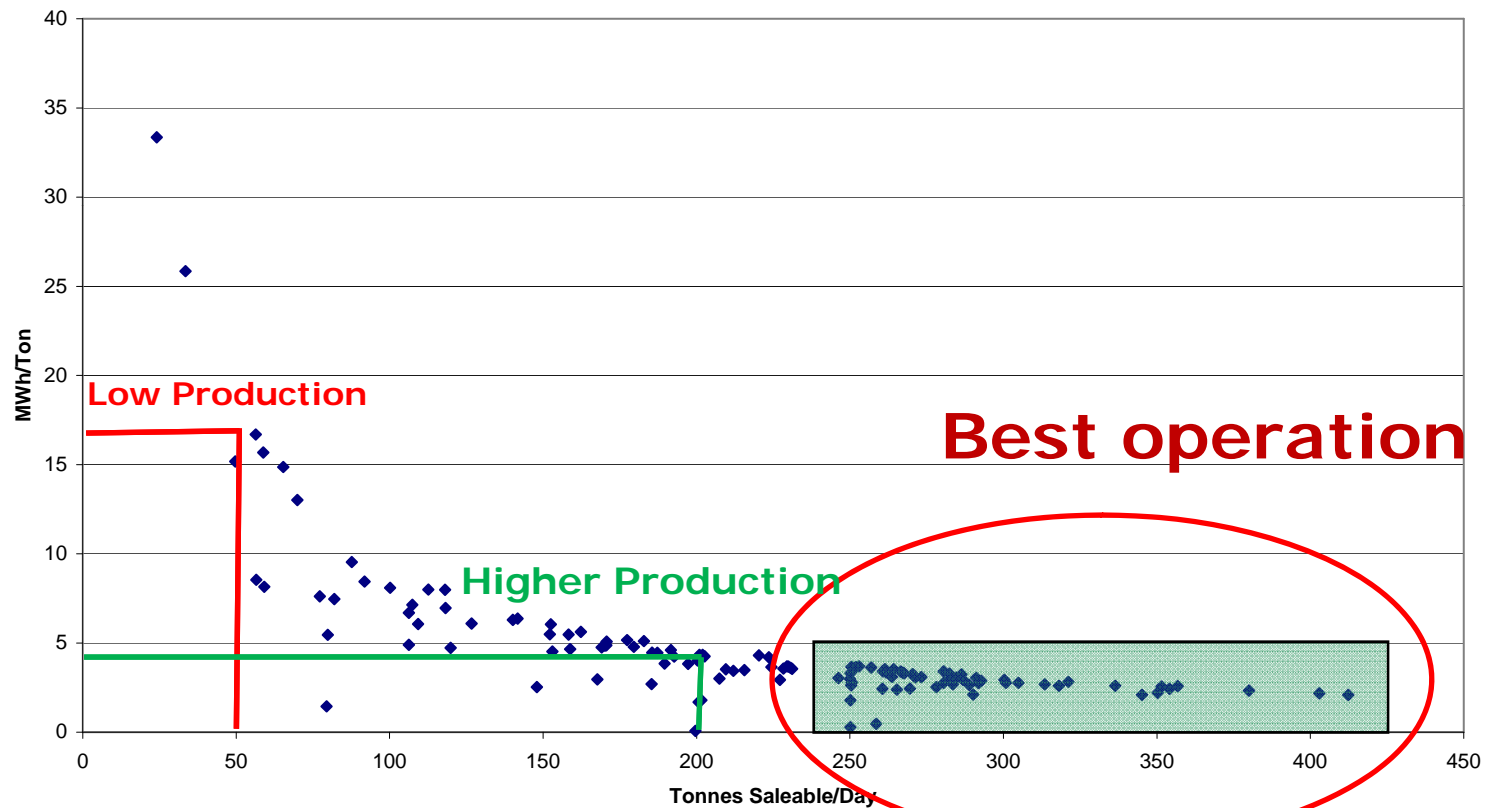
# Good Furnace Performance

Daily Electricity Consumption vs. Daily Total Production



# Furnace Specific Energy Use

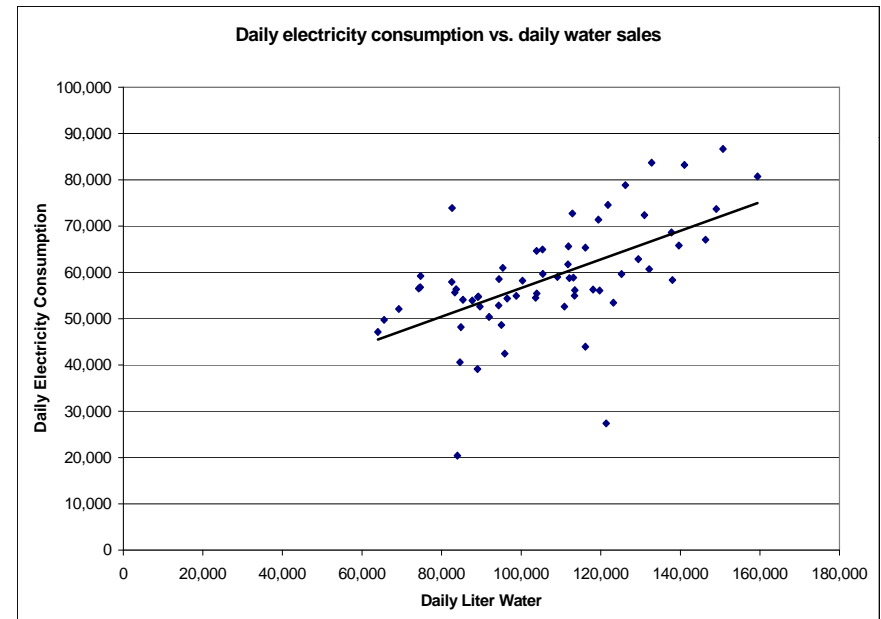
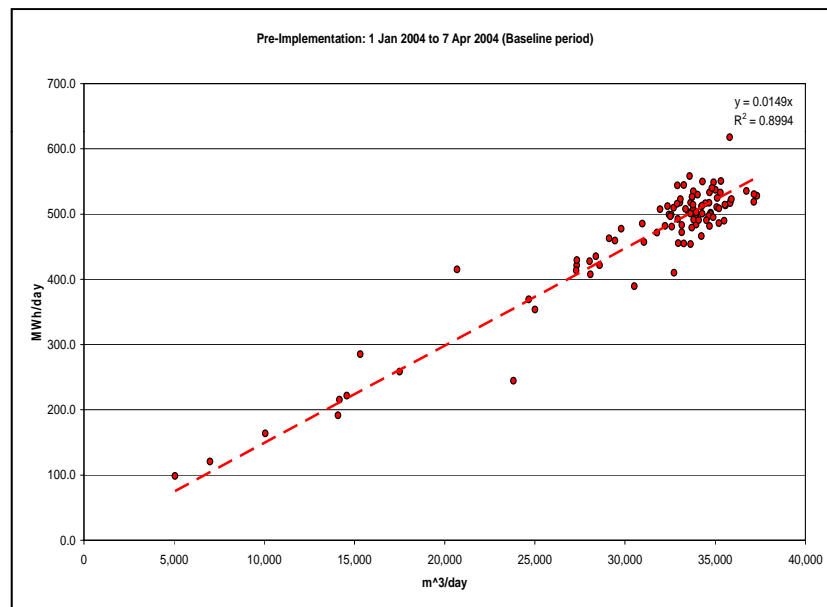
Specific Energy Consumption



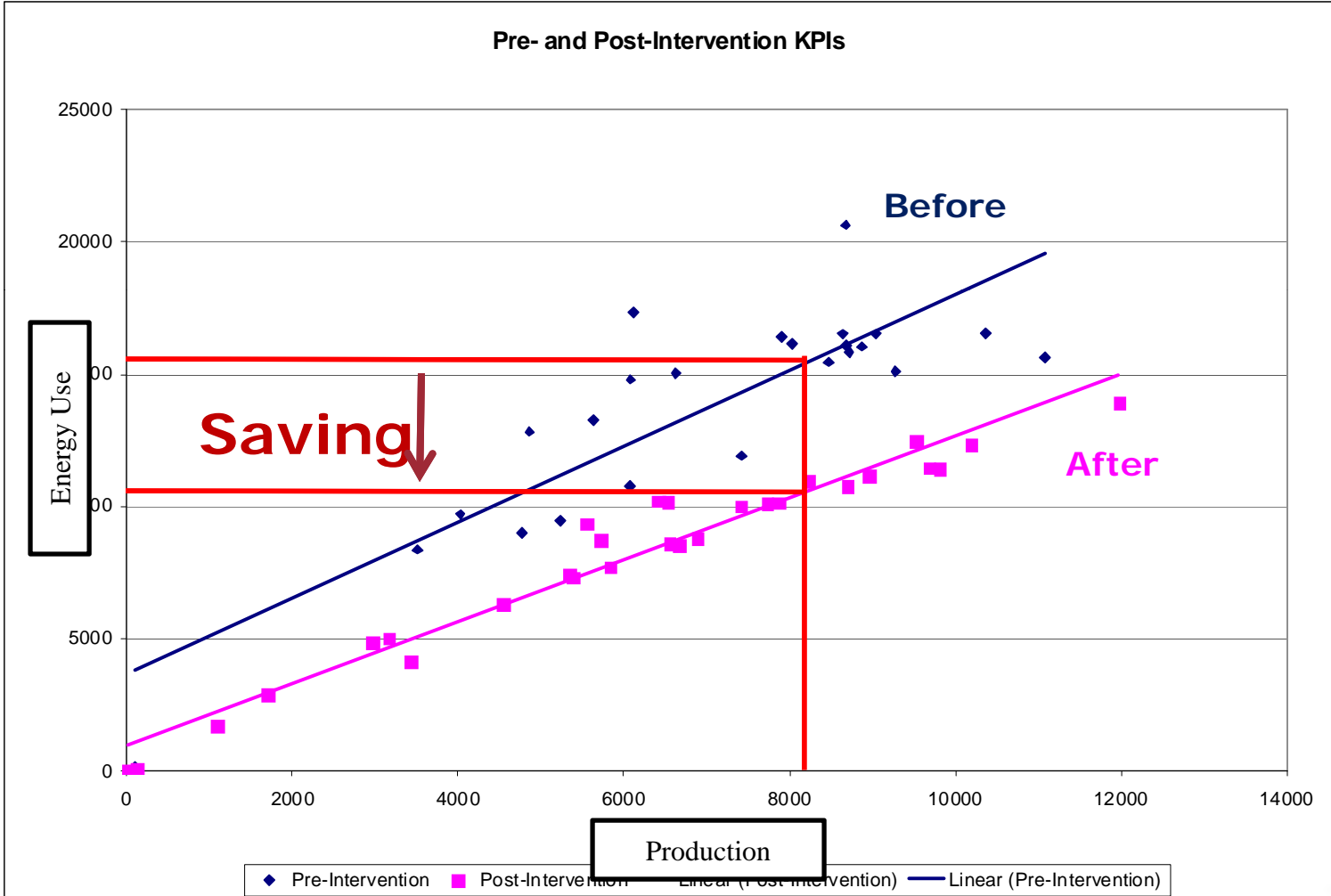
# System and Process Behaviour

- Process Pumping

- Mine Pumping

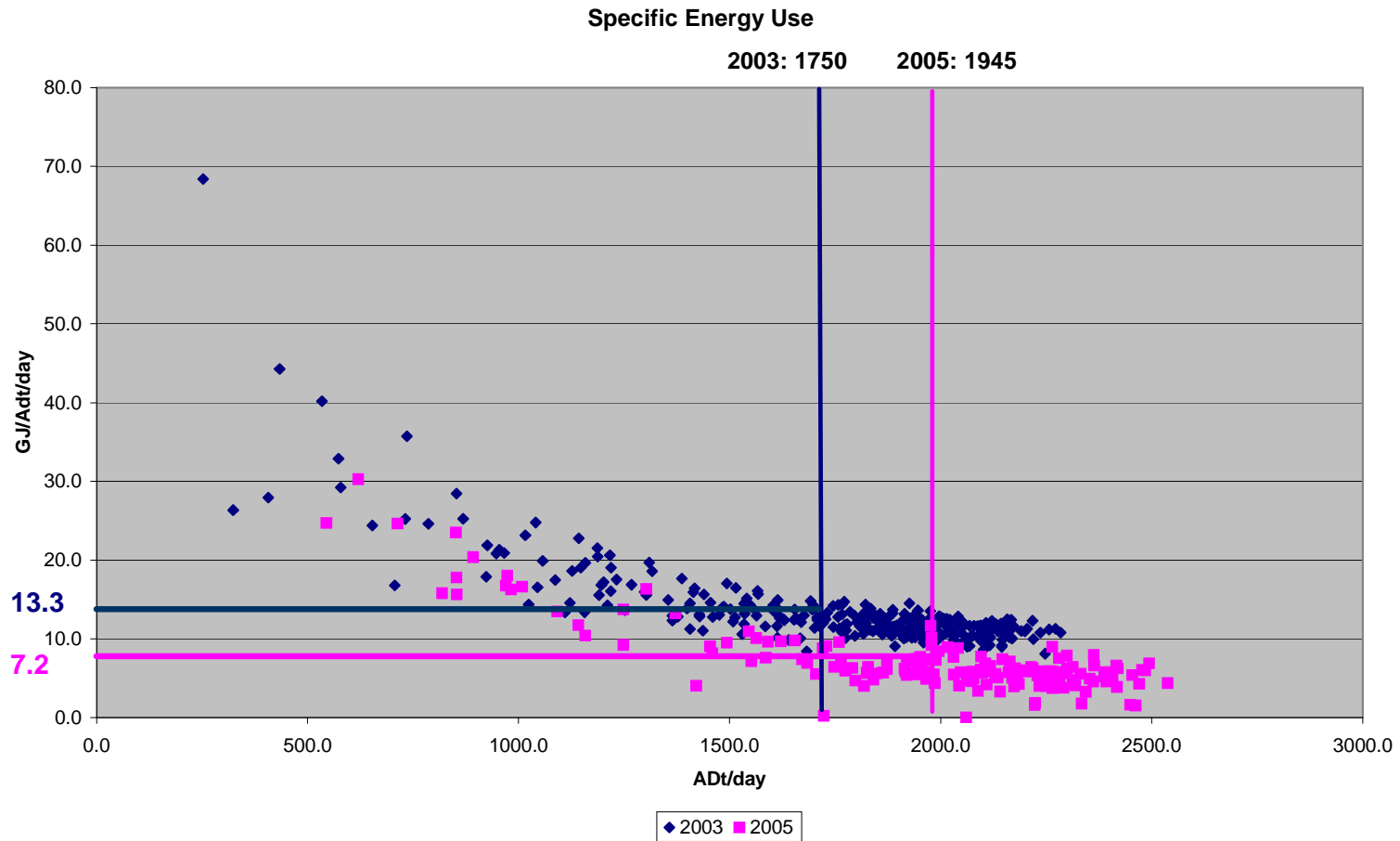
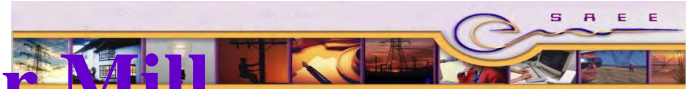


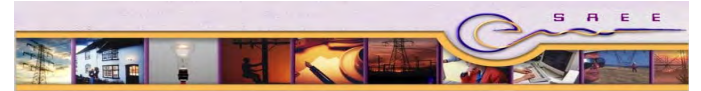
# Pumping Efficiency Improvement



# Case Study – Paper Mill

## Specific Energy Use



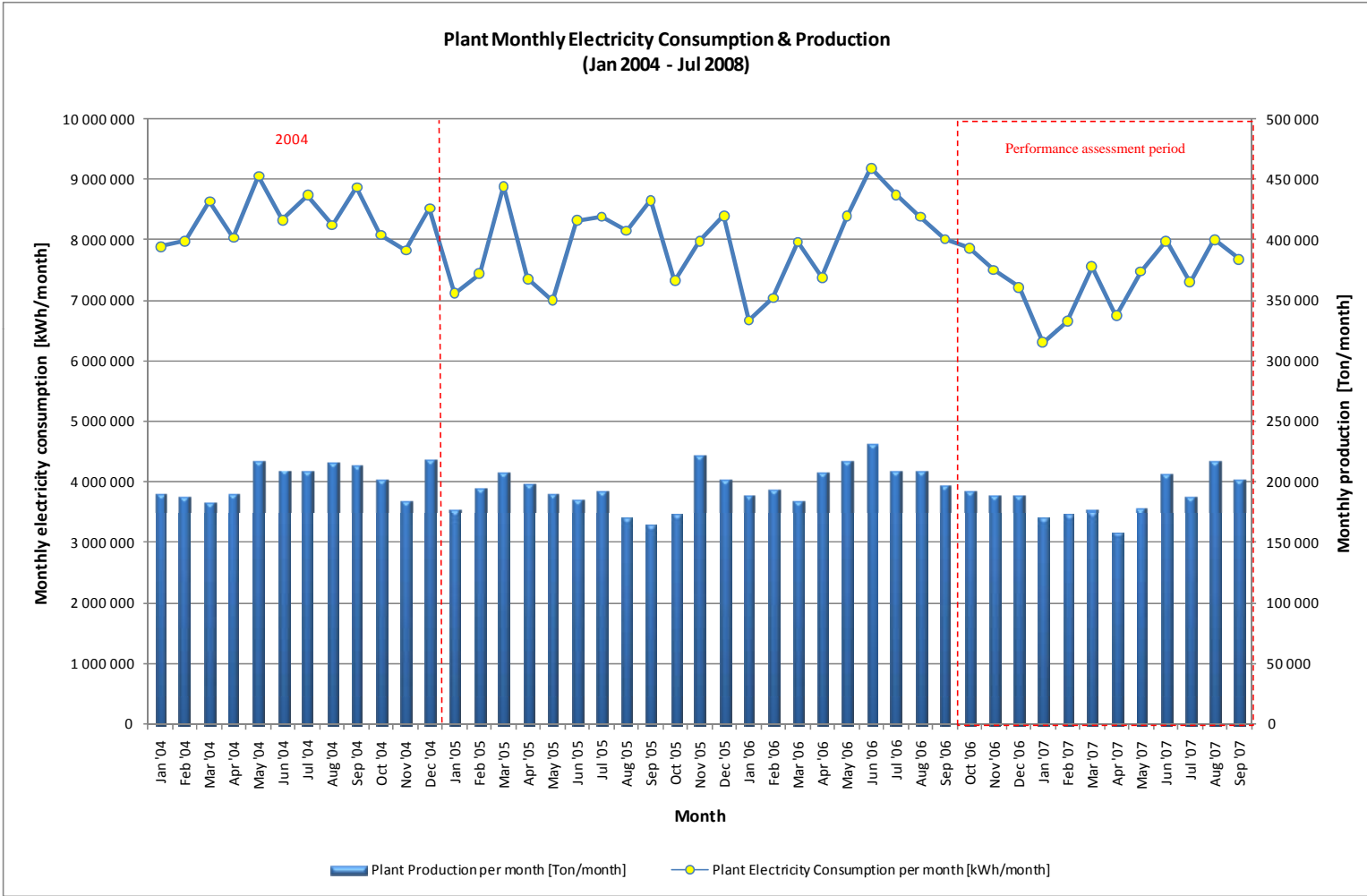


# ENERGY EFFICIENCY SAVINGS: EXAMPLE – MINING OPERATION





# Plant Electricity Consumption & Production History (Monthly data: Jan'04 to Sep'07)

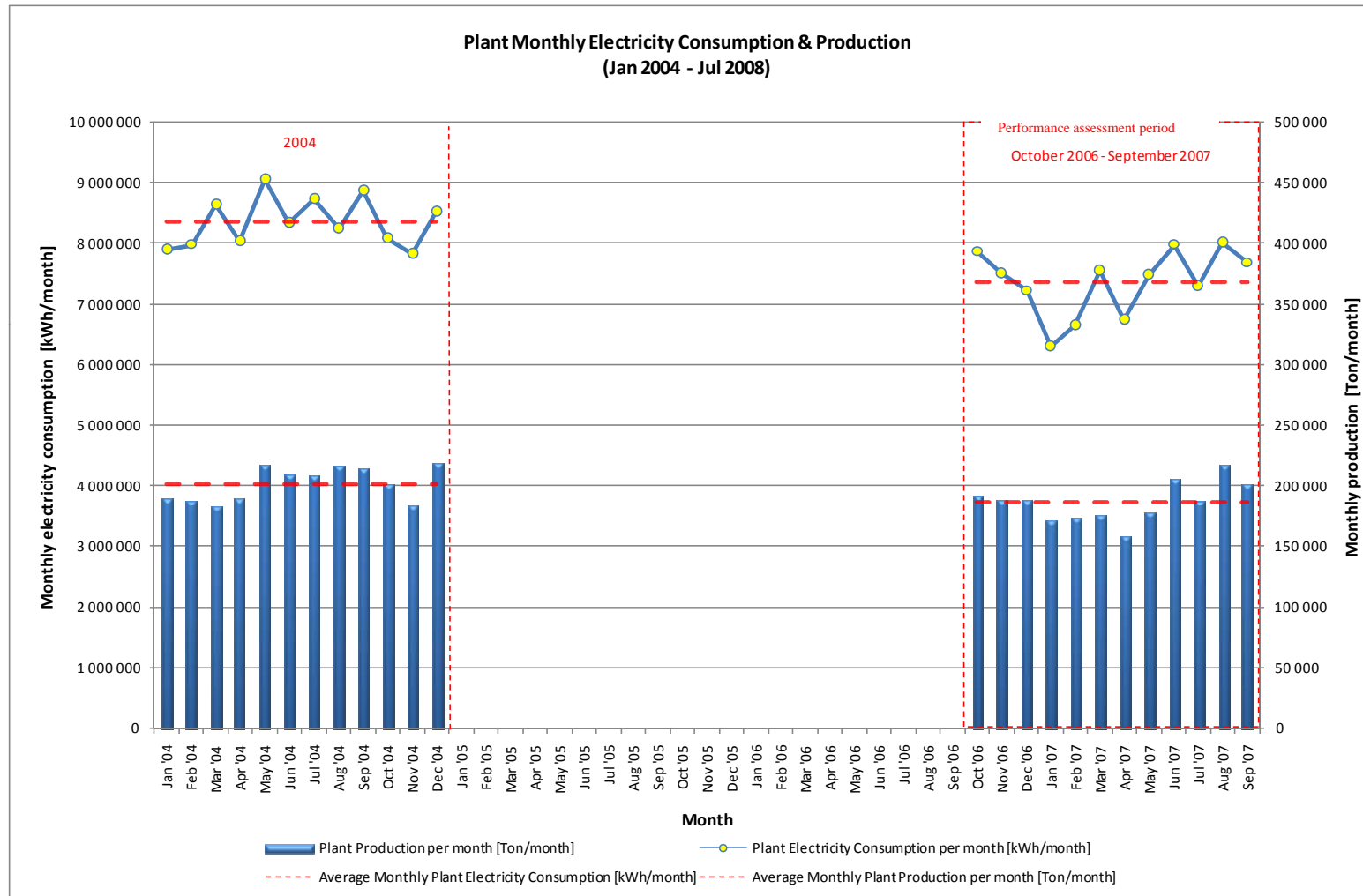


*Requested Baseline period: 2004 Calendar year*





# Plant Electricity Consumption & Production History (2004 to performance assessment period)



Requested Baseline period: 2004 Calendar year



**ENERGY  
CYBERNETICS**



## Actual Energy Use

### 2004 Figures: (Baseline Period)

- Average monthly electricity consumption: 8,362,162 kWh/month
- Average monthly production: 210,396 ton/month
- Electricity intensity: 42 kWh/ton

### 2007 Figures: (Performance Assessment Period):

- Average monthly electricity consumption: 7,362,884 kWh/month
- Average monthly production: 186,438 ton/month
- Electricity intensity: 39 kWh/ton

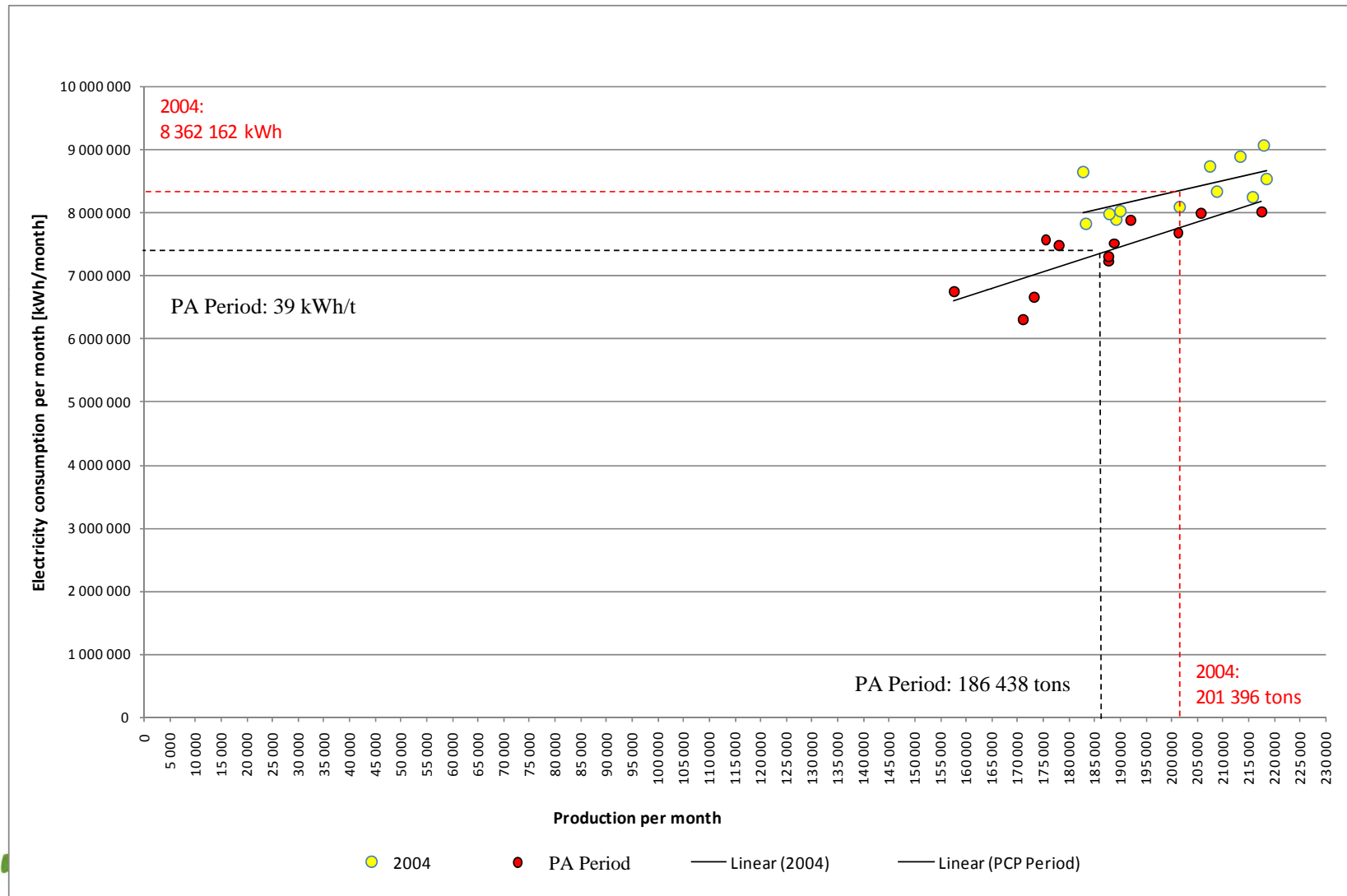
### Changes between 2004 and 2007:

- Average monthly electricity consumption: down by 999,278 kWh/month (11.9%)
- Average monthly production: down by 14,958 ton/month (7.1%)
- Electricity intensity: down by 3 kWh/ton (7.1%)

What is the saving ....?

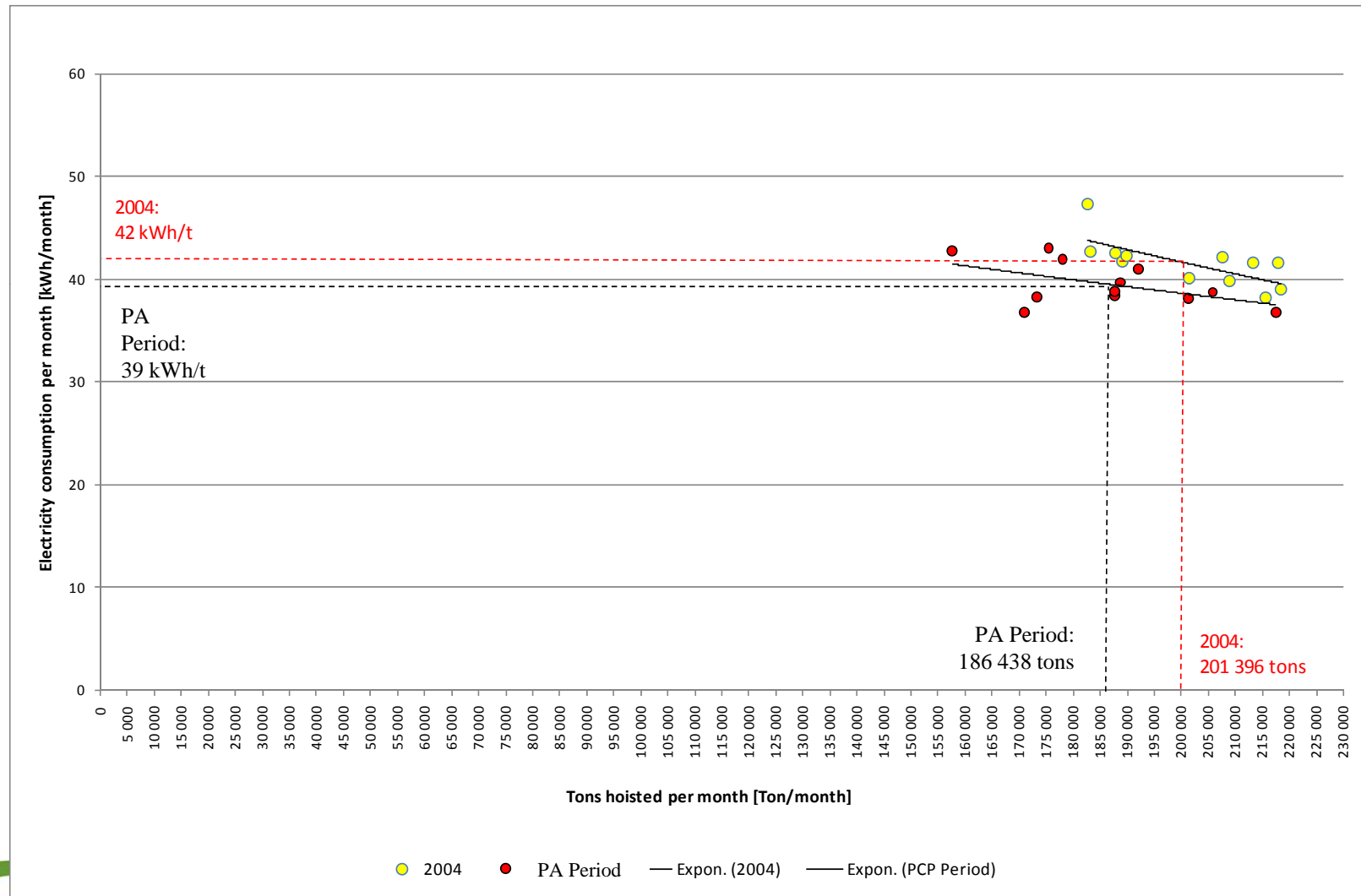


# Monthly Electricity Consumption vs. Production (Baseline & Performance assessment period)



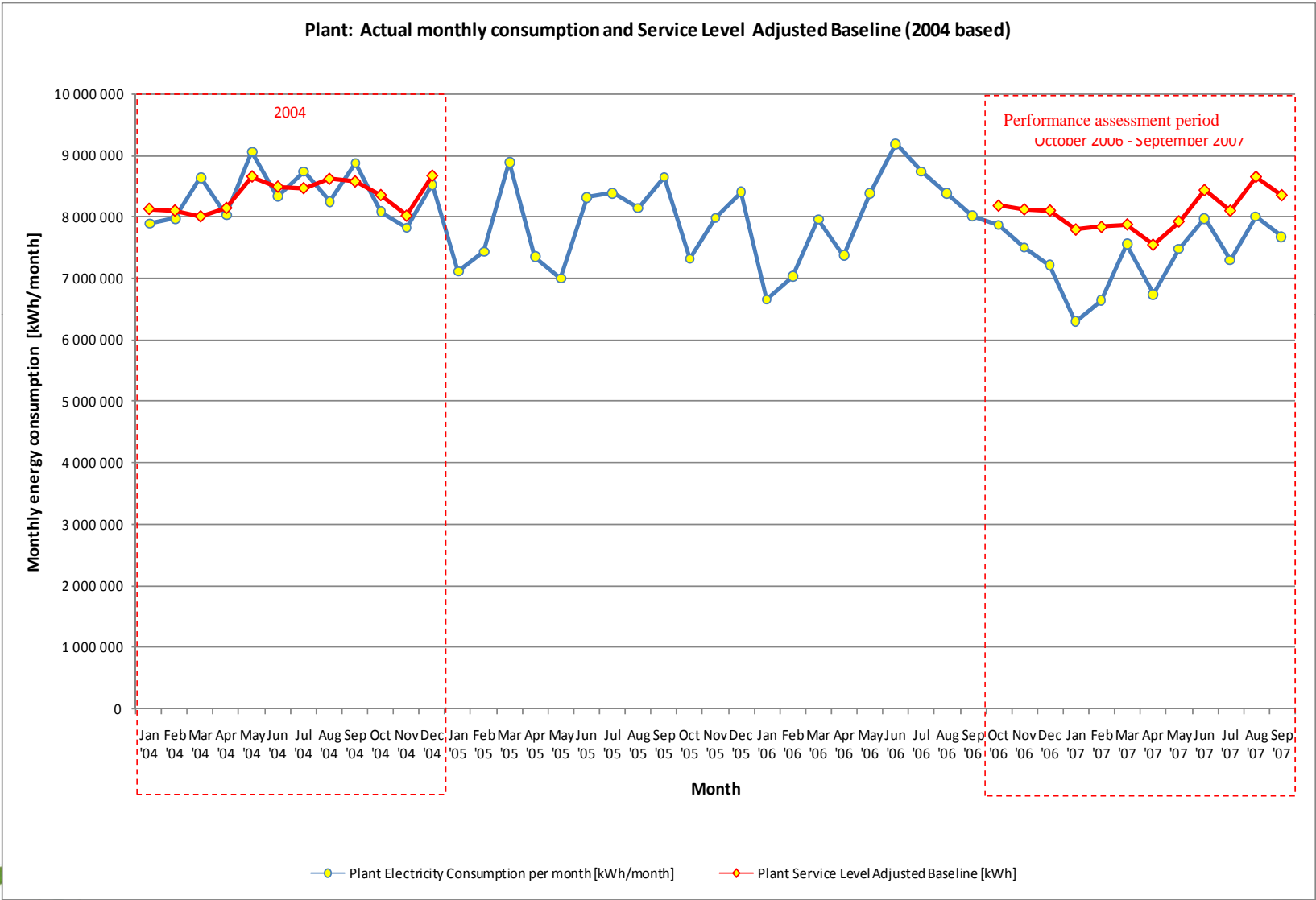


# Monthly Electricity Consumption/ton vs. Production (Baseline & Performance assessment period)





# Actual vs. Service Level Adjusted Baseline





## Results Summary

### Baseline (2004):

- Average monthly electricity consumption: 8,362,162 kWh/month
- Average monthly production: 210,396 ton/month
- Electricity intensity: 42 kWh/ton

### Performance Assessment Period (2007):

- Average monthly electricity consumption: 7,362,884 kWh/month
- Average monthly production: 186,438 ton/month
- Electricity intensity: 39 kWh/ton

### Total impact on Energy Use between Baseline and 2007

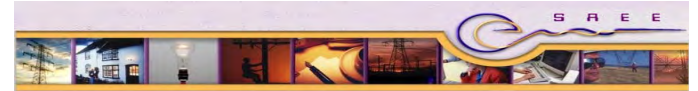
- Total impact: 999 278 kWh/month reduction (11.9%)
- **Energy Efficiency impact: 719 220 kWh/month reduction (8.6%)**
- Production related impact: 280 058 kWh/month reduction (3.3%)

### Total impact of specific energy use:

- Total impact: 3 kWh/ton reduction (7.1%)
- **Energy Efficiency impact: 5 kWh/ton reduction (11.9%)**
- Production related impact: 2 kWh/ton **increase (4.8%)**

**What is the EE saving?**

**719 220 kWh/month (8.6%)**



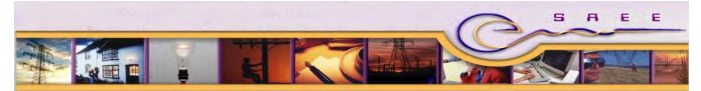
## M&V could be more complex ...

In open pit mining the energy/fuel use of a haulage truck depends on the following:

- Horizontal distance travelled loaded
- Horizontal distance travelled unloaded
- Route planning
- Vertical lift
- Vertical up and down
- Tonnes hauled
- Driver operation
- Type of truck

$$\text{Fuel use} = F(X1, X2, X3 \dots Xn)$$

**Multi-dimensional relations**



# M&V SYSTEMS





# M&V System

Welcome LJ Grobler | Logout

ENERGY CYBERNETICS

POWERWATCH™

Landing Overview Dials ACC Use Profiles2 My New Page Map My New Page My New Page My New Page Site 1 Month Map My New Page Add widgets

### Rankings

**Daily Rankings**

Profile	Ranking
Zap 1st Floor	●
Telepassport	●
EC Potch	●
EC Pretoria	●
EC Buildings	●
MTN Ground Floor	●
Rhodes Foods	●
Namibia Site 1	●
Benny and Wilson	●

**Monthly Rankings**

Profile	Ranking
Telepassport	●
Zap 1st Floor	●
MTN Ground Floor	●
EC Pretoria	●
EC Potch	●
EC Buildings	●
Namibia Site 1	●
Benny and Wilson	●
Rhodes Foods	●

### Usage

EC Potch  
July 2009 - Usage

Category	kWh
Baseline	3455
Target	3110
Actual	2735
Savings	721

Legend: Baseline (blue), Target (green), Actual (red), Savings (light green)

### Status

EC Potch

ENERGY CYBERNETICS  
POWERWATCH™

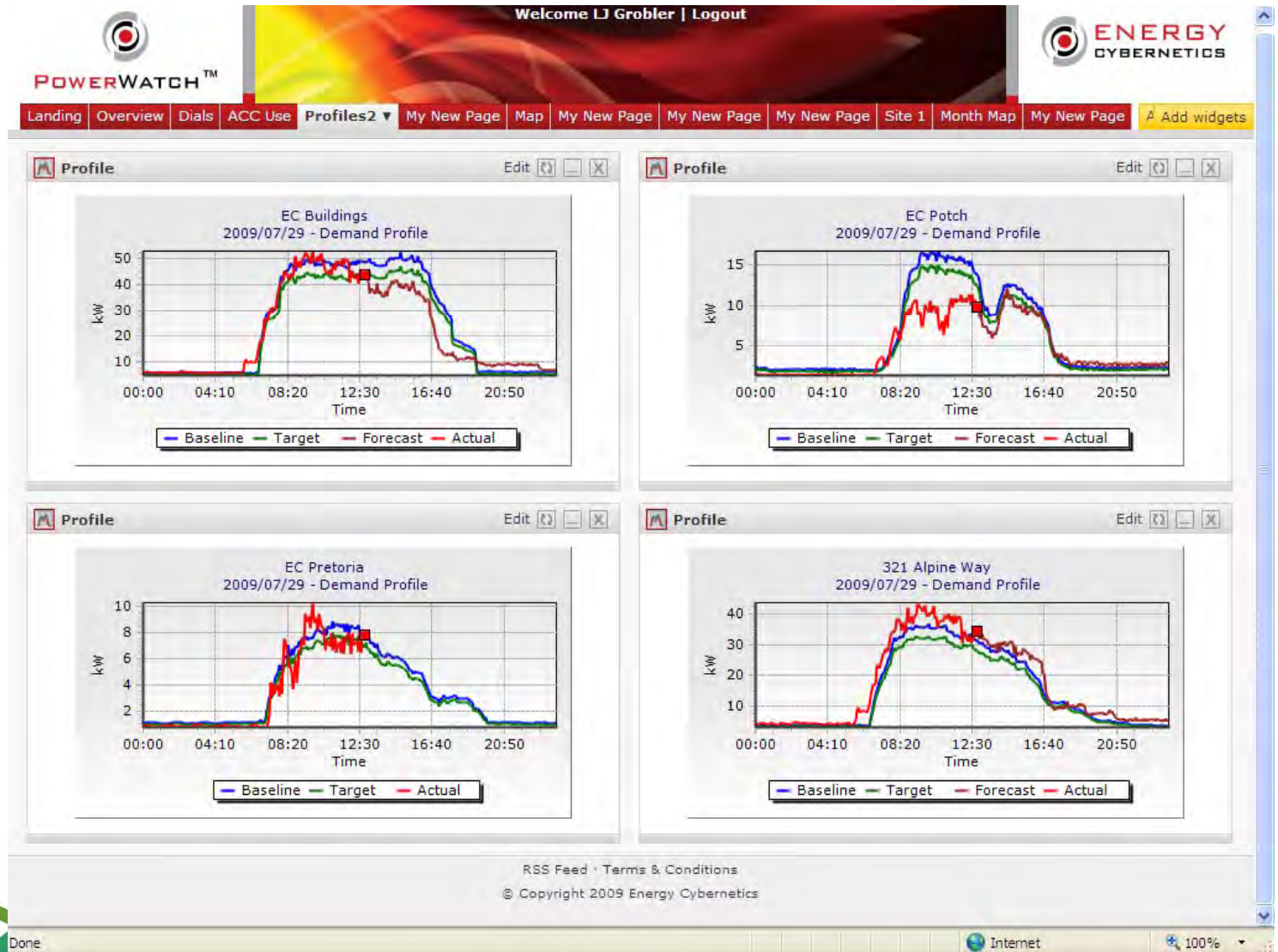
### Power Alert

Region: National  
Status: Green - Up  
Updated: 2009/07/29 17:40:00

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# Real-Time M&V

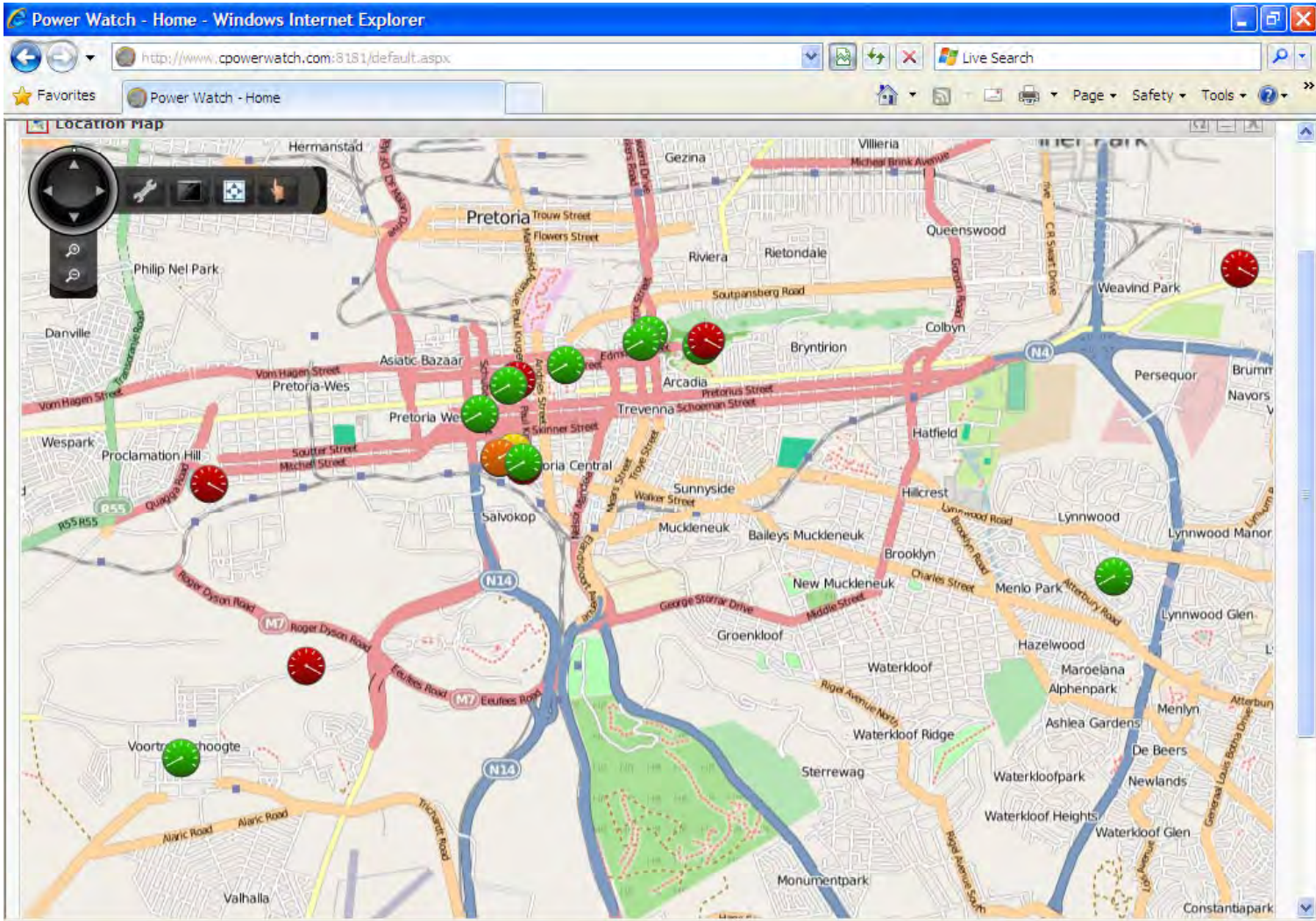


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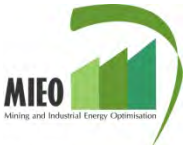
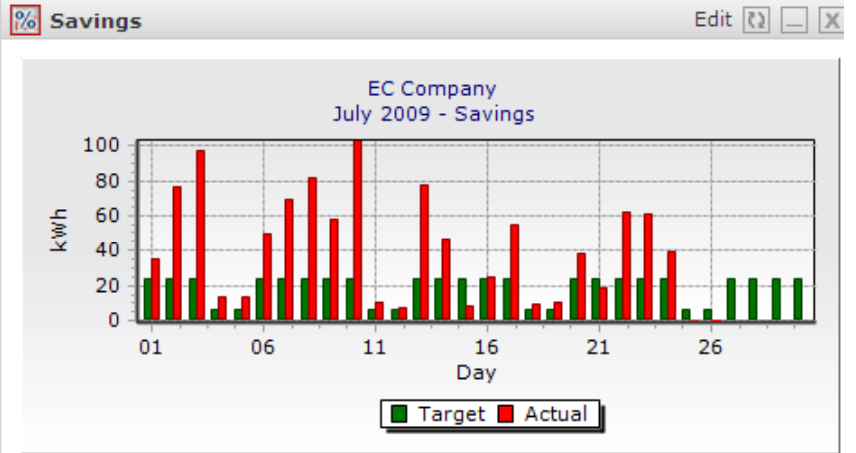
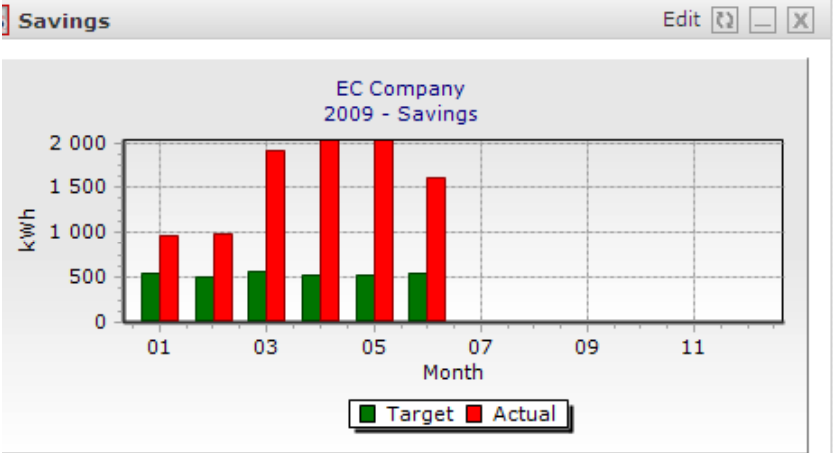
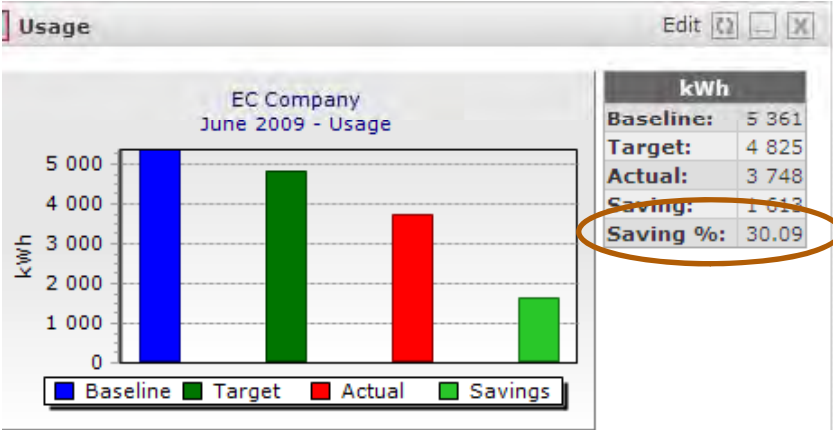


# GIS Map



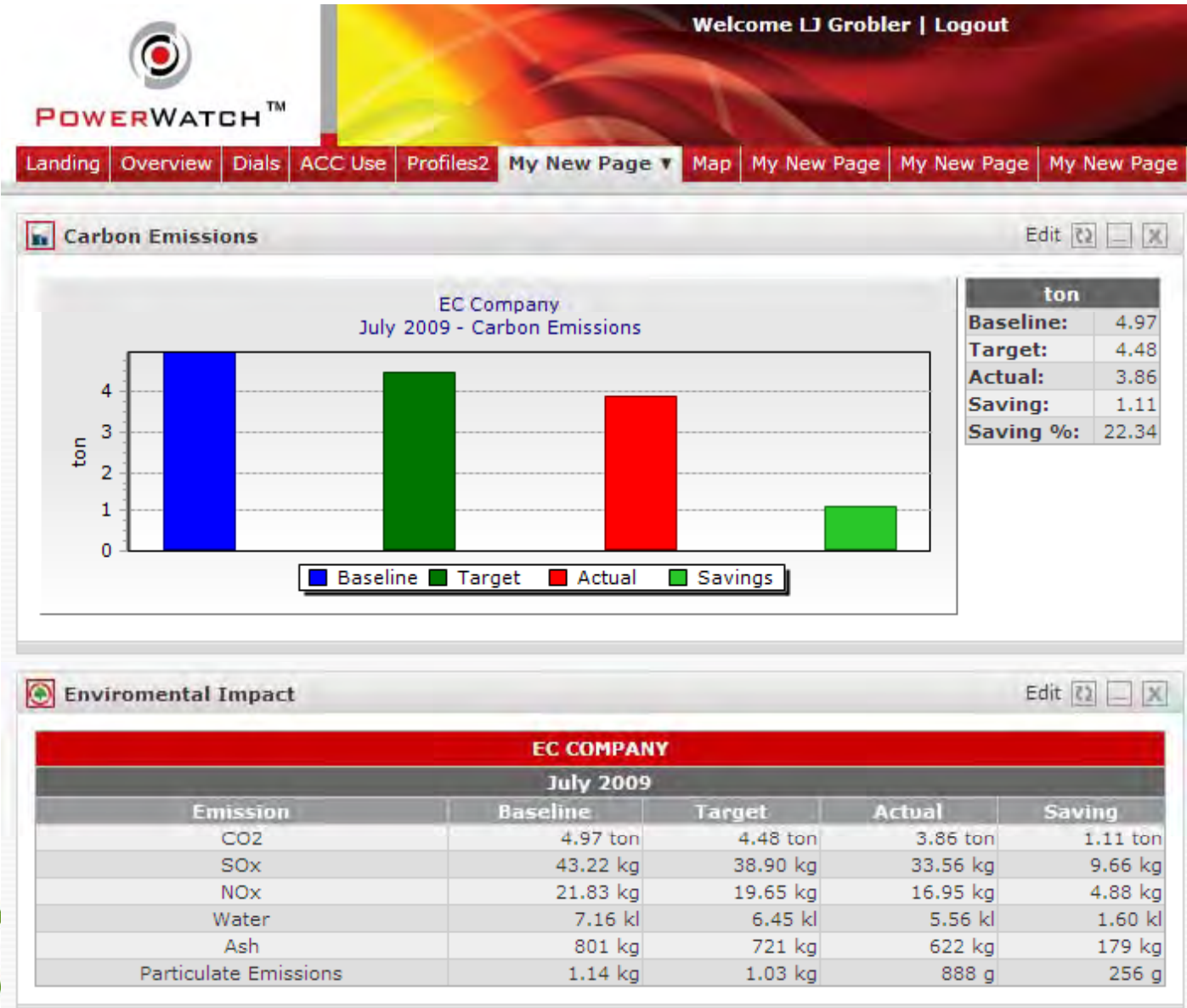


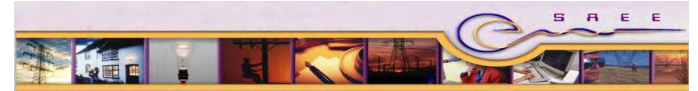
# Energy Savings





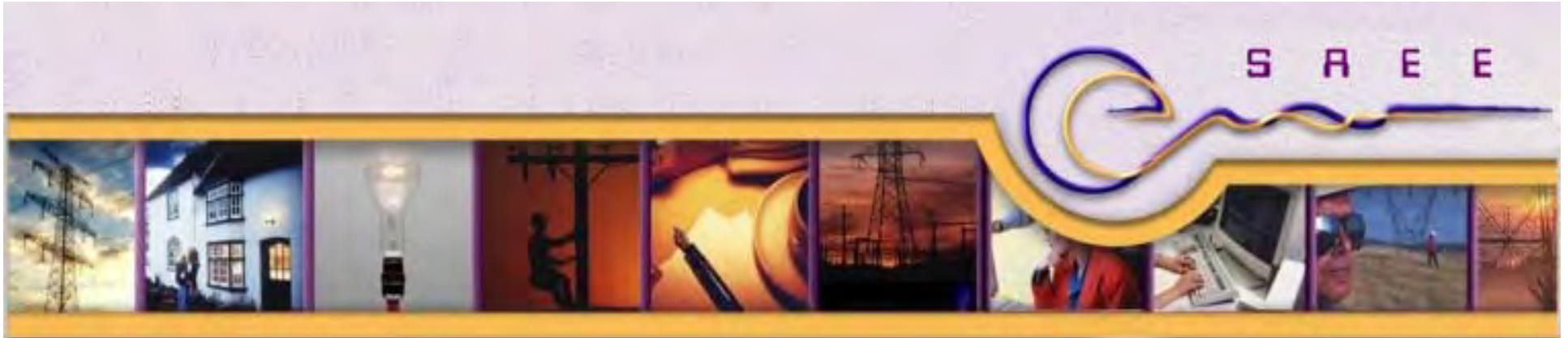
# Environmental Impact and Savings





## Conclusions

- Understanding drivers of energy is essential for M&V
- EE Tax Incentives requires independent M&V
- Without M&V you cannot get benefit of Tax Incentives
- Baselines need to be credible
- Without metered data you cannot develop baselines
- Without metered data you cannot claim EE Tax Incentives or Standard Offer



## Questions??

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[lj@energycybernetics.com](mailto:lj@energycybernetics.com)