



# Energy productivity: the untapped opportunity in minerals processing

IMPC Energy Plenary

Dr Mary Stewart | Director and General Manager – Energetics, Board Member – CEEC | 13 September 2016

energetics



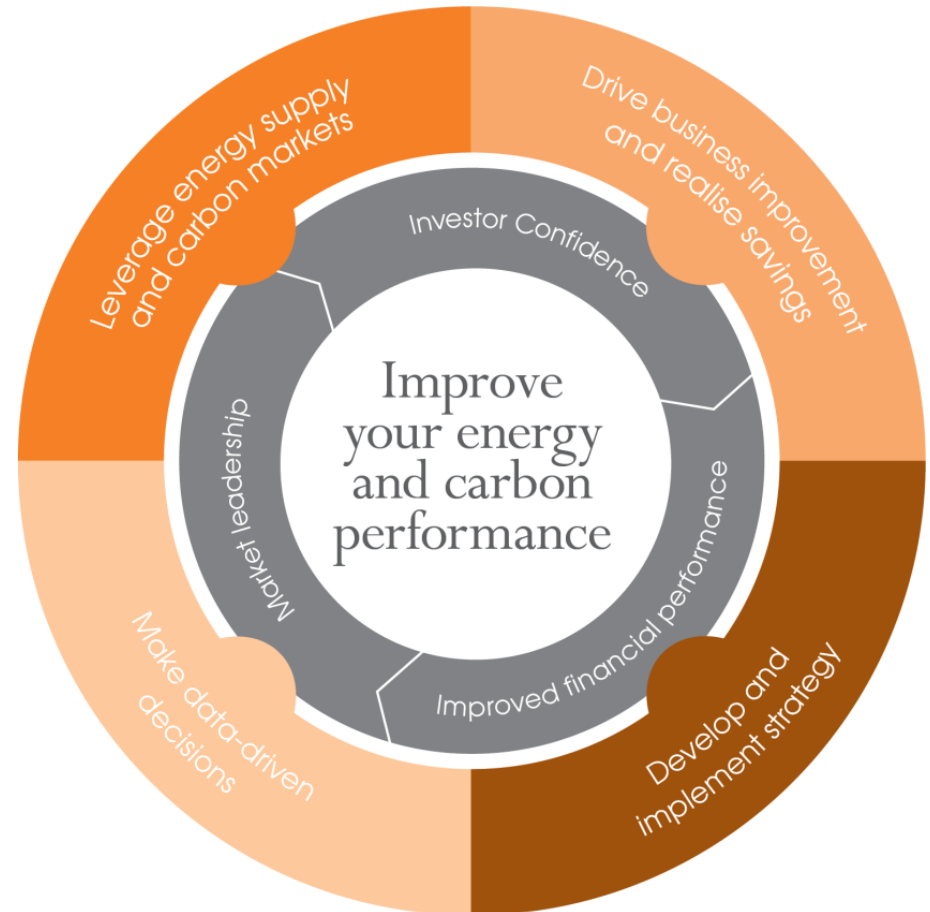
# About Energetics

A specialist energy, carbon and sustainability consultancy.

For more than 30 years we have worked with Australia's largest energy users and all levels of government.

We help clients:

- mitigate climate change risks and meet all compliance obligations,
- identify and develop opportunities
- reduce costs and lift productivity,
- improve market positioning through enhanced brand and reputation.





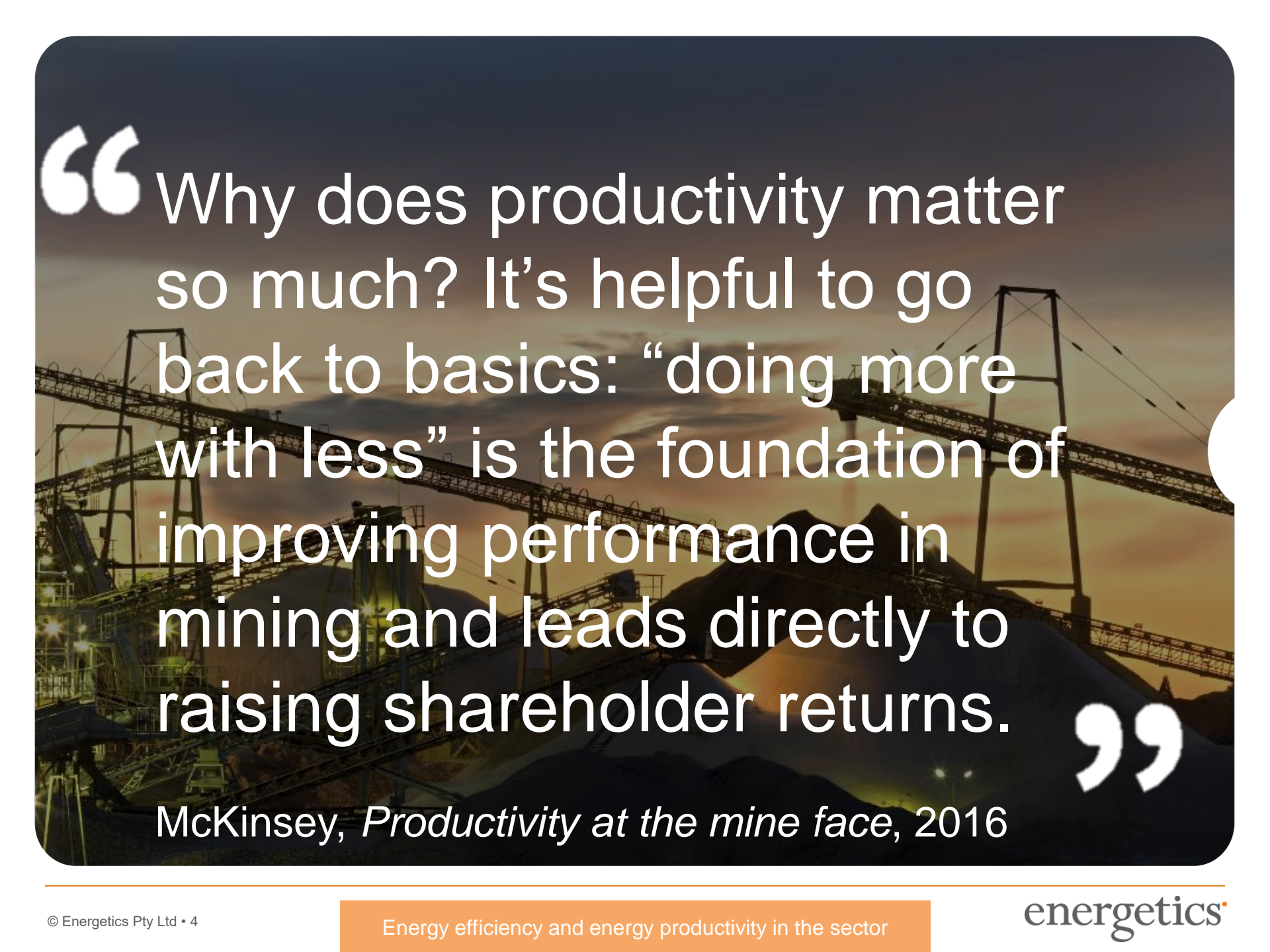
# Overview

**Energy  
efficiency and  
energy  
productivity in  
the sector**

**What does your  
energy dollar  
buy?**

**Different  
opportunities for  
reducing this  
spend**

**What does this  
mean for  
research?**



“ Why does productivity matter so much? It’s helpful to go back to basics: “doing more with less” is the foundation of improving performance in mining and leads directly to raising shareholder returns. ”

McKinsey, *Productivity at the mine face*, 2016

# Energy efficiency vs energy productivity



## Energy efficiency

kWh per production amount

- kWh per tonne total material moved
- kWh per ROM tonne

## Energy productivity

kWh per \$ product

\$kWh per \$ product

## Energy intensity

kWh per tonne product

# Energy efficiency vs energy productivity



## Energy efficiency

kWh per production amount

- kWh per tonne total material moved
- kWh per ROM tonne

## Energy productivity

kWh per \$ product

\$kWh per \$ product

## Energy intensity

kWh per tonne product

**Does it really matter?**



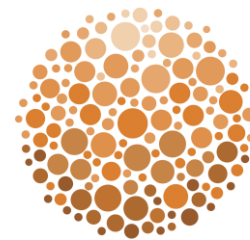
# Corporate energy productivity: information sources

## Energy information

- Sustainability reports/GRI G3 and G4
  - Totals available, breakdown for regions not consistent
- CDP focus on emissions
  - Energy totals for regions not broken down by source

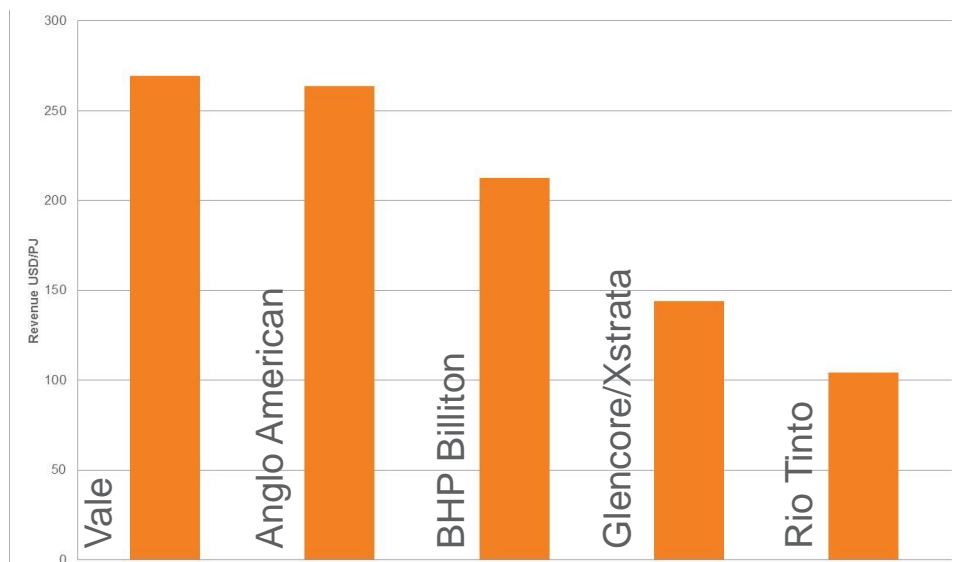
## Financial information

- Quarterly and Annual reports
  - Consistent and comprehensive
  - Rules are well established



# Corporate energy productivity

Company	2012	2013	2014	EBITDA as % of revenue
	Revenue per energy consumed (USDm/PJ)			
Vale	257	304	247	Not reported
Anglo American	-	277	251	28
BHP Billiton	239	203	196	48
Glencore/Xstrata	-	147	140	36
Rio Tinto	101	106	106	40







# Commodity energy productivity



## Where did I look?

- Sustainability reports
- CDP reports
- Production reports
- Annual reports



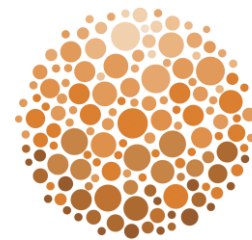
# Commodity energy productivity



## Where did I look?

- Sustainability reports
- CDP reports
- Production reports
- Annual reports

**Energy Efficiency**  
Opportunities



# Commodity energy productivity

Commodity group	Sales value per energy consumed (USDm/PJ)
Iron ore	1100 – 1800
Gold	250 – 500
Coal <i>thermal and coking</i>	180 – 300
Base metals <i>Ni, Cu, Zn, Pb, Mn</i>	100 – 240
Alumina	0.1 – 0.3



# How can this be used

## Corporate Program or Policy

- Economy-wide requires a commodity focus
- Corporate performance is too complex to generalise
  - Company-specific KPIs
- Publicly available information sets are currently not adequate to inform energy productivity outcomes

## Site improvement

- Understanding what your energy \$ buys is important
- Energy efficiency is not the whole answer
- Link to commodity performance through sales value

“

Assessing the company's overall energy portfolio to identify ways to optimise both supply and demand factors before the inevitable rises in prices occur.

”

Deloitte, *Tracking the Trends*, 2016



# What does your electricity \$ buy?

## Retail charges

- Consumption (kWh)
- Peak, shoulder and off peak

## Environmental

- LRET (kWh)
- SRES (kWh)

## Network

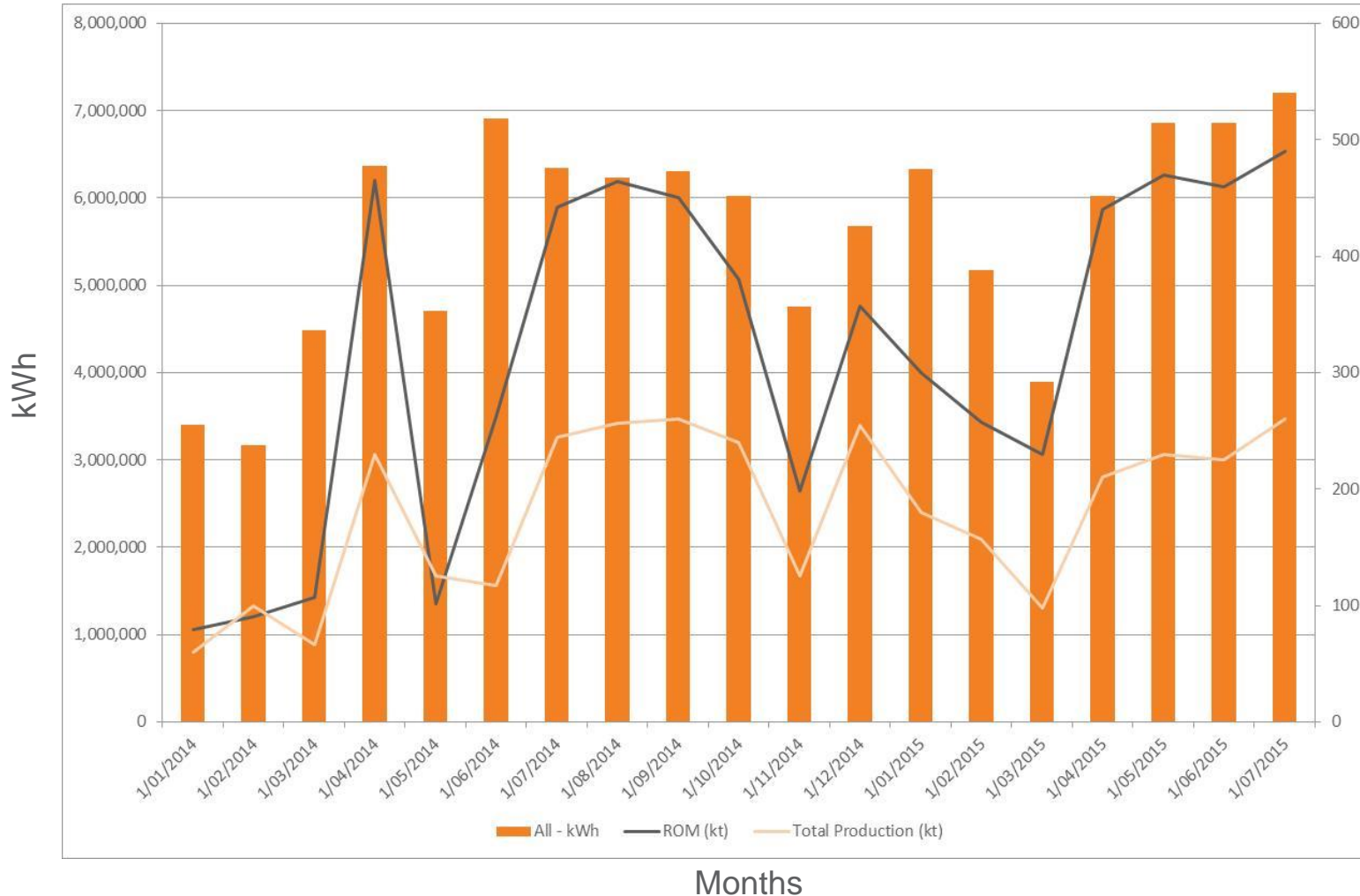
- Fixed (day)
- Capacity (kVA and rolling kVA)
- Demand (kWh)

## Other contestable

- Market (kWh)
- Metering (day)

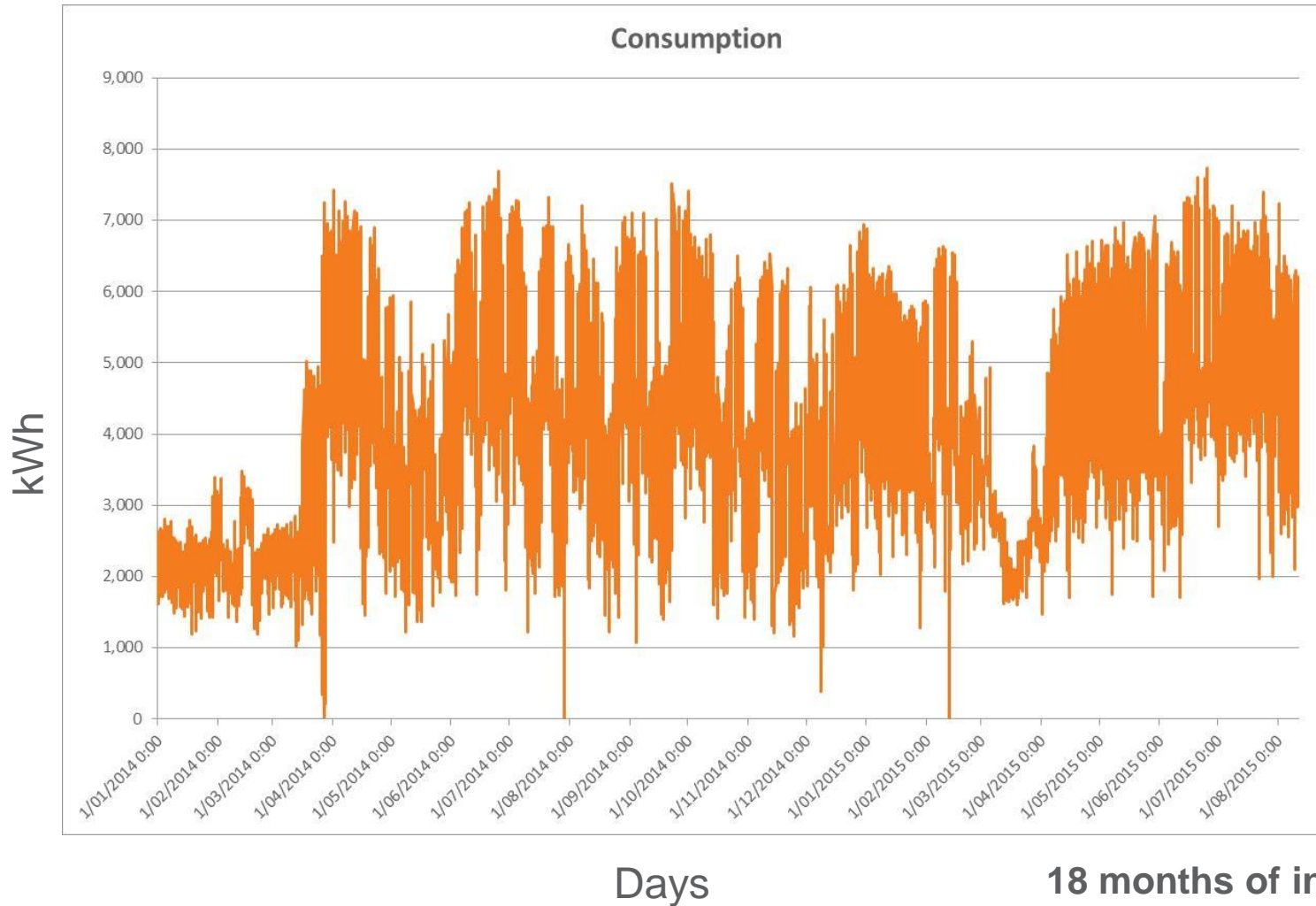


# Applying this to an open cut mine





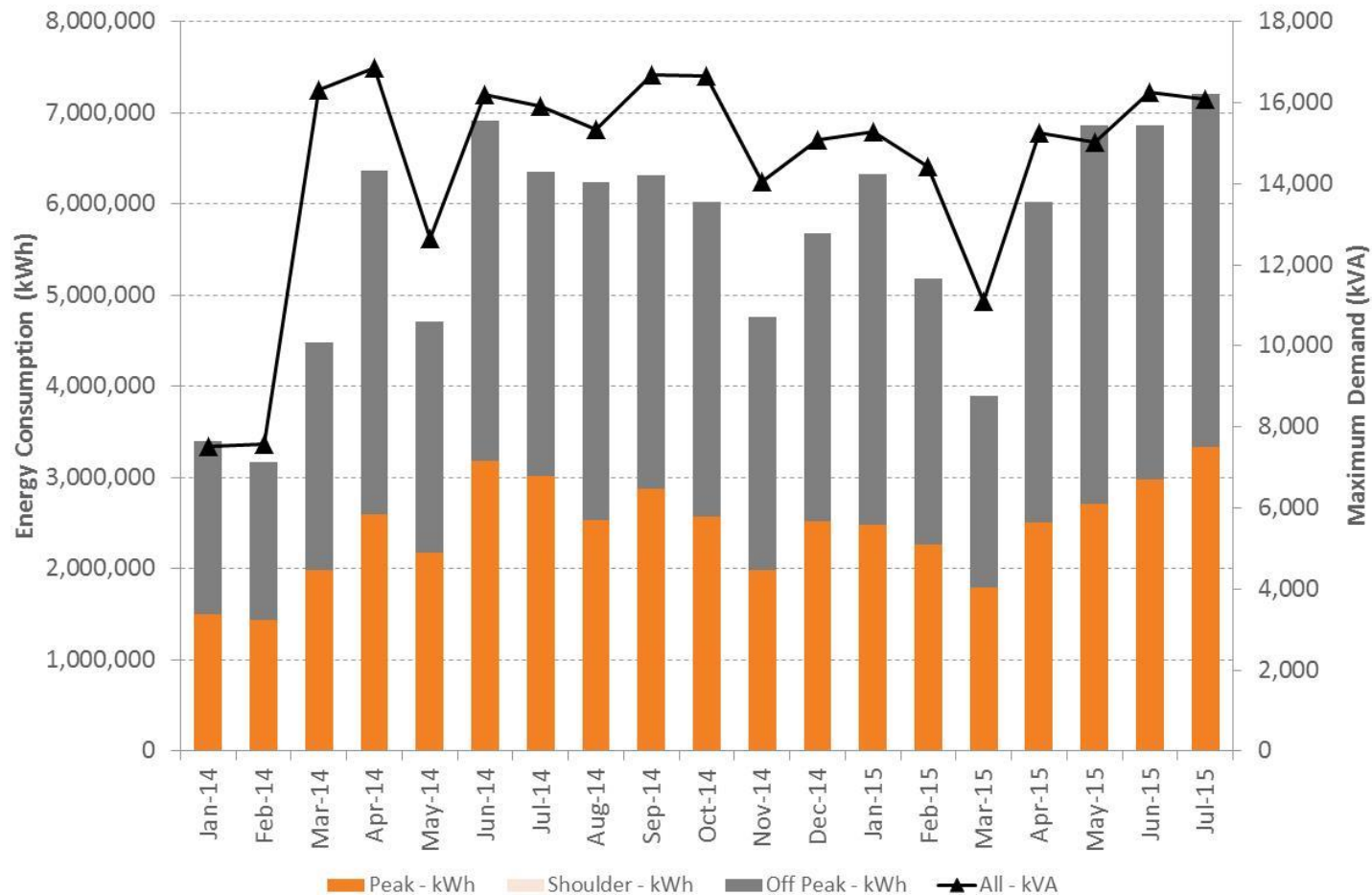
# Based in 15 minute interval data





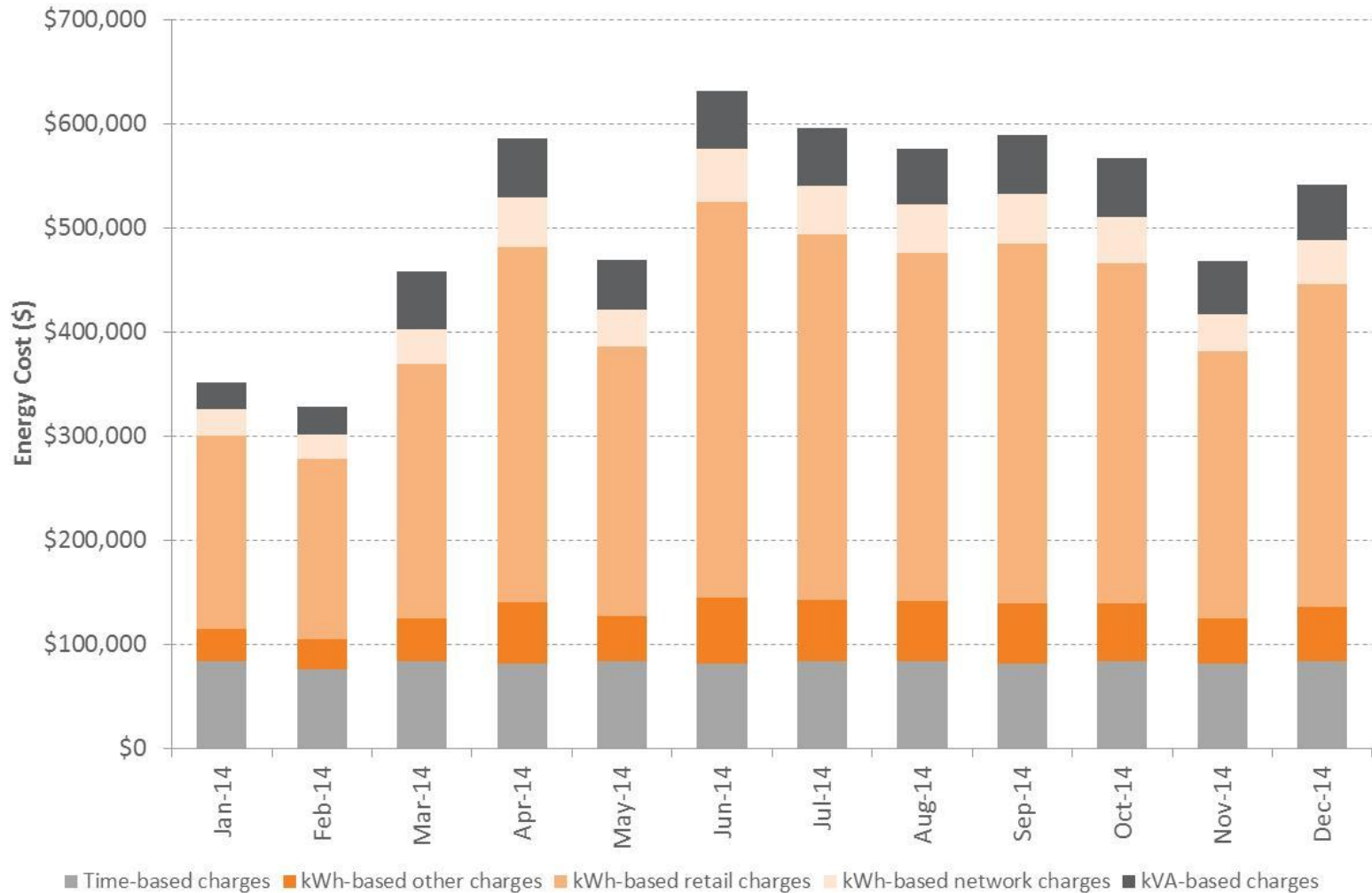


# Breaking down time of use



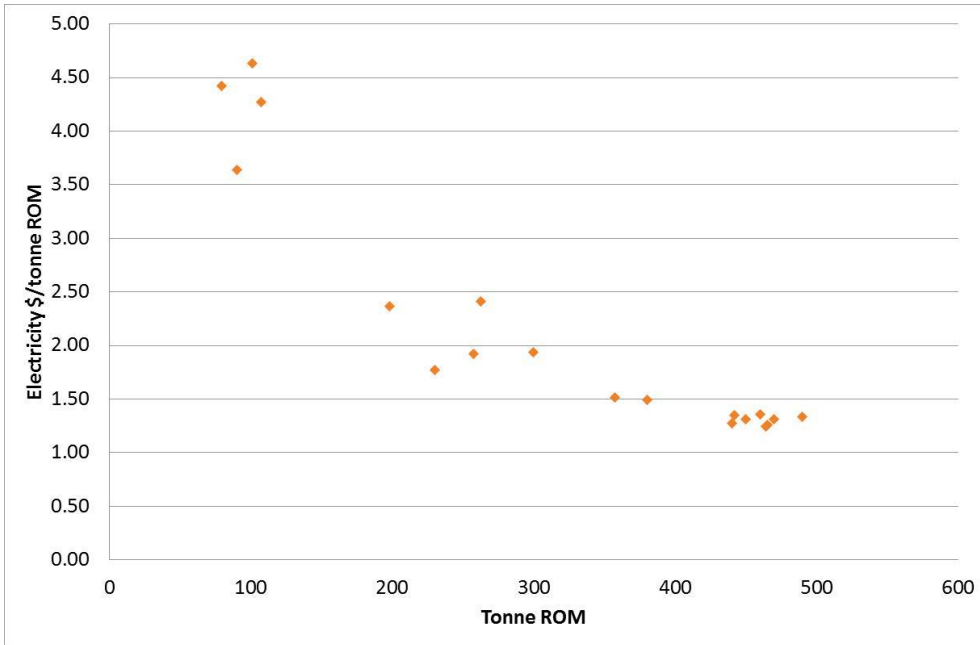


# Applying differential costs

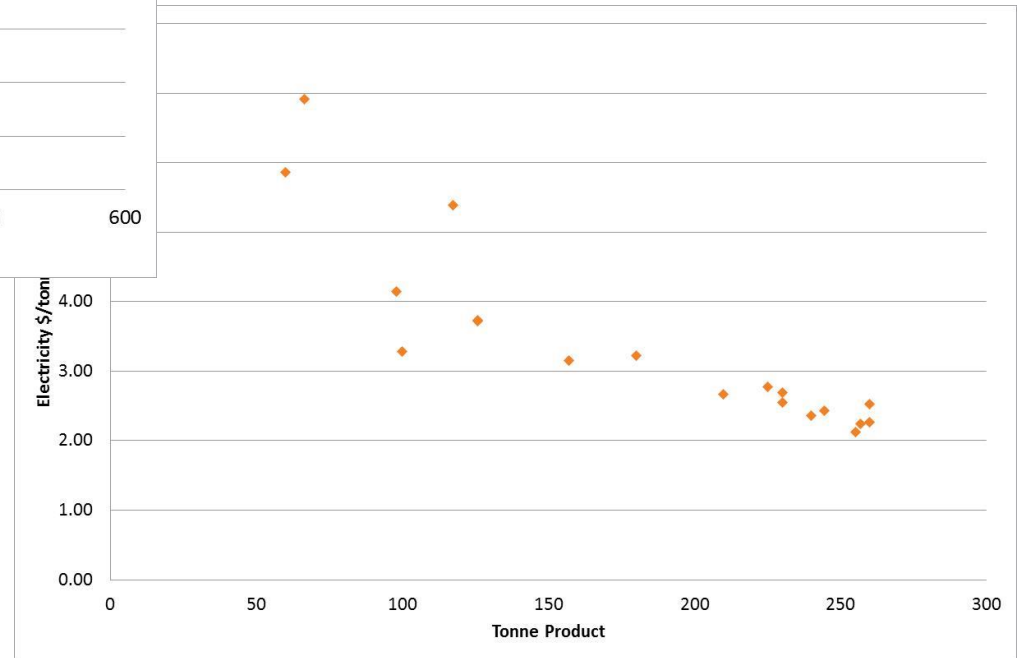




# Electricity cost KPIs



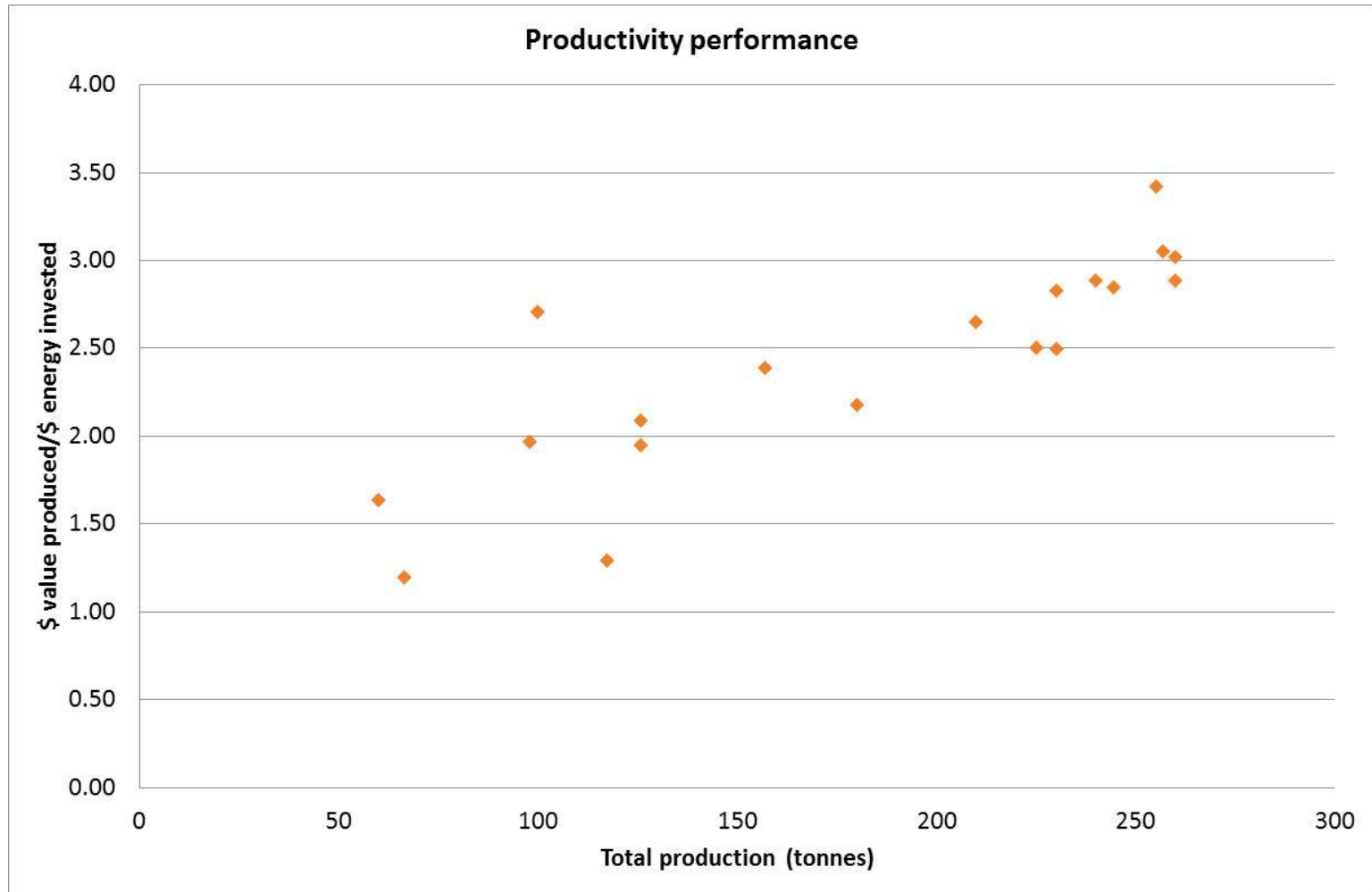
Electricity \$/tonne product




Electricity \$/tonne ROM



# Electricity productivity KPI



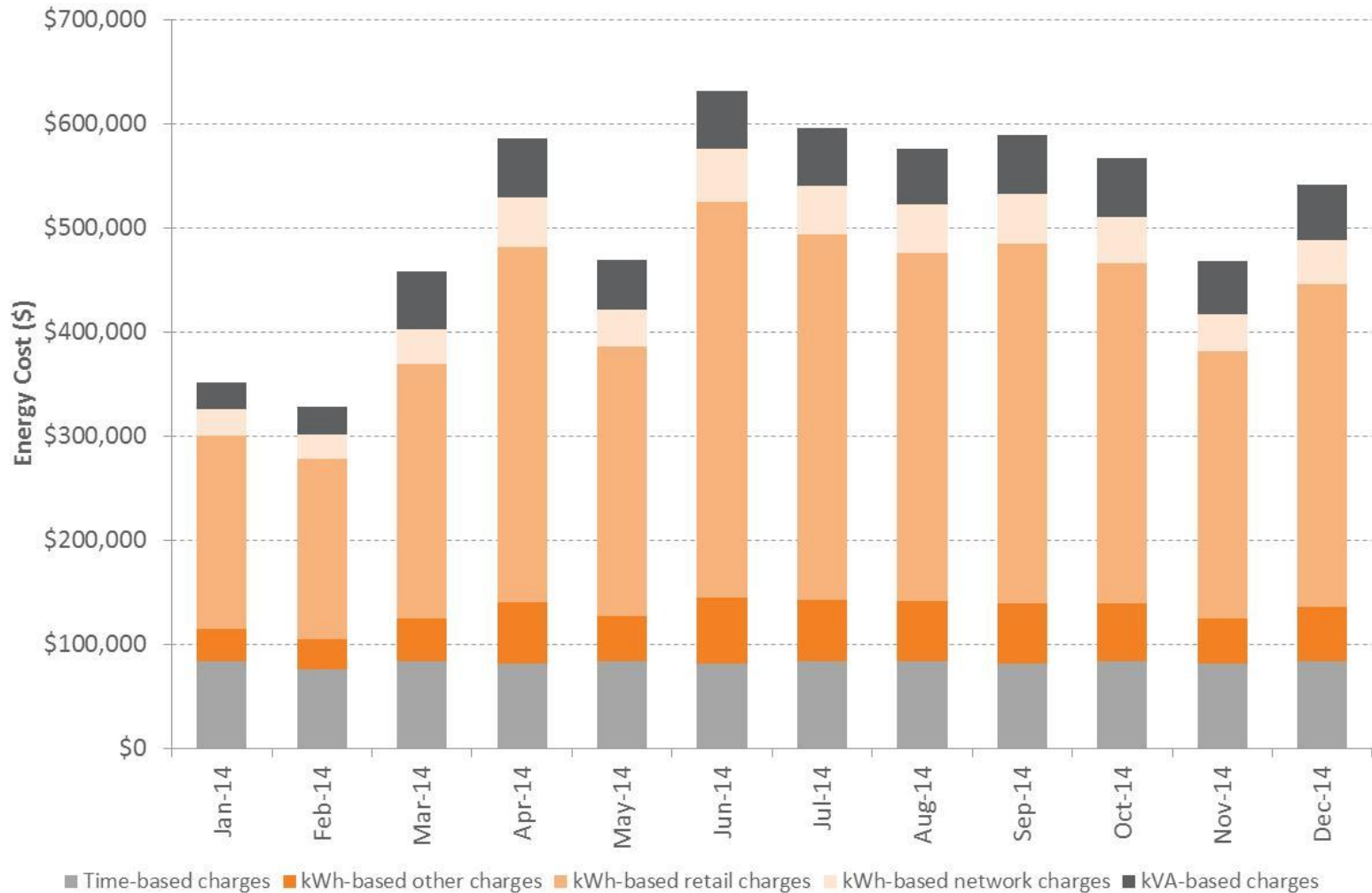


“ The Coalition for Eco Efficient Comminution estimates that a 15% improvement in energy productivity is possible by adopting best-practice energy management in comminution without investing in new equipment. ”

CEEC, *Annual Report, 2016*

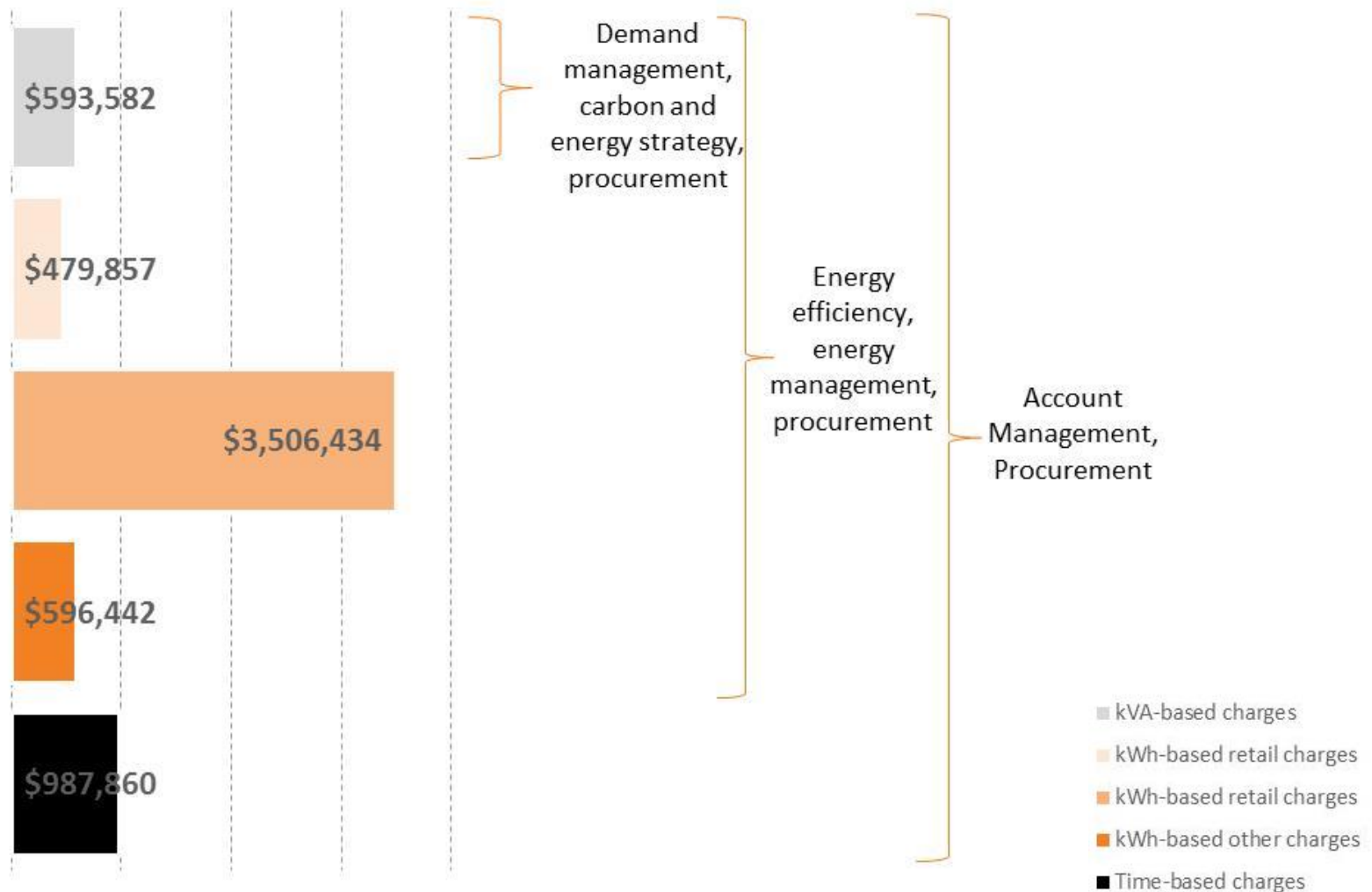


# Site specific improvements



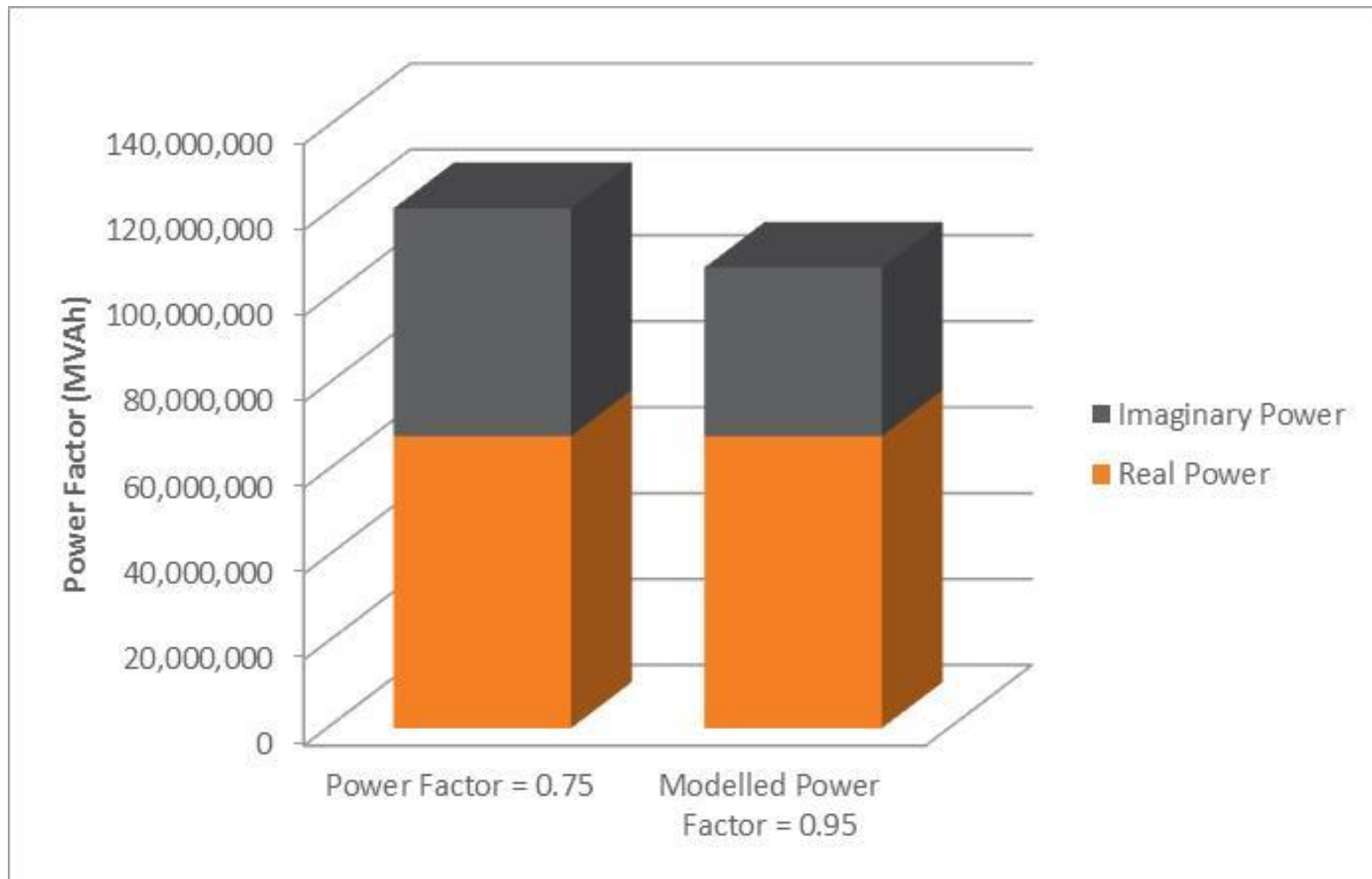


# How can this be improved?





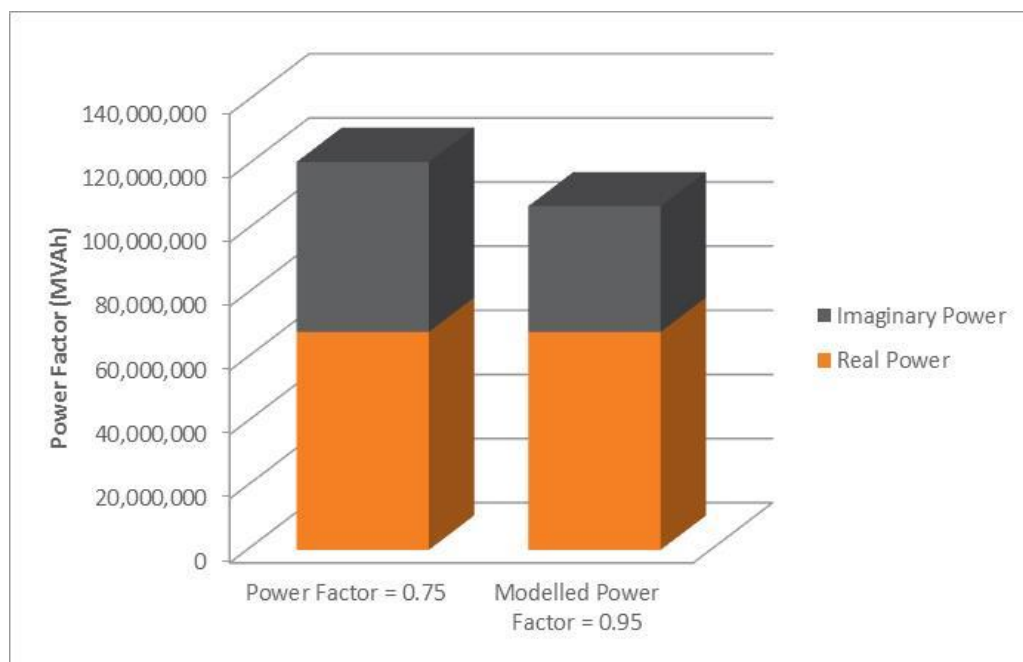
# Impact of equipment on site







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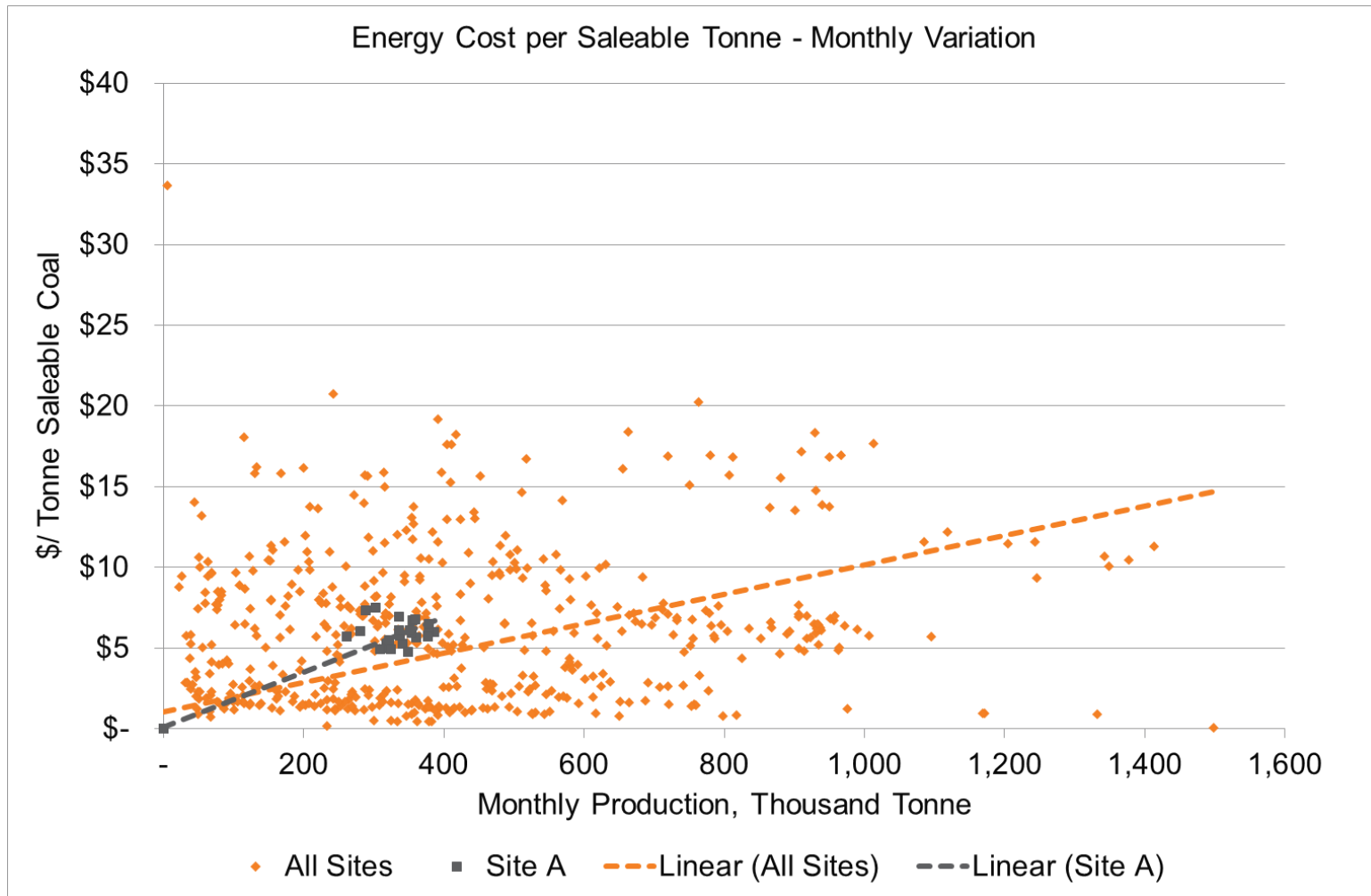
## Manage harmonics on site and reduce costs

- Energy and maintenance

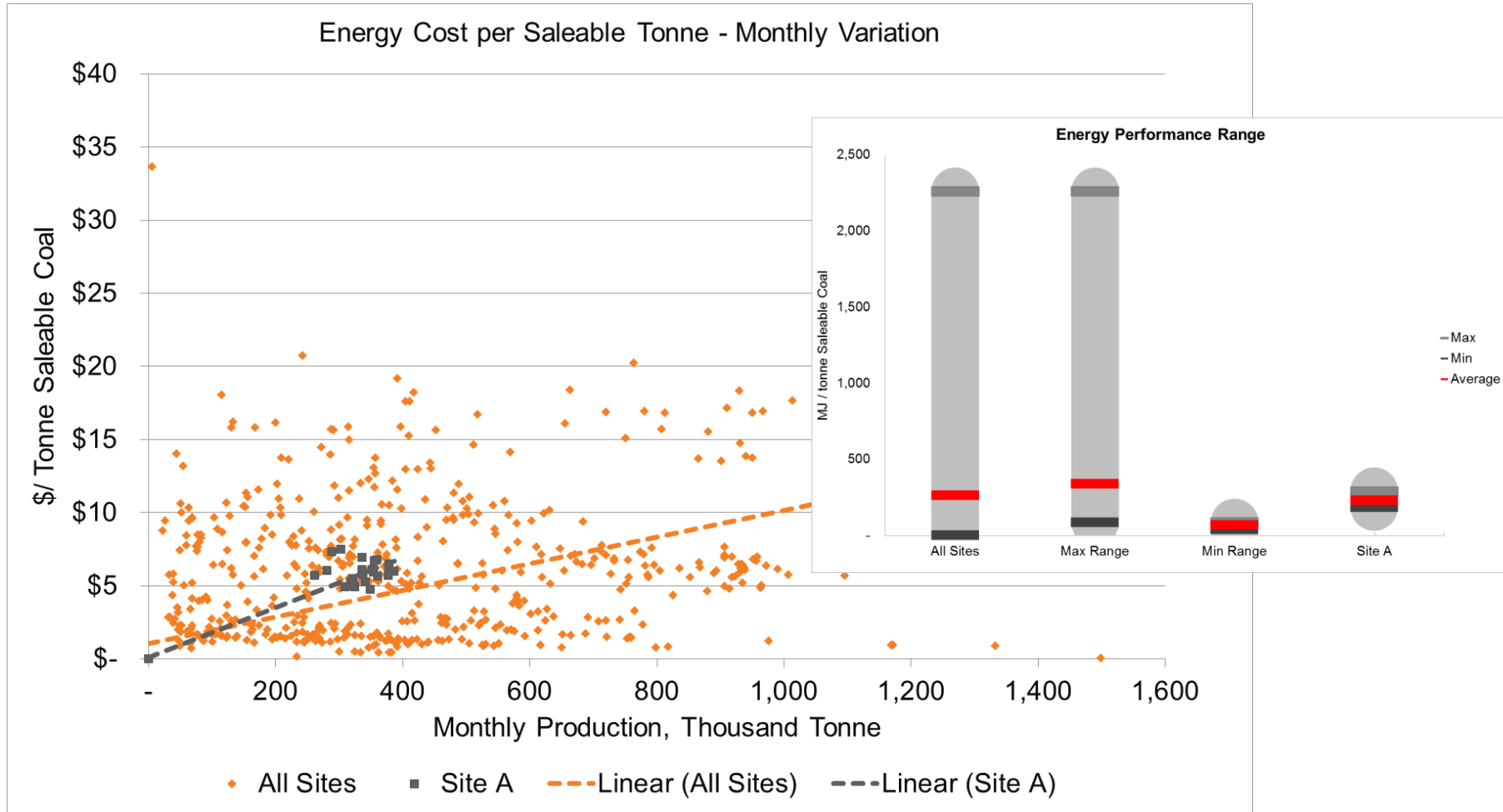
## Off grid sites

- Very similar impacts to on grid sites: contracts include kWh, kVa constraints
- Reduced need for spinning reserve to support poor power factor

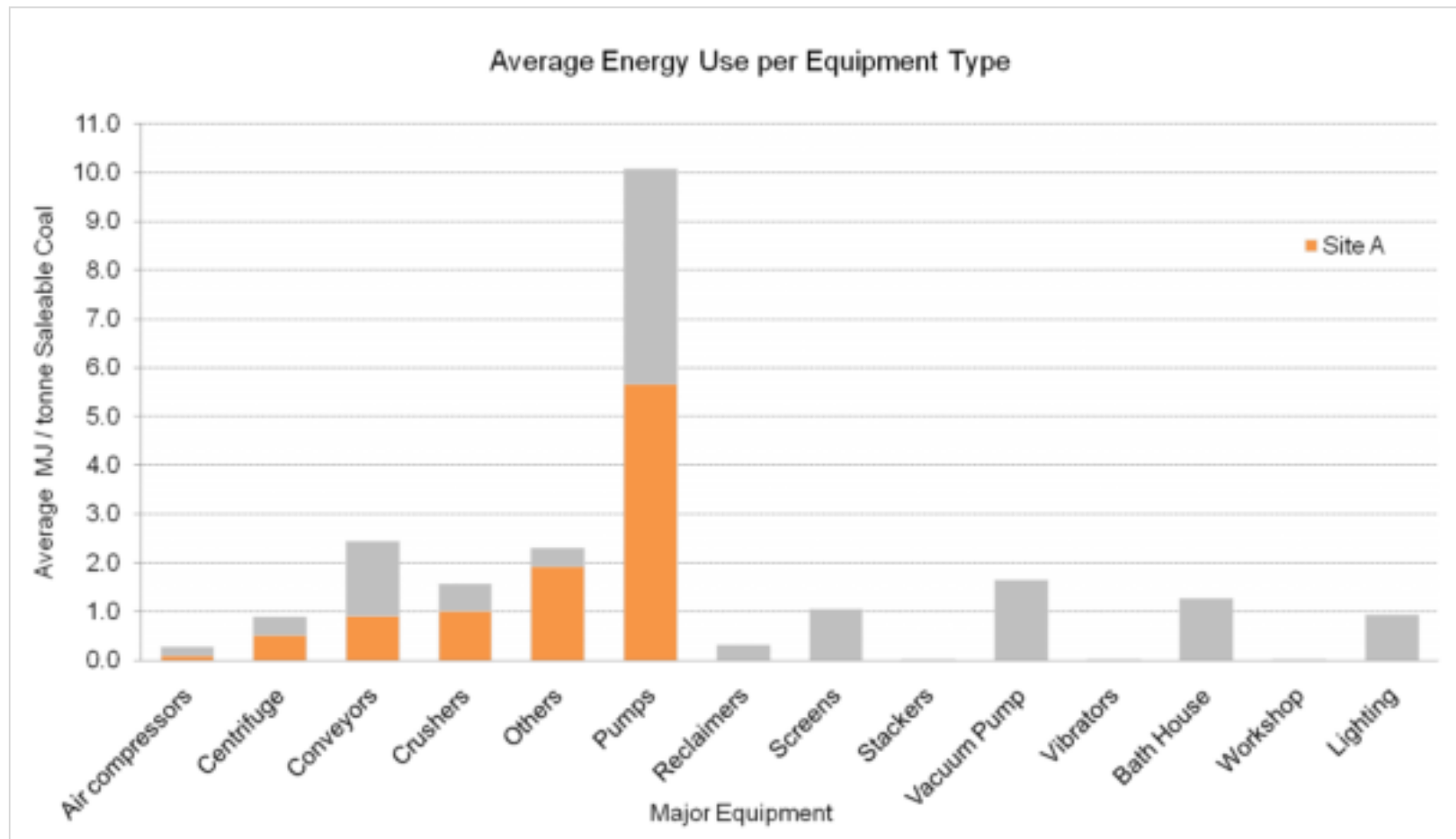
# Benchmarking to target reductions



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# CEEC Energy Curve program

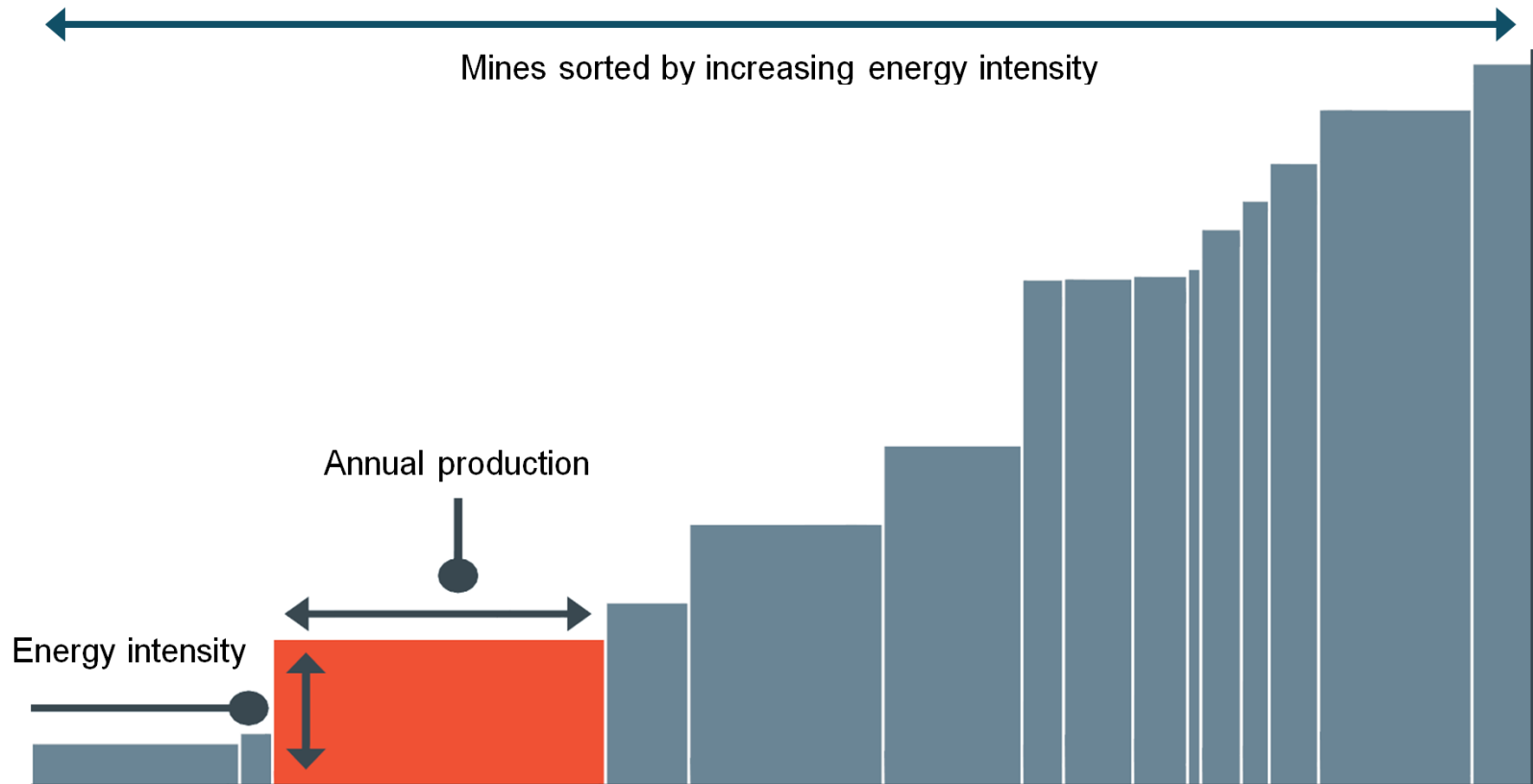
Collect, measure and compare comminution energy intensity

Provide a simple, visual and global methodology for assessing best practise

Motivate operations to improve comminution efficiency (move down the Energy Curve) to achieve best practice



# Energy Curve methodology







# Initial sources of data for the Energy Curve



16 technical databases including JKMRC, JKTech, AusIMM publications

Growing number of operators providing real operating data

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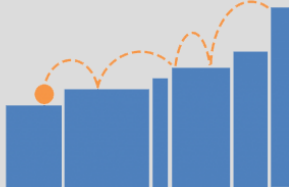
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The Coalition for Eco-Efficient Comminution (CEEC) has been established and is supported by a broad range of mining sector companies keen to accelerate awareness, knowledge transfer and, by implication, improve energy and cost outcomes in the substantive area of comminution.

[> About](#)

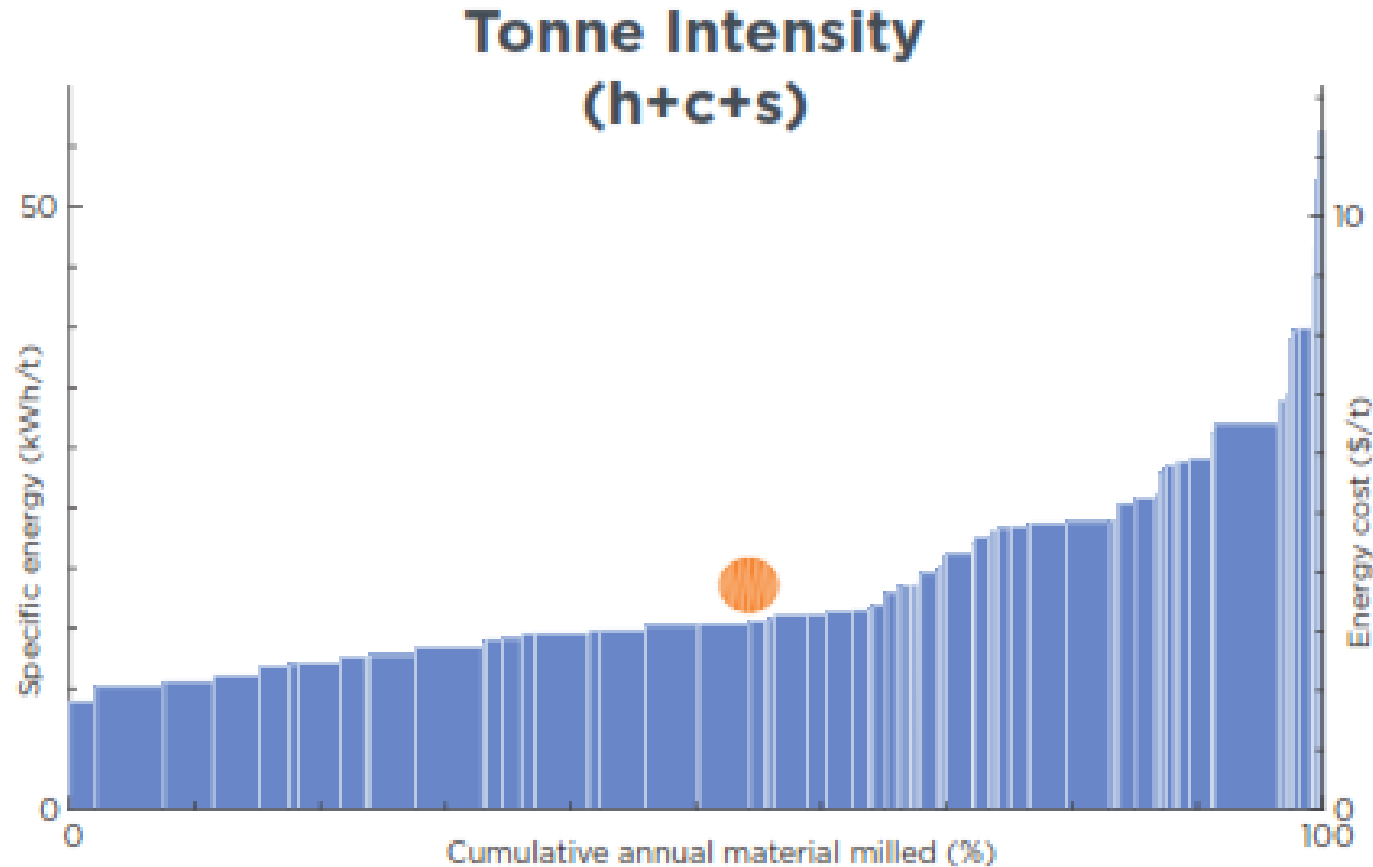
## Energy Curve Program

[Participate Now](#)



Welcome to the CEEC Energy Curve Program, a tool which allows comminution circuit operators to benchmark the energy efficiency of their operations and to contribute anonymously to the database on which the tool is based.

# Are there real improvements that can be made?

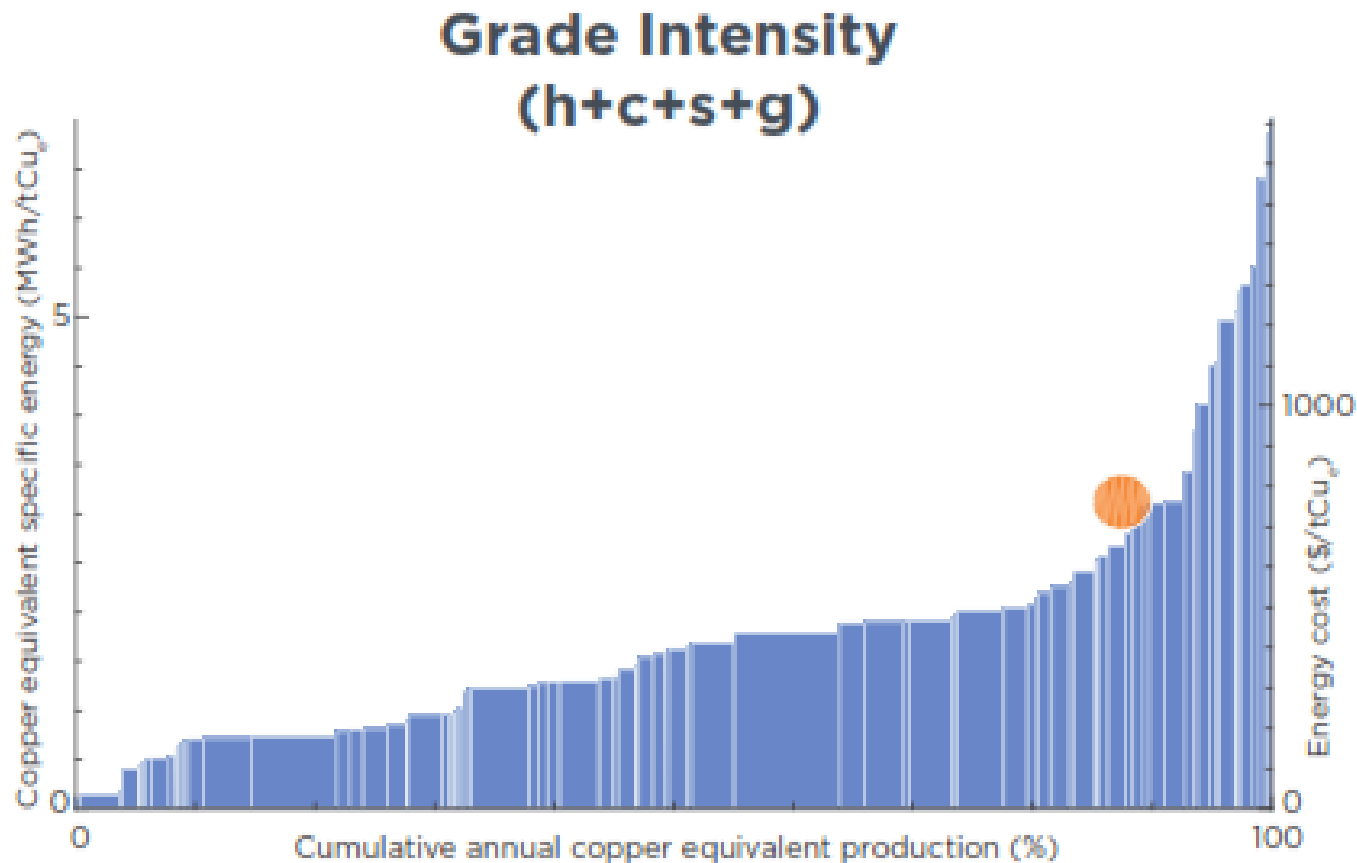


Ballantyne 2014

Different opportunities for reducing this spend

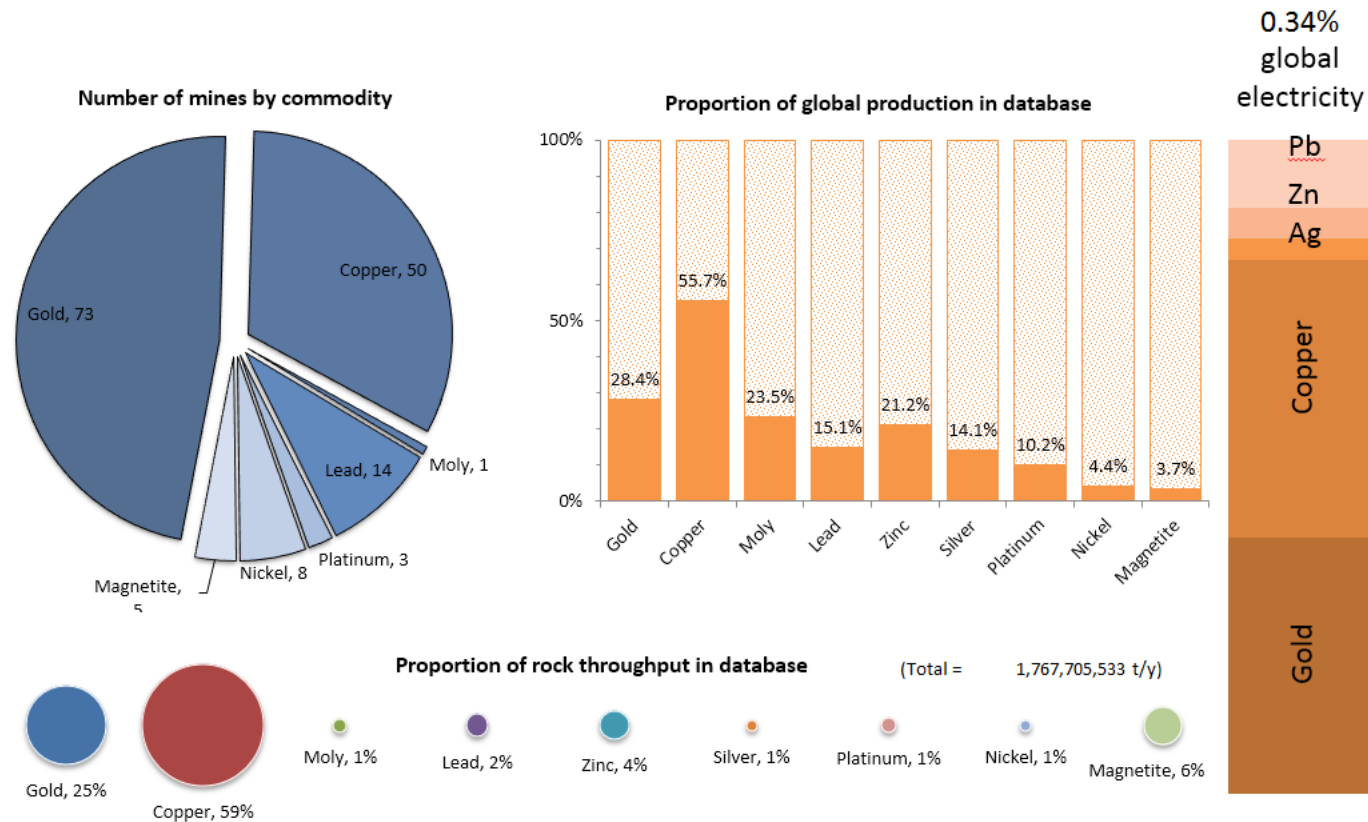


# Productivity considerations change the response



Ballantyne 2014

# Current energy curve database



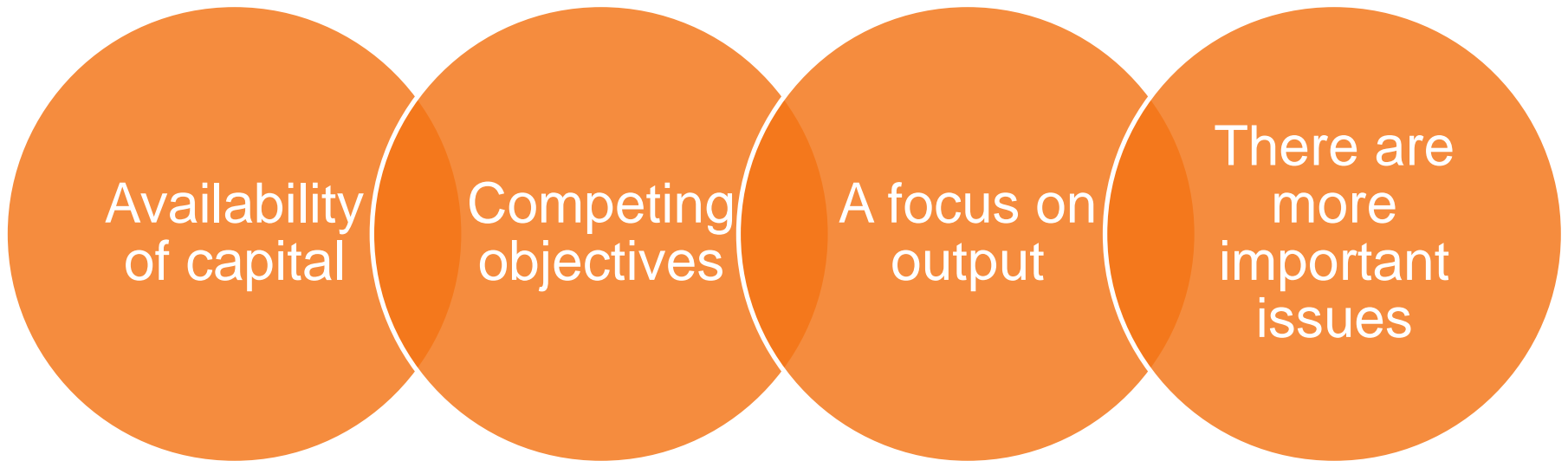
As at 23/08/2016

Global production is assessed using data from the [US Geological Survey](http://www.usgs.gov/)

<http://www.ceecthefuture.org/energy-curve-program/>



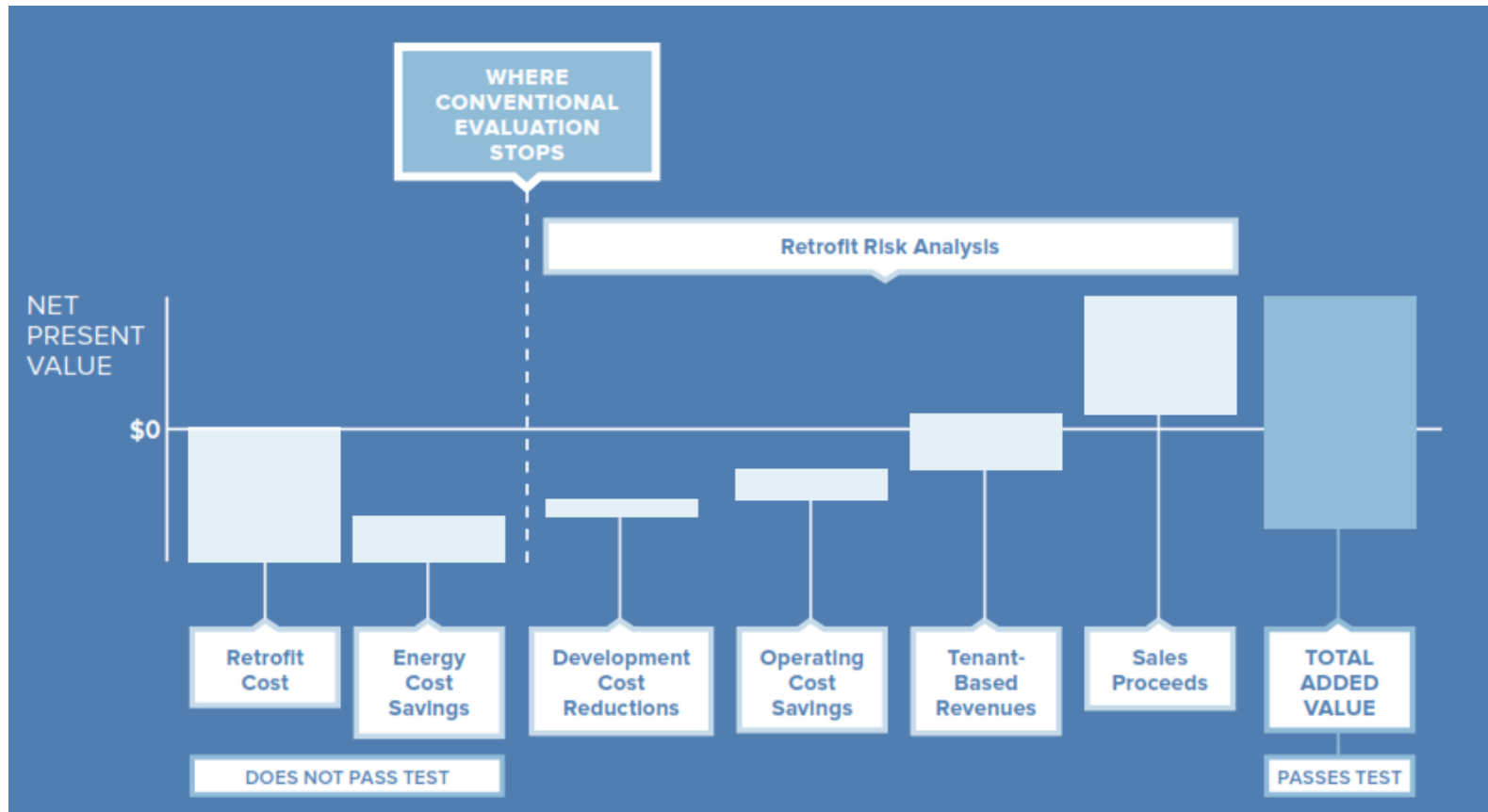
# Barriers to change



All of these point to the materiality of the decision, if there was more at risk the decisions would be different



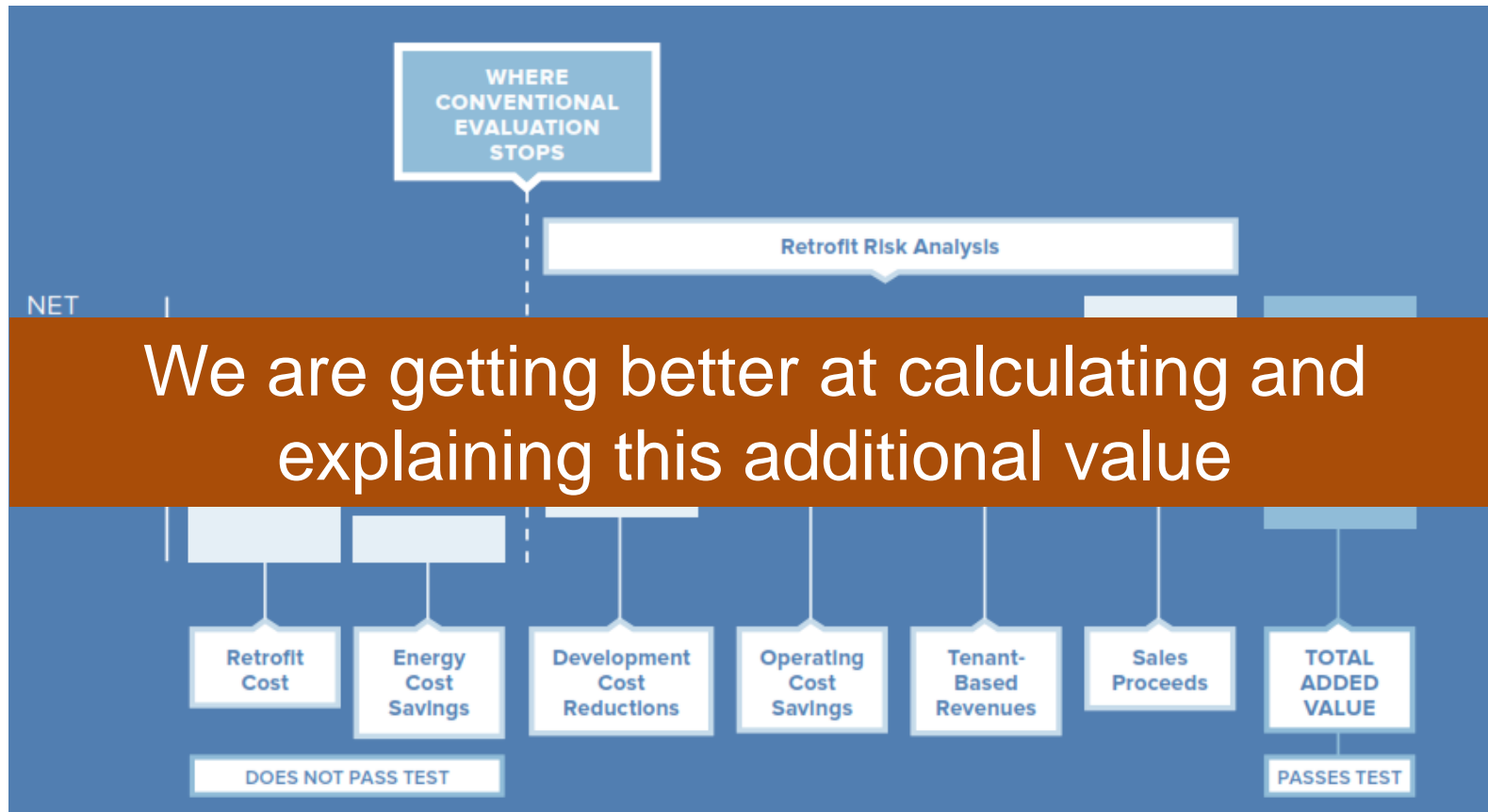
# Approaches in other sectors



RMI 2015 [www.rmi.org/retrofit\\_depot\\_deepretrofitvalue](http://www.rmi.org/retrofit_depot_deepretrofitvalue)



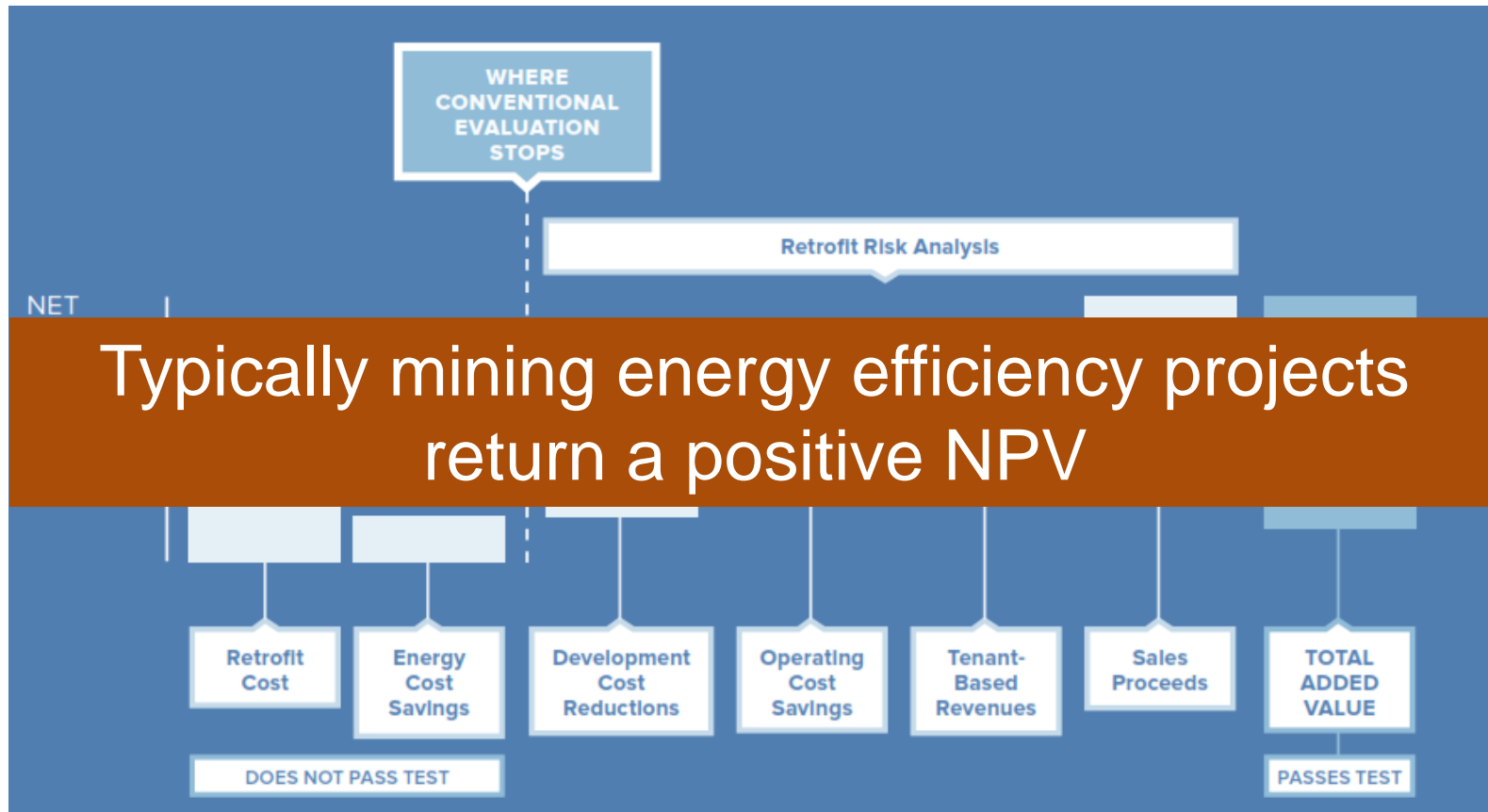
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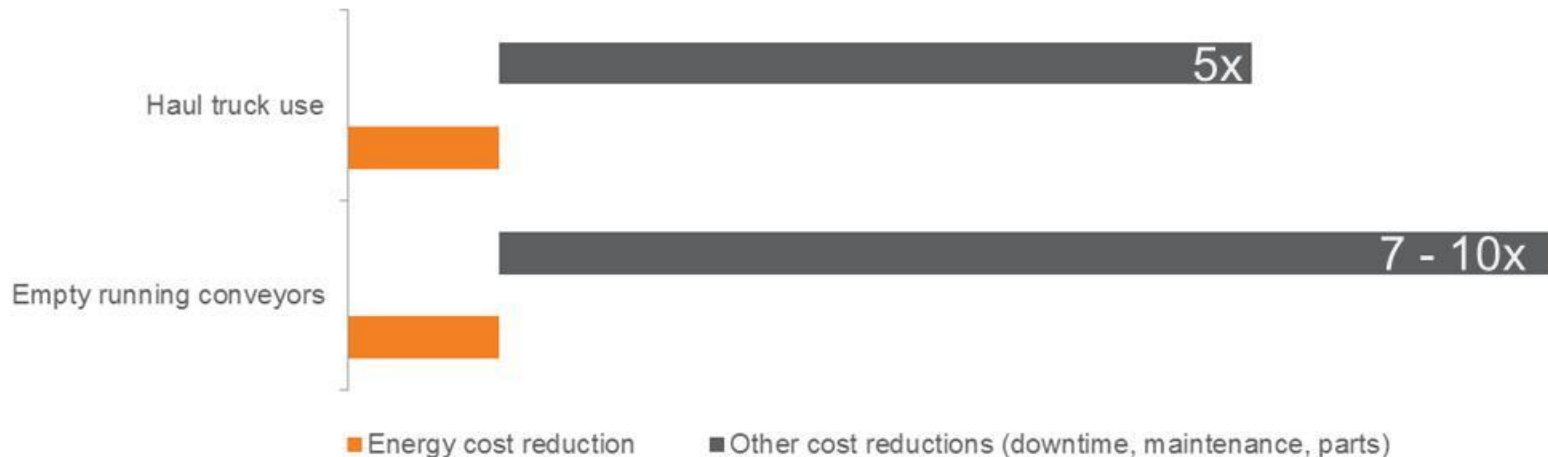


RMI 2015 [www.rmi.org/retrofit\\_depot\\_deepretrofitvalue](http://www.rmi.org/retrofit_depot_deepretrofitvalue)

# Can we paint the same picture for mining?



Many energy efficiency projects return a positive NPV on energy cost alone



Energy is around 10% of operating costs but influences significantly more savings

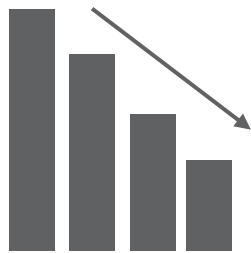
Energy is a powerful diagnostic tool for overall plant productivity

- And it is easy to measure

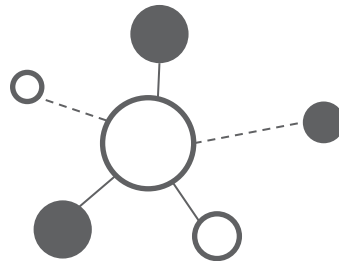


# The bigger picture

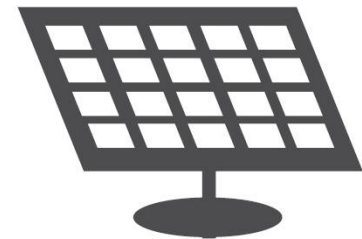
Lower total energy demand has multiple benefits:



Reduces the size of any installed site generation capacity



Reduces demands on aging reticulation equipment and associated connection costs



Improves the case for renewables on site

- Changing the energy cost profile over time can extend mine life





# The research challenge

- Energy savings are typically under-estimated when treated as a fixed cost: \$ per kWh
- Consider impacts of reductions in:

**↙ kVa**  
power draw, start up power

**↙ kWh**  
as well as shifting time of use

- Energy costs should be encoded as non-linear functions in optimisation
  - Time
  - kWh
  - kVa



# Summary

**Energy efficiency and energy productivity in the sector**

The differences and what this means for companies and policy

**What does your energy dollar buy?**

Contract structures and time of use considerations

**Different opportunities for reducing this spend**

Understand your energy cost breakdown to focus your efforts – contract, demand shifting, benchmarking, management

**What does this mean for research?**

Energy cost as a non-linear function of time, kWh and kVa

Questions

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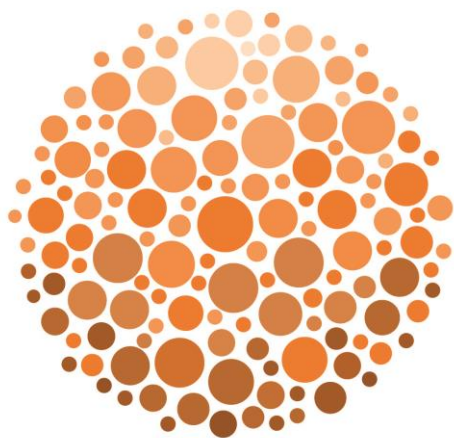
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