



**BARRICK**

**IMPROVING ENERGY EFFICIENCY IN  
BARRICK GRINDING CIRCUITS**

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SAG 2011

# Barrick Gold Corporation



- 26 mines world-wide
- Largest gold producer in the world
- 7.8 million ounces per year of gold delivered
  - 140 million ounces of gold reserve
- 600 million pounds per year of copper
  - 17 billion pounds reserve
- 1 billion ounces of silver reserve.

# Global Operations



# Presentation Outline

- Barrick's energy and climate change program
- Commintion in terms of the energy footprint
- Defining and implementing improvement opportunities
- The results and putting it into perspective

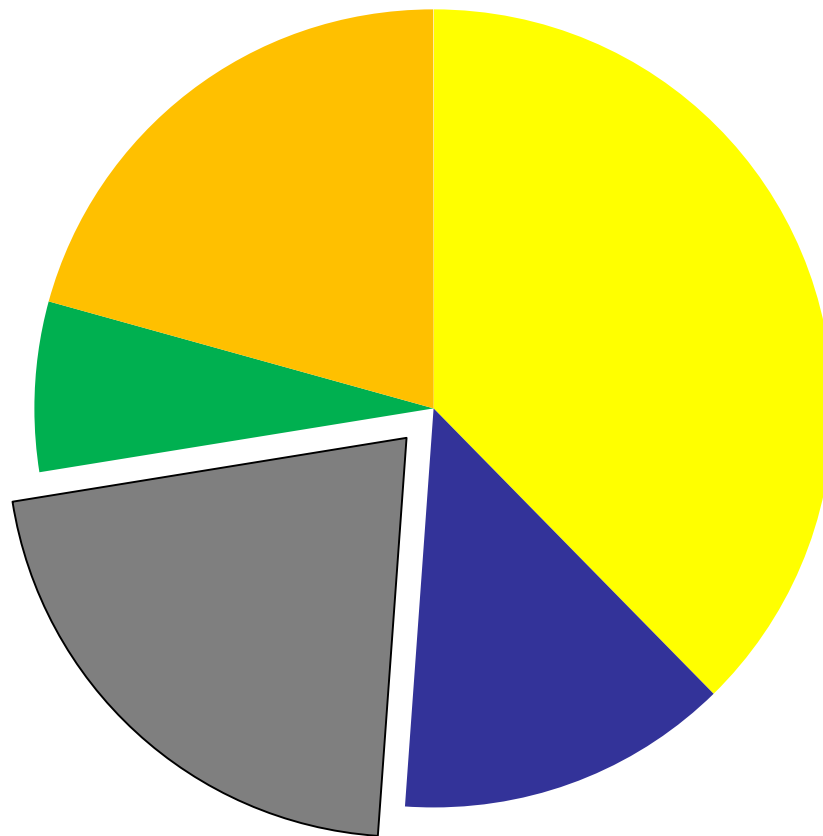
- **51 million gigajoules of energy consumed annually**
  - 1 GJ equals 26 litres of diesel
  - 1 GJ equals 278 kWh of electricity
  - Pretty close to a decatherm (million BTU's)
- **5 million tonnes of greenhouse gases (CO<sub>2</sub> equivalent) generated annually**

- Climate change is recognized as a significant factor in corporate governance
- Energy consumption is the principle driver of greenhouse gas (GHG) emissions
- Energy accounts for 25 – 30% of direct operating costs each year.
- Barrick has targeted improving energy efficiency by 8% through 2012.
  - Defined as calculated energy savings relative to “Business as Usual”

# Comminution in terms of Energy Footprint



Energy %



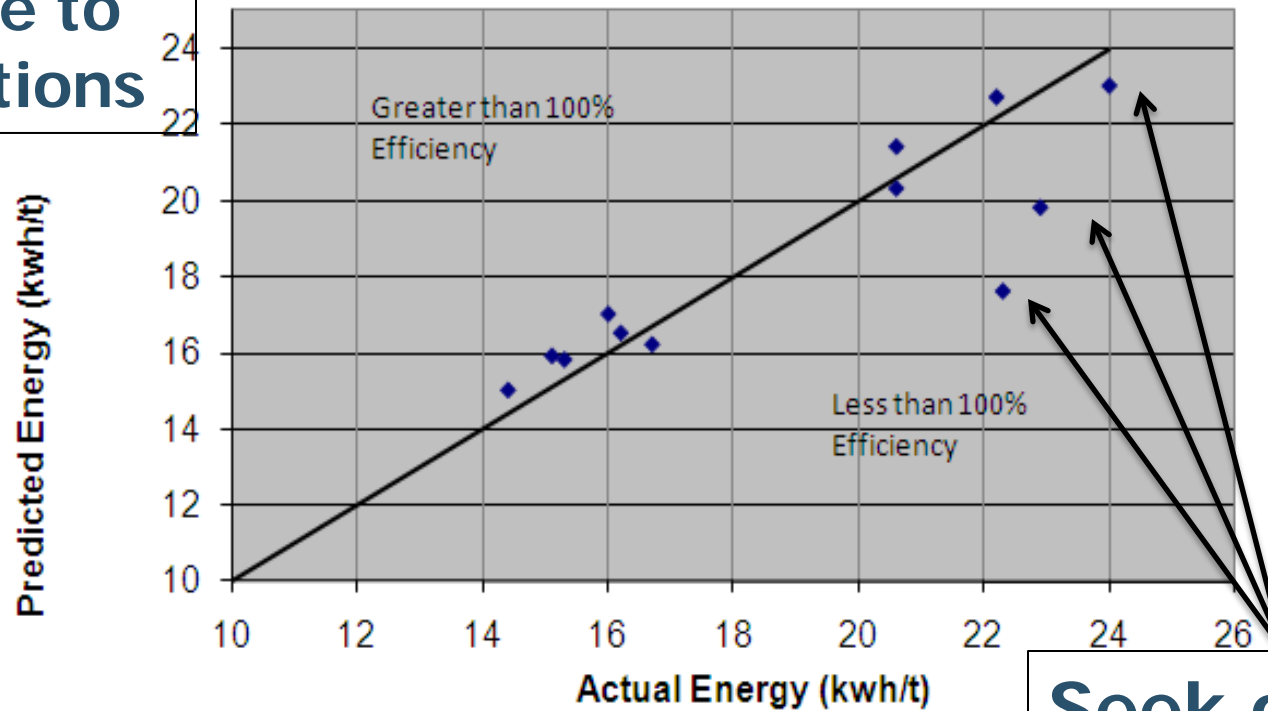
- Open Pit Mining
- Underground Mining
- Comminution
- Heap Leaching
- Rest of Process

Energy =  
Diesel, Electricity,  
Propane, Natural Gas,  
Gasoline, Biofuels,  
Explosives, etc.

# Seeking Comminution Opportunities

Survey the circuits and compare to expectations

Morrel Power Prediction- Barrick existing plants



Seek out the under-performers



- **Analyze the grinding circuits for improvement opportunities**
  - Seek to optimize the throughput
  - Feed crushing
  - SAG mill operation including breakage functions and “pumping” capacities
  - Pebble crushing
  - Classification
  - Ball milling

# Common Improvement Themes?

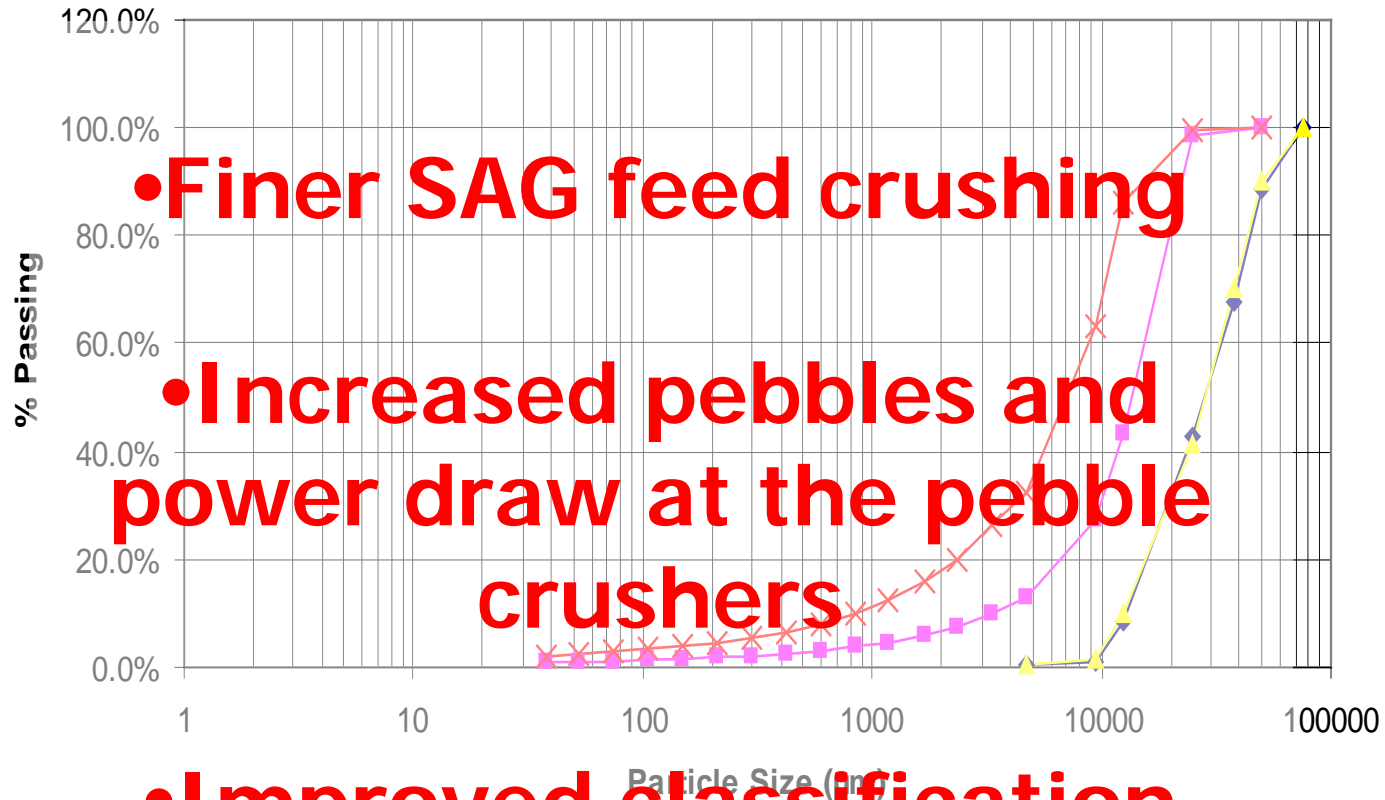
- There are amazingly few “common themes”
- Three mines reviewed in the paper had 16 improvement opportunities amongst them, only one was “common”
  - *Pebble crushing*
- Each grinding circuit must be individually studied

# Opportunities Were Various





Average Cumulative % Passing vs. Particle Size



• Finer SAG feed crushing

• Increased pebbles and power draw at the pebble crushers

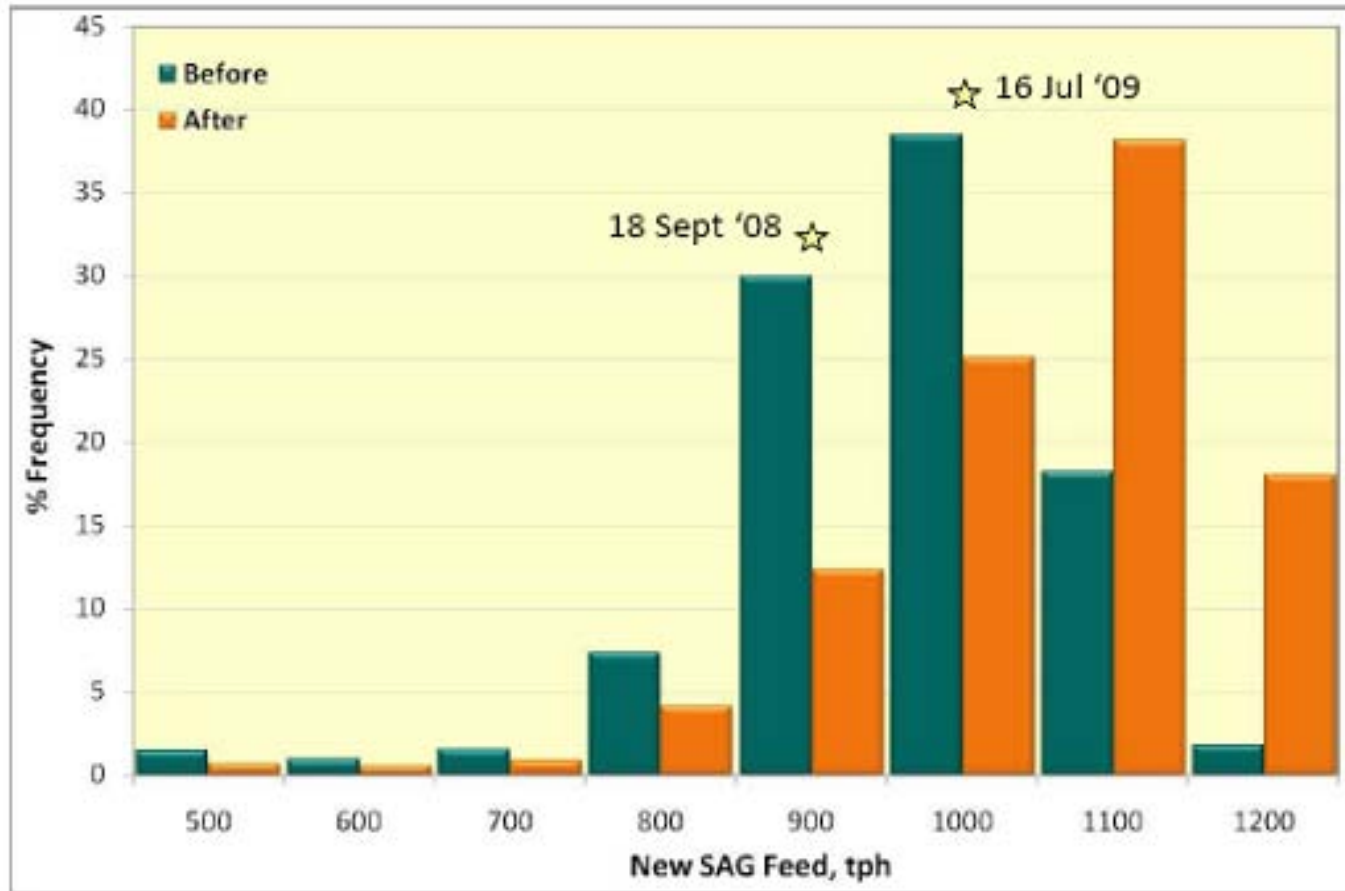
• Improved classification

◆ Fd Fine Liner    ■ Discharge Fine Liner    ▲ Fd Med Liner    × Discharge Med Liner



- 
- A photograph showing the interior of a SAG mill. The top part of the image shows the metallic, curved surface of the mill's shell, with several vertical lifters (spacers) protruding downwards. The bottom part of the image shows a thick, brownish slurry filling the mill. A semi-transparent white rectangular box is overlaid on the center of the image, containing three bullet points in red text.
- Changes to lifter spacing
  - Improved slurry discharge from SAG mills
  - Optimized ball mill power draw

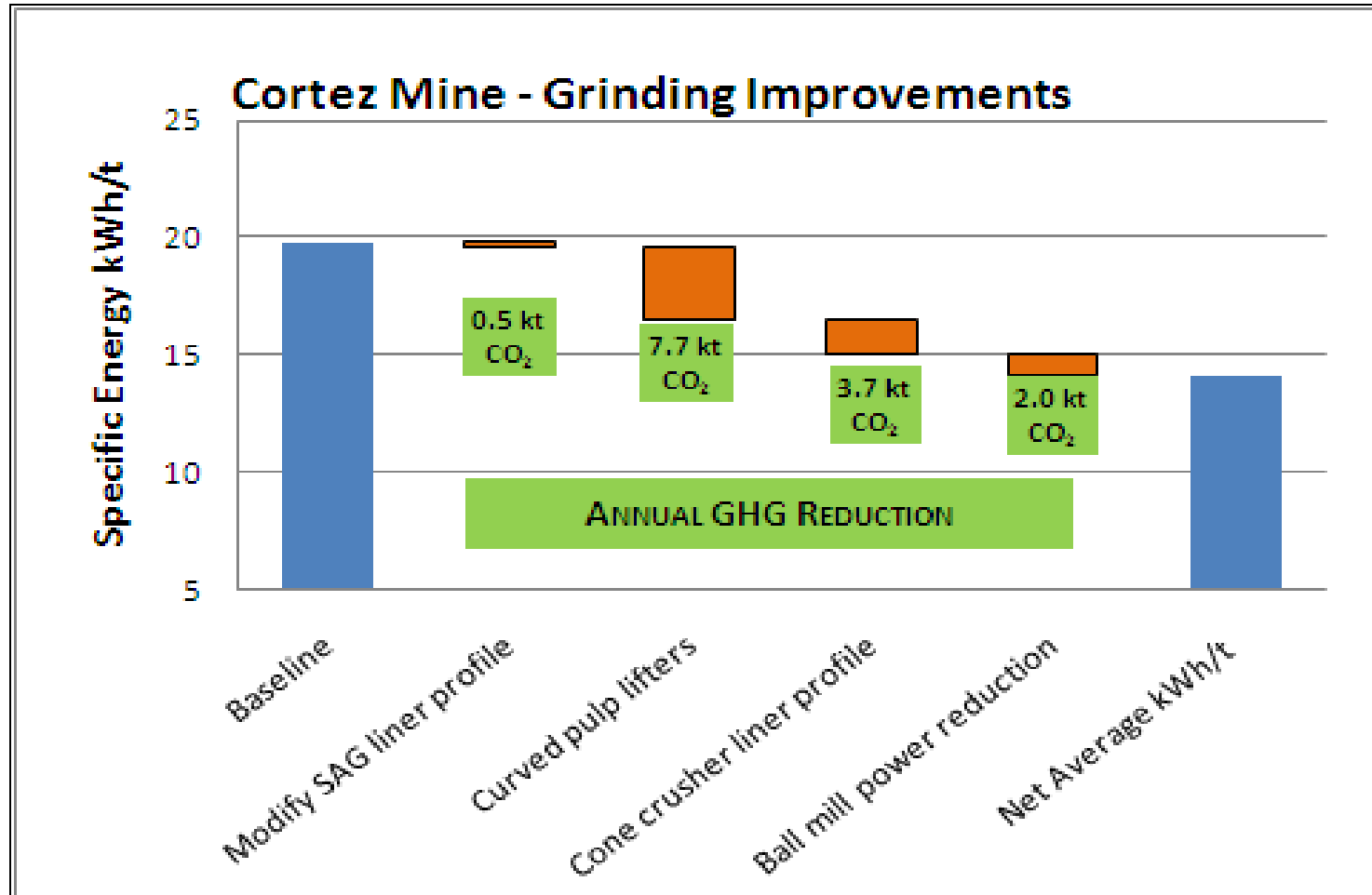
# Cowal Mine – Before and After



**Increased  
average  
throughput  
by 110  
tonnes per  
hour**

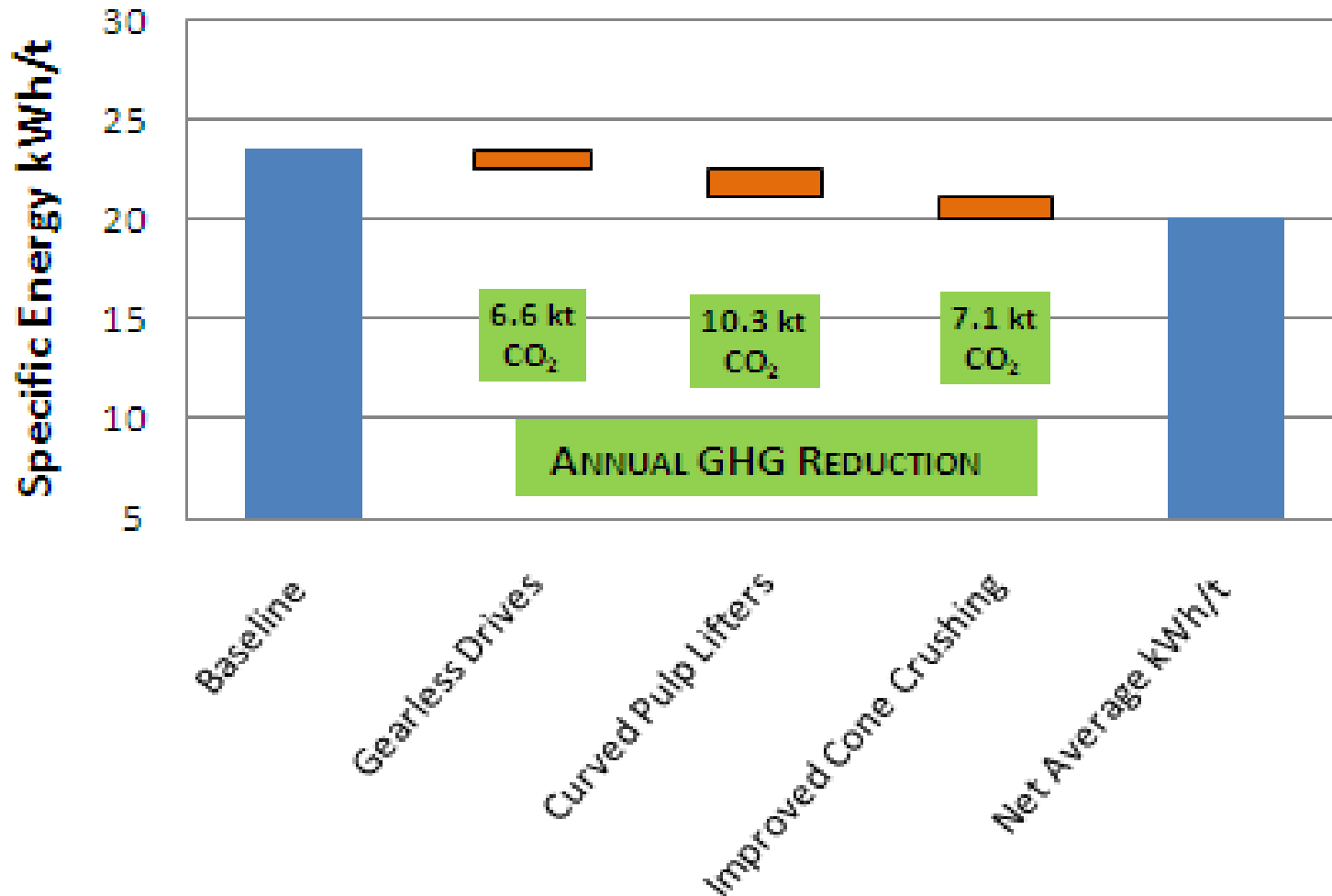
★ Circuit surveys, before and after significant changes

# Improvements Quantified



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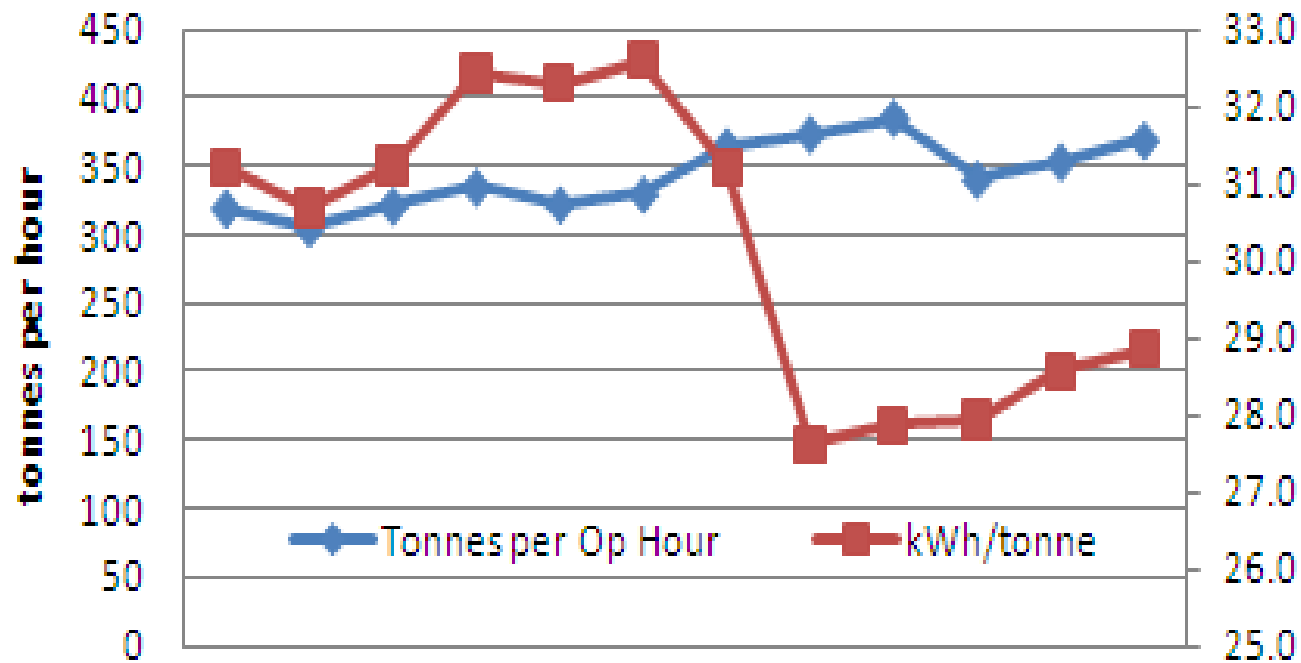
## Cowal Mine - Grinding Improvements





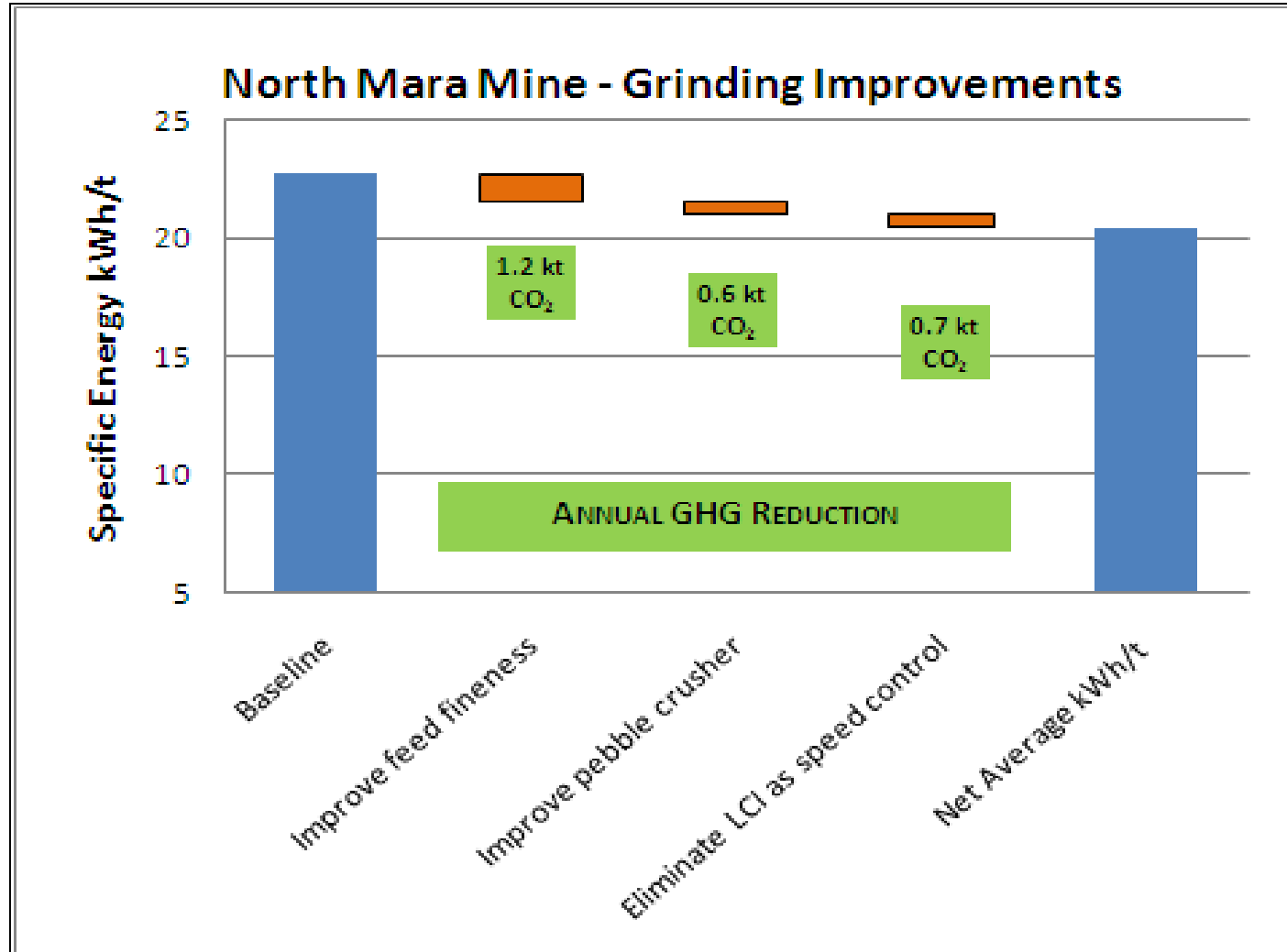


## North Mara Grinding Circuit



Avg Jan Feb Mar April May June July Aug Sep Oct Nov  
09 '10 '10 '10 '10 '10 '10 '10 '10 '10 '10 '10

# Improvements Quantified



# Energy and GHG Reductions from Three Improvement Events



BARRICK

- 60 million kWh annual savings = 216,000 GJ
  - 0.5% net efficiency improvement for Barrick global
  - Average improvement of 3.7% of the 3 mine sites' total energy
  - Average of 8% improvement of the processor's footprint
- 43,000 tonnes of CO<sub>2</sub>(e) annual reduction
  - 0.9% net GHG efficiency improvement for Barrick global
  - Average improvement of 5.3% for 3 mine sites' total energy.
- \$5.2 million annual direct electrical savings
- \$1.1 million potential future annual savings with CO<sub>2</sub> projected at \$25/tonne

# Acknowledgements



- Barrick Gold

A corporation with the enthusiasm to advance efforts in energy stewardship

- Co-authors:

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