ArcelorMittal South Africa
Industry perspective on challenges and successes in Industrial Energy Efficiency

15 Oct 2019
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Agenda

1. Steel Industry – quick overview
   - Production and usage
   - Process Routes

2. Why is Energy Efficiency important in the Steel Industry

3. Saldanha Works IEE implementation

4. Challenges in Energy – an Industry Perspective
   a. Differences in challenges between Developing/Emerging and Developed countries
   b. Internal and External Challenges
   c. Industry Solutions
      - Some Examples of Regulatory challenges & Best Practices

5. Successes in Industrial Energy Efficiency @ Vanderbijlpark
   - VDBP Energy strategy improvement components VSD’s
   - Total Energy Efficiency Performance
   - Energy Ideas
   - 3rd Party funding
   - Electricity Metering Plan
   - Training : Knowledge and Skills
   - Conclusion
Steel Industry Overview – World Steel Organisation

- Some growth in steel demand expected
- Chinese steel demand remains robust owing to government stimuli
- Steel demand in the developed world reacts to a weaker trade environment
- Developing economies (excluding China) present a positive but mixed picture
- African demand flat with South African demand declining
2. Why is Energy Efficiency Important in the Steel Industry

- **Energy Cost Route Dependent:** 25%-40%

- Energy & Capital Intensive: Require 17% EBITDA to be sustainable (McKinsey report & World Steel Association)

**Future improvements & energy efficiency in Steel production**
- Today’s best-available steelmaking processes have optimised energy use.
- Medium-term energy efficiency improvements in the steel industry are expected through technology transfer, or applying best-available technology to outdated steel plants worldwide.
- **Breakthrough technologies are expected** to lead to major changes in steel manufacturing (2030 and beyond).

**Not ALL bad...**
- **Steel saves energy over product life cycles**
  - While steel products require energy to be produced, they can
    - offer savings over the life cycle of the product, sometimes greater than the energy used during their production.
    - example, over 20 years, a three-megawatt wind turbine can deliver 80 times more energy than is used in the production and maintenance of the material used.
- **Steel in the circular economy**
  - Steel can also reduce product life cycle energy use and emissions in other ways, by maximising the value of resources through improved product design, recovery and reuse, remanufacturing and recycling.
Key Themes – Challenges – an Industry perspective

- **Actual Results**: Arcelormittal Saldanha Works

- **Difference** between challenges for Developing/Emerging economies and Developed Countries

- **Internal** (Company) and **External** (Policy and Regulatory) Challenges

- **Industry solutions**: creative and can find solutions
  - Funding Solutions

- **Biggest Challenges** (usually related to the “BIG” solutions) in the Policy and Regulatory Environment
  - Often uncertain, restrictive, complex and unclear
Statistical information

- Electricity demand: **160 MW** (R1.15 billion p.a.)
- Daily water consumption: **8,000 kilo liters** (world best for an integrated steel plant)
- Sales output: 1.1 million ton HRC/annum
Energy Efficiency Approach

Project Types: Roadmap

**Systems & Behaviour**
- EnMS
- Renewed focus
- SPIN Campaigns (problem areas)
- AM Group
  - Best Practice stds

**Tariff Structure/Supply**
- Eskom/NERSA industry tariff

**Operational Efficiency**
- Stable operations
- BTP program
- SMART fast track ideas

**Process/Efficiency Innovation**
- Eg. Optimise slag at Corex (more LI/less fuel)
- Eg. Increase LI production at Corex

**Technology & Capex**
- SMART – Fast track ideas
- Optimise Own Generation
- VSD’s energy efficiency contracting

Short Term
- IPP: Renewable
  - Dilute Eskom tariff

Medium Term
- ISO 50001
  - Pre-audit/certification
- IPP

Longer Term
- IPP
- Fuel Switch
- AGD - Corex

Other energy eff. contracting
- SMART capex fast-track
3. ArcelorMittal Saldanha Works IEE Results

**Results Summary**

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**How : Key Focus**

- Low Capital
- EnMS
- Energy Manager & team
- Awareness & Behavior
- Cross Boundary leakage
- Baseload reduction

**Next Inflection point :**

- Technology investment
- Continue Process innovation

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**Saldanha Plant Electricity Consumption**

Jan 2018 - Dec 2018 against baseline

\[ y = 1130.7x + 2E+07 \]

\[ R^2 = 0.8932 \]

\[ y = 965.88x + 2E+07 \]

\[ R^2 = 0.9606 \]

**Saldanha Works : MWH Savings**

- Total MWh saving against baseline
- Cumulative saving

- 2011: 182,006 MWh
- 2012: 182,006 MWh
- 2013: 182,006 MWh
- 2014: 208,006 MWh
- 2015: 403,006 MWh
- 2016: 609,006 MWh
- 2017: 715,006 MWh
- 2018: 1,113,326 MWh

**Cumulative saving**

- 2011: 14.8%
- 2012: 14.8%
- 2013: 14.8%
- 2014: 29.6%
- 2015: 44.4%
- 2016: 59.2%
- 2017: 74.0%
- 2018: 88.8%

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**Regressions**

- Linear (Actual kWh)
- Linear (Baseline calc consumption)
### Developing/Emerging Economies

- Policy frameworks new – unintended consequences for new policies/implementation pains
- **Policy certainty an issue**
- Policy Changes, Government changes
- Basic infrastructure and utility challenges – translating into increased cost
- Skills, transport and logistical challenges
- Lower productivity levels
- Higher inflationary environments
- Availability of capital/ perceived barriers and higher risks for investors

### Developed Countries

- Well developed policies optimized over time
- Economies well established
  - high education levels,
  - good infrastructure,
  - optimized and paid off utility and infrastructure networks
  - high productivity
- Low inflationary environment,
- Availability of capital
- Low perceived risks
- Access to R&D and new technologies
4b. Challenges for IEE implementation for Industry

Economic Challenges: South Africa

- Expensive Energy

- Expensive Rail
  Av. 12% YOY increase = 2x CPI
  - Extremely challenging for Manufacturing and beneficiation
  - Similar challenges in most African countries

- Expensive Ports (+88% global average)

FYI (Page 10)

“Although port costs have declined significantly since 2012, they remained 88 percent higher than the global average in 2016/17. Bringing down cargo and inland handling costs, and improving port efficiency, can support innovation. Furthermore, South Africa’s port tariffs continue to favour the transport of minerals over manufactured goods. This increases the cost of technology absorption that occurs via the import of capital goods in the form of advanced technology. It also makes the country a less competitive destination for export-oriented industries.”
4b. Challenges for IEE implementation for Industry

**Benchmark data Logistic routes:**

- International benchmarking within the group revealed TFR rates are +/- 250% higher

- Saldanha moved coal supplies from rail to ship with a significant cost saving
  - Considering the additional handling and logistical chain it is surprising and a further illustration of the uncompetitive TFR rail rates.
  - Port cost is 88% higher than the world average according to the World Bank Study. There is thus also uncompetitive rates build into the shipping route, but it is still more cost effective than rail.
4b. Challenges for IEE implementation for Industry - Internal

Developing Countries – Africa and South Africa

Internal Challenges :

• People :
  – Knowledge & Skills: Energy Efficiency knowledge & skills (e.g. UNIDO programs to address)
  – Organisational Structure – Energy manager/level in organization etc.

• Management System
  – Energy KPI's, Target and Tracking against
  – Integrated as part of the business strategy

• Equipment
  – Age and performance of Equipment
  – Access to new technology

• Funding/ Capital
  – Challenging environment (Steel industry: pressure on margins due to structural oversupply since 2009)
  – Very few plants operate average of 17% margin required for sustainable operations and investment
  – Competing for Capital on equal footing
    • Safety, Environmental, Risk, Return and energy projects
  – Long Term Sustainability questions due to structural economic challenges – cannot commit to longer terms contracts
    • Impacts on ability to resolve issues and commit to long term contracts with cost benefits and updated energy efficient technology
4b. Challenges for IEE implementation for Industry - External

Focus: Developing Countries – Africa and South Africa

External Challenges:

- **Policy Certainty**
  - Better to have a adequate policy than an everchanging policy striving for perfection
  - Policy certainty is a *critical* aspect for investment – keep in mind that in the energy environment 15-30 year contracting the norm…

- **Clarity for the implementation and administrative processes associated with policies**
  - What is required
  - Where/how and how long to get the approvals/licenses etc – current NERSA < 10MW embedded generation

- **Complexity, overlaps & Timelines**
  - Number of departments/involvement to approve
  - Overlaps in legislation

- **Regulated environment – ensure globally competitive**
  - Can achieve the opposite, result in inefficiency and eliminate potential benefits/solutions
  - Result in structural barriers for sustainability, investment and IEE
    - Eskom/Transnet Rail/ Port Cost
4c. Challenges for IEE implementation for Industry – Industry Solutions

• A few examples (but not limited to):

  **Lack of availability of Capital & Aged Equipment/Assets**
  – Off-balance Sheet Funding
  – Service contracts (VSD’s, lighting etc.)
  – Off-take agreements
  – Private Sector loans (World Bank etc.)

  **Skills and Resources**
  – UNIDO IEE Capacity building in Developing Countries
  – Consultants to assist with implementation of energy programs
Example - <1MW & 10MW imbedded Generation in RSA

- Confusion on legal and legislative framework for own power generation or off-take scenarios
- Market not open yet, though there is in principle room for <1MW and <10MW generation
- <1MW – exempted from generation license (register with NERSA –process for registration not defined)
- 1-10MW: need generation license form NERSA & need to show that the installation comply with the IRP
  - Current IRP not approved and previous IRP 2010 (outdated)
  - Currently a blanket approval in principle of all installation < 10MW, but still no administrative process at NERSA on how to handle and process applications.
- >10 MW: require full generation license application (test against valid IRP and grid code compliance etc.)

PPA (Power Purchase agreements) - difficult outside the DOE’s renewable buy-in tariff process. Obstacles for private projects – *Its ALL ABOUT RISK (and who carries it)*

- Price & termination clauses an issue
- All licenses difficult to coordinate – round robins for approvals etc.
- Off-taker view:
  - Finding right partner difficult
  - Forecasting and contracting 20 year pricing difficult within corporate structure
  - Complexity and rigid contracting practices requiring off-taker to take on all the risk problematic
- Funders/Bankers view
  - *More interested in larger scale projects – require same transaction cost and resources as smaller projects*
  - Developed portfolio funding to aggregate size of investment, diversify exposure to any single supply/off-take agreement and cross subsidise projects to spread risks/income
    - Can be mixture of less and more attractive projects – as long as the portfolio makes sense the investor would still consider.
Practical concerns:

- Experienced Contractors with proven track record
- Grid Connection: some in place but not with required approvals
  - even exemption projects need to have grid connection approvals from ESKOM – no process in place to fast track <1MW or <10MW applications,
  - Municipalities can only approve once documentation from NERSA and Eskom has been submitted
  - Municipalities supportive and allow connections – still unlawful and risk to investor/developer; impacts on finance ability of projects.
- Finding a way for municipalities to transition from Eskom On sale model to wheeling income from IPP’s within the municipality – deregulation required to enable this.
1. **NERSA**

2. **Ministerial Departments required to align and approve**
   - DOE (Now mining & Energy)
   - DEA
   - DTI
   - Transport (Port’s authority)
   - State Owned Enterprises
     - (included in Strategy and Procurement activities)
     - Transnet
     - Eskom

- Timelines unclear
- Administrative process Complex
- COSTLY
  - just land based EIA = R4m
  - No guarantee on return
Other Examples – Best Practice

Kafita Co-operative Society (Zambia)
• Solar – mini grid (Mpanta)

Challenge
• Isolated area
• Demand 60kW (+ 40kW for future requirements)
• Alternative back-up power source required
• Communities’ ability to pay

Opportunity
• Renewable energy – can drive economic activity

Project Financing
• Long term loan from UNIDO
• Pricing model – fixed monthly charge (based on estimated household requirement)
• Currently not viable – not meeting productive use capability

Project Outcome
• 480 households with access to electricity
• New plans for a renewable energy agricultural farm
• Project developer equipped through lessons learned to plan further projects with upgraded mini-grids and technologies to overcome the issues experienced with this project

Other Examples – Best Practice

Gada Hamlet (Nigeria)
- 5kW kinetic unit @ 15kWh/day (modular to 25kW)

Challenge (Nigeria)
- Severe energy shortages
- Many areas/cities not connected to the grid
- Gada – small and rural and not included in any development plans

Opportunity
- Next to river: all-year water flow
- Single phase grid from hydro-power between 7 houses

Project Financing
- Renewable energy – can drive economic activity

Project Financing
Smart Hydro Power Nigeria financed project

Project Outcome
- 40 members benefit with access to electricity
- Example of inexpensive standardized rural electrification.
- New plans for workshop in Gada (economic benefit)

• Make it EASY and VIABLE for Industry to do the right thing!!
Successes in Industrial Energy Efficiency

Vanderbijlpark Works
VDBP Energy strategy improvement components - a successful energy program consists of 3 interdependent building blocks

A successful energy program consists of 3 interdependent building blocks

Energy Management System (EnMS) *
Total Energy Efficiency Performance trend improved with 10-15% its kWh / ton LS taking production variability into account
All Energy Ideas – Coal, Electricity, Natural and Cryogenic Gases
Annualized savings, Rand million

Capex required

2019 Actual and Forecast savings
3rd Party funding be rolled out to more VSD, Lighting, Solar, Waste heat
- Example VSD’s 3rd Party funding savings of R34m savings with No Capex from Nov 2016.
- Understand the cost of “Do-Nothing” when we have limited capex

![Graphed Results](Image)

Cumulative Performance against forecasted ‘Minimum Net Saving’

![Lighting Project Financial comparison benefits NPV](Image)

Lighting Project Financial comparison benefits NPV:
(Own Capex vs 3rd Party Fund vs Cost of “doing nothing”)

Ph 1 priority of the 3rd Party funding of the R60m funding available that give biggest energy savings and OHS Act Lux requirements are:
1. Medium - High bay lighting
2. Offices
Electricity Metering Plan
How do we manage what we do not measure accurately and still put systems in place to ensure improvement?

Electricity metering plan & prioritisation wrt spend
(Most users are NOT currently metered but see HSM example being rolled-out to manage & track hr of pumps. Fans as significant energy users real-time)

Electricity metering reporting tool is available
(Web tool for plants to track electricity pro-actively per hr)
Real Live data available on line
http://156.8.221.101:88/ECC/Content/ECC/Default.aspx

The new Electricity metering reporting to be made available in real-time to pro-actively manage it on the plant level

Note the KWh values per hour will also be multiplied by the Megaflex R/KWh tariff for peak, std and off-peak periods to give Rand values per hr to indicate the cost of plants electricity when for example idling.
AM Vanderbijlpark – IEEP Journey to improve energy knowledge and identify energy case studies that can be implemented as training opportunities

- First encounter with IEEP – Dec 2013
- EnMS 2 day training – Feb 2014
- EnMS Expert level training - May 2014
  - Financial Benefits into ID & ranking of ideas (Energy roadmap developed)
  - Energy metering & auditing
  - Reporting and Monitoring
  - Data Analysis (Energy efficiency vs Prod energy driver graphs)
  - Measurement and verification to monitor and sustain savings
  - 3 EnMS Expert level Arcelor Mittal graduates

- CASO 2 day training – June 2014
- PSO 2 day training – Mar 2014
- PSO Expert Level training – Jul 2014
- FSO 2 Day Training – Sep 2014
- FSO Expert Level Training – Oct 2014
- SSO 2 Day Training – Sep 2014
- SSO Expert Level Training – Feb 2015
- CASO Expert Level Training – Feb 2018
- Case studies in Pumps / Fans / VSD’s – Oct 2019
Vanderbijlpark – Engagement Proposal with IEEP

**Short Term (1 year)**
- Complete deep steam, compressed air and fan systems assessments and implement no / low cost savings projects
- Broaden management and worker awareness of EnMS
- Capacitate all maintenance & Engineering staff through a series of 2 day and expert level end user workshops in steam, fans, pumps, motors, compressed air.
- Refine cogeneration and Waste Heat Recovery strategy
- Implement 2 year payback projects from steam, fan, pump and compressed air assessment findings
- Host IEEP process heating training & identify optimisation opportunities

**Long Term (2-3 years)**
- Develop EnM champions and expand EnMS to all facilities
- Compile best practice guides and logic tools
- Explore Renewable Energy options
Conclusion

- EnMS assisted with a structured approach to unlock energy efficiency
- EnMS system even more critical in sustaining these savings
- There must be resources to implement the plan (Human and Capital)
  - Resource allocation learnings
  - Capital allocation learnings – “new cash generation” vs risk ratios
- The resources (people) must be equipped with the applicable skills to identify, drive and implement energy efficiency
- Awareness and education is a critical part for sustained savings and can never be stopped
- Stability and reliability is a prerequisite for optimisation efforts – maintenance strategies must support this to prevent leakage on energy efficiencies

Current Challenges:

- Access to Capital
- Skills retention impacting on training need and numbers, as well as expert system optimisation input/audits to potentially counter the skills loss
- Regulatory constraints impacting on ability to implement imbedded generation/ LNG importation etc.
QUESTIONS???
References & Sources


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<td>BF injection</td>
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<td>Motors/pumps/compressors</td>
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Energy Cost Route Dependent 25%-40%

World Steel Association: FACT SHEET Energy use in the steel industry
Saldanha Works Energy Performance
EnMs implementation 2010/2011

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How : Key Focus

- Low Capital
- EnMS
- Energy Manager & team
- Awareness & Behavior
- Cross Boundary leakage
- Baseload reduction

Next Inflection point :

- Technology investment
- Continue Process innovation

2018:
- Conarc Electricity reduction 6%
- Crx: 3% fuel rate improvement

RM Impact: +8%

SAL Specific Energy Consumption
[Gi/t LS]

Low Volume Scenario optimized: Almost variabilised all energy input

Full production, but basic conditions deteriorate

Ore quality deterioration


Coal Coke Electricity LPG
Morocco:
- electricity consumption is projected
  - double by 2025
  - 5x by 2050.
  - Importing 96% of its energy

- Decisions: Renewable energy.
  - set targets - increase generation
    - 42% from renewables by 2020
    - 52% by 2030
  - reducing energy consumption
    - by 12% by 2020 and
    - 15% by 2030 through enhanced energy efficiency.
- Achieved in 2016:
  - 400 GWh from solar thermal technologies,
  - 1662 GWh from solar energy and
  - 3000 GWh from wind in.

Noor Project: renewable energy (CSP)
- supported through investments from the World Bank, European Union, the African Development Bank and bilateral finance from countries such as Germany and France.
- workers hired mostly Moroccans
- planned to produce 500 MW at the conclusion of the project.

Challenges:
- However, the country is also facing challenges, mainly in the implementation phase:
  - several energy projects are behind schedule, and a
  - real participatory strategy and decentralized approach of the energy transition still needs to be established.

Requirements for supportive Policy and Regulatory Environment

**Figure 1. Summary of Best Practice Policies for Energy Efficiency**

- **Operational Policies**
  - Policies for Households: Insulation, retrofits for existing homes, Minimum energy performance standards (MEPS) and building codes, Energy efficiency certification, Appliance MEPS and labeling, High efficiency appliance endorsement, Efficient lighting.

- **Policies for Utilities to enable all sectors**

- **Cross-sectoral: Governance**
  - Enabling frameworks, National strategies, plans and targets, Institutional arrangements, Energy efficiency operational agencies, Coordination mechanisms, Cities and Regions, Data, statistics and evaluation.

- **Cross-sectoral: Finance**

**Independent Regulator Assist if:**

- Transparent
- Fair
- Accountable

- **INVESTMENT**
  - Credible & Predictable regulatory decisions
  - Certainty:
    - ✓ Market Access
    - ✓ Tariffs
    - ✓ Revenues