Energy Performance of Tata Steel, Jamshedpur  
...a journey towards excellence

Energy Efficiency Summit, 29-31 August’2018
CII, Hyderabad

Sanjay Singh & Pradip Chakraborty
Tata Steel Limited
Company Profile

Tata Steel Group
Established in 1907, presence in 26 countries, is 2nd most geographically diversified Steel producer.

Tata Steel Group
Capacity: 27 mtpa
Revenue (FY-17) Rs 1,17,420 cr
Ranked 10th in World by Global Steel Production

India & SEA
[Tata Steel India]
[NatSteel]
[Tata Steel Thailand]
Capacity: 14.8 mtpa

Europe
[Tata Steel Europe]
Capacity: 12.2 mtpa

Bagged the Deming Application Prize and Deming Grand Prize for continuous improvement.

Awarded best integrated steel plant 13 times; won PM’s Trophy 11 times; Certificate for Excellence twice

Named as Steel Sustainability Champion 2017 by World Steel Association

Tata Steel awarded the CII Environmental Best Practices Trophy 2018
Key Work Process (Tata Steel, Jamshedpur)

Raw Materials
- Ore Mining
- Coal Mining
- Captive & Purchased Ore, Flux, Coal

Iron Making
- Sinter Making
- Pellet Making
- Coke Making
- Blast Furnaces
- BOF Shop

Steel Manufacturing
- Billet Caster
- Slab Caster
- Flat Product Mills

Casting & Rolling
- Long Product Mills
Energy Mix of Tata Steel Jamshedpur FY’18

Coal & Coke 7.517 MT (50.30 MGcal)
Pur. Power 2638 GWh (6.33 MGcal)
Pur. Pellet 105457 T (0.053 MGcal)
Pur. Oxygen 1458 x 10^6 m^3 (2.41 MGcal)
Pur Nitrogen 919 x 10^6 m^3 (0.44 MGcal)
Petro-Fuel 5435 KL (0.05 MGcal)
Water 40 x 10^6 m^3 (0.02 MGcal)
Propane 3700 T (0.04 MGcal)

Energy Sold or to Stock 2.72 MGcal

Steel Works Energy Input = 59.64 MGcal
Net Energy Usage = 56.92 MGcal

Cost of Energy Rs. 2060 per Gcal

Energy Bill for FY-18 Rs. 11,600 crores
Energy Consumption

Plant Specific Energy Consumption (Gcal/tcs)

<table>
<thead>
<tr>
<th></th>
<th>FY-09</th>
<th>FY-12</th>
<th>FY-15</th>
<th>PAT-I Target</th>
<th>FY-18</th>
<th>ABP FY-19</th>
<th>WSA (BM)</th>
</tr>
</thead>
</table>

FY 15 Target for SEC under PAT was **6.070 GCal/tcs**. TSL achieved **5.960 GCal/tcs**; BEE, MOP awarded 40,188 numbers ESCerts.

Implementation of Best Practices

- Utilization of by product gases for steam and Power generation.
  - coal firing boiler to by-product gas firing
- Phasing out old and inefficient units.
  - Open hearth fce, small capacity mills

Adoption of New Technologies

- Top Recovery Turbine at Blast Furnaces
- Regenerative Burners at Hot Strip Mills
- Coke Dry Quenching at Coke Plant
- Thin Slab Caster & Rolling
- Use of Pellet
- LED Lights & Solar Panel

**BEE**: Bureau of Energy Efficiency; **PAT**: Perform, Achieve and Trade; **WSA**: World Steel Association; **BM**: Benchmark; **SEC**: Specific Energy Consumption
Energy Consumption – comparison with competitors

Source: Feedback report of POJ team of “Prime Minister’s Trophy Award for Best Integrated Steel Plant 2015-16”, CHAPTER 2 15-16.pdf
**Benchmark Study – Gap Analysis**

WSA data is derived taking various factors related to all the global steel plants. A few of the factors are not applicable to Indian steel plants. Hence, to arrive at most authentic BM figure a like to like comparison was done as shown below:

<table>
<thead>
<tr>
<th>Stage-wise Energy Consumption(Gcal/tcs)</th>
<th>Tata Steel FY17</th>
<th>BM - WSA Ref. Plant</th>
<th>Sp. Energy Consumption (Gcal/tcs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron Making</td>
<td>4.644</td>
<td>3.194</td>
<td></td>
</tr>
<tr>
<td>Steel Making</td>
<td>0.254</td>
<td>0.040</td>
<td></td>
</tr>
<tr>
<td>Rolling &amp; Finishing</td>
<td>0.473</td>
<td>0.846</td>
<td></td>
</tr>
<tr>
<td>Boiler &amp; Power House</td>
<td>0.144</td>
<td>0.026</td>
<td></td>
</tr>
<tr>
<td>Auxiliaries &amp; Losses</td>
<td>0.216</td>
<td>0.194</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5.673</strong></td>
<td><strong>4.300</strong></td>
<td></td>
</tr>
</tbody>
</table>

TSL: Tata Steel, WSA: World Steel Organization, IJM: Ijmuiden
Benchmark Study – Gap Analysis

WSA data is derived taking various factors related to all the global steel plants. A few of the factors are not applicable to Indian Steel Plants. Hence, to arrive at most authentic BM figure a like to like comparison was done as shown below:

Differentiating factors for BM calculation between WSA and Tata Steel – Gcal/tcs

- HM/CS Ratio (less scrap use) – 0.900
- Refractories Prod. (own plant) – 0.122
- Benzol Recovery (not done) – 0.079
- Purchased Power (grid eff.) – 0.080
- Coke Ash (higher ash) – 0.038
- Hot Metal Silicon (higher) – 0.035
- Coal Ash (higher) – 0.117
- Coal Volatile Matter (higher) + 0.045
- Sec/Plate Mill (NA) + 0.248

Total (Differentiating Factors) 1.078
Roadmap to achieved Benchmark (unit in Gcal/tcs)

<table>
<thead>
<tr>
<th>Energy Efficiency Improvement Measures</th>
<th>Completion By</th>
<th>Savings (Gcal/tcs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reduction in fuel rate at Iron Making installation of LED Lights</td>
<td>FY-20</td>
<td>0.111</td>
</tr>
<tr>
<td>• VFD in HT motors of fans at LD-3 &amp; TSCR, F-BL fce etc</td>
<td>FY-19</td>
<td>0.003</td>
</tr>
<tr>
<td>• Power Generation from CDQ at Batt # 10 &amp; 11</td>
<td>FY-19</td>
<td>0.102</td>
</tr>
<tr>
<td>• Additional 5MW Power Generation at PH#4</td>
<td>FY-20</td>
<td>0.005</td>
</tr>
<tr>
<td>• New LD Gas Holder for gas recovery from LD#2</td>
<td>FY-19</td>
<td>0.061</td>
</tr>
<tr>
<td>• Other Initiative</td>
<td>FY-20</td>
<td>0.033</td>
</tr>
<tr>
<td>• TRT at F BF, Sinter Cooler Heat Recovery</td>
<td>FY-21</td>
<td>0.012</td>
</tr>
<tr>
<td>• Install VFD in power intensive LT motors</td>
<td>FY-20</td>
<td>0.015</td>
</tr>
<tr>
<td>• Waste Heat Recovery from available sources</td>
<td>FY-21</td>
<td>0.041</td>
</tr>
<tr>
<td>• Power generation from additional BF gas</td>
<td>FY-20</td>
<td>0.085</td>
</tr>
</tbody>
</table>
### Energy Recovery Gap Analysis & Opportunity (MGCal)

#### Thermal Energy Input vs Waste Heat

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>56.92</td>
<td>47.48</td>
<td>2.90</td>
<td>6.54</td>
</tr>
</tbody>
</table>

- **A**: Total thermal Energy Input.
- **B**: Heat Energy available for use.
- **C**: Heat Energy converted to useful work. (Petro-fuel)
- **D**: Loss due to Condensation, Radiation & Others.

#### Waste Energy Available vs Recovery

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>47.48</td>
<td>26.06</td>
<td>2.90</td>
<td>18.52</td>
</tr>
</tbody>
</table>

- **B**: Heat Energy available for use.
- **E**: Heat Energy being Recovered.
- **F**: Future Plan for Energy Recovery.
- **G**: Opportunity to be explored.

#### Opportunity for Waste Heat Recovery

<table>
<thead>
<tr>
<th></th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18.52</td>
<td>14.55</td>
<td>2.90</td>
<td>3.05</td>
</tr>
</tbody>
</table>

- **G**: Opportunity to be explored.
- **H**: Sensible Heat of flue gases, By-Product Gases & Water.
- **I**: Thro’ application of Daily Mgt. 50% can be Recovered.
- **J**: Technology available but not economically viable.
## Energy Saving Projects Implemented (2015-16) – selected few

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Electricity (Lakhs Kwh)</th>
<th>Coal (tons)</th>
<th>Gas (Lakhs Nm³)</th>
<th>Savings (Rs. L)</th>
<th>Investment (Rs. Lakhs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repairing &amp; modification LP steam line n/w to reduce steam loss.</td>
<td>-</td>
<td>10,950</td>
<td></td>
<td>145</td>
<td>170</td>
</tr>
<tr>
<td>Replacement of HP N₂ consumption by MP N₂ at ‘H’ Blast furnace</td>
<td>85</td>
<td>-</td>
<td></td>
<td>324</td>
<td>Nil</td>
</tr>
<tr>
<td>Optimizing cold blast blowing at Bl. Fces. to increase power generation</td>
<td>300</td>
<td>-</td>
<td></td>
<td>1,140</td>
<td>Nil</td>
</tr>
<tr>
<td>Reduction in Ball Mill RPM at D&amp;G area of Pellet plant</td>
<td>66</td>
<td>-</td>
<td></td>
<td>252</td>
<td>Nil</td>
</tr>
<tr>
<td>Reduction in steam &amp; condensate loss by improving steam trap mgt.</td>
<td>-</td>
<td>22,688</td>
<td>(steam)</td>
<td>104</td>
<td>18</td>
</tr>
<tr>
<td>Reduction in power consumption and compressed air loss.</td>
<td>41</td>
<td>-</td>
<td></td>
<td>163</td>
<td>Nil</td>
</tr>
<tr>
<td>Improving in pulverised coal injection at Bl. Fce.</td>
<td>-</td>
<td>454,700</td>
<td>(coke)</td>
<td>19,306</td>
<td>14,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>492</strong></td>
<td></td>
<td><strong>21,434</strong></td>
<td><strong>14,188</strong></td>
</tr>
</tbody>
</table>
## Energy Saving Projects Implemented (2016-17) – selected few

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Electricity (Lakhs Kwh)</th>
<th>Coal (tons)</th>
<th>Gas (Lakhs Nm(^3))</th>
<th>Savings (Rs. L)</th>
<th>Investment (Rs. Lakhs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxiliary power reduction at LD#3 installing VFD.</td>
<td>27</td>
<td></td>
<td></td>
<td>102</td>
<td>191</td>
</tr>
<tr>
<td>Elimination of WP Booster house by modifying coke oven gas n/w</td>
<td>92,400 (Steam)</td>
<td></td>
<td></td>
<td>572</td>
<td>248</td>
</tr>
<tr>
<td>Optimizing charging system &amp; suction at SP3 to reduce power</td>
<td>70</td>
<td></td>
<td></td>
<td>268</td>
<td>Nil</td>
</tr>
<tr>
<td>Logic modification to reduce O2 vent loss at LD shops</td>
<td>7,920 (O(_2))</td>
<td></td>
<td></td>
<td>158</td>
<td>Nil</td>
</tr>
<tr>
<td>Increase power generation at PH3 by reducing COG vent loss</td>
<td>144</td>
<td></td>
<td></td>
<td>549</td>
<td>14</td>
</tr>
<tr>
<td>Exhaust steam heat recovery for preheating of Ammonia Still.</td>
<td>21,900 (Steam)</td>
<td></td>
<td></td>
<td>382</td>
<td>77</td>
</tr>
<tr>
<td>Optimization of damper opening of fume extraction system at Bl. Fce</td>
<td>9.87</td>
<td></td>
<td></td>
<td>38</td>
<td>Nil</td>
</tr>
<tr>
<td>Reduction in coal tar consumption at Pellet plant.</td>
<td>6698 (Coal Tar)</td>
<td></td>
<td></td>
<td>1,138</td>
<td>5.0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>3,208</strong></td>
<td><strong>535</strong></td>
</tr>
</tbody>
</table>
## Energy Saving Projects Implemented (2017-18) – selected few

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Electricity (Lakhs Kwh)</th>
<th>LDO (kl)</th>
<th>Gas (Lakhs Nm$^3$)</th>
<th>Savings (Rs. L)</th>
<th>Investment (Rs. Lakhs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elimination of west plant booster house</td>
<td>66</td>
<td></td>
<td></td>
<td>256</td>
<td>248</td>
</tr>
<tr>
<td>Reduce power rate for SP3 by improvements in (Waste Gas) system</td>
<td>47</td>
<td></td>
<td></td>
<td>734</td>
<td>12</td>
</tr>
<tr>
<td>Use of wash oil in boilers.</td>
<td>0</td>
<td>385</td>
<td></td>
<td>135</td>
<td>12</td>
</tr>
<tr>
<td>VFD application for LD3 ID fan</td>
<td>11</td>
<td></td>
<td></td>
<td>42</td>
<td>92</td>
</tr>
<tr>
<td>Reducing power consumption at LD3 Vessel ID fan.</td>
<td>23</td>
<td></td>
<td></td>
<td>90</td>
<td>Nil</td>
</tr>
<tr>
<td>Reduce damper opening of cast house fume extraction system.</td>
<td>10</td>
<td></td>
<td></td>
<td>37</td>
<td>Nil</td>
</tr>
<tr>
<td>Reduce Power Consumption in INBA</td>
<td>21</td>
<td></td>
<td></td>
<td>80</td>
<td>Nil</td>
</tr>
<tr>
<td>Stop booster idle running</td>
<td>16</td>
<td></td>
<td></td>
<td>60</td>
<td>Nil</td>
</tr>
<tr>
<td>Modification in control system to optimize pumping operation at LD3</td>
<td>11</td>
<td></td>
<td></td>
<td>43</td>
<td>4</td>
</tr>
<tr>
<td>Reduction in power consumption in PLTCM by reduction of idle power</td>
<td>1</td>
<td></td>
<td></td>
<td>3</td>
<td>Nil</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>205</strong></td>
<td></td>
<td><strong>1480</strong></td>
<td><strong>368</strong></td>
<td></td>
</tr>
</tbody>
</table>
Innovative Projects implemented in the 3 years

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Increase in LD gas recovery at LD1 &amp; LD3</th>
<th>Savings</th>
<th>Rs 16 crores/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem Statement</td>
<td>There is potential to increase LD gas recovery at LD1 &amp; LD3 from 40,000 Nm³/hr to 60,000 Nm³/hr, which can be utilized to increase power generation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Action Taken**
- Logic modification to recovery of gas during parallel blow.
- Modification in gas holder limit from 74% to 80% by installing additional limit switches.
- TBM & DM to reduce analyzer fault
- Modification in “recovery stop logic” to increase recovery duration by 30 seconds.
- Increase reliability of analyzer to reduce analyzer fault.
- Improve CO pickup by operational practices to increase recovery window by 90 sec.
- SOP & Check Sheet for recovery in case only 1 person available at recovery station.

**Results**

Gas Recovery increase from 40,000 to 59,000 Nm³/hr in FY-18.
Innovative Projects implemented in the 3 years

**Project Title**: Increase Coke Oven gas utilization at Pellet Plant

**Savings**: Rs 11 crores/yr

**Problem Statement**
Coke Oven gas & Coal Tar is used as fuel in Induration machine of Pellet Plant. While both are by-product fuel, Coal Tar can stored & sold.

**Action Taken**
A new gas line was laid to increase supply of CO gas to Pellet Plant boosters there by reducing the use of Coal Tar and utilizing the excess CO gas that used to be flared.

![Diagram of gas line](image)

**Results**

![Graph showing Pellet Plant COG Flow](image)

![Graph showing COG Flaring Reduction by 2000 Nm3/hr](image)
Innovative Projects implemented in the 3 years

Project Title: Utilize cold blast loss through snort valve

Problem Statement: Due to cold blast O₂ enrichment, cold blast demand at BF Fce. has reduced resulting in air at 5 bar vented @ 40,000 Nm³/hr through the snort valve.

Action Taken: Utilize the extra cold blast at Blast Furnace to reduce the moisture of the coke.

Results: Reduction in Coke Moisture by 2% in FY-18 over FY-17

Savings: Rs 4 crores/yr
Utilization of Renewable Energy Source

**3 MW SOLAR PV PLANT at Noamundi**

- Total fenced area of 19.2 acre.
- At the Noamundi Solar Plant, Poly Crystalline type Global Tier-I Modules are being used.
- Pyranometer for measurement of radiation level
- Weather Monitoring system also installed.

**Benefits**

- Improve Power availability in the day time.
- Saving of DG power @ Rs.17/Unit to Solar power @ Rs 10/Unit.
- Fulfilment of REC (Renewal Energy Certificate) Obligation by Generating 4% of power from Renewable source.
- Reduction of CO₂ emission by 3200 tpa

1.2 MW roof top solar panel has been installed inside Works

**Way Forward**

- 3 MW ground solar panel to be installed at the local airport.
- 6 roof top solar panel have been identified for 23 MW installation
- Potential 200 MW at Dimna etc
Utilization of waste material as fuel – project 1

Use of waste wash oil as fuel in boilers

- Generation of spent wash oil
  Clean Coke oven gas for process use
  - Wash Oil
  - Spent Wash Oil
  - Coke oven gas
  - Coke
  - Blast furnace

- Current practice in Tata Steel
  - Direct selling as low value waste for disposal as distillation require capital investment

- Concerns in Current practices
  - Considerable amount
  - Storage, handling & disposal
  - Social obligation Accountability for entire life cycle; brand image.

- Development of Idea to use spent oil efficiently with zero investment
  - Quality improved with impurities <0.003% by increasing preheater & regenerator temperature for distillation
  - Successfully used in boiler in place of LDO through readjustment of atomization pressure and logic modification

- Result and conclusion
  - Annual saving 1.35 Cr (recurring)
  - Reduced energy consumption in Steel Works 3712 Gcal/year
  - Solution developed after several PDCA cycle has been patented
  - High potential to deploy in similar application
Use of waste wash oil as fuel in boilers

Naphthalene is absorbed in wash oil

Coke oven gas

Rich oil is preheated up to 140 °C

Clean Coke oven gas

Rich oil is preheated up to 150 °C

Naphthalene and wash oil is separated

Increased up to 170 - 175 °C

Temperature is maintained at 160 °C (range 150-180)

Polymerized Oil
Utilization of waste material as fuel – project 2

Plasma Gasification – waste to energy

Highlights

- Any steel plant waste (wood, plastic, rubber, cable, electrical waste, oil soaked cotton, oil sludge etc.) can be handled
- Plasma gasification process converts the waste into Syngas
- Also, vitrified slag is generated which can be used as land filling.

We failed to get the desired result; trying to explore in consultation with subject experts

1.0 TPD Pilot plant at TSL, JSR Works
CO2 Emission Intensity

Conversion of Coal Fired Boilers to Gas Firing
8.4 MW LCI Drive-SP3
8.4 MW LCI Drive-SP4
2 x 21.5 MW LCI Drives-Blowers
H BF
2 x 4 MW VFD – SP1
TRT in G BF
CDQ in Batt.5,6 & 7
I BF: TRT, Stove WHR, E.Blower + LCI drive, INBA
Granulation Pellet Plant, TSCR
TRT & Stove WHR in H BF
RHF3/HSM - HiTAC
Higher Gas recovery, Higher BF Coal injection
BF Optimisation
3 MTPA Expansion
2 x 21.5 MW LCI Drives-Blowers

TSJ expected to continue as Indian Steel sector (BF-BOF) Benchmark in CO2

Unit in Ton of CO2 per ton of crude
FY-05 FY-06 FY-07 FY-08 FY-09 FY-10 FY-11 FY-12 FY-13 FY-14 FY-15 FY-16 FY-17 FY-18
TSJ BP: WSA IJM
FY- TSJ 2016 FY-12
18 FY17

TSJ: Tata Steel, Jamshedpur  BP: Best Practice  WSA: World Steel Association  IJM: Tata Steel, Ijmuiden
CO2 Emission—comparison with competitors

Source: Feedback report of POJ team of “Prime Minister’s Trophy Award for Best Integrated Steel Plant 2015-16”, CHAPTER 2 15-16.pdf
## CO2 Emission – reaching < 2 t/tcs

### Additional Capital Scheme:
- Sinter Cooler 3&4, TRT F BF, Hi Efficiency Power Plant, Dry BF GCP G, H & I BFs
- **Shikhar25:** EEIC (25 MW set upgrade, PH4 Coal Stop, LED, VFD, Enhance LDG recovery)

<table>
<thead>
<tr>
<th>FY-18A</th>
<th>Gas</th>
<th>Additional Capital Based DRI Projects</th>
<th>BOF 3rd Vessel,</th>
<th>IM C-rate HM</th>
<th>Pellet 6 to 8 mtpa</th>
<th>Replace PCI with CNG</th>
<th>Ongoing schemes</th>
<th>Target Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.303</td>
<td>0.097</td>
<td>0.065</td>
<td>0.050</td>
<td>0.045</td>
<td>0.025</td>
<td>0.020</td>
<td>0.019</td>
<td>1.982</td>
</tr>
</tbody>
</table>

**Slide No. 23**
GHG Management Systems Program

Resources: Methodology & Tool

❖ Implementation of GHG management system

• **Excel sheet** – World steel guideline based excel sheet for accounting Steel Works level emission

• **Other software** – World steel guideline based tool (named as “MoniCA”) for accounting department level emission

*We use *globally accepted* Methodology* and *IT tool, built in-house*

![Diagram of CLIMATE ACTION Member](image)

![Diagram of worldsteel ASSOCIATION](image)

**New Initiatives - Organizational level**

- Internal Carbon Pricing
  - Capex projects evaluated with Shadow Pricing & Proposals from Subsidiaries included

- Methodology (ISO 14404) on assessment of project for GHG reduction to pave way for technology transfer under BOCM

- Engagement at BIS level to support IS/ISO 50000 work (MED39)

- Scaled up Climate Disclosure covering our all integrated Steel plants in 2017- going beyond in 2018
GHG Management Systems Program

Process: Information Flow

<table>
<thead>
<tr>
<th>Source</th>
<th>Analysis &amp; Reporting</th>
<th>Stakeholders</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAP</td>
<td></td>
<td>All Divisions / Departments of Steel Works</td>
<td>• Performance Recording</td>
</tr>
<tr>
<td>i-Monitor</td>
<td></td>
<td>CS&amp;P, BOSS</td>
<td>• Tracking &amp; Review</td>
</tr>
<tr>
<td>Accounts</td>
<td></td>
<td>R&amp;D, Technology</td>
<td>• Process control</td>
</tr>
<tr>
<td>FMD</td>
<td></td>
<td>TQM, KM, CC</td>
<td>• Planning &amp; Target setting (ABP &amp; LTP – BO&amp;S)</td>
</tr>
<tr>
<td>IBMD</td>
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<tr>
<td>ET&amp;D</td>
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<tr>
<td>Travels</td>
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<td>CSD</td>
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<tr>
<td></td>
<td></td>
<td>MoniCA</td>
<td>• Benchmarking &amp; Gap Analysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GHG Tools</td>
<td>• Analysts’ input</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Responsible Advocacy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Setting directional inputs (Vision &amp; Goals)</td>
</tr>
</tbody>
</table>

Admin: Group Environment
Server: IJmuiden, Netherland (MLE)

*Deployed horizontally at Kalinganagar in 1st year of operation in FY17*
Shikhar Initiative - Key differentiating features

Enablers for program success

**Ownership**
- High senior management commitment
- Top Down target setting for each theme/division
- Targets cascaded down through BO&S

**Governance**
- Robust 3-Tiered governance across organisation (Steering Committee, LEAD Centre, IMPACT Centres)
- Cross functional project management

**Speed**
- Accelerated decision making through IMPACT centres (*Escalation by exception*)
- All Support functions (Finance, TGs, R&D) embedded in governance

**Capability Building**
- Capability building intertwined with program execution (On the job)
- Structured training for Project leaders, front line managers, other change agents
Governance structure

- **Chief BPE-O**
- **Implementatio n Tracking Group**
  - 3-4 Persons
  - Track the progress of various Project.
- **PMO Facilitators**
  - 1 per IMPACT Centre
  - Support Shikhar25 Champions to drive Project and reviews
  - Step in to drive high impact Project
  - Drive key Project with line teams
- **Central Analytics team**
  - 4-5 people team
  - Data analytics
  - Simulation & Modeling
- **Shikhar25 Champion**
  - 1 per war room (Full time)
  - Responsible for driving Shikhar25 IMPACT Centre
  - Will be supported by 1-2 fulltime members
- **GM/EIC/CoMs**
- **BAG**
  - Part time
  - Support business case development
  - Validate financial impact
- **Project Team**
  - Part time
  - Implement projects

Functional IMPACT Centre (Weekly Impact Center Review)

LEAD Centre Review (Fortnightly VP Review)

Steering Committee Review (President Review)

Fortnightly update to MD Tata Steel & SEA
GREEN SUPPLY CHAIN

Stage Gate Process of Value Identification & Rigorous Deployment

1. Diagnostics & Potential mapping
   - KPI Drill Down & Data Collection
   - Belief Audit & Data Syndication
   - KPI Prioritization & Benchmarking (BDP)
   - Potential Mapping & Syndication

2. Ideation & Prioritization
   - Aspiration Driven Workshops
   - Idea / Enablers consolidation
   - Idea Prioritization methodology
   - Analysis/ Solutioning team formation
   - Idea & Team syndication

3. Solutioning & Sign-off
   - Expert discussions
   - Root cause analysis
   - Advanced analytics
   - Industry best practices
   - Project roadmapping
   - Implementation team formation
   - Idea Sign-off

4. Implementation & Tracking
   - Project Execution
   - DICE/Rigor tracking
   - Project Completion
   - KPI & Savings tracking
   - Idea Sign-off
GREEN SUPPLY CHAIN

Weekly Progress update; Benefit Achieved

<table>
<thead>
<tr>
<th>Overall idea pipeline status</th>
<th>Saving Accrual</th>
</tr>
</thead>
<tbody>
<tr>
<td>761</td>
<td>764</td>
</tr>
<tr>
<td>35</td>
<td>30</td>
</tr>
<tr>
<td>200</td>
<td>200</td>
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<tr>
<td>279</td>
<td>224</td>
</tr>
<tr>
<td>208</td>
<td>211</td>
</tr>
<tr>
<td>39</td>
<td>99</td>
</tr>
</tbody>
</table>

- **D0**: Top down potential
- **D2**: Roadmap map underway/prepared
- **D4**: Implemented
- **D1**: Enabler identified & sized
- **D3**: Signed off & under impl.


Saving Accrual chart shows cumulative target and actual values with a clear upward trend.
GREEN SUPPLY CHAIN

Energy Efficiency Impact Centre
Improvement Theme

Increase In-house Power Generation
Reduce Power Consumption
↑ Recovery & ↓ Consumption of Liquid & Gaseous Energy
Renewable & non-Conventional Power
Export Energy & Commercial Levers

1. Increase in-house (Gas based) power PH3, PH4, PH5, PH6
2. Increase Power Generation from TRTs
3. Higher CDQ steam generation & Power Generation
4. Efficient drive like VFD
5. Energy Efficient Light (LED)
6. Energy Efficient Equipment
7. Process load optimization
8. Increase Recovery of LD/CO/BF Gas
9. Optimization of reheating furnace
10. Increase Boiler Efficiency
11. Power Generation from low heat sources.
12. Use of waste energy
13. Solar power.
15. Tolling arrangement with TATA Power

Foundations

17. Promote energy efficiency through employee engagement by creating awareness (JDCs, organizing Seminar, Online campaign etc)
18. Collaboration with Internal & External Stakeholders
Energy efficiency awareness and sensitization campaign across the organization

Energy Efficiency Awareness Campaign through JDC

Development of energy champions across the organization

Session by Experts from Japan

Energy Course in Collaboration with Tata Steel, Europe
Team work, Employee Involvement & Monitoring

Energy Efficiency Campaign

Release of Energy Book

Address by CEO & MD

Recognition by CEO & MD to top ideas of online campaign

Participation of employees from all department
Team work, Employee Involvement & Monitoring

DAILY MONITORING & REVIEW THROUGH ROBUST GOVERNANCE & REVIEW

Weekly IMPACT Center Review and assessment on progress

Idea status, KPI and Countermeasure board
Implementation of Green Co/IGBC rating

1st Platinum rated Steel Company in India (CII)

GreenCo Platinum rating by CII-GBC*
Indian Benchmark (amongst GreenCo assessed companies) in
Energy Efficiency  GHG Management  Life Cycle Analysis
Water Conservation  Material Conservation
Green Supply Chain  Product Stewardship  Others (Innovation)

* CII-Sohrabji Godrej Green Business Centre
# Energy saving customized Technologies for Steel Industry

<table>
<thead>
<tr>
<th>Technology</th>
<th>Adoption in TSL</th>
<th>Technology</th>
<th>Adoption in TSL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinter Cooler Waste Heat Recovery</td>
<td></td>
<td>BOF Gas Recovery Device</td>
<td></td>
</tr>
<tr>
<td>(diffusion rate 34%)</td>
<td></td>
<td>(diffusion rate 63%)</td>
<td></td>
</tr>
<tr>
<td>High Efficient Burner at Sinter Plant</td>
<td></td>
<td>BOF gas sensible heat recovery device</td>
<td></td>
</tr>
<tr>
<td>(diffusion rate 45%)</td>
<td></td>
<td>(diffusion rate – no data)</td>
<td></td>
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<tr>
<td>Coke Dry Quenching (CDQ)</td>
<td></td>
<td>Ecological &amp; Economical Arc Furnace</td>
<td></td>
</tr>
<tr>
<td>(diffusion rate 35%)</td>
<td></td>
<td>(diffusion rate 0%)</td>
<td></td>
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<tr>
<td>Coal Moisture Control (CMC)</td>
<td></td>
<td>Waste Heat Recovery from EAF</td>
<td></td>
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<tr>
<td>(diffusion rate 10%)</td>
<td></td>
<td>(diffusion rate 0%)</td>
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<tr>
<td>Inverter VVVF Drive for motor</td>
<td></td>
<td>Rotary Hearth Fce Dust Recycling Sys.</td>
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<tr>
<td>(diffusion rate – no data)</td>
<td></td>
<td>(diffusion rate – no data)</td>
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</tr>
<tr>
<td>Regenerative Burner for reheating fce</td>
<td></td>
<td>Energy Monitoring &amp; Mgt. system</td>
<td></td>
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<tr>
<td>(diffusion rate 0%)</td>
<td></td>
<td>(diffusion rate – no data)</td>
<td></td>
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<tr>
<td>Top Pressure Recovery Turbine (TRT)</td>
<td></td>
<td>Cogeneration (GTCC)</td>
<td></td>
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<tr>
<td>(diffusion rate 28%)</td>
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<td>(diffusion rate – no data)</td>
<td></td>
</tr>
<tr>
<td>Pulverized Coal Injection (PCI) System</td>
<td></td>
<td>Compressed Air Pressure Optimization</td>
<td></td>
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<tr>
<td>(diffusion rate 65%)</td>
<td></td>
<td>(diffusion rate – no data)</td>
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</tr>
<tr>
<td>Hot Stove Waste Heat Recovery</td>
<td></td>
<td>Power by Steam Turbine in PSR</td>
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<tr>
<td>(diffusion rate 255%)</td>
<td></td>
<td>(diffusion rate – no data)</td>
<td></td>
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</tbody>
</table>

- Implemented
- Under Implementation
- Not Implementation
- Not Applicable

*Diffusion rate (%) - Technology adopted in 7 major Indian Steel Companies of India*

Source: Published during Indo-Japan Collaboration Initiative
**Way Forward – efficient & emerging technologies**

**LED Lighting**

- Potential reduction in lighting load of JSR Works ~ 8 MW
- 1,10,045 Nos of light fittings replaced till date.

Reduction in Daily lighting load of JSR works ~ 4.1 MW (Achieved)

**Packaged TRT for Power Generation at BF**

- Recovery of energy at low pressure
- Compact design with higher efficiency
- Shorter installation period

Potential to generate 2.54 MW Power from F Bl. Fce. – investment Rs. 48cr.

TRT: Top Recovery Turbine
**Way Forward – efficient & emerging technologies**

**Low Heat Recovery using OCR Technology**
- Ability to recover energy from low temperature source
- Adaptive control system & sophisticated diagnostic
- Investment is Rs. 28 cr for 1.2 MW Power

**Micro Turbine to reduce losses in PRDS**
- Loss thro’ PRDS can be utilized to generate power with help of Micro Turbine.
- Micro Turbine will provide required quality of steam & will generate power

There is a potential to generate 24 MW power at JSR. – high investment

There is a potential to generate 6.3 MW power for free – investment Rs. 7 cr.
Vapor Absorption Machine to Recover Waste Heat from Boiler Blow Down Water

4th Boiler DCS Building

VAM 100 TR

Hot Water Tank

Cooling Tower

1W+1S
Cooling Water Pump

Chilled water outlet 7°C
Ø100mm

Chilled water outlet 32°C,
Ø150mm

Hot Water Line

PRDS # 2

Chilled water inlet 12°C
Ø100mm

Hot Water Pump

Investment Rs 70 Lakhs
Benefit Rs 34 Lakhs/yr

Canteen

DM Plant Lab Room
1 no. 12000 CFM AHU

Way Forward – efficient & emerging technologies

12000 CFM AHU
Way Forward – efficient & emerging technologies

**Generation of Methane from Coke Oven Gas**

- H2, Co & CO2 contained in the Coke Oven gas will be synthesized to methane which will be extracted along with CH4 already present in Coke Oven gas.
- Propane is used for slab cutting & CGL2 annealing process.
- The propane generated in this process will be used in the Steel Making process, replacing the existing purchased propane.

Potential saving through propane replacement is Rs. 15 cr/yr at an investment of Rs. 48 cr.
We share good ideas & practices through internal/external publications.

Part of Japan India collaboration to improve Energy performance.

We are one of only 193 companies that have made it to CDP’s Climate A List.
Thank you