Identification of Energy Savings Opportunity

Category	Example
Thermal Utilities	Fuels and combustion, Boilers, Steam, Furnaces, Insulation / refractory,
Electrical Utilities	Motors, Air System, HVAC & Refrigeration, Fans / Blowers, Pumps, Cooling towers, Lighting, DG set, Electrical Systems (PF improvement, Soft Starter, VVVF etc….)
Reduction of energy waste	Idle running, Leakages, Waste heat recovery etc…

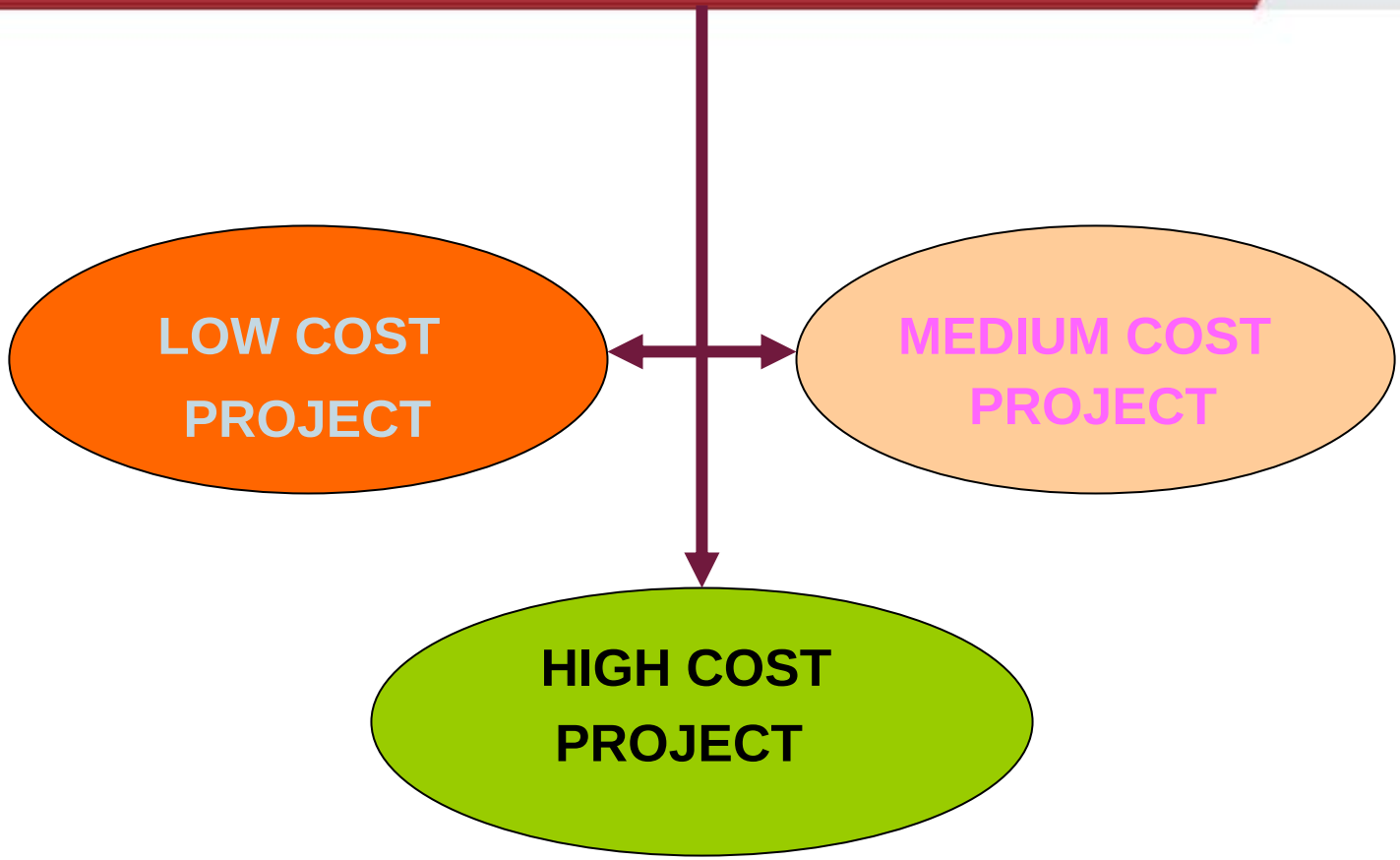
Significant Aspects for energy gain

- Optimization of pumps, blowers and compressors efficiencies
- Optimization of production process
- Increase capacity utilization
- Improvement in operation and Maintenance practices.
- Reduction in Start up and shutdown.

Guidelines – Potential Energy Savings

- Low cost - Medium / High return
- Medium cost - Medium / High return
- High cost - High return

Energy Conservation Activities



Energy Savings - Hot Strip Mill

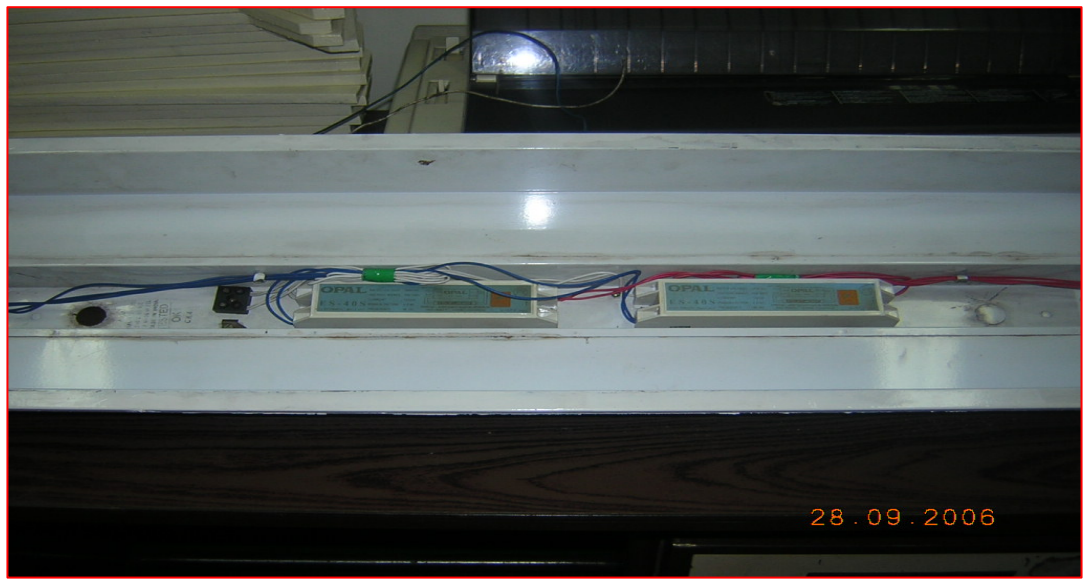
Low Cost Projects – Hot Strip Mill

1. Replacement of electronic ballasts for Tube light fittings.

Replaced - 500 nos. Energy saving - 11 KW

Energy saving per Year - 0.97 Lakh kWh

Saving per year - 3.86 Lakhs @ 4.0 Rs / kwh



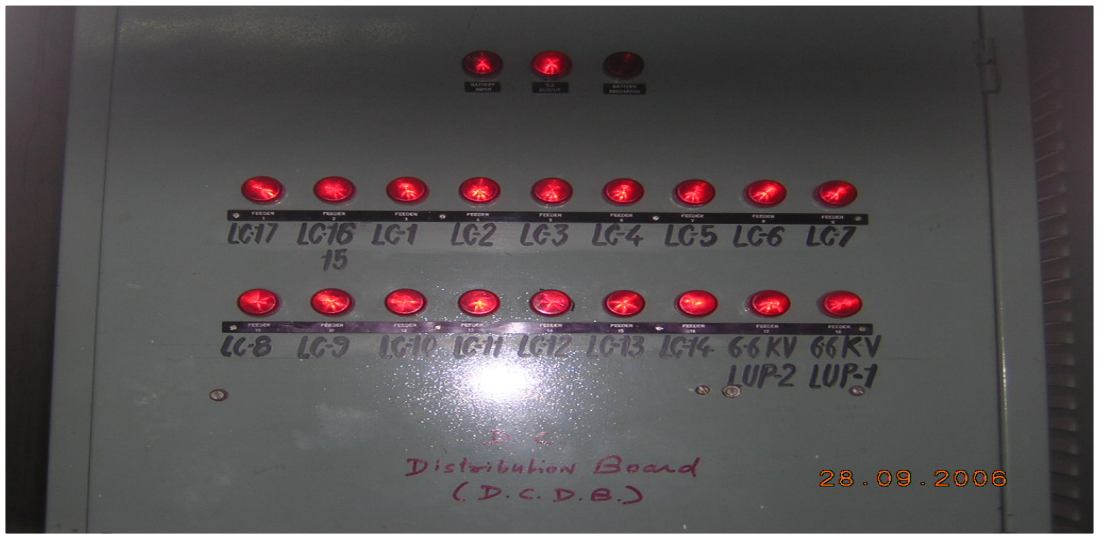
Low Cost Projects – Hot Strip Mill

2. Replacement of conventional Indication assembly by Long life LED type assembly.

Replaced - 1000 nos, Energy saving - 8 KW

Energy saving per Year - 0.7 Lakh kWh

Saving per year - 2.8 Lakhs @ 4.0 kwh / Rs



Process Optimization - HSM

Stoppage of Idle running of equipments in HSM

- Stopping idle running of applications during shutdown and long stoppage.
- Power reduced from 6 MW to 4.4 MW

  Power Saving :- 1600 KW per hour

  Total :- 450 Hrs per Annum

  Total Power Saving :- 7.2 Lakh kWh considering shutdowns and down time

  Annual Saving :- 28.8 Lakhs @ 4.0 kWh / Rs

Process Optimization - HSM

Product mix and Production

- Power Saving due to product mix and proper schedule of process have increased in production rate and hence decreased in power consumption.
- Production data

  2005-06 - 2546680 T at specific power – 95.84 kWh/T

  2006-07 - 2919009 T at specific power – 87.54 kWh/T

  Power Saving = 8.3 kWh/T at 3.72 Lakh production

  Total Energy Saving :- 30.91 Lakh kWh

  Annual Saving :- Rs. 123.65 Lakhs @ 4.0 kWh / Rs

Energy Saving Summary - HSM

Description	Energy Saved – Lakh kWh	Investment Incurred - Lakhs	Savings - Lakhs
Electronic Ballast replacement	0.97	1.0	3.86
Installation of LED Lamps	0.70	-----	2.80
Stoppage of Idle equipments	7.20	-----	28.80
Process Optimization	30.91	-----	123.65
TOTAL SAVINGS	39.78	1.00	159.11

Energy Savings - Utility

Low Cost Projects - Utility

Centrifugal Chillers (Capacity 300 TR – 04 nos) :

Evaporator and condenser's tube side (water) as well as shell side (refrigerant) were Chemically cleaned resulted in better heat transfer and enhancing the individual capacity. Stopping of one chiller. Refrigerant side first time done. Energy Saving 143 KW

Investment : Rs. 1.11 Lakhs.

Total energy savings : 12.8 Lakhs kWh

Savings = 51.2 Lakhs per annum @ **4.0 Rs/kWh**

Annual Savings (2006-07)
RS. 51.2 Lakhs

Low Cost Projects - Utility

Compressor Cooling Pump : One running pump stopped after establishing the flow with two pumps. E**nergy savings : 90kW**

Total Energy savings : 7.88 Lakhs kWh

Cost Saving : 31.54 Lakhs per annum @ 4.0 Rs/kWh.

Chilled Water Pump : One running Pump stopped after establishing the flow with two pumps and Chemical cleaning of Evaporators. **Energy savings : 50kW**

Investment :- Rs. 0.21 Lakh

Total Energy savings : 4.38 Lakhs kWh

Cost Saving : 17.52 Lakhs per annum @ 4.0 Rs/kWh.

Annual Savings (2006-07)
RS. 49.06 Lakhs

Low Cost Projects - Utility

Condenser Cooling Water Pump :

One running pumps stopped after establishing the flow with two pumps and chemical cleaning of Condensers. This pump will required to be run in summer due to High Water temp. (Saving for 250 days per annum only).

Energy Saved : 60 W

Total energy savings : 3.6 Lakhs kWh

Cost Savings : Rs. 14.4 Lakhs per annum @ 4.0 Rs/kWh

Annual Savings (2006-07)
RS. 14.4 Lakhs

Low Cost Projects - Utility

Oxygen Plant Centrifugal Chiller : Chilled water flow & Secondary water flow established in Pre column chamber for minimize the loss of chilled water. Energy savings : 47.5kW

Total Energy Savings – 4.16 Lakh kWh

Cost Savings - 16.65 Lakhs @ 4.0 Rs/kWh

Roll Coolant Pump, CRM : Flow adjustments done by regulating the valves after optimization. Energy savings : 54kW

Total Energy Savings – 4.73 Lakh kWh

Cost Savings - 18.93 Lakhs @ 4.0 Rs/kWh

Annual Savings (2006-07)
RS. 35.58 Lakhs

Medium Cost Projects - Utility

Plate type Heat exchangers, EAF cooling water system :

Chemical cleaning carried out resulted in improvement in efficiency of supply water pumps.

Total Investment :- Rs. 9.5 Lakh

Energy Savings :- 47.62 Lakhs kWh per annum

Cost savings : 190.48 Lakhs per annum @ 4.0 Rs/kWh

Annual Savings (2006-07)
RS. 190.48 Lakhs

Medium Cost Projects - Utility

Chiller # 4 : Enhanced the capacity (by 9 TR) by increasing the condenser water flow from 47 to 85 m3/hr after installing the booster pump, Model : KDS 1537+, Kirloskar.

Energy Savings - 28.2 kW

Total Investment :- 0.28 Lakh

- Total energy savings : 2.47 Lakh kWh
- Cost Savings 9.90 Lakhs per annum @ 4.0 Rs/kWh

Annual Savings (2006-07)
RS. 9.90 Lakhs

Medium Cost Projects - Utility

Crane 160 # 2 Cabin A/C : Old ductable unit modified in split one. Energy Saving :- 3.45 kWh

Investment : Rs. 0.85 Lakh

- Total energy savings : 0.3 Lakhs kWh
- Cost Savings 1.21 Lakhs per annum @ 4.0 Rs/kWh

Annual Savings (2006-07)
RS. 1.21 Lakhs

High Cost Projects - Utility

- **EAF 1 & 2 Cooling system :**
- 02 nos Plate type heat exchangers added. This resulted in truncation of peak temp. helping SMP to achieve a new milestone. Additionally, 01 no pump of EAF Primary system stopped.

Investment :- Rs. 80 Lakhs

- Total Energy Savings :- 45.72 Lakhs kWh
- Cost Savings :- 182.88 Lakhs @ 4.0 Rs/kWh

Annual Savings (2006-07)
RS. 182.88 Lakhs

High Cost Projects - Utility

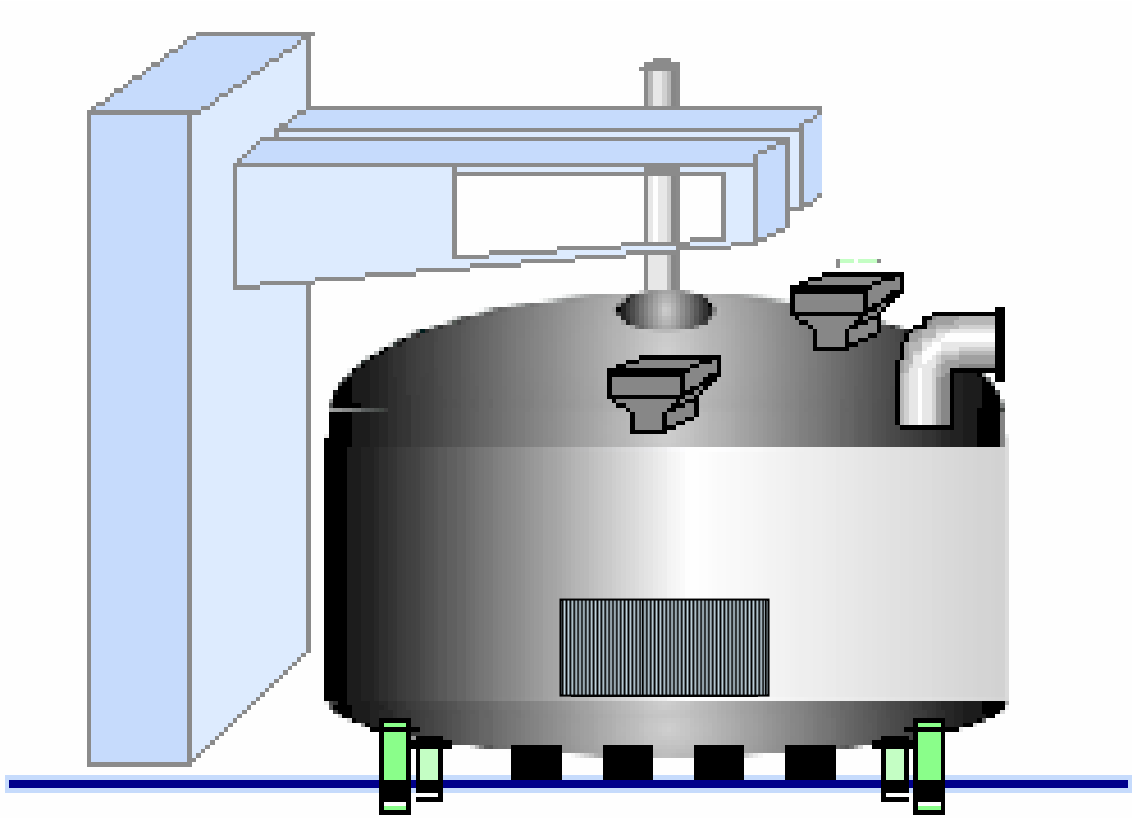
Resource Saving :

- Wooden Drift Eliminators replaced with PVC " C " Type Drift Eliminators in EAF Secondary cooling towers. This resulted in reduction of Specific Water consumption of EAF by 0.02 m3/Tonne of liquid steel.
- Total Saving of Water consumption :- 60000 m3
- Water treatment, pumping etc.. cost is 14 Rs/m3
- Energy Saving :- 2.1 Lakh kWh
- Cost Saving :- Rs. 8.4 Lakh per Annum

Energy Saving Summary - Utility

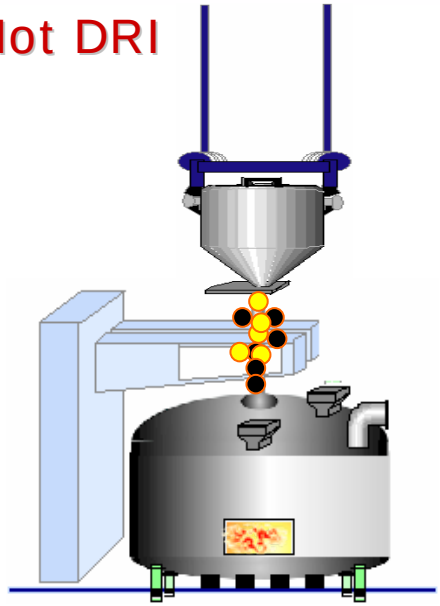
Description	Energy Saving – Lakh kWh	Investment Incurred Lakhs	Savings - Lakhs
Stopping of one chiller	12.80	1.11	51.20
Stopping of cooling pump	7.88	----	31.54
Chilled water pump stopped	4.38	0.21	17.52
Condenser water pump stopped	3.60	----	14.40
Chilled water flow optimization	8.89	----	35.58
Efficiency improvement	47.62	9.5	190.48
Booster pump installation	2.47	0.28	9.90
AC duct modification	0.30	0.85	1.21
Heat Exchanger installed	45.72	80.00	182.88
Resource saving	2.10	----	8.40
TOTAL	135.76	93.91	543.04

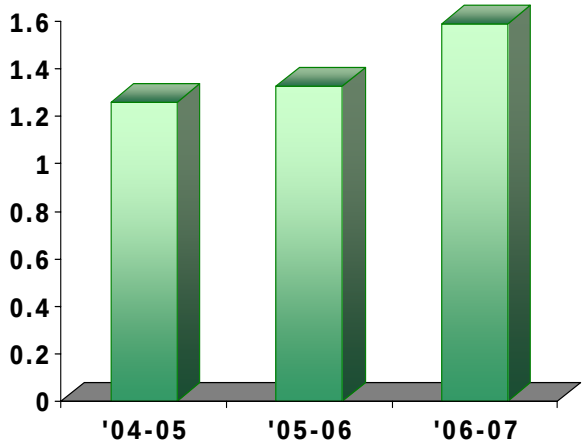
Energy Savings - SMP



Energy Savings - SMP

Increase in Hot DRI





Increase in the usage of Hot DRI in Steel Making.

[A project being pursued hand in hand with HBI and HED]

Total Energy Saving = 26007900 kWh

Increase in Annual Savings (2006-07)

RS. 1040 Lakhs

Low Cost Projects – SMP

Energy saving By Installing CFL

- **Replacement of Conventional 160w lamp with 23w CFL (40 nos.)**

Energy saving	**: 40505 kWh**
Saving	**: Rs. 1,92,019/- Year**
Investment on	**: Rs. 8520/-**
Payback Period	**: 16 days**

Annual Savings (2006-07)
RS. 1.92 Lakhs

Low Cost Projects – SMP

Replacement of conventional Indication assembly by Long life LED type assembly.

Replaced - 718 nos, Energy saving - 1.149KW

Energy saving per Year - 10063 kWh

Saving per year - Rs. 40,253/- @ 4.0 kwh / Rs

Energy Saving Summary - SMP

Description	Total Energy- Lakh kWh	Investment Incurred - Lakhs	Savings - Lakhs
HDRI	**260.08**	**100**	1040
CFL Installation	**0.41**	**0.08**	1.92
LED lamp indication	**0.10**	**----**	0.40
TOTAL	**260.59**	**100.08**	**1042.32**

LONG CONVEYOR XF 1.14 SINGLE DRIVE OPERATION

- Long conveyor XF 1.14 is approx. 1KM in length having two 250KW LT Squirrel cage induction Motors, one at head end & other at tail end. Both the Motors are running with 250KW AC VVVF drive Siemens make.
- Drives are connected to Siemens PLC through Profibus communication
- Conveyor design capacity is 2000TPH
- Motors full rated current is 420A.
- Current drawn by two Motors when running with 60% speed i.e. 900 RPM is approx 100-150A (each motor) at normal flowrate 800TPH

Energy Saving - MH

Calculation :-

- Power saving is approx 27.8 % (77/256*100)
- Power Saving per Hour is approx **31.2KW**

  Current reduced by running with one drive = 276-199 = 77A

  KW Saving = (1.732 X 260V X 77A X 0.9PF)

  (Average current drawn is 199A)
- Monthly power saving is approx **16,474 KWH** (Considering 22 days operation)

- Energy Savings :- 1.98 Lakhs kWh per annum
- Cost Saving :- **7.91 Lakhs per annum @ 4.0 Rs/kWh**

Total Annual Savings Rs. 7.91 Lakhs

Replacement of Quench Tank Pumps

- Replacement of over capacity pumps of quench tank pumps thereby reducing specific power consumption @ 0.2 kWh/t.

Total Production: 3590302 MT

Total energy saving 3590302 x 0.2 = 7.18060 Lakh kWh.

Cost Saving = Rs. 28.72240 Lakhs @ Rs. 4 / kWh

Total Savings Rs. 28.72 Lakhs

Energy Saving - HBI

Replacement of compressor

- At Mod 2, existing seal gas compressor replaced with water ring compressor, thereby reducing specific power consumption.
- **Plant running hours: 8063 hrs**
- Earlier capacity of seal gas compressor motor 700 kW, Compressor replaced with water ring compressor motor capacity 380kW.
- Energy Saving per Hour – 160kw.
- Total Running hours of the compressor – 8063 hrs.
- **Total energy saving – 8063 x 160 = 12.90 Lakh kWh**
- **Cost Saving = Rs. 51.6 Lakhs @ Rs 4 / kWh**

Total Savings Rs. 51.60 Lakhs

Energy (Fuel) Saving - HBI

Reduction in NG consumption

- At all modules reduction in oxygen consumption and zero Flaring operation, to reduce NG specific consumption @8 SM3/t.
- Total Production: 3590302 MT
- NG saved :- 3990302 * 8 = 31922416 sm3
- Cost Saving :- Rs. 255.3423 Lakhs

Total Savings Rs. 255.34 Lakhs

Energy Saving Summary – MH / HBI

Description	Total Energy Saved - Lakh kWh	Investment Incurred - Lakhs	Savings - Lakhs
Conveyor motor stopped	1.98	-----	7.91
Replacement of Quench Tank Pumps	7.18		28.72
Compressor Replacement	12.90		51.6
TOTAL Savings	22.06		88.23

Reduction in Lighting Transformer Voltage

- **Problem :** At 440 voltage, single phase voltage was 255 V. Total power consumption was 476.1 KW

- **Analysis :** Voltage reduced to 400 V by changing the tap position to make single phase voltage 230 V. Total Power consumption measured is 783.32 KW.

- **Result :** Energy Saving **476.10 - 387.32 = 88.78 KW**
  Energy of 2130.72 KWH every day.

- **Energy Saved : 7,77,712** KWH per annum
- **Cost Saved : Rs. 3110848 at @ 4.0 kWh / Rs**

Annual Savings (2006-07)
RS. 31.11 Lacs

VVVF Drive Installation

- **Description:** VVVF drive installation for rapid cool Motor

- **Analysis :** VVVF drive installed for rapid cool motor and reduced 5 Hrs cycle time for Base Fan motor(37 KW), Rapid cool Motor(11 KW) and Cooling hood motor(22 KW). Power Saving of 8.85, 6 and 7.75 KWH respectively.
- **Result :** Energy Saving **113 KW**

- **Investment :- 1.2 Lakhs**

- **Energy Saved : 2,90,322** KWH per annum
- **Cost Saved : Rs. 11,61,328 @ 4.0 kWh / Rs**

Annual Savings (2006-07)
RS. 11.61 Lacs

Speed reduction of base fan motor

- **Description:** Speed reduced from 1450 RPM to 1000 RPM at the time of N2 purging

- **Analysis :** Output power at Speed at 1450 RPM=37 KW
  power at Speed at 1000 RPM=15 KW
- **Result :** Energy Saving **22 KW per 4 Hrs cycle**

- **Energy Saved** : **2,26,500** kWh per annum
- **Cost Saved** : Rs. **9,06,000** @ **4.0 kWh / Rs**

Annual Savings (2006-07)
RS. 9.06 Lacs

Medium Cost Projects – ARP (CRM)

Energy saving By Installing VVVF Drive

- **VARIABLE FREQUENCY DRIVE INSTALLED AT ARP (CRM COMPLEX) FOR 02 NOS OF BLOWERS.**

Medium Cost Projects – ARP (CRM)

Energy saving By Installing VVVF Drive

- **Conversion of 315 KW HT Motor by 250KW LT Motor. With Variable frequency drive.**
- **Installation of Variable frequency drive for V30 Blower**

Saving	**: Rs. 18,00,000/- Year**
Investment on VFD	**: Rs. 12,00,000/-**
ROI	**: 8 MONTHS**

Annual Savings (2006-07)
RS. 18 Lakhs

Analysis Of Data

ESSAR

ANALYSIS OF ENERGY SAVINGS AFTER INSTALLATION OF VVVF DRIVE

SR NO.	REGENERATED ACID PRODUCTION (KL)	V-31MOTOR			V-30 MOTOR		
		EXISTING HT MOTOR METER READING (KWHr)	AFTER INSTALLATION OF VVVF DRIVE (KWHr)	DIFFERENCE (KWHr)	EXISTING METER READING OF V30 BLOWER (KWHr)	AFTER INSTALLATION OF VVVF DRIVE (KWHr)	DIFFERENCE (KWHr)
1	98	5500	4023	1477	2380	1973	407
2	98	5100	4459	641	2320	2250	70
3	96	5200	4310	890	2500	2210	290
4	97	5400	4027	1373	2400	2236	164
5	86	5300	3570	1730	2277	2040	237
			Average	1222.2		Average	233.6

APPROX. 1500 KWhr Power Saving per day

Plant Running per year : 300 days

Total Power Savings :1500x300=450000

Total Saving per year :450000x4=1800000 (Eighteen Lals per year)

Total Investment : 1200000/- (Twelve Lacs Rupees)

ROI : 8 Months

Process Optimization at Pickling Lines

Optimization of Effluent Discharge in PKL1

- Effluent Discharge Reduced from 9.00 KL/hr to 4.00 KL/hr

  Power Saving :- 2.2 KW /hr

  Total Power Saving :- 14256 kWh considering (540 hrs Running per month.)

  Annual Saving :- 57,024/-

Process Optimization at Pickling Lines

Optimization of Effluent Discharge in PKL2

- Effluent Discharge Reduced from 11.0 KL/hr to 7.5 KL/hr

  Power Saving :- 3.75 KW /hr

  Total Power Saving :- 24300 kWh considering (540 hrs Running per month.)

  Annual Saving :- 97,200/-

Energy Saving Summary – CRM/DSC

Description	Energy Saving – Lakh kWh	Investment Incurred Lakhs	Savings - Lakhs
Reduction in Lighting voltage	7.78	--	31.11
VVVF Drive Installation at BAF	2.90	1.20	11.61
Speed reduction at BAF	2.27	--	9.06
VVVF Drive at CRM	4.50	12.00	18.00
Optimization of Effluent Discharge at PKL	0.39	--	1.55
TOTAL	17.84	13.20	71.33

Total Saving Summary – Essar Steel

PLANT	Energy Saved - Lakh kWh	Investment Incurred - Lakhs	Savings - Lakhs
HOT STRIP MILL (HSM)	39.78	1.00	159.11
UTILITY	135.76	93.91	543.04
STEEL MELT SHOP (SMP)	260.59	100.08	1042.32
HBI and MH	22.06	----	88.23
CRM / DSC	17.84	13.20	71.33
TOTAL	476.03	208.19	1904.03

Proposed project - HSM

- **Proposed projects at HSM :**
  - Optimization of air usages during various mill application.
    - Primary audit is done with the help of external agency.
    - Feasibility report is under progress.
  - **Replacement of 160 W HPMV lamp by 70 W HPSV lamp.**
    - Feasibility report is made.
    - Phase wise implementation, 200 this year.
    - Expected savings, 5 Lakhs per annum.

Proposed project - HSM

- Proposed projects at HSM :
  - **Revamping of Reheating furnace.**
    - Proposal is received from external agency.
    - Feasibility study is under progress.
  - **Installation of Energy Management system.**
    - SKADA system is procured.
    - Will be Commissioned by DEC – 2007.
    - Expected results are :
      - Real time data for better monitoring and analysis.

Future projects at Essar Steel

1. Oxy-Fuel Project – HSM

Total Cost –Rs 5.00 crores
Activities under process.
Benefits- More productivity benefits expected. Nitrogen dioxide emissions may possibly reduce.

Future projects at Essar Steel

2. Utilization of Waste heat gases from Electric Arc furnaces.

- Preliminary evaluation has been carried out by Thermal Systems – Hyderabad. Party has carried out projects of such nature involving dust in Birla Copper (Hindalco) and Hindustan Zinc .
  The technical report from Thermal systems is expected.

- Possibility of power generation is up to 50 MW. With installation of single turbine system/hunting turbine system
  Cost of project is up to 4.5 crore per MW. Total up to 225 crores.

- An preliminary estimate of Carbon credits at will be 4000 CER/MW that is up to 200,000 CER/year using thumb rules.

Future projects at Essar Steel

3. 25 MW waste heat recovery project

Government of India - approval received on 20th April 2007.

We are implementing 19 MW project – With basis of 4000 CER/MW total carbon credits is up to 76000 CER/annum.

Cost of project is 75 crores.

Equipment such as Chinese Boilers, Siemens Electrical, has been ordered . Tata Consulting Engineers is project consultant for same.