

Detailed Project Report On IGBT type induction furnace

Belgaum Ferrocast (India) Private Limited
Belgaum (Karnataka)

Prepared for

Bureau of Energy Efficiency
(13/GEF-UNIDO-BEE/LSP/14/4562)



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This DPR has been originally prepared by TERI as a part of 'Capacity Building of LSPs' activity under the GEF-UNIDO-BEE project 'Promoting Energy Efficiency and Renewable Energy in selected MSME clusters in India'.

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GEF-UNIDO-BEE Project, Bureau of Energy Efficiency, 2018
"Capacity Building of Local Service Providers"

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Acknowledgement

The Energy and Resources Institute (TERI) places on record its sincere thanks to Global Environment Facility (GEF), United Nations Industrial Development Organization (UNIDO) and Bureau of Energy Efficiency (BEE) for giving opportunity to partner in this prestigious assignment on Capacity Building of Local Service Providers (LSPs) under the GEF-UNIDO-BEE project 'Promoting energy efficiency and renewable energy in selected MSME clusters in India'.

TERI is particularly grateful to Mr Milind Deore, Director, Bureau of Energy Efficiency, Mr Sanjay Shrestha, Industrial Development Officer, Industrial Energy Efficiency Unit, Energy and Climate Branch, UNIDO, Mr Suresh Kennit, National Project Coordinator, UNIDO, Mr Niranjana Rao Devela, National Technology Coordinator, UNIDO, Mr Sadanand Humberwadi, Cluster Leader, Belgaum Foundry Cluster, UNIDO, Mr P. Nagraj, M/s Belgaum Ferrocast Private Limited, and Belgaum Foundry Cluster Association for their support and guidance during the project.

Last but not least, the interactions and deliberations with numerous foundry units, Industry Associations, technology providers and who were directly or indirectly involved throughout the study were exemplary and the whole exercise was thoroughly a rewarding experience for TERI.

The Energy and Resources Institute (TERI)
New Delhi

Table of contents

Acknowledgement.....	1
List of tables.....	1
List of figures.....	1
List of abbreviations.....	1
Executive summary.....	i
1.0 Details of the unit.....	1
1.1 Particulars of unit	1
2.0 Energy profile.....	3
2.1 Process flow diagram.....	3
2.1.1 Sand preparation plant	3
2.1.2 Core preparation and moulding.....	3
2.1.3 Melting	3
2.1.4 Knockout and finishing	3
2.2 Details of technology identified.....	4
2.3 Energy used and brief description of their usage pattern.....	4
2.4 Energy sources, availability & tariff details	4
2.5 Analysis of electricity consumption.....	5
2.6 Analysis of other energy forms/ fuels.....	5
3.0 Proposed technology for energy efficiency	7
3.1 Replacement of existing induction furnace by new IGBT type induction furnace	7
3.1.1 Background	7
3.1.2 Observations and analysis.....	7
3.1.3 Recommendation.....	8
3.2 Cost benefit analysis.....	8
3.3 Pre-training requirements	9
3.4 Process down time for implementation.....	9
3.5 Environmental benefits	9
3.5.1 CO ₂ reduction.....	9
3.5.2 Reduction in other pollution parameters (gas, liquid and solid).....	9
4.0 Project financials	11
4.1 Cost of project and means of finance	11
4.1.1 Particulars of machinery and technology comparison.....	11
4.1.2 Means of finance	11
4.2 Financial statement (project)	11
4.2.1 Assumptions	11
4.2.2 Payback.....	12

4.2.3 NPV and IRR.....	12
4.3 Marketing & selling arrangement	13
4.4 Risk analysis and mitigation	14
4.5 Sensitivity analysis	14
5.0 Conclusions & recommendations.....	17
5.1 List of energy conservation measures.....	17
5.2 Summary of the project.....	17
5.3 Recommendations	17
6.0 Financing schemes for EE investments for MSME sector.....	19
Annexures	25
Annexure 1: Budgetary offers / quotations	27
Annexure 2: Instruments used.....	33

List of tables

Table 1.1: Particulars of the unit.....	1
Table 2.2: Details of existing technology.....	4
Table 2.3: Energy used and description of use.....	4
Table 2.4: Energy sources, availability and tariffs.....	4
Table 2.5: Electricity consumption profile.....	5
Table 2.6: Analysis of other energy/ fuel consumption.....	5
Table 3.1.1: Details of existing furnace.....	7
Table 3.2: Cost benefit analysis for recommended energy savings measures.....	9
Table 4.1.1: Particulars of machinery proposed for the project.....	11
Table 4.1.2: Means of finance.....	11
Table 4.2.1: Assumptions made.....	11
Table 4.2.2: Payback.....	12
Table 4.2.3a: NPV and IRR (100% equity).....	12
Table 4.2.3b: NPV and IRR (D/E- 70:30).....	13
Table 4.2.3c: NPV and IRR (D/E- 50:50).....	13
Table 4.3: Marketing & selling arrangements.....	13
Table 4.4: Risk analysis and mitigation.....	14
Table 4.5: Sensitivity analysis.....	14
Table 5.1: Summary of the energy conservation measures.....	17
Table 5.2: Summary of the project.....	17
Table 6.1: Major government schemes.....	19
Table 6.2: BEE's VCFEE and PRGFEE scheme.....	20
Table 6.3: IREDA's financing guidelines.....	21
Table 6.4: Major EE financing schemes/initiatives of SIDBI.....	22
Table 6.5: JBIC-SBI Green Line.....	23
Table 6.6: Canara bank scheme of EE SME loans.....	24

List of figures

Figure 2.1.4: Process flow chart.....	3
Figure 2.5: Demand pattern and energy consumption profile.....	5
Figure 2.6: Percentage share of various fuel types in the unit.....	6
Figure 3.1.2a: Power consumption trend of induction furnace.....	8
Figure 3.1.2b: Trend of specific power consumption of induction furnace.....	8

List of abbreviations

BEE	Bureau of Energy Efficiency
CO ₂	Carbon Dioxide
D/E	Debt /Equity
DPR	Detailed Project Report
DSCR	Debt Service Coverage Ratio
EE	Energy Efficient
DM	Demineralised
FAD	Free Air Delivery
FIs	Financial Institutions
GEF	Global Environmental Facility
GHG	Green House Gas
HESCOM	Hubli Electricity Supply Company Limited
IDC	Interest Defer Credit
IGDPR	Investment Grade Detailed Project Report
IGBT	Insulated-Gate Bipolar Transistor
IRR	Internal Rate of Return
kV	Kilo vault
kVA	kilovolt-ampere
Kg	Kilogram
kW	Kilo Watt
kWh	Kilo Watt Hour
LDO	Light Diesel Oil
LSPs	Local Service Providers
LPG	Liquid Petroleum Gas
MSME	Micro, Small and Medium Enterprises
NPV	Net Present Value
O&M	Operation and Maintenance
RE	Renewable Energy
ROI	Return On Investment
Rs	Rupees
SPP	Simple Payback Period
TERI	The Energy and Resources Institute
Toe	Tonnes of oil equivalent
UNIDO	United Nations Industrial Development Organization
VFD	Variable Frequency Drive
WACC	Weighted Average Cost of Capital

Executive summary

The overall aim of the GEF-UNIDO-BEE project 'Promoting Energy Efficiency (EE) and Renewable Energy (RE) in selected MSME clusters in India' is to develop and promote a market environment for introducing energy efficiency and enhancing the use of renewable energy technologies in process applications in selected energy-intensive MSME clusters in India. This would help in improving the productivity and competitiveness of the MSME units, as well as in reducing the overall carbon emissions and improving the local environment.

Under the GEF-UNIDO-BEE Project, TERI has been entrusted to undertake Capacity building of Local Service Providers (LSPs) to BEE. The Scope of Work under the project,

- Organizing 4 one-day training/ capacity building workshops for LSPs in each cluster.
- Development of 10 bankable DPRs for each cluster, based on mapping technology needs with capacities of local technology suppliers/service providers, and also replication potential and applications to banks in each cluster.

Brief introduction of the MSME unit

Name of the unit	M/s Belgaum Ferrocast (India) Private Limited
Constitution	Private Limited
MSME Classification	Small
No. of years in operation	16
Address: Registered Office:	Plot No. 150, Sy. No. 585 & 589, BEMCIEL Indl. Estate, Machhe, Belgaum 590014
Industry-sector	Steel casting
Products manufactured	Manufacturer of fabricated metal products, Machine components and assembly
Name(s) of the promoters/ directors	Mr Sachin Sabnis
Existing banking arrangements along with the details of facilities availed	State Bank Of Mysore

A detailed assessment study was undertaken in the identified area with the use of the sophisticated handheld instruments. Energy consumption pattern and production data were collected to estimate the specific energy consumption of the unit. The unit level baseline of the unit was also estimated using the historical data. The total energy consumption of the unit during last 12 months was 748.1 toe which is equivalent to 766 lakh rupees. The total CO₂ emission during this period is estimated to be 3,925 tonnes. Electricity and diesel were considered for CO₂ emission estimation.

The unit manufactures the fabricated metal products, machine components and assembly. The total annual production of the unit during 2017-18 is estimated to be about 5,835 tonne. The major source of energy is electricity, consume in the foundry, machining and lighting.

Accepted/ recommended technology implementation

The recommended technology considered after discussion with the plant personnel for implementation in the unit is given below.

Technology	Annual energy saving Electricity (kWh)	Investment (Rs lakh)	Monetary savings (Rs lakh/ year)	Simple payback period (Years)	Emission reduction (tonnes of CO ₂)
Replacement of existing induction furnace by new IGBT type induction furnace	6,18,547	38.4	43.9	0.87	507

Other benefits

- The proposed project is not expected to bring in any change in process step or operating practices therefore no change expected in the product quality.
- Implementation of the selected technology in the unit may result in reduction in CO₂ emissions.

Cost of project & means of finance

S. No.	Particulars	Unit	100% equity	D/E- 70:30	D/E- 50:50
1	Cost of Project	Rs. In Lakh	38.4	38.4	38.4
2	D/E Ratio	-	-	7:3	1:1
3	Project IRR	%	84.8	80.7	81.9
4	NPV	Rs. In Lakh	80.3	73.7	75.6
5	DSCR	-	-	2.1	0.9

1.0 Details of the unit

1.1 Particulars of unit

Table 1.1: Particulars of the unit

1	Name of the unit	M/s Belgaum Ferrocast Pvt. Ltd	
2	Constitution	Private Limited	
3	Company CIN	U27320KA2005PTC035442	
4	PCB consent No.	NA	
5	Date of incorporation / commencement of business	2005	
6	Name of the Contact Person	Mr P. Nagraj	
7	Mobile / Ph. No	+91-9480839971	
8	Email	maintenance@bfplindia.com	
9	Address: Registered Office	Plot 7A & 8A, R.S No.680/2 BEMCIEL, Udyambag, Belgaum 590008	Owned
10	Factory	Plot. No. 150. Sy. No. 585 & 589, BEMCIEL, Indl. Estate, Belgaum 590014	Owned
11	Industry / Sector	MSME/Manufacturing	
12	Products Manufactured	Manufacturer of fabricated metal products, machine components and sub assembly	
13	No of hours of operation/shift	12	
14	No of shifts/ day	2	
15	No of days/year	350	
16	Installed capacity	7,200 MT per year	
17	Whether the unit is exporting its products (Yes/ No)	No	
18	Quality Certification, if any	ISO 9001 : 2000	

2.0 Energy profile

2.1 Process flow diagram

The major steps of process are mould sand preparation, charge preparation followed by melting, pouring, knockout and finishing. The steps are explained below.

2.1.1 Sand preparation plant

The major equipment installed is sand siever, sand mixer and sand transport belts and elevators. Electricity is used to run all rotary machines in sand preparation plant. Fresh sand is mixed with adhesives in sand mixer then it is pressed in mould casing by pressing machine. In casing some amount of burnt sand is reused with fresh sand.

2.1.2 Core preparation and moulding

For core preparation, fresh sand is used. Cores are baked in LDO fired ovens. After hardening of core it is mounted in mould. In mould preparation fresh and burnt sand is pressed by machines which operate on pneumatic in mould casing. Upper and lower half of mould is assembled together and then it gets ready to pouring.

2.1.3 Melting

Melting of charge is done with help of induction furnace. Induction furnace runs on medium frequency three phase electrical supply. Once melt attained required temperature and metallurgy, the liquid melt is poured into the earlier prepared sand moulds using ladles.

2.1.4 Knockout and finishing

Mould is left to cool for certain time, then it follows to a vibrator with grated surface, it knocks-out the sand and the casting is send for finishing, which involves shot blasting and machining job.

The process flow diagram for major product and steel grade casting produced in the foundry is given in figure 2.1.4.

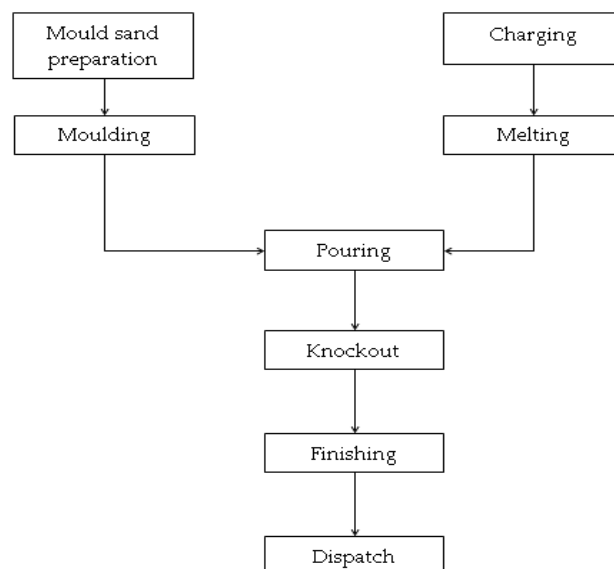


Figure 2.1.4: Process flow chart

2.2 Details of technology identified

The details of the existing technology installed in the unit are given in Table 2.2.

Table 2.2: Details of existing technology

Parameters/ Equipment ID	Value
Equipment	Induction furnace
Type	SCR
Make	-
Purpose/ Application	Melting
Capacity	500 kg
Operating Temperature (°C)	1600
Mode of operation (batch/continuous)	Batch
Batch duration (minute)	150-160
Fuel Details	Type
	Electricity
	Consumption (unit/batch)
	600-650 units/ tonne of melt

2.3 Energy used and brief description of their usage pattern

The unit uses grid power supplied by Hubli Electricity Supply Company Limited (HESCOM) under tariff category HT-2(a). Table 2.3 provides the details of energy uses.

Table 2.3: Energy used and description of use

S. No.	Energy source	Description of use
1	Electricity	Motive power for different drives in different process sections and utilities
2	LDO	Core making process
3	LPG	Core making process/ladle preheating

2.4 Energy sources, availability & tariff details

Different energy sources, availability of listed energy types and their respective tariffs are given in table 2.4.

Table 2.4: Energy sources, availability and tariffs

Particular	HT-2(a)
Demand charges	Rs. 200/kVA/month
Energy charges	Rs. 6.6/kWh (For first One lakh units) Rs. 6.8/kWh (for balance units)

If the Consumer is availing power at voltage higher than 13.2 kV, he will be entitled to a rebate as indicated below:

- 33/66 kV: 2 Paise/ unit of energy consumed
- 110 kV: 3 Paise/ unit of energy consumed
- 220 kV: 5 Paise/ unit of energy consumed

2.5 Analysis of electricity consumption

Table 2.5: Electricity consumption profile

Month & Year	Electricity consumption (kWh)	Sanctioned load/demand (kW)	Power factor	Recorded demand, kVA	Demand charges (Rs)	Energy charges (Rs)	Monthly bill (Rs)
Oct-17	2,95,560	1,250	0.95	1,125	5,96,250	14,77,800	20,96,171
Nov-17	3,59,160	1,250	0.96	1,164	6,16,920	17,95,800	22,51,749
Dec-17	3,95,340	1,250	0.95	1,125	5,96,250	19,76,700	26,08,094
Jan-18	4,26,780	1,250	0.94	1,214	6,43,420	21,33,900	27,83,467
Yearly	44,30,520	-	-	-	73,58,520	2,21,52,600	2,92,18,443

Figure 2.5 presents contract demand, recorded maximum demand and the energy consumption of the unit.

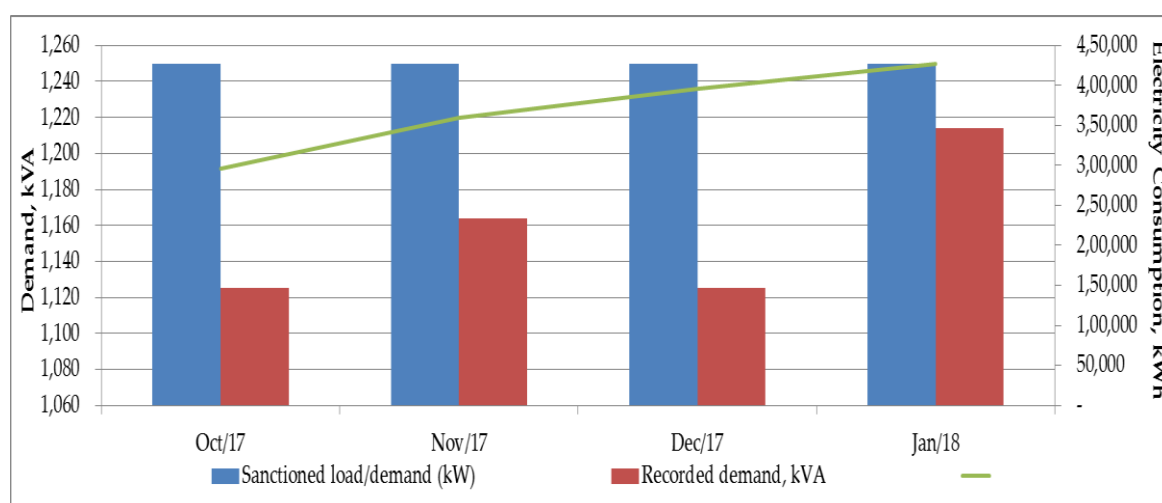


Figure 2.5: Demand pattern and energy consumption profile

2.6 Analysis of other energy forms/ fuels

The analysis of the other fuels/forms of energy used in the unit is given in table 2.6.

Table 2.6: Analysis of other energy/ fuel consumption

Parameters	LPG (kg)	LDO (Litre)
Consumption unit/year	10,355	95,328
Calorific value per unit	11,900	9,202
Equivalent toe per year	12.3	87.7
Price (Rs per unit)	58.6	29.9
Total price per year	6,06,699	28,49,905

The share of various energy forms used in the unit is given in figure 2.6.

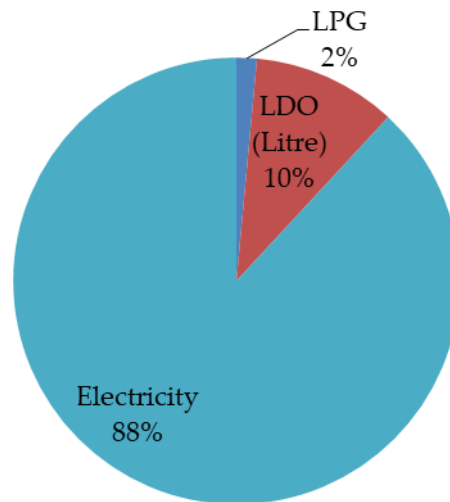


Figure 2.6: Percentage share of various fuel types in the unit

The plant is consuming about 44,30,520 kWh of electricity per year. The annual consumption of the LDO is 95328 litres and LPG is 10,355 kg. The total energy consumption of the unit during last 12 months is estimated to be 841 toe which is equivalent to 798 lakh rupees. The total CO₂ emission during this period is estimated to be 3,925 tonnes. Electricity, LDO and LPG were considered for CO₂ emission estimation.

3.0 Proposed technology for energy efficiency

Based on the measurements, observations/ findings during detailed assessment study conducted in the unit, the following technology has been identified for energy efficiency improvement. The detail is given below.

3.1 Replacement of existing induction furnace by new IGBT type induction furnace

3.1.1 Background

The Belgaum Ferrocast Private Limited is manufactures of the fabricated metal products, except machinery and equipment for Indian railways and installed an induction furnace of rated capacity of 1,250 kW with three crucibles of capacity of 500 kg each for melting. The details of the existing furnace installed in the unit are given in Table 3.1.1.

Table 3.1.1: Details of existing furnace

Parameters/ Equipment ID	Value
Equipment	Induction furnace
Type	SCR
Make	-
Purpose/ Application	Melting
Capacity	500 kg
Operating Temperature (°C)	1,600
Mode of operation (batch/continuous)	Batch
Batch duration (minute)	45-50
Fuel Details	Type
	Consumption (unit/batch)
	Electricity
	600-650 units/ tonne of melt

The operational parameters of the induction furnace including the electricity consumption and material charged were measured during the detailed assessment study and analysis of the past one-year data.

3.1.2 Observations and analysis

The specific power consumption of the induction furnace is estimated based on the data measured/collected during the field visit in the unit. The unit is charging approximate 100 kg pig iron, 150 kg MS, 250 kg scrap in a batch of approximate 500-520 kg. The average melting per batch has been estimated to be 500 kg per batch based on the data provided by the plant. The average pouring temperature is 1,430°C.

The average production of the melting section of the unit is estimated to be 29,085 kg melt production per day. The specific power consumption of the unit is estimated to be 651 kWh per tonne of liquid metal. The trend of specific power consumption (kWh per tonne of melt) of the induction furnace is shown in table.

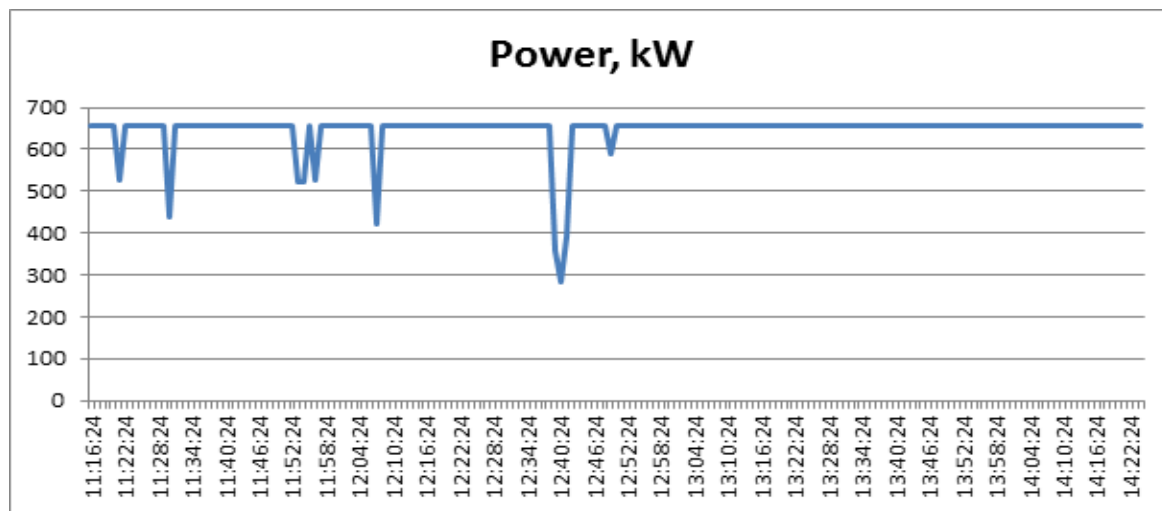


Figure 3.1.2a: Power consumption trend of induction furnace

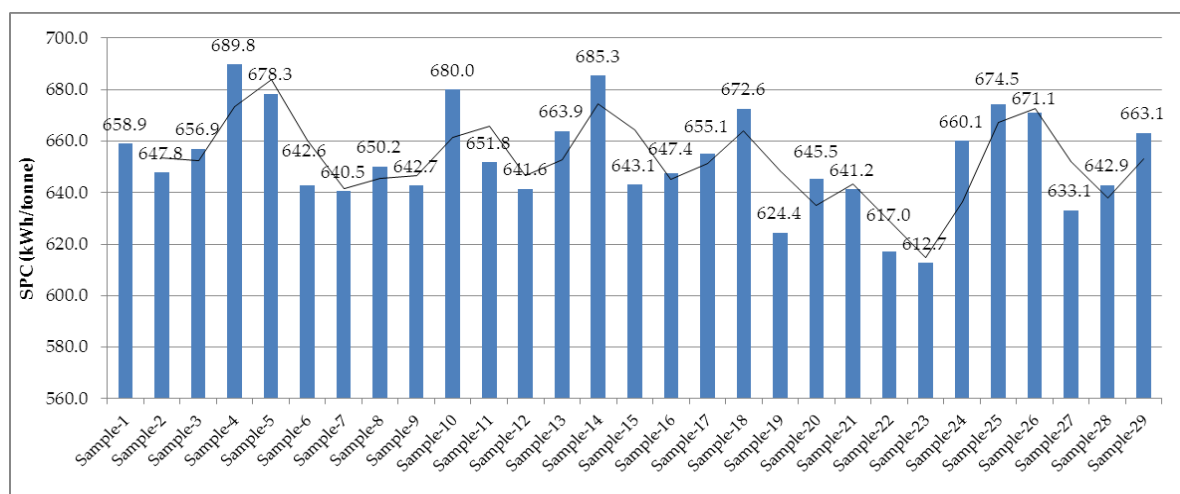


Figure 3.1.2b: Trend of specific power consumption of induction furnace

The specific energy consumption is higher than the consumption in similar categories of furnaces. Therefore, it is recommended to replace the existing induction furnace with a new induction furnace.

3.1.3 Recommendation

It is recommended to install new induction furnace with IGBT technology which will help to reduce the specific power consumption of melting. The specific energy consumption (induction furnace and auxiliary) of new furnace would be 540 kWh per tonne (weighted average of metal and slag @4%) as specified by vendor.

3.2 Cost benefit analysis

The estimated annual energy savings by replacement of existing SCR type induction furnace with IGBT type furnace is 618,547 kWh equivalent to a monetary saving of Rs 43.92 lakh. The investment requirement is Rs 38.4 lakh with a simple payback period of 0.87 year. The detailed calculations of the recommended energy conservation measures for DPR are provided in table 3.2.

Table 3.2: Cost benefit analysis for recommended energy savings measures

Parameters	Unit	Existing	Proposed
Make	-	Electrotherm	Oritech
Type	-	SCR	IGBT
Average input power	kWh/day	10,856	9,086
Average melting rate	kg/day	16,672	16,672
Specific energy consumption	kWh per metric tonne	651	545
Cycle time	Minute per batch	45	45
Total melting	Metric tonne per year	5,835	5,835
Total annual consumption	kWh per year	37,98,809	31,80,263
Annual energy saving	kWh per year	-	6,18,547
Electricity cost	Rs per unit	-	7.1
Monetary saving	Rs lakh per year	-	43.92
Investment cost	Rs lakh	-	30.7
Taxes and other misc. cost	Rs lakh	-	7.7
Total investment	Rs lakh	-	38.4
Payback period	Year	-	0.87

3.3 Pre-training requirements

The training would be required on best charging practices and best melting operations. Also best practices to be adopted for operation like - initial charging, pouring, superheating, holding for chemical analysis or de-slagging.

3.4 Process down time for implementation

The estimated process down time required for implementation of recommended measure is estimated to be 3 days after commissioning and testing of the new furnace.

3.5 Environmental benefits

3.5.1 CO₂ reduction¹

Implementation of the selected energy conservation measures in the unit may result in reduction in CO₂ emissions due to reduction in overall energy consumption. The estimated reduction in GHG emission by implementation of the recommended energy conservation measures is 507 tonne of CO₂ per year.

3.5.2 Reduction in other pollution parameters (gas, liquid and solid)

There is not significant impact on the reduction in other pollution parameters including gas, liquid and solid.

¹ Source for emission factor: 2006 IPCC Guidelines for National Greenhouse Gas Inventories & for electricity: CO₂ Baseline Database for the Indian Power Sector, user guide version 12.0, May 2017 (CEA)

4.0 Project financials

4.1 Cost of project and means of finance

4.1.1 Particulars of machinery and technology comparison

The particulars of machinery proposed for the project is given in table 4.1.1.

Table 4.1.1: Particulars of machinery proposed for the project

S. No.	Name of machinery (Model/ specification)	Name of manufacturer, contact person	Advantage	Disadvantage
1	IGBT based Induction Power Source with DM Water Circulation Unit, Tank Capacitor banks, Hydraulic Unit, 500 Kg Aluminum Frame Box type melting furnace.	Mr Shailesh Patel Director B/2-3, Sarthi Comp. & Estate, Opp. Gujarat Vahepari Maha Mandal (GVMM), Odhav, Ahmedabad - 382 415 (India) M: 093747 64116	<ul style="list-style-type: none"> Intelligent active demand manager. Medium frequency IGBT based induction furnace Provide end-end solution (such as panel, crucible, transformers, water cooling system, PLC etc.) Experience in the sector Old relationship with unit Local service centre 	-

4.1.2 Means of finance

The means of finance for the project is shown in table 4.1.2.

Table 4.1.2: Means of finance

S. No.	Details	100% equity	D/E- 70:30	D/E- 50:50
1	Additional (Share) Capital	38.4	11.5	19.2
2	Internal Accruals	-	-	-
3	Interest free unsecured loans	-	-	-
4	Term loan proposed (Banks/FIs)	-	26.9	19.2
5	Others	-	-	-
	Total	38.4	38.4	38.4

4.2 Financial statement (project)

4.2.1 Assumptions

The assumptions made are provided in table 4.2.1.

Table 4.2.1: Assumptions made

Details	Unit	100% equity	D/E- 70:30	D/E- 50:50
General about unit				
No of working days	Days		350	

DPR on IGBT type induction furnace (Belgaum Ferrocast India Pvt. Ltd., Belgaum)

Details	Unit	100% equity	D/E- 70:30	D/E- 50:50
No of shifts per day	Shifts		2	
Annual operating hours	Hrs/year		8,400	
Installed production capacity	tonnes/year		7,200	
Production in last financial years	tonnes/year		5,835	
Capacity utilization factor	%		81%	
Proposed investment (Project)				
Total cost of the project	Rs. (in Lakh)	38.4	38.4	38.4
Investment without interest defer credit (IDC)	Rs. (in Lakh)	38.4	38.4	38.4
Implementation time	Weeks	6	3	3
Interest during the implementation phase	Rs. in lakhs	-	0.2	0.1
Total investment	Rs. in lakhs	38.4	38.5	38.5
Financing pattern				
Own funds	Rs. in lakhs	38.4	11.7	19.3
Loan funds (term loan)	Rs. in lakhs	-	26.9	19.2
Loan tenure	Years	-	5.0	5.0
Moratorium period (No EMI (interest and principal amount))	Months	-	3.0	3.0
Total repayment period	Months	-	60.0	60.0
Interest rate	%	-	10.5%	10.5%
Estimation of costs				
Operation & maintenance costs	%		5.0	
Annual escalation rate of O&M	%		5.0	
Estimation of revenue				
Reduction in energy cost	Rs lakh/year		43.9	
Total saving	Rs lakh/year		43.9	
Straight line depreciation	%		16.21	
IT depreciation	%		80.0	
Income tax	%		33.99	
Period of cash flow analysis	Years		5.0	

4.2.2 Payback

The simple payback period on the investments made are shown in table 4.2.2.

Table 4.2.2: Payback

Details	100% equity	D/E- 70:30	D/E- 50:50
Total project cost (Rs. In lakh)	38.4	38.5	38.5
Cash flow as annual saving (Rs. In lakh/year)	43.9	43.9	43.9
O&M Expenses for first year (Rs. In lakh/year)	1.9	1.9	1.9
Net Cash flow (Rs. In lakh/year)	42.0	42.0	42.0
SPP (months)	11.0	11.0	11.0
Considered (month)	11.0	11.0	11.0

4.2.3 NPV and IRR

The NPV and IRR calculations are shown in table 4.2.3.

Table 4.2.3a: NPV and IRR (100% equity)

Particulars / years	0	1	2	3	4	5
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Particulars/ years	0	1	2	3	4	5
	(Rs. in lakhs)					
Profit after tax	-	35.78	19.69	21.79	21.39	21.25
Depreciation	-	6.22	6.22	6.22	6.22	6.22
Cash outflow	38.38	-	-	-	-	-
Net cash flow	-38.38	42.00	25.91	28.01	27.61	27.47
Discount rate % @ WACC	9.30	9.30	9.30	9.30	9.30	9.30
Discount factor	1.00	0.92	0.84	0.77	0.70	0.64
Present value	-38.38	38.44	21.71	21.48	19.38	17.65
Net present value	80.28					
Simple IRR considering regular cash flow	84.85%					

Table 4.2.3b: NPV and IRR (D/E- 70:30)

Particulars/ years	0	1	2	3	4	5
	(Rs. in lakhs)					
Profit after tax	-	34.38	18.60	20.52	20.48	20.74
Depreciation	-	6.25	6.25	6.25	6.25	6.25
Cash outflow	38.54	-	-	-	-	-
Net cash flow	-38.54	40.63	24.85	26.76	26.72	26.99
Discount rate % @ WACC	10.10	10.10	10.10	10.10	10.10	10.10
Discount factor	1.00	0.91	0.83	0.75	0.68	0.62
Present value	-38.54	36.89	20.49	20.04	18.17	16.67
Net present value	73.72					
Simple IRR considering regular cash flow	80.69%					

Table 4.2.3c: NPV and IRR (D/E- 50:50)

Particulars/ years	0	1	2	3	4	5
	(Rs. in lakhs)					
Profit after tax	-	34.78	18.91	20.88	20.74	20.89
Depreciation	-	6.24	6.24	6.24	6.24	6.24
Cash outflow	38.49	-	-	-	-	-
Net cash flow	-38.49	41.02	25.15	27.12	26.98	27.13
Discount rate % @ WACC	9.90	9.90	9.90	9.90	9.90	9.90
Discount factor	1.00	0.91	0.83	0.75	0.69	0.63
Present value	-38.49	37.33	20.83	20.45	18.51	16.94
Net present value	75.57					
Simple IRR considering regular cash flow	81.88%					

4.3 Marketing & selling arrangement

The marketing and selling arrangements of the unit are given in table 4.3.

Table 4.3: Marketing & selling arrangements

Items	Remarks
Main Markets (locations)	Pan India
Locational advantages	-
Indicate competitors	Other manufacturing units
Any USP or specific market strength	-
Whether product has multiple applications	NA

Items	Remarks
Distribution channels (e.g. direct sales, retail network, distribution network)	Direct sales
Marketing team details, if any.	NA

4.4 Risk analysis and mitigation

The risk analysis and mitigation for the proposed options are given in table 4.4.

Table 4.4: Risk analysis and mitigation

Type of risk	Description	Mitigation
Technology	The equipment/ technology provided by the supplier may not be of high quality, which may result in underperformance.	The equipment/ technology should be procured from standard/reputed vendors only.
Market /Product	Demand of the product manufactured by the unit may change resulting in lower capacity utilization.	Regular vigilance/tab on the market scenario by the SME will help in better understanding of new substitute product. The unit may modify the product line based on the emerging market trend.
Policy/Regulatory	Changes in government regulation/policy related to pollution and taxes & duties can affect the viability of the unit.	Local industrial association may play a role in discussing these issues with the relevant governmental bodies on a regular basis, so that any concerns of the unit are brought to their notice.

4.5 Sensitivity analysis

A sensitivity analysis for various scenarios which may affect the return on investment is given in table 4.5.

Table 4.5: Sensitivity analysis

S. No.	Scenario	D/E ratio	SPP	NPV	IRR	DSCR	ROI
			(months)	(Rs lakh)	(%)		(%)
1	10% increase in estimated savings	100% equity	2.2	11.6	48.9	-	44.2
		70:30	2.2	11.2	48.3	2.1	47.0
		50:5	2.2	11.3	48.5	0.9	46.2
2	10% reduction in estimated savings	100% equity	2.7	9.3	39.3	-	43.3
		70:30	2.7	9.0	38.7	2.1	46.6
		50:50	2.7	9.1	38.9	0.9	45.6
3	10% rise in interest rates	70:30	2.4	9.9	43.4	2.1	46.8
		50:50	2.4	10.1	43.6	0.9	45.9
4	10% reduction in interest rates	70:30	2.4	10.3	43.6	2.1	46.8
		50:50	2.4	10.4	43.7	0.9	45.9

5.0 Conclusions & recommendations

The IGDPR prepared for the replacement of existing induction furnace by new IGBT type induction furnace based on the performance assessment study conducted at unit and the acceptance of the unit management. The brief of selected energy conservation measure is given below.

5.1 List of energy conservation measures

The brief summary of the energy conservation measures are given in table 5.1.

Table 5.1: Summary of the energy conservation measures

Technology	Annual energy saving	Investment (Rs lakh)	Monetary savings	Simple payback period (Years)	Emission reduction (tonnes of CO ₂)
	Electricity (kWh)		(Rs lakh/year)		
Replacement of existing induction furnace by new IGBT type induction furnace	6,18,547	38.4	43.9	0.87	507

The measure has an estimated investment of 38.4 lakh rupees and can yield a savings of 43.9 lakh rupees per year. The total annual reduction in emission by implementation of recommended measure is estimated to be 507 tonnes of CO₂. The financial indicators provided above in the table shows the project is financially viable and technically feasible.

5.2 Summary of the project

The summary of the project is given in table 5.2.

Table 5.2: Summary of the project

S. No.	Particulars	Unit	100% equity	D/E- 70:30	D/E- 50:50
1	Cost of Project	Rs. In Lakh	38.4	38.4	38.4
2	D/E Ratio	-	-	7:3	1:1
3	Project IRR	%	84.8	80.7	81.9
4	NPV	Rs. In Lakh	80.3	73.7	75.6
5	DSCR	-	-	2.1	0.9

5.3 Recommendations

The financial indicators provided above show the project is financially viable and technically feasible. It is recommended that the implementation of the identified the energy conservation measures may be undertaken by the unit.

6.0 Financing schemes for EE investments for MSME sector

Government of India has many schemes to provide concessional finance for EE technologies among MSMEs. Some major government schemes are summarised in table 6.1.

Table 6.1: Major government schemes

Name of the scheme	Brief Description and key benefits
ZED assessment and certification	<p>Assessment process, fee and subsidy are as follows: Online (e-Platform) self-assessment: Nil fee Desk Top assessment : Rs 10,000 per SME Complete assessment : Rs 80,000 ZED rating per SME; Rs 40,000 for additional ZED defence rating; Rs 40,000 for re-rating The rating costs will include cost of Rs 10,000/- as certification cost by QCI. Subsidy for Micro, Small and Medium Enterprises are 80%, 60% and 50% respectively.</p>
Credit Linked Capital Subsidy Scheme (CLCSS) (2000-ongoing)	<p>15% capital subsidy of cost of eligible plant and machinery / equipment for adoption of proven technologies for approved products / sub-sectors for MSE units subject to ceiling of INR 15 lakhs</p>
Credit Guarantee Fund Scheme for Micro and small Enterprises (in partnership with SIDBI) (2000-ongoing)	<p>This scheme was launched by MoMSME and SIDBI to alleviate the problem of collateral security and enable micro and small scale units to easily adopt new technologies. Under the scheme, collateral free loans up to Rs 1 crore can be provided to micro and small scale units. Additionally, in the event of a failure of the SME unit which availed collateral free credit facilities to discharge its liabilities to the lender, the Guarantee Trust would guarantee the loss incurred by the lender up to 75 / 80/ 85 per cent of the credit facility.</p>
Technology and Quality Up gradation Support to MSMEs (TEQUP) (2010-ongoing)	<p>The benefits available to SMEs under TEQUP include – technical assistance for energy audits, preparation of DPRs and significant capital subsidy on technologies yielding an energy savings of over 15%. The scheme offers a subsidy of 25% of the project cost, subject to a maximum of Rs. 10 lakhs. TEQUP, a scheme under NMCP, focuses on the two important issues in enhancing competitiveness of the SME sector, through EE and Product Quality Certification.</p>
Technology Upgradation Fund Scheme (TUFS) (1999-ongoing)	<p>Interest subsidy and /or capital subsidy for Textile and Jute Industry only.</p> <ol style="list-style-type: none"> To facilitate Technology Up gradation of Small Scale (SSE) units in the textile and jute industries. Key features being: <ul style="list-style-type: none"> Promoter’s margin -15%; Subsidy - 15% available on investment in TUF compatible machinery subject to ceiling of Rs 45 lakh; Loan amount - 70% of the cost of the machinery by way of Term Loan

Name of the scheme	Brief Description and key benefits
	<ul style="list-style-type: none"> • Interest rate: Reimbursement of 5% on the interest charged by the lending agency on a project of technology upgradation in conformity with the Scheme • Cover under Credit Guarantee Fund Scheme for Micro and Small Enterprises (CGMSE) available <p>2. To enable technology upgradation in micro and small power looms to improve their productivity, quality of products and/ or environmental conditions</p> <ul style="list-style-type: none"> • 20% margin subsidy on investment in TUF compatible specified machinery subject to a ceiling of Rs 60 lakhs or Rs 1crore (whichever is applicable) on subsidy amount to each unit - released directly to the machinery manufacturer.
Tax incentives	<ul style="list-style-type: none"> • Accelerated depreciation is provided to the customers / users of the energy saving or renewable energy devises under the direct tax laws. • Under indirect taxes, specific concessional rates of duty are only available to CFLs and not to all energy efficient products • A further waiver of import tariffs and taxes for EE technology imports are dealt on a case to case basis, meaning higher costs for those imported technologies that are not available in the domestic markets at present.

Two financing schemes have been created by Bureau of Energy Efficiency (BEE) under The National Mission for Enhanced Energy Efficiency (NMEEE) for financing of energy efficiency projects - Venture Capital for Energy Efficiency (VCFEE) and Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE). These funds seek to provide appropriate fiscal instruments to supplement the efforts of the government for creation of energy efficiency market. Highlights of these two schemes are provided in the table 6.2.

Table 6.2: BEE's VCFEE and PRGFEE scheme

Venture Capital for Energy Efficiency (VCFEE)	<ul style="list-style-type: none"> • This fund is to provide equity capital for energy efficiency projects in Government buildings and Municipalities in the first phase. • A single investment by the fund shall not exceed Rs 2 crore • Fund shall provide last mile equity support to specific energy efficiency projects, limited to a maximum of 15% of total equity required, through Special Purpose Vehicle (SPV) or Rs 2 crore, whichever is less
Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE)	<ul style="list-style-type: none"> • A PRGF is a risk sharing mechanism lowering the risk to the lender by substituting part of the risk of the borrower by granting guarantees ensuring repayment of part of the loan upon a default event. • Guarantees a maximum 50% of the loan (only principal). In case of default, the fund will: <ul style="list-style-type: none"> ○ Cover the first loss subject to maximum of 10% of the total guaranteed amount ○ Cover the remaining default (outstanding principal) amount on

Venture Capital for Energy Efficiency (VCFEE)	<ul style="list-style-type: none"> This fund is to provide equity capital for energy efficiency projects in Government buildings and Municipalities in the first phase. A single investment by the fund shall not exceed Rs 2 crore Fund shall provide last mile equity support to specific energy efficiency projects, limited to a maximum of 15% of total equity required, through Special Purpose Vehicle (SPV) or Rs 2 crore, whichever is less
	<p>partial basis upto the maximum guaranteed amount</p> <ul style="list-style-type: none"> PFI shall take guarantee from the PRGFEE before disbursement of loan to the borrower. The Guarantee will not exceed Rs 300 lakh per project or 50% of loan amount, whichever is less. Maximum tenure of the guarantee will be 5 years from the date of issue of the guarantee

Indian Renewable Energy Development Agency (IREDA), a non-banking financial institution established by the government also extends financial assistance for setting up projects relating to new and renewable sources of energy and energy efficiency/conservation. The detailed financing guidelines for energy efficiency projects are provided in table 6.3.

Table 6.3: IREDA's financing guidelines

Eligible companies who can apply	Private Sector Companies/ firms, Central Public Sector Undertaking (CPSU), State Utilities/ Discoms/ Transcos/ Gencos/ Corporations, Joint Sector Companies which are not loss making.
Minimum loan amount	<ul style="list-style-type: none"> Rs. 50 lakh
Type of projects considered for term loans	<ul style="list-style-type: none"> Replacement / retrofit of selected equipment with energy efficient equipment Modification of entire manufacturing processing Recovery of waste heat for power generation
Incentive available	<ul style="list-style-type: none"> Rebate in central excise duty Rebate in interest rate on term loan Rebate in prompt payment of loan instalment
Interest rate	<ul style="list-style-type: none"> 10.60% to 11.90% depending upon the grading of the applicant with prompt payment rebate of 15 bps if payment is made on / before due dates Interest rates are floating and would be reset on commissioning of the project or two years from the date of first disbursement. Thereafter, the rates will be reset after every two years. Rebate of 0.5% in interest rates are available for projects set up in North Eastern States, Sikkim, J&K, Islands, Estuaries. Rebates of 0.5% in interest rates are also available for projects being set up by SC/ST, Women, Ex Servicemen and Handicapped categories involving project cost of upto Rs. 75.00 lakh.
Loan	Upto 70% of the total project cost. Promoter's contribution should be Minimum 30% of the total project cost
Maximum debt	3:1

equity ratio	The project cash flow should have a minimum average Debt Service Coverage Ratio of 1.3
Maximum repayment period	12 years with moratorium of maximum 12 months
Procurement procedures	The borrower is required to follow the established market practices for procurement and shall demonstrate that the quality goods and services are being purchased at reasonable and competitive prices. Wherever the loan is sanctioned against international lines of credit such as the World Bank, Asian Development Bank, kfW, etc., the relevant procedures will have to be followed and requisite documents will have to be submitted by the borrower

Small Industries Development Bank of India (SIDBI) has several schemes and focused lines of credit for providing financial assistance for energy efficiency and cleaner production projects for SMEs. Highlights of some of the major financial assistance schemes/projects managed by SIDBI are given in table 6.4.

Table 6.4: Major EE financing schemes/initiatives of SIDBI

End to End Energy Efficiency (4E) Program	<p>Support for technical / advisory services such as:</p> <ul style="list-style-type: none"> • Detailed Energy Audit • Support for implementation • Measurement & Verification <p>Financing terms:</p> <ul style="list-style-type: none"> • Terms loans upto 90% • Interest rate upto 3% below normal lending rate.
TIFAC-SIDBI Revolving Fund for Technology Innovation (Srijan Scheme)	<p>To support SMEs for up-scaling and commercialization of innovative technology based project at flexible terms and interest rate.</p> <p>Preference accorded to sustainable technologies / products. Soft term loan with an interest of not more than 5%.</p>
Partial Risk Sharing Facility for Energy Efficiency (PRSF) Project (supported by World Bank)	<p>Sectors covered:</p> <ul style="list-style-type: none"> • Large industries (excluding thermal power plants) • SMEs • Municipalities (including street lighting) • Buildings <p>Coverage:</p> <ul style="list-style-type: none"> • The minimum loan amount Rs 10 lakh and maximum loan amount of Rs 15 crore per project. • The extent of guarantee is 75% of the loan amount
JICA-SIDBI Financing Scheme	<ul style="list-style-type: none"> • The loan is used to provide SMEs with funds necessary to invest in energy-saving equipment (and some medical equipment) in the form of two-step loans through SIDBI or three-step loans through intermediary financial institutions.

	<ul style="list-style-type: none"> • Project uses an Energy Saving Equipment List approach • Equipment/machinery with energy saving potential less than 10% is not eligible. • Interest rate: As per credit rating and 1% below the normal lending rate • Separate technical assistance component which is used for wetting of loan applications, holding seminars to raise awareness of energy saving among SMEs and to improve the ability of financial institutions to screen loan applications for energy-saving efforts
KfW-SIDBI Financing Scheme	<p>Coverage</p> <ul style="list-style-type: none"> a) SMEs for energy efficiency projects b) SMEs and clusters for cleaner production and emission reduction measures, waste management and Common Effluent Treatment Plant (CETP) facilities <p>Interest rate</p> <p>As per credit rating and 1% below the normal lending rate</p> <p>Eligible criteria</p> <p>3 t CO₂ emission reduction per year per lakh invested</p> <p>List of eligible equipment/technology and potential suppliers developed for guidance</p>

State Bank of India (SBI) has been provided a green line of credit by Japan Bank for International Cooperation (JBIC) for financing of energy efficiency investments. Highlights of the line of credit are given in table 6.5.

Table 6.5: JBIC-SBI Green Line

<p><u>Key Features</u></p> <ul style="list-style-type: none"> • Amount : USD 90 million • Repayment Schedule: First repayment on May 30, 2017 and final repayment date May 30, 2025 (equal instalment) • <p><u>Eligibility Criteria</u></p> <ul style="list-style-type: none"> • Projects contributing to preservation of global environment, i.e. significant reduction of GHG emissions • Acceptance of JBIC-MRV ("J-MRV") by the project proponent in terms of the numerical effect of the environment preservation. To ensure effective GHG reduction emissions in Green financed projects, JBIC reviews such effects through simple and practical Measurement Reporting Verification (MRV) process both in (a) prior estimation and (b) ex-post monitoring. • Procurement in line with the "Guidelines for Procurement under Untied Loans by Japan Bank for International Cooperation"

Canara bank has a dedicated scheme for financing EE investment among SME sector as mentioned in table 6.6.

Table 6.6: Canara bank scheme of EE SME loans

Purpose	For acquiring/adopting energy conservation/savings equipment/ measures by SMEs
Eligibility	Units under Small and Medium Enterprises Cost of energy for the unit should constitute not less than 20% of the total cost of production Unit should possess energy audit report issued by an approved energy Consultant/ Auditor. Borrowal a/cs-ASCC code S1 or S2 during previous review. Current account holders having dealings exclusively with us satisfactorily for a period of last one year
Maximum loan	Maximum Rs 100 lakhs in the form of term loan
Security	Prime: Assets created out of loan Collateral: Upto Rs.5 lakhs – NIL Above Rs.5 lakhs, as determined by the bank
Repayment	Maximum 5-7 years including moratorium of 6 months
Guarantee cover	Cover available under CGMSE of CGTMSE available for eligible loans
Margin	10% of the project cost
Rate of interest	1% less than the applicable rate
Upfront fee	1% of the loan
Insurance cover	Assets acquired and charged as security to Bank to be insured
Special offer, if any	Grants : Bank provides 25% of the cost of Energy Audit / Consultancy charges with a maximum of Rs 25000/- to the first 100 units on a first come first served basis which is in addition to the grant of Rs 25000/- being provided by IREDA(First 100 units)

Among the private sector banks in India, Yes Bank is also active in financing of renewable energy and energy efficiency projects. The bank has an MOU with SIDBI for providing funding for EE through PRSF.

Most commercial banks charge interest rate between from 11% to 13% from MSMEs depending upon general criteria such as credit ratings, references, past lending record, balance sheet for last 3 years and so on. Interest rebate is offered for a few customers whose collateral value is around 125% of the loan amount. Further 0.5% concession in interest rate was offered to women entrepreneurs.

Annexures

Annexure 1: Budgetary offers / quotations

Quotation – 1: Oritech Solutions



May 11, 2018
Industrial Energy Efficiency & Sustainable Technologies
The Energy & Resources Institute (TERI)
Darbari Seth Block, I H C Complex
Lodhi Road, New Delhi 110 003/India
Mobile: 9910648515

Kind Attn: Mr. Pawaan Kumar Tiwari

SUBJECT: Offer for 550 kW / 500 Kg IGBT based INDUCTION MELTING FURNACE

Dear Sir,

This is in connection to our discussion regarding your requirement of Induction melting Furnace for steel Melting.

As per your requirement please find our offer No.: OTM/1661/1819 for 550 kW IGBT based Induction Power Source with DM Water Circulation Unit, Tank Capacitor banks, Hydraulic Unit, 500 Kg Aluminum Frame Box type melting furnace.

We look forward to associate further with your company.
For any further information/details, please feel free to contact us.

Thanking you,

Yours faithfully,

for **ORITECH** solutions

Shailesh Patel
DIRECTOR
M: 093747 64116

Qtn. No.: OTM/1661/1819
Date: 11-May.-18
Page: 2 of 10

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Delhi



QUOTATION

Sr.No.	Description	Qty.	Price (Rs. in Lacs)
1.	550 kW / 500 Hz IGBT Based Solid State Power Source. <ul style="list-style-type: none"> 550 kW Solid State Fully fired uncontrolled Rectifier. Medium Frequency IGBT based 550 Kw rated inverter. Programmable Logic Controller with 7" Colour Touch screen HMI. Energy Meter with Ethernet Communication. Earth Leakage and Water Conductivity Monitoring System. Electrical wiring drawings and water circuit diagrams. 	1 No.	16.60
	Intelligent Active Demand Manager. <ul style="list-style-type: none"> Active Demand Controller with Auto Power Control circuit. Additional Programmable Logic Controller Module. One No. Additional Energy Meter with RS-485 Communication. Enclosure with 96 x 96 cutout for Energy Meter, with internal wiring and Fuse Protection. 	1 unit	
	Auxiliaries: <ul style="list-style-type: none"> D. M. Water circulation unit complete with non-Ferrous pump, Plate type Heat Exchanger and D.M. Resin Cylinder. Hydraulic Power Pack direction control valves, sub plate, mounting stand with Hydraulic Pipes. 	1 set	
2.	500 kg Aluminum Frame Box type Melting Furnace. <ul style="list-style-type: none"> One No. of 500 kg Aluminum frame melting furnace. One set Medium frequency tank capacitor bank. Copper Bus-bars from Capacitor bank to Melting Furnace. One set of Inlet and Outlet manifolds, Magnetic Flow switches, Valves, Temperature and Pressure Gauges. Furnace Erection materials consisting of Carbon Free Rubber hoses, fastener, fittings, etc. Hydraulic tilting components consists of direction control valve, interconnecting seamless pipe etc. 	2 No.	12.40
3.	Additional Plate type heat exchanger for Coil DM water cooling.	1 No	1.70
TOTAL OF ABOVE			Rs. 30.70 LAC.
TOTAL INDIAN RUPEES THIRTY LAC AND SEVENTY THOUSAND ONLY.			



Extra features of the IGBT based Induction melting system

- **Most advanced and highly efficient IGBT Inverter design compared to conventional Thyristorised design available in market.**
- **Guaranteed 7.5 – 10 % less energy Consumption compared to any other furnaces.**
- **Indigenously developed IGBT Inverter design NO IGBT Chopper.**
- **Maintains Output power with wide variation in input voltage.**
- **Water cooled cable carries only active current of inverter, saving of electrical energy upto 2-5%.**
- **Max. demand controller gives same production even with upto 10-15% lower sanctioned load.**
- **7" colour touch screen HMI with following specification.**
 - Display with 65536 colour, resolution 800x480 pixels, MCU 32 bit RISC micro controller, Flash ROM 128MB, 64MB SDRAM, Backup memory 16 MB, 01 nos USB client Ver 1.1,)3 nos com port.
- **Max. Up to 10 years of Storage facility of data like KWh consumed, daily/ shift wise production report, tripping log ETC.**
- **Automatic Sintering facility for upto 99 type of different sintering pattern.**
- **Data can be saved to USB pen drive and further printed in to MS- Excel format.**
- **Online interlock and tripping navigation facilities with description and photographs for easy diagnostic of fault.**
- **Ethernet connectivity to access system from anywhere in the world.**
- **No Separate Load Manager, Power Optimizer OR power factor correction bank required.**

TERMS AND CONDITIONS

- | | | | |
|----|--------------------------------|---|--|
| 1. | Price | : | Ex our works. |
| 2. | Validity | : | 30 days from the date of this Quotation. |
| 3. | Packing | : | 1% of the basic value for wooden box packing(Except item No 2). |
| 4. | GST | : | 18 % Or as applicable at the time of dispatch. |
| 5. | Other Levis / Taxes | : | As applicable at the time of dispatch, to your account. |
| 6. | Freight with Transit Insurance | : | At actual, to your account. |
| 7. | Delivery Period | : | 14 to 16 weeks after receipt of Techno-Commercial confirmed Purchase Order and Advance payment. |
| 8. | Payment Terms | : | 40 % as Advance with Purchase Order;
Balance against Proforma Invoice before dispatch. |
| 9. | Warranty | : | 12 months from the date of Commissioning or
15 months from the date of Dispatch whichever is earlier. |

OTHER AUXILIARIES THAT ARE NOT IN OUR SCOPE OF SUPPLY

1. 600 KVA, 33KV/0.575 KV, 3ph 50 Hz Rectifier Duty furnace transformer.
2. Input Supply of 565 KVA, 575V, 3-ph, 50 Hz with Suitable rated cable/ busbars along with terminations and cables for the Main Equipment.
3. Pumps for DM water cooling and Coil cooling DM water circulation.
4. Cooling tower (90 TR).
5. Communication data cable from plant main input to melting furnace power supply unit.
6. DM Water storage tank for coil cooling circuit with associated pipe line, valves, filters and gauges etc.
7. Overhead water tank and underground water storage arrangement.
8. Melting former and hydraulic oil. (drawing of melting former will be provided by us).

B/2-3, Sarthi Comp. & Estate, Opp. Gujarat Vahepari Maha Mandal (GVMM),
Odhav, Ahmedabad – 382 415 (INDIA)
Ph: +91-79-32957055, Tele-fax: +91-79-22901350 | E-mail: info@oritech.in | web: www.ortech.in

Qtn. No.: OTM/1661/1819
Date: 11-May.-18
Page: 8 of 10

Industrial Energy Efficiency &
Sustainable Technologies
Delhi



OTHER TERMS & CONDITIONS

Installation & Commissioning:

Total Installation will be done by customer as per drawings submitted by us. However if required we can provide our Representative on per day charge bases. After completion of erection work and making all other necessary arrangements for start-up like power, water, manpower raw materials etc, we will depute our representative for commissioning. During commissioning, you will provide necessary skilled and unskilled work force with tools and tackles to our engineers. **We will provide you assistance of our engineers for a maximum of 3 days at your end. This period is sufficient for commissioning of the above equipment and in case the number of working days exceeds, extra commissioning charge of Rs. 7000/- will be charged per day / engineer.**

In addition, you will arrange boarding and lodging, to & fro fare, conveyance and any other incidental expenses during Installation and commissioning or the same will have to be paid by you at actual as applicable.

Any third party inspection and testing required during erection and commissioning will be arranged by the customer. All expenses regarding testing & inspection will be borne by the customer. If any approvals, work permits, insurance coverage, etc. are needed to be procured from the local governing bodies or as per the local statutes, then the same will be arranged by the buyer.

Warranty:

The equipment is guaranteed for 12 months from the date of commissioning or 15 months from the date of dispatch, whichever is earlier. It should be clearly understood that this guarantee is against any manufacturing/ design defects, if any. The warranty does not extend to components like fuses, thyristors, capacitors, etc. and consumables such as refractory, hydraulic oil, rubber/ plastic parts. However all the control cards are guaranteed for above mentioned time period. Our liability is only limited to repairing the equipment or replacing any defective control card which is been supplied by us, but does not extend to any incidental or consequential damages.

This warranty is valid only if

1. The equipment is commissioned and serviced by our engineer,
2. The equipment is used as per our guidelines and
3. You use genuine spare parts supplied by us.

The warranty may elapse if the customer is found to be using components from any other sources or manufactured by himself without our express written permission or has tampered any of the settings of the system. Further the warranty will not cover any failure arising out of improper operation, maintenance negligence, heavy voltage fluctuation, erratic supply voltage or any accident.

After Sales Service:

It is suggested that the buyer employ's well trained maintenance staff capable of carrying out all routine maintenance jobs themselves as per our instructions. After

B/2-3, Sarthi Comp. & Estate, Opp. Gujarat Vahepari Maha Mandal (GVMM),
Odhav, Ahmedabad – 382 415 (INDIA)
Ph: +91-79-32957055, Tele-fax: +91-79-22901350 | E-mail: info@oritech.in | web: www.oritech.in

Qtn. No.: OTM/1661/1819
Date: 11-May.-18
Page: 9 of 10

Industrial Energy Efficiency &
Sustainable Technologies
Delhi



sales services will be provided by our representative without any service charges during warranty period and on chargeable basis thereafter, depending on availability.

However, in both the cases actual expenses like traveling, lodging boarding, etc will be borne by the customer.

Price Escalation

The prices quoted is based on the current price of raw-materials like Steel, Copper, Stamping, etc. and major components like capacitors, thyristors etc. Any major escalation in the price of the above items will alter the equipment price if delivery time will prolonged by customer beyond 3 months from committed time.

Delayed Payment

Delayed payment will accordingly delay the delivery of equipment. Further interest @ 15% per annum will be charged on the amount of delayed payment after a grace period of 30 days.

Termination

If the purchaser terminates the order after placing his order, the purchaser shall reimburse the seller all costs including materials purchased and committed, direct and indirect labor, manufacturing and engineering costs plus 30% overheads to cover other expenses. In no case, the termination charges will be less than 30% of the purchase order. *All legal disputes subject to Ahmadabad Jurisdiction.*

Arbitration

Any dispute arising regarding the contract shall be referred to two arbitrators, one to be appointed by either party. The arbitrators shall, before proceeding with the arbitration nominate an umpire. For the time being the umpire will be nominated by the president of Gujarat Chamber of Commerce. The arbitration will be held in Ahmedabad and in accordance with the provision of Indian Arbitration Act 1940 and/or any act substituting statutory modification thereof.

Force Majeure Clause:

The delivery schedule as mentioned by us is subject to Force Majeure Clause. The Force Majeure conditions would mean delay in delivery commitment due to:

1. Civil wars or hostilities whether declared or not.
2. Riot or civil commotion.
3. Earthquake, flood, fire or natural disasters.
4. Load shedding or power breakdown or disruption in water supply due to reasons beyond our reasonable controls.

The delivery period as offered by us shall automatically get extended by the period of delay occurred due to any of the factors mentioned above or any other factors which may influence delivery period.

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Qtn. No.: OTM/1661/1819
Date: 11-May.-18
Page: 10 of 10

Industrial Energy Efficiency &
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Delhi



Jurisdiction

All disputes are subject to Indian laws and are covered by Ahmedabad, India Jurisdiction only.

Modifications

Neither this offer nor any provisions of this offer can be changed, modified, waived, discharged orally but only by an instrument in writing agreed by both the parties against which enforcement of the change, modification, waiver, discharge is sought.

for **ORITECH** solutions

Shailesh Patel
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Annexure 2: Instruments used

Instruments	Model/ Make	Application	Accuracy
Power analysers	Fluke: 435, Fluke: 43B,	Electrical Parameters Harmonics analysis, power logging	$\pm 0.5\%$
Thermal imager	875-2/Testo	Surface Temperature & Image	$\pm 2\%$
Infrared thermometer	Testo: 845, Comark: KM848	Surface Temperature	$\pm 0.75\%$ of mv