

# Detailed Project Report On Waste Heat Recovery

M/s Big Castings 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

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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 Niranjan Rao Devela, National Technology Coordinator, Mr Sadanand Humberwadi, Cluster Leader, Belgaum Foundry Cluster, UNIDO, Mr Mahantesh Mangasuli (GM), M/s Big castings 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



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## List of abbreviations

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BEE	Bureau of Energy Efficiency
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon Dioxide
D/E	Debt /Equity
DPR	Detailed Project Report
DSCR	Debt Service Coverage Ratio
EE	Energy Efficient
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
IRR	Internal Rate of Return
kCal	kilocalories
kg	Kilogram
kV	Kilo vault
kVA	kilovolt-ampere
kW	Kilo Watt
kWh	Kilo Watt Hour
LPG	Liquid Petroleum Gas
LSPs	Local Service Providers
MD	Maximum Demand
MSME	Micro, Small and Medium Enterprises
NPV	Net Present Value
O&M	Operation and Maintenance
O <sub>2</sub>	Oxygen
PID	Proportional Integral Derivative
RE	Renewable Energy
ROI	Return On Investment
Rs	Rupees
SPP	Simple Payback Period
TERI	The Energy and Resources Institute
toe	tonne of oil equivalent
UNIDO	United Nations Industrial Development Organization
WACC	Weighted Average Cost of Capital



## Executive summary

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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 Big Castings (P) Ltd.
Constitution	Private Limited
MSME Classification	Medium
No. of years in operation	16
Address: Registered Office:	Plot No.75, KIADB, Honaga Industrial Area, BELGAVI - 591113
Industry-sector	Steel and Graded castings
Products manufactured	Castings for Mining, earthmoving and construction equipment's
Name(s) of the promoters/ directors	Mr. Chandrashekhar Dolli (CMD), Mr. Mahantesh Mangasuli (GM)

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 556.6 toe which is equivalent to 407.3 lakh rupees. The total CO<sub>2</sub> emission during this period is estimated to be 3,350 tonnes. Electricity and LPG were considered for CO<sub>2</sub> emission estimation.

The unit manufactures Castings for Mining, earthmoving and construction equipment's. The total annual liquid metal production of the unit during 2017-18 is estimated to be 3,750 tonnes and good castings production is around 3,000 tonnes. 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:

Energy conservation measures	Annual energy savings	Investment <sup>1</sup>	Savings	Simple Payback	Emission reduction
	LPG (kg)	(Rs Lakh)	(Rs. Lakh/ year)	(Year)	(tonnes CO <sub>2</sub> )
Installation of recuperator for heat treatment furnace	6,423	4.42	3.76	1.2	19.2

## 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 CO<sub>2</sub> 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	4.42	4.59	4.54
2	D/E Ratio	-	-	7:3	1:1
3	Project IRR	%	59.03	52.65	54.44
4	NPV	Rs. In Lakh	5.91	5.10	5.33
5	DSCR	-	-	3.74	5.20

<sup>1</sup>Investment including the recuperator – Rs. 3.95 lakhs & taxes and miscellaneous – Rs. 0.47 lakhs

# 1.0 Details of the unit

---

## 1.1 Particulars of unit

**Table 1.1:** Particulars of the unit

Name of the unit	M/s Big Castings Private Limited
Constitution	Private Limited
Date of incorporation / commencement of business	2002
Name of the Contact Person	Mr. Mahantesh Mangasuli (GM)
Mobile / Ph. No	+91-9972937800
Email	mahantesh.mangasuli@bigcastings.com
Address: Factory	Plot No. 75, KIADB Industrial Area, Honaga, Belgaum, Karnataka-591113
Industry / Sector	MSME/Manufacturing
Products Manufactured	Castings for Mining, earthmoving and construction equipment's
No of hours of operation/shift	8
No of shifts/ day	03
No of days/year	300
Installed Capacity	4,600 MT per year
Whether the unit is exporting its products (Yes/ No)	Yes
Quality Certification, if any	ISO 9001:2008



## 2.0 Energy profile

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### 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 electrical 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.

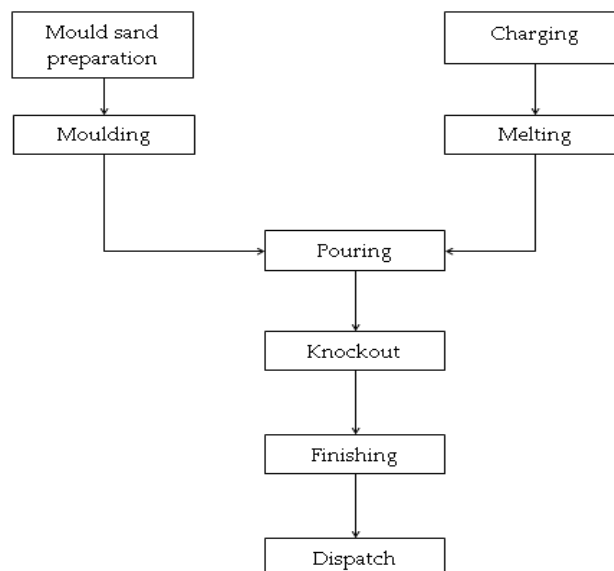


Figure 2.1.4: Process flow chart

## 2.2 Details of technology identified

The unit manufactures steel castings and graded steel castings. Most of the castings are a part of heavy duty machinery and hence require special heat treatment operations to be performed on them like tempering, hardening etc. For this purpose unit has three heat treatment furnaces out of which furnace #1 is equipped with proper burners and PID controllers where as furnace #2 and #3 are having regular burners with ON/OFF controllers, the details are given in Table 2.2.

Table 2.2: Details of heat treatment furnaces

Parameters/Equipment ID	Unit	HT#1	HT#2	HT#3
Equipment (Brief Description)	-	Heat treatment	Heat treatment	Heat Treatment
Type	-	Continuous type	Box	Box
Make/year	-	-	-	-
Purpose/ application	-	Normalizing/ Tempering/ hardening	Tempering/ hardening	Tempering/ hardening
Design Capacity	kg	3,000	1,000	1,000
Burners	No.s	4.0	2.0	2.0
Blower	kW	3.7	2.2	2.2

## 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	LPG	Fuel for heat treatment furnaces

## 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)
LPG	Rs.59 per kg

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



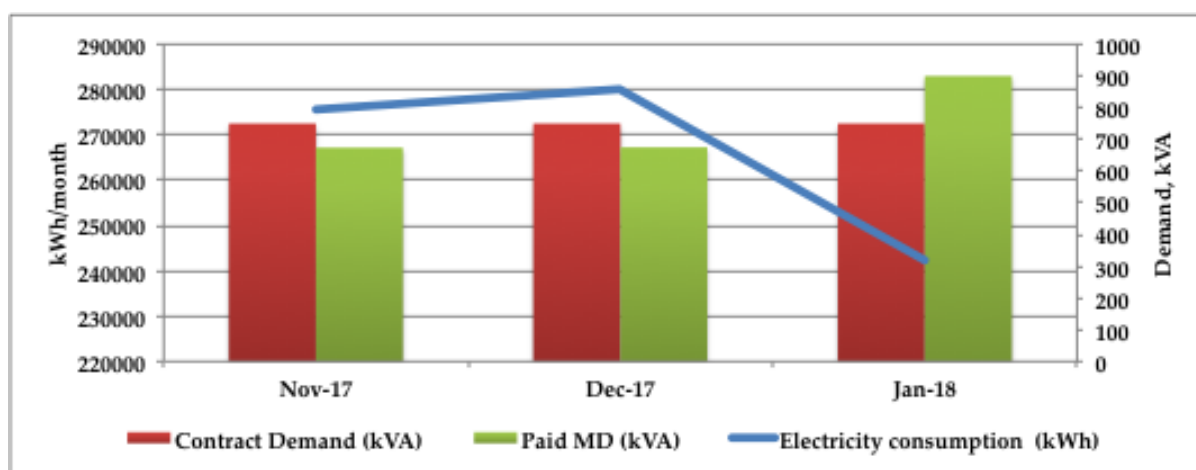
- 110 kV: 3 Paise/unit of energy consumed
- 220 kV: 5 Paise/unit of energy consumed

## 2.5 Analysis of electricity consumption

**Table 2.5:** Electricity consumption profile

Month & year	Electricity consumption (kWh)	Contract Demand (kVA)	Paid MD (kVA)	Demand Charges, Rs./month	Power factor	Total electricity bill (Rs)
Nov-17	275,352	750	674	134,800	0.98	2,136,633
Dec-17	280,312	750	675	135,000	0.99	2,173,129
Jan-18	242,136	750	900	145,000	0.98	2,278,984
<b>Average</b>	<b>265,933</b>	<b>750</b>	<b>750</b>	<b>138,267</b>	<b>0.99</b>	<b>2,196,249</b>
<b>Total</b>	<b>3,191,200</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>26,354,984</b>

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

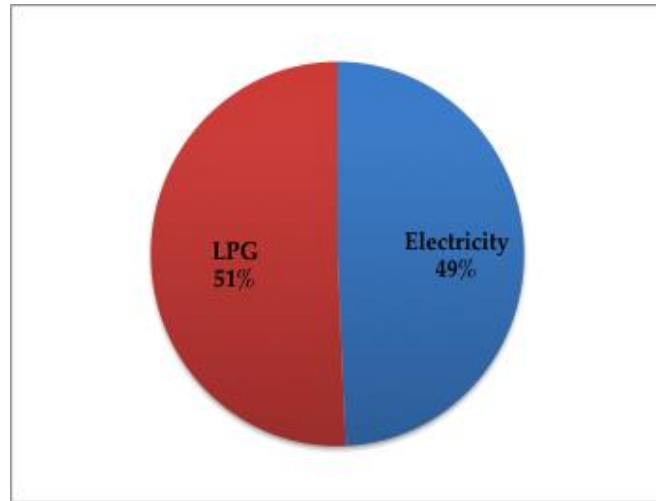
## 2.6 Analysis of energy forms

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

**Table 2.6:** Analysis of fuel consumption

Parameters	Electricity (kWh)	LPG, kg
Consumption (unit/year)	31,91,200	2,45,385
Gross calorific value (per unit)	860	11,500
Equivalent toe (per year)	274	282
Price (Rs per unit)	6.35	59
Total cost (lakh Rs per year)	264	144

The distribution of energy share based on type is shown in the chart below;



**Figure 2.6:** Distribution of energy share based on type

The plant is consuming about 3,191,200 kWh of electricity per year along with 245,385 kg of LPG per year. The total energy consumption of the unit during last 12 months is estimated to be 556.6 toe which is equivalent to 407.3 lakh rupees. The total CO<sub>2</sub> emission during this period is estimated to be tonne 3,350. Electricity and LPG were considered for CO<sub>2</sub> 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 Installation of recuperator for heat treatment furnace

#### 3.1.1 Background

The Big Castings Private Limited is manufactures of the castings industries for Mining, earthmoving and construction equipment's have installed induction furnace for melting. Most of the castings are a part of heavy duty machinery and hence require special heat treatment operations to be performed on them like tempering, hardening etc. For this purpose unit has three heat treatment furnaces out of which only furnace #1 i.e. continuous type of furnace is equipped with waste heat recovery system with proper burners and PID controllers whereas furnace #2 and #3 are having regular burners with ON/OFF controllers without waste heat recovery system, the details are given in Table 3.1.1.



**Table 3.1.1** Details of heat treatment furnaces

Parameters/Equipment ID	Unit	HT#1	HT#2	HT#3
Equipment (Brief Description)	-	Heat treatment	Heat treatment	Heat Treatment
Type	-	Continuous type	Box	Box
Make/year	-	-	-	-
Purpose/ application	-	Normalizing/ Tempering/ hardening	Tempering/ hardening	Tempering/ hardening
Design Capacity	kg	3,000	1,000	1,000
Burners	nos.	4.0	2.0	2.0
Blower	kW	3.7	2.2	2.2

#### 3.1.2 Observations and analysis

The unit has installed heat treatment furnace #2 of capacity 1,000 kg per batch. One batch has cycle time of around 8 hours and 3 batches per day is the current operation time. Presently temperature of air at the inlet of burner is around 40°C, which is very low. The flue gas temperature is more than 650°C resulting in substantial heat losses and reduced efficiency of the furnace. It was also observed that there was carbon monoxide formation due to excess air quantity present in more than required amount and is resulting in un-burnt losses. The details of the present operating parameters are given in the table below;

**Table 3.1a:** Flue gas analysis of Furnace #2

Parameter	Unit	Value
-----------	------	-------

Parameter	Unit	Value
Atmospheric Temperature	°C	34.9
Flue gas Temperature	°C	750
O <sub>2</sub>	%	14.7
CO	ppm	1,046
CO <sub>2</sub>	%	4.3
Excess air	%	70

**Table 3.1b:** Performance of heat treatment furnace

Observation and Measurements	Heat Treatment Furnace	
Fuel Type	-	LPG
Calorific Value	kCal/kg	11,500
Mode of operation	-	Batch
Days per year	-	300
Feed temperature	°C	40
Operating Temperature	°C	950
Flue gases temperature	°C	750
Excess air level	%	110
Dry bulb temperature	°C	33.0
Type of insulation	-	Ceramic
Skin temperature	°C	70
External Surface area	m <sup>2</sup>	18

It is recommended to install the recuperator, which can recover heat from flue gases and preheat the inlet air up to 250°C and will reduce LPG consumption significantly.

### 3.1.3 Recommendation

The unit may adopt to retrofit new recuperator to heat treatment furnace to reduce the energy consumption. The proposed technology will have energy efficient operation of heat treatment furnace with high monetary savings.

## 3.2 Cost benefit analysis

The envisaged energy savings of LPG will be 6,423 kg per year, which is equivalent to a monetary savings of Rs 3.76 lakh per year. The envisaged investment is Rs. 4.4 lakh showing a payback period of 1.2 years. The corresponding reductions in emissions are estimated to be 19.2 tonnes of CO<sub>2</sub> per year. The detailed calculations of the recommended energy conservation measures for IGDP are provided in table 3.2.

**Table 3.2:** Cost benefit analysis for recommended energy savings measures

Recuperator for Waste Heat Recovery	Unit	Value
Avg. LPG consumption kg per day	kg/day	229.5
LPG consumption per hour	kg/hour	9.6
LPG consumption per hour in kg/hour	kg/hour	9.6
Theoretical quantity of air required	kg/kg of LPG	11.1
Excess air supplied,	%	70
Quantity of air supplied	kg/kg of	18.9

Recuperator for Waste Heat Recovery	Unit	Value
	LPG	
Total air supplied to furnace	kg/hour	180.4
Specific heat of air (@ 650°C)	kCal/kg °C	0.27
Blower inlet air temperature	°C	35
Present blower air temperature at inlet to burner	°C	40
Proposed inlet air temperature at burner after recuperator Installation	°C	250
Quantity of heat input to furnace	kCal/hour	1,09,969
Quantity of heat in flue gas	kCal/hour	34,835
% heat loss in flue gas	%	32
Present heat gain by air	kCal/hour	217
Anticipated hear gain after installing recuperator	kCal/hour	10,475
Additional heat gain due to recuperator	kCal/hour	10,258
% heat recovered from flue gas	%	29
Annual hours of operation	hours/year	7,200
Annual fuel saving due to recuperator	kg/year	6,423
Overall annual fuel saving	kg/year	6,423
	toe/year	7.39
Monetary saving	Rs	3.76
	lakh/year	
Investment required	Rs lakh	4.4
Simple Payback Period	Years	1.2

### 3.3 Pre-training requirements

The training would be required on preventive maintenance and cleaning of new recuperator.

### 3.4 Process down time for implementation

The estimated process down time required for implementation of recommended measure is estimated to be 2 days after commissioning and testing.

### 3.5 Environmental benefits

#### 3.5.1 CO<sub>2</sub> reduction<sup>2</sup>

Implementation of the selected energy conservation measures in the unit may result in reduction in CO<sub>2</sub> emissions due to reduction in overall energy consumption. The estimated reduction in GHG emission by implementation of the recommended energy conservation measures is 19.2 tonne of CO<sub>2</sub> per year.

<sup>2</sup> Source for emission factor: 2006 IPCC Guidelines for National Greenhouse Gas Inventories & for electricity: CO<sub>2</sub> Baseline Database for the Indian Power Sector, user guide version 12.0, May 2017 (CEA)

### 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.

## 4.0 Project financials

### 4.1 Cost of project and means of finance

#### 4.1.1 Particulars of machinery proposed for the project

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	Basis of selection of supplier	Remarks (after sales service etc.)
1	Recuperator for Waste heat recovery	Ambit Energy Private Ltd, 12-A, Ghanshyam, Nagar (W), Street No. 1, B/h, IOC Colony, Kalawad road, Rajkot - 360 005	Reputed supplier	-

#### 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

Sl. No.	Details	100% equity	D/E - 70:30	D/E - 50:50
1	Additional (Share) Capital	4.42	1.33	2.21
2	Internal Accruals	-	-	-
3	Interest free unsecured loans	-	-	-
4	Term loan proposed (Banks/FIs)	-	3.10	2.21
5	Others	-	-	-
	<b>Total</b>	<b>4.42</b>	<b>4.42</b>	<b>4.42</b>

## 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
<b>General about unit</b>				
No of working days	Days		300	
No of shifts per day	Shifts		3	
Annual operating hours	hours/year		7,200	
Installed production capacity	tonnes/year		4,600	
Production in last financial years	tonnes/year		3750	
Capacity utilization factor	%		83	
Total cost of the project	Rs. (in Lakh)	4.42	4.42	4.42
Investment without interest defer credit (IDC)	Rs. (in Lakh)	4.42	4.42	4.42
Implementation time	Months	6.0	6.0	6.0
Interest during the implementation	Rs. in lakhs	-	0.16	0.12

Details	Unit	100% equity	D/E- 70:30	D/E- 50:50
phase				
Total investment	Rs. in lakhs	4.42	4.59	4.54
<b>Financing pattern</b>				
Own funds	Rs. in lakhs	4.42	1.49	2.33
Loan funds (term loan)	Rs. in lakhs	-	3.10	2.21
Loan tenure	Years	-	5.0	5.0
Moratorium period (No EMI (interest and principal amount))	Months	-	6.0	6.0
Total repayment period	Months	-	66	66
Interest rate	%	-	10.5%	10.5%
<b>Estimation of costs</b>				
Operation & maintenance costs	%		5.0	
Annual escalation rate of O&M	%		5.0	
<b>Estimation of revenue</b>				
Reduction in energy cost	Rs. lakh/year		3.76	
Total saving	Rs. lakh/year		3.76	
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

Calculation of simple payback period (SPP)	100% equity	D/E 70:30	D/E: 50:50
Total project cost (Rs. In lakh)	4.42	4.59	4.54
Cash flow as annual saving (Rs. In lakh/year)	3.76	3.76	3.76
O&M Expenses for first year (Rs. In lakh/year)	0.22	0.23	0.23
Net Cash flow (Rs. In lakh/year)	3.54	3.53	3.54
SPP (months)	14.99	15.57	15.40
Considered (month)	<b>15.00</b>	<b>15.60</b>	<b>15.40</b>

### 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 (Equity 100%)

Particulars / years	0	1	2	3	4	5
	(Rs. in lakhs)					
Profit after tax	-	2.83	1.85	1.65	1.61	1.59
Depreciation	-	0.72	0.72	0.72	0.72	0.72
Cash outflow	4.42	-	-	-	-	-
Net cash flow	-4.42	3.54	2.57	2.37	2.32	2.31
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	-4.42	3.24	2.15	1.82	1.63	1.48
<b>Net present value</b>		<b>5.91</b>				



Particulars / years	0	1	2	3	4	5
	(Rs. in lakhs)					
<b>Simple IRR considering regular cash flow</b>	<b>59.03%</b>					

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

Particulars / years	0	1	2	3	4	5
	(Rs. in lakhs)					
Profit after tax	-	2.63	1.75	1.48	1.47	1.50
Depreciation	-	0.74	0.74	0.74	0.74	0.74
Cash outflow	4.59	-	-	-	-	-
Net cash flow	-4.59	3.38	2.49	2.22	2.22	2.25
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	-4.59	3.07	2.06	1.67	1.51	1.39
<b>Net present value</b>	<b>5.10</b>					
<b>Simple IRR considering regular cash flow</b>	<b>52.65%</b>					

**Table 4.2.3b:** NPV and IRR (D/E - 50:30)

Particulars / years	0	1	2	3	4	5
	(Rs. in lakhs)					
Profit after tax	-	2.69	1.78	1.53	1.51	1.53
Depreciation	-	0.74	0.74	0.74	0.74	0.74
Cash outflow	4.54	-	-	-	-	-
Net cash flow	-4.54	3.42	2.51	2.27	2.25	2.27
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	-4.54	3.12	2.08	1.71	1.54	1.42
<b>Net present value</b>	<b>5.33</b>					
<b>Simple IRR considering regular cash flow</b>	<b>54.44%</b>					

## 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 foundry units
Any USP or specific market strength	-
Whether product has multiple applications	NA
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 (months)	NPV (Rs lakh)	IRR (%)	DSCR	ROI (%)
1	10% increase in estimated savings	100% equity	13.50	6.88	66.55	-	27.74
		70:30	14.10	6.05	59.96	4.09	36.74
		50:50	13.90	6.28	61.80	5.68	33.48
2	10% reduction in estimated savings	100% equity	16.80	4.94	51.43	-	24.46
		70:30	17.40	4.15	45.25	3.39	33.89
		50:50	17.20	4.37	46.98	4.72	30.33
3	10% rise in interest rates	70:30	15.60	4.88	52.02	3.66	35.31
		50:50	15.40	5.17	53.97	5.09	31.94
4	10% reduction in interest rates	70:30	15.50	5.33	53.29	3.82	35.63
		50:50	15.40	5.50	54.90	5.32	32.16

## 5.0 Conclusions & recommendations

The IGDP prepared for the retrofitting of recuperator for waste heat recovery from flue gas of heat treatment 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

Energy conservation measures	Annual energy savings	Investment	Savings	Simple Payback	Emission reduction
	LPG (kg)	(Rs Lakh)	(Rs. Lakh/year)	(Year)	(tonnes CO <sub>2</sub> )
Installation of recuperator for heat treatment furnace	6,423	4.42	3.76	1.2	19.2

The measure has an estimated investment of 4.42 lakh rupees and can yield a savings of 3.76 lakh rupees per year. The total annual reduction in emission by implementation of recommended measure is estimated to be 19.2 tonnes of CO<sub>2</sub>. 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	4.42	4.59	4.54
2	D/E Ratio	-	-	7:3	1:1
3	Project IRR	%	59.03	52.65	54.44
4	NPV	Rs. In Lakh	5.91	5.10	5.33
5	DSCR	-	-	3.74	5.20

### 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"> <li>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"> <li>Promoter’s margin -15%;</li> <li>Subsidy - 15% available on investment in TUF compatible machinery subject to ceiling of Rs 45 lakh;</li> <li>Loan amount - 70% of the cost of the machinery by way of Term Loan</li> </ul> </li> </ol>

Name of the scheme	Brief Description and key benefits
	<ul style="list-style-type: none"> <li>• Interest rate: Reimbursement of 5% on the interest charged by the lending agency on a project of technology upgradation in conformity with the Scheme</li> <li>• Cover under Credit Guarantee Fund Scheme for Micro and Small Enterprises (CGMSE) available</li> </ul> <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"> <li>• 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.</li> </ul>
Tax incentives	<ul style="list-style-type: none"> <li>• Accelerated depreciation is provided to the customers / users of the energy saving or renewable energy devises under the direct tax laws.</li> <li>• Under indirect taxes, specific concessional rates of duty are only available to CFLs and not to all energy efficient products</li> <li>• 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.</li> </ul>

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"> <li>• This fund is to provide equity capital for energy efficiency projects in Government buildings and Municipalities in the first phase.</li> <li>• A single investment by the fund shall not exceed Rs 2 crore</li> <li>• 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</li> </ul>
Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE)	<ul style="list-style-type: none"> <li>• 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.</li> <li>• Guarantees a maximum 50% of the loan (only principal). In case of default, the fund will: <ul style="list-style-type: none"> <li>○ Cover the first loss subject to maximum of 10% of the total guaranteed amount</li> <li>○ Cover the remaining default (outstanding principal) amount on</li> </ul> </li> </ul>

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

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"> <li>Rs. 50 lakh</li> </ul>
Type of projects considered for term loans	<ul style="list-style-type: none"> <li>Replacement / retrofit of selected equipment with energy efficient equipment</li> <li>Modification of entire manufacturing processing</li> <li>Recovery of waste heat for power generation</li> </ul>
Incentive available	<ul style="list-style-type: none"> <li>Rebate in central excise duty</li> <li>Rebate in interest rate on term loan</li> <li>Rebate in prompt payment of loan instalment</li> </ul>
Interest rate	<ul style="list-style-type: none"> <li>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</li> <li>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.</li> <li>Rebate of 0.5% in interest rates are available for projects set up in North Eastern States, Sikkim, J&amp;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.</li> </ul>
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"> <li>• Detailed Energy Audit</li> <li>• Support for implementation</li> <li>• Measurement &amp; Verification</li> </ul> <p>Financing terms:</p> <ul style="list-style-type: none"> <li>• Terms loans upto 90%</li> <li>• Interest rate upto 3% below normal lending rate.</li> </ul>
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"> <li>• Large industries (excluding thermal power plants)</li> <li>• SMEs</li> <li>• Municipalities (including street lighting)</li> <li>• Buildings</li> </ul> <p>Coverage:</p> <ul style="list-style-type: none"> <li>• The minimum loan amount Rs 10 lakh and maximum loan amount of Rs 15 crore per project.</li> <li>• The extent of guarantee is 75% of the loan amount</li> </ul>
JICA-SIDBI Financing Scheme	<ul style="list-style-type: none"> <li>• 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.</li> </ul>



	<ul style="list-style-type: none"> <li>• Project uses an Energy Saving Equipment List approach</li> <li>• Equipment/machinery with energy saving potential less than 10% is not eligible.</li> <li>• Interest rate: As per credit rating and 1% below the normal lending rate</li> <li>• 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</li> </ul>
KfW-SIDBI Financing Scheme	<p>Coverage</p> <ul style="list-style-type: none"> <li>a) SMEs for energy efficiency projects</li> <li>b) SMEs and clusters for cleaner production and emission reduction measures, waste management and Common Effluent Treatment Plant (CETP) facilities</li> </ul> <p>Interest rate</p> <p>As per credit rating and 1% below the normal lending rate</p> <p>Eligible criteria</p> <p>3 t CO<sub>2</sub> 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><b><u>Key Features</u></b></p> <ul style="list-style-type: none"> <li>• Amount : USD 90 million</li> <li>• Repayment Schedule: First repayment on May 30, 2017 and final repayment date May 30, 2025 (equal instalment)</li> <li>•</li> </ul> <p><b><u>Eligibility Criteria</u></b></p> <ul style="list-style-type: none"> <li>• Projects contributing to preservation of global environment, i.e. significant reduction of GHG emissions</li> <li>• 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.</li> <li>• Procurement in line with the “Guidelines for Procurement under Untied Loans by Japan Bank for International Cooperation”</li> </ul>
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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	<b>Grants :</b> 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 : Ambit Energy Pvt. Ltd.



**Ambit Energy Private Ltd.**  
12-A, Ghanshyam Nagar (W),  
Street No. 1, B/h. IOC Colony,  
Kalawad Road, Rajkot - 360 005, Gujarat (India)  
**Mobile:** +91 9427229262  
**Email:** ambitenergy.ae@gmail.com  
**www.ambitenergy.in**

Ref. No.: AEPL/MS/QT/14 -15/29

Date: 28/10/2017

Your Ref. No.- Telephonic

To,  
TERI,  
REA-Rajkot.

Sub: - Supply of Recuperator

Kind Attention: Mr. Sharma

Dear Sir,

Greeting from Ambit Energy Private Ltd.!!!

Kindly find the quotation as per your requirement.

Sr. No.	Description	Rate or MRP	Qty	Total (Rupees)
1	Design, Engineering and Manufacturing of Recuperator as per requirement identified at site with feasibility study and Standard Specification.	3,95,000.00	1 No.	3,95,000.00

Trust that, the above is in line with your requirements and for any further clarification or support; you are gratefully welcome to make a call to our Mr K. R. Siddhapura (Cell No. 94272 29262) Mr V. B. Doshi (Cell No. 98980 07457).

Thanking you and assuring you of our best attention and services at all times. We remain

Yours truly,

--sd--

K. R. Siddhapura,  
Director,  
Ambit Energy Private Ltd,  
Rajkot.



## Annexure 2: Instruments used

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Instruments	Model/ Make	Application	Accuracy
Flue gas analyser	Testo: 330-2LL	Flue gas O <sub>2</sub> , CO, CO <sub>2</sub> & Temperature	±0.1vol%, 1ppm, 1ppm, 0.1°C
Thermal imager	875-2/Testo	Surface Temperature & Image	± 2%
Infrared thermometer	Testo: 845, Comark: KM848	Surface Temperature	±0.75% of mv
Digital Temperature indicator	Comark: N1001, Testo: 925	Temperature	± 1%
Anemometer	Testo: 425, Airflow: TA45	Air Velocity	±(0.03 m/s +5% of mv)
Differential pressure meter	Testo: 512	Air pressure	0.5% full-scale value / ±1 digit