

# Detailed Project Report On VSD Air Compressor with PMSM

Shri Suguna Machine Works Private Limited  
Coimbatore (Tamil Nadu)

*Prepared for*  
Bureau of Energy Efficiency  
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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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“Capacity Building of Local Service Providers”

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## List of abbreviations

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BEE	Bureau of Energy Efficiency
CFM	Cubic feet per minute
CO <sub>2</sub>	Carbon Dioxide
D/E	Debt /Equity
DPR	Detailed Project Report
DSCR	Debt Service Coverage Ratio
DISCOM	Distribution Company
EE	Energy Efficient
FAD	Free Air Delivery
FIs	Financial Institutions
GEF	Global Environmental Facility
GHG	Green House Gas
HP	Horse Power
IDC	Interest Defer Credit
IGDPR	Investment Grade Detailed Project Report
IRR	Internal Rate of Return
kV	Kilo vault
kVA	kilovolt-ampere
kW	Kilo Watt
kWh	Kilo Watt Hour
LDO	Light Diesel Oil
LSPs	Local Service Providers
MSME	Micro, Small and Medium Enterprises
MT	Metric Tonne
NPV	Net Present Value
O&M	Operation and Maintenance
PMSM	Permanent Magnet Synchronous Motor
RE	Renewable Energy
ROI	Return On Investment
Rs	Rupees
SPC	Specific Power Consumption
SPP	Simple Payback Period
TANGENDCO	Tamil Nadu Generation and Distribution Company
TERI	The Energy and Resources Institute
Toe	Tonnes of oil equivalent
UNIDO	United Nations Industrial Development Organization
USP	Unique Selling Proposition
VFD	Variable Frequency Drive
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 Shri Suguna Machine Works (P) Ltd.
Constitution	Private Limited
MSME Classification	Small
No. of years in operation	5
Address: Registered Office:	55-B, V.K Road, Vilankurichi Post, Coimbatore, Tamil Nadu
Industry-sector	Foundry
Products manufactured	Manufacturer of pump parts, engineering castings, machine parts
Name(s) of the promoters/ directors	Mr Ramesh (Manager), Mr. Boopathi (AGM-Technocal & Projects)

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 386.5 toe which is equivalent to 198 lakh rupees. The total CO<sub>2</sub> emission during this period is estimated to be 2,117 tonnes. Electricity and Coke were considered for CO<sub>2</sub> emission estimation.

The unit manufactures castings like pump parts and engineering parts and supplies it to relevant industries. The total annual liquid metal production of the unit during 2017-18 is estimated to be 3,000 tonnes and good castings production is around 2,400 tonnes. The major source of energy is electricity, consume in the foundry, machining and lighting and coke is used in the cupola furnace.

## 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
	Electricity (kWh)	(Rs Lakh)	(Rs. Lakh/ year)	(Year)	(tonnes CO <sub>2</sub> )
VSD Air Compressor with PMSM	83,030	13.31	5.81	2.3	68

## 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	13.3	13.8	13.7
2	Means of Financing	-	-	7:3	1:1
3	Project IRR	%	20.3	14.6	16.2
4	NPV	Rs. In Lakh	3.6	1.4	2.0
5	DSCR	-	-	2.1	2.8

<sup>1</sup> Investment including (i) Air compressor system – Rs. 11.0, and (ii) Taxes and other misc. cost – Rs. 1.98 lakh

# 1.0 Details of the unit

---

## 1.1 Particulars of unit

**Table 1.1:** Particulars of the unit

Name of the unit	M/s Shri Suguna Machine Works Private Limited	
Constitution	Private Limited	
Date of incorporation / commencement of business	2013	
Name of the Contact Person	Mr. Boopathi (AGM-Tech. and Project)	
Mobile / Ph. No	+91-9442221267	
Email	smwvkr@gmail.com	
Address: Factory	55-B, V.K. Road, Vilankurichi Post, Coimbatore-641035	Owned
Industry / Sector	MSME/Manufacturing	
Products Manufactured	Manufacturer of pump parts, engineering castings, machine parts	
No of hours of operation/shift	12	
No of shifts/ day	01	
No of days/year	300	
Installed Capacity	9,000 MT per year	
Whether the unit is exporting its products (Yes/ No)	No	
Quality Certification, if any	NA	



## 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 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.

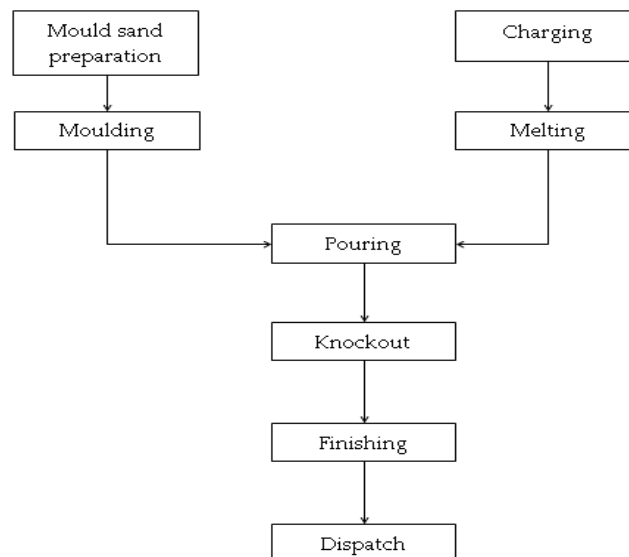


Figure 2.1.4 Process flow chart

## 2.2 Details of technology identified

The details of the air compressors installed in the unit are given in table 2.2.

Table 2.2: Details of air compressors

Particulars	Unit	Comp -1	Comp -2
Make	-	ELGI	KG Khosla
Type	-	Screw	Reciprocating
Model	-	E37-10	2HY2
Year of Installation	-	2012	2001
Purpose	-	Pneumatic utilities	Pneumatic utilities
Capacity of Receiver	M <sup>3</sup>	1	1
Rated Capacity	M <sup>3</sup> /Min	5.49	7.46
Rated Capacity	CFM	194	263
Motor rating	kW	37	45

## 2.3 Energy used and brief description of their usage pattern

The unit uses grid power supplied by Tamil Nadu Generation and Distribution Company (TANGENDCO) under the tariff category HT-1(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	Coke	For Cupola melting furnace

## 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

S No	Energy source	Availability	Tariff details
1	Electricity	Supplied by TANGEDCO	Tariff category: HT-1(A) @ 11 kV Demand charges: Rs 350/kVA Energy charges: Rs 6.35/kWh Time of day charges: 2200-0600 hrs: 5% rebate on energy charge 0600-0900 hrs: 20% additional energy charge 1800-2100 hrs: 20% additional energy charge PF penalty charges:



S No	Energy source	Availability	Tariff details
			Every 0.01 drop below 0.90, penalty 1% of energy charge Every 0.01 drop below 0.85, penalty 1.5% of energy charge Every 0.01 drop below 0.75, penalty 2% of energy charge Harmonics penalty: If beyond the permissible limits as specified by CEA regulations, 15% of energy charge
2	Coke	Local suppliers	Rs.28 per kg

## 2.5 Analysis of electricity consumption

Table 2.5: Electricity consumption profile

Month & Year	Electricity consumption in grid (kWh)	Recorded Maximum demand (kVA)	Billed Demand (kVA)	Power factor
Jan-17	57,256	295	315	0.95
Feb-17	73,404	325	325	0.92
Mar-17	62,136	334	334	0.93
Apr-17	44,316	269	315	0.90
May-17	37,244	267	315	0.91
Jun-17	48,644	300	315	0.87
Jul-17	45,228	237	315	0.92
Aug-17	47,476	228	315	0.94
Sep-17	49,292	244	315	0.96
Oct-17	38,184	228	315	0.95
Nov-17	48,332	267	315	0.93
Dec-17	44,644	222	315	0.93
<b>Average</b>	<b>49,680</b>	<b>268</b>	<b>317</b>	<b>0.93</b>
<b>Total</b>	<b>596,156</b>	<b>-</b>	<b>-</b>	<b>-</b>

\*The plant is procuring power from various sources including DISCOM, open access and wind mills through grid of TANGEDCO. The average cost of electricity has been estimated to be Rs. 7.0 per kWh in consultation with plant personal.

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

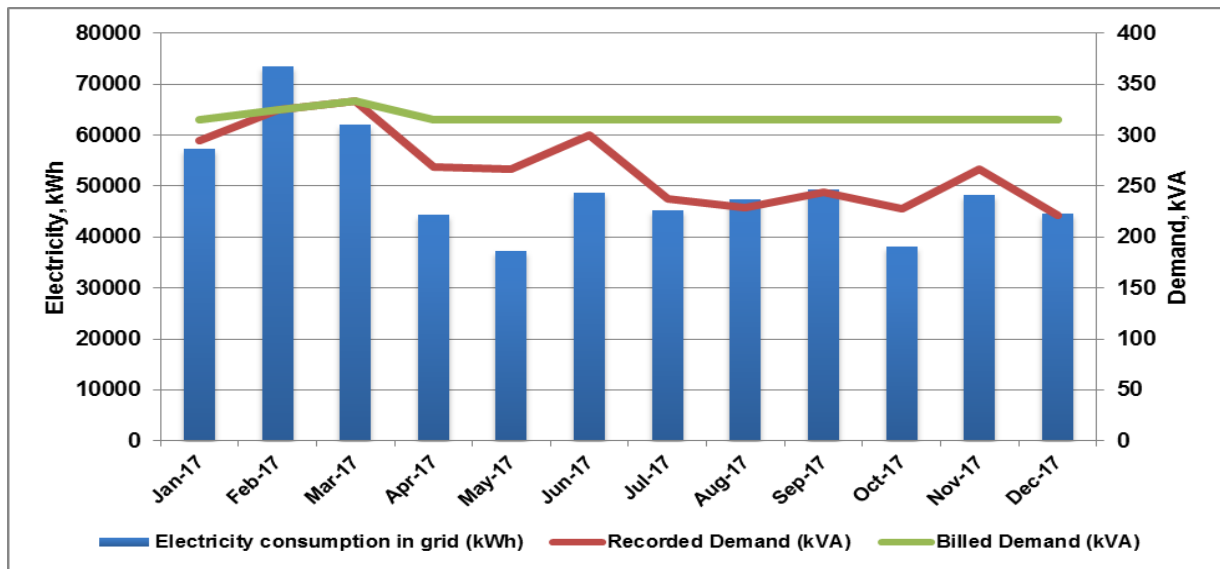


Figure 2.5: Demand pattern and energy consumption profile

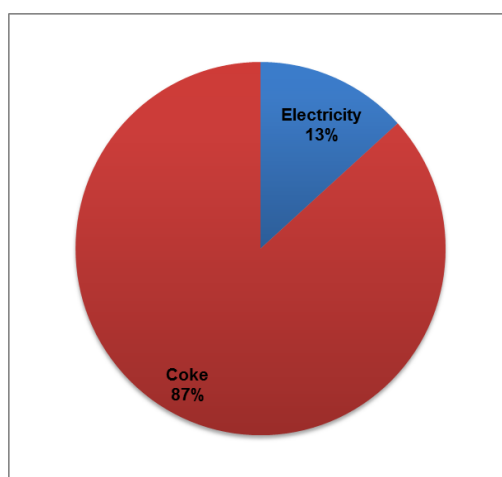
## 2.6 Analysis of other energy forms/ fuels

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	Electricity (kWh)	Coke, MT
Consumption unit/year	5,96,156	559
Calorific value per unit	860	6,000
Equivalent toe per year	51.3	335.2
Price (Rs per unit)	7.0	28
Total price per year	41.7	156.4

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 596,156 kWh of electricity per year. The annual consumption of the coke is 559 MT. The total energy consumption of the unit during last 12 months is estimated to be 386.5 toe which is equivalent to 198 lakh rupees. The total CO<sub>2</sub> emission during this period is estimated to be 2,117 tonnes. Electricity and coke 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 Replacement of existing two air compressors (screw and reciprocating) with VFD enabled screw air compressor with PMSM

#### 3.1.1 Background

Shri Suguna Machine Works Private Limited is manufacturer of castings for pump industries and installed a Cupola furnace of 25 in diameter for melting. The plant has Arpa moulding line and along with that some other pneumatic applications where compressed air is required. In the existing scenario, plant is operating two air compressors (one screw and one reciprocating) to cater the compressed air requirement of the process. The details of the air compressors installed in the unit are given in table 3.1.1.

**Table 3.1.1:** Details of air compressors

Particulars	Unit	Comp -1	Comp -2
Make	-	ELGI	KG Khosla
Type	-	Screw	Reciprocating
Model	-	E37-10	2HY2
Year of Installation	-	2012	2001
Purpose	-	Pneumatic utilities	Pneumatic utilities
Capacity of Receiver	M <sup>3</sup>	1	1
Rated Capacity	M <sup>3</sup> /Min	5.49	7.46
Rated Capacity	CFM	194	263
Motor rating	kW	37	45

#### 3.1.2 Observations and analysis

During the detailed assessment study of the compressed air system, it was observed that the actual demand of the compressed air in plant is about 60% of the total capacity installed. The compressor is having different modes of operation like loading and unloading condition, ON/OFF operating mode based on the number of starts/stops in an hour of air compressor motor. The performance assessment of the compressed air system is provided in table 3.1.2.

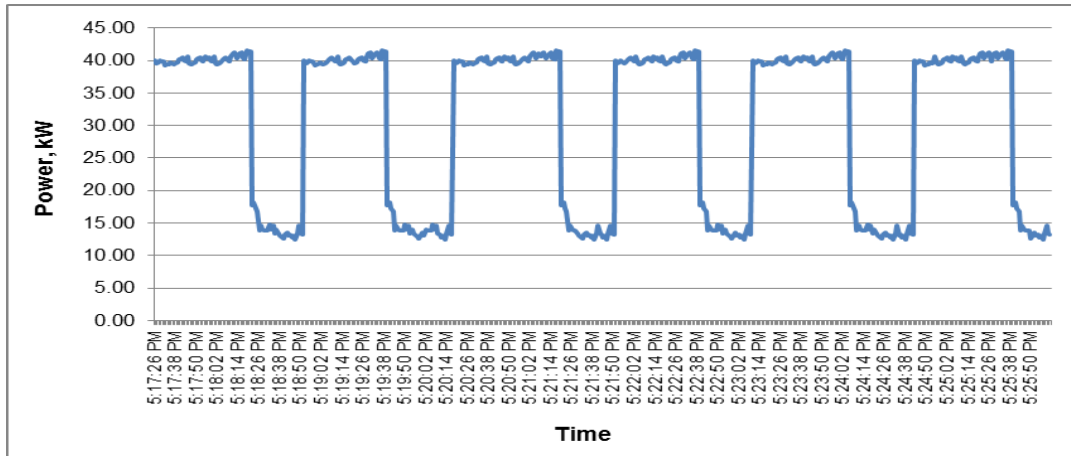


Figure 3.1.2: Power consumption trend of air compressor

Table 3.1.2 Present performance of Air Compressors

Particulars	Unit	Comp -1	Comp -2
<b>Design details</b>			
Make	-	ELGI	KG Khosla
Type	-	Screw	Reciprocating
Model	-	E37-10	2HY2
Year of Installation	-	2012	2001
Purpose		Pneumatic utilities	Pneumatic utilities
Capacity of Receiver	M <sup>3</sup>	1	1
Rated Capacity	M <sup>3</sup> /Min	5.49	7.46
Rated Capacity	CFM	194	263
<b>Operational parameters</b>			
Operating Pressure	kg/cm <sup>2</sup>	8.5	7
Initial Pressure	kg/cm <sup>2</sup>	0	0
Atmospheric pressure	kg/cm <sup>2</sup>	1.013	1.013
Capacity of Receiver	M <sup>3</sup>	1	1
Additional holdup of volume	M <sup>3</sup>	0	0
Pump up time	seconds	102	75
Inlet air temperature	°C	35	35
<b>Calculated/Analysed parameters</b>			
Actual FAD	M <sup>3</sup> /Min	4.94	5.53
Actual FAD	CFM	174	195
Volumetric Efficiency	%	89.9	74.1
Isothermal Power	kW	17.4	17.7
Motor input power	kW	41.0	38.0
Efficiency of Motor	%	92.7	92.5
Shaft input power	kW	38.0	35.2
Isothermal Efficiency	%	45.7	50.3
Operational SPC	kW/M <sup>3</sup> /min	8.3	6.9
Specific power consumption	kW/cfm	0.20	0.19
Loading	%	65	60
Unloading	%	35	40
Loading	kW	41.0	38.0
Unloading	kW	13.7	12.7
Annual operating hours	hours/day	10	10

Particulars	Unit	Comp -1	Comp -2
Annual energy consumption	kWh/year	94,300	83,600

The demand of compressed air system fluctuates during the daily operation heavily, which leads to undetermined load and unload conditions. The use of variable speed mechanism may automatically adjust the rotations (RPM) of air compressor based on the desired air pressure and deliver the appropriate quantity of air without unload operation/mode.

### 3.1.3 Recommendation

By installing new air compressor with variable frequency drive (VFD) and permanent magnetic synchronous motor (PMSM), the power consumption during unloading condition of compressor can be avoided as compressor will run at variable speed based on the air requirement.

The unit may adopt a single unit of screw air compressor of capacity 243 CFM air output. The specific energy consumption of new air compressor will be around 0.14 to 0.16 kW per CFM.

## 3.2 Cost benefit analysis

The estimated annual energy savings by replacement of existing two air compressors with new air compressor is 83,030 kWh equivalent to a monetary saving of Rs 8.4 lakh. The investment requirement is Rs 10 lakh with a simple payback period of 1.2 years. 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

Particular	Unit	Existing	Proposed
Power consumption of two air compressors	kWh/year	177,900	-
Power consumption of new air compressor	kWh/year	-	94,870
Reduction in electricity consumption	kWh/year	-	83,030
Monetary saving	Rs lakh/year	-	5.81
Total investment <sup>2</sup>	Rs. lakh	-	13.31
Simple payback period	Years	-	2.3

## 3.3 Pre-training requirements

The training would be required on preventive maintenance of new air compressor machine. Best practices to be adopted for housekeeping near the location of installation.

## 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 of the new compressor.

<sup>2</sup> Quotation - 1 has been considered for estimation of investments

## **3.5 Environmental benefits**

### **3.5.1 CO<sub>2</sub> reduction<sup>3</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 68 tonne of CO<sub>2</sub> 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.

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<sup>3</sup> Source for emission factor: 2006 IPCC Guidelines for National Greenhouse Gas Inventories & electricity: CO<sub>2</sub> 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 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	EE Screw Air Compressor with Permanent Magnet Synchronous Motor 50HP with 243 CFM capacity	Atlas Copco	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	13.3	4.0	6.7
2	Internal Accruals	-	-	-
3	Interest free unsecured loans	-	-	-
4	Term loan proposed (Banks/FIs)	-	9.3	6.7
5	Others	-	-	-
	<b>Total</b>	<b>13.3</b>	<b>13.3</b>	<b>13.3</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	Hrs/year		7,200	
Installed production capacity	tonnes/year		9,000	
Production in last financial years	tonnes/year		3,000	
Capacity utilization factor	%		33%	
<b>Proposed investment (Project)</b>				
Total cost of the project	Rs. (in Lakh)	13.3	13.3	13.3

Details	Unit	100% equity	D/E- 70:30	D/E- 50:50
Investment without interest defer credit (IDC)	Rs. (in Lakh)	13.3	13.3	13.3
Implementation time	Months	6.0	6.0	6.0
Interest during the implementation phase	Rs. in lakhs	-	0.5	0.3
Total investment	Rs. in lakhs	13.3	13.8	13.7
<b>Financing pattern</b>				
Own funds	Rs. in lakhs	13.3	4.5	7.0
Loan funds (term loan)	Rs. in lakhs	-	9.3	6.7
Loan tenure	Years	-	5.0	5.0
Moratorium period (No EMI (interest and principal amount))	Months	-	6.0	6.0
Total repayment period	Months	-	66.0	66.0
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		5.8	
Total saving	Rs lakh/year		5.8	
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)	13.3	13.8	13.7
Cash flow as annual saving (Rs. In lakh/year)	5.8	5.8	5.8
O&M Expenses for first year (Rs. In lakh/year)	0.7	0.7	0.7
Net Cash flow (Rs. In lakh/year)	5.1	5.1	5.1
SPP (months)	31.0	32.3	32.0
Considered (month)	31.0	32.3	32.0

## 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
	(Rs. in lakhs)					
Profit after tax	-	2.99	3.81	1.34	1.20	1.15
Depreciation	-	2.16	2.16	2.16	2.16	2.16
Cash outflow	13.31	-	-	-	-	-
Net cash flow	-13.31	5.14	5.97	3.50	3.36	3.31
Discount rate % @ WACC	9.25	9.25	9.25	9.25	9.25	9.25

Particulars/ years	0	1	2	3	4	5
	(Rs. in lakhs)					
Discount factor	1.00	0.92	0.84	0.77	0.70	0.64
Present value	-13.31	4.71	5.00	2.68	2.36	2.12
<b>Net present value</b>	<b>3.56</b>					
<b>Simple IRR considering regular cash flow</b>	<b>20.35%</b>					

**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	-	2.41	3.50	0.81	0.80	0.89
Depreciation	-	2.24	2.24	2.24	2.24	2.24
Cash outflow	13.80	-	-	-	-	-
Net cash flow	-13.80	4.65	5.73	3.05	3.03	3.12
Discount rate % @ WACC	10.09	10.09	10.09	10.09	10.09	10.09
Discount factor	1.00	0.91	0.83	0.75	0.68	0.62
Present value	-13.80	4.22	4.73	2.29	2.06	1.93
<b>Net present value</b>	<b>1.44</b>					
<b>Simple IRR considering regular cash flow</b>	<b>14.56%</b>					

**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	-	2.57	3.59	0.96	0.91	0.96
Depreciation	-	2.21	2.21	2.21	2.21	2.21
Cash outflow	13.66	-	-	-	-	-
Net cash flow	-13.66	4.79	5.80	3.18	3.13	3.18
Discount rate % @ WACC	9.86	9.86	9.86	9.86	9.86	9.86
Discount factor	1.00	0.91	0.83	0.75	0.69	0.62
Present value	-13.66	4.36	4.81	2.40	2.15	1.99
<b>Net present value</b>	<b>2.03</b>					
<b>Simple IRR considering regular cash flow</b>	<b>16.19%</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	-
Any USP or specific market strength	-
Whether product has multiple applications	NA
Distribution channels ( e.g. direct sales, retail network, distribution)	Direct sales

Items	Remarks
network )	
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	Payback period (months)	NPV (Rs lakh)	IRR (%)	DSCR	ROI (%)
1	10% increase in estimated savings	100% equity	27.90	5.06	24.74	-	15.87
		70:30	29.00	2.90	18.95	2.24	24.10
		50:50	28.70	3.51	20.58	3.09	20.59
2	10% reduction in estimated savings	100% equity	35.00	2.06	15.81	-	11.88
		70:30	36.50	-0.03	10.00	1.88	17.89
		50:50	36.10	0.56	11.64	2.60	15.17
3	10% rise in interest rates	70:30	32.50	1.01	13.96	2.02	20.88
		50:50	32.10	1.72	15.76	2.79	17.84

DPR on PMSM VSD Air Compressor (Shri Suguna Machine Works (P) Ltd.,Coimbatore, TN)

S. No.	Scenario	D/E ratio	Payback period (months)	NPV (Rs lakh)	IRR (%)	DSCR	ROI (%)
4	10% reduction in interest rates	70:30	32.20	1.88	15.16	2.10	21.78
		50:50	31.90	2.36	16.62	2.90	18.38



## 5.0 Conclusions & recommendations

The IGDP prepared for the replacement of existing two air compressors with one EE screw air compressor with PMSM 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 (tonnes CO <sub>2</sub> )
	Electricity (kWh)	(Rs Lakh)	(Rs. Lakh/year)	(Year)	
VSD Air Compressor with PMSM	83,030	13.3	5.8	2.3	68

The measure has an estimated investment of 13.3 lakh rupees and can yield a savings of 5.8 lakh rupees per year. The total annual reduction in emission by implementation of recommended measure is estimated to be 68 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	13.3	13.8	13.7
2	Means of Financing	-	-	7:3	1:1
3	Project IRR	%	20.3	14.6	16.2
4	NPV	Rs. in Lakh	3.6	1.4	2.0
5	DSCR	-	-	2.1	2.8

### 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:</p> <p>Online (e-Platform) self-assessment: Nil fee</p> <p>Desk Top assessment : Rs 10,000 per SME</p> <p>Complete assessment : Rs 80,000 ZED rating per SME; Rs 40,000 for additional ZED defence rating; Rs 40,000 for re-rating</p> <p>The rating costs will include cost of Rs 10,000/- as certification cost by QCI.</p> <p>Subsidy for Micro, Small and Medium Enterprises are 80%, 60% and 50% respectively.</p>
Credit Linked Capital Subsidy Scheme (CLCSS) (2000-ongoing)	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
Credit Guarantee Fund Scheme for Micro and small Enterprises (in partnership with SIDBI) (2000-ongoing)	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.
Technology and Quality Up gradation Support to MSMEs (TEQUP) (2010-ongoing)	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.
Technology Upgradation Fund Scheme (TUFS) (1999-ongoing)	<p>Interest subsidy and /or capital subsidy for Textile and Jute Industry only.</p> <p>1. To facilitate Technology Up gradation of Small Scale (SSE) units in the textile and jute industries. Key features being:</p> <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>

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>
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	<p>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>
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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> <ol 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> </ol> <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> </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

<b>Purpose</b>	<b>For acquiring/adopting energy conservation/savings equipment/ measures by SMEs</b>
<b>Eligibility</b>	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
<b>Maximum loan</b>	Maximum Rs 100 lakhs in the form of term loan
<b>Security</b>	Prime: Assets created out of loan Collateral: Upto Rs.5 lakhs – NIL Above Rs.5 lakhs, as determined by the bank
<b>Repayment</b>	Maximum 5-7 years including moratorium of 6 months
<b>Guarantee cover</b>	Cover available under CGMSE of CGTMSE available for eligible loans
<b>Margin</b>	10% of the project cost
<b>Rate of interest</b>	1% less than the applicable rate
<b>Upfront fee</b>	1% of the loan
<b>Insurance cover</b>	Assets acquired and charged as security to Bank to be insured
<b>Special offer, if any</b>	<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**

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Quotation 1: Global Airtech Systems



## GLOBAL AIRTECH SYSTEMS

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**Office:-** 219, Akshar Arcade, Opp. Memnagar Fire Station, Nr. Vijay Cross Road, Ahmedabad -380014.  
**Tel:-** 079-26563142, **Email:-** [info@globalairtechsystems.com](mailto:info@globalairtechsystems.com); **Web :** www.globalairtechsystems.com  
**Mobile-** 9824035330

**To,**  
**M/s. Nil Shedge**

**Date:** 27-03-2018  
**Ref. No:** QU/2018/G-126

**Kind Attn : Mr Nilesh Teri**

**Ref.: Discussion with our Mr Archit Shah**

**Subject: Your Requirement of Atlas Copco Screw Air Compressor having integrated VSD**

Dear Sir,

We thank you very much for your above referred enquiry and with reference to the same, we would like to submit the following proposal for your requirements.

We shall also take this opportunity to introduce ourselves as Atlas Copco. Atlas Copco is a global leader and continuously maintains its legacy of leadership through continuous research and development. Backed by a century of leading the compressor industry, Atlas Copco products stand for the best in quality and efficiency. Assembly facilities, manufacturing capabilities for production of compressor elements and other core components and all other major operations in the company ISO 9001 and ISO 14001 certified.

Please find enclosed herewith the following

- Technical Specifications ( GA VSD+ compressor )
- Price Schedule
- Terms and Conditions

We trust you will find our offer in order and in line with your requirements. Should you need any further information/ clarification, please feel free to contact us.

Thanking you again for your enquiry and faith reposed in our product.

**Yours Faithfully,**  
**FOR, Global Airtech Systems**

**Archit Shah**  
**Mo. No. - 9925152791**  
**(Authorized Signatory)**



## ATLAS COPCO OIL-INJECTED ROTARY SCREW COMPRESSOR

### Model GA VSD<sup>+</sup>

The new revolutionary GA VSD<sup>+</sup> is packed with innovative features that increase its efficiency, cut its energy consumption, lower its noise levels, and reduce its operating costs. On top of that, it meets or even exceeds all currently applicable standards.

With its innovative vertical design, Atlas Copco's GA VSD<sup>+</sup> brings a game-changing revolution in the compressor industry.

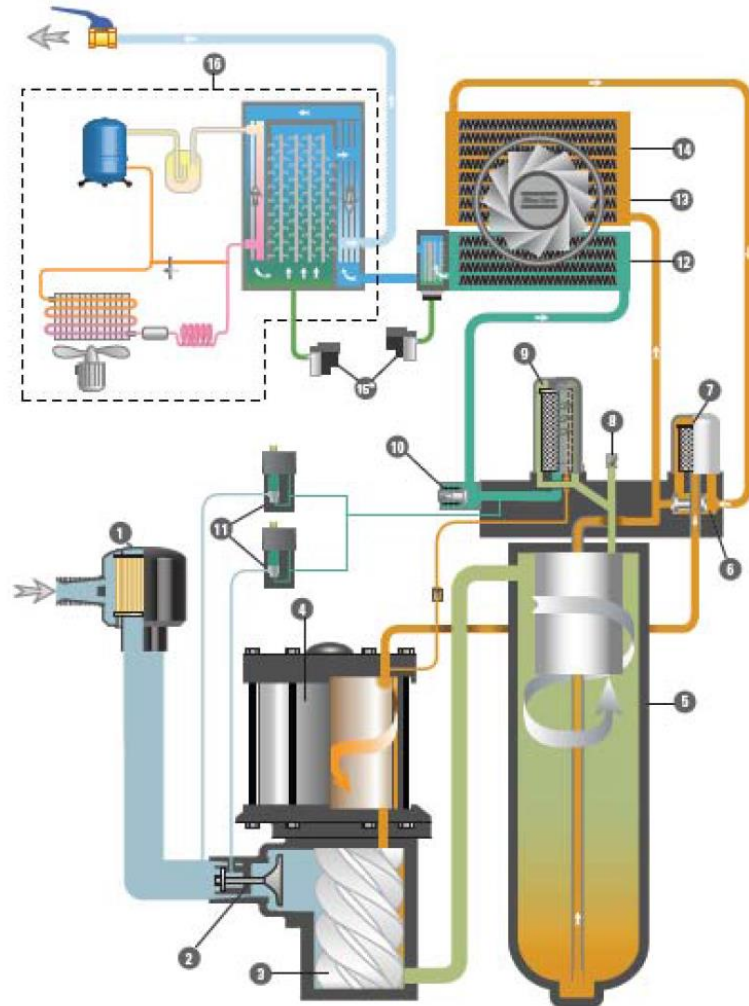
It offers Variable Speed Drive<sup>+</sup> as standard, a compact motor and footprint thanks to its in-house design and iPM (interior Permanent Magnet) technology.

The GA VSD<sup>+</sup> **reduces energy consumption** by **50%** on average, with uptimes assured even in the harshest operational conditions. The GA VSD<sup>+</sup> is the air compressor of the future, designed in-house by Atlas Copco. It will set a new standard for years to come, positioning Atlas Copco as a leader in the compressed air industry.





**Inside the innovative GA VSD<sup>+</sup>**



- |                              |   |                    |
|------------------------------|---|--------------------|
| 1 Inlet filter               | 9 Oil separator   | Intake air         |
| 2 Sentinel valve             | 10 Minimum pressure valve   | Air/oil mixture    |
| 3 Screw element              | 11 Solenoid valves for condensation prevention cycle and Sentinel valve | Oil                |
| 4 IPM                        | 12 After cooler   | Wet compressed air |
| 5 Air/oil vessel             | 13 Fan  | Condensate         |
| 6 Thermocstatic bypass valve | 14 Oil cooler   | Dry compressed air |
| 7 Oil filter                 | 15 Electronic drain (* mounted on after cooler and dryer)               |                    |
| 8 Safety valve               | 16 Dryer  |                    |



### Price Summary

Sr. No.	Product Description	Qty.	Rate / Each Ex Pune
1	<b>GA - 37 - VSD+ - P</b> Capacity : 55 – 276 cfm @ 7 Bar Motor Rating : 37 KW (50 HP) 67 dba Air Cooled <b>With integrated Drive</b> Base Mounted	1	<b>Rs. 11,00,000.00</b>



## **TERMS AND CONDITIONS**

### **PRICES**

Prices quoted are for each number and meant for delivery at site basis on **FREIGHT TO PAY BASIS** .

### **PACKING & FORWARDING**

This will be charged @ 3%.  
GST will be applicable on P& F.

### **GST**

This will be charged @ 18%.

### **TRANSIT INSURANCE**

Transit insurance will be in the customer's scope. However if desired, it can be arranged by if discussed prior to order placement and clearly specified in the purchase order. The additional cost for arranging transit insurance shall be 1 %. Even if the insurance is arranged by us, the responsibility of completing documents / formalities regarding surveying or claiming of insurance in case of transit damage shall rest with the buyer or consignee. Insurance claim if any will be only entertained if the Consignment is opened in the presence of Atlas Copco Engineer or their authorized personnel. In case any shipment damage is found, it has to be intimated to the insurance company immediately. Further please note that no insurance claim will be entertained if the same is not reported to the insurance company within 30 days from the date of LR.

### **SUPERIVISION OF COMMISSIONING**

Free of Cost

### **DELIVERY**

Ex- Pune within 6-8 weeks of receipt of your technically & commercially clear order along with advance



**WARRANTY**

Our warranty is for 12 months from the date of installation or 4000 working hours whichever is earlier, against manufacturing defects only. This does not cover normal wear & tear of consumable and rubber parts. If our Service Engineer is required to do regular maintenance during warranty period, an Annual Maintenance Contract can be offered to you separately. Atlas Copco (India) Ltd ("ACIL") will not be responsible nor will it be held liable for any loss or damages arising to the buyer, as a result of delay, if any, in delivery / commissioning of the machine/s and /or the products of the Company due to the non-availability of site or reasons beyond the control of ACIL or for any product deficiency arising by reason of improper or wrongful use by the buyers of the machinery and/ or the products of the ACIL. ACIL will also not be liable for any consequential damages to the buyer or any other person either by way of loss of profits or otherwise, in connection with the use and performance of the machinery and/or the products of ACIL or for any reason whatsoever.

**PAYMENT**

30 % payment advance along with the order and balance with all taxes / duties against Proforma Invoice.

**VALIDITY**

30 days from the date of our offer.

**FORCE MAJEURE**

This clause is applicable.

**OUR TAX REGISTRATION NOS.:**

GST No: 24AAEFG3326P1ZA  
PAN No: AA EFG3326P

**Yours Faithfully,  
FOR, Global Airtech Systems**

**Archit Shah  
Mo. No. - 9925152791  
(Authorized Signatory)**





## Annexure 2: Instruments used

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Instruments	Model/ Make	Application	Accuracy
Power analysers	Fluke: 435, Krykard ALM 10,	Electrical Parameters Harmonics analysis, power logging	± 0.5%
Anemometer	Testo: 425, Airflow: TA45	Air Velocity	± (0.03 m/s +5% of mv)
Digital Temperature indicator	Comark: N1001, Testo: 925	Temperature	± 1%
Infrared thermometer	Testo: 845,	Surface Temperature	± 0.75% of mv