

# Detailed Project Report On Switchover to natural gas firing system in tunnel kiln

Khurja Kuttir and Handicraft Welfare Society (CFC)  
Khurja (Uttar Pradesh)

*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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## **For more information**

GEF-UNIDO-BEE PMU

Bureau of Energy Efficiency

4th Floor, Sewa Bhawan, Sector-1,

R.K. Puram, New Delhi-110066

Email: [gubpmu@beenet.in](mailto:gubpmu@beenet.in)

[pmc@teri.res.in](mailto:pmc@teri.res.in)

Website: [www.beeindia.gov.in](http://www.beeindia.gov.in)

[www.teriin.org](http://www.teriin.org)

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The Energy and Resources Institute (TERI)  
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# Table of contents

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<b>Acknowledgement .....</b>	<b>1</b>
List of tables .....	1
List of figures .....	1
<b>List of abbreviations.....</b>	<b>1</b>
<b>Executive summary.....</b>	<b>i</b>
<b>1.0 Details of the unit .....</b>	<b>1</b>
1.1 Particulars of unit.....	1
<b>2.0 Energy profile.....</b>	<b>3</b>
2.1 Process flow diagram.....	3
2.2 Details of technology identified .....	3
2.3 Energy used and brief description of their usage pattern .....	3
2.4 Energy sources, availability & tariff details.....	4
2.5 Analysis of electricity consumption.....	4
2.6 Analysis of other energy forms/ fuels.....	5
<b>3.0 Proposed technology for energy efficiency.....</b>	<b>7</b>
3.1 Replacement of existing fuel oil based firing system with natural gas firing system in tunnel kiln .....	7
3.1.1 Background.....	7
3.1.2 Description of existing technology/ equipment .....	7
3.1.3 Existing Tunnel kiln in CFC .....	8
3.1.4 Observations and analysis .....	8
3.1.5 Recommendation.....	8
3.2 Modified Tunnel kiln in CFC .....	9
3.3 Equipment specification .....	9
3.4 Availability of equipment.....	10
3.5 Terms and conditions in sales of equipment.....	10
3.6 Cost benefit analysis .....	10
3.7 Pre-training requirements .....	11
3.8 Process down time for implementation.....	11
3.9 Environmental benefits.....	12
3.9.1 CO <sub>2</sub> reduction.....	12
3.9.2 Reduction in other pollution parameters (gas, liquid and solid) .....	12
<b>4.0 Project financials.....</b>	<b>13</b>
4.1 Cost of project and means of finance.....	13
4.1.1 Particulars of machinery proposed for the project.....	13
4.1.2 Means of finance.....	13
4.2 Financial statement (project) .....	14

4.2.1 Assumptions.....	14
4.2.2 Payback.....	14
4.2.3 NPV and IRR.....	15
4.3 Marketing & selling arrangement.....	16
4.4 Risk analysis and mitigation.....	16
4.5 Sensitivity analysis.....	16
<b>5.0 Conclusions &amp; recommendations .....</b>	<b>19</b>
5.1 List of energy conservation measures .....	19
5.2 Summary of the project .....	19
5.3 Recommendations.....	19
<b>6.0 Financing schemes for EE investments for MSME sector .....</b>	<b>21</b>
<b>Annexures.....</b>	<b>27</b>
<b>Annexure 3.1: Typical P&amp;I diagram of gas train for a gas based system.....</b>	<b>29</b>
<b>Annexure 3.2: Typical P&amp;I diagram of air train for a gas based system.....</b>	<b>31</b>
<b>Annexure 3.3: Bill of materials and specifications for gas based kiln.....</b>	<b>33</b>
<b>Annexure 3.4: List of LSP for natural gas piping, gas and air train .....</b>	<b>35</b>
<b>Annexure 3.5: Quotation for Gas contract from Adani Gas Ltd. ....</b>	<b>37</b>
<b>Annexure 3.6: Quotation for Gas Train.....</b>	<b>41</b>
<b>Annexure 3.7: Instruments used .....</b>	<b>49</b>

## List of tables

<b>Table 1.1:</b> Particulars of the unit .....	1
<b>Table 2.2:</b> Details of existing technology .....	3
<b>Table 2.3:</b> Energy used and description of use .....	3
<b>Table 2.4:</b> Energy sources, availability and tariffs .....	4
<b>Table 2.5:</b> Electricity consumption profile.....	4
<b>Table 2.6:</b> Analysis of other energy/ fuel consumption .....	5
<b>Table 3.2:</b> Salient features of NG fired tunnel kiln .....	9
<b>Table 3.2:</b> Cost benefit analysis for recommended measures .....	10
<b>Table 4.1.1:</b> Particulars of machinery proposed for the project .....	13
<b>Table 4.1.2:</b> Means of finance .....	13
<b>Table 4.2.1:</b> Assumptions made .....	14
<b>Table 4.2.2:</b> Payback.....	14
<b>Table 4.2.3a:</b> NPV and IRR (100% equity) .....	15
<b>Table 4.2.3b:</b> NPV and IRR (D/E- 70:30).....	15
<b>Table 4.2.3c:</b> NPV and IRR (D/E- 50:50) .....	15
<b>Table 4.3:</b> Marketing & selling arrangements .....	16
<b>Table 4.4:</b> Risk analysis and mitigation .....	16
<b>Table 4.5:</b> Sensitivity analysis.....	16
<b>Table 5.1:</b> Summary of the energy conservation measures.....	19
<b>Table 5.2:</b> Summary of the project .....	19
<b>Table 6.1:</b> Major government schemes .....	21
<b>Table 6.2:</b> BEE's VCFEE and PRGFEE scheme.....	22
<b>Table 6.3:</b> IREDA's financing guidelines .....	23
<b>Table 6.4:</b> Major EE financing schemes/initiatives of SIDBI .....	24
<b>Table 6.5:</b> JBIC-SBI Green Line.....	25
<b>Table 6.6:</b> Canara bank scheme of EE SME loans .....	26

## List of figures

Figure 2.1: Process flow chart .....	3
Figure 2.5: Demand pattern and energy consumption profile .....	5
Figure 2.6: Percentage share of various fuel types in the unit .....	5
Figure 3.1.2: Views of existing tunnel kiln and products.....	8





## List of abbreviations

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BEE	:	Bureau of Energy Efficiency
CO <sub>2</sub>	:	Carbon Dioxide
D/E	:	Debt /Equity
DPR	:	Detailed Project Report
DSCR	:	Debt Service Coverage Ratio
EE	:	Energy Efficient
GEF	:	Global Environmental Facility
GHG	:	Greenhouse Gas
HSD	:	High Speed Diesel
IDC	:	Investment without interest defer credit
IGDPR	:	Investment Grade Detailed Project Report
IRR	:	Internal Rate of Return
kW	:	Kilo Watt
kWh	:	Kilo Watt Hour
LSPs	:	Local Service Providers
MSME	:	Micro, Small and Medium Enterprises
MT	:	Metric Tonne
NG	:	Natural Gas
NPV	:	Net Present Value
O&M	:	Operation and Maintenance
RE	:	Renewable Energy
ROI	:	Return On Investment
SME	:	Small and Medium Enterprises
SPP	:	Simple Payback Period
TERI	:	The Energy and Resources Institute
Toe	:	Tonnes 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 Khurja Kuttir and Handicraft Welfare Society
Constitution	Common Facility Centre (CFC)
MSME Classification	Small
No. of years in operation	-
Address: Registered Office:	Industrial Area, G T Road, Khurja - 203131, UP
Industry-sector	Ceramic
Products manufactured	Stoneware products (cup, mug, bowl etc.)
Name(s) of the promoters/ directors	Mr Darshan Chhatwal

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 plant is consuming about 1.38 lakh kWh of electricity per year. The annual consumption of the fuel oil is 100 kL. The total energy consumption of the unit during last 12 months is estimated to be 111 toe, which is equivalent to 62.61 lakh rupees. The total CO<sub>2</sub> emission during this period is estimated to be 405.6 tonnes. Electricity, HSD and fuel oil were considered for CO<sub>2</sub> emission estimation.

The unit manufactures stoneware products and crockery. Products include ceramic items like milk mugs, ceramic pots, tea cups, painted jars, money saver pots, toys, soup and bowl sets, etc. The average production of the unit during 2017-18 is estimated to be 563 tonne.

## Accepted/ recommended technology implementation

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

Energy conservation measure	Annual energy saving (toe/year)	Investment (Rs. Lakh)	Monetary savings (Rs. Lakh/year)	Simple payback period (years)	Emission reduction (tonnes of CO <sub>2</sub> )
Switchover to natural gas firing system in tunnel kiln	23.4	16.7	25.6	0.7	144

## 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	16.70	17.31	17.14
2	D/E Ratio	-	-	7:3	1:1
3	Project IRR	%	118.93	110.53	112.87
4	NPV	Rs. In Lakh	51.66	48.03	49.04
5	DSCR	-	-	6.51	9.08

# 1.0 Details of the unit

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## 1.1 Particulars of unit

**Table 1.1:** Particulars of the unit

1	Name of the unit	M/s Khurja Kuttir and Handicraft Welfare Society (CFC)
2	Constitution	Common Facility Centre
3	Name of the Contact Person	Mr Darshan Chhatwal
4	Mobile / Ph. No	9837013160
5	Email	jindia@gmail.com
6	Address: Registered Office	Industrial Area, G T Road, Khurja - 203131, UP
7	Factory	Industrial Area, G T Road, Khurja - 203131, Uttar Pradesh
8	Industry / Sector	MSME/Ceramic
9	Products Manufactured	Ceramic ware
10	No of hours of operation/shift	8
11	No of shifts/ day	1
12	No of days/year	250
13	Installed Capacity	2.25 tonne per day
14	Whether the unit is exporting its products (Yes/ No)	No
15	Quality Certification, if any	NA



## 2.0 Energy profile

### 2.1 Process flow diagram

Manufacturing of ceramic item uses wide range of raw material combination to produce different shape, size and colour. It requires both electrical and thermal energy at different stages of the process to operate the ball mill, casting/moulding, kilns, cutting & finishing machines and utilities such as motors, pumps, etc. Ceramic manufacturing process primarily consists of mould preparation, body material preparation, shaping, drying and firing. Typical process flow chart is shown with figure 2.1.

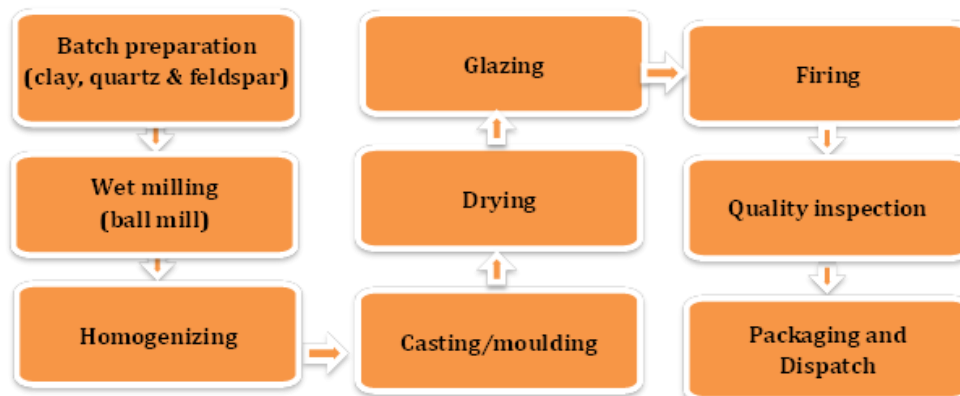


Figure 2.1: Process flow chart

### 2.2 Details of technology identified

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

Table 2.2: Details of existing technology

Parameters/Equipment ID		Value
Equipment		Tunnel kiln
Purpose/Application		Firing of ceramic products
Capacity		2.25 tonne per day
Mode of operation (batch/continuous)		continuous
Cycle time		24 hour
Fuel details	Type	Fuel oil
	Consumption (litre/day)	400

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

The unit uses grid power supplied by Paschimanchal Vidyut Vitaran Nigam Limited under the tariff category LMV6. 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	Fuel oil	Kiln firing
2	HSD	Generator backup power

## 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	LMV6
Fixed charges	• Up to 4 kW : Rs. 245/kW/month
	• Above 4 kW to 9 kW : Rs. 255/kW/month
	• Above 9 kW : Rs. 275/kW/month
Energy charges	• Up to 1,000 kWh/month : Rs. 7.00/kWh
	• Up to 2,000 kWh/month : Rs. 7.35/kWh
	• Above 2,000 kWh/ month : Rs. 7.60/kWh
TOD Charges	<b>Summer Months (April to September)</b>
	• 05:00 hrs-11:00 hrs : (-) 15%
	• 11:00 hrs-17:00 hrs : 0%
	• 17:00 hrs-23:00 hrs : (+)15%
	• 23:00 hrs-05:00 hrs : 0%
	<b>Winter Months (October to March)</b>
	• 05:00 hrs-11:00 hrs : 0%
	• 11:00 hrs-17:00 hrs : 0%
	• 17:00 hrs-23:00 hrs : (+)15%
	• 23:00 hrs-05:00 hrs : (-)15%

## 2.5 Analysis of electricity consumption

**Table 2.5:** Electricity consumption profile

Month & Year	Total electricity consumption (kWh)	kVAh	Sanctioned load/demand (kVA)	Recorded demand, kVA	Demand charges (Rs)	Energy charges (Rs)	Monthly bill (Rs)
Jan-18	10,358	10,550.80	34.00	27.40	6,782	72,957	85,824
Feb-18	14,175	14,383	34.00	34	8,316	71,422	114,890
Mar-18	11,720	11,879	34.00	26	6,435	73,303	95,229
Apr-18	9,897	10,787	34.00	27	6,584	73,155	87,180
May-18	11,309	11,458	34.00	27	6,732	73,006	92,227
Jun-18	11,035	12,183	34.00	32	7,871	71,868	98,646
Jul-18	12,136	12,701	34.00	31	7,623	72,115	102,222
<b>Average</b>	<b>11519</b>	<b>11992</b>	<b>34</b>	<b>29</b>	<b>7192</b>	<b>72546</b>	<b>96603</b>
<b>Total</b>	<b>138,224</b>		<b>-</b>	<b>-</b>	<b>86,300</b>	<b>870,556</b>	<b>1,159,231</b>



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

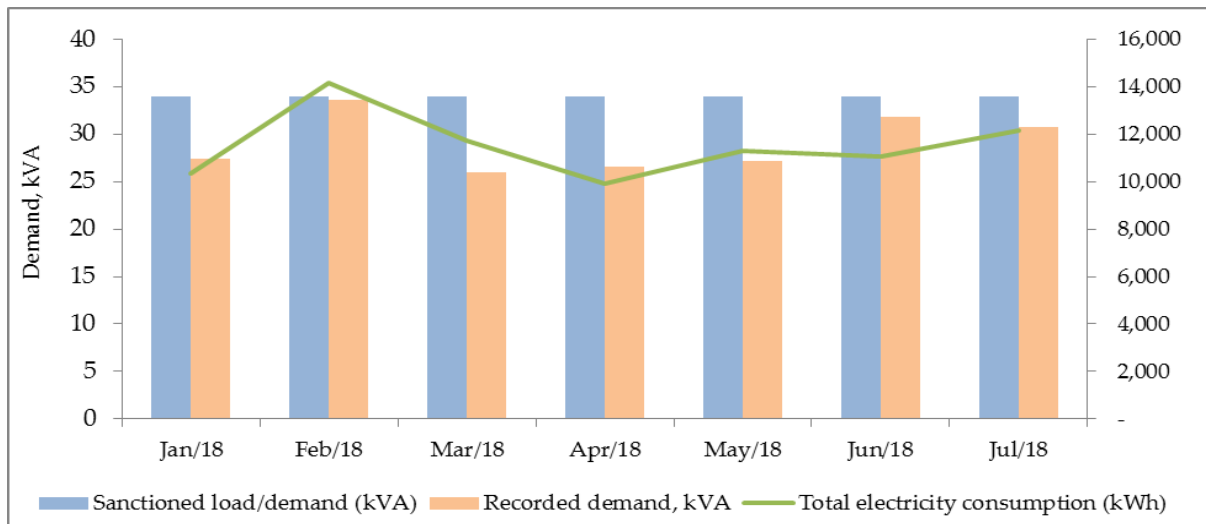


Figure 2.5: Demand pattern and energy consumption profile

## 2.6 Analysis of 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	Fuel oil (litre)	HSD (Litre)
Consumption unit/year	100000	1,500
Calorific value per unit	9765	8,300
Equivalent toe per year	97.7	1.2
Price (Rs per unit)	50.0	68.0
Total price Rs lakh per year	5,000,000	102,000

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

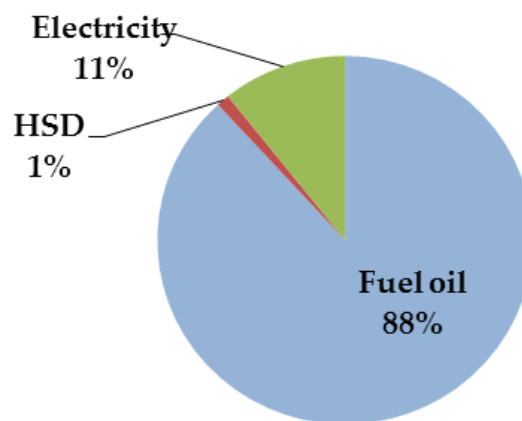


Figure 2.6: Percentage share of various fuel types in the unit

The plant is consuming about 138224 kWh of electricity per year. The annual consumption of the fuel oil is 100 kL. The total energy consumption of the unit during last 12 months is estimated to be 110.8 toe which is equivalent to 62.61lakh rupees. The total CO<sub>2</sub> emission during this period is estimated to be 405.6 tonnes. Electricity fuel oil and HSD were considered for CO<sub>2</sub> emission estimation.

## 3.0 Proposed technology for energy efficiency

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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 fuel oil based firing system with natural gas firing system in tunnel kiln

#### 3.1.1 Background

The Khurja Kuttir and Handicraft Welfare Society (CFC) is manufacturer and supplier of ceramic stone ware crockeries and mugs. A fuel oil fired tunnel kiln is used in firing process. The average production is 2.25 tpd; Total firing time in a tunnel kiln is 20 hours per trolley with an average fuel consumption of 400 litres per day. The details firing cycle such as temperature profile, burner sequences, controlling mechanism and consumption of energy were monitored and collated during the detailed assessment study.

#### 3.1.2 Description of existing technology/ equipment

A typical tunnel kiln operates continuously and number of product day largely depends on overall production capacity and market demand. Most of the tunnel kiln units use fuel oil except a few with natural gas. These kilns are constructed traditionally without any scientific inputs. Traditional tunnel kilns have different geometrical shape depending on the user convenience, quantity of products to be fired and space availability within the factory premises. A majority of the tunnel kilns are built using ordinary red fire clay/IS-8 brick with minimal insulating arrangement to avoid structural heat losses.

Flue gas released from the kiln is at a temperature of over 800 °C and used for pre-heating of the product before exhausted through chimney. Combustion air is used at ambient temperatures. The kilns use only temperature indicators to monitor temperature of kiln chamber; no other instrumentation is used for monitoring and controlling of process parameters.

At CFC, there are six numbers of burners used during firing; and all six burners continue during firing period. Generally, the firing temperature is maintained constant after attaining maximum firing temperature (~ 1200°C) depending on the products under firing without any flame out. The firing practices are same across different tunnel kilns. There are no proper fuel train and air train with monitoring instrument for fuel and airflow; hence the units do not keep records of key operating parameters. The fuel combustion is controlled through eye judgments and flame colour.



**Figure 3.1.2:** Views of existing tunnel kiln and products

### 3.1.3 Existing Tunnel kiln in CFC

This unit has a tunnel kiln based on fuel oil fire system. The salient features of the existing kiln used for firing of green potteries in the unit are shown in table 3.1.3. The operating parameters of the furnace are controlled manually, leading to inefficiencies.

**Table 3.1.3:** Salient features of existing tunnel kiln

Parameter	Value
Production capacity	2.25 tonne per day
Operation	Continuous
Annual operation	250 days
Firing time	24 hour/day
Make of burner	Local
Make off blower	local
Blower operation	continuous
Number of burners	6
Burner arrangement	3 each on either side of vertical wall
Burner operation sequence	All fire continuously
Burner capacity	NA
Type of control	Manual
Waste heat recovery	Product pre-heating
Refractory compatibility	Limited use of high temperature compatible and insulating refractories leading to higher structural heat losses.
Temperature of kiln chamber	1200°C
Instrumentation	Temperature indicator for kiln chamber
Draft control	Natural draft with chimney arrangement
Fuel used	Fuel oil
Design fuel consumption	20 L/hr

### 3.1.4 Observations and analysis

The design of tunnel kiln in the cluster is evolved traditionally to meet the process requirements. No scientific effort has been put in so far to improve its performance. A detailed analysis on the existing kiln revealed the following salient features:

- Poor design and inferior materials used for construction of kiln
- Non-compatible insulation material resulting in higher structural heat losses
- Lack of proper monitoring and control system for critical process parameters like kiln temperature, gas and air flow ratio etc.
- Burners are locally fabricated and suitable for high pressure application resulting incomplete combustion

### 3.1.5 Recommendation

The industry may replace existing fuel oil based firing system with natural gas firing system in kiln with same capacity of production. This switch over would help in reducing energy consumption and overall operating cost. The details of modified kiln, equipment specification and cost benefit analysis with other necessary details are provided in the following sections.

## 3.2 Modified Tunnel kiln in CFC

Existing fuel oil based firing can be appropriately modified to use natural gas as fuel and improve its energy and environment performance. The proposed modification is designed to avoid any radical change in constructional and operational practices so that workers are receptive to these changes. The design is evolved considering the existing kiln condition and process requirement to ensure trouble free operation during firing cycle. Keeping safety of operating natural gas fired system, the existing firing system is modified with an appropriate gas and air train with low pressure burner and better instrumentation and controls for temperature measurements, fuel pressure, air pressure, air ratio, etc. The modified system will help in minimising human errors. The followings are the salient feature of the modified natural gas based firing system of tunnel kiln:

- Introduction of proper gas train and air train with safety devices
- Installation of compatible low pressure burner
- Installation of proper measuring instruments to monitor and control main process parameters

The salient features of the modified tunnel kiln of CFC are shown in table 3.2.

**Table 3.2:** Salient features of NG fired tunnel kiln

Parameter	Value
Production capacity	2.25 tonne per day
Operation	Continuous
Firing time	24 hour/day
Make of burner	ITEPL
Make off blower	Local
Blower capacity	Existing
Blower operation	24 hour/day
Number of burners	6
Burner arrangement	3 each on either side of vertical wall
Burner operation sequence	All fire continuously
Burner capacity	14 kW./hr. (minimum) and 140 kW./hr. (maximum)
Type of control	Automatic
Make of safety devices	MADAS
Refractory lining	Existing
Temperature of kiln chamber	1200°C
Instrumentation	Gas flow meter, air flow meter, temperature indicators, pressure gauges, etc.
Draft control	Existing
Fuel used	Natural gas
Design fuel consumption	20 SCM/hr

## 3.3 Equipment specification

A detailed P&I diagrams for gas train and air train are provided with Annexure 3.1 and Annexure 3.2 respectively. The technical specifications and bill of materials of equipment for gas train and air train that will be employed while converting existing system are provided in Annexure 3.3.

### 3.4 Availability of equipment

Due to availability of piped natural gas supply by M/s Adani Gas Ltd within the Khurja pottery industrial area, a few progressive industries in the cluster converted their kiln to operate with natural gas as fuel. A large number of entrepreneurs of pottery industries in Khurja are aware and convinced about the energy efficiency benefits by adopting gas fired systems. One of the key reasons for the local service providers not supplying improved system is high costs of proposed materials/ systems. However, a number of fabricators and equipment suppliers are available to supply the proposed system and related equipment once system configuration is made available to them under commercial terms. Details of the equipment suppliers of the natural gas based kiln are provided in Annexure 3.4.

### 3.5 Terms and conditions in sales of equipment

The complete gas train, air train and other accessories will be integrated and commissioned by the supplier of the system on a turn-key basis to convert the existing tunnel kiln to gas fired system. However, the entrepreneur of the concerned kiln needs to build in the guarantee clause under the scope of the fabricator while negotiating commercial terms and conditions. The budgetary quotations for natural gas contract as well as gas and air train system are provided in Annexure 3.5 and Annexure 3.6 respectively.

### 3.6 Cost benefit analysis

The estimated annual energy savings by replacement of existing fuel oil based firing system with natural gas firing system in tunnel kiln is 23.4 toe equivalent to monetary savings of 15.4 lakhs/year . The investment requirement is Rs 16.7 lakh with a simple payback period of 0.7 years. The detailed calculation of the recommended energy conservation measure is provided in table 3.2.

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

Parameter	Operation details		
	Unit	Existing	Proposed
Fuel in use	(-)	Fuel Oil	NG
Density of fuel oil	kg/lit	0.93	0.65
GCV of fuel oil	kcal/kg	10500	
	kcal/lit or SM <sup>3</sup>	9765	9000
Average combustion efficiency	(%)	80%	95%
Average cost of fuel	Rs/lit or SM <sup>3</sup>	50	42
No trolley fired	trolley/day	20	20
Annual working days	day/year	250	250
Production			
Average weight of product	kg/piece	0.1	0.1
Production per day	piece/day	22500	22500
	tpd	2.25	2.25
	tpy	562.5	562.5
Products per box packaging	pcs/box	96	96
Weight per box package	kg/box	9.6	9.6
	tonne/box	0.0096	0.0096
Selling rate of class 1	Rs/box	350	350
Selling rate of class 1	Rs/tonne	36458	36458

Operation details			
Parameter	Unit	Existing	Proposed
Selling rate of class 2	Rs/box	330	330
Selling rate of class 2	Rs/tonne	34375	34375
Share of class-1 product	%	75	80
Share of class-2 product	%	15	15
Share of rejection of product	%	10	5
<b>Saving from yield</b>			
Cost of total salable yield	Rs in lakh/yr	182.8	193.1
Monetary benefit from yield	Rs in lakh/yr		10.3
<b>Saving from energy cost</b>			
Fuel consumption	lit/day	400	330
	lit/yr	100000	82500
Fuel costs:	Rs lakh/yr	50	34.7
Saving from energy cost	Rs lakh/yr		15.4
<b>Summary</b>			
Savings from fuel costs	Rs lakh/yr	15.4	
Saving from increased yield	Rs lakh/yr	10.3	
<b>Total effective saving</b>	Rs lakh/yr	<b>25.6</b>	
<b>Capital investment</b>			
Gas meter	Rs lakh		2.5
Advance for fortnightly billing cycle	Rs lakh		5.19
Gas and air train including on site expenses	Rs lakh		7.98
Miscellaneous expenses at site during system integration plus freight	Rs lakh		1
<b>Total investment</b>	<b>(Rs lakh)</b>		<b>16.7</b>
<b>Simple payback period</b>			
	<b>(year)</b>		<b>0.7</b>
	<b>(month)</b>		<b>7.8</b>

### 3.7 Pre-training requirements

Training of operator/supervisor is required on operating natural gas based kiln and safety issues in handling highly inflammable natural gas system. Also training on general maintenance practices and periodic cleaning of the accessories of both gas and air train are to be provided.

### 3.8 Process down time for implementation

Implementation of the proposed modification in the existing tunnel kiln will require only changes in gas and air train system for retrofitting in the existing system to switch over from fuel oil fired to natural gas fired. Finalizing gas contract with supply agency (Adani Gas Ltd), piping, system integration and commissioning at site may not take more time but procurement of equipment may take around 2-3 months. The turn-key supplier will be able to complete erection, system integration and commissioning within 2 weeks provided essential preparatory work is completed in advance by the unit. The modification would suit best during one of the scheduled down time during seasonal/ festive holiday period of the factory when no production is undertaken.



## **3.9 Environmental benefits**

### **3.9.1 CO<sub>2</sub> reduction<sup>1</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 144 tonnes of CO<sub>2</sub> per year.

### **3.9.2 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>1</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	Advantage	Disadvantage
1	NG contract and gas skid	Adani Gas Limited Khurja, 203131, UP	-	-
2	Equipment for switchover to natural gas firing system	Rajesh Tripathi 8826694523 Certified Energy Manager Bureau of Energy Efficiency For Innovative Thermal Engineering Pvt. Ltd. Rgd. Off: 690, VIKASKUNJ, VIKASPURI, NEW DELHI - 18 Works : WZ-49/H/1, Budhela , Vikaspuri, New Delhi - 18 www.itepl.net	-	-
3	Equipment for switchover to natural gas firing system	Madan Bhati 09999957244 M B Engineers Office :2266, Sector 03, Ballabhgarh ,Faridabad -121004 (HR) Works : Rajiv Colony, Near Fogat School, Sector 56A, Faridabad Website : mbengineers.com Email: bhati.madan@gmail.com	-	-

#### 4.1.2 Means of finance

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

**Table 4.1.2:** Means of finance

S. No.	Details	100% equity	D/E- 70:30	D/E- 50:50
1	Additional (Share) Capital	16.70	5.01	8.35
2	Internal Accruals	-	-	-
3	Interest free unsecured loans	-	-	-
4	Term loan proposed (Banks/FIs)	-	11.69	8.35
5	Others	-	-	-
	<b>Total</b>	<b>16.70</b>	<b>16.70</b>	<b>16.70</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		250	
No of shifts per day	Shifts		1	
Annual operating hours	Hrs/year		2000	
Installed production capacity	tonnes/year		800	
Production in last financial years	tonnes/year		563	
Capacity utilization factor	%		70	
<b>Proposed investment (Project)</b>				
Total cost of the project	Rs. (in Lakh)	16.70	16.70	16.70
Investment without interest defer credit (IDC)	Rs. (in Lakh)	16.70	16.70	16.70
Implementation time	Months	6.00	6.00	6.00
Interest during the implementation phase	Rs. in lakhs	-	0.61	0.44
Total investment	Rs. in lakhs	16.70	17.31	17.14
<b>Financing pattern</b>				
Own funds	Rs. in lakhs	16.70	5.62	8.79
Loan funds (term loan)	Rs. in lakhs	-	11.69	8.35
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. (in lakh)/year		25.60	
Total saving	(Rs Lakh/year)		25.60	
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

## DPR – Switchover to natural gas firing system in tunnel kiln (CFC)

Total project cost (Rs. In lakh)	16.70	17.31	17.14
Cash flow as annual saving (Rs. In lakh/year)	25.60	25.60	25.60
O&M Expenses for first year (Rs. In lakh/year)	0.84	0.87	0.86
Net Cash flow (Rs. In lakh/year)	24.77	24.73	24.74
SPP (months)	8.09	8.40	8.31
Considered (month)	8.10	8.40	8.30

### 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	-	22.06	10.64	13.77	13.59	13.53
Depreciation	-	2.71	2.71	2.71	2.71	2.71
Cash outflow	16.70	-	-	-	-	-
Net cash flow	-16.70	24.77	13.35	16.47	16.30	16.24
Discount rate % @ WACC	9.25	9.25	9.25	9.25	9.25	9.25
Discount factor	1.00	0.92	0.84	0.77	0.70	0.64
Present value	-16.70	22.67	11.19	12.63	11.44	10.43
<b>Net present value</b>		<b>51.66</b>				
<b>Simple IRR considering regular cash flow</b>		<b>118.93%</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	-	21.33	10.25	13.11	13.09	13.20
Depreciation	-	2.81	2.81	2.81	2.81	2.81
Cash outflow	17.31	-	-	-	-	-
Net cash flow	-17.31	24.14	13.06	15.92	15.89	16.01
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	-17.31	21.93	10.77	11.93	10.82	9.90
<b>Net present value</b>		<b>48.03</b>				
<b>Simple IRR considering regular cash flow</b>		<b>110.53%</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	-	21.54	10.36	13.30	13.23	13.29
Depreciation	-	2.78	2.78	2.78	2.78	2.78
Cash outflow	17.14	-	-	-	-	-
Net cash flow	-17.14	24.32	13.14	16.07	16.01	16.07
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	-17.14	22.14	10.89	12.12	10.99	10.04
<b>Net present value</b>		<b>49.04</b>				
<b>Simple IRR considering regular cash flow</b>		<b>112.87%</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)	All over India and export
Locational advantages	-
Indicate competitors	Other manufacturing 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 has been carried out to ascertain how the project financials would behave in different situations 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	7.30	58.26	132.49	-	35.59
		70:30	7.60	54.49	123.58	7.13	42.27

DPR - Switchover to natural gas firing system in tunnel kiln (CFC)

S. No.	Scenario	D/E ratio	Payback period (months)	NPV (Rs lakh)	IRR (%)	DSCR	ROI (%)
		50:50	7.50	55.54	126.06	9.95	40.07
2	10% reduction in estimated savings	100% equity	9.00	45.06	105.44	-	33.22
		70:30	9.40	41.56	97.55	5.89	40.76
		50:50	9.30	42.54	99.75	8.21	38.21
3	10% rise in interest rates	70:30	8.40	46.71	109.71	6.37	41.52
		50:50	8.30	48.07	112.27	8.87	39.17
4	10% reduction in interest rates	70:30	8.40	49.39	111.36	6.66	41.66
		50:50	8.30	50.04	113.47	9.29	39.28



## 5.0 Conclusions & recommendations

The IGDP prepared for retrofitting gas and air train to convert fuel oil based tunnel kiln to natural gas fired kiln system 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 measure	Annual energy saving (toe/year)	Investment (Rs. Lakh)	Monetary savings (Rs. Lakh/year)	Simple payback period (years)	Emission reduction (tonnes of CO <sub>2</sub> )
Switchover to natural gas firing system in tunnel kiln	23.4	16.6	25.6	0.7	144

The measure has an estimated investment of 16.6 lakh rupees and can yield a savings of 25.6 lakh rupees per year. The total annual reduction in emission by implementation of recommended measure is estimated to be 144 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	16.70	17.31	17.14
2	D/E Ratio	-	-	7:3	1:1
3	Project IRR	%	118.93	110.53	112.87
4	NPV	Rs. In Lakh	51.66	48.03	49.04
5	DSCR	-	-	6.51	9.08

### 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>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> </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

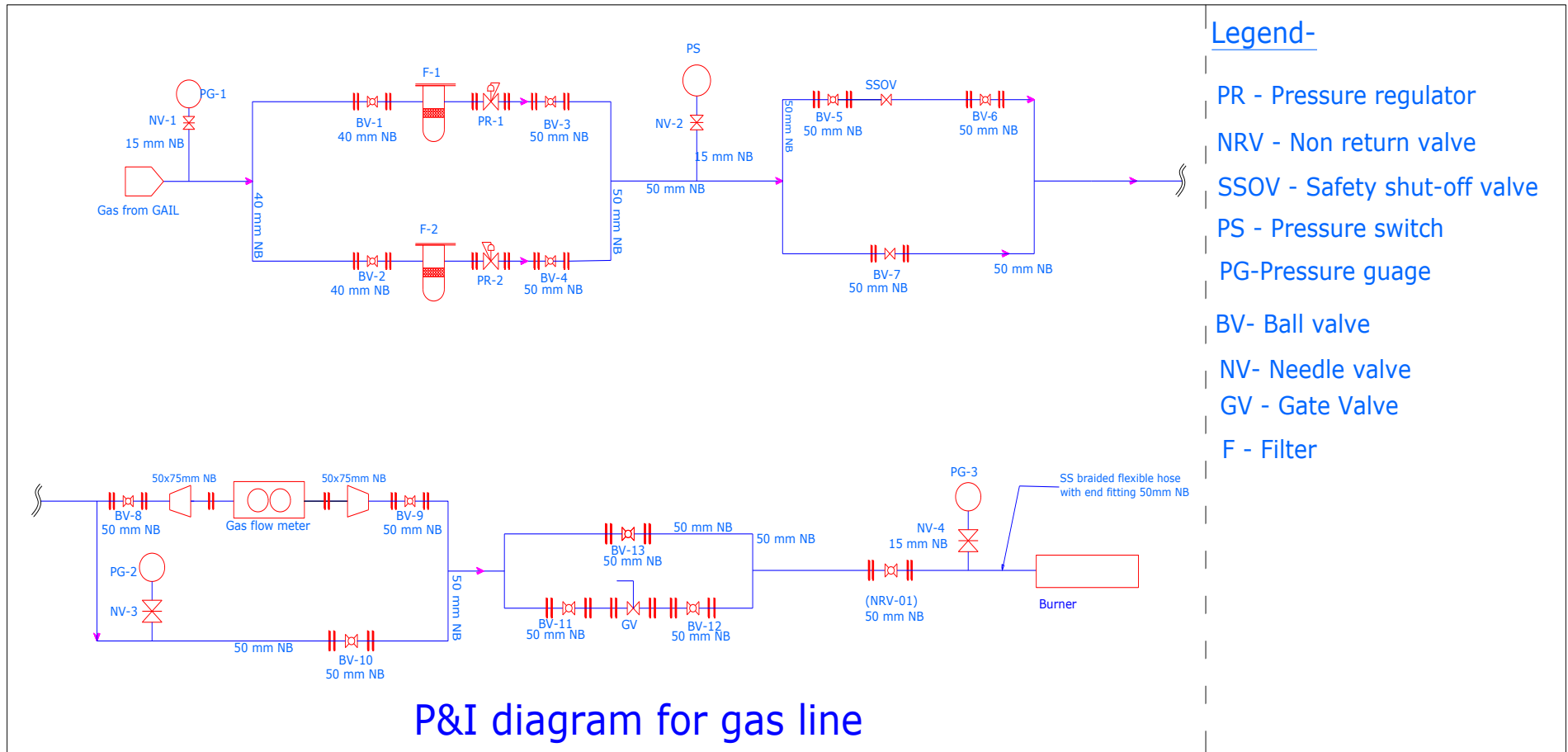




# Annexure 3.1: Typical P&I diagram of gas train for a gas based system

## P&I of typical gas train

The primary components of gas train of a gas based combustion system are pre-filter, gas meter, pressure regulator, pressure gauge, pressure switch, burner, etc. A typical gas train used in a kiln system are shown below.

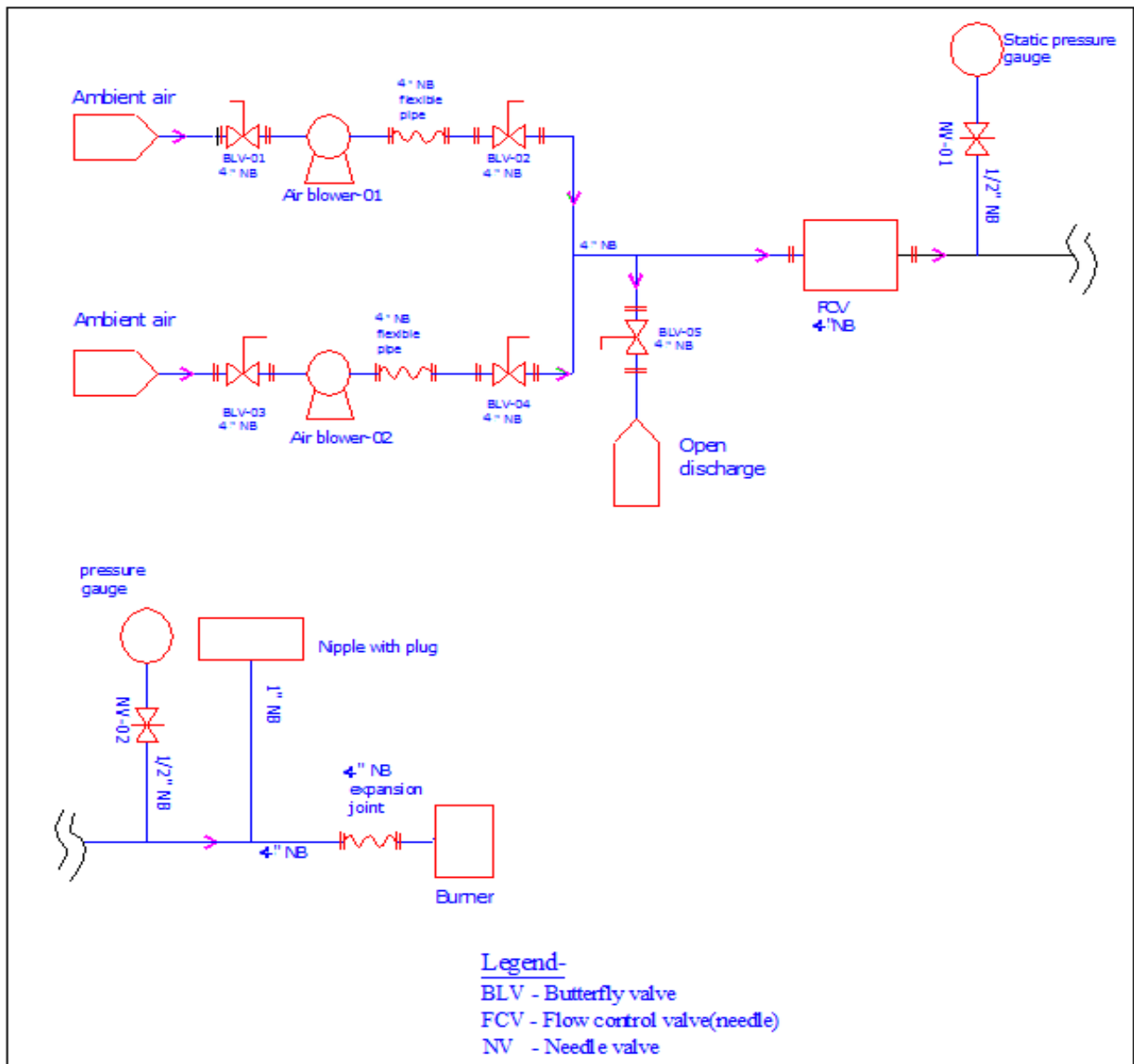




## Annexure 3.2: Typical P&I diagram of air train for a gas based system

### P&I of typical air train

The primary components of air train of a gas based combustion system include ID/FD fans, control valves, pressure gauges, air flow meter, etc. A typical air train used in a gas based system are shown below.





## Annexure 3.3: Bill of materials and specifications for gas based kiln

The detailed specifications of the materials and measuring instruments are provided with table. These are essential for natural gas fired kiln system to ensure trouble free operation.

**Table:** Equipment specifications

Item	Quantity	Specifications
Flow control valve	1	Size: 4 inches NB Type: gate valve Material: gun metal End connection: flange
Burner	6	Low pressure nozzle mix burner compatible for the following operating conditions: Maximum air temperature: 50 °C Fuel flow: 10 Sm <sup>3</sup> /h (maximum) Fuel pressure at burner input: 150 mm WC Type of fuel: piped natural gas
Gas filter	2	Type: Simplex Filtering element: cartridge Housing material: MS Medium: natural gas Maximum flow rate: 60 Sm <sup>3</sup> /h Minimum flow rate: 20 Sm <sup>3</sup> /h Gas temperature: 25 °C Minimum inlet pressure: 1.5 bar Maximum inlet pressure: 3 bar Flow direction: out to in Filtration rating: 3 µm (absolute) Line size: 50 mm NB with screw end fitting Accessories: drain valve and common differential pressure gauge
Regulator (PRV)	2	Type: self-operated Housing material: cast iron Medium: natural gas Maximum flow rate: 60 Sm <sup>3</sup> /h Minimum flow rate: 20 Sm <sup>3</sup> /h Gas temperature: 25 °C Inlet pressure: 3 to 1.5 bar (gauge) Outlet pressure: 200–800 mm WC (gauge) Line size: 50 mm NB End connection: NPT Screw Feed quality: filtered up to 3 µm
Safety shut-off valve	1	Type: pneumatic with flame-proof enclosure Size: 50 mm NB; operating fluid – natural gas; valve orientation – horizontal

DPR – Switchover to natural gas firing system in tunnel kiln (CFC)

Item	Quantity	Specifications
		Three operating conditions: 1. low pressure – 200 mm WC 2. high pressure – 1200 mm WC 3. electrical power failure during operation
Temperature sensor	2	Type K; temperature up to 1370°C Material: aluminium–chromium Length: 24 inches
Indicator	2	Display: 4 digit (absolute figure) Resolution: 1 °C
Pressure Gauge	3	Material: MS Dial size: 100 mm Range: 0 – -5 Kg/cm <sup>2</sup> (one); 0 – 1500 mm WC (one); and 0 – 1000 mm WC (one)
Miscellaneous		2-inches gun metal (GM) gate valve to control gas flow; MS pipes, reducers, bends, isolation valves, flanges, and SS braided flexible hose as required to complete the piping. Compatible compensating cable as required

Notes: Sm<sup>3</sup>/h – standard cubic metres/hour

WC – water column

SS – stainless steel

MS – mild steel

ID – inner diameter

OD – outer diameter

NB – nominal bore

## Annexure 3.4: List of LSP for natural gas piping, gas and air train

A List of local service providers or contractors who have experience in undertaking pipeline work for distribution of natural gas within the plant beyond meter regulating grid and for providing necessary accessories for gas and air train required for conversion of liquid fuel fired kiln to natural gas fired system. This list is neither an exhaustive nor any one of them is recommended to obtain services. This list has been compiled only to facilitate the prospective customers interested in switching over to natural gas based system. The customers have to make the final decision of selection on the basis of their own assessment of quality of work / rates etc.

<b>Techno Gas Engineers</b> Village Daulatabad, Sector 16-A Old Faridabad, Faridabad Contact person – Mr. Sunrender Tanwar Mobile: 9873078134 Email: <a href="mailto:technogasengineers@gmail.com">technogasengineers@gmail.com</a>	<b>M B Engineers</b> G-101, Trikha Colony, Sector 3, Ballabhgarh Faridabad – 121004 Contact person – Mr. Madan Bhati Mobile:-9999957244 / 9211957231 Email: <a href="mailto:bhati.mada@gmail.com">bhati.mada@gmail.com</a>
<b>Aarti Flames</b> 16/5 Mathura Road Faridabad Contact person – Mr. Neeraj Ahuja Mobile:-9810181880	<b>Gas Master</b> Contact Person – Mr. Om Pal Singh Mob No. 9810146076
<b>Metallic Fabricators Pvt Ltd.</b> A-61/5, G.T. Karnal Road, Industrial Area, New Delhi-110033 Phone no. - +91-11-27225150 Contact person – Mr. Sanjeev Mittal Mobile: 9811205272 Email: <a href="mailto:mfgas@aol.in">mfgas@aol.in</a>	<b>Perfect Pipeline Projects</b> A-15, IInd Floor, Fateh Nagar, New Delhi Contact person – Mr. Harpreet Singh Walia Mobile: 9810054353 Email: <a href="mailto:perfectpipelineprojects@gmail.com">perfectpipelineprojects@gmail.com</a>
<b>Ekta Engineers</b> 4, Sita Ram School Complex, Sihi, Sector 8, Faridabad Contact person – Mr. Sanjay Kumar Mobile: 9716157495 Email: <a href="mailto:ekta.engineers@yahoo.in">ekta.engineers@yahoo.in</a>	<b>Akta Engineers &amp; Consultants</b> B-72, Second Floor, Nehru Ground, N.I.T Faridabad Phone No. – 0129-2414773 Contact person – Mr. Ramesh Prasad Mobile: 9899577747 Email: – <a href="mailto:aktaengg@yahoo.co.in">aktaengg@yahoo.co.in</a>
<b>M/S Ziya Enterprises</b> B/C 352, Gali no. 7, Badkal Village, NIT Faridabad – 121001 Contact person – Mohd. Rafeeq Ahmed Mobile: 9911449550 Email: – <a href="mailto:saiifiappliances84@gmail.com">saiifiappliances84@gmail.com</a>	<b>Amitash Gas Service Pvt. Ltd.</b> 1925/19 (L.G.F.) Govind Puri Extn. Kalkaji, New Delhi – 110019 Contact Person – Mr. Sanjay Chopra Mobile: 9811329107, 9871903863 Email: <a href="mailto:sanjay.chopra37@gmail.com">sanjay.chopra37@gmail.com</a> , <a href="mailto:amitashgas@gmail.com">amitashgas@gmail.com</a>





## Annexure 3.5: Quotation for Gas contract from Adani Gas Ltd.

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August 08,2018

To,  
Teri  
Kind. Attn.- Mr. Anand Mohan Ghosh

**Subject: Commercial Proposal for Supply of Natural Gas to your unit**

Dear Sir,

This is with reference to your EOI & equipment details submitted by you. We are pleased to make following proposal for the supply of Natural Gas to your unit along with estimated cost.

1. **Connection Security Deposit:** We have technically evaluated the load requirement at your unit. Based on the recommendation from our technical department the amount payable towards Metering & Regulating Skid (MRS) and other charges for providing gas connection to your plant, such as pipeline admeasuring max 15 mtrs from our nearest distribution mains shall be Rs **4,30,000/-**, referred to as "**Connection Security Deposit**". The above charges shall be collected as **Interest Free – Refundable deposit**.

Based on the equipment details provided in EOI form, following calculations were done:

Connected Equipment	Capacity	Fuel Type	Calculated Load (SCMH)
Shuttle Klin-1	800lt/Batch (6 Burners)	Natural Gas	62

Connected Equipment's capacity shall not exceed the specified "calculated load", at any time. Gas delivery pressure at outlet of MRS shall be maximum of **1.5 Bar**.

You shall have to pay 10% advance at the time of signing of the Gas Sales Agreement. Balance 90% shall be payable 15 days before delivery of Metering & Regulating Skid. Kindly note that Meter Removal Charges including Service Tax shall be deducted from Interest free – Refundable Connection Security Deposit at time of Permanent Disconnection.

2. **Conversion Cost & Internal Piping:** This is the cost to be incurred in converting your equipment's to operate on Natural Gas. You will also be required to appoint a reputed and experienced pipeline vendor qualified by AGL, for supply and installation of internal piping from AGL's Measurement Equipment up to the tip of equipment's as per AGL's specification. List of qualified vendors is enclosed in Annexure I for your reference.

3. **Security Instrument:** You shall have following options for payment of Refundable Security Instrument in from of:

- **Cash Security deposit (CSD) = Daily Contracted Qty. of Gas x 30 days x Gas Price (prevailing at the time of submitting deposit) incl. VAT**  
We offer an interest of **6% p.a.** on CSD.

Or

- **Bank Guarantee (BG) = Daily Contracted Qty. of Gas x 45 days x Gas Price (prevailing at the time of submitting guarantee) incl. VAT**  
BG to be issued from, Nationalized Banks as acceptable to the Buyer.

You shall have to provide the above mentioned Security Instrument within 15 (fifteen) days of signing of the agreement.

4. **Gas Sales Agreement (GSA): Salient Features:** We are offering following Gas Sales Agreement according to the consumption profile of your industrial unit.

5. **Additional Cost:** Any additional pipeline, if laid shall be invoiced separately as non-refundable cost prior to commissioning of Gas Supply to your unit.

For Seller  
For Adani Gas Ltd

Name: Somesh Jha  
Designation: Associate Manager

August 08,2018

To,

Teri

Kind. Attn.- Mr. Anand Mohan Ghosh

**Subject: Payment Security Deposit for Natural Gas Connection**

Dear Sir,

We are offering following Gas Sales Agreement according to the consumption profile of your industrial unit. Details of the same are:

Particulars	No MGO - GSA
Gas Price	1211.30 Rs./MMBTU
Contract Quantity(Daily)	106SCM/(3.79)mmbtu
Gross Calorific Value (GCV)	Above Prices are based on GCV basis
Cash Security Deposit (CSD) OR Bank Guaranty(B G)	Rs 1,38,000(One Lacs Thirty Eight Thousand only) OR Rs 02,06,000(Two Lacs Six Thousand Only)
MGO liability	No minimum liability
Excess Gas	Quantity above 110% of Contracted Quantity on fortnightly basis
Billing	Fortnightly
Payment	7 days from the date of generation of Invoice

For Seller  
For Adani Gas Ltd

Name: Somesh Jha  
Designation: Associate Manager

Note :- Payment Security Deposit is liable to change wrt PNG Price. Present offer is valid for 15 days only.



## Annexure 3.6: Quotation for Gas Train

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Dear Sir,

Ref to your enquiry and further our discussion.

Thanks for interest shown in our product range. Based on the inputs provided we are pleased to submit our offer for supply of required combustion system.

Offer includes supply of combustion system with below features

1. Auto ignition and flame safety.
2. Combustion System is designed as per safety norms of standard NFPA – 86
3. Components selected are fail safe.
4. Offered Burners are with metering orifice at Air & Gas inlets which makes easy to maintain fuel air ratio and doesn't requires any additional metering system.
5. Temperature controllers are programmable and required temperature profile can be set very easily.
6. Offered system is capable to control process temperature with in limit of 5 deg C.
7. Burning efficiency of Burners are 98% in case of Natural gas at 3% O2 level.

I am confident enough that offered system is best & economical solution for conversion of Tunnel Kiln from liquid fuel to Gas.

***We are committed to provide safe, reliable and efficient thermal solution for Industrial heating applications.***

***Thanks once again***

***With Best Regards***

Rajesh Tripathi

8826694523

Certified Energy Manager

Bureau of Energy Efficiency

For INNOVATIVE THERMAL ENGINEERING PVT. LTD.

Rgd. Off: 690, VIKASKUNJ, VIKASPURI, NEW DELHI – 18

Works : WZ-49/H/1, Budhela , Vikaspuri, New Delhi – 18

[www.itepl.net](http://www.itepl.net)



**INNOVATIVE THERMAL ENGINEERING PVT. LTD.**

THTF/DELHI/Q-10112/13082018/RT

To,

Date:13 AUG 2018

**TERI**

**Lodhi Road,**

**NEW DELHI**

Sub: Offer for Natural Gas Based Combustion system for Tunnel Kiln for potteries

Kind Attn: Shri A. M. Ghosh

Dear Sir,

Thanks for your inquiry regarding requirement of combustion system for CFC, Khurja.

Inputs considered for proposal

1. Number of Burners : 06 Nos.
2. Fuel : NG
3. Turn down ratio of Burner : 10:1
4. Application : Tunnel Kiln
5. Process temperature : 1350°C

Based on the inputs and conclusion of discussion, we are pleased to submit offer for supply of best suitable combustion system.

- Offer is with Burners of make ITEPL having metering orifice at Air & Gas inlet, which makes easy to maintain fuel air ratio and there is no need to have separate metering system..
- Burners selected are suitable for process temperature up to 1450 °C.
- Offered system is designed considering safety standard NFPA – 86

**Annexure I Scope of supply & Price schedule**

**Annexure II: Terms & Condition**

Trust offered system is best suitable solution for firing of ceramic Kilns , for further any clarification required please feel free to contact.

Thanks

With Best Regards

Team ITEPL

+91 7835806379, +91 8826694523

[energymanagerscs@gmail.com](mailto:energymanagerscs@gmail.com) ; [www.itepl.net](http://www.itepl.net)

**INNOVATIVE THERMAL ENGINEERING PVT. LTD.**

Regd. Off: 690 VIKASKUNJ, VIKASPURI, NEW DELHI 110018

GSTIN: 07AAECI3105P1ZH





**INNOVATIVE THERMAL ENGINEERING PVT. LTD.**

Annexure I Scope of Supply & Price Schedule

A] LPG Based Fully Automatic Combustion System

Sl.	Item Description	Qty.	Total Ex- Delhi Price INR
1.	Burner Assembly Make : ITEPL Model : Agni NGB 50 HV Temperature suitability : 1450°C. Capacity Max. : 140 KW Capacity Min : 14KW Burner Assembly includes <i>Basic burner, peep sight, spark igniter, Butterfly valve for air line, Ball valve for gas line, Metering orifice for Air &amp; Gas refractory block.</i>	04 Nos.	2,08,780.00
2.	Burner Assembly Make : ITEPL Model : Agni NGB 25 HV Temperature suitability : 1450°C. Capacity Max. : 75 KW Capacity Min : 7.5KW Burner Assembly includes <i>Basic burner, peep sight, spark igniter, Butterfly valve for air line, Ball valve for gas line, Metering orifice for Air &amp; Gas refractory block.</i>	02 Nos.	83,512.00
2.	Auto ignition & Flame safety Gas solenoid valve – 01 Nos. (MADAS ) Burner Sequence controller – 01 Nos. (Linear) Ignition Transformer – 01 Nos. (Cofi ) Ionization rod – 01 Nos.	06 Set	1,11,300.00
4.	Air gas ratio & Temperature control Air gas ratio regulator – 04 Nos. (MADAS) Motorized valve – 02 Nos.(INNOVATIVE) PID Temperature controller – 02 Nos.(CHINO JAPAN)	01 Set	1,24,600.00
6.	Gas valve Train (Assembled, tested & pre cabled up to junction box) Inlet pressure 0.8 to 1.8 Bar Ball valve – 02(Audco / L&T) Gas filter – 01(MADAS) Gas Pressure regulator – 01 (MADAS) Gas pressure gauge with push cock – 02 (Warie/HGuru) High Gas pressure switch – 01(Dungs) Low Gas Pressure Switch – 01 (Dungs) Vent valve 01 (MADAS) Safety Shut Off Valve – 01 (MADAS)	01 Set	1,06,820.00
7.	Burner Control Panel – Relay based Logic	01 Set	27,800.00

Above prices are Exclusive of IGST.

Exclusions

1. Pipe & Pipe fittings
2. Compensating cables



**INNOVATIVE THERMAL ENGINEERING PVT. LTD.**

3. Cables & Electric fittings
4. Field cables
5. Cable Trays
6. UPS for regulated Power supply
7. Any other material that is not included in the above scope of supply.

## **Annexure II to Commercial Terms and Conditions**

Price Basis	: Unpacked, IGST : 18% Any variation will be to purchasers account.
Delivery	: Delivery period will be 3-4 Working Weeks from the date of receipt of technically and commercially clear purchase order along with advance. Any time required for approval of drawings, specifications, documents and inspection would be extra.
Inland Freight	: Extra at actual
Inland Insurance	: To purchaser account
P & F Charges	: Extra @ 2% of order value
Terms of Payment	: <b>50% Advance along with technically and commercially clear purchase order and balance with all taxes, duties &amp; other charges by D / D before dispatch of materials.</b>
Documentation	: We will supply one copy of O & M / Product manual for the equipment supplied by us.
Erection & Commissioning	: Unless explicitly specified, the cost of the equipment does not include erection or commissioning services. Commissioning services are available at extra cost. Service tax shall be charged extra as applicable.
Exchange Rate Variation	: Offer is based on the prevailing exchange rate as on offer date. Any change in exchange rate at the time of clearing the goods will to the purchaser's account in case of offers having foreign exchange content.
Cancellations	: In case of cancellation of LOI / Purchase order, following cancellation charges will apply. Within 1 month of LOI / Order: 20% Within 2 month of order: 50% After 2 months of order: 100%
Warranty & Guarantee	: Products offered by us are warranted against any manufacturing defects for a period 12 months from the date of dispatch. The company guarantees to the original Purchaser that the offered equipment will perform at rated capacity, only when: Properly installed, connected, started and maintained in accordance to Company instructions, information guides, as revised from time to time. Used for the application specified. Used in the environments as specified or as limited. The company accepts responsibility only for equipment offered by it.
Limitation of Liability	: In no event we shall be liable for any consequential loss or damage arising out of or connected with this Purchase order in any way what so ever.
Force Majeure	: No liability shall be attached to us for delayed execution of the order as a result of force majeure. The delivery schedule shall be suitably extended if the following FORCE MAJEURE conditions affect our VENDOR or us / MAJOR SUB CONTRACTORS. Acts of Good. Fires, Epidemics, Floods, Riots, Wars. Changes in the Govt.'s Import Policy relevant to vendor's imported inputs. Any Act of Govt.'s Bodies / Institutions / Law Enforcing Agencies e) Any situation beyond our reasonable control or that of our vendor.
Arbitration.	: All disputes and differences arising out of or connected with this order, failing amicable settlement, shall be referred to arbitration under the Indian Arbitration Act 1940 or any statutory modification for the time being in force and such arbitration shall take in Delhi only.
Jurisdiction	: Subject to Delhi jurisdiction





**INNOVATIVE THERMAL ENGINEERING PVT. LTD.**

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Validity : Our offer is valid for a period of 30 days from the offer date and thereafter subject to confirmation.

**No deviation will be considered valid unless agreed in writing prior to release of LOI / P.O**

## M.B. ENGINEERS

**Deals in:** Oil & Gas Burners & Spare Parts, Boiler, Chemicals, IBR Fittings, & Valves, Boiler Jobs, Pipeline Insulation, M.S./S.S. Fabrication & PNG Gas Pipe Line Etc.

**Office :** 2266, Sector 03, Ballabhgarh ,Faridabad -121004 (HR)  
**Works :** Rajiv Colony, Near Fogat School, Sector 56A, Faridabad  
**Website :** mbengineers.com  
**Email:** bhati.madan@gmail.com

**Ref. No.:** MBE/PNG/2018/MI/10/08

Date : - 10.08.2018

Attn. Mr. ANAND MOHAN GHOAH,

**Sub:** Offer for Supply and Installation of PNG Gas Pipe Line for MAYA INDUSTRIES, KHURJA-UP

**Ref:** As per your Email & Discussion on dated 10-08-2018 for Above Subject.

Dear Sir,

With reference to your discussion with me for the installation of PNG-Gas Pipe Line at your site, We are pleased to enclosed lowest offer as per details below.

S.No.	Item Description	Qty.	Unit	Unit Rate (Rs.)	Amount. (Rs.)
<b>PNG GAS PIPE LINE WORKS:-</b>					
1	P/ F of "JINDAL" Make 2"M.S.'C' Class Pipe Line with Fittings.	1	R-Feet	250	250.00
2	P/ F-Special Pipe Supports/ "U" Clamp	1	Nos	100	100.00
3	Fabrication of Pipe "L" Supports.	1	Nos	150	150.00
4	P/ F-2" Ball Gas Valves Make: L&T/ DRP/ Audco	2	Nos	6500	13,000.00
5	P/ F-1" Ball Gas Valves Make: L&T/ DRP/ Audco	6	Nos	2800	16,800.00
6	P/ F-0-300 mili Bar-Gas Pressure Gauge with Caliribition Certificate	7	Nos	1850	12,950.00
7	P/ F.1/ 2" Ball Gas Valves Make: L&T/ DRP/ Audco for Pressure Gauge.	2	Nos	1700	3,400.00
8	P/ F-Pipe Line Hindi / English Stickers	1	Nos	75	75.00
9	Pressure and Leakage PNG Pipe Line Testing and Pipe Line Sketch Drawing Charges	1	Set	8500	8,500.00
10	P/ F- OF Complite Gas of Train of Make: GECA/ Tecno Gas/ Madas For Control PNG	1	SETS	159500	159,500.00

S.No.	Item Description	Qty.	Unit	Unit Rate (Rs.)	Amount. (Rs.)
	Gas Include PRV-DN 50, FILTER DN 50, SAFETY RELIEF VALVE-DN50, SAFETY RELIEF VALVE-DN25, 2 NOS PRESSURE GAUGE IN mBar, Push to Tsting Valve, DN50 SOLONIDE VALVE, and OTHERS FITTINGS.				
11	P / F-of S.S. Flexible pipe-1/ 2"X 1.5 Meter Long.	6	Nos	1600	9,600.00
	Product Total Cost Rs.				224,325.00
	GST-Taxes Extra ( @18%)				40,378.50
	Cost including GST				264,703.50

### Terms and conditions:-

- \* 60% Along with the work order, 40% after compilation of works.
- \* **OUR SERVICE WILL BE 24 HOURS AVAILABLE, OMPLAINT CALL WILL BE ATTEND -WITH IN 30 MINITUES.**
- \* Work to be commenced 10-15 days after receipt of confirmed order with 60% advance.
- \* Support MS angle and pipe line painting not in our scope
- \* *Existing air train and blower will be used, flow meter for air and gas is excluded as gas kid will have flow meter for gas and air ratio will be set during commissioning time.*
- \* *Unit may incur around Rs 50000 extra for miscellaneous expenses during integration, which may considered towards total expenses.*

Best Regards

For M.B. Engineers

Madan Bhati

Mobile: 09999957244



## Annexure 3.7: Instruments used

Instruments	Model/ Make	Application	Accuracy
Power analysers	Fluke: 435, Fluke: 43B,	Electrical Parameters Harmonics analysis, power logging	± 0.5%
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%
Digital Temperature indicator	Comark: N1001, Testo: 925	Temperature	± 1%
Anemometer	Testo: 425, Airflow: TA45	Air Velocity	±(0.03 m/s +5% of mv)
Temperature data logger	175-T3/Testo	Temperature	± 0.5%