Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Presentation by StraConsult Ltd

on the findings of the Survey

24 January 2019

Conference A, Atal Bihari Vajpayee Tower

From 09.00 to noon

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Purpose of carrying out the survey

- To obtain a breakdown of energy use in the industries and the SME sectors in terms of consumption of electricity, fossil fuels, gas and renewable energy sources by different end use;

- To obtain details on the renewable energy technology installations (photovoltaic and solar water systems) and on stand-by generators installed in the sectors;

- To determine the level of energy efficiency of the industry facilities and SMEs, through Energy Use Intensity (EUI) calculations

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Methodology

- Standard questionnaire was developed and sent to enterprises

- Assistance was provided through
  - Face to face interview (site visits)
  - Phone calls
  - Emails

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Classification of Industry and SME

Industry

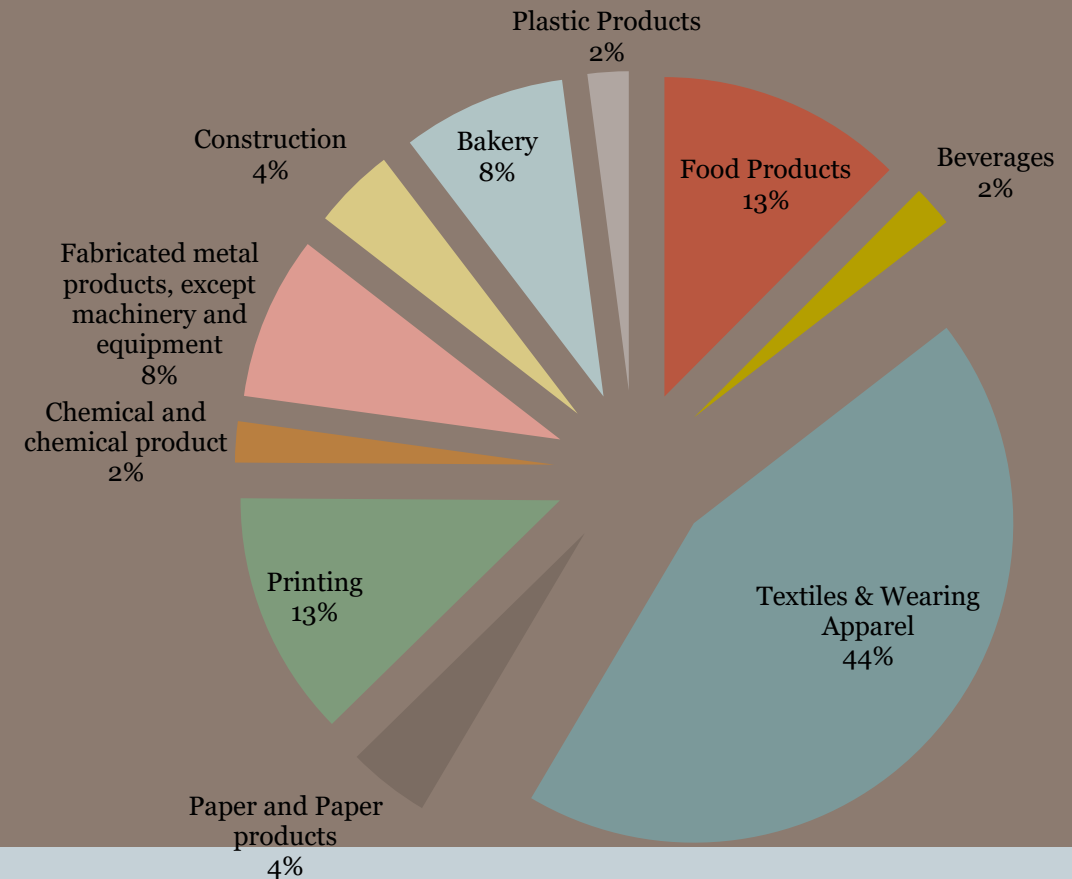Industry Sector has been classified as enterprises generating an annual turnover above Rs 50M

SME

Enterprises with an annual turnover not exceeding Rs 50 million rupees

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Targeted sample for Industry and SME Sectors

Sub-sector	Total number of enterprises per sub sector
Bakery	20
Beverages	5
Chemical and chemical product	5
Construction	10
Fabricated metal products, except machinery and equipment	20
Food Products	30
Paper and Paper products	10
Plastic Products	5
Printing	30
Textiles & Wearing Apparel	106
Total	**241**

Total number of enterprises per sub sector

Plastic Products 2%
Construction 4%
Bakery 8%
Food Products 13%
Beverages 2%
Fabricated metal products, except machinery and equipment 8%
Chemical and chemical product 2%
Printing 13%
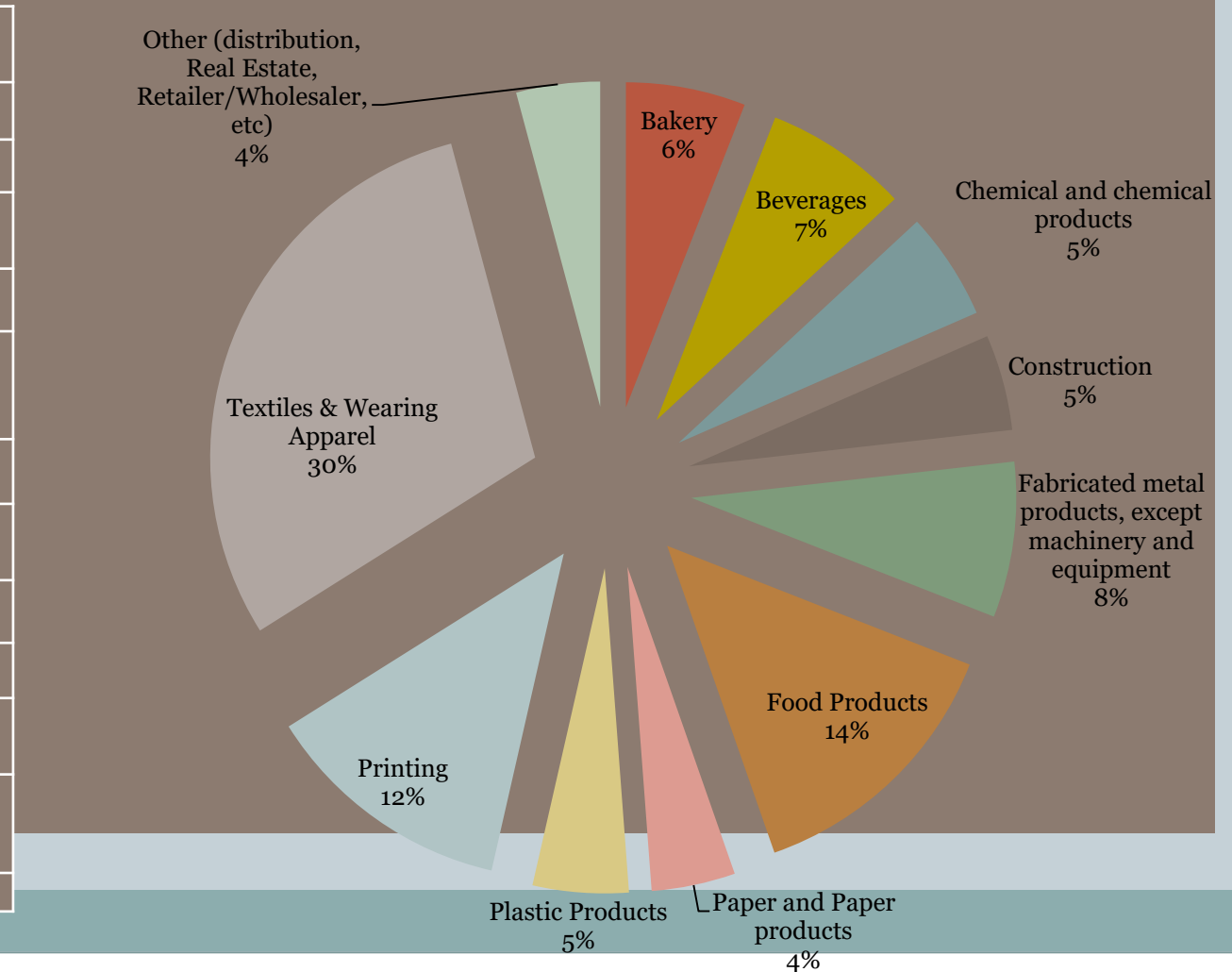Paper and Paper products 4%
Textiles & Wearing Apparel 44%

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

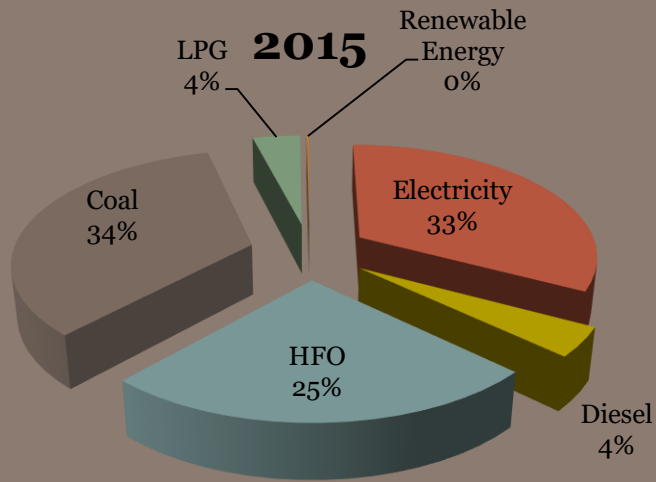## Enterprises which responded to the survey (industry and SME)

Sub-sector	Total number of enterprises per sub sector
Bakery	10
Beverages	12
Chemical and chemical products	9
Construction	8
Fabricated metal products, except machinery and equipment	13
Food Products	23
Paper and Paper products	7
Plastic Products	8
Printing	21
Textiles & Wearing Apparel	50
Other (distribution, Real Estate, Retailer/Wholesaler, etc)	7
Total	**168**

Total number of enterprises per sub sector

- Other (distribution, Real Estate, Retailer/Wholesaler, etc) 4%
- Bakery 6%
- Beverages 7%
- Chemical and chemical products 5%
- Construction 5%
- Fabricated metal products, except machinery and equipment 8%
- Food Products 14%
- Paper and Paper products 4%
- Plastic Products 5%
- Printing 12%
- Textiles & Wearing Apparel 30%

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Annual Breakdown of Energy sources in the Industry and SME sectors

2015
- LPG 4%
- Renewable Energy 0%
- Electricity 33%
- Diesel 4%
- HFO 25%
- Coal 34%

2016
- LPG 4%
- Renewable Energy 0%
- Electricity 34%
- Diesel 4%
- HFO 27%
- Coal 31%

2017
- LPG 4%
- Renewable Energy 0%
- Electricity 34%
- Diesel 6%
- HFO 27%
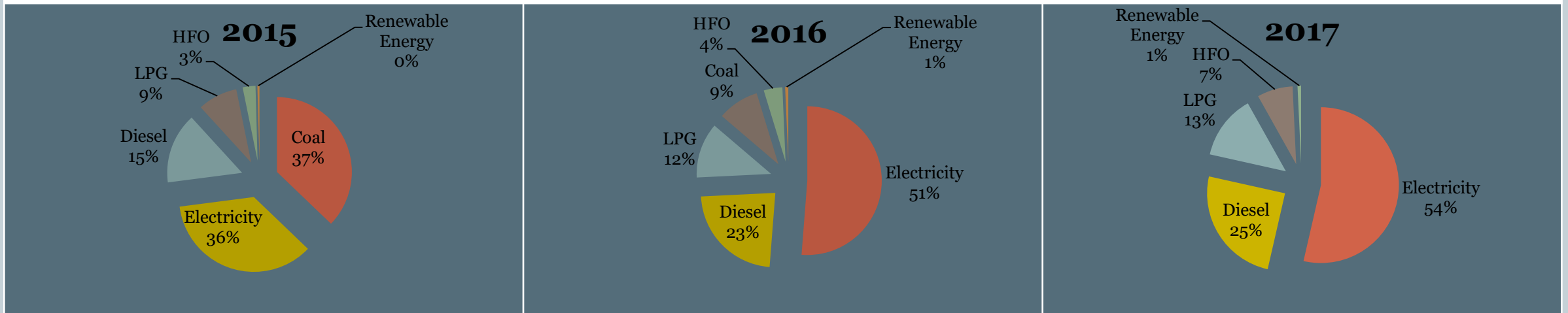- Coal 29%

OBSERVATIONS

- Electricity consumption was found to be percentagewise constant, at around 33%, from 2015 to 2017

- There is a gradual Shift in consumption from COAL to HFO and diesel from 2015 to 2017

- Renewable energy consumption was found to be constant at 0.2% from 2015 to 2017 (in absolute terms increase from 1,196,089 kWh in 2015 to 1,210,445 kWh in 2017)

Breakdown of Energy sources in the Industry and SME Sectors from 2015-2017

	Electricity	Diesel	HFO	Coal	LPG	Renewable Energy
2015	201,306,426	25,345,497	152,152,857	209,808,984	23,379,257	1,196,089
2016	198,497,647	26,134,776	155,432,570	181,378,743	22,219,762	1,199,726
2017	206,796,015	39,730,949	167,342,240	178,454,325	21,383,531	1,210,445

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors
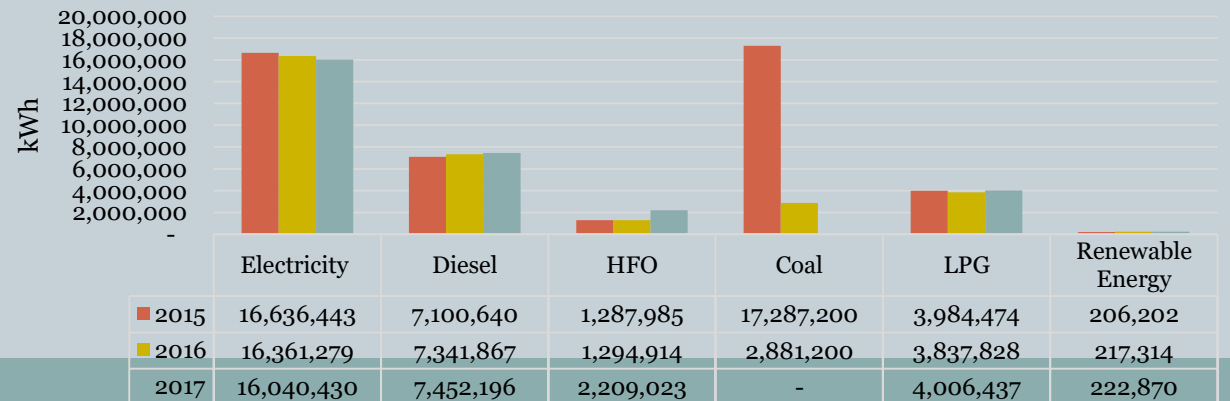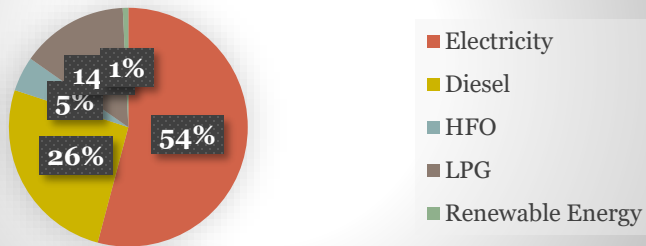
Annual Breakdown of Energy sources in the SME sector

2015
- HFO 3%
- Renewable Energy 0%
- LPG 9%
- Diesel 15%
- Electricity 36%
- Coal 37%

2016
- HFO 4%
- Renewable Energy 1%
- Coal 9%
- LPG 12%
- Diesel 23%
- Electricity 51%

2017
- Renewable Energy 1%
- HFO 7%
- LPG 13%
- Diesel 25%
- Electricity 54%

OBSERVATIONS

Electricity was found to be the key driver in energy sources in 2016 and 2017

Diesel consumption has increased from 15% in 2015 to reach 23% in 2016 and 25% in 2017

The drop in coal consumption is due to one firm shifting to diesel and HFO

Breakdown of Energy Sources in the SME Sector from 2015-2017

	Electricity	Diesel	HFO	Coal	LPG	Renewable Energy
2015	16,636,443	7,100,640	1,287,985	17,287,200	3,984,474	206,202
2016	16,361,279	7,341,867	1,294,914	2,881,200	3,837,828	217,314
2017	16,040,430	7,452,196	2,209,023	-	4,006,437	222,870

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors
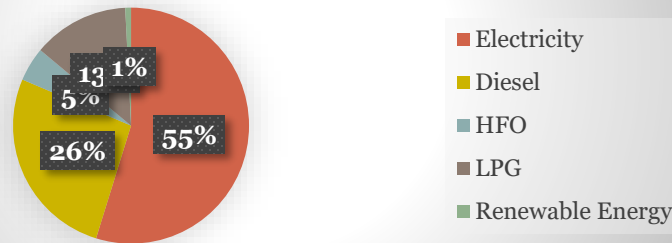
Annual Breakdown of Energy sources in the SME sector

- Observation – Only one company was consuming coal from 2015 to 2017. For better analysis, the company was excluded and the breakdown of energy sources from 2015 to 2017 are as follows:-
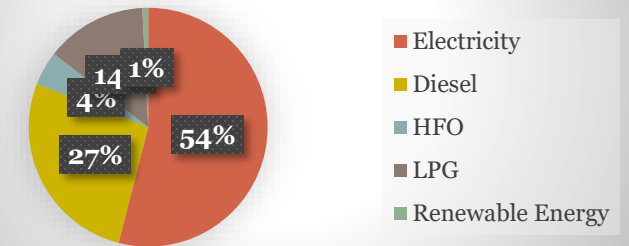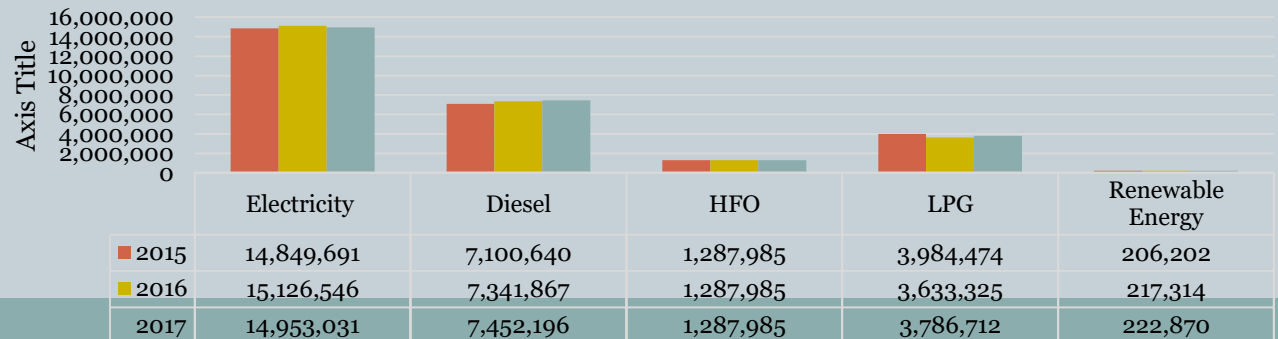
Breakdown of energy sources in the SME sector 2015

Electricity 54%, Diesel 26%, HFO 5%, LPG 14%, Renewable Energy 1%

Legend: Electricity, Diesel, HFO, LPG, Renewable Energy

Breakdown of energy sources in the SME sector 2016

Electricity 55%, Diesel 26%, HFO 5%, LPG 13%, Renewable Energy 1%

Legend: Electricity, Diesel, HFO, LPG, Renewable Energy

Breakdown of energy sources in the SME sector 2017

Electricity 54%, Diesel 27%, HFO 4%, LPG 14%, Renewable Energy 1%

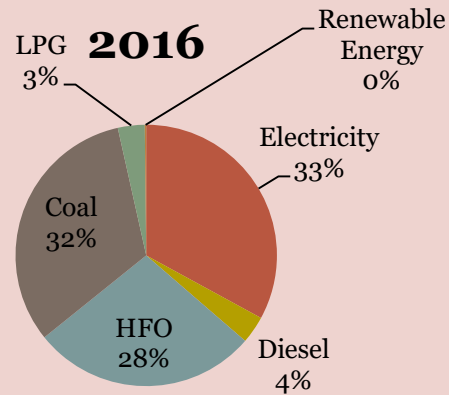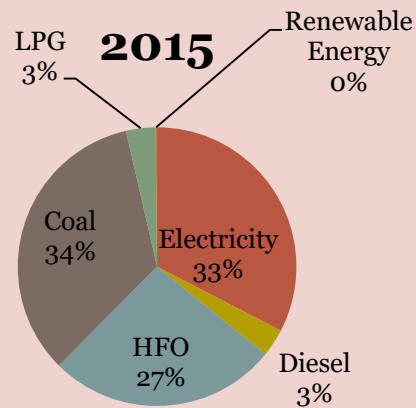Legend: Electricity, Diesel, HFO, LPG, Renewable Energy

OBSERVATIONS

Throughout 2015 to 2017, the prime energy source was Electricity followed by Diesel, LPG, HFO and Renewable energy

Breakdown of Energy Sources in the SME Sector from 2015-2017

Axis Title

|	Electricity	Diesel	HFO	LPG	Renewable Energy
2015	14,849,691	7,100,640	1,287,985	3,984,474	206,202
2016	15,126,546	7,341,867	1,287,985	3,633,325	217,314
2017	14,953,031	7,452,196	1,287,985	3,786,712	222,870

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Annual Breakdown of Energy Sources in the Industry Sector

2015
- LPG 3%
- Renewable Energy 0%
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- Coal 34%

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- Diesel 6%
- HFO 28%
- Coal 30%
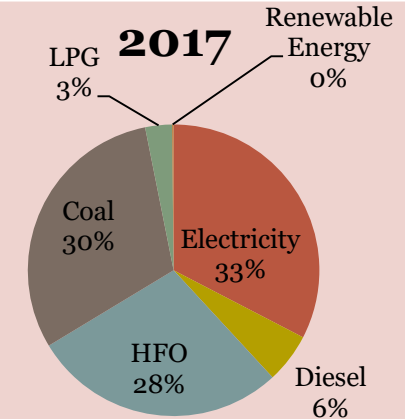
OBSERVATIONS

Key drivers of energy sources from 2015 to 2016 remains Electricity, Coal and HFO
Shift from coal to HFO and diesel.

Breakdown of Energy sources in the Industry Sector 2015-2017
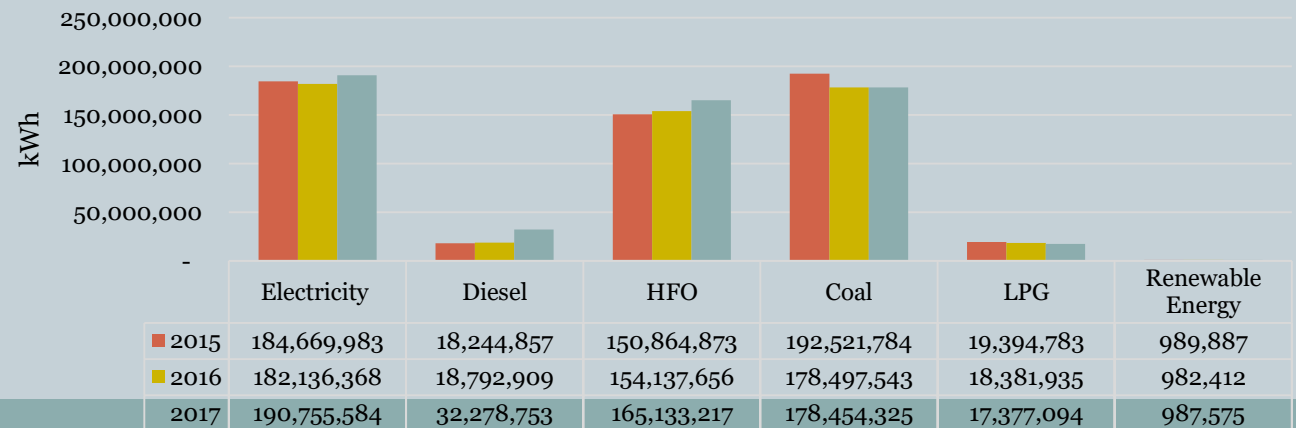
(kWh)

	Electricity	Diesel	HFO	Coal	LPG	Renewable Energy
2015	184,669,983	18,244,857	150,864,873	192,521,784	19,394,783	989,887
2016	182,136,368	18,792,909	154,137,656	178,497,543	18,381,935	982,412
2017	190,755,584	32,278,753	165,133,217	178,454,325	17,377,094	987,575

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

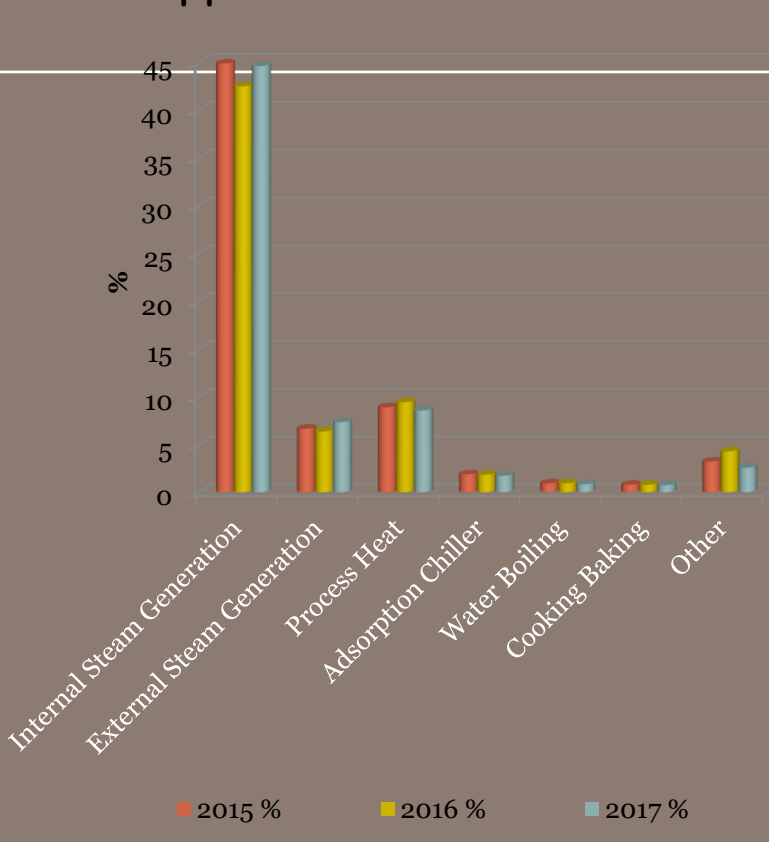## Breakdown of Energy Consumption by End Use for Industry and SME Sectors (2015-2017)

Electricity - Non-Thermal Applications
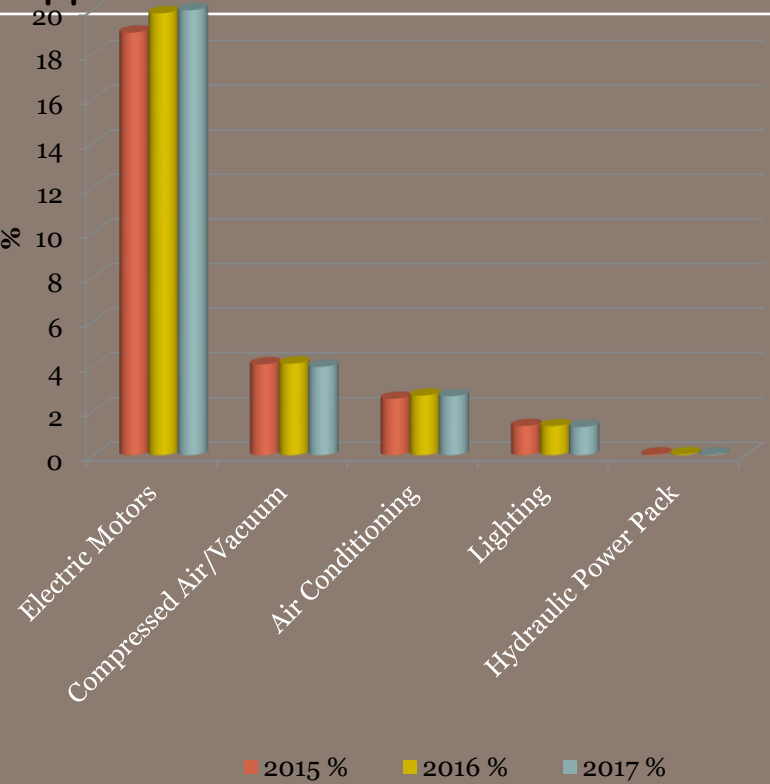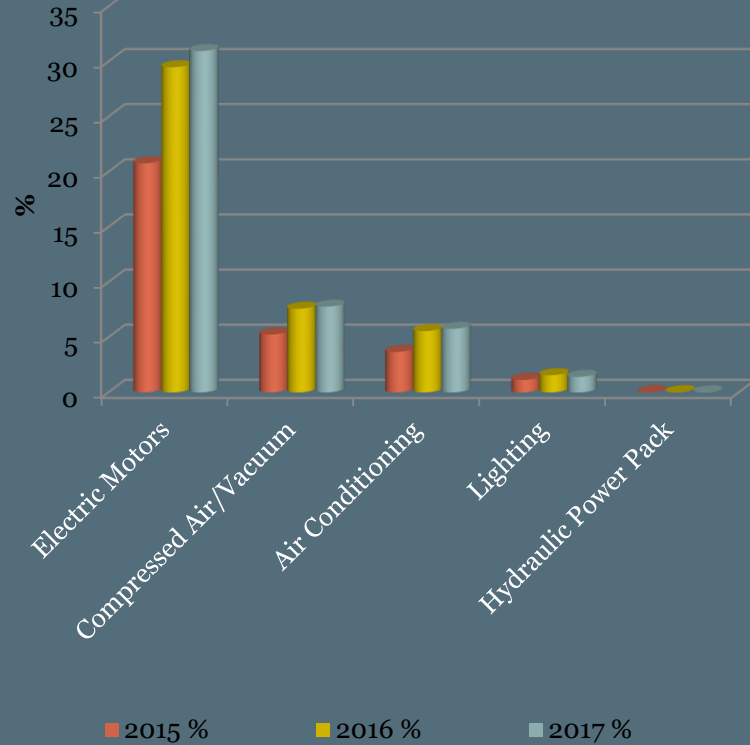
Electricity - Thermal Applications

FUEL Applications

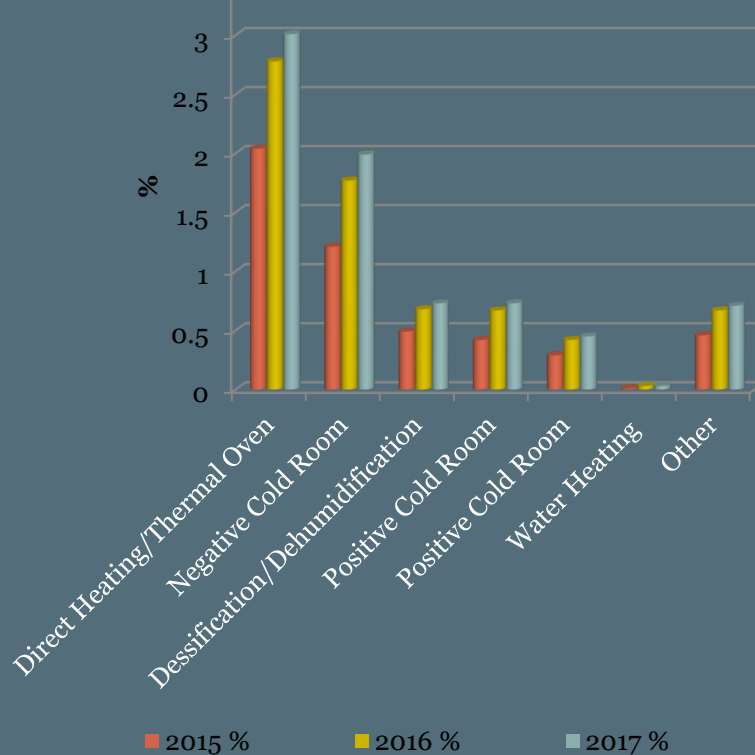# Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

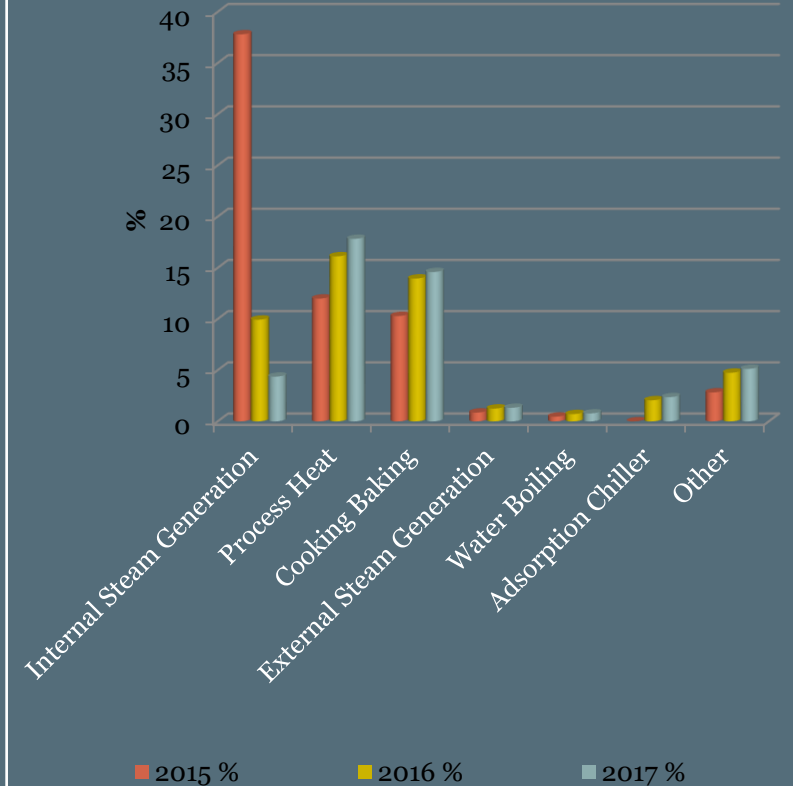*Breakdown of Energy Consumption by End Use for SME Sector (2015-2017)*
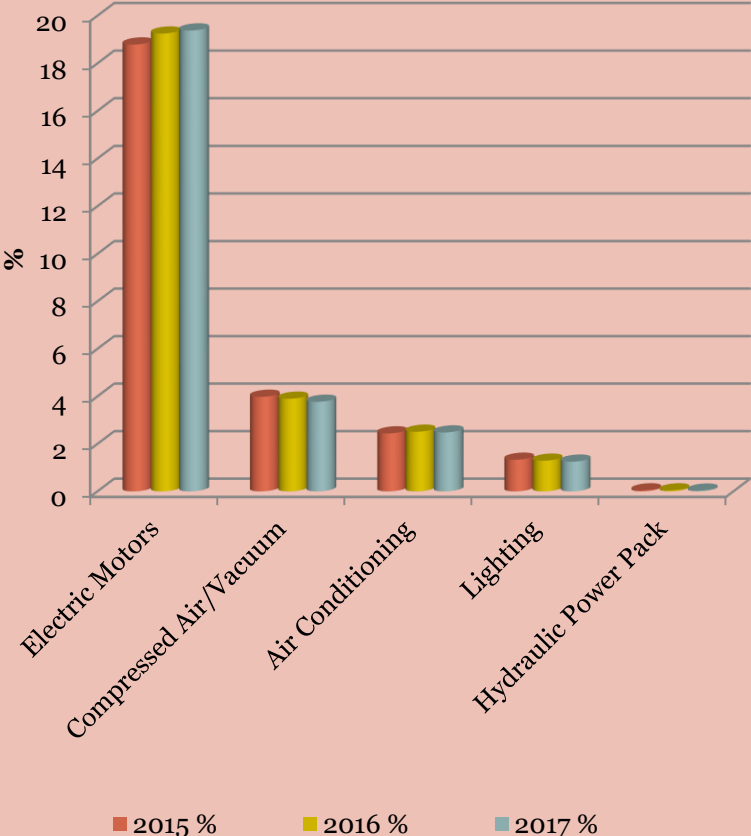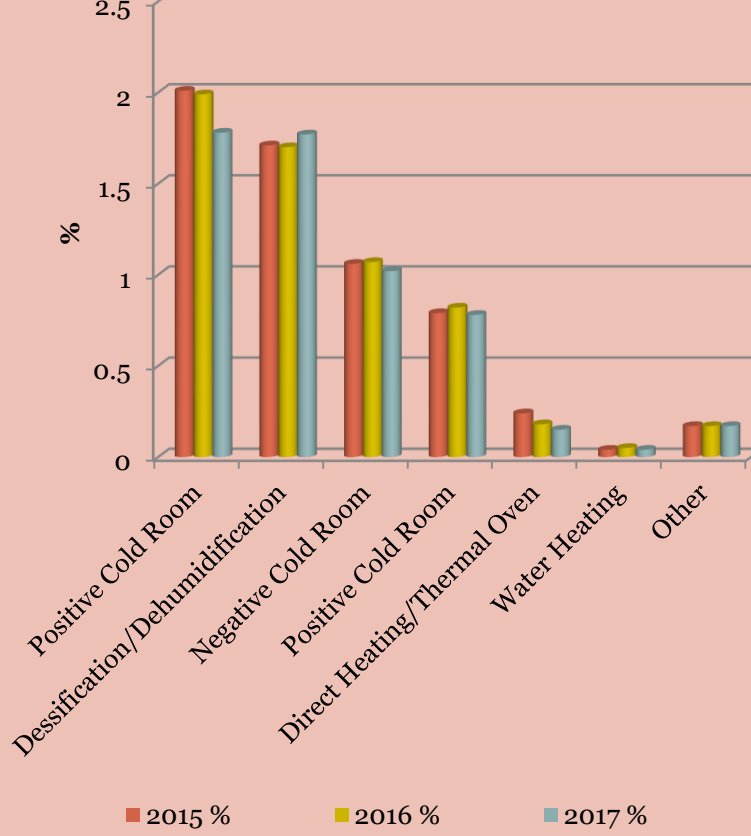
Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

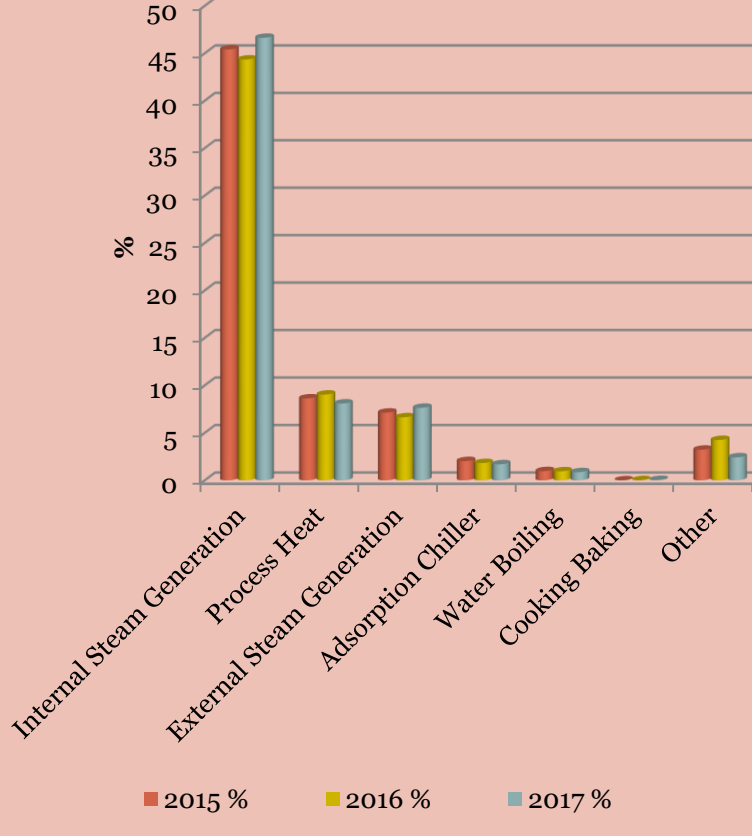## Breakdown of Energy Consumption by End Use for Industry Sector (2015-2017)
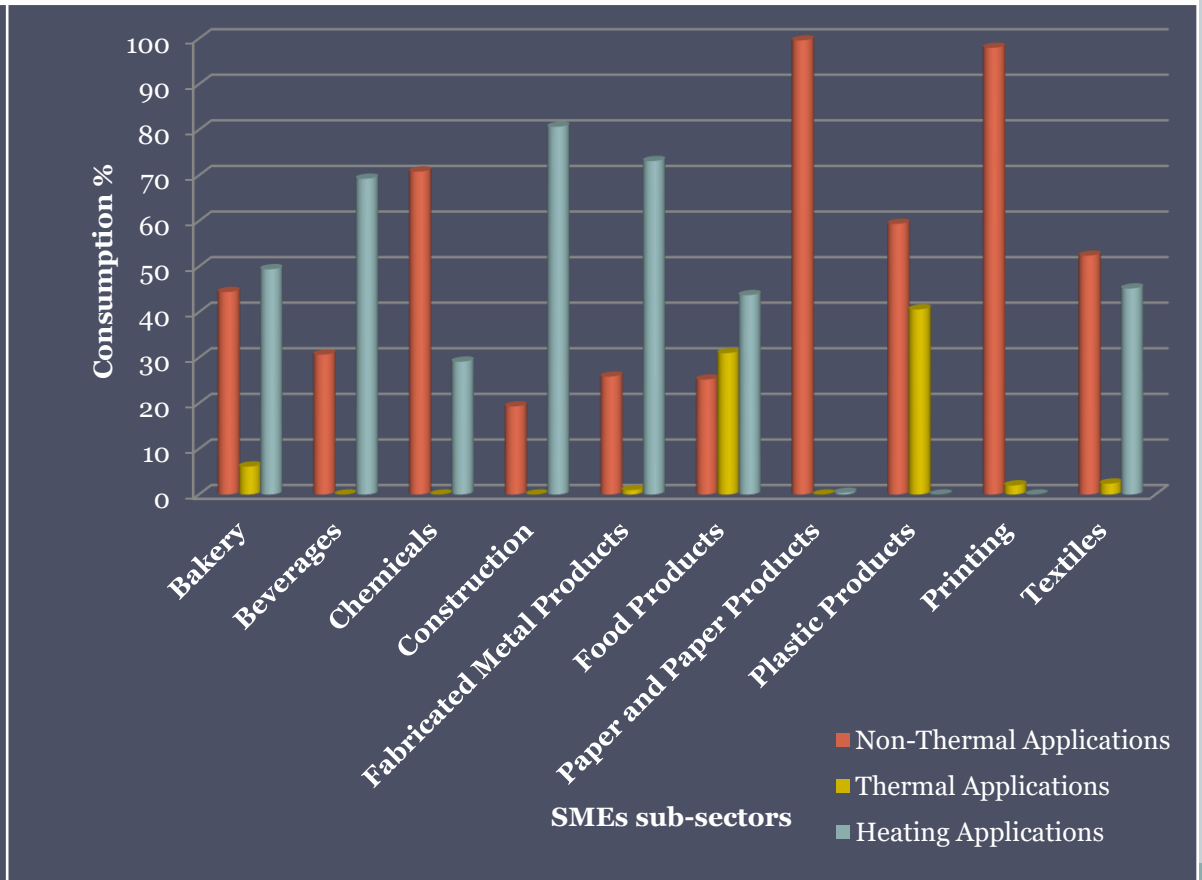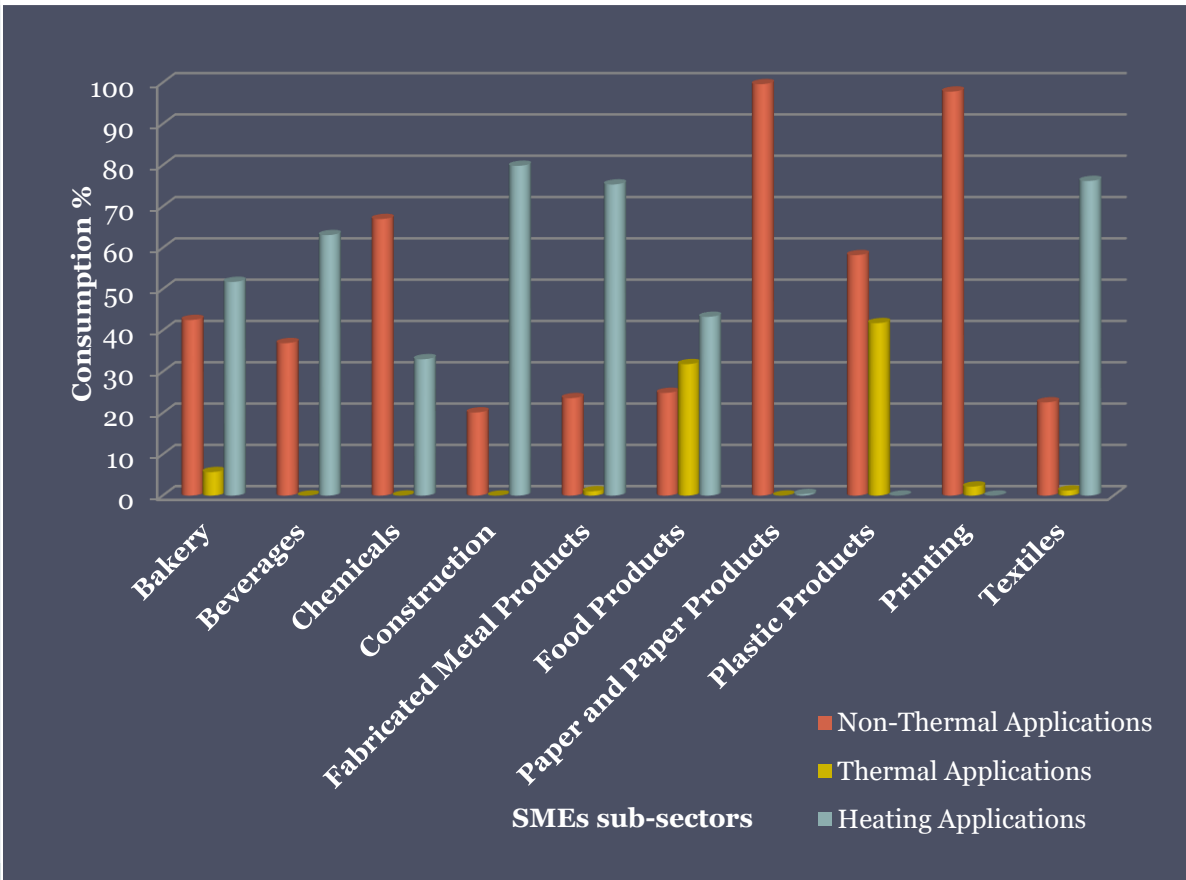
Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Breakdown of End Energy Use by Sub-sectors for SME Sector in 2015

Breakdown of End Energy Use by Sub-sectors for SME Sector in 2016

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

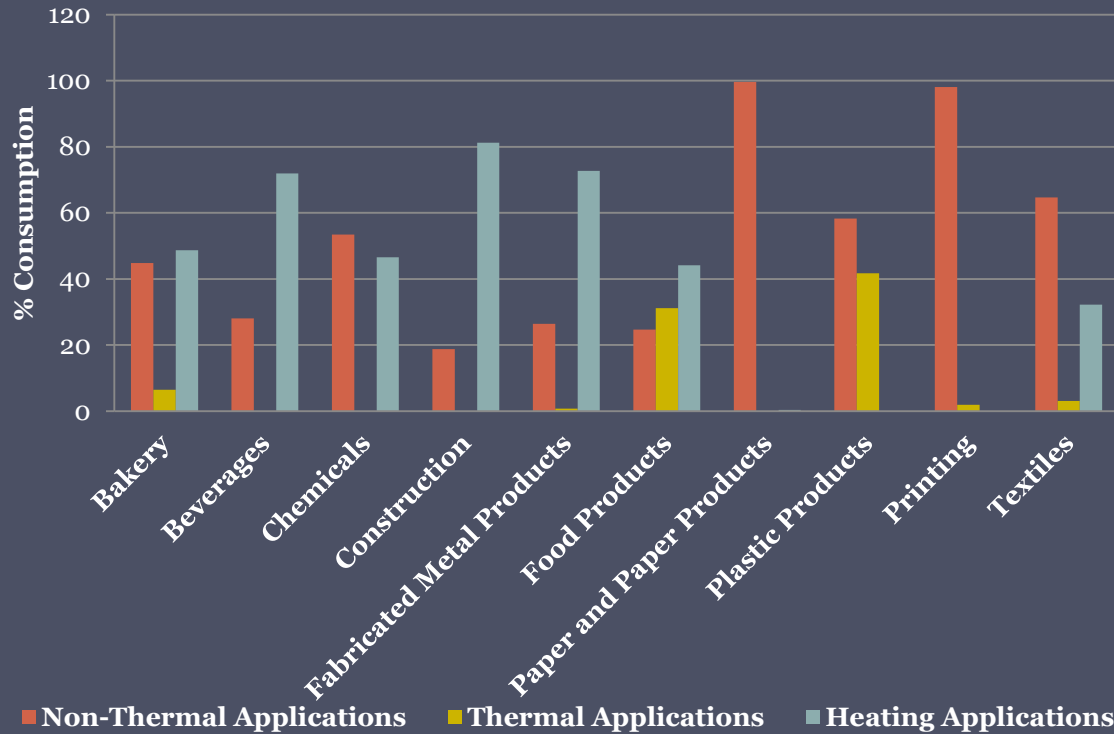| Breakdown of End Energy Use by Sub-sectors for SME Sector in 2017	Observations
	• Over the years, share of Electricity for Non-Thermal Applications, Electricity for Thermal Applications and Fuel Applications did not change significantly for all sub-sectors except for the Textile sector. • Textiles: Share of Fossil fuel decreases from 2015 to 2017 – Delocalization of production.

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Breakdown of End Energy Use by Sub-sectors for Industry Sector in 2015

Breakdown of End Energy Use by Sub-sectors for Industry Sector in 2016

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

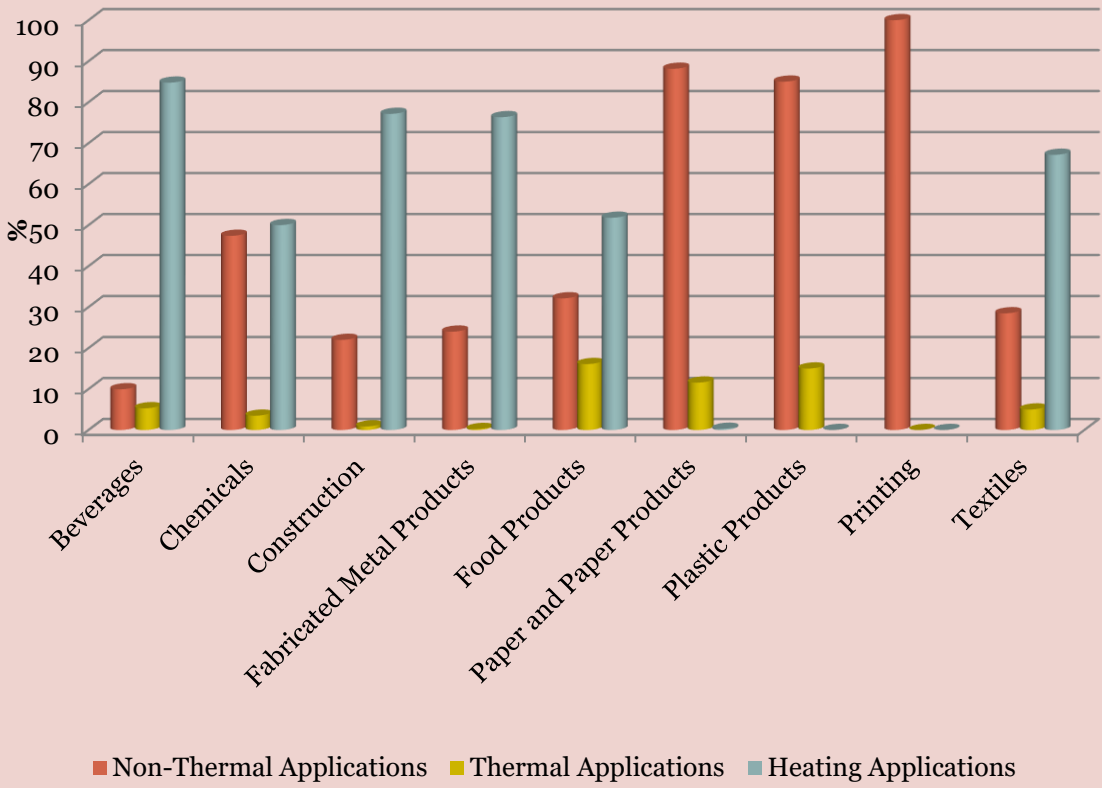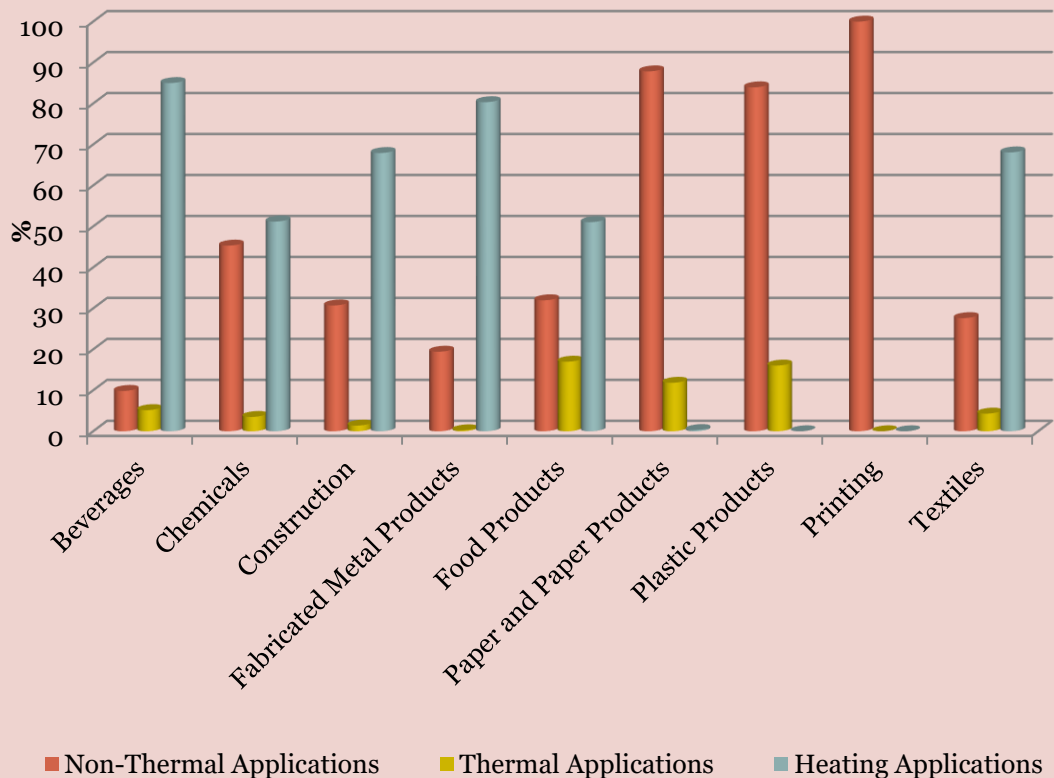| Breakdown of End Energy Use by Sub-sectors for Industry Sector in 2017	Observations
	• Share of Electricity for Non-Thermal Applications, Electricity for Thermal Applications, and Fossil Fuel Applications did not change significantly for all subsectors. • There has been no change in technology for production over the three years.
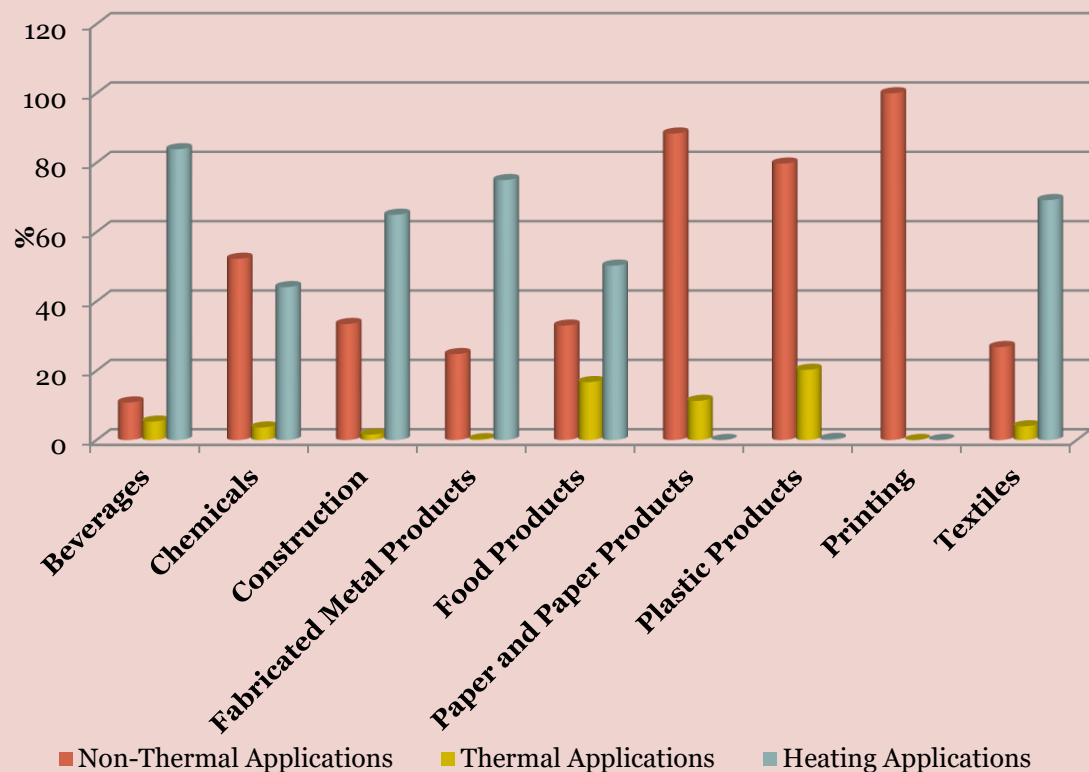
Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

RENEWABLE ENERGY

A. **Solar Water Heaters**

15 firms reported the installation of Solar Water Heaters. However, only 3 firms, i.e one from industry and two from SME, use the Solar Water Heaters for production purposes.

B. Solar PV

Two firms from the industry sector confirmed the use of Solar PV to produce electricity

C. Uses of Biomass

One SME reported the use of ravenala leaves for heating

Renewable Energy in the Industry and SME Sectors from 2015 to 2017

	2015	2016	2017
Solar Water Heaters	1,011,750	1,011,750	1,011,750
Solar PV	89,887	82,412	87,575
Biomass	94,452	105,564	111,120
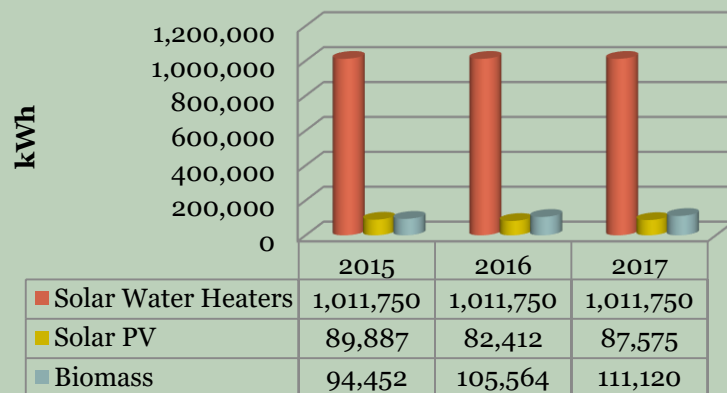
Renewable Energy in the SME Sector from 2015 to 2017

	2015	2016	2017
Solar Water Heaters	111,750	111,750	111,750
Biomass	94,452	105,564	111,120
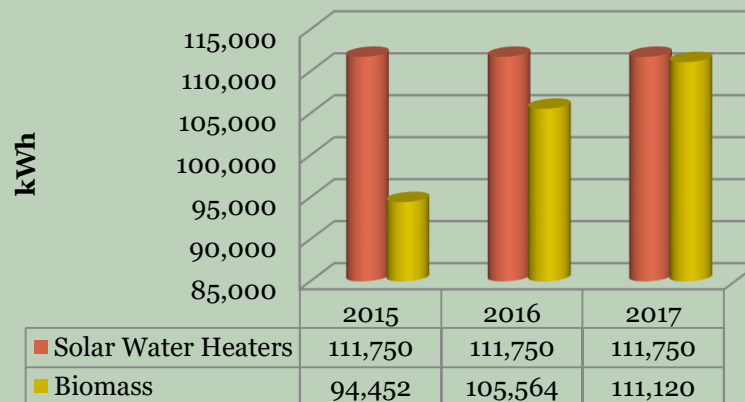
Renewable Energy in the Industry Sector from 2015 to 2017

	2015	2016	2017
Solar Water Heaters	900,000	900,000	900,000
Solar PV	89,887	82,412	87,575
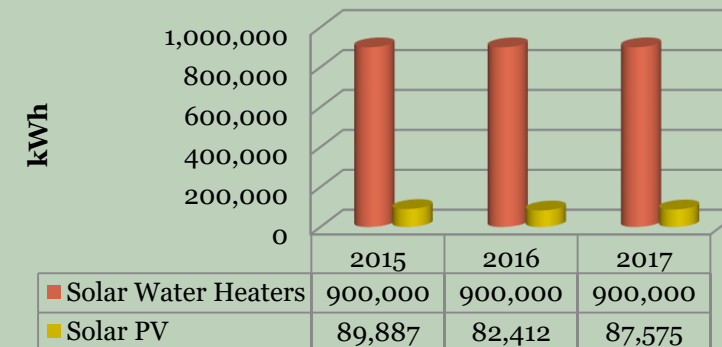
Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Standby Generators

41 firms indicated that they have Standby Generators. Out of which 13 are SMEs and 28 operate in the industry sector.

The size of the generators varies from 6 kVA to 3400 kVA

Use of Standby Generators to produce electricity

	2015	2016	2017
SME	29,525	31,140	31,626
Industry	153,307	160,213	199,692

kWh
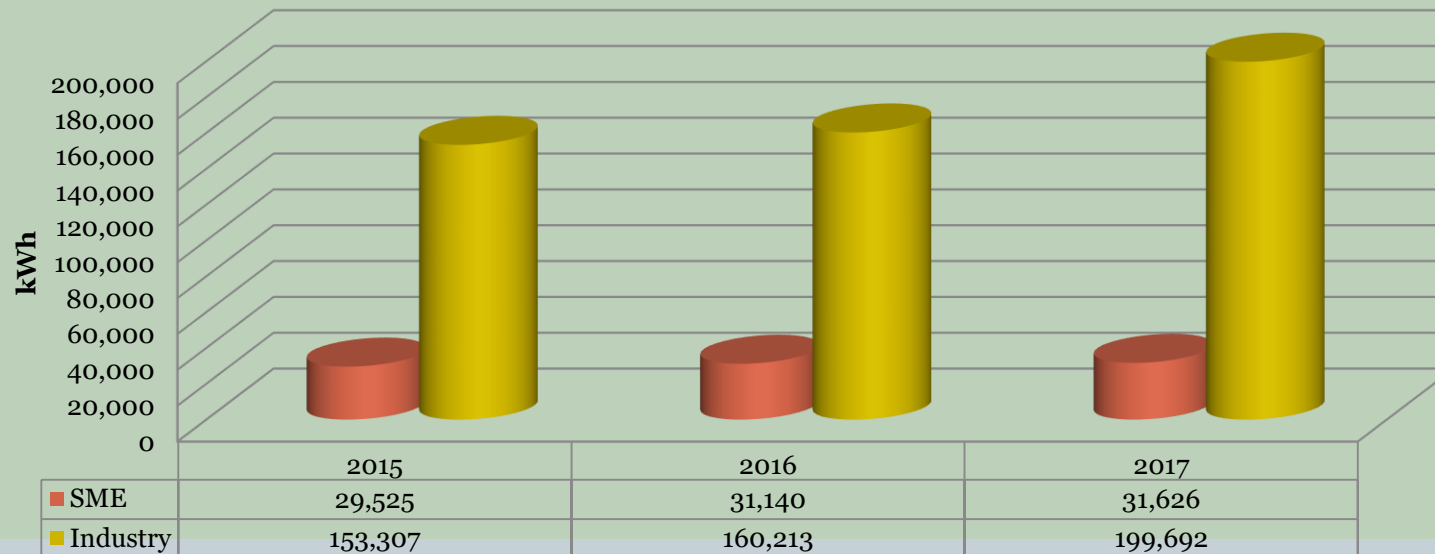
Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Energy Unit Intensity (EUI)

EUI is a indicator to measure the performance of an enterprise on different variables which could be:-

    a. Number of employees

    b. Floor area

    c. Production output, etc.

For the purpose of this survey, the EUI has been calculated on fixed variable of Production Output giving the rating as kWh/Production Output

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Formula for EUI by different energy uses

Electric Energy Unit Intensity Per Production Output for 2017 = $\dfrac{\text{Electric Energy Consumed by a Firm in 2017 (kWh)}}{\text{Quantity of Products Manufactured by Firm in 2017}}$

Fossil Fuel Energy Unit Intensity Per Production Output for 2017 = $\dfrac{\text{Fossil Fuel Energy Consumed in 2017 (kWh)}}{\text{Quantity of Products Manufactured by Firm in 2017}}$

Total Energy Unit Intensity Per Production Output for 2017 = $\dfrac{\text{Total Energy Consumed by Firm in 2017 (kWh)}}{\text{Quantity of Products Manufactured by Firm in 2017}}$

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Example on EUI analysis carried out in the bakery sector

Number of breads baked	:	6,000,000
Annual Electricity Consumption	:	24,000 kWh
Annual Fossil Fuel Consumption (Diesel)	:	420,000 kWh
Total Energy Consumption	:	444,000

Electricity EUI   = 24,000 kWh/6,000.000 breads   = 0.004 kWh/bread.

Fossil Fuel EUI   = 420,000 kWh/6,000,000 breads   = 0.07 kWh/bread.

Total EUI   =444,000 kWh/6,000,000 breads   = 0.074 kWh/bread.

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Main Findings on EUI in SME Bakeries

Six companies showed a strong negative relationship between EUI per unit of bread and quantity of bread baked

Electricity Consumption

For the production of one bread in 2015 – 0.1182 kWh compared to 0.1146 and 0.116 in 2016 and 2017 respectively. For each additional million of bread baked, the consumption decreases by 0.007 kWh

Fossil fuels consumption

In 2015, the production of one bread required 0.7825 kWh of fossil fuels against 0.7672 and 0.7574 kWh in 2016 and 2017 respectively. The production of each additional million of bread baked decreases the consumption by 0.06 kWh

Total Energy Consumed (combination of electricity and fossil consumption)

The total energy consumption per bread in 2015 amounted to 0.9007 kWh, 0.8815 in 2016 and 0.8734 in 2017. It is estimated that each additional million bread baked decreases the consumption by 0.07 kWh

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Main Findings on EUI – SME Food Products

5 firms demonstrated a strong negative relationship between EUI per unit weight of food products and weight of food products while a moderate negative relationship was found between the corresponding variables for fossil fuels

Electricity Consumption for one ton of food products
- In 2015 = 752.83 kWh
- In 2016 = 682.43 kWh
- In 2017 = 642.85 kWh

The consumption reduces, for each additional ton of food products produced, by 0.3168, 0.2794 and 0.2479 kWh in 2015, 2016 and 2017 respectively

Fossil Fuels consumption for one ton of food products
- In 2015 = 2758.2 kWh
- In 2016 = 2804.4 kWh
- In 2017 = 2797.4kWh

The consumption reduces, for each additional ton of food products produced, by 1.3721, 1.3831 and 1.3124 kWh in 2015, 2016 and 2017 respectively

Total Energy Required

- In 2015 = 3511 kWh
- In 2016 = 3486.8 kWh
- In 2017 = 3440 kWh

The consumption reduces, for each additional ton of food products produced, by 1.6889, 1.6626 and 1.5603 kWh in 2015, 2016 and 2017 respectively

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Main Findings on EUI – Plastic Products

2 companies which participated in the survey were in plastic injection molding

Data for Plastic Injection Molding Sorted according to Weight of Products

- Process uses only electricity

- There is no clear relationship between EUI and weight of plastic injection moulding.

- Values of electricity EUI (equal to total EUI) are quite close to each other.

- The lowest value of EUI can be used as a benchmark.

Benchmark value for plastic injection molding is 2,926.9 kWh/ton

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Main Findings on EUI – SME Printing

5 firms showed a moderate to strong negative relationship between EUI per unit weight of printed matter and weight of printed products

Source of Energy : Electricity only

Consumption of electricity per ton of printed documents in

2015: 8032 kWh
2016: 8928 kWh
2017 : 8304 kWh

Consumption decreases by 71.134 kWh in 2015, 80.344 kWh in 2016 and 74.557 kWh in 2017 for each additional ton of printed matter

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Main Findings on EUI – SME Textiles (Knitted Garments)

6 firms revealed a strong negative relationship between the EUI per unit of knitted garment and number of knitted garments

Source of Energy : Electricity

Consumption of electricity to produce one knitted garment
- 2015 : 0.5723 kWh
- 2016: 0.617 kWh and
- 2017 : 0.5771 kWh

For each additional 1000 knitted garments produced, the consumption decreased by 0.0005 kWh in 2015, 0.0004 kWh in 2016, and 0.0005 kWh in 2017.

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Main Findings on EUI – Industry Beverages

Producers of Rum

5 firms showed a moderate negative relationship between electricity EUI (kWh/liters) and number of liters.

Electricity Consumption for the production of one litre of rum
2015 : 0.5341 kWh
2016 : 0.5732 kWh
2017 : 0.618 kWh

For each additional million of litres of rum produced the consumption decreased by 0.05 kWh in 2015, 0.06 kWh in 2016, and 0.06 kWh in 2017.

Producers of Tea

2 firms were from tea factories.

Data for the Two Tea Factories Sorted by Weight of Tea

There is no clear pattern between EUI and Weight of tea produced.

Respective values of EUIs are quite close to each other. Therefore, lowest values can be used as benchmarks.

Benchmarks are 1.0372 kWh/kg for electricity EUI, 3.7905 kWh/kg for fossil fuel EUI and 4.8903 kWh/kg for total EUI.

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Main Findings on EUI – Chemicals industry – Paint Sector

The data of the 2 paint manufacturers were analysed.

EUIs for the two firms show a consistent reduction over the three years meaning that the two firms are improving their energy efficiency.

Respective values of EUIs are quite close to each other. Therefore, lowest values can be used as benchmarks.

Benchmarks are 0.839 kWh/liter of paint for electricity EUI and 0.839 kWh/liter of paint for total EUI.

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Main Findings on EUI – Industry Food Products - Poultry

Data of the 2 poultry firms were analysed.

Data for Poultry Producing Firms Sorted by Weight of Products

Electricity EUI and total EUI decrease as weight of products increases.

Respective values of EUIs are quite close to each other. Therefore, lowest values can be used as benchmarks.

Benchmarks are 452.15 kWh/ton for electricity EUI, 44.94 kWh/ton for fossil fuel EUI and 576.44 kWh/ton for total EUI.

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

Main Findings on EUI – Industry Textiles – Knitted Garments

5 firms showed a moderate to strong relationship between EUIs and number of knitted garments.

Electricity Consumption for production of one knitted garment
- In 2015 = 0.501 kWh
- In 2016 = 0.5696 kWh
- In 2017 = 0.5107 kWh

The consumption of electricity decreases by 0.0001 kWh for each additional 1000 knitted garments produced

Total Energy Required for one knitted garment
- In 2015 = 0.5814 kWh
- In 2016 = 0.57 kWh
- In 2017 = 0.5104 kWh

The consumption of electricity decreases by 0.0001 kWh for each additional 1000 knitted garments produced

PROBLEMS ENCOUNTERED

Survey on Energy Use and Energy Efficiency in the Industry and SME Sectors

- There is a lack of awareness on the Energy Efficiency Act 2011

- Not all enterprises have the services of a Maintenance Officers who oversee energy issues

- CEB consumption were compiled in terms of accounting figures for financial purposes instead of unit consumed on a monthly basis

- Many enterprises were not able to properly analyse their CEB bills. A good analysis can lead to energy savings.

- Asset Registers were made on the basic of value of the equipment and not in terms of electric ratings

- For SMEs almost all inputs on the questionnaire were filled-in by the Accounting department of the enterprises

Example of CEB Bill

	Units	Price - Rs	Amount - Rs
Consumption(kWh)	7027.00	2.86	20,097.22
Actual Demand (kVA)	47.08		
6 month demand high kVA	79.16	144.00	11,399.04
kVAh	8,578		
Power Factor	0.82		
Excess demand (kVA)	4.20	81.00	340.20
Meter Rental	1	430	430
Total			**32,266**

Explanation of Real Power, Reactive Power, Apparent Power and Power Factor
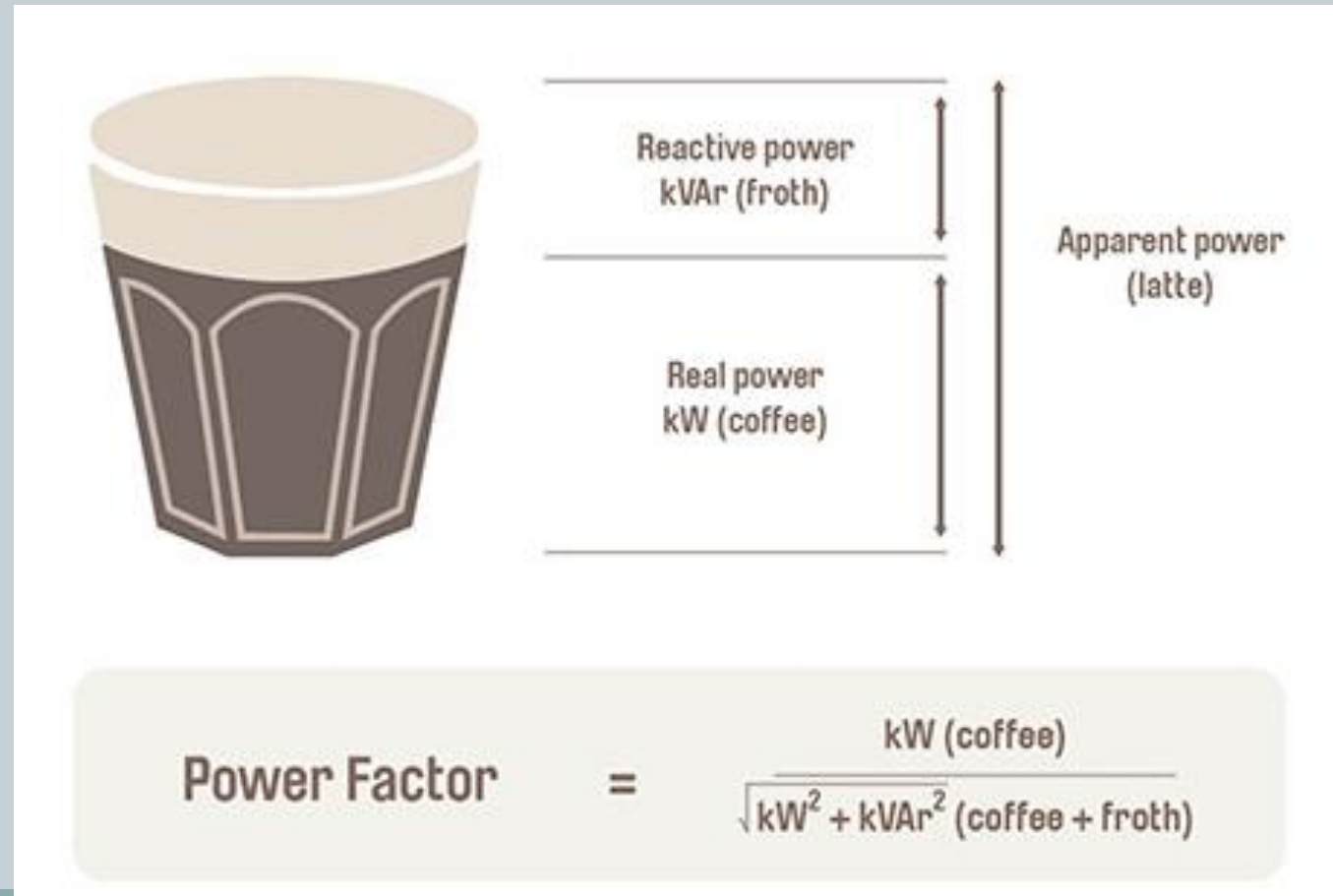
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Savings on CEB Bill By Increase in Power Factor

- Increase power factor from 0.82 to at least 0.95 through installation of capacitor bank.

- No excess demand kVA since power factor>0.9. Savings of Rs 340.20.

- Peak kVA would be reduced to 50 kVA. Savings of 29 kVA x Rs 144 per kVA = Rs 4,176.

- Total savings = Rs 4,516.

- Investment on capacitor bank = Rs 75,000. Lifetime is at least 15 years.

- Payback period is 17 months.

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- Create an awareness of Energy Efficiency Act amongst all incorporated bodies and sole traders registered by the Registrar of Companies

- Organisation of regular road-shows to educate all consumers on the importance of Efficiency Energy Management

- Continuous dedicated training to Maintenance Officers on Energy Efficiency

- Develop appropriate guidelines to support companies willing to invest in Energy Efficiency Programme

- Design and develop appropriate technical and financial tools to support companies in implementing an Energy Efficiency Management Programme

- Develop a Preferential Financial support for Energy Efficiency Programme

- Design standard Form for continuous collection of data by EEMO

- Encourage companies to use renewable energy such as solar water heaters for their internal process. In addition to saving cost, there will be a positive impact on imports of fuel and emission of greenhouse gases.

- The biggest bulk of electricity in the industry and SME sectors is utilized to run electric motors. The Government should, therefore, come up with policies that will encourage firms to use more efficient electric motors. Again, this will result in cost savings for the firms, as well as a reduction in fuel imports and a decrease in the emission of greenhouse gases because the CEB generates most of its electricity using fossil fuels.

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