



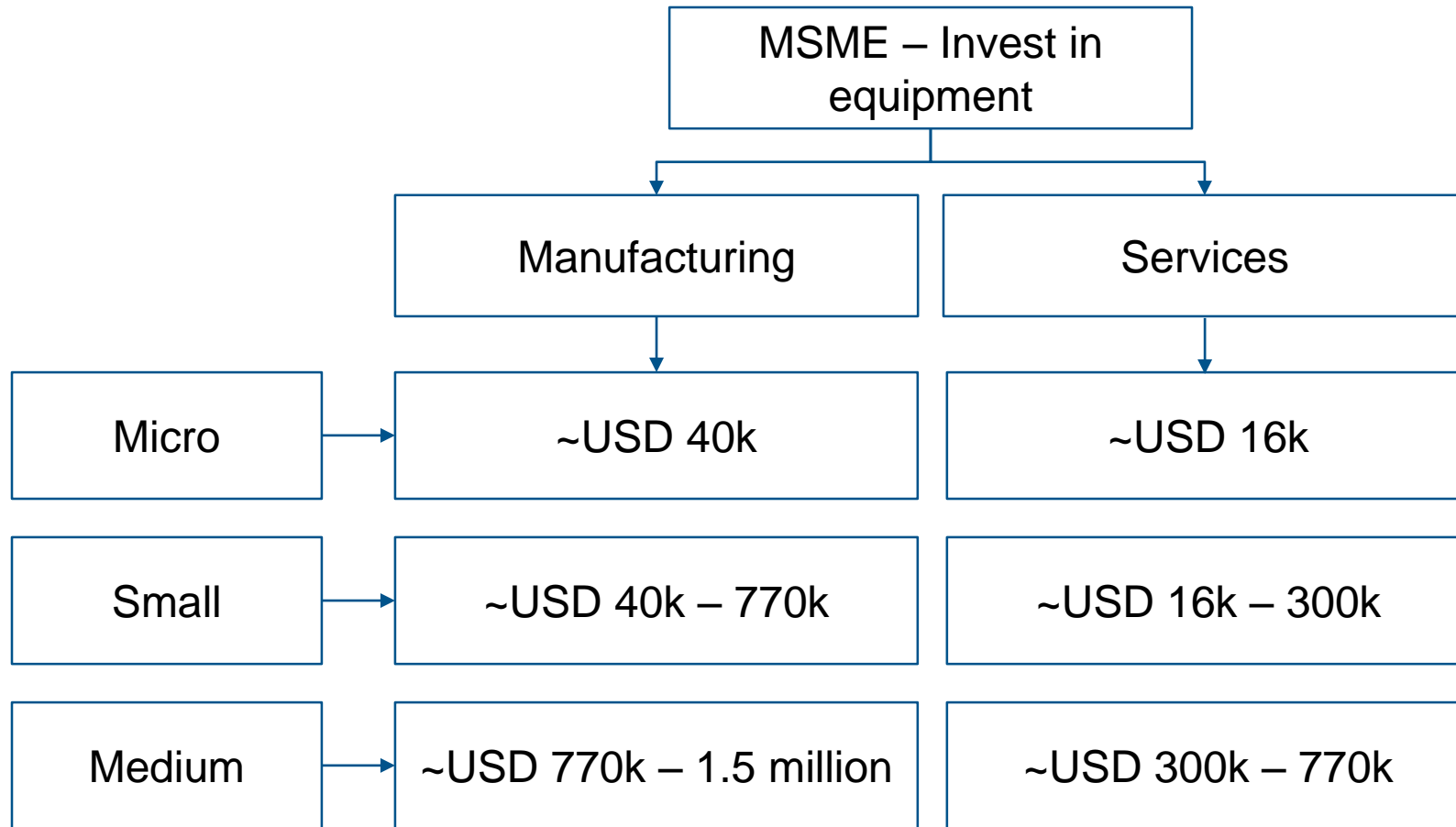
Energy Efficiency in Micro, Small and Medium scale industries



June 2018

MSME

How MSMEs are defined?

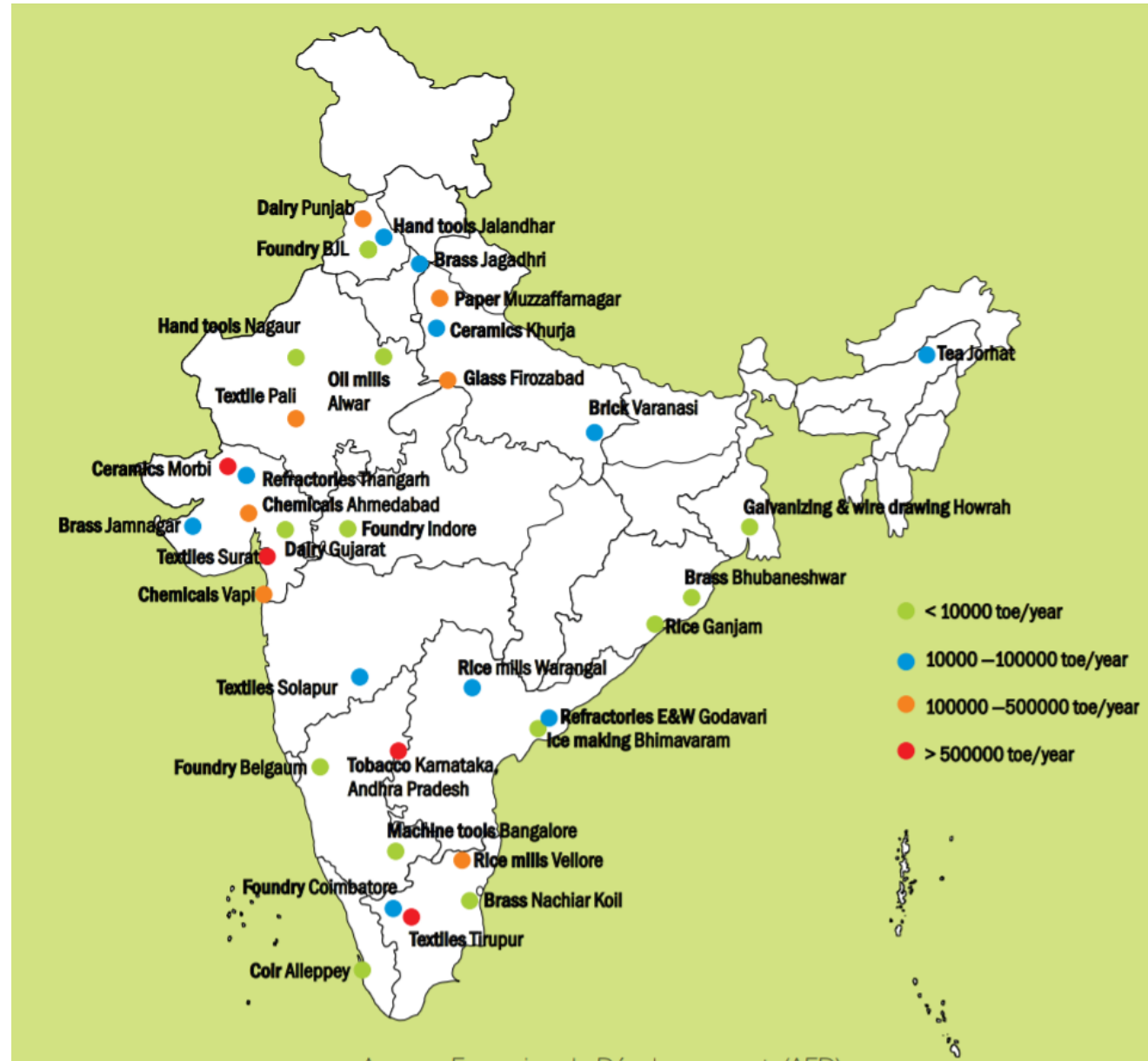


Importance of MSME

- ~ 44 million enterprises constitutes 80% of industrial volume in India
- ~ 600 Modern and 2000 Rural and artisan-based clusters
- ~ 8% of GDP
- ~ 45% of manufacturing output
- ~ 35% of exports
- ~ Employs 59 million
- ~ 50 million tonnes of oil equivalent

MSME

Energy Mapping

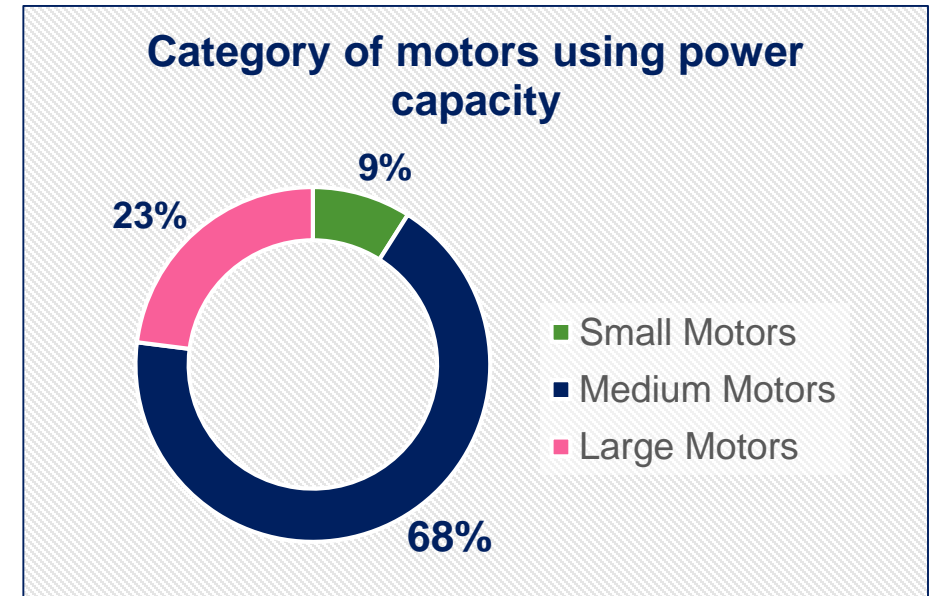


Source : AFD, BEE, ADME, TERI

MSME

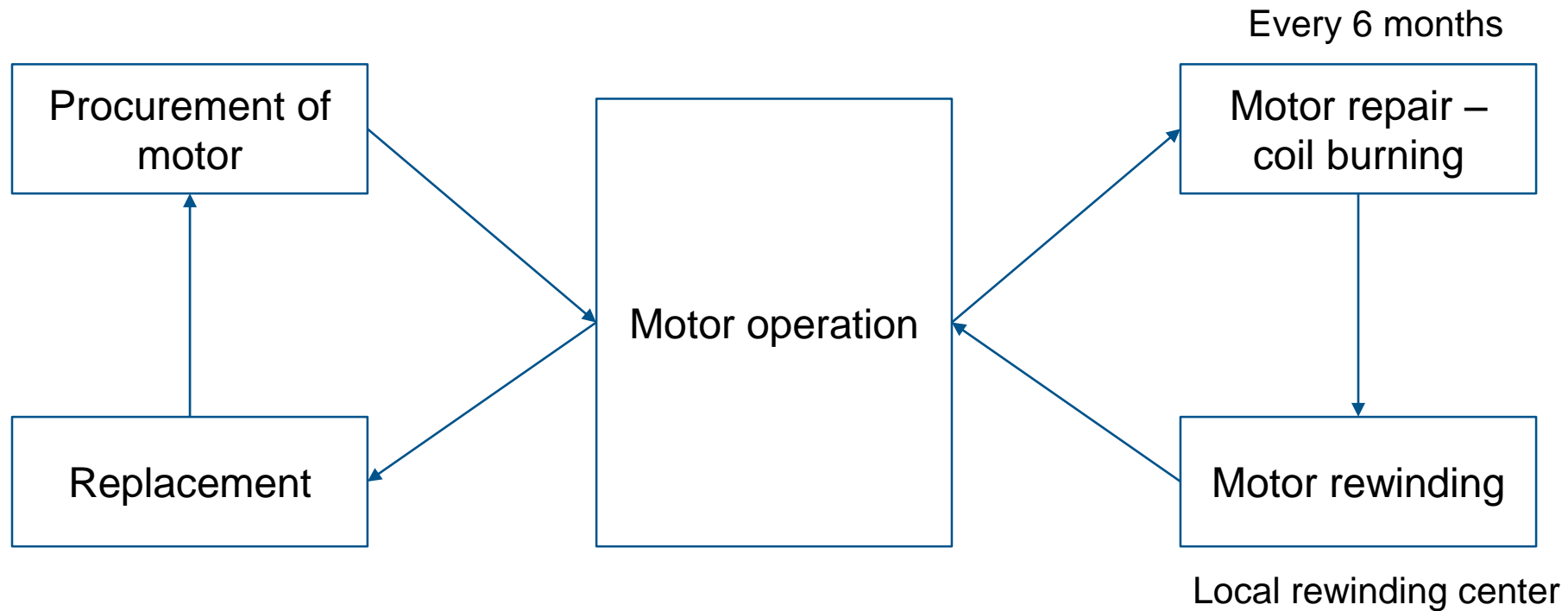
Situational analysis of motor market in India

- Electric Motors account for **45 per cent**¹ of the electricity consumption across all sectors.
- Around **70 per cent** of the electricity is consumed by motors in the industrial sector which accounts for 300 billion kWh²
- Motors can be classified into three categories based on its size
 - Small sized Motors range between 0.01 kW to 0.75 kW
 - Medium sized Motors range between 0.75 kW to 375 kW
 - Large sized Motors range above 375 kW
- It is observed during our assessment that the share of medium sized motors account for about **68 per cent**³ of the overall volume of motors in the industries



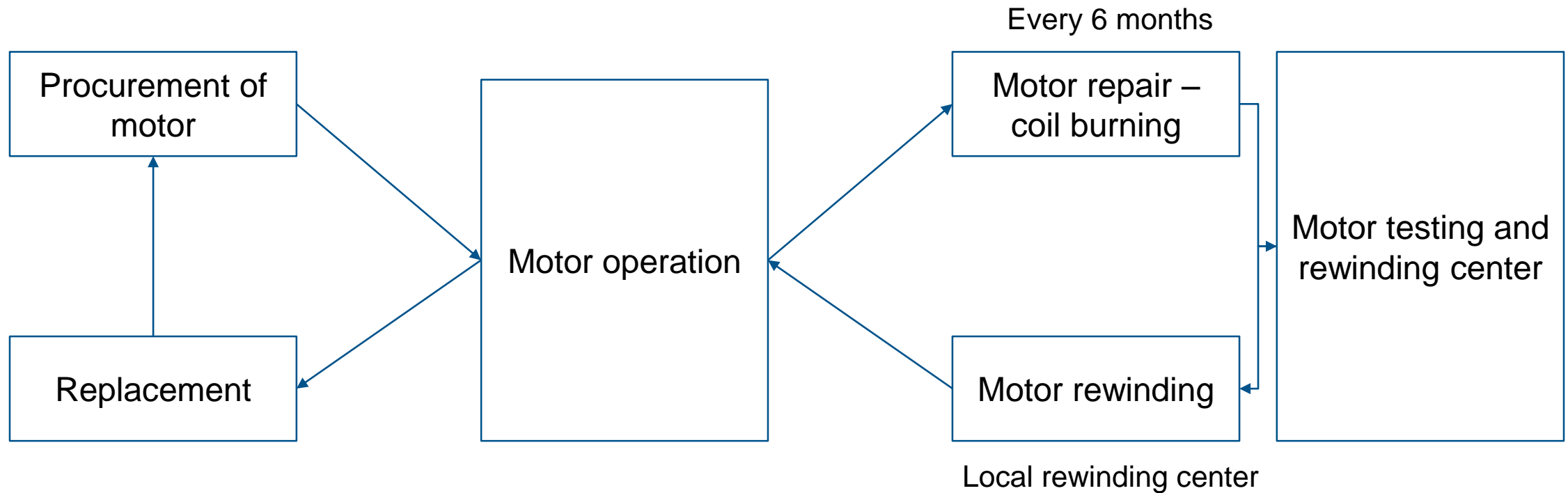
MSME

Motor life cycle in MSME



MSME

Motor life cycle in MSME



Comparison of Best Practices and Local Practices

S. No.	Methods	Energy efficient rewinding practices	Conventional rewinding practices followed by motor rewinding shop owners in few SMEs cluster	Impacts or Importance
1.	Preliminary Inspection	<ul style="list-style-type: none">I. The motor undergoes visual inspection.II. The technical specifications of the motors as per design are also sharedIII. Inputs such as operating load on the motor, typical operating hours, ambient temperature, exposure to environmental conditions, etc. are notedIV. The motor then undergoes Insulation Resistance Test and Surge Test.	<ul style="list-style-type: none">I. No detailed preliminary observation carried outII. The motors coming for rewinding directly undergoes dismantling of stator and rotor, as a result of which, the possible reason of motor failure is missed out.	<ul style="list-style-type: none">I. Understand the possible reason of motor failure such as overheating, cooling ducts, obstruction, etc.II. Insulation Resistance Test and Surge Test gives the initial presumption about the windingsIII. Rewinding of the motors are carried out on assumption basis rather than on actual data collected.

Comparison of Best Practices and Local Practices

S. No.	Methods	Energy efficient rewinding practices	Conventional rewinding practices followed by motor rewinding shop owners in few SMEs cluster	Impacts
2.	Dismantling the Casing, Stator & the Rotor	I. A systematic way of dismantling is adopted to avoid any damage to the components of the motor. The rotor is removed with the help of rotor removal tool.	I. Typically the motor rewinders uses hammers, chisels, screw drivers and bench vice for dismantling which causes significant damage to the rotor and stator casing.	I. This is done with utmost care as there is a possibility of scraping along the stator bore during removal of the rotor which may damage the air gap on the surfaces of both stator & rotor and increase the frictional and windage losses.

Comparison of Best Practices and Local Practices

S. No	Methods	Energy efficient rewinding practices	Conventional rewinding practices followed by motor rewinding shop owners in few SMEs cluster	Impacts
3.	Removal of Old Windings and cleaning the core	<ol style="list-style-type: none"> I. Crosschecking existing winding details such as type, size, thickness, number of turns etc., with technical data provided II. The winding wire has to be cut as close to the stator core as possible without damaging the stator core. III. The varnish and insulation have to be broken down before the windings can be removed from the stator core. IV. The motor is placed in a controlled temperature burnout oven V. After burnout process, the windings are removed manually or with the help of cutting machines to rewind. VI. The stator part is cleaned thoroughly by either careful scraping, wire brushing or high pressure washing. 	<ol style="list-style-type: none"> I. Usually, a rough measurement of winding details is taken by the rewinder. II. Most local rewinding shops remove winding manually and is practically done in a crude manner using hammers and screw driver III. The re-winding centres still use hand gas torch instead of ovens for preheating and winding insulation removal. IV. No mechanism is in place to ensure complete removal of the old winding. 	<ol style="list-style-type: none"> I. Rewinding of motor is done on inappropriate assumptions II. Avoid damage to the stator core in order to decrease the friction and windage loss. III. Inappropriate heating in the winding and the stator will increase the core losses in the motor. IV. Improper removal of old winding leads to improper rewinding.

Comparison of Best Practices and Local Practices

S. No	Methods	Energy efficient rewinding practices	Conventional rewinding practices followed by motor rewinding shop owners in few SMEs cluster	Impacts
4.	Rewinding	<ol style="list-style-type: none"> I. Insulation sleeves are used to cover the joints made at the coil ends and coil leads which are available for standard wire sizes. II. In order to ensure the same or even slightly higher efficiency of the rewound motor, the center minimize the length of the coil extensions and increase the copper cross sectional in each coil. IV. The original winding shape is usually restored using the semi-automatic motor winding machine. V. After rewinding, routine test such as winding resistance tests and phase balance test/surge comparison test are conducted. VI. The rewinders conducts insulation resistance test after rewinding. 	<ol style="list-style-type: none"> I. Due to requirement of the motors by MSMEs in a short period of time, the rewinding shops tends to use available quality and size of wires for re-winding. II. Insulation papers are used but are not as per specification mandated by the motor manufacturer. III. Rewinding is carried out manually by physically looping and inserting in the slots which leads to deviations IV. Typically, local rewinders tests the motor for checking whether it is operational. 	<ol style="list-style-type: none"> I. Decreases the efficiency as well as might cause frequent burn out of the motor due to improper insulation. II. The original winding shape is not restored due to manual intervention. III. Tests are essential to cross check the overall balance of the motor. IV. The thermal insulation plays a vital role in motor windings.

Comparison of Best Practices and Local Practices

S. No	Methods	Energy efficient rewinding practices	Conventional rewinding practices followed by motor rewinding shop owners in few SMEs cluster	Impacts
5.	Varnishing	<p>The re-wounded stator is usually varnished by any of the following techniques:</p> <ol style="list-style-type: none"> Dip and Bake system Vacuum Impregnation System Trickle Impregnation System 	The conventional system of manual application of varnish/resin to the rewind motor is still in practice.	Manual application does not ensure uniformity of the varnish/resin across the stator. This causes more energy consumption for the same output.
6	Re-assembling & Final Testing	<ol style="list-style-type: none"> Once the varnishing is dried, the stator and rotor should be reassembled by ensuring proper air gap between them. After the completion of re-winding, the surge test and ground test has to be done . A detailed report of these tests are provided to the customer for their record. 	<ol style="list-style-type: none"> Once the rewinding is over, the re-assembling of stator and rotor is done manually. At present, no performance testing is conducted. The motor is kept under operation for about 1 to 2 hours on no load to check whether it is operational. 	<ol style="list-style-type: none"> Improper air gap causes magnetic fluctuations thereby decreasing the efficiency of the motor. To ensure the motor is properly wounded. To check the new efficiency levels of the re-wound motor and the percentage deviation for its design value.

Motor rewinding center

Benefits

- ✓ Ability to provide a one-stop solution in the MSME cluster
- ✓ Convenient facility for MSME cluster
- ✓ Overall loss to the MSME minimized due to proximity to the center.
- ✓ Quality of motor ensured
- ✓ Capacity building in terms of efficient practices in motor selection, operation and maintenance.
- ✓ Provides skilled technicians to MSME through apprenticeship programme at the center.

The center shall not only improve the efficiency of the MSMEs but also help the MSMEs save energy and reduce their overall costs

Motor Rewinding Scenario

■ Barriers :

Several barriers deter the adoption of these best practices and technologies for motor rewinding in India. They are:

- ✓ Lack of Standards and Guidelines
- ✓ Lack of Awareness
- ✓ Time Constraints
- ✓ Financial Constraints
- ✓ Technological Constraints

TECHNOLOGY UPGRADATION IN THE CENTRE

- *Uncontrolled heating using gas torch to Oven*
- *dipping and baking Method to Vacuum Impregnation*
- *Manual Winding to semi-automatic Winding Machine*
- *Low Quality Copper Wire to High Quality Copper Wire*

■ Recommendations :

- ✓ Awareness and Capacity building : Vocational education, Workshops and Skill India Scheme
- ✓ Standards and Policies on Rewinding : Motor Rewinding Standards, Nodal Agencies and New Policies
- ✓ Establishment of World Rewinding Class Centre with proper technology upgradation

Technology	Investments (INR)	Investments (USD)	Payback (Months)
<i>Uncontrolled heating using gas torch to Oven</i>	3,00,000	4387.50	17
<i>Conventional dipping and baking Method to Vacuum Impregnation</i>	12,00,000	17550.00	27
<i>Manual Winding to semi-automatic Winding Machine</i>	1,00,000	1462.50	3
<i>Low Quality Copper Wire to High Quality Copper Wire</i>	18,90,000	27641.25	1

For further information, Please contact

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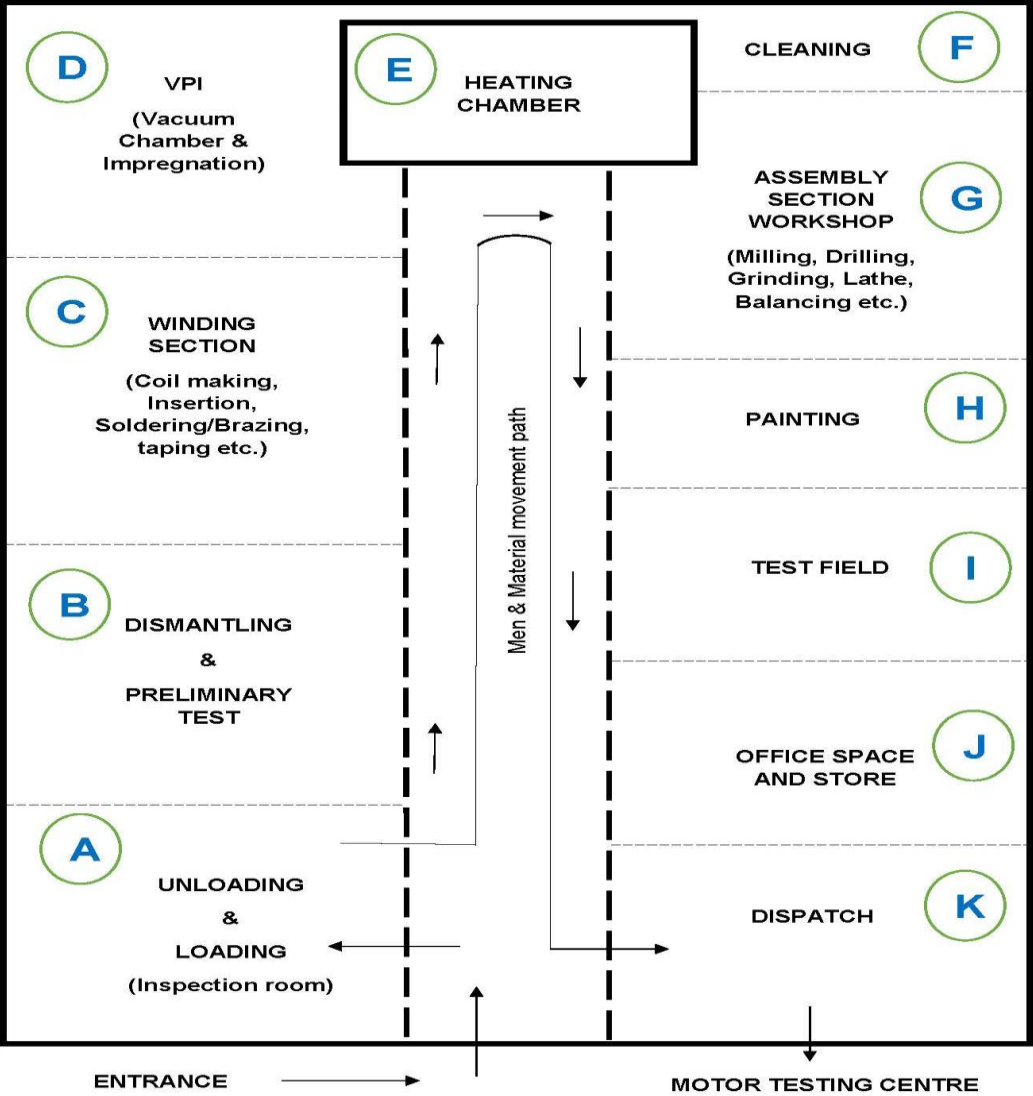
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THANK YOU !



Layout Design of the Centre



Estimated Financial Implication:

Sl. No.	Component	Cost in INR	Cost in USD
1	CAPEX: Machinery & Equipment	90,96,000/-	133,000/-
2	Opex: Working Capital per Month	Rs. 5,08,000 /- per Month	7400/- per Month
	Staff & Labour Cost per Month	72,000/-	1055/-
	Raw Material Requirement per Month	2,50,000/-	3650/-
	Utilities per Month	82,000/-	1200/-
	Other contingent Expenses per month : Rent, Repair & Maintenance, Bills, Advertisements etc	1,12,000/-	1600/-
Total Cost for establishing the centre and running it for a year from the date of establishing		1,50,0000/- (approx.) (One Crore Fifty only)	2,00,000/--(approx.) (Two Lakh only)

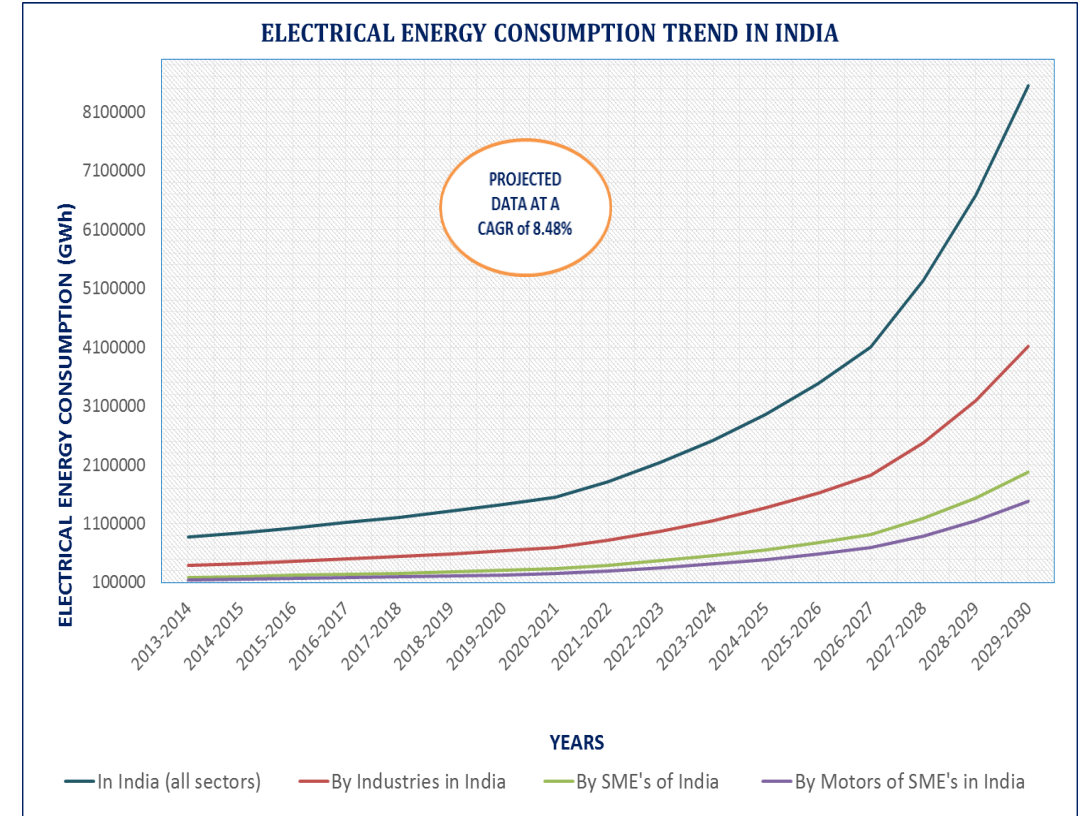
Key aspects of the Center

- ✓ Estimated investment required – INR 1 to 1.5 Crores (land and building not included)
- ✓ Targeted motor range - < 50 HP three phase induction motors
- ✓ Targeted number of motors to be rewound in a day - 5
- ✓ Ideal breakeven period – 1-2 years
- ✓ Potential Assistance from State or Central Government under various schemes
- ✓ Potential accreditation from Nodal agencies such as Bureau of Energy Efficiency, State Designated Agencies (SDA), etc.
- ✓ Potential for up-scaling the center for other categories of motors or other major equipment in the cluster

Case Study – Faridabad Energy Efficient Motor Rewinding Centre For the MSME units

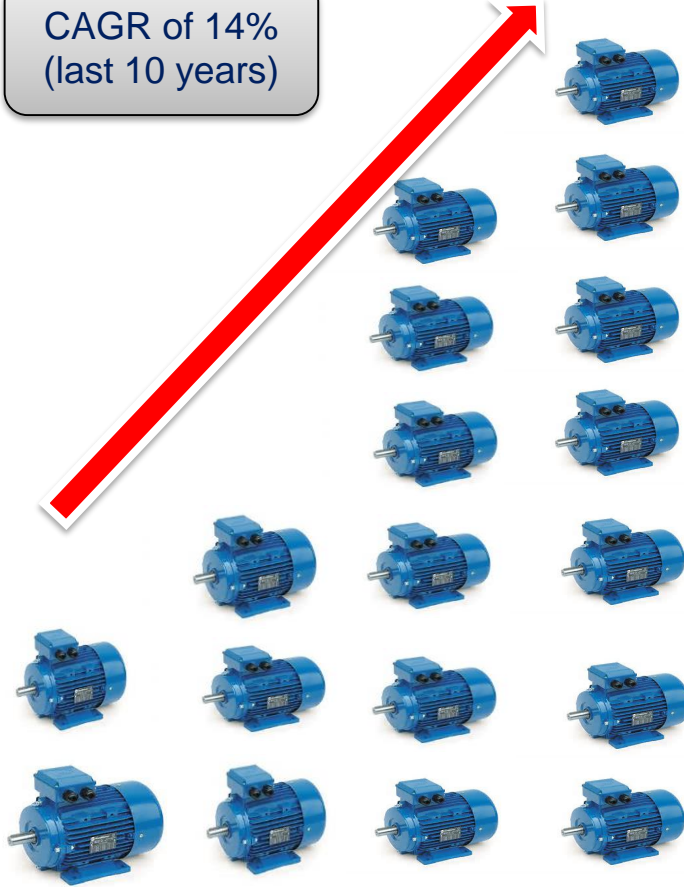
Study covered the following aspects-

- Need & Purpose of the Rewinding and Testing Centre
- Identification of Barriers
- Feasibility Study of the Centre
- Layout Design
- Technical Specification of the Equipment and Accessories
- Financial Estimations
- Identification of Potential Challenges and Risk for self sustainability of the centre



Case Study – Faridabad Energy Efficient Motor Rewinding & Testing Centre

CAGR of 14%
(last 10 years)



Motor Population in India

Cost of Establishing
1.5 Crore
Or **2 Lakh USD**
(approx.)

Effective Rewinding
and Testing is very
essential for
Faridabad MSME
cluster and India

Faridabad

- 80 GWh/Year
- 45 Cr.INR or 66 Lakhs US\$ /Year

Potential Savings

Potential In Few South Asian Countries - Industries

OBSERVATION-

GWh/Year reduction in energy consumption in Bangladesh is higher than Thailand.

But the tariff – **US \$/kWh** for Thailand is much higher than Bangladesh.

So, even the overall monetary saving for the industries is almost same.

Bangladesh

- 280 GWh/Year
- 150 Lakhs US \$ /Year

India

- 5500 GWh/Year
- 4200 Lakhs US \$ /Year

Thailand

- 100 GWh/Year
- 150 Lakhs US \$ /Year

Vietnam

- 4000 GWh/Year
- 3300 Lakhs US \$ /Year

Key assumption and facts

- The CAGR of 8.72 per cent and 10.69 per cent is considered as the growth of total energy consumption in India and energy consumption by Industries in last 10 years.
- Approximately 48 per cent is considered as MSME's share of the nation's industrial electrical energy consumption.
- Approximately 0.41 per cent of MSME energy consumption is considered as Faridabad cluster's energy consumption
- Approximately 75 per cent is considered as the electrical energy consumed by motors in a typical Indian SME industry.
- Approximately 14 per cent is considered as the CAGR of motor growth between FY17 and FY 22.
- The average motor size of 15 hp and an average operating period of 3000 hours per annum is considered
- The operational life of a correctly sized motor for a specific application and operated under normal conditions as per the manufacturers design is considered as 15 years .
- For a particular year, rewinding is carried out only for the old/existing motors. The newly procured motors are not considered to have undergone rewinding in its first year of operation.
- In order to assess the losses conservatively, minimum frequency of failure of two times a year and average efficiency drop of 1.03 per cent per rewinding for the old motors is considered.
- The highest name plate efficiency of motors as 90 per cent and efficiency drop due to rewinding of motors as 2 per cent per year is considered.
- The increase in energy consumption was calculated for each year using the formula,
- Increase in energy consumption=
$$\left\{ \frac{1}{\eta_{\text{burnt motor}}} \right\} - \left\{ \frac{1}{\eta_{\text{name plate}}} \right\}$$