Alliance for an Energy Efficient Economy

SHAKTI SUSTAINABLE ENERGY FOUNDATION

Transforming the Energy Services Sector in India

Towards a Billion Dollar ESCO Market

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Transforming the Energy Services Sector in India

Towards a Billion Dollar ESCO Market

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Sudha Setty, Neha Yadav and Akash Goenka

Acknowledgement

Alliance for an Energy Efficient Economy (AEEE) would like to take this opportunity to recognise the invaluable contributions of various stakeholders in writing this report. They have aided AEEE in reinforcing its intelligence and defining strategic next steps for enabling markets and regulations for expanding energy efficiency in India.

AEEE expresses its sincere gratitude to Shakti Sustainable Energy Foundation (SSEF) for the project grant. Shakti works to strengthen the energy security of India by aiding the design and implementation of policies that support renewable energy, energy efficiency and the adoption of sustainable transport solutions. AEEE conveys its thanks to Mr. Chinmaya Kumar Acharya, Mr. Subhashish Dey, Mr. Rana Pujari and Ms. Nandini Sharma for their time and effort in the project.

AEEE also thanks the Sustainability Outlook team for collaboration in analysing the market and evaluating the role of ESCOs in the industrial sector in India. The team's contribution in the market survey and market sizing exercises, and in the development of Standardisation and Financing frameworks has greatly strengthened the report.

The team remains inspired by the leadership of Energy Efficiency Services Limited (EESL) as India's Transformative ESCO that catalyses large-scale energy savings and saves consumers' energy expenditure. AEEE is especially thankful to Mr. Saurabh Kumar, Mr. Soumya Garnaik, Ms. Aanchal Kumar and Mr. Hemant Kumar for their generosity in sharing knowledge on EESL's apparatus of energy services across all sectors in India.

As a strategic partner, AEEE also conveys gratitude to the Bureau of Energy Efficiency (BEE) for their time and guidance on the role of ESCO market in India. The team appreciates the opportunity to convene the 'Pumping Roundtable' that fostered a constructive dialogue between ESCOs and pump manufacturers for demand side management in municipalities and agriculture sectors. The team expresses its profound thanks to Mr. Abhay Bhakre for his leadership, Dr. Ashok Kumar, and Mr. Milind Deore for sharing their insights on increasing the efficiency of water-energy nexus.

A pan-India survey of 35+ ESCOs was an essential part of deriving actionable findings that ESCOs and policy makers can use alike for scaling up energy efficiency in India. AEEE applauds the survey responders for sharing their on-the-ground experiences and suggesting edits as the team prepared ESCO profiles and readied them for final dissemination through the report. A full compilation of ESCO profiles is in the appendix. The survey effort has enabled AEEE to illume the current characteristics of ESCO projects accurately.

AEEE is truly thankful to the ESCO community and Financial Institutions, particularly Yes Bank and SIDBI for their active participation in workshops, deal days, road shows, webinars and roundtables organised across the country for building intelligence into the growth of ESCO market in India. Interaction with stakeholders has bolstered the direction and recommendations of this report. A complete set of outcomes and ESCO related information gained during the events has been outlined in the report.

Last but not the least, AEEE is grateful to the in-house support team of Mr. Sandeep Kachhawa, Ms. Mohini Singh, Ms. Sangeeta Mathew, Mr. Akshay Pandey, Mr. Sarbojit Pal and Ms. Nidhi Sharma for their consistent efforts in bringing this report to fruition.

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BUREAU OF ENERGY EFFICIENCY
(Government of India, Ministry of Power)

FOREWORD

Energy efficiency has multi-dimensional rewards for India's economy. Making energy efficiency the first fuel will aid energy security, avoid power generation and carbon emissions, surge private sector investments and help India lead on global energy commitments such as the Nationally Determined Contributions (NDCs) and Sustainable Development Goals.

Bureau of Energy Efficiency has been steering and championing energy efficiency in India. BEE has launched various energy efficiency programmes in the country. The market has been given thrust in the form of training and certification of energy professionals, and empanelment of companies.

However, the energy efficiency market cannot achieve its true potential without an active inclusion of Energy Service Companies (ESCOs) in its landscape. The ESCO Market Assessment Report by AEEE highlights the transformative role ESCOs can play in growing the energy efficiency market in India. The report offers in-depth analysis through direct outreach efforts to ESCOs, Equipment manufacturers, End users and Financial institutions, that can benefit private and public players, including policy makers.

The report begins with a rigorous market survey analysis of active ESCOs in the country and a bottom-up market sizing exercise. It goes on to identify key energy efficiency solutions for technology-specific standardization and outlines a financial framework to streamline transactions. The report ends with a comprehensive set of actionable recommendations for transforming the ESCO market in India.

This is a timely report and I strongly encourage the energy efficiency community in India to read and benefit from it.

Congratulations to AEEE on the successful completion of the project.

A Bakre 24.8.17

(Abhay Bakre)
Director General
Bureau of Energy Efficiency

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ENERGY EFFICIENCY SERVICES LIMITED
(A Joint Venture of PSUs of Ministry of Power, Govt. of India)

MESSAGE

The ESCO market in India is at a tipping point. The success of EESL has provided confidence in the market for end users, financial institutions and development organizations. While EESL replicates the success in lighting and pumps to air-conditioners and other appliance-oriented energy conservation measures, it is important to start thinking about expanding this success into solution-based energy conservation measures. The detailed market sizing exercise in the report reinforces the huge potential that exists in the country. The size of the Indian market needs the active involvement of the ESCO community. The report addresses some definite ways to transform the market, including standardisation in which EESL has firmly believed and demonstrated success. Information Technology has disrupted many markets and the report has pointed to ways in which technology can be utilized for the ESCO market. Creating a billion-dollar energy services market in India is a certain possibility and it is essential that this work is leveraged and organizations come together to enable this market transformation.

EESL congratulates AEEE for its efforts and commends this report to India's ESCO community.

(Saurabh Kumar)

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Preface

The success of Energy Efficiency Services Limited has rekindled interest in the Indian Energy Services sector. A demand aggregation model targeting the low hanging fruits and marrying them with cost-effective and proven energy efficient technologies, shows that India can use its size to create a thriving market for energy efficient products and services with the help of right business models. This is giving hope that India may yet follow in the footsteps of the US and China, markets that have been able to create multi-billion-dollar ESCO industry that encourages stakeholders to take calculated risks to deliver significant value in terms of sustained energy savings to end customers. Can India create a positive feedback loop that helps grow the market and let it achieve the critical mass for scale?

Many studies and reports have been prepared in the past dealing with barriers and challenges that ESCO market in India faces and possible solutions that may work. When AEEE commissioned this study, with the steadfast support from Shakti Sustainable Energy Foundation, our intention, right from day one was not to produce one more report that talks about challenges and barriers but to do some innovative thinking and through our analysis, plug the gaps that we believe has played a significant role in holding the ESCO industry back in India.

AEEE envisions that the window of opportunity for scaling up energy efficiency investments may start to close in India if policy makers, energy service companies and financial institutions do not work together for the following reasons:

1. As renewables continue to drive down the prices of electricity, it may become more difficult to justify the return on investments for energy efficiency projects;
2. ESCOs need to not just think about what and how to deliver efficiency but also to think about when to deliver efficiency as Time of Use electricity pricing becomes a reality, and the cost of energy storage will start to compete with reduction in energy demand during hours when energy from cheap renewable sources may not be available.

Based on the trends that AEEE can observe in other countries and the innovation taking place in the field of Internet of Things (IOT), big data analytics, miniaturization and yet enhanced accuracy of sensors and meters, we predict that measurement and verification of energy savings will undergo significant transformation and will become much more transparent as issues related to baseline setting, energy savings calculations involving equations and normalizations will be replaced by metered and monitored data potentially opening the ESCO market for scale up in a more transparent fashion.

Realizing the urgency of the matter, AEEE's latest report has made three significant contributions:

1. There is the first-of-a-kind ESCO Survey that AEEE has carried out providing information on more than 30 ESCOs. This should help financial institutions and end customers in identifying the right ESCOs and also help ESCOs to market their services better if they continue to provide the information that AEEE has tried to compile;
2. There has not been any bottom-up exercise that has been conducted so far in India to estimate the market size for energy services sector. While AEEE has made significant assumptions while coming up with a national estimate, we feel that this bottom-up information can help both ESCOs and FIs target different segments based on their area of focus or expertise. This will also enable policy makers to direct incentives or other policy mechanisms and track the progress over a period of time;
3. AEEE has also made a strong case for standardizing the energy services sector by learning from other energy sectors (e.g. oil & gas sector or renewables) where standardized approach for technologies and financing has helped in achieving scale that has escaped the energy service sector;

AEEE remains bullish that a dynamic and thriving energy services sector can be created and it is ready to play a key market enabling role through innovative ideas and facilitation services.

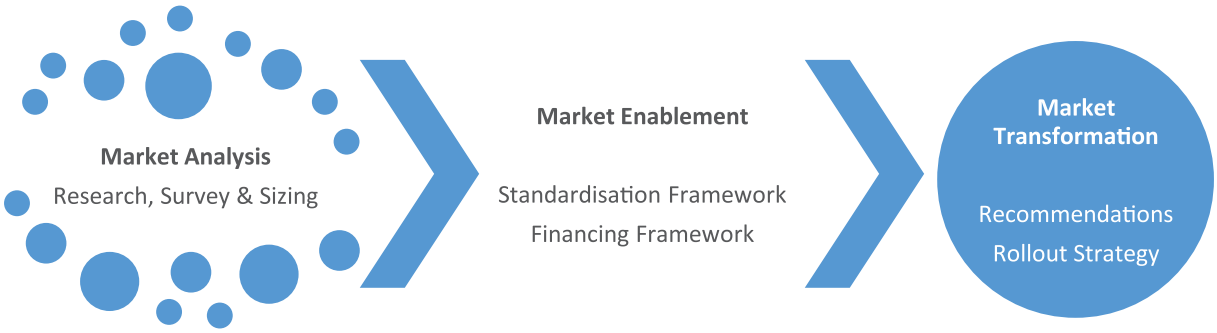
Satish Kumar

Executive Director (Interim), AEEE

Executive Summary

The Energy Efficiency (EE) market in India has been a sleeping giant for more than two decades now. For a market potential that is estimated anywhere between $10 billion to $35 billion, combined revenues by Energy Services Companies (ESCOs) of about a quarter billion is only a fraction of what exists in similar size EE markets such as the US, Europe, China and Brazil. Lack of access to financing, lack of a strong policy level push and lack of trust within the ecosystem emerge as the biggest challenges of the ESCO market. Lack of trust in the ecosystem again points to the absence of several factors that helped build trust in other markets, viz. access to credible market data, standardisation of technology-specific solutions, tight contractual frameworks and legal enforcements. A deep-dive into the challenges faced by the Indian ESCO market vis-à-vis a comparison of success stories in other markets leads us to the premise that one of the critical gaps has been an absence of a credible market maker that can enable and transform the industry by facilitating interactions with policy makers, ESCOs, financial institutions and end customers.

This project is a step towards enabling that transformation. The project carried out a spectrum of activities to analyse the current ESCO market in India.



A nation-wide ESCO survey

A country-wide first-of-its-kind survey was conducted with active and inactive ESCOs to identify their market presence, roadmap, strengths, commitment, challenges and support needed. 1-1 interactions with a host of Technology Providers, Consultants, End Users, Financial Institutions, Start-ups and Policy Makers were conducted. Technology-specific Workshops and Vertical-specific Deal-days were organized to understand the market process.

A comprehensive market sizing endeavour

A comprehensive bottom-up market sizing exercise was conducted to identify the addressable potential of the EE market and to identify business opportunities in Commercial Buildings, Industries, Agriculture and Municipalities. The exercise points to a market of around INR 93,000 to INR 120,000 crores across these four verticals, through a rigorous bottom-up analytical approach that involved data assembly, parametrization, categorization, modelling and validation. The report goes ahead and identifies pertinent recommendations that are needed to be actioned to help the market achieve this potential.

Technology-specific Standardisation framework to enable scale

The report does a deep dive into one such recommendation – Standardisation of technologies to enable scale for the ESCO market. The standardisation methodology dwells upon creating technology-specific framework for standards, energy measurement, savings validation and market acceptability. The methodology also takes into account ESCO capabilities and OEM availability for the solutions.

Financing mechanisms for ESCOs

For the shortlisted solutions, the report goes on to evaluate financial instruments for success vis-à-vis a framework that evaluates the amenability for buyer's credit, supplier's credit and project financing routes. The framework keeps in mind the fact that the financing mechanism has to be streamlined to lower transaction costs for financial institutions as well as simplifies the process for ESCOs and End users, while ensuring protection for both sides.

Way-forward recommendations for ESCO market transformation

The report culminates into a set of workable and industry-needed recommendations for ESCO market transformation. The recommendations both identify and suggest the way forward with a market enablement strategy and a rollout model.

The recommendations for ESCO market transformation include:

1. Creation of a nation-wide energy efficiency data repository with benchmarks
2. Creation of standardised solutions to build trust and enable scale in the market
3. Creation of a technology-enabled EE collaboration and marketplace platform
4. Modification of ESCO accreditation process to enhance confidence & credibility
5. Creation of a neutral ESCO market enablement entity for awareness and facilitation

The intended audience for this report are ESCOs, Technology providers, Service providers, End users, Start-ups, Financial institutions, Policy makers, Research institutions and Foundations who are and will be responsible for the transformation of the ESCO market in India.

CHAPTER-1

Introduction

1.1 The need for Mainstreaming Energy Efficiency as India's First Fuel

As India charts the locus of economic transformation, it also stands committed to the Paris Climate Agreement. Under its Intended Nationally Determined Contributions (INDC), India targets a 10% reduction in energy consumption (from 2015 levels) by 2018-19[1]. These competing demands can be met only through the judicious use of energy at minimum environmental costs.

With a projected peak load of 2499 TWh in 2030, the ongoing schemes may not be sufficient in curbing energy consumption to cater to the increasing demands for energy use in India. To achieve these standards, it has become imperative to adopt more ambitious energy efficiency policies and programmes to meet these targets – for instance, the efficient lighting programme is projected to save energy up to 100 billion kWh per year. Analysis by IEA and New Climate Economy shows that there are opportunities for implementing energy efficiency at national, state and local levels. For unlocking billions of investments potential, jobs and business opportunities in India, a greater thrust towards increasing domestic energy efficiency practices is needed[2].

Building an energy efficient economy will facilitate the reduction of the primary energy demand by 9% by 2040, as compared to the business-as-usual scenario shown by IEA's New Policies[3], with two-thirds of the total contributions coming from energy efficiency measures. Energy efficiency is also the most cost-effective way of decarbonising the India economy. This makes energy efficiency a strong lever to address the social and economic transformation in energy consumption practices and responding to climate change. For India to achieve universal energy access without exhausting existing energy sources and avoiding sourcing additional supply of energy from neighbouring countries it is essential to inculcate a robust EE market. As a country that houses a third of the world's poor, ensuring consistent supply of energy for meeting basic needs and to create sources of livelihood, habitats and areas of development without increasing the oil import is both a challenge and an opportunity.

1.2 ESCO – A definitive means to Implementing Energy Efficiency

One of the most important means for achieving energy savings is Energy Service Companies (ESCOs) though Energy Savings Performance Contracting (ESPC). ESCOs implement energy efficiency and sustainable energy projects – performance contracting is a core element of the ESCO business. Research shows that ESCOs have the potential to tap a significant portion of the energy savings market of India, which was estimated at 183.5 billion kWh per year in a study conducted by the World Resources Institute in 2009. Appendix – Chapter 1 delineates the different kinds of ESCOs active in India and the different types of ESPCs they use.

1.2.1 Evolution of the ESCO Market in India

India was introduced to the ESCO market in the early 1990s, along with China and Brazil, when USAID in collaboration with World Bank decided to aid developing countries with the potential for energy conservation through structured financial and technical aids. A market commercialisation programme, Energy efficiency Commercialisation (ECO) programme, was brought into effect in 2001-2. This programme aimed at nurturing Indian ESCOs by initiating partnerships among

US and Indian companies to outsource technical expertise and training. Under the ECO-I and ECO-II projects, Energy Performance Services of the US partnered with Thermax Limited to set up Thermax-EPS. Similar partnerships were built among three more Indian ESCOs, namely, INTESCO Asia, Asian Electronics, Saha Sprague and EPRI. An ESCO feasibility study was simultaneously conducted to help understand the specific needs of the ESCO markets in India.

During 2002-3 to 2006-7, the UN Foundation through UNEP and with technical expertise from World Bank, launched a project to develop financial mechanisms for energy efficiency markets. This project was launched in India as a collaborative effort with the Indian Renewable Energy Development Agency (IREDA) and became the Three Country Energy Efficiency project (3CEE) – India, China and Brazil – which facilitated exchanges between these three countries on banking & financial models, technical up-gradations through ESCO associations and robust policies and regulatory environment from collaborations among government institutions. The Small Industries Development Bank of India through its Credit Guarantee Trust fund for Small Industries (CGTSI) was an active partner in this project.

These initiatives triggered EE practices in India and exposed Indian banks to EE financing and contracting. Until the Bureau of Energy Efficiency (BEE) was instituted in 2008 to empanel ESCOs with the help of credited rating agencies such as CRISIL, ICRA, and CARE, five public sector Banks namely, State Bank of India, Bank of Baroda, Canara Bank, Bank of India and Union Bank of India rolled-out unique energy efficiency financing loan schemes after internally approving such schemes from the board of directors.

Appendix – Chapter 1 details key financial institutions and bilateral/multi-lateral funds active in the ESCO space.

1.2.2 Lessons from International and Indian success stories

ESCO market has globally succeeded through strong policy push, progressive financing mechanisms and standardisation of solutions[4].

US: Mandatory adoption of energy efficiency in Government buildings led to large scale emergence of ESCOs in the US. Because of a credible market created by the Government, funding started flowing in, from Non-Banking Financial Companies (NBFCs) to begin with, followed by mainstream banks. Further impetus through building labelling and disclosures along with removal of utility disincentives through correct pricing mechanisms put the ESCO market under a catapult. Utilities brought in large capital that was then deployed to improve EE in Commercial and Industrial (C&I) establishments. The EP Act, Federal ESPC, development of IPMVP and the MUSH market – all contributed to the development of a robust ESCO market.

Europe: Europe benefitted from stiff policy targets covering longer horizons (such as 20% reduction by 2020 and 30% by 2030). EE certificates for building sales and rentals along with strong standards and labelling mechanisms and energy services directives provided the necessary market stimulation. Further to this, standardisation of solution approaches gave the scale needed to grow the market.

China: World Bank / GEF aggressively funded three ESCOs that enabled shared savings model in a large way providing the necessary scale for ESCO projects. Government matched this progress by making energy efficiency part of successive 5-year plans with clear targets and incentives. Further, ESCO was made a priority industry and Energy Efficiency from Energy Performance Contracting (EPC) was listed as a major initiative for Energy Efficiency.

Brazil: Utilities were mandated to invest a minimum percentage of their revenues in energy efficiency. Government and private lending were supported with strong lines of credit. A strong ESCO association carried forward responsible Government lobbying along with awareness creation.

India: The largest success in India has come through the EESL model that simplified and standardised the procurement, execution and M&V of equipment-oriented projects (lighting with great success, fans, pumping and air conditioning under roll out). Demand aggregation on the large-scale requirements greatly brought down the prices which created further impetus to the targeted ESCO segments.

1.3 Key Government initiatives in the Energy Efficiency Space

The Government of India, through the Bureau of Energy Efficiency (BEE) under the Ministry of Power (MoP), seeks to boost energy efficiency to avoid capacity addition of 19.6 GW and fuel savings of around 23 million tonnes per year at its full implementation stage, in addition to the 10% reduction in energy consumption by 2018-19 (under the Paris Agreement). The policy framework of India includes[5]:

- The Energy Conservation Act (2001) for encouraging efficient use of energy and its conservation
- Policies based on fiscal instruments such as the Perform, Achieve and Trade (PAT) Scheme as a market-based energy efficiency trading mechanism in eight energy intensive industrial sectors of India that account for a third of total energy consumption in the country.
- Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE), which provides a risk sharing and mitigating mechanism for financial institutions with a partial coverage of risk involved in extending loans for energy efficiency projects
- Venture Capital Fund for Energy Efficiency (VCFEE), a trust fund dedicated to giving "last mile" equity capital to energy efficiency companies
- Creation of bodies such as Energy Efficiency Services Limited (EESL) in the capacity of a super ESCO and market enabler for energy service companies in India - the main programmes of EESL are:
  - Domestic Efficient Lighting Programme (DELP)
  - Municipal Street Lighting
  - Agriculture Demand Side Management (AgDSM)
  - Buildings Energy Efficiency Retrofit Programme (BEERP)
  - Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE)
- National policy think-tanks such as National Institution for Transforming India (NITI) Aayog which aims to promote involvement and participation in the economic policy making process by the state governments

1.4 The extant status of the Indian ESCO Market

The Energy Efficiency market in India is estimated to be anywhere between $10 billion and $35 billion. However, the Indian ESCO market is a miniscule percentage of what exists in similar size EE markets such as the US, Europe, China and Brazil. Though EESL has managed to disrupt the equipment oriented ESCO market (lighting primarily) in India, it does not do justice to the vast EE potential that exists in the country. The actual combined revenues of the ESCO business is not expected to be more than $150 million, excluding EESL's revenues. Lack of a strong policy level push, lack of access to financing and lack of trust among stakeholders are frequently cited as reasons for the market gap. However, unless the market is assessed holistically, top-down and bottom-up, unless data exists to identify business opportunities, unless specific energy conservation measures (ECMs) are identified and standardised, unless contractual frameworks are created and the financing risks are mitigated, the market cannot transform. This project aims to fill these gaps, through the activities listed below:

- **Market Survey:** A first of its kind nation-wide market survey exercise was conducted with ESCOs, profiling them on their strengths, challenges, projects, financing mechanisms and success stories. The survey of ESCOs along with discussions with End users, financial institutions, Technology providers and Policy makers helped AEEE come up with much needed workable recommendations for transforming the ESCO market in India.

- **Market Sizing:** A comprehensive bottom-up market sizing exercise involving data assembly, parametrization, categorization, modelling and validation was carried out for Industries, Buildings, Municipalities and Agriculture to estimate the addressable potential of the ESCO market.

- **Identification of ECMs for Standardisation:** Based on the outcomes of the market interaction activities along with evaluation of global success stories, a standardisation framework was created for shortlisted ECMs for rolling out ESCO solutions at scale covering standards, energy measurement, savings validation and market acceptability.
- **Financing framework for ECMs:** Global financing instruments were analysed vis-à-vis their applicability in India and four instruments were identified for transforming the Indian ESCO market – Credit guarantee, Green bonds, On-bill financing and Savings Insurance. The standardisation ECMs were further evaluated against critical success factors for scale.

CHAPTER-2

Understanding the ESCO Market: Outcomes of a comprehensive ESCO Survey

AEEE undertook a comprehensive exercise to evaluate the current status of the ESCO market in India through a nation-wide survey. This investigation spanned ESCOs empanelled by BEE and many ESCOs not yet empanelled by BEE. The survey aimed to capture the pulse of the ESCO market in India – leading to the creation of ESCO profiles, energy-saving solutions on offer, projects implemented and the challenges faced in financing and implementing ECMs.

2.1 Methodology

The methodology followed through this survey was a 3-step process as outlined below:

Step 1 Identification: AEEE identified ESCOs from the list of ESCOs empaneled by BEE and others engaging the ESCO model.

Step 2 Prescreening: A preliminary desktop research of the identified ESCOs coupled with a short survey administered telephonically revealed that many BEE-empaneled ESCOs were not undertaking any energy saving business at all. Some ESCO prescreened were either non-responsive or uninterested in participating in this activity.

Step 3 Detailed survey: The team designed a detailed questionnaire that ensued from similar assessments conducted in other parts of the world. This questionnaire comprised 6 sections – general overview, financing ECMs, top ECM categories, deep dive into ECMs, challenges and opportunities and general organizational information. The survey was administered through an interview conducted either in person or telephonically and was responded by key people within the ESCO organization. A total of 37 ESCOs actively participated in the survey.

The survey gleaned many aspects of the ESCO business world – general operation, summary of ECMs on offer and financing them. This has been tabulated in Tables 2.1-2.3.

Table 2.1: General operation of the ESCOs surveyed

ESCO	General			
	Region of operation	Empanel-ment	Primary ESCO service(s)	Team strength and activities
Amplebit Energy Solutions Pvt. Ltd.	National	BEE (Grade 3)	Provide efficient technologies, services provider (general ESCO)	<25 General management, project management, design and engineering, sales and marketing
Aspiration Energy	National	–	Solar thermal manufacturers extended to full ESCO services	<25

ESCO	General			
	Region of operation	Empanel-ment	Primary ESCO service(s)	Team strength and activities
BEBLEC Energy System Pvt. Ltd.	Multinational	–	Audit consulting, services provider (general ESCO)	25 to 50 General management, project management, design and engineering, performance contracting and project risk management, sales and marketing, energy auditing and accounting
Bosch	Multinational	BEE (Grade 1)	Full ESCO services, technology vendor	25 to 50 General management, project management, design and engineering, energy auditing and accounting
Development Environergy Services Ltd.	Multinational	BEE (Grade 2)	Full ESCO services, audit consulting, services provider (general ESCO)	–
ENCON Energy Services	National	BEE (Grade 3)	Full services ESCO, consultant ESCO, design, supply and installation of ESCO projects	<25
Energized Solutions	National	BEE (Grade 2)	LED manufacturers, extended into lighting as a service	<25
Enfragy Solutions India Pvt. Ltd.	National	BEE (Grade 2)	Audit consulting, provide efficient technologies, services provider (general ESCO)	25 to 50 General management, project management, design and engineering, performance contracting and project risk management, sales and marketing, energy auditing and accounting
eSmart	National	_	Full ESCO services	100 to 250
Ethan Power	National	_	General ESCO that acts as a technology re-seller for VFDs of ABB make	<25
First ESCO Ltd	Multinational	BEE (Grade 4)	Full ESCO services, develops technology in-house and specializes in WHR systems and medium voltage VFDs	<25
Forbes Marshall	Multinational	BEE (Grade 1)	Full services ESCO offering multiple ECMs bundled as a part of 'next technologies' offering	–

ESCO	General			
	Region of operation	Empanel-ment	Primary ESCO service(s)	Team strength and activities
Greetude	National	BEE (Grade 4)	Full ESCO Services, metering services, website/portal development services for monitoring ECMs	<25
Grundfos Pumps India Pvt. Ltd.	Multinational	–	Provide efficient technologies, audit consulting	>250 General management, design and engineering, sales and marketing, energy auditing and accounting
Havells India Ltd.	Multi-national	_	Provide efficient technologies	>250
HMX	National	_	O&M services	50 to 250 Design and engineering, factory work
Honeywell	Multinational	BEE (Grade 1)	Full ESCO services, designs solutions based on market available components and manages implementation of the same for the clients	–
Intemo Services Ltd.	Andhra Pradesh	BEE (Grade 4)	–	<50 General management, design and engineering
India SME Technology Services Ltd. (ISTSL)	National	BEE (Grade 2)	Services provider (general ESCO), audit consulting	<25 General management, project management, performance contracting and project risk management, energy auditing and accounting
Jaabilli Energy Efficiency Concepts Pvt. Ltd.	National	_	Full services ESCO model Provide efficient technologies Services Provider (General ESCO)	<25
Johnson Controls	Multinational	BEE (Grade 1)	Full ESCO services, provide efficient technologies	–
Kirloskar Brothers Ltd.	National	BEE (Grade 2)	Full ESCO Services, efficient pumping solutions developer, technology vendor	Energy audits
Lloyd Insulation India Ltd.	Gujarat, Punjab, Harayana, Uttar Pradesh, Delhi, West Bengal, Sikkim, Tamil Nadu	BEE (Grade 2)	Services provider (general ESCO), audit consulting	<25 Energy auditing and accounting

ESCO	General			
	Region of operation	Empanel-ment	Primary ESCO service(s)	Team strength and activities
Olive Exports	Multinational	BEE (Grade 4)	Provide efficient technologies	<25
Promethean	National	_	Equipment vendor ESCO, involved in design, manufacture, supply and installation of ESCO projects	<25
Price water house Coopers Pvt. Ltd.	Multinational	BEE (Grade 2)	Services provider (general ESCO), audit consulting	>250 General management, project management, design and engineering, performance contracting and project risk management, sales and marketing, energy auditing and accounting
SavEn India Energy Management	Maharashtra	_	Full ESCO services, provide efficient technologies, services provider (general ESCO), audit consulting	<25 General management, design and engineering, sales and marketing, energy auditing and accounting
Schneider Electric India Ltd.	Multinational	BEE (Grade 1)	Provide efficient technologies, leasing vendor (vendor-driven ESCO), O&M services	>250
Secure Meters Ltd.	Multinational	BEE (Grade 1)	Meter and measurement, extended into full ESCO services, has in-house manufacturing capability for meters	_
See-Tech	National	BEE (Grade 2)	Full ESCO services, works on building custom solutions for clients across various areas using available solution components.	<25 people
Shakti Pumps (India) Ltd.	National	BEE (Grade 3)	Provide efficient technologies	>250
Siri Exergy & Carbon Advisory Services Pvt. Ltd.	Multinational	BEE (Grade 3)	Provide efficient technologies, services provider (general ESCO), audit consulting	<25 Project management, sales and marketing
Smart Joules	National	BEE (Grade 3)	Full ESCO services	25 to 50 General management, project management
Stenum Asia	Multi-national	BEE (Grade 3)	Audit consulting, post-audit implementation support	<25 Energy auditing and accounting

ESCO	General			
	Region of operation	Empanel-ment	Primary ESCO service(s)	Team strength and activities
Suveg Electronics	National	–	Equipment vendor ESCO which installs lighting solutions equipped with central monitoring systems for real time monitoring	<25
Tata Power Delhi Distribution Ltd.	Regional	BEE (Grade 1)	Act as an enabler in ESCO market	>250
Thermax	National	BEE (Grade 2)	Full ESCO Services, efficient boiler design and development, power plant developer	–

Table 2.2: Technical information on the ESCOs surveyed

ESCO	Technical		
	Top ECMs offered	Sector (and segments)	Source of solution
Amplebit Energy Solutions Pvt. Ltd.	HVAC optimisation through automation and AI, power factor improvement	Buildings, MSME, IT (data centres/telecom)	Developed in-house
Aspiration Energy	Solar water heating, heat pumps, LEDs	Large industries	Reselling
BEBLEC Energy System Pvt. Ltd.	Lighting systems	Municipal services, large industries, IT (data centres/ telecom), construction services	Reselling
Bosch	HVAC, Waste heat recovery, integrated heating and cooling, Steam distribution optimization	Large industries, MSME	Developed in-house
Development Environergy Services Ltd.	Thermal measures, pumping systems	Large industries (chemical/ fertilizer, petroleum refining, pulp & paper, rubber/plastic, iron & steel, food & beverages, textiles), MSMEs, IT (data centres/telecom), buildings	Reselling
ENCON Energy Services	Compressed air optimization, lighting, HVAC	Large industries and buildings	Reselling
Energized Solutions	LED and HVAC retrofits	Large Industries and Buildings	Developed in-house
Enfragy Solutions India Pvt. Ltd.	Lighting, solar space heating system, HVAC	Buildings, municipal services	Reselling
eSmart	Energy efficient lighting, and control devices	Municipal services/Utilities	–

ESCO	Technical		
	Top ECMs offered	Sector (and segments)	Source of solution
Ethan Power	VFD, power factor controller	Large industries	VFD is resold, power factor controller is developed in-house
First ESCO Ltd.	Medium voltage variable frequency drives in fans and pumps, induction lighting systems, HVAC	Large Industries, buildings	Developed in-house
Forbes Marshall	Boiler efficiency optimization as well as process heat recovery, boiler replacement and automation, thermic heating/ cooling	Large Industries	Developed in house
Greetude	Lighting systems, VFDs, HVAC, pumps	MSME, large industries (Powder metallurgy, Dairy) and buildings	Reselling
Grundfos Pumps India Pvt. Ltd.	Pumping solution	Large industries (chemical/ fertilizer)	Developed in-house
Havells India Ltd.	Fans, lighting, pumps/motors	Large industries, MSME	Developed in-house
HMX	Pre-cooling direct/return air	Large industries (iron & steel, textiles, automobiles), buildings	Developed in-house
Honeywell	Building automation equipment, lighting, hot water generation, chillers	Large industries, MSME, buildings	Reselling
Intemo Services Ltd.	Lighting, pumps, control devices	Municipal services, large industries (mining)	–
India SME Technology Services Ltd. (ISTSL)	Lighting, drives/motors, EE manufacturing equipment	Buildings, municipal services, MSME	Reselling
Jaabilli Energy Efficiency Solutions Pvt Ltd.	_	Buildings, municipal services	Developed in-house
Johnson Controls	HVAC, building automation, VFDs	Buildings, large industries (chemical/fertilizer, food & beverage, electrical and electronic equipment), IT (datacentres, telecom)	Developed in-house
Kirloskar Brothers Ltd.	Pumping Solutions	Large Industries and Agriculture	Developed in-house

ESCO	Technical		
	Top ECMs offered	Sector (and segments)	Source of solution
Lloyd Insulation	Replacements/ Refurbishment Thermal insulation	–	–
Olive Exports	LED lighting	Buildings, municipal services	Developed in-house
Promethean	Waste heat recovery from chillers and compressors	Large industries	Developed in-house
Price water house Coopers Pvt. Ltd.	Energy efficiency in municipal street lighting, buildings, municipal water pumping	Implementing solutions as consultants through ESCOs	Recommend technologies after discussions with several established technology suppliers
SavEn India Energy Management	Lighting, drives/pumps/fans/ motor systems	Buildings, MSME	Developed in-house
Schneider Electric India Ltd.	Lighting, building envelope, building automation, HVAC	Buildings, large industries	Developed in-house
Secure Meters Ltd.	Pumps, metering equipment	Large industries, MSME, municipal services	Reselling pumps, meters developed in-house
See-Tech	Lighting, HVAC, pumping	Large industries and buildings	Reselling
Shakti Pumps (India) Ltd.	Pumps	Buildings, large industries, MSME, agriculture, IT	Developed in-house
Siri Exaergy & Carbon Advisory Services Pvt. Ltd.	Lighting, drives/pumps/fans/ motor systems, solar hot water heating	–	–
Smart Joules	Operational central AC equipment, redesigning on site, automation	Buildings	Developed in-house, reselling
Stenum Asia	Thermal system, compressed air optimisation, lighting	Buildings, large industries, (iron & steel, food & beverage), MSME	Developed in-house
Suveg Electronics	Lighting	Municipal services	Developed in-house
Tata Power Delhi Distribution Ltd.	–	–	–
Thermax	WHR with electricity generation/ steam (steam and process heat as a service), boiler retrofits, heat pumps	Large industries	Licensed/developed in-house

Table 2.3: Financial information on the ESCOs surveyed

ESCO	Financial			
	Primary source(s) of funding	ESCO model	Typical payback period (years)	Typical ticket size (cr INR) 1 cr = $150,000
Amplebit Energy Solutions Pvt. Ltd.	Client funded, self-funded	Fee for service, shared savings, guaranteed savings, deferred payment	<1 to 3	<0.1 to 2
Aspiration Energy	Client funded, bank funded	Shared savings	1 to 3	0.5 to 2
BEBLEC Energy System Pvt. Ltd.	Bank funded	Fee for services, deferred payment	<1 to 3	<0.1 to 5
Bosch	Self-funded	Deferred payment	1 to 3	_
Development Environergy Services Ltd.	Client funded, self-funded, bilateral/multilateral funded	Fee for service	1 to 3	0.1 to 0.5
ENCON Energy Services	Self-funded	Shared savings	1 to 3	0.5 to 2
Energized Solutions	Bank funded	Shared savings	_	0.5 to 2
Enfragy Solutions India Pvt. Ltd.	Self-funded	Deferred savings, deemed savings	1 to 5	0.1 to 5
eSmart	Client funded, bank funded, self-funded	Guaranteed savings	1 to 3	>5
Ethan Power	_	Shared savings, guaranteed savings	<1 to 3	<0.1 to 2
First ESCO Ltd.	Client funded, bank funded	Shared savings, guaranteed savings	1 to 3	>5
Forbes Marshall	Client funded	Guaranteed savings	1to 3	
Greetude	Client funded	Deemed savings	1 to 3	0.1 to 0.5
Grundfos Pumps India Pvt. Ltd.	_	Fee for service	1 to 3	0.1 to 0.5
Havells India Ltd.	Self-funded	Fee for service	_	_
HMX	_	Fee for service	_	_
Honeywell	Client funded	Guaranteed savings	1 to 3	>5

ESCO	Financial			
	Primary source(s) of funding	ESCO model	Typical payback period (years)	Typical ticket size (cr INR) 1 cr = $150,000
Intemo Services Ltd.	Client funded, bank funded	Fee for service, shared savings, guaranteed savings	1 to 3	>5
India SME Technology Services Ltd. (ISTSL)	Self-funded	Fee for service, guaranteed savings	1 to 3	<0.1 to 0.5
Jaabilli Energy Efficiency Solutions Pvt Ltd.	Self-funded	Fee for service		0.1 to 0.5
Johnson Controls	Client funded	Fee for service, guaranteed savings	<1 to 3	0.1 to 2
Kirloskar Brothers Ltd.	Client funded, bank funded	Shared savings, guaranteed savings	1 to 3	>5
Lloyd Insulation	Self-funded, bilateral and multilateral funding	_	>5	<0.1
Olive Exports	Self-funded	Fee for service	_	2 to 5
Promethean	_	Shared savings	< 1	0.1 to 0.5
Price water house Coopers Pvt. Ltd.	Consultancy services only	_	1 to 5	2 to 100
SavEn India Energy Management	Self-funded	Shared savings	1 to 3	<0.1
Schneider Electric India Ltd.	Client funded	Guaranteed savings	_	0.5 to 2
Secure Meters Ltd.	Self-funded	Shared savings	1 to 3	0.5 to 2
See-Tech	Client funded, bank funded	Shared savings, guaranteed savings	_	_
Shakti Pumps (India) Ltd.	Client funded	Fee for service	_	_
Siri Exaergy & Carbon Advisory Services Pvt. Ltd.	Self-funded	Shared savings	1 to 3	<0.1
Smart Joules	International grants, self-funded	Deferred payment	1 to 3	0.5 to 2

ESCO	Financial			
	Primary source(s) of funding	ESCO model	Typical payback period (years)	Typical ticket size (cr INR) 1 cr = $150,000
Stenum Asia	Client funded, bank funded	Fee for service	<1 to 3	<0.1
Suveg Electronics	_	Shared savings	>3 years	1 to 2
Tata Power Delhi Distribution Ltd.	Bank funded (Tata Cleantech)	_	_	_
Thermax	Self-funded	Shared savings		>2

2.2 Key outcomes of the survey – ESCO Profiling

The following subsections integrate the survey results to provide a fuller sense of the current ESCO market in India.

2.2.1 General operation

Region of operation: Out of the 37 ESCOs that actively responded to the detailed survey, 19 identified themselves as national ESCOs working across India, whereas 15 identified themselves as multinational ESCOs working in India. 3 ESCOs work actively only in (and around) the states of Andhra Pradesh, Maharashtra and Delhi respectively.

Age: Figure 2.1 represents the age distribution of the ESCOs surveyed. However, this is not indicative of the years they have been operating on the ESCO model. Three ESCOs did not respond to this question.

Empanelment: In 2008, BEE initiated the empanelment process for ESCOs through an open invitation and evaluation process. Three credit rating agencies conduct this process – CRISIL, CARE and ICRA. The criteria for empanelment on a 5-point scale grading scale include:

- Success in implementation of EE projects
- Ability of technical man-power
- Financial strength to invest in such projects
- Assessment of business risk (track record and market position)
- Organisational set-up
- Financial capability of the organization

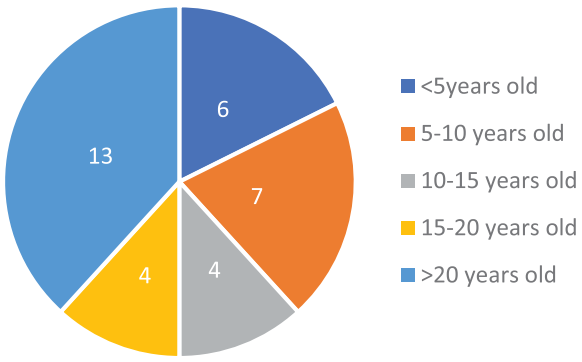


Figure 2.1: Age distribution of the ESCOs surveyed

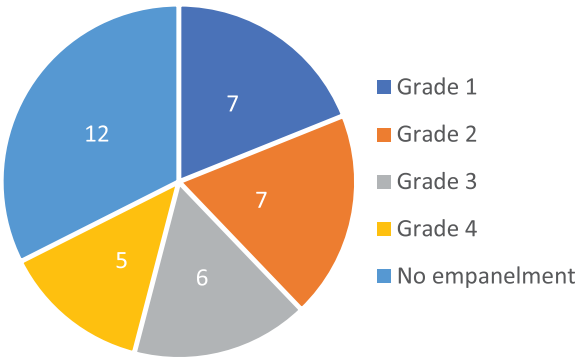


Figure 2.2: The distribution of the surveyed ESCOs across the BEE grading categories (Grade 1 – 5)

The ESCO grades reflect the opinion of the credit agencies on the ability of ESCOs to undertake EE projects in India. The pie chart in Figure 2.2 depicts the distribution of the surveyed ESCOs across the BEE Grade 1 – 5 categories.

While most ESCOs refrained from commenting on the usefulness of BEE grading system of ESCOs, many indicated that the empanelment process needs to be reviewed. Many commented that it helped them qualify for government tenders (Figure 2.3).

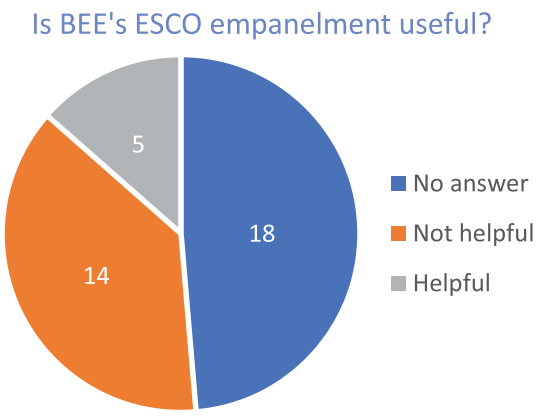


Figure 2.3: ESCOs' responses on the usefulness of BEE's ESCO empanelment

Primary ESCO services: 17 ESCOs identified full ESCO services (financing, energy auditing, technology providers, installation, M&V) as their primary ESCO service i.e. they can provide bespoke energy-saving services within the ESCO business construct; other top choices were vendor ESCOs, technology providers and audit consulting. Most ESCOs identified themselves with more than one service category (Figure 2.4).

Team strength and activities: Most ESCOs (17) have small teams of <25 people. Some national and multinational ESCOs have >250 employees, however it is unclear how many of them are dedicated to ESCO related roles. The teams are typically distributed in the departments (all or a combination of) of general management, project management, design and engineering, performance contracting, project risk management, sales and marketing, energy auditing and M&V.

2.2.2 ECMs on offer

Top ECM categories: A large diversity was noticed among ECMs offered by the ESCOs surveyed. Lighting, drives/

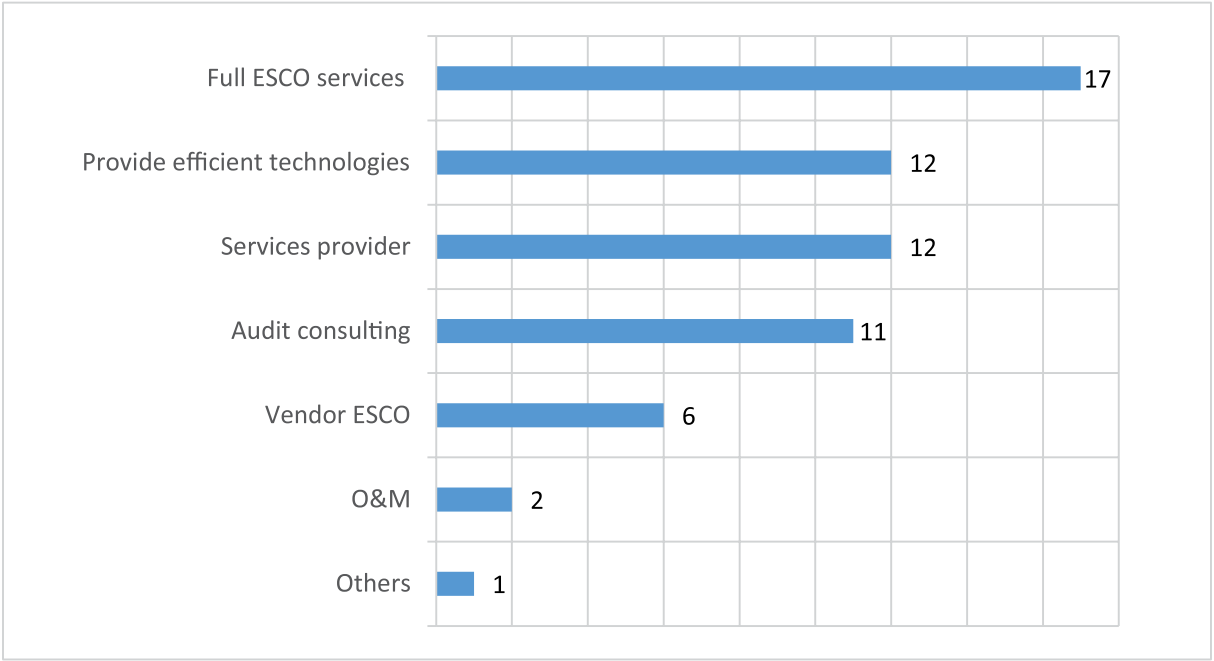


Figure 2.4: Top services offered by the ESCOs surveyed

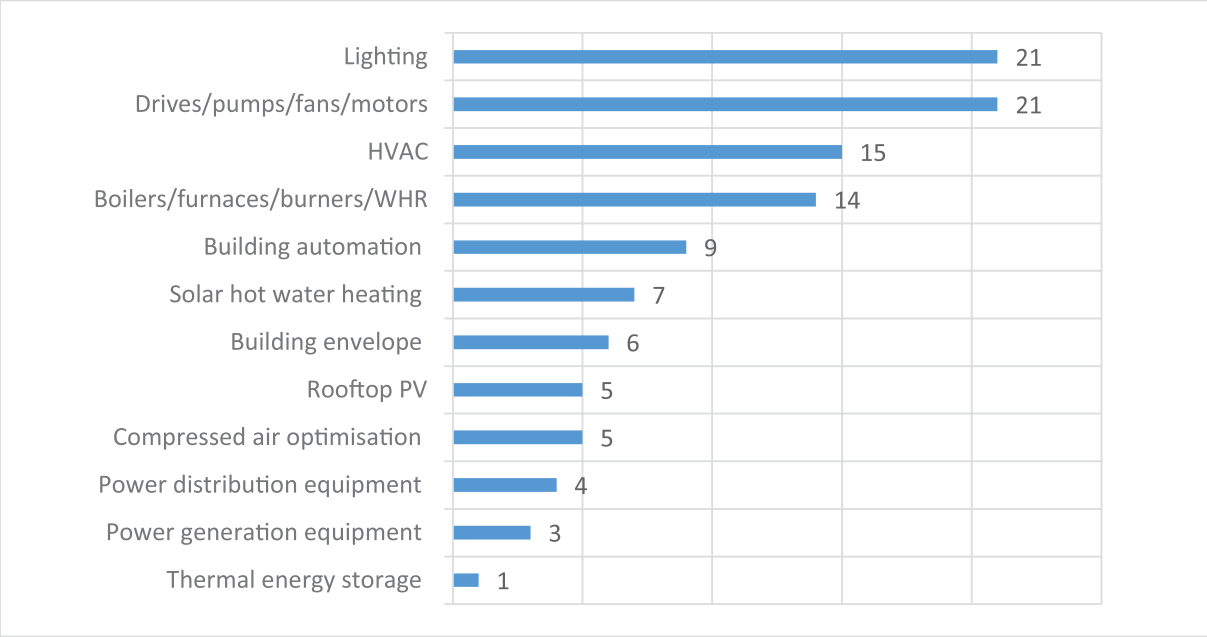


Figure 2.5: Top ECM categories identified

pumps/fans/motors, HVAC, boilers/furnaces/burners/ waste heat recovery and building automation were identified as the top ECM categories (Figure 2.5). Most ESCOs offer ECMs pertaining to more than one of these ECM categories. Some observations from the survey are:

- Only a few ESCOs implement complex solutions (like waste heat recovery) due to the associated technological risks and difficulty in getting buy-in from the decision makers.
- Type of projects that are implemented are skewed in favour of relatively simpler cross cutting ECMs.

A majority of the established ESCOs started off by implementing EE projects in buildings. Owing to complexities associated with M&V, the industries sector has become more challenging for ESCO operation. It also requires a range of process-specific solutions in addition to cross-cutting technologies.

Sectors served: Large industries, buildings, MSMEs, municipalities, IT (datacenters/telecom) and agriculture were identified as the top sectors where ECMs are being implemented. Most ESCOs implement ESCOs in more than one sector. Figure 2.6 aims to pictorially represent the relative presence of these sectors in the working of the surveyed ESCOs. Listed below are some deductions on this topic:

- Many ESCOs started off from working within the buildings sector due to relatively simple M&V processes in them before venturing into the industries sector.
- The industries sector has significant scope for broadening the ECM portfolio to include more capital intensive and complex interventions which will require high technical expertise. Within the industries sector, the focus of most ESCOs has largely been on cross-cutting interventions (like lighting) which are relatively easy to implement – however, even within cross-cutting interventions, ESCOs have experienced low levels of engagement in SMEs.
- Consultant ESCOs have had limited success in the MSMEs sector and tend to engage with an elite clientele from the large industries sector.
- Vendor ESCOs are more likely to venture into more than one sector.
- The lion's share of EE projects has been carried out in the private sector – the public sector has not yet warmed up to the ESCO model of project implementation.

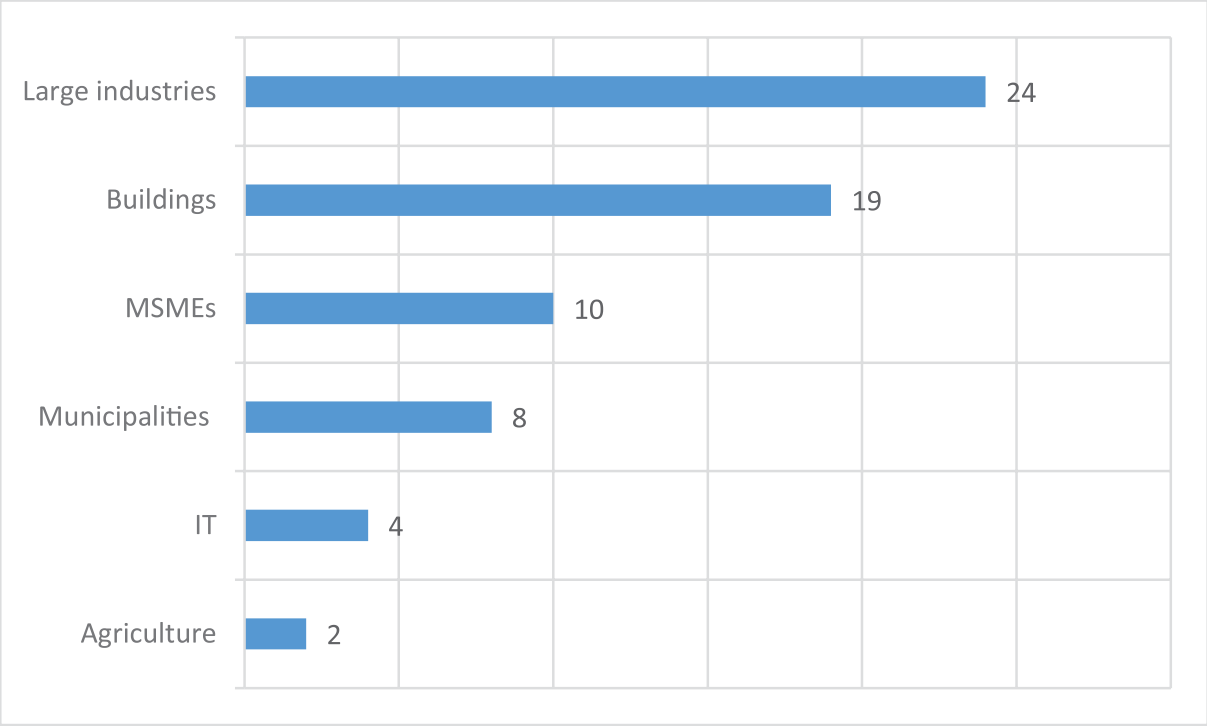


Figure 2.6: Top sectors served by the ESCOs surveyed

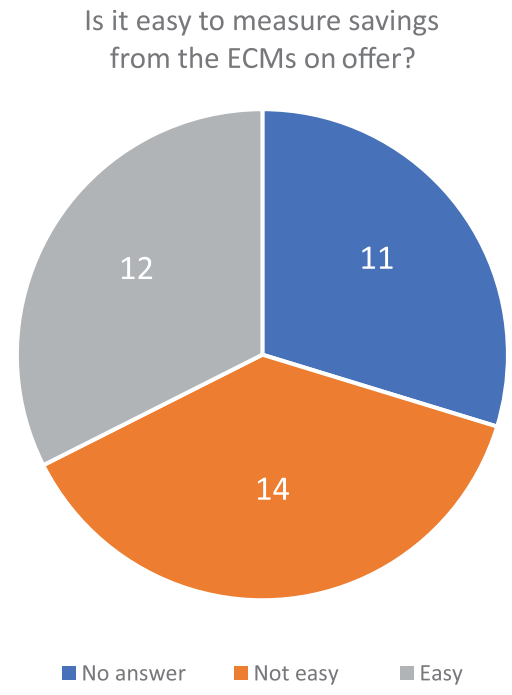


Figure 2.7: ESCOs' responses on the ease of measuring savings from ECMs

Source of solution: ECMs are typically developed in house or sold through resellers and system integrators.

Ease of measuring energy savings: While 11 ESCOs did not comment of the ease of measuring savings from the ECMs they offer, the remaining indicated a near 50:50 response – in some cases the energy savings could be measured directly using metering equipment whereas the others indicated that the measurement was either expensive or depended on the end-user's pattern of use of the ECM, or both (Figure 2.7).

2.2.3 Financing ECMs

Primary sources of funding: Most often ECMs are end-user or ESCO financed, followed by bilateral/multilateral financing and in some cases financed by third party financial institutions.

Top ESCO models: Shared savings, fee for service, guaranteed savings and deferred payment were identified as the top ESCO models used by the surveyed ESCOs. Figure 2.8 shows the relative popularity of these ESCO models within

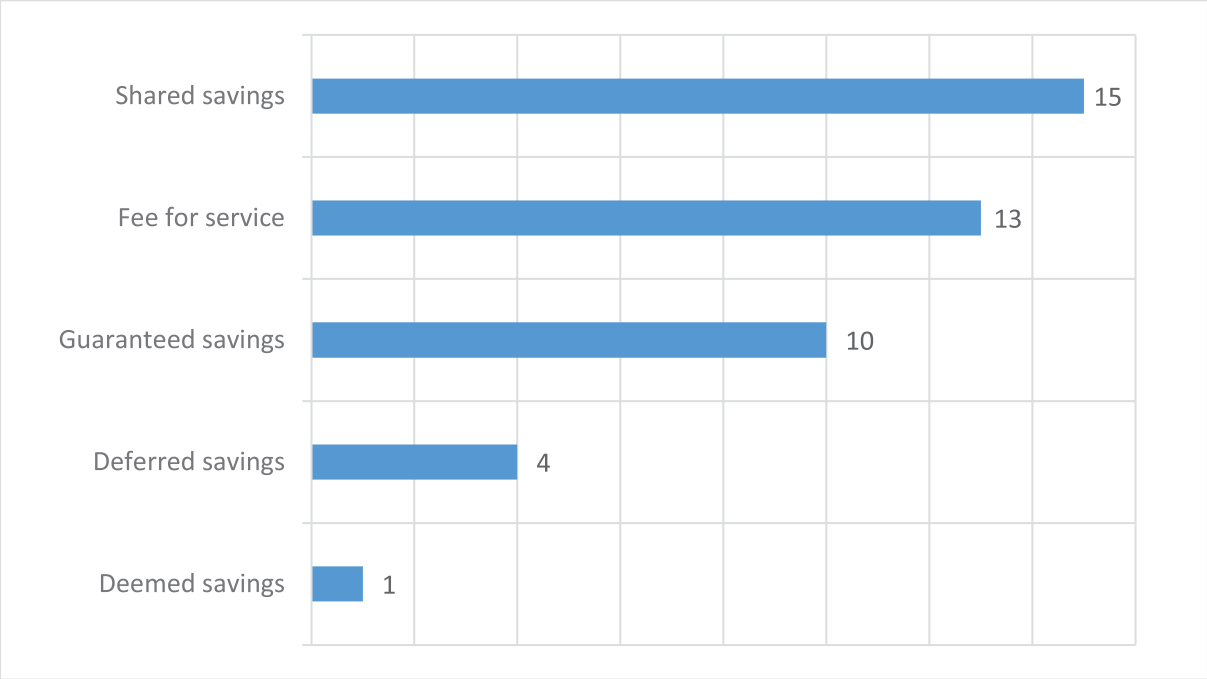


Figure 2.8: Top ESCO models and their relative popularity within the ESCOs surveyed

the ESCOs surveyed, based on actual projects undertaken by them. In the shared savings model, ESCOs arrange the funds which is compensated by the savings through the installed ECMs; in the guaranteed savings model, funding is availed by the end-user, either internally or through loans.

Most typical payback period: 1 to 3 years was chosen as the most typical payback period.

Most typical ticket size: INR 1,000,000 to 20,000,000 (approx. $15,000 to $300,000)/project was observed as the most typical ticket size. There was no obvious correlation between typical ticket sizes and the BEE empanelment of the ESCOs (subsection 4.1.1) or the size of the company (in terms of the region of operation or team strength). The small ticket size is characteristic of an incipient market wherein large capital-intensive intervention are still rare – ESCOs in India are yet to achieve a scale in operations which would enable them to collectively capture a sizeable share of a significantly large market potential.

Appendix – Chapter 2 contains succinctly complied profiles of the 37 ESCOs surveyed.

2.3 A discourse on the key challenges in the ESCO market in india

There is a range of challenges that plagues the ESCO market in India. This involves and affects all stakeholders in India's ESCO market – ESCOs, end-users, financial institutions, policy makers, regularity bodies, technology providers and equipment manufacturers. Broadly, process and thermal energy ESCOs talk about handling M&V disputes to prove energy savings as being their primary challenge owing to the inherent difficulty in measurement of saved energy; for electrical solution ESCOs, Standardisation of audits, solutions, contracts, project execution and savings validation becomes the primary challenge; for ESCOs dealing with simple solutions such as power, lighting and HVAC optimization, challenges vary– the ones that are relatively large feel lack of proper contractual frameworks is their primary challenge, while the smaller ones feel access to financing is their biggest challenge. For the aspiring ESCOs who are reluctant

to take financial risks, opportunity identification itself is a big challenge.

Presented below are the top challenges, identified and inferred from the ESCO survey outcomes, that is preventing the ESCO market from growing – most of these challenges have a combination of policy-type, finance and technology theme.

Ambiguous definition of ESCOs in India: ESCOs in India do not have a hard-and-fast definition. The ecosystem suffers from ambiguity in roles and capabilities of the market actors. ESCOs can be broadly classified as technology providers (vendors/data providers), solution providers, aggregators (utilities), super ESCOs and consulting ESCOs. Clarity in definition, roles and capabilities of various stakeholders – in financing, auditing, technology provision and equipment vendor – within the ESCO ecosystem is deficient.

Energy efficiency – a non-priority: Limited energy efficiency policy, lack of adequate enforcement at the state and municipal levels, the absence of good governing practices like the poor provision of energy-related data in the public domain and irregularities in support available for the operation of ESCOs in different states limit the widespread adoption of the ESCO model for saving energy.

There is a lack of systemic, integrative approach to accelerate the adoption of energy efficiency across the economy. For instance, the Make in India mission relies heavily on the energy-intensive industrial sector; however, there has only been a modest call for action for greater energy efficiency as a part of this programme through the Zero Effect, Zero Defect (ZED) policy to rate medium and small industries on quality control and certification for energy efficiency.

Suggested revision of BEE's ESCO empanelment process: There are many unlisted ESCOs, consulting organizations or equipment manufacturers in the market that provide services on a contract basis to a diverse set of clients. The survey indicated a strong suggestion from the ESCO community that technical aspects should be given higher weightage as compared to financial aspects in the empanelment process.

A fundamental disconnect between the ESCOs' and the end-users' preferred business model: ESCOs have not experimented much with new ESCO models for project implementation. As shown in subsection 4.1.3, shared savings is the most widely used ESCO model in the market today. ESCOs finance projects on their own balance sheets to mitigate financial risks – this hinders the implementation of many projects. However, ESCOs prefer the CAPEX/deemed savings model in which the ESCO would not have to arrange financing.

Shared savings projects are also costlier to implement – the overall costs are higher than the basic investment. It typically puts more pressure on the end-user and the ESCO to justify any gaps in performance compared to the expectations listed out in the performance contract. The decision-making cycle is significantly slower in this model as compared to the CAPEX model.

Managerial attitudes towards ESCO operations: Although funds are usually allocated for energy conservation projects in large industries, decisions pertaining to investments in energy efficiency are usually made at multiple thresholds – engineering, finance and others. Obtaining the buy-in from the engineering department is difficult at times; however, the finance department is disadvantaged to fully understand ECMs from a technical viewpoint, as is true in most purchase decisions. The turbulent flow of information leads to long delays in approvals. ESCO contracts are usually very detailed (to circumvent any disputes in M&V, sharing savings) – this also encumbers the contract approval significantly.

In MSMEs there is generally no funds allocated for installing ECMs. Factory owners are incumbent to make all decisions on investments – however, they view energy efficiency as a non-critical issue and are usually not equipped to understand energy saving technologies.

Technological risks associated with ECMs: Technological risks associated with newer technologies like low grade heat recovery is usually high when compared to mature and simple technologies such as LED lighting and pumps/motors – management buy-in becomes difficult in such cases. Within an industrial setting, cross-cutting interventions (like

lighting) are more widely accepted than process-specific ECMs, although it may so happen that process-specific interventions can deliver greater energy savings.

Challenges in baselining and M&V: The main barrier in baselining is the lack of sufficient data. It is also very time consuming and means an upfront cost for the ESCOs. Oftentimes, ESCOs do not budget sufficiently long times for capturing the operations of the facility. M&V is heavily tied to baselining. An inadequate metering infrastructure is a very significant challenge in the ESCO ecosystem and deserves urgent attention.

Many ESCOs have indicated that actual savings from ECMs would heavily depend on the client's production cycle. Since this is usually beyond the purview of ESCOs' control (unless suitably accounted for in the contract), the energy savings are usually normalized. This is key deterrent in the shared savings/guaranteed savings ESCO model. In the guaranteed savings models, the onus is on the ESCO to ensure that the guaranteed performance happens at the end-user site. In the absence of standard M&V protocols to account for deviations from baseline conditions, ESCOs stand the risk of losing the guaranteed amount to the end-user if savings fall short. Additionally, there is limited understanding of instrument calibration and end-users may expect ESCOs to use high precision industrial grade metering equipment which can drive costs up pointedly – although, low cost metering equipment could have also given reasonable precision. M&V can also be challenging in established cross-cutting ECMs. Many-a-time the M&V methodology is bespoke and decided between the end-user and the ESCO – this leaves scope for disputes arising from the precision and accuracy of the method. Many ESCOs provide a bundle of many ECMs wherein M&V protocols are not laid out for individual ECMs.

Preference for very short payback periods: Pricing disincentives for energy efficiency investments, energy subsidies and price distortions seriously impede the ESCO industry. If input energy costs are already quite low, end-users are not particularly motivated to install ECMs that could reduce their energy bills through energy efficiency. The most preferred payback period is 1-3 years. This severely restricts the penetration of projects with longer paybacks.

Lack of trust in the ESCO ecosystem: There is a general feeling of mistrust among end-users and financiers who prefer to remain within the confines of small projects with conservative and safe returns instead of scaling up projects. They also prefer working with established ESCOs with proven track records which often makes it difficult for new and deserving ESCOs to build their portfolios.

Difficulty in availing financing: ESCOs continue to be constrained by financial reasons. While large vendor ESCOs are better placed to finance shared savings projects on their books, small ESCOs, with weak assets and collateral support, struggle to secure financing – bankers are uninterested in small ticket size projects and sometimes skeptical about ESCOs' non-standardised solutions. Bankers are reluctant to transition from the traditional asset-based financing to future cash-flow-based financing, which is an important feature of international ESCO businesses. This stems from the bankers' poor understanding of ECMs. In many cases, even though ESCOs are investing their equity component and taking risks on their own balance sheet, banks insist on guarantees and security/fixed deposits which cumulate to make the cost of availing financing much higher than it is. Cost of audits significantly increase the transactional cost.

Financial schemes such as Partial Risk Guarantee Fund (PRGF) are not being used to their fullest potential because of poor awareness of EE financing and heavy transaction costs. Further, with some financiers, for the part of the loan for which guarantee is not provided, a collateral must be given in the form of a fixed deposit or other property-type collateral which raises the effective cost of capital for the ESCO.

The challenges faced by ESCOs can be grouped under five segments of ESCO classification. While complex solution ESCOs that deal with process and thermal energy (e.g. Enzen, Thermax, Forbes Marshall, Bosch) talk about handling M&V disputes being their primary challenge owing to the inherent difficulty in measurement of saved energy, for electrical solution ESCOs restricted to the utilities (e.g. Honeywell, Schneider Electric, Kirloskar), standardisation of

audits, solutions, contracts, project execution and savings validation becomes the primary challenge. For ESCOs dealing with simple solutions such as power, lighting and HVAC optimization, the ones that are relatively large (e.g. DESL) feel lack of proper contractual frameworks as their primary challenge while the smaller ones (e.g. Amplebit, Greetude) feel access to financing is their biggest challenge. For the aspiring ESCOs (e.g. HMX, Grundfos) who are reluctant to take financial risks, opportunity identification itself is a big challenge (Figure 2.9).

There are subtle differences in the way some of these challenges are articulated as well. For example, M&V disputes for complex solution ESCOs are about the challenge in measurement of saved energy while the same for simple solution small ESCOs are about the fear of payment risks. Similarly, access to financing is not a huge challenge for million-dollar savings solutions since end users are comfortable doing that investment, while it is a challenge for ESCOs dealing with relatively smaller value of solutions.

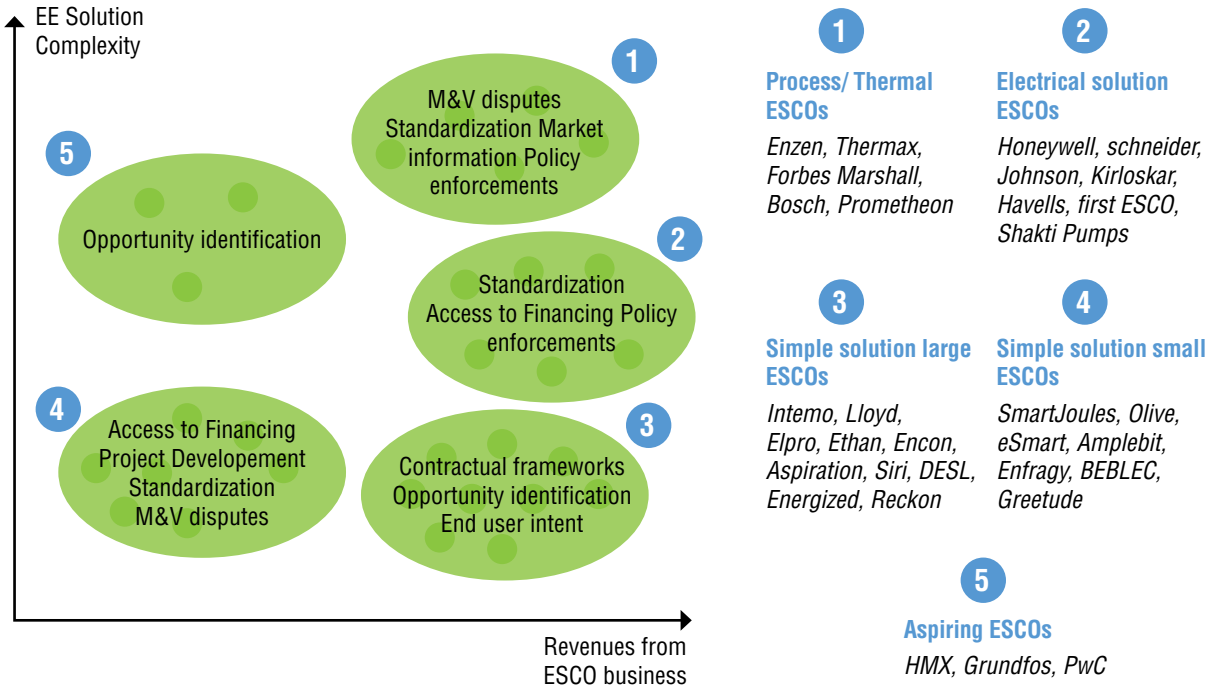


Figure 2.9: Top challenges faced by ESCOs

CHAPTER-3

Sizing the Energy Efficiency Market in India

3.1 Introduction

Measuring energy consumption is the first step in making energy efficiency policy measures, enabling market interventions. AEEE strongly believes that reliable energy data is the foundation of effective, evidence based energy policies and market actions that can fully expand India's energy saving opportunities. Only modest efforts have been or are being made to procure data that characterises electricity consumption in energy intensive sectors of India, namely: Commercial Buildings, Industries, Agriculture and Municipalities. For achieving greater levels of energy efficiency through growth of ESCO market and diffusion of energy saving technologies, it is imperative to granularly understand the energy performance of each sector and the segments falling within each sector - in current, near and long terms scenarios.

AEEE also pursued this exercise with a broader aim of assisting the energy efficiency community in India - Government, Businesses and Non-Profit organisations - with reliable and customised methodologies for estimating electricity consumption and saving potential. While only a scarce number of market sizing reports are available in public domain, most of the reports do not explain the methodology used for estimation and rely on old sources of data. Figure 3.1 schematically describes the process and objective of market sizing.

Objective

There were three components to the objective of market sizing exercise:

- To estimate the electricity consumed, savings potential and business potential in Commercial Buildings, Industries, Agriculture, Municipality Sectors in India.
- To identify addressable opportunities in each sector through deeper, segment wise assessment of electricity consumption and savings potential that elucidates investment opportunities for ESCOs to act upon and to buttress near to long term policy decisions - market based and regulatory actions - led by key ministries.
- To devise methodologies and illuminate key sources of data for long term assistance to researchers, policy makers and business community in conducting market sizing exercises in future that remain central to promoting data driven policy measures and market actions.

Approach

While the processes of estimating market size were customised based on the sectors, they were consistent in bottoms-up analysis to get a granular understanding of sectors through segmentation and categories within each. Addressable opportunities in mid to longer term have also been highlighted. For agriculture and municipal sectors, energy conservation measure based approach has been adopted to estimate the energy saving and business potential. Four energy intensive sectors were considered for this exercise. The specific approaches to characterising their market and energy saving potential have been summarised in Table 3.1 below. The subsequent chapters expand on the methodology followed for each sector.

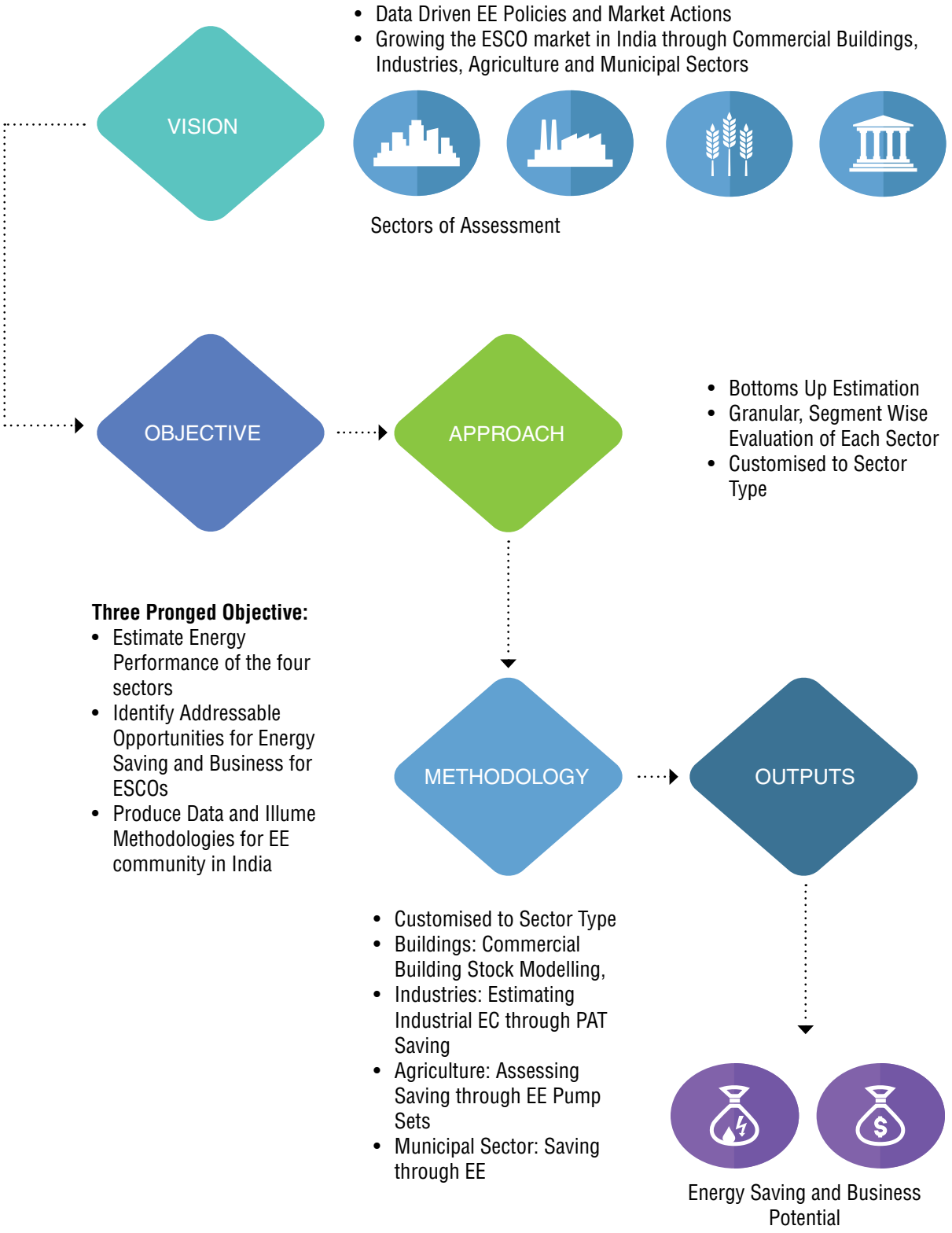


Figure 3.1: Strategy for EE Market Sizing in India

Table 3.1: Approach for sizing different sectors

Sector	Segments	Approach
Commercial Buildings	• Offices, • Hospitals, • Hotels, • Educational Buildings, • Retail, • Places of Worship	Commercial Building Stock Modelling Bottoms-Up, Building Typology Based, Large Number of Small Assumptions, Pan India Assessment
Industries - Large and Medium	• Fertilizers • Chemicals • Chlor Alkali • Steel and Metals	Estimating Total Savings and Business Potential Through Perform Achieve and Trade (PAT) programme; Projections for 3 years and 6 year timeline.
Agriculture	• Water Pumping	Assessing Savings from Diffusion of Energy Efficient Pump Sets and the required investment.
Municipalities	• Water Pumping • Street Lighting	Assessing Savings and Investment Potential from Diffusion of Energy Efficient Technologies

3.2 Key results of Four Sectors

The total investment potential for EE projects in commercial buildings, agriculture pumping, municipal pumping,street lighting and industries is between INR 93,000 - 120,000 Crore. Electricity savings between 65 - 90 Billion Units can be made annually in commercial buildings, agriculture and municipal sectors. In the industrial sector, 6.1 MTOE can be saved (3.76 in cross-cutting solutions and 2.42 MTOE in process solutions) if large scale energy efficiency projects are put in place through energy service companies. Maximum investment and savings potential exists in agriculture pumping, followed by industries and commercial buildings (Table 3.2).

Table 3.2: Savings and Investment Potential*

Sector	Energy Consumption (BU)	Potential Savings (BU)	Monetary Savings (in Crores)	Investment Potential Less than 3 year payback)
Commercial Buildings	71	15 - 21	7500 - 10500	15000 - 21000
Agriculture Pumping	168	40 - 60	20000 - 30000	40000 - 60000
Municipal Water pumping	18.8	3.7 - 4.7	1850 - 2350	3700 - 4700
Municipal Street Lighting	8.7	4 - 4.6	2000 - 2300	4000 - 5000
Industries	321.22 (MTOE)	6.1 (MTOE)	-	30000 - 31000
Total				**92700 - 119700**

* At INR 5 per kWh, the monetary savings in commercial buildings are 7500 - 10500 Cr, agriculture pumping 20000 - 30000 Cr, Municipal water pumping 1850 - 2350 Cr, Municipal street lighting 2000 - 2300 Cr.

3.3 Sector 1: Commercial Buildings

Commercial buildings account for nearly 9% of total energy consumed in India. For the purpose of assessing the energy performance and built up area segments including: **Offices, hospitals, hotels, educational buildings, retail and places of worship** were considered. The overall strategy was to appraise the current energy consumption in comparison to the built-up area per segment. This was done understand the current and emerging growth in energy consumed and the size of the commercial building stock in India. The total built up area of commercial buildings was estimated at 1.4 Billion Sq. m in 2016. The total electricity consumed by commercial buildings was estimated at 71 Billion Units per annum as of 2017.

3.3.1 Methodology

To model the energy demand in commercial buildings, AEEE devised a **Commercial Building Stock Energy Modelling** methodology to inform ESCO investments and encourage data driven policies for energy efficiency. It rests on a bottoms-up and building typology based process for estimation of energy consumption in existing and imminent building stock. Bottoms - up approach has been used to decipher the meta scale of building stock in India, formed of millions of building units, in terms of energy consumed and built area[6]. This characterisation will be fundamental in developing a thorough understanding of the current state of energy consumption at building segment level and calculating viable energy saving opportunities in this sector[7].

As opposed to a top down model that measures the change in status quo at a sectoral level, the bottoms up methodology is a multi-tiered[8] exploration. Building segments are categorised based on parameters drawn from Geometry (Form) and Operations (Type of use, occupancy and equipment load). Categorisation is determined by a large number of small, educated assumptions[9] that are informed with extensive data collection and analysis process for each segment separately.

A bottoms up approach allows for a deeper evaluation of rate of change in energy consumption and volume of building stock in each category. This paves the way for targeted energy saving strategy that policy makers can use for prioritising actions for reducing energy consumption and built up area within each segment. On synthesising estimations of total energy consumption and built up area, the trajectory of EPI and built up area over the course of next 20 years has been mapped. For policy intervention, the results of this exercise will help policy makers in prioritising interventions for sections that have high energy intensity.

Stages:

The overall methodology of AEEE's Commercial Building Stock Energy Modelling has six stages. These six stages were followed individually for each of the six building segments as shown by Figure 3.3 ahead. Between some stages the progression was lateral than linear as depicted in the figure on previous page:

Stage 1: Data Assembly

Assembling segment specific data points was the foundation of this exercise that informed all of the succeeding stages. Statistics from key GoI and private sources were recorded into an Excel WorkBook: Census, Economic Surveys, Open Government Platforms, Annual reports published by related ministries, MoSPI, and NGO reports. Market surveys conducted by industry association, in-house energy audit reports, building surveys and case studies were also gathered. Wherever feasible websites of specific establishments were also visited. When available, data points from annual government reports were used because they are updated on a periodic basis and can continue to inform the modelling exercise for updating the estimations in the coming years. Quantitative estimates of both geometric and non-geometric characteristics of buildings were considered at this stage.

The data assembled was scrutinised to remove unreliable and obsolete estimations. Triangulation and internal expert reviews were used for testing validity and reliability of numbers. About 40 - 50% of data points were discarded.

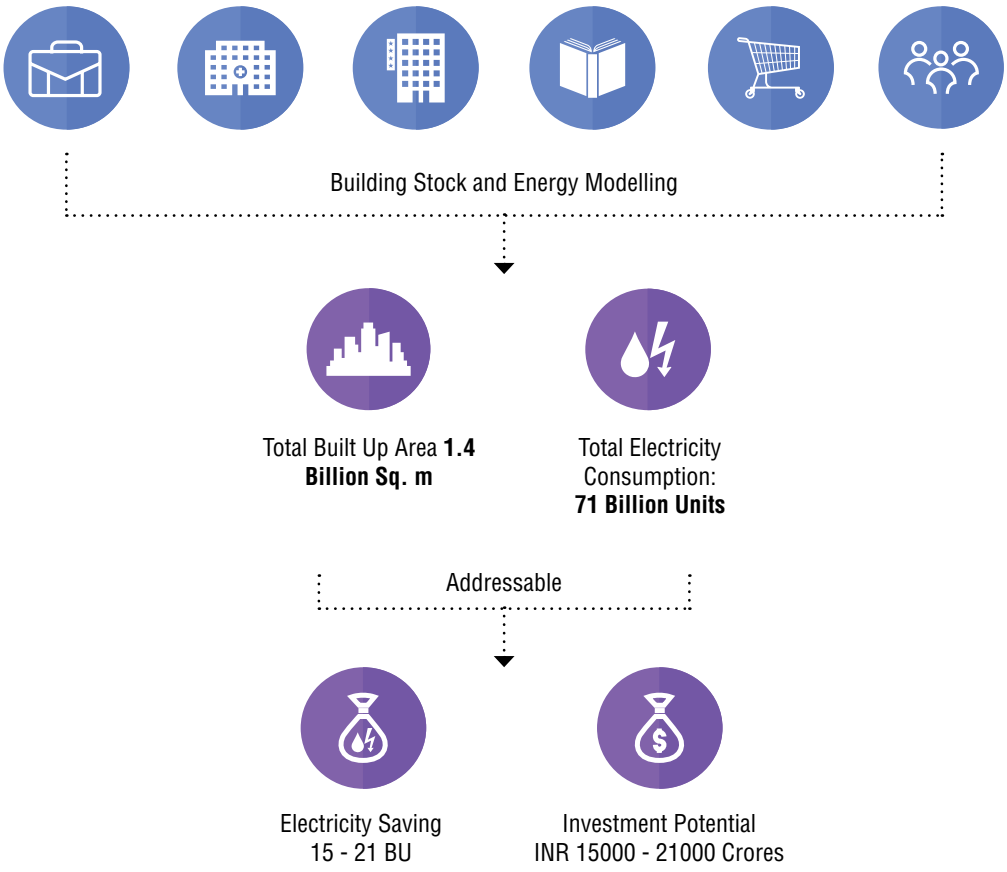


Figure 3.2: Overall Strategy for Market Sizing

Remaining were analysed to identify patterns which were used for making informed assumptions for further stages of the exercise. The efforts in data aggregation, screening and assembly into the excel workbook illustrated multiple tiers of data points that could be combined[10] and/or used in their entirety. The comprehensive survey of public and private sources of energy and buildings related data also highlighted areas for improvement to support data driven energy policies in India.

The goal of this stage was to arrive at informed approximations that are in the vicinity of number of buildings per segment, number of users per segment, Energy Performance Index (EPI), built area, electricity bill and consumption. The main output at this stage was an Excel Database with the Most Reliable Energy Data Points. It served as an input for the next stages.

Stage 2: Parameterisation

This stage has two purposes: to find logical routes for estimating building characteristics in absence of data and help in categorising the building segment for granular examination of built up area and energy consumption in the segment. The potential of a parameter in estimating the total size of the segment was a significant determinant in selecting a parameter.

For this methodology, a parameter is understood as a measurable macro-economic indicator of an overarching sector that the building segment supports and which can help in derivation of key characteristics of the building segment. Majority of parameters were sourced from annual reports and data published on the websites of ministries looking after the overarching sectors (Table 3.3).

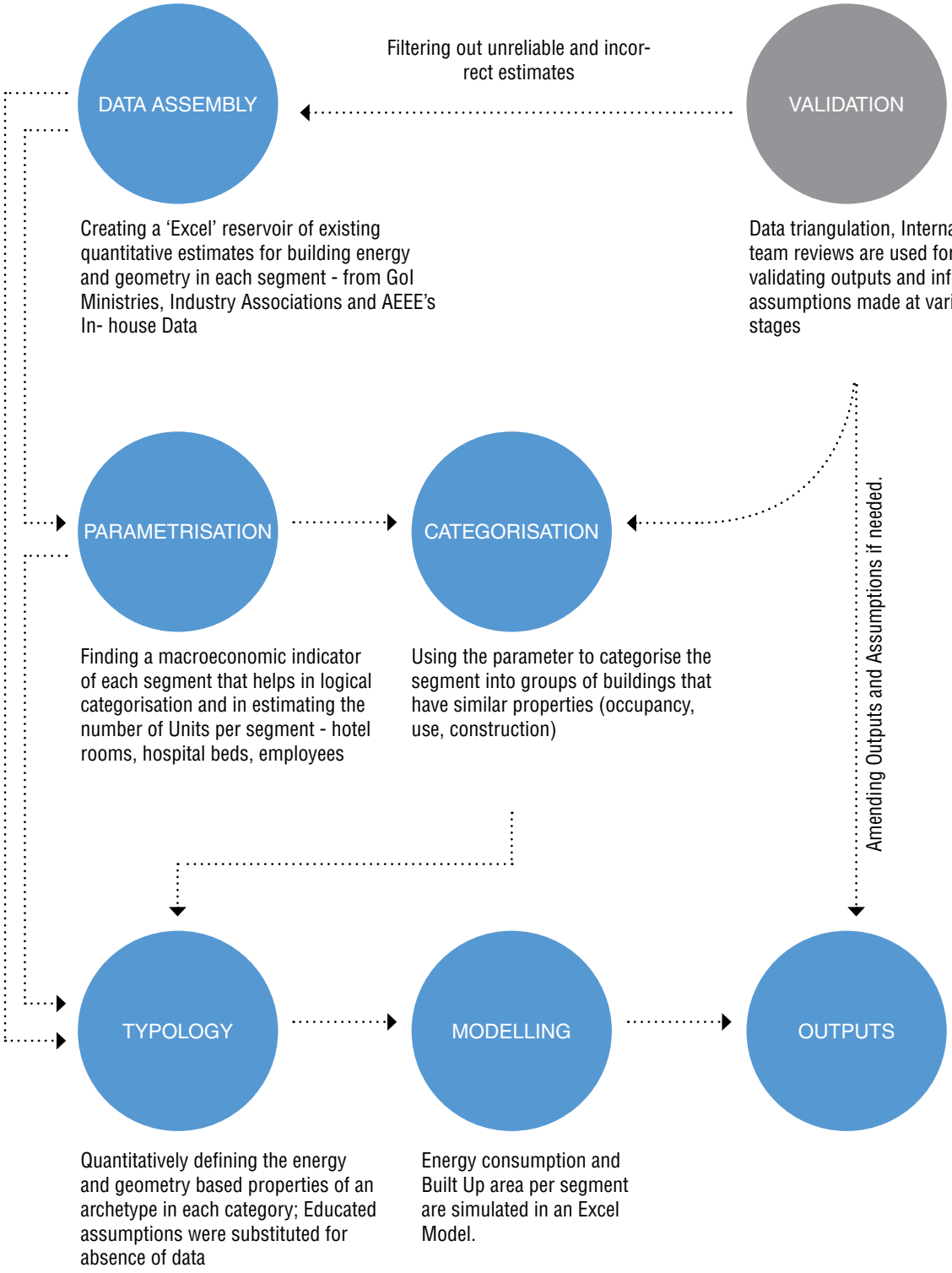


Figure 3.3: Methodology: Multi-tiered Commercial Building Stock Energy Modelling

Table 3.3: Stage 2 - Parameters used for Categorisation of each segment

Building Segment	Overarching Sector(s)	Key Parameter
Office Buildings	Employment and GDP	Number of employees working in public and private sector
Hospital Buildings	Public Health Infrastructure and Development	Number of Government and Private Hospital Beds
Educational buildings	Education and Human Resource Development	Number of Public and Private Schools, Colleges and Institutes of Higher Education
Retail	Retail sector, GDP	Number of Mom and Pop Stores per 1000 persons in India
Hotels	Tourism and Hospitality	Number of Hotel Rooms
Places of Worship	Tourism, Census	Number of Places of Worship

For instance, for office building segment, number of employees per public and private office type was selected as key parameter. It indicates the growth in employment in India in public and private sectors. Concrete estimations on number of employees coupled with estimations on space per employee, helped in arriving at the total built up area per office type.

Stage 3: Categorisation

The parameters identified in preceding stage were used to dissect each building segment into categories of buildings. Each category was a grouping of buildings with common construction characteristics, average geometry and operation of buildings[11]. In some instances, buildings were also grouped based on common energy related properties, such as average annual electricity bill and EPI benchmarks. Thus, each category was given a nomenclature determined by the common properties (Table 3.4).

Categorisation was paramount to identify key groups of buildings within each segment that have high potential for energy saving and investment by ESCOs. It also illuminated the differing rate of growth in built up area and electricity consumption in categories.

Using a parameter helped in categorising segments where only partial information on categories (Office buildings). For some segments such as Hotels, well established pre-existing star categories were used. In cases with no information to support categorisation process, informed assumption derived from data aggregation stage was used (such as for Places of Worship). The categories created were validated through data and reports aggregated in stage 1 of this exercise, along with multiple segment focused internal team reviews.

Stage 4: Typology

Adopting a typology based approach was a concerted effort to realise the bottoms up assessment of building stock and corresponding energy performance by systematically describing the characteristics of a typical building belonging to a category. A building typology is defined as “systematic description of the criteria for the definition of typical buildings as well as to a set of exemplary buildings representing the building types”[12].

Preceding stages of parametrisation, categorisa- tion, and data aggregation were used to characterise energy related and geometric features archetype for every category. Case studies, building surveys, energy audit reports, websites of key portfolios of the segment (such as in hotel and education building segment) were specifically referred for arriving at the typology. In absence of data points, assumptions were used as a substitute. Assumptions were informed with data pool

Table 3.4 Stage 3 - Categorising Each Segment for Granular Energy Performance

	Segment	Parameter	Categories	
COMMERCIAL BUILDINGS SECTOR	Office Buildings	Number of employees working in public and private sector	Private	IT/ITes
				Banking, Services and Finance
			Public	Central Government
				State Government
				Quasi Government
				Local Government
	Hotels	Number of Hotel Rooms per star category	1 Star	
			Other	
			2 Star	
			3 Star	
			4 Star	
			5 Star	
			Heritage	
	Hospitals	Number of Government and Private Hospital Beds	Public	Urban
				Rural
			Private	Nursing homes, Multi Speciality Hospitals
	Educational Buildings	Number of Public and Private Schools, Colleges and Institutes of Higher Education	Schools	Primary
				Upper Primary
				Secondary
				Higher Secondary
			University	Public
				Private
				Institutes of National Importance
			Stand Alone Institutions	
	Retail	Number of Mom and Pop Stores per 1000 persons in India	Modern	Malls
			Traditional	Small Mom and Pop Shops
				Large Mom and Pop Shops
	Places of Worship	Number of Places of Worship	Super Large Complexes	
			Large Places Complexes	
			Medium Places of Worship	
			Small Places of Worship	

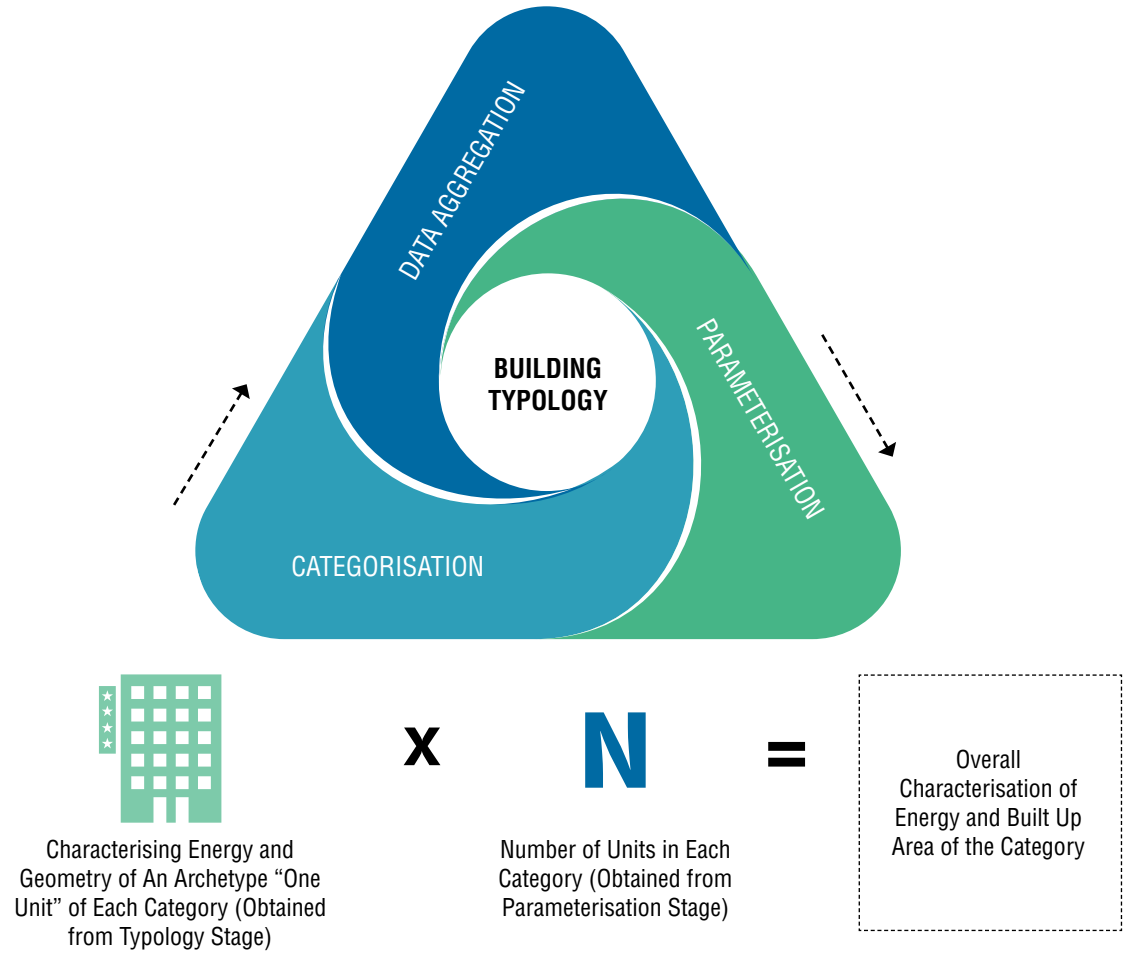


Figure 3.4: Stage 4 - Using Building Typology to Estimate Energy Performance and Form of the Overall Segment of Building

from Stage 1 as well as validation via several rounds of data triangulation and internal team reviews. Back calculations were also performed to validate assumptions after calculation of energy consumption in the category and segment.

For every category, the goal was to arrive at estimates that can determine the built up area (per room in case of hotels, per bed in case of hospital, per building in case of educational buildings), Energy Performance Index (EPI) of an archetype and derive the electricity consumption.

By defining the typology, one Unit of the category ("archetype building") was characterised in terms of energy and geometry. Unit was obtained from parameter identified in the previous stage. This was multiplied by the estimated number of units per category to estimate the total energy consumption and built area. More detailed explanation of this process has been included under the Modelling Stage. (See Figure 3.4 and Table 3.4)

Stage 5: Modelling

The energy consumption, built up area and savings potential for each segment was simulated in an Excel Model. The following calculation workbook shows the modelling of data. The outputs of electricity consumption and built up area for each segment were validated through data aggregated at stage one as well as in-house data and team reviews for each segment.

Stage 6: Validation

The outputs obtained from modelling were validated with the help of data assembled in earlier stages of the methodology. Inter segment comparisons were also drawn to review the assumptions and outputs in each sector. Rigorous in house data analysis and team reviews were used to review outputs of every stage and inform the assumptions.

Table 3.5: Stage 4 - Building Typology Characteristics for Each Category within the Commercial Building Segment

Segment	Parameter	Categories		Typology: Characteristics Used
Office Buildings	Number of employees working in public and private sector	Private	IT/ITes	• **Geometrical:** Built Up Area per Seat (Employee) for IT Offices • **Energy:** EPI Estimates for IT/ ITes and Central Government Offices
			Banking, Services and Finance	
		Public	Central Government	
			State Government	
			Quasi Government	
			Local Government	
Hotels	Number of Hotel Rooms per star category	1 Star		• **Geometrical:** Built Up Area per Room for 4, 5 Star and Heritage Category • **Energy:** Annual Energy Expenditure per Room, EPI Estimates for 4 and 5 Star Categories
		Other		
		2 Star		
		3 Star		
		4 Star		
		5 Star		
		Heritage		
Hospitals	Number of Government and Private Hospital Beds	Public	Urban	• **Geometrical:** Built Up Area per Bed • **Energy:** Electricity Consumption per bed, EPI for Private Hospitals
			Rural	
		Private	Nursing homes, Multi Speciality Hospitals	
Educational Buildings	Number of Public and Private Schools, Colleges and Institutes of Higher Education	Schools	Primary	• **Geometrical:** Built Up Area per School and Institutes of National Importance • **Energy:** EPI Estimates for Institutes of National Importance
			Upper Primary	
			Secondary	
			Higher Secondary	
		University	Public	
			Private	

Table 3.5: Stage 4 - Building Typology Characteristics for Each Category within the Commercial Building Segment

Segment	Parameter	Categories		Typology: Characteristics Used
			Institutes of National Importance	
		Stand Alone Institutions		
Retail	Number of Mom and Pop Stores per 1000 persons in India	Modern	Malls	• **Geometrical:** Built Up Area per Mall and Large Mom and Pop Stores • **Energy:** EPI Estimates for Malls
		Traditional	Small Mom and Pop Shops	
			Large Mom and Pop Shops	
Places of Worship	Number of Places of Worship	Super Large Complexes		• **Geometrical:** Built Up Area for Super Large Complexes • **Energy:** Electricity Costs for Super Large Complexes
		Large Places Complexes		
		Medium Places of Worship		
		Small Places of Worship		

3.3.2 Results of Commercial Buildings Stock Energy Modelling

After performing the commercial building stock energy modelling, it was found that as of 2017 commercial building segments, namely Hotels, Hospitals, Offices, Retail, Education and Places of Worship account for a total of 1400 Million Sq. m. On average, they consume about 71 Billion Units of electricity annually. Out of this, 15 - 21 BU can be saved with an investment potential of INR 15000 - 21000 Crore as given in Table 3.6 below. Each segment was examined separately to project the growth in energy performance index (EPI) and built up area in the next ten and twenty years. The projections are given in the summary results for each segment.

It is also important to recognise that for certain segments (such as places of worship and small retail shops that are placed adjacent to residential areas) it was not clear whether buildings draw electricity from commercial or residential load. CEA and MoSPI statistics were referred for clarification. *Secondly, there are additional commercial building segments aside from the ones included in this exercise. These include railway buildings, educational cum retail buildings such as admission institutes. It has been assumed that the categories excluded will comprise 10% of overall commercial energy, which as per CEA is 78 BU[13].

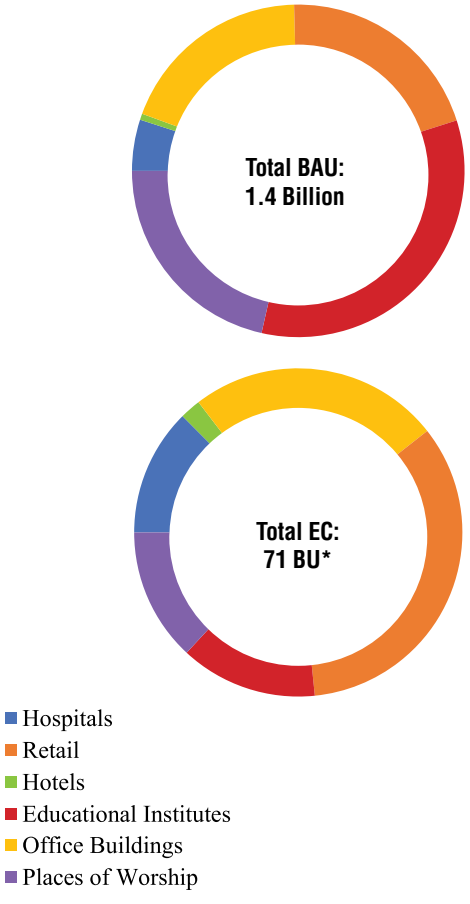


Figure 3.5: Total kWh and BUA for Commercial Buildings

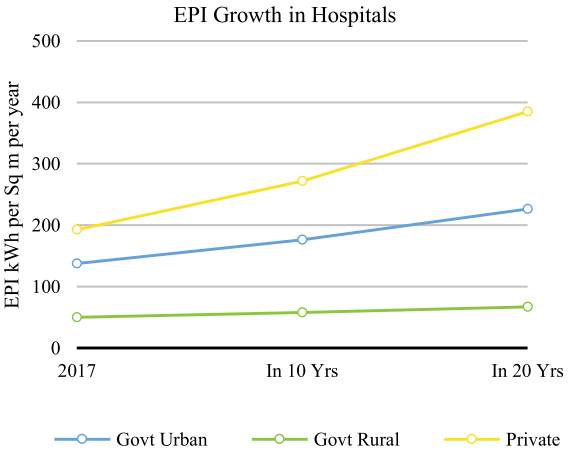
Table 3.6: Outputs of Commercial Building Stock Modelling - Total built up area, electricity consumption, and energy savings

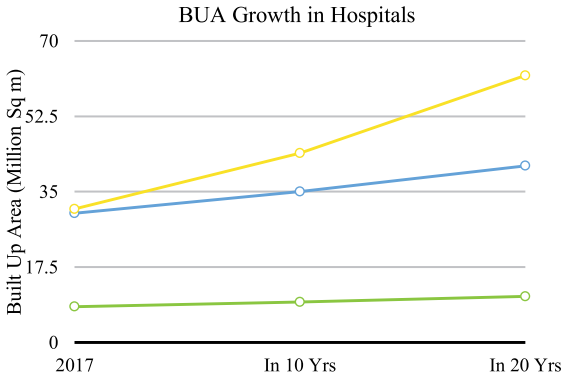
Commercial Building Segment	Total BUA (Million Sq M)		Total EC (Billion Units)		Total Savings (Billion Units)	
	Min	Max	Min	Max	Min	Max
Hospitals	64	75	7.4	10.3	2.6	3.2
Hotels	7.79	9.03	1.23	1.67	0.19	0.23
Office Buildings	214	317	14	21	3.11	4.44
Retail Sector	242	330	17	31	5.3	7.15
Educational	451	483	7.74	11.34	2.25	2.86
Places of Worship	256	343	6.68	11.80	1.93	2.75
Total	1234.79	1234.79	54.05	87.11	15.38	20.63

Segment: Hospital Buildings

1. Tabular Summary of Results

Categories	Number of Beds (A)	Sq M per Bed (B)	EPI (kWh per Sq M per year) (C)	Total Built Up Area (Million Sq M)	kWh per bed per year (D)	Total EC per year (Billion Units)	Energy Saving Potential (E)	Total kWh Savings
Government - Urban	5,37,931	50-60	110-165	27-32	5000-7000	2.7-3.8	30-40 %	0.97-1.3
Government - Rural	2,16,793	35-42	44-55	7.6-9.1	2500-3500	0.54-0.78	20-25 %	0.13-0.16
Private - All	4,15,276	70-80	165-220	29-33	10000-14000	4.15-5.81	30-35 %	1.5-1.7
Total				64-75		7.4-10.3		





2. Projections for EPI and BUA

Hospital Segment	CAGR	Current (2017)	In 10 years	In 20 Years
Government - Urban	EPI 2 - 3 %	137.50	176.20	226.33
	BUA 1.5 - 2 %	30	35	41
Government - Rural	EPI 1 - 2 %	50	58	67
	BUA 1 - 1.5 %	8.3	9.4	10.7
Private	EPI 3 - 4 %	192.5	271.83	385
	BUA 3 - 4 %	31	44	62
EPI in kWh per Sq m per year and BUA in Million Sq m. In the next 10 and 20 years, number of hospital beds per capita is likely to increase. Currently it is 0.9 beds per 1000 persons in India. Number of hospitals in private sector are likely to grow. This is likely to cause a surge in cooling demand, appliance usage in the inpatient facilities.				

3. Sources and Assumptions

A. Number of beds and hospitals were sourced from National Health Profile[14] 2016, Central Bureau of Health Intelligence. Private hospital beds were estimated based on GoI's 11th Plan Estimate[15] - CAGR approx. 12% and 262,256 beds in 2002. Only Inpatient facilities were considered in the stock modelling.

B. Sq. M per bed was triangulated from estimates from Indian Public Health Standards[16] (IPHS) Revised Guidelines for Health Centres 2012 issued by Directorate General of Health Services and in house hospital survey data (N= 130). In-house energy audit reports of hospitals were also used to estimate area per bed in private hospitals. Due to additional services available, area per bed in private hospitals was assumed to be 30% higher than that in government - urban hospitals.

C. In house energy audit reports, BEEP[17] and in house hospital survey data was used for determining EPI estimates. EPIs for government urban and rural hospitals were assumed to be 75% and 50% of private hospitals respectively.

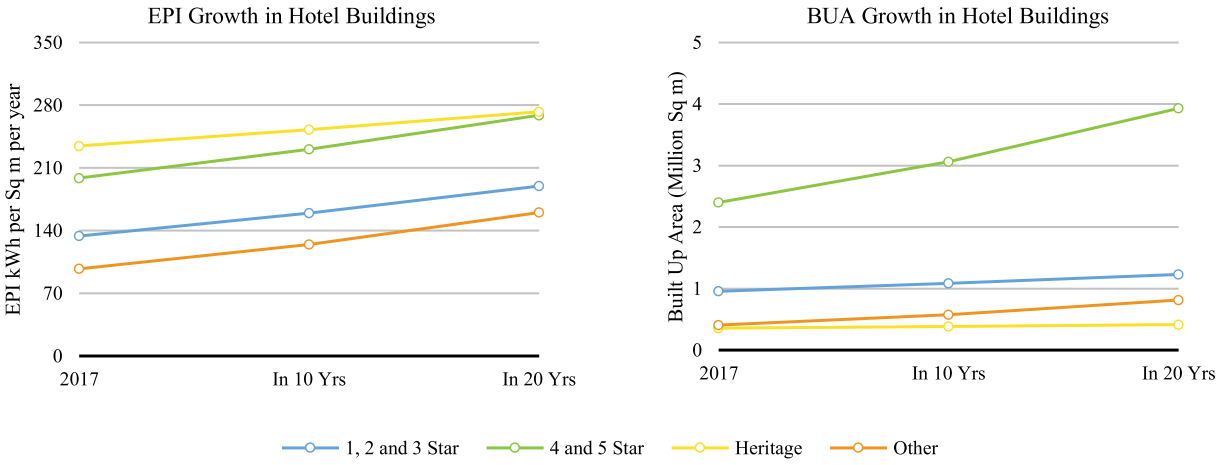
D. kWh per bed per year for private hospitals has been estimated through in house data from energy audit reports and in house hospital building surveys. kWh per bed in rural hospitals is assumed to be 20% of urban hospitals. kWh per bed for private hospitals was estimated through in house energy audit reports. kWh per bed in urban hospitals was assumed to be 75% of that in private hospitals. Outputs were validated through presentations[18] made by subject matter experts in India and CBERD[19] report on Hospital EE in India.

Segment: Hotels

1. Tabular summary of results:

Categories	Number of Hotels (B)	Number of Rooms (C)	Annual (Direct) Energy Costs per Room (D)	BUA per Room (E)	BUA per Category (Million Sq m) (F)	EPI (G)	EC per category (BU)	Saving Potential (H)	Savings (BU)
1 Star	260	10900	27247	30-35	0.33 - 0.38	55 - 82.5	0.0179 - 0.031	30 - 40 %	0.038 - 0.051w
2 Star	495	22950	48099	35-40	0.80 - 0.92	110 - 137.5	0.0883 - 0.126		
3 Star	505	30100	75787.5	50-60	1.5 - 1.8	137.5 - 165	0.206 - 0.297		
4 Star	134	22770	99760.5	60-70	1.4 - 1.6	165 - 192.5	0.225 - 0.306	25 - 30 %	0.12 - 0.14
5 Star	165	43965	124816	70-80	3.07 - 3.52	192.5 - 220	0.592 - 0.773		
Heritage	70	4200	77282	80-90	0.34 - 0.38	220 - 247.5	0.073 - 0.093	25 - 30 %	0.020 - 0.025
Other (A)	7078	-	38175	-	0.38 - 0.44*	82.5 - 110	0.031 - 0.048	30 - 40 %	0.012 - 0.016
Total					7.79 - 9.03 Million Sq m		1.23 - 1.67 BU		0.19 - 0.24 BU

2. Projections for EPI and BUA



Hotel Segment	CAGR	Current (2017)	In 10 years	In 20 Years
1, 2 and 3 Star	EPI 1.5 - 2 %	133.95	159.37	189.73
	BUA 1 - 1.5 %	0.96	1.08	1.23
4 and 5 Star	EPI: 1 - 2 %	198.69	230.84	268.84
	BUA 2 - 3 %	2.4	3.06	3.93
Heritage	EPI 0.5 - 1 %	234.56	252.83	272.68
	BUA 0.5 - 1 %	0.36	0.39	0.41
Other	EPI 2 - 3%	97.31	124.70	160.17
	BUA 3 - 4 %	0.41	0.58	0.81
EPI in kWh per Sq m per year and BUA in Million Sq m. Cooling requirement and appliance usage will see a rise in 1, 2 and 3 star hotels. Due to smartphone apps and shared economy ventures in hospitality businesses, growth in number of rooms in Other category is highly likely to occur. An increase in the number of rooms in 4 and 5 Star hotels is also highly likely due to rising incomes and consumer demand. Increase in cooling demand will be offset by EE gains in 4 and 5 Star categories.				

3. Sources and Assumptions

A. Other' category was defined with the help of energy costs per room from Federation of Hotels and Restaurants Association in India (FHRAI) - Indian Hotel Industry Survey 2015 - 2016. FHRAI's estimates on annual energy costs per room for 'Other' category showed that this category existed between 1 and 2 star hotels. Similar category was also included in MoSPI's statistics on hotels. It was assumed that the total built up area of 'Other' category was 15% more than that of 1 Star hotels.

B. Estimates were triangulated from data points obtained from Federation of Hotels and Restaurants Association in India (FHRAI) 2016 Survey, HVS Hotels in India Trends and Opportunities 2016 Research and estimates from HOSTS[20] - Hospitality Sourcing Show in India.

C. Estimates from Federation of Hotels and Restaurants Association in India (FHRAI) 2016 Survey, HVS Hotels in India Trends and Opportunities 2016 Research and estimates from HOSTS Hospitality Sourcing Show in India. Number of rooms for 'Other' category was not available.

D. FHRAI Survey 2016 provided estimates on annual energy costs per room. Direct energy costs have been assumed to be the electricity costs and also assumed to be half of the total energy cost. The latter assumption is based on estimates obtained from sample studies on hotels[21].

E. Estimates of room area were sourced from websites of hotels[22]. It was assumed that Sq. M per room includes room area and service area of hotel (parking and green/ open area was excluded).

F. Total Built up area of 'Other' category is assumed to be 15% more than that of 1 Star hotels.

G. EPI has been estimated through multiple sources: CBERD[23] reports, energy audit reports of hotels, ECO III estimates and CSR reports[24] [25] of 5 Star hotel groups. These estimates were down sized for 1, 2, 3 and 'Other' category

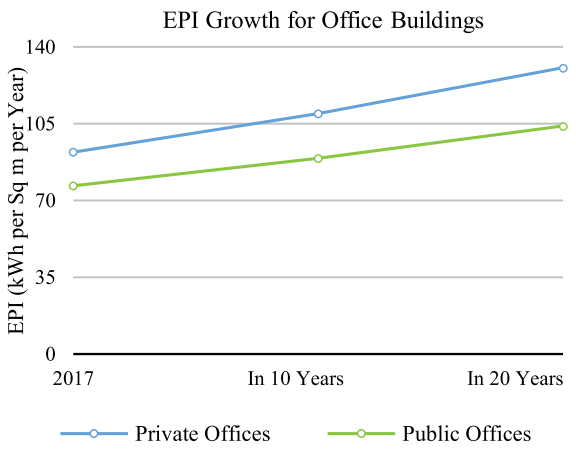
H. Based on energy audit reports, interviews, roundtables and in-house research and analysis.

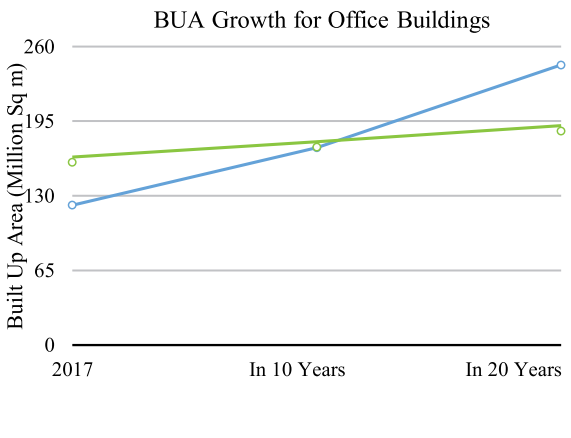
Segment: Office Buildings

1. Tabular summary of results:

Categories	Total Number of Employees (Millions) (A)	Built Up Area per Employee (Sq. m) (B)	Total Built Up Area (Million Sq. m)	EPI kWh per Sq. m per year (C)	Total EC (Billion Units)	Savings Potential	Savings (BU)
Private Offices							
IT/ITes	8.2 – 10	9 - 11	73.8 - 110	82.5 - 110	6.08 - 12.01	20 - 30 %	1.82 - 2.73
Banking, Services, Finance and Insurance (BSFI)	3.5 – 4	6 - 8	21 - 32	55 - 82.5	1.35 - 2.97	20 - 30 %	0.43 - 0.65
Sub Total			94.8 - 142		7 - 15		
Public Offices							
Central Government	2 - 2.1	12 - 15	24 - 31.5	77 - 99	1.68 - 2.84	30 - 40 %	0.75 - 0.99
State Government	6.5 - 6.7	10 - 12	65 - 80.4	66 - 77	3.9 - 5.63	20 - 25 %	1.04 - 1.31
Quasi Government	5.5 - 5.7	8 - 10	44 - 57	77 - 88	3.08 - 4.56	25 - 30 %	1.12 - 1.35
Local Government	1.8 – 2	3 - 5	5.4 - 10	22 - 33	0.108 - 0.3	25 - 30 %	0.095 - 0.1
Sub Total			138.4 - 178.9		9.76 - 15.48		
Total			233 - 320		15.35 - 26.72		5.27 - 7.15 BU

2. Projections for EPI and BUA





Segment	CAGR	Current (2017)	In 10 years	In 20 Years
Private Offices	EPI 1.5 - 2 %	92.12	109.61	130.49
	BUA 3 - 4%	122	172	244
Public Offices	EPI 1 - 2%	76.80	89.23	103.91
	BUA 0.5 - 1%	164	177	191
EPI in kWh per Sq m per year and BUA in Million Sq m. Based on MoF Employment estimates, the rate of employment in private sector is steadily increasing and declining in private and public sector, respectively. Likewise, growth will be reflected in private and public office building stock in India. Private sector building stock will almost double in 20 years. Energy consumption in Public sector will grow due to increased air conditioning requirements and greater appliance usage. Use of air conditioning will rise in Private Sector Offices as well, but EE gains and green building strategies will bring offsets in electricity consumption.				

Sources and Assumptions:

A. Ministry of Finance's Employment data[26] from 1995 - 2011 was extrapolated to derive estimates for current times - 'Employment in Organised Sectors - Public and Private'. Accessed from Open Gov. Data Platform. MoF estimates on number of employees in IT/ITes and BSFI offices were triangulated with estimates from India Brand Equity Foundation[27] (IBEF)

B. Estimates were obtained from in-house office buildings data, case studies on workplace design of IT/ITes offices[28] and government offices as well as government guidelines[29] for designing public offices. Benchmarking data[30] obtained through interviews with state governments[31] were also used. Based on multiple sources of data, BUA per employee in central government offices was assumed to be nearly 30% more than IT/ITes offices. BUA for State, local and quasi government offices was downsized from estimates of Central government offices.

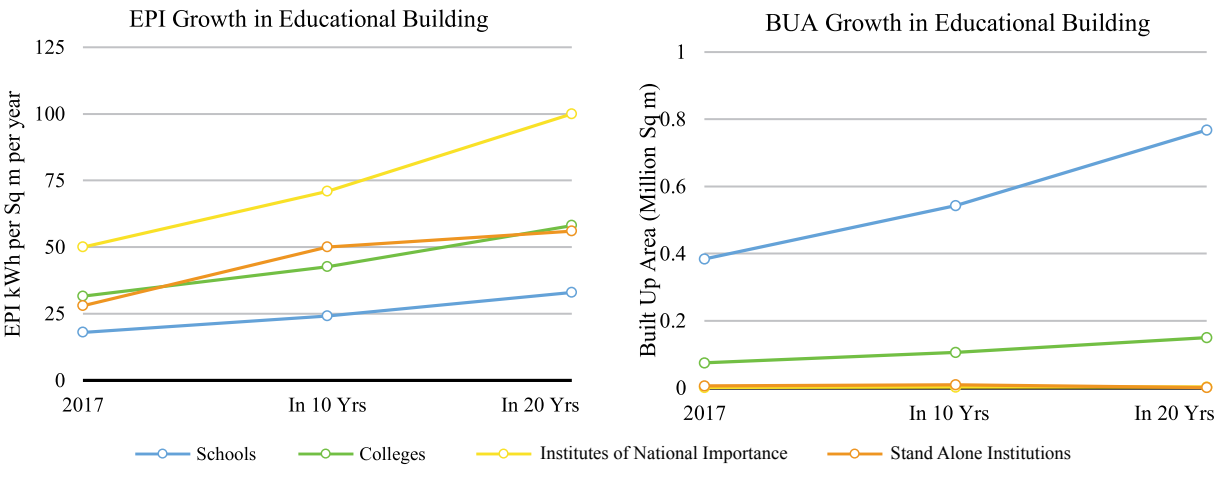
C. EPI numbers have been estimated through triangulation of multiple sources, including energy audit reports, case studies, in-house buildings data, state government reports (such as Energy Management Center, Kerala). Quasi government offices have been assumed to be operated with an equal mix of public and private office standards. Hence, EPI for these offices has been assumed to be the average of EPI of central government and IT/ITes offices.

Segment: Education Buildings

1. Tabular summary of results

Categories	Number (A)	Built Up Area per building (Sq m) (B)	BUA (Million Sq m)	EPI (kWh per Sq m per year) (C)	EC per Category (In Billion Units)	Saving Potential	Savings (BU)
Schools							
Primary	677694	150 - 160	101 - 108	20 - 25	2.03 - 2.71	25 - 30 %	1.72 - 2.06
Upper primary	340075	301 - 310	102 - 105	20 - 25	2.04 - 2.63		
Secondary	108268	554 - 560	59 - 60	30 - 40	1.79 - 2.42		
Higher Secondary	87454	1313 - 1320	114 - 115	30 - 40	3.44 - 4.61		
Colleges							
Rural	23098	1500 - 2000	34 - 46	22 - 27.5	0.762 - 1.270	20 - 30 %	0.474 - 0.711
Urban	15399	2000 - 2500	30.7 - 38.5	33 - 44	1.02 - 1.70		
Institutes of National Importance	75	20000 - 25000	1.50 - 1.88	44 - 55	0.066 - 0.103	15 - 20 %	0.009 - 0.020
Stand Alone Institutions	12276	500 - 600	6.14 - 7.37	22 - 33	0.135 - 0.243	20 - 30 %	0.037 - 0.056
Total			451 - 484 Million Sq m		7.73 - 11.34 Billion Units		2.25 - 2.86 Billion Units
In schools, savings potential can be achieved through more energy efficient lighting and fans. In colleges and standalone institutions, savings potential can be achieved through fans, lights and streetlights. In Institutes of National Importance, savings are not very high because of existing penetration of EE strategies and green building architecture.							

2. Projections for EPI and BUA



Segment	CAGR	Current (2017)	In 10 years	In 20 years
Schools	EPI 2 - 4 %	18	24.22	33
	BUA 3 - 4 %	384	543	768
Colleges	EPI 2 - 4 %	31.6	42.63	58.08
	BUA 3 - 4 %	75	106	150
Institutes of National Importance	EPI 3 - 4 %	50	71	100
	BUA 3 - 4 %	1.7	2.4	3.4
Stand Alone Institutions	EPI 3 - 4 %	28	50	56
	BUA 3 - 4 %	6.7	9.5	13.4
EPI in kWh per Sq m per year and BUA in Million Sq m. EPIs will grow in the next 10 and 20 years due to increased electricity consumption from greater air conditioning demand and appliance usage. With growth of literacy rates and need for imparting better skills for better employment prospects, number of colleges and institutes will also grow.				

3. Sources and Assumptions

A. Statistics on number of institutions per category has been sourced from Ministry of Human Resource Development[32] - Education Statistics - At a Glance 2016. Only pucca schools have been considered in this exercise. Based on MoHRD about 20% are kuchcha schools. Same source notes that there are about 38498 colleges in India, out of which 60% exist in rural areas. Institutes of National Importance include IITs, IIMs and NITs, and Stand Alone Institutes include Diploma Institutes, Institutes Under Ministries, Polytechnics.

B. Built up area estimates for schools have been sourced from NCERT's 7th All India School Education Survey[33]. Reports from private research reports[34] were also used to inform assumptions and validate estimates. For colleges and standalone institutions, in house building survey data, energy audit reports[35], archetypes[36] and case studies[37] on public and private universities have been used. Built up area in private universities has been assumed to be 30% lesser than public universities.

C. EPI estimates have been sourced from energy audit reports and case studies. In secondary schools, EPI has been assumed to be 30% higher than primary schools' due to more appliances and facilities for use.

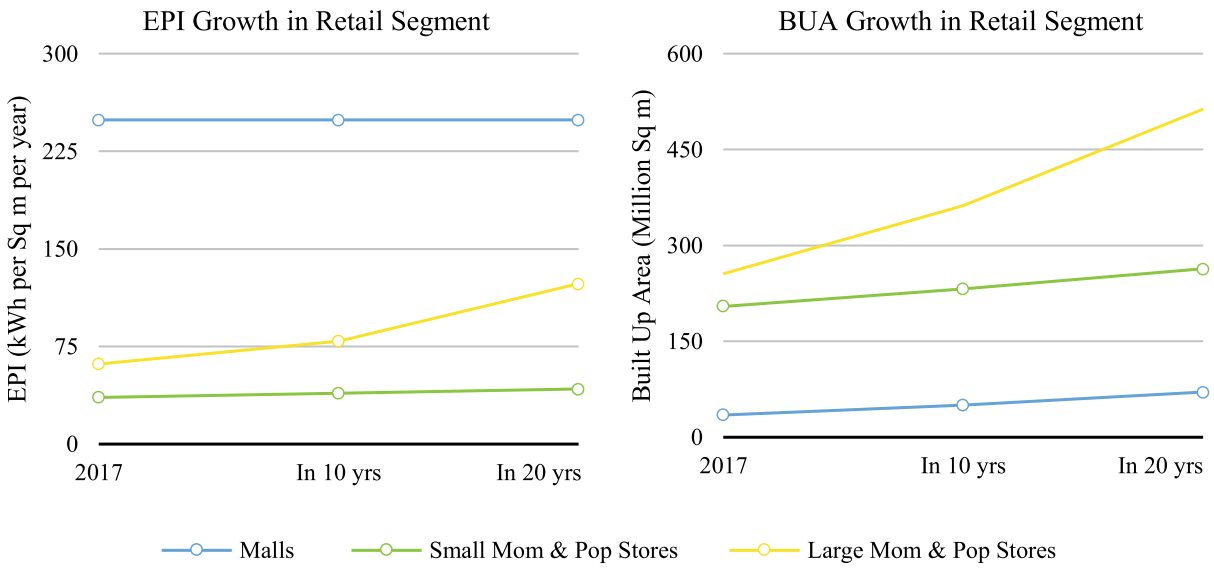
Segment: Retail

1. Tabular summary of results

Categories	Number (A)	Built Up Area (BUA) per building (Sq m) (B)	BUA (Million Sq m)	EPI (kWh per Sq m per year) (C)	EC per Category (In Billion Units)	Energy Saving Potential	Savings (BU)
Modern - Malls	700 - 750	48697	34 - 37	220 - 275	7.5 - 10	20 - 30 %	1.75 - 2.63
Traditional - Small Mom and Pop 'Kirana' Stores	11.5 - 13.4 Million	14 -18	160 - 250	33 - 38.5	5.3 - 9.6	15 - 20 %	1.11 - 1.50
Traditional - Large Mom and Pop 'Kirana' Stores	0.48 - 0.56 Million	42 - 55	20 - 31	55 - 66	1.1 - 2.06	15 - 20 %	2.37 - 3.20
Total			215 - 317 Million Sq m		14 - 21 Billion Units		3.1 - 4.4 Billion Units

2. Projections for EPI and Built Up Area (BUA)

Segment	CAGR	Current (2017)	In 10 years	In 20 years
Malls	EPI 0%	248. 45	248. 45	248. 45
	BUA 3 - 4%	35	50	70
Small Mom and Pop 'Kirana' Stores	EPI 0.5 - 1%	36	39	42
	BUA 1 - 1.5%	205	232	263
Large Mom and Pop 'Kirana' Stores	EPI 2 - 3%	61.7	79	123
	BUA 3 - 4%	256	362	513
EPI in kWh per Sq m per year and BUA in Million Sq m. Share of large mom and pop stores will see growth due to the emergence of established retail groups in this segment. Increased cooling requirement will surge the EPI of large stores in the coming years. Growth of small Kirana stores will continue in rural areas due to consumerism and their potential as a source of employment and livelihood. In malls, increase in energy consumption will be offset by EE gains.				



3. Source and Assumptions

A. Estimate of total number of malls[38] was sourced from Malls of India Sixth Edition 2013 - 2016 published by Images Research, a retail research group. Estimates on number of traditional mom and pop stores, also known as Kirana stores, were obtained from multiple[39] retail articles and forums[40] that included cases of large retailers such as Future Group and Reliance venturing into this category. Kirana stores include segments such as grocery, apparel and footwear, small restaurants, book stores and others. Kirana stores account for 95% of the market share in retail business[41]. There are about 10 Kirana stores per 1000 persons in India, 12 to 14 Million[42]. Only 4% of these are large in size about 500 Sq. ft., 96% are of smaller size[43]. In this exercise, small stores have been assumed to be a third of the size of large stores.

B. For malls[44], built up area per mall was obtained from industry research reports. For Kirana stores[45], multiple sources were used along with field survey for validating estimates for small and large Kirana stores. This equates to about 2 Sq. ft. per person of retail space in India[46].

C. EPI for malls was estimated through in-house energy audit reports and building survey data on malls and shopping centres. ECO III and BEEP[47] estimates for EPI of malls were also used.

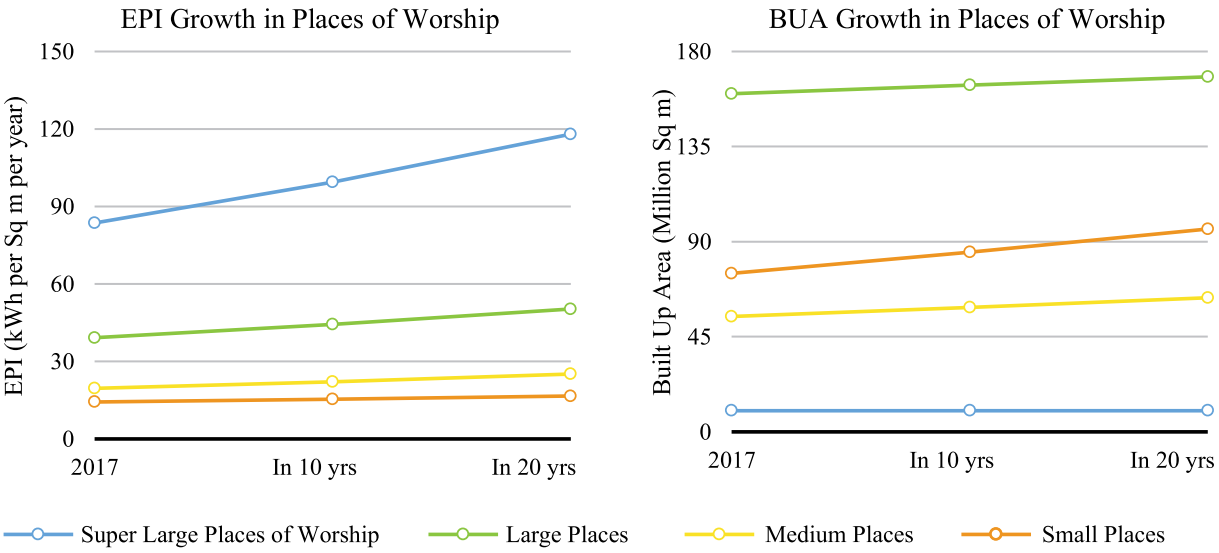
Segment: Places of Worship

1. Tabular Summary of Results

Categories	Number of Units (A)	BUA per Unit (Sq m) (B)	BUA per category (Million Sq m)	EPI (kWh per Sq m per year) (C)	EC per Category (In Billion Units)	Energy Saving Potential (D)	Savings (BU)
Super Large Places of Worship	800 - 1000	10000 - 12000	8 -12	77 - 88	0.62 - 1.05	30 - 40 %	0.25 - 0.33
Large Places of Worship	140000 - 150000	1000 - 1200	140 - 180	33 - 44	4.62 - 7.92	20 - 30%	1.25 - 1.88
Medium Sized Places of Worship	600000 - 612000	80 - 100	48 - 61	16.5 - 22	0.792 - 1.34	20 - 25%	0.214 - 0.27
Small Places of Worship	2000000 - 2250000	40 - 50	80 - 112	11 - 16.5	0.66 - 1.48	20 - 25%	0.215 - 0.27
Total			276 - 365 Million Sq m		6.28 - 11.07 Billion Units		1.93 - 2.75

2. Projections for EPI and Built Up Area (BUA)

Segment	CAGR	Current (2017)	In 10 years	In 20 years
Super Large Places of Worship	EPI 1.5 - 2%	83.6	99.46	118
	BUA 0%	10	10	10
Large Places of Worship	EPI 1 - 1.5 %	39.19	44.38	50.30
	BUA 0 - 0.5 %	160	164	168
Medium Sized Places of Worship	EPI 1 - 1.5 %	19.58	22.18	25.13
	BUA 0.5 - 1 %	54.6	58.8	63.47
Small Places of Worship	EPI 0.5 - 1 %	14.30	15.41	16.62
	BUA 1 - 1.5 %	75	85	96
EPI in kWh per Sq m per year and BUA in Million Sq m. Energy consumption in super large places of worship will increase but it will be offset by EE interventions. There will be a growth in energy consumption in large and medium sized places of worship due to increased cooling requirements and appliance usage. Total BUA for Small and Medium places of worship will continue to grow with residential built up area.				



3. Sources and Assumptions

A. As per 2011 Census[48], there are a total of 30,13,315 Places of Worship in India. These include all sects. Based on multiple tourism reports and ministry of tourism websites, it was assumed that on average there are about 30 - 40 Super Large Places of Worship per state in India. These places are valuable for pilgrimage, tourism and as archeological icons of the country. Large Places of Worship are predominantly in urban regions and were assumed to account for approximately 5% of the segment. These are landmark places of worship in cities and include retail, office spaces and housing facilities. Medium and Small Places of Worship are mostly situated within residential areas and were assumed to account for 20 and 75% of the segment respectively. Medium ones include housing for priests as well as community gathering facilities. The assumptions were validated through case studies[49], reports[50] and information gathered through survey of places of worship.

B. Multiple sources such as archetypes, energy related news articles[51], official websites[52] [53] of places of worship were used for informing the estimates on built up area per unit.

C. For super large places of worship, energy reports and presentations[54] by state governments focusing on places of worship were used for estimating EPI. For Large category, reports[55] on energy efficiency projects have been used to estimate EPI. For medium sized places, building survey and interview with building occupants have been used to inform assumptions. EPI for Small Places is assumed to be 75% of medium ones.

3.4 Sector 2: Agriculture

Segment: Energy Efficient Water Pumping

Agriculture sector accounts for nearly 18%[56] of national electricity consumption. Agriculture sector hinges on adequate electricity supply and water pumping for successful crop irrigation. About 14%[57] of India's GDP and nearly half of the population relies on it for livelihood. In near to medium term, the demand for electricity and extraction of ground water sources for irrigation will surge due to rising demand for food for a growing population. Hence, Energy Efficient Pump Sets (EEPS) were identified as the key sector where ESCO investment can bring significant reduction in energy consumption from water pumping.

Currently about 20.27 million agricultural pump sets exist in India. About 0.5 million[58] new pump sets are installed annually in India. Pumping not only helps in extracting water for irrigation but also to regulate the water flow.

Methodology

The size of energy savings and investment potential from installation of energy efficiency pump sets (EEPS) was estimated with the help of data obtained through interviews and workshops targeting agriculture pumping, and case studies and benchmarking studies done by Bureau of Energy Efficiency (BEE) and Energy Efficiency Services Limited (EESL). The overall segment size was calculated with the help of electricity consumption and saving potential per 5HP pump set.

Results

It is important to recognise that because of subsidies, state government pays INR 1.15 where as DISCOMs pay INR 3.5 for purchasing one unit of electricity. Because of this difference, marginal increase in electricity consumption levies heavier costs on the balance sheet of DISCOMs than on State government.

Table 3.7: Energy Saving Potential in Agriculture Pumping

Total Energy Consumption in Agriculture Sector (GWh)	168913
Total Number of Pump Sets in India	20270000
Annual Electricity Consumption per Pump Set (kWh)	7980
Total Electricity Consumption from Pump Sets (BU per year)	161
Total Energy Saving Potential	25 to 37%
Total Savings from EEPS (BU per year)	40 - 60
Average Cost of Replacement per pump set	30000
Total Investment Needed (INR Crores)	60810
Total Annual Gains for DISCOMs and State Government at INR 3.5 per unit kWh (INR Crores)	14000 - 20000

3.5 Sector 3: Municipalities

Street Lighting and Water Pumping are two viable segments for ESCO business intervention and for reducing energy expenditure of municipalities, which account for nearly half of the total budget of municipalities.

Public Lighting: As per Central Electricity Authority's (CEA) General Review 2016[59] in 2014 - 15 public lighting consumed 0.92% of total electricity consumed in India. Based on the consumption in previous three years, this sector will grow at a CAGR of 4%.

Efficient lighting infrastructure can reduce the energy consumption by about 25 - 60%. Efficient lighting systems include LED lamps (16W to 240W) and lighting control management systems which will ensure same lighting output at reduced energy consumption. Based on estimates by Energy Efficiency Services Limited[60], about 50% savings can be achieved through retrofitting conventional lighting with EE street lighting. At a national level, this will result in an opportunity of annual saving worth 4300 - 5000 GWh of electricity with monetary savings worth INR 2500 Crores, assuming per unit cost of electricity is INR 5.

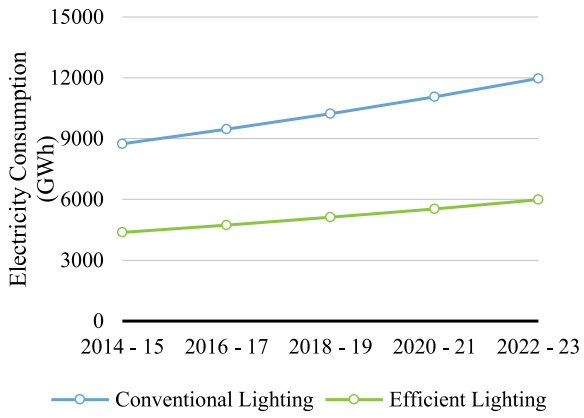


Figure 3.6: Growth in EC of Conventional and Efficient Lighting

Empirical evidence from detailed energy audits[61] by Bureau of Energy Efficiency (BEE) shows that there is an opportunity of saving 711 Million kWh annually aggregated across 269 Urban Local Bodies (ULBs) and Municipalities in India, which include 33.65 lac street lights in total. This will shave down consumption by 50% and result in monetary savings of INR 345 Crores. The total investment envisaged is INR 2500 Crores. As of July 5, 2017, Energy Efficiency Service Limited's Street Light National Programme[62] has replaced 2.63 lac streetlights that has resulted in savings of 370 Million kWh.

Public Waterworks: India's exponential urbanisation, shortage of water and electricity, exerts additional municipal energy expenditure to consistently pipe clean and affordable water to city dwellers. Less than 50% of urban population has access to piped water in India[63]. Eradicating this problem will need cost effective and efficient pumping - that prevents squandering electricity used in supplying water to dwellers.

Public water works and sewage pumping consume 1.99%[64] of total electricity consumed in India, about 18837 GWh in 2015. There is a potential for at least 20%[65] savings from no to low cost municipal water pumping[66], resulting in 3700 GWh of annual savings annually.

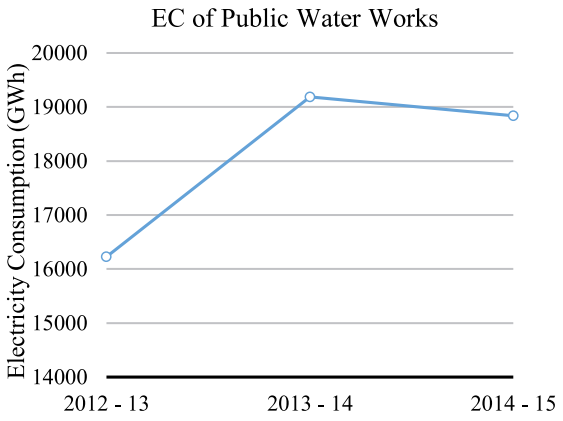


Figure 3.7: Growth in EC in public water works

3.6 Sector 4: Industries

3.6.1 Methodology

The choice of segments for the market sizing analysis was made based on their share in the overall industrial energy consumption. The most energy-intensive industrial segments which contribute to about 80% of the overall industrial energy consumption have been analysed individually; those

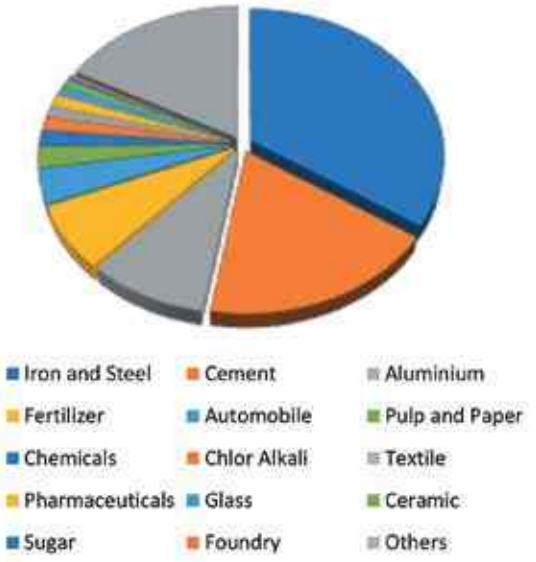


Figure 3.8: Energy consumption distribution in the industries sector by segment

contributing to the remaining 20% have been grouped under the 'others' category and addressed together (Figure 3.8).

The Perform-Achieve-Trade (PAT) scheme was initiated by the Bureau of Energy Efficiency (BEE) as a market-based mechanism for energy efficiency. Currently, the PAT scheme is in its second cycle and covers highly energy intensive industrial segments – cement, iron and steel, fertilizer, chlor alkali, aluminium, pulp and paper, textiles, thermal power, refineries and railways. 621 industrial units within these segments have been labelled 'Designated Consumers' (DC) and are required to engage the services of energy auditors to carry out energy consumption baselining, post which they are given targets for energy consumption reduction by BEE. These industrial units are required to implement energy efficiency projects and carry out M&V of the same at the end of 3 years, the cycle duration, to evaluate the energy savings achievements vis-à-vis the set targets. A DC that exceeds its target is eligible for availing Energy Saving Certificates (ESC), which it can then sell to other DCs which haven't been successful in achieving their set targets.

For this study, the thermal power segment has not been included as it does not fall under the category of manufacturing industry. Refineries and railways also haven't been covered as there is already a significant penetration of energy efficient technologies in them - these segments have a relatively higher scope for energy efficiency through process-specific measures rather than cross cutting measures.

It can be seen from Figure 3.9 that the iron and steel segment has the highest energy consumption (in percentage terms) followed by cement and aluminium. As can be seen in Figure 3.10, most of the PAT segments have a predominance of thermal energy consumption as compared to electrical energy consumption, barring aluminium and chlor Alkali.

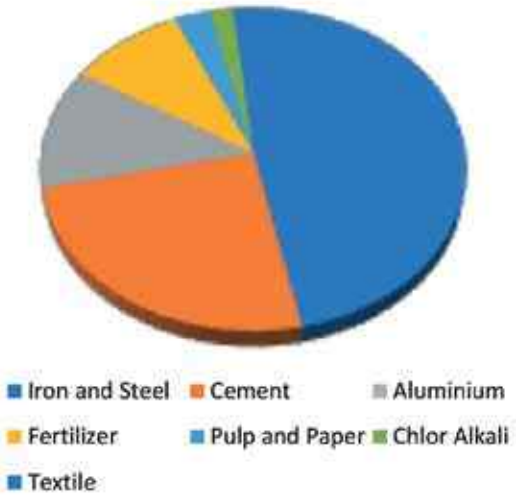


Figure 3.9: Energy consumption distribution in the industries covered by the PAT scheme

For this study, the estimates of market sizes have been prepared for 2 timelines – near to mid-term (from first year of PAT-2 to end of PAT-2 cycle) and long term (from end of PAT-2 cycle to 3 years post PAT-2 cycle). It has been assumed that the PAT scheme is not continued after cycle 2 and investments into energy efficiency would happen as part of regular economic decision-making in the industries. If the third cycle of PAT is implemented with moderate to stiff targets for energy efficiency, as is likely, then the estimates for the long-term may go up to that extent. However, it should be noted that some of the current cross cutting interventions would start nearing saturation (for instance, LED lighting) and industries and ESCOs would need to tap into other solutions to meet the new targets.

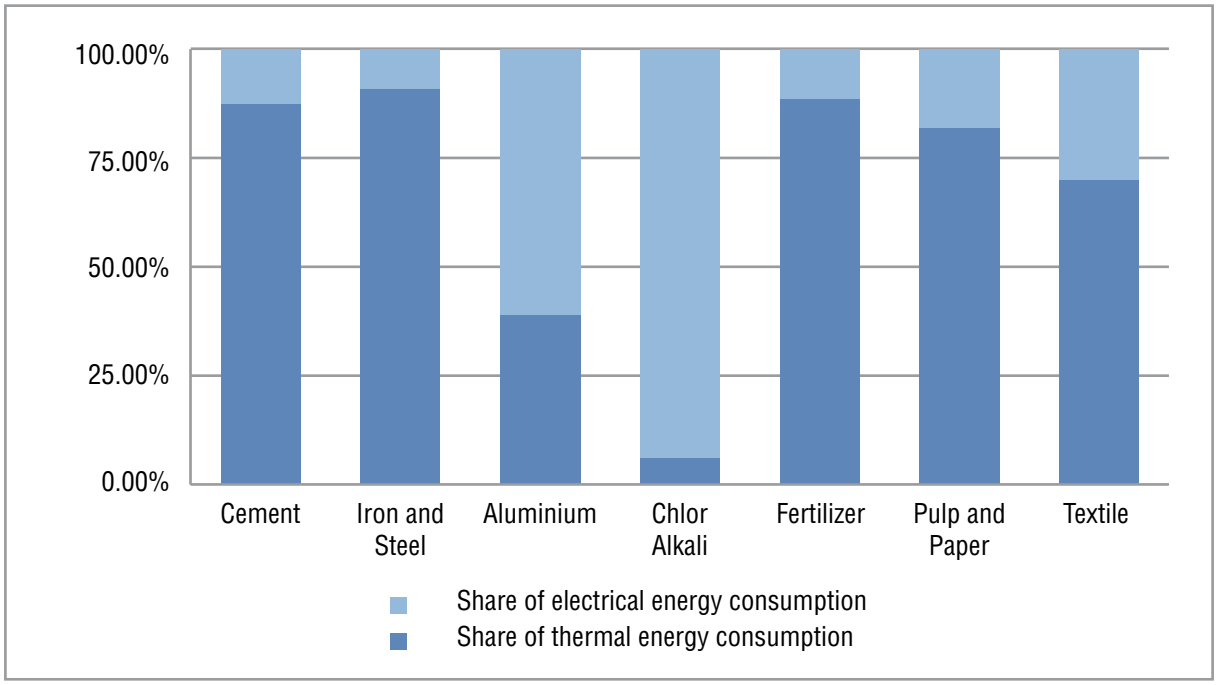


Figure 3.10: Share of thermal and electrical energy consumption for different PAT segments

3.6.2 Industry Segments in PAT Scheme

The industrial energy efficiency market potential for PAT segments (considering cycle 1 segments excluding thermal power segment) is estimated to be approximately INR 30,000 crores. The outputs of the market sizing framework for PAT segments are presented in Table 3.8 - 3.10.

The estimates provided in Table 3.8 were compared as a percentage of gross fixed assets for that segment, obtained through the Annual Survey of Industries (ASI) 2013-14. For segments such as aluminium, fertilizer and cement, the investment outlays were significant (>5% of gross fixed assets) and hence, there is some uncertainty on whether these investments would get made by the industry or whether support in terms of financing/incentive schemes may be required.

As can be seen in Table 3.9, most segments would end up achieving PAT 2 targets with the envisaged investments except for iron and steel and textiles. In the iron and steel segment, the achievements are estimated to fall short of the PAT 2 target by a substantial margin. In our estimation and expert considerations, it was perceived that prevailing cross cutting technologies have a limit to the energy savings achievable and there is a need for technology suppliers to evolve additional process-specific interventions.

In the textile segment, the focus has largely been on cross cutting technologies even in the first cycle of the PAT scheme. Given that the scope of meeting the target taking such measures is limited, it may be inferred that there is a need to explore and invest more in process-specific technologies.

Given the complexity associated with estimation of investment potential for process-specific measures, for this study, a few process specific measures were selected based on expert interviews and the combined potential for such technologies has been taken as the aggregate potential for process specific measures. As can be seen from Table 3.10, investments in process-specific technologies are high for aluminium and cement segments. It is quite likely that industry players would be able to optimise these investments by efficient sourcing or by finding relatively less expensive alternatives.

Table 3.8: Estimated investment potential in PAT 2 and post PAT 2 (for PAT segments)

Segment	Investment potential in PAT 2 (near plus mid-term) (crore INR)	Post PAT 2 (long term) (crore INR)	Total (crore INR)
Cement	6960	3108	10068
Aluminium	6924	2973	9898
Iron and Steel	4000	1505	5505
Fertilizer	1116	1016	2132
Pulp and Paper	967	535	1502
Textile	747	465	1211
Chlor Alkali	273	152	425
Total	20890	9719	30609

Table 3.9: Estimated achievement on PAT 2 targets

Segment	Estimated achievement on PAT 2 targets by end of cycle	Overachievement of PAT 1 targets (based on BEE figures) (as a comparative)
Pulp and Paper	134%	211%
Cement	111%	206%
Chlor Alkali	121%	204%
Fertilizer	134%	184%
Iron and Steel	32%	150%
Textile	70%	124%
Aluminium	96%	160%

Table 3.10: Estimated investments on cross cutting and process-specific technologies

Segment	Estimated investment on Cross cutting technologies (crore INR)		Estimated investment on Process specific technologies (crore INR)		
	Near plus medium term	Long term	Near plus medium term	Long term	Total
Pulp and Paper	825	464	142	71	1502
Cement	3716	1606	3244	1502	10068
Chlor Alkali	195	126	78	26	425
Fertilizer	908	815	208	201	2132
Iron and Steel	2639	1020	1361	485	5505
Textile	676	403	71	61	1211
Aluminium	629	615	6295	2358	9898
Total	9588	5050	11398	4704	30740

Key results:

- 1.46 MTOE of energy savings is estimated to come from cross cutting technologies in the second cycle of PAT.
- The investment potential for cross cutting technologies is estimated at INR9588 crores and the investment potential for process-specific technologies is estimated at INR11,398 crores in the near + medium term.
- Out of all cross-cutting technologies, WHR systems for steam/power generation is estimated to see the maximum investment in the near + medium and long terms. WHR systems are estimated to have the highest energy saving potential in the second cycle of PAT. It may be noted that per expert consultations, high-grade WHR is more complicated than other interventions – earlier implementations have struggled to deal with issues like particulate matter in flue gases due to a variety of fuel mix being used by industry or the high ash content of coal. This may influence both the adoption rates and the success of implementation.
- The investment potential for cross cutting technologies is estimated to be INR 5,050 crores in the long term.
- The investment potential for process specific technologies is estimated to be INR 4704 crores in the long term.
- Iron and steel, cement and fertilizer segments hold the maximum share of the investment potential for VFDs in PAT-2 cycle. Overall investments in VFDs is estimated to be INR 1381 crores in near + medium term and INR 703 crores in the long term. The energy saving potential for VFDs in PAT-2 is estimated to be 0.19 MTOE (cumulative).
- Fertilizer, paper and pulp and cement segments hold the maximum share of the investment potential in energy efficient process Boilers in the PAT-2 cycle. Overall investment in process boilers is estimated to be INR 830 crores in near + medium term and INR 667 crores in the long term. The energy saving potential for process boilers in the PAT-2 cycle is estimated to be 0.35 MTOE (cumulative).
- Cement and iron and steel segments hold the maximum share of the investment potential in waste heat recovery systems in the PAT-2 cycle. Overall investment in WHR systems is estimated to be INR 4887 crores in near + medium term and INR 2005 Crores in the long term. Energy saving potential for WHR in the PAT-2 cycle is estimated to be 0.40 MTOE (cumulative).
- Fertilizer and pulp and paper segments hold the maximum share of the investment potential in economizer/air preheater retrofits in the PAT-2 cycle. Overall investment in economizer/air preheater retrofits is estimated to be INR 97 Crores in near + medium term and INR 72 Crores in the long term. Energy saving potential for economizer/ air preheater retrofits in the PAT-2 cycle is estimated to be 0.15 MTOE (cumulative).
- Iron and steel segment holds the maximum share of the investment potential in energy efficient lighting systems in the PAT-2 cycle. Overall investment in energy efficient lighting is estimated as INR 308 crores in near+ medium term and INR 179 Crores in the long term. Energy saving potential for EE lighting in the PAT-2 cycle is estimated as 0.06 MTOE (cumulative).
- Iron and Steel segment holds maximum share of investment potential in Energy efficient pumps in the PAT 2 cycle. Overall investment in Energy efficient pumps estimated as INR 1131 Crores in near + medium term and INR 780 Crores in the long term. Energy saving potential for EE pumps in PAT-2 estimated at 0.18 MTOE (cumulative).
- Cement segment holds maximum share of investment potential in Energy efficient compressors in the PAT 2 cycle. Overall investment in Energy efficient compressors estimated as INR 102 Crores in near + medium term and INR 66 Crores in the long term. Energy saving potential for EE compressors in PAT-2 estimated at 0.01 MTOE (cumulative).
- Iron and Steel segment holds maximum share of investment potential in Energy efficient motors in the PAT 2 cycle. Overall investment in Energy efficient motors estimated as INR 391 Crores in near + medium

term and INR 254 Crores in the long term. Energy saving potential for EE motors in PAT-2 estimated at 0.06 MTOE (cumulative).

- Textile and Pulp and Paper segments hold maximum share of investment potential in Solar Water heating in the PAT 2 cycle. Overall investment in Solar Water heating systems estimated as INR 38 Crores in near + medium term and INR 32 Crores in the long term. Energy saving potential for Solar water heating systems in PAT-2 estimated at 0.01 MTOE (cumulative). Textile segment holds maximum share of investment potential in HVAC in the PAT 2 cycle. Overall investment in HVAC estimated as INR 24 Crores in near + medium term and INR 20 Crores in the long term.

3.6.3 Industry Segments in Non PAT Scheme

The non-PAT industrial segments chosen for this study represent a mix of large and small industries (which include SMEs as well). It can be seen in Figure 3.11 that the automobile segment has the maximum energy consumption among the non-PAT segments followed by chemicals and pharmaceuticals.

Remaining industries which have not been addressed individually have been grouped under the 'Others' category.

Figure 3.12 shows that while segments such as glass and ceramic have a major share of thermal energy consumption, segments such as automobile have a high share of electrical energy consumption.

In most of the non-PAT segments barring ceramics, the investment potential as a percentage of gross fixed assets was less than 1%. In the absence of a mandate, significant investments in energy efficiency are not expected to be made in these segments.

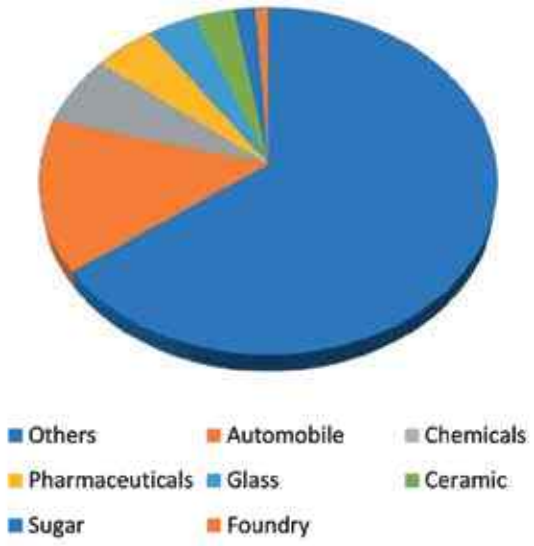


Figure 3.11: Share of energy consumption in non-PAT segments

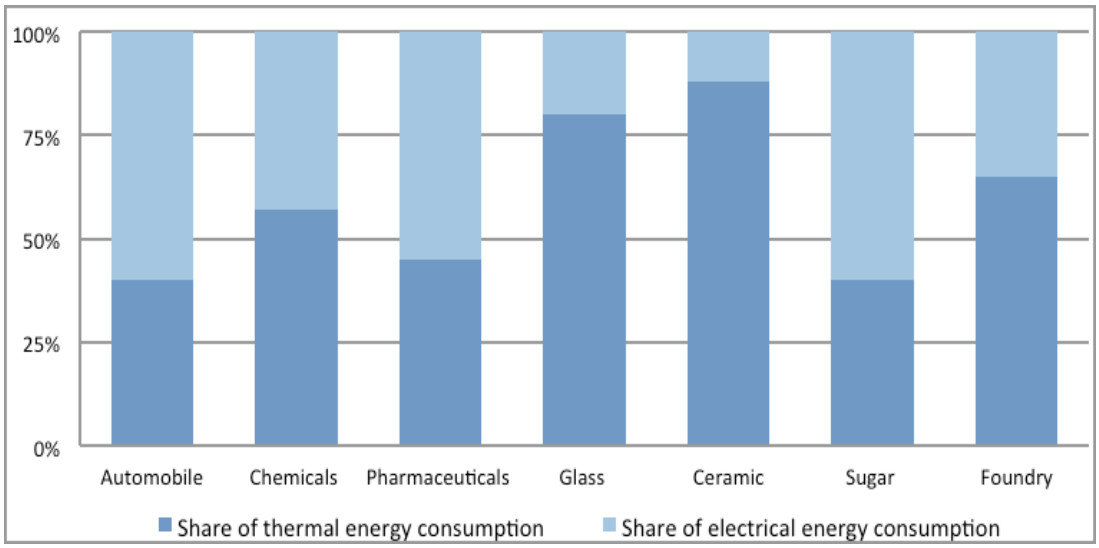


Figure 3.12: Share of electrical and thermal energy use in non-PAT segments

Table 3.11: Investment potential in cross cutting technologies

Segment	Investment potential in PAT 2 (near plus mid-term) – Crores INR	Post PAT 2 (long term)	Total
Pharmaceuticals	221	221	442
Automobile	453	453	906
Glass	56	56	112
Ceramic	47	42	89
Sugar	111	76	186
Foundry	103	103	206
Chemicals	321	321	642
Others	589	589	1178
Total	1901	1861	3762

Key results:

- Energy efficient pumps are estimated to be among the technologies with highest energy saving potential in the 2nd cycle of PAT. 0.30 MTOE (cumulative) of energy savings estimated to come from cross cutting technologies in the 2nd cycle of PAT.
- Energy efficient pumps followed by VFDs are estimated to see the maximum investment in the near, medium and long term out of the cross-cutting technologies. Near + Medium term investment potential for cross cutting technologies estimated at INR 1902 Crores.
- Long term investment potential for cross cutting technologies estimated at INR 1862 Crores.
- Investment potential for Process Boilers found to exist among non-PAT industries only in Sugar segment. Potential estimated at 96 Cr in near + medium term and 61 Cr in long term
- Waste heat recovery for Steam/Power found to have potential only in foundry estimated at 56 Cr in near + medium term and 56 Cr in long term.
- Apart from other industries, automobile segment holds maximum share of investment potential in VFDs in the PAT 2 cycle. Overall investment in VFDs estimated as INR 420 Crores in near + medium term and INR 417 Crores in the long term. Energy saving potential for VFDs in PAT-2 estimated at 0.06 MTOE (cumulative)
- Apart from other industries, automobile segment holds maximum share of investment potential in Energy efficient lighting systems in the PAT 2 cycle. Overall investment in Energy efficient lighting estimated as INR 211 Crores in near+ medium term and INR 211 Crores in the long term. Energy saving potential for EE lighting in PAT-2 estimated at 0.04 MTOE (cumulative).
- Chemicals segment holds maximum share of investment potential in Energy efficient pumps in the PAT 2 cycle. Overall investment in Energy efficient pumps estimated as INR 437 Crores in near + medium term and INR 437 Crores in the long term. Energy saving potential for EE pumps in PAT-2 estimated at 0.07 MTOE (cumulative).
- Automobile segment holds maximum share of investment potential in Energy efficient compressors in the PAT 2 cycle. Overall investment in Energy efficient compressors estimated as INR 126 Crores in near + medium term and INR 124 Crores in the long term. Energy saving potential for EE compressors in PAT-2 estimated at 0.02 MTOE (cumulative).
- Apart from other industrial segments, automobile segment holds maximum share of investment potential in Energy efficient motors in the PAT 2 cycle. Overall investment in Energy efficient motors estimated as INR 274 Crores in near + medium term and INR 274 Crores in the long term. Energy saving potential for EE motors in PAT-2 estimated at 0.04 MTOE (cumulative).
- Automobile segment holds the maximum investment potential in the PAT 2 cycle for Solar Water heating systems. Investment potential estimated at 167 Crore in near + medium term and 17 Crore in long term. Energy saving potential for Solar Water heating in PAT-2 estimated at 0.002 MTOE (cumulative).
- Automobile segment holds maximum share of investment potential in HVAC in the PAT 2 cycle. Overall investment in HVAC estimated as INR 196 Crores in near + medium term and INR 196 Crores in the long-term Energy saving potential for HVAC in PAT-2 estimated at 0.02 MTOE (cumulative).

CHAPTER-4

Standardisation of EE solutions to achieve scale[67]

Standardisation has been cited as one of the most important requirements for ESCO market expansion, particularly when it comes to financing. Standardisation has shown to reduce transaction costs for the financier, and the ESCO market in China and Europe are good examples of this philosophy. Standardisation refers to creating technology-specific frameworks and templates for audit approach, contracts, project execution and M&V.

This section is based on discussions with ESCOs, Technology providers and End users along with an evaluation of the overall market potential, to achieve scale of EE solutions in a 3-5 year timeframe.

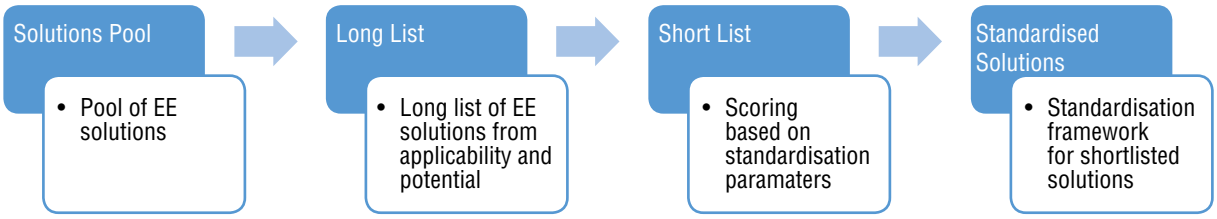
4.1 Long list of solutions from EE Pool for standardisation

Large Industries

- **Waste Heat Recovery –** Reuse of wasted heat in one process in some other process, including setting up of a captive power plant from the wasted heat.
- **MV Drives for Pumps & Fans –** Use of Variable Frequency Drives (VFD) for MV range (600 V+) in Pumps and Fans applications for speed control and automation.
- **Boilers Optimization –** Improving combus- tion efficiency, Flue gas recirculation, improving steam distribution, eliminating leaks and losses, replacement with efficient boilers, implementing better boiler controls[1].
- **Combined Heat and Power –** Use of a heat engine or a power station to generate electricity and useful heating / cooling at the same time by capturing excess heat from the process.
- **Pumps & Fans Optimization –** Optimizing the pump selection, installation of adjustable speed drivers, improving instrumentation, retrofitting the inefficient parts and replacement with energy efficient pumps and fans.

MSMEs

- **Compressed Air Optimization –** Identification of the right pressure requirement for the use, fixing leaks in the system, elimination of inappropriate uses of compressed air, segregation of high and low-pressure requirements, installing the right compressor technology and improved system control for compressed air[2].
- **Power Optimization –** Power optimization through power factor improvement, demand controllers and installation of capacitors.



- **Heat Pumps –** Use of heat pump technologies to reduce heating and cooling requirements by combining the systems.
- **Drive Controls for Pumps, Fans and Compressed Air System –** Use of LV variable frequency drives (VFD) for speed control and automation of pumps, fans and compressed air systems.
- **Chilled Water Optimization –** Evaluating the use of chilled water, optimizing control sequences, optimizing the distribution, selection of appropriate cooling tower / chiller, optimizing the piping[3].

Buildings

- **Lighting Optimization –** Timer and occupancy control for lighting, zonal lighting optimization, installation of lighting energy savers and replacement with energy efficient lighting systems
- **HVAC Optimization –** Implementation of control sequences, identification of right compressor technology, optimizing equipment operations, identification of right temperature set points4
- **Enthalpy Control System –** Effective use of environmental conditions to lower heating or cooling requirements for energy efficiency in a building
- **Building Management System –** Use of a building automation system for monitoring and control of mechanical and electrical equipment

Municipalities

- **Street Lighting –** Timing control of street lights, replacement with energy efficient lights and evaluation of alternate sources of power
- **Pumping –** Improving pump efficiency, implementing right pumping controls, eliminating leakages and losses, replacing with efficient pumps

The above solutions are mapped to the different market verticals along with indicative savings percentage on the solution and typical project size for the implementation of the solution.

4.2 Shortlisting For Standardisation

The above solutions were analysed on eight parameters for standardisation shortlist – on the ability of the solution to be standardised, and on the qualification of the solution for standardisation.

The four parameters for the ability of the solution to be standardised are as follows. The idea here is to see if the parameters can be achieved within 20% deviation by ESCOs once the standardisation templates are created.

1. **Standardisation of audits –** whether the audit approach, methodology, measurement techniques and savings estimation can be standardised
2. **Standardisation of solution –** whether the solution design, BoM, procurement and commercials can be standardised
3. **Standardisation of project execution –** whether the contract can be standardised, project can be executed in a standardised way with respect to construction, set up, installation, commissioning, down time
4. **Standardisation of M&V –** whether the measurement techniques, protocols, adjustments and M&V reports can be standardised

The four parameters to calculate the merit of picking of the solution are as follows.

5. **Market size –** size of the market available for the solution across market verticals (available market already takes into consideration an acceptable financial payback, hence cost of the solution or typical savings percentage are not considered separately in the scoring framework)
6. **Execution risk –** risk associated in terms of being able to execute the project to achieve the estimated savings, for installation and commissioning, post-installation maintenance and M&V

Table 4.1: Evaluation of solutions picked for standardisation

S No	Segments	Solutions	Typical Market Verticals	Typical Savings %	Typical Proj. Size (INR)
1	Large Industries	Waste Heat recovery	Cement, Metals, Chemicals, Fertilizers, Chlor Alkali	10 to 20	2 cr - 100 cr
2		MV Drives for Pumps & Fans	Power Plants, Cement, Metals, Chemicals, Fertilizers	20 to 30	1 cr - 10 cr
3		Boilers Optimization	Power Plants, Chemicals, Fertilizers, Paper	10 to 20	5 cr - 20 cr
4		Combined Heat & Power	Petrochemicals, Chemicals, Fertilizers	10 to 25	2 cr - 100 cr
5		Pumps & Fans Optimization	Power Plants, Cement, Metals, Chemicals, Fertilizers, Chlor Alkali, Paper, Petrochemicals, Auto, F&B, Pharma	20 to 30	1 cr - 15 cr
6	MSMEs	Compressed Air Optimization	Most	10 to 25	5 L - 25 L
7		Power Optimization	All	1 to 3	2 L - 10 L
8		Heat Pumps	F&B, FMCG	10 to 20	10 L - 50 L
9		Drive controls for Pumps, Fans & Comp Air	All	20 to 30	1 L - 10 L
10		Chilled Water Optimization	Most	10 to 20	1 L - 50 L
11	Buildings	Lighting Optimization	All	5 to 20	1 L - 10 L
12		HVAC Optimization	All	10 to 20	2 L - 20 L
13		Enthalpy Control System	All	10 to 20	15 L - 50 L
14		Building Management System	All	10 to 30	20 L - 1 cr
15	Municipalities	Street Lighting	All	20 to 40	-
16		Pumping	All	20 to 30	-

7. **ESCO capability –** ability of ESCOs to execute the solution from audits and solution making to project execution and M&V

8. **OEM availability –** presence of technology OEMs to provide the BoM required for the project execution

Table 4.2: Scoring comparison for shortlisted solutions

S No	Segments	Solutions	Std of Audits	Std of Soln	Std of Exec	Std of M&V	Mkt Size	Exec Risk	ESCO Capab	OEM Avail	Score	Shortlist
1	Large Industries	Waste Heat recovery	5	4	4	4	5	4	4	4	34	31-35
2		MV Drives for Pumps & Fans	5	5	5	4	5	4	2	3	33	31-35
3		Boilers Optimization	5	4	3	3	3	3	2	3	26	<= 30
4		Combined Heat & Power	3	3	3	3	2	3	3	2	22	<= 30
5		Pumps & Fans Optimization	5	5	5	4	5	4	5	5	38	36-40
6	MSMEs	Compressed Air Optimization	3	3	4	3	5	4	4	4	30	<= 30
7		Power Optimization	5	5	5	5	4	5	5	5	39	36-40
8		Heat Pumps	4	3	3	4	3	4	3	3	27	<= 30
9		Drive controls for Pumps, Fans & Comp Air	5	5	5	4	5	4	5	5	38	36-40
10		Chilled Water Optimization	3	4	5	3	4	4	5	5	33	31-35
11	Buildings	Lighting Optimization	5	5	5	5	4	5	5	5	39	36-40
12		HVAC Optimization	5	4	4	4	5	4	5	5	36	36-40
13		Enthalpy Control System	5	4	5	4	3	4	4	5	34	31-35
14		Building Management System	4	5	4	4	5	5	5	5	37	36-40
15	Municipalities	Street Lighting	5	5	5	4	5	5	5	5	39	36-40
16		Pumping	4	5	5	4	5	4	5	4	36	36-40

Key

- **Scores –** Score for the particular parameter out of 5
- **GREEN –** Shortlisted, currently being addressed in the market in a large scale
- **YELLOW –** Shortlisted, not addressed currently in a large scale, but has the merits to be addressed
- **RED –** Not shortlisted for standardisation in this iteration

Based on the above scoring criteria, the solutions picked for standardisation are:

- **Large Industries**
  - Waste Heat Recovery
  - MV Drives for Pumps and Fans
  - Pumps & Fans optimization
- **MSMEs**
  - Power Optimization
  - Drive Controls for Pumps, Fans and Compressed Air System
  - Chilled Water Optimization
- **Buildings**
  - Lighting Optimization
  - HVAC Optimization
  - Building Management System
- **Municipalities**
  - Street Lighting
  - Pumping Optimization

4.3 Deep dive of solutions picked for standardisation

This section talks about the business opportunity of technology-specific standardisation solutions, analysing the capabilities needed by an ESCO to address a solution vs the capabilities available.

The solutions are mapped with the current availability of ESCOs in the Indian market and technology providers (OEMs). The criteria for listing ESCOs in the mapping are:

1. At least one project executed either in a guaranteed savings model or shared savings model for that group sector
2. Capability exists currently for executing the solution in an ESCO model
3. Company has roadmap to continue ESCO activities for the solution in the group sector

Table 4.3: Standardisation evaluation of select ECMs

ECM	Description of ECM and drivers	
Waste Heat recovery for Steam/ Electricity generation	- Offered as a Technology. It is used for reducing the specific steam consumption of steam turbine generators and improve the heat rate - Energy savings- Up to 40%, and payback period varies from 2 to 4 years based on customer load cycle and ability to handle particulate matters in flue gas - Stoppage time of 15 days is required - Low capital efficiency and higher technical complexity leads to low adoption rate - Widely prevalent globally but penetration in India has been limited - Vendor ESCOs with higher technical expertise such as Thermax willing to give guarantees **Drivers/Challenging aspects** - Getting management buy-in and implementing the project is difficult due to low capital efficiency and higher technical complexity but measurement aspect is manageable - Shared savings is the most commonly used ESCO model. Its choice is driven by Capital/ budget constraint and lack of willingness at customer end to take any risk on the solution	
Waste Heat recovery through economizers/air preheaters	- Offered as a Technology. It is used to extract the waste heat from flue gas to optimize the operation of the steam boilers - Energy savings is 6-8% for both economizer and air preheater retrofits, payback period <1 year. High capital efficiency means it can be prioritized over other solutions by industry - Stoppage time is slightly more than a day - Widely prevalent globally and nationally - Generally, not installed in ESCO model as the low ticket-size is not very attractive for the bigger Vendor ESCOs such as Thermax **Drivers/Challenging aspects** - Installed in the Capex sales model usually as this is a small ticket size intervention for vendor ESCOs - Getting management buy-in is relatively easier as compared to other WHR techniques. Savings are easily measurable - High capital efficiency means it can be prioritized over other solutions by industry	

	Sectors of relevance (based on market potential)	Capability of ESCOs - Needed - available	Vendor Mapping
	Among PAT sectors: Cement and Iron and Steel sectors **Among Non PAT sectors:** Foundry	**Capability needed** - Technical complexity of projects is high (high particulate matter in flue gas can result in poor performance), so a vendor ESCO with higher technical expertise would be better placed as compared to other ESCOs **Capability Available** - 4 of the surveyed ESCOs namely First ESCO, Bosch, Thermax and Forbes Marshall offer the technology. Very few vendors are operating as ESCOs - Most of the ESCOs implementing the ECM are larger vendor ESCOs - Vendors for the technology are available but mainly operate on capex sales model	- Thermax - Forbes Marshall - Bosch - First ESCO - Opel Energy Systems - Transparent Energy systems - Radhe Renewable Energy Dev. Pvt. Ltd - Nippon Steel & Sumikin Engineering Co. Ltd. - Kawasaki Heavy Industries, Ltd. - Veesons Energy Systems Private Ltd
	Among PAT sectors: Fertilizer and Pulp and paper	**Capability needed** - Low to Moderate level of technical expertise is required to implement project as it has low level of technical complexity. Can be implemented by equipment reseller as well manufacturer **Capability Available** - 1 surveyed ESCO namely- Thermax offers the technology but owing to minimum ticket size constraint for ESCO model projects, offers through	- Thermax - Opel Energy Systems Pvt. Ltd - Transparent Energy systems - Yajna Fuel Services

ECM	Description of ECM and drivers	
Low grade waste heat recovery from compressors and chillers	- Offered as a solution (measurement system is also a part of the offering) - Used to recover waste heat from Chillers and compressors - Moderate level of Energy Savings, Cost savings is 3 times the investment, payback period is 6-18 months. Capital efficiency moderate. - Stoppage time of the plant is 2-3 hrs only - Not very highly prevalent in Industries as it is limited to industries which have hot water requirement - It is able to deliver hot water more consistently than solar water heaters **Drivers/Challenging aspects** - Installed in the Capex sales model usually - Getting management buy-in is relatively difficult as this is a relatively new technology	
Process Boilers (New installations + Optimiza- tion)	- Offered as a technology in case of installation of new boiler and as a solution in case of boiler automation - The existing process boiler which uses conventional fuel is replaced by a new energy efficient process boiler. The older boiler is either decommissioned or used as a standby by the industrial client - Energy Savings of up to 15%, payback period is less than 3 years. Capital Efficiency is high - Stoppage time ranges from 5-10 days as these are new installations which just need to be taken online after making the input and output connections. - Applicable to all sectors with a reasonable process steam requirement **Drivers/Challenging aspects** - Installed in capex sales by Thermax and in Guaranteed savings mode by Forbes Marshall. Both are driven by client willingness to finance the projects on their books. Sectoral growth is also a driver for new installations but boiler automation kind of optimization requires a knowledgeable client - There are no specific issues with implementation and measurability, however getting management buy-in is difficult	

	Sectors of relevance (based on market potential)	Capability of ESCOs - Needed - available	Vendor Mapping
	Among PAT sectors: Cement, Iron and steel, Fertilizer, Textile **Among Non PAT sectors:** Chemicals, Pharmaceuticals and Sugar Food and beverages and dairy industry, which fall under the other industry category also have high potential	**Capability needed** - Limited technical expertise is required as it is easy to implement - The ESCO should target a client set in the non PAT industries with high potential which would make it easier to secure business opportunities. In the PAT sectors, industries may not focus as the opportunity for this ECM is relatively smaller as compared to other ECMs. - Can be implemented by equipment reseller as well manufacturer **Capability Available** - 2 surveyed ESCO namely- Promethean Energy and Aspiration offers the technology - ESCO found to be implementing is a small sized firm - The number of ESCOs as well as Vendors is both low	- Promethean Energy - Aspiration Energy - Energized solutions
	Among PAT sectors: Fertilizer, Paper and Pulp and Cement **Among Non PAT sectors:** Sugar	**Capability needed** - A high level of technical expertise is required as it is a high complexity project, but measurability and implementation are less concerning than WHR - ESCO should be willing to expand to multiple sectors in operation to capture the huge market opportunity - Can be implemented by equipment manufacturer much better than resellers due to understanding of technology **Capability Available** - 2 surveyed ESCOs namely- Thermax and Forbes Marshall offer the technology. - ESCOs implementing ECM are large sized firms. - Number of Vendors is high but that of ESCOs is low	- Thermax - Forbes Marshall - Industrial Boilers Limited - Patel Boiler Services - Utech Projects - Pvt. Ltd. - Aerotherm Systems Pvt. - Ltd - Cheema Boilers

ECM	Description of ECM and drivers	
Variable Frequency Drives	- Offered as a technology retrofit and also as a solution along with certain technologies such motors - Helps in improving the part load efficiency of motors - Energy savings can be 10% - 15% with a payback period of up to 1.5 years. Capital efficiency is moderate - Payback is highly dependent on client load cycles - Degree of prevalence of VFD in LV drives is fairly high in India but that in MV drives is low **Drivers/Challenging aspects** - Stoppage time is <1 day - Implementing the project and measurement of savings is difficult. Getting management buy-in for MV VFDs is also difficult due to technology having high complexity and - Deemed savings is commonly used in case there is a high variation in duty cycle at client end	
Energy Efficient Pumps	- Offered as a technology as well as a solution. When offered as a solution, this can involve installation of new motors, metering systems, change in piping or sub-component level retrofits - Is implemented as a replacement of old inefficient pump with newer more efficient pump suited to the operating point required for the application - Energy saving of up to 15%, payback period is 1-2 years for replacements. Capital efficiency is moderate - ESCOs such as Kirloskar are open to giving performance guarantees as well as warranties **Drivers/Challenging aspects** - Getting buy-in from the decision makers is difficult, however there are no concerns on measurability and implementation - Shared savings model is used by majority of the ESCOs	

	Sectors of relevance (based on market potential)	Capability of ESCOs - Needed - available	Vendor Mapping
	Among PAT sectors: Iron and Steel, Cement and Fertilizer **Among Non PAT sectors:** Automobile **Among Non Industry sectors:** Buildings Municipalities	**Capability needed** - A moderate level of technical expertise is required as the ECM has medium level of technical complexity for MV drives and low complexity for LV drives. Installation of MV drives leads to harmonic disturbances in the grid - ESCOs need to be able to identify motors on which the load cycle gives higher savings due to VFDs (longer duty cycle with high variability). - Can be implemented by equipment reseller as well manufacturer **Capability Available** - 4 surveyed ESCOs namely Yantra Harvest, First ESCO, Greetude Energy and Ethan Power offer the technology - ESCOs surveyed and implementing ECM are small companies - There are many vendors but number of ESCOs is low	- Danfoss - Siemens - ABB - Schneider Electric - Rockwell Automation - Hitachi - Tangent - Technologies - Vraj Electricals - Micro Systems - Yantra Harvest - First Esco - Greetude - Ethan Power
	Among PAT sectors: Iron and Steel **Among Non PAT sectors:** Chemicals **Among Non Industry sectors:** Buildings Municipalities	**Capability needed** - Low to medium level of technical expertise is required to meet the low to medium level of complexity - Market is huge, so the ESCOs should work across multiple sectors to capture market share - Can be implemented by equipment reseller as well manufacturer **Capability Available** - 5 surveyed ESCOs namely- Kirloskar, Greetude, See-tech, ENCON, Secure Meters offer the technology - Number of Vendors as well as ESCOs is reasonable - ESCOs implementing are a mix of small and large companies	- Grundfos - Kirloskar - Crompton Greaves - KSB - Sulzer - Shakti Pumps - GE

ECM	Description of ECM and drivers	
Energy Efficient Motors	- Offered as a technology as well as a solution along with other equipment such as pumps or fans or VFDs - Replacement of old inefficient motors with newer energy efficient motors leads to reduction in energy input required for the drive - Energy Savings of up to 15%, payback period 12-24 months. Capital efficiency is moderate - Stoppage time is minimal which could vary from 1 hr to 3 hrs. If a standby equipment is available, then no stoppage will be required - Energy efficient motors are globally prevalent but the latest class IE4 and IE5 motors are not as well prevalent in India **Drivers/Challenging aspects** - There are no concerns on measurability, implementation or getting buy-in from the decision makers - Shared savings model is used by majority of the ESCOs	
Energy Efficient Compressors	- Offered as a technology as well as a solution along with other equipment such as motors or metering systems - Replacement of old inefficient compressor with an energy efficient compressor leads to energy savings - Energy Savings of up to 20%, payback period of 12-18 months. Capital efficiency is moderate - Stoppage time for the plant is very minimal and may not be required at all in case of standby arrangement **Drivers/Challenging aspects** - There are no concerns on measurability, implementation or getting buy-in from the decision makers - Shared savings model is used by majority of the ESCOs	
Energy Efficient Lighting	- Offered as a technology as well as a solution along with other equipment such as building management systems - The ECM involves replacing the existing lighting with energy efficient LEDs which provide the desirable levels of lighting - Energy Savings is 40%, payback period is 6 months to 8 months. - Capital efficiency is moderate - Plant Stoppage is generally not required - Highly prevalent globally and in India Drivers/Challenging aspects - Getting management buy-in is also not very difficult as it is an established technology - Shared savings is the most common model for implementation	

	Sectors of relevance (based on market potential)	Capability of ESCOs - Needed - available	Vendor Mapping
	Among PAT sectors: Iron and Steel **Among Non PAT sectors:** Automobile	**Capability needed** - Low level of technical expertise is required - Can be easily implemented by Consultant ESCOs, Vendor ESCOs as well as General ESCOs - Can be implemented by equipment reseller as well manufacturer **Capability Available** - 1 surveyed ESCO- ENCON Energy management services offer the technology. - ESCOs implementing are small companies - Number of Vendors is high but that of ESCOs is low	- Shah Enterprises - The General - Electric Agency - Bharat Bijlee
	Among PAT sectors: Cement and Iron and Steel Among Non PAT sectors: Automobile	**Capability needed** - Low level of technical expertise is required but a high expertise with metering is helpful for optimization projects - Can be implemented by equipment reseller as well manufacturer **Capability Available** - 1 surveyed ESCO- ENCON Energy management services offers the technology. - Surveyed ESCO is a small company	- Atlas Copco - Parker Hannifin - Group/ Legris - ARS Engineering Pvt. Ltd - Shah Enterprises - Hitachi Industrial Equipment Systems Co. Ltd. - Pecma Air Systems Pvt. Ltd.

CHAPTER-5

Financing ESCO Projects

This chapter focuses on the financing interventions and products from financial institutions (FIs), for scaling up of energy efficiency projects. Frequently cited challenges of FIs for ESCO financing are: Lack of standardised templates for financing EE solutions, lack of credit worthiness of the ESCOs, relatively smaller per-project size of EE solutions, technical complexity of EE solutions that increases the transaction costs for project evaluation, and lack of insurance instruments for solution performance risk. However, with improved thrust at the policy and development levels, this scenario is changing and Financing Institutions are more open to consider financing ESCO projects in India.

5.1 Global Instruments for ESCO Financing

There are three broad categories of the EE financing instruments: Loan Instruments, Bond Instruments, and Maintenance Instruments. A comparison of traditional and emerging instruments for EE Financing is provided in Appendix.

Loan Instruments:

1. **Dedicated credit lines (Soft loans) -** Credit lines for EE measures extended to the end users with preferential terms. These are typically provided by Development Banks (national and international), further distributed through regional partner retail banks.

   Why Soft loans? Since EE projects positively impact climate change, development funds have historically supported lending for such projects and thus bringing down the financing cost, required for the nascent ESCO market.

2. **Real estate and Infrastructure funds -** Well established structures for investing in real estate and infrastructure, EE component is typically hidden in the investment.

   Why Infrastructure funds? Infrastructure funds typically come with a long term outlook and building in energy efficiency as part of the capital investment and clubbing it with the construction project deliverables provides a de-risking mechanism.

3. **Leasing -** Financing through rents (leases), typically suited for equipment based ECMs

   Why leasing? Removes out the services complications usually associated with EE projects. The financing risk and collateral modalities are covered within the boundaries of the equipment.

4. **Energy Efficiency Funds -** Designated vehicles for EE investments with a combination of private and public funding.

   Why Energy Efficiency Funds? EE funds are open to the market, managed by fund managers, operated as a regular fund portfolio.

5. **Risk Sharing Funds -** Mechanisms to enhance credit aspect of a financial instrument through shared risks typically backed up by a guarantee fund.

   Why risk sharing funds? Reduces the level of risk for financiers (e.g. performance risk).

Bond Instruments:

6. **Green Bonds -** These are fixed-income financial instrument for raising capital through the debt market for green projects (Around $50 bn bonds issued globally, $1 bn in India).

   Why Green Bonds? Green bonds have the price advantage over traditional financing instruments such as commercial lending and equity finance. They have the potential to bring in new investors with reliable certification and standards, including international investor base such as pension funds, sovereign funds and insurance companies.

7. **Secondary Market Bonds -** Portfolio of loans issued in a primary market is packaged into a loan portfolio or tradable security such as bond or asset-backed security that are sold in the secondary market.

   Why Secondary Market Bonds? Lower transaction costs, provide transparent market price, provide financiers / ESCOs an exit strategy so their balance sheet can be freed up to fund new projects thereby increasing the number of lenders. They open up market to pension funds, insurance companies, private equity, etc.

8. **Covered Bonds -** Regulated bonds with superior credit ratings, backed by the issuing entity as well as by a cover pool of a portfolio of energy efficiency loans which are used as collateral for the bond.

   Why Covered Bonds? Cheaper access to long-dated funds, bond investors gain exposure to assets with minimal adaptation of portfolio.

Maintenance Instruments:

9. **Energy Service Agreements (ESAs) -** Project developer sets up an SPV to fund the EE project. End user pays the SPV for the actual energy saved, either as a fixed percentage of savings or as a floating percentage of energy bill. SPVs set up through public funding becomes a Public ESCO model.

   Why ESA? An innovative finance model that leverages project-stage investment merging traditional approach with an emerging requirement.

10. **On-bill Financing -** Investments made by utility or third-party financier, repayment is done through monthly utility bills.

    Why On-bill repayment? Leverages existing relationship between utility and customer and the default rates are usually very low.

11. **On-tax Financing (Property Assessed Clean Energy Financing – PACE) -** Loans are attached to the property and is repaid through local taxes.

    Why On-tax Finance? Minimal repayment risk since attached to municipal taxes.

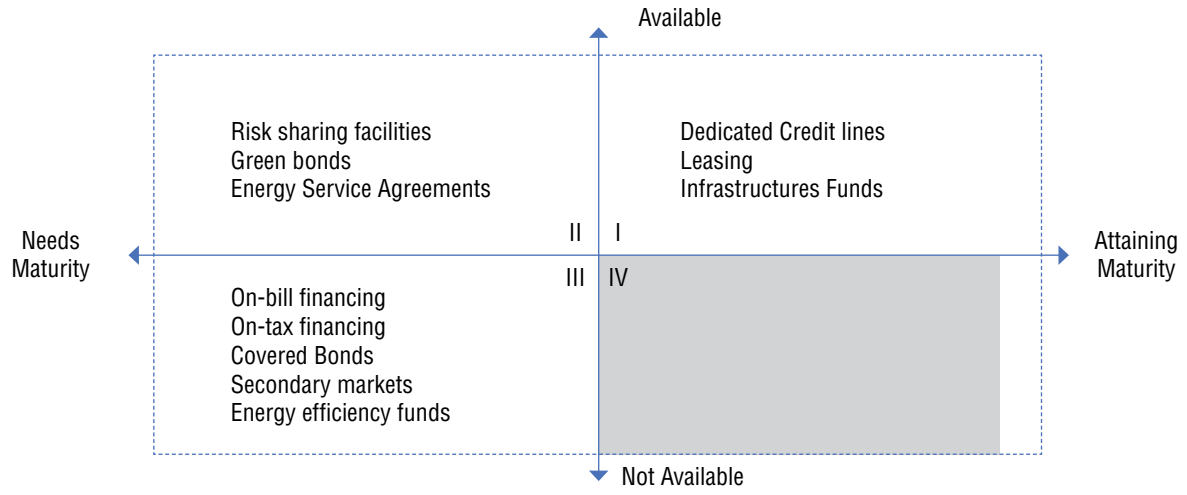


Figure 5.1: An EE Financing relevance chart for the Indian ESCO market

The Need for Green Banks and Non-Banking Financial Companies (NBFCs) in EE Financing

Globally, Green Banks and NBFCs have played an important role in EE Financing.

Green Banks are publicly funded institution that finance renewable energy, energy efficiency and other clean infra projects in partnership with private lenders. Green Banks are established in seven countries including US, UK, Japan and Australia (e.g. UK Green Investment Bank).

Why Green Banks? Neither traditional Government programmes with limited engagement with markets nor the private sector with its competitive pressures can play a transformative role. Green banks have many tools at their disposal to grow clean energy markets, which fall into three primary forms:

- Offering flexible, affordable lending that matches the terms and payback period of a clean energy project, thereby lowering the cost of energy.
- Using financial products and techniques to mitigate specific risks that currently limit investment in the Indian clean energy market.
- Engaging in market development and demand generation.

NBFCs are Financial institutions that do not meet the legal definition of a bank, cannot take deposits from public.

Why NBFCs? NBFCs usually drive the EE financing until it reaches a scale that will interest mainstream banking companies. In developed markets, NBFCs have led the EE Financing before the mainstream banks got into (e.g. Hannon Armstrong in the US).

5.2 Financial Instruments for the Indian ESCO Market

Many financial instruments are available for ESCO projects in India: Dedicated credit lines (Soft loans), Leasing, Infrastructure funds, Energy Service Agreement, Risk sharing facilities, Green bonds, On-bill financing. Based on discussions with FIs, ESCOs, Consultants and Utility companies, four growth instruments have been identified for the Indian ESCO market - Soft Loans, Green Bonds, On Bill Financing and Energy Efficiency Insurance.

Soft Loans with Credit Guarantee

Credit guarantee is required to mitigate concerns of the lenders regarding the credit worthiness of the off-taker (customer) - both for vanilla loans and receivables finance providers in the Supplier' Credit route – as the repayments are based on the cash flows from the customers. This tool enables the ESCO to raise the credit rating of the project by reducing the risk of non-performance to the lender. In case of default of payment by the customer to the ESCO, the lender is serviced by the guarantor up to the pre-defined guaranteed amount.

Partial Risk Sharing Facility (PRSF) is a guarantee programme to kick start market for energy efficiency projects implemented by ESCOs through Energy Performance Contracting (EPC). The PRSF is managed by SIDBI and is extended to PFIs (Participating Financial Institutions). This facility would provide partial risk guarantees to cover a share of the default risk that financial institutions face in extending loans to eligible EE projects. The programme will last for 15 years. A detailed PRSF eligibility criteria and the process are captured in Appendix.

The PFIs who have currently signed MoU with SIDBI are - Yes Bank, Tata Cleantech and Electronica Finance. The eligible sectors include Large industries (excluding thermal power plants), MSMEs, Municipalities and Buildings. The eligibility criteria, among other as mentioned in the Appendix mandates that either the ESCO or End user should be an MSE.

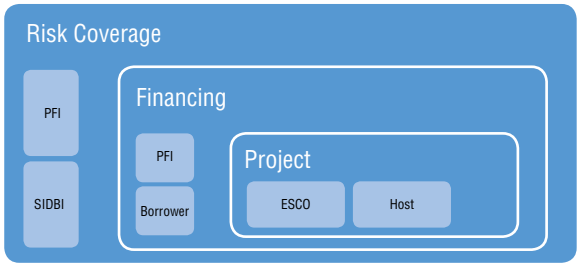


Figure 5.2: Interaction between stakeholders of PRSF scheme

Green Bonds

A bond is a debt instrument with which an entity raises money from investors. The bond issuer gets capital while the investors receive fixed income in the form of interest. When the bond matures, the money is repaid. A green bond is a debt instrument where the money raised is used for financing green projects, both energy efficiency and renewables[68]. Green bonds typically offer a lower interest rate compared to other bond instruments, but that is because it inherently carries lower risk. The repayment is tied to the issuer and not the success of the projects, so the risk of the project not performing stays with the issuer rather than the investor.

Benefits of Green Bonds include[69]:

- Expand the quantum of capital and broaden the investor base.
- Increase liquidity and develop a project pipeline for green investment.
- Better financial terms such as lower lending rates and flexible terms.
- Facilitating scaling up of smaller distributed clean energy resources.
- Mitigating further risk of investing in clean energy.

Several entities have issued green bonds in India, raising around $2 billion so far. These entities are – Yes Bank, EXIM, CLP Wind Farms, ReNew Power Ventures, Hero Future Energies and IREDA. The details are available in Appendix.

Strategies to expand green bonds in India are:

- Reduce cost of capital through standards and certification, competitive credit enhancement products and reducing foreign exchange hedging costs.
- Stimulate demand from institutional and retail investors by mandating public investment, regulating insurance and pension funds and providing tax incentives.
- Expand and diversify the issuers base through training & awareness, credit enhancement products and simplification & standardisation of issuance and compliance.

On-bill financing

This indicates purchase and deployment of energy efficiency solutions that are repaid on an instalment basis through electricity bills.

Advantages

- Mitigates the high upfront cost barrier faced in many low-income consumer class.
- Highly cost effective for Utility as it involves complete cost recovery through consumer bills.
- Provides greater assurance of energy savings for Utilities.

Limitations

- Stringent regulations and enforcement are required for securing on-bill loans.
- Higher administration costs for billing system modifica -tions.
- Programmes targeting high investment appliances may limit consumer participation.

Strategies to expand On-bill Financing include:

- Develop guidelines and standards for effective replacement of defective products to improve consumer confidence in such programme.
- Establish whether the on-bill programme administrators have to comply with state money lending laws or national financial laws.
- Develop criteria to establish who gets paid first in case of customer default, this is important for investors who seek to evaluate the risk of consumer default.
- Develop risk mitigation mechanisms to manage defaults when building occupants / tenants change.

EESL's UJALA Programme adopted On-bill Financing as key design component for projects in 15 states for 20 million LED lamps. EESL extends an on-bill loan directly to consumer through a consent deed and the utilities simply play the role of recovering on-bill charges via utility bill. The programme is considering expansion into tubular lamps, ceiling fans and air conditioners.

Energy Efficiency Savings Insurance

Energy Efficiency Insurance products would provide a financial risk mitigation package that includes an insurance product that would cover projected energy savings for specifically defined and verifiable energy efficiency measures. ESCOs would purchase the insurance product to back their guarantee with the view of increasing EE sales to their clients. In the event that projected financial flows associated with energy efficiency savings are not realized and subsequently the payment, the instrument would provide partial compensation to the end users or to the ESCOs. Underwriting process will have to take care of performance benchmarking, establishing project cost, evaluating key project financials and developing risk matrix. The flowchart below depicts a typical energy savings insurance mechanism[70].

The EE insurance typically covers the following:

- **Asset performance:** Typically covers the annual shortfall in energy savings compared to the amount of savings insured by the policy. It covers shortfall caused by deficiencies in the design or implementation of energy saving measures in the event of no equipment damage.
- **Material damage:** Covers physical damage, including breakdown to equipment and material installed as part of an energy savings project.
- **Business interruption:** Covers loss of gross revenue and increased cost of working following insured damage to equipment.

Based on an initial evaluation, possible Indian insurance companies that can be interested in EE Insurance are AIG, ICICI Lombard, LIC, United India and IFFCO Tokio.

STEP-1

Understanding current state of ECM Financing

- Evaluating shortlisted ECMs for financing
- Assessing amenability of an ECM to a financing route
- Correlation of mapped ECMs with current state of affairs

STEP-2

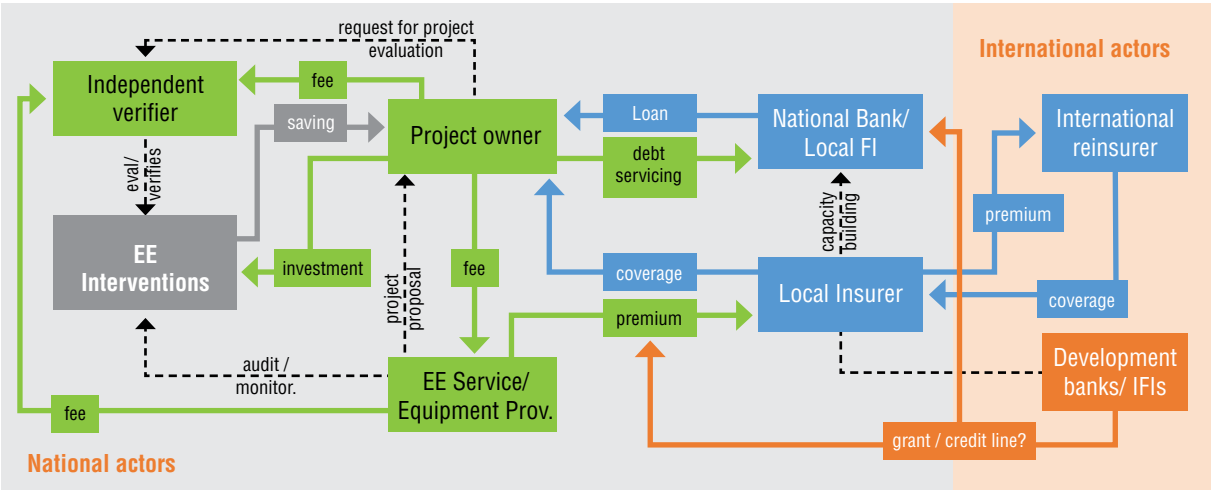
Estimating market opportunities

- Estimating the likely future state of EE financing models
- Estimating the market potential over the next few years for identified models

STEP-3

Mitigating risks

- Identifying risk mitigation instruments needed
- Computing potential requirements in future for extending credit to the ESCOs



LEGEND: *private actors, bank / insurance, international public institutions.*

Figure 5.3: Insurance mechanism for an energy saving project.

5.3 ECM Financing Matrix

The ECM Financing[71] Matrix identifies and assesses the financing interventions for scaling up of ESCO market. The methodology used to develop the matrix is captured below.

ESCO financing can happen through buyer's (end user) credit, supplier's (ESCO) credit or through a Special Purpose Vehicle (SPV)iv. A comparison is provided below.

A comparison of ECMs by credit versus savings demonstration approach

As discussed above, high certainty in savings, high/medium certainty in measurements, high/medium ticket size with aggregation and isolatable and non-distributed nature of an ECM makes the ECM more amenable towards financing by the ESCO, either through supplier's credit or SPV route. The following is the likely shift in the ECMs in the future.

Table 5.1: Comparing different ways of ESCO financing

	Description	Recourse for Bank	Typical ECMs	Typical Payback	Typical Ticket Size
Buyer's credit	On end user's balance sheet via internal funds of bank loans	End user	High returns, Low risk, credible ECMs	< 3 years	< 50 lakhs
Supplier's credit	On ESCO's balance sheet (25-30% equity and the rest through loans and receivables financing)	ESCO	Credibility of ECMs still to be established, but high measurability and high certainty in savings	> 3 years (or less if ticket is small)	50 lakhs – 2 crores (or less for credible ECMs)
Project Financing through SPV	Off-balance sheet financing through SPV (30% ESCO equity, 15% market equity, up to 70% debt), ESCOs would prefer non-distributed nature of assets as risk is shifted to the lender and ESCO's debt capacity is freed for other investments	Limited to project assets and cash flows (minimal recourse to ESCO during implementation)	ECMs with high/ medium degree of certainty in savings, without need for sophisticated M&V, Assets should be isolatable	Can cover a wide range	15-20 crores of aggregated projects
The financier gets exposed to purely performance risk of ECM only in case of SPV structure. In case of supplier's credit route, even when primary cash flow is dependent on the performance risk of the ECM, the FI has recourse to collateral and cash flow coming from other projects and so is not completely dependent on the ECM in question for loan repayment.					

	Deemed Savings	Guaranteed Savings	Shared Savings
Buyer's credit	WHR via economizer / air preheater	LV VFD	-
	Boilers		
Supplier's credit	EE Lighting	HVAC	WHR from chillers / compressors
	EE Pumps	EE Compressors MV VFD	
	EE Motors		Solar water heating
SPV	-	-	WHR from steam / electricity

Highly accepted **Credibility of ECM** *Evolving*

LEGEND: **High market adoption** **Low market adoption**

Table 5.2: Evaluation of shortlisted ECMs on Key Factors affecting Decision for Financing

	LV VFD	MV VFD	Process Boiler – New Installations	WHR for Steam/ Electricity	WHR for Economizer/APH	
Ticket Size (INR)	10L – 50L	50L – 2Cr; >2Cr	2Cr	>2Cr	10L – 50L	
Is the asset distributed or Non relocatable?	•	•	×	×	×	
Payback Period	0-2 years	1-3 years	1-3 years; >3 years	1-3 years; >3 years	0-1 year	
Degree of certainty of savings on installation						
Critical Success Factors	Duty cycle (operating hrs/day) and variability of load	Duty cycle (operating hrs/day) and variability of load	Quality of boiler feed water; Operating load of boiler w.r.t rated capacity	Consistency of input gas flow rate; dust particle concentration in flue; Less variation in price of electricity	Consistency of flue gas flow rate	
Degree of certainty of measurability of ongoing savings without issues/ disputes/ costly metering set up						
Type of ECM	Automation/ Electronic component retrofit	Automation/ Electronic component retrofit	Technology/ Installation	Technology/ Installation	Technology/ Installation	
Standard v/s Customised	Custom Built	Custom Built	Moderate customization	High customization	Low customization	

Low High

Low-grade WHR from Chiller/ compressor	EE Lighting	EE Pumps	EE Compressor	EE Motors	HVAC	Solar Water Heating
10L – 50L	<50L; 50L-2Cr	50L to >5Cr	>1Cr	10L – 50L; 50L-2Cr	>2Cr	50L – 2Cr
×	•	×	×	×	•	×
1-3 years	1-3 years	1-3 years	1-3 years	0-1 years; 1-3 years	1-3 years	>3 years
Duty cycle (operating hrs/day) of parent equipment	Duty cycle (operating hrs/ day)	Duty cycle (operating hrs/ day); operating load w.r.t pump curve	Duty cycle (operating hrs/ day); Operating load w.r.t compressor curve	Duty cycle (operating hrs/ day); Operating load as a % of rated capacity	Duty cycle (operating hrs/ day); use of whole facility method	Price of conventional heating source,
Technology/ Installation	Technology/ Installation	Technology/ Installation	Technology/ Installation	Technology/ Installation	Technology/ Installation	Technology/ Installation
Standard	Standard	Standard	Standard	Standard	Standard	Standard

CHAPTER-6

Hands-on events to further ESCO Market enablement

6.1 Workshops with Yes Bank

Date: 25 November 2016, 27 December 2016, 21 January 2017

Venue: New Delhi, Bangalore, Hyderabad

Objective: To connect Yes Bank with ESCOs for exploring financing leads, to introduce ESCOs to PRSF, to address concerns of ESCOs in availing financing, to update the ESCO community on AEEE's activities in being a market enabler

Discussion points:

- Along with standardised contract process and documents, the idea of standardisation of solutions will help in speeding up the loan decision making process.
- End user intent has been lacking even for ESCO financed projects, but with the ecosystem value chain getting built, the market should improve.
- AEEE's CMVP programme and capabilities for technical assistance can come in handy for ESCOs and FIs when it comes to M&V.

Outcome:

- ESCOs were happy to learn about PRSF and the fact that Yes Bank was willing to expand into ESCO financing on a large scale. ESCOs connected with Yes Bank and AEEE post the workshops for projects that needed financing.
- ESCOs nominated their team members for similar events that happened pan-India, with discussions happening at regional levels on specific opportunities.
- Smart Joules, a budding ESCO, could close a PRSF deal with Yes Bank for around 1.5 crores for a Hospital client post the workshop with Yes Bank

6.2 Roundtable on Energy Efficient Agriculture Pumping (Organised by BEE and Convened by AEEE)

Date: 17 April 2017

Venue: BEE office, New Delhi

Attendees: BEE, AEEE, EESL, Crompton Greaves, cKinetics, Danfoss, Desire Energy, Duke Pumps, Grundfos Pumps, Varuna Pumps, Shakti Pumps, Indian Pump Manufacturers Association

Objective: To discuss existing and recently implemented ESCO projects ESCO projects for replacing agriculture pump sets, unique barriers in financing and implementation and on the ground lessons acquired by ESCOs

Discussion points:

- Metering is the starting point for energy efficiency in India. Metering electricity will help government bodies and DISCOMs to establish a baseline of electricity demand.
- Consensus was reached on energy savings potential and design of standardised solutions for upgrading pump efficiency.

- Agriculture Demand Side Management (AgDSM) is one of the most challenging sectors for promoting energy efficiency. The implementation and financial models for replacing water pump sets for agriculture purposes are distinct from the water pumping solutions used in sectors such as municipalities.
- ESCOs agreed that the top-most challenge they face in scaling up their business is the lack of available financing.

Outcomes: With the inputs received from BEE, ESCOs and AEEE, the following were advised as the way forward:

- The AgDSM programme design should be structured in a way that not every stakeholder is trying to resolve all the problems, all at once. There are certain actions that only state government and DISCOMs can and must take to unlock the market. Many times, these are showstopper issues that, while allowing 1-2 pilot projects involving a few hundred or a few thousand pumps to happen, won't lead to scaling up of AgDSM programme involving hundreds of thousands of pumps. Similarly, notification and enforcement of energy-efficient pumps in states must be taken up by BEE, in partnership with Bureau of Indian Standards (BIS) and Ministry of Agriculture to pave the way for high penetration of energy-efficient pumps in the sector.
- Identify 4 to 5 priority areas for focused, constructive actions to mitigate barriers and advocate for policy and institutional alternatives, such as development of super-efficient pump sets, pushing for better pricing mechanisms to ensure electricity conservation from the demand side in agricultural sector.
- Leverage the existing documents and audit reports that BEE and EESL have on agricultural water pumping to start developing a market profile - in terms of market size, energy savings potential and range of energy savings possible - to help design a simplified M&V approach. Such a programmatic approach can drastically reduce the complexity on the implementation side.
- Considering the multi-dimensional nature of the problems and significant implementation difficulties, it is unrealistic to expect that private sector financial institutions and ESCOs would take the lead in such risky ventures. Government should think of a dedicated credit line or revolving fund at the state level with energy department and DISCOMs as primary beneficiaries to roll out schemes that would enable the ESCOs or AgDSM service providers to become partners in this initiative.
- Create broader categories within ESCO water pumping projects and develop protocols per category, which will help in more streamlined availability of finances and loans from banks and implementation of project on the site.
- Creating a core group, with members from BEE, AEEE, ESCOs, State Energy Department and DISCOMs, to target agricultural pumping solutions, to work on driving forward standardisation efforts for efficient pump sets, and to identify fiscal and technological policy alternatives is critically needed for coordinated EE measures in the agricultural sector. The participant ESCOs could send 6 to 7 key points to AEEE that can initiate work in this direction.

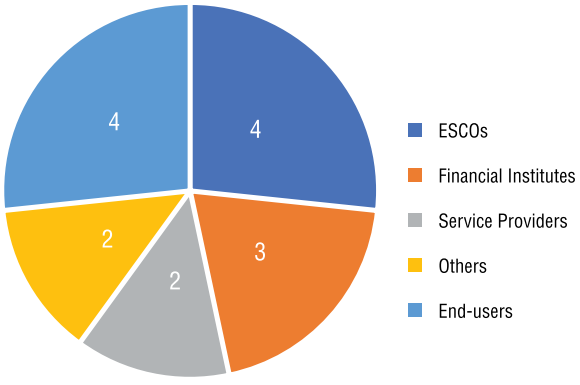
6.3 "Deal Day" for advancing Energy Efficiency in the healthcare industry

Date: 5 May 2017

Venue: New Delhi

Objective: To empower leading actors in India's healthcare industry to transform the way energy is managed in hospitals

Attendees:



Discussion points:

- Deep-dive into technical and commercial aspects of specific energy efficiency interventions that can be quickly and cost-effectively implemented by Hospitals
- Developing a concrete plan on how they can benefit from these solutions
- Sharing information on other energy saving measures that have already been championed in hospitals

Outcome:

- An environment was provided such that each member of the group could craft a concrete action plan through constructive working sessions to improve energy efficiency in their own facilities.

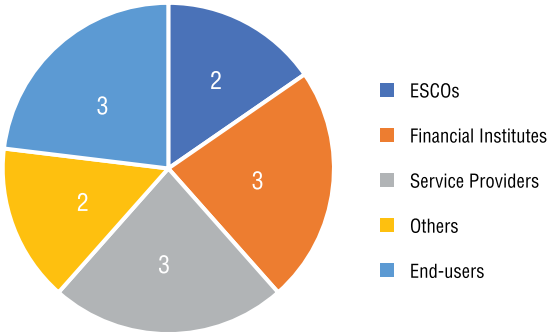
6.4 Roundtable on standardisation approach for HVAC solution

Date: 2 May 2017

Venue: New Delhi

Objective: To create an ecosystem for enabling large scale investments in the existing building sector with a sharp focus on central plant

Attendees:



Discussion points:

- Urgent need to have metering and monitoring systems
- Shift from EE product to EE system approach
- Better understanding of each other's needs and apprehensions
- Standardised approach

Outcomes: AEEE along with the ESCO ecosystem should work on the following important aspects:

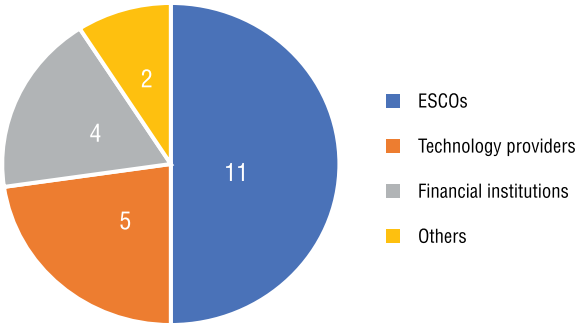
- Creating a documented technical approach for standardisation and contracts
- Defining legal boundaries and facilitating arbitrations
- Creating an independent 3rd party verification unit for ESCO proposals vetting and M&V
- Creating end user awareness on both technical and financial fronts
- Working on policy advocacy to encourage more budget allocation for EE projects
- Developing energy use benchmarks for different demand sectors
- Creating a collaboration framework for the industry to interact
- Conduct capacity building exercises including knowledge series for different stakeholders
- Create a more credible ESCO accreditation framework that builds trust in the ecosystem

6.5 Roadshows in Pune, New Delhi, Bangalore

Venue: Pune, New Delhi, Bangalore

Dates: Nov 2016 to Jan 2017

Attendees:



Objective: To connect with stakeholders of the ESCO ecosystem over 1-1 meetings, understand their market presence, roadmap, challenges, leadership commitment and support needed for ESCO business.

Discussion points:

- ESCO service and technology providers feel access to financing and strong policy level push could be the biggest change makers for the industry.
- ESCOs feel that a neutral market enabler is needed to enable connections, facilitation, deal flow, financing, capacity building and policy advocacy.
- ESCOs need a technically capable entity for assistance and overall guidance in audits, contract making and M&V.

Outcome:

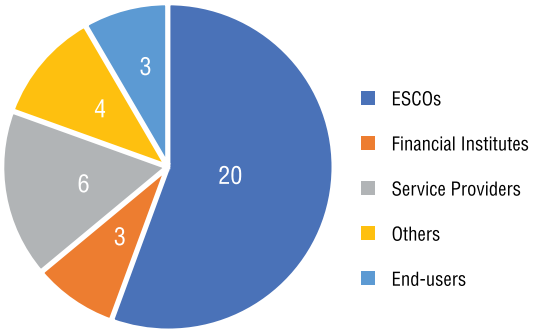
- The challenges faced by ESCOs came out clearly from the 1-1 interactions and AEEE was able to come up with short term and long term strategies for ESCO market transformation, most of which are covered in this report.
- Business-enabling connections were made post the meetings (example, connecting an ESCO with an FI, connecting a Technology provider with an ESCO, connecting an ESCO with an End user).
- AEEE was able to build a bottom-up strategy for ESCO market transformation in India based on the 1-1 interactions with the ESCO community.

6.6 Networking Event Co-Hosted by The Energy Resources Institute (TERI)

Venue: Bangalore

Dates: 11 July 2017

Attendees:



Objective: To together various stakeholders of ESCO businesses, to gain mutual benefits from each other's projects and experiences

Discussion points:

- The participants shared experiences through case studies, of projects implemented, technologies and products they have developed and marketed.
- Banks, Financial Institutions such as SIDBI and Venture Capital investors were also present, and shared their schemes and supports for the ESCOs and their end-customers.
- The discussion brought up many questions and concerns relating to government policies and programmes, project implementation, technologies, and solutions.
- There was also a keen interest in exploring partnerships among ESCOs to develop offerings that can address a wider range of EE needs of the clients.

Outcome:

The event created awareness among buildings segment and the bulk energy consumers such as Hospitals, Hotels and Institutions, the building owners and energy 'end users' with limited budgets, who may yet want to access EE services.

CHAPTER-7

Recommendations

AEEE's exercise of a comprehensive ESCO market assessment reaffirms the fact that the Indian ESCO market has not lived up to its huge potential. For a market potential that is estimated to be around INR 110,000 crores (USD ~20 billion), the total combined revenues of the ESCOs are not expected to be more than INR 1000 crores (USD150 million), excluding that of EESL revenues. There are 120+ registered ESCOs with BEE, but not more than 40 are active. Even within ESCO projects, "Shared or guaranteed savings model" is a tiny subset.

7.1 Key Recommendations

While lack of financing, lack of a strong policy push and lack of trust are frequently cited as significant reasons for the market gap, these typically fall in place for any market once it matures to a minimum threshold. Unfortunately, that has not been the case with the Indian ESCO market. AEEE's study brings out the need for the following:

1. Creation of a nation-wide energy efficiency data repository with benchmarks
2. Creation of a technology-enabled EE collaboration and marketplace platform
3. Creation of standardised solutions to build trust and enable scale in the market
4. Modification of ESCO accreditation process to enhance confidence and credibility
5. Creation of a neutral ESCO market enablement entity for awareness and facilitation

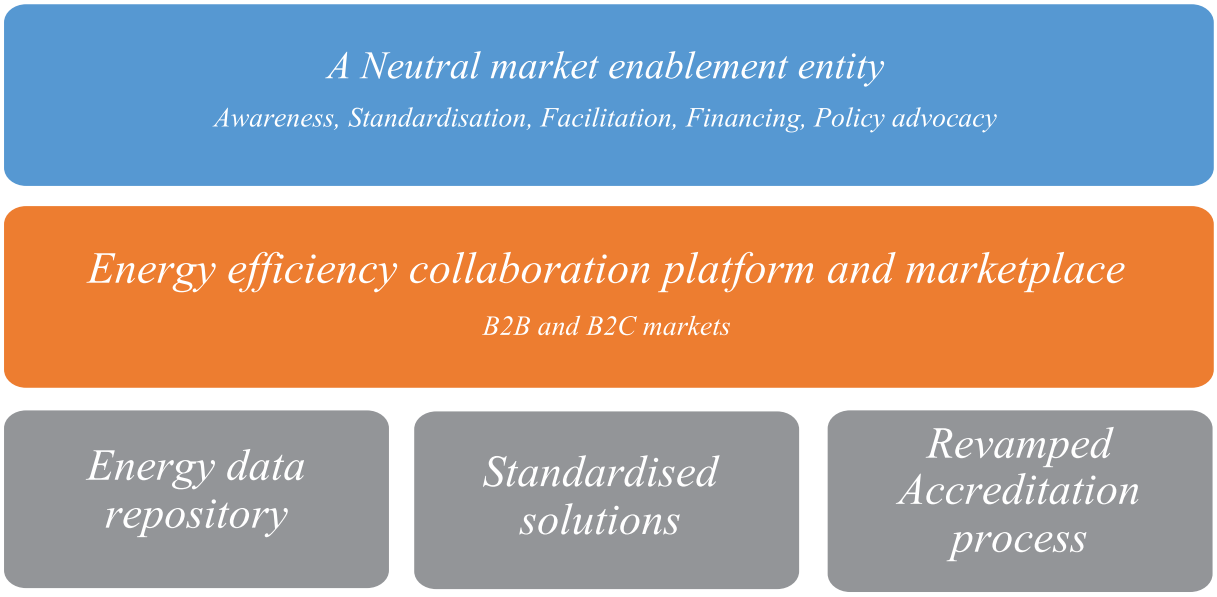


Fig 7.1. AEEE's recommendations for ESCO market enablement

Creation of a nation-wide energy efficiency data repository

For any market to develop, there has to be access to credible data. While several top-down exercises have been carried out, they do not clearly point to addressable opportunities for an ESCO or a Financier. The market data that exists today, for example does not throw light on the mapping between solutions and opportunities vis-à-vis the market segments, regions and where possible, customers. The market sizing exercise that AEEE has carried out has tried to address some shortcomings but a more rigorous and data-centric mindset will lead to better analysis that will give the confidence to investors that is currently lacking

AEEE proposes that a country-wide repository of energy and energy efficiency data be created that hosts end use data, efficiency solutions, savings achieved, etc. on an ongoing basis for end users spread across Buildings, IT, Industries and Municipalities. The repository will start with aggregation of data that exists today with entities such as Ministries, EESL, BEE, CII, etc. It will consolidate the goldmine of audit report data from audits carried out across the country over the last decade. Audit companies and end users shall be encouraged through incentives to share the end use energy data.

Once the repository is formed, normalized benchmarks will be created for end use data, by vertical, region, size and types. This will enable end users to benchmark themselves against their peers and ESCOs to gather credible market information. This will further be enhanced to provide solution-wise recommendations based on benchmarks, both to end users and ESCOs.

Creation of a technology-enabled ESCO collaboration platform

One of the consistent challenges cited by the ESCO community is the absence of a collaborative platform for the different stakeholders of the EE ecosystem, to come together for discussions, announcements, lead flows, capacity building initiatives and discourse on success stories. AEEE recommends the creation of a country-wide collaboration portal that will bring the entire EE community of ESCOs, Technology providers, Start-ups, Consultants, End users and Financial institutions on to a digital social media platform. The platform will then link up and host country-wide energy efficiency data with calculated benchmarks based on the creation of the energy data repository. The collaboration platform shall subsequently evolve into a technology-driven app-based marketplace for businesses and consumers for EE transactions.

Creation of standardised approach to solutions

EE solutions have to be standardised for audit approach, solution design, solution engineering, project execution, M&V and O&M. Frameworks and templates have to be created for audit reports, contracts and M&V reports for the standardised solutions. Globally accepted best practices must be leveraged. Standardization not only improves the scale of adoption, but also greatly reduces the transaction costs for financiers, thereby providing further impetus to the industry. Many countries including China have embarked on this model and AEEE believes that India needs focus in the short-term, and the success of EESL is a reinforcement to this view.

Modification of the ESCO accreditation process

One of the important credibility-building measures for a nascent ESCO market is the existence of an effective accreditation process for ESCOs. Even though a process exists today, one of the significant feedbacks received from the ESCO community is that the current accreditation process carried out by BEE needs to be strengthened and upgraded. A larger parent company running a small ESCO business gets favoured in the current process because of its financial health and size, compared to a smaller ESCO with good credibility for executing a project. This not only leads to mistrust within ESCOs, but also fails to capture the credibility of the rest of the ecosystem. End users are not able to make informed decisions on an ESCO's capability for a specific solution, Financiers are not able to understand the execution capability of an ESCO for a multi-year project and Technology OEMs are not equipped to make partnership decisions.

Only an accreditation process that weighs technical and project management capabilities of an ESCO vis-à-vis its financial strength can roll out a comprehensive rating system. AEEE recommends that the current accreditation process be revamped through the following modifications.

1. **Team:** Analysis of the employee strength in ESCO business, viz. energy auditors, solution architects, project bidding and contracting personnel, risk management members, project engineers, project managers and certified professionals
2. **Organization commitment:** Analysis of organization commitment through understanding of team strength in non-technical roles of business development, sales and marketing with thresholds of minimum 25% time-spends or targets allocated for ESCO business
3. **Past Projects:** Analysis of energy assignments done historically and in the last 3 years, alongside revenues for energy audits, consulting assignments, energy efficiency projects, energy monitoring projects, O&M projects, ESCO projects, guaranteed vs shared savings
4. **Current Projects:** Understanding of ESCO projects currently in execution to gauge the disposition of the company in the ESCO business
5. **Solution Capabilities:** Analysis of Solution capabilities of ESCOs vis-à-vis projects executed, savings promised vs achieved and major technology tie-ups with OEMs
6. **Leadership Commitment:** Measurement of management commitment to ESCO business by looking at investment made into ESCO business in the last few years while understanding the estimated investment over the next few years

A detailed version of the proposed questionnaire for the ESCO accreditation process is attached in the Appendix.

Creation of a neutral market enablement entity

Overall market analysis, correlations with international success stories, interactions with the ESCO ecosystem point to the need for a knowledgeable, neutral and credible market maker that can work with the different stakeholders to holistically look at and enable roll out of execution methodologies at technical, business, financing and policy levels. The role of such a market maker should be:

1. To create awareness on EE as a resource
2. To enable access to financing
3. To make organizational facilitation of contracts
4. To work with policy makers on enforcements

Awareness on EE as a resource: While the importance of energy efficiency is understood, the cost of implementation versus the opportunity cost of non-implementation is not necessarily understood by the end users. A culture of energy management has to be created within the country with the benefits of data-driven decision making through energy measurement and management well understood by stakeholders.

Access to financing: The ESCO process and contracts have to be streamlined to lower transaction costs for financial institutions. Post that, the financial community has to be connected to the ESCO community to work out financial models and instruments. The new entity should be in a trusted position for financiers for technical due diligence, solution certification, ESCO accreditation and M&V dispute resolution.

Organizational facilitation of contracts: Technical assistance for audits, solution engineering, project management, M&V and carbon credits has to be provided. Business facilitation for solution selling and contract making has to be enabled. Arbitration during M&V and payment conflicts has to be ensured.

Policy advocacy: Existing EE programmes (such as PAT, ECBC, Standards & Labelling) have to be rolled out more effectively for continued sustenance. Growth programmes such as Smart Cities, Power for All, Make in India and Start up India have to be leveraged to drive energy efficiency. EE Financing has to become a priority sector lending.

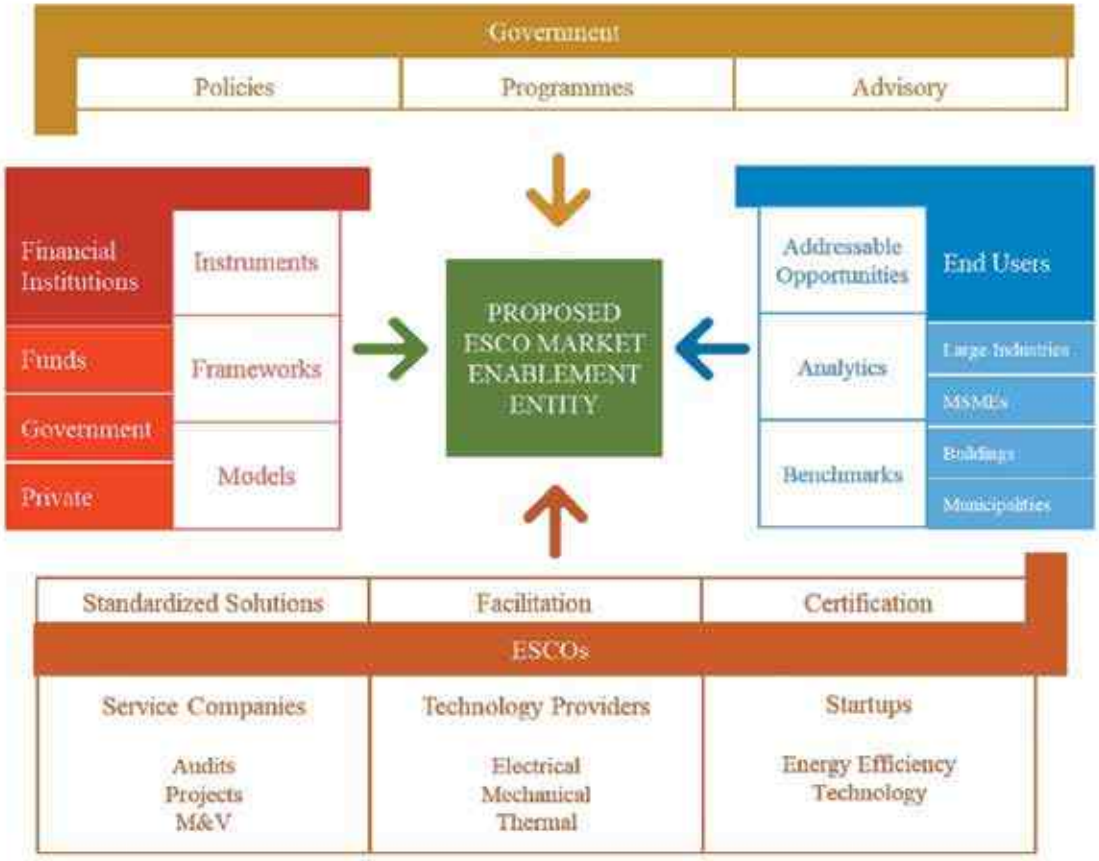


Figure 7.2 ESCO ecosystem positioning of the market enablement entity

The market enablement entity should have the following strengths and credentials.

Neutral Body: The entity should be an industry neutral body that is trusted by the ESCO ecosystem to transform the EE market in India. The entity cannot have affiliations with specific institutions including the Government, and to ensure independence, should be not-for-profit.

Network: The entity should have a strong network and working relationships with the different spokes of the ESCO wheel, viz. Policy makers, End users, ESCOs, Technology providers, Start-ups and Financial institutions.

Capability: The entity should have the capabilities to work across the spectrum of the EE ecosystem, be it at the technical, business, financing or policy levels.

Policy Advocacy: The entity should have credentials to work with different levels at the policy for Buildings, Industries, MSMEs, Municipalities, Infrastructure and Agriculture.

Capacity Building: The entity should have expertise in capacity building through training programs, workshops, seminars, webinars and courses.

Global Name: The entity should be recognised globally so that not only the best practices can be leveraged but also the global ecosystem could be leveraged for technology and funding.

7.2 ESCO Market enablement strategy

The ESCO market in India needs conjunctive actions on the policy and the business fronts. A composite approach of Awareness Building, Market Enablement and Business Facilitation has to be unleashed. Through a two-pronged strategy of Business-driven and Technology-driven catalysis, an industry transformation model should be rolled out.

The Business-driven enablement will start with Facilitation activities that include Project assistance on the technological, business and financing fronts. This will be carried out alongside creation of technology specific standardisation approach for solutions, eventually maturing into a Certification process that includes accreditation / incubation of ESCOs and ESCO solutions.

The Technology-driven enablement will aim to create benchmarks through analytics of energy consumption data and audit reports, which will further enable the creation of a cloud-based benchmarking tool for end users and a report generation tool for auditors, culminating into the creation of a B2B and a B2C marketplace for energy efficiency in India based on an open collaborative framework.

7.3 ESCO Market enablement strategy rollout model

Along with Partners such as EESL, BEE, CII, etc., the market enablement shall be driven through a two-pronged business and technology strategy.

The strategy will look to use Energy Efficiency Services Limited's (EESL) success in appliance/equipment based energy efficiency projects for replication of solution-oriented ESCO projects. EESL's strengths in demand aggregation, supply chain streamlining and national implementation shall be leveraged to orchestrate this enablement strategy.

Partnership with Bureau of Energy Efficiency (BEE) shall improve the ESCO accreditation process along with financial rating agencies such as CRISIL and ICRA, incorporating both financial and technical aspects. The vast amount of energy and energy audit data with BEE, CII and Industry associations shall be utilized to create country-wide energy and energy efficiency data. Collaborations with Technology and Service providers shall drive technology-specific standardisation approach and create end use benchmarks of energy data. The data will further be kept updated through the cloud-based marketplace platform.

The enablement will result in EE emerging as a marketplace in India.72

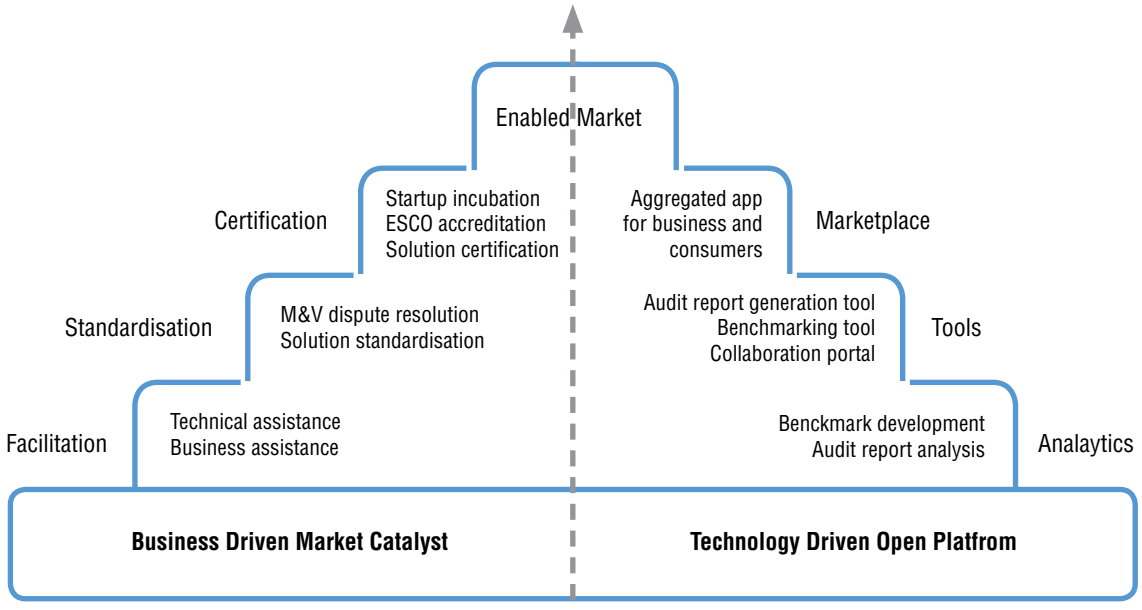


Figure 7.3. ESCO market enablement pyramid

7.4 Evolution of future ESCO Market

AEEE envisions that significant changes will happen to the energy services sector in the near future because of the following megatrends:

a) As renewables continue to drive down the prices of electricity, it may become more difficult to justify the return on investments for energy efficiency projects;

b) ESCOs need not just think about what and how to deliver energy efficiency but also about when to deliver efficiency as Time of Use electricity pricing becomes a reality, and the cost of energy storage will start to compete with reduction in energy demand during hours when energy from cheap renewable sources may not be available;

c) With the innovation taking place in the field of Internet of Things (IOT), big data analytics, miniaturization and yet enhanced accuracy of sensors and meters, the measurement and verification of energy savings will undergo significant transformation and will become much more transparent.

The policymakers, end customers and financial institutions will be tracking these developments and making greater demands of the ESCOs in future. For ESCOs to survive and thrive in this environment, it will be important for them to stay rooted in the present with an eye on the future as they navigate the eco-system transformation taking place in the energy infrastructure.

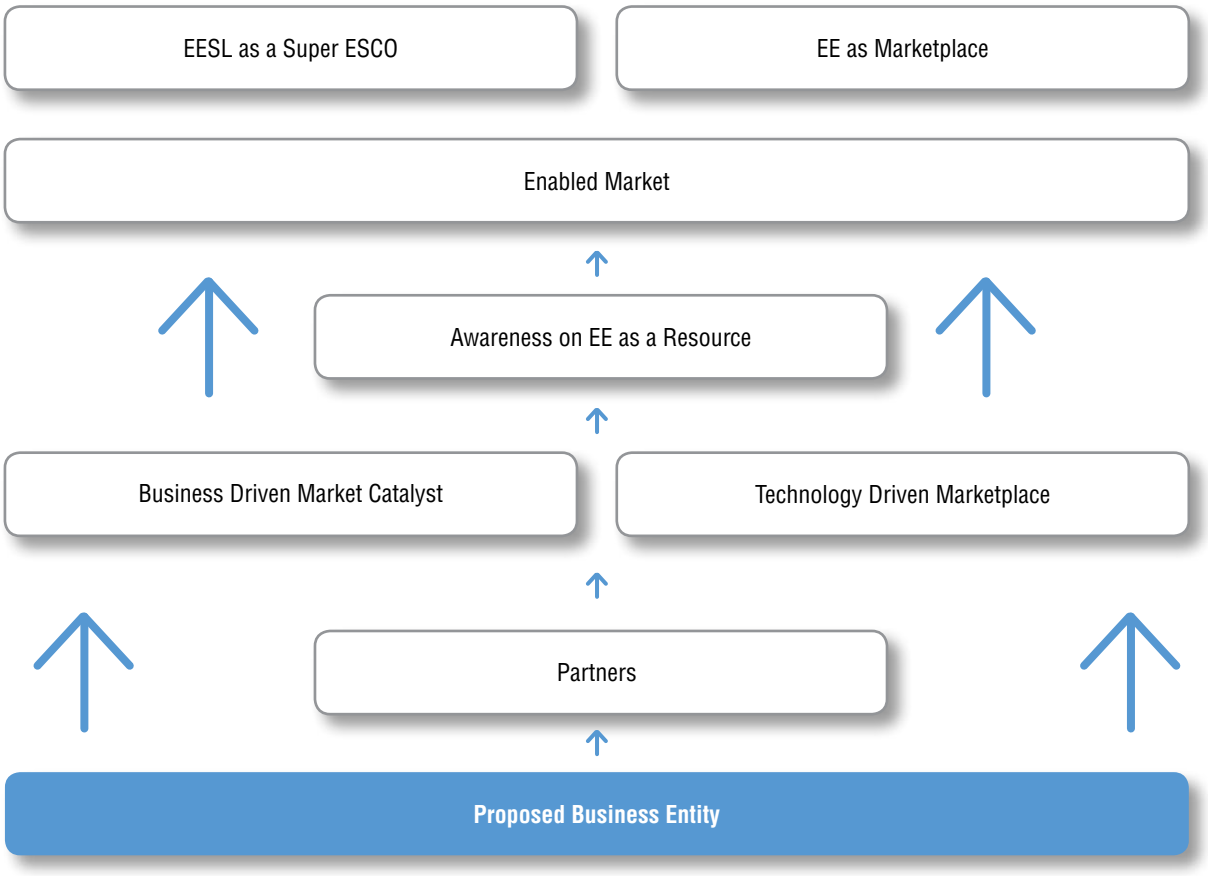


Figure 7.4 ESCO market enablement strategy rollout model

APPENDIX

Chapter 1

Kinds of ESCOs active in India

- GENERAL ESCO - An ESCO not affiliated with or owned or operated by an equipment manufacturer or an energy supplier - these ESCOs are engaged in carrying out end-to-end or turn-key implementation of projects and perform a wide range of activities such as baseline audits, detailed energy audits, solution design, sourcing of technology, implementation of M&V standards and providing performance guarantees. They typically specialize in a range of technologies. They leverage their technical expertise to expand market reach through the ESCO models.
- VENDOR ESCO - An ESCO affiliated with or owned by an equipment or controls systems manufacturer. A few manufacturers of energy efficient technologies also offer ESCO services. They either have intellectual property rights for a technology or hold licenses to use such technologies. This category of ESCOs has both small scale and large-scale operations. Some of these ESCOs finance projects on their own balance sheets. Based on the credibility of the industrial client they are found to offer equipment leasing as well as equipment supplier credit model. Due to minimum ticket size limit (which often happens to be higher than the typical ticket size for SME projects), they are generally not active in the SME segment. The ESCO business of such companies is usually a much smaller fraction of their overall business volume and the strategic decisions are greatly influenced by the outlook of their global teams towards the ESCO model.
- CONSULTANT ESCO - An ESCO offering recommendations to a client based on knowledge or specialisation in an aspect of energy efficiency. These ESCOs are typically energy auditors or technical or engineering consultants who have ESCO business in the form of performance contracts with their clients. They enter into technology tie-ups with established equipment manufacturers to act as re-sellers or system integrators and have the capability to carry out system studies and optimization of thermal energy, electrical energy or air flow etc. in addition to the equipment commissioning and M&V. Some ESCOs are also BEE accredited energy auditors with in-depth knowledge of the processes of the sectors under the ambit of the Perform Achieve Trade (PAT scheme). These ESCOs have the capability to implement the 'low hanging fruit' interventions as well as the complicated process interventions through system studies.

Key EPSCS used in india

- SHARED SAVINGS (EQUIPMENT SUPPLIER CREDIT) MODEL - The ESCO provides financing through its own funds or a loan from a bank or an FI. The client and ESCO share the energy savings based on a predetermined ratio. When the project size is high, and the certainty of savings and measurability of the savings (on a month-to-month or year-on-year basis) is also high, the ticket size of the project is large and the asset is re-locatable and not of a distributed nature, the projects are easy to find finances. In Project financing of an ESCO project, the equipment vendor would have to create a Special Purpose Vehicle (SPV) and arrange for a financier to fund the project.
- GUARANTEED SAVINGS MODEL - The customer provides financing and ESCO guarantees performance. The ESCO is paid a fixed fee if the guaranteed savings is achieved through the upgrade. A variant of the guaranteed savings model is the deferred payment model in which

the industrial client can defer the payments to the ESCO (notionally out of the monthly savings in energy) by a duration specified in the contract. The conditions for amenability of such projects for Project Financing are the same as mentioned earlier. However, the difference in case of guaranteed savings projects is that the Industrial client would create the Special Purpose Vehicle instead of funding the project on its own balance sheet.

- DEEMED SAVINGS MODEL - This approach is used in projects where the technology is simple and well established with consistent performance characteristics. This involves multiplying the saving per measure by the number of measures installed which gives the estimate of energy savings. The estimated energy savings can be complemented by on-site inspections on sample basis. The conditions for the project financing of such projects are the same as those of the Equipment Supplier Credit model and the SPV is created by the Equipment vendor.
- CHAUFFAGE BASED MODEL - This is an integrated solution generally refer to a greater value-added approach. As per a study done by International Finance Corporation (IFC), "the concept offers conditioned space at a specified price per energy unit to be consumed under a supply and demand contract offered by the ESCO". Here ESCO manages all the demand and supply efficiencies. This model is derived from the contractual French approach of energy services delivered by a private company to a public authority or to another private body. A chauffage based model lends more responsibility and accountability to the energy service company that provides consistent maintenance and repair support for optimum and promised energy savings.

List of FIs

Institution	Energy Efficiency specific products
Energy Efficiency Financing platform (EEFP) of BEE	Platform was created to improve access to commercial lending for ESCOs. PTC and SIDBI are a part of the platform. Products include: Interest subsidies for ECBC compliant buildings, Hotels EE financing, take out financing for ESCO projects (ESCO projects can be bought the fund (Bank) after the project had proven its viability for a certain period (1 year).
Tata Cleantech Capital Ltd	TCCL's financial and advisory services will range from market analysis of technology solutions, sustainability strategy development through implementing and managing a sustainability solution. Respected parentage - 80 % and 20 % equity ownership by Tata Capital and IFC respectively. MoU with BEE and EESL.
ICICI Bank Limited	Risk Appraisal Methodology: projects are appraised on case by case basis. Appropriate financing structures are designed based on project features with the help of staff that is proficient in evaluating technology, EE technicalities more than financing. When the involved ESCOs did not have the financial strength to implement the projects by themselves, the bank tries to monetize the savings using an escrow account. An energy efficiency credit line of INR 25 million was created with the World Bank to finance technologies.
SIDBI (Small Industries Development Bank of India)	One of the main actors lending to energy efficiency projects at the level of small and medium-sized deals. In 2007-08, SIDBI received the first lines of credit from Japan International Cooperation Agency to finance existing energy efficiency projects. A second line of credit was implemented using KfW funds, and it was based on pre-selected machinery and equipment. Eventually, the French Agency for Development (Agence Française de Développement, AFD) came in with a third line of credit.

Yes Bank	A MoU between SIDBI and YES Bank is expected to provide credit guarantee to more than 500 Energy Service Company (ESCO) implemented Energy Efficiency projects, which would mobilize financing of the tune of USD 127 million. Further, the project is also expected to result into significant energy savings of the tune of 1,002.1 GWh and CO2 emissions reductions of the tune of 0.734 million tons.
Electronica Finance	Registered as a Non-Banking Finance Company (NBFC) and provides equipment finance to Small and Medium Enterprises. As a part of the Partial Risk Guarantee Scheme, Electronica Finance has signed an agreement with SIDBI to be a Participating Financial Institution (PFI). The long and short credit lines combine to a total of INR 175 Crores.
HSBC	The Bureau of Energy Efficiency (BEE) and The Hongkong and Shanghai Banking Corporation Limited, India (HSBC India) signed a Memorandum of Understanding to work on BEE's Energy Efficiency Financing Platform (EEFP) with the objective of the EEFP to create a mechanism towards mainstream financing of energy efficiency projects and to explore energy efficiency improvements by ESCO-based performance contracts and Demand Side Management initiatives.

List of bilateral engagements

Country and Organisation Name	Programme Names
US - India Energy Cooperation	First three ESCO in India with the help of funding from USAID in early 1990s. Partnership to advance Clean Energy (PACE-D) was created with a pipeline of project. Country wide ESCO stakeholder workshops were conducted to form an Indian ESCO association. Introducing the concept of Demand Side Management (DSM) in India.
US Agency for International Development (USAID) India	ECO phase I (ECO-I) helped India set up the Bureau of Energy Efficiency (BEE) to enforce the country's Energy Conservation Act of 2001. ECO-II helped agencies in a few targeted states develop energy conservation strategies and test new approaches through pilot projects. It also contributed to the establishment of India's first energy efficiency (EE) codes for buildings. ECO-III (2006-2011) helped BEE develop and implement the Energy Conservation Building Codes (ECBC) and provided technical assistance to Government of Gujarat and Punjab. USAID also helped in the creation of The Alliance for an Energy Efficient Economy.
	Development Credit Authority (DCA) - uses risk-sharing agreements to mobilise local private capital to close the financing gap in emerging markets like India.
Indo-German Energy Programme (IGEN)	Support for EE through insulation solutions; collaboration with KAEFER, one of the world's largest provider of complete insulation solutions, under the PPP project 'Moving India's MSMEs towards Energy Efficiency' (MovIEE). Providing access to advisory services, training, and credit schemes; awareness generation through 'Energy Bus' initiative. Pilot projects in different clusters.

	Demand Side Energy Efficiency and Low Carbon Growth Strategies
KfW India	Line of credit from KfW Development Bank for financing EE projects; Financial assistance to MSMEs through SIDBI; Provides list of EE equipment and measures eligible for financing
	Energy Efficiency in Public Buildings and Infrastructure
	Technical assistance to EESL
France - Agence Française de Développement (AFD)	EESL - Supporting Energy Efficiency through Innovative Financial Model
	Improving the Energy Efficiency of Indian SMEs – SIDBI
UK - Department of International Development (DFID) India	Public Private Partnerships for street lighting programmes in Indian cities such as Bhubaneshwar.

List of Multilateral Funds

Organisation	Programme and Partnerships
The World Bank	Partial Risk Sharing Facility (PRSF)
	International Finance Corporation (IFC)- Working with local municipal bodies for efficient street lighting in India
	Three Country Study by World Bank and UNEP (3CEE)- Brazil, China and India
	World Bank–GEF Project: Financing energy Efficiency at MSMEs (2010-2014) - Targeted at five selected energy intensive clusters; Capacity and awareness building; Support for walk-through/ detailed energy audits and preparation of Investment Grade DPRs; Performance-linked grants to early adopters; Knowledge management and sharing
United Nations Development Programme (UNDP)	UNDP-GEF-BEE project: Energy Efficiency Improvements in Commercial Buildings
Asian Development Bank (ADB)	Demand Side EE Investment Project: ADB will provide a loan to Energy Efficiency Services Limited (EESL), to be guaranteed by the Government of India, to support demand-side energy efficiency investments in several Indian states

APPENDIX

Chapter 2

Amplebit Energy Solutions Pvt Ltd

Sector	Buildings, MSME, IT (data centers/telecom)
ESCO Empanelment	BEE (Grade 4)
Area served	National
Founded	August 2009
Team strength	<25
Key people	Arvind M T (Managing Director)
Website	www.amplebitenergy.com/
Top ECM categories	HVAC, building automation equipment
Typical ticket size	INR 10 lakhs to 2 crores
Typical payback period	<1 to 3 years

Amplebit Energy are solution and service providers (general ESCO) and provide efficient technologies in the building, MSME and IT sectors. The team is distributed in the departments of general management (10%), project management (40%), design and engineering (30%) and sales and marketing (20%). All hardware and software associated with the ECMs are self-developed and locally done. It has availed the CRISIL ESCO rating.

Energy savings from the implementation of energy efficiency solutions can be measured directly in some cases using metering equipment. In other cases, the savings can be baselined on full/ideal load but actual savings depend on the client's production/ work cycle or building loads.

Amplebit Energy has undertaken self-funded and client-funded projects. It implements ECMs in exchange for a fee for service, shared savings, guaranteed savings or deferred payment.

It works with Public Sector Undertakings (PSUs) to offer its ESCO and audit consulting services, for which a share of the revenue is given to the PSU. Amplebit has worked with some PSUs for a sufficiently long period of time – for such projects, securing bank loans and guarantee mechanisms such as PRSF becomes easier.

Aspiration Energy

Sector	Large industries (automotive, pharmaceuticals)
ESCO Empanelment	No empanelment
Area served	Tamil Nadu, Karnataka, Andhra Pradesh, Telangana, Kerala, Maharashtra, NCR
Founded	2010
Team strength	<25
Key people	Bhoo Thirumalai (CEO)
Website	http://aspirationenergy.com/
Top ECM categories	Heat pumps, Solar water heating systems, LED
Typical ticket size	INR <10 lakhs to 2 crores
Typical payback period	1 to 3 years

Aspiration Energy Private Limited (AEPL) provides full ESCO services in the medium and large industries sector. AEPL provides decentralized solar thermal systems for industrial process heating and advanced high temperature process heating using industrial heat pumps. For industries that adopt to green energy initiatives, AEPL offers long term predictable low-energy costs on a unique monthly performance based energy payment. a) Solar As A Service (SaaS) - Giving solar solutions on a monthly performance based fee - paradigm change from the perception of solar as a capital intensive system investment. Pay Per Unit (PPU) for solar electricity, Pay As You Save (PAYS) for solar industrial process heat. b) Energy As A Service (EaaS) - Energy Efficiency and Thermal energy solutions including Industrial Heat Pumps on a monthly performance based fee (PAYS) and PPU (Pay Per Unit (PPU - Rs/kCal heat delivered) c) Asset-light - model of connecting investors for off-grid solar power plants with end-users of solar systems. d) Addressing niche market segments - where solar is naturally economical even without Government support: example: Telecom towers, industrial process heating, rural electricity. e) Technology Innovation - Decentralized Energy Generation on a monthly payment model

Savings from heat pumps and solar water heating can be measured directly using metering equipment – however, it requires the stoppage of the production line for a moderate time (<1 day) for installation. Baseline for savings from replacing existing lighting with LEDs can be full/ideal load, but actual savings depend on the client's production cycle.

Aspiration Energy notes a significant difference in the management mindset between CAPEX/deemed savings projects and OPEX/pay-as-you-go projects. In CAPEX projects, clients typically stop closely monitoring energy performances after the initial investment has been made and energy savings have been demonstrated once. In OPEX projects, however, there is a regular review of energy savings, which puts pressure on both the plant personnel and the ESCO to keep justifying any gaps in performance as compared to the contract.

It also notes that very often clients expect ESCOs to use industrial grade high precision instruments, which can drive up project costs significantly even though low cost metering equipment can deliver a reasonable level of precision.

BEBLEC Energy System Pvt Ltd

Sector	Public sector & state government enterprises, municipal services, large industries (textiles, cement, steel, pharma, engineering, automobiles, paper and plastic), IT (datacenters/ telecom), construction services
ESCO Empanelment	BEE
Area served	Multinational
Founded	1984
Team strength	25 to 50
Key people	S Raghavan (Managing Director)
Website	www.beblec.com
Top ECM categories	Lighting energy saver, solar lighting and pumps, luminaires – led, induction, MH
Typical ticket size	INR <10 lakhs to 5 crores
Typical payback period	<1 to 3 years

BEBLEC provides general ESCO and audit consulting services. Its team is distributed in the departments of general management, project management, design and engineering, performance contracting and project risk management, sales and marketing and energy auditing and accounting.

BEBLEC is presently exploring ECMs in lighting and solar applications. Savings from energy efficient lighting can be measured directly using metering equipment. ECMs are resold through third party engagement.

It undertakes bank-funded projects against a fee for services or a deferred payment.

Bosch Energy and Building Solutions, Bosch Limited

Sector	Large, medium and small industries and commercial buildings In particular in the sectors: steel re-rolling, pharma, precision engineering, automotive, dairy, hospitals, hotels and textiles, medical centres
ESCO Empanelment	BEE (Grade 1)
Area served	Multinational
Founded	1951
Team strength	45
Key people	Soumitra Bhattacharya (Managing Director)
Website	www.boschindia.com
Top ECM categories	HVAC Efficiency Improvement, Waste Heat Recovery Solution, Steam Distribution Optimization and Integrated Heating and Cooling solutions
Typical ticket size	INR <10 lakhs to 2 crores
Typical payback period	2 to 3 years

Bosch provides full ESCO services to industries and commercial buildings as a pure ESCO. Bosch has also availed the ICRA rating for ESCOs based on engineering skills, diversified projects implemented and financial strength. Energy efficiency solutions are developed in-house by the firm. Bosch has very strong engineering team who develops these unique customized solutions for various segments and targets around 10 to 25% of total energy saving for customers.

M&V is not a key challenge for Bosch as the standard operating procedures for implementing solutions are based on ISO standards and guided by IPMVP.

Developing transparent Monitoring & Verification procedure for various industries is the core strength of Bosch. Standard operating procedures for implementing solutions are based on ISO standards and guided by International performance and verification protocols (IPMVP). Based on customer need, Bosch also provides complete remote monitoring platform to capture real-time data for verification of savings. This also helps in implementing operational saving measures to improve efficiency of systems year-on-year. Bosch provides all energy efficiency solutions to customers on guaranteed saving (performance contracting) mode, and customer gets risk-free solution (both technical and commercial risks) to maximize positive cashflow. Bosch also offers flexible commercial models to customers, who face challenges in arranging budget/funds for these projects can opt for deferred payment mode. Bank Guarantee or Letter of credits are typical payment security mechanisms considered in these projects.

Development Environergy Services Ltd (DESL)

Sector	Large industries (aluminium, chemical/fertilizer, petroleum refinery, pulp & paper, rubber/ plastic, iron & steel, food & beverages, textiles), MSME, IT (data centers/telecom), buildings, municipal services
ESCO Empanelment	BEE, ISTSL
Area served	Multinational
Founded	1999
Team strength	25 to 50
Key people	Rangaraj Rajmohan (CEO)
Website	www.deslenergy.com/
Top ECM categories	HVAC, lighting, building envelope, building automation, drives, pumps, fans, motor systems, boilers, furnaces, burners, waste heat recovery systems, solar water heating systems, thermal energy storage equipment, rooftop PV systems, compressed air optimization, power generation and distribution equipment, municipal pumping optimization systems
Typical ticket size	INR 10 to 50 lakhs
Typical payback period	1 to 3 years

DESL has pioneered the development of ESCO performance contract system in India, and established itself as a reputed player in this segment. It has actively collaborated with Government, bilateral and multilateral programmes in diverse sectors. The company has built its business model on strong theoretical framework, tested and sound technological solutions, and through process management controls and systems, with optimized cost framework.

DESL has established itself as a reputed player in the global consulting market in implementing energy conservation and optimizations projects. Over the years, DESL has worked to transform the ESCO market in India by adopting innovative business models built around technical performance and simplified measurement and verification models. A knowledge management system comprising software packages, data formats and documented project experiences have been developed in-house. DESL has extensive experience in design and evaluation of diverse types of ESCO transaction models as well as policy & regulatory analysis. It has already executed projects in over 25 countries under mandate from institutions like World Bank, Asian Development Bank, UNDP, UNOPS, IFC, USAID, GIZ, DfiD; public sector companies in India and overseas as well as private industries and commercial facilities.

ENCON Energy Management Services Pvt Ltd

Sector	Thermal Power plants, Railways, Steel, Pulp & Paper, Ships, Chemicals, Pharmaceuticals, API, IT & Commercial Buildings, Banks & Hotels,
ESCO Empanelment	BEE, MEDA
Founded	10 Sept. 2007 as Private Limited (Founded in 2001 as proprietary as "Encon Services")
Team strength	Have developed organization with trained manpower to conduct energy audit at 2-3 plants simultaneously. It imparts training in each organization at the end of 'Energy Audit'.
Key people	S Kumar (CEO)
Website	http://www.enconenergy.in/
Top ECM categories	Power Distribution System, Power Quality, Harmonic, Energy Monitoring System, HVAC, drives/pumps/fans/motor systems, lighting systems, Compressed Air Optimization, Cooling Tower Performance, Boiler Performance, Thermal Power Plant,
Typical ticket size	INR < 10 lakhs to 2 crores
Typical payback period	1 to 3 years

ENCON operates as a full services ESCO in large industries including chemicals/fertilizers, pharmaceuticals, automotive and railways. Energy efficiency solutions are resold from third parties by ENCON. They have undertaken both client funded and self-financed projects based on two models - full shared saving (pay for equipment out of the savings) and pay for auditor service out of savings. Deemed savings approach have been tried for lighting retrofits and deferred payment approach has been tried for equipment restoration in which 40% of the cost was paid by the client upfront and the rest was recovered as EMI (equal to the savings).

ENCON notes that baseline setting is a very important part of the process – for example, in a lighting project, there can be compromise on the lux levels if the baseline and the expected lux levels are not defined properly. They believe that risk of repayment and customer satisfaction are amongst the high-risk areas associated with ESCO business in India which also includes project execution and savings achievement risk in the medium category.

Energized Solutions

Sector	Buildings, large industries (chemicals/fertilizers, textiles, automotive)
ESCO Empanelment	BEE (Grade 2), CRISIL (Grade 2)
Area served	National
Founded	2010
Team strength	<25
Key people	Dhruv Dhanda (Director)
Website	www.energizedsolutions.org/
Top ECM categories	Lighting, HVAC (pilot only)
Typical ticket size	INR < 10 lakhs to 2 crores
Typical payback period	1 to 3 years

Energized Solutions provides full ESCO services. It has developed in-house manufacturing capacity for LED lighting and fixtures. They offer a wide range of bespoke retrofits to their clients and offer assurance on fixture life and light quality. It has partnered with suppliers of real time monitoring systems.

Energy efficiency solutions are developed in-house. Savings from lighting ECMs can be measured but there are too many metering points to make it cost effective. In retrofits, fixtures or wiring is not modified – if the client agrees on a comprehensive lighting study, the whole layout can be completely revamped which could lead to the addition or reduction of fixtures.

Energized Solutions has undertaken bank-funded and client-funded projects. It implements ECMs in exchange for shared savings. When it had started operations, the projects were self-funded, which later evolved into bank-funded projects through structured term loans partly backed by collateral. With time, it has moved to lines of credit backed by client contracts. LED solutions are also sold on CAPEX basis. In the shared savings model, the loan is usually 70% of the overall receivables which is sufficient to include both the LED and the project costs. Hypothecation can be done, either based on receivables or fixtures. The payment by the client is in the form of EMI for a pre-defined period and the EMI I knocked-off from the monthly receivable for the client. This sharing of profits continues for up to 5 years whereas the contract duration is longer, up to 14 years.

Enfragy Solutions India Private Limited

Sector	Buildings, Municipal & Industrial sector
ESCO Empanelment	BEE (Grade 2)
Area served	National
Founded	November 2004
Team strength	25 to 50
Key people	Nilanjan Bose (Senior Manager - Energy)
Website	www.enfragy.com
Top ECM categories	HVAC, lighting, building automation and drives/pumps/fans/motor systems, solar water heating and municipal lighting system
Typical ticket size	INR 20 lakhs to 2 crores
Typical payback period	1 to 5 years

Enfragy is the ESCO and wholly owned subsidiary of Idam Infrastrutcure Adviosry. The company's core strength is carrying out load research to design, develop, implement, and evaluate DSM programmes, and working with utilities to strengthen their energy efficiency mandate. Through its end-use efficiency improvement programmes, it works in municipal, residential, commercial, and industrial sectors and specializes in developing and implementing sector-specific end-use programmes to improve energy efficiency. The Enfragy team develops ESCO projects based on advisory support for energy management, detailed energy audits. It also supports clients in negotiations and finalizing technologies and successful project implementation.

The ESCO projects are built on sound M&V protocols to demonstrate savings. Enfragy has developed its own IOT based technology solution for baseline development and verification of energy savings which is utilises for its own ESCO projects as well as offer it to other ESCOs. Enfragy has expertise to help stakeholders such as utilities, industries, financial institutes, and energy service companies in M&V of ESCO projects. Energy efficiency solutions are developed in-house or resold from a third party. Enfragy also has unique ability of implementing renewable energy applications such as water heaters, rooftops.

Enfragy Solutions offers audit consultancy and operates as an ESCO in the buildings, municipal and industrial sectors, especially in textiles, cement, power plant, distribution, ship building and SME Sectors. The team is distributed in the departments of energy auditing and accounting (40%), project management (20%), sales and marketing (15%), and performance contracting and project risk management (10%) and design and engineering (15%). It has availed the ICRA ESCO rating.

Enfragy Solutions has undertaken self-funded projects. It implements ECMs under deferred payment and deemed savings model.

eSmart Energy Solutions Pvt Ltd

Sector	Municipal services
ESCO Empanelment	BEE (Grade 3)
Area served	Maharashtra, Gujarat, Odisha, Punjab, Uttar Pradesh, Haryana, Sri Lanka
Team strength	250 to 400
Key people	Suresh Hiralal Shah, Sudhir Chauhan, V H Mulchandani
Website	www.esmartlighting.com
Top ECM categories	LED Lighting
Typical ticket size	INR 5 crores to 250 crores

eSmart provides full ESCO services in the municipal sector. Its main activities are equipment manufacturing, management and operations, installation, engineering design and financing. It has availed ESCO rating and is a Grade 3 ESCO. eSmart also provides solution in wireless camera and pollution monitoring devices for which they have tie-ups with other organisations for technical assistance.

Energy savings from the implementation of LED lighting solutions can be measured directly using metering equipment. It wishes to venture into energy efficient pumps as it sees a huge market potential there. eSmart has undertaken self-funded, bank-funded and client-funded projects. It implements ECMs in exchange for guaranteed savings with penalty clause.

eSmart has already installed more than 2 lakh LED street light in various ULBs including Bhubaneswar, Durgapur, Jamnagar, Gandhidham, Junagadh, Mohali etc. eSmart is presently installing about 24,000 LED street lights in Municipal Corporation, S.A.S. Nagar, Mohali, under ESCO model. Lucknow, Kanpur, Ludhiana, Shahjahanpur, Gorakhpur, Yavatmal, Pachora are some of the cities eSmart is following.

There are enormous opportunities in public street lighting sector to achieve energy efficiency to the tune of 75-85%, by adopting road illumination requirements as per national standards. The deemed savings method is preferred by project consultants and ULBs. This approach makes the overall project structure very simple, but energy efficiency suffers badly. Under the deemed savings model, the energy efficiency achieved is only in the range of 45-52%. In case the guaranteed savings model is adopted, additional 30-35% savings can be achieved with equal or lesser project investment. Under this model, the M&V protocol is also very stringent. Under the deemed savings model, wattage of lamps takes precedence over lux levels; whereas under the guaranteed energy saving model, lux levels on different category of roads takes precedence over wattages. LUX is most the important parameter and dimming is a must as per American Medical Association which has been adopted by lighting societies throughout the world.

Ethan Power Pvt Ltd

Sector	Large industries (infra, thermal power plants)
ESCO Empanelment	BEE, CRISIL (Grade 4)
Area served	All India
Founded	2013
Team strength	14
Key people	Amit Gaur (Director)
Website	www.ethan.net.in
Top ECM categories	Drives, pumps, fans, motor systems, power factor correction
Typical ticket size	INR < 10 lakhs to 2 crores
Typical payback period	1 to 3 years

Ethan Power provides full ESCO services in large industries. It has its own manufacturing facility. It focuses both medium voltage (MV) variable frequency drives (VFDs) and low voltage (LV) VFDs and power factor correction. For VFDs, one-time measurement pre-installation and post installation is done to counter the variations in baseline conditions that may create possibility of dispute.

Ethan Power has undertaken self-funded and client funded projects, though many times, the customer insists that the ESCO finances the projects on its own books. The company has implemented ECMs under guaranteed savings models. Shared savings approach has been offered for VFDs.

A challenge being faced by the ESCO is that the sales cycle is long and moreover, for VFDs though there is a fair level of industry awareness about the technology. However, awareness about the certainty regarding energy savings achievement is not very high.

First ESCO India Pvt. Ltd.

Sector	Large industries (iron and steel, cement, glass, petroleum refining), buildings, municipal services
ESCO Empanelment	BEE (Grade 4), CRISIL (Grade 4)
Area served	Multinational (focus on the Middle East and India)
Founded	2006
Team strength	<25
Key people	Vijaykumar Kunche (Managing Director)
Website	www.firstesco.in/
Top ECM categories	HVAC, boilers/furnaces/burners/waste heat recovery systems, lighting systems
Typical ticket size	INR 10 lakhs to >5 crores
Typical payback period	1 to 3 years

First ESCO provides full ESCO services in the buildings, large industries and municipal services sectors. It does not participate in bidding for tendered projects in India – First ESCO only implements projects that are requested by clients.

Energy efficiency solutions are developed in-house. First ESCO is presently exploring anti-fouling systems for efficiency improvements in process boilers which will eliminate fouling of pipes and make heat transfer more effective. Savings from waste heat recovery (WHR) systems and anti-fouling systems can be measured directly using metering equipment. Savings from medium voltage variable frequency drives in fans and pumps can be baselined on full/ideal load but actual savings depends on the client's production cycle. Implementation of waste heat recovery systems may require stopping of the production line for 10 to 15 days, whereas the implementation of anti-fouling systems and medium voltage VFDs in fans and pumps require stopping of the production line for less than a day. First ESCO notes that well-established technologies (like WHR systems using the simple Rankine cycle) face less resistance from the top management in large industries as compared to unconventional technologies (like low grade WHR systems using the organic Rankine cycle which has a high potential in the steel and cement segments).

First ESCO has undertaken client-funded and bank-funded projects. It prefers undertaking CAPEX projects wherein the client company funds the project based on its own balance sheet rather than First ESCO having to arrange financing. It intends on using Partial Risk Sharing Facility (PRSF) for upcoming projects. It implements ECMs in exchange for shared savings or guaranteed savings.

Forbes Marshall

Sector	Large industries (Engineering /chemicals/fertilizers, textiles)
ESCO Empanelment	BEE (Grade 1), CRISIL
Area served	Multinational
Founded	1985
Key people	Satyadev Purohit (Director)
Website	www.forbesmarshall.com/
Top ECM categories	Boilers/Steam & condensate system/Instrumentation & control/burners/waste heat recovery systems, thermic heating/cooling
Typical ticket size	INR 50 lakhs to 5 crores
Typical payback period	1 to 2 years

Forbes Marshall provides solutions and services in the small, medium, and large industries sector.

Energy efficiency solutions are developed in-house through Energy Service Division and Steam System Division. Through Energy Audits Forbes Marshall (FM) offers comprehensive solutions-based on cutting edge technology yielding the lowest specific thermal consumption and best value for money, at existing plants across all industrial sectors. Through Utility Design Consultancy FM provides superior, future-ready designs for lowest specific utility consumption.

ECMs are identified through a detailed audit of the customer or through a survey-based data. There are three categories of ECMs, which are prioritized based on impact and ROI. First is stop wastage category which are small proposals, easy to implement and has good potential energy savings. Second category is system optimization wherein medium-scale investment and process impacting proposals are covered. Clients prefer category 1 and 2 interventions since they are less capital intensive, have quick paybacks and are least disruptive. Third category includes proposals which impact productivity, such as heat pinch technologies. These are capital intensive.

The first two category proposals can be implemented without requiring major shutdown using parallel arrangements. Major proposals are implemented during downtime to minimize production loss. Installation takes 1-2 months, and results are evident another 1-2 months. Savings from ECMs can be baselined on full or ideal load. However, the savings achieved, depend on the client's actual plant-load conditions during validation. There are complexities associated with baselining in case of multi-product or complex plants where steam and condensate interventions are required. For fuel reduction projects, measurement, and verification (M&V) can be a challenge.

Apart from regular ECMs, FM provides solutions related process parameters troubleshooting, process debottlenecking which substantially impact plant productivity and profitability. FM is exploring steam engine systems which can be replace high pressure steam systems. Pressure reduction and pinch analysis are part of their upcoming offerings. FM has undertaken client-invested projects, and implements them through guaranteed savings. For large industries, investments in the guaranteed savings model are a function of the CAPEX cycles. When the year's budget is exhausted, it is difficult to get management approval to invest in additional projects. Though FM has implemented projects in SME sector (e.g., plywood industry), the company has concerns about expanding to other SME clusters as the expectation of short payback (of less than 1 year) may not be achievable.

Greetude Energy

Sector	MSME
ESCO Empanelment	BEE (Grade 4), ICRA
Area served	Regional (Mumbai, Bengaluru)
Founded	2014
Team strength	< 25
Key people	Pratik Pradeep Hakay (Founder and Director)
Website	www.greetude.com/
Top ECM categories	VFDs, HVAC pumps, lighting systems, polypropylene balls for insulation of open tanks
Typical ticket size	INR 10 to 50 lakhs
Typical payback period	1 to 3 years

Greetude provides full ESCO services in the Commercial Buildings, Residential complexes and MSME sector and has undertaken client-funded projects.

Apart from standard ECMs, Greetude has developed a self-analytical tool for lighting replacement and operational optimization, that helps Commercial Buildings and Residential Complexes save energy seamlessly. Greetude also executed projects linked to electrolytic processes industry in Pune with a payback of around 2 months. Polypropylene balls were used for insulating open tanks used in electrolysis that have high heat loss. These polypropylene balls covered the whole upper layer to prevent evaporation and subsequent heat loss.

Greetude implements ECMs through the deemed savings approach. Shared savings approach is complicated to follow since the savings vary depending on load conditions at the client end and is beyond the ESCO's control. One of the key challenges faced by Greetude for ESCO business is to arrange Project financing independent of the ESCO's financial status. There is a substantial risk posed by the equipment vendor and the financier as both see the work being done by ESCO as ESCO's risk entirely. A clarity in the technical process, client credentials and standard empirical data can relieve ESCO the burden of risking its own balance sheets for funding the client replacements all the time.

Grundfos Pumps India Pvt Ltd

Sector	Large Industries
ESCO Empanelment	None
Area served	Multi-National
Founded	1998 (In India)
Team strength	> 250
Key people	Sanjeev Sirsi (Head Water Utilities)
Website	http://in.grundfos.com
Top ECM categories	Pumping solutions
Typical ticket size	INR 10 to 50 lakhs
Typical payback period	1 to 3 years

Grundfos Pumps has been on the leading edge of energy efficient pumps and systems, as well in high efficiency solar pumps. Grundfos applies and complements its equipment with green buildings programmes and provides bundled solutions. Strong emphasis on training and post-installation support ensures high degree of energy savings as well assured payback. This secures their long-term market and creates new business where cost reduction is a major concern.

Grundfos offers audit consultation and efficient pumping technologies in the large industries (chemicals and fertilizers) sector. The team is distributed in the departments of general management, design and engineering, sales and marketing, and energy auditing and accounting.

Grundfos offers ECMs like solutions, energy audits and reports on pump audits, on a fee based on service ESCO model. Strong emphasis is put on training and post-installation support that ensures high degree of energy savings and assured payback that builds confidence in customers. This helps Grundfos in securing a long-term position in the market, and expanding the business in areas where cost reduction is a major concern.

Havells India Ltd.

Sector	Municipal services, MSME, large industries
Area served	National
Founded	1973, offering ECMs since 2009
Team strength	>250
Key people	Sandeep Mathur, Nisha Taank (General Managers)
Website	www.havells.com/
Top ECM categories	Lighting, drives/pumps/fans/motor systems

Havells India Ltd. is a lighting and electrical appliances company with a range of industrial electrical solutions from circuit protection and surge protection devices, reactive power solutions, HT & LT cables, induction motors, to professional lighting and heavy-duty fans. Early in 2017 Havells India acquired Lloyd Electrical and Engineering Ltd, from the B.R. Punj Group. Havells practices ECMs within their own manufacturing facilities (It does not offer energy saving services.) Lighting and VFD motors have been the focus in its production units. Havells is ISO:50001 certified and ranked among the top companies under the Zero Effect, Zero Defect (ZED) programme under the Make in India campaign.

Havells has an industrial product range which includes air circuit breakers to manage heavy electrical overload, automated transmission systems facilities with a high level of industrial automation. Havells have strategically positioned their lighting products and expertise, along with their energy-efficient motors and heavy duty industrial fans to provide comprehensive ESCO based services and plant upgrades. Energy efficiency solutions are developed in-house and essentially replace existing (less efficient) equipment (rather than retrofitting).

Havells has undertaken self-funded projects. It implements ECMs in exchange for a fee for service.

A.T.E. Enterprises Private Limited (Business unit: HMX)

Sector	Industrial and commercial establishments
ESCO Empanelment	None
Area served	National, MENA, APAC
Founded	1998
Team strength	50 to 250
Key people	Rishabh Matta (Assistant Manager, Marketing & Business Development)
Website	www.ategroup.com/hmx
Top ECM categories	HVAC
Typical payback period	1 to 2 Years

HMX, the pioneers of indirect evaporative cooling, offers unique, energy-efficient, and eco-friendly solutions for space and process cooling. The core of every HMX product is DAMA – HMX's patented cross-flow type sensible heat exchanger.

Designed keeping in mind the most crucial aspects of modern day and future HVAC requirements such as energy efficiency, sustainability, Indoor Air Quality (IAQ), fluctuations in productivity due to IAQ, health ramifications, and affordable life cycle cost, HMX cooling solutions are being increasingly preferred by leading corporates.

- Two-stage evaporative air cooling units: provide 100% fresh, clean, cool air, and are an excellent upgrade over air-washers and ventilation systems as well as an energy efficient alternative to conventional air-conditioners.
- Pre-cooling units: pre-cool the fresh air supplied to centrally air-conditioned spaces in the most economical manner, thereby reducing the load on chillers.
- Hybrid air-conditioning units: a revolutionary concept that provides comfort in all seasons using both indirect direct evaporative cooling and refrigerated air-conditioning.

HMX has the world's largest installed base of 35 million CFM in Indirect Evaporative Cooling solutions, cooling more than 7 million square feet of area. HMX's customer base includes more than 600 happy customers which includes the biggest brands like Volkswagen, Tata Motors, Amazon, Big Basket, Bosch, General Electric, Coca-Cola, Infosys, Wipro and many more.

Honeywell Automation India Ltd

Sector	Buildings, large industries (FMCG, textiles, pharma, bearing), MSME
ESCO Empanelment	BEE (Grade 1), CRISIL
Area served	Multinational
Team strength	Turnkey solution provider, starting from Auditing, designing, Engineering, Supplying, Installation, testing, Commissioning of equipment along with maintaining the site till the contract period with Guaranteed Energy saving with Performance Bank Guarantee.
Separate team of Solution Development, Engineering, Project Management and Operations located in all the regions of India.	
Key people	Manoj Kumar Singh, Manish Gautam
Website	honeywell.com/country/in
Top ECM categories	Building automation equipment, motor optimization systems, Electrical solutions, waste heat recovery systems, lighting systems, cooling tower automation, process automation, chiller and hot water generation systems
Typical ticket size	INR 10 lakhs to > 5 crores
Typical payback period	1 to 3 years

Honeywell provides full ESCO services in the buildings, large industries and MSME sectors. It designs solutions based on components available in the market and manages the implementation of the same too.

Honeywell prefers to suggest a combination of ECMs to the client for implementation to make a meaningful project size given the relatively long sales cycles. Difficulties in the baselining, unclear M&V protocol and getting a buy-in from the decision makers are some of the challenges faced by the ESCO.

Honeywell has primarily undertaken client-funded projects and offers guaranteed savings model. Honeywell has hardly seen an occasion in which the bank guarantee was encashed by the client since appropriate buffers are kept for the energy savings achievable.

Honeywell does not finance projects on its balance sheet and thus, choosing a client company with the ability to finance projects from its own funds or to obtain financing for the same is key.

Intemo Systems Ltd

Sector	Municipal services, large industries (mining), agriculture, DISCOMS, Railways.
ESCO Empanelment	BEE (Grade 4)
Area served	National, focus in Andhra Pradesh, Telangana
Founded	1993
Team strength	<50 (At present <10)
Key people	K Satyanarayana (Managing Director)
Website	UNAVAILABLE
Top ECM categories	Lighting, drives/pumps/fans/motor systems/ Distribution/Buildings/ boilers/furnaces/burners/ waste heat recovery systems
Typical ticket size	INR >5 crores
Typical payback period	1 to 3 years

Intemo offers full ESCO services in the municipal, large industries (mining) and agriculture, DISCOMS, Railways sectors. Its principal activities include equipment manufacturing, management and operations, installation, engineering design and R&D. The team is distributed in the departments of general management (20%) and design and engineering (80%). Energy savings from the implementation of energy efficiency solutions can be measured directly using metering equipment. Designed and Developed in-house by Intemo Systems. Intemo has undertaken client-funded and bank funded projects. It implements ECMs in exchange for a fee for service, shared savings or guaranteed savings.

Intemo believes that the lack of adequate understanding of the ESCO model at the financier's end is a deterrent to availing financing for ECMs under the ESCO model. Intemo notes that the low cost of electrical energy is an important barrier to the success of its ECMs.

Intemo Systems has a track record of 25 years in energy audit and management. Works closely with the power utilities in Southern States, especially Telangana and AP. They have scaled up their activities over the last 2 years with 5 crores financial assistance from Technology Development Board, for expansion of Infrastructure facilities. The ESCO offerings are being strengthened by commercialising electrical energy management and energy saving equipment which complement the power reforms of the govt. Their unique expertise is in a range of products such as: a) GSM Based Energy Saver System to manage multiple loads in electrical circuits and reduce fluctuations, and build up their resilience to power spikes, surges and reactive power, b) Power Management System to stabilise supply in energy intensive industries such as the PAT DC's, railway facilities, protection of sensitive equipment such as ATM Centres, Airports; c) Customised Mini SCADA- system for local or plant-level power management complying with IEC, IEEE, ANSI, and NEMA standards. The company has recently entered into a partnership with JENEFFCo, which complements its technical strength with financial and management expertise. This would boost its credibility to take on ESPC projects especially in large urban and industrial load centres.

India SME Technology Services Ltd (ISTSL)

Sector	Buildings, Municipal services, MSME
ESCO Empanelment	BEE (Grade 2), SIDBI, MNRE, CARE (Grade 2), QCI
Area served	National
Founded	November 2005
Team strength	<25
Website	techsmall.com/
Top ECM categories	HVAC, lighting, drives, pumps, fans, motor systems, boilers, furnaces, burners, waste heat recovery systems, solar hot water systems, rooftop PV system, compressed air optimization, power distribution equipment, energy efficient manufacturing equipment, co-generation
Typical ticket size	INR 10 to 50 lakhs
Typical payback period	1 to 3 years

ISTSL has been incorporated by SIDBI and 4 other banks, namely, State Bank of India, Indian Bank, Indian Overseas Bank and Oriental Bank of Commerce, with the aim of building a synergy between technology and finance for the MSME sector. ISTSL is working in the fields of energy efficiency and cleaner production, consultancy and technology advisory, renewable energy (particularly solar) and loan syndication.

ISTSL's core team is comprised of BEE accredited and certified energy auditors with extensive experience in Energy Efficiency and Renewable Energy. Apart from core team members, ISTSL has empanelled 65 technical consultancy firms with domain expertise in of energy efficiency and renewable energy. ISTSL is offering the following services: Implementing ESCO projects in Buildings and MSMEs; Owner's & Lender's Engineer for ESCO / RE projects; Project Management services for ESCO / RE projects; 3rd party technical due diligence / appraisal for EE and RE projects; 3rd party baseline and M&V audits, Implementing lean manufacturing / Resource efficiency / Energy efficiency projects in MSMEs. Some of the unique projects that are being currently handled by ISTSL include the following:

- Implementing an ESCO project in SIDBI Offices resulting in 40% energy reduction & online energy monitoring
- Implementing agency for SIDBI's flagship Energy efficiency scheme, "End-to-End Energy Efficiency (4E) Scheme" for promoting energy efficiency in MSMEs. So far, ISTSL has facilitated around 170 energy audits resulting in identification of more than 1200 ECMs which would result in more than INR 76 crore annual energy cost savings
- Third party M&V Audits for energy efficiency projects – more than 100 such audits have been facilitated
- Peer review of Bankable DPRs for implementing Energy Efficiency projects – BEE MSME project
- Project management services to five Government of India Ministries in implementing solar PV rooftop systems for a cumulative capacity of 40 MW
- Lender's engineer service for SIDBI's loan scheme for financing small solar PV rooftop projects (for existing MSME units

Jaabilli Energy Efficiency Concepts Pvt Ltd

Sector	Buildings, Municipal services
ESCO Empanelment	ICRA submitted its report to BEE for ESCO grading
Area served	Andhra Pradesh, Telangana
Founded	2016
Team strength	<25
Key people	Mahesh Varikuti, Venkat Muramalla, Ramesh Tatineni
Website	Jeneffco.com
Top ECM categories	Building automation, automation of substations, municipal lighting systems, municipal pumping, Industrial Energy Efficient systems, rooftop PV systems, power generation/ distribution, automation equipment, net metering
Typical ticket size	INR 10 lakhs to 5 crores
Typical payback period	30 to 84 months

MOUs JENEFFCO has entered in to MOUs with high business aspiring industries in their respective EE activities is in regular consultation and thus can use their expertise for fast growth

Jaabilli provides full ESCO services in the building and municipal sectors. The team is distributed in the departments of general management (10%), project management (15%), design and engineering (50%), performance contracting and project risk management (5%) and sales and marketing (20%). It has technology tie-ups with Intemo Systems Ltd, Reckon Green Innovations Pvt Ltd Sharada Industries and Zenith Energy Services Pvt Ltd It has entered in to MoUs with high business aspiring industries in their respective EE activities is in regular consultation and thus can use their expertise for fast growth Energy saving solutions are developed in-house. It is planning to under energy efficiency projects in major Industries and electrical distribution companies and planning to implement projects for solar generation plants' unique specifications. It has undertaken self-funded projects. It implements ECMs in exchange for a fee for service. Jaabilli and Intemo would jointly take up ESCO projects in power utilities and DISCOMs across India starting in the southern states. The combined expertise would be in products and services such as: a) GSM based energy saver system to manage multiple loads in electrical circuits and reduce fluctuations, and build up their resilience to power spikes, surges and reactive power; b) Power management systems to stabilize supply in energy intensive industries such as the PAT DCs, railway facilities, protection of sensitive equipment such as ATM Centres, Airports; c) Customized mini SCADA system for local or plant-level power management complying with IEC, IEEE, ANSI, and NEMA standards. Jaabilli with its in-house R&D abilities can customize user requirements to the best of their convenience and its MoUs with different technology-oriented industries will complement its technical strength with financial and management expertise. This would boost its credibility to take on ESPC projects especially in large urban and industrial load centres.

Johnson Controls India Private Limited

Sector	Buildings, Healthcare, Hospitality, Small, Medium & Large Industries, IT and ITeS
ESCO Empanelment	BEE (Grade 1)
Area served	Multi - National
Founded	1995
Team strength	500
Key people	TK Nanthagopalan (Director Service), Sanjay Mittal (GM Service), Shashi Saraswat (Sr. Engineer, Service Sales- North), Fazil Ahmed Sayyed (Manager, Service Sales- West), Prakash KN (Manager, Service Sales- South)
Website	http://www.johnsoncontrols.com
Top ECM categories	HVAC, Lighting, Building Automation, Drives, Waste Heat Recovery Systems and Water Conservation
Typical ticket size	INR 10 lakhs to 5 crores
Typical payback period	<1 to 3 years

Johnson Controls offers full ESCO services and provides efficient technologies in the buildings, hospitals, hotels, industries (chemical/fertilizer, pharmaceutical, electric utility, food and beverages, electrical and electronic equipment), banking, IT and ITeS sector. While, JC owns multiple leading brands like YORK in HVAC & IR, Ruskin, Titus, Rolastar & Lau in Air Side, Metasys in BMS, TYCO in Fire and Security, Johnson Controls also have joint venture with Hitachi. Johnson Controls has availed the CRISIL ESCO Grade 1 rating.

Energy study and efficiency solutions are developed in-house. Energy savings from implementation of these solutions can be measured directly using metering equipment. It has modified its approach to EPC in India through guaranteed equipment performance and equipment savings established by detailed M&V, can also provide customer centric Dashboards. These dashboards help to convert dynamic and stored data into useful information that can be used for M&V, day to day operation & tracking and management MIS.

Johnson Controls undertakes client funded projects. Johnson Controls implements ECMs under both fee for service and guaranteed savings model. It works with facility management companies and institutions on large contracts with wide range of payback including relatively longer payback of 3 to 4 years.

Johnson Controls provides single window solution for HVAC, IR, Building Automation, Security & Fire Safety, and Air Distribution Products.

Kirloskar Brothers Ltd.

Sector	Agriculture, large industries (chemicals/fertilizers, petroleum refining, pulp/paper, cement, iron/steel, textiles)
ESCO Empanelment	BEE (Grade 2)
Area served	National
Founded	1920
Website	www.forbesmarshall.com/
Top ECM categories	Drives/pumps/fans/motor systems
Typical ticket size	INR 50 lakhs to > 5 crores
Typical payback period	1 to 3 years

Kirloskar provides full ESCO services in the large industries sector.

Energy efficiency solutions are developed in-house. Savings from ECMs can be baselined on full/ideal load but actual savings depend on the client's production cycle. Energy audits of pumps and pumping systems is carried out by Kirloskar. 'Before' and 'after' implementation parameters such as flow, head, input parameters and efficiency are compared to establish savings. Verification audit is conducted one week after installation. Some margin is kept for lab vs site conditions. Implementing ECMs requires replacement of old equipment which takes less than a day. Since there is no aftermarket for old pumps, industries are not willing to invest in the equipment or have the ownership transferred to them in BOT contracts.

Kirloskar has undertaken client-funded and bank-funded projects. It implements ECMs in exchange for mostly guaranteed savings. If savings estimated through interventions in the guaranteed savings model are not achieved, pumps are either rectified or the bank guarantee is encashed by the customer. Shared savings have been tried in Gujarat. For shared savings, the typical ticket size falls into the larger ticket size bracket, whereas for the guaranteed savings model, the typical ticket size falls into the smaller ticket size bracket. PSU projects of 5 to 6 crores and GREC projects of 11 crores have been implemented.

Lloyd Insulations (India) Pvt Ltd

Sector	Engineering Contracts
ESCO Empanelment	BEE (Grade)
Area served	National (In north, east and south region)
Founded	1990
Team strength	<25
Key people	Ajay Singh (General Manager)
Website	http://lloydinsulations.com
Top ECM categories	Thermal Insulation
Typical ticket size	INR < 2 lakhs
Typical payback period	>5 years

Lloyd Insulations is a general ESCO service provider and audit consultant for thermal energy related energy saving services. It has technology tie-ups for measures such as Mactech insulation fibres and water proofing. Lloyd Insulation offers end to end industry solutions by partnering with other OEMs. They specialize in supplying, contracting, and manufacturing of insulation, refractory, pre-insulated sandwich panels, pre-engineered buildings, metallic profiled sheets, fire-proofing and mechanical erection works. It has availed the ICRA ESCO rating.

Based on their thermal and energy audit expertise they can provide unique combination of ESCO services in the thermal systems including study of steam generation, distribution and utilization including flue gas analysis, combustion, condensate recovery, thermal insulation (hot/cold/acoustic) and cooling tower performance evaluation among others. It specializes in compressed air system studies, water pumping system studies, refrigeration & air conditioning system studies, study of electrical furnaces/ ovens, study of DG sets, illumination studies among others.

Lloyd Insulations has undertaken projects supported by bilateral and multilateral funding.

Olive Exports Pvt Ltd

Sector	Buildings, municipal services
ESCO Empanelment	BEE
Area served	Multinational
Founded	1994
Team strength	<25
Key people	Shyam Jindal (CEO)
Website	www.oliveled.in/
Top ECM categories	LED Lighting
Typical ticket size	INR 2 to 5 crores
Typical payback period	It can be 8 months to years depending up on site and the requirement

Olive Exports Pvt Ltd provides efficient technologies in the building and municipal sectors. The organization is managed by professional and technical people. Good infrastructure and experience in manufacturing are Olive's strong points. Energy efficiency solutions are developed in-house.

Olive Exports has undertaken self-funded projects. It implements ECMs in exchange for a fee for service. Olive believes that it is very strong in quality, inspection, and production. Putting big money in ESCO is a bit of a challenge, production is not a big challenge. In fact, we think after product installation, recovery of funds in instalment may be a problem. As there are various of peoples taking care of project and each person have their own understanding with each other. Change in staff at sites and sometime bureaucracy and political situation give variety of threats/questions in putting fund in ESCO. Small companies may get some challenge in recovery.

Promethean Energy Pvt Ltd

Sector	Large and medium scale industries
ESCO Empanelment	Not empanelled
Area served	National
Founded	2014
Team strength	< 25
Key people	KP Ashwin, Rajat Agarwal
Website	www.prometheanenergy.in/
Top ECM categories	Waste Heat Recovery from Chillers and Compressors
Typical ticket size	INR 10 to 50 lakhs
Typical payback period	< 1 year

Promethean is an equipment vendor ESCO involved in designing, manufacturing, supplying and installing ECMs, specifically related to waste heat recovery systems. As a manufacturer, Promethean is comfortable with having tie-ups with other ESCOs as it would be helpful in expansion of sales. Textile, automobile, pharma, food/beverages and dairy are some segments which have a high potential for WHR from chillers and compressors.

Promethean has explored the shared savings model in India. However, even though the ECM is well established technology globally, the sales cycle is long (around 8-9 months) and getting management buy-in is difficult for the ESCO.

PricewaterhouseCoopers (PwC) Pvt Ltd

Sector	Municipalities, Buildings, Industries
ESCO Empanelment	BEE (Grade 2)
Area served	Multi - National
Founded	2007
Team strength	> 70
Key people	Manoj Kumar Bansal (Associate Director)
Website	https://www.pwc.in
Top ECM categories	Municipal street lighting, Municipal water pumping, HVAC, building lighting, building envelope, building automation equipment, drives/pumps/fans/ motor systems, boilers/ furnaces/ burners/waste heat recovery system, solar water heating systems, thermal energy storage system, rooftop PV system, compressed air optimization, power generation equipment, small wind generation system, power distribution equipment
Typical ticket size	INR 2 to 100 crores
Typical payback period	1 to 5 years

PwC provides consultancy and advisory for implementation of solutions through ESCOs. Much of the team is dedicated to the Performance Contracting and Project Risk Management (40%), Sales and Marketing (80%) and Energy Auditing and Accounting (50%). PwC seeks partnership on a project to project basis.

PwC ESCO team takes up comprehensive system energy audit at the client sites in municipal corporations, buildings, industries, among others. Projects include LED-based municipal street lighting projects, waste to energy projects, and implementation of ISO 50001 EM Systems as well as M&V audits. PwC also does Third party verification of ESCO grade projects implemented by other OEMs. PwC supports BEE in policy formulation and other market survey type activities on ESCO business for BEE, as well as awareness and capacity building activities. PwC expertise include conducting feasibility studies, financial modelling, running tendering process, M&V within the ESCO project life cycle. Assessing technology interventions and design of payment security mechanisms.

Energy efficiency technologies are recommended after discussions with multiple technology suppliers. PwC ESCO team takes up through consultancy mode comprehensive system energy audit at the client sites in buildings, industries and municipal corporations, among others. PwC today is one of the largest service provider in ESCO market in India. Till date PwC has executed more than 50 projects in ESCO in municipal street lighting, buildings and industries. The number of ongoing projects is more than 20.

SavEn India Energy Management

Sector	Buildings, MSME
ESCO Empanelment	Maharashtra Energy Development Agency (MEDA)
Area served	Maharashtra
Founded	2010
Team strength	<25
Key people	Praveen Dadhich, Rohit Sharma (Directors)
Website	www.savenindia.com/
Top ECM categories	Lighting, drives/pumps/fans/motor systems, Boilers, HVAC, Air Compressors
Typical ticket size	INR <20 lakhs
Typical payback period	1 to 3 years

SavEn India, a Pune-based company, offers full ESCO services, general ESCO services, efficient technologies and audit consulting in the building and MSME sector. The team is distributed in the departments of general management (12%), design and engineering (40%), sales and marketing (12%) and energy auditing and accounting (20%). SavEn India provides energy management services, assisting clients in purchasing or generating energy at the least cost and managing energy consumption at peak efficiency by adopting best suitable technologies.

Energy efficiency solutions are developed in-house; SavEn has partnered with cutting edge product manufacturers. The usage of new age information technology makes SavEn India different than other companies in this space. Energy savings from the implementation of the solutions are baselined and actual savings are monitored with the help of IOT technologies. SavEn India uses IOT technologies and data analytics to maintain specific energy consumption (SEC) at peak levels even when there are variations in production cycles. In some cases, SavEn India has produced savings up to 50% where normal trend was only 15 to 20%.

SavEn has undertaken self-funded projects. It implements ECMs in exchange for shared savings. Its ESPC aims to ease the fiscal and financial burden on the clients through retrofit solutions which may not require large capital expenditures. SavEn is selective about undertaking ESCO contracts depending on capital availability and the risk profile of the client. SavEn India has completed more than 30 projects under the ESCO model in residences, colleges, five-star hotels and mid-size plants in rubber and defence equipment manufacturing plants. SavEn India has conducted 100+ energy audits in buildings and mid & large-size plants including very big power plants. SavEn India has also conducted energy audit outside of India.

SavEn India has been awarded as ESCO by MEDA and several of its customers too have won MEDA awards.

Schneider-Electric India Pvt Ltd

Sector	Buildings and Large Industries
ESCO Empanelment	BEE Grade 1
Area served	Multi National
Founded	1995
Team strength	21,000+ total employee strength in India with 20 members comprising the ESCO team
Key people	Upendra Pratap Singh (AGM – Energy Consulting), Bindu Thomas (Manager – Energy Consulting)
Website	http://www.schneider-electric.co.in/en/
Top ECM categories	HVAC, lighting, building envelope, building automation equipment, drives/pumps/fans/motor systems, solar water heating, rooftop PV systems, power distribution equipment
Typical ticket size	More than INR 50 Lakhs for a typical ESCO project, of which energy audit and energy management consultancy charges are usually around 5-10%.
Typical payback period	2 to 5 years

Globally, Schneider Electric (SE) executes energy efficiency projects in various environments including data centers, industrial and commercial complexes. It has delivered successful energy service performance contracts (ESPCs) to hospitals, institutions, municipalities and central and state governments.

With our solutions and expertise, we make sure that our customers not only enhance efficiency and sustainability; they also boost the productivity, safety, and reliability of their operations. Together with our customers, we minimize carbon impacts and curb climate change, ensuring sustainable energy for all.

For example, in 2013, for a manufacturing plant in Goa, SE India implemented a zero-downtime seamless transfer solution involving energy management and critical power, which was funded by the client with an investment of INR 6.1 Crores; for which SE India successfully delivered on a 3-year performance contract on a guaranteed savings model.

SE India has always been rated as a Grade 1 ESCO; by CRISIL in 2012 and 2015 and again by ICRA in 2017. Till date, a total of 10 ESCO projects have been undertaken and successfully completed by SE India (one ESCO project is ongoing). SE India has undertaken client-funded projects and provides energy saving services on a guaranteed savings model.

Secure Meters Ltd

Sector	Large industries (petroleum refining, Steel, pulp/paper, thermal), municipal services (MUDSM- Pumps), MSME
ESCO Empanelment	BEE (Grade 1), CRISIL (Grade 1)
Area served	National
Founded	1987
Team strength	25 to 50
Website	www.securemeters.com
Top ECM categories	Drives/pumps/fans/motor systems/M&V Solutions
Typical ticket size	INR 50lakhs to > 15 Crores
Typical payback period	1 to 3 years

Secure Meters offers full ESCO services in the large industries, municipal services and MSME sectors. It offers M&V solutions, server based online solutions and online monitoring systems. It has acquired many European metering technology companies and has in-house manufacturing capability.

Energy efficiency solutions are developed in-house. Retrofitting and optimization are considered before directly replacing pumps – this requires stopping the production line for usually less than a day. Savings from ECMs can be baselined on full/ideal load but actual savings would depend on the client's production cycle.

It has undertaken self-funded projects using the shared savings model and is open to trying other models such as guaranteed savings. It has dealt with municipal corporations in doing shared saving projects without any payment security mechanism in place, completely based on goodwill.

See-Tech Solutions Pvt Ltd

Sector	Buildings, Industrial Utilities
ESCO Empanelment	BEE (Grade 2)
Area served	All over India (Operating from 12 cities)
Founded	1993
Team strength	100
Key people	Milind Chittawar (CEO)
Website	www.seetechsolutions.in
Top ECM categories	Delivering about 20% savings in commercial buildings and industrial utilities
Typical ticket size	INR 50 lakhs to 5 crores
Typical payback period	6 months to 2 years (guaranteed)

See-Tech provides full ESCO services (guaranteed and shared savings) in the commercial buildings and manufacturing sectors. Situation specific energy efficiency solutions are selected, developed, designed and implemented by our team while we remain technology or brand independent in implementing energy cost reduction projects. We also monitor our all sites by dedicated teams to maximize daily savings. We have perfected overall process of delivering savings through 25 energy conservation technologies. Normally we select 8 to 12 of these technologies to deliver 20% savings in overall energy cost. Our top 15 project sites are together delivering savings of more than INR 0.35 Million/day

Areas covered in Commercial Buildings: HVAC, Hot water, boiler, Steam distribution, laundry, kitchen, Lighting, Pumping, Cooling Tower, Fans, Ventilation system etc., Use of knowledge based software for maximizing energy saving, Facility Management Services, Electrical Safety services, Turnkey projects etc.

Areas covered in Manufacturing Sector: Compressed air system, Hot water system, Steam system, Thermic fluid system, Oven, Furnaces (melting, non-melting), Insulation (hot & cold), HVAC system, Fans & blowers, Pumping system, Cooling Tower, Ventilation systems, Humidification system, All types of industrial utilities, Use of EE motors etc. Facility Management Services, Electrical Safety services, Turnkey projects, use of knowledge based software for maximizing energy saving etc.

Shakti Pumps (India) Ltd (SPIL)

Sector	Agriculture, Buildings, municipal services, large industries, Cooling and AC, Renewable Energy, Water supply.
ESCO Empanelment	BEE (Grade 3)
Area served	National
Founded	1982
Team strength	>250
Key people	Dinesh Patidar (CMD), Piyush Patidar, Dinesh Kumar Saxena and Manu Sharma
Website	www.shaktipumps.com/
Top ECM categories	Drives/pumps/motor systems
Typical ticket size	INR > 2 crores
Typical payback period	< 3 years

SPIL is one of the leading manufacturers of pumps & motors along with associated panels and control systems technologies which are developed in-house. The pumps and motors (0.5 HP to 335 HP) are in different sizes of 75 mm to 300 mm. The company is second largest stainless-steel submersible pump sets manufacturer in the world.

The company has also obtained BIS certificate for ISI mark in 1989. Through continuous process improvement and streamlining the quality system at par with international standards, it has now acquired ISO: 9001:2008 certifications. Shakti pumps also specialises in manufacturing stainless steel submersible pump sets ranging between 0.5 to 260 HP. It exports pump sets to more than 125 countries.

SPIL has undertaken client-funded projects. It implements ECMs in exchange for a fee for service. With the range of pumping technologies and controls, SPIL is strongly positioned to offer ESCO projects, in the municipal, residential, and commercial buildings sector. The agricultural sector has many small end users – this makes the ESCO model weak. A market aggregator ESCO can significantly contribute and strengthen the ESCO approach here.

SPIL ventured into energy related services in FY11 by securing a contract for supplying installation, operational and maintenance of energy efficient pumps set, flow meter and energy meter and proving minimum 10% guaranteed saving for reduction of power charges from Public Health Engineering Department (PHED), Bharatpur for 5 years. This is a performance based contract, in which SPIL would incur costs on the supplying, installation and maintenance and the reduction in energy savings would be shared between SPIL and PHED. SPIL has replaced 67 pumps at the five sites namely Bari, Bilada, Nadbai, Nagar and Ransigaon as per the contract with PHED and has delivered an energy efficiency of 33% translating in an income of INR 3.26 crore by making an investment of INR 2.64 crore till CY14.

Siri Exergy & Carbon Advisory Services Pvt Ltd

Sector	Buildings, Municipalities, Large Industries and MSMEs
ESCO Empanelment	BEE
Area served	Multi National (India and some parts of Asia)
Founded	2008
Team strength	< 25
Key people	G Subramanyam (Director)
Website	http://www.siriexergy.com
Top ECM categories	Lighting, building envelope, drives/pumps/fans/motor systems, solar water heating, municipal lighting system, municipal pumping optimisation systems, rooftop PV systems
Typical ticket size	< INR 10 lakhs
Typical payback period	1 to 3 years

Siri Exergy offers general ESCO services, audit consultancy and provision of efficient technologies. The team is distributed in project management (10%), Sales and Marketing (10%) and Energy Auditing and Accounting (80%) functions. Siri Energy has technology tie-ups for super-efficient fans and LED lights based energy conservation measures. It has availed the ICRA ESCO rating.

Exergy efficiency solutions are developed in-house. Siri Exergy notes that savings can be measured directly using metering equipment or baselined on full or ideal load but actual savings depend on client production cycle/building loads.

Siri Exergy has undertaken self-funded projects. It provides ESCO services on a shared savings or pay per unit model.

Siri Exergy notes that repayment from the client is the biggest risk for availing financing for ECMs under ESCO model. Other limitations in ESCO financing include high risk perception of ESCO model at financier end, lack of interest in financiers for projects of small ticket size and inadequate contract enforceability. Siri Exergy also opines that risks associated with repayment are impeding the ESCO market's growth in India and that they can be mitigated through better technical skills in performance contracting.

Smart Joules

Sector	Buildings
ESCO Empanelment	BEE (Grade 3)
Area served	National
Founded	December 2014
Team strength	27
Key people	Arjun Gupta (CEO); Ujjal Majumdar (Director of Operations)
Website	www.smartjoules.co.in/
Top ECM categories	HVAC, lighting, building envelope, building automation and drives/pumps/fans/motor systems
Typical ticket size	INR 50 lakhs to 2 crores
Typical payback period	1 to 3 years

Smart Joules offers full ESCO services in the building sector. The team is distributed in the departments of general management (10%), project management (50%) and technology development (40%). Energy efficiency solutions are developed in-house and implemented in exchange for a share of savings over a fixed period of time. Under Smart Joules' JoulePAYS model, energy savings from the implementation of these solutions are verified by comparing actual energy consumption during the contract period with the customers' historical energy consumption. Smart Joules works with high quality suppliers such as Carrier for air-conditioning, Armstrong for pumping, Philips for lighting, and so on. Smart Joules' self-developed building energy management system is the backbone of its ESCO projects, allowing for constant online monitoring and virtual controls of key energy consuming equipment. It has availed the CRISIL ESCO rating.

Smart Joules has undertaken self-funded projects and other projects supported by international grants. They are particularly strong in the hospitals and hotels segments, having won First Prize in the National Energy Conservation Awards from the Ministry of Power in the hospitals segment for their project at Sant Parmanand Hospital, where they delivered 26% energy savings on a year-on-year & bill-to-bill comparison basis. Smart Joules is now replicating this model in other large hospitals under long-term contract.

Smart Joules is an early adopter of the SIDBI and the PRSF scheme. It is one of the few ESCO's who are willing to borrow on their balance sheet to deliver an EPC. Smart Joules is ready to take risk with new clients (for e.g. hospitals) that are not regular borrowers from banks. They are also in talks with large players in the cement industry and financial institutions to develop a replicable ESCO model for that sector.

STENUM Asia

Sector	Buildings, Large Industries and MSMEs
ESCO Empanelment	BEE (Grade 3)
Area served	Multinational (India and some parts of Asia)
Founded	2007
Team strength	< 25
Key people	Rajat Batra (CEO), Vikas Singh, Sohail Pathan
Website	http://www.stenum-asia.org
Top ECM categories	HVAC, lighting, building envelope, drives/pumps/fans/motor systems, boilers/furnaces/ burners/waste heat recovery, solar water heating, compressed air optimisation
Typical ticket size	INR < 10 lakhs
Typical payback period	< 1 to 3 years

STENUM Asia offers audit consultancy and post audit implementation support in the building, large industries and MSME sector. 90 percent of the team is dedicated to energy auditing and accounting. STENUM Asia has ties with European entities as knowledge partners. Its partnerships evolve to complement its projects. It has availed the CRISIL ESCO rating.

Energy efficiency solutions are developed in-house in close cooperation with the client. Capacity building at various levels of the client organization is an important step that enables real change on the ground. Energy savings from the implementation of these solutions can be measured directly using metering equipment or sometimes at utility/section level. Most solutions proposed have payback periods less than 1 year (typically 6 to 9 months) as these are focused on optimization of existing processes rather than a change in technology.

STENUM Asia is headed by a technical expert and the company has a small team of consultants with unique expertise. Evolving partnerships to suit the project size is their USP. STENUM believes that introduction of certain financial support and guarantee schemes would help grow the ESCO market particularly for the huge MSME sector in the country.

STENUM Asia has undertaken client-funded and bank-funded projects under a fee for service model. It provides energy auditing services and post auditing implementation support in exchange for a Fee. The range of energy audit covers from MSME (covering all types of manufacturing industries), buildings to large thermal power plants. STENUM Asia is well equipped with all the latest and advanced instruments required to conduct energy audits and other assessments.

Suveg Electronics

Sector	Municipal services
ESCO Empanelment	BEE, ICRA, SIDBI
Area served	Regional (Gujarat)
Founded	1985
Key people	Kartik Bakeri (Partner)
Website	www.suvegelectronics.com/
Top ECM categories	Lighting systems (including LED and central monitoring systems)
Typical payback period	4 years (with 11 hours of operation per day)

Suveg provides full ESCO services in the municipal services sectors. It engages in technology tie-ups for central monitoring systems i.e. real-time monitoring systems for measuring savings. The monitoring system is installed as part of the project and adds approximately 30% to the total project costs.

Suveg has undertaken bank-funded projects. It implements ECMs in shared savings model. It is open to trying deemed savings and guaranteed savings models. It would like to expand lighting solutions into the industrial sector on the guaranteed savings model.

Suveg suggests that a provision of a single window for all kinds of approvals and document submission can help expediting the implementation of a project.

Tata Power Delhi Distribution Ltd.

ESCO Empanelment	BEE (Grade 1)
Area served	Regional (Delhi)
Founded	2002
Team strength	<250
Key people	Praveer Sinha (CEO), Sujay Kumar Saha (Head, DSM)
Website	www.tatapower-ddl.com

TPDDL acts as a market enabler for ESCOs and a one cut solution to bring down consumption and reduce electricity bills. It has a business services and a demand side management group. The DSM group launched an AC programme, LED programme and a 5-star fan programme. It undertakes bank-funded projects.

The company has empanelled seven ESCOs and offers a single window solution to customers for carrying out a detailed energy audit and provides recommendations with respect to cost-benefit analysis and payback period, project implementation plan for energy efficiency measures within a defined timeframe, execution of project as per contract with consumer, monitoring and verification (M&V) of energy savings, complying with performance guarantee against annual energy savings or revenue sharing guarantee as per contract with the customers, offering a financing model of consumer investment for capital with performance guarantee from the ESCO.

TPDDL's 'ESCO model for implementing energy efficiency improvement projects' in the commercial and industrial load category has been awarded at the 17th National Award for Excellence in Energy Management as an 'innovative energy saving service' by the Confederation of Indian Industry (CII) in Hyderabad.

Thermax Limited

Sector	Large industries (chemical/fertilizers, cement, textiles, food and beverages, distillery)
ESCO Empanelment	BEE (Grade 2), CRISIL
Area served	Multinational
Founded	1980
Website	thermaxglobal.com/
Top ECM categories	Boilers/furnaces/burners/waste heat recovery (WHR) systems
Typical payback period	1 to 3 years

Thermax provides full ESCO services in the large industries sector. It offers steam and process heat as a service. It engages in audits/ walk-through surveys, investment, installation, and operation of energy efficient solutions. Clients pay for the service on an INR/unit basis. Thermax is presently exploring cogeneration and waste heat recovery with the possibility of third part financing. It has partnered with Babcock and Wilcox for super critical boilers. It is also looking to engage with other ESCOs for equipment leasing. Thermax, as an equipment vendor, wishes to collaborate with system integrator ESCOs in which it would provide performance guarantee to the ESCO in exchange of client-side monitoring and recovery complexity.

Optimization projects are typically classified as retrofits or revamps. Retrofits include the fluidized bed combustion technology for boilers and WHR bottoming cycle retrofits. Revamps include replacing old air preheaters with new ones. Energy efficiency solutions are resold from third parties. Savings can be directly measured using M&V metering equipment – this is not a challenge in WHR systems used to generate power since the parameters to be measured are clearly defined and easily measurable. Thermax uses international benchmarks to set the norms for energy saving.

Thermax has undertaken self-funded projects. It implements ECMs in exchange for shared savings. Funding cost can have a base component to cover the operating and credit cost spread and a variable component based on the savings realized. It has a relatively high minimum threshold ticket size for carrying optimization projects.

APPENDIX

Chapter 5

A comparison of traditional and emerging instruments for EE Financing is captured below.

Traditional structures	Emerging structures
Objective: Showcase the importance of EE measures	**Objective:** Enable EE investments at scale and depth
Instruments: • Dedicated credit lines (Soft loans) • Real estate and Infrastructure funds • Leasing	**Instruments:** • Risk sharing facilities • Energy Services Agreement (ESA) • Green Bonds • On-bill repayment (to Utilities) • On-tax finance (PACE) • Energy efficiency funds • Covered bonds • Secondary Markets
Needs rapid expansion / adoption in India: • Dedicated credit lines (Soft loans)	**Needs rapid expansion / adoption in India:** • Risk sharing facilities • On-bill repayment (to Utilities) • Green Bonds

Some details specific emerging instruments in the Indian market are noted below.

About PRSF – Partial Risk Sharing Facility

Partial Risk Sharing Facility (PRSF) is a guarantee programme to kick start market for energy efficiency projects, managed by SIDBI and extended to PFIs (Participating Financial Institutions).

The $43 million project consists of:

- A partial risk sharing facility of $37 million funded from a Global Environment Facility (GEF) contribution of $12 million backstopped by a Clean Technology Fund (CTF) contingent guarantee of $25 million
- A technical assistance and capacity building component of $6 million funded from GEF that also includes market development, management and information systems and standard documentation systems

Eligibility criteria

- Loan to ESCO or End user entity falling under MSE category
- Min 75% of loan should go towards EE investment
- ESCOs could be BEE empaneled or graded by rating agency

- EE project has to be implemented by an ESCO and an ESPC (Energy Services Performance Contract) has to be signed
- ESCROW / TRA mechanism has to be set up

Extent of coverage

- 75% of loan or outstanding
- Min loan amount of 10 L, maximum loan amount of 15 cr
- Maximum exposure to a single ESCO or End user will not be more than 45 cr (Grade 5 – 40 cr)
- Guarantee tenure will by 5 years or loan tenure, whichever is lower
- Guarantee fee will be slab-wise and based on ESCO grading (up to 1% of loan amount)

Interactions between stakeholders and working of the scheme:

1. Initiation of discussion between ESCO and End user (also known as the 'Host')
2. Identification of energy saving opportunities
3. Decision on shared / guaranteed savings
4. Signing of ESPC contract
5. Borrower (ESCO / End User) approaches SIDBI / PFI for loan
6. Appraisal and loan sanction considering PRSF
7. Submission of PRSF guarantee application by PFI
8. Evaluation of guarantee application by SIDBI
9. Issuance of PRSF guarantee
10. Payment of guarantee fee within 30 days
11. Quarterly report by the PFI
12. Loan closure with guarantee coverage coming to an end

Green Bonds

The institutes who have issued Green Bonds for the Indian ESCO market are below.

- **Yes Bank -** Yes Bank issued country's first green infrastructure bond for $161 million in Feb 2015 with a 10 year tenure and it received an AA+ rating. The issue was oversubscribed by almost two times, demonstrating a huge demand. Yes Bank then issued another 10-year $50 million green bond in Aug 2015 and it was completely subscribed by IFC who subsequently issued an AAA rated Green Masala Bond on the London Stock Exchange for the same amount.
- **Export-Import Bank of India (EXIM) -** EXIM Bank issued India's first ever dollar-denominated green bond in Mar 2015. The 5-year BBB rated bond raised $500 million with a 3x over-subscription.
- **CLP Wind Farms -** CLP became the first Indian corporate issuer of green bonds in Sep 2015 when it raised $90.3 million and receive an AA- ratings and attracted Indian mutual funds.
- **ReNew Power Ventures -** ReNew issued the second corporate green bond in Sep 2015 when it raised $68 million to refinance loans for the company's 85 MW wind power wind power plant. Asian Development Bank (ADB) and India Infrastructure Finance Company Ltd (IIFCL) jointly guaranteed the bond further increasing its rating to AA+.
- **Hero Future Energies -** Hero Group raised India's first certified climate bond in Feb 2016 when it raised $44 million by issuing non-convertible debentures.
- **IDBI Bank -** IDBI raised $350 million in BBB rated 5-year green bonds in Nov 2015 becoming India's first public sector bank to raise funds through green bonds.
- **IREDA -** In Jan 2016, IREDA raised a tax-free $150 million green bond offering investors 7.68 percent interest rate for tenures ranging between 10 and 20 years

Etimate of risk mitigation instruments for industries

The risk mitigation instruments for ESCO financing are Credit guarantee (through schemes like PRSF) and Savings Guarantee (through insurance). This section talks about a high-level approach to estimating the size of the guarantee with INDUSTRIES as an example.

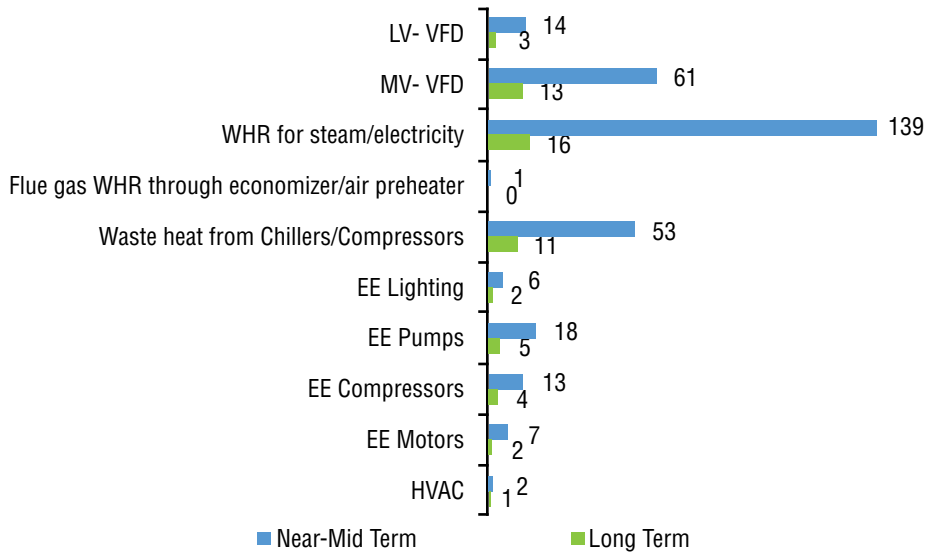
For Savings Insurance, it is assumed that 100% of the projects financed via SPV route will require 100% coverage (of the loan amount) over the next three years (near-medium

term). However, in the long term (3-6 years) as the certainty of realisation of savings increases due to past case examples, only ~50% of such projects are projected to require coverage (assumed 100% coverage of the loan amount).

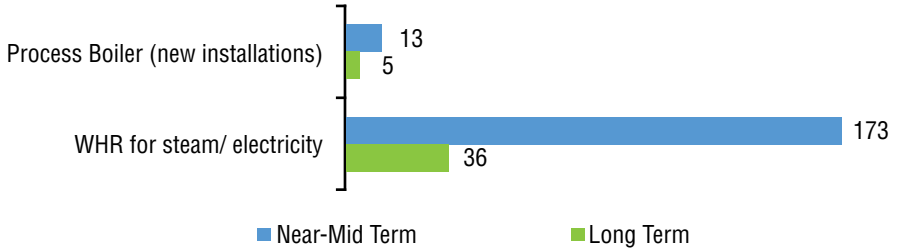
For Credit Guarantee, it is estimated that due to limited evidence, 75% coverage of the debt capital for the 100% projects – both with high rated and non-high rated customers – financed via supplier's credit will required via credit guarantee over the next three years. However, as evidence is created and credibility is established only the 50% coverage is projected to be required for the EE projects with low rated customers in the long term (3-6 years). For calculation purpose, 60% of the customers in the PAT Industries and 30% in non-PAT industries are assumed to be have high credit rating (BBB and above) in the long term. Savings Insurance is primarily needed for financing projects under the SPV route due to their long payback period and high ticket size. Credit Guarantee is mainly required by the projects for the ECMs being financed by Supplier's credit due to low their perceived credibility in the market.

Based on this the following projections has of the required amount for both types of instruments have been done.

Credit Gaurantee Estimated for EE Financing - by ECM (INR crores)



Saving Insurance Estimated for EE Financing - by ECM (INR crores)



Instrument	Near-medium term Potential (INR crores)	Long Term Potential (INR crores)	Total (INR crores)
Credit Guarantee	314	57	371
Savings Insurance	186	41	227

APPENDIX

Chapter 7

Proposed ESCO rating questionnaire

A) General Information

1. Name of the Organization:
2. Address:
3. Year of Establishment:
4. Year of Commencement of ESCO Business:
5. Total number of employees:
6. Total number of employees in ESCO Business:
7. Split of employees in ESCO Business:

Energy Auditors / M&V Professionals	Solution Architects	Project Bidding, Risk Management, Contracting	Project Engineers	Project Managers	Others

8. Certified energy professionals:

Certified energy auditors	Certified energy managers	Certified M&V professionals

9. Split of employees in ESCO business in non-technical roles:

Business Development / Sales roles (min 25% of total target assigned for ESCO business)	Marketing roles

10. Details of key management personnel:
11. Details of Awards / Recognitions:

B) Technical Information

12. Number of energy assignments:

Number of assignments	In last 3 years	Total
Number of energy audits done		
Number of energy consulting assignments other than audits		
Number of energy efficiency projects done		
Number of energy efficiency projects done in ESCO mode		
Number of ESCO projects done in guaranteed savings mode		
Number of ESCO projects done in shared savings mode		
Number of ESCO projects funded by self (ESCO)		
Number of ESCO projects funded by financial institutions		
Number of energy monitoring systems (EMS) projects		
Number of annual O&M projects done for ESCO projects		

13. ESCO projects currently in execution:

Market segment	Investment (INR)	Solutions offered	Shared / Guaranteed Savings

14. Details of projects where promised savings was not achieved, if any:

Market segment	Investment (INR)	Promised Savings (%)	Savings shortfall (%)

Further details of each of the above projects (e.g. solution provided, reason for shortfall, etc.) below:

15. Solution capabilities:

Solution	Number of executed ESCO projects	In-house or Sourced	Typical savings (%)	References

16. Major technology tie-ups with OEMs:

17. Customer references:

Name of the customer		
Address		
Market segment		
Brief details of the project		
Shared / Guaranteed Savings		
Funded by Client / ESCO / FI		
Duration of the project		
Total investment (INR)		
Total estimated savings (INR)		
Actual savings achieved (INR)		
Contact details of customer	Name: Email:	Designation: Phone:

C) Financial Information

18. Revenues of the company:

Year	Revenues (INR)
Revenue forecast for current year (T)	
Revenues of last year (T-1)	
Revenues of earlier year (T-2)	
Revenues of earlier year (T-3)	

19. Revenues from ESCO business:

Revenue item	Achieved in last year (INR)	Forecast for current year (INR)
Revenues from energy audits and consulting assignments		
Revenues from energy efficiency projects		
Revenues from ESCO projects		
Revenues from EMS projects		
Revenues from others		
Total Revenues from ESCO business		

20. Investment in ESCO business last year (INR):

21. Estimated investment in ESCO business in the current year (INR):

22. Estimated CAGR for ESCO business over the next three years (%):

D) Attachments

23. Company profile with 3-year Financial statements of the company

24. 3-year Financial statements of the ESCO division

25. Organization structure of the ESCO business

26. Audit instruments owned by the company

27. Customer / Partner testimonials and Awards, Certifications and Recognitions

28. Details of one reference where a project due diligence can be done

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