Telangana - INDIA

Identifying and Prioritizing Energy Efficiency Opportunities in Telangana

This report was developed by ICF under USAID's Energy Efficiency for Clean Development Program (EECDP), a Leader with Associates Award Cooperative Agreement. EECDP promotes sustained and achievable reductions in energy use and associated greenhouse gas (GHG) emissions through analysis and capacity building. Since 2011, EECDP has worked with USAID missions globally on projects addressing key questions and critical barriers around energy efficiency to enable strategies that can be expanded across countries and regions. Project locations include Bangladesh, El Salvador, Ghana, Indonesia, Kazakhstan, Mexico, Mozambique, South Africa, and Tanzania.

EXECUTIVE SUMMARY

Over the last several decades, demand side energy efficiency and demand response have become essential cornerstones of clean energy strategies in mature markets. If deployed as a "first fuel" at a large scale, energy efficiency can keep demand growth manageable and allow clean energy sources to achieve rising market shares. When used to lower peak demand, energy efficiency and demand response (i.e. curtailing or shifting periods of energy consumption) are also less expensive than most supply options. In the utility industry, these opportunities are referred to as demand-side management (DSM) programs since they displace the need to purchase more power or build new power plants—considered *supply side resources*. DSM strategies can ensure lower customer bills, lower total system costs (which leads to lower tariffs over time), lower total emissions, and improved system reliability and resiliency.

A fundamental barrier to wider adoption of DSM measures in developing countries is the difficulty of selecting high-impact measures and designing the corresponding implementation strategies, while addressing significant development-related market barriers. Using a data-driven approach, the ICF team developed a methodology to evaluate the viability of demand side management energy efficiency programs using information on country-specific indicators and fundamental building blocks for energy efficiency. Through discussions and reviews with local stakeholders, along with research and the construction of a database of energy-efficient technologies specific to Telangana, the ICF team profiled the applicability and viability of opportunities to scale up energy efficiency.

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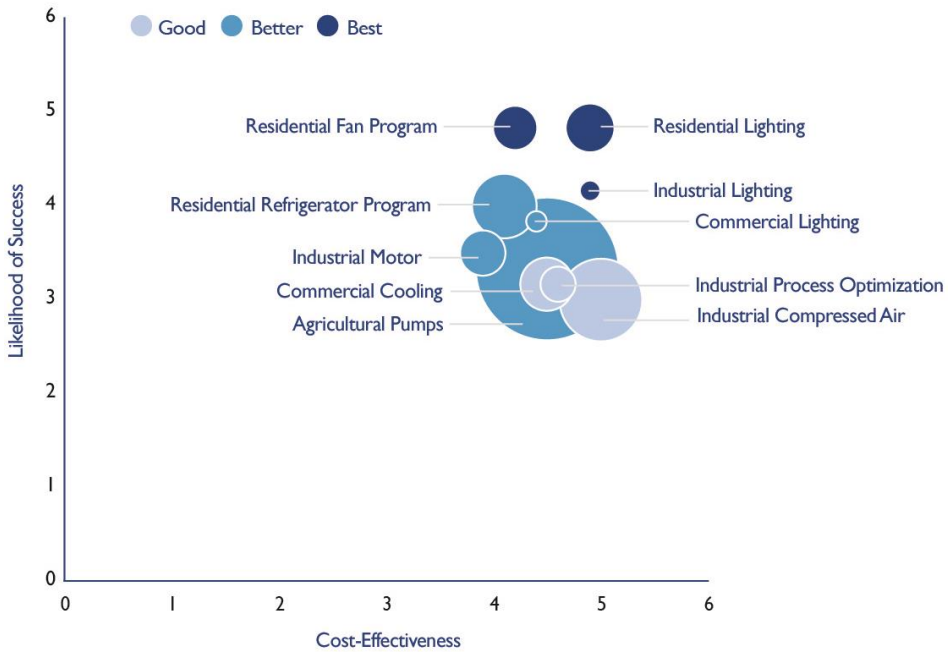
The most promising program areas for Telangana (TS) are listed in Exhibit 1, below. The 'best' energy efficiency programs are Residential Lighting, Residential Fans, and Industrial Lighting, as they were assessed to be the most cost-effective and have the highest likelihood of successful implementation (upper-right side of chart). However, the study identifies ten programs in Exhibit 1 which all present strong investment opportunities to cost-effectively scale up energy efficiency. The top ten energy efficiency opportunities together amount to a technical energy saving potential of 33,257 GWh in 2018. These programs are identified using the following metrics:

- Likelihood of Success: A review of each energy efficiency opportunity across six country-level indicators assesses the associated risk. The higher the score, the higher the likelihood of success of that individual energy efficiency opportunity.
- Cost-effectiveness: Local data collected n product costs and energy savings potential is used to calculate the cost-effectiveness of each energy efficiency opportunity. The higher the score, the higher the cost-effectiveness of that individual opportunity.
- Size of Opportunity: The area of each circle indicates the size of the energy savings potential of each energy efficiency program.

Exhibit 1. Top ten energy efficiency opportunities for Telangana



INTRODUCTION

Energy efficiency holds great potential to contribute to development objectives and key policy priorities in emerging markets. Policy priorities include expanding energy access enabling low emission development. Strategies include promoting sustainable social and economic development while reducing greenhouse gas (GHG) emissions. Through strong energy efficiency, costs to expedite clean energy and upgrade transmission and distribution systems can be reduced, and families and businesses can save money on their utility bills.

The *Energy Efficiency Opportunity Study*, implemented under USAID's EECDP, demonstrates a rapid assessment methodology developed by ICF for identifying the programs and measures with the greatest likelihood of cost-effectively lowering energy demand through efficiency. The Opportunity Study gives the policy makers of Telangana information and tools to make decisions on the best investments in energy efficiency policy and programs. Telangana was selected as one of two states in India along with six other countries to pilot the methodology. Results of this study will contribute to a robust, flexible framework that can be applied worldwide on a country-by-country basis.

The significant variability between countries and states in terms of energy tariffs, subsidies, energy intensity, and general market readiness, means that measures that work well in one setting at a particular point in time, may not work well in others. The uncertainty over what strategies to invest in can cause efficiency to be deprioritized in favor of policy and program solutions that are better understood. For long-term growth, increased certainty on energy efficiency investments and improved understanding of the areas that build market readiness for scaling up energy efficiency is required.

METHODOLOGY

Energy efficiency concepts and pilot projects have been implemented for some time in Telangana, and much of the important market infrastructure needed to support future programs and greater impact is in place or under development. In order to identify the energy efficiency programs that represent the best investments in TS today, three sets of data were considered: (1) cost and savings information, (2) the applicability of energy efficiency measures (i.e. country-specific indicators), and (3) market readiness and enabling environment (i.e. "energy efficiency building blocks"). Using all three of these sets of data together makes it possible to integrate energy efficiency into emerging markets. Elements of the framework are described in more detail in the following sections.

The ICF team encoded the analytical framework in a software tool: the USAID Opportunity Assessment Tool, which uses Microsoft Excel to create a simple visual way to record information collected for each data type, and to identify energy efficiency programs with the highest potential for and likelihood of success. The user-friendly tool is designed for USAID and local stakeholders implementing programs in developing countries. Users can select their country, and then proceed through additional steps to determine country-specific energy efficiency program recommendations. The assessment includes scoring the country-specific indicators for each program under consideration, and evaluating the building blocks for energy efficiency through a standard set of questions

The ICF team held meetings with the following key stakeholder organizations in November 2016: Bureau of Energy Efficiency (BEE), Energy Efficiency Services Limited (EESL), and Telangana State New and Renewable Energy Development Agency (TNREDCL) of Telangana.

The stakeholders and ICF team discussed energy efficiency opportunities, financing avenues, and efficiency-related initiatives. They also described barriers for energy efficiency programs, relaying concerns about market conditions, capacity building, and access to international markets. In January 2017, the ICF team returned to

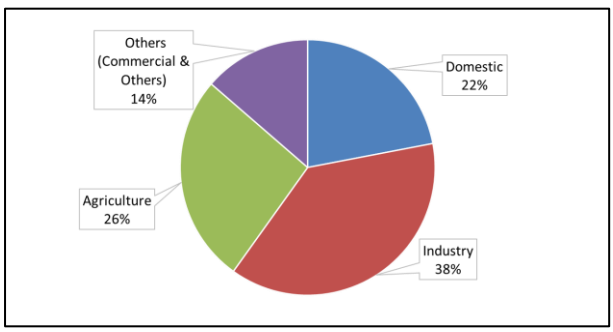
Hyderabad, TS to meet with stakeholders a second time to present preliminary findings and collect feedback on assumptions and the functionality of the tool. ICF met with additional stakeholder organizations, including BEE, EESL, and other government departments in TS. A description of each organization and list of associated contacts can be found in Appendix A.

COUNTRY ASSESSMENT

Cost and Savings Information

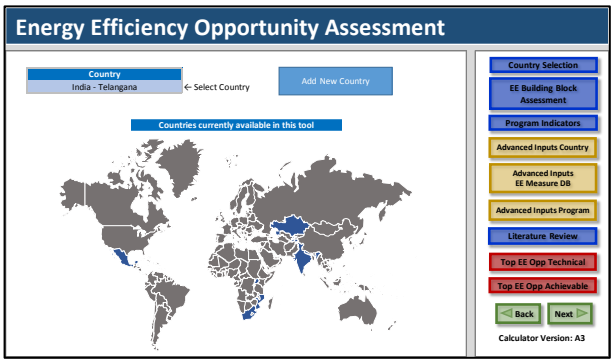
The collection of explicit costs and energy savings data for a particular country is required to calculate the potential impact of energy efficient measures and programs and make comparisons. To do this, the ICF team created a database of costs specific to TS using literature review, regional pricing information, discussions with key stakeholders, and results from pilot projects, case studies, and energy audits. Research into energy consumption at the sector- and end-use levels (e.g. industrial motors, residential lighting) was conducted using international data sources to ensure that the savings associated with individual measures were properly allocated and could be compared against total consumption (see Figure 1).

Figure 1. Electricity consumption in Telangana (residential, industrial, agricultural, and commercial & public services)



Step 1 of the tool involves selecting India – Telangana (TS) – India from the list of countries currently available in the tool (see Figure 2).

Figure 2. USAID Energy Efficiency Assessment Tool



Once a location is selected, the tool generates a ranking of energy efficiency programs by cost and energy savings (see Figure 3). The distribution in the graph shows which programs have the lowest cost and the largest impact, thus being the most cost-effective if no barriers were present in the market.

Programs are designed to promote individual measures, such as industrial motors, or bundles of related measures, such as various residential appliances. Table 1 lists the programs evaluated for TS and the technologies bundled for each one. Costs are defined in terms of costs per kWh saved. Measures estimated to deliver large energy savings for little investment are shown as low, long bars, close to the horizontal axis. Impact is based on energy savings estimates, as well as sector-level and end use consumption to determine the potential for savings.

Stakeholders can use the graph to compare program costs to the standard rate or tariff in the country to show how competitive energy efficiency is when compared to increased generation. The total cost of each program can be determined based on the area of each column. Note, these costs are exclusive of any program or administrative costs and only represent the cost-effectiveness of the energy savings measures included.

Figure 3. Top energy efficiency programs ranked by cost-effectiveness

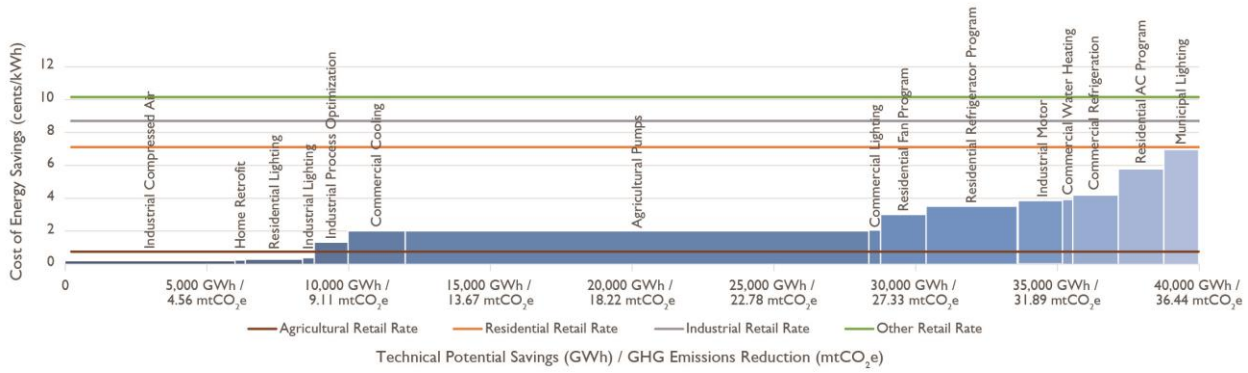


Table 1. Cost-effective programs assessed for Telangana

Program	Technologies Included
Residential Lighting	Replacement of ICL with LED
	Replacement of CFL with LED
Residential Refrigerator Program	Efficient Refrigerators - 5 Star
Residential Fan Program	5 Star Energy Efficient Fan
Residential AC Program	Energy efficient AC- 5 star (Household)
Commercial Lighting	FTL with LED
	LED Fixture Lighting
	T5 Lighting
	LED Down Lighting
Commercial Cooling	Energy efficient AC- 5 star (Commercial)
	Dual Enthalpy Economizer
	Preventative Maintenance
	Set Point Adjustment
	VSD/VAV on Chiller System
	Install Building Energy Management Systems
	New Construction Design Assistance
Commercial Water Heating	Hot Water Pipe Insulation
	Solar Hot Water Heater
Commercial Refrigeration	High Efficiency Solid Door Freezer
	High Efficiency Refrigerated Vending Machines
	High Efficiency Multi-deck Cooler
	High Efficiency Reach-in Cooler
Home retrofit	High Performance New Homes
	Window Shade
	Roof Insulation R-19

	Double Glazed Windows U-Value = 3.41 W/m2K and SHGC = 0.27
	Double Glazed Windows U-Value = 1.99 W/m2K and SHGC = 0.3
	Double Glazed Windows low E U-Value = 1.8 W/m2K and SHGC = 0.4
Industrial Lighting	T8 LED tube Lighting
	LED Fixture Lighting High Bay
Industrial Motor	Properly Sized Motors and Optimized Drives
	High Efficiency Motors
	Variable Frequency Drive
Industrial pumping	Energy efficient pumps
Municipal Lighting	Energy efficient LED street light
	Solar based LED street light
Municipal Pumping	EE pumps in municipalities
	VFDs in Municipal pumps
Agricultural Pumps	Energy efficient Ag pumps
	Solar based pumps
Industrial Compressed Air	Air Compressor Controls (demand)
	Alternate Compressor
	VFD Compressor
	Reduce Compressor Leaks to <10%
Industrial Lighting	LED Fixture Lighting Low Bay
	T5 Lighting Low Bay
Industrial Process Optimization	Process Heating Pipe Insulation (R-5 insulation)
	Process Heating - Automated Temperature Control
	Heat Pumps for Process Water Heating
	Heat Recovery from Condensate
	Waste Heat recovery
	Energy Audit of Industries
	Install Power Factor Optimizer
	Energy Management System - Cooling Plant Optimization
	Replacement of resistive heater coils with automated cycling controlled infrared lamps

Country-Level Indicators

Critical factors that contribute to the feasibility and impact of individual energy efficiency programs vary on a country-by-country basis. These factors include the price and accessibility of technologies, the expertise of the service industry to install and maintain equipment, and the willingness of energy users to invest in efficiency. Because these factors are vital to program success, ICF developed a set of indicators to help identify programs with the highest likelihood of achievement.

To judge the applicability and market-readiness of a given program, it is assessed across six dimensions in terms of its anticipated level of impact using a 1 to 5 score (see Table 2 for a description of each indicator). These dimensions were developed based on factors included in program evaluation methodologies used in emerging economies combined with ICF's more than 20 years of experience designing and implementing energy efficiency programs. This framework is being tested and refined as a part of this project. Engagement with stakeholders in different countries covered by this study will provide the proper vetting and feedback needed for further improvement.

Table 2. Description of Country-Level Indicators

Indicator	Description
Market Transformation Potential	The potential for programs to influence their relevant market channels over the long run (e.g., the extent to which the program may change retailer stocking practices over time) and the likelihood of changing purchasing decisions (e.g., the probability that consumers would buy energy-efficiency products once a financial incentive is no longer available).
Political Feasibility	How likely local utility and government stakeholders are to accept and support the program. Without buy in from key stakeholders, a program is likely to never make it out of the planning stage. This may be affected by key stakeholders having backed a similar program in the past that did not have positive results.
Program Complexity	Marketing, administration, and evaluation burden all add to the complexity of implementing programs. This factor is evaluated based on available resources, experience, and expertise in these areas. The score could be high if a particular country has implemented similar programs recently that can be leveraged when implementing a new activity.
Environmental Aspects	The lifecycle impact of the program on waste, water use, and emissions. For example, if facilities and infrastructure for recycling CFL lamps are not present in the country, a CFL lighting program may score poorly in that country.
Economic Aspects	The potential to increase jobs and development of the local manufacturing industry. If, as a part of the program, manufacturing demand is increased or jobs are created as people are needed for energy audits or installations, this score will be high.
Equity / Affordability	How a program would perform in providing DSM options to customer class within each of its target sectors. The score relates to the relative benefit to one particular market segment over another.

Indicators for each energy efficiency program considered under the evaluation are scored using a scale of one (1) to five (5), with five (5) representing the highest probability of success for a program within a given indicator, and one (1) representing the lowest or no probability of achieving positive outcomes for a given indicator (see Figure 4). These are subjective scores and are intended to be sensitive to shifts and changes in the marketplace.

Programs are scored based on information gathered through direct conversations with key stakeholders in addition to literature reviews. While not an exact science, the scores should represent the best available information and understanding of the market at a particular point in time. Scoring for each of the country-specific indicators should be modified as more information becomes available and as markets mature through growth in technology availability, technical capacity, and in other areas including policy that enable new program opportunities with greater impact potential.

Once the assessment tool has identified energy efficiency programs that are cost-effective for a specific country, the indicator scores are used to further assess each program on the viability of implementation. This shifts the focus onto those programs that have a high chance for success in a particular marketplace. As an illustration of how these scores were assessed for programs in TS, the reasoning behind several of the selections are outlined, below.

- The Residential Lighting program is scored with a *Market Transformation Potential* of 5 because household customers are likely to understand and value the savings that result from this program, causing them to continue to invest in high efficiency lighting in the future.
- The Municipal Lighting and Municipal Pumping programs are scored with a *Program Complexity* of 4 since the programs are relatively straightforward to design, implement, and manage. Additionally, the EESL, with support from the Asian Development Bank (ADB), is helping municipalities in states to design and implement energy efficiency programs for lighting and pumps.
- The Home Retrofit program is scored with a *Program Complexity* of 1 because it very difficult to administer and ensure savings for this type of comprehensive program.
- The Residential air conditioner (AC) program is scored with an *Environmental Aspects* of 5. It is anticipated that a new, energy efficient AC will not only save energy but will use environmentally-friendly refrigerants to reduce the overall impact on climate.

Moving forward, these indicator scores can be adjusted directly by stakeholders who are working in these markets.

Figure 4. Scoring summary for Telangana country-level indicators

Program Name	Market Transformation Potential	Political Feasibility	Program Complexity	Environmental Aspects	Economic Aspects	Equity
Residential Lighting	5	5	4	5	5	5
Residential Refrigerator Program	5	4	3	5	4	3
Residential Fan Program	5	5	4	5	5	5
Residential AC Program	5	4	2	5	3	1
Commercial Lighting	4	4	3	5	3	4
Commercial Cooling	3	3	3	5	3	2
Commercial Water Heating	3	4	2	5	3	1
Industrial Motor	5	4	3	3	2	4
Industrial Process Optimization	4	3	2	4	3	3
Industrial Lighting	4	4	4	5	3	5
Industrial pumping	5	3	3	3	3	3
Municipal Lighting	4	4	4	4	3	4
Municipal Pumping	4	4	4	4	3	4
Agricultural Pumps	5	4	2	5	2	2
Commercial Refrigeration	3	3	3	5	3	2
Industrial Compressed Air	4	2	2	4	3	3
Home retrofit	4	1	1	3	3	2

Building Blocks for Energy Efficiency

An enabling policy and market environment significantly improves the opportunity for success and long-term impact of individual energy efficiency programs, as well as the continued uptake of related practices and technologies, as discussed above under Country-Specific Indicators. With this in mind, the ICF team categorized areas of the market that affect the opportunity and potential impact for energy efficiency into six building blocks. The building blocks are derived from ICF's 20+ years of experience designing and implementing energy efficiency programs across North America, Europe, and developing countries. This approach builds on and complements informal guidance on building blocks for renewable energy from USAID's Global Climate Change Office (i.e. grid integration, smart incentives, competitive procurement of generation capacity, locational concentration, climate planning, and financing support). The building blocks further encompass recognized drivers and barriers for energy efficiency (IEA 2010). While there are certainly additional factors that lead to strong country-level support for efficiency, these non-country-specific building blocks were developed as the most relevant for success.

The building block assessment does not affect the final ranking of energy efficiency opportunities; however, the results inform future activities that seek to improve the enabling environment for energy efficiency. Strengthening the market through each of these building blocks promotes market transformation and scaling of energy efficiency by reducing the most significant barriers.

Market characteristics associated with a strong environment for energy efficiency include effective policies, easily accessible information, and technical expertise (RCEEE 2015). Each of the six areas are equal in importance and no specific

order to their development is required. A careful assessment of the available opportunities to strengthen each of these areas can advance needed infrastructure, provide support to energy efficiency activities, and lead to greater energy savings and emission reduction impacts.

- **Skilled Workforce** represents the presence of a local network that can support the important processes of identifying and implementing energy efficiency improvements. An effective network includes trained professionals to perform energy assessments and other analyses for residential, commercial, public, and industrial buildings, as well as technicians to install and service energy-efficient equipment and building components (e.g. energy management systems, lighting, windows, and insulation). This network can be developed through partnerships with universities and professional trade organizations, and should include mechanisms to provide workforce training and certifications that help the service and professional industries keep pace with technical and strategic advances in energy efficiency.
- **Financing Support** refers to recognition among banks and other lenders of the need for and potential return on investment from energy efficiency. Financing can be an essential building block in helping overcome the capital-cost barrier associated with higher-cost/greater-savings energy efficiency investments. Public policies and lending practices that enable energy efficiency project finance can be key to increasing initial consumer investment in efficiency, and thus delivering the many associated economic and environmental benefits.
- **Public Awareness** of energy efficiency, including the understanding that efficiency means getting the same level of service with less energy, is a fundamental building block across most end-use markets. Awareness is foundational to energy consumer interest in and action on efficiency investment; it is, therefore, important that consumers are not only aware of the cost and environmental savings that efficiency provides, but also know about strategies to improve efficiency.
- **Regulatory Mechanisms** and policies that support energy efficiency can include building energy codes, product and appliance standards, requirements for energy audits, utility regulatory reform to encourage utility investment in efficiency, and national or regional energy efficiency targets. These are effective at influencing the market to adopt efficiency technologies, building designs, and operating practices. Standards also set a baseline that can reduce costs by establishing a reliable market for these products.
- **Smart Incentives** include subsidies or rebates offered to encourage the purchase and installation of energy-efficient products or the purchase of a service to promote efficiency, such as a building audit. Incentives are particularly effective when promoting new or unfamiliar technologies and related services. Energy-efficient products often enter the market with a higher initial cost even though they offer greater cost savings over time. Smart incentives can influence skeptical customers to try out products and services, and then be phased out as those technologies and strategies become more accepted and consumers have a greater understanding of their value.
- **Technology Development** is critical to sustainable market transformation for efficiency. In order for efficient products to be purchased, they must be easily identifiable, deliver consistent energy performance, and not be cost prohibitive. The necessary infrastructure for producing, testing, and labeling quality products needs to be in place for this to be ensured. This can include in-country or regional testing and labeling protocols and programs. Promoting the energy-efficiency technologies and labels, and showcasing country-specific application of technologies, are also important.

The Opportunity Study Assessment Tool provides users with a list of yes/no questions about barriers related to each building block. The answers determine how well developed, or under developed, a building block area is in the current

market (see Figure 5).

Figure 5. Energy efficiency building block responses for Telangana

#	Building Block Present?	Building Block Description
Skilled Workforce		
1	Yes	Trained professionals that focus on identifying energy efficiency opportunities (Ex: energy auditors or home energy raters)
2	Emerging	Network of actors in government, utility, and private sector are well connected and able to work together to deliver energy efficiency programs
3	Yes	Energy Services Companies (ESCOs) exist and energy performance contracts are able to be contractually upheld under current regulatory framework
4	Emerging	Government and/or industry effort to collect and maintain inventory of energy efficient technologies exists
5	No	Standard training or certification exists for performing energy efficiency assessments in buildings
6	Yes	Standard training and certification for performing energy efficiency assessments is widely adhered to
7	Emerging	Tools and models to analyze energy efficiency opportunities are available to energy professionals
8	No	Tools and models to analyze energy efficiency opportunities are available to financial professionals
Financing Support		
9	Emerging	Significant funding for energy efficiency measures
10	Emerging	Consumers are not discouraged by high initial cost of implementation of energy efficiency measures
11	Emerging	Energy efficiency perceived as low risk/high return investment
12	Yes	Government incentives to buy down first cost of new technologies exists
Public Awareness		
13	Emerging	Customer awareness level of energy efficiency programs (incentive offerings) already in place is high
14	Emerging	Consumers have previous positive experience with energy-efficient products achieving marketed claims
15	Emerging	High consumer/purchaser knowledge of energy efficiency - allows customer to make informed decisions when purchasing products
16	Yes	Current energy efficiency programs are accessible to and positively affect all levels of income
Regulatory Mechanisms		
17	Yes	EE legislation to leverage municipalities and companies to implement energy efficiency
18	Emerging	Country/utilities have clear short and long term goals for energy development/expansion
19	No	Building energy codes for commercial/residential buildings have compliance mechanisms in place
20	Yes	Building energy codes for commercial/residential buildings exist
21	Emerging	Energy Efficiency contributes to local/regional plans such as Low Emission Development plans (LEDs)
22	Emerging	Energy prices reflect true cost of production, procurement, and transmission (i.e. not subsidized)

23	Not Applicable	Mechanisms in place to assist on this issue of those financing the energy efficiency measures (e.g. building owners) paying cost, but only users benefiting (e.g. tenets)
24	Not Applicable	Limited taxes or tariffs are collected on the import of energy-efficient products, keeping prices reasonable
25	Yes	Governmental functions operate independently of energy sales (i.e. municipalities and governments are not dependent on energy sales)
Smart Incentives		
26	No	Residential demand side management programs with incentives exist
27	Emerging	Commercial demand side management programs with incentives exist
28	No	Industrial demand side management programs with incentives exist
29	No	Tax incentives for purchasing specific energy-efficient products exist
Technology Development		
30	Yes	Testing facilities for energy-efficient products exist in country/region
31	Yes	Appliance energy rating standards exist and are complied with
32	Yes	Non-energy benefits (i.e. cascading benefits of utility bill reduction, avoided emissions, job creation) are included in EE planning and cost-effectiveness
33	Yes	EE measures capable of modifying market behavior even after incentives are removed

As an illustration of how these barriers were assessed for TS, the reasoning behind several selections are outlined, below.

- "Building energy codes for commercial/residential buildings exist" is marked as present for TS under the Regulatory building block since the state government has made adoption of energy conservation building code (ECBC) mandatory in Telangana.
- "Industrial demand side management programs with incentives exist" is marked as not present under the Smart Incentives building block because utilities in TS do not offer any incentive program to reduce the cost of energy efficient technologies in industrial sector.
- "Tools and models to analyze energy efficiency opportunities are available to energy professionals" is marked as emerging under Skilled Workforce, since several agencies such as Energy Efficiency Services Limited (EESL), Shakti Sustainable Energy Foundation, Natural Resources Defense council (NRDC), and others are working with the TNREDCL to build technical capacity and provide tools and models to professionals for energy efficiency implementation.

RESULTS

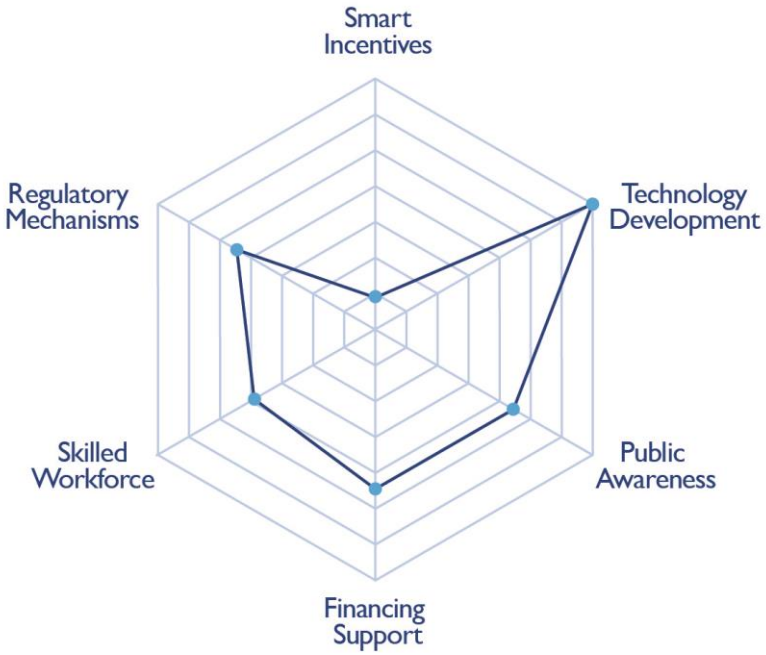
After completing the steps of the assessment framework (i.e. cost/savings information, indicators, and building blocks), a clear picture emerges of current support in the market for energy efficiency, and the programs with the greatest chance of success and impact in Telangana and are the best investment opportunities at this time. The tool uses simple graphics to display this information and help users determine the most suitable energy efficiency program to pursue under different market conditions. This section summarizes the building blocks assessment as well as the program indicator rankings and program impact estimates, integrating these three data types into an overall assessment of the top 10 energy efficiency opportunities for TS's power sector.

Energy Efficiency Building Block Results

The results of the building block assessment for TS

are displayed in Figure 7, below. Areas that are well-developed in the marketplace and have few barriers are marked further from the center of the chart.

Figure 7. Building blocks for energy efficiency in Telangana



For TS, smart incentives and capacity building are the areas of the market most in need of development to support the deployment of energy efficiency programs. Examples of improvements that can be made to strengthen these building blocks include introducing programs that offer smart incentives (e.g. subsidized refrigerators, lighting, industrial motors programs or appliance trade-in programs), and availability of analytical tools and models to help TNREDCL staff and other stakeholders in analyzing energy efficiency opportunities in the state. Additionally, a platform for public and private sector professionals to come together and engage in regular discussions on energy efficiency opportunities and relevant government's policies could also help in greater implementation of energy efficiency programs in the state.

Top 10 Energy Efficiency Program Results ("Opportunities")

To advance energy efficiency under current market conditions, the Opportunity Assessment Tool identifies ten programs with significant potential for impact. Figure 8 shows the cost-effectiveness of each program on the horizontal axis, and the likelihood of success (based on country-level indicators) on the vertical axis. The diameter of each circle represents the amount of energy savings associated with each opportunity. These top 10 opportunities, shown in Figure 8 and 9, combine the results of the cost-effectiveness calculations, energy efficiency indicators, and the amount of the energy savings in a three-dimensional view of how energy efficiency program options are likely to perform in Telangana.

Figure 8. Top ten energy efficiency opportunities for Telangana.

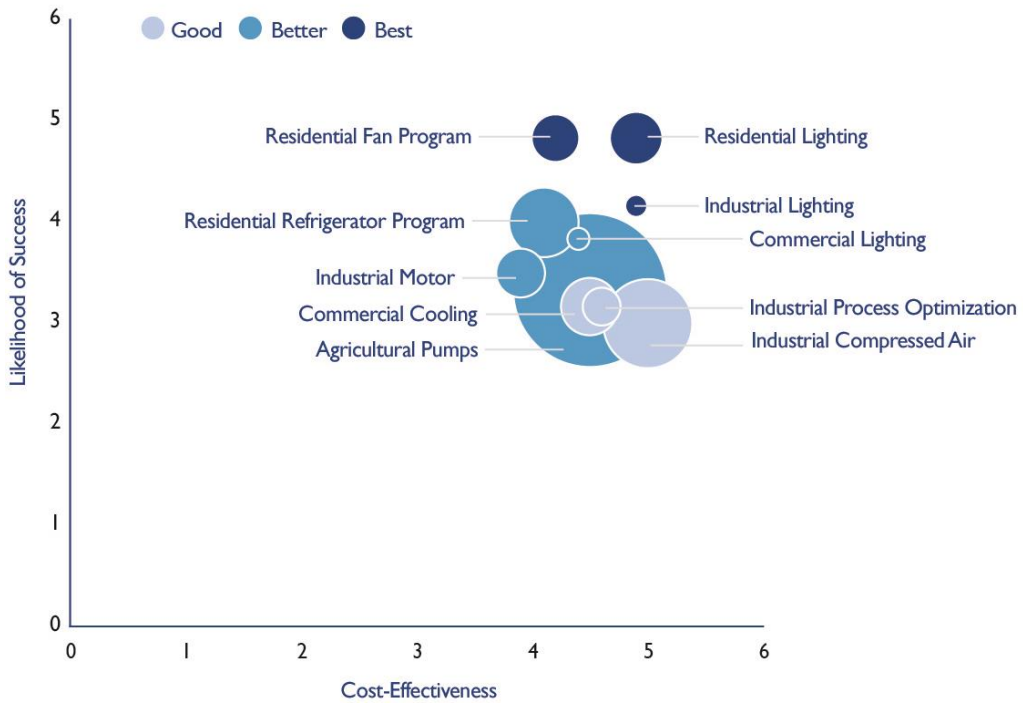


Figure 9. Top ten energy efficiency opportunities for Telangana

Program	Estimated Energy Savings (GWh) in 2018
Residential Lighting Program	1,994
Residential Fan Program	1,581
Industrial Lighting Program	301
Residential Refrigerator Program	3,163
Commercial Lighting Program	166
Industrial Motor Program	1,626
Agricultural Pumps Program	15,803
Industrial Process Optimization Program	1,028
Commercial Cooling Program	2,173
Industrial Compressed Air Program	5,421

Each of the energy efficiency opportunities listed above deserves consideration for implementation as they all represent proven, cost-effective strategies. Top ten energy efficiency opportunities together amount to a technical energy saving potential of 33,257 GWh in 2018.

For Telangana, Residential Lighting, Residential Fan Program, and Industrial Lighting, are the most cost-effective opportunities with a high likelihood of success given the program level indicators as assessed at this time. In particular, residential and industrial lighting programs have significant technical potential (over 2000 GWh) and are relatively easy to implement and therefore more likely to be successful. In addition, the Agricultural Pumps and Industrial Compressed Air programs are attractive option as they are cost-effective with larger amount of energy savings potential (together over 20,000 GWh) and their likelihood of success will improve due to the associated visibility with stakeholders.

Two types of support need to be provided as next steps to pursue any of these top ten highly impactful programs: (1) technical program design support, and (2) program implementation support.

First, technical program design needs to be performed to take this analysis to a level of specificity that can be used within a particular area of the state or sector. This support includes advancing beyond the technical energy efficiency potential calculated in this report, to calculate achievable energy efficiency potential. From this estimated potential, incentive levels or cost-levels that can be borne by the program are then calculated and a program offering is designed. A program offering includes many details on the administrative structure, markets methods, and delivery channels for the program. Program design also includes a process for approving and documenting program projects, along with aggregating energy and emissions savings from the program.

Second, program implementation support includes further research into specific program opportunities through stakeholder engagement. Other stakeholders involved in this process include municipalities, relevant government departments, as well as the local electricity distribution companies.

During this phase, it will be important for stakeholders to work together to gather and analyze data. For instance, the Bureau of Energy Efficiency (BEE) and Energy Efficiency Services Limited (EESL) have worked diligently to collect relevant data from utilities, industries and others in TS, which could be very helpful for local utilities in program design and implementation. Plans to facilitate the regular collection of energy consumption and GHG data from industry by collecting it electronically in the near future may be helpful in program design and implementation.

DISCUSSION

Increasing energy efficiency is a cost-effective strategy to accomplish a number of objectives. Reducing the amount of electricity needed to run machinery at industrial plants, light office buildings, and homes, for example, is widely recognized as having a beneficial effect on the entire power sector. Delivery of electricity can be more consistent and investments in transmission and distribution upgrades can be scaled back. Energy efficiency also can be incorporated into power sector planning to accomplish a significant share of GHG emission reductions. Energy efficiency offers an opportunity to reduce the cost of adding new clean and high-efficient generation technology by reducing the total amount of generation needed. The cost to reduce energy demand, through energy efficiency programs, is cheaper than the cost of building new generation to supply the same amount of power.

It is important to highlight that efficiency also supports sustainable economic growth and important USAID and state government's objectives in other ways. Efficiency is implemented through trainings and skill development, investment by businesses and homeowners in new technology, and the creation of new services. Not only are energy efficiency programs making investments in energy demand reduction, they are investments in local businesses and long-term

jobs.

The main challenge for the Government of Telangana in capturing all of these benefits, particularly through policy, is the need for more and higher quality data to support analysis and evidence-based decision-making and sufficient resources (financial and human) as Telangana is a new formed state.

This analysis, including the application of the tool, does not replace a comprehensive energy efficiency potential study, nor capture all of the barriers to implementation for energy efficiency programs. By identifying the top ten energy efficiency opportunities in TS, the goal is to bring energy efficiency into the conversation on power sector planning and economic development in the state. By communicating the scale of potential impact and focusing on a small set of areas where success is likely to be achieved, the results empower further action and cost-effective next steps for program design.

The ICF team designed the tool to be updated to reflect changes in areas of the energy efficiency market, more reliable and disaggregated energy end use information and measure costs. Modifying the tool to reflect newly available financing or a reduction in the price difference between an energy efficient product and its conventional counterpart, for example, will shift the likelihood of success for some measures. Over time, strengthening of the information used in the tool will enable more sophisticated assessments and efficient identification of the most attractive energy efficiency opportunities.

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APPENDIX A

The ICF team met with public and private organizations that had a significant role in understanding and shaping future energy efficiency programs.

Organization	Contacts	Description
Telangana New & renewable Energy Development Corporation Ltd. (TNREDCL)	A. Sudhakar Rao G. Satya V Prasad Hemanth Kumar Pavan Kumar	State Nodal agency for Energy Efficiency and Renewable Energy
Bureau of Energy Efficiency	Saurabh Diddi Arijit Sen Gupta Ishan Jain	A statutory body of Government of India, Ministry of Power
USAID, India	Apurva Chaturvedi	A leading U.S. Government agency that works to end extreme global poverty and help communities to manage and benefit from their natural resources.
Energy Efficiency Services Limited (EESL)	Soumya P Garnaik Sashi Kant P. Madhu	A public sector enterprise of Government of India focusing on energy efficiency and energy conservation
German India Corporation, GIZ	A. K. Asthana	A German agency works closely with Govt. of India for sustainable economic, ecological and social benefits.