CLEAN TECHNOLOGY FUND APPLICATION

Cover Page for CTF Project/Program Approval Request[1]

1. **Country/Region**	India	2. **CIF Project ID#**	(CIF AU will assign ID.)
3. **Investment Plan (IP) or Dedicated Private Sector Program (DPSP)**	☐ IP ☒ DPSP III	4. **Public or Private**	☒ Public ☐ Private
5. **Project/Program Title**	Scaling Up Demand-Side Energy Efficiency (Sector) Project		
6. **Is this a private sector program composed of sub-projects?**	☐ Yes ☒ No		

7. Financial Products, Terms and Amount

	USD (million)	**EUR** (million)[2]
Grant	1.90	
Fee on grant	0.10	
MPIS (for private sector only)		
Public sector loan		
• Harder terms		
• Softer terms	46.0	
Senior loan		
Senior loans in local currency hedged		
Subordinated debt / mezzanine instruments with income participation		
Second loss Guarantees		
Equity		
Subordinated debt/mezzanine instruments with convertible features		
Convertible grants and contingent recovery grants		
Contingent recovery loans		
First loss Guarantees		
Other (please specify)		
Total	**48.00**	

8. **Implementing MDB(s)**	Asian Development Bank
9. **National Implementing Agency**	Energy Efficiency Services Limited
10. **MDB Focal Point**	*Christian Ellermann*

[1] This cover page is to be completed and submitted together with the MDB project/program proposal when requesting CTF funding approval by the Trust Fund Committee.
[2] Please also provide USD equivalent in the column to the left

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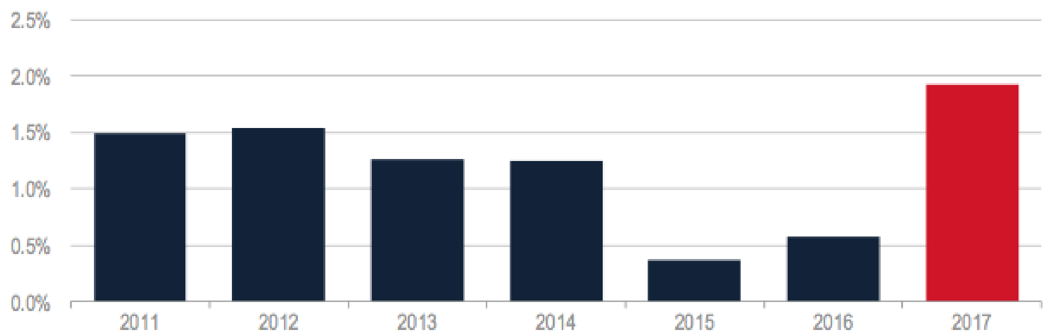
11. **Brief Description of Project/Program (including objectives and expected outcomes)**

Country and sector background

Sustained economic growth continues to drive energy demand in India. India is one of the world's fastest growing large economies. Its economy is expected to grow at an annual rate of 7.4% in 2018 and 7.8% in 2019, surpassing China's projected growth in the same period.[3] The rapid economic and population growth are putting pressure on the country's energy demand. In 2017, India's primary demand increased by 4.1%, which is above the five-year average annual rate of 3.2% since 2012; this is two-fold higher than the global primary energy demand of 1.9% which is also the largest annual increase since 2010 (Figure 1).

Figure 1: Change in global primary energy demand



Source: IEA report

According to World Energy Outlook 2017, India is one of the largest contributors to global demand growth between 2016 and 2040, amounting to almost 30%. Energy consumption is expected to grow by 4.2% per annum, faster than all major economies in the world.[4]

Coal remains the main energy source to meet the country's growing energy demand. Although the overall share of primary energy demand for coal decreased from 65% in 2000 to 57% in 2018, coal remains the largest source and will contribute the most in meeting the country's energy demand. According to BP Energy Outlook 2018, demand for coal sees the biggest growth, expanding by 132%, from the current 196 gigawatt (GW) to 330-441 GW by 2040.

India has the fifth largest power generation capacity in the world[5]. As of June 2018, total installed capacity of power stations stood at 343.89 GW. About 64% of the electricity consumed in India is

[3] Source: https://www.imf.org/en/Publications/WEO/Issues/2018/07/02/world-economic-outlook-update-july-2018
[4] Source: https://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/energy-outlook/bp-energy-outlook-2018.pdf
[5] Source: https://qz.com/india/1237203/india-is-now-the-worlds-third-largest-electricity-producer/

generated by thermal power plants, 20% from renewable energy sources, 13.2% by hydroelectric power plants, and 2% from nuclear power plants.[6]

Table 1: Installed Capacity, June 2018

Source	**Megawatt (MW)**	**% of total**
Total thermal	222,693	64
Coal	*196,958*	*57.3*
Gas	*24,897*	*7.2*
Oil	*838*	*0.2*
Hydro (Renewable)	45,403	13.2
Nuclear	6,780	2.0
Renewable energy	69,022	20.1
Total	**343,899**	

Source: Ministry of Power

The demand for oil continued to be strong because of air and road transport use, while coal use grew mainly for power generation. Coal consumption for power generation (utilities) was recorded at 545.9 million tons in 2015-2016[7], a 41% increase from 387 million tons in 2010-2011.

Renewable energy is fast emerging as a major source of power in India. The Government of India is working towards increasing the share of renewable energy for increasing share of carbon free energy in the energy mix. Through the National Solar Mission, the government announced its ambitious target of installing 175 GW of renewable energy capacity by 2022, which include 100 GW solar, 60 GW wind, 10 GW from biomass and 5 GW from small hydro capacity.

Renewable power installed capacity has already reached close to 70 GW while over 40 GW renewable power capacity is under construction/tendered. In the year 2016-17, aggregate capacity of around 11,322 MW of renewable energy was installed, and in year 2017-18, aggregate capacity of around 11,887 MW was installed.

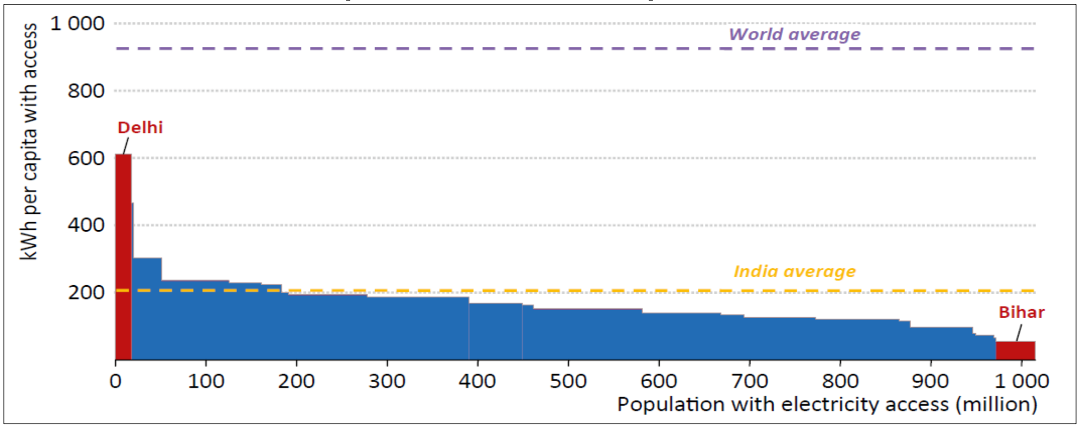
India is improving its access to electricity but per capita electricity consumption is still low. Access to electricity has improved from 56% of the population in 2001 to over 80% in 2016. In April 2018, the government declared that all 597,464 villages in the country have now with access to electricity.[8] Despite this rapid extension of power system reach, about 250 million people are still without grid connections.

The country's per capita energy consumption is still substantially lower than that of most developed and some developing countries. Although it is the world's third largest consumer of electricity, its per capita electricity consumption of 1,090 kilowatt-hours (kWh) is only one-third of world average. In terms of residential electricity consumption (REC) per capita, India's average is about one-fourth of world average. As shown in figure 1, among the states, those with relatively

[6] Source: https://powermin.nic.in/en/content/power-sector-glance-all-india
[7] The gross coal consumption is about 2.7 million tons coal per year per 1000 MW versus about 2 million tons coal per year per 1000 MW for best-in-class coal fired power plants. This indicates substantial opportunity for supply-side efficiency at existing thermal power plants.
[8] The government considers a village to be electrified if the number of households electrified is at least 10% and electricity is provided to public buildings including schools, health centers, dispensaries, community centers and village councils. https://www.bbc.com/news/world-asia-india-43946049

less incomes and low rates of electrification rank lower. Delhi has four times higher REC per capita than India's average and 25 times more than Bihar. [9]

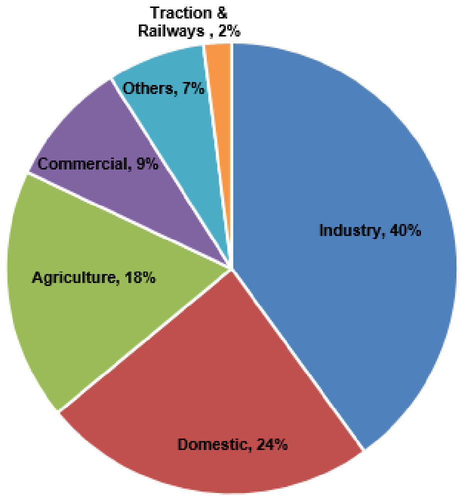
Figure 2: Annual residential electricity consumption per capita by state in India (for those with access), 2013



Source: IEA (2015) India Energy Outlook, World Energy Outlook Special Report

Figure 3 shows that industry, domestic and agriculture sectors have the highest share of electricity consumption.

Figure 3: Electricity Consumption by Sector in India, 2016-2017



Source: Energy Statistics 2018, Twenty-Fifth Issue, Central Statistics Office, Ministry of Statistics and Programme Implementation

Reliable grid electricity supply remains a challenge. India's overall electricity generation efficiency remains relatively low compared to other countries. It needs to expand power generation capacity to serve its rapidly growing demand and to overcome the shortages which causes regular load shedding. Electricity transmission and distribution networks require massive

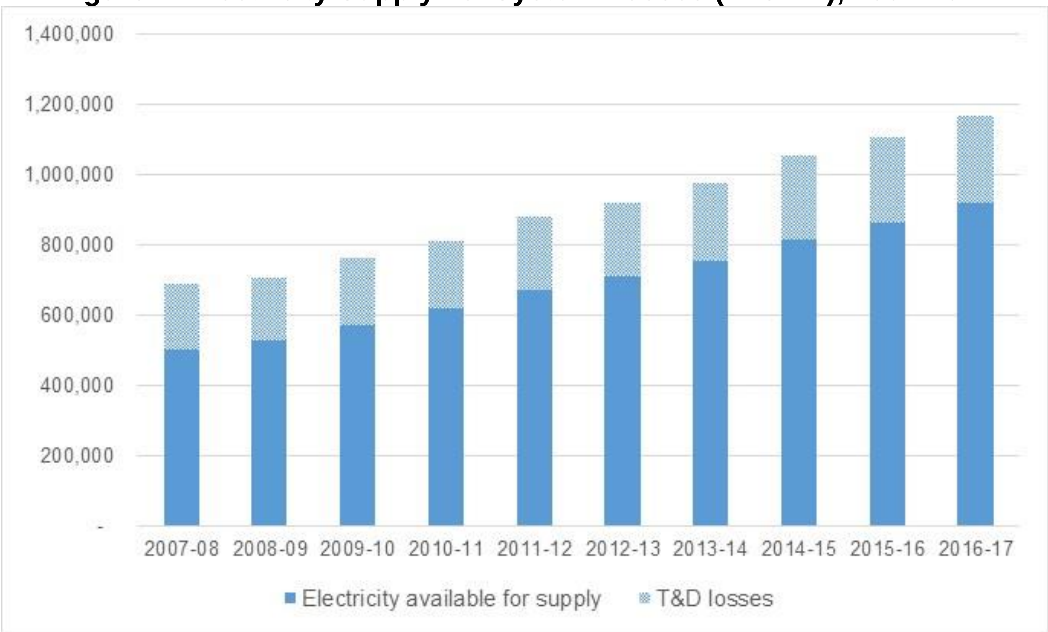
[9] Source: India Energy Outlook 2015; file:///C:/Users/s4g/Downloads/Residential_Electricity_Consumption_in_India.pdf

investments to transport growing amounts of power, bring down notoriously high losses, deal with increasing volatility in power generation and connect to the grid millions of people without access to electricity.

Heavily indebted distribution companies (Discoms) are unable to afford network investments and adequate power purchases to allow them to provide reliable supply. Public Discoms incur $15 billion annual losses and are estimated to have $66 billion in cumulative financial losses. Households and agricultural consumers face unreliable supply and load shedding.

Peak demand shortage has been reduced from 6,103 MW (4.5%) in 2014 to 2,608 MW (1.6%) in 2017. In March 2018, national power demand was 158,520 MW of which 156,720 MW was met, for peak deficit of 1,800 MW. Transmission and distribution losses have increased in aggregate (as shown in the figure below) but have decreased from 27.18% in 2007-08 to 21.30% in 2016-17.

Figure 4: Electricity Supply vs. System Losses (in GWh), 2007-2017



Source: Energy Statistics 2018, Twenty-Fifth Issue, Central Statistics Office, Ministry of Statistics and Programme Implementation, http://mospi.nic.in/sites/default/files/publication_reports/Energy_Statistics_2018.pdf

India's climate change commitments will require a significant focus on energy efficiency improvements. India's climate change commitments to reduce carbon intensity by 33-35 percent by 2030 from 2005 level will require a significant focus on renewable energy switch and energy efficiency improvements. There is a need to emphasize energy conservation by improving energy efficiency throughout the electricity and other supply chains.

In 2010, India emitted 1,574 million tons (MT) of carbon dioxide (CO_2), of which energy consumption accounted for 1,441 MT, contributing 92% of total greenhouse gas (GHG) emissions in that year (BUR, 2015). Electricity generation accounted for 52% of total CO_2 emissions, followed by industrial sector at 19% and the transport sector by 12%. Eleven major cities of India are the most polluted in the world with poor air quality causing public health issues. Local pollution comes from thermal power stations, vehicle tailpipes, brick kilns, industrial activities and traditional biomass used for cooking and heating.

Table 2: India and World Average Selected Indicators, 2014

	Per capita TPES (toe / capita)	Per capita electricity consumption (MWh / capita)	CO_2 / Population (tCO2 / capita)	CO_2/GDP (kgCO2/ 2010 $)	TPES / GDP (toe/'000 2010 $)	CO_2/ TPES (tCO2/toe)
World	1.89	3.03	4.47	0.44	0.19	2.36
India	0.64	0.8	1.56	0.92	0.38	2.45

GDP = gross domestic product, kgCO2 = kilogram of carbon dioxide, MWh = megawatt-hour, tCO2 = tons of carbon dioxide, TOE = tonne of oil equivalent, TPES = Total Primary Energy Supply.

Comparing to world average, India's per capita energy supply, electricity consumption and carbon emissions are much lower. However, India's energy intensity and carbon intensity in relation to GDP and the carbon intensity of its energy supply are much higher. The country's heavy dependence on coal for power generation and the use of inefficient subcritical plants to burn it push up the carbon intensity of India's power sector.[10]

Energy efficiency potential remains largely untapped to address high energy intensity of the economy. India's energy efficiency market is estimated at $23 billion (around Rs1.5 trillion) with a vast potential to grow. Table 3 below shows potential savings of more than 220,000 gigawatt-hour per year (GWh/y), which is equivalent to 31.5 GW of baseload electricity generating capacity. India's energy efficiency potential remains largely untapped, in part due to limited availability and high cost of financing for energy efficiency investments. As shown in table below, India's energy savings potential is estimated to be 15-30% across major demand segments, representing about $11.4 billion (Rs. 740 billion), with industry, residential, and agricultural sectors offering the highest saving potential[11].

Table 3: Estimated energy savings potential by sector

Sector	Energy Savings Potential (million toe per year)	Energy Savings Potential (gigawatt-hours per year)
Industry	9.45	109,903
Residential	5.95	69,198
Agriculture	2.58	30,005
Public lighting	0.72	8,374
Commercial buildings	0.30	3,489
Total	**19.01**	**220,969**

Source: World Bank – ESMAP, "Utility Scale DSM Opportunities and Business Models in India," 2016

The sector faces challenges and barriers from demand side, supply side and regulatory side that limit its development. These include: (i) the rebound effect of retail electricity prices being continuously subsidized by most distribution utilities; (ii) voluntary-based energy efficiency programs; (iii) limited capacity of distribution companies and municipalities to support needed scaling of energy efficiency; (iv) high up-front costs for advanced renewable energy, energy efficiency, and vehicle technologies, but individual project sizes are small from a lender's perspective and returns may be difficult to analyze; (v) the economic benefits of efficiency investments may be quantifiable, but cannot be readily monetized and delivered as up-front financing; and (vi) limited understanding of energy-saving technologies and associated benefits which limit market penetration.

[10] Source:https://www.iea.org/publications/freepublications/publication/IndiaEnergyOutlook_WEO2015.pdf
[11] Source: World Bank EESL Energy Efficiency Scale-up Program Program Appraisal Document (PAD)

Project Description

The proposed ***Scaling Up Demand-Side Energy Efficiency Sector Project*** will support scale-up of investments in a growing energy efficiency market in India by expanding EESL business lines and will focus on market transformation in agriculture and public sectors. It will help support promotion and deployment of energy efficient technologies, and scale-up of new pilot tested energy efficient technologies and services. The project's outcome will be increased electricity end-use efficiency in the project areas and the impact will be an expanded market for energy-efficient technologies and reduced emissions intensity of economy,[12] aligned with the National Mission on Enhanced Energy Efficiency (NMEEE) and India's intended nationally determined contributions (INDC) to the UN Framework Convention on Climate Change (UNFCCC).

The project will be the second Asian Development Bank (ADB) investment to EESL to support replication, scale up, and expansion of energy savings investments following new business models which are tested and improved to address more expansive opportunities. This project is aligned with energy priorities in ADB country partnership strategy 2018–2022, which articulates ADB assistance through boosting economic competitiveness to create more and better jobs, providing inclusive access to infrastructure networks and services, and addressing climate change and increasing climate resilience.

The project has three outputs with three core subprojects:

(i) **Energy efficient technologies promoted and deployed in eligible states.** The core subprojects[13] include distributed solar, electric mobility, and smart meters.

(a) Solarizing agricultural feeders

The Decentralized Solar Plants Program ("tail-end" solar) of EESL will support a minimum of 160 MW solar photovoltaic (PV) to meet agricultural demand, mainly for daytime irrigation electricity requirements. Tail-end PV plants will be effective in meeting agricultural demand, reducing transmission and distribution system losses, and avoiding generation from centralized power plants which are dominated by coal-fired plants. The proposed projects are spread across different districts and states, with individual installation capacity ranging from 0.25 MW to 2 MW. The solar capacity will be complemented by deployment of more efficient pumps at the consumer end of the electricity supply chain.

Tail-end solar plants will be installed inside-the-fence at 33/11 kV sub-stations with segregated 11 kV feeders for agricultural consumers. The agricultural feeders are kept live and free of load shedding during the day time to meet agriculture demand. Any excess generation from solar can flow back to the local grid, and if agriculture demand is high the differential would be provided by the grid. EESL will design, procure, supply, install, test, and commission grid connected small solar PV plants (including associated civil, mechanical and electrical works). EESL will also ensure comprehensive O&M for the

[12] Emissions intensity of the economy refers to ratio of greenhouse emissions produced to gross domestic product.

[13] These projects have been selected based on implementation readiness, including initial assessments of energy efficiency savings potential, stakeholder consultations, and advanced discussions on contract parameters with the relevant municipalities and distribution utilities. The final project list will be confirmed during due diligence.

entire useful life of 25 years. EESL would sign Power Purchase Agreements (PPA) with DISCOMs at an agreed tariff (approved by State Electricity Regulatory Commission).

(b) E-mobility

The E-mobility Program is in line with the government's vision of achieving 100% e-mobility by 2030. It aims to replace the existing fleet of petrol and diesel vehicles in the country.

The project will support deployment of 10,000 electric vehicles (EVs) to various government departments across the country. EESL's strategy is to aggregate the demand and provide EVs on a lease basis. EESL will procure these vehicles in bulk to create economies of scale. The actual contract price (as determined through International Competitive Bidding (ICB) process) will be used to calculate the cost of providing mobility services; this cost of service plus a reasonable profit will determine the lease terms and conditions. EESL will assist clients in establishing captive charging infrastructure.

(c) Smart meters and other intelligent energy management elements ("smart grid")

The Smart Meter National Program (SMNP) aims to replace conventional meters with smart meters in India. The roll out of smart meters will revamp the current manual system of revenue collection, which exhibits poor billing and collection efficiencies. Smart meters, connected through a web-based monitoring system, will help reduce commercial losses of distribution utilities, enhance revenues, and serve as an important tool in further power sector reforms.

The project will support the installation of five million smart meters and other intelligent energy management elements ("smart grid") in eligible states. This could include a variety of hardware and software enhancements that improve electricity system efficiency and operational resilience without major modification to existing systems (i.e., "digital exoskeletons"). Meters will be procured in bulk by EESL and will be leased out to DISCOMs at rentals that are equal to or less than the enhanced revenues that will be generated from increased billing efficiency and avoided meter reading costs.

(ii) End-user energy efficiency awareness increased

The project will support a series of workshops and events to help increase end-users awareness on the benefits and buy-in of energy efficient technologies.

(iii) New energy efficient technology pilot tested and scaled up.

The investment project will be complemented by a knowledge and support technical assistance (TA) for expanding policy dialogue, implementing large-scale energy efficiency projects, mobilizing private sector participation in energy efficiency services, identifying new business opportunities, transferring knowledge on successful energy efficiency investments, and pilot testing new technologies and business models. The TA will provide project management support, technology and business model analyses, workshops and seminars, and selective pilot testing of promising technologies[14] which can be rapidly deployed at scale. The TA will have two outputs: (i) EESL's capacity to identify and implement energy efficiency investments streamlined; and (ii) new energy efficiency business opportunities identified.

Financing

The total project cost is $594 million consisting of $250 million from ADB's Ordinary Capital Resources (OCR), $48 million from Clean Technology Fund (CTF, $46 million concessional loan and $2 million grant for associated technical assistance) and $296 million counterpart funds from EESL.

Table 4: Summary of Financing Plan

Source	Amount ($ million)	Share of Total (%)
Asian Development Bank		
Ordinary capital resources (regular loan)	250.0	42.2
Clean Technology Fund (loan) [a]	46.0	7.8
Energy Efficiency Services Limited	296.0	50.0
Subtotal	**592.0**	**100.0**
Technical Assistance		
Clean Technology Fund (grant) [a]	2.0	NA
Energy Efficiency Services Limited [b]	0.1	
Total	**594.1**	**100.0**

[a] Administered by the Asian Development Bank.
[b] EESL counterpart support through in-kind contribution
Sources: Asian Development Bank staff estimates based on discussions with EESL

EESL has requested a sovereign guaranteed loan of $250 million from ADB's ordinary capital resources (OCR) and $46 million loan from ADB Clean Technology Fund, to be administered by ADB to help finance the project. The OCR loan will have a 20-year term, including a grace period of 5 years, an annual interest rate determined in accordance with ADB's London interbank offered rate (LIBOR)-based lending facility, a commitment charge of 0.15% per year, and such other terms and conditions to be set forth in the draft loan and guarantee agreements. Based on this and the loan repayment schedule agreed with EESL, the average loan maturity is 12.75 years. Softer terms and conditions are requested for the CTF loan (40-year term, including a grace period of 10 years, an annual interest rate of 0.25%, a management fee of 0.18% per year), and such other terms and conditions set forth in the draft loan and project agreements. EESL will bear the foreign exchange risk under this loan. The remaining financing will be mobilized by EESL, including debt from other lenders and equity contributions.

[14] For example, a logical complement to the tail-end solar plants is upgrading of upstream 33 kV lines with advanced conductors and other smart grid components such as automated digital substations.

12. Consistency with CTF investment criteria

(1) Potential GHG emissions savings.

The estimated greenhouse gas (GHG) emission reductions directly attributable to the project is 232,197 tons of carbon dioxide equivalent (tCO2e) annually and about 5.5 million tCO2e over project lifetime.

Table 5: Estimated Greenhouse Gas Emission Savings

Project Components	Project Targets	Estimated annual GHG emission savings (tCO2e)	Estimated lifetime GHG emission savings (tCO2e)
Decentralized Solar Plant	160 MW	218,369	5,459,232 (25 years)
Electric vehicles	10,000	13,828	138,280 (10 years)
Smart meters	5,000,000	0	0
Total		**232,197**	**5,597,505**

For distributed solar PV, the estimate assumed 160 MW capacity operating at 8,760 hours per year with 19% capacity utilization factor. It will displace an equivalent of 266 gigawatt-hours per year of grid power in the baseline scenario, which is dominated by coal. The estimate is as follows:

160 MW x 8760 hours / year x 19% = 266,304 MWh / year

266,304 MWh / year x 0.82 tCO2/MWh[15] = 218,369 tCO2 / year

For electric vehicles, the following assumptions were considered:

Parameter	Emissions from Internal Combustion Engine Vehicles		Emissions from Electric Vehicles	
Average fuel consumption	15	km/liter	0.1503	kWh / km [a]
Duty cycle km / year	24,960	kms	24,960	kms
Total fuel consumption / year	1,664	liters	3.752	MWh
Emission per unit of fuel	2.68	Kg CO2/liter	0.82	tons CO2/ MWh
Emission from vehicle / year	4.46	tCO2	3.08	tCO2
Net reduction per vehicle / year	4.46 – 3.08 = 1.38 tons CO2/vehicle			

Note: [a] = fuel consumption includes consideration of 90% charger efficiency and 15% grid system losses. GHG reductions will be larger in magnitude as the grid emissions factor declines and if renewable electricity is used to directly charge vehicles.

In terms of number of passengers using low carbon transport, each electric vehicle can accommodate up to four passengers. The 10,000 vehicles, each on a single trip per day with four passengers will serve 40,000 passengers per day; actual passenger usage may be higher.

[15] Combined Margin emission factor for grid electricity factor - Central Electricity Authority

For smart meters, no GHG emission savings were assumed.

(2) Cost-effectiveness

The project will help scale-up existing and already proven EESL programs. EESL has a pipeline of subprojects in various stages of readiness for each investment type (smart meters, electric vehicles, solar energy, municipal lighting, agricultural and municipal pumps, and buildings). CTF will directly finance the deployment of 160 MW of tail end solar capacity.

The cost effectiveness table below considers two phases. Phase I assumes only GHG reductions accruing from the 160 MW of tail-end solar capacity at a cost of $134 million. Phase II includes other EESL technologies (i.e., efficient street lighting, efficient municipal and agricultural pumps, and efficient buildings). Phases I and II have a total cost of $1 billion[16]. The cost effectiveness in both cases is consistent with CTF guidance.

Table 6: Project Cost Effectiveness

Case	Lifetime Avoided Emissions (tCO_2e)	CTF$ / tCO_2e	Total project $ / tCO_2e
Phase I: Decentralized Solar PV Total cost: $134 million	5,459,232	$8.4	$24.55
Phase II: Project scale-up with additional financing (other EESL technologies – also see Tables 7 and 8) Total project cost: $1 billion	9,204,169	$5.0	$108

Reduced cost of low carbon technologies and practices. EESL approach to aggregate demand and use bulk procurement is expected to deliver further cost reductions and facilitate scale up and replication.

The approach is to aggregate demand for energy efficiency services and use bulk procurement to achieve economies of scale which drives down the cost of technology and services and improves affordability while ensuring quality. Using a combination of financing sources, including equity capital from its promoters, along with loans from development partners and commercial lenders, EESL provides upfront financing for investment, delivers solutions, and is repaid based on energy saved by the consumers. EESL has been able to mitigate upfront financing risk for its customers by making the entire upfront capital investment using its own capital, and has demonstrated the viability of the deemed savings approach as the basis for contracts, paving the way for use of this and other performance-based contractual models by private ESCOs. In addition, by procuring large volumes from a variety of suppliers that meet strong technical standards, this model can help spur development of manufacturing capacity in India.

Solar PV for agricultural feeders. Installation of solar PV at distribution substations will alleviate overloading and technical losses in the low-voltage network and reduce the need for more centralized generation plants. Power quality to end users, specifically to farmers, will improve in the 11 kV feeders; this will be complemented by deployment of more efficient agricultural pumps, with the lifetime of pumps extended compared to business-as-usual. Losses in the upstream 33 kV lines are expected to be reduced by a maximum of 1%; further loss reductions could be

[16] See Annex 1 for details on GHG emission reduction for each technology.

achieved through conductor replacement and other distribution system upgrades.

Electric vehicle. The capital cost of electric vehicles today is higher than internal combustion engine (ICE) vehicles which is a real cost barrier to most consumers. Demand aggregation and bulk procurement can bring down the delivered cost. In a study conducted by the Niti Aayog and Rocky Mountain Institute, batteries account for about one-third of the total purchase price of an electric vehicle. Using bulk procurement, vehicle production can be scaled up and components can be standardized which will help drive down upfront costs and reduce life-cycle cost of service. India's electric vehicle program could drive down global battery prices by as much as 16 percent ($60 per kWh). Given the projected scale of its domestic market, India could support global-scale manufacturing facilities and eventually become an export hub for battery production.[17] EESL plans to lease these vehicles to government agencies at rates comparable to the rate at which ICE vehicles are currently hired. This program would help government vehicle fleets transition to more sustainable mobility options on a revenue-neutral or revenue-enhanced basis.

Smart meters. Smart meters will not directly reduce energy consumption or GHG emissions but will reduce non-technical system losses and will reduce financial losses incurred by the distribution utilities. Distribution companies may reduce their peak power purchases and reduce commercial losses through reductions in usage by highly subsidized consumers. These utilities are required to provide power at highly subsidized prices to some consumers, and collection efficiency among these consumers might also be low. The end-use efficiency projects target reduced consumption and reductions in peak power demand, both of which will improve the financial position of the utilities. Smart meters will enable future energy savings via wider application of time-of-day electricity pricing and deployment of automated demand response systems.

(3) Demonstration potential at scale

The project will scale-up investments and spur growth in India's energy efficiency market by supporting expansion of EESL business lines. EESL has created a "new normal" for more efficient lighting, pumping, and buildings, and will continue to service these traditional end-use market segments that present potential savings of more than 200 terawatt-hours per year. EESL is expanding its market scope to include "upstream" efficiency opportunities that have not been targeted by traditional energy service company investments. New business models are being tested and improved to address more expansive opportunities, including on-grid distributed renewable energy in the "last mile" of on-grid supply to rural agricultural areas and electric mobility.[18] Continued efficiency gains across energy supply chain spectra will reduce the need for new centralized electricity generation plants, facilitating the future decommissioning of obsolete fossil-fuel power plants.

The proposed project will result in increased use of energy efficient technologies. The increased deployment of efficient end-use technologies could result in increased acceptance of these technologies in the country through demonstrated effectiveness and decreased upfront costs.

Scope for avoided annual GHG emissions. The proposed project will directly contribute towards

[17] https://mercomindia.com/100-percent-evs-2030-can-create-300-billion-market-ev-batteries-india/
[18] Electric mobility opportunities include truck and bus fleets, 2- and 3-wheel vehicles, other "ride-able" vehicles, and water-borne transport.

achieving NMEE's target of energy savings of 19,598 MW and fuel savings of around 23 million tons per year, as well as contribute to achieving the 100 GW solar capacity target by 2022. CTF will help finance EESL's programs particularly the Decentralized Solar Program which has high potential for replication and scale up considering the government overall targets (see Table 7).

Table 7: EESL selected programs targets and accomplishments

Project Output	National Targets	EESL Program Targets	EESL Completed as of Q2 2018
Solarization of agricultural feeders	10,000 MW capacity across India	Install 500 MW of tail-end solar capacity	200 MW auctioned and is in various stages of implementation
Smart Metering	Replace all analog metering with pre-paid and smart meters	Replace 250 million conventional meters	100 meters
Electric Mobility	5-7 million electric vehicles	Replace 500,000 ICE cars for government usage	125 vehicles
Ongoing Projects & Possible Scale-up			
More efficient lighting	35 million conventional street lights	Replace 13.4 million conventional street lights (under SLNP)	6.28 million conventional street lights replaced (under SLNP)
More efficient pumping	21 million inefficient pumps	21 million inefficient pumps	30,700 conventional pumps replaced
More efficient buildings	50,000 buildings	14,900 buildings (Central / State Governments, private sector)	8,924 buildings retrofitted and 2,685 in progress

EESL = Energy Efficiency Services Limited, ICE = internal combustion engine; SLNP = Street Lighting National Programme, Q = quarter.

Transformation Potential. In order to meet the unprecedented demand and ensure energy security for sustainable economic growth, the introduction of new energy efficiency measures is necessary. The subprojects have significant transformation potential. Given the national targets above, there is high potential for scaling up. Replication and scale-up will deliver an expected emission reduction estimated at 65 million tCO2e annually for all project components as shown in Table 8.

Table 8: Replication and Scale up Potential

Project Components	Estimated lifetime emission savings (tCO2e)	Replication and Scale-up factor	Replication and Scale-up lifetime emission savings (tCO2e)
Decentralized Solar Plant (160 MW)	5,459,232	10	54,592,320
Electric vehicles (10,000 units)	138,280	20	2,765,600
Smart meters (5 million	0	-	-

units)			
Possible scale-up with additional financing			
LED streetlight	2,862,825	2.6	7,443,345
Efficient agricultural and municipal pumps	594,592	1	-
Efficient buildings	149,240	3.3	492,492
Total	**9,204,169**		**65,001,937**

(4) Development impact

The project will help the country improve energy efficiency in various consumer markets, including direct support to some of the poorest and most vulnerable consumers. The project will facilitate reduction in state government subsidies while supporting (i) increase access to quality and reliable energy services, (ii) provide environmental and public health benefits; and (iv) provide employment opportunities.

Increase access to reliable and quality energy services. The solar installations connected to agriculture feeders will improve voltage profiles and reliability and quality of power, enhancing their agricultural productivity and farmer's income levels. Agriculture sector is third largest consumer of electricity with around 18.33% of India's total energy consumption in 2016-2017, almost 13% increase from previous fiscal year. According to the Central Electricity Authority (CEA, 2015), the consumption of electricity in the agricultural sector, mainly for pumping, was estimated at 195.4 billion kWh during 2016-2017. This power consumption is expected to rise by more than 50% between 2016 and 2022 which must be matched by system-wide efficiency improvements complemented by expanded power supplies.[19]

However, the sector suffers from insufficient supply and poor quality of electricity. This makes it difficult for farmers to make full and efficient use of the pumps they purchase. The irregular supply of electricity does not just discourage the installation of efficient pumps. The voltage level of electricity in most agricultural regions is significantly lower than that required by quality pump sets, therefore farmers often use cheaper pump sets that can operate at much lower voltage levels. These pumps are highly inefficient, leading to national-level losses in terms of the total power consumed.[20]

Electric vehicles can play a significant role in grid management, by incentivizing vehicle charging during off peak periods (overnight and/or in the afternoon when solar output is at maximum). The transport sector accounted for more than 15% of total energy demand in 2015. The increase in energy demand from this sector presents a challenge to energy security, since more than 95% of transport demand is met by oil, almost 75% of which is imported.

Implementation of smart meters will benefit distribution companies in terms of reduced aggregate technical & commercial (AT&C) losses, and improved load forecasting, system stability, reliability and transparency in corporate accounting. Consumers will benefit in terms of error free billing, faster restoration of power outage, and automatic monitoring of consumption pattern with no direct and immediate increase in retail electricity prices. Smart metering will facilitate expanded use of time-of-day electricity pricing, automated demand response programs, and integration of other automated and digital power technologies.

[19] file:///C:/Users/s4g/Downloads/INDIA-HIO-REPORT_WEB%20(1).pdf
[20] Ibid.

Environmental and health benefits. The project will result in reduced fossil fuel use, greenhouse gas emissions, and associated adverse health impacts. For example, electric mobility comprising a shared and connected vehicle fleet by 2030 will cut energy demand by 64% and carbon emissions by 37%, with direct benefits to public health and energy security.

According to World Health Organization study on global pollution in 2016, India is home to 14 of the world's 15 most polluted cities with respect to fine particulate matter (PM2.5). With zero tail-pipe emissions, electric vehicles reduce localized pollution. The net tailpipe emission reduction due to 10,000 vehicles is around 13,828 tCO_2 per annum; the reduction of other pollutants will result in substantial localized health benefits.[21]

Employment opportunities. The Project is expected to generate substantial employment opportunities. With EESL's approach of procuring large volumes from a variety of suppliers, these can help spur development and create more opportunities in the country's manufacturing industries, gain efficiencies of scale and drive down costs, and grow technical competencies. This in turn is expected to create more jobs available locally. In addition, operation and maintenance activities under the project will have many opportunities for employment creation as well as skill development.

The proposed tail end solar PV projects will open windows of opportunities for full time and part time jobs. The projects will attract local talent for semi-skilled roles and skilled roles from the design stage to installation and then to operate and maintain. As per the statistics released by IRENA and study conducted by the Skill Council for Green Jobs (SCGJ), the estimated jobs per MW for grid connected solar PV is 3.45; the projects under ADB loan will create 1,725 full time jobs (based on estimates by SCGJ and IRENA, are for the grid connected MW scale focusing on the solar PV parks). Apart from the direct jobs, the proposed tail-end solar plants will also enhance skill for women and create a talent pool for similar opportunities in other areas. In addition, enhancing power quality and voltage regulation through tail end solar PV plants will lead to increase in farmers' incomes and agriculture produce, which again has the direct impact on logistics and mini enterprises to convey produce to markets.

For the electric vehicles, the project will provide impetus to the entire e-mobility ecosystem and will support market and job creation in the vehicle manufacturing industry, charging infrastructure companies, fleet operators, and service providers.

(5) Implementation potential

EESL will be the borrower for the project and will also serve as the executing agency to implement all subprojects. As requested by EESL, advance contracting and retroactive financing will be considered, subject to a ceiling of 20% and a time limit of not more than 12 months prior to the date of the respective loan agreement. ADB's Procurement Policy (2017, as amended from time to time) will be followed. A project director within EESL will oversee implementation of projects under the ADB loan including CTF, coordinating across all municipalities and distribution companies and ensure compliance with ADB requirements.

[21] The reduced tailpipe emissions are offset by emissions from the grid, which today is dominated by fossil fuels. In the foreseeable future, charging will include use of renewable electricity, e.g., from solarized car parks and charging otherwise purchased directly from renewable energy producers.

EESL was established in 2009 as a government-owned company that is a joint venture of four public sector utilities[22] under the Ministry of Power (MOP), established as an implementing arm of the Bureau of Energy Efficiency (BEE). EESL is supporting activities outlined in the NMEEE in an advisory and consultancy role and in implementing energy efficiency subprojects.

EESL is a public sector ESCO, or Super ESCO, mandated to promote the uptake of energy efficient appliances and catalyze market development through provision of EE products and services. It seeks to unlock energy efficiency markets in India, estimated to be at least $12 billion by way of innovative business and implementation models. EESL has designed an innovative business model that is scalable, flexible, embraces different and emerging technologies, and incentivizes all stakeholders. Capable of delivering outcomes in a time-bound manner to enable more, it has the power to unlock demand in sectors where none existed. EESL can therefore drive large scale initiatives to create markets for disruptive solutions.

Currently, EESL has the largest energy efficiency portfolio in the world taking the forefront of promoting EE in residential and public sectors, addressing barriers and helping unlock the EE potential in many segments which had remained largely untapped for decades. Using a combination of financing sources, including equity capital from its promoters, along with loans from development partners and commercial lenders, EESL provides upfront financing for investment, delivers solutions, and is repaid based on energy saved by the consumers. EESL has adopted an organizational structure with clearly defined roles and responsibilities. Decision-making structures are clear and have been observed to be effective in achieving program results. Project-related performance targets are set annually. Project implementation is coordinated between headquarters and field offices, and there are functional units and divisions with clear mandates.

ADB will manage the CTF technical assistance grant implementation with counterpart commitment and support from EESL.

Leverage: The project will be funded by ADB with $250 million through its ordinary capital resources, $46 million concessional loan and $2 million grant from CTF, and $296 million from EESL. The CTF leverage ratio will be 12.33:1 (calculated at $592 million / CTF$48 million = 12.33) before replication and scale up.

The associated TA is estimated to cost $2.1 million, of which $2 million will be financed on a grant basis by the CTF. EESL will provide counterpart support in the form of counterpart staff, office accommodation, and other in-kind contributions.

(6) Additional costs and risk premium

To determine financial viability of the project, financial analysis of one sample subproject was conducted for each of the outputs being financed by ADB. The financial internal rate of return (FIRR) to EESL, calculated on a real post-tax basis (and assuming no reflow of loan proceeds), for smart meters and electric vehicles is 2.70% and 3.23% per annum respectively, higher than the weighted average cost of capital (WACC) of 2.6%. These subprojects are considered to be financially viable under ADB guidelines.

[22] Four national public sector utilities - NTPC Limited, Power Finance Corporation Limited, Rural Electrification Corporation Limited, and POWERGRID Corporation of India Limited.

For the distributed solar subproject, the real post-tax FIRR is 1.1% per annum and WACC is 1.14% without CTF; in this base case the subproject is not financially viable. With CTF the WACC is 0.82%, rendering the subproject financially viable, and showing clearly the CTF additionality. The softer CTF terms are conditions are justified in accordance with paragraph 25 (b) of the *CTF Investment Criteria for Public Sector Operations* (2009), and paragraph 20 (b) ii and paragraph 25 (a)[23] and (b) of the *Clean Technology Fund Financing Products, Terms, and Review Procedures for Public Sector Operations* dated 15 December 2011.

Overall, the investment project is expected to be economically viable and financially sustainable. In addition, analysis indicates that the project would generate an even higher financial internal rate of return if subsequent reflows were considered. Although the ADB loan is for a 20-year tenor, the cost recovery of assets financed under the project (except distributed solar, which will earn revenue over 25 years) would range from 6-8 years. Consequently, the tenor of the ADB loan is substantially longer than the tenor of the cash reflows that EESL will receive through a transfer of assets. EESL will use such cash flows for similar subprojects until the ADB loan is repaid, which is expected to widen the impact of the project.

Additional CTF investment criteria for private sector projects/ programs	
(1) Financial sustainability	n/a
(2) Effective utilization of concessional finance	n/a
(3) Mitigation of market distortions	n/a
(4) Risks	n/a

13. **For DPSP projects/programs in non-CTF countries, explain consistency with FIP, PPCR, or SREP Investment Criteria and/or national energy policy and strategy.**

n/a

14. **Stakeholder Engagement**

Project beneficiaries are spread across the regions traversed by the project and include agricultural, household, institution consumers, and electricity distribution companies in selected states in India. For each subproject, the consumer needs are assessed through a consultative process, and the proposed intervention is demonstrated on a limited scale to ensure those needs are met. The potential energy savings are assessed and agreed with the distribution utilities or municipalities, and contracts are only entered upon agreement of all parties. The subprojects targeting households and agricultural consumers will ensure that they will not incur additional costs as a result of adopting the more efficient technology. Consumers will benefit from reduced electricity bills from the use of more energy-efficient technologies.

The project will also implement activities to promote consumers' education and awareness campaign about various energy efficient options available in the market.

15. **Gender Considerations**

The project is expected to benefit women and children. The increased and more reliable power supply have inherent gender benefits, such as job creation that benefits both men and women, and can contribute towards further electrification of households improving women's welfare and time-burden.

[23] Paragraph 25 (a) specifically refers to the risk of "the intermittence of solar and wind resources."

The project will conduct end-user gender sensitive awareness programs to maximize gains. It will explore means of promulgating programs in the project areas using the experiences of women's self-help groups as they promote the use of energy efficient lighting and appliances. This will include the establishment of 'energy clinics' which conduct user-awareness programs, led by women 'champions' promoting energy efficiency, targeting women consumers. The stakeholder communication will include end-user awareness programs in subproject areas that focus on women's participation, gender sensitive training modules, and the adoption and use of energy efficient technologies. The solar PV subprojects will require a local pool to install, commission and operate the power plants. It will provide employment opportunity for women from the installation to operation and maintenance of the plants. It will enhance the local skill for women for low level jobs (e.g. cleaning of modules, module integration, structure alignment and installation, troubleshooting of the components etc.), mid-level job (e.g. quality inspection, components trouble shooting, data acquisition support, site support for electrical and civil drawings etc.) to senior level jobs (e.g. site engineer (electrical/civil/mechanical), O&M in-charge, accounts and admin head, etc.). The e-vehicle component could train women as potential drivers. The electric vehicle subproject, through the attached TA, will provide skills training to women to become commercial drivers expanding employment opportunities available for them.

16. **Indicators and Targets**	
Project/Program Timeline	
Expected start date of implementation	October 2019
Expected end date of implementation	December 2025
Expected investment lifetime in years (for estimating lifetime targets)	25
Core Indicators	**Targets**
GHG emissions reduced or avoided over lifetime (tonnes of CO_2-eq)	5.4 million tCO2e (solar only)
Annual GHG emissions reduced or avoided (tonnes of CO_2-eq/year)	218,369 tCO2e (solar only)
Installed capacity of renewable energy (MW)	160 MW
Energy savings cumulative over lifetime of investment (MWh)	6.66 million MWh (solar only)
Annual energy savings (MWh/year)	266,304 MWh (solar only)
Identify relevant development impact indicator(s)	**Targets**
Job creation	*To be determined*

17. **Co-financing**		
	Please specify as appropriate	Amount (in million USD)
• MDB 1	ADB	250.0
• MDB 2 (if any)		
• Government	EESL	296.0
• Private Sector		
• Bilateral		
• Others (please specify)		
Total		**546.0**

18. **Expected Date of MDB Approval**
Q3 2019

Version December 9, 2014

Annex 1: Other EESL technologies for possible project scale-up with additional financing

Other technologies and services that may be considered with the additional financing include street lighting, agricultural and municipal pumps, building upgrades, and new services identified via pilot testing, as described below.

(a) Efficient street lighting

The project will support Street Light National Program (SNLP) though installing at least 665,000 streetlights with LED lamps in eligible states. These lights will be smart and connected through a web-based monitoring system to enable remote operations and additional operational savings.[24] EESL enters into long-term annuity agreements with cities or municipalities to retrofit existing streetlights with light emitting diodes (LED) lightbulbs and fixtures, and maintain (free replacements and maintenance of lights at no additional cost to the municipality) them for up to seven years. The entire investment is made upfront by EESL and recovered from the energy savings (of typically 50%) of municipalities/cities over the project duration.

(b) Energy efficient of agricultural and municipality pumps

The project will support the Agricultural Demand side management (AgDSM) program through replacing 40,000 inefficient agricultural and municipal pumps with new BEE 5 Star rated pump sets in eligible states. EESL replaces the pump sets and maintains them for the project duration creating. More efficient agricultural pumps complement the tail-end solar plants discussed above. Reducing energy consumption for pumping reduces power purchase costs for DISCOMS while reducing the subsidies borne by the government.

(c) Energy efficient buildings

The project will support Buildings Energy Efficiency Programme (BEEP) through retrofitting of 650 buildings with more efficient end use appliances. It will retrofit LED lights, energy efficient ceiling fans and aircons in these buildings. The program services also include detailed energy audit, capacity building and training of O&M officials.

[24] The latest generation of LED technologies includes units with built-in storage, which could facilitate some on-grid time-shifting services.

Components	Targets	Estimated annual emission savings (tCO2e)	Estimated lifetime emission savings (tCO2e)
LED streetlight	665,000	229,885	2,862,825 (12.5 years)
Efficient agricultural and municipal pumps	40,000	84,942	594,592 (7 years)
Efficient buildings	650	21,320	149,240 (7 years)
Total		**336,147**	**3,606,657**

Assumptions used in computing greenhouse gas emission savings

LED Street Lighting:
To calculate GHG emissions savings, the following assumptions are considered:

- Wattage of conventional lamp:150 W and associated ballast losses for each conventional lamp: 15 W
- Wattage of proposed LED lamp: 60 W
- Annual operating hours: 4015 hours
- LED lamp life: 12.5 years
- Emission factor for grid electricity: 0.82 tCO_2/ MWh[5]

Efficient Agriculture Pups:
To calculate GHG emissions savings, the following assumptions are considered:

- Average Size of a pump: 5 HP
- Number of hours of operation in a day: 6 hours
- Number of operating days in a year: 270
- Tentative energy savings: 30%
- Emission factor for grid electricity: 0.82 tCO_2/ MWh[5]
- Lifetime of the pump: 7 years

Efficient Building:
To calculate GHG emissions savings, the following assumptions are considered:

- Typical load of a building: 100 kW
- Tentative energy savings: 20%
- Annual operating hours: 2000 hours
- Life of EE measures in building: 7 years
- Emission factor for grid electricity: 0.82 tCO_2/ MWh[5]