Energy Distribution

The Problem

Power distribution system has been characterized with high losses in most parts of the country. Aggregate transmission and commercial (AT&C) losses in India were 24 percent in FY16 (PFC report, 2017) which is higher than the established international norms of 15 per cent (Kapure and Mahajan, 2016). High losses have resulted in poor financial health of the sector and utilities i.e. State Electricity Board's (SEB's) and Distribution Companies (DISCOMs). The consequence of continued losses in the utilities means that the owners i.e. the state Governments have to provide subsidies on an ongoing basis.

A highly inefficient tariff structure which discriminates across consumers through a complex cross subsidization has created perverse incentives for all stakeholders. The State Government has been providing significant amount of subsidy, particularly for agricultural consumers. A review of RERC tariff orders for FY 17 and FY 18 indicates that approximately ₹ 7,000 crores were provided for the agriculture sector. As a result, farmers paying less than one-fourth of the tariff determined by regulator and Government subsidy covering the balance.

In Andhra Pradesh (A.P.), annual subsidy support varied between INR 3,188 crores in 2014-15 to INR 3,700 crores in 2017-18 (APERC, 2015; 2017). Among other sectors, agriculture has been one of the major inefficient users of electricity in India. The Government of A.P. has been a leader in power distribution reform and agricultural demand side management. It has initiated various energy efficiency measures such as introduction of High Voltage Distribution System (HVDS), replacement of inefficient pumps with energy efficient pumps (EEPS), and introduction of solar pumpsets, amongst others. Some of the initiatives have reached scale such as HVDS (implemented in 54% of the network) while others such as EEPS are in early stages. Despite lower AT&C losses, accumulated financial losses of the DISCOMs have been increasing and were INR 14,484 crore in 2015-16. Further, subsidy provided by the State Government has increased over the years to INR 3,700 crores in 2017-18 (APERC, 2018). This is due to a variety of reasons including inability of DISCOMs to make a case for tariff increase, high power procurement cost and less than optimal operational performance.

This research paper aims to evaluate options to enhance energy efficiency in AP – specifically in power distribution and agriculture irrigation pumping. The two interventions analysed are High Voltage Distribution System (HVDS): Conversion of low tension lines feeding agriculture consumers to HVDS and HVDS and Energy Efficient Pumpsets (EEPS): Intervention 1 plus replacement of inefficient pump sets with efficient ones.

Solutions

Interventions	BCR	Total benefit (INR crore)	Total cost (INR crore)
HVDS - Upgrade agricultural power distribution to high voltage	2.80	20,028	7,147
HVDS and EEPS - Energy efficient agricultural water pumps running on high voltage	3.06	43,294	14,164

Total costs and benefits are discounted at 5%

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High Voltage Distribution System (HVDS)

The Problem

Power distribution is the weakest link in Indian power system due to technical and management inefficiencies in the system. Political interference in tariff setting and operations have further accentuated the state of affairs. Financial losses have resulted in inadequate investments leading to inadequate and poor quality of supply i.e. frequent interruptions and poor voltage level and dissatisfied consumers in most parts of the country (Bansal, Gill and Gupta, 2012). Presently, AT&C losses in India were 24 percent in 2015-16 (PFC, 2017), significantly higher than the established international norms (Kapure and Mahajan, 2016).

Following the implementation of various initiatives, AT&C losses (average) at the national level have reduced from 38 percent in 2003-04 to 24 percent in year 2015-16 (PFC, 2005; 2017). AT&C losses in A.P. are amongst the lowest as compared to other states. Further, a consistent downward trend is noted from 13.3 per cent in 2014-15 to 12.28 per cent in 2017-18. One of the major reason for significantly lower level of AT&C losses is A.P.'s leadership in upgrading the network serving agricultural consumers to HVDS (GoI and GoAP, 2017). Agriculture is one of the major consumers of electricity with a share of 24 per cent in total sales

Among other sectors, agriculture is identified as one of the major inefficient users of electricity. One of the major reasons for high losses was the adoption of low tension distribution network spread over long distances to serve disperse and relatively small individual agriculture connections. This resulted not only in high technical losses but also high commercial losses by enabling easy tapping into the network. Theft of power was further facilitated by unmetered supply and flat tariff.

The Solution

The HVDS intervention aims to upgrade LT agricultural network to HVDS by replacing existing transformers (mostly 100/63 kVA) with smaller capacity 3-phase distribution transformers (16/25 kVA) close to the consumer load points (APEPDCL, 2016; USAID, 2010).

Implementation rate of HVDS will improve voltage profile, reduce LT Line losses, and lower the failure of distribution transformer and pumpset burn-out. This intervention is proposed to be implemented by the respective DISCOMs in network serving agricultural consumers.

The life of the project has been assumed to be 25 years as heavy capital investment infrastructure projects usually have long gestation period.

Costs

The total cost of HVDS include capex cost of conversion of LT lines into HV (11 kV) lines and erection of HVDS transformer (16 kVA). Total investment at 5 per cent discount rate was estimated to be INR 7,147 crore.

Benefits

There are four types of benefits emanating from HVDS intervention: energy savings due to lower losses, savings due to reduction in pumpset failure, savings due to reduction in DTR failure rate and carbon savings. Total benefit at 5 percent discount rate was estimated to be INR 20,028 crore.

HVDS and Energy Efficient Agricultural Pumpsets (EEPS)

The Problem

The agriculture sector is one of the major inefficient use of power in India due to unmetered supply and zero marginal tariff. The water use efficiency in India at about 30-40 percent, one of the lowest in the world (EESL, 2014). The irrigation pumpsets used in India are inefficient with operating efficiency level of 30% or less. The pumpsets are generally oversized to extract water from increasingly lower ground water levels and also to withstand large voltage fluctuations. The energy consumption is high mainly due to improper selection and installation, use of high-friction piping, lack of proper maintenance and frequent repairs. Demand for water for agriculture is expected to increase from 470 Billion Cubic Metres (BCM) in 1985 to 740 BCM in 2025 (EESL, 2014). However, the actual availability of the water will reduce from 83% to 69%, resulting in increasing stress on water availability and thereby on famers (EESL, 2014). Such a scenario will likely further increase energy intensity of pumping due to lowering of water table.

Ministry of Power along with Bureau of Energy Efficiency and Energy Efficiency Services Ltd has initiated pilots for improving agriculture pump efficiency in East Godavari district of Andhra Pradesh by replacing 2496 inefficient pumps with EEPS (EESL, 2014).

The Solution

The second intervention proposes to replace inefficient pumpsets with high energy efficient pumpsets. HVDS is a pre-condition to implement EEPS in order to ensure that pumps deliver the expected savings. Old inefficient pumps will be destroyed to ensure that they are not reused through grey market sales.

Across the states, share of agriculture sector in total sales of electricity has been one of the highest in Andhra Pradesh. APDISCOMs have proposed to replace 1 lakh inefficient pumps with energy efficient pumps on pilot basis (APEPDCL, 2017; APSPDCL, 2017).

This intervention may be implemented by the Bureau of Energy Efficiency (BEE) or Energy Efficiency Services Ltd (EESL) in collaboration with respective DISCOMs. Alternatively, private Energy Services Companies (ESCO) may be enlisted for the job. There were 15.7 lakh pumpsets in 2015. All pumpsets were proposed to be replaced in 2018 and the life of the project is assumed to be 25 years.

Costs

The total cost of energy efficient pumpsets has two components. First, cost of energy efficient pumpset which includes installation cost. Second, cost of metering and related accessories. Total investment at 5 per cent discount rate was estimated to be INR 14,164 crore.

Benefits

There are four benefits of EEPS intervention: energy savings due to lower consumption by EEPS and lower losses, savings due to reduction in pumpset failure, savings due to reduction in DTR failure rate and Carbon savings. Energy and carbon savings are higher in this case as new pumpsets require 30 percent less energy. Total benefit at 5 percent discount rate was estimated to be INR 43,294 crores.