# Energy Storage

## The Problem

India is expected to face a rising energy demand in future. Presently, India's energy demand is primarily being met through coal. A minor portion of the total energy demand is being met through other renewable sources viz. solar and wind. Carbon dioxide emissions from coal combustion have been projected to total 1.3 billion metric tonnes in 2030 (TERI, (2006)). More than 30% of the total energy demand arises from the commercial building sector of India which is expected to grow with a rising urbanization in future. Hence to reduce dependence on fossil fuels like coal, energy conservation measures by means of thermal energy storage (TES) in commercial buildings can be an option. TES can help to address the gap between demand and supply of energy by peak load shaving and shifting in commercial buildings of India.

According to an EIA (U.S. Energy Information Administration) projection, the fastest growth in commercial building energy consumption by 2040 will occur in India. Energy consumption in commercial building sector of India is expected to increase by an average of 2.7% by 2040, which is more than twice the global average (EIA (2017) ; (Cabeza et al, 2002)). In India, the building sector consumes approximately about 31% of the total energy production of India. Within this, nearly 9% is consumed by commercial buildings (UNDP (2011)). To tackle the problems arising from growing building energy use, the Indian government had issued the Energy Conservation Building Code (ECBC) in 2007.

A plethora of impediments and barriers exists while installing TES in the commercial building. These barriers include high upfront costs, challenges in sustained economic benefit generation, dearth of information and awareness, and lack of policy and institutional support. This study analyses the benefits and costs from TES applications in commercial buildings for two technological applications (with ice and hybrid salt as phase change materials respectively) in the state of Andhra Pradesh (AP) in an ex-ante situation when the technology is yet to be widely applied in commercial buildings. It is an ex-ante study that has been estimated for a period of 15 years.

## Solutions

| Interventions | BCR | Benefit per sq ft of building carpet area | Cost per sq ft of building carpet area |
|---|---|---|---|
| **Water based thermal energy storage for commercial buildings** | 2.72 | 1,448 | 531 |
| **Salt Hybrid based thermal energy storage for commercial buildings** | 2.56 | 1,448 | 566 |

Total costs and benefits are discounted at 5%. Period of analysis is 15 years.

The full paper by **Anandajit Goswami** Research Fellow, TERI School of Advanced Studies **& Kaushik Ranjan Bandyopadhyay** Associate Professor, IIM Lucknow is available on www.APpriorities.com/energy.

## Thermal Energy Storage for commercial buildings

### The Problem

Andhra Pradesh (AP) is one of the fastest-growing states of India, with demand for commercial office-space. It has increased since 2005, when the demand for office space was less than 2 million. AP adopted an Energy Conservation Building Code (ECBC) for large commercial and public buildings and major retrofits. The ECBC is expected to reportedly

reduce energy consumption by as much as 40-60%, improve reliability of access to electricity,

and enable consumers to save money.

Heating, Ventilation and Air Conditioning (HVAC) systems are key contributors to peak loads of commercial buildings and contribute nearly 40% of the energy demand of a commercial building in India (Rajan, S. (2016)). There is rise in the demand for controlled climate spaces in the last two decades in mechanically controlled commercial buildings.

## The Solution

The proposed intervention is TES in commercial buildings of two types based on phase change materials (namely ice and hybrid salt) for the state of AP.

Commercial buildings of urban centres face higher prices to meet the peak demand leading to high cost of electricity use. This could be curtailed to a large extent by moving towards efficient end-use Load Management thus making TES a lucrative option.

Thermal Energy Storage is a form of energy storage technology that "stocks thermal energy by heating or cooling a storage medium so that the stored energy can be used at a later time for heating and cooling applications and power generation."(IRENA, 2016)

In the commercial building segment of India, the main application of TES therefore would be in the Air Conditioning (AC) segment. TES apart from solving the intermittency problem of renewable sources can be integrated with conventional thermal power stations for storage of excess off-peak energy for use at peak times which may also increase plant efficiency.

## Costs

For calculating the discounted cost, the study has taken into account capital cost and O&M cost. Capital costs are considered to be same for both technologies in this analysis as based on the test case parameters comes to an average cost of INR 368 per sq ft. O&M cost is assumed to be 5% of capital costs for ice TES and 6% for salt hybrid TES.

The estimated cost per sq ft of building carpet area of water based thermal energy storage for commercial buildings is Rs. 531 and the same for salt hybrid-based TES for commercial buildings is Rs. 566 at 5% discount rates.

## Benefits

The direct benefits have been considered in terms of the energy and carbon emission savings. Indirect benefits could be generated in terms of long term employment generation. The benefits through energy and carbon emission will lead to climate change mitigation measures, reduced coal consumption, reduced emissions with concomitant health benefits.

It has been assumed that the TES system runs for an optimum of 6 hours and can avoid 60% of the energy requirement of the peak load capacity.

The estimated benefits per sq ft of building carpet area for the water or salt hybrid-based TES is Rs. 1,448 at 5% discount rates.