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Establishing a commercial building energy data framework for India

Approaches, use cases, and institutions

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ESTABLISHING A COMMERCIAL BUILDINGS ENERGY DATA FRAMEWORK FOR INDIA – APPROACHES, USE CASES AND INSTITUTIONS

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ABSTRACT

Buildings account for over 40% of the world's energy consumption and are therefore a key contributor to a country's energy as well as carbon budget. Understanding how buildings use energy is critical to understanding how related policies may impact energy use. Data enables decision making, and good quality data arms consumers with the tools to compare their energy performance to their peers, allowing them to differentiate their buildings in the real estate market on the basis of their energy footprint. Good quality data are also essential for policy makers to prioritize their energy saving strategies and track implementation. The United States' Commercial Building Energy Consumption Survey (CBECS) is an example of a successful data framework that is highly useful for governmental and non-governmental initiatives related to benchmarking energy forecasting, rating systems and metrics, and more. The Bureau of Energy Efficiency (BEE) in India developed the Energy Conservation Building Code (ECBC) and launched the Star Labeling program for a few energy-intensive building segments as a significant first step. However, a data driven policy framework for systematically targeting energy efficiency in both new construction and existing buildings has largely been missing. There is no quantifiable mechanism currently in place to track the impact of code adoption through regular reporting/survey of energy consumption in the commercial building stock. In this paper we present findings from our study that explored use cases and approaches for establishing a commercial buildings data framework for India.

INTRODUCTION

Enhancing energy efficiency of the commercial building stock is an important aspect of any national energy policy. Understanding how buildings use energy is critical to formulating any new policy that may impact energy use. During 2002-12, the services sector in India registered an annual growth rate of about 10% and accounted for over 60% in gross value addition in 2012 – one of the highest rates of growth in this sector in recent times in the world (MOSPI 2015, GOI 2015). In view of this accelerated growth, and given that buildings account for the bulk of electricity consumption in the commercial sector as a whole, there is significant potential to improve the sector's energy performance through improvements in buildings. This paper presents specific use cases that would benefit from national commercial building energy data collection, outlines potential institutional mechanisms for targeting these use cases, provides some discussion on key performance indicators (KPIs) relevant to these use cases, and briefly outlines the approach to establishing a commercial buildings energy data framework in India.

CONSIDERED USE CASES

The study considered a set of potential use cases to develop a comprehensive and expandable commercial buildings data framework for India that will have the possibility to transform policy making and the tracking of its impact on the commercial buildings stock. (Iyer, M. et al. 2016) The potential use cases address the commercial building sector at the city and building level, while encapsulating both new and existing buildings. At the city level, the use cases helps determine the commercial building sector energy consumption and energy consumption by EE buildings (ECBC, green rating systems complied buildings), including the existing retrofitted buildings. The three use cases

considered in this paper are outlined in Table 1 on the following page. The priorities were determined based on an understanding of observed building energy data uses in India, stakeholder discussions, as well as other policy needs including code updates, evaluation and implementation guidelines, and the more recent developments such as Smart Cities Mission.

The Commercial Building Energy Consumption (CBECS) Survey conducted by the U.S. Energy Information Administration is an excellent example of a national survey that has found success in terms of its ability to serve a wide range of use cases- from national to local, regulations to market transformation programs and codes. CBECS is relied upon by governmental policymakers and other stakeholders for developing metrics and rating systems (for example, ENERGY STAR, which in turn is the basis for the U.S. Green Building Council’s LEED standard and city-based building efficiency programs, among many others), benchmarking (for example, the Better Buildings Challenge and the 2030 Challenge), tracking industry progress in energy efficiency, and energy forecasting (for example the National Energy Modelling Systems (NEMS)). Careful consideration of the desired use cases and ensuring that the data collected are conducive to these use cases is paramount.

KEY PERFORMANCE INDICATORS (KPIs) AND DATA COLLECTION CONSIDERATIONS

The KPIs that are useful to assess the performance of a building are generally developed and prioritized based on specific use cases and the needs of the various stakeholders. The parameters considered in this study for the data collection template were based on their collection feasibility.

When applying use cases to improve the energy efficiency of buildings, particularly when setting building and/or city benchmarks and rating systems, it is important to categorize buildings based on several parameters such as climate, building age, building use, etc., as KPI benchmarks and targets can vary based on these parameters. For example, KPI targets for hotels would be different from targets for hospitals or offices. Further, KPI targets for 5-star hotels may be different from those for 3-star business hotels. Table 2 recommends parameters to be included in order to categorize commercial buildings

Table 1: Use Cases Classification

Use Cases	New Building	Existing Building	Priority	Primary Audience
Develop, Update, and Implement Building Energy Codes and Guidelines	●	○	High	BEE, BIS*, MOUD, ULBs
Develop and Update Building EE Rating and Labels	○	●	High	Rating organizations (e.g. BEE, USGBC*, IGBC*, GRIHA*)
Modeling the Building Sector Energy Consumption; Understanding the Impact of Buildings at the City Level	●	●	Medium	MOUD*, MoP*, Smart Cities Mission, NITI Aayog*, BEE*, ULBs*
● Fully applicable ○ Partly applicable NA Not applicable				

Table 2: Categorization of Parameters for Buildings

Categorization Parameter	Description
Climate Zone	Hot & Dry, Warm & Humid, Composite, Moderate, Cold
Activity	Primary use of building, e.g. Hospital, Hotel, Educational establishments, Retail establishments, Restaurants, Offices etc.
Activity Sub-category	Hotels: Heritage, Luxury, Budget, Resort. Hospital: Single-Specialty, Multi-Specialty, Super-Specialty, Clinics, Diagnostic Labs Retail Establishments: Shopping Malls, Large, Medium, Small Retail Stores Educational Establishments: Institutions of Higher Education, Schools Offices: Information Technology (IT), Information Technology enabled Services (ITeS), Public, Non-IT
Age*	Building age, based on specific ranges, e.g. 0-5 years, 5-10 years, 10-20 years and above 20 years
* Building age is an important parameter in Indian context as the country has been recently experiencing rapid rise in air-conditioned buildings along with incorporation of building energy conservation codes (ECBC) and green building rating systems	

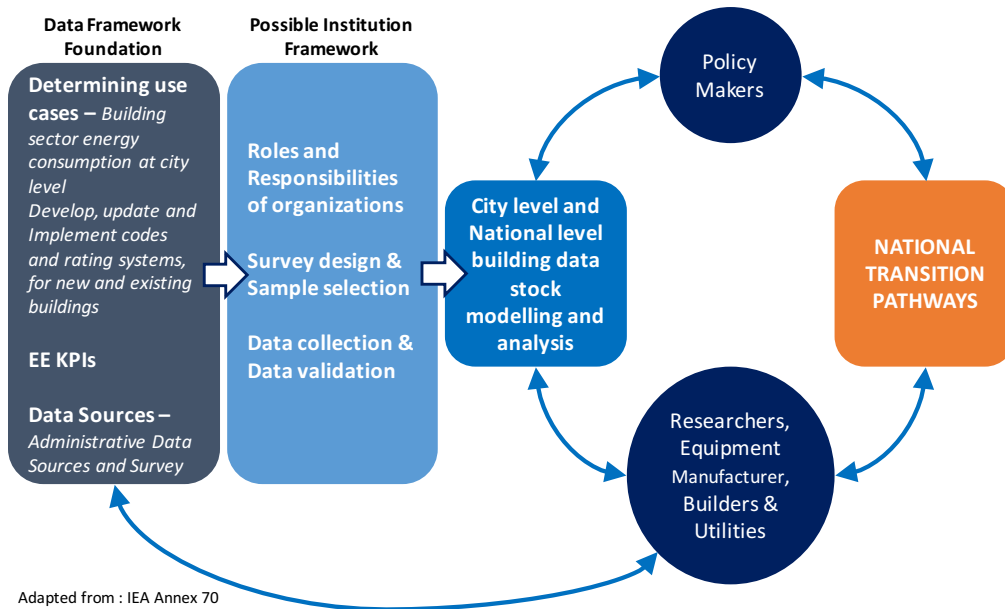
Data collection for building energy analysis is almost always resource intensive, time consuming and highly prone to data quality issues. Therefore, the scope and priorities for data collection should be carefully assessed and determined based on several key considerations, primarily the intended use cases and allocated resources. Broadly, given the use cases outlined in Table 1 above, the following categories of data would be required for the commercial building stock:

- Categorical data such as building activity type, age and location.
- General building-level information such as contact information, size, occupancy characteristics (e.g. typical operating house, number of daily employees/visitors). This category also includes data fields specific to building types, e.g., number of hotel rooms, number of hospital beds, types of meals served in restaurants.
- Whole building energy consumption for electricity and fuels.
- End use system characteristics for cooling, heating, lighting, water pumping, cooking and service equipment. Data fields for this category include system capacity (e.g. total cooling connected load), demand (e.g. total hot water requirement per month), efficiency (e.g. lighting power density), and system type.

ESTABLISHING AN INSTITUTIONAL FRAMEWORK FOR DATA COLLECTION AND DISSEMINATION

A robust institutional framework is essential in order to effectively facilitate data collection and analysis, and reporting and tracking of building stock energy performance(see Figure 1 below). This framework can help ensure standardized reporting of data and ultimately a coherent data outcome. A comprehensive and current building energy use dataset, among other things, enables (1) Adoption of superior energy-efficient building design, operation and maintenance practices, and (2) Better specification and procurement of end-use equipment and systems

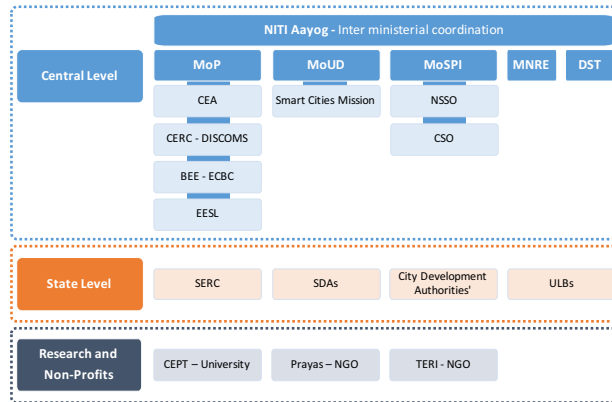
Figure 1: Commercial Building Data Framework



Institutions

Effective and comprehensive analyses and modelling of energy use and energy performance of India’s commercial building stock requires data on energy use, building structure and equipment and users/occupants. At present no single institution collects, analyzes and disseminates data on building energy performance. However, several government ministries and departments collect some data on energy, buildings and appliances and equipment that is required for administrative purposes within their respective departments. Figure 2 below summarizes government institutions at the central, state, and research or non-profit levels that collect such data.

Figure 2: Government and Non-Government Institutions



The benefits of current and comprehensive data on commercial building energy consumption and performance are far-reaching and extend beyond government initiatives and programs. Stakeholders at the city, state and national levels would benefit from such data in various ways. Additionally, they could be key contributors by providing data and expertise to institutionalize building energy performance reporting. Such stakeholders are described below.

- Utilities and DISCOMS could provide consumer data such as electricity usage, contract demand, connected load, electricity from DG and RE sources, as well as the expertise in collecting and analyzing such data.

- Facility managers and ESCOs, responsible for managing facility costs and energy consumption could share collected/monitored data on building energy consumption, equipment energy performance, building activities and occupancy.
- Real Estate Developers, Equipment and Building Materials Manufacturers Developers and manufacturers could support the program by assisting in data collection on buildings and equipment, especially given that they may periodically conduct market surveys in order to assess needs.

Table 3 and Table 4 on the following pages present an overview of the current data collection, analysis and dissemination functions of various organizations.

LEGISLATION (ACTS POLICIES & REGULATIONS)

Providing state and city governments with the mandate and infrastructure to collect, analyze and publish building energy performance data is a critical step in institutionalizing a large-scale data collection effort. The Energy Conservation Act (2001) classifies buildings with connected loads of 500kW or more, or contract demand of 600 kVA or more as Designated Consumers (DC), and gives state governments the authority to direct them to perform periodic energy audits. However, the majority of commercial buildings fall below the threshold connected load and contract demand to be considered a DC, and thus are not required to comply.

Table 5 (see below) provides an overview of the existing legislation that pertain to data collection,, analysis, and dissemination relevant to commercial building energy use. As discussed further in “Recommendations”, these existing policies could be utilized to institutionalize data collection on energy use for the entire commercial buildings sector.

Table 3: Government Institutions’ Collection & Dissemination of Building Energy Data

Institution	Data Collection, Analyses & Dissemination
NITI Aayog	<ul style="list-style-type: none"> • Formulates National Energy Policy • Develops and manages India Energy Security Scenarios (IESS) tool for modelling energy supply and demand scenarios • Exploring how to implement Energy Data Management at National level • Signed MoU’s with IEA and EIA to improve Energy Data Management
Ministry of Power (MoP)	<ul style="list-style-type: none"> • Has statutory bodies, (CEA and BEE), with specific mandates and functions that collect, analyze and disseminate data
⇒ Bureau of Energy Efficiency (BEE)	<ul style="list-style-type: none"> • Collects energy consumption data from “designated consumers” in the industry sector • Data collection on building energy performance under ECBC is voluntary • Collects sales data on labelled appliances • Limited public access to data; specific data required for research can be requested
⇒ Central Electricity Authority (CEA)	<ul style="list-style-type: none"> • Collects data on electricity generation and consumption • Has mandate to publish electricity data • Reports on electricity generation and consumption are available on their website
Ministry of New and Renewable Energy (MNRE)	<ul style="list-style-type: none"> • Collects data on RE appliances availed under schemes for subsidy, incentives, loans; however, there is no tracking of RE appliances bought outside the scheme

Institution	Data Collection, Analyses & Dissemination
Ministry of Statistics and Programme Implementation (MOSPI)	<ul style="list-style-type: none"> Collects some energy consumption data through Census and National Sample Survey Office (NSSO), for e.g. electricity, fuel consumption and appliances in households Collects enterprise level data about building demographics through economic census conducted every 5-7 years. Provides support in designing surveys, data collection & data analysis Has mandate to disseminate statistics Publishes Annual Energy Statistics Report Central Statistics Office (CSO) disseminates data to international bodies (UN, IMF) The Annual Survey of Industries (ASI) collects some energy data such as electricity consumed, electricity generated, fuels purchased and consumed. An upcoming Annual Survey of Service Sector (ASSS) could be used to collect energy data on commercial buildings
⇒ National Statistics Commission (NSC) (NSSO and CSO comes under NSC)	<ul style="list-style-type: none"> Recommends measures to improve statistical system and data collection in India
Ministry of Urban Development (MOUD) ⇒ Smart Cities Mission	<ul style="list-style-type: none"> Aims to improve public services, accountability and transparency through the use of technology, providing information and services online
State Designated Agencies (SDA)	<ul style="list-style-type: none"> Some SDAs identify buildings with a relatively larger contract demand as “designated consumers” and mandate energy audits every year, alongside collection of detailed energy consumption data
Urban Local Bodies (ULB)	<ul style="list-style-type: none"> Urban local bodies collect detailed data on building structure, envelope, area, age and activity for planning approval and for collection of property taxes
Department of Science and Technology (DST) ⇒ National Informatics Centre	<ul style="list-style-type: none"> Responsible for portal data.gov.in through which NDSAP is being implemented
EESL	<ul style="list-style-type: none"> Collects data on LED street light installations and LED bulb distribution for households Publishes <i>SLNP Dashboard</i> with up-to-date information on total LED streetlight installations per state, average electricity saved per light per day, total electricity saved per day, CO₂ emission reduction per day and avoided capacity Publishes <i>National Ujala Dashboard</i> with up-to-date information on number of LED bulbs distributed per state, total electricity saved per day, total cost savings per day, CO₂ emission reduction per day and avoided peak demand

Table 4: Other Organizations’ Collection & Dissemination of Building Energy Data

Institution	Data Collection, Analyses & Dissemination
TERI (Non-profit)	<ul style="list-style-type: none"> Publishes <i>TERI Energy and Environment Data Directory and Yearbook</i>, which includes high level data on commercial and household energy consumption
Utilities	<ul style="list-style-type: none"> Utilities collect energy consumption and TOD consumption for billing purposes, which is accessible online to consumers Some utilities, such as Tata Power Delhi Distribution Limited, conduct surveys to collect energy, building and equipment data
ESCOs	<ul style="list-style-type: none"> ESCOs collect detailed energy information when conducting audits and implementing EE projects
Green and NZEB Buildings	<ul style="list-style-type: none"> Infosys and the CII-Godrej buildings have instituted extensive Enterprise Energy Management programs for which they collect and analyze building energy data

Table 5: Legislation Supporting Data Collection and Dissemination

Act / Policy / Regulation	Data Collection & Analysis	Data Dissemination
Energy Conservation Act, 2001	<ul style="list-style-type: none"> • BEE & SDAs can recommend any energy user as a “designated consumer” (DC) • Gives BEE & SDAs the mandate to direct “designated consumers” to perform energy audits and furnish energy consumption data periodically 	<ul style="list-style-type: none"> • No specific provisions mandating data dissemination
Electricity Act, 2003	<ul style="list-style-type: none"> • Mandates CEA to collect electricity data • Mandates all entities involved in generation, transmission, distribution of electricity to provide data required by CEA 	<ul style="list-style-type: none"> • Mandates CEA to publish electricity data
<ul style="list-style-type: none"> • CEA - Furnishing of Statistics, Returns and Information (Regulations, 2007, MoP) 	<ul style="list-style-type: none"> • Mandates all entities involved in generation, transmission, distribution of electricity to provide data in a timely manner in a specified format 	
<ul style="list-style-type: none"> • Energy Conservation – Form and Manner and Time for Furnishing Information With Regard to Energy Consumed and Action Taken on Recommendations of Accredited Energy Auditor (Rules, 2008, MoP) 	<ul style="list-style-type: none"> • DCs are expected to report on energy consumption annually (within 3 months of end of financial year) • Reported data must be authenticated by energy manager appointed by DC and furnished to BEE 	<ul style="list-style-type: none"> • No specific provisions mandating data dissemination
Census Act, 1948 amended 1994	<ul style="list-style-type: none"> • Mandatory for all citizens to participate • Includes some information on household electricity & fuel consumption, appliances 	<ul style="list-style-type: none"> • Mandates publishing of census data
Collection of Statistics Act, 2008	<ul style="list-style-type: none"> • Grants central and state governments the power to collect statistics on economic, demographic, social, scientific and environmental aspects • Informants are bound to furnish the required data; refusing to furnish data is punishable • Authorizes statistics officer to access any record or document in the possession of the informant in order to collect the required data 	<ul style="list-style-type: none"> • Mandates confidentiality when publishing data
National Data Sharing and Accessibility Policy (NDSAP) (2012, Department of Science and Technology)	<ul style="list-style-type: none"> • Aims to set standards for data, metadata, data management and technology • Facilitates data access and sharing among the public and government departments to avoid duplication of data collection • Government ministries and departments required to upload high value data sets within 3 months of policy notification, and thereafter every quarter 	<ul style="list-style-type: none"> • Applies to all data and information generated, collected and archived using public funds; • Recognizes that non-sensitive government data can be shared with civil society – “all shareable data to be made available on an as-is where-is basis” • Recommends a technology-based culture for data sharing and access, with standards for open access, restricted access and other levels of access

RECOMMENDATIONS

Mandate for Building Energy Performance Data Collection and Dissemination

Existing provisions within the Energy Conservation Act, 2001 and the Collection of Statistics Act, 2008 could be used to identify all commercial buildings as “Designated Consumers” and mandate the collection and reporting of all data related to building energy performance.

The National Data Sharing and Accessibility Policy (NDSAP), Department of Science and Technology, could be utilized to support the dissemination of building energy performance data in a timely manner to enable both the government and the public to access and use such data.

A “One-Stop” Information Portal for Energy Data Dissemination, Analysis and Modelling

Creating a single portal for all building energy performance data would be the first step in making the data easily accessible to all branches of the government and the public. This would also enable the creation of standards and processes for metadata, as well as data collection, validation, transfer and protection.

NITI Aayog could lead this effort with the support of various ministries and governmental and non-governmental organizations. NITI Aayog already formulates the National Energy Policy and develops and manages the IESS energy modelling tool. NITI Aayog is also exploring the idea of Energy Data Management and has signed MoU’s with IEA and US DOE EIA to help develop such a program.

MOSPI and the National Informatics Centre (NIC), Department of Science and Technology, both of which disseminate data to the public, could pool their efforts and expertise in building a common Building Energy Performance Data System under the purview of NITI Aayog.

CONCLUSIONS

A viable institutional framework will help facilitate regular and coordinated data collection, analysis, creation of policies, and evaluation of policies followed by policy updates to achieve the desired impact. The institutional framework identifies the roles and responsibilities of relevant ministries and organizations, lays down procedure for survey selection; and outlines data collection and validation for data driven policies through ECBC, Smart Cities Mission, Green Building Rating tools and data Disclosure mandates. Following are some key outcomes from the study:

- NITI Aayog is well positioned to form an inter-ministerial steering committee and can also request assistance from international organizations;
- MOSPI’s statistical expertise in designing samples and conducting surveys and collaborative spirit could be tapped to help the leading organization with data collection;
- DISCOMs which are identified as DCs under PAT project could be strategically used to support data collection;
- Limited budgets and resource constraints impede the cause of building sector data collection and analysis to some degree.

The launch of India Smart Cities Mission will help establish stringent EE building sector policies and their methodical implementation. India’s NDCs to address climate change also outlines EE in the buildings sector as a mitigation strategy for climate change. Below are key recommendations to successfully institutionalize the data framework:

- Mandates for data dissemination: Under EC Act and Statistical Act, organizations like BEE and MOSPI have been disseminating data; however, additional mandates could catalyze a more systematic data dissemination effort. Some examples include:

- Through Indian Smart Cities Mission, energy consumption related data disclosure can be mandated. This could be initiated by MOUD at the central government level or through Urban Development departments at the state level;
- Extending the existing mandate surrounding ECBC compliant buildings in various states should enable data collection and dissemination from these buildings as part of ECBC compliance process;
- Develop a robust strategy to collect existing data: No new legislation is required to collect existing data. DISCOMs already have building energy consumption data and ULBs have building category & structure data. However, establishing a mechanism to enable independent data collection at the city or state level to be channeled into a national building data collection framework may require the involvement of a nodal agency at the national level. A government entity should take charge and execute this initiative. Following are some key steps for this entity:
 - Utilizing existing data with the DISCOMs and ULBs more effectively -- DISCOMs and ULBs have their unique identification numbers for each building. They could be directed to standardize their identification numbers, which can enable database design and simplify data extraction and validation for use by different organizations;
 - Post collection of data from utilities and ULBs as a first step; a survey can be conducted for more detailed building energy consumption information on a subset of buildings. To simplify the data collation and compilation process, utilities and ULBs with data in an electronic format could be targeted first.
 - Large organizations like hotels/ hospitals chains, which have a presence across the country, can be requested to supply data under a voluntary/mandatory buildings data disclosure initiative.
- Allocate budget and technical resources for data collection: Before initiating a large scale data collection effort, develop budget estimates and find funding sources.
- Two-tiered Approach to Data Collection - City and National level:
 - A national level effort could be implemented either through new commercial buildings survey, or through MOSPI's proposed Annual Survey of Services Sector (ASSS) encompassing comprehensive energy related data from buildings/building units. As a second tier, a more detailed but smaller survey can be conducted in select cities to obtain detailed energy consumption data from individual buildings.
 - City level efforts could begin with a few select cities in different regions/climate zone/ tier types, which can be scaled up to the national level through a bottom up approach.

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