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Commercial Energy Data Management

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About Shakti Sustainable Energy Foundation:

Shakti Sustainable Energy Foundation seeks to facilitate India's transition to a sustainable energy future by aiding the design and implementation of policies in the following areas: clean power, energy efficiency, sustainable urban transport, climate change mitigation, and clean energy finance.

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Contents

Figure

Tables

List of Abbreviations

AHPI	–	Association of Healthcare Providers (India)
ASHRAE	–	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASI	–	Annual Survey of Industries
ASSSE	–	Annual Survey of Services Sector
BBMP	–	Bruhat Bengaluru Mahanagara Palike
BEE	–	Bureau of Energy Efficiency
BIS	–	Bureau of Indian Standards
BPD	–	Building Performance Database
CAGR	–	Compound Annual Growth Rate
CBHI	–	Central Bureau of Health Intelligence
CBECS	–	Commercial Buildings Energy Consumption Survey
CEA	–	Central Electricity Authority
CEUS	–	California Commercial End-Use Survey
CSO	–	Central Statistics Office
DDN	–	Digital Door Number
DGs	–	Diesel Generators
DISCOM	–	Electricity Distribution Company
ECBC	–	Energy Conservation Building Code
EESL	–	Energy Efficiency Services Limited
EIA	–	Energy Information Administration
EPA	–	Environmental Protection Agency
EPI	–	Energy Performance Indicators
EUI	–	Energy Use Intensity
FHRAI	–	Federation of Hotel & Restaurant Associations of India
GEPTIS	–	GIS Enabled Property Tax Information System
GIS	–	Geographic Information System
GVA	–	Gross Value Added
GW	–	Gigawatt
IESS	–	India Energy Security Scenario
ISRO	–	Indian Space Research Organisation
JNNURM	–	Jawaharlal Nehru National Urban Renewal Mission
KMC	–	Kanpur Municipal Corporation
LBNL	–	Lawrence Berkeley National Laboratory
MoHFW	–	Ministry of Health and Family Welfare
MoHUA	–	Ministry of Housing and Urban Affairs
MoPNG	–	Ministry of Petroleum and Natural Gas
MoSPI	–	Ministry of Statistics and Programme Implementation

NGO – Non-Governmental Organisation
NILM – Non-Intrusive Load Monitoring
NSC – National Statistics Commission
NSO – National Statistics Office
NSS – National Sample Survey
NSSO – National Sample Survey Office
PAN – Permanent Account Number
PAT – Perform, Achieve and Trade
PID – Property Identification Code
PMC – Pune Municipal Corporation
PPAC – Petroleum Planning and Analysis Cell
SDMC – South Delhi Municipal Corporation
SKO – Superior Kerosene Oil
TAN – Tax Deduction and Collection Account Number
TWh – Terawatt-hour
UJALA – Unnat Jyoti by Affordable LEDs for All
ULB – Urban Local Body
UT – Union Territory

Executive Summary

Demand side energy management strategies for commercial buildings depend on accurate, comprehensive data that is readily available and up to date. In India, multiple administrative agencies, including Central Electricity Authority (CEA), Ministry of Petroleum and Natural Gas (MoPNG), and Ministry of Statistics and Programme Implementation (MoSPI), publish some data on electricity and fuel consumption in the commercial sector. However, this information lacks granularity, and, in the case of petroleum products like liquefied petroleum gas (LPG), kerosene, and high speed diesel (HSD), consumption data exclusively from the commercial sector is not available. Missing information on end-use consumption, critical appliance parameters, and disaggregated data at the state/city level are some of the other data challenges in this sector. In addition to the above mentioned administrative agencies, a few other government organisations, such as the Central Bureau of Health Intelligence (CBHI), and private associations like the Federation of Hotel & Restaurant Associations of India (FHRAI) and Association of Healthcare Providers (India) (AHPI) are also involved in the collection and dissemination of energy and activity data such as number of hospital beds, number of hotel rooms and others which can be used to estimate energy consumption indicators for commercial buildings. However, the objective behind the data collection by these agencies is not to understand energy usage in commercial buildings. As a result, the information collected is not comprehensive and does not enable policymakers to make informed decisions and effectively plan energy efficiency interventions. As the commercial floor area is expanding rapidly, at over 9% per year, driven by the strong growth in the services sector, the energy consumption in the commercial sector will also rapidly increase in the future. As a result, policy interventions focused on reducing energy demand through efficiency measures, are needed, and such interventions will be based on energy consumption data, the availability, timeliness, and granularity of which must be ensured.

The findings of the sub-group constituted by NITI Aayog highlighted this issue by, identifying the current status of energy and activity data, challenges in the existing framework, and identifying actions to overcome the data challenges. Building on this past effort by NITI Aayog, this study has carried out a detailed assessment to evaluate the robustness of commercial sector energy consumption data. Detailed mapping of the different building categorisation frameworks followed by different agencies dealing with commercial building data like the Ministry of Housing and Urban Affairs (MoHUA), CEA, Bureau of Energy Efficiency (BEE), electricity distribution companies (DISCOMs) and Urban Local Bodies (ULBs) was done. The variation in the categorisation by various DISCOMs and ULBs in India was also mapped. The study found that there were significant variations in categorisation among the various administrative agencies, DISCOMs, and ULBs. The study also mapped the existing institutional setup and sources of commercial building energy data. Additionally, critical indicators for policymaking and overall gaps in current commercial sector energy data were identified. Inconsistent building categorisation and lack of data—on consumption of petroleum products specifically in the commercial sector, end-use wise consumption, floor area, and other-building related indicators—are key gaps identified in the study that need to be addressed. Another issue is that CEA only collects and publishes electricity sales data from DISCOMs, thus excluding data on the total electricity self-generated and consumed from solar rooftop systems or diesel generators (DGs).

In order to address these challenges, a set of recommendations are provided. Most important is institutionalising data by making an agency responsible for periodic data collection, analysis, and dissemination at the required level of granularity. In order to collect more granular data, a dedicated commercial building energy consumption survey should be initiated, in line with the United States Energy Information Administration (US EIA) Commercial Buildings Energy Consumption Survey (CBECS). This will enable informed decision making for planning energy efficiency (EE) interventions and track the progress of energy efficiency. An agency should be made responsible for compiling the scattered information spread across different agencies and drawing insights from the available data. To enable the compilation of data collected from various organisations, standardisation of the building categories is essential. Digital technologies such as Geographic Information System (GIS), the Digital Door Number (DDN) framework, can be leveraged to create a data repository for commercial buildings, transferring and disseminating data in a seamless manner.

Introduction

The commercial sector plays a huge role in fuelling India's economic growth. As per the Economic Survey 2019-20, the commercial sector contributed an estimated 55.3% to India's Gross Value Added (GVA) in 2019-20, much more than the manufacturing and agricultural sectors. The sector witnessed a growth rate of 6.9% in 2019-20 and contributed to 32.04% of the total employment generation (MoSPI 2020, Statista).

The electricity consumption in the commercial sector accounted for 8% of country's total electricity demand in 2018-19 and is expected to grow by a Compound Annual Growth Rate (CAGR) of 9.4 – 12.1% through 2030 (Energy Statistics 2020, Brookings 2018). With the continued future growth of the commercial sector, as a result of the ongoing economic liberalisation, information technology (IT) revolution, market development, increase in health consciousness, and economic affluence, thereby creating demand for various goods and services, the contribution of commercial buildings to total energy consumption is expected to increase, as well. In addition to electricity, the commercial sector is also a consumer of liquefied petroleum gas (LPG), kerosene, and HSD. As per the India Energy Security Scenario (IESS) 2047, the commercial building energy consumption was 97 terawatt-hours (TWh) in 2017 and is expected to grow by 664% in 2047. The increasing demand for electricity and fuel will be responsible for global warming and climate change.

Since India ratified the Paris Agreement on climate change, energy efficiency has become a crucial aspect in the development of several policies and programmes including standards and labelling programme, Energy Conservation Building Code (ECBC), star rating programme for buildings, Perform, Achieve and Trade (PAT) scheme to reduce the rising demand for energy in commercial buildings.

However, the implementation of the above policies need to be evaluated in terms of their effectiveness and impact on a regular basis. In order to do this, more granular data, e.g. energy consumption by end-use, equipment type, commercial building category, is needed. Such data is largely not available, and in its absence assumptions have to be made, or numbers extrapolated based on random sample studies. To evaluate the adequacy of existing energy consumption data in India, NITI Aayog constituted a sub-group on demand side building energy data management in June 2018. The broad mandate of the sub-group was to assess the existing data collected by various agencies and government bodies, identify the frequency of data collection and data gaps, and recommend measures to fill the gaps, in order to enhance the completeness, relevance, and user-friendliness of energy data. A robust energy data system is crucial to understand energy consumption trends, fuel mix patterns, and growth in the built-up space, which is, in turn, needed to facilitate effective decision making by policymakers. The findings from the sub-group discussions highlighted the data gaps in the existing framework and suggested measures to overcome these gaps, emphasising the need for uniform building categorisation and standard formats for the collection of data with high granularity.

Building on this previous research, this study carried out an in-depth assessment of commercial sector energy data management, identify several data challenges and concludes with recommendations on creating a robust energy data management framework for the commercial sector.

Rationale

A comprehensive commercial building energy consumption database will enable policymakers to track the effectiveness of related policy measures and design more robust policy interventions in the future. The table below summarises the major identified use cases for commercial building energy consumption and activity[1] data and how the data can contribute to the use cases.

1 Activity variable is essential to normalise the energy consumption value which enables comparison at a building/city/state/national level. Activity variable can be floor area, number of hospital beds, number of hotel rooms, number of occupants among others.

Table 1: Use cases for commercial energy data

Use case	Application of energy/activity data in use case
Commercial building sector modelling	• Creating baseline energy demand models for future forecasting • Continuous model validation and refinement
Development, updating, & implementation of Building Energy Codes and Guidelines	• Creating database of predominantly used building materials in commercial buildings • Establishing baseline energy consumption at building, system, and equipment levels • Evaluating impact of existing building codes and measures for continual improvement/ refinement
Development and updating of Building EE Rating and Labels	• Creating database of predominantly used equipment in commercial buildings • Revising minimum energy performance benchmarks for different equipment • Estimating the energy savings impact of existing rating/ labelling scheme
Design and implementation of enterprise energy management and building retrofit programmes	• Creating database of buildings, systems, equipment, etc. to understand energy consumption pattern and trends • Design and development of an effective demand response program by DISCOMs • Estimating the impact of retrofit measures on energy cost savings
Design, updating, & implementation of clean fuel policies	• Mapping of commercial sector fuel choices for different end-use applications • Creating database on access to and monthly consumption of different types of energy/fuel sources
Design of financing schemes, incentives, and business models	• Creating database of existing technology for different end-use applications, fuel sources used, appliance age & efficiency level, etc. • Deployment of best available technologies for scaling up energy efficiency

Considering the importance of robust energy data management (demand side) in policy planning, this study has been initiated to evaluate the status of demand side energy data in the commercial sector and the associated gaps and challenges. The terms “commercial sector” and “service sector” are used interchangeably in this paper.

Project Goal and Objectives

Goal

The overall goal of the study is to facilitate in developing a robust energy data management framework in the commercial building sector. This will support policy decision making through the timely collection, processing, and dissemination of reliable energy consumption data with adequate granularity and fixed periodicity. The energy consumption data is crucial to tracking the progress of sectoral EE interventions and designing new policies and schemes for continual improvement.

Project Objectives

The main objective of this study is to conduct an in-depth assessment of the commercial building energy consumption data available through various administrative and survey data sources. The project aims to evaluate the robustness of the data and provide recommendations on how to strengthen the data management and institutional framework. The specific objectives of this study are as follows:

1. In-depth assessment of:
    a. Building/consumer categorisation followed by different governmental agencies, DISCOMS, and ULBs.
    b. Existing institutional setup for the collection and dissemination of energy and activity data.
    c. Administrative and survey data sources (both government and private), to determine the availability of energy consumption and activity data for commercial buildings.
2. Identification of critical energy indicators for policy formulation and evaluation and, based on these indicators, the data gaps.
3. Identification of digital initiatives by various ULBs that could potentially contribute to the strengthening of commercial building energy consumption data management.
4. Provision of recommendations on how to strengthen the commercial building energy data management and institutional framework.

Building Categorisation

Building categorization across administrative bodies

The following administrative bodies all have their own criteria for classifying buildings: MoHUA, Bureau of Indian Standards (BIS), CEA, BEE, ULBs, and DISCOMs. Table 2 summarises the relevant categorisation frameworks per administrative body and their basis for classification.

Table 2: Building categorisation rationale

Administrative Body	Basis and reason for categorisation
MoHUA- Model Building Bye Laws 2016 BIS- National Building Code 2016	Purpose of use/ activity in the building, in order to determine type of building construction to protect building from hazards like fire, earthquake, etc.
BEE- Energy Conservation Building Code 2017	Functional requirements of building design, construction, and energy use
CEA- General Review 2019	Purpose of use/ activity in the building
DISCOMs- Electricity Tariff Order	Purpose of use/ activity in the building, in order to determine electricity tariff
ULBs- Property Tax Structure	Purpose of use/ activity in the building, in order to determine property tax rate

As the basis and reasons for classification vary across administrative bodies, the categorisation also varies. Based on its categorisation criteria, a particular administrative body groups all the buildings with similar characteristics under a specific category. For example, CEA groups all the buildings used for residential purposes under the “Domestic” category.

Table 3 below shows the building categorisation by different administrative bodies.

Table 3: Building categorisation by administrative bodies

MoHUA (Model Building Bye Laws)	BIS (National Building Code)	CEA	BEE (ECBC)	DISCOMs	ULBs
Residential • One or more family dwellings • Apartment buildings • Flats • Private garages of abovementioned buildings • Hostels • Hotels with lodging services **Educational** • Buildings exclusively used for a school or college • Buildings for educational use • Research institutions • Accommodation for essential staff at educational institution • Buildings used as hostel for educational institution **Institutional** • Dharamshalas • Hospitals • Sanatoria • Custodial and penal institutions—jails, prisons, mental hospitals, houses of correction and detention, reformatories, etc. **Assembly** • Buildings used for assembly of people for recreational activities, wedding, fitness, sports, worship, transport, etc.	**Residential Buildings** • Lodging and rooming houses • One- or two-family private dwellings • Dormitories • Apartment buildings • Hotels • Starred hotels **Educational Buildings** • Schools up to senior secondary level • All others/training institutions **Institutional Buildings** • Hospitals and sanatoria • Custodial institutions • Penal and mental institutions **Assembly Buildings** • Buildings having a theatrical purpose or showing motion pictures or any other stage and fixed seats • Buildings used for assembly of people for recreational activities, wedding, worship, transport, sports, fitness, etc. • Buildings with mixed assembly and mercantile purposes	**Domestic** **Commercial** **Industrial (Low-Voltage (LV) & Medium-Voltage (MV))** **Industrial (High-Voltage (HV))** **Public lighting** **Traction** **Agriculture** **Public water works** **Miscellaneous**	**Hospitality** • Star hotel • No star hotel • Resort **Educational** • College • University • Institution • School **Healthcare** • Hospital • Outpatient healthcare **Shopping complex** • Shopping mall • Stand-alone retail • Open gallery mall • Super market **Business** • Large office (>30,000 square metres (m^2)) • Medium office (10,000 – 30,000 m^2) • Small office (<10,000 m^2)	**Domestic** **Non-domestic** **Industrial** **Agriculture** **Public utilities** **Others** *(This is an indicative list, as the categorisation varies across DISCOMs throughout the country)*	**Banquet Hall** **Hotel** **Hospital** **Guest House** **Medical College** **Shopping Complex** **Restaurant** **Railway Station** **Etc.** *(This is an indicative list, as the categorisation varies across ULBs throughout the country)*

Contd...

MoHUA (Model Building Bye Laws)	BIS (National Building Code)	CEA	BEE (ECBC)	DISCOMs	ULBs
Business • Offices, banks, professional establishments, court houses, etc., if their principal function is transaction of business and/or record/ bookkeeping. **Mercantile** • Building or part thereof used for wholesale or retail activities, including office, storage, and service facilities incidental thereto and located in the same building **Industrial** • Assembly plants, laboratories, power plants, refineries, gas plants, mills, dairies, factories, etc. **Storage** • Building used as a warehouse, cold storage unit, freight depot, transit shed, store house, public garage, hangar, truck terminal, grain elevator, barn, or stable **Hazardous** • Building or part thereof used for storage, handling, manufacture of hazardous materials like explosives, etc. **Mixed land use** • Building partly used for non-residential activities and partly for residential purpose **Wholesale establishment** • Establishment wholly or partly engaged in wholesale trade and manufacture	**Business Buildings** • All buildings used for professional services (e.g. doctor's/lawyer's office) • Laboratories • Data centres • Buildings used for provision of tele-communication services **Mercantile Buildings** • Shops • Stores • Departmental stores • Markets • Underground shopping centres **Industrial Buildings** • Buildings used for low / moderate / high hazard industries **Storage Buildings** **Hazardous Buildings** • Buildings used for storage, handling, or manufacturing of hazardous materials. **Mixed Occupancy**		**Assembly** • Multiplex • Theatre • Building used for transport services **Mixed use building**		

Discussion

- As the reason for categorisation is not same for all the administrative bodies, the categorisation varies among them, as evident from the table above.
- The categorisation structure adopted in MoHUA's "Model Building Bye Laws" and BIS's "National Building Code" is the same. The buildings are classified in these guidelines based on the use of the premises or activity in the building, in order to provide category wise guidelines on architectural design and construction aspects to protect buildings against fire, earthquake, noise, structural failures, and other hazards. For example, the "residential" category includes buildings in which sleeping accommodation is provided for normal residential purposes, with or without cooking or dining or both facilities, thereby including lodging and rooming houses, hotels, dormitories, etc.; this is due to the fact that their fundamental purpose and corresponding design/ construction requirements will be similar.
- In contrast, the categorisation structure adopted by all the DISCOMs across the country is not the same. Similarly, building categorisation by various ULBs throughout the country also differs.
- ECBC categorises commercial buildings on the basis of the functional requirement of the building design, construction, and energy use. It categorises buildings in a structured manner and clearly differentiates the various building types based on different levels of energy consumption.
- As the energy perspective is not factored into the building category structures of different administrative bodies, except BEE (for ECBC), merging datasets sourced from two different bodies in order to track energy efficiency progress on a larger scale will be challenging.

DISCOM consumer categorisation across ECBC categories

DISCOM consumer categorisation is not uniform across all DISCOMs in the country. To understand this variation in more detail with respect to commercial buildings, the consumer categories of three DISCOMs—Pune, Kanpur, and Delhi—were mapped against the respective ECBC building categories. As the ECBC comprehensively covers all commercial building categories, these categories were used as a basis for comparison. Table 4 below presents the results of the mapping, highlighting the categorisation differences among the different DISCOMs.

Table 4: DISCOM consumer categories vs. ECBC categories

ECBC Category	Delhi DISCOM Consumer Category	Kanpur DISCOM Consumer Category	Pune DISCOM Consumer Category
Hospitality (Hotels) – star, no star, resort	Non-domestic	Non-domestic light, fan, and power	Non-residential or commercial
Educational – college, university, institution, school	• Domestic (more than 90% of govt funded institutions) • Non-domestic (all others)	Public and private Institutions	Public services (govt and others)
Healthcare – hospital, outpatient healthcare	• Domestic (more than 90% of govt funded institutions) • Industrial (others)	Public and private Institutions	Public services (govt and others)
Shopping Complex – shopping mall, standalone retail unit, open gallery mall, supermarket	Non-domestic	Non-domestic light, fan, and power	Non-residential or commercial
Business – office	Non-domestic	• Non-domestic light, fan, and power • Non-industrial bulk loads	Non-residential or commercial
Assembly – multiplex, theatre, building used for transport services	Non-domestic	• Non-domestic light, fan, and power (cinema) • Public Institutions (railway building)	• Non-residential or commercial • Public services – others (railway and airport, low-tension (LT) and high-tension (HT))

Discussion

- The DISCOMs categorise consumers for the purposes of charging corresponding electricity tariffs. The usual practice followed by DISCOMs is to club all the sub-categories to which a given tariff applies under a single broad category.
- Hence, if the same tariff is charged to two different types of commercial buildings, they are grouped under the same consumer category. For example, more than 90% of government funded educational institutions and healthcare facilities fall under the domestic category in Delhi. Similarly, in Kanpur, government educational institutions and healthcare facilities come under the public institutions category, and private educational institutions and healthcare facilities, under the private institutions category. Thus, for DISCOM purposes, educational and healthcare facilities are sometimes lumped together in a certain category, even though they fall under separate categories in the ECBC.
- Two different tariff rates can exist for same type of commercial building, depending on its ownership, i.e. public or private, and, hence, one commercial building type can be assigned to two different consumer categories. The abovementioned examples from Kanpur and Delhi illustrate this; educational facilities, for example, are divided into two separate consumer categories (domestic/non-domestic, private/public institutions), even though they constitute one ECBC building type.
- In spite of the different categorisation frameworks followed by the various DISCOMs, they still report category wise energy consumption data to CEA as per the CEA category structure mentioned in Table 3.
- The proposed 2018 amendments to the "National Tariff Policy 2016" (Paragraph 8.3), make recommendations on consumer category simplification. The amendments request adoption of not more than five major categories based on "purpose of use", i.e. Domestic, Commercial, Agriculture, Industrial, and Institutional. Additionally, the sub-categorisation is to be done on the basis of "supply voltage level," and this process of merging of categories/sub-categories should be done progressively over a period of three years, starting from 2018. This is a good initial step towards uniform categorisation across the country.

ULB building categorisation across ECBC categories

Similar to the mapping of DISCOM's consumer categories, the building categorisation followed by ULBs across the country has also been mapped against the respective ECBC categories in order to understand the variation. The ULBs from the same three Indian cities, Pune, Kanpur, and Delhi, were selected for this exercise. Table 5 below indicates the variation in ULB building categorisation.

Table 5: ULB building categories vs. ECBC categories

ECBC Categories	Delhi (South Delhi Municipal Corporation - SDMC)	Kanpur (Kanpur Municipal Corporation - KMC)	Pune (Pune Municipal Corporation - PMC)
Hospitality – star, no star, resort	Hotels/Restaurants	Hotel, Guest house	Nonresident – other
Educational – college, university, institution, school	Institutional - Educational	Degree college, medical college, school/institution, technical institute	Nonresident - other
Healthcare – hospital, outpatient healthcare	Institutional - Medical	Employees' State Insurance (ESI) Hospital, Hospital, Nursing Home	Nonresident – clinic
Shopping Complex – shopping mall, standalone retail unit, open gallery mall, supermarket	Convenient shopping centre, local shopping centre, metropolitan city centre, non-hierarchical commercial centre, shop	Shopping Complex	Nonresident – shop
Business - office	Commercial general	Office	Nonresident - office
Assembly – multiplex, theatre, building used for transport services	Malls/Multiplexes/PVRs	Cinema Hall, Railway Station, Bus Station	Nonresident - other

**This is just an indicative list - there are many other building types in ULB categorisation*

Discussion

- The ULBs categorise buildings for the purpose of charging property tax.
- The property tax categories vary across these three ULBs, as seen in the table above. Delhi has 30 broad categories for commercial buildings, Kanpur has 51 broad non-residential categories, and Pune has 4 main categories and 5 sub-categories for all commercial buildings.
- Pune does not have a separate category for buildings providing hospitality services, educational institutions, or assembly buildings for transportation or recreational activities, like bus stations, multiplexes, etc.
- Delhi does not have a separate category for buildings used for transport services like railway and bus services.
- Due to these variations in ULB building categorisation, compilation of data from all ULBs in a given state or at a national level is a challenge. A uniform categorisation framework, if adopted across the country, would make the process of data collection, compilation, and analysis at a national or state level less complex and challenging. Similar efforts towards uniform categorisation such as that initiated by Ministry of Power through its National Tariff Policy can be made in the case of ULBs. In this case, MoHUA may take the initiative to implement such a uniform categorisation framework across all the ULBs, with some flexibility at the sub-categorical level according to the local context.

Institutional Setup for Energy and Activity Data Collection

A comprehensive analysis of building energy use requires data on building materials and structure, appliance penetration, equipment efficiency levels, end-use energy patterns, occupancy, fuel mix, etc. At present, no single body is involved in the collection, analysis, and dissemination of commercial building energy consumption data. Multiple ministries and non-governmental organisations (NGOs) collect some data on commercial energy consumption, as required for analysis within their organisations. In this section, a description of the agencies involved in collecting different key data is provided. Figure 1 below depicts the existing institutional setup for energy/activity data collection, which consists of a central agency collecting specific data from other bodies.

Electricity consumption

As specified in the Electricity Act 2003 (Section 177, read with Section 74 and clause (1) of Section 73), the licencees, i.e. DISCOMs, must furnish statistics, returns, and other data related to the distribution and consumption of electricity to the CEA at such times as specified under the regulations. The Format-15 entitled “Details of electricity consumers, connected load and consumption” is used by DISCOMs to provide consumer category wise information on the total number of electricity consumers, along with the consumers added in the current year, connected load, and electricity consumption in both rural and urban areas. The data has to be submitted annually by June 30th, and CEA publishes this data in its annual “General Review”.

Petroleum and natural gas consumption

The data on consumption of petroleum products is reported on a monthly basis by the Public Sector Undertakings and Private Oil Companies, including oil refineries, to the MoPNG. The sector wise annual consumption data for petroleum products like LPG, Superior Kerosene Oil (SKO), and HSD is published by MoPNG in its annual “Indian Petroleum and Natural Gas Statistics” report.

Electricity and petroleum fuel consumption

The MoPNG and CEA report sector wise consumption data on petroleum products and electricity, respectively, to the National Statistics Office (NSO) under MoSPI. The NSO compiles data collected from various sources and publishes them in its annual “Energy Statistics” report. NSO also creates

an energy balance, which is a framework that compiles data on all energy products entering, existing, and being used within the country during a reference period (e.g. a year).

Number of hotel rooms

The Indian Hotel Industry Survey by Federation of Hotel & Restaurant Association of India (FHRAI) provides an interface between the hospitality industry, policy and regulatory bodies, and other stakeholders. FHRAI analyses the performance of the Indian hospitality industry across parameters such as facilities, manpower, operational performance, and marketing trends, through its annual survey, which they have been conducting since 2015-16. FHRAI only conducts the survey with its member hotels and data such as the number of hotel rooms with respect to the star category, air-conditioned (AC) / Non-AC, occupancy, etc. is collected from the member hotels. In the 2018-19 survey, responses were received from 1300 member hotels, of which data from 475 properties was analysed and used in the report.

Number of hospital beds

The Central Bureau of Health Intelligence (CBHI) tries to compile all health-related data into a single document—namely, the National Health Profile (NHP), published annually since 2005. Central ministries and departments, all 36 states/Union Territories (UTs) and their health authorities, autonomous organisations, & other agencies provide activity data—e.g. number of beds in government and trust hospitals—to CBHI. Along with this, data on demographics, socio-economic status, health status, heath finance indicators, human resources in the health sector, and healthcare infrastructure is also collected.

The Association of Healthcare Providers (India) (AHPI) is a not-for-profit organisation representing at least 10,000 member hospitals. APHI collects data on the number of hospital beds, detailed address, contact details, medical specialities, etc. from member hospitals that have more than 100 beds. AHPI disseminates this information through its annual "Hospital Directory" publication.

Directory of establishments

The Economic Census is a means of measuring the diversity of non-farm economic activities to get insights into location-wise economic activities, occupations, employment, and relatively inactive locations in terms of the characteristics measured. In the sixth Economic Census, conducted in 2013, all houses / households / establishments were surveyed, with the survey work assigned to people like anganwadi workers, gram sevaks, panchayat secretaries, unemployed youth, NGO workers, etc. in some states / UTs. The survey work was done under the statutory provisions of the Collection of Statistics Act, 2008 and Rules made thereunder. The data collected from the establishments includes the type of activity, type of ownership, total number of workers, year of start of operations, detailed address, Permanent Account Number (PAN), Tax Deduction and Collection Account Number (TAN), contact details, whether the establishment is registered, the Act under which it is registered, etc.

Review of Existing Data Sources/Surveys

The data related to energy consumption and activity in commercial buildings is published by various organisations that capture data either from other administrative departments or through surveys. The data on energy consumption is published by CEA and MoPNG for electricity and petroleum products (like LPG and kerosene), respectively. MoSPI compiles this data from several administrative sources and publishes it in its annual "Energy Statistics" report. There are multiple commercial building/activity data sources, including the FHRAI Survey Report, Hospital Directory, National Health Profile, etc., which publish information on the number of hotel rooms and hospital beds. Table 6 below summarises the various data sources that publish data related to commercial building energy consumption and activity.

Table 6: Existing commercial building energy and activity data sources

Publication name	Source agency	Energy / activity data available	Periodicity
General Review (All India Electricity Statistics)	CEA	• State /UT wise electricity consumption in commercial category • Connected consumers & connected load in commercial category	Annual
Indian Petroleum & Natural Gas Statistics	MoPNG	• Sector wise consumption of LPG (Non-domestic/ Industry/Commercial) • Sector-wise consumption of kerosene (Commercial/Industry)	Annual
Energy Statistics	MoSPI	• LPG consumption in Manufacturing/Non-domestic sector • Kerosene consumption in Commercial/ Industrial sector	Annual
National Health Profile	CBHI	Number of beds in government and trust hospitals	Annual
Hospital Directory	AHPI	Number of beds, detailed address, contact details, etc. in hospitals with 100+ beds	Annual
Indian Hotel Industry Survey	FHRAI	Average total number of rooms and number of occupied rooms per hotel with respect to star category, AC/Non-AC, etc.	Annual
Directory of Establishments	MoSPI (part of Economic Census)	Establishment address & details related to activity, ownership, number of workers, etc.	Every five years

Building Key Energy Performance Indicators

An energy performance indicator is a measure of energy intensity used to understand the EE status of a building or buildings in a particular geographical region. It can be used to gauge the effectiveness of past energy management efforts, model future energy demand, and identify target areas for future EE interventions.

The commercial sector is complex, as it includes a wide variety of buildings providing different services, and the energy consumption can drastically vary across different commercial categories. The energy consumption depends on end-use application, equipment used, occupancy patterns, building operating hours, and energy source type, among other factors. Thus, estimation of end-use energy consumption and equipment-specific indicators is critical to assessing the effectiveness of policy measures focused on reducing energy demand in the commercial sector.

The chart below lays out the key energy performance indicators at different levels in the commercial sector, as identified by the International Energy Agency (IEA).

- **Level 1 indicators**: Total energy consumption in commercial sector per unit activity variable
- **Level 2 indicators**: Energy consumption in particular end-use applications, e.g. space cooling or lighting, per unit activity variable
- **Leve 3 indicators**: End-use energy consumption by equipment type / fuel type / commercial category type per unit activity variable
- **Activity variable**: Depends on end-use or ease of availability of data and can be floor area, number of persons occupying room, number of hospitals beds, number of hotel rooms, etc.

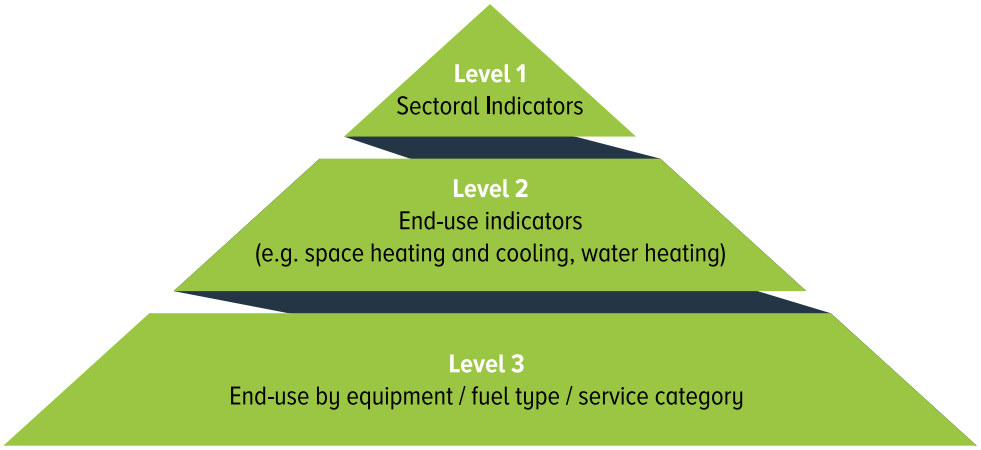

Figure 1: Energy Performance Indicator Pyramid for Commercial Sector

These indicators are helpful in setting benchmarks, which enables comparison of EE progress in a particular facility with that of another, more energy efficient facility. The quantity and quality of data increases as we go from Level 1 to Level 3 in the pyramid. From the perspective of policy design and evaluation, indicators in Level 3 are very important. They are useful in the following:

- Tracking the progress of India's EE policies
- Country level comparisons to prioritise policy actions
- Identification of target areas for intervention in different commercial categories/technologies etc.
- Understanding the potential for EE improvement

However, looking at the current state of energy data collection in India, indicators even at a sectoral level (Level 1) are difficult to estimate, due to the non-availability of data, as shown in Table 7 below, and, hence, the immediate priority should be to collect the data needed to estimate indicators in Level 1 and Level 2, i.e. end-use.

Level 1 indicators correspond to sectoral indicators, i.e. total energy consumption by the commercial sector per unit activity. Activity can be commercial sector GVA, total floor area, etc. However, using energy consumption per unit of GVA as an indicator implies a consistent relationship between economic growth and energy consumption, whereas buildings with the same EE level and size in terms of floor area can still generate different economic output. Thus, using GVA as the activity indicator can have certain drawbacks with respect to decision making. Floor area can be a comparatively better indicator in this regard, as it can provide insights into how the end-use drives changes in energy use.

The activity variable used for the development of energy indicators depends on the specific end-use or commercial category type. For specific end-uses like space cooling, floor area or number of persons can be used as an activity variable, as the cooling energy consumption is linked to the floor area and occupancy level. When estimating energy performance in a restaurant, the number of tables can be used as an activity indicator if the data for floor area is not easily available. For hospitals, the number of beds can more easily be determined than total floor area; the same is true for the number rooms in a hotel, vs. total floor area. Hence, the ease of data collection also affects the selection of an activity variable for a particular commercial category type or end-use type.

Table 7 below briefly explains the different types of indicators, availability of data to estimate them, and their relevance in terms of policymaking and impact assessment. Although the activity variable used here is floor area, it can change depending on the data available and the linkage of the activity variable to energy consumption. Also, the end uses considered here are space cooling and lighting, however, depending upon the commercial building type, some more end-uses can be considered in a similar way.

Table 7: Building key commercial sector energy performance indicators & their relevance to policymaking

Level	Indicator	Energy / activity data	Data availability	Significance for policymaking
1	Total energy consumption per floor area	Total energy consumption	Not available	If the structure of the service sector remains constant, this indicator can help understand the progress of EE on a macro level. However, due to multiple factors contributing to this indicator including the building's functional requirements, end-use wise consumption, age and efficiency of technology for end-use, fuel mix, etc. it is difficult to draw conclusions regarding the selection of a target area for an EE intervention.
		Total floor area	Not available	
	Total electricity consumption per floor area	Total electricity consumption	Available	
		Total floor area	Not available	
2	Space cooling energy consumption per floor area cooled	Total cooling energy consumption	Not available	Good insight can be obtained from this data regarding the potential for improving EE in the end-use. However, the intensity is influenced by the factors like the occupancy level, building age, the building's envelope efficiency, and cooling equipment efficiency, along with climatic conditions. As a result, to provide a strong basis for policy development, more detailed information on buildings and equipment is required.
		Total floor area cooled	Not available	
	Lighting energy consumption per floor area	Total lighting energy consumption	Not available	Lighting energy intensity can potentially provide valuable insights into the level of lighting efficiency in a country and the potential to further reduce energy consumption. However, it does not take into account the specific requirements of lighting in different commercial categories and the efficiency of the lighting technology used.
		Total floor area	Not available	
3	Space cooling energy consumption per floor area cooled (by space cooling system)	Cooling energy consumption by cooling system β	Not available	Better tracking of EE policies or understanding of the potential for improvement requires data on cooling intensity in different commercial categories and the use of different cooling technologies. This information is also needed to reduce energy consumption in the cooling sector through policy interventions and enables cross country comparisons.
		Floor area cooled with cooling system β	Not available	
	Space cooling energy consumption per floor area cooled (by commercial category)	Cooling energy consumption for commercial category A	Not available	
		Floor area of commercial category A cooled	Not available	
	Lighting energy consumption per floor area (by commercial category)	Lighting energy consumption for commercial category A	Not available	Disaggregation of the lighting intensity by commercial category and type of lighting equipment provides a better metric for cross country comparison. Additionally, it also enables better tracking of the progress of previous policies and measures and assessment of the potential for energy reduction from lighting as a result of interventions in specific areas.
		Floor area of commercial category A	Not available	
	Lighting energy consumption per floor area (by type of lighting equipment)	Lighting energy consumption by lighting equipment β	Not available	
		Floor area lighted by lighting equipment β	Not available	

Data Gaps in Commercial Building Energy Consumption Data

Previous studies have highlighted the data gaps in overall energy data management in India at a macro level. Various recommendations have been provided in these studies on how to improve energy data quality and usability. This study takes a closer look at energy data management specifically in the commercial sector, and the following section highlights the data gaps that were identified, during the evaluation of data for estimating the building key energy performance indicators till level 3, and while, reviewing the existing data sources and institutional set up.

Inconsistency in building categorisation

As the categorisation followed by a particular body is decided based on the purpose of classification, there is variation across different bodies. As highlighted in the section entitled "Building Categorisation", CEA, MoHUA, BEE, DISCOMs, ULBs and other agencies follow different categorisation frameworks. Categorisation also varies among ULBs and DISCOMs, throughout the country. This creates challenges in merging datasets from different bodies for analysis.

Data on petroleum fuel consumption is not reported exclusively for the commercial category

The electricity consumption data in the commercial sector is reported by CEA in their annual "General Review Report". However, MoPNG publishes data on LPG and kerosene consumption in the "Non-domestic / Industry / Commercial" and "Commercial / Industry" categories, respectively, not isolating data from the commercial sector. Moreover, the data on HSD consumption in the commercial sector is reported under the "Resellers / Retail" or "Miscellaneous" category. This makes it difficult to estimate total commercial energy consumption.

Insufficient data for policymaking

The existing commercial energy consumption data framework does not provide the comprehensive information needed by policy researchers or decision makers, as described below:

- Exclusive commercial sector fuel consumption data for LPG, kerosene, & HSD—is not available.
- End-use (i.e. space cooling, lighting and other) energy consumption data is not available.
- Equipment usage parameters like penetration, connected load, usage hours, efficiency, etc. for top energy consuming end-uses like space cooling, heating and lighting are not available.
- The energy demand in the commercial sector is linked to the type of service provided. The consumption varies across different commercial categories and, thus, commercial category wise energy consumption data is needed. However, obtaining commercial category wise data is a challenge, as the aggregate data on commercial sector energy consumption is not even available.
- There is currently no mechanism to track the commercial floor area growth in the country, which is an important data point, as commercial energy demand is directly linked to floor area. ULBs collect information on floor area, as the property tax is directly linked to it, but this data is not available in the public domain. This data is critical to developing EE benchmarks across different cities, states, etc. and designing appropriate interventions. It is not only important for the research community but also for the policymakers for decision making. s

No mandate for administrative bodies to disclose data

The designated consumers (large, energy-intensive businesses) under BEE's PAT scheme (4th and 5th cycles with 2020-21 and 2021-22 assessment years, respectively) include commercial buildings, with hotels as a designated sub-sector. The PAT scheme mandates disclosure of energy related

data by all designated consumers to verify their compliance with energy reduction targets set under PAT. The PAT Notification shares data on the total floor area, baseline energy consumption, and target specific energy consumption for the designated consumers. However, it has been observed in the previous PAT cycles that the data on actual reduction in designated consumers' specific energy consumption is not shared by BEE. As the current and target energy consumption data is disclosed under PAT, the data on actual reduction in energy consumption should also be shared by BEE. Moreover, ULBs are not obligated by any law or regulation to share the floor area data collected for property tax calculation. The datasets of BEE and ULBs include a wealth of information on energy consumption in the hotel industry, as well as commercial building stock. This data that is already collected by different administrative departments should be shared with the public to aid researchers and policy makers in their analysis and the assessment and design of EE initiatives.

No designated national agency to coordinate with ULBs

CEA coordinates with DISCOMs across the country to collect sector wise electricity consumption data and reports the same in its "General Review Report". Similarly, the Petroleum Planning & Analysis Cell (PPAC) coordinates with Public Sector Undertakings and Private Oil Companies to report data on sector wise LPG and kerosene consumption at the national level. However, there is no designated body at the national or state level to coordinate with the 3,723 ULBs across the country to collect data on commercial building floor area.

Non-availability of granular data

CEA reports state wise data on commercial electricity consumption in their "General Review Report". However, for LPG and kerosene, the annual data is available at the national level for the commercial and industrial categories together, in the "Indian Petroleum & Natural Gas Statistics" report. Efforts towards further disaggregating the data at the city, end-use, or specific commercial category level, have not yet been initiated. Granular data is crucial for the identification of target areas with potential for improvement in energy efficiency.

Lack of activity data for indicator estimation

In order to develop indicators to enable cross country comparison or comparison within the country, the activity variable is very critical. The most relevant activity variable for developing an indicator depends on the specific end-use or commercial category type. The existing framework, however, lacks data related to specific activity variables. At present, there is no central agency responsible to collect and share floor area data in the public domain. If the information for floor area is not easily available, there can be proxy activity variable depending on the commercial building category, e.g. the number of beds in hospital, number of rooms in hotel, number of tables in restaurants, number of classrooms in educational institutions, etc., but this data is missing too.

Delay in data dissemination

There is a significant delay, of about 1 - 1.5 years, in data agencies disseminating the data via the Energy Statistics report, PNG Statistics report, CEA General Review, etc. For example, the "Energy Statistics 2020" publication only contains data up to 2018-19. Moreover, "PNG Statistics 2018-19" is yet to be published, as of May 2020. The delay in data publishing creates a deficiency in updated data for analysis.

Lack of self-generated electricity data from CEA

A new element is entering the energy data space: rooftop solar PV systems. India has an ambitious goal of achieving 40 gigawatts (GW) of installed rooftop solar capacity by 2022. As a result, electricity self-generation through rooftop solar PV systems is expected to increase in the near future. However, comprehensive data on electricity self-generation (both from solar and other systems like DGs) is not

being collected by any agency. When net metering is used, the data on electricity imported from the grid and exported to the grid is provided in the electricity bill. However, there is additional solar power generated and consumed by the building owner, and this is not recorded anywhere. Furthermore, there is a possibility that only the net sale of electricity is reported to CEA by the DISCOMs. As a result, the CEA data does not give a comprehensive picture of electricity consumption in commercial buildings. If, in the future, rooftop solar accounts for a significant share of the total electricity mix, it will be crucial to collect this self-generation data at the national level.

Digital Initiatives by Urban Local Bodies

This section presents the data-related initiatives being implemented by Urban Local Bodies (ULBs), namely, "GIS for Property Tax Mapping" and "Digital Door Number Framework," which aim to interlink data on built up area, electricity and gas bills, etc. with the unique property identification number. This existing framework can be further leveraged to complement the existing residential energy data management system and thus create an energy data repository.

GIS for Property Tax Mapping

The Jawaharlal Nehru National Urban Reforms Mission (JNNURM) mandates reform of the property tax system to make ULBs efficient units of self-governance, as property tax is a significant source of revenue for them. In order for the ULBs to have a complete record of all the properties in the city, proper Geographic Information System (GIS) property mapping has been promoted. This has led to several ULBs integrating GIS into their property tax collection systems.

The Bruhat Bengaluru Mahanagara Palike (BBMP), in collaboration with Indian Space Research Organisation (ISRO), created a comprehensive database of 19.45 lakh total properties (both residential and commercial) with the help of the GIS Enabled Property Tax Information System (GEPTIS). ISRO provides updated satellite data on the properties to the BBMP every six months. A unique property identification number (PID) is given to each property, and a database is created based on a combination of information from aerial maps, door-to-door surveys, and existing ULB data. The data on property ownership, building usage, type of construction, built up area, number of floors, etc. is linked to the PID number, along with the GIS map. The Hyderabad, Chandigarh, Mumbai, Kolkata, Delhi, Vishakhapatnam, Bhopal, Kanpur, and Patna ULBs, among others, have initiated similar property geotagging, but the property-related information that is linked to the PID or GIS maps varies across ULBs.

Digital Door Number for e-Governance

The "Digital Door Number" (DDN) initiative has been taken up by the municipal corporations of New Delhi, Bengaluru, Indore, Chandigarh, Vijayawada, Hyderabad, etc. In DDN framework, addressing or numbering of all properties follows a uniform system or technique. DDN combines the latest geospatial and cloud computing technologies with standard methodologies in street addressing and door numbering. This unique property number can be linked to services such as electricity, gas, water, property tax, sanitation, emergency services, postal services, etc. to improve governance. The benefits of DDN include ease in locating property and hassle free governance, among others. DDN is already linked with utility data, furthermore, linkage of floor area data from ULBs with DDN will enable estimation of the Energy Performance Index (EPI) at the building and city level.

Commercial Building Energy Consumption Data in USA

The key building energy data sources in the United States (US) are the Commercial Building Energy Consumption Survey (CBECS), California Commercial End-Use Survey (CEUS), and Building Performance Database (BPD), which compiles commercial and residential building energy data. The BPD is based on multiple existing data sources, including CBECS and CEUS. In CBECS 2018, 8,000 commercial buildings, out of the estimated 5.6 million in the US, responded to the survey. In CEUS 2016, data from 2,790 commercial buildings in California was collected, whereas in CEUS 2018-20, onsite data is being collected from 27,000 commercial buildings. Survey data, along with energy standards, existing building models, and expert knowledge, are used to select the input model that best represents a specific building's characteristics and operations. With the help of the input model and building energy simulation programmes like EnergyPlus, energy consumption is calculated. There are various simulation data sources in the US that are used by researchers for a variety of applications. These applications include quantifying the contributions of different components to heating and cooling loads in US commercial buildings, determining the energy performance of commercial building samples in CBECS, assessing the technical viability of net zero commercial buildings, etc.

The CEUS and CBECS provide a large amount of representative sample data for building energy performance benchmarking. Based on CEUS, the Lawrence Berkeley National Laboratory (LBNL) developed Cal-Arch, a California-based distributional benchmarking model. CEUS is also used to identify the contributions of different components to energy consumption in commercial buildings. Based on CBECS, the US Environmental Protection Agency (EPA) developed the Energy Star National Energy Performance Rating System, which is a national regression-based benchmarking model. Furthermore, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 100 used the CBECS data as a reference to create Energy Use Intensity (EUI) targets. In addition, future energy consumption in the commercial sector is estimated using the data from CBECS and CEUS. CEUS and CBECS also provide support in the development of national energy related policies and standards. The CEUS, CBECS, and BPD can also be used to estimate energy retrofit savings in the commercial building sector. Thus, the data from CBECS and CEUS surveys, and BPD, is used for various energy interventions which further enable effective EE policy design and energy efficiency tracking in US.

Recommendations on Commercial Energy Data Management

Framework development for uniform nationwide categorisation

Estimation of energy performance indicators in the commercial sector requires the sharing of electricity and activity data from various agencies with a common agency. The current scenario is that the bodies containing data, i.e. DISCOMs and ULBs across the country, as well as central administrative bodies, follow different consumer/ building categorisation frameworks. This variation impedes streamlined data collection and analysis at the national level. The 2018 Amendments to the National Tariff Policy have recommended the adoption of not more than five major consumer categories—Domestic, Commercial, Agriculture, Industrial, and Institutional and state that the process of merging categories/sub-categories can be done over three years, starting from 2018. If implemented, this could strengthen the existing data collection framework and facilitate large-scale data collection and analysis in India. An initiative for uniform categorisation similar to this is also needed for ULBs, as their categorisation frameworks also vary. MoHUA can take the lead in developing a framework for uniform categorisation to be followed by all ULBs, which may overlap with the DISCOM categorisation framework.

Leveraging existing digital infrastructure to create energy data repository

As discussed in the previous section, several ULBs in the country have initiated GIS mapping of properties and interlinking of governance-related services via a DDN. The GIS framework will result in the creation of a digital database for property wise information (such as built up area, energy consumption etc.). Moreover, the utility bills (electricity, gas, water), property tax details, etc. are going to be interlinked with the DDN. Hence, this DDN framework can be further leveraged to interlink the built-up area information obtained from the geotagging exercise with the utility bills. This will result in the creation of a property wise database for electricity bills, gas bills, built-up area, etc. and enable estimation of energy performance indicators (EPI) at the building and city level. Furthermore, in the future, if all ULBs in India adopt GIS mapping and DDN, this database will facilitate the estimation of Level 1 indicators at the state and national level, as well. MoHUA can develop standard guidelines on the collection and interlinking of important data from the ULBs. MoHUA can also designate a central agency to coordinate data collection with the ULBs across the country. ULBs can then adopt the guidelines and share data with MoHUA or any designated agency under MoHUA in the future. This will lead to the creation of a data repository on total floor area, energy sources consumption and performance indicators at the building, city, state, and national level.

Collection and publication of commercial sector-specific fuel consumption data

As mentioned in the data gaps section, consumption of petroleum products like LPG and kerosene is reported for the commercial and industrial categories together, rather than separately. Furthermore, the consumption of HSD in the commercial sector is reported under "Resellers/Retail or Miscellaneous category. This non-availability of fuel consumption data exclusively for the commercial sector makes it difficult to perform data analysis and understand the fuel wise energy consumption trends in the commercial sector. Thus, MoPNG should develop a mechanism for collection and reporting data on LPG, kerosene, HSD, and other fuel consumption separately in the commercial sector.

Strengthening the institutional capacity of administrative bodies and survey agencies for proper energy data dissemination

As discussed in the "Data Gaps" section, the data collected by MoPNG, CEA, etc. is disseminated 1-1.5 years after the collection date. Hence, there is a need to strengthen the statistical division of these organisations, by building their statistical capability or increasing the human resources available, to enable them to reduce the data processing time and disseminate the data within a year. Services like data collection, processing, and dissemination can be outsourced if in-house capacity building is not feasible.

Strengthening existing institutional framework for data compilation and modelling

Commercial building data is collected by multiple organisations, including CBHI, AHPI, FHRAI, etc. Similarly, administrative bodies, such as PPAC, CEA, etc., report on sector wise trends in energy consumption in their annual publications. Hence, efforts towards data compilation, harmonisation, avoidance of duplication, and dissemination of the results from different datasets are urgently needed.

The Central Statistics Office (CSO) under MoSPI issues an annual publication called "Energy Statistics", where the data from multiple ministries and agencies—MoPNG, CEA, Office of the Coal Controller, Ministry of New and Renewable Energy (MNRE), Office of the Economic Adviser, Ministry of Commerce and Industry, etc.—is collected and disseminated. Along with the dissemination of this data, CSO creates an energy balance, which is a framework that compiles data on all energy products entering, exiting, and being used within the country during a reference period (e.g. a year).

Therefore, in addition to the existing data compiled by CSO through administrative agencies, an effort to compile the data collected through various surveys can also be made to generate more

insights from the data. Thus, CSO should take the initiative to generate estimates on commercial energy consumption trends and patterns by evaluating different data sources and performing energy demand forecasting for commercial energy consumption.

Mandating data disclosure by administrative agencies

Some high energy-consuming hotels are designated consumers under the PAT scheme, which mandates the sharing of detailed energy related data by designated consumers with the BEE. However, this data is not made available to the public or research community, stating confidentiality issues as the reason for this. The PAT data collection framework is very robust and contains useful information that could help better understand energy consumption in luxurious hotels. Therefore, BEE could take the initiative to compile and analyse the data collected from designated consumers and disseminate anonymized non-sensitive information in the public domain, to facilitate further analysis for policy research.

Similarly, ULBs collect property wise floor area data, as the property tax is dependent on it, but do not share this data with the public, as there is no law that obligates them to do so. MoHUA should develop property tax-related reforms in which the ULBs are mandated to share the floor area data available with them with a designated national agency. The responsibility to develop a national data repository on floor area and growth in the floor spaces will be an additional responsibility of the identified agency. The agency can disseminate floor area data, growth in floor spaces, urbanization rate and other details city wise, state wise, and at a national level through its dashboard or web page. The scope of responsibility can also be extended to include modelling future trends in commercial floor area growth.

Strengthening existing services sector survey by NSS for energy data collection

The Ministry of Statistics & Programme Implementation (MoSPI) is planning to undertake an Annual Survey of Services Sector (ASSSE), along similar lines to the Annual Survey of Industries (ASI) it conducts every year. The purpose of this survey is to create a comprehensive database to monitor the growth and other related aspects of this sector in India. As a result, a pilot survey was undertaken in selected states and metro cities in 2012-13 using a 'list frame' of enterprises having 10 or more workers, as available in the Economic Census 2005 database. However, due to an improper list frame in the pilot survey, the National Statistical Commission (NSC) decided to conduct a complete list frame-based survey of commercial sector enterprises in the NSS 74th round (July 2016 – June 2017) which was a prelude to the proposed ASSSE. The following commercial activities were broadly covered in the survey:

- Wholesale and retail trade; repair of motor vehicles and motorcycles
- Transport and storage (excluding transport via railways, transport via pipeline, urban or suburban tramways, and air transport)
- Accommodation and food service
- Information and communication
- Real estate
- Professional, scientific, and technical activities
- Administrative and support services
- Education
- Healthcare and social work
- Arts, entertainment, and recreation
- Other service activities (excluding activities of trade unions and political organisations)

As this survey comprehensively covers commercial buildings, this framework can be further strengthened to collect data on energy consumption in these buildings. Currently, information on "energy charges" is included in the survey questionnaire. Additional data on electricity consumption

and the covered floor area for the particular building can also be collected. Thus, without utilising additional resources, relevant data on energy performance indicators for different commercial building types can be obtained on a regular basis.

Initiating exclusive "Commercial Building Energy Consumption Survey"

As discussed in the data gaps section, there is no data available at present to estimate energy efficiency indicators in the commercial sector. None of the existing data sources provide a comprehensive information on energy consumption by source and activity for different commercial building categories. However, for policy analysis and development, the end use energy data (by equipment, building type, fuel source) is essential which at the moment cannot be collected through any of the existing frameworks. Therefore, a nationwide survey for commercial building sector can be planned to collect the data required to estimate end-use energy consumption and establish the energy performance indicators at various levels.

In past, the government has launched several programs to improve energy efficiency in the commercial buildings including ECBC, building star rating, standard and labelling etc. The impact of these measures needs to be tracked.

Hence, it is essential to initiate a survey similar to the US EIA CBECS to strengthen the commercial building energy data framework. As NSSO is proficient in conducting statistical surveys all over India, it can take the lead on implementing CBECS in India. Initially, a pilot survey in Class A, B, and C cities can be conducted, and the lessons learned can then be used to implement a nationwide survey.

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