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India Commercial Buildings Data Framework: A Summary of Potential Use Cases

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Abbreviations

BEE	Bureau of Energy Efficiency
BIS	Bureau of Indian Standards
CREDAI	Commercial Real Estate Developers Authority of India
DC	Designated Consumer
DISCOM	Distribution Company
ECBC	Energy Conservation Building Code
EE	Energy Efficiency / Energy Efficient
ESCO	Energy Service Company
IGBC	Indian Green Building Council
KPI	Key Performance Indicator
kW	Kilowatt
kWh	Kilowatt-hour
MoUD	Ministry of Urban Development
MW	Megawatt
PAT	Perform Achieve Trade
PPD	Plug Power Density
Toe	Tons of oil equivalent
ULB	Urban Local Body
W	Watt

1. INTRODUCTION

This document details a potential set of use cases for India's Commercial Buildings Data Framework. The use cases are aimed at enabling data-driven, evidence-based policy making and at transforming the market for energy efficiency in the building sector by facilitating the adoption of (1) superior energy-efficient building design and operation and maintenance practices, and (2) better specification and procurement of end-use equipment and systems.

Each use case is described with respect to:

- Goals and intended benefits
- Users and primary audience/stakeholders
- Primary and secondary data required
- Energy Efficiency Key Performance Indicators (EE KPIs), derived from primary and secondary data to achieve primary goals
- Data granularity (component, system, building, city or national level)
- Data sources
- Data calculation, normalization and modelling methods for secondary/derived data
- Data measurement, collection and calculation periodicity (daily, weekly, monthly, annually)
- Effort involved and feasibility of collecting data (technical, financial, logistical, legal)

2. USE CASE MATRIX

Table 2.1 lists the set of use cases reviewed for the India Commercial Building Data Framework. The table also includes the use cases' applicability to new and existing buildings, the primary audience for each use case and the priority for inclusion in the framework. The priorities were determined based on internal discussions amongst the team- which has extensive knowledge of building sector energy consumption, as well as various policies, codes and guidelines including smart city mission and ECBC. Additionally, an extensive stakeholder discussion and workshop was held.

Use cases marked high priority and their associated EE KPIs will be included in the first release of the India Commercial Building Data Framework. Additionally, common KPIs which are applicable to all four use cases (including the medium & low priority use cases) will be part of the first release of the framework.

Table 2.1 Use Case Overview

Use Cases	New Building	Existing Building	Primary Audience	Priority
1. Modeling the Building Sector Energy Consumption; Understanding the Impact of Buildings at City Level	●	●	Ministry of Urban Development, Ministry of Power, Smart City Mission, NITI Aayog, BEE, ULBs	Medium
2. Develop, Update , and Implement Building Energy Codes and Guidelines	●	○	BEE, BIS, MoUD, ULBs	High
3. Develop and Update Building EE Rating and Labels	○	●	Rating organizations (e.g. BEE, USGBC, IGBC, GRIHA)	High
4. Design and Implement Enterprise Energy Management and Building Retrofit Programs	NA	●	Public and Private sector organizations, ESCOs, Discoms, Energy Auditors, Facility Managers, Equipment Manufacturers	Low

● Fully applicable ○ Partly applicable NA Not applicable

Table 2.2 below classifies the use cases based on their applicability to the macro or micro level for new and existing buildings.

Table 2.2 Use Case Classification

Use Case Classification	New Building	Existing Building
Macro Level (National, Urban, Neighborhood)	**Primary use cases: UC-1** Secondary use cases: UC-2	**Primary use cases: UC-1** Secondary use cases: UC-3
Micro Level (Building, System/Component, Equipment/Appliance)	**Primary use cases: UC-2** Secondary use cases: UC-3	**Primary use cases: UC-3, UC-4** Secondary use cases: UC-2

3. USE CASES

The sections below summarize the motivations, goals and intended impacts, and target users of each of the four use cases.

3.1. Modeling the Building Sector Energy Consumption; Understanding the Impact of Buildings at the City Level

3.1.1. Summary and Motivations

1. Improve the accuracy of building sector growth and resulting energy use projections in national energy models
2. Better understand heat island effect in urban areas as a result of building construction
3. Develop data aggregation methodologies for developing indicators to report energy efficiency of cities and neighborhoods

3.1.2. Goals and Intended Impacts

1. Enable climate and energy action planning at the national and sub-national levels
2. Convey the importance of promoting energy efficiency in the building sector
3. Help reduce the impacts of urban heat islands in major Indian cities through better planning, landscaping and treatment of roofs and pavement areas – low-cost and quick win strategy
4. Empower current and emerging market actors in their building design, construction and management decisions
5. Enable third parties to build data analysis applications that function across multiple jurisdictions and market stakeholders through a common data standard, facilitating easy aggregation of impacts
6. Better understand the impact buildings have on energy use at the city level

3.1.3. Potential Users

1. Ministry of Urban Development
2. Ministry of Power
3. Smart City Mission
4. NITI Aayog
5. Bureau of Energy Efficiency
6. Urban and Local Bodies or Municipal Corporations

3.2. Develop, Update, and Implement Building Energy Codes and Guidelines

3.2.1. Summary and Motivations

1. Collect information on both the level of compliance (specifically administrative challenges with the implementation of building energy codes) and the ease of specification and availability of building materials and equipment complying with the energy code
2. Determine whether prescriptive or performance-based compliance methods are widely used and the rationale behind this selection
3. Understand the challenges faced by Urban Local Bodies (ULB) and state implementation agencies in compliance enforcement and include suggestions for improving the code
4. Gather data to assess the performance of ECBC-compliant buildings against BAU or pre-ECBC era buildings

3.2.2. Goals and Intended Impacts

1. Collect data to help inform the optimal stringency level in future ECBC revisions
2. In future ECBC revisions, data collected is expected to help specify technical details and approaches for ECBC compliance checks
3. Help determine the availability of efficient products and the cost premium being charged for more efficient products/components or systems
4. Help determine the EPI of commercial buildings meeting minimum threshold requirements of future versions of ECBC and the existing building level benchmarks to set ECBC improvement targets/stringency levels
5. Consider developing residential building energy code or guidelines based on the data being collected for commercial buildings

3.2.3. Potential Users

1. Bureau of Energy Efficiency (BEE)
2. Municipal corporations or Urban and Local Bodies (ULBs)
3. Bureau of Indian Standard (BIS)
4. Building developers/owners
5. Commercial Real Estate Developers Authority of India (CREDAI)
6. Distributed Companies (DISCOMs)
7. Equipment or Materials Manufacturers

3.3. Develop and Update Building EE Rating and Labels

3.3.1. Summary and Motivations

1. Bridge the gap between design intent and actual performance of commercial buildings
2. Build a database of energy use/efficiency in Indian commercial buildings that will be the basis of EE ratings
3. Estimate connected loads for commercial buildings to help set targets based on the energy-efficient characteristics of buildings and avoid rules of thumb[1]

3.3.2. Goals and Intended Impacts

1. Develop an Energy Efficiency Scorecard for buildings with specific Energy Efficiency indicators at the building and/or system level
2. Set benchmarks for these indicators including asset and operational ratings; periodically review and update these benchmarks
3. Rate and certify buildings based on the EE scorecards

[1] Connected loads are mostly determined on rules of thumb and there is a need to more accurately estimate them because it can lead to unnecessary and wasteful charges that enterprises pay to Discoms on one side and a difficult problem for Discoms to estimate the ratio of obligated and actual demand / load – Infosys is a case in point.

4. Help determine the building energy data disclosure requirements in commercial real estate transactions to attach higher market (leasing and selling price) value for more energy-efficient properties. Enable cities and/or others in planning departments to aim for higher energy performance in building stock
5. Develop a data-driven framework, consistent with PAT (Perform Achieve Trade) methodology for industry (e.g. use of sector-focused specific energy consumption norms), to determine energy-intensive commercial buildings suitable for assigning "designated consumers" status
6. Use the framework to accord any incentives or special status (e.g. reduced property taxes for low carbon footprint, reduced electrical tariffs if energy efficiency thresholds are met) to highly efficient commercial buildings

3.3.3. Potential Users

1. Bureau of Energy Efficiency (BEE)
2. Building developers / owners and tenants
3. Facility managers
4. Commercial Real Estate Developers Authority of India (CREDAI)
5. Municipal corporations or Urban and Local Bodies (ULBs)
6. Distribution Companies (DISCOMs)
7. Energy Service Companies (ESCOs) and Energy Auditors
8. Rating organizations IGBC, GRIHA, USGBC

3.4. Implement Enterprise Energy Management Program

3.4.1. Summary and Motivations

1. Enable enterprises to reduce and manage energy costs through energy efficiency measures
2. Enable enterprises to comply with EE and environmental ratings required by government, customers or business partners
3. Enable enterprises to comply with EE and environmental rating in line with corporate values and image
4. Enable enterprises to comply with environmental reporting requirements for listed companies
5. Enable Utilities and Distribution Companies to design and implement demand response programs

3.4.2. Goals/Intended Impacts

1. Collect and analyze energy usage data for the whole building with the aim of reducing and/or managing total energy usage for the enterprise
2. Collect and analyze energy usage data for various systems and components with the aim of reducing and/or managing the energy used by these systems
3. Collect and analyze operational parameters of various systems and components with the aim of increasing the operational efficiency of these systems
4. Contribute EE data on the building, systems and components to a national building performance database to help develop building, system and component design and operation guidelines

5. Use demand response as a resource to cut peak demand requirements and ease the pressure on the electrical grid

3.4.3. Potential Users

1. Enterprises
2. ESCO's
3. Energy auditors
4. Facility managers
5. Equipment manufacturers
6. DISCOMs
7. BEE (only as user of EE data input to national building performance DB)

4. BUILDING CATEGORIES

When applying use cases to improve the energy efficiency of buildings, especially 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., since 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 4.1 lists the parameters used to categorize buildings.

Table 4.1 Categorization Parameters for Buildings

Categorization Parameter	Description
Climate Zone	Hot & Dry, Warm & Humid, Composite, Moderate, Cold
Activity	The primary use of the 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 and Small Retail Stores Educational Establishments: Institutions of Higher Education, Schools Offices: IT, ITeS, Public, Non-IT
Age*	The age of the building, 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	

5. ENERGY EFFICIENCY KPIs

Table 5.1 lists the EE KPI's, their unit of measurement, granularity and the priority for inclusion in the India Commercial Building Data Framework. Use cases 1,2,3, and 4 represent the aforementioned four use cases. Use case priority is indicated by H (High), M (Medium) and L (Low). Use case level of granularity is represented by C (City Level), B (Building Level), and S (System Level). Annexure 1 has more details on each KPI and its applicability to the various use cases.

Table 5.1 EE KPIs

EE KPI	Unit	Use Case				Granularity		
		1	2	3	4	B	C	S
Annual electrical energy consumed per unit area	kWh/m^2/year	H	H	H	H	B	C	
Annual total energy consumed per unit area	toe/m^2/year	H	H	H	H	B	C	
Average demand density	kW/m^2, W/m^2	H	H	H	H	B	C	
Maximum demand density (at any TOD)	kW/m^2, W/m^2	H	H	H	H	B	C	
Buildings with cool / green roof	%	H	H	H	H	B	C	
Buildings using wall insulation	%	H	H	H	H	B	C	
Building with single glazing windows	%	H	H	H	H	B	C	
Buildings with double glazing windows and low-e coated glass	%	H	H	H	H	B	C	
Buildings with demand response control systems	%	H	H	H	H	B	C	
Buildings with Building Energy Management systems *(BEMS to be equipped with measuring, monitoring and controlling and must include sub-metering of building HVAC & lighting)*	%	H	H	H	H	B	C	
% of electricity sourced from grid	%	H	H	H	H	B	C	
% of electricity sourced from diesel generator	%	H	H	H	H	B	C	
% of electricity sourced from renewable energy	%	H	H	H	H	B	C	
Passive-cooled (design features) area within building	% or m^2	H	H	H	H	B	C	
Active-cooled area within building	% or m^2	H	H	H	H	B	C	
Use of HVAC control system	%	H	H	H	H	B	C	
Use of lighting sensor & control system	%	H	H	H	H	B	C	
Types of HVAC system	%, Enumerated	H	H	H	H	B	C	
Space cooling efficiency area-wise	m^2/ton		H	H	H	B		
Space cooling efficiency of system	kW/ton		H	H	H	B		
Type of lighting systems	%, Enumerated	H	H	H	H	B	C	
Lighting power density	W/m^2	H	H	H	H	B		

% of total energy use to economic output	%	H	M	M	H	B	C	S
Contracted demand	kW and kVA		H	H		B		
Contracted demand utilization	% or kW		H	H		B		
Annual CO_2 emissions per unit area	kg/m^2/year	H	H			B	C	
Aggregate demand	MW	H					C	
Demand that can be curtailed / shed	MW, %	H					C	
ECBC compliance in the city	%	H					C	
Naturally Ventilated buildings	%	H					C	
Mixed mode buildings *(Buildings which are naturally ventilated as well as air conditioned)*	%	H					C	
Active cooled buildings	%	H					C	
Passive cooled buildings	%	H					C	
Buildings with window shading (external)	%	M	M	M	M	B	C	
Annual electrical energy consumed per occupant[2]	kWh/person/year	M	M	M	M	B	C	
Annual total energy consumed per occupant	toe/person/year	M	M	M	M	B	C	
Annual CO_2 emissions per occupant	kg/person/year	M	M	M	M	B	C	
Plug power density (PPD)	W/m^2		M	M	M	B		
Building Window-Wall Ratio (WWR)	%		M	M	M	B		
Cool pavement	%	M					C	
% of total energy used for space cooling	%				L	B		
% of total energy used for space lighting	%				L	B		
UPS System Efficiency (at full charge)	%		L		L			S
% of total energy used for hot water & steam	%		L		L	B		
% of total energy used for cooking	%		L		L	B		
% of total energy used for laundry	%		L		L	B		
Number of commercial refrigeration units	Number		L		L	B		
% of units vertical closed transparent	%		L		L	B		
% of units horizontal closed solid	%		L		L	B		
% of units horizontal closed transparent	%		L		L	B		
Type, capacity & efficiency of hot water / steam systems	Enumerated		L		L	B		
Type, capacity & energy factor of laundry systems	Enumerated		L		L	B		
Type &burner input rates of cooking systems	Enumerated		L		L	B		
Average operating hours of cooking systems	Hours		L		L	B		
% of total electrical energy consumption - ICT	%		L		L	B		

[2] Occupant could be employee (office), bed (hospital), room (hotel), etc

6. DATA COLLECTION CONSIDERATIONS

6.1. Data Fields

The attached data sheet (Annexure 2) has the data fields that need to be collected in order to derive the EE KPIs listed in Section 5. Broadly, the data fall into the following categories:

- Building categorical data such as building activity type, age and location.
- General building-level information such as contact information, occupancy characteristics. Additionally, this category 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.

Each data field is defined by a name, unit of measure, and permissible values. Many data fields can be interpreted in different ways depending on the context and will therefore also need a definition and guidance on interpretation.

6.2 Prioritization of Data Fields

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.

- Start with the use case, not the data. Always use the specific KPIs and analysis requirements of a use case to determine data needs and priorities. In other words, each data field should have an explicit reason for being included in a data collection effort – either as an input for a KPI or a normalizing/clustering variable.
- Consider the level of effort. The level of effort required to collect data varies significantly across data fields. Obtaining the number of guest rooms in a hotel is orders of magnitude easier than obtaining a detailed end use energy disaggregation. It may be worthwhile assigning a 1-5 score for level of effort required to collect the data for each field and using that as a consideration when prioritizing which fields to collect. For critical fields that are very difficult to collect, consider proxy fields that may require less effort. For example, use the nameplate efficiency of a chiller if the actual operational efficiency is not easily obtained.
- Assess the likelihood of poor data quality. Some fields may seem easy to collect but may

be highly prone to poor data quality. For example, experience indicates that even a seemingly basic data field such as gross floor area can be significantly misreported. For certain building types, alternative measures of floor area may be more reliable. For example, net leasable area is likely to be more reliable because it is has a critical business purpose in leased buildings.

6.3 Survey Design and Approach

Once the data fields have been selected and prioritized, the following are key considerations for the survey design and data collection approach.

- Statistical sampling vs. 'opportunistic' data collection. Some use case analysis questions, e.g., obtaining a national or state-level estimate of sector-wide energy use, clearly require using formal statistical sampling methods. However, sampling may require collecting data from buildings for which data collection is especially difficult or even impossible. An alternative approach is to collect data 'opportunistically' i.e. pursue data collection from entities that are supportive and capable of providing data, e.g., large portfolio owners. In theory, such a dataset will not be a true statistical sample but may still be able to address most use case analysis questions with a reasonable level of rigor.
- Breadth vs. depth of data collection. As with any data collection effort with a constrained budget there is a tradeoff between the number of buildings from which data is collected and the amount of data collected from each building. Use case priorities will determine this tradeoff. For example, an initial data collection effort may choose to focus on only a few geographic regions in order to afford more in-depth data for each building.
- Remote vs. on-site data collection. In general, remote data collection (e.g. via telephone, web survey forms, email) requires less effort than on-site data collection. For the scope of data fields addressed with this set of use cases, it may be difficult to completely avoid site visits without seriously compromising data quality, especially for building system characteristics data fields. However, the time spent on-site could be minimized by collecting as much data as possible remotely.
- Limit the number of touch-points for obtaining the data. No one person or documentation system will likely have all the data required for these use cases in any given building. However, as far possible, the number of touch-points should be limited in order to ease data collection effort. For example, for large portfolio owners there may be a central repository that contains data across all buildings at least for certain data fields.
- Minimize the burden on the data provider. Any tactics that help reduce the time spent by the data provider will help ease data collection. For example, if some data are located in certain documents (drawings, specifications, etc.), the data collector could offer to look up the data in those documents rather than requesting the data provider to do the same.

Annexure 1: EE KPI Details

Table A.1. Common EE KPIs

EE KPI	Unit	Relevant Use Case & Granularity	Periodicity
Annual electrical energy consumed per unit area	MWh/km^2/year kWh/m^2/year	UC-1: Neighborhood, City, National UC-2, UC-3, UC-4: Building	Annual
Annual total energy consumed per unit area	Mtoe/km^2/year toe/m^2/year	UC-1: Neighborhood, City, National UC-2, UC-3, UC-4: Building	Annual
Annual electrical energy consumed per occupant[3]	kWh/person/year	UC-1: Neighborhood, City, National UC-2, UC-3, UC-4: Building	Annual
Annual total energy consumed per occupant	toe/person/year	UC-1: Neighborhood, City, National UC-2, UC-3, UC-4: Building	Annual
Annual CO_2 emissions per unit area	tons/KM^2/year kg/m^2/year	UC-1: Neighborhood, City, National UC-2: Building	Annual
Annual CO_2 emissions per occupant	kg/person/year	UC-1: Neighborhood, City, National UC-2: Building	Annual
Average demand density	MW/m^2 kW/m^2 or W/m^2	UC-1: Neighborhood, City UC-2, UC-3, UC-4: Building	Averaged over a year
Maximum demand density (at any TOD)	MW/m^2 kW/m^2 or W/m^2	UC-1: Neighborhood, City UC-2, UC-3, UC-4: Building	Highest during the year
Aggregate demand	MW	UC-1: Neighborhood, City	Over a year
Demand that can be curtailed / shed	MW, % of total demand	UC-1: Neighborhood, City	Over a year, based on seasons
Cool pavement	% of total pavement area	UC-1: Neighborhood, City, National	Annual
Buildings with cool / green roof	% of total roof area OR % of total buildings	UC-1: Neighborhood, City, National UC-2: Neighborhood, City	Annual
Buildings using insulation	% of total buildings	UC-2: Neighborhood, City	Annual

[3] Occupant could be employee (office), bed (hospital), room (hotel), etc.

EE KPI	Unit	Relevant Use Case & Granularity	Periodicity
Building with single glazing windows	% of total buildings	UC-2: Neighborhood, City	Annual
Building with double glazing windows	% of total buildings	UC-2: Neighborhood, City	Annual
Building with triple glazing windows	% of total buildings	UC-2: Neighborhood, City	Annual
ECBC compliance in the city	% of total buildings	UC-2: Neighborhood, City	Annual
Contracted demand	kW and kVA	UC-2, UC-3: Building	Annual
Contracted demand utilization	% OR kW	UC-2, UC-3: Building	Annual
Buildings with demand response control systems	% of total buildings	UC1, UC-2: Neighborhood, City	Annual
Buildings with Building Energy Management systems *(BEMS to be equipped with measuring, monitoring and controlling and must include sub-metering of building HVAC & lighting)*	% of total buildings	UC1, UC-2: Neighborhood, City	Annual
% of electricity sourced from grid	% of electricity	UC-1: Neighborhood, City UC-2, UC-3, UC-4: Building	Annual
% of electricity sourced from diesel generator	% of electricity	UC-1: Neighborhood, City UC-2, UC-3, UC-4: Building	Annual
% of electricity sourced from renewable energy	% of electricity	UC-1: Neighborhood, City UC-2, UC-3, UC-4: Building	Annual
Building Envelope: Window-Wall Ration (WWR)	%	UC-2, UC-3, UC-4: Building	One-time / retrofit

EE KPI	Unit	Relevant Use Case & Granularity	Periodicity
Building Envelope: Window glazing / film	Enumerated	UC-2, UC-3, UC-4: Building	One-time / retrofit
Building Envelope: Window shading (external)	Enumerated	UC-2, UC-3, UC-4: Building	One-time / retrofit
Plug power density (PPD)	W/m^2	UC-2, UC-3, UC-4: Building, System	Calculated dynamically, averaged for a year
Passive cooled area within building	% OR m^2	UC-2, UC-4: Building	One-time / change
Active Air-conditioned area within building	% OR m^2	UC-2, UC-4: Building	One-time / change
Types of HVAC system	Enumerated (technology, EE rating)	UC-2, UC-3, UC-4: Building, System	One-time / change
Use of HVAC controls	%	UC-2, UC-3, UC-4: Building, System	One-time / change
Space cooling efficiency	kW/ton OR m^2/ton	UC-2, UC-3, UC-4: Building, System	Calculated dynamically (kW/ton) or seasonally / yearly (m^2/ton)
% of total energy used for space cooling	%	UC-4: Building	Annual
Type of lighting systems	Enumerated (technology, EE rating)	UC-2, UC-3, UC-4: Building, System	One-time / change
Lighting power density	W/m^2	UC-2, UC-3, UC-4: Building, System	Calculated dynamically (W/m^2) and averaged for a year
% of total energy used for space lighting	%	UC-4: Building	Annual

EE KPI	Unit	Relevant Use Case & Granularity	Periodicity
Use of lighting sensor & control system	%	UC-2, UC-3, UC-4: Building, System	One-time / change
% of total energy use to economic output	%	UC-1: Neighborhood, City UC-2, UC-3, UC-4: Building	Annual
Naturally Ventilated buildings	%	UC-1, UC-2: Neighborhood, City	Annual
Mixed mode buildings	%	UC-1, UC-2: Neighborhood, City	Annual
Active cooled buildings	%	UC-1, UC-2: Neighborhood, City	Annual
Passive cooled buildings	%	UC-1, UC-2: Neighborhood, City	Annual

Table A.2. Building Category-Specific EE KPIs

EE KPI	Unit	Relevant Use Case & Granularity	Periodicity
UPS System Efficiency (at full charge)	%	UC-2, UC-4: Building, System	System rating or measured periodically?
% of total energy used for hot water & steam	%	UC-2, UC-4: Building (hotels, hospitals)	Annual
% of total energy used for cooking	%	UC-2, UC-4: Building (hotels, hospitals)	Annual
% of total energy used for laundry	%	UC-2, UC-4: Building (hotels, hospitals)	Annual
% of total energy used for refrigeration units (kitchen)	%	UC-2, UC-4: Building (hotels, hospitals)	Annual
Type, capacity & efficiency of hot water / steam systems	Enumerated (technology, EE rating)	UC-2, UC-4: Building (hotels, hospitals)	One-time / retrofit

EE KPI	Unit	Relevant Use Case & Granularity	Periodicity
Type, capacity & energy factor of laundry systems	Enumerated (technology, EE rating)	UC-2, UC-4: Building (hotels, hospitals)	One-time / retrofit
Type, capacity & efficiency of cooking systems	Enumerated (technology, EE rating)	UC-2, UC-4: Building (hotels, hospitals)	One-time / retrofit
Type, capacity & efficiency of refrigeration units	Enumerated (technology, EE rating)	UC-2, UC-4: Building (hotels, hospitals)	One-time / retrofit
% of total electrical energy consumption used for ICT equipment	%	UC-2, UC-4: Building (offices, hospitals)	Annual

Table A.3. Organizational Capacity KPIs

EE KPI	Unit	Relevant Use Case & Granularity	Periodicity
ECBC Compliance Check Method	Prescriptive or Performance or Trade-off	UC-2: City	Annual
Capacity at ULBs or SDAs to conduct compliance checks of building design and construction	Qualitative, through interviews & surveys	UC-2: City, State	Annual
ECBC compliance application for both prescriptive and performance path	Qualitative, through interviews & surveys	UC-2: City	Annual

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Annexure 2: Commercial Building Energy Consumption Survey Questionnaire

Name of Surveyor:

Date of Survey:

BUILDING CATEGORY DATA (Select the relevant data from each column – Mandatory)							
Climate Zone	**Age of Building**	**Activity**	**Activity Sub-category**				
Hot and dry	0-5 years	Hotel	Heritage	Luxury	Budget	Resort	
Warm and Humid	6-10 years	Hospital	Single-Specialty	Multi-Specialty	Super-Specialty	Clinics	Diagnostic Labs
Composite	11-20 years	Educational establishment	Institutions of Higher Education		Schools		
Moderate	20+ years	Retail establishment	Shopping Malls	Large Retail Store *> 5000sqm*	Medium Retail Store *500-5000sqm*	Small Retail Store *50-499sqm*	
Cold		Office	IT	ITeS	Public	Non-IT	
		Restaurant					
Remarks for each category (if any)							

Questions with an asterisk are mandatory					
S.NO.	**QUESTIONS**	**VALUE**	**DATA UNIT**	**PERMISSIBLE UNIT**	**GUIDANCE/ INSTRUCTIO**

					NS
General Information					
1	Facility name*		-	-	
2	Contact person*		-	-	
3	Address*		-	-	
4	Contact number*		-	-	
5	Email ID*		-	-	
6	City/ Town*		-	-	
7	State/ UT*		-	-	
8	Building occupancy type*		-	Owner Occupied, Single Tenant, Multiple Tenants, Landlords + Multi Tenants	
9	Building daily occupancy hours*		-	-Number of hours daily(8/16/24/other)	
10	Building weekly occupancy days*			-Number of Days weekly(5/6/7)	
11	Number of daily shifts carried in the building*		-	One, Two or Three Shifts	
12	Total building occupancy per shift*		-	Number of people per shift (shift 1/ shift2/ shift 3)	
13	Building Management System (BMS) installed in building? * *BMS must include monitoring and measuring. (System controls is optional for BMS). Further, sub-metering must be provided for HVAC and lighting under BMS.*		-	Yes/ No	
Additional Information on OFFICES					

14	Number of organizations within the building complex		-	Single/ Multiple Organizations (Specify total number if multiple)	
15	Building structure owned/leased		-	Owned/ Leased	
16	Data center having connected load more than 100 kW*		-	Yes/ No (Specify connected load kW)	
17	Data center gross area			m^2 or ft^2	
18	Data center monthly energy consumption			kWh	
19	Data center peak demand			kW	
20	Data center power usage effectiveness (PUE)		-	PUE value	
Additional Information on HOSPITALS					
21	List specialities of hospital*		-	Name	
22	Total number of beds in hospital*		-	Number of beds	
23	Hospital ownership type*		-	Private/ Public	
24	Total full time hospital staff		-	Number	
25	Number of inpatients in an year		-	Number	
26	Number of outpatients in an year		-	Number	
Additional Information on HOTELS					
27	Hotel service class*		-	1/2/3/4/5 star	
28	Total number of rooms in hotel*		-	Number of rooms	
29	Average room occupancy		-	Percent	
30	Number of Banquets/ Conference guests per year		-	Number	
31	Number of swimming pools in the hotel		-	Number	

32	Provision of laundry service at the hotel		-	Yes/ No	
33	Average quantity of laundry handled per day		-	kg	
Additional Information on INSTITUTIONS					
34	Type of establishment*			Primary school/ Secondary school/ Senior secondary school, Institution for higher education (BA/MA/B.Tech/M.Tech etc.)	
35	Hostel facility provided on campus*		-	Yes/ No	
36	Total number of students*		-	Number of students per shift	
37	Total number of permanent faculty		-	Number of faculty per shift	
38	Data center having connected load more than 100 kW*		-	Yes/ No	
39	Data center gross area			m^2 or ft^2	
40	Data center monthly energy consumption			kWh	
41	Data center peak demand			kW	
42	Data center power usage effectiveness (PUE)		-	PUE value	
Additional Information on RETAIL ESTABLISHMENTS					
43	Operator type		-	Single/ Multiple operator (Specify number if multiple)	
44	Total number of restaurants (if any)		-	Number of restaurants	
45	Average type of meals served in the restaurants (shopping mall/ large retail store)		-	Breakfast/ Lunch/ Dinner/ Coffee/ Snack/ Dessert	

46	Average occupancy rate of the restaurants		-	Occupancy rate	
Additional Information on RESTAURANTS					
47	Average type of meals served in restaurant		-	Breakfast/ Lunch/ Dinner/ Coffee/ Snack/ Dessert	
48	Average occupancy rate		-	Occupancy rate	
Building Construction					
1	Building construction year*		-	Year	
2	In which year was the last major renovation done* *(if applicable)*		-	Year	
3	Building longer façade orientation*		-	North-South/ East-West/ NorthEast-SouthWest/ SouthEast-NorthWest	
4	Building window to wall ratio (WWR)*		-	WWR value (>50%/ <50%)	
5	Building roof type – Cool Roof/ Green Roof*		-	Yes/ No (Specify green/ cool roof)	Yes if only provided for more than 50% of roof area
6	Number of floors in building*		-	Number	
7	Number of basements in building*		-	Number	
8	Total site area*			m^2 or ft^2	
9	Total built-up area*			m^2 or ft^2	
10	Total built-up area excluding parking (includes parking in basement areas even if partially used for the purpose)			m^2 or ft^2	
11	Total parking area (includes parking in basement areas even if partially used for the purpose)			m^2 or ft^2	
12	Total area for service floors/areas (includes services in basement areas even if partially used for the purpose)			m^2 or ft^2	

13	Total carpet area			m^2 or ft^2	
14	Type of glazing on building north facade		-	SGU(clear/tint), DGU(clear/tint), TGU(clear/tint) - (Indicate the type installed more than 50% for each façade)	SGU – Single glazed unit, DGU – Double glazed unit, TGU – Triple glazed unit
15	Type of glazing on building south facade		-		
16	Type of glazing on building east facade		-		
17	Type of glazing on building west facade		-		
18	Wall insulation provided for all facades		-	Yes/ No	
19	'Green Building Certification' received by building		-	Yes/ No	
20	Specify the Green Building Certification rating authority		-	GRIHA, IGBC, LEED, EDGE (any other)	
21	Number of stars/points /grade achieved in Green Building Certification		-	Number of stars/ points/ grade/ other	
22	Year of award of the rating		-	Year	
23	Year of renewal of rating		-	Year	
Building Energy Consumption					
1	Sanctioned contract demand for building*			kVA	
2	Building total connected load*			kW	
3	Building monthly electricity consumption from the grid*			kWh or units (Specify for each month)	
4	Building monthly electricity consumption from RE installed on site (if any)*			kWh (Specify for each month)	
5	Building monthly electricity consumption from RE installed on offsite (if any)*			kWh (Specify for each month)	
6	Building monthly electricity consumption from DG or non-RE*			kWh or units (Specify for each month)	
7	Capacity of RE installed on site*			kW	
8	Capacity of DG set on site			kW	

9	Average number of hours DG is operational		-	Hours	
10	Electricity produced on site from RE per month (if any)			kWh	
11	Building peak demand			kW	
12	Types of fuel used on site for electricity generation, contributing to more than 5% in total electricity demand*		-	Gas/ Diesel/ Other (Specify name)	
13	Quantity of each fuel used per month on site*			kg or kl (specify quantity for each fuel type)	
14	Willing to participate in Demand Response (DR) programme		-	Yes/ No	
15	Building demand that can be curtailed			kW	
Building Energy Consumption for Cooling					
1	Building total cooling connected load*			kW	
2	Type of cooling system provided for building*		-	Passive Cooling System (design feature), Active Cooling/ Both/ None	
3	Number of months space cooling is operational*		-	Number of months	
4	Average number of hours space cooling is operational*		-	Number of hours	
5	Average cooling set point temperature*			Temperature	
6	Are cooling controls provided in the building*		-	Yes/ No/ Partly	
7	Building air conditioned gross area			m^2 or ft^2	
8	Building air conditioned carpet area			m^2 or ft^2	
9	Building monthly energy consumption for cooling			kWh	
10	Number of fans installed in building		-	Number of fans	
11	Number of fans installed in active cooled area		-	Number of fans	

12	Type of passive cooling system (design feature - if any)		-	Air cooling towers/Earth air tunnel/Solar chimneys/ Other(Specify type)	System installed for more than 30% conditioned area
13	Type of active cooling system – Refrigerant based or Non-refrigerant based (if any)		-	WRAC-mini splits, CUAC air cooled, Multi-splits/Cassette, Air-cooled chiller, Water-cooled chiller, Radiant cooling etc.	System installed for more than 30% conditioned area
14	How much area is passive cooled (if any)			m^2 or ft^2	
15	How much area is active cooled (if any)			m^2 or ft^2	
16	Cooling system capacity			kW or RT (Mention capacity of each cooling system)	
17	Energy efficiency rating of cooling system (BEE rating)		-	1/2/3/4/5 star (Mention rating for each cooling system)	
18	Energy efficiency ratio (EER) of cooling system		-	EER value	
19	Year of award of EER and rating		-	Year	
Building Energy Consumption for Heating					
1	Building total heating connected load*			kW	
2	Type of heating system installed in the building		-	forced-air or radiant (specify any other)	
3	Number of months space heating is operational*		-	Number of months	
4	Average number of hours space heating is operational daily*		-	Number of hours	
5	Average heating set point temperature*		-	Temperature	

6	Are heating controls provided in the building*		-	Yes/ No/ Partly	
7	Building gross heated area			m2 or ft2	
8	Building heated carpet area			m2 or ft2	
9	Building monthly energy consumption for heating			kWh	
10	Heating system capacity			kW	
Building Energy Consumption for Lighting					
1	Building total lighting connected load*			kW	
2	Type of lamps installed in building (Specify type of lamp along with wattage and total number)			Lamp type (Number & Wattage of each lamp) (Type of lamps – LED, CFl, GSFL, MH, HPSV, HPMV etc.)-	Mention types having total installed capacity more than 5% of the total installed capacity
3	Average number of daily operating hours of indoor lights*			Hours	
4	Average number of daily operating hours of outdoor lights*			Hours	
5	Building monthly energy consumption for lighting			kWh	
6	Building average Lighting power density (LPD)			W/m^2 or W/ft^2	
7	Specify whether lighting controls are installed in building			Yes/ No/ Partly	
Building Energy Consumption for Water Pumping					
1	Connected load for pumping ground/ municipal water*			kW	
2	Monthly energy consumption for pumping ground/ municipal water			kWh	
3	Pumps daily average operational hours		-	Hours	
4	Wastewater treatment system connected load*			kW	

5	Monthly energy consumption for treating waste water			kWh	
6	Building total hot water requirement per month			kl	
7	Type of building water heating system		-	Electricity/ Solar/ Gas	
8	Total connected load of water heating system (if electricity)*			kW	
9	Monthly energy consumption of water heating system (if electricity)			kWh	
10	Installed capacity of solar water heating system (if solar)			kW	
11	Monthly quantity of gas/other fuel used for water heating			Kg or kl	
Building Energy Consumption for Cooking					
1	Type of cooking fuel used in building		-	Electricity/ Gas	
2	Total connected load for cooking systems (if electrical)			kW	
3	Annual energy consumption for cooking systems			kWh/kBtu	
4	Quantity of gas/other fuel used for cooking			Kg or kl	
5	Number and type of refrigeration units used in kitchen			Mention all type and the number of units	
6	Installed capacity of each type of refrigeration unit			kW	
Building Energy Consumption by Service Equipment					
1	Number of Lifts/ Escalators/ Travelator used in building			Number	
2	Type of Lifts/ Escalators/ Travelator installed in building			Geared, Gearless, Regenerative lift, Sensor Based etc.	
3	Total connected load for each of the Lifts/ Escalators/ Travelator			kW	
4	Monthly energy consumption for Lifts/ Escalators/ Travelator			kWh	