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India SMART UTILITY Week 2025

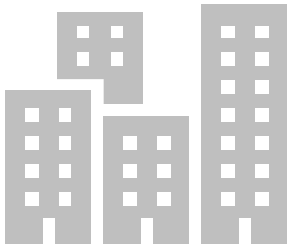
Grid Integrated Buildings

India's Transition Towards Low Carbon GIBs

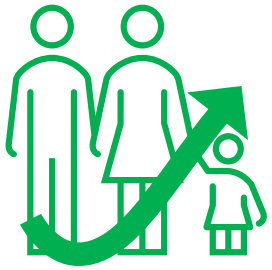
Presented By

SP Garnaik, India Country Representative, Global Green Growth Institute (GGGI)

Growing Need for Grid Integrated Buildings (GIBs)

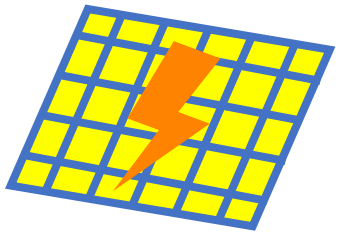


50% of global electricity consumption. Expected to rise to 60% by 2050



Urban India population may reach **~600** mn by 2030, increasing power demand

Cooling is **~40%** of peak electricity demand in India. May 3x by 2040. Delhi witnessed 8 GW peak in June 2023



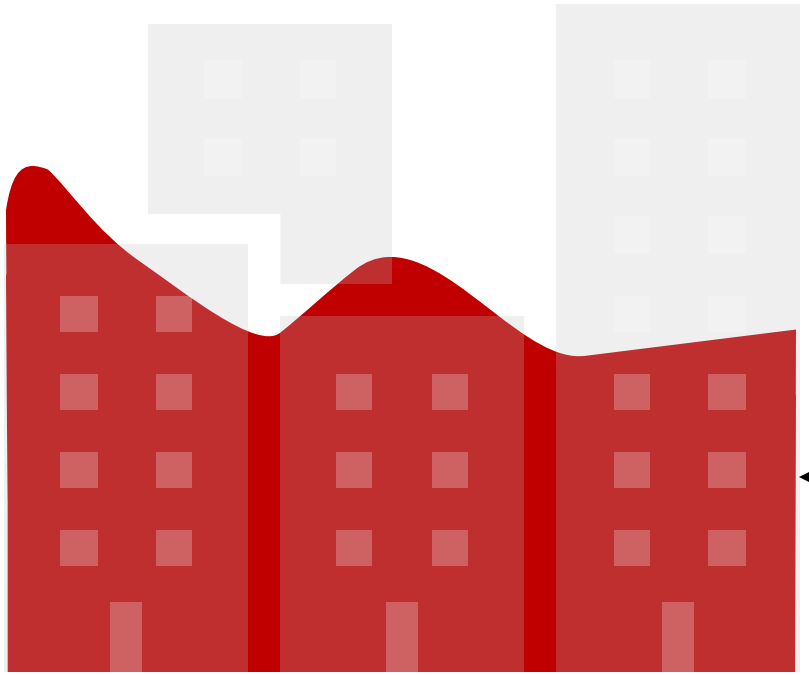
India's rooftop solar capacity is expected to reach **40-50** GW by 2030, if pace is sustained

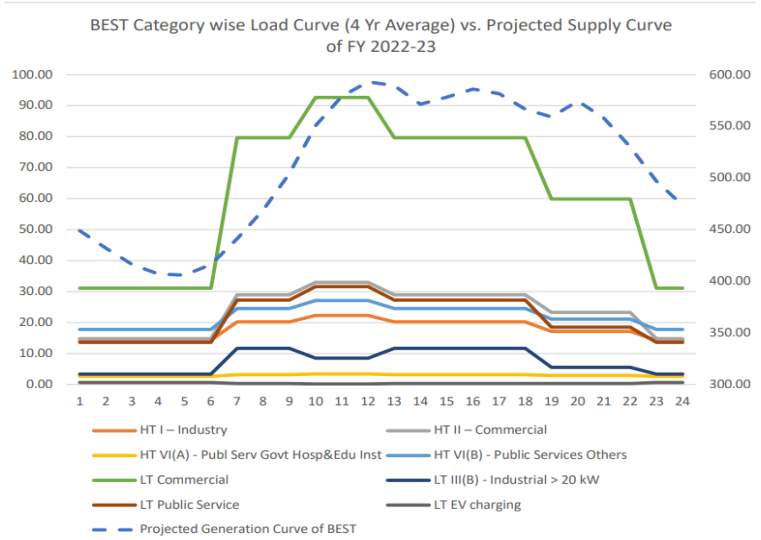
Rising dynamic demand and variable renewable generation, necessitate effective integration of buildings with the grid for resilience & sustainability.

The Present Energy & Carbon Intensive Buildings

Inefficient appliances,
waste of energy

An efficient AC would save INR 5,000 per year





Load curves vary as per the nature of building operation & occupancy

Grid based power
has heavy thermal footprint

Onsite Diesel Use
offers dirty backup

An inefficient DG set emits 40% (~45 tonnes) more CO2

The Future of Low Carbon GIBs

EFFICIENT

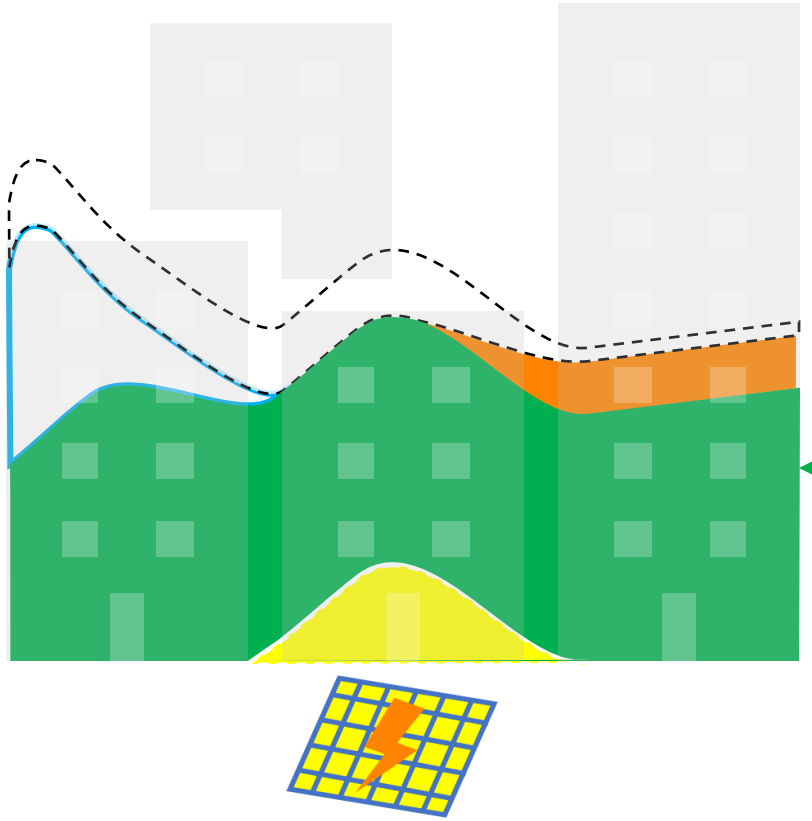
Persistent low energy use minimizes demand on grid resources and infrastructure

Efficient Appliances
reduce load

Sensors & smart controls
shed/ modulate load

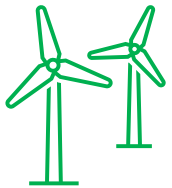
SMART

Analytics supported by sensors and controls co-optimize efficiency, flexibility, and occupant preferences



Onsite Solar
shaves peak load

Energy Storage
shifts/ balances load



Grid based Renewable Energy
powers the rest

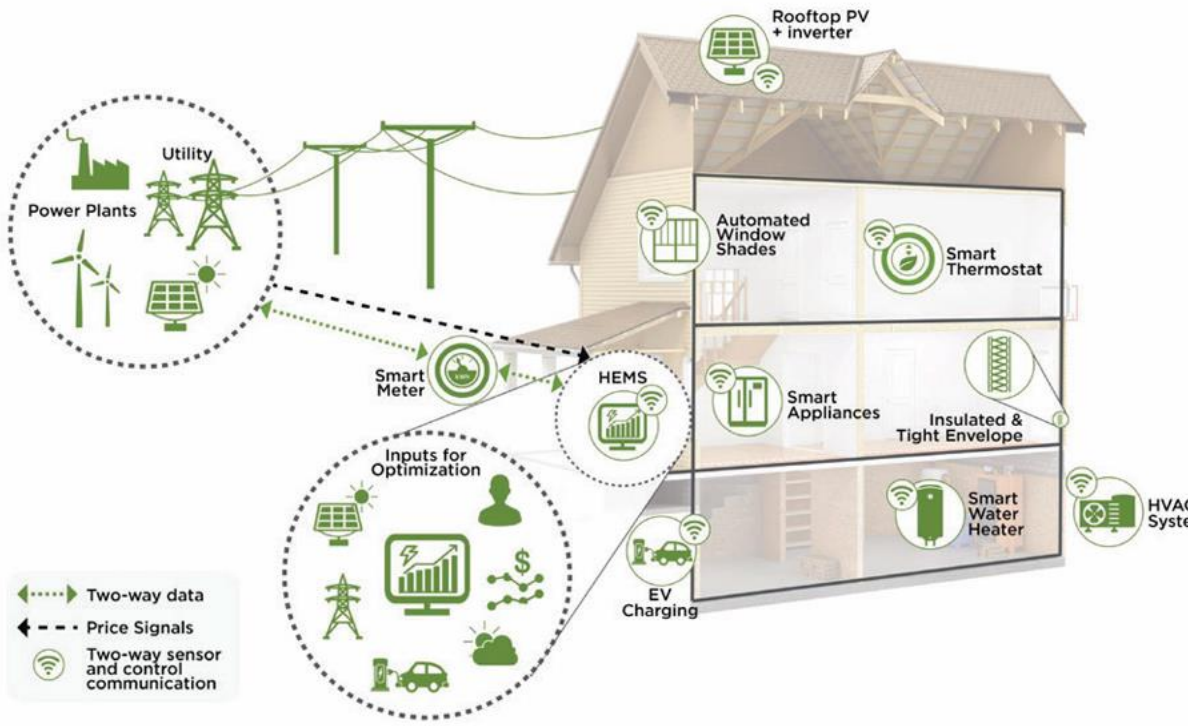
CONNECTED

Two-way communication with flexible technologies, the grid, and occupants

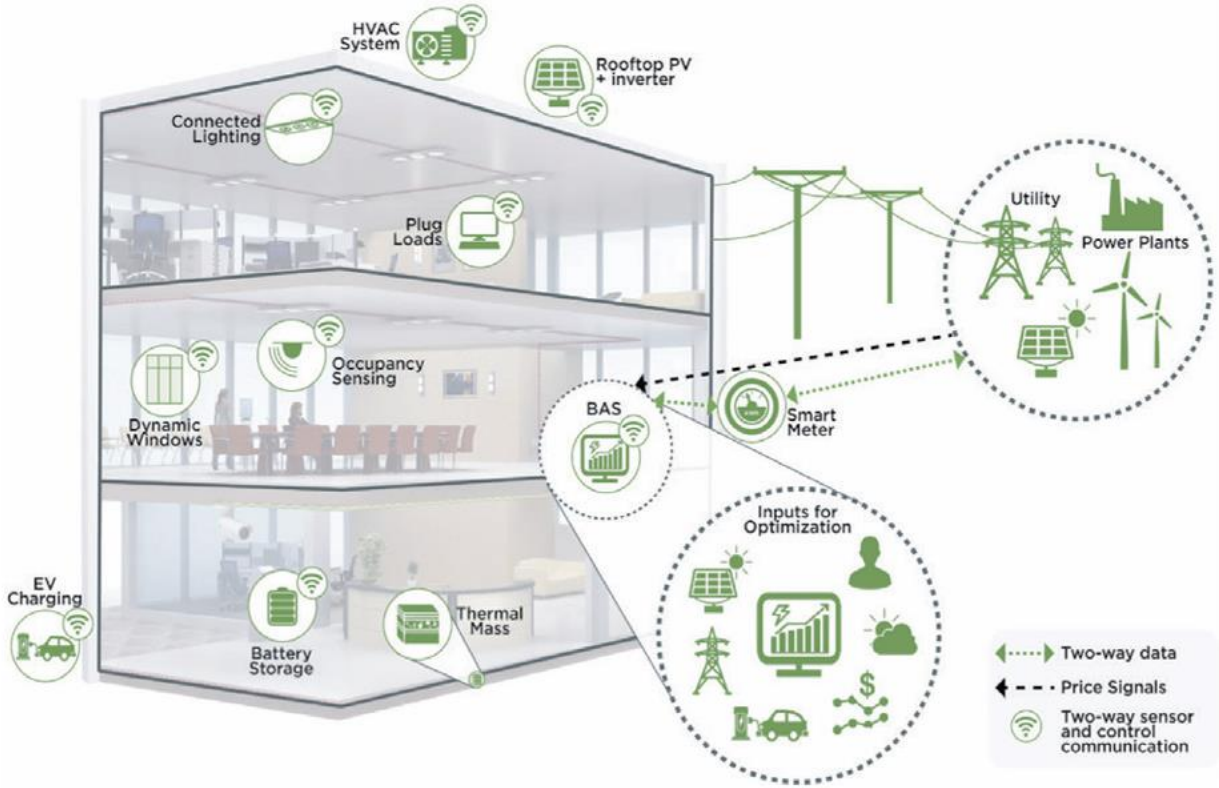
FLEXIBLE

Flexible loads and distributed generation/storage can be used to reduce, shift, or modulate energy use

Examples of Grid Integrated Buildings



Residential Building



Commercial Building

Technologies Enabling Grid Interactivity

- **Smart Meters & Energy Management Systems (EMS):** Real-time monitoring and automated load control optimize energy flows between the grid and buildings.
- **Battery Energy Storage Systems (BESS):** Enables storage of excess solar energy during the day for night-time use, reducing dependence on fossil fuel-based generation. BESS deployment in India is targeted to reach 208 GWh by 2030, supporting greater renewable energy integration.
- **IoT & AI-powered automation:** Smart controls for HVAC, lighting, and appliances can reduce energy wastage by 25-30%. India aimed to install 250 million smart meters by 2025, enabling automated energy optimization in buildings.
- **Vehicle-to-Grid (V2G) Systems:** Electric Vehicles (EVs) can store surplus energy and feed it back to the grid during peak hours, enhancing grid stability.

Policy & Regulatory Support for GIBs in India

- **Reforms in Net Metering Policies:** Incentivizing two-way energy flows between buildings and the grid.
- **Time-of-Use (ToU) Tariffs:** Encouraging demand-side flexibility by charging lower tariffs during off-peak hours.
- **ECBC (Energy Conservation Building Code) & Standard & Labeling (S&L):** Making Energy Efficient buildings.
- **Green Energy Open Access Rules (2022):** Allowing industries and commercial buildings to directly procure renewable energy, promoting GIBs.
- **Key Policy Priorities:** India's Green Hydrogen Mission and Energy Storage Policy (2023) emphasize grid flexibility through demand-side innovations.

Key Question for Development of GIBs

- **What factors are driving utility interest** in GIB program offerings (e.g., building electrification, EVs, solar penetration, energy market opportunities, state policy, technology advances)?.
- **Which of the grid services that GIBs provide are most valuable to utilities and customers** (e.g., demand reduction, load shedding or shifting, grid frequency, voltage control)?
- **Are there any anticipated capacity constraints** over the next 5+ years? How would this impact the need for demand response/demand flexibility?
- **How does the utility currently model / financially value** demand response and DERs?
- **What level of certainty would you require** to count on cost savings from demand response?
- **What current programs or partnerships can be leveraged**? Are there successes to replicate?
- **What new technologies or services would need to be procured** to deliver GIBs, which involve more grid interaction and building automation than typical customer energy programs?
- **Which customer segments can most benefit** from GIBs? **What types of outreach, education, and incentives would be needed t**o engage them?

Suggested Roadmap for Development of GIBs

ROAD MAP	RECOMMENDATION
1. Advancing GIBs through Research, Development and Data	• Develop/Accelerate deployment of technologies • Accelerate technology interoperability • Improve access and use of DF data
2. Enhancing the values of GIBs to Consumers and Utilities	• Develop Innovative Incentive based programs • Expand price-based program adoption • Introduce incentives for utilities to deploy Demand side Resources • Incorporate DF into resource planning
3. Empowering GIB users, Installers, and Operators	• Understand user interactions with GIBs and role of tech • Develop GIB design & operation decision making tools • Integrate smart technology into existing programs
4. Supporting GIB deployment through National, State and Local Enabling Programs and Policies	• Lead by example • Expand funding and financing options • Consider use of codes & standards • Consider implementing state targets or mandates

Economic Benefits & Business Models

- **Revenue Generation:** GIBs can participate in energy trading, demand response markets, and ancillary services, creating new revenue streams.
- **Cost Savings:** Reduced electricity bills via dynamic pricing, peak shaving, and solar energy optimization.
- **Green Finance & ESG Benefits:** GIBs attract investments through green bonds and sustainability-linked loans.
- **Numbers Speak:** India's energy efficiency market is valued at $12 billion, with GIBs playing a central role in investment opportunities.
- **Smart Building Automation** reduces HVAC energy use by 30%, cutting operational costs by ₹5-10 per sq. ft annually.

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