GRIDOPTIMAL-INDIA: PROMOTING BUILDING-GRID OPTIMIZATION IN SOUTH ASIA

Pilot Project Selection Methodology

New Buildings Institute (NBI)

South Asia Regional Energy Partnership (SAREP)

October 2024

CONTENTS

INTRODUCTION AND VALUE PROPOSITION

South Asia's energy systems are rapidly transforming, but there is much work to succeed in energy decarbonization while improving reliability, safety, and affordability. Electric utilities and grid operators are vulnerable to spiking energy generation costs during peaks and increasing capacity needs as demand grows from new construction, building electrification, and electric vehicles. Buildings are at the center of regional electricity grids and face real risks in terms of cost and resilience – but buildings also have substantial opportunities to benefit through better integration of building design and operations with electricity grid operations.

Passive strategies, including some traditional "energy efficiency" strategies, can help shape building energy demand profiles to minimize peak demand. Active strategies, including today's "demand response" tools, can empower buildings to shed and shift demand. Even basic HVAC control strategies can deliver upwards of 20% demand reductions during peak times. Building designers and owners in India can deploy both passive and active behind-the-meter technologies and operations in an integrated, optimized manner to realize operational benefits such as reduced operating costs, carbon emissions, and enhanced resiliency. Grid operators also benefit buildings with a relatively high degree of demand flexibility and with time-oriented energy efficiency strategies implemented can become grid resources that reduce the need for additional network augmentation and can absorb high levels of variable renewable energy (e.g., wind, solar).

New Buildings Institute (NBI), a US-based nonprofit organization, is bringing its GridOptimal metrics and utility program framework to South Asia. NBI has worked with Indian government agencies, utility companies, and private sector leaders to develop and deliver India-specific metrics and analysis methodologies that promote energy efficiency and decarbonization of energy systems.

OBJECTIVE OF THE PROJECT

This project, supported under USAID's South Asia Regional Energy Partnership (SAREP) Partnership Fund, (SPF), leverages NBI's extensive experience in the US to help accelerate the transformation of South Asia's energy sector. This project's big-picture, long-term goal is to enable leading utilities and policymakers in India and across South Asia to accelerate the transformation and decarbonization of electricity energy systems through the deployment of buildings and associated behind-the-meter distributed energy resources as grid assets. The central objective of this project is to develop, deliver, and disseminate India-specific GridOptimal metrics and analyses that facilitate building-grid optimization by identifying critical behind-the-meter, time-oriented, energy efficiency and demand flexibility strategies in major building typologies and grid contexts.

OBJECTIVE OF THIS DOCUMENT

The objective of this guidance memo is to inform government, utility, and private sector decision makers about best practices in identifying GridOptimal Pilot Projects. This document is meant for utilities interested in exploring what benefits GEBs (grid-interactive efficient buildings) may be able to offer: it may be leveraged as a starting point by utilities or other entities seeking to select potential GEB pilot projects in areas under their jurisdiction. At the same time, this document may be useful for building designers, owners, and consultants who are considering selecting one or more buildings to be GEB pilots and would like to learn about GEB metrics, characteristics and capabilities.

GridOptimal pilot projects are buildings or groups of buildings that seek to deploy building-grid integration technologies and operations to achieve one or more value streams, including reduced operational costs, reduced peak demand, improved resilience, reduced upstream emissions, or other priorities.

WHAT IS A GRIDOPTIMAL PILOT PROJECT?

A GridOptimal pilot project is a building or a set of buildings that seeks to use design strategies, technology deployments, and/or operational approaches to improve its building-grid integration outcomes. Pilot projects may be new construction, major renovations, additions, controls adjustments, or simply operational improvements. A variety of building types may be selected as good GridOptimal pilot projects. This memo will discuss metrics and what can make for a successful pilot project, then will recommend specific applications to explore in early pilot projects.

HOW CAN PROJECT TEAMS DEFINE SUCCESS?

What cannot be measured, cannot be managed. Quantitative metrics are an important way to optimize project plans and to make informed decisions about what design strategies and building system investments should be made. Through this project, a set of metrics has been developed that can help project decision makers deliver better buildings that cost less to operate, are more resilient, are more environmentally friendly, and help the grid maintain affordability and resilience even while decarbonizing. For general use with non-technical audiences, the two market-oriented GridOptimal Metrics described below are easy to understand and communicate. For energy modelers, engineers, and researchers, the project team has developed a free Excel-based calculator tool built to support either relatively simple or more complex and detailed research and design applications.

MARKET-ORIENTED GRIDOPTIMAL METRICS

In many cases, one or two simple metrics can be most valuable[1]. We recommend using **grid peak contribution** (coincident peak demand reduction) to assess a building's power (kW) demand during coincident hours (when the grid is at its peak load) and **demand flexibility** to assess a building's capability to flexibly shed power (kW) over an hour-long period. These two metrics are energy-based and so relate easily to smart meter data and energy model outputs.

Grid Peak Contribution Index: a measure of a building's average normalized net power demand (W/m²) during high-priority grid peak hours. The high-priority hours can be defined as specific hours (for example, weekdays June through September from 3 to 8 pm) or may be defined as the annual

---

[1] The full set of research-grade (more complex and fully featured) GridOptimal metrics are used to calculate the Leadership in Energy and Environmental Design (LEED) GridOptimal Alternative Compliance Path pilot credit. There are eight metrics overall. Some focus on evaluating the impacts of passive building features and permanently deployed systems such as schedules. Some focus on evaluating various aspects of building demand flexibility. One metric evaluates resilience capabilities of the building across both sides of the meter. Find metrics documentation, free calculators ,design guidance factsheets, and more at https://newbuildings.org/resource/gridoptimal/.

hours when total system load is highest (for example, the top 5% or peak 438 hours of the year). The grid-delivered power to the building (net kW) during that subset of hours forms the entire basis for the metric.

- Measuring or calculating this index requires hourly net demand data available via building energy modeling or hourly building metering (smart meters).

Demand Flexibility Index: a measure of how much load a building can shed (W/m²) based on a utility signal over a one-hour period, much like a demand response call. Demand flexibility (DF) is estimated based on the building's peak-day conditions, regardless of whether the grid is at peak load or not. Buildings can provide DF several ways, for example by throttling electric vehicle charging, HVAC setpoint changes, charging/discharging onsite stationary batteries, using stored thermal energy to limit chiller or boiler power, cutting power to selected lighting/plug loads, and cutting power to water heaters, among other approaches.

- Measuring or calculating this index may in some cases require an estimate of load shed potential based on parametric energy simulation modeling, customized technical assessments by facility managers, energy storage capacity evaluation, or other approaches.

THE GRIDOPTIMAL-SOUTH ASIA METRICS CALCULATOR

This free spreadsheet tool plots and analyzes the results of extensive energy modeling of common Indian and South Asian buildings. The goal of the tool is to visualize and quantify the load reduction benefits of various energy-saving interventions in buildings, including retrofits and controls, that improve energy efficiency and adjust controls to provide short-term demand response. These load reduction benefits are placed in the context of the electricity grid to highlight which interventions can best avoid peak demand on the grid.

The primary expected users for this tool are building project teams/building developers, to assess the impact of energy efficiency and demand response interventions at an example building. The tool may also be used by jurisdictions and code officials, utility staff, and planners and advocates for research purposes.

The spreadsheet tool and user guide are available at: https://drive.google.com/drive/folders/1RH2cfG17ncvq00h_hTuENEc2ygQ7X1rk.

INITIAL GRIDOPTIMAL-INDIA PARTNERS AND RESEARCH

The GridOptimal-India project team partnered with two utilities: Madhya Pradesh Paschim Kshetra Vidyut Vitaran Company Limited (MPPKVVCL) and Dakshin Haryana Bijli Vitran Nigam (DHBVN). Based on an evaluation of grid load, power procurement cost, customer disaggregation, and other data helpfully provided by these two partners, the project team undertook an analysis to explore the benefits of various efficiency and demand flexibility interventions across a wide range of building types. The team selected the following building types:

1. Assembly
2. Hospital
3. Secondary School
4. University

5. Small office
6. Large office
7. Strip mall
8. Shopping Mall
9. Hotel
10. Residential (multifamily)

The modeling determined load shapes for new and existing buildings with and without a range of efficiency and demand response measures across a set of common building types. The models estimate the energy demand reduction (amount and time) for the interventions for each building type. Input was solicited from the DISCOMs and incorporated into the final models and EE interventions. Table 1 summarizes the interventions included in the modeling.

TABLE 1. SUMMARY OF MODELING INTERVENTIONS.		
INTERVENTION NAME	DESCRIPTION	APPLICABLE BUILDING TYPES
LED lighting upgrade	Efficient lighting for different spaces (SuperECBC level of ECBC 2017)	All
HVAC efficiency upgrade	Efficient chillers, unitary ACs, efficient motors for fans and pumps,controls (SuperECBC level of ECBC 2017)	All
Hot water upgrade	Convert conventional space heating and service hot water system to efficient Heat pump systems.	All
High efficiency celling fans	Convert conventional induction motor-based ceiling fans to Brushless DC fans or BEE 5 Star fans	Residential
High-efficiency appliances	Specifically for residential buildings. BEE 5 star rated refrigerators, TV, etc.	Residential
Combined intervention	A combined package of all efficiency measures applicable for the given building type	All
Lighting demand response	Daylight and occupancy sensors to minimize daytime lighting loads.	All, except Assembly, Shopping Mall, Strip Retail
HVAC demand response	Setback setpoint temperature 2C during peak load hours.	All, except Assembly, Shopping Mall, Strip Retail

PRIORITIZING KEY BUILDING TYPES AND INTERVENTIONS FOR PILOT PROJECT SELECTION

While it is true that nearly every building can make some improvements in terms of building-grid integration, some building projects are stronger candidates than others. The following key considerations can help decision makers choose the right early pilot projects for maximum impact and learning:

Project Champion: It is critical to have someone on the project team that is committed to championing the project's success. This person may be a designer, an advocate for the owner, or a consultant, but they must be involved in the project as early as possible and have access to meetings and communications where project priorities are defined, and decisions are made. The project champion's ability to get the owner and other decision-makers to buy in to the idea of improving building-grid integration is foundational to the pilot project's success.

New vs Existing Buildings: In general, it is often easier and less costly to include grid-interactive communications technology and peak-demand mitigating strategies in new construction projects. Existing building retrofits can be useful pilot projects especially when building lighting, HVAC, and other controls retrofits are naturally occurring, where distributed energy resources such as onsite solar, batteries, and electric vehicle charging systems are being installed, and where controls retro commissioning is planned.

Building Types: It is important to select building types with systems that can reasonably minimize power during coincident peak conditions or deploy demand response strategies without undue impact to occupants or processes. Buildings with uninterruptible and critical loads such as data centers and buildings with high process load such as manufacturing facilities may not be ideal early pilot project candidates. Recommended high-priority building types include single- and multi-family residential, office, retail, healthcare (noncritical loads only), lodging, and education.

Intervention Strategies: The most impactful interventions are those that trim the power demand of the most energy-intensive building systems, which are often HVAC systems. However, combining multiple interventions across multiple building systems (HVAC, lighting, etc.) as well as layering efficiency and demand flexibility can often deliver dramatically higher savings. Figure 1 shows predicted coincident peak demand savings across multifamily residential and selected commercial building types in Indore, based on the modeling conducted through this project. HVAC demand response strategies tailored to peak hours can often deliver savings of 20% or more and layering other demand response strategies (where feasible) can deliver higher demand savings. Similarly, combining efficiency interventions across multiple building systems (HVAC, lighting, water heating, etc.) can provide "passive" energy savings that can trim overall coincident peak demand by up to 50%.

Figure 1. Coincident Peak Demand Savings Ranges by Intervention Type (Modeled)
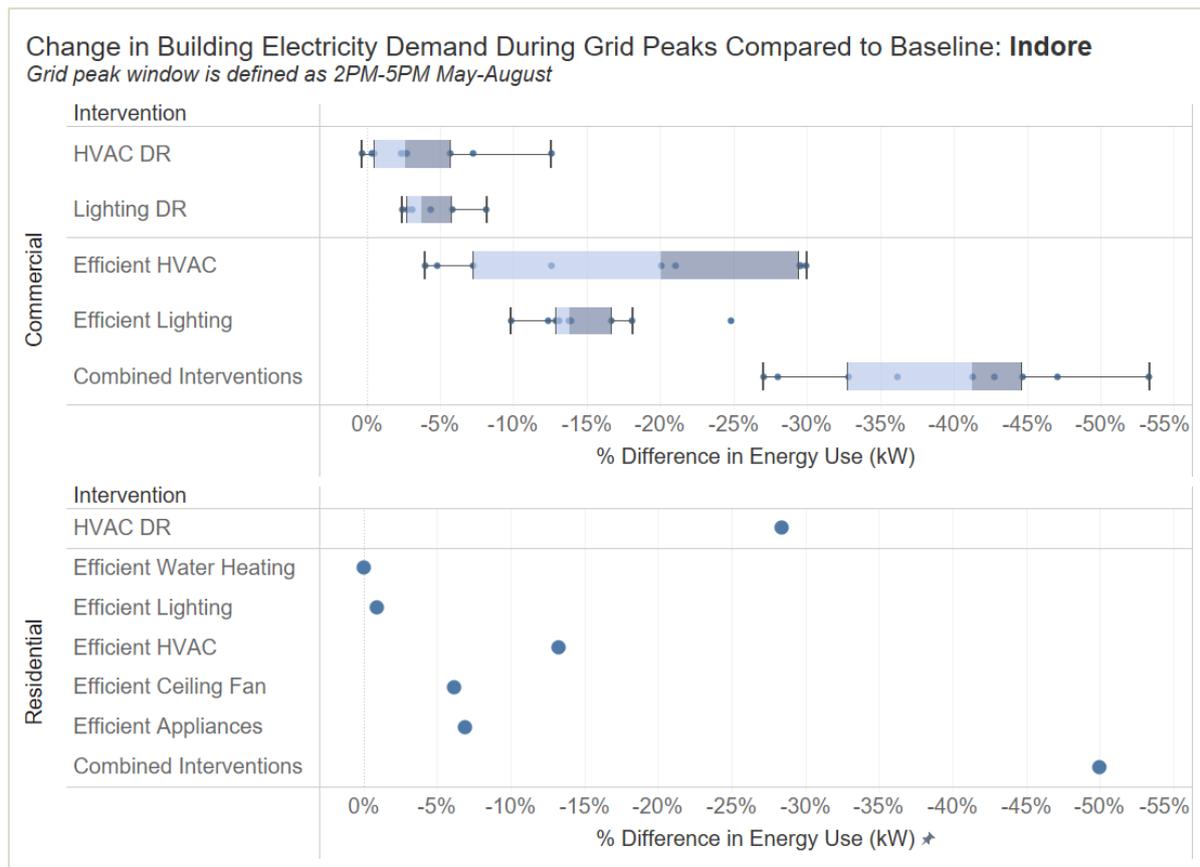
CONCLUSION

GridOptimal buildings are an important part of the solution as our energy sectors transform toward a more equitable, sustainable, and affordable future state. Pilot projects are a critical first step in moving forward toward this shared goal. By focusing on achievable, impactful, and beneficial building-grid integration strategies, Indian GridOptimal pilot projects will show a feasible path for the region's built environment to play its rightful central role in the energy transition while benefitting residents, owners, and operators through reduced costs and improved resilience.

More resources are available from multiple sources, including the following short list of high-quality sources:

1. For an overview of the topic and educational resources including a variety of white papers, recorded webinars, design and operations factsheets, articles, dashboards, tools, and memos, see the GridOptimal Buildings Initiative webpage: https://newbuildings.org/resource/gridoptimal/.

2. For a detailed general overview of smart grid applications in buildings, see ASHRAE's Smart Grid Applications Guide. Overview and link at: https://www.ashrae.org/about/news/2020/ashrae-releases-smart-grid-application-guide-integrating-facilities-with-the-electric-grid.

3. For actionable, detailed design and operations guidance, including specification language examples and reference standards, see ASHRAE's Grid-Interactive Buildings for

Decarbonization: Design and Operation Resource Guide. Overview and link at: https://newbuildings.org/hot-off-the-presses-new-grid-interactive-buildings-for-decarbonization-guide/.

For any query please contact:

Apurva Chaturvedi
Senior Clean Energy Specialist
USAID/India
achaturvedi@usaid.gov

Namrata Mukherjee
Chief of Party
USAID's SAREP
nmukherjee@sarep-southasia.org