GRIDOPTIMAL™
BUILDINGS INITIATIVE

Year Two Progress and Outcomes

A Summary of Achievements from the second year of the GridOptimal Buildings Initiative

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Acknowledgements

The GridOptimal Buildings Initiative has made substantial progress since its formal launch in July 2018. NBI and project partners have now completed Phase 1 and Phase 2 and have provided this overview of current progress to the supporting members and other Technical Advisory Committee (TAC) members of the GridOptimal Buildings Initiative. The Phase 1 outcomes summary document was delivered to the TAC in June 2019 and is available upon request.

GridOptimal is a joint initiative led by New Buildings Institute (NBI) and the US Green Building Council (USGBC). The majority of work in Phase 2, including this Phase 2 Outcomes Summary, was conducted by NBI. Both NBI and USGBC would like to acknowledge the support of the sponsors (shown below) of the GridOptimal Buildings Initiative whose support has have made this work possible.

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Contents

1. Executive Summary

The GridOptimal™ Buildings Initiative, a collaborative initiative led by New Buildings Institute (NBI), in partnership with the U.S. Green Building Council (USGBC), focuses in large part on developing metrics by which building features and operating characteristics that support more effective grid operation can be measured and quantified. This will support the least-cost decarbonization of the grid through better integration of both distributed energy resources (DER) and utility-scale wind and solar energy. This document describes the work completed by the GridOptimal project team during the second phase of the project, from July 2019 to June 2020.

Key achievements during Phase 2 include:

- **Metrics Development:** NBI led the development and documentation of GridOptimal metrics, including the creation of a spreadsheet calculation tool, internal TAC documentation memos (shared with the TAC in December and updated in April 2020), a blog, and a peer-reviewed conference paper. NBI convened and facilitated the Metrics and Mechanics Working Group and achieved consensus on GridOptimal metrics among this group and the TAC.
- **Credit Thresholds:** For deployment of GridOptimal metrics in rating systems such as LEED or Austin Energy Green Buildings, in utility programs, and in other venues, it is critical to define the minimum creditable performance for each metric (i.e. what is "good enough"). NBI undertook an analytical effort to investigate typical GridOptimal metric scores for the various categories across a reasonably comprehensive set of commercial building types, US climate zones, US grid regions, building code vintages, and onsite renewable installation sizes. The results of these analyses were shared with the TAC in a series of memos during Q2 2020.
- **Rating System Deployments:** Draft language for a LEED/Austin Energy Green Buildings pilot credit was created during Phase 2; implementation is underway with substantial activity anticipated during Q3 2020.
- **Pilot Projects:** Three separate pilot projects were undertaken during Phase 2: a K-12 school in the Northeastern US, an urban office building in the Pacific Northwest, and a large multi-tenant master planned development in the Inland Northwest.

Key focus areas for Phase 3 include:

- The deployment of GridOptimal metrics in rating systems,
- The development of utility program criteria to enable programmatic metrics deployment,
- The development and dissemination of market-facing design guidance, and
- Potential code/policy deployment.

2. Metrics Development

The bulk of Phase 2 work focused on the development and fine-tuning of GridOptimal metrics. The TAC and the Metrics and Mechanics Working Group met throughout the year to discuss these topics. Many options were considered throughout this process. As of June 2020, GridOptimal metrics. A detailed memo defining data inputs, evaluation methodology, and metrics scoring (i.e. outputs) was delivered to the TAC first in December 2019 (v1) and again in April 2020 (v2). NBI published a summary of these metrics in a brief blog on the NBI website[1]. In addition, NBI will publish a conference paper detailing these metrics in the proceedings of the ACEEE 2020 Summer Study conference; this paper has completed peer review and will be published in August 2020. NBI developed a spreadsheet to calculate GridOptimal scores, called the GridOptimal Metrics Tool, which has been shared with those TAC members who have requested it. GridOptimal metrics at this stage include:

GridOptimal Metric	What it Measures
Grid Peak Contribution	Degree to which building demand contributes to load on the grid during system peak hours
Onsite Renewable Utilization Efficiency	Building's consumption of renewable energy generated onsite (not exporting to grid) over a year
Grid Carbon Alignment	Degree to which the building demand contributes to upstream (grid) carbon emissions over a year
Energy Efficiency vs. Baseline	Percent better than code (annual total energy use)
Short-Term Demand Flexibility	Building's ability to reduce demand (shed) for 1 hour
Long-Term Demand Flexibility	Building's ability to reduce demand (shed) for 4 hours
Dispatchable Flexibility	Building's ability to automatically reduce demand (shed) for 15 minutes, controlled by utility/ third party
Resiliency	Building ability to island from grid and/or provide energy for critical loads for 4-24 hours; motor soft start capability to help grid restart after outage

2.1 Data Sources

In order to calculate these metrics across a wide range of buildings in a comprehensive manner, a range of data sources are necessary. NBI and other GridOptimal members have worked together to assemble a data library for GridOptimal. Key data sources include:

Data Type	Source	Status
Grid System Load Data	Energy Information Administration Hourly Grid Data Monitor[2]	Available (data approved; web visualization tool in beta)
Building Demand Profiles	DOE Commercial Building Prototype Models[3]	Available as energy model files; NBI generated 8760 profiles
Building Onsite Generation Profiles	PVWatts[4]	NBI generated 8760 profiles

[1] https://newbuildings.org/gridoptimal-metrics-offer-guidance-on-optimizing-building-grid-interaction/
[2] http://www.eia.gov/beta/electricity/gridmonitor
[3] https://www.energycodes.gov/development/commercial/prototype_models
[4] https://pvwatts.nrel.gov/pvwatts.php

Data Type	Source	Status
Current Marginal Grid Carbon Emissions Factors	WattTime[5]	Available from WattTime; has been used only for limited testing/evaluation of metrics
Current Average Grid Carbon Emissions Factors	NREL Standard Scenarios 2020 Report[6]	Currently in alpha. Full availability anticipated Oct 2020. Has been used for metrics testing.
Long-run Marginal Grid Carbon Emissions Factors	NREL Standard Scenarios 2020 Report[4]	Currently in alpha. Full availability anticipated Oct 2020.
Building Demand Flexibility Potential	"Commercial Building Load Modification and Flexibility Potential" (by Red Car Analytics)	Commissioned by NBI to support GridOptimal during Phase 1; completed and available

3. Credit Thresholds

In order to deploy these metrics in rating systems, utility programs, and other market-facing channels, we must define what is "good enough" for a building or project to get credit in each metric. In order to make informed recommendations for each metric, NBI undertook a substantial research and analysis task to calculate GridOptimal scores in tens of thousands of cases representing a comprehensive set of combinations of:

- 16 building types
- 16 climate zones
- 2 code vintages
- 13 grid regions (for grid system load profile)
- 134 grid subregions (for grid emissions factors)
- 48 locations for onsite PV systems
- 11 cases of onsite PV generation (from no onsite renewables to 100% zero net energy)

The full set of combinations of code vintage, building type, climate zone, grid location, and onsite generation profile resulted in 16,896 individual runs, each with its score in each load shape metric (i.e. Grid Peak Contribution, Grid Carbon Alignment, and Onsite Renewable Utilization Efficiency). NBI used the GridOptimal Metrics Tool (spreadsheet) to calculate these scores. Then NBI used Tableau, a data visualization software tool, to visualize the outputs of those calculations and to evaluate the impacts of various factors such as building type, climate zone, etc. on the scores.

The results of this analysis were summarized in a series of three memos (one for each of the aforementioned metrics) sent to the GridOptimal TAC during Q2 2020. In multiple cases, the analysis raised questions relevant to both the methodology of GridOptimal metrics and the interrelationships between metrics and building performance/outcomes. For example, NBI found that as onsite PV arrays became larger, the grid peak contribution and grid carbon alignment scores increased. This effect was

[5] https://www.watttime.org/
[6] https://www.nrel.gov/analysis/standard-scenarios.html

explored in detail in the Q2 2020 GridOptimal TAC meeting and in multiple emails (to the TAC at large and to specific TAC members including the Metrics and Mechanics Working Group).

This credit threshold analysis was used to evaluate the range of performance outcomes (scores) in each analyzed metric. Similar analysis was undertaken for the demand flexibility metrics based on the analysis completed by Red Car Analytics during Phase 1. The outcomes of this analysis are being applied in the context of the LEED green building rating system and of utility program criteria.

4. Rating System Deployments: LEED and Austin Energy Pilot Credits

The GridOptimal metrics are fundamental but can have the greatest impacts on enhancing building-grid integration when implemented through third-party channels such as green building rating systems. Great progress has been made on this front during Phase 2. NBI developed a structure for a grid harmonization pilot credit structure using the GridOptimal metrics, drafted pilot credit language, and vetted that language with key USGBC and Austin Energy Green Buildings staff members. NBI will present this draft to the USGBC Energy and Atmosphere Technical Advisory Committee in August 2020 and anticipates that this pilot credit will be incorporated into the LEED rating system as an alternate compliance pathway for the Grid Harmonization Pilot Credit, and in some part (specifically for Resiliency) as an alternate compliance pathway for the Passive Survivability Credit. Similar efforts are underway for the Austin Energy Green Buildings rating system.

5. Pilot Projects

Pilot projects enable the real-world testing and fine-tuning of GridOptimal metrics, guidance, evaluation tools, and other resources. In Phase 2, NBI has worked with project teams on three separate pilot projects: a K-12 school in the Northeastern US, an urban office building in the Pacific Northwest, and a large multi-tenant master planned development in the Inland Northwest. The focus areas of these pilot projects include emissions-sensitive time of use (TOU) energy efficiency design features and strategies, thermal energy storage deployment strategies (co-optimization to simultaneously achieve emissions savings, system grid peak savings, and building demand savings), building system and controls strategies, and commissioning considerations.

NBI is in conversations about other pilot projects and is actively seeking participants in further pilot projects and is pursuing ancillary funding to move GridOptimal pilot projects forward.

Interaction with pilot projects enables GridOptimal to analyze measure impacts, evaluate options, and explore practical applications. These strategies, and the analysis undertaken to produce the recommendations, represent a progressive approach to building/grid integration that will serve the building and community well as we move to decarbonize the electric grid and modernize grid operation to incorporate new generating resources and transportation loads. Critically, pilot projects can help define ways in which GridOptimal strategies can fit into evolving utility programs. By demonstrating practical strategies, implementation pathways, and opportunities, pilot projects help support the broader goals of the GridOptimal Buildings Initiative.

6. Conclusions and Next Steps

Over the last year, NBI and the GridOptimal team have made substantial progress in multiple areas. In the coming year, the main focus will be on implementing the GridOptimal metrics in the market through rating systems, utility programs, and potentially code and policy avenues. In addition, the team anticipates developing market-facing resources including building design guidance materials to help industry stakeholders (designers, builders, building owners, operators, etc.) deliver enhanced building-grid interaction outcomes.

NBI and the GridOptimal Buildings Initiative team look forward to advancing this critical work and we are grateful to our supporters for enabling progress to date and in the future.

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New Buildings Institute (NBI) is a nonprofit organization driving better energy performance in buildings. We work collaboratively with industry market players—governments, utilities, energy efficiency advocates, and building professionals—to promote advanced design practices, innovative technologies, public policies, and programs that improve energy efficiency. We also develop and offer guidance and tools to support the design and construction of energy efficient buildings.

Throughout its 20-year history, NBI has become a trusted and independent resource helping to drive buildings that are better for people and the environment.