Sometimes Talking is More Important than Walking

A Conversation about Grid-Interactive Efficient Buildings

Paulomi Nandy and Alison Lindburg, MEEA

Giselle Procaccianti, NEEP

August 2020

MEEA
MIDWEST ENERGY EFFICIENCY ALLIANCE

Abstract

Buildings account for approximately 75% of the electricity use in the United States and, more importantly, drive as much as 80% of peak power demand. While buildings are a key driver of electricity demand, they are also a key element in relieving stress on the grid and moderating peak demand.

A Grid-interactive Efficient Building (GEB) is an energy efficient building with smart technologies characterized by the active use of DERs to optimize energy use for grid services, occupant needs and preferences and cost reductions in a continuous and integrated way. The key characteristics and strategies of grid-interactive efficient buildings are discussed in this section. These smart, flexible, grid-connected buildings can be an asset both in net energy reduction and peak demand management. While reducing consumption is the essential first step, GEB goes beyond building efficiency and provides the flexibility needed to help reduce grid stress and cost, and increase the reliability, resiliency and efficiency of the electric grid.

This paper will share the findings of 2019 GEB's study conducted by the author that assess the full spectrum of GEB initiatives, programs and policies related to residential and commercial grid-integrated efficient buildings in the Midwest and Northeast regions. This research walks through the policy and programs. It identifies the significant similarities and key differences in GEB's research and developments currently taking place in the two regions, as well as the key technologies for the broader use of GEB.

Introduction

The electric grid in the U.S. is aging. With more and more renewable energy being sent to the grid, in addition to the prospect of rapidly developing technologies in the field of energy storage and distributed energy resources, there is an urgent need to modernize the grid. Increasing needs to "shelter in place" due to natural disasters and pandemics such as COVID-19 highlight the need for resiliency in our buildings, communities and grid. There has been a wide range of responses to this increasingly critical situation. States all over the country have numerous efforts underway to design or implement a road map for policies, plans, pilot programs and regulations to ensure the grid is more resilient, reliable and affordable to meet customer's needs.

This paper focuses on states in Midwest (MEEA) region and Northeast (NEEP) region on their initiatives to modernize the grid, which caused a shift in the technological and regulatory landscapes facilitating the growth in grid-interactive efficient buildings (Partnership, 2020). We will also discuss the programs utilities in these states are running which encompasses energy efficiency rebates and upgrades, time of use rates or peak demand management programs to help shift and shed load on the grid, solar and battery storage programs along with community-level microgrid to test optimization strategies and resiliency during power shortages. Each of these features is the key aspect of a GEB.

Definition of GEB

A Grid-interactive Efficient Building (GEB) is an energy-efficient building with smart technologies, characterized by the active use of Distributed Energy Resources (DERs) to optimize energy use

for grid services, occupant needs and preferences and cost reductions in a continuous and integrated way (Neukomm, Nubbe, & Fares, 2019). According to the U.S. Department of Energy (DOE), "The vision of GEB is the integration and continuous optimization of DERs for the benefit of the buildings' owners, occupants, and the electric grid."

An example GEB (Figure 1) may "utilize analytics supported by sensors and controls to optimize energy use for occupant patterns and preferences, utility price signals, weather forecasts, and available on-site generation and storage…[with] a suite of advanced building technologies—including the HVAC system, connected lighting, dynamic windows, occupancy sensing, thermal mass, and distributed generation and battery storage— [all] are optimized to meet occupant and grid needs."

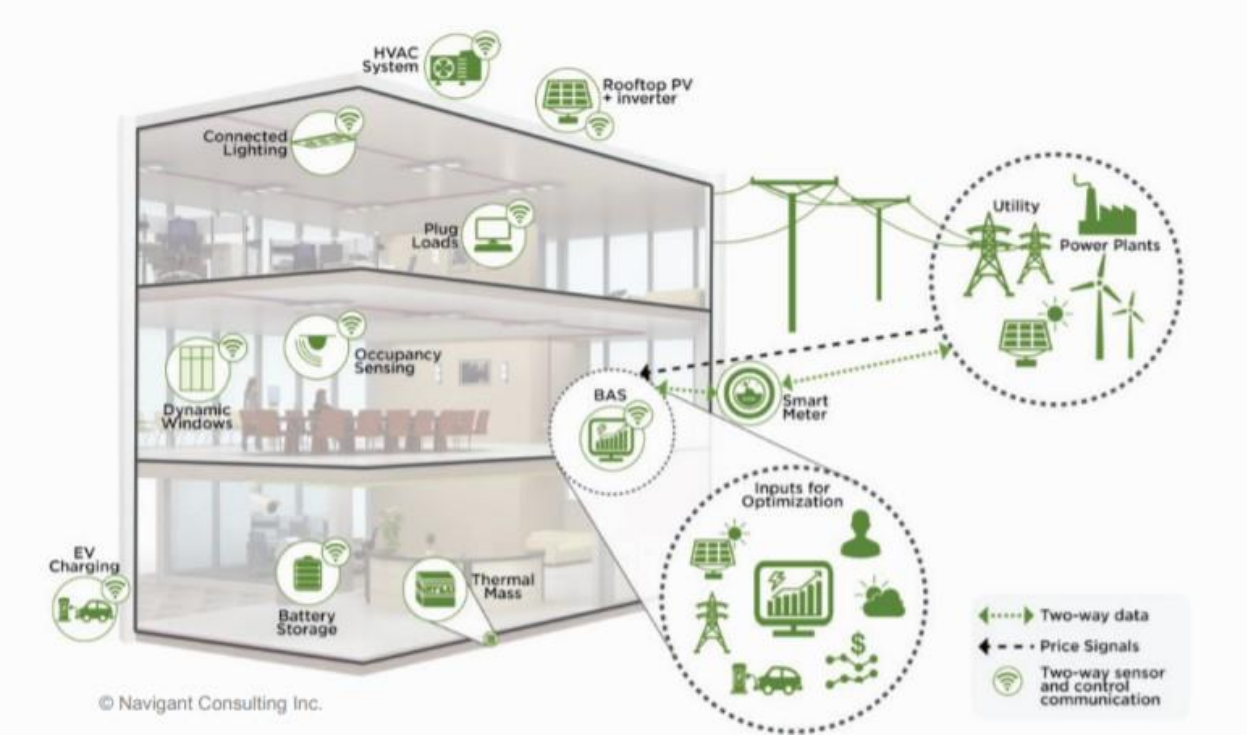

Figure 1. Example Commercial Grid-interactive Efficient Building. The Building Automation System (BAS) utilizes analytics supported by sensors and controls to optimize energy use for occupant patterns and preferences, utility price signals, weather forecasts and available on-site generation and storage. *Source:* (Neukomm, Nubbe & Fares, 2019).

Energy efficiency is key to the concept of GEB. As shown in Figure 1, the characteristics of GEB are that the building is efficient, connected, smart and flexible. Efficiency is especially important because it helps to reduce the overall demand on the grid, minimizing the amount of resources needed to create grid resiliency and flexibility and reducing the fuel needed to produce electricity.

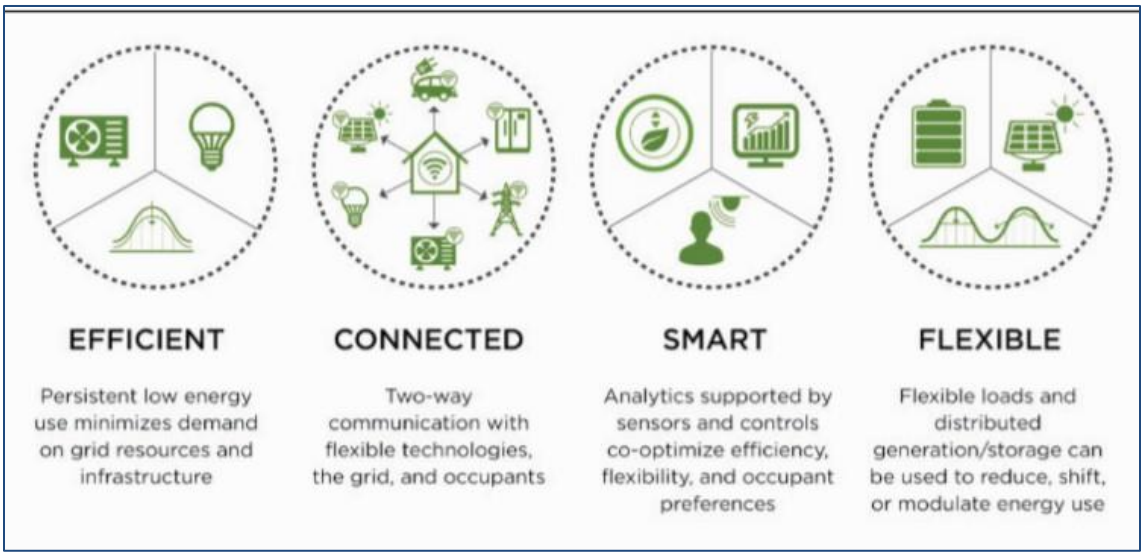

Figure 1. Characteristics of GEB. *Source*: (Neukomm, Nubbe, & Fares, 2019)

State Energy Plans and Grid Modernization Initiatives

NASEO's recent report, "Road mapping: A Tool for States to Advance Load Flexibility and Grid-interactive Efficient" (Grid-interactive Efficient Buildings Working Group, 2019) identifies the steps state energy offices and public utility commissions are taking to help understand the role they can play in learning and exchanging ideas about load flexibility and GEBs, technologies and applications and helps to identify opportunities and impediments and discern interests, priorities and concerns. The road mapping report is more oriented towards comprehensive energy plan development but can be applicable to roadmapping exercises where complex technical, economic, policy, regulatory and legal matters interact. Illinois, Minnesota, Michigan, Massachusetts, New York and Ohio, among many states, are already working on their grid modernization initiatives. These states are on the way of completing at least the first three steps identified in the report towards roadmapping for grid modernization. As a result, many utility plans and programs have been developed as part of the state energy plans, which not only helps customers in energy efficiency, but shed, shift, modulate and generate as a GEB.

No significant changes have been made to the electric grid for decades, but many changes are evolving recently. The current trends are "de-centralizing, digitizing and de-carbonizing." A lot of this change is driven by the fact that customers are not only users of energy but also generators. It is also driven by the need to improve reliability, resiliency and reduce environmental impact (i.e., integrate renewable/low-emitting resources into the existing grid).

Midwest

Table 1. Major Smart Grid and Grid Modernization Initiatives in the Midwest

Illinois	Mandated Smart Grid Advisory Council stakeholder group
Minnesota PUC	Exploring policy to promote distribution system investment and time of use rate offerings; 2025 Energy Action Plan to develop indicators and actions to advance clean and efficient technologies from E21 stakeholder-led initiative
Ohio PUC	PowerForward initiative, which is addressing the future of electricity in the state
Michigan	MI Power Grid Program, which focuses on customer engagement, integrating emerging technology and optimizing grid performance and investments

Illinois

According to GridWise Alliance's latest Grid Modernization Index, Illinois is second only to California for overall grid modernization efforts. Illinois' grid modernization effort began with the Energy Infrastructure Modernization Act of 2011 (EIMA), which authorized the two investor owned electric utilities in Illinois – Commonwealth Edison (ComEd) and Ameren Illinois (Ameren) – to recover the costs of up to $3.2 billion in grid modernization investments. This was followed by the Future Energy Jobs Act (FEJA) (Future Energy Jobs Act, n.d.) went into effect of June 1, 2017, which included grid modernization provisions. FEJA established NextGrid Illinois (NextGrid, 2018) which was an 18-month collaborative initiative managed by the University of Illinois in consultation with the Illinois Commerce Commission (ICC). The goals of the initiative include developing both a final report detailing the opportunities and challenges of grid modernization and establishing a "21st Century" regulatory model. The group focused on an investigative study to identify, research and develop ideas to help address the issues Illinois' electric grid is facing due to aging grid infrastructure. The study describes grid modernization benefits and challenges for consumers, utilities and the environment, identifies legal, regulatory and policy revisions needed to support grid modernization and examines the trends and benefits of emerging technologies to help drive the change. In the Spring of 2019 Clean Energy Jobs Act (CEJA) (Clean Energy Jobs Act, n.d.), HB3624/SB2132, was introduced in Illinois to expand renewable energy. CEJA seeks to vastly expand renewable energy development in Illinois, support vehicle electrification, energy storage development, decarbonization of the power sector and investments in fossil fuel communities, and expand energy efficiency. The state is precited to be 46% renewable powered with wind and solar energy and 1,000 MW battery storage by 2030.

Minnesota

E-21 (E21 Initiative, 2014) is Minnesota's multi-interest initiative on grid modernization that was launched in February, 2014. It is a collaborative forum that aims to provide regulators and decision makers with recommendations on how Minnesota's regulatory framework and utility business models may have to respond to a change in the electric industry and infrastructure. Primarily, what impacts increasing adoption of distributed energy resources have on the electric system and the way consumers interact with the system, and how should utilities, regulators and

decision-makers respond. The e-21 initiative is currently in its third and final phase. Phase 1 focused on updating regulatory models in two fundamental ways. Firstly, to shift away from the traditional utility business model of providing customers with only few options on their energy source and towards customers having more options on where and how their energy is produced. Secondly, shifting away from a regulatory system that rewards the sale of electricity and building large, capital-intensive power plants and other facilities toward one that rewards utilities for achieving an agreed-upon set of performance outcomes that the public and customers want (e.g., energy efficiency, reliability, affordability, emissions reductions, predictable rates, etc.).

Ohio

PowerForward (Commision) is public utility commission office's (PUCO's) review of the latest technologies and regulatory innovations that could enhance consumers' electric reliability in cost effective manner. PUCO hosted 127 speakers and received 100 hours of education throughout the three phases of PowerForward. In the first phase, speakers from the electric industry developed a business case for PowerForward and the modernization of the grid. Some of the technology included advanced metering infrastructure (AMI), distribution automation circuit reconfiguration (DACR), Volt/VAR optimization (VVO) and control (VVC), conservation voltage reduction (CVR), Distributed Energy Resources (DERs) and storage. The second phase educated commission staff on grid architecture—both engineering and cyber physical—and how this infrastructure needs to evolve to support a modern grid. Finally, the commission discussed platform elements of a modern grid as well as traditional areas of regulation that the Commission will need to address in order to advance the modern grid. Specific topics addressed in the third phase included distribution system planning, operations and markets.

Michigan

Michigan recently launched its grid modernization initiatives called MI Power Grid Program (MPSC-MI Power Grid, 2019). It focuses on customer engagement, integrating emerging technology and optimizing grid performance and investments. The group will engage a variety of stakeholders including utilities, energy technology companies, customers, consumer advocates, state agencies and others.

Northeast

New York

The New York State Energy Research Development Authority (NYSERDA) will be administering the funding for grid technology companies and research institutions that will address challenges ranging from the need for greater real-time system data to incorporating smart technologies and energy storage into power grid planning and operations. The first part of the funding will focus on advanced DER monitoring, controls, data analytics, advanced forecasting and assisting Orange and Rockland with improving smart inverter functionality to provide seamless integration of distributed resources, improve grid stability and reduce system losses.

Massachusetts

Massachusetts Department of Public Utilities (DPU) had issued orders in 2019 to help lead investments in clean energy technology, improve grid resiliency, service reliability and quality for customers in National Grid territory. The Order will help accelerate development of electric vehicle infrastructure, offer off-peak charging incentives for residential customers. National Grid, under this order, also plans on implementing an energy storage demonstration project. The department also approved a performance-based ratemaking mechanism which strives to balance funding the replacement of essential aging infrastructure with avoiding constantly increasing rate case expenses which result in uncertainty for Massachusetts residents and businesses. Under the proposal, National Grid is incentivized to identify and implement cost-reducing energy efficiencies, improve system resiliency, increase customer satisfaction and make investments in advanced clean energy technologies.

Aspects of GEB

The overall vision of GEB is this integration and optimization of energy efficiency, energy generation and energy load management on the grid through connection of buildings. This includes many different technologies and methods. Smart load optimization and management, onsite generation (renewable, fossil or others) and energy storage can be combined and configured as a microgrid to provide energy resilience to buildings, campuses and communities. The load flexibility characteristics of GEBs can optimize performance both when grid-connected and when operating off the grid in "islanded" mode. For example, a GEB would have advanced building technologies which would include efficient and controllable HVAC systems, connected lighting, dynamic windows, occupancy sensors sensing occupant's movement and comfort. The building would also have distributed generation and battery storage which are optimized to meet the building occupant and electric grid needs. Finding a true GEB that integrates all of these is still uncommon, but the concepts do exist on their own. The following section details examples of policies and programs that meet the individual concepts of energy efficiency, energy generation and energy load management.

Energy Efficiency

An energy efficient technology is any technology that helps continuous reduction in energy use while providing the same or improved levels of building function. This would have the greatest impact for the grid during high-cost periods and minimize utilization of costly generation resources. Energy efficiency technologies can range from using LED lighting systems to installing a higher grade of building insulation, low u-factor windows and efficient heating and cooling systems.

Future Energy Jobs Act in Illinois

FEJA in Illinois made all energy efficiency (EE) programs the responsibility of utilities instead of a shared effort with the state, including market transformation efforts (MT). Cook County in Illinois completed $112 capital improvement project targeting EE that impacted 75% of the county buildings and focuses mainly on lighting upgrades, building automation system upgrade and boiler and chiller replacement. Under FEJA gas utility energy efficiency programs would have to triple the amount of savings achieved, with a requirement that 50% of program spending be on whole building programs or measures that reduce heating needs, including insulation, air sealing, duct sealing, demand control ventilation in commercial buildings and advanced

thermostats. There is a reduced reliance on rebates for heating equipment in the revised programs.

Consumers Energy Savers Club

In Oct 2017, Consumers Energy in Michigan launched Energy Savers Club (Future, Leadership, & Alliance, 2018) a pilot program designed to reduce the energy load on Swartz Creek substation. This was a non-wire alternative (NWA) pilot focusing on energy efficiency to help defer utility infrastructure investment. The Swartz Creek substation was selected as the targeted location due to its observed potential need for capacity upgrades in future years (not immediate). The load appeared to be highly dependent upon the weather as no system changes (large transfers or large, new customers) had been observed. Piloting an NWA at this location was an opportunity to test an NWA solution's feasibility without risking the equipment or customer reliability due to an observed overload the prior year. It addresses the role that intentional targeting of EE and DR programs to specific capacity-constrained geographies can play in managing load and deferring capacity-related investment.

MassSave

In 2008, the Green Communities Act mandated the acquisition of all cost-effective energy efficiency and stimulated program administrators (PAs) in Massachusetts to rethink the way energy efficiency programs were designed and delivered. This resulted in the MassSave (MassSave, n.d.) program. This program is sponsored by Massachusetts' natural gas and electric utilities and energy efficiency providers, including National Grid, Eversource, Liberty Utilities, Unitil, Columbia Gas of Massachusetts, Berkshire Gas Company, Blackstone Gas Company and Cape Light Compact. These sponsors work closely with the Massachusetts Department of Energy Resources to provide a wide range of service, incentives, trainings and information promoting energy efficiency that helps residents and businesses manage their energy use and related costs. MassSave helped a projects in Florence, MA though the New Construction Program where the customer received incentives for super insulated building envelope, low u-value window, a roof mounted PV system, 100%, LED lighting, mini-split heat pump and energy recovery ventilation system. National Grid in Massachusetts and Rhode Island runs a wide range energy efficiency programs for homeowners, renters and landlords. ConEdison and District of Columbia Sustainable Energy Utility (DCSEU) also provide rebates and technical assistance that applies to lighting, heating and cooling equipment, home appliances, LED lighting fixtures, prescriptive variable frequency drives and new construction projects. In 2017 NYSERDA started the Air Source Heat Pump (ASHP) (NYSERDA Utility Program: Heat Pumps, n.d.) program in support of cleaner, more efficient technology. Residential customers get incentives to install program qualified ASHP systems.

Load Shed and Load Shift

Load shed is the ability to reduce electricity use for a short time period and typically on short notice. Shedding is typically dispatched during peak demand periods and during emergencies. Load shifting is the ability to change the timing of electricity use. In some situations, a shift may lead to changing the amount of electricity that is consumed. Shifting takes advantage of the cheapest electricity prices or reducing the need for renewable curtailment. Battery storage, onsite microgrid, thermal mass and similar technology can be considered load shedding while

shift capabilities covers peak demand saving programs and time of use rates utilities often have in their territories.

ComEd Community Energy Storage Pilot

ComEd in Illinois launched a pilot program to test the use of battery storage technology to reduce the impact of power outages in residential areas. ComEd's Community Energy Storage (CES) (ComEd Conducting Illinois' First Community Energy Storage Pilot, 2017) pilot is being conducted in Beecher, IL, approximately 40 miles south of Chicago. The pilot will focus on improving power reliability for customers experiencing multiple interruptions. ComEd will also evaluate the potential of this technology to serve as a proactive tool to drive continuous improvement in service reliability. It features a 25kWh lithium-ion battery, the CES unit was installed near the existing ComEd equipment that provides power to the homes of Beecher customers selected for the pilot.

AEP Ohio's It's Your Power Program

AEP Ohio's It's Your Power program (AEP Ohio- It's Your Power, n.d.) serves 1.5 million residential customers via Google Play and the Apple App Store. Customers with homes that are equipped with smart meters can request an Energy Bridge, enabling real-time engagement in the home's energy usage. In addition, the Energy Bridge also acts as a smart home hub, allowing for the control and automation of smart devices, including bulbs, switches and sensors. As part of the program, customers are offered a Powerley Thermostat to balance HVAC energy usage with comfort, while also enabling AEP Ohio to execute demand response events.

Ameren IL Power Smart Pricing and ComEd Hourly Pricing Programs

Illinois mandates utilities to offer customers the option of market based hourly pricing through utility procurement from wholesale energy markets operated by either MISO for Ameren Illinois customers or PJM for ComEd customers. The law requires residential hourly pricing program to be administered by a non-utility third party. Ameren Illinois' Power Smart Pricing program uses day-ahead hourly prices, whereas the ComEd Hourly Pricing program uses hourly real-time prices.

Xcel Energy Time of Use Pilot

Under e21 in January 2017, the Minnesota Public Utility Commission required Xcel Energy to include in its next resource plan the procurement of 400 megawatts (MW) of additional demand response resources by 2023 and to evaluate the cost-effectiveness of 1,000 MW of additional demand response by 2025. Xcel Energy increased its demand response portfolio (Drake, 2020) by 50 percent with Minnesota stakeholders from 2017-2019. Xcel Energy proposed a pilot to test time of use rates for residential customers. The pilot was designed to explore if the peak period should be longer since demand spikes immediately after the peak period ends. It would also focus on integration of renewable energy based on Xcel's projection to increase its wind and solar generation between 2024 and 2030. The stakeholder for the pilot program also gave input on weekend time of use (TOU) rates. This utility rate design pilots have incorporated many best practices and would help in developing widespread opt-out TOU rates. The 2-year pilot might potentially engage 17,500 customers to use 3 tier off peak Minnesota wind power. Xcel market research reveal there is a substantial need of customer education on variable pricing.

I&M Home Energy Management and Work Energy Management programs

Indiana Michigan Power (I&M) (Power, 2019) launched few NWA such as demand response and volt/VAR optimization. I&M 's home energy management (HEM) program is a load management program for residential customers. Its designed to achieve peak demand reduction and operate on an ongoing basis to reduce customer energy use. The program utilizes smart, Wi-Fi connected thermostats to manage customer HVAC systems to reduce usage during peak load events and to reduce overall energy consumption through more efficient operating conditions. Similarly, Work Energy Management (WEM) Program is for commercial and industrial (C&I) customers. WEM equipment allows C&I customers to reduce energy use during peak demand and high market energy prices. I&M deploys switches, sensors, control systems, near real-time communication channels and back office control software algorithms to manage customer loads.

DTE Energy' CoolCurrents Program

DTE Energy' CoolCurrents program (Guster, 2019) helps residential customers save on electric bills during summer. The utility will install a small wireless box mounted near customer's separately metered CoolCurrents meter. By enrolling, customers allow DTE to adjust their central air conditioner on very hot days, when demand for electricity is very high. The AC cycles on and off for 15 minutes every 30 minutes for no more than eight hours daily. The program provides more reliable service to all customer on days when the demand electricity is high due to extreme weather.

ComEd IoT App and Smart Meter Connected Device Service

ComEd has become one of the nation's first utilities to provide access to Internet of Things (IoT) (Company, 2019) apps that enable the automatic response of smart appliances such as smart thermostats to real-time conditions when time-varying prices fluctuate or pre-cool in advance of an expected curtailment event. Smart Meter Connected Device (SMCD) service is also available, which provides near real-time usage data and estimated electricity cost information to energy-management equipment. However, IoT is at an early stage and its full potential is yet to be determined.

Con Edison and National Grid Time-of-Use Programs

In 2018, Con Edison started its Time-of-Use Rates program (Con Edison, n.d.) as a way to avoid brownouts and blackouts during hot weather. For this program, residential consumers are charged significantly extra for electricity during times of peak demand and rewarded with sharply reduced rates during non-peak demand hours. National Grid offers Time-of-Use programs to commercial, industrial and residential customers. Its Time-of-Use (G-3) program is primarily available for large commercial and industrial customers with demand greater than 200 kW. National Grid's Residential Voluntary Time-of-Use rate (SC-1 VTOU) program allows Upstate NY customers the opportunity to reduce their energy costs by shifting their EV charging – and other appliance use – to the off-peak hours of 11:00 p.m. to 7:00 a.m. (excluding weekends and holidays).

ACES Program

Advancing Commonwealth Energy Storage (ACES) Program in Massachusetts (Massachusetts Clean Energy Center, n.d.) was announced in 2015 by Baker-Polito Administration as a part of his Energy Storage Initiative (ESI). This program not only encourages technical demonstration but also business model demonstration. The complementary technologies included in the ACES projects consist of solar PV, demand management, wind, EV charging, gas plants and combined heat and power. As part of ESI, Massachusetts Clean Energy Center is partnering with the City of Boston to install a solar and energy storage system at the Boston Fire Department (BFD) training facility on Moon Island (Moon Island, n.d.). The installation will also provide resilience for the training facility in case of an electrical outage during extreme weather events. The installed systems will be incorporated into the first responder training for the BFD, other local fire departments and local AHJs. Moon Island has the unique utility location of being in Eversource territory with all connections to the mainland being in National Grid territory. This will require the system to create special procedures for the interconnection process.

NYSERDA Energy Storage Program

The NYSERDA Energy Storage Program (NYSERDA Energy Storage, n.d.) offers a single up-front payment at a fixed incentive amount per kilowatt hour (kWh) of usable energy storage for projects up to five megawatts (MW). The incentives vary throughout the state and the NYSERDA energy storage incentive dashboard provides the incentive amount by region. Eligible participants include small businesses, large commercial and industrial businesses, demand-metered customers installing standalone storage or adding storage to a completed solar project. Incentives are performance-based. Customers can participate in this program either by installing a battery with a new solar PV system or by adding a battery to an existing solar PV system. Customers who have a battery without a solar PV system can participate but will not be able to export power to the electric grid.

Generation

Generation is the ability to produce electricity for on-site consumption and even dispatch electricity to the grid in response to a signal from the grid. Battery technology is often included under generation, as they improve the process of dispatching such as generated power. In this paper, we have considered battery systems under load shed and shift since we did not come across any programs that have the capability where battery system dispatches electricity to the grid. DERs microgrids under considered in this section.

The Clean Energy Jobs Act of Illinois (proposed)

The Clean Energy Jobs Act (CEJA) is comprehensive clean energy legislation (Senate Bill 2132/House Bill 3624) proposed in the Illinois General Assembly. CEJA in Illinois would establish minimum new build requirements for renewable energy of 5 million MWh of new construction delivered each year between the delivery year commencing June 1, 2021 through June 1, 2030. Of that total, the legislation requires that 50% of the renewable energy total comes from solar photovoltaics, and a percentage of the solar development is to be procured from roof top and community solar projects through the IPA's Adjustable Block Program. The percentage for roof top and community solar starts at 33% of the annual requirement, which is the equivalent of 669

MW per year, and grows to 42% of the annual requirement by 2030, which is the equivalent of 827 MW per year. Of the total 5 million MWh of new renewable construction in the legislation each year, 50% of that total comes from photo voltaic. The percentage required to come from large-scale, also known as utility-scale, solar projects starts off at 67%, or 1,024 MW per year, and declines each year to 892 MW per year as the required amount from roof top and community solar ramps up and the projected MWh output from each MW of solar installed increases. The split between investment in Northern Illinois and Central and Southern Illinois from large scale solar development is significantly closer than rooftop and community solar, which is mandated to follow the load levels of each region. It is projected that large-scale solar development would deploy more in Central and Southern Illinois due to the availability of land and to replace the capacity loss from the closure of coal plants.

Ameren IL Microgrid

As the market develops under FEJA, DER integration will likely increase. While interconnection with grid require DER to be able to connect to the grid and have the capability to interact with the grid, integration would help support the grid and provide value to the customer to be able to transact in the competitive market. Wide deployment of DER would require modernization in grid design and resource-integration technology, including smart inverters and adaptive protection and control systems. From distribution point of major advantage of having behind the meter microgrid is it can operate as a single aggregated load which operates within the compliance with the grid rules without hampering the resiliency and security of the grid. Ameren IL is testing multi-sourced microgrid (Ameren, 2017) in Champaign, IL. It has the capacity to produce 1,475 kilowatts, enough to power more than 190 homes. The leased generation assets located on site include a 100kW Northern Power Systems Wind Turbine, 125 kW Yingli Solar Array, 1000kW Caterpillar Natural Gas Generator, 250kW S&C Electric Company Battery Storage.

ComEd Bronzeville Microgrid Demonstration Project

The Illinois Commerce Commission has approved ComEd's microgrid demonstration in Chicago's Bronzeville neighborhood. Phase I of the project will include 2.5 MW of load and require reconfiguration of an existing feeder and installation of battery storage and solar PV. It will directly serve approximately 490 customers. Phase II of the project will add approximately 570 customers and an additional 4.5 MW of load and 7 MW of DERs, enough to meet the peak electricity demand of customers within the microgrid footprint and maintain service when the microgrid is islanded from ComEd's grid. The completed project will serve approximately 1,060 residential, commercial and small industrial customers. ComEd is leveraging DOE's 2 grant awards to develop the Community microgrid (ComEd An Exelon Company, 2019).

Shedd Aquarium Solar and Battery Storage Project

Shedd Aquarium (Microgrid Knowledge, n.d.) in Chicago is home for 2,500 animals and 1,500 different species. It is working to reduce its energy consumption by 50% by 2020. As part of their sustainability goals they house a 265-KW rooftop system with 913 PV panels on the marine mammal pavilion which is the largest solar installation at a cultural institution in Illinois. It also has a 1-MW/250-kWh lithium-ion battery energy storage system deployed for frequency regulation in the PJM market along with a sophisticated building management and metering analytics.

Massachusetts Community Microgrids Program

The Massachusetts Clean Energy Center (MassCEC) currently runs a Community Microgrids Program (Massachusetts Clean Energy Center, n.d.) that seeks to catalyze the development of community microgrids throughout Massachusetts to lower customer energy costs, reduce greenhouse gas (GHG) emissions and provide increased energy resilience. This program intends to award funding for feasibility assessments to advance proposed microgrid projects through the early project origination stages and attract third party investment to these opportunities. MassCEC is soliciting Expressions of Interest (EOIs) from groups interested in participating in feasibility assessments for community microgrid projects across the Commonwealth. Respondents may include municipalities and their public works departments, electric distribution companies, municipal light plants, emergency services departments, owners of critical infrastructure such as hospitals and financial institutions, self-organized groups of commercial building owners, developers or any other actor that either owns property within a potential microgrid or can demonstrate that they represent stakeholders with the capability of developing a community microgrid.

Connecticut Microgrid Program Pilot

Under Public Act 12-148, Section 7, Connecticut created a Microgrid Program (Energize Connecticut, n.d.) to help support local distributed energy generation for critical facilities. This act required the Department of Energy and Environmental Protection (DEEP) to establish a pilot of the Microgrid Program. It was created as a result of multiple episodes of severe weather that caused widespread power outages for extended periods and is designed to help create ways to ensure that critical buildings remain powered during electrical grid outages. Grants were awarded to recipients to support critical facilities and were generally split between small, medium and large municipalities, if possible. In 2016, the program's bond funding was expanded to provide matching funds or low-interest loans for an energy-storage system or clean distributed-generation projects for a Microgrid. In August 2017, DEEP issued a request for applications for Round 4 of the Microgrid Program.

Mass Solar Loan Program

In January 2015, the Department of Energy Resources (DOER) announced its partnership with the Massachusetts Clean Energy Center (MassCEC) as the program central administrator for the Mass Solar Loan Program (Massachusetts Solar Loan Program, n.d.). This program was launched to use credit enhancement to encourage solar lending, thereby facilitating homeowner access to attractive solar loans and providing new business opportunities for local lending institutions. The program includes three incentives: Interest Rate Buy Down incentive, Loan Loss Reserve incentive and Income-Based Loan Support incentive.

Rhode Island Distributed Generation Standard Contracts Program

In Rhode Island, the Distributed Generation Standard Contracts Program (State of Rhode Island Office of Energy Resources, n.d.)(DG Program) supports the development of new, locally-based renewable energy projects. Enacted in 2011, this program required electric distribution companies to enter into long-term contracts at a fixed price (with terms of up to 20 years) for 40 MW of newly developed distributed generation projects in the Rhode Island load zone by December 30, 2014. The 40 MW DG program is "carved-out" of the 90 MW Long-Term

Contracting Standard for Renewable Energy (LTC) capacity obligation. The Distributed Generation Standard Contracts Board sets annual ceiling prices for categories of different renewable energy technologies.

New Hampshire's Renewable Energy Fund Programs

New Hampshire's Renewable Energy Fund Programs (Commission, 2019) stimulate investment in low emission renewable energy generation technologies within the state. These programs include Competitive Grant Program, Low-Moderate Income Solar Program and Solar Rebate Programs. Under Competitive Grant Program New Hampshire Public Utilities Commission (PUC) issued an annual request for proposals (RFP) to fund renewable energy projects. Two projects selected for funding are heat recovery system for an existing biomass-fueled electricity generator which captures waste heat to heat greenhouses and a wood-chip fueled co-generation system that will be used to dry wood chips and generate electricity for on-site use.

The New Hampshire Clean Energy Jobs and Opportunity Act of 2017 included a funding allocation requirement for a program intended to reduce market barriers to solar energy participation by low and moderate income (LMI) residential customers. Working closely with stakeholders and the net metering working group, a new LMI competitive grant program was designed and implemented in 2018. In 2019 RFP was issued seeking proposals for community solar photovoltaic (PV) projects providing direct benefits to New Hampshire LMI residential electric customers. With the help of New Hampshire's Solar Rebate Programs, 14 MW of solar PV was interconnected during calendar year 2018. During 2019, the incentive levels of the residential solar program remained at $0.20 per watt, up to a maximum $1,000, and $0.40 per watt, up to a maximum $50,000 for commercial and industrial (C&I) installations. On July 3, 2019 the C&I solar rebate program was closed to new applications with a waitlist totaling approximately $20,000. The construction cycle for large C&I projects is, on average, approximately one year.

Conclusion

States are already taking steps through regulatory change, encouraging their utilities to provide programs and support to their customer to have more control of source of their energy and amount of energy they are using. With the aging grid and continuous increase in demand buildings can be used as asset to the grid than a burden. GEB helps in increasing electrical system efficiency and reliability. It is evident that even though there is lack of full-fledged holistic GEB program, states and utilities are taking steps toward parts of GEB vision.

The majority of policies and programs we see in Midwest and Northeast and mainly focused on energy efficiency, peak demand and time of use pricing. Utilities are also testing and implementing community level generation and storage system to help them better understand optimization strategies and demonstrating resilience efforts. Illinois has the largest deployment of AMI which provides utilities in the state valuable information of energy use patterns and will help them developed effective program elements as part of GEB. Best practices from each piece of this pie will in future help develop a full GEB program and buildings which have capabilities to communicate back and forth with the grid.

References

AEP Ohio- It's Your Power: https://itsyourpowerohio.com/. Accessed March 2020.

Ameren. (2017). *Ameren News Release*. Retrieved from Ameren unveils one of North America's most advanced distributed energy resource facilities: https://www.nyserda.ny.gov/All-Programs/Programs/Energy-Storag

Clean Energy Jobs Act. (n.d.). Retrieved from https://ilcleanjobs.org/who-we-are/clean-energy-jobs-act/

ComEd An Exelon Company. (2019). Retrieved from ComEd Bronzeville Community Microgrid Demonstrates Ability to Keep Power Flowing in Event of an Emergency: https://www.comed.com/News/Pages/NewsReleases/2019_04_17.aspx

ComEd Conducting Illinois' First Community Energy Storage Pilot. (2017). Retrieved from https://www.comed.com/News/Pages/NewsReleases/2017_03_16.aspx#:~:text=ComEd's%20Community%20Energy%20Storage%20(CES,40%20miles%20south%20of%20Chicago.&text=Featuring%20a%2025kWh%20lithium%2Dion,customers%20selected%20for%20the%20pilot.

Commision, O. P. (n.d.). *PowerForward Ohio, A Roadmapto Ohio's Electric Future*.

Commission, N. H. (2019). *NEW HAMPSHIRE RENEWABLE ENERGY FUND: Annual Report*.

Company, C. A. (2019). *U.S. DOE Awards Grant to ComEd, Partners to Advance "Energy Internet"*.

Con Edison: https://www.coned.com/en/save-money/energy-saving-programs/time-of-use. Accessed March 2020.

Drake, T. (2020). Stakeholders Provide Guidance as Xcel Energy Looks at 50 Percent Increase in Demand Response.

E21 Initiative. (2014). Retrieved from https://e21initiative.org/about-e21/

Energize Connecticut. (n.d.). Retrieved from Connecticut Microgrid Program- Project Financing: https://www.energizect.com/your-town/solutions-list/microgrid_financing

Future Energy Jobs Act. (n.d.). Retrieved from https://www.futureenergyjobsact.com/

Future, E. 4., Leadership, P. L., & Alliance, S. E. (2018). *Non-Wires Alternatives: Case Study from Leading U.S. Projects*.

Grid-interactive Efficient Buildings Working Group, N.-N. (2019). *Roadmapping: A Tool for States to Advance Load Flexibility and Grid-Interative Efficient Buildings*. National Association of State Energy Officials.

Guster, B. (2019). *DTE Energy*. Retrieved from SmartCurrents: A smarter way to save energy: https://empoweringmichigan.com/smartcurrents-a-smarter-way-to-save-energy/#:~:text=The%20DTE%20Energy%20SmartCurrents%20program,cost%20of%20your%20energy%20bill.

Massachusetts Clean Energy Center. (n.d.). Retrieved from Advancing Common Wealth Energy Storage (ACES): https://www.masscec.com/advancing-commonwealth-energy-storage-aces

Massachusetts Clean Energy Center. (n.d.). Retrieved from Expressions of Interest - Community Microgrids Program: https://www.masscec.com/expressions-interest-community-microgrids-program

Massachusetts Solar Loan Program: https://www.mass.gov/service-details/massachusetts-solar-loan-program. Accessed March 2020.

MassSave: https://www.masssave.com/. Accessed March 2020.

Microgrid Knowledge. (n.d.). Retrieved from The Shedd Aquarium: A Sustainability Mission & Microgrid Journey: https://microgridknowledge.com/white-paper/shedd-aquarium-mission-microgrid/

Moon Island. (n.d.). Retrieved from Massachusetts Clean Energy Center: https://www.masscec.com/moon-island

MPSC-MI Power Grid: https://www.michigan.gov/mpsc/0,9535,7-395-93307_93312_93593---,00.html. Accessed March 2020.

Neukomm, M., Nubbe, V., & Fares, R. (2019). *Grid-interactive Efficient Buildings: Overview*. U.S Department of Energy.

NextGrid, I. (2018). *The Future Study- DRAFT, Compiled by the Univesity of Illinois at Urbana-Champaign*.

NYSERDA Energy Storage: https://www.nyserda.ny.gov/All-Programs/Programs/Energy-Storage. Accessed March 2020.

NYSERDA Utility Program: Heat Pumps: https://www.nyserda.ny.gov/ny/pumped. Accessed March 2020.

Partnership, N. E. (2020). *Grid-Interactive Efficient Buildings (GEBs): Tri-Region Status Report*.

Power, I. M. (2019). *INTEGRATED RESOURCE PLANNING REPORT TO THE INDIANA UTILTIY REGULATORY COMISSION*.

State of Rhode Island Office of Energy Resources. (n.d.). Retrieved from Distributed Generation Contracts Program: http://www.energy.ri.gov/renewable/dg/