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Massachusetts Grid Services Primer

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Primer Contents

1. Introduction to DERs and Grid Services

1.0. Purpose of this Study

This Massachusetts Grid Services study is intended to delve into the value that non-utility-owned energy resources may be able to provide to the electric distribution grid and inform the design of potential programs or mechanisms to compensate those resources. While there are a wide range of benefits that different energy resources may provide to the broader electric grid, for the purpose of this study, "Grid Services" will refer specifically to the benefits provided by distributed energy resources (as defined below) to the local electric distribution system. This primer is intended as a reference guide to accompany the early stages of the study and provide stakeholders with context for the discussion and public-facing workshops to follow.

1.1. Distributed Energy Resources (DERs) and their Benefits

Distributed energy resources (DERs) are technologies connected to the distribution grid which can generate electricity or reduce or shift grid loads. DERs include energy efficiency, demand response, distributed solar PV, distributed energy storage, and electrification loads such as from EV and heat pumps. DERs can provide a range of services to the electric grid, including generating, storing, and modulating the use of electricity, among others. DER grid services can play a critical role in meeting local demand, easing localized constraints, and improving reliability. DERs have the potential to provide these services more quickly, at less cost, and with fewer community burdens than traditional grid infrastructure solutions. In addition to these services to the electric grid, DERs can also help to achieve societal benefits and policy goals such as a reduction in greenhouse gas emission or other hazardous air pollutants.

DERs include a vast array of customer-sited technologies that can interact with the electric grid in some way beyond simply using or exporting electricity whenever they are plugged in and turned on. DERs are often categorized based on how they are used. For example, DERs like rooftop or community solar allow customers to generate zero carbon electricity for their own consumption or export to the grid, while other DERs including electric vehicles (EVs), smart thermostats, or battery energy storage systems (BESS) grant users the flexibility to shift their energy demand to different times of the day, potentially reducing strain on the electric grid. Any given DER might have multiple uses, and it is up to the DER owner and/or grid operator to make the most of those varied benefits.

Rate-Related Benefits: Avoided and Deferred Costs

When it comes to thinking about the benefits that DERs can provide to the electric grid, it can be useful to start with the benefits that directly impact costs shared with other electric customers. If you can reduce these costs – such as for building new generation or infrastructure – you can reduce the rates that everyone must pay. Even if you only defer, or delay, the need to build that infrastructure, there is value to an electric company and its ratepayers in providing temporary savings. For the purposes of this study, these benefits are therefore referred to as Avoided and Deferred Costs.

For the electric distribution company (EDC),[1] as the distribution grid operator, any DER alternative must be as reliable as the traditional solution to enable the associated Avoided and Deferred Costs. Real time grid operators must be able to call upon DERs when and where it is needed with complete confidence that the DER will respond and perform when activated (e.g., Wi-Fi thermostat will adjust, managed charging will initiate, battery will discharge). The EDCs are building enabling technology for DER visibility and remote management. This technology is expected to interface with customer systems, based on agreed upon parameters.

Non-Rate Impacts

It is also important to realize the impacts of a DER beyond those that alter the rate electric customers pay. In addition to impacting the cost of the electric grid, DERs and policies surrounding them may result in either positive or negative impacts for society, including the reliability of the grid, pollution that is created or avoided but not fully factored into electric rates, or economic growth. A subset of these may also be tied to or recognized as grid services and evaluated in this study.

Who Is Impacted?

Just as the types and magnitude of impacts from DERs should be evaluated, policies and program design must also consider who experiences these impacts. DERs may provide direct benefits to the owner, rather than the grid as a whole. In these cases, since the customer is already seeing a benefit, they may not need additional incentives from the electric company. On the other hand, some non-rate impacts that similarly do not show up as obvious benefits for the electric grid might still benefit society as a whole and may be worth recognizing.

Environmental Justice

Tied to the question of *"Who is impacted by DERs and related policies?",* a key consideration in our study is how environmental justice may be considered in evaluating the grid services DERs provide. Environmental justice (EJ) populations have historically faced the greatest harm from air pollution, climate change, and other negative impacts that may come from energy infrastructure and energy generation. Additionally, these populations often spend a high share of their total income on energy. At the same time, disadvantaged or low-income populations typically have limited economic resources to adopt DERs, so without incentive or rebate programs targeted to these communities they may be less likely to enjoy the localized or participant benefits. We will seek to better understand how these concerns may be addressed. As a part of this study and the stakeholder process, we especially welcome feedback from and involvement by representatives of EJ populations to ensure they benefit from the clean energy transition.

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[1] The electric distribution companies referred to as part of this study include Eversource, National Grid, and Unitil. They may also be referred to as "utilities" or "electric companies".

1.2. What are Grid Services?

"Grid services" can broadly refer to services that help grid operators and planners manage the electric system, including services related to the regional electric generation capacity, transmission network, and local distribution systems. The focus of this study is to explore ways to value and compensate customers for providing *distribution* grid services, which can be highly location-specific in nature. For this reason, "Grid Services" and "Distribution Grid Services" may be used interchangeably in this primer and study effort moving forward.

As a part of the Electric Sector Modernization Plan (ESMP) process, the Massachusetts EDCs identified the potential for DERs to offer value and flexibility in addressing areas of need on the distribution system. The primary sources of value identified by the EDCs include: (1) avoiding or deferring investment in traditional grid infrastructure; (2) avoiding the need for risky and costly mitigations to address local overloads, such as portable generators; (3) providing grid operators with another "tool in the toolbox" to respond to reliability and power quality concerns on the electric system to optimize the system in real time.

Within their ESMPs, the EDCs have put forth several initial suggestions for how this grid services value might be determined and compensated. This study intends to build upon those ideas in a collaboration between the Massachusetts Clean Energy Technology Center (MassCEC), the EDCs, the Department of Energy Resources (DOER), and the Attorney General's Office (AGO). This effort is intended to include several opportunities for the involvement of a broad group of stakeholders. The ultimate outcomes of this effort will include:

- A Massachusetts-specific, statewide compensation framework for DERs providing location-specific grid services to the distribution grid, including specific attention to understand the value that DERs can provide in EJ populations.
- A roadmap describing steps to establish and implement both near-term and future grid services programs. This roadmap will detail ways to access value from customer-owned DERs which are both useful and reliable for grid planning, as well as deliverable from a customer experience perspective.

Over the coming months, MassCEC and its collaborators will host a series of 4 workshops to provide transparency to stakeholders and solicit public input and participation in this effort.

1.3. Compensation for DERs

DER programs use a variety of compensation mechanisms to recognize the benefits that DERs provide and to support further adoption. This compensation may take different forms, ranging from up-front rebates to pay-for-performance bill credits. The level of compensation may be determined based on the grid service needed at a specific location, specific types of value a DER provides to the grid, or simply based on what price point is expected to incentivize a certain amount of program participation. Since there are many overlapping compensation frameworks in the same EDC's service territory, it is important to consider how they intersect to ensure that DERs are being fairly compensated and that customers are given clear price signals to support beneficial DER adoption.

DER programs in Massachusetts

The Commonwealth of Massachusetts, in collaboration with the EDCs, hosts several existing programs to support the growth of DERs.[2] DERs may also be eligible to participate directly in wholesale markets. A few of these programs are listed as examples below:

- **ConnectedSolutions**: The ConnectedSolutions program offers financial incentives to homeowners and businesses for participating in demand response initiatives, like reducing energy use during system peak times or enrolling smart devices to help balance the grid.
    - Additional Information:
        - https://www.eversource.com/content/residential/save-money-energy/energy-efficiency-programs/demand-response/battery-storage-demand-response
        - https://www.eversource.com/content/residential/save-money-energy/energy-efficiency-programs/demand-response/smart-thermostat-demand-response
        - https://www.nationalgridus.com/MA-Home/Energy-Saving-Programs/ConnectedSolutions
- **SMART**: The SMART program provides financial incentives to homeowners, businesses, and organizations for installing solar and energy storage systems, offering payments based on the amount of energy produced. The program supports both residential and large-scale solar projects with incentives that decline over time as targets are met.
    - Additional Information:
        - https://www.masmartsolar.com/
        - https://www.eversource.com/content/residential/save-money-energy/clean-energy-options/solar-energy/smart-program
        - https://unitil.com/ways-to-save/solar-private-generation/smart-program
- **Clean Peak Standard**: The Massachusetts Clean Peak Energy Standard is designed to provide incentives to clean energy technologies that can supply electricity or reduce system-wide demand during seasonal peak demand periods established by DOER.
    - Additional Information:
        - https://www.mass.gov/clean-peak-energy-standard
        - https://www.masscec.com/clean-peak-standard-cps
- **Net Metering**: The Net Metering program allows distributed energy generation owners to earn credits for the excess electricity they produce and send back to the grid, which can offset future energy bills. These credits are based on specific components of the retail rate.

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[2] We note that while these programs are specific to the EDCs, several MLPs have similar offerings aiming to achieve similar ends in their own service territories. The MLPs are not the subject of this study.

- Additional Information:
  - https://www.mass.gov/info-details/net-metering-guide
  - https://www.eversource.com/content/residential/save-money-energy/clean-energy-options/solar-energy/net-metering-defined
  - https://unitil.com/ways-to-save/solar-private-generation/net-metering

2. Glossary of Acronyms and Industry Terms

Term	Definition
ADC	Avoided and Deferred Costs, a means for valuing a resource based on its ability to delay or avoid the need for making investments in additional utility grid infrastructure
AMI	Advanced Metering Infrastructure, a modern system of utility meters, sometimes referred to as "smart meters"
Bridge to Wires	The use of DER dispatched by a utility to address a present or imminent reliability need on the distribution system prior to the completion of a wires-based solution
BTM	Behind-the-Meter, referring to a resource that is located on the customer's side of the electric meter, indicating that is a customer resource, rather than a utility resource; see FTM (Front of the Meter)
Community Solar	Community Solar refers to solar generation facilities that provide electricity or bill credits to multiple utility customers.
Cost Shift	A phenomenon in utility rates increase for a given customer class to pay for costs incurred by another class
CS	ConnectedSolutions, a behind-the-meter demand response program in Massachusetts that provides and incentive to customer who reduce their load during system-wide peak events
DER	Distributed Energy Resources, technologies connected to the distribution grid which can generate electricity or reduce or shift grid loads. Including energy efficiency, demand response, distributed solar PV, distributed energy storage, and electrification load such as from EV and heat pumps
DG	Distributed Generation, solar PV and energy storage systems that are connected to the distribution system and generate electricity to reduce demand on the system.
DR	Demand Response, programs that compensate customer to reduce their load during hours in which the electric grid faces constraints
EDC	Electric Distribution Company, Massachusetts' major investor-owned utilities
EE	Energy Efficiency, programs that cause long-lived, non-dispatchable load reductions through improvements to building systems, structures, or operations
EJ	Environmental Justice, from current state law, is based on the principle that all people have, a right to be protected from environmental hazards and to live in and enjoy a clean and healthful environment regardless of race, color, national origin, income, or English language proficiency

Commented [Ch1]: This does not match my understanding of bridge to wires. My understanding would be "The use of NWAs to address a present reliability need on the distribution system". It does not need to be pre-existing, and the reliability need trumps operational flexibility

Commented [AS2R1]: Thanks Charles - Revised here. Let me know if this better aligns with what you're thinking.

Commented [Ch3R1]: That matches. Thanks!

EJ Populations	Environmental Justice Populations are defined in Section 56 of "An Act Creating A Next-Generation Roadmap for Massachusetts Climate Policy", as a neighborhood that meets one or more of the following criteria: (i) the annual median household income is not more than 65% of the statewide annual median household income; (ii) minorities comprise 40% or more of the population; (iii) 25% or more of households lack English language proficiency; or (iv) minorities comprise 25% or more of the population and the annual median household income of the municipality in which the neighborhood is located does not exceed 150% of the statewide annual median household income.
ELCC	Effective Load Carrying Capability, the ability of a resource to effectively meet system needs and align with the timing of energy demand. This is often represented as a scalar applied to the rated capacity of the resource
Equity	Equity means engaging all stakeholders – including our customers and communities with respect and dignity while working toward fair and just outcomes, especially for those burdened with economic challenges, racial inequity, negative environmental impacts, and justice disparities. This includes the three dimensions of equity articulated by the American Council for an Energy-Efficient Economy (ACEEE) in its Leading with Equity Framework; procedural equity, distributional equity, and structural equity.
EV	Electric Vehicle
Feeder	Electrical circuits emanating from a substation that supply underground areas at distribution level voltages.
FTM	Front of the Meter, referring to activities, technologies, or systems that are located on the utility side of the electricity meter; see BTM (Behind-the-Meter)
GHG	Greenhouse Gas (emissions)
Grid Services	Value that DERs can provide to the electric grid. This study is primarily focused on localized distribution system value.
Headroom	The margin of available capacity at a specific equipment to accommodate additional load without causing violations of equipment specifications
Interconnection	The connection of DERs to the power grid in a manner that ensures safe operations under all grid conditions
kW/kWh/kW-yr	Kilowatt, kilowatt-hour, and kilowatt-year, measurements of electric energy and capacity
Load	The demand for electricity, electricity consumption, or the amount of electric power delivered to any specified point on a system, accounting for the requirements of the customer's electrical equipment.
NEM	Net Energy Metering, a form of compensation for a distributed energy resource located on a customer's premise wherein a customer consumes some portion of the generation themselves and is also compensated for energy exported to the grid.
NWA	Non-Wires Alternatives, technologies or operating practices intended to reduce grid congestion and manage peak demand to offset a utility's need to make additional investments in conventional assets like wires, poles, and substations. The technologies can include distributed energy resources, such as microgrids or batteries, and practices and programs focused on load management, demand response or energy efficiency.
O&M	Operations & Maintenance
PCT	Participant Cost Test, one of the standard cost tests used to evaluate the benefits and costs of a measure to participant
Peak Load	Peak load refers to the highest electricity demand experienced by the grid during a specific period
PV	Photovoltaic (solar)

Reliability	Assurance that electric power is available even under adverse conditions, such as storms or outages of generation or transmission lines.
Resilience	The ability of the grid to withstand and rapidly recover from power outages and continue operating with electricity, heating, cooling, ventilation, and other energy- dependent services.
RIM	Ratepayer Impact Measure, one of the standard cost tests used to evaluate the benefits and costs of a measure to other non-participating utility ratepayers; see SCT
SCT	Societal Cost Test, one of the standard cost tests used to evaluate the benefits and costs of a measure to society at large; see RIM
SMART	Solar Massachusetts Renewable Target, a commonwealth program that provides incentives for solar and paired storage
Substation	A facility used to translate electricity from transmission level voltages to distribution level voltages
TOU	Time of Use, a type of retail rate under which the cost of electricity differs based on the time of day. Also known as Time Varying Rates (TVR).
TRC	Total Resource Cost, one of the standard cost tests used to evaluate the total benefits and costs of a measure within the bounds of the study
VPP	Virtual Power Plant, an aggregation of DERs that can balance electrical demand and supply and provide utility scale and utility-grade services like a traditional power plant.

For additional terminology and acronym definitions, the appendices of the EDCs' Electric Sector Modernization Plans provide detailed glossaries, from which several of the above definitions were borrowed and should be attributed. Links to these ESMPs can be found in the "Additional Resources" section of this primer.

3. Additional Resources and Educational Materials:

Distributed Energy Resources and Grid Services: Summary and background of the Massachusetts Grid Services study.

- https://www.masscec.com/grid-modernization-and-infrastructure-planning/grid-services-study

Distributed Generation and Distributed Energy Resources: Additional background information on DG and DERs.

- Distributed Generation of Electricity and its Environmental Impacts https://www.epa.gov/energy/distributed-generation-electricity-and-its-environmental-impacts
- Distributed Energy Resources for Resilience https://www.energy.gov/femp/distributed-energy-resources-resilience#:~:text=Distributed%20energy%20resources%20(DERs)%E2%80%94,Portfolio%20Resilience%20Planning%20and%20Implementation.

Electric Distribution: A summary of Eversource's electric distribution system, including the impacts of DERs such as energy storage and grid modernization.

- https://www.eversource.com/content/residential/about/transmission-distribution/electric-distribution

Electric Sector Modernization Plans: Commonwealth-mandated utility plans for updated distribution and transmission systems to ready the grid for anticipated challenges, including high electrification, increased renewables, climate change, and ratepayer impacts.

- Massachusetts Department of Public Utilities Background: https://www.mass.gov/info-details/electric-sector-modernization-plan-resources?_gl=1%2Aaedzts%2A_ga%2AMTEwNzM0ODMwNS4xNzA1NTA1MjI4%2A_ga_MCLPEGW7WM%2AMTcwODk4MTI5OS4zLjAuMTcwODk4MTI5OS4wLjAuMA..
- Eversource: https://www.eversource.com/content/docs/default-source/default-document-library/eversource-esmp%20.pdf
- National Grid: https://www.nationalgridus.com/media/pdfs/our-company/massachusetts-grid-modernization/future-grid-full-plan.pdf
- Unitil: https://unitil.com/sites/default/files/2024-01/Unitil-ESMP-2025-2050-DPU-FINAL.pdf

Grid Modernization Advisory Council (GMAC): Resources related to the review of the EDCs' ESMPs

- https://www.mass.gov/orgs/grid-modernization-advisory-council-gmac

Existing EDC Programs: A non-exhaustive list of links to existing Commonwealth and utility programs that offer incentives for distributed energy resources.

- Eversource:
  - Residential Customers: https://www.eversource.com/content/residential/save-money-energy
  - Business Customers: https://www.eversource.com/content/business/save-money-energy
- National Grid:
  - Residential Customers: https://www.nationalgridus.com/MA-Home/Energy-Saving-Programs/
  - Business Customers: https://www.nationalgridus.com/MA-Business/Energy-Saving-Programs/
- Unitil:
  - https://unitil.com/ways-to-save

Additional Resources:

- Clean Energy States Alliance (CESA) Resource Library: https://www.cesa.org/resource-library/