Massachusetts Grid Services & DER Compensation Study

Roadmap Report

September 15, 2025

MASSACHUSETTS CLEAN ENERGY CENTER®

Prepared by

Energy+Environmental Economics

RMI

Executive Summary – Context and Objectives

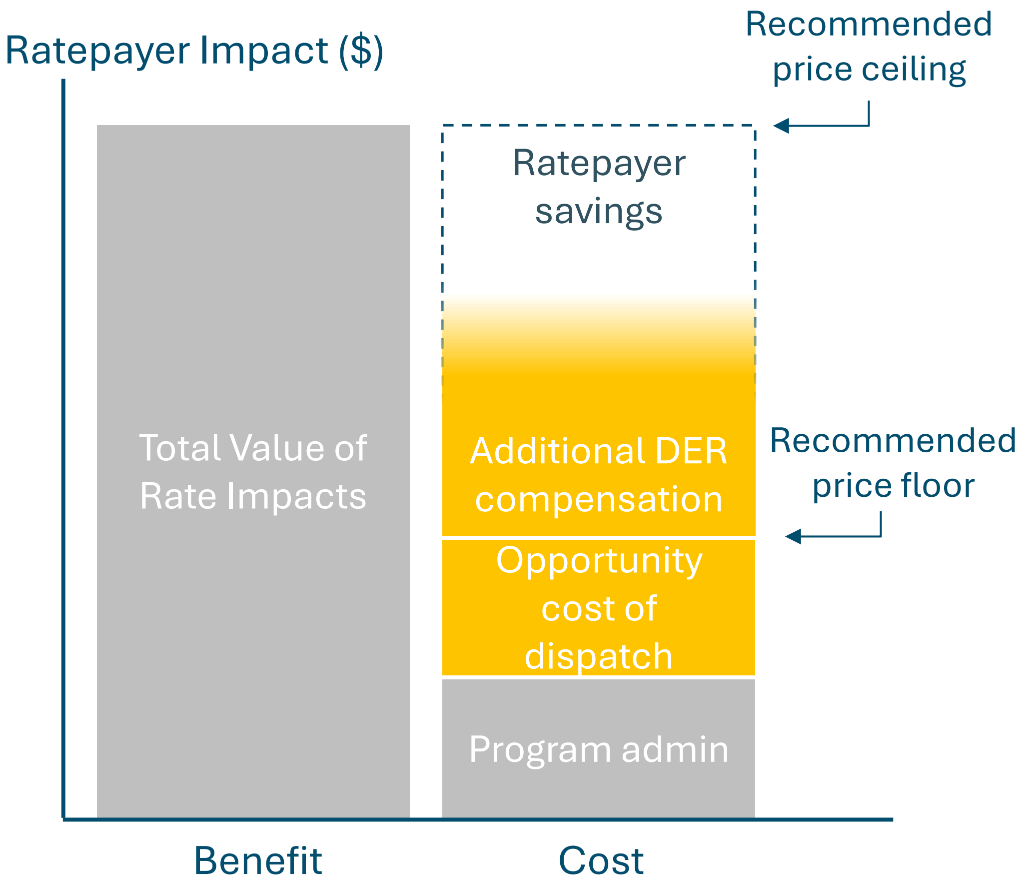
- **Evolving demands on the electric grid to address new loads, decarbonization goals, and resiliency needs drive increased spending and pose challenges for energy affordability**
- **Grid Services provide an opportunity for electric distribution companies (EDCs) to leverage flexible Distributed Energy Resources (DERs) to reduce distribution system costs in specific locations**
- **DERs can provide Grid Services through:**
  - **Deferral of Infrastructure Investments** – By dispatching to reduced local peak demands, DERs can delay the need for infrastructure upgrades
  - **Bridge-to-Wires (B2W)** opportunities – Where infrastructure upgrades are needed but cannot be built in time to accommodate new loads, DER dispatch can provide a 'bridge' of temporary relief and avoid the need for other costly interim solutions
- **Incorporation of Grid Services into utility planning and operations will allow Massachusetts to improve energy affordability and support continued decarbonization of the electric grid**

This study provides frameworks for valuing and compensating Grid Services from organically deployed DERs and recommendations for implementing offerings with consideration for equity and environmental justice

Executive Summary - Key Findings

1. **Distribution Grid Services require location-specific valuation and compensation mechanisms beyond what is available through existing programs**
2. **Infrastructure investment deferral by DERs can create quantifiable savings for customers and harder-to-quantify benefits for impacted communities**
3. **DERs can offer Bridge-to-Wires support where infrastructure upgrades are delayed and there is an immediate need**
4. **DER benefits provided by DERs in investment deferral and B2W scenarios should be carefully categorized by their impact on the utility revenue requirement to create a clear understanding of ratepayer impacts**
5. **To ensure ratepayer savings, compensation for Grid Services should be capped by the net reduction in revenue requirement, or rate impact value, that the services provide**

Recommended Compensation Floor and Ceiling Based on Ratepayer Impacts

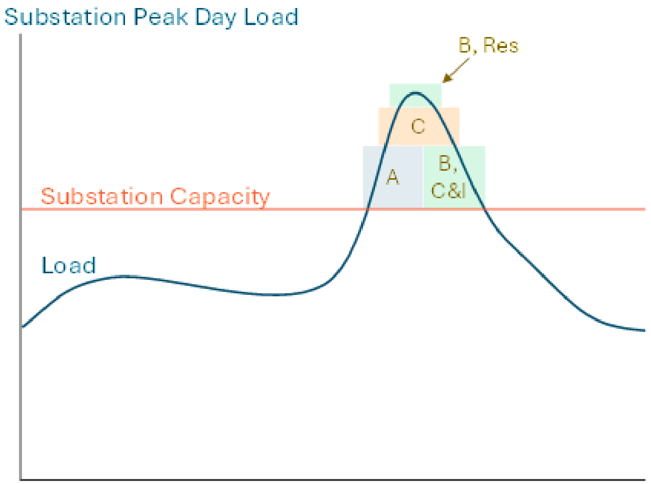


Executive Summary - Key Findings

6. Encouraging DER participation will require that compensation for Grid Services exceed the opportunity cost of DERs
7. Dispatch signals across all DER programs, including Grid Services offerings, should be coordinated for efficient use of ratepayer funds
8. To support equity and environmental justice, Grid Services must take a comprehensive approach and engage impacted communities in offering development and decision making
9. Grid Services offerings will be most effective when they are tailored and complementary rather than using a one-size-fits-all approach
10. The value of Grid Services in the future will be maximized by information improvement and “learning by doing”

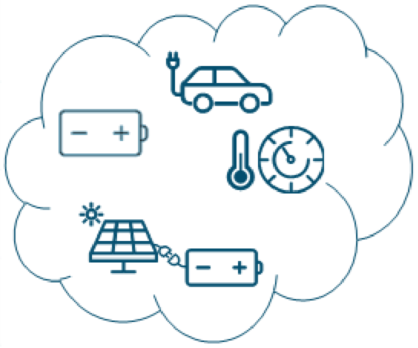
A Combination of Varied Offerings can be Used to More Effectively Fulfill Grid Needs

Utility Planner’s Perspective



Customer’s Perspective

Customer/ DER Type	Grid Services Offerings	Potential DER Participants*
Residential	Offering A	
Residential	Offering B	
Commercial & Industrial	Offering B	
Front of the Meter	Offering C	



*Eligible DERs shown are a non-exhaustive sample for illustration only

Agenda

- **Executive Summary**
- **Study Overview**
- **Introduction to Grid Services**
- **Designing a Framework for Grid Services Offerings**
  - Valuation Framework
  - Guidelines for Compensation
- **Grid Services Implementation**
  - Near-Term Objectives
  - Long-Term Recommendations
- **Study Resources**

Study Overview

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Collaborative Study Partners:

- **Study is led & funded by MassCEC's Net Zero Grid team**
- **Massachusetts state agencies:**
  - Department of Energy Resources (DOER)
  - Attorney General's Office (AGO), Office of the Ratepayer Advocate
- **Investor-owned Massachusetts electric distribution companies (EDCs):**
  - Eversource
  - Unitil
  - National Grid
- **Consultants:**
  - Energy and Environmental Economics (E3)
  - Rocky Mountain Institute (RMI)

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Vision for Grid Services

The utility / energy sector is early on the journey of using customer DERs to address local grid constraints

- The project partners envision a future in which customer **flexibility is further integrated into distribution network planning and operations** as a complementary lever to physical distribution investments, maximizing the value of customer flexibility to reduce the costs of the clean energy transition
- In Massachusetts, **we have industry-leading *system-wide* EE and DR programs**, but **the collective industry is nascent on its journey to leverage customer flexibility for *local* distribution grid constraints**
- **A "walk before you run" approach** will enable EDCs and their customers to start capturing the benefits of DER providing local grid services while gathering best practices and insights to further develop programs over time
- **This Grid Services Study will provide critical input** to EDCs as we develop programs that provide compensation for customers that enroll their DERs to provide local grid services
  - **Statewide valuation frameworks** that provide guidance on how compensation should vary based on location, driven by the value of local grid needs
  - **Consistent guidelines** to inform program development (e.g., added value in EJ communities, coordination with existing non-locational DER compensation programs)
  - **Implementation roadmap** with guidance on short-term techniques to get started animating the market for flexibility and more advanced capabilities to build towards.

Grid Services offerings can act as a multitool for utilities in building and maintaining a cleaner, more affordable grid

- Incorporate the full achievable potential of DERs in utility planning to optimize grid investments and reduce costs for all ratepayers
- Integrate DER dispatch calls with utility operations to provide real-time system relief during stress events
- Enable and accelerate electrification by alleviating local constraints
- Reduce the need for other financially and/or environmentally costly short-term solutions
- Advance equity by providing direct benefits to EJ populations, including compensation to support EJ ownership of DERs

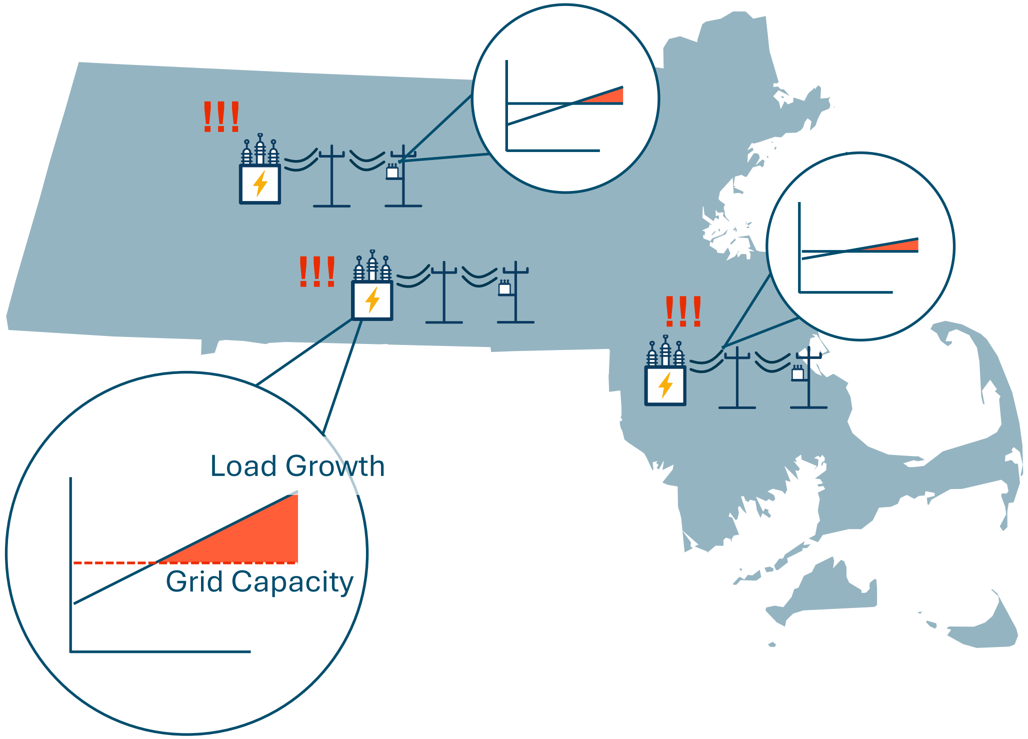
Objectives for the Massachusetts Grid Services Study

1. Develop an initial methodology for calculating location-specific distribution grid services value that may be provided by flexible Distributed Energy Resources (DERs) in Massachusetts
2. Explore potential compensation frameworks specific to this grid services value – balancing policy objectives and avoiding overlap or double-counting with other available benefits/incentives
3. Integrate equity and environmental justice (EJ) impacts in both valuation and compensation for grid services
4. Create a roadmap to guide near- and long-term development of grid services programs for DERs
5. *Provide opportunities to incorporate stakeholder input!*

The Grid Services Study explores how to value and compensate DERs – a companion DOER Load Management Study is exploring resource potential

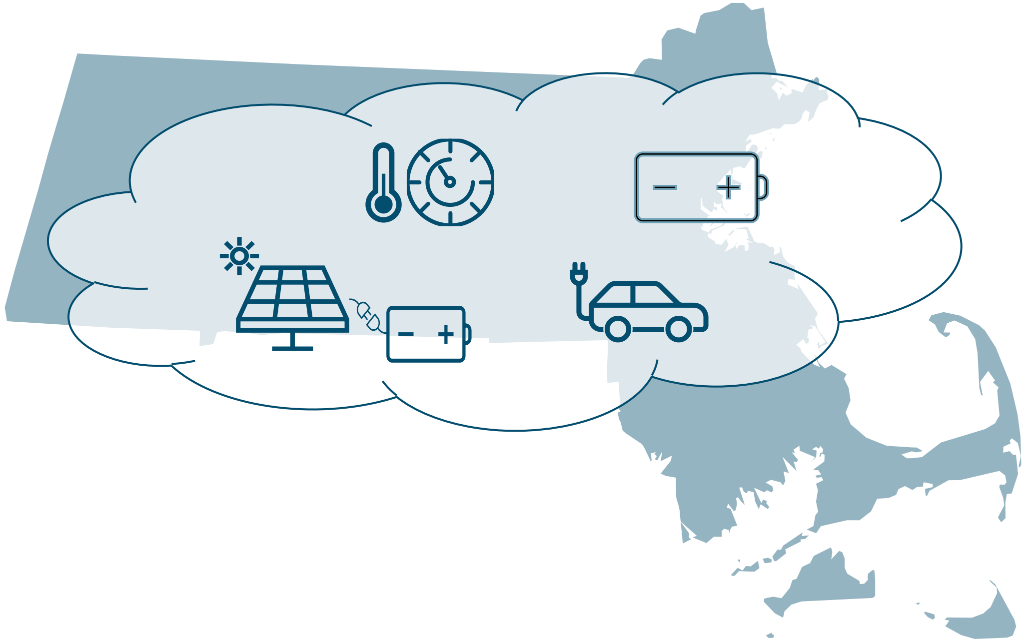
Grid Services Study

Provides framework for valuing specific opportunities and determining compensation to motivate DER participation



Load Management Study

Identifies statewide flexible load potential (in MW and $) that can be leveraged through rates and programs (including Grid Services)



Study work products - included within the Grid Services Report

Valuation Framework

- Incorporate distribution grid services and non-rate impacts
- Must be applicable statewide and include consideration for EJ communities

Compensation Mechanism Assessment

- Evaluate components or levers for building compensation offerings
- Determine criteria for evaluating and selecting from offerings

Near Term Implementation Plan

- Outline early-stage objectives and information needed to support the long-term vision
- Identify specific actions to stand up initial grid services offerings

Long Term Implementation Plan

- Address challenges and opportunities in scaling grid services offerings
- Provide recommendations for continued process and program evolution

Timeline of Grid Services Study

Study Timeline

Fall 2024
Study begins

December 2024 - Summer 2025
Stakeholder engagement

September 2025
Study published

And Beyond…
Grid services work continues outside of this specific coalition of partners

Engagement Channels

4 Public Workshops
December 2024 through June 2025

EJ Focus Groups
April 2025

Written Feedback
Ongoing, including post-workshop surveys

Future engagement to be determined:

Engagement within and outside of regulatory processes
Facilitated sessions and targeted interviews

Written Feedback
Ongoing, including surveys, emails, and public comments

Workshop Topics Areas

Workshop 1

Building understanding and a vision for the role of DERs and grid services in MA

- Motivations, goals, and approach for establishing grid services compensation mechanisms
- Role of stakeholder engagement in this study
- Initial feedback on study goals and approach

Workshop 2

- Approaches to valuing distribution grid services
- Introduction to compensation structures
- Feedback Areas: Valuation methods; Compensation structures; Considerations for implementation and reducing barriers to access

Workshop 3

- Summary of engagement to date and feedback from equity and EJ focus groups
- Context and priority objectives for compensation offerings
- Components of compensation
- Feedback Areas: Priorities and preferences for compensation structures

Workshop 4

- Understanding policy considerations for implementing grid services
- Near-term objectives and Long-term vision for grid services in Massachusetts
- Expected implementation timeframe to follow this study
- Feedback Areas: Vision, Objectives, and prioritization of each

Recordings and materials from all workshops can be found on the MassCEC Grid Services Study webpage

Introduction to Grid Services

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Study Context – What are DERs?

Distributed energy resources (DERs) are technologies connected to the distribution grid which can generate electricity or reduce or shift grid loads.

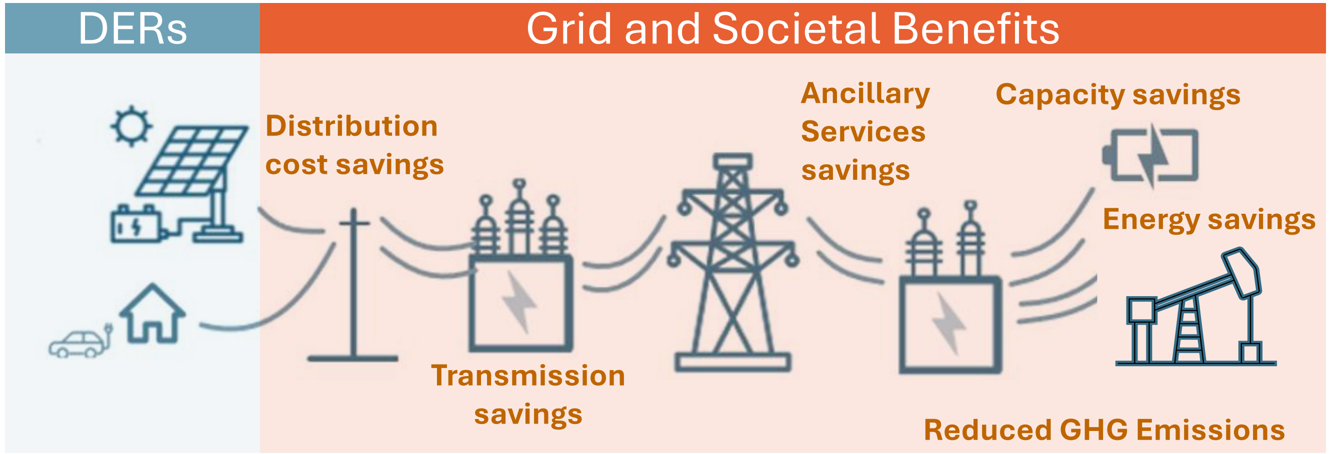
DERs include energy efficiency, demand response, distributed solar PV, distributed energy storage, and electrification loads such as from EV and heat pumps.

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 can perform a variety of valuable functions for the electric grid, which can result in savings for utility customers

+ **DERs can benefit the grid by:**
  - Generating carbon-free electricity
  - Reducing customer electricity loads
  - Shifting customer loads to times when the grid is less constrained

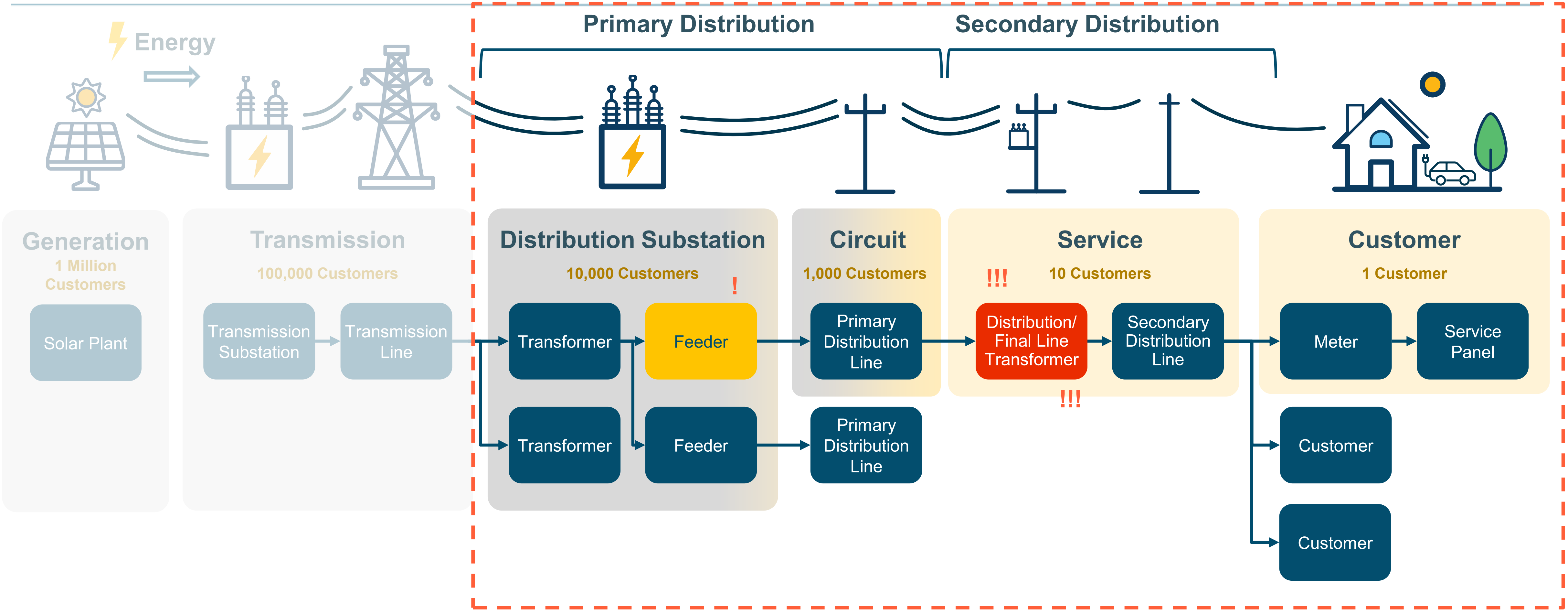
These benefits may reduce costs for electric grid operators; resulting savings can be passed on to ratepayers



+ **DERs can also provide societal benefits in the form of 'Non-Rate Impacts', such as reduced emissions of greenhouse gases or other pollutants harmful to human health**

This study focuses specifically on *distribution-related* Grid Services. We seek to establish a framework for valuing these benefits and to lay out a roadmap for how they can be effectively captured and compensated

Distribution Grid Services address highly location-specific needs



To capture these benefits and value them appropriately, Grid Services must be similarly location-specific and will only target certain areas of the grid

Designing a Framework for Grid Services Offerings

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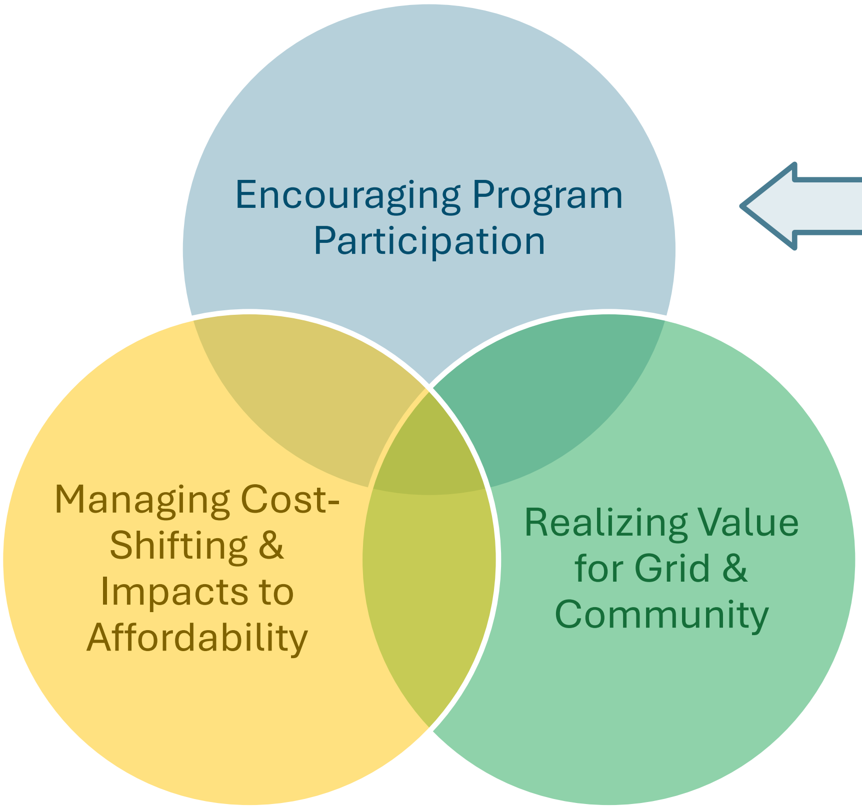
Framework design must balance competing goals and ultimately be actionable

Offerings must appeal to DER owners to result in meaningful participation and provide value

Offerings may provide value to and be funded by all ratepayers, potentially affecting electric rates and shifting costs between participants and non-participants



Value arises from reduced revenue requirement and societal values (e.g., emissions reductions)

Core priorities for Grid Services framework design:

1. **Generate ratepayer savings**
2. **Improve environmental justice within the scope of distribution Grid Services**

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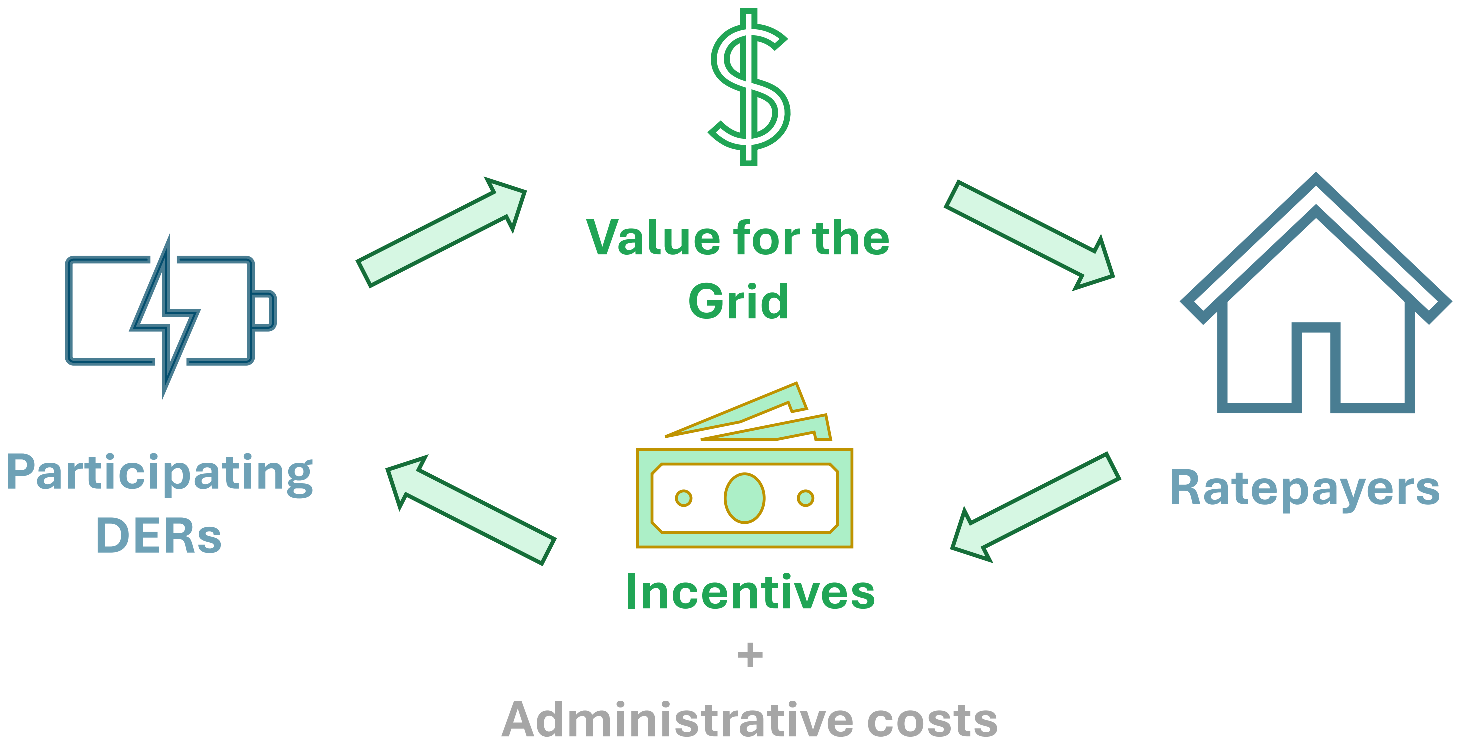
Valuation Framework

Grid Services offerings can provide value to ratepayers and the grid by incentivizing helpful DER behavior



Ratepayers benefit from Grid Services through reduced electric system costs and rates

They pay for these benefits through incentives to DERs, plus the cost to administer offerings

This study values Grid Services in two core scenarios of local capacity constraints

Investment Deferral Scenario

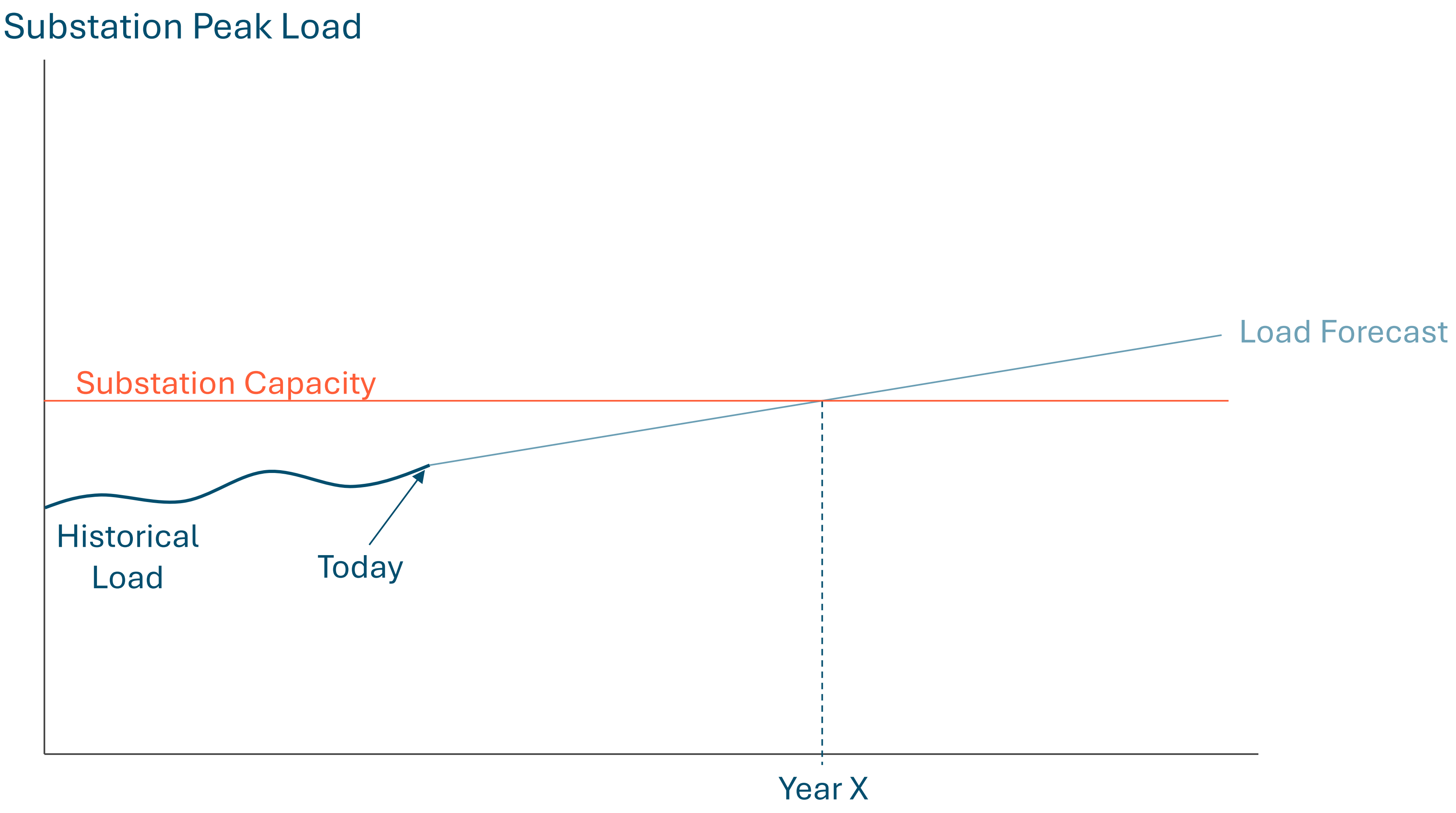
- DERs can provide additional capacity that may enable utilities to delay investments in traditional solutions, reducing costs for customers
- Deferral can support Incremental Investment
  - When calling upon DERs, utilities can right-size capacity procurement to suit near-term needs
  - This provides an implementation benefit, though does not change the total value of deferral itself
- Deferral also offers additional Optionality value
  - Planners can wait and see how system needs develop before committing to long-term investments – potentially making investments more efficient

Bridge-to-Wires Scenario

- DERs can help meet near-term capacity needs while longer-term infrastructure solutions are under construction
- This can avoid costs for alternate interim solutions or reduce operational risks to the electric system (e.g. over-straining equipment or preventing outages in the most extreme scenarios)

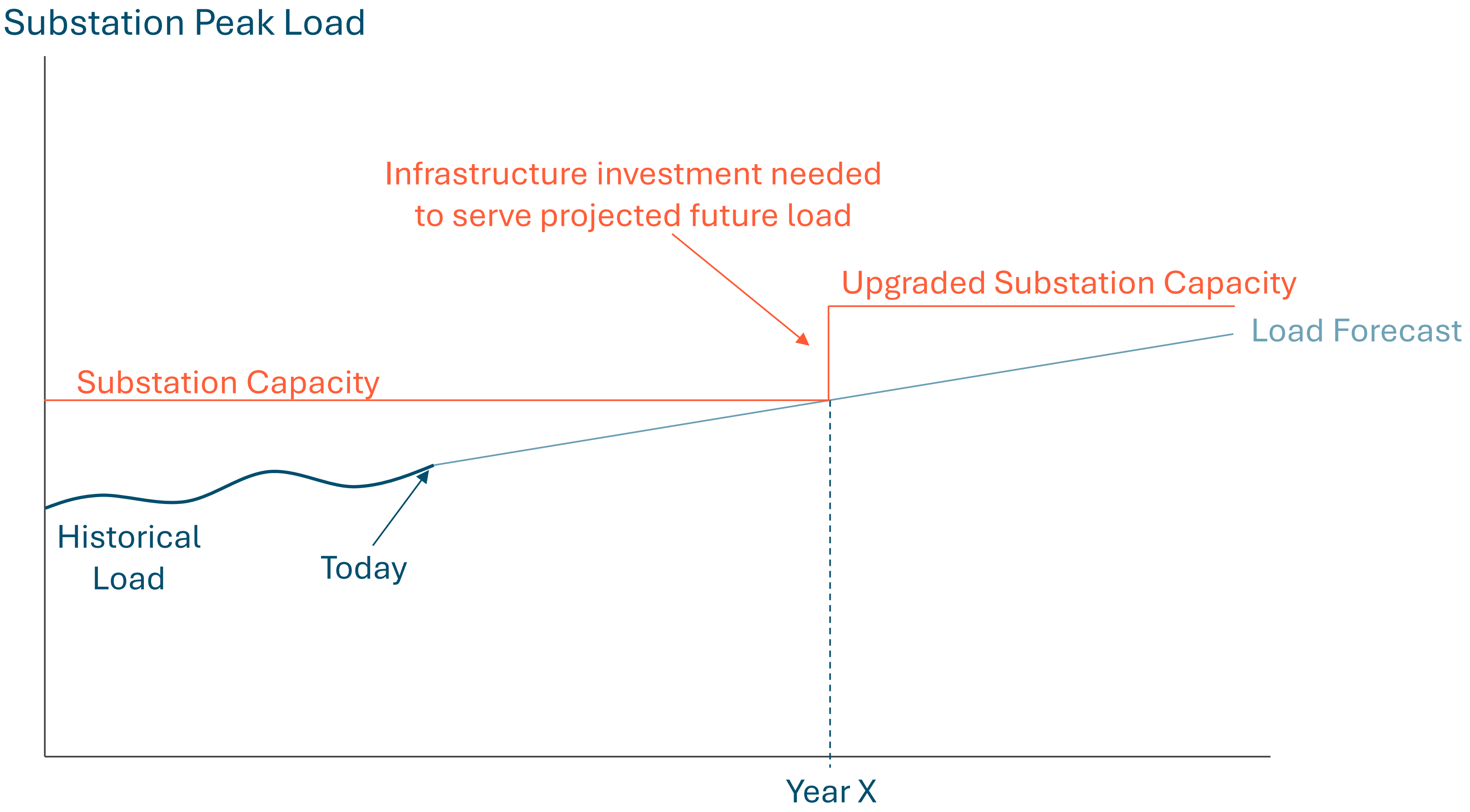
Distribution equipment forecast for overloading may be a candidate for DER-based deferral

Investment Deferral Scenario

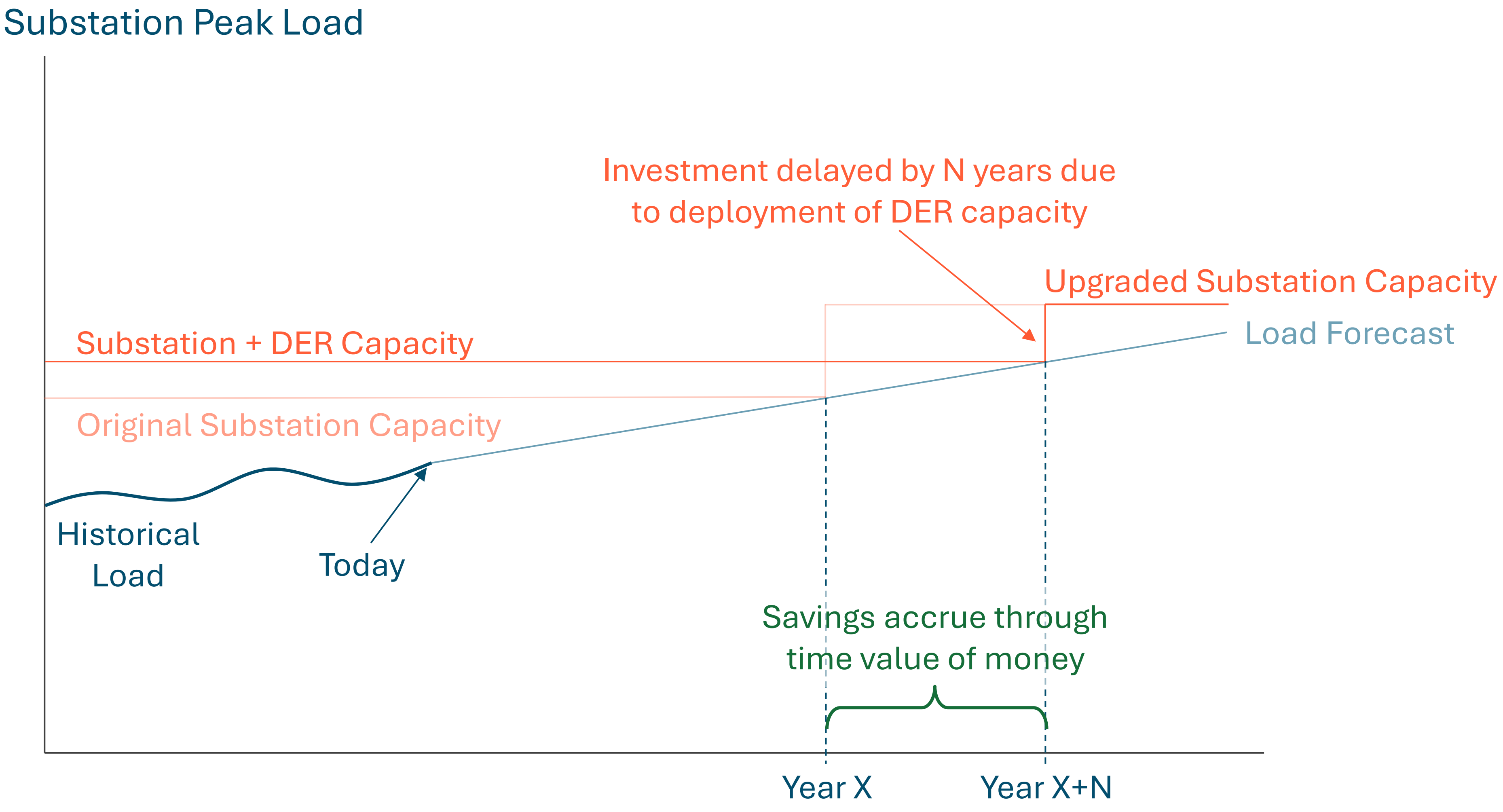


Traditional solutions upgrade equipment to meet long-term forecasted load

Investment Deferral Scenario



Reliable DER capacity downstream of the equipment can delay the need for new infrastructure and generate savings



Deferral Value is based on the discounted value of the deferred investment

EXAMPLE CALCULATIONS – Values are not intended to represent any specific real-world scenario

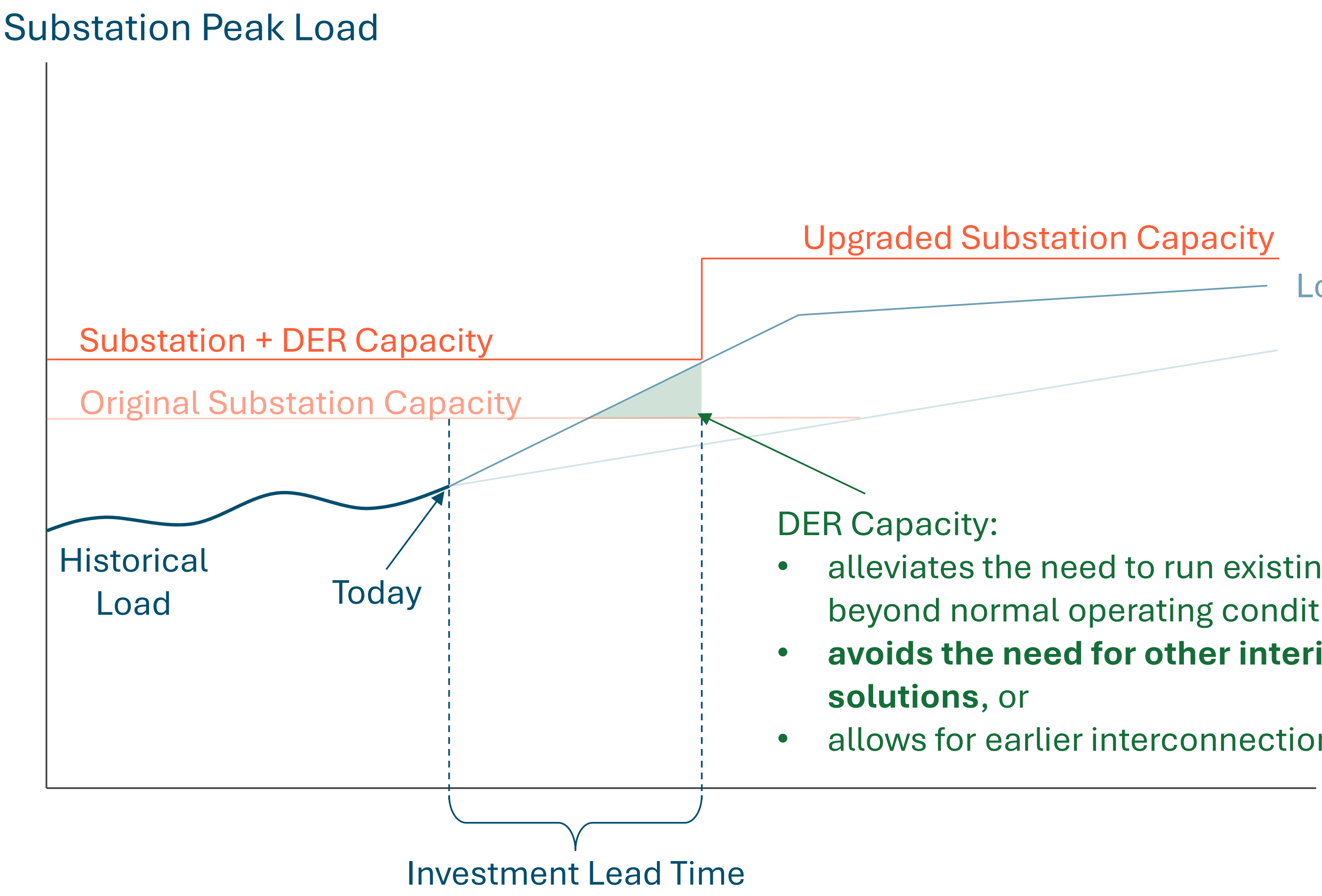
Original Investment Cost: $100M
Capacity Need in Year 3: 8.3 MW

Key	Attribute	Formula	Value
A	Cost Escalation	*input value*	6%
B	Straight-line Depreciation	*1 / Investment Useful Life*	2.50%
C	Discount Rate (Utility WACC)	*input value*	8%
D	Annual Revenue Requirement Allocator	*input value*	12.5%
E	Line Losses	*input value*	9.8%
F	Capital Cost - No deferral ($M)	*input value*	$ 100
G	Capital Cost - 3-year deferral ($M)	*F * (1+ A)^3*	$ 119

Key	Attribute	Formula	Values											
	Year		Year X	Year X+	Year X+	Year X+	Year X+	Year X+	...	...	...	...	...	...
H	Discount Year		0	1	2	3	4	5	...	39	40	41	42	43
	No Deferral													
I	Year of Investment Life		0	1	2	3	4	...	...	39	40			
J	Revenue Requirement	*F * D * (1 - B * I) / (1 - E)*	$ 13.9	$ 13.5	$ 13.2	$ 12.8	$ 12.5	...	...	$ 0.3	$ -	-	-	-
K	Discounted Revenue Requirement	*J / (1 + C)^H*	$ 13.9	$ 12.5	$ 11.3	$ 10.2	$ 9.2	...	...	$ 0.02	$ -	-	-	-
L	NPV Revenue Requirement ($M)	*NPV(Row J at Discount Rate C)*	*$ 76.6*											
	3-year Deferral													
M	Year of Investment Life					0	1	2	...	...	...	38	39	40
N	Revenue Requirement	*G * D * (1 - B * M) / (1 - E)*	-	-	-	$ 16.5	$ 16.1	$ 15.7	...	...	...	$ 0.8	$ 0.4	$ -
O	Discounted Revenue Requirement	*N / (1 + C)^H*	-	-	-	$ 13.1	$ 11.8	$ 10.7	...	...	...	$ 0.04	$ 0.02	$ -
P	NPV Revenue Requirement ($M)	*NPV(Row N at Discount Rate C)*	*$ 72.4*											
Q	3-year Deferral Savings	*L - P*	*$ 4.2*											

DER capacity can also be leveraged to meet near-term need before an infrastructure solution can be built

Bridge-to-Wires Scenario



DER Capacity:

- alleviates the need to run existing equipment beyond normal operating conditions,
- **avoids the need for other interim backup solutions**, or
- allows for earlier interconnection of load

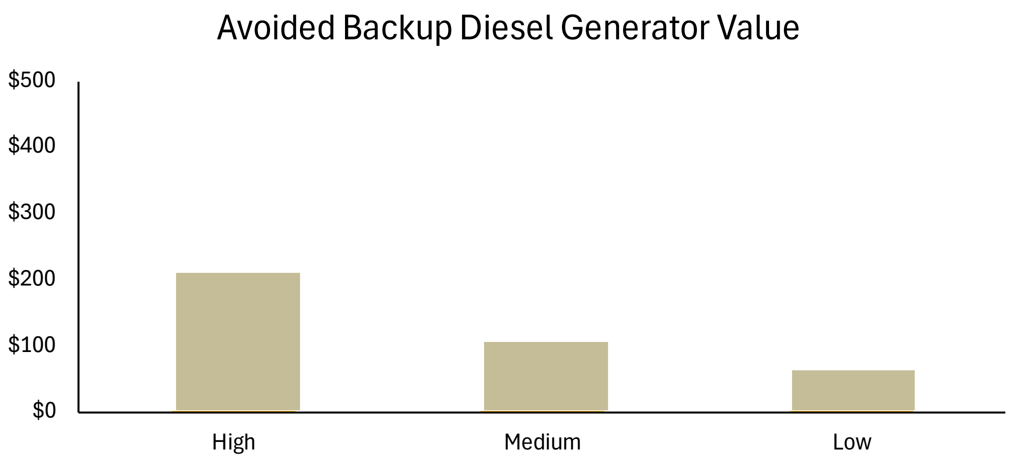
Bridge-to-Wires values is based on the avoided cost of an alternate interim solution

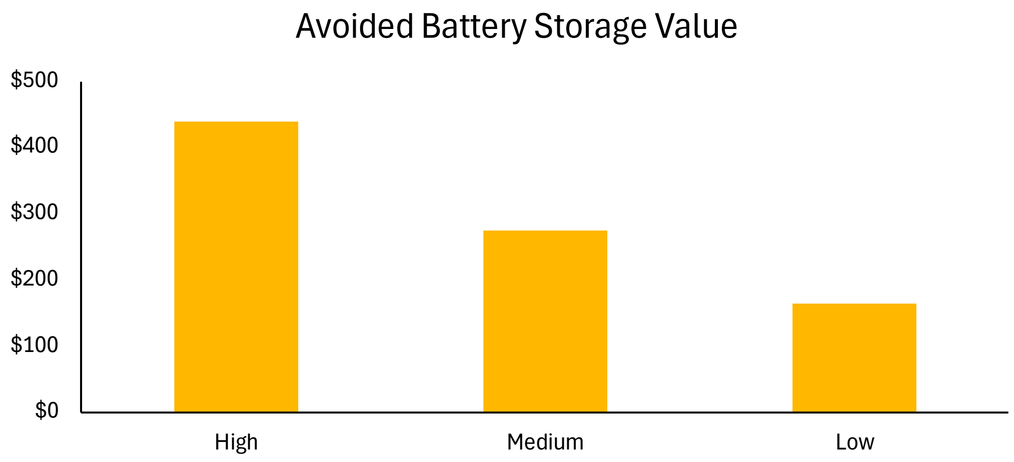
Bridge-to-Wires Scenario

EXAMPLE CALCULATIONS – Values are not intended to represent any specific real-world scenario

	Avoided Backup Diesel Generator	*Medium*	High	Medium	Low	Reference
1	Backup Generator Size (kW)	1000	1000	1000	1000	
	Operating Expenses					
2	Generator Rental Cost, including setup/breakdown ($ / year)	$100,000	$200,000	$100,000	$32,300	
3	Days of Usage per year	30	30	30	30	
4	Hours of Usage per day	8	8	8	8	
5	Fuel Cost ($/hour)*				$107	
6	Fuel Cost ($ / year)*				*$25,680*	*[3] * [4] * [5]*
7	Annual Operating Expenses ($ / year)	*$100,000*	*$ 200,000*	*$ 100,000*	*$ 57,980*	*[2] + [6]*
8	Backup Capacity Annualized Marginal Cost ($ / kW-year)	*$100*	*$ 200.00*	*$ 100.00*	*$ 57.98*	*[7] / [1]*

*For Medium and High Diesel Generator cost examples, the fuel cost is included within the rental cost for the generator





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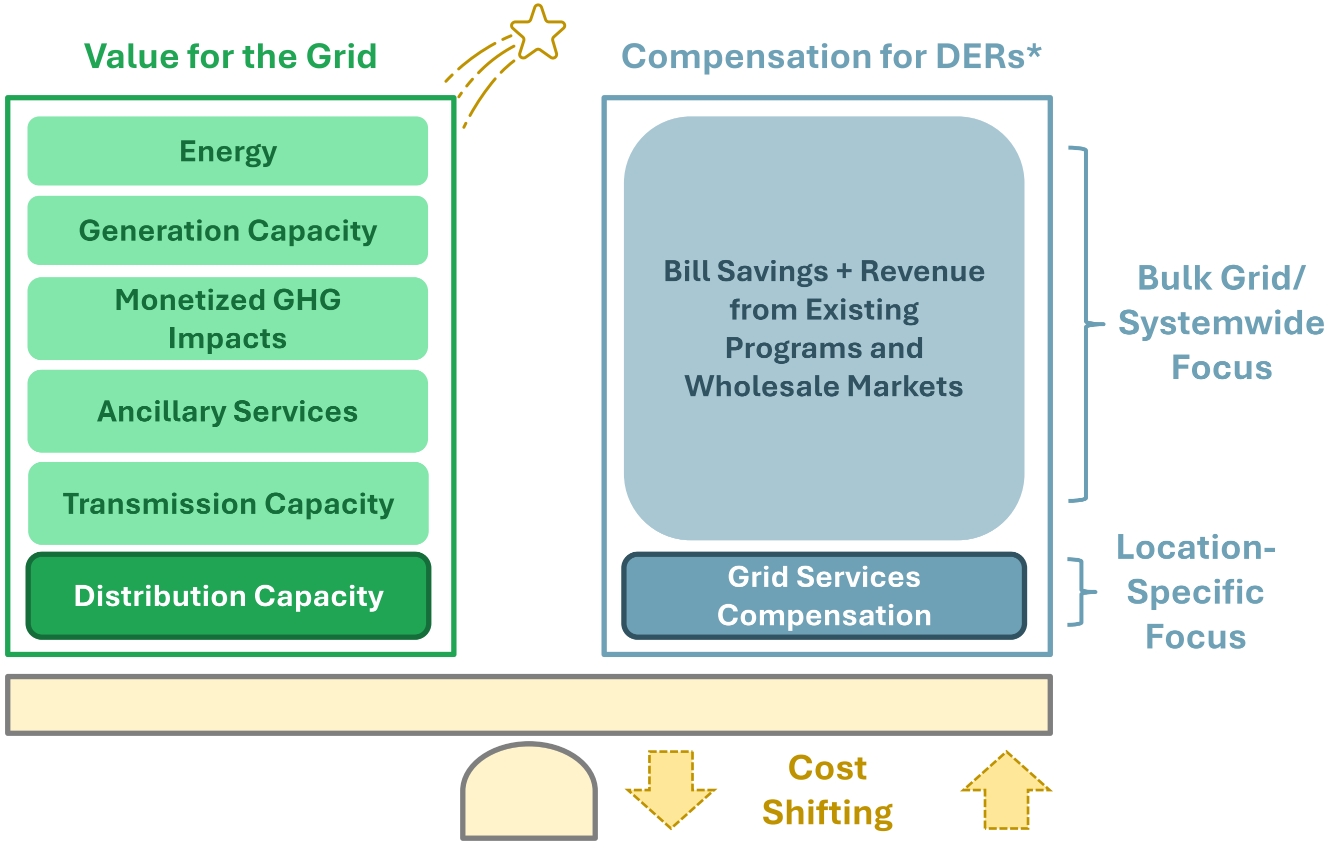
Guidelines for Compensation

Valuation provides a North Star for determining compensation

+ **Quantifying value provided by a resource helps determine funding available to pay for that resource without increasing costs**
  - This can ensure that impacts on ratepayers are positive or net neutral
  - If impacts are not neutral, this shift costs between ratepayers and DER participants
+ **While compensation does not need to equal the value provided, this should be a conscious decision**
  - When setting incentives to meet policy goals, it's important to understand the net cost to achieve those



Equity should always be considered here, as excess costs for incentives can increase energy burdens for all ratepayers, with a greater relative burden for low-income customers

Plus costs of administration

Benefits which impact the utility revenue requirement drive ratepayer savings and should set the ceiling for compensation

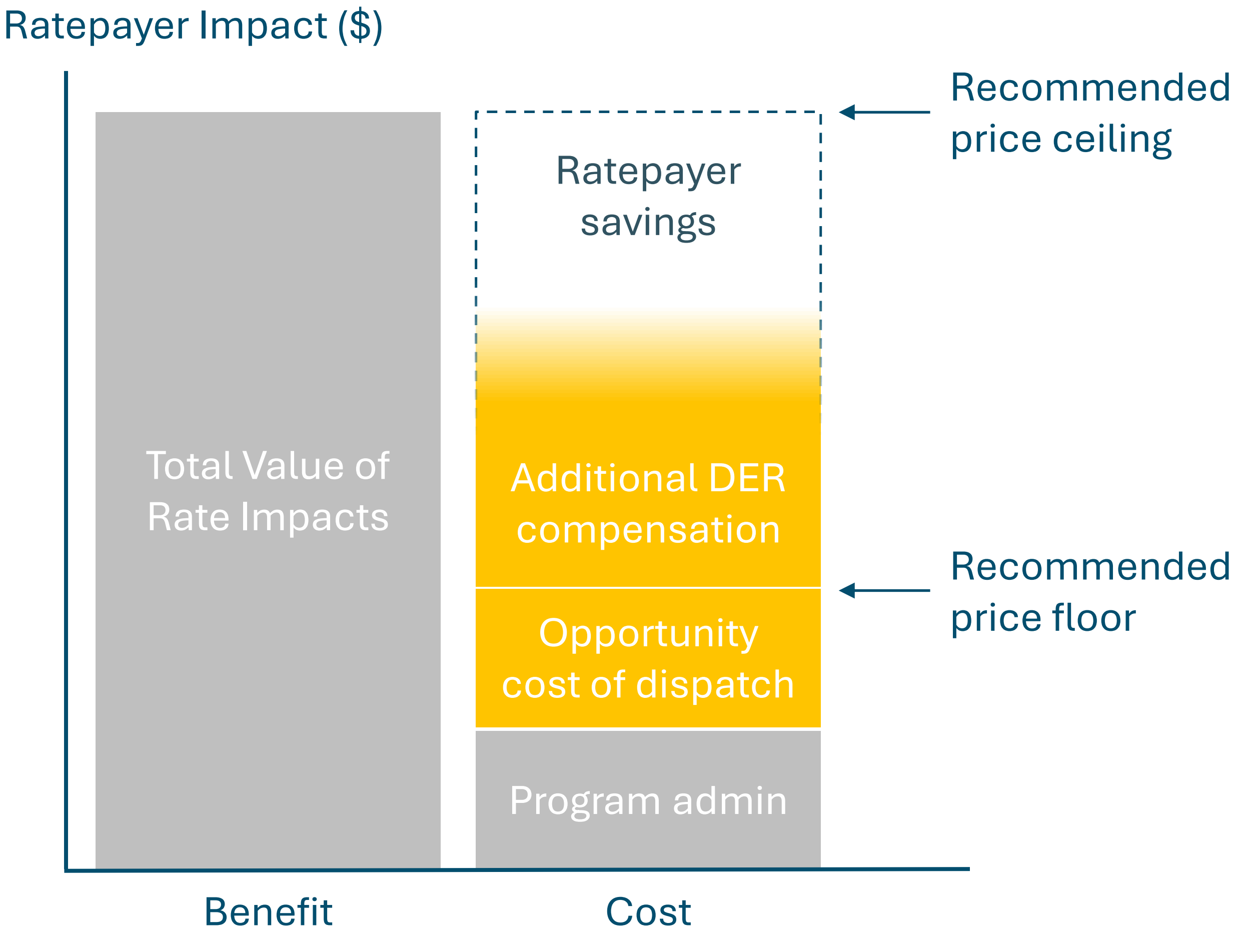
Capacity Constraint Scenario	Rate Impact Value Stream	Non-Rate Impact Value Stream
Investment Deferral	**Deferral Value** Value of Incremental Investment Optionality	**Environmental Justice Impacts**
Bridge-to-Wires	**Avoided Backup Diesel Generation** OR **Avoided Backup Storage**	**Environmental Justice Impacts** Value of Lost Load Improved Air Quality Avoided Degradation Load Growth Accommodation

Environmental Justice Impacts provide an avenue for further incorporating equity in Grid Services offerings

Greyed-out value streams are not recommended for direct inclusion in determining compensation at this time

To provide ratepayer savings, spend on Grid Services should be less than the total value to the grid but enough to encourage DER participation

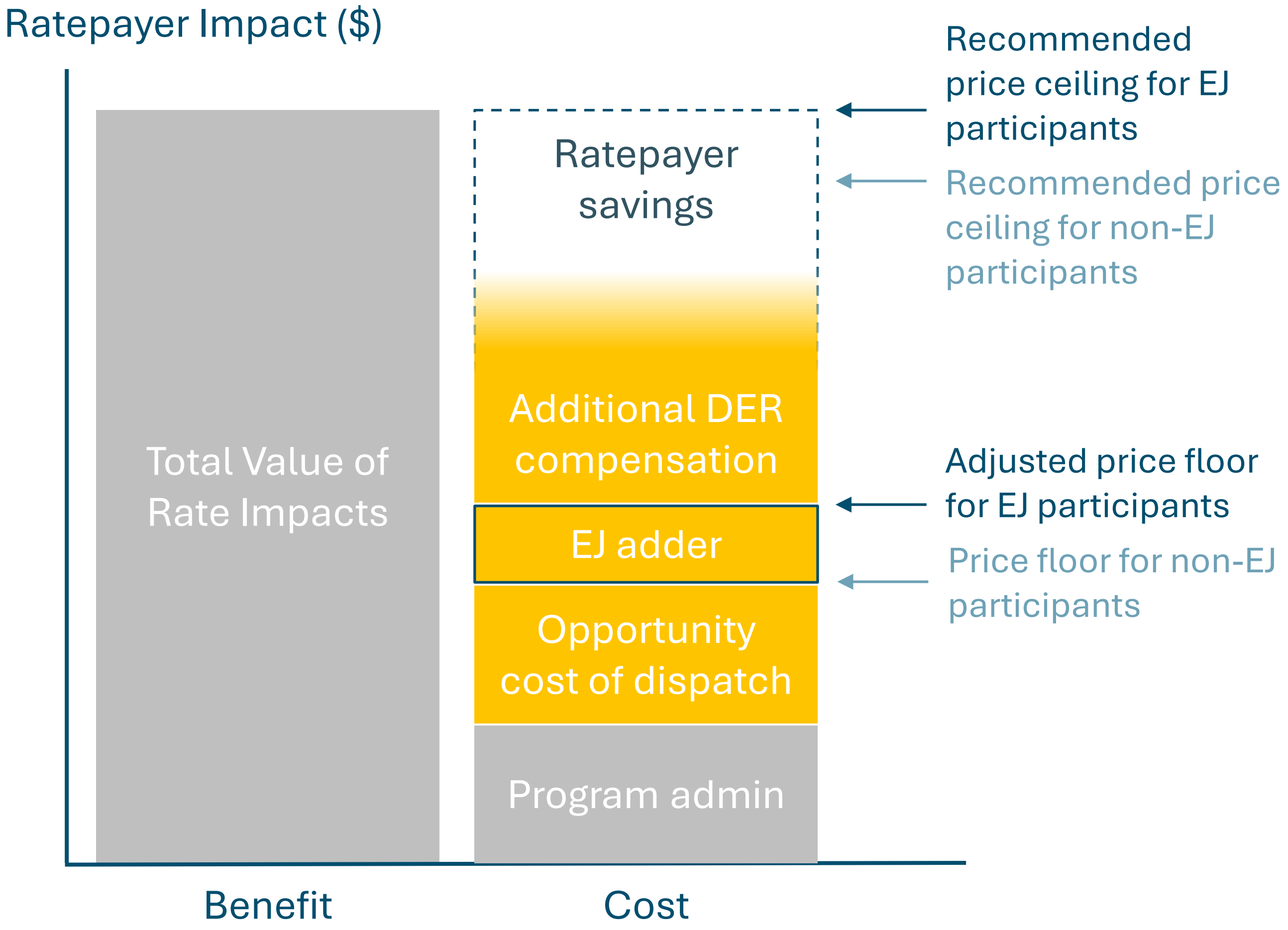
Recommended Compensation Floor and Ceiling Values



- **The recommended ceiling for compensation is the total value to the grid less administrative costs of Grid Services offerings**
- **The opportunity cost of DERs to dispatch sets an effective price floor for compensation**
  - Grid Services offerings need to make it appealing for DERs to participate
- **The difference between total benefits and total costs represents net ratepayer savings**
  - Ratepayer savings are greatest when DERs can provide high value and don't require much compensation to participate

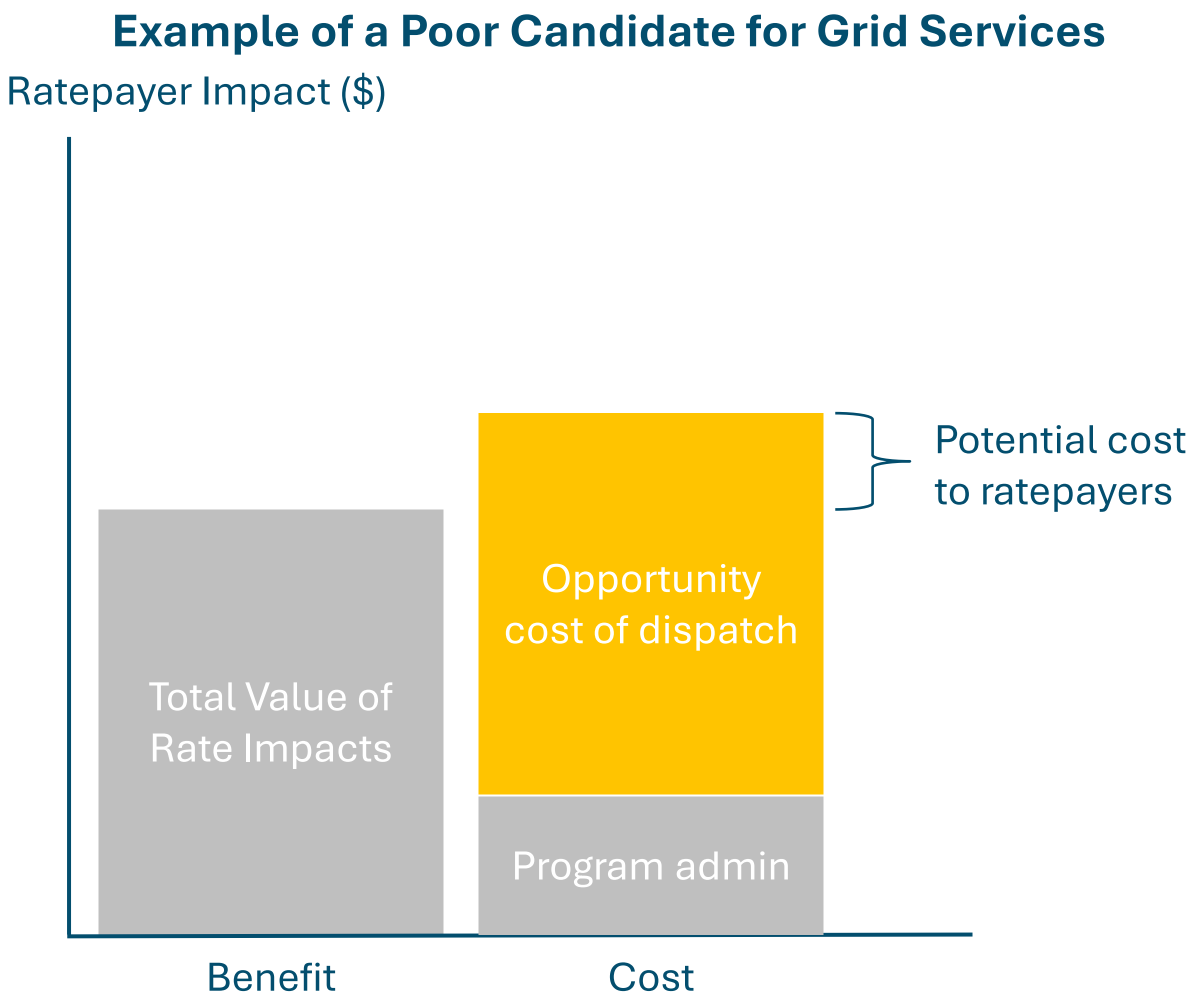
Compensation adders can be used to support EJ participation

Recommended Compensation Floor and Ceiling Values Incorporating EJ Adders



- **EJ adders reflect additional value as a form of *Non*-rate impacts**
  - So that EJ compensation stays within the ceiling set by rate impacts, the effective ceiling for non-EJ participants should be adjusted to equal to the total value of rate impacts minus the EJ adder
- **These adders can be simple multipliers or based on valuation of other non-rate impacts for environmental justice communities**
  - In the near-term, we recommend a mix of these, depending on the capacity constraint scenario

Where costs to support offerings would exceed the benefits, Grid Services should not be pursued as a solution



+ **In instances where administrative costs plus the price floor would exceed the value provided, it is inefficient to pay DERs for Grid Services**
  - The location-specific nature of distribution system needs means that while there may be significant Grid Services value in some areas, others will have none
+ **Utilities will want to target the highest value locations and avoid spending ratepayer dollars on offerings that come at a net cost**
  - A key goal of Grid Services is to recognize the difference between these and ensure efficient spending

Grid Services Implementation

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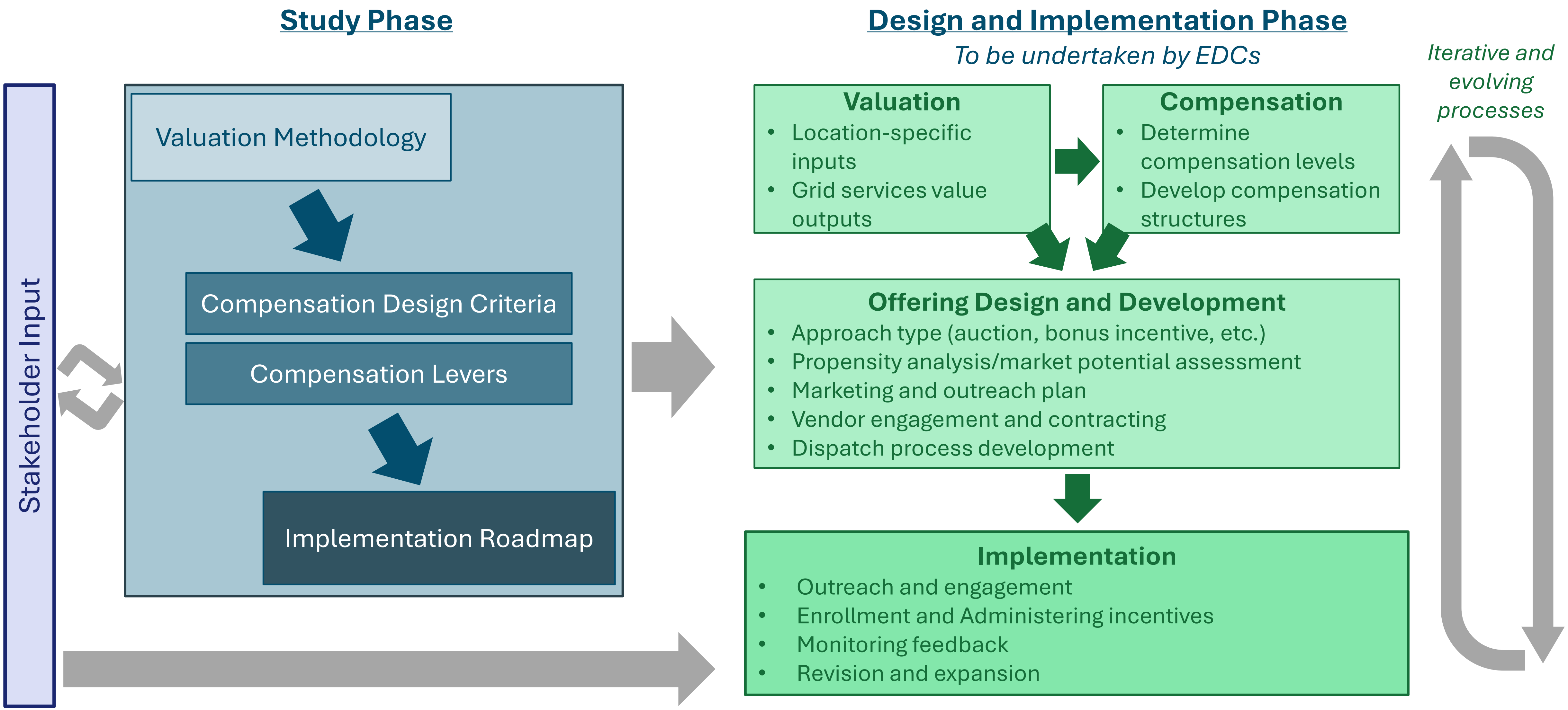
Bringing it all together



Grid Services Implementation Timeline

Implementation Timeline

Fall 2024 – Summer 2025: Study Phase
Build frameworks to guide EDC work

We Are Here

June 2025 – DPU Ruling on ESMPs

2025 - 2029: Bi-Annual ESMP Reports (Fall and Spring)
Updates and formal comments through utility bi-annual reporting process

2029: Public Filing
EDCs file updated plans with Department of Public Utilities

2030+ : Scaled Grid Services Programs
Grid services work continues

Late 2025 - 2026
EDCs test offerings in limited locations

2025 - 2029
Test increased use cases over time

Driving Questions

How can Grid Services benefit customers?

What are stakeholder priorities?

How can we trial offerings and implement effectively?

How did initial years of Grid Services go?

What can be improved?

What do scaled programs look like?

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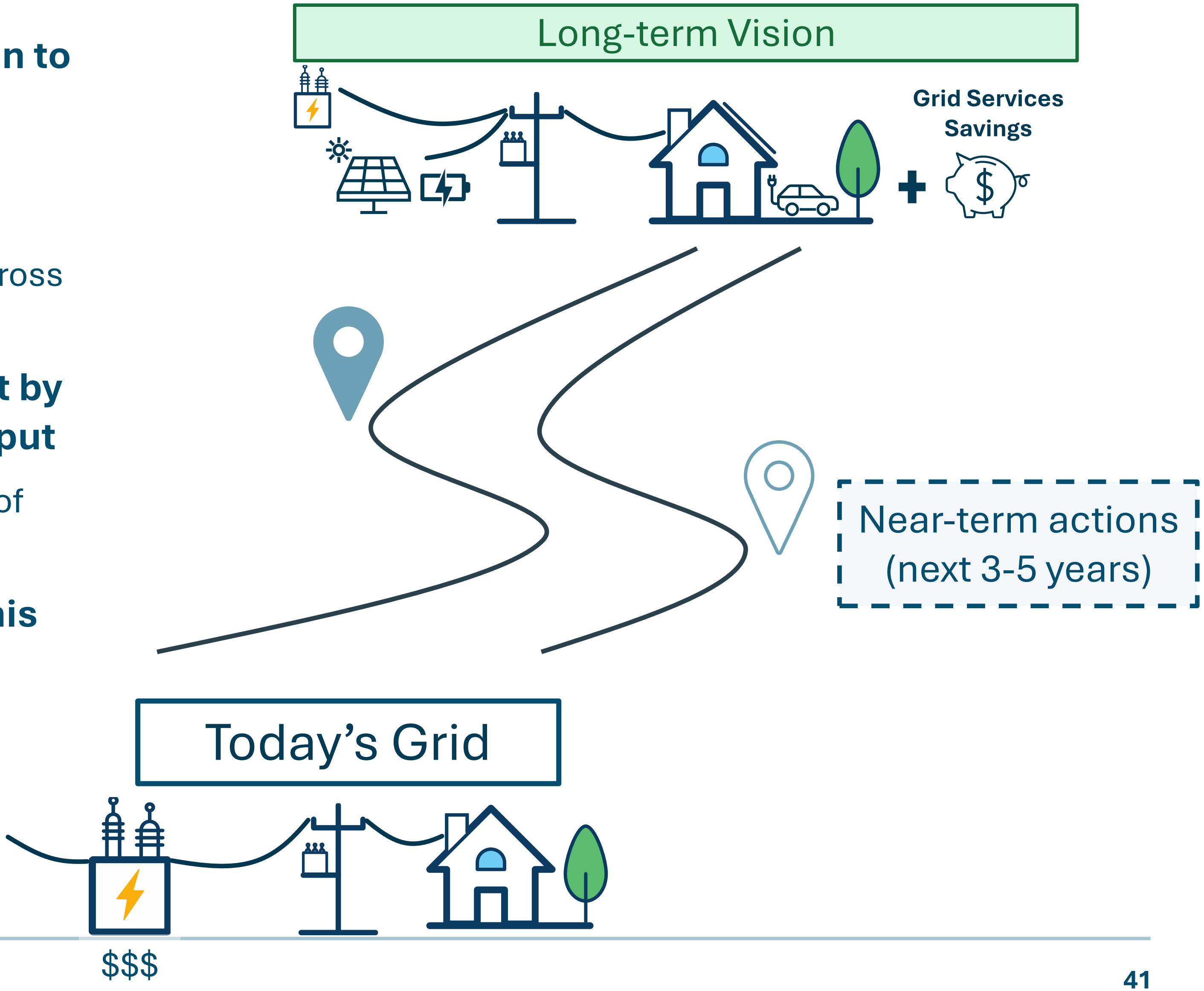
Near-Term Objectives

Actionable near-term objectives set us on the path to achieving long term ambitions

+ **As this study concludes, the EDCs will begin to test out grid services offerings**
    - Roll out timelines will vary, with National Grid targeting the first offerings this summer
    - Offerings may be intentionally differentiated across territories to explore a wider range of options
+ **These trial offerings will be informed in part by the results of this study and stakeholder input**
    - The trials in turn will serve as additional points of reference in pursuing the long-term vision
+ **Clear and attainable objectives can ease this near-term implementation and maximize benefits and learnings**



Near-term objectives prioritize gathering information and testing approaches to fulfill core goals

- Test and refine grid services offerings & implementation approaches
- Identify data and process requirements to take full advantage of Grid Services opportunities
- Understand DER market capabilities, needs, and appetite for grid services offerings
- Provide ratepayer savings via investment deferral
- Mitigate system risks in Bridge-to-Wires scenarios

Specific actions underpin the range of objectives

Near-term Objectives

- Test and refine grid services offerings
- Identify data and process requirements
- Understand DER capabilities and needs
- Provide ratepayer savings
- Mitigate system risks

Supporting Actions

+ Identify high-need areas of the distribution system and determine the value that DERs could provide in each
+ Refresh and refine valuation inputs and methods at specified intervals
+ Find and fill information gaps regarding system needs and availability of DERs in specific locations
+ Develop compensation mechanisms incorporating stakeholder input and study findings
+ Develop transparent processes for receiving and acting on stakeholder feedback
+ Create channels to educate community members about Grid Services offerings and impacts

Overcoming Implementation Challenges

The EDCs must overcome implementation challenges relating to technology limitations, forecasting visibility, and barriers to participation. These challenges will vary by location and based on the nature of the compensation mechanism

- **Technology Limitations and Enablement:** The EDCs will need to accelerate investments in technology platforms that enable visibility, coordination, and dispatch of DERs, and may require participants to adopt enabling technology
- **Forecasting Uncertainty and Visibility of Loads and DERs**: New systems and software tools can provide real-time visibility into DER behavior and load growth to improve localized planning and grid operations and allow for location-specific offerings
- **Addressing Barriers to Participation**:

Barrier	Potential Solutions
Steep learning curve to understand offerings	Simplicity, predictability, and customer-centric design, with transparency around location-specific incentives
Lack of trust between EJ communities and utilities	Built trust by recognizing historical inequities of energy systems and establishing relationships and responsive communication with community leaders and organizations
Affordability and cost shifting concerns	Ensure savings for ratepayers and provide simple educational materials describing how Grid Services are intended to benefit both participants and non-participants alike
Limited access to DERs due to high costs and split incentives for renters	Coordinate Grid Services offerings with programs designed to expand DER access. Grid Services offerings may not overcome this barrier alone but can be co-deployed with other incentives and initiatives, including recent actions to support renter access

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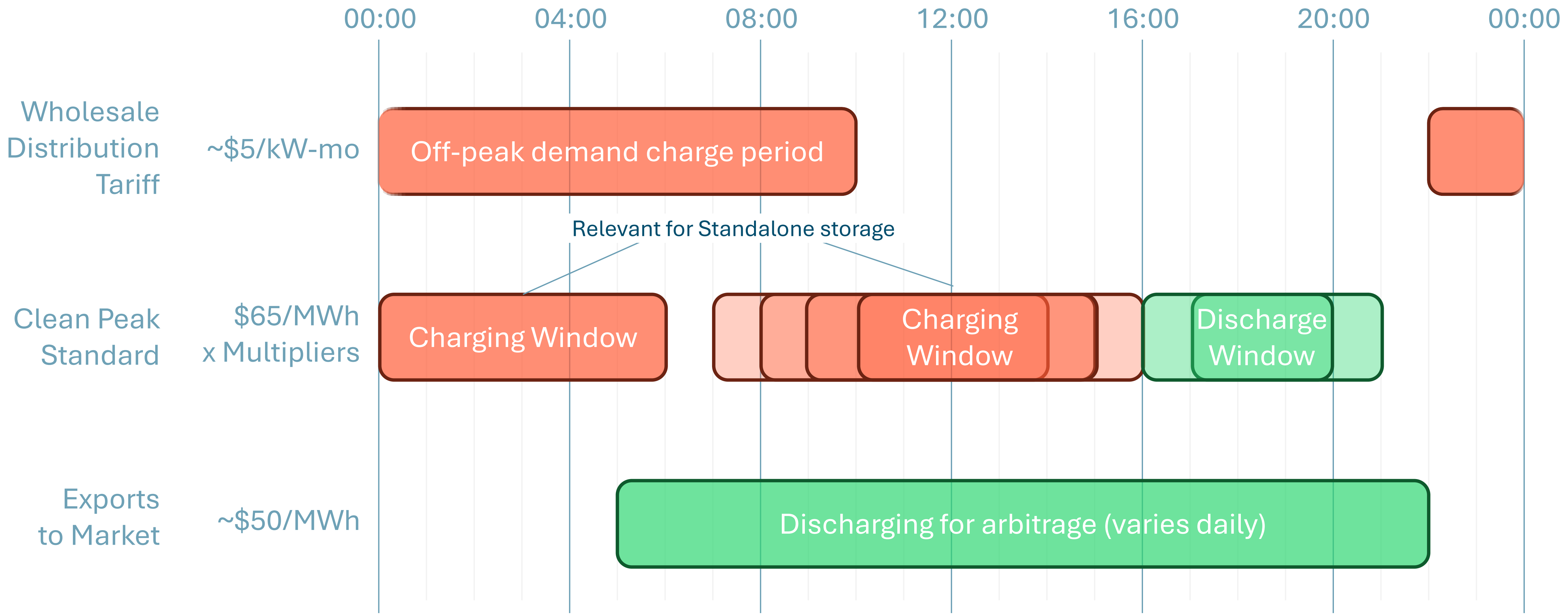
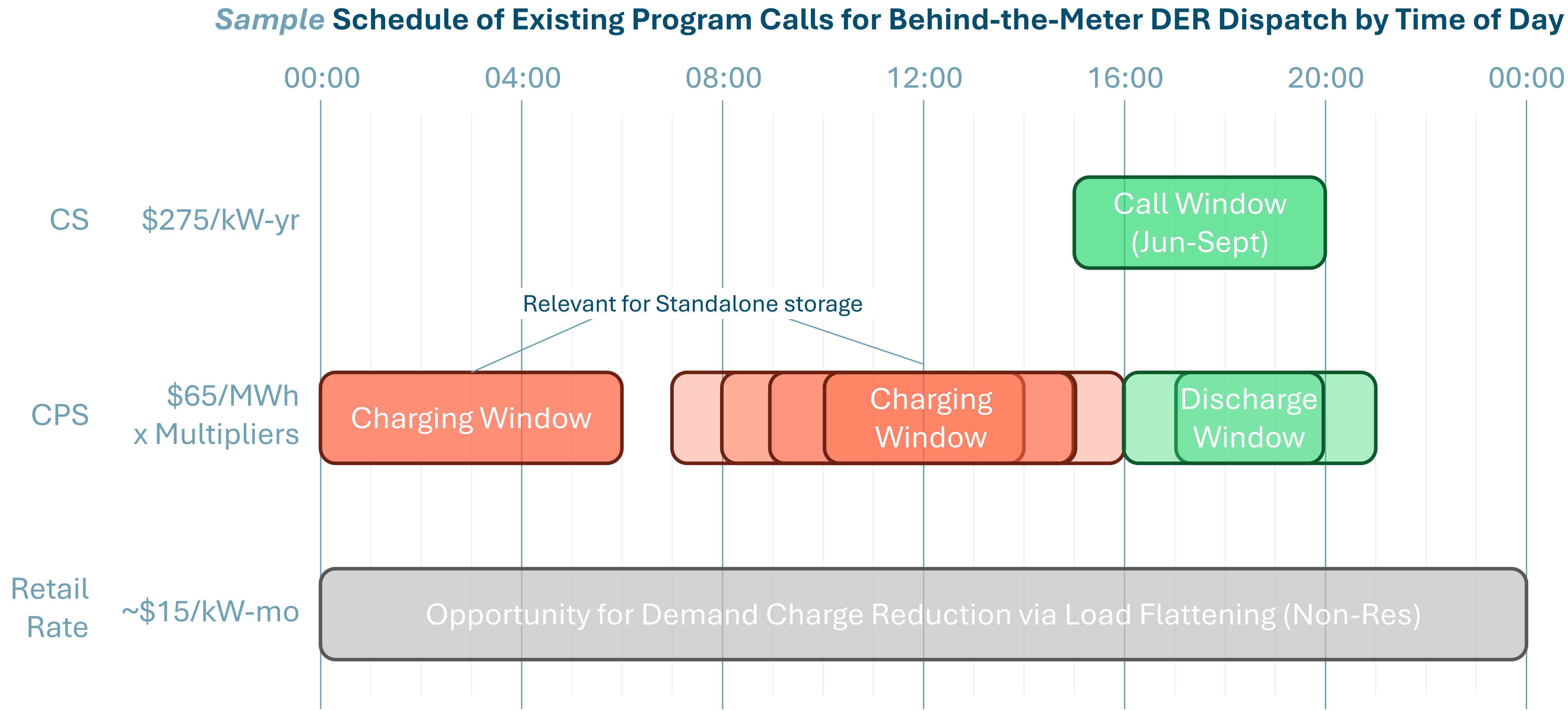
Interactions with Other DER Offerings

Grid Services offerings will join a range of Massachusetts programs calling on DERs to address varied grid needs at different times

Sample **Schedule of Existing Program Calls for Front-of-Meter DER Dispatch by Time of Day**



Available programs and calls will vary for different types of customers and DER owners



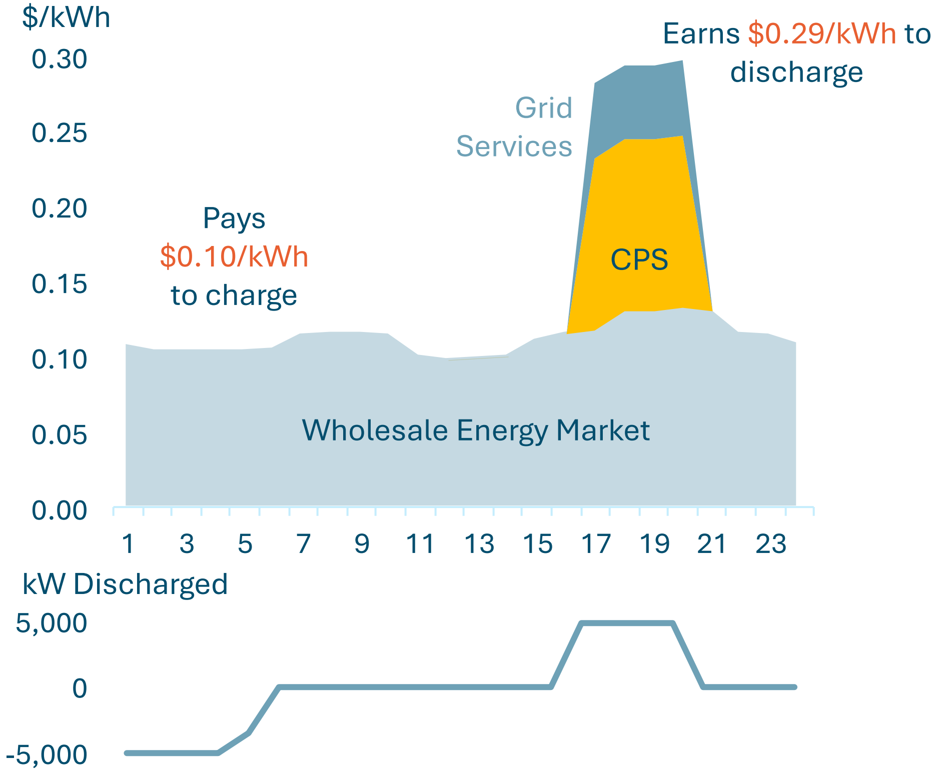
The alignment of Grid Services needs with bulk system needs will dictate the timing and opportunity cost of dispatch

Front-of-the-Meter DER dispatch when Grid Services calls are vs. aren’t aligned with bulk grid signals

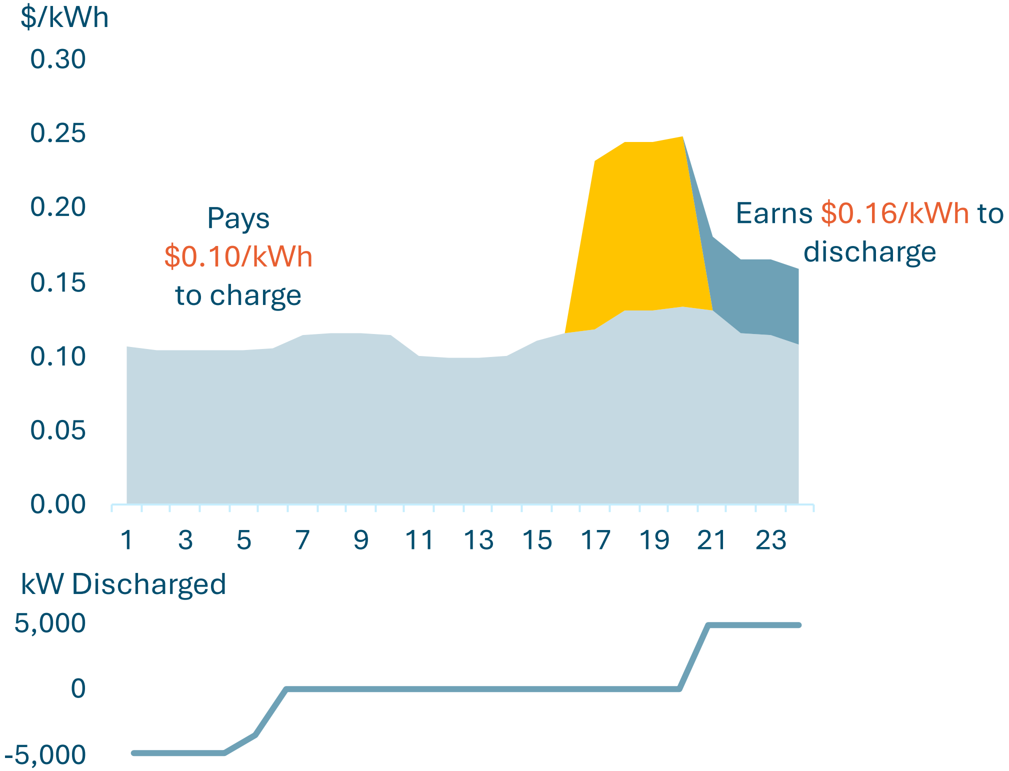
Price signals by source and hour of day

Dispatch behavior to meet Grid Services need

Grid Services Call at 5pm **(Aligned w CPS)**



Grid Services Call at 8pm **(Not Aligned w CPS)**



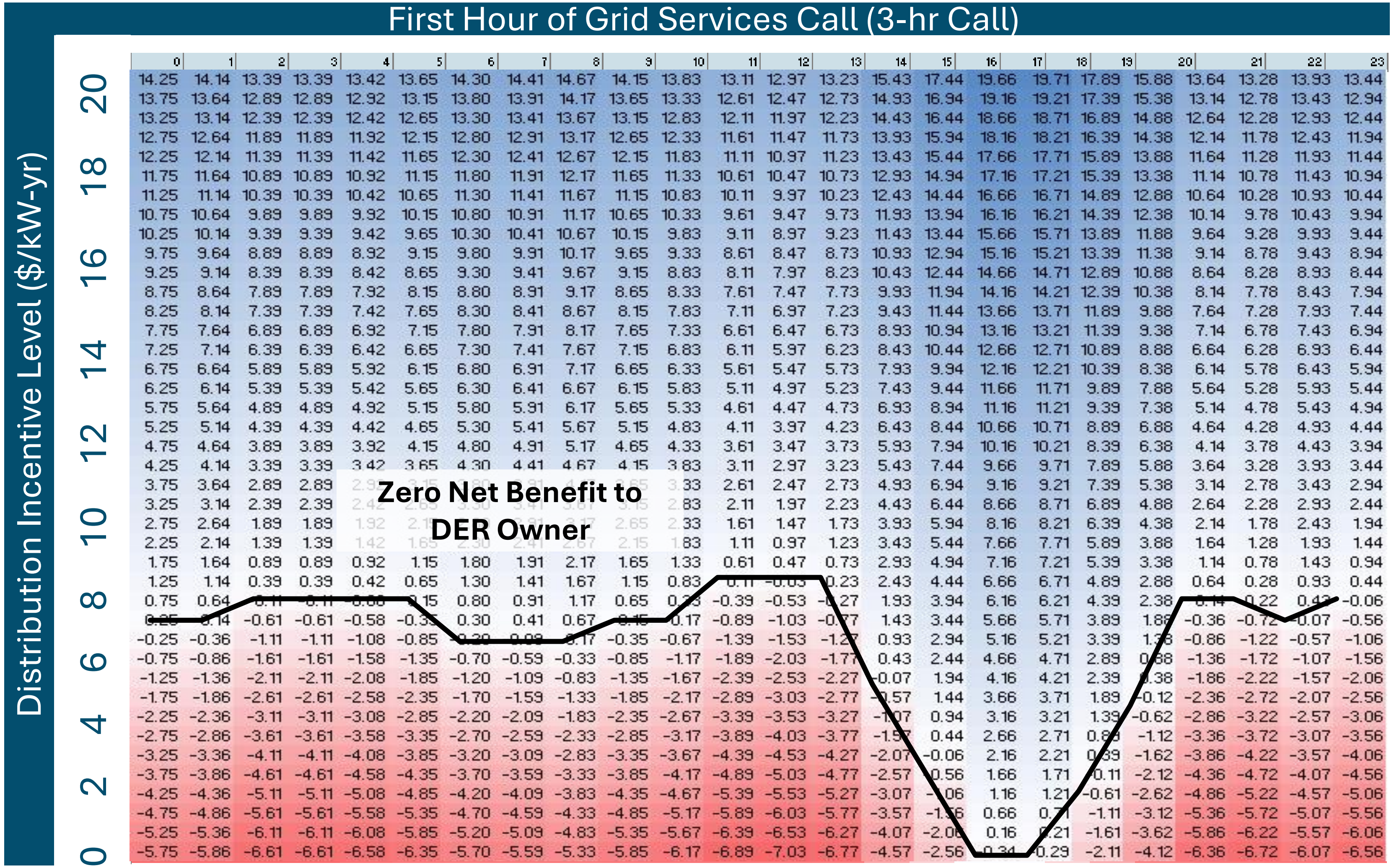
When local and bulk grid needs **are** aligned, it isn’t necessary to pay extra for behavior DERs are already incentivized to pursue

When needs are **not** aligned, Grid Services would need to pay more to elicit participation (if it’s cost effective to do so)

Different offerings should be coordinated to pay for the optimal behavior and not compete for the same resources

Example: Annual Incremental Net Benefit to DER Owner (Summer)

- **The example modeled 4-hr FTM storage system earns $105/kW-year prior to any grid services revenue**
- **Chart shows the difference in revenue if the system is forced to dispatch in response to the distribution incentive, at various Dx incentive prices and various hours of the day**
  - Wholesale market prices range from a low of 0.02$/MWh in the middle of the day and high of $0.13/MWh in the evening peak
  - A more volatile market with more renewables would increase the opportunity cost of discharging in non-evening hours
- **30 distribution calls, each lasting 3 hours, occurring in the winter**



0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
14.25	14.14	13.39	13.39	13.42	13.65	14.30	14.41	14.67	14.15	13.83	13.11	12.97	13.23	15.43	17.44	19.66	19.71	17.89	15.88	13.64	13.28	13.93	13.44
13.75	13.64	12.89	12.89	12.92	13.15	13.80	13.91	14.17	13.65	13.33	12.61	12.47	12.73	14.93	16.94	19.16	19.21	17.39	15.38	13.14	12.78	13.43	12.94
13.25	13.14	12.39	12.39	12.42	12.65	13.30	13.41	13.67	13.15	12.83	12.11	11.97	12.23	14.43	16.44	18.66	18.71	16.89	14.88	12.64	12.28	12.93	12.44
12.75	12.64	11.89	11.89	11.92	12.15	12.80	12.91	13.17	12.65	12.33	11.61	11.47	11.73	13.93	15.94	18.16	18.21	16.39	14.38	12.14	11.78	12.43	11.94
12.25	12.14	11.39	11.39	11.42	11.65	12.30	12.41	12.67	12.15	11.83	11.11	10.97	11.23	13.43	15.44	17.66	17.71	15.89	13.88	11.64	11.28	11.93	11.44
11.75	11.64	10.89	10.89	10.92	11.15	11.80	11.91	12.17	11.65	11.33	10.61	10.47	10.73	12.93	14.94	17.16	17.21	15.39	13.38	11.14	10.78	11.43	10.94
11.25	11.14	10.39	10.39	10.42	10.65	11.30	11.41	11.67	11.15	10.83	10.11	9.97	10.23	12.43	14.44	16.66	16.71	14.89	12.88	10.64	10.28	10.93	10.44
10.75	10.64	9.89	9.89	9.92	10.15	10.80	10.91	11.17	10.65	10.33	9.61	9.47	9.73	11.93	13.94	16.16	16.21	14.39	12.38	10.14	9.78	10.43	9.94
10.25	10.14	9.39	9.39	9.42	9.65	10.30	10.41	10.67	10.15	9.83	9.11	8.97	9.23	11.43	13.44	15.66	15.71	13.89	11.88	9.64	9.28	9.93	9.44
9.75	9.64	8.89	8.89	8.92	9.15	9.80	9.91	10.17	9.65	9.33	8.61	8.47	8.73	10.93	12.94	15.16	15.21	13.39	11.38	9.14	8.78	9.43	8.94
9.25	9.14	8.39	8.39	8.42	8.65	9.30	9.41	9.67	9.15	8.83	8.11	7.97	8.23	10.43	12.44	14.66	14.71	12.89	10.88	8.64	8.28	8.93	8.44
8.75	8.64	7.89	7.89	7.92	8.15	8.80	8.91	9.17	8.65	8.33	7.61	7.47	7.73	9.93	11.94	14.16	14.21	12.39	10.38	8.14	7.78	8.43	7.94
8.25	8.14	7.39	7.39	7.42	7.65	8.30	8.41	8.67	8.15	7.83	7.11	6.97	7.23	9.43	11.44	13.66	13.71	11.89	9.88	7.64	7.28	7.93	7.44
7.75	7.64	6.89	6.89	6.92	7.15	7.80	7.91	8.17	7.65	7.33	6.61	6.47	6.73	8.93	10.94	13.16	13.21	11.39	9.38	7.14	6.78	7.43	6.94
7.25	7.14	6.39	6.39	6.42	6.65	7.30	7.41	7.67	7.15	6.83	6.11	5.97	6.23	8.43	10.44	12.66	12.71	10.89	8.88	6.64	6.28	6.93	6.44
6.75	6.64	5.89	5.89	5.92	6.15	6.80	6.91	7.17	6.65	6.33	5.61	5.47	5.73	7.93	9.94	12.16	12.21	10.39	8.38	6.14	5.78	6.43	5.94
6.25	6.14	5.39	5.39	5.42	5.65	6.30	6.41	6.67	6.15	5.83	5.11	4.97	5.23	7.43	9.44	11.66	11.71	9.89	7.88	5.64	5.28	5.93	5.44
5.75	5.64	4.89	4.89	4.92	5.15	5.80	5.91	6.17	5.65	5.33	4.61	4.47	4.73	6.93	8.94	11.16	11.21	9.39	7.38	5.14	4.78	5.43	4.94
5.25	5.14	4.39	4.39	4.42	4.65	5.30	5.41	5.67	5.15	4.83	4.11	3.97	4.23	6.43	8.44	10.66	10.71	8.89	6.88	4.64	4.28	4.93	4.44
4.75	4.64	3.89	3.89	3.92	4.15	4.80	4.91	5.17	4.65	4.33	3.61	3.47	3.73	5.93	7.94	10.16	10.21	8.39	6.38	4.14	3.78	4.43	3.94
4.25	4.14	3.39	3.39	3.42	3.65	4.30	4.41	4.67	4.15	3.83	3.11	2.97	3.23	5.43	7.44	9.66	9.71	7.89	5.88	3.64	3.28	3.93	3.44
3.75	3.64	2.89	2.89	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.33	2.61	2.47	2.73	4.93	6.94	9.16	9.21	7.39	5.38	3.14	2.78	3.43	2.94
3.25	3.14	2.39	2.39	2.42	2.65	3.30	3.41	3.67	3.15	2.83	2.11	1.97	2.23	4.43	6.44	8.66	8.71	6.89	4.88	2.64	2.28	2.93	2.44
2.75	2.64	1.89	1.89	1.92	[illegible]	[illegible]	[illegible]	[illegible]	2.65	2.33	1.61	1.47	1.73	3.93	5.94	8.16	8.21	6.39	4.38	2.14	1.78	2.43	1.94
2.25	2.14	1.39	1.39	1.42	1.65	2.30	2.41	2.67	2.15	1.83	1.11	0.97	1.23	3.43	5.44	7.66	7.71	5.89	3.88	1.64	1.28	1.93	1.44
1.75	1.64	0.89	0.89	0.92	1.15	1.80	1.91	2.17	1.65	1.33	0.61	0.47	0.73	2.93	4.94	7.16	7.21	5.39	3.38	1.14	0.78	1.43	0.94
1.25	1.14	0.39	0.39	0.42	0.65	1.30	1.41	1.67	1.15	0.83	[illegible]	[illegible]	0.23	2.43	4.44	6.66	6.71	4.89	2.88	0.64	0.28	0.93	0.44
0.75	0.64	[illegible]	[illegible]	[illegible]	[illegible]	0.80	0.91	1.17	0.65	[illegible]	-0.39	-0.53	[illegible]	1.93	3.94	6.16	6.21	4.39	2.38	[illegible]	[illegible]	[illegible]	-0.06
[illegible]	[illegible]	-0.61	-0.61	-0.58	[illegible]	0.30	0.41	0.67	[illegible]	[illegible]	-0.89	-1.03	[illegible]	1.43	3.44	5.66	5.71	3.89	[illegible]	-0.36	-0.72	[illegible]	-0.56
-0.25	-0.36	-1.11	-1.11	-1.08	-0.85	[illegible]	[illegible]	[illegible]	-0.35	-0.67	-1.39	-1.53	[illegible]	0.93	2.94	5.16	5.21	3.39	[illegible]	-0.86	-1.22	-0.57	-1.06
-0.75	-0.86	-1.61	-1.61	-1.58	-1.35	-0.70	-0.59	-0.33	-0.85	-1.17	-1.89	-2.03	-1.77	0.43	2.44	4.66	4.71	2.89	[illegible]	-1.36	-1.72	-1.07	-1.56
-1.25	-1.36	-2.11	-2.11	-2.08	-1.85	-1.20	-1.09	-0.83	-1.35	-1.67	-2.39	-2.53	-2.27	-0.07	1.94	4.16	4.21	2.39	[illegible]	-1.86	-2.22	-1.57	-2.06
-1.75	-1.86	-2.61	-2.61	-2.58	-2.35	-1.70	-1.59	-1.33	-1.85	-2.17	-2.89	-3.03	-2.77	[illegible]	1.44	3.66	3.71	1.89	-0.12	-2.36	-2.72	-2.07	-2.56
-2.25	-2.36	-3.11	-3.11	-3.08	-2.85	-2.20	-2.09	-1.83	-2.35	-2.67	-3.39	-3.53	-3.27	[illegible]	0.94	3.16	3.21	1.39	-0.62	-2.86	-3.22	-2.57	-3.06
-2.75	-2.86	-3.61	-3.61	-3.58	-3.35	-2.70	-2.59	-2.33	-2.85	-3.17	-3.89	-4.03	-3.77	[illegible]	0.44	2.66	2.71	[illegible]	-1.12	-3.36	-3.72	-3.07	-3.56
-3.25	-3.36	-4.11	-4.11	-4.08	-3.85	-3.20	-3.09	-2.83	-3.35	-3.67	-4.39	-4.53	-4.27	-2.07	-0.06	2.16	2.21	[illegible]	-1.62	-3.86	-4.22	-3.57	-4.06
-3.75	-3.86	-4.61	-4.61	-4.58	-4.35	-3.70	-3.59	-3.33	-3.85	-4.17	-4.89	-5.03	-4.77	-2.57	[illegible]	1.66	1.71	[illegible]	-2.12	-4.36	-4.72	-4.07	-4.56
-4.25	-4.36	-5.11	-5.11	-5.08	-4.85	-4.20	-4.09	-3.83	-4.35	-4.67	-5.39	-5.53	-5.27	-3.07	[illegible]	1.16	1.21	-0.61	-2.62	-4.86	-5.22	-4.57	-5.06
-4.75	-4.86	-5.61	-5.61	-5.58	-5.35	-4.70	-4.59	-4.33	-4.85	-5.17	-5.89	-6.03	-5.77	-3.57	[illegible]	0.66	[illegible]	-1.11	-3.12	-5.36	-5.72	-5.07	-5.56
-5.25	-5.36	-6.11	-6.11	-6.08	-5.85	-5.20	-5.09	-4.83	-5.35	-5.67	-6.39	-6.53	-6.27	-4.07	[illegible]	0.16	[illegible]	-1.61	-3.62	-5.86	-6.22	-5.57	-6.06
-5.75	-5.86	-6.61	-6.61	-6.58	-6.35	-5.70	-5.59	-5.33	-5.85	-6.17	-6.89	-7.03	-6.77	-4.57	-2.56	[illegible]	[illegible]	-2.11	-4.12	-6.36	-6.72	-6.07	-6.56

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Developing Compensation Mechanisms

Individual offerings can be developed based on a set of compensation components, which can act as levers to pull

Compensation Component	Scale
Tenor – length of any applicable contract terms	Multi-year — 1-hour
Control – What level of control / influence would the utility have on participant behavior?	
Activation – When is specific participant behavior scheduled?	
Availability – When is availability agreed upon relative to the grid need?	
Allocation – how participating DERs may be selected	
Payment structure – relative balance between reservation/availability and activation/performance payments (payment basis + performance)	Reservation - Set payments to all participants ($) — Performance - Issued for successful response ($/kW)

These components are a modified set of those presented in the 2024 Baringa Value of Distributed Energy Resources for Distribution System Grid Services report.

- Additional components such as Volume and Price are critical and can be determined by the localized capacity need and value provided to the grid
- Policymakers must also consider how Grid Services may stack with other offerings to ensure that they are complementary and do not double-pay for benefits

Each compensation lever presents trade-offs, and choices made in design may have implications for other levers

Compensation Component	Scale		
Tenor – length of any applicable contract terms	Multi-year	⟷	1-hour
Control – What level of control / influence would the utility have on participant behavior?	Natural behavior	⟷	Direct utility control
Activation – When is specific participant behavior scheduled?	At time of initial agreement	⟷	Real-time load-following
Availability – When is availability agreed upon relative to the grid need?	Multiple years ahead of need	⟷	Day-ahead / rolling enrollment
Allocation – how participating DERs may be selected	Self-enrollment – First come, first serve	⟷	Utility selects bids based on need
Payment structure – relative balance between reservation/availability and activation/performance payments (payment basis + performance)	Reservation - Set payments to all participants ($)	⟷	Performance - Issued for successful response ($/kW)

Example – Easy Enrollment Offering

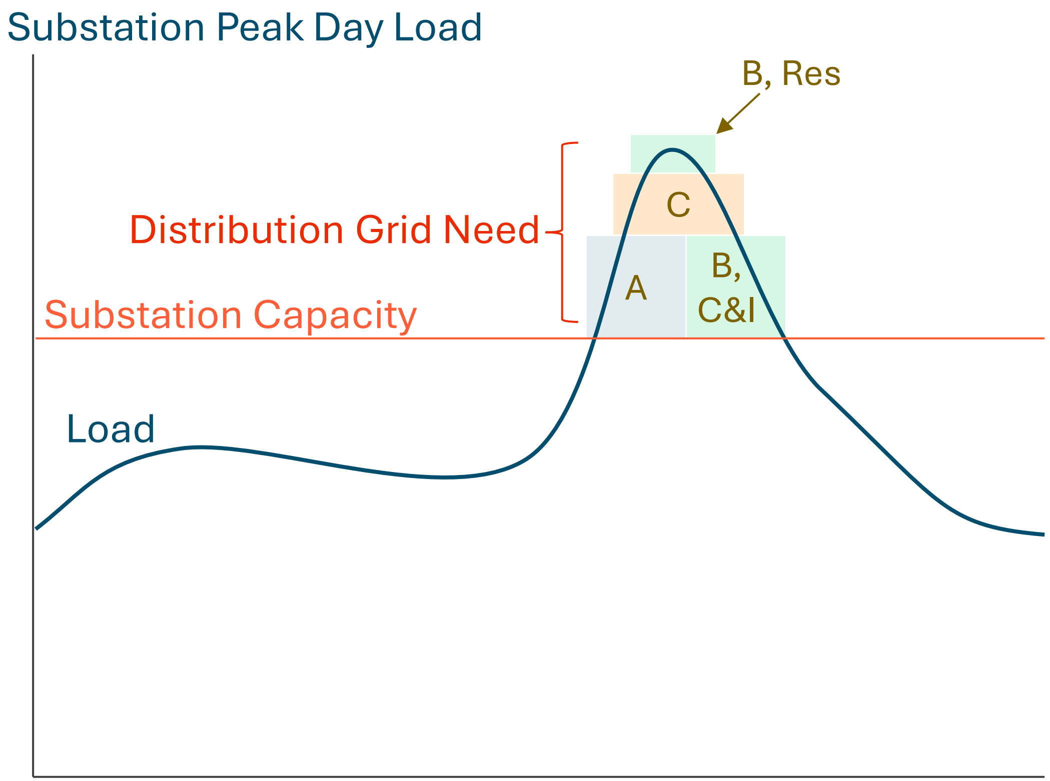
Example Selection

Direction of offering as Grid Services evolve

Compensation Component	Scale	
Tenor – length of any applicable contract terms	Multi-year	1-hour
Control – What level of control / influence would the utility have on participant behavior?	Natural behavior	Direct utility control
Activation – When is specific participant behavior scheduled?	At time of initial agreement	Real-time load-following
Availability – When is availability agreed upon relative to the grid need?	Multiple years ahead of need	Day-ahead / rolling enrollment
Allocation – how participating DERs may be selected	Self-enrollment – First come, first serve	Utility selects bids based on need
Payment structure – relative balance between reservation/availability and activation/performance payments (payment basis + performance)	Reservation - Set payments to all participants ($)	Performance - Issued for successful response ($/kW)

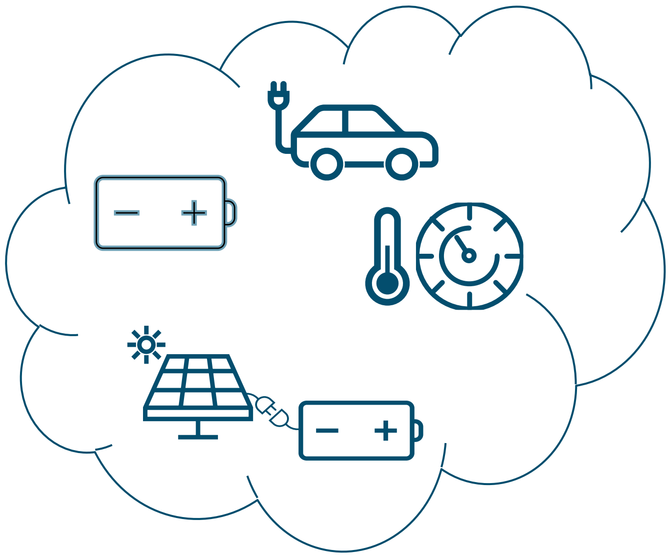
Utilities should implement a variety of complementary Grid Services offerings to appeal to a wide range of customers and address grid needs

Utility Planner's Perspective



Customer's Perspective

Customer/ DER Type	Grid Services Offerings	Potential DER Participants*
Residential	Offering A	
Residential	Offering B	
Commercial & Industrial	Offering B	
Front of the Meter	Offering C	



*Eligible DERs shown are a non-exhaustive sample for illustration only

Long-Term Evolution of Grid Services

Grid Services offerings must grow and adapt over time to achieve policy goals

Valuation

- **React to Changes in Value Over Time:** What should be the frequency of updates to the valuation of grid services?
- **Explore and Expand Value Streams:** Are there additional value streams that should be included future offerings? How can these be quantified and proven out?
- **Evaluate Cost Shifts:** How can we verify and ensure that the grid services offerings create ratepayer savings? Is the program unfairly advantaging or burdening customers?

Compensation

- **Refine Compensation Structure:** Is compensation providing sufficient signals in the right locations to alleviate local constraints?
- **Facilitate Participation:** Is compensation driving participation sufficient to meet program goals? Can compensation structures be improved to facilitate greater participation and DER deployment?
- **Deliver Value to EJ Populations:** Are compensation structures sharing benefits and facilitating participation in EJ populations?

Implementation

- **Monitor for Success:** How can we evaluate reliability of response? Are local grid constraints relieved? Is the program providing savings and enabling electrification?
- **Improve Education:** Is the program well understood? How can the EDCs inform customers on the benefits of grid services and participation?
- **Build Trust with Communities:** How can utilities and aggregators engage with communities in a supportive manner? How can they demonstrate that they are worthy of trust?

Milestones for Updating Offerings

Grid Services offerings should evolve over time alongside changes in the distribution grid needs and capabilities and in response to learnings from implementation

- **Project-by-Project Updates:** Each time a new Grid Services need is identified, and offering is implemented, grid planners should review and update inputs to the valuation calculation to determine an appropriate compensation ceiling
- **Updates to Valuation Methodology:** The valuation methodology should be revisited on a regular basis to determine whether approaches can be improved or different categories of costs or benefits should be quantified to inform Grid Services value
- **Improvements to Distribution System Forecasting**: Grid Services offerings should take advantage of advances in distribution forecasting which support scenario-based planning and improved granularity and accuracy. This will allow planners to get ahead of Bridge-to-Wires scenarios and better leverage deferral opportunities.
- **Updates to Compensation Mechanisms**: The EDCs should use experience from each successive Grid Services use case to begin to shape future compensation decisions and eventually standardize a selection of offerings. In the long-term, Grid Services and other DER incentives should be harmonized into holistic offerings that encourage optimal DER utilization across both local and bulk grid needs.

Study Resources

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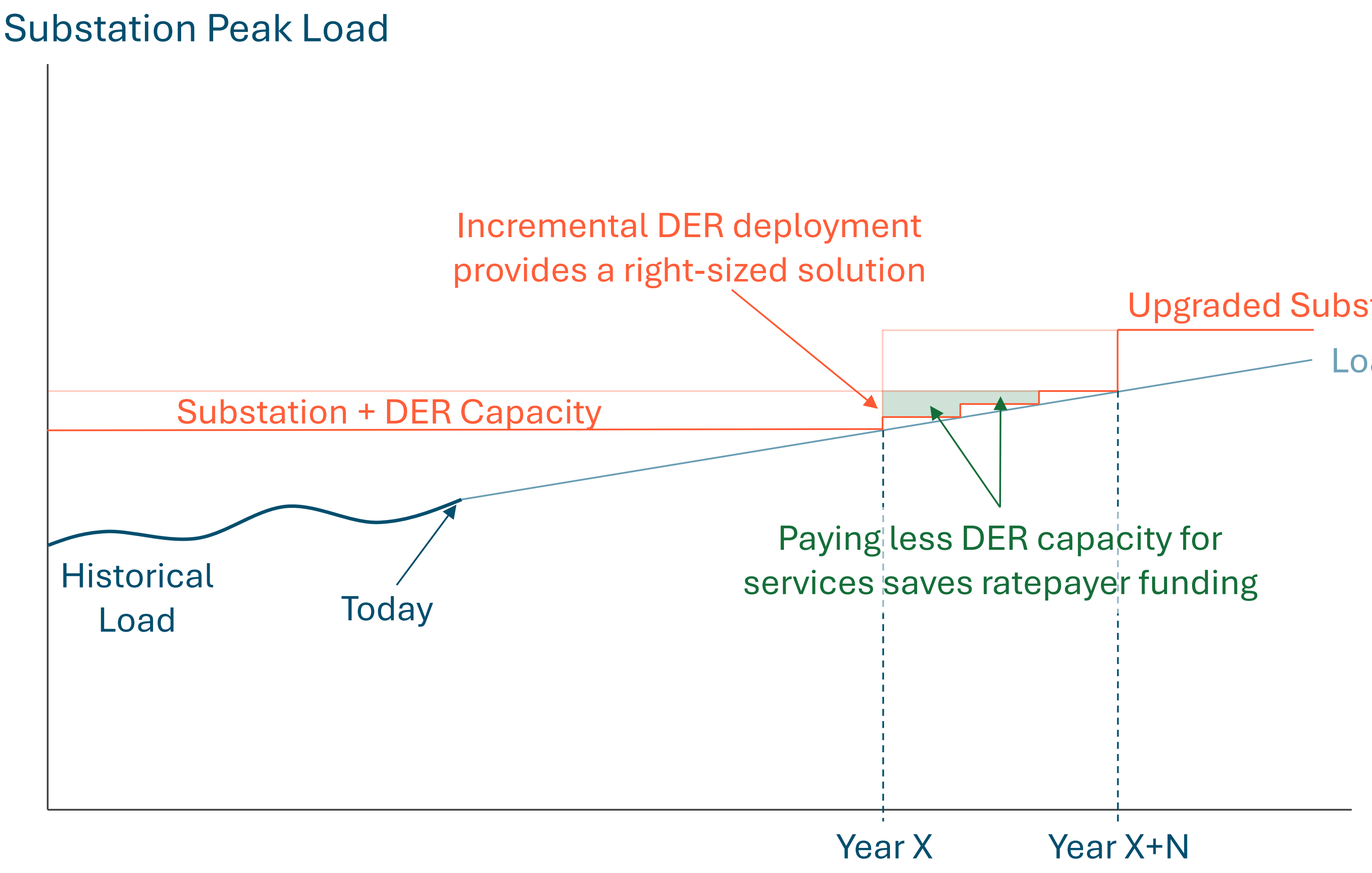
Further Materials and Communication

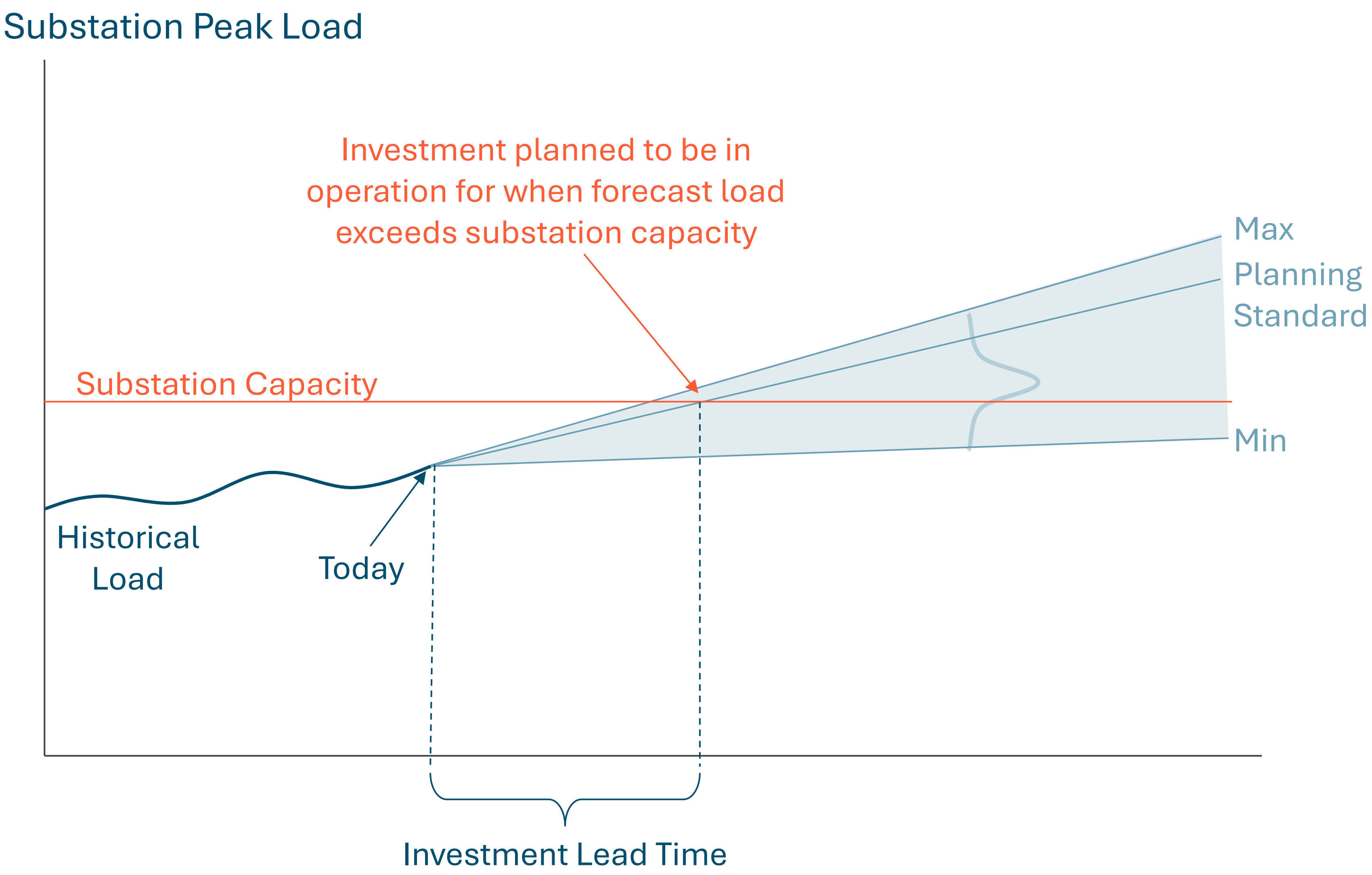
+ **The full written report, workshop session slides, and recordings can be found on the MassCEC website:**
    - https://www.masscec.com/grid-modernization-and-infrastructure-planning/grid-services-study
    - This site is the home for general information about the study, including stakeholder presentations and a primer for this workshop series
+ **Please send questions or feedback to:**
    - Grid@masscec.com

Appendix – Incremental Investment and Optionality Value

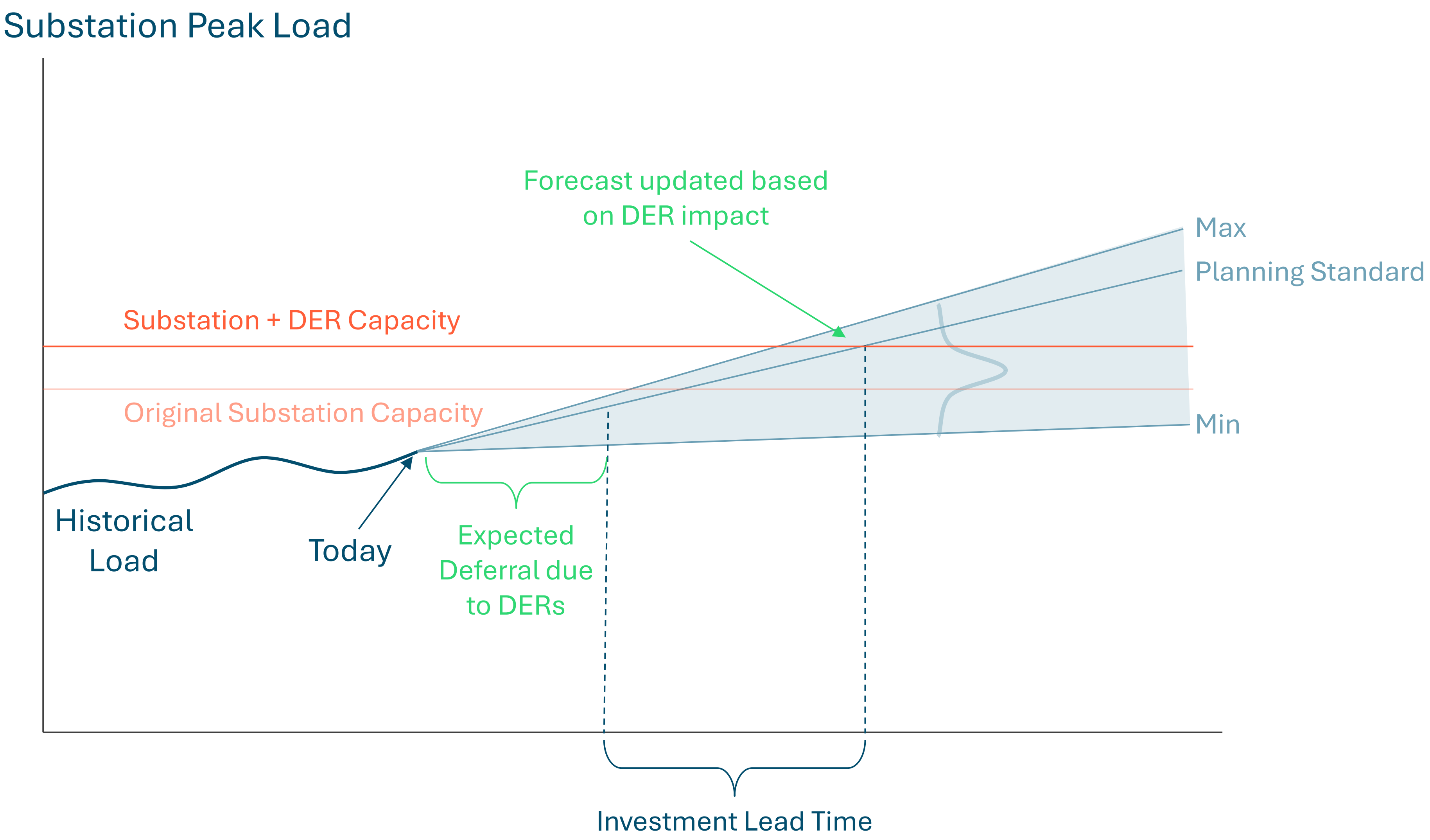
The ability to rely on incremental investment through DERs offers a potential implementation benefit



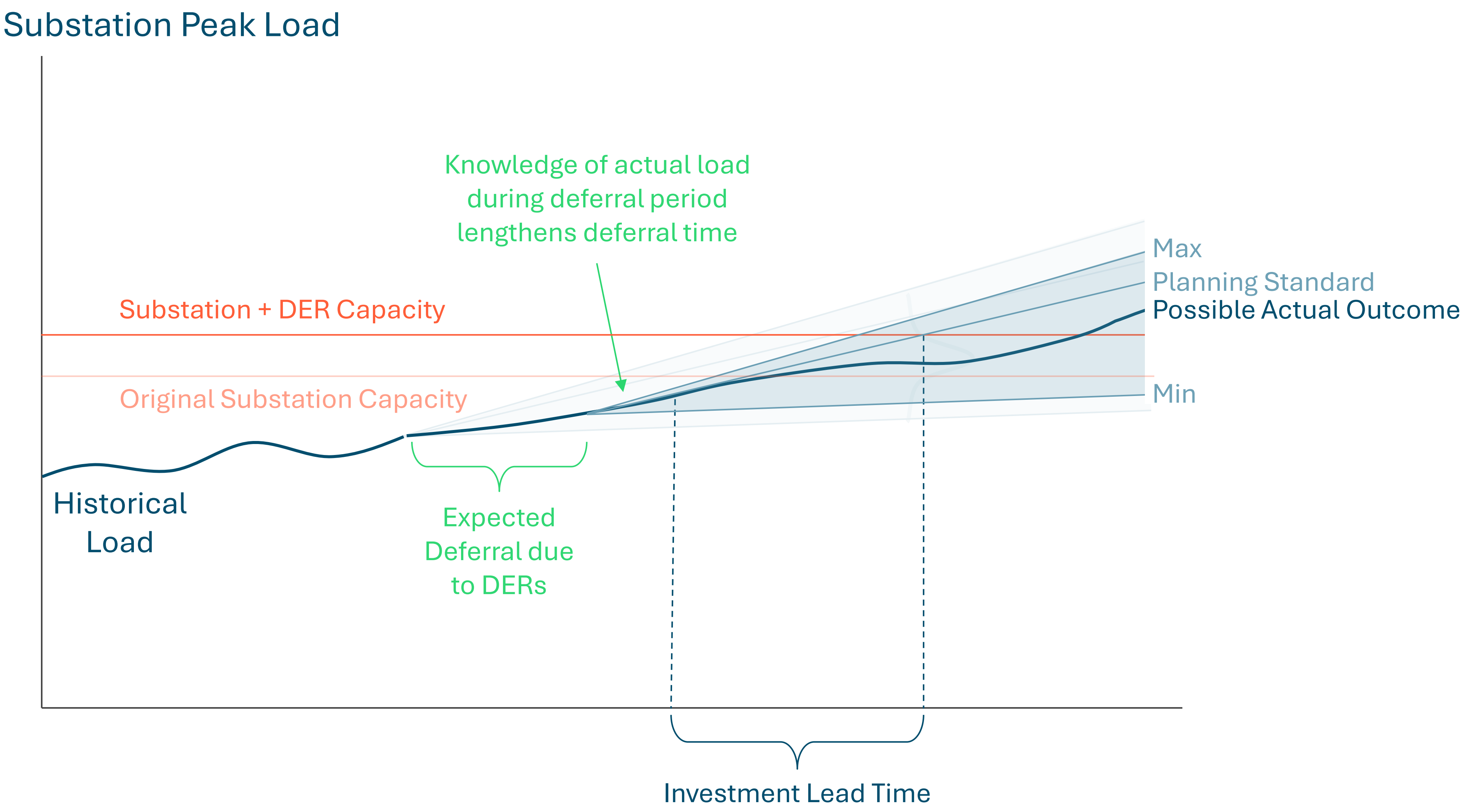
Forecasts of load growth used to plan investments are uncertain



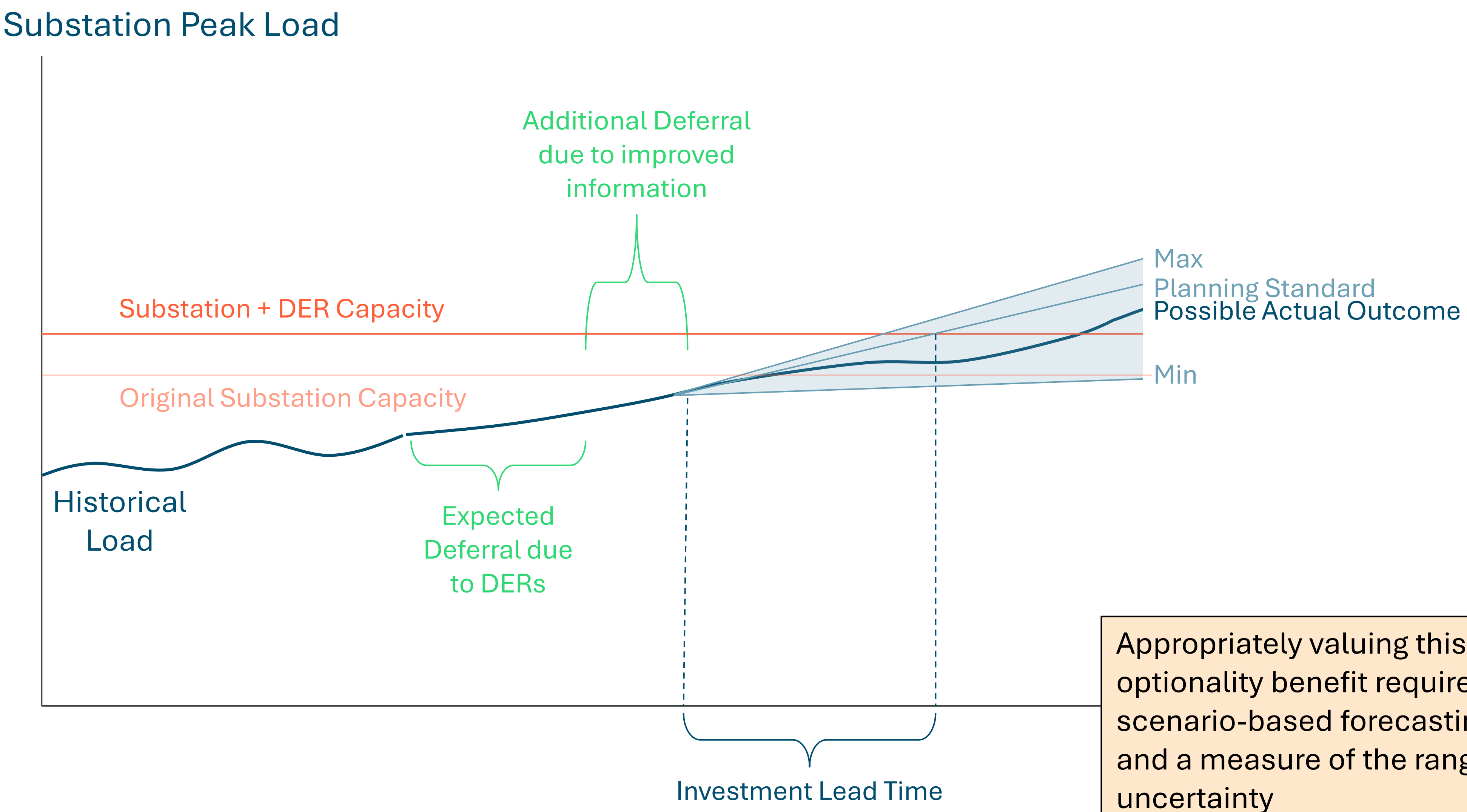
DER capacity can defer the need for investment in new capacity



Actual future peak load growth may differ from planning forecast



When actual load growth is smaller than planning standard load growth during deferral years, the reduced uncertainty creates additional deferral



Appropriately valuing this optionality benefit requires scenario-based forecasting and a measure of the range of uncertainty