dunsky Energy + Climate

New Hampshire VDER Study

Results Presentation

September 28th 2022

With support from:

POWER ADVISORY

Meeting Agenda

1. Introduction
2. VDER Study Overview
3. Value Stack Results
4. Rate & Bill Impact Assessment Results
5. Next Steps

1. Introduction

- Project Team
- Meeting Objectives

Speakers

Claire Cameron | SENIOR CONSULTANT
Dunsky Energy + Climate Advisors

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ACCELERATING THE CLEAN ENERGY TRANSITION

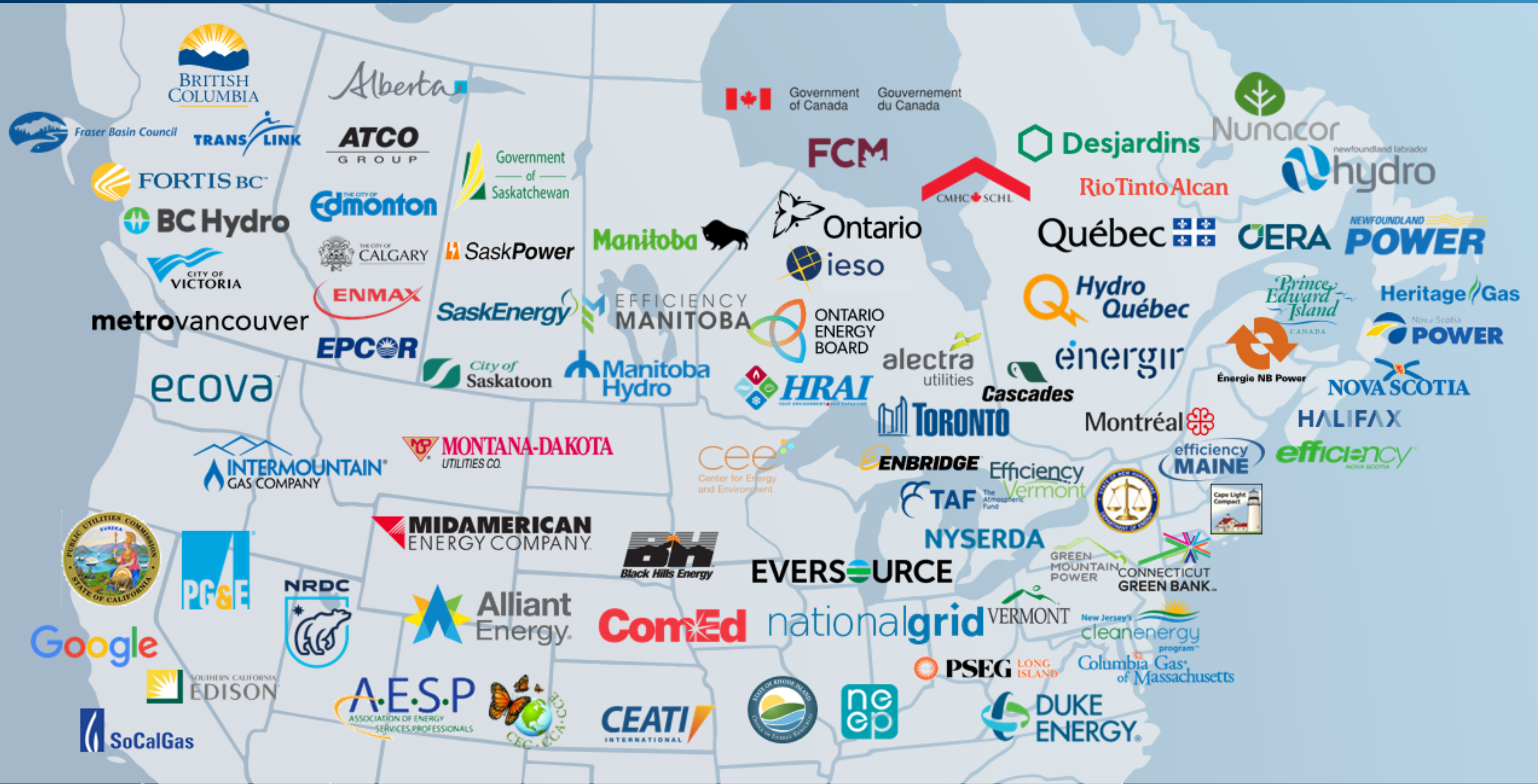
ANALYSIS + STRATEGY

BUILDINGS

MOBILITY

INDUSTRY

ENERGY



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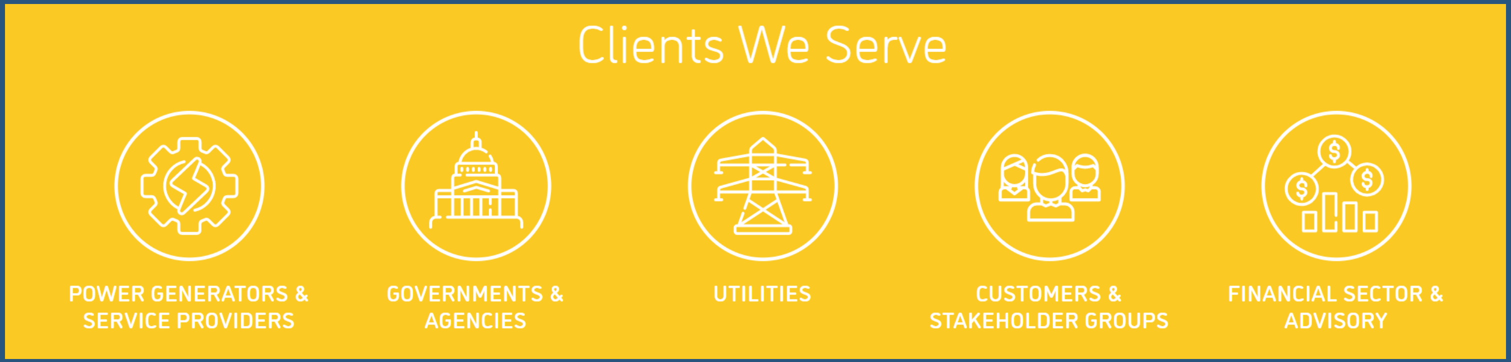
Meeting Objectives

1. Review the VDER Study scope and assessment framework
2. Present the results of the value stack and rate and bill impact assessments
3. Gather feedback from stakeholders focused on clarity/communication of results

Power Advisory LLC

Power Advisory is an electricity sector management consulting firm. Founded in 2007 and rooted in New England with headquarters in Concord, MA

Our consulting services are provided by seasoned electricity sector professionals, offering a wide breadth and significant depth of industry knowledge. This experience and knowledge, combined with a detailed understanding of market fundamentals yields strategic insights that provide clients with a competitive advantage.



Select Project Experience

- New York VDER Analysis (Multiple Clients)
- South Carolina Avoided Cost & Renewables Integration Independent Expert (SC PSC)
- ISO-NE Energy, Capacity, A/S and REC Forecasting
- Distributed Energy Resource Compensation Jurisdictional Scan (PEI Energy Corp)
- Vermont Renewables Program Design & Testimony (former VT Public Service Board)

2. VDER Study Overview

- Project Parameters
- Study Assessment Framework
- Summary of Deliverables

Project Parameters

Objectives of the VDER Study:

1. Estimate hourly avoided costs attributable to net-metered distributed generation (DG) using test criteria methodologies from standard energy efficiency benefit-cost analysis where appropriate.
2. Analyze rate and bill impacts to estimate the direction and magnitude of the impacts of DG deployment on all ratepayers and any potential cost-shifting between customers with and without DG.
3. Provide data and analysis to inform future net metering rate design and tariff development.

Value stack assessment:

- Sixteen avoided cost criteria assessed from the utility perspective
    - Environmental externality benefits considered as a sensitivity
- Two distributed energy resource (DER) types – solar (w/storage sensitivity) and small-scale hydro
- Three utility service territories (Eversource, Liberty, Unitil)

Rate and bill impact assessment:

- Two net metering tariff scenarios: current alternative net metering tariff and a tariff that reflects compensation for net exports at the full avoided cost value generated by DERs (as assessed in the Value Stack)

Study timeframe: 15-year period (2021-2035)

VDER Study Assessment Framework

Establish Avoided Cost Value Stack

- Technology neutral
- Hourly 8760 data
- For each study year

Calculate Value Achieved by DG Systems

- DG system production profiles
- Overlaid on avoided cost value stack

Rate & Bill Impact Assessment

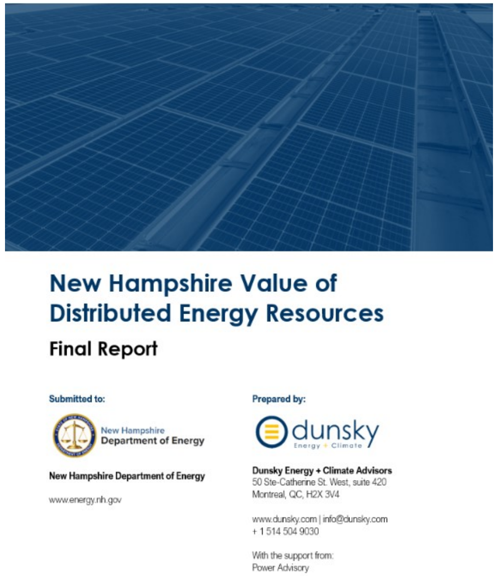
- Impact of DG deployment on NH ratepayers
- Considering two DG compensation scenarios

\+ **Study Adders:** High Load Growth assessment
Market Resource Value assessment

Summary of Deliverables

Final Study Report

The report will summarize the study scope, methodology, assumptions, data inputs, and results for all study components. Specifically, it will cover the value stack assessment, sensitivities performed around the value stack assessment, customer net costs summaries, and rate and bill impacts analysis.


New Hampshire Value of Distributed Energy Resources

Final Report

Submitted to:

New Hampshire Department of Energy

New Hampshire Department of Energy

www.energy.nh.gov

Prepared by:

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With the support from:

Power Advisory

Valuation Model

The model will have the capability to provide dynamic valuation results, allowing users to toggle key inputs and criteria. The excel-based tool will support the assessment of how changes to study factors can be expected to impact valuations, summarizing the results on a user-friendly dashboard.

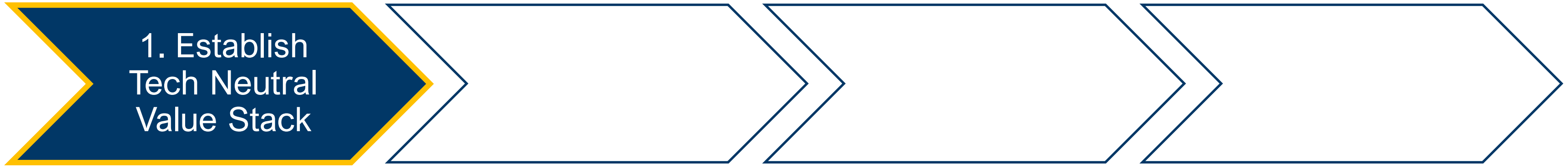
3. Value Stack Results

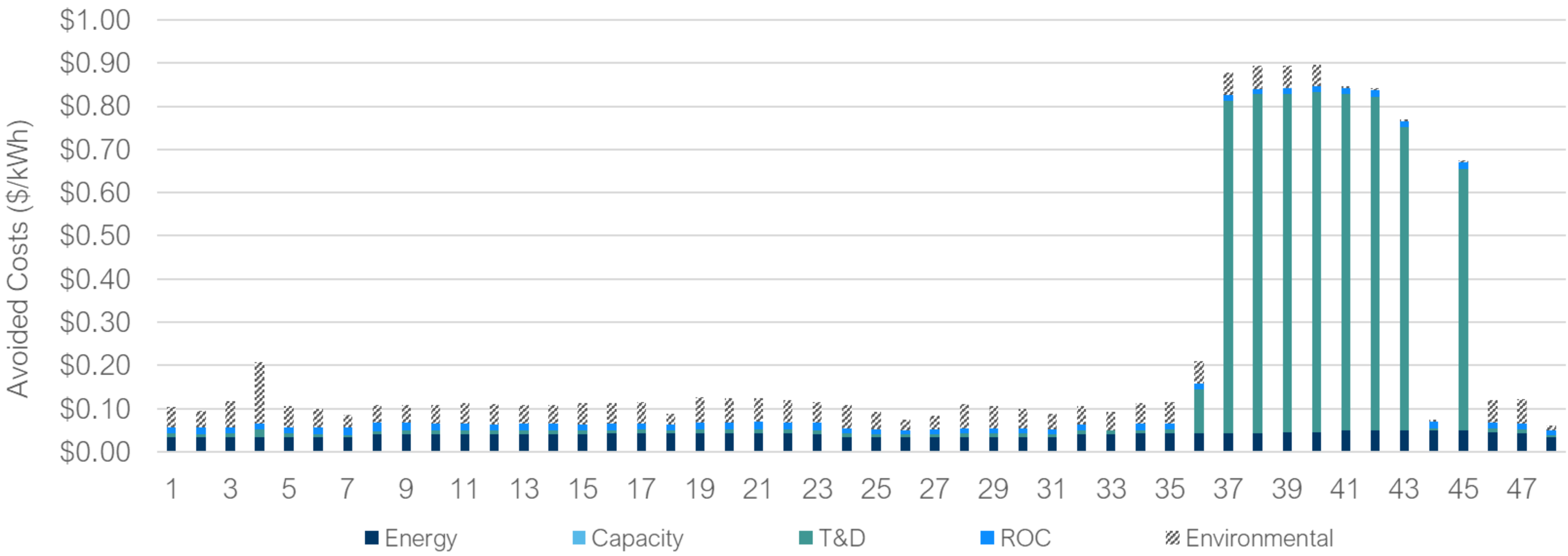
- Methodology Summary
- Key Results

Methodology Summary

1. Establish Tech Neutral Value Stack
2. Develop Representative DG System Output Profiles
3. Combine to Assess DER Value
4. Test Sensitivities

Methodology Summary





ROC = Rest of (Value Stack) Components

Technology Neutral Value Stack

The VDER Study avoided cost criteria may be categorized in three groupings based on the data analyzed and evaluation methodology:

Evaluated using Avoided Energy Supply Costs (**AESC) data, methods, and results**.

Evaluated using **quantitative methods unrelated to AESC**.

Evaluated using **qualitative review**.

- These groupings align with the *Study Parameters, Avoided Cost Criteria and Methods* as developed through the stakeholder group process and approved by the Commission.
- The blue and green methodologies resulted in avoided cost values that were included in the quantitative value stack assessment. The orange methodology resulted in qualitative assessments, which are explored in the narrative report.

Technology Neutral Value Stack

The table below summarizes which grouping each value stack criteria falls under:

Evaluation Methodology:	AESC data, methods, and results	Quantitative methods unrelated to AESC	Qualitative review
Value Stack Criteria:	• Energy • Capacity • Ancillary services and load obligation charges • RPS Compliance • Transmission Line Losses • Distribution System Line Losses • Wholesale Market Price Suppression • Hedging/Wholesale Risk Premium	• Transmission charges • Distribution capacity • Distribution System OPEX • Distribution Utility Administrative Costs	• Transmission capacity • Transmission and Distribution System Upgrades • Distribution Grid Support Services • Resiliency

Environmental Externality Sensitivity

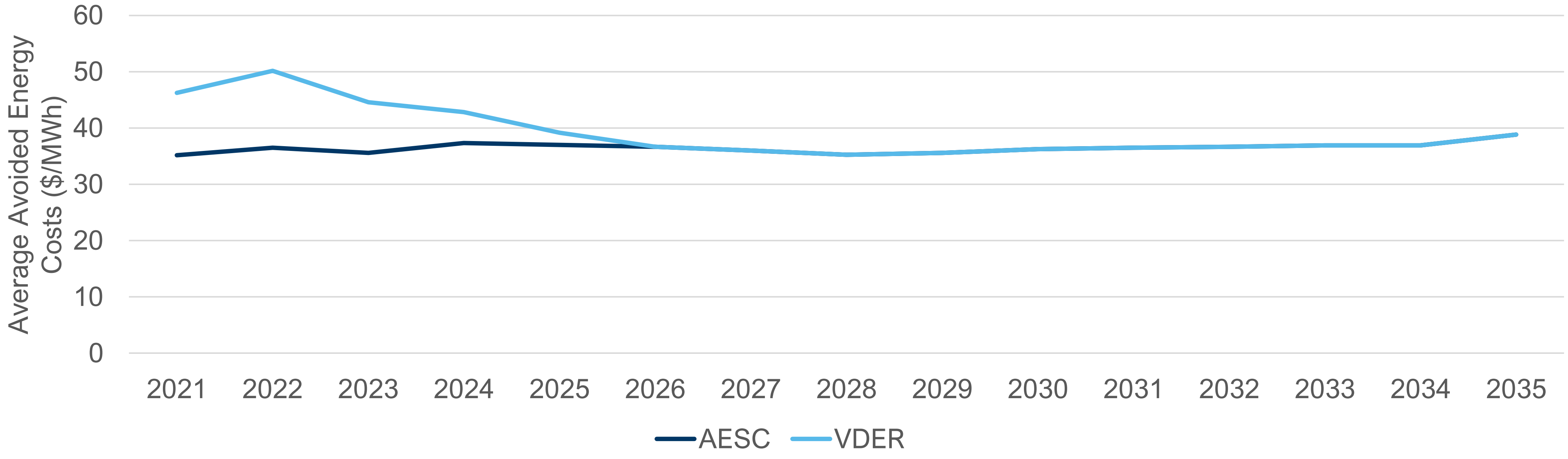
Assess impacts of including environmental costs that are not already embedded in wholesale electric energy prices:

- Social cost of CO_2 emissions net of RGGI compliance costs
- Social cost of NOx

Technology Neutral Value Stack

Energy: A notable adjustment to the AESC forecast

- At the study's start in 2021, energy prices were adjusted to be higher than the AESC forecasts to account for near-term natural gas prices increases (see graph)
- Energy prices have continued to increase (up to $220/MWh as of August), but recent changes were not captured in the value stack analysis and modelling. This study represents a snapshot in time, and there is a high degree of uncertainty around how prices can be expected to move in the future



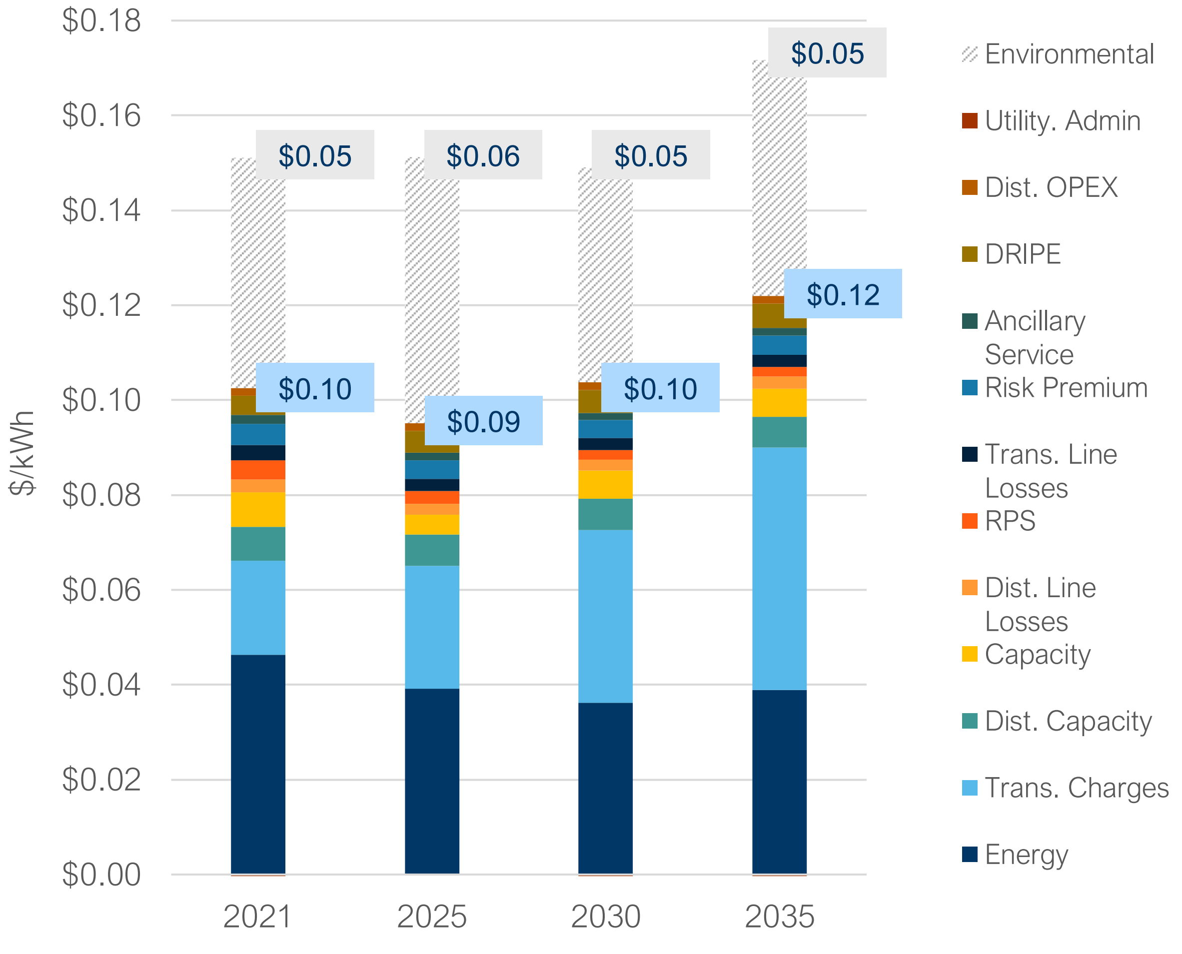
Technology Neutral Value Stack

The technology neutral value stack quantifies the **total avoided cost value during each hour** of the study period

These **hourly values can be averaged across each study year** to generate average annual avoided costs *(graph to the right)*

- There is **considerable variation from hour-to-hour** within a given year

The impact of **environmental externalities is shown in grey**



Note: All values are in $2021

Technology Neutral Value Stack

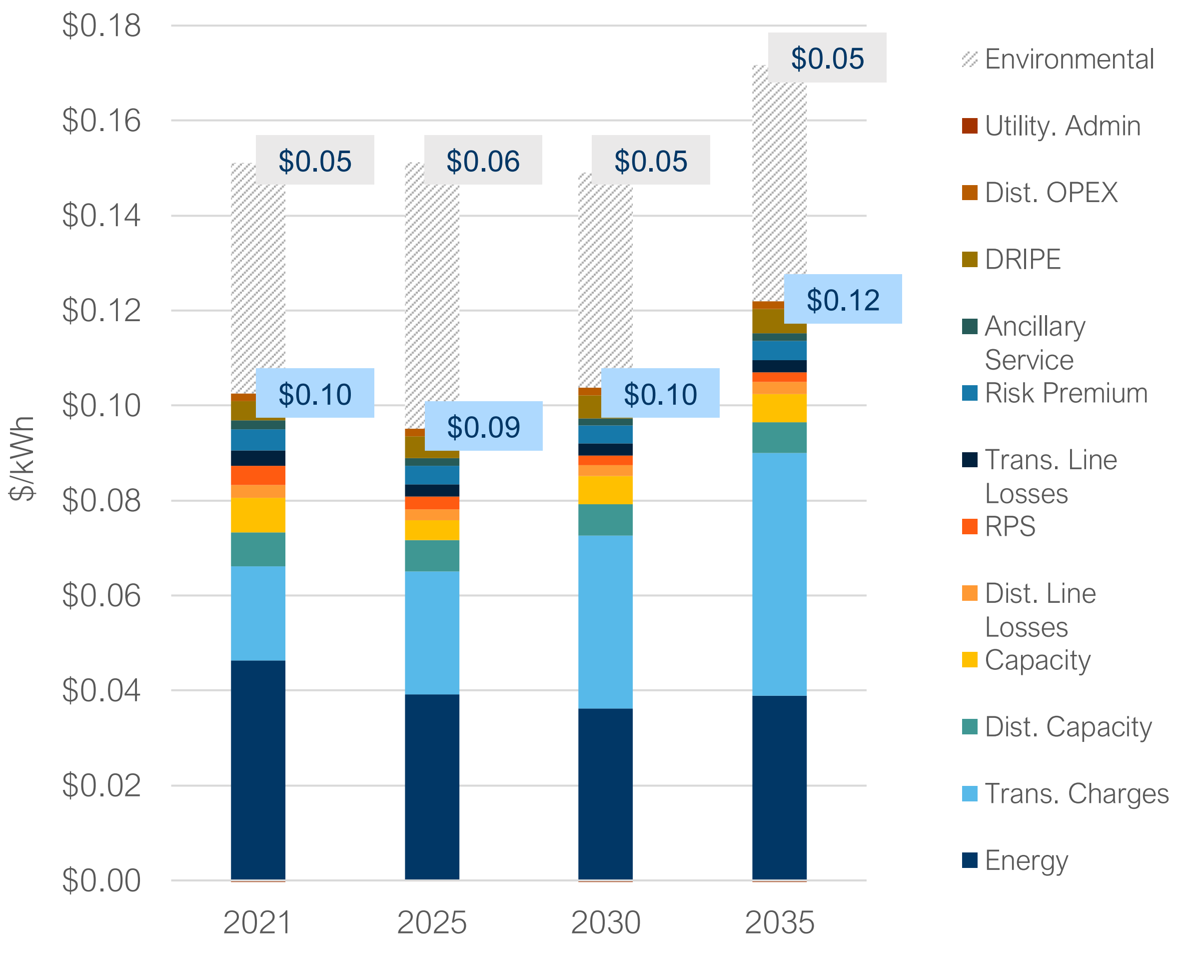
The avoided cost value of **energy** is **higher in initial years**, but **declines over time**

- **High near-term prices** driven by near-term impacts of high natural gas prices (modified AESC energy forecast to account for this)
- **Declining value over time** is a result of increases in lower-cost resources such as offshore wind and solar

Transmission charges are forecasted to **increase over time**, increasing avoided cost value

- Trend sourced from near-term projections for RNS charges that account for planned expenditures

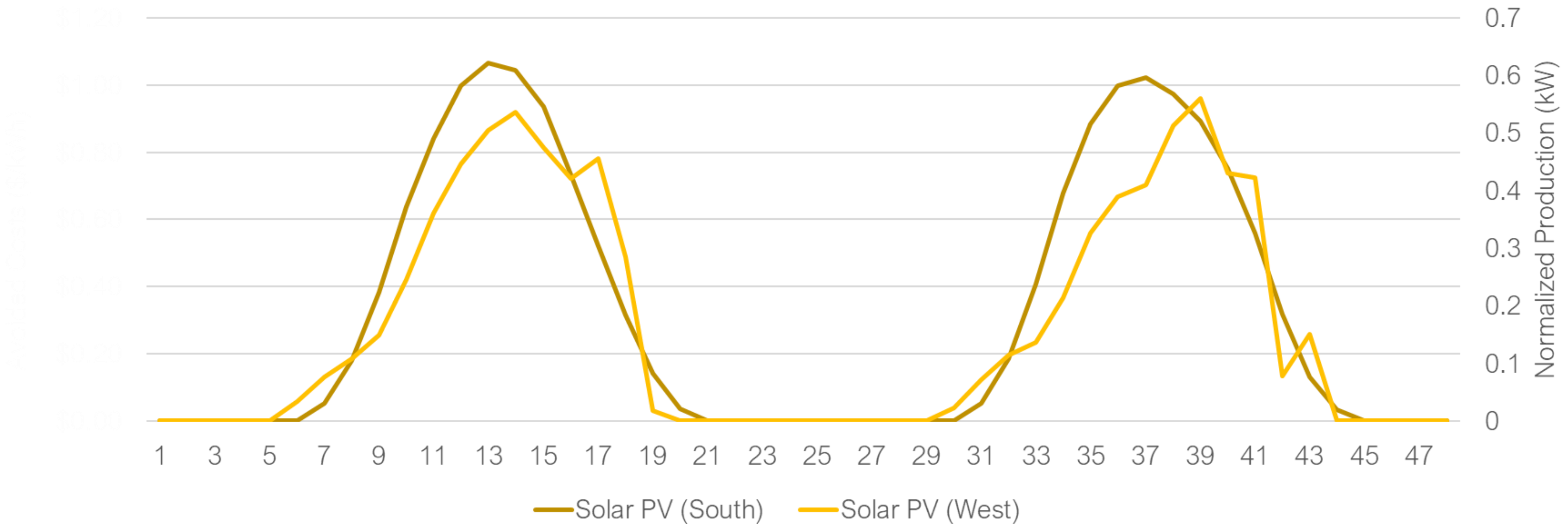
Environmental externalities increase the avoided cost value by 41% to 59%, varying by year



Note: All values are in $2021

Methodology Summary

1. Establish Tech Neutral Value Stack
2. Develop Representative DG System Output Profiles



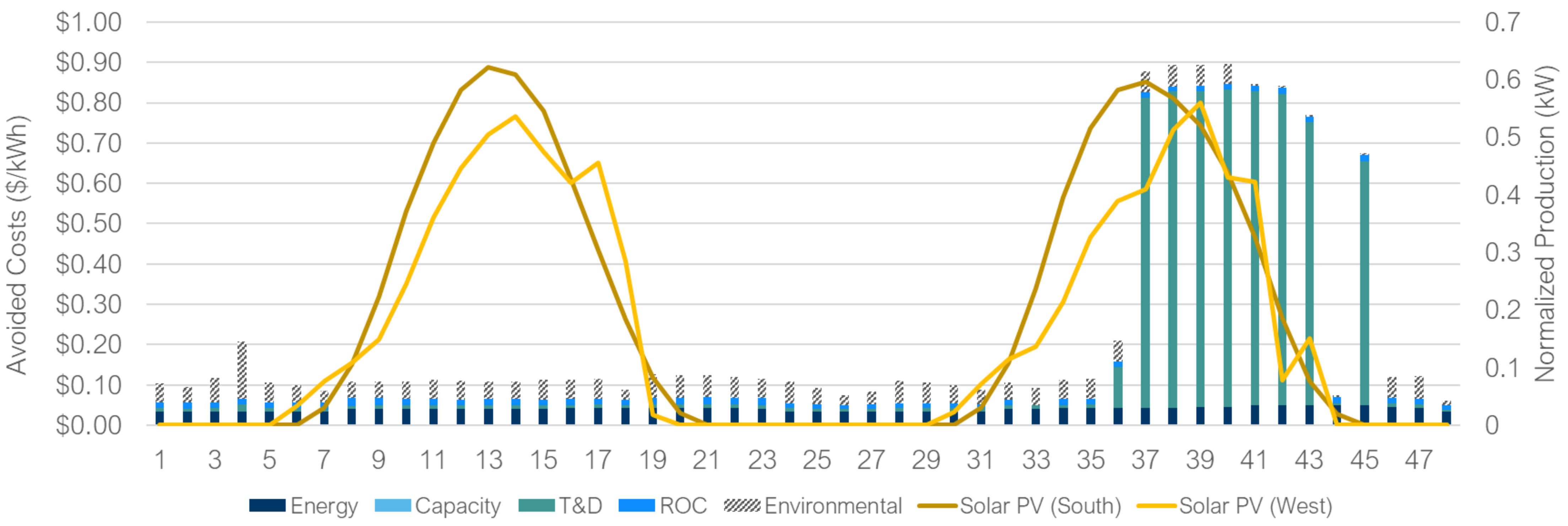
Representative DG Systems Modelled

Sector	System
Residential	South-facing solar
	West-facing solar
	South-facing solar with storage
Commercial	South-facing solar
	West-facing solar
	South-facing solar with storage
	Large Group Host Commercial Solar
	Micro Hydro

For the purpose of the value stack assessment, we calculated the hourly netting from a south-facing solar PV system then applied this assumption to the west-facing and south-facing solar with storage systems within a given sector. Although the current NEM tariff in New Hampshire uses monthly netting, hourly netting is an emerging practice used in VDER studies conducted in other jurisdictions given its ability to capture temporal values more granularly.

Methodology Summary

1. Establish Tech Neutral Value Stack
2. Develop Representative DG System Output Profiles
3. Combine to Assess DER Value



ROC = Rest of (Value Stack) Components

Value Achieved by DG Systems

Value **decreases over time** for all types of **solar-only systems**

- This is primarily a result of decreasing energy avoided costs

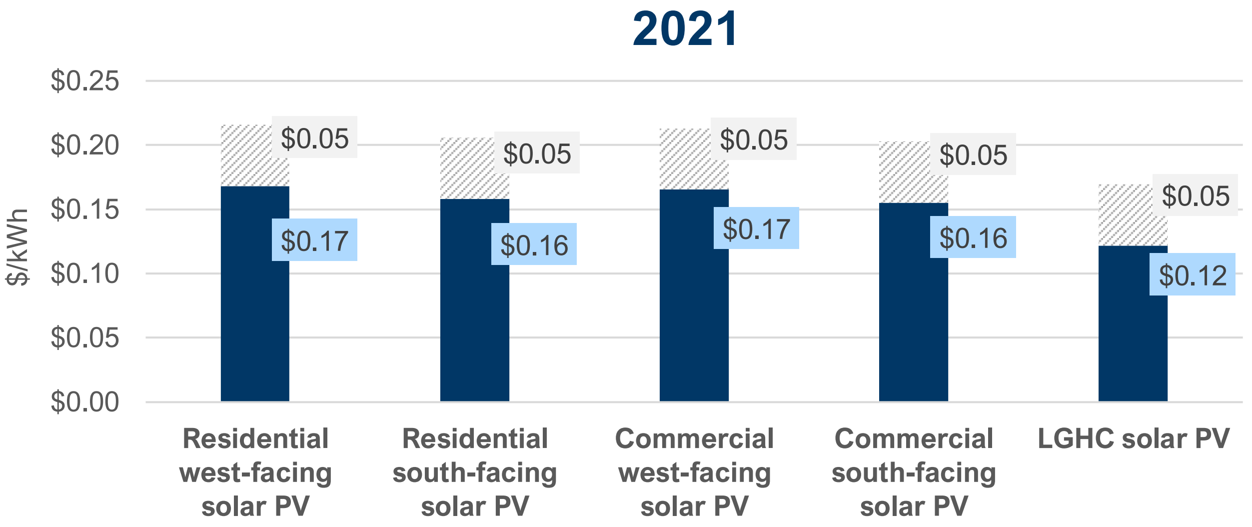
For a given segment, **west-facing systems** generate **6-10% more avoided cost value**

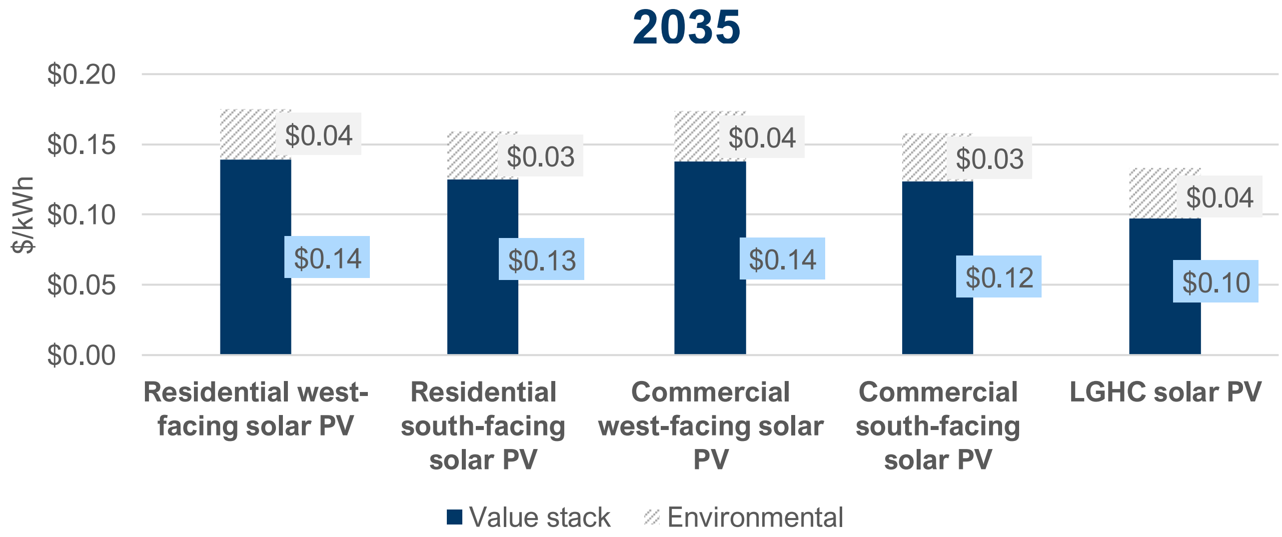
- **Deployment of these systems is expected to be limited** – customers currently incentivized to maximize volumetric production through south-facing installations

Commercial systems achieve less total value than residential systems

- Primarily due to **reduced line loss** and **reduced RPS** avoided cost value (due to lower % of energy assumed to be consumed BTM)

Environmental externalities **increase value by 26-40%**





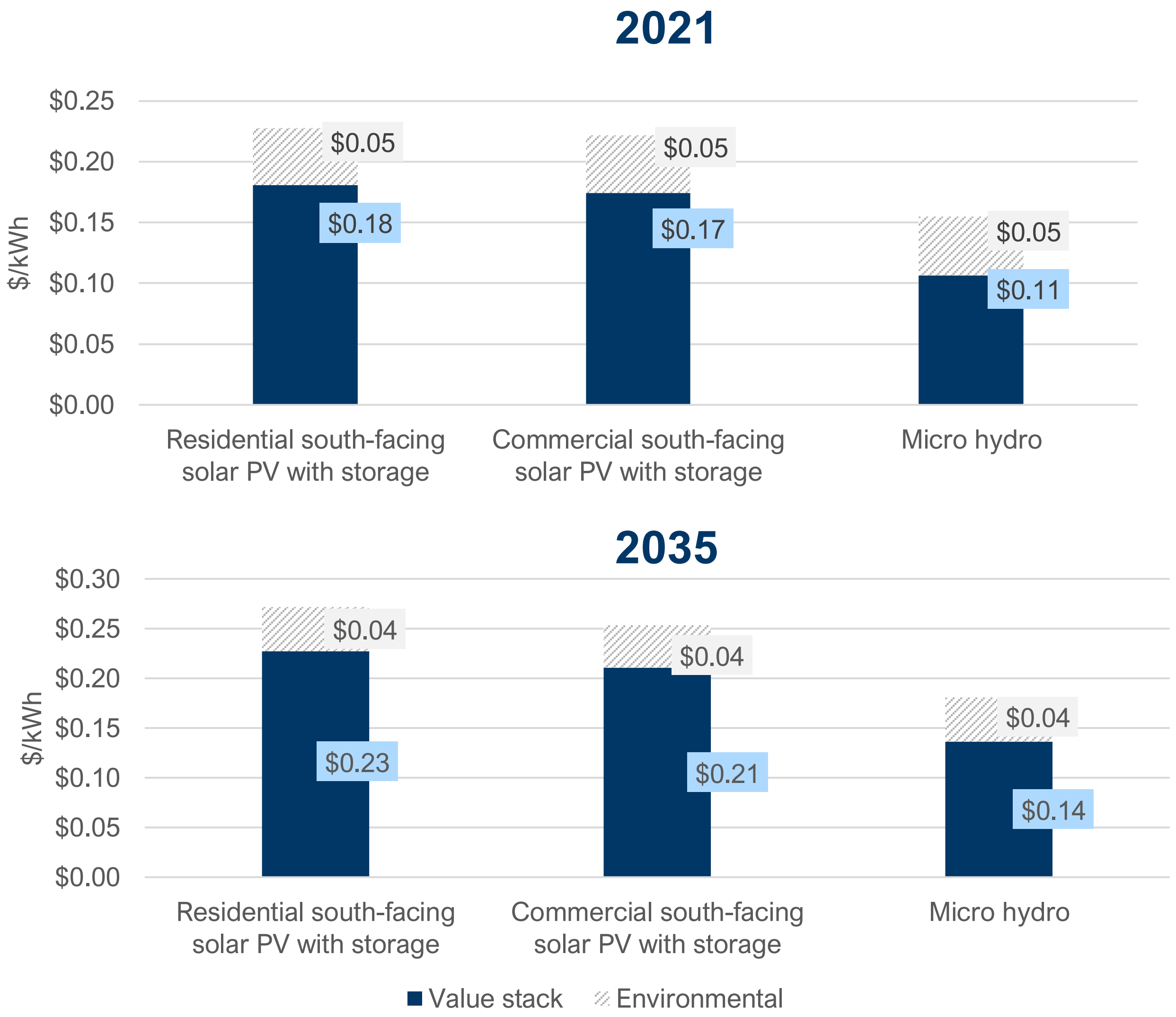
Note: All values are in $2021

Value Achieved by DG Systems

Value increases over time for **solar paired with storage** and **micro-hydro systems**

- These systems **achieve greater transmission avoided costs**
- **Increased transmission avoided costs over the study period** drive increased value over the study period

Environmental externalities **increase value by 20-45%**



Note: All values are in $2021

Sensitivities

1. Establish Tech Neutral Value Stack → 2. Develop Representative DG System Output Profiles → 3. Combine to Assess DER Value → **4. Test Sensitivities**

Sensitivity	Description	Impact
High Load Growth Scenario	Assess impacts of high load growth (e.g., due to transportation and building electrification)	• Higher loads drive **0% to 5% higher values** than the baseline value stack, **varying by year and DG system type**
Market Resource Value Scenario	Assess impacts of DERs participating as aggregated, passive resources in the ISO-NE markets	• From a utility system perspective, under current market rules, all DG systems provide **1% to 11% greater value by reducing load than by participating as aggregated resources** in the market, with the **exception of micro hydro.** Micro hydro facilities are able to consistently generate during the summer and winter reliability periods, **increasing their value** in the capacity market by **2% to 4%.**

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Q & A Period

4. Rate & Bill Impacts Assessment Results

- Overview and Methodology
- Results and Key Considerations

Overview

The analysis provides insight into the impact of DG deployment in New Hampshire on ratepayers, considering both the benefits and the costs that would be incurred by the utilities

- The assessment is intended to serve as a future-looking estimate of the direction and magnitude of the impacts of DG deployment on all ratepayers and any potential cost-shifting between customers with and without DG.
- ***It is not intended to represent an exact projection of future electricity rates and cost recovery. Instead, it serves as a future-looking approximation of the impacts on ratepayers attributable to DG.***

The assessment highlights the impacts across:

- The three regulated electric utilities serving New Hampshire
- Three representative rate classes for each utility (residential, small general service, large general service)
- Three representative customer archetypes (typical DG customer, typical non-DG customer, average utility customer)

The analysis considers the impacts under two scenarios for DG compensation:

- The existing alternative net metering tariff (effective September 2017) (NEM); and
- A different tariff structure based on the outcomes of the VDER study; where customers are compensated for grid exports at the value of the avoided cost values (Avoided Cost Value (ACV) Tariff)

Methodology

- **Step 1:** Estimate load under a hypothetical no-DG scenario and under the forecasted future DG deployment in NH
- **Step 2:** Assess the rate impacts of DG using the following framework:

$$Rates_{Post\ DG} = Rates_{Pre\ DG} + \frac{(Lost\ Revenues\ - Avoided\ Costs) + (Admin\ Costs + Export\ Bill\ Credits)}{Load\ _{Post-\ DG}}$$

- **Step 3:** Estimate bills pre- and post-DG for each customer group

Methodology Overview

The "net" of these components (i.e., the difference between lost revenues and avoided costs) is estimated to represent proxy of the required fixed cost recovery

A Utilities' revenues are reduced

B Utilities capture benefits from avoided costs

$$Rates_{Post\ DG} = Rates_{Pre\ DG} + \frac{\overbrace{(Lost\ Revenues\ - Avoided\ Costs)}^{\textit{Fixed Cost Recovery}} + \overbrace{(Admin\ Costs + Export\ Bill\ Credits)}^{\textit{Program Costs Recovery}}}{Load_{\ Post-\ DG}}$$

C Utilities need recover costs to accommodate DG / operate programs

D Costs are recovered over fewer kWh

Methodology

- **Step 1:** Estimate load under a hypothetical no-DG scenario and under the forecasted future DG deployment in NH
- **Step 2:** Assess the rate impacts of DG using the following framework:

$$Rates_{Post\ DG} = Rates_{Pre\ DG} + \frac{(Lost\ Revenues\ - Avoided\ Costs) + (Admin\ Costs + Export\ Bill\ Credits)}{Load\ _{Post-\ DG}}$$

- **Step 3:** Estimate bills pre- and post-DG for each customer group

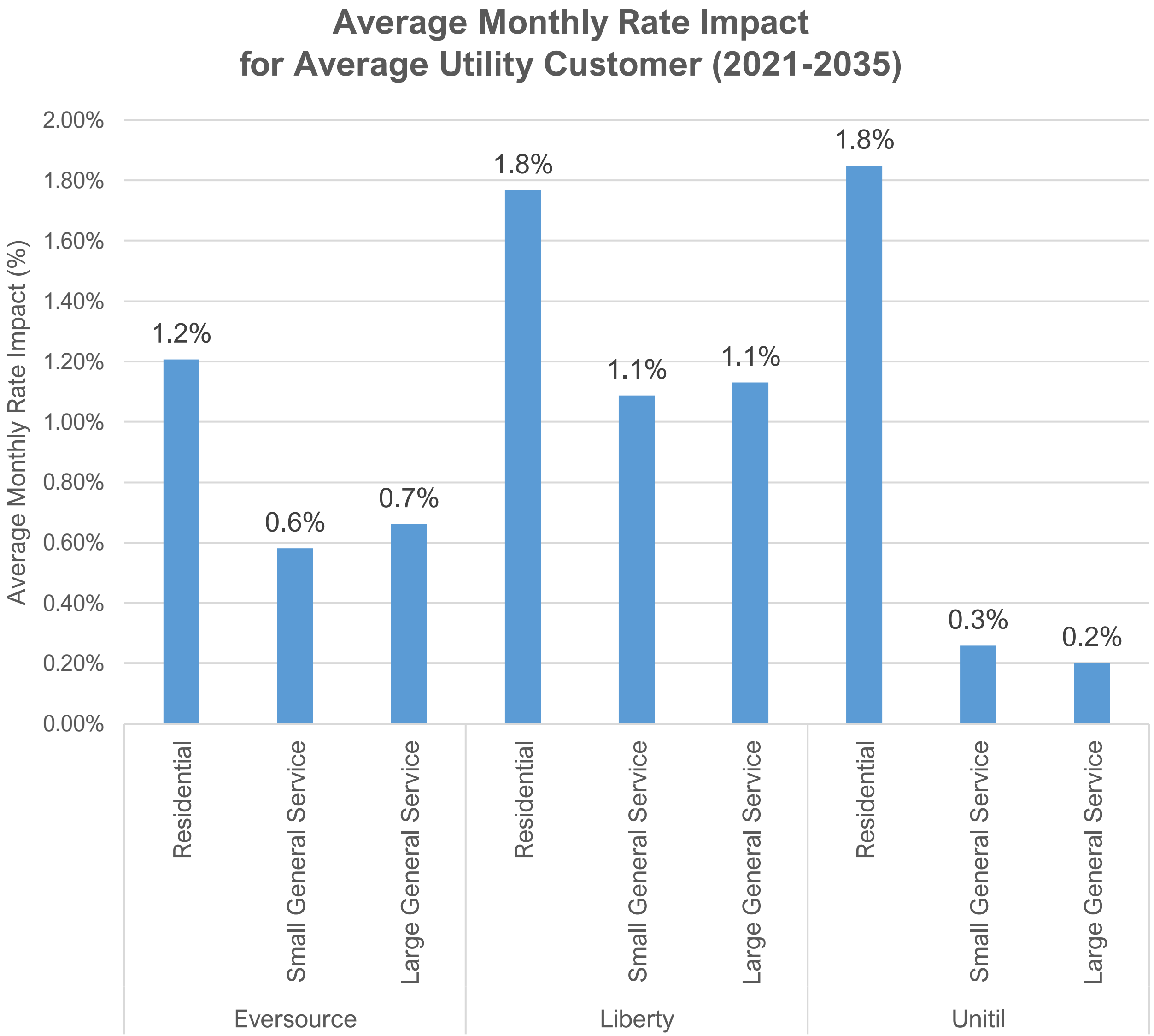
The results in this presentation and the study are predominantly focused on two key metrics: :

- Rate impacts are presented as the **average annual percent increase/decrease in rates relative to a no-DG scenario** over the period 2021 to 2035 for each rate class to indicate the long-term impact of DG.
- Bill impacts are presented as the **average annual percent increase/decrease in customers' bills attributable to DG** over the period 2021 to 2035 for each of the typical customer archetypes considered to calculate bill reductions and potential cost shifting

NEM: Rate Impacts

Over the study period (2021-2035), the forecasted DG adoption is expected to result in slight rate increases <u>relative to a no-DG scenario.</u>

- **Residential** customers are expected to experience a statewide average monthly increase of 1.3% in residential rates across the utilities
- **Small General Service** customers are expected to experience a statewide average monthly rate increase of 0.57%
- **Large General Service** customers are expected to experience a statewide average monthly rate increase of 0.63%.

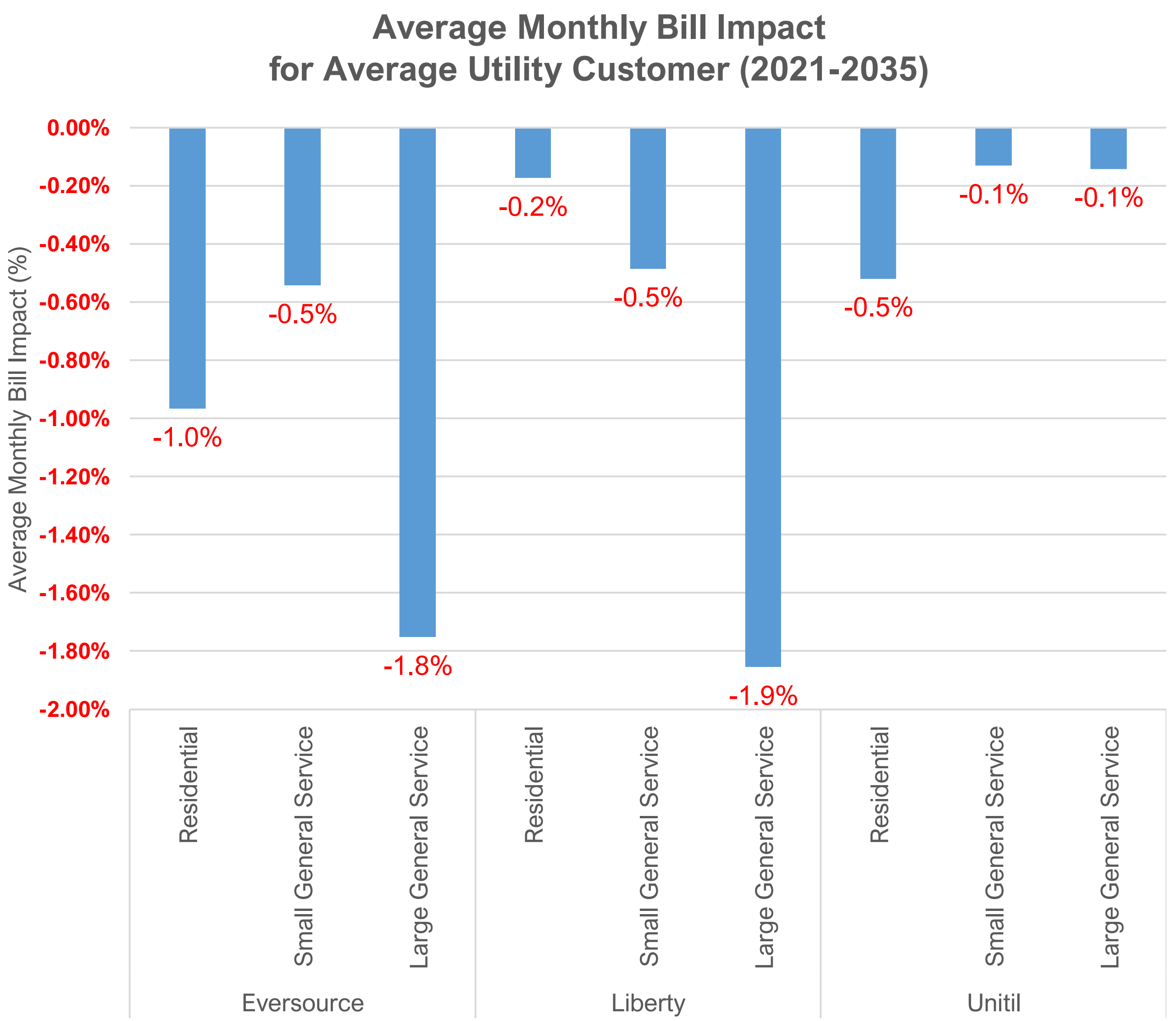


Based on a weighted average of utility customers across the three utilities Eversource (80%), Liberty (7%) and Unitil (12%).

NEM: Bill Impacts – Average Utility Customer

Despite the forecasted electricity rate increase, monthly bills for the average utility customer across all utilities and rate classes are expected to decline on average over the study period

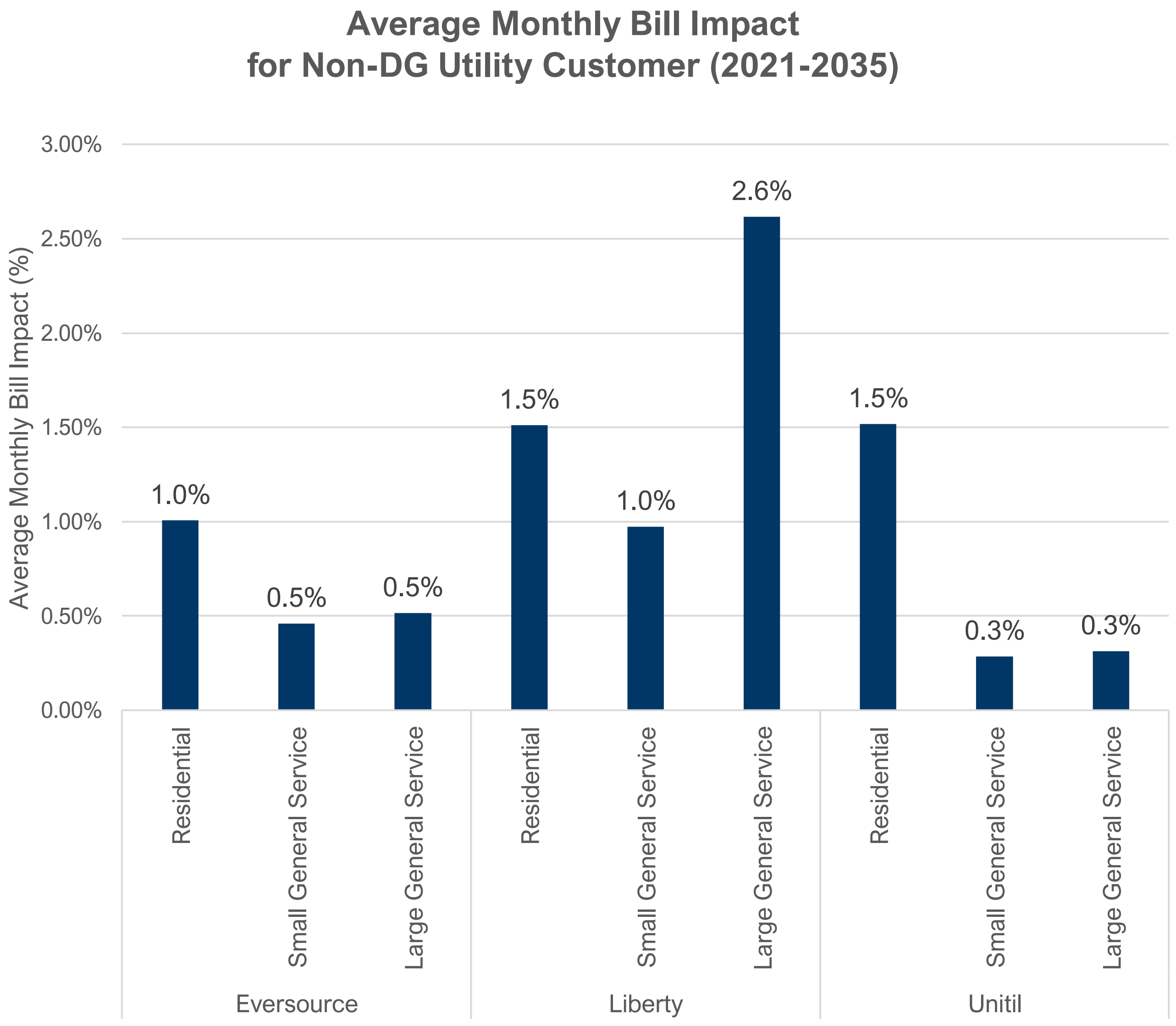
- The average monthly declines range from **0.1% to 1.9%**
- **Largest reductions** observed for **Large General Service** customers in **Eversource's and Liberty's** service territories (**1.8% - 1.9%**, in average monthly bill decreases)
- **Eversource's residential customers** observe a **1.0% reduction** in average monthly bills
- **Minimal impacts** observed for **residential** customers in **Liberty's and Unitil's** territories as a **result of the low DG deployment** by customers in those customer sectors



NEM: Bill Impacts – Non-DG Customers

The monthly bills for the Non-DG utility customers across all utilities and rate classes are expected to increase on average over the study period.*

- The average monthly increases range from **1% to 1.5% for Residential, 0.3% to 0.5% for Small General Service, 0.3% to 2.6% for Large General Service.**
- **Largest increases** observed for **Large General Service** customers in **Liberty's** service territory.



*when averaged across the entire study period; Liberty's Lg Gen Service bill impacts are related to its treatment of costs and demand charges.

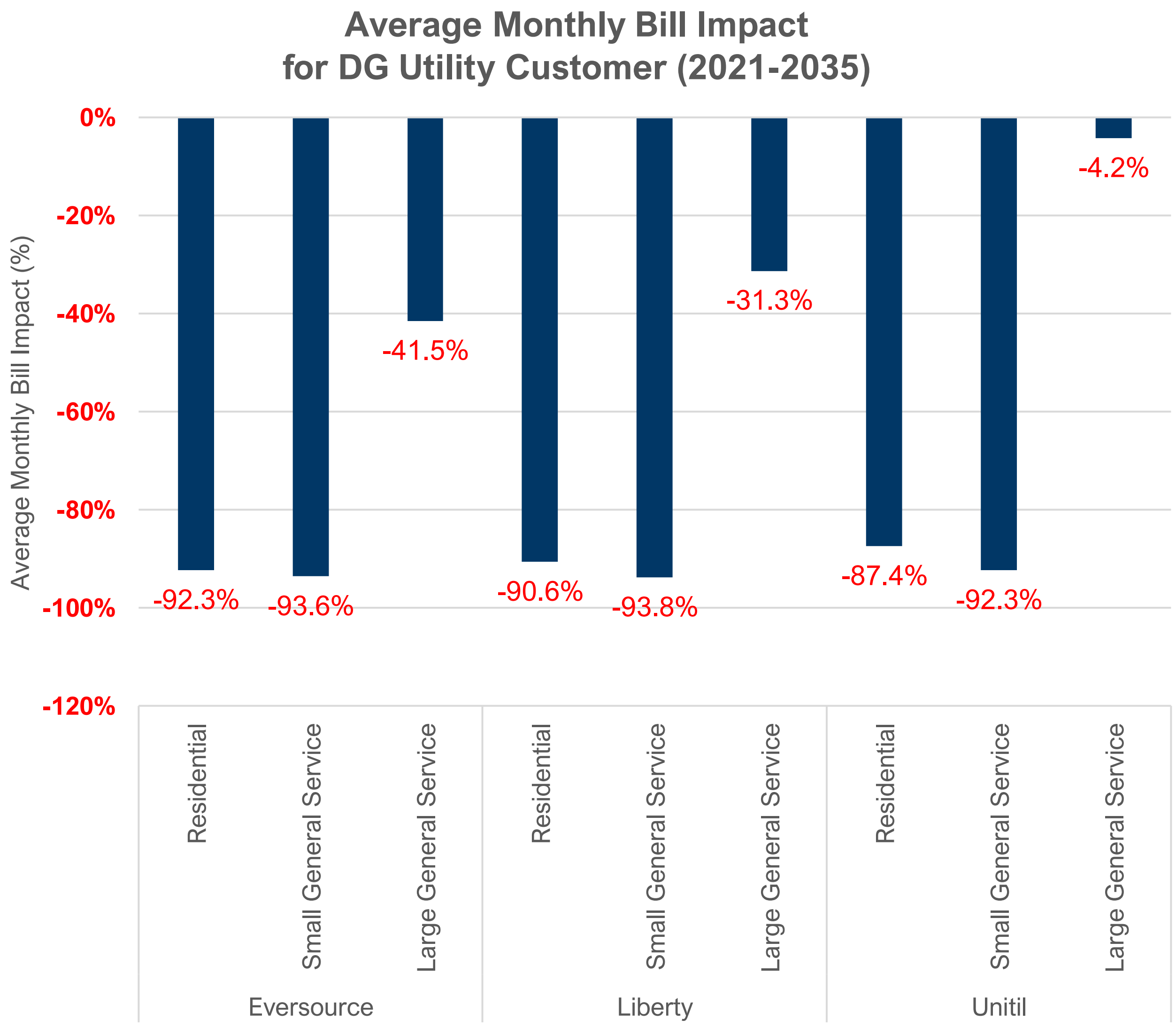
NEM: Bill Impacts – DG Customers

DG customers will observe significant bill savings as a result of DG adoption.

Residential Customers across all the utilities will see from 87% to 92% average monthly bill savings from DG adoption over the study years.

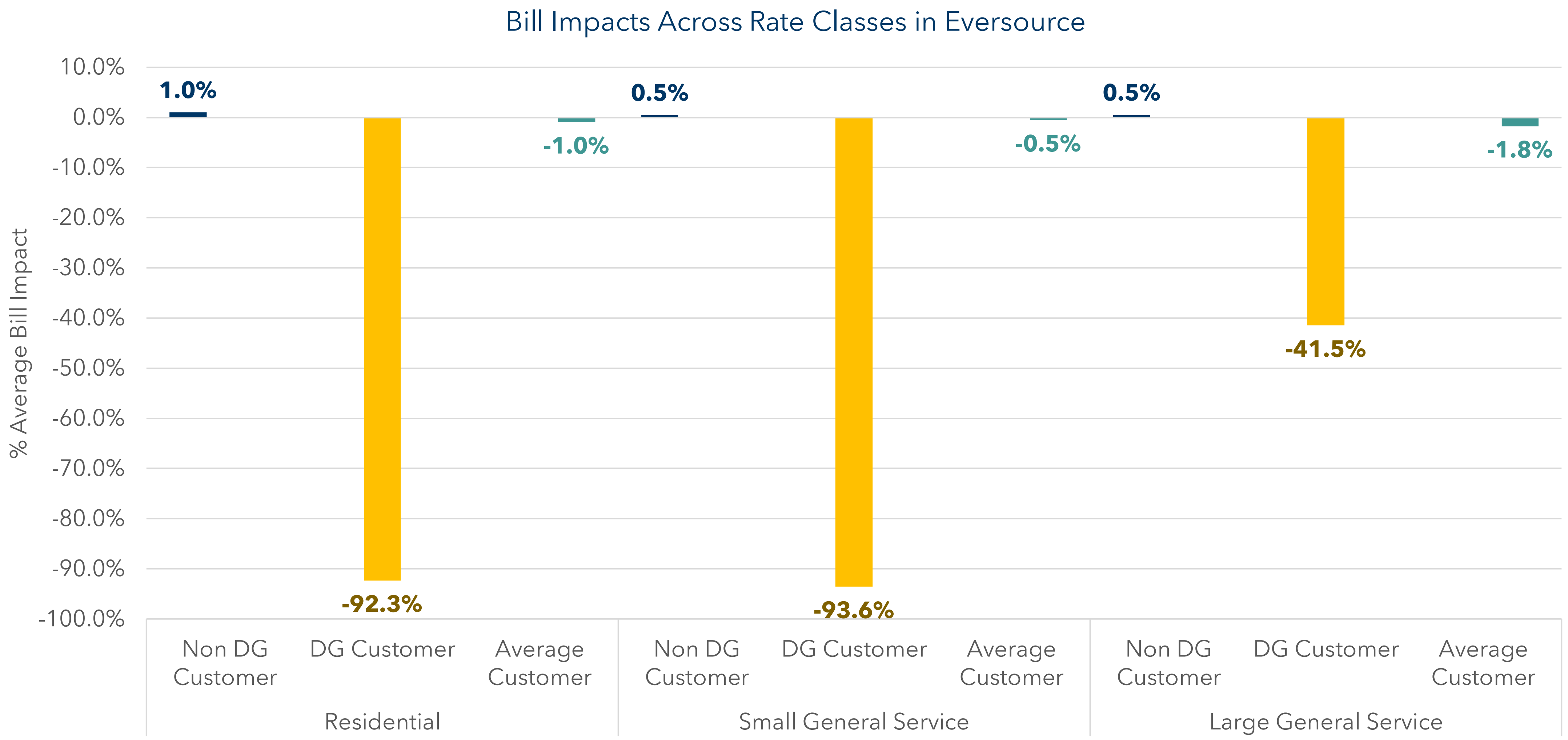
Small Commercial Customers across all the utilities will see about 93% average monthly bill savings from DG adoption over the study years.

Large General Service Customers across all the utilities will see from 4% to 40% average monthly bill savings from DG adoption over the study years, depending on their PV system size.



The analysis does not include the cost of installation

Bill Impact Across Rate Classes: Eversource (NEM)

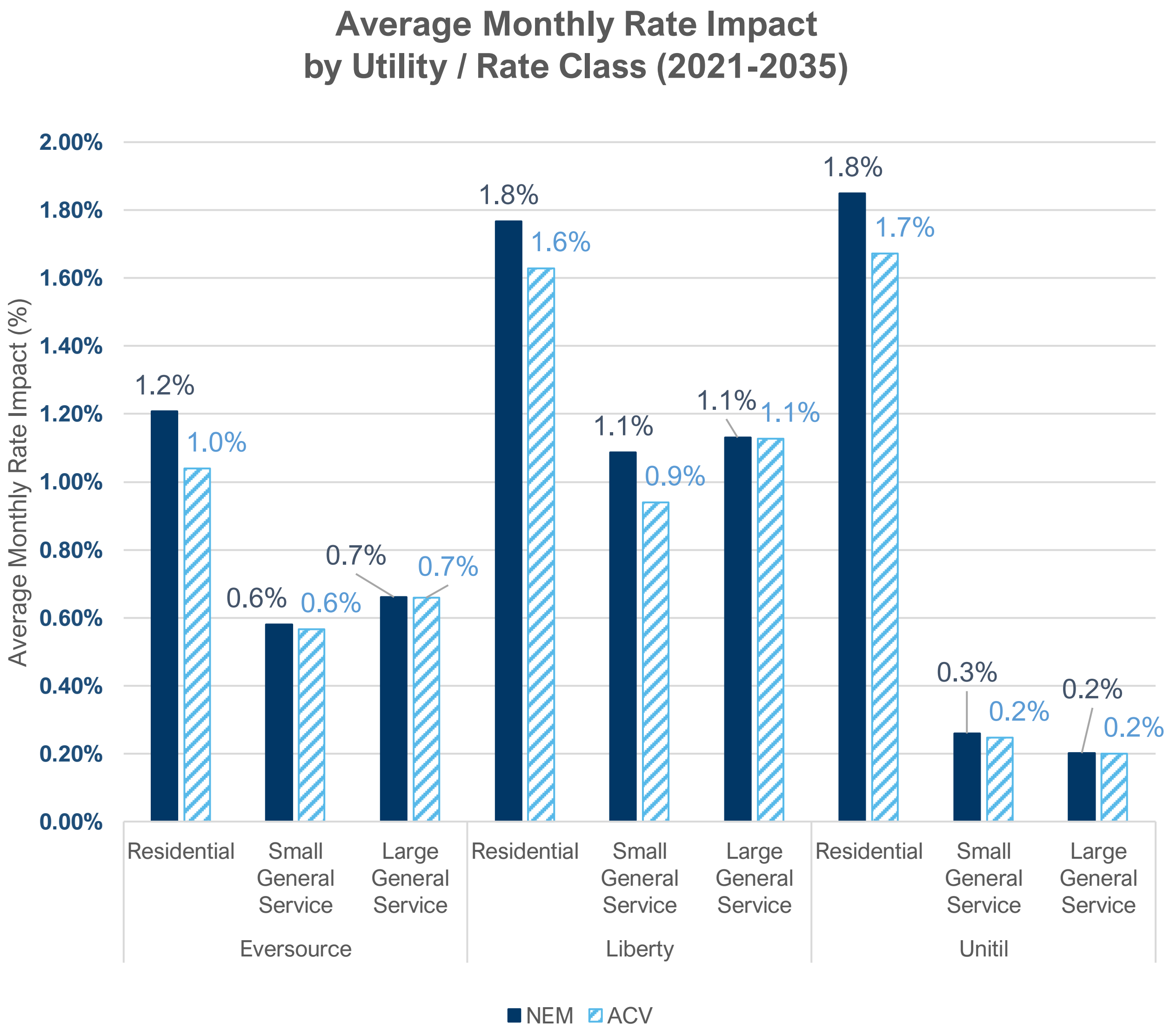


The analysis does not include the cost of installation

ACV Tariff: Rate Impacts

Under the modelled ACV Tariff, no significant differences are observed with respect to the NEM scenario. Both tariffs show a slight increase in rates.

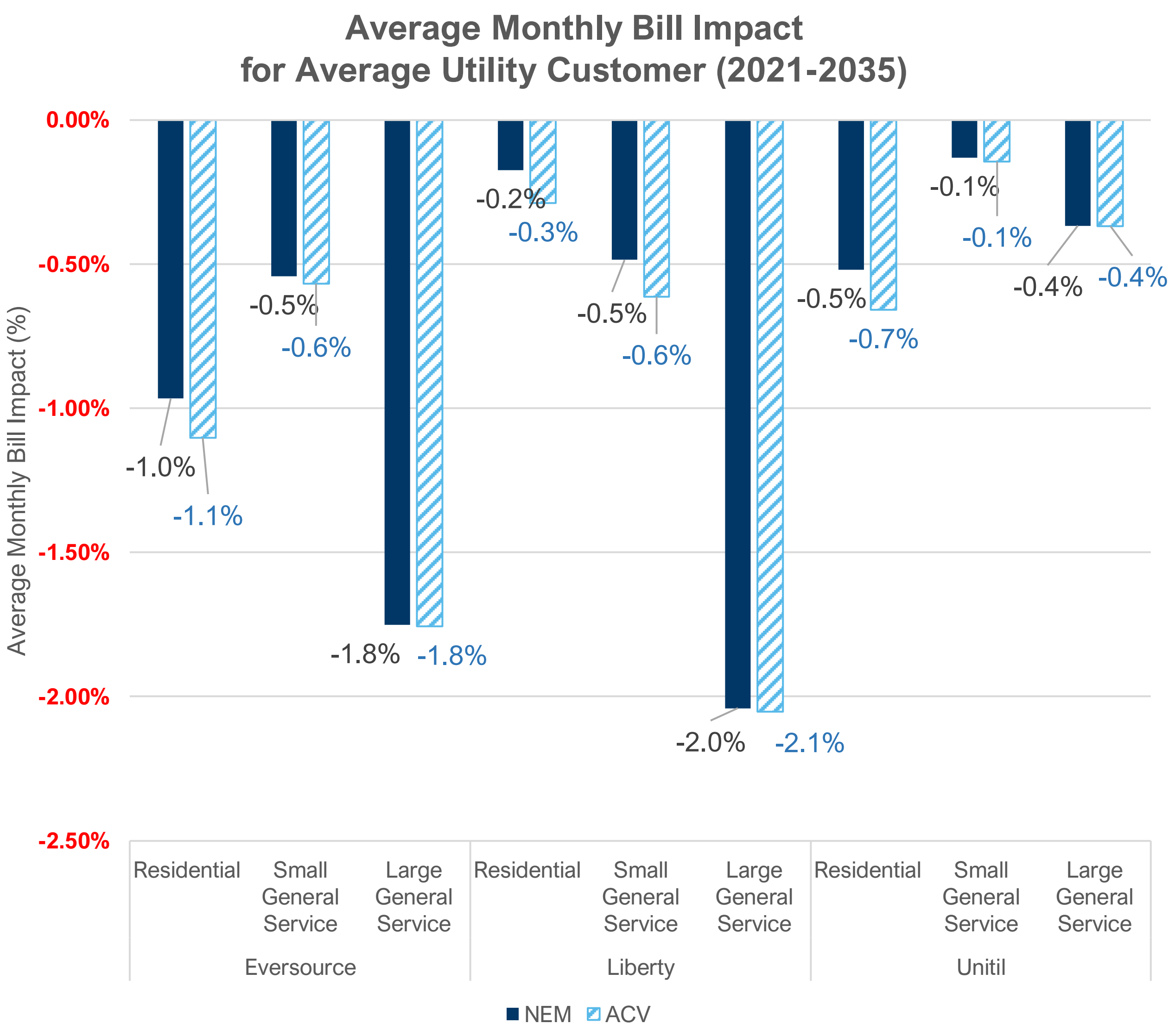
- **Differences** are predominantly observed in customer sectors **where a significant portion of the generated energy is exported to the grid**
  - **Residential customers** across all three utilities **experience lower rate increase impacts**
  - **Similar rate impacts are experienced for all small general service customers.**
  - **Similar rate impacts are observed for large general service customers** across the utilities under both compensation mechanisms



Note: The analysis does not consider the impact the transition to an ACV Tariff would have on DG deployment trends in NH.

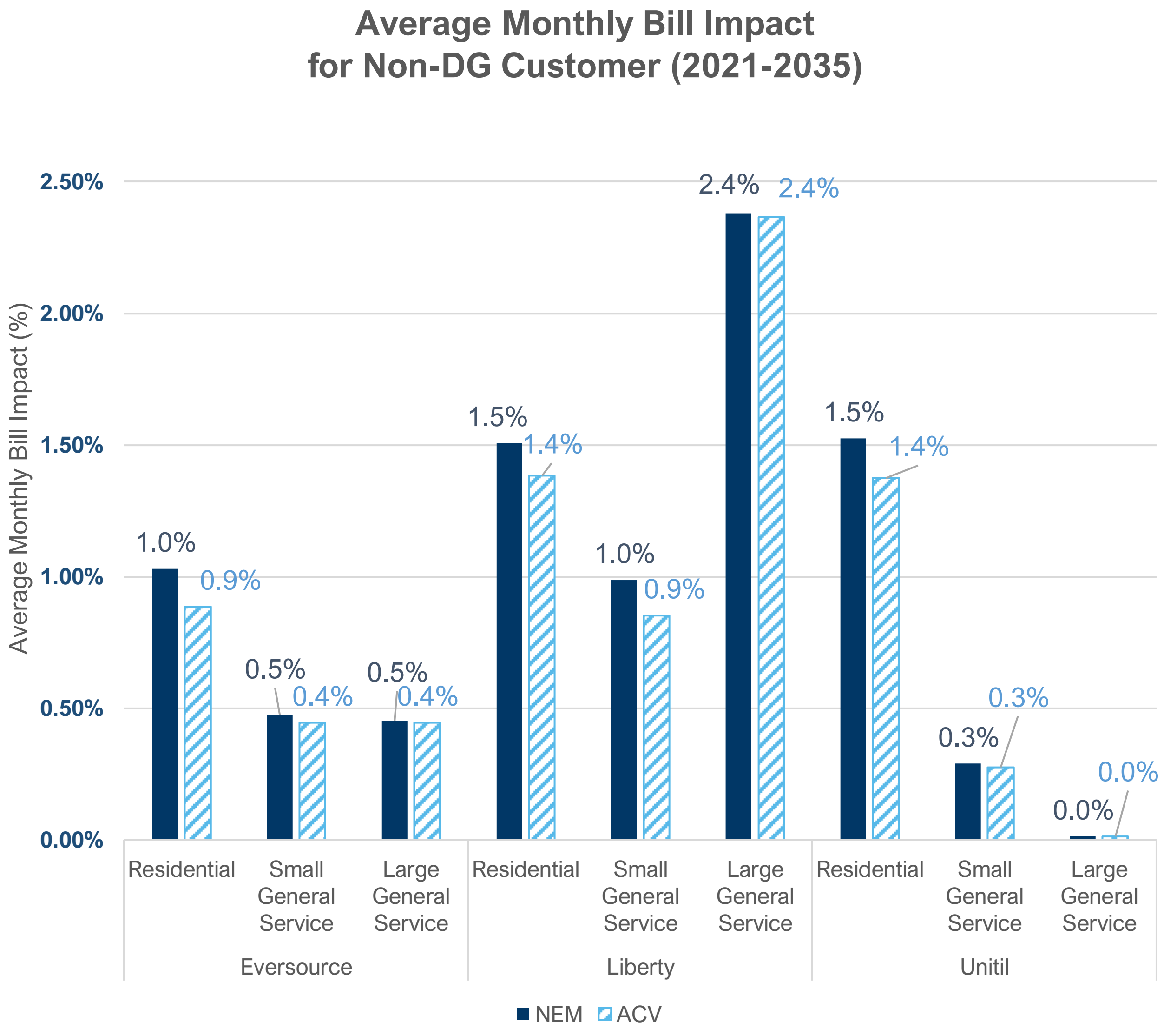
ACV Tariff: Bill Impacts – Average Utility Customer

Insignificant differences in average monthly bill reductions are observed for the average utility customer across most utilities and rate classes.



ACV Tariff: Bill Impacts – Non-DG Customers

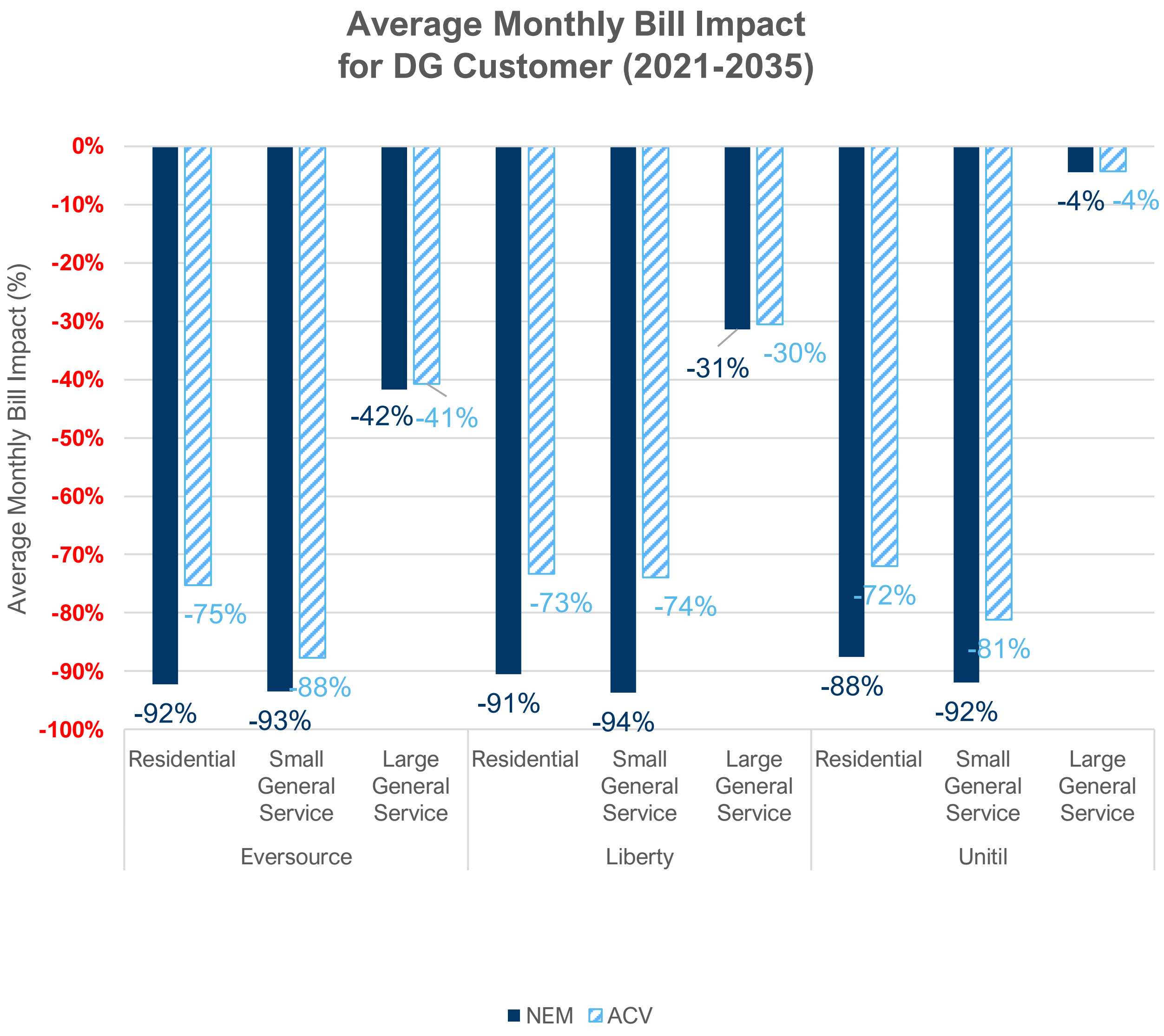
Insignificant differences in average monthly bill impacts are observed for non-DG customers in the affected customer segments under the ACV tariff relative to the NEM tariff.



ACV Tariff: Bill Impacts – DG Customers

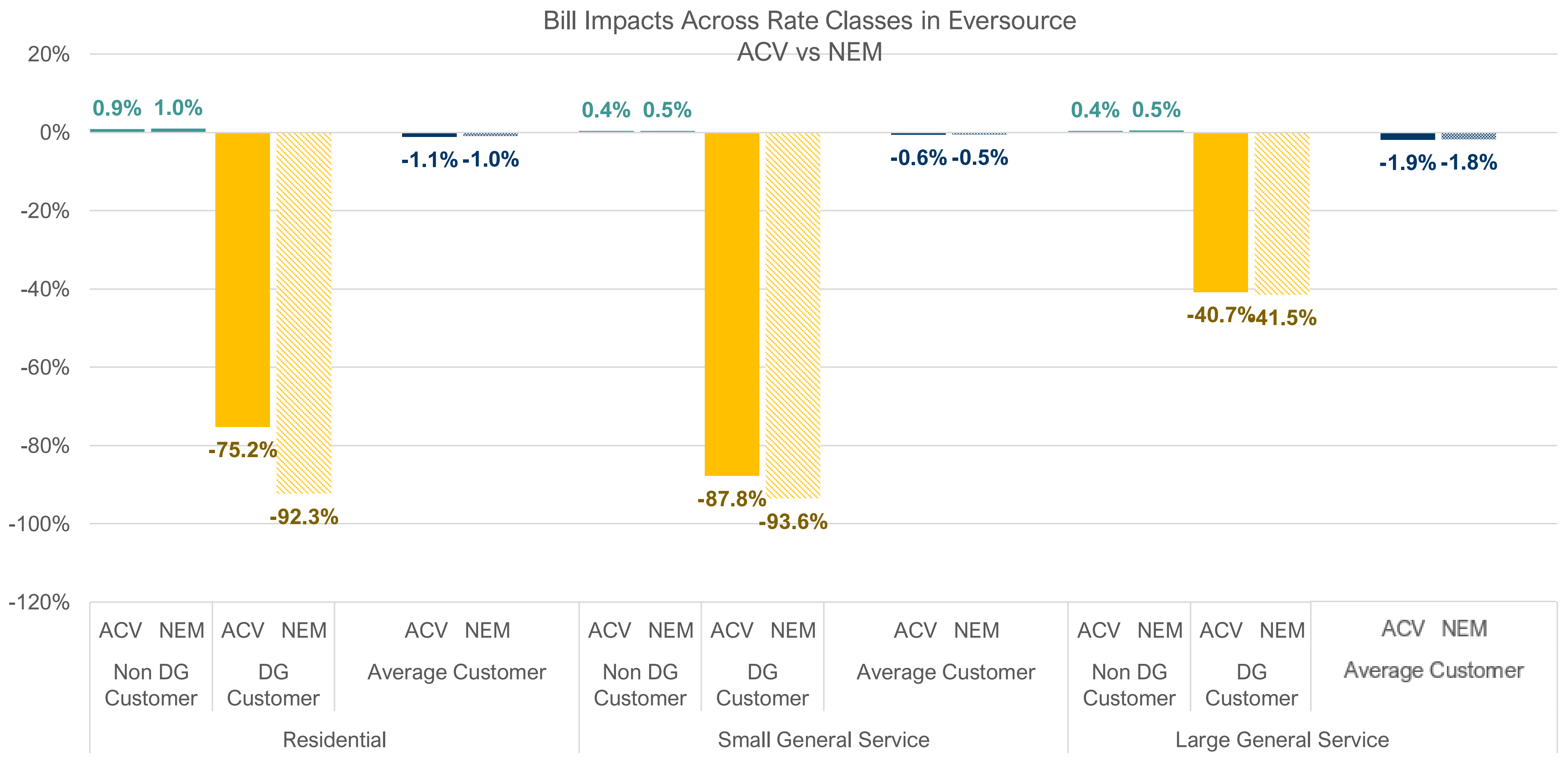
Relatively minor differences are seen in most DG customers' average monthly bills under the ACV and NEM tariffs, with impacts primarily observed in customer segments with higher net exports.

- **Residential Customers** would experience a difference of **18%** in average monthly bill savings as between the ACV and NEM tariffs.
- **Small General Service Customers** would experience a difference of **up to 20%** in their average monthly bill savings under the ACV tariff as compared to the NEM tariff.
- **Large General Service Customers** would experience minimal **impacts in their average monthly bills,** given the large share of DG self-consumption assumed for such customers.



The analysis does not include the cost of installation

Bill Impact Across Rate Classes: Eversource (ACV)



The analysis does not include the cost of installation

Q & A Period

5. Takeaways and Next Steps

- Summary of Key Takeaways
- Next Steps

Key Takeaways: Value Stack Analysis

- In New Hampshire, DERs are forecasted to achieve a total average annual net avoided cost value of **$0.11 to $0.18 per kWh energy produced in 2021** and **$0.10 to $0.23 per kWh produced in 2035**, varying by DER system type, and excluding environmental externalities
- West-facing systems provide **5-10% greater avoided cost value**; however, customer-generators in New Hampshire are currently incentivized to maximize solar production by installing south-facing systems.
- **Net-metered DERs are expected to provide some additional value beyond what is shown here**, notably for those value stack criteria addressed qualitatively in this study: transmission capacity (for non-pool transmission facilities), transmission and distribution system upgrades, distribution grid support services, and resiliency. Additional research and data collection might support quantifiable valuation of these criteria in the future.
- The results that are presented show annual averages for representative years, however values within a year vary – sometimes significantly – by hour. **Storage can target load reductions such that they occur during periods of higher avoided cost value**.

Key Takeaways: Rate & Bill Impacts Analysis

- **All rate classes would be expected to see minimal rate increases** however the average utility customer would see a decrease in bills under both the NEM and ACV Tariff scenarios.
- For all utilities and all rate classes the average utility customer sees a decrease in average monthly bill amounts
- Monthly **bills would increase by a small percentage for non-DG customers** (1% to 1.5% for residential, 0.3% to 2.6% for commercial), but would **decrease by a large percentage for DG customers**
- **There are minimal differences between the RBI impacts under the NEM and ACV tariffs**, which are largely concentrated in rate classes with a higher proportion of DG exports.

Next Steps

- Written comments will be accepted **by email** until October 5
    - Stakeholder comments should be submitted to: Deandra Perruccio
        - deandra.m.perruccio@energy.nh.gov
    - **Note: stakeholders' comments should also be circulated to all those on the distribution list**

- Final report to be submitted to the DOE by **October 31, 2022**

Q & A Period

Contact

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APPENDIX

Technology Neutral Value Stack

- The *Avoided Energy Supply Components in New England: 2021 Report* (AESC or AESC 2021) study methodologies and avoided costs are used for various value stack components, as outlined in the study parameters that were developed through the stakeholder group process and approved by the Commission.

- AESC 2021 contains four "counterfactual" scenarios that forecast avoided costs under various assumptions regarding the degree of demand-side resource deployment in New England. **For this study we used Counterfactual #2**.

	Description
Counterfactual #1	Excludes EE, ADR, and BE impacts
Counterfactual #2	Excludes BE impacts only
Counterfactual #3	Excludes EE impacts only
Counterfactual #4	Excludes EE and ADR impacts only

- For the VDER Study, the ideal avoided cost scenario would include region-wide EE, ADR, BE, and transportation electrification impacts along with non-New Hampshire distributed generation impacts. This scenario, unfortunately, is not readily available.

- In the absence of the ideal scenario, Counterfactual #2 – which excludes BE impacts – is deemed the most appropriate AESC 2021 scenario.

- Data for the AESC components (i.e., those evaluated using AESC data, methods, and results) is taken from Counterfactual #2 unless otherwise indicated in the methodologies.

Value Stack: Representative DG System Output Profiles

Sector	System	Size	Assumed BTM Consumption (% of Total Production)
Residential	South-facing solar	7.8 kW DC	38% (Hourly Netting)
	West-facing solar	7.8 kW DC	-
	South-facing solar with storage	7.8 kW DC solar system 4-hour duration 2.5 kW (10 kWh) storage system	-
Commercial	South-facing solar	36 kW DC	24% (Hourly Netting)
	West-facing solar	36 kW DC	-
	South-facing solar with storage	36 kW DC solar system, 4-hour duration 10 kW (40 kWh) storage system	-
	Large Group Host Commercial Solar	195 kW DC, single-axis tracking	0%
	Micro Hydro	3 MW	0%

For the purpose of the value stack assessment, we calculated the hourly netting from a south-facing solar PV system then applied this assumption to the west-facing and south-facing solar with storage systems within a given sector. Although the current NEM tariff in New Hampshire uses monthly netting, hourly netting is an emerging practice used in VDER studies conducted in other jurisdictions given its ability to capture temporal values more granularly.

RBI: Modelling Assumptions

The RBI assessment captures the impact of the avoided costs on generation, distribution, and transmission rate components. Environmental Externalities were not included in the rate and bill impacts assessment.

- **Generation**: For the rate impact assessment, Avoided Energy, RPS, Ancillary Services, Distribution and Transmission Line Losses, and Risk Premium were considered pass-through components, while Avoided Capacity and DRIPE benefits were considered to have an impact on rates.
- **Distribution**: For the bill and rate impact, we included Avoided Distribution CAPEX and OPEX, Distribution Grid Services, T&D System Upgrades, and Resiliency Services.
- **Transmission**: We included transmission Capacity and Transmission Charges for the bill and rate impact. The rate impact assessment assumes only the portion attributable to the part of NH load as a percentage of the ISO-NE system ~ 9.54%.
- **Cost allocation assumes that 100% of the cost recovery is attributed to the group causing it.**

- **Monthly netting is assumed for residential and small general service customers and hourly netting for large general service customers.**
- **Rate Class Assumptions:**
  - **Small General Service:** All commercial customers with less than 1 million kWh electric sales.
  - **Large General Service:** All commercial customers with greater than 1 million kWh electric sales.

PV System sizes are based on aggregated utility data (AC kW)

Customer	Eversource	Unitil	Liberty	% Self Consumed
Residential	7.6	12.2	10.1	72% (Monthly Netting)
Small Commercial	24.5	43.0	41.3	65%- (Monthly Netting)
Large Commercial	329.2	47.2	209.6	99% (Hourly Netting)

RBI: Modelling Assumptions: Forecasted DG Uptake

Between 2021 and 2030, ISO-NE forecasts that an additional 140 MW of distributed generation will be deployed in NH

- The forecast uptake is in addition to the ≈120 MW already deployed in the state today.
- Predominantly expected to be BTM Solar
- Using insights from historical interconnection data, we estimate the expected distribution of DG uptake among utilities and rate classes