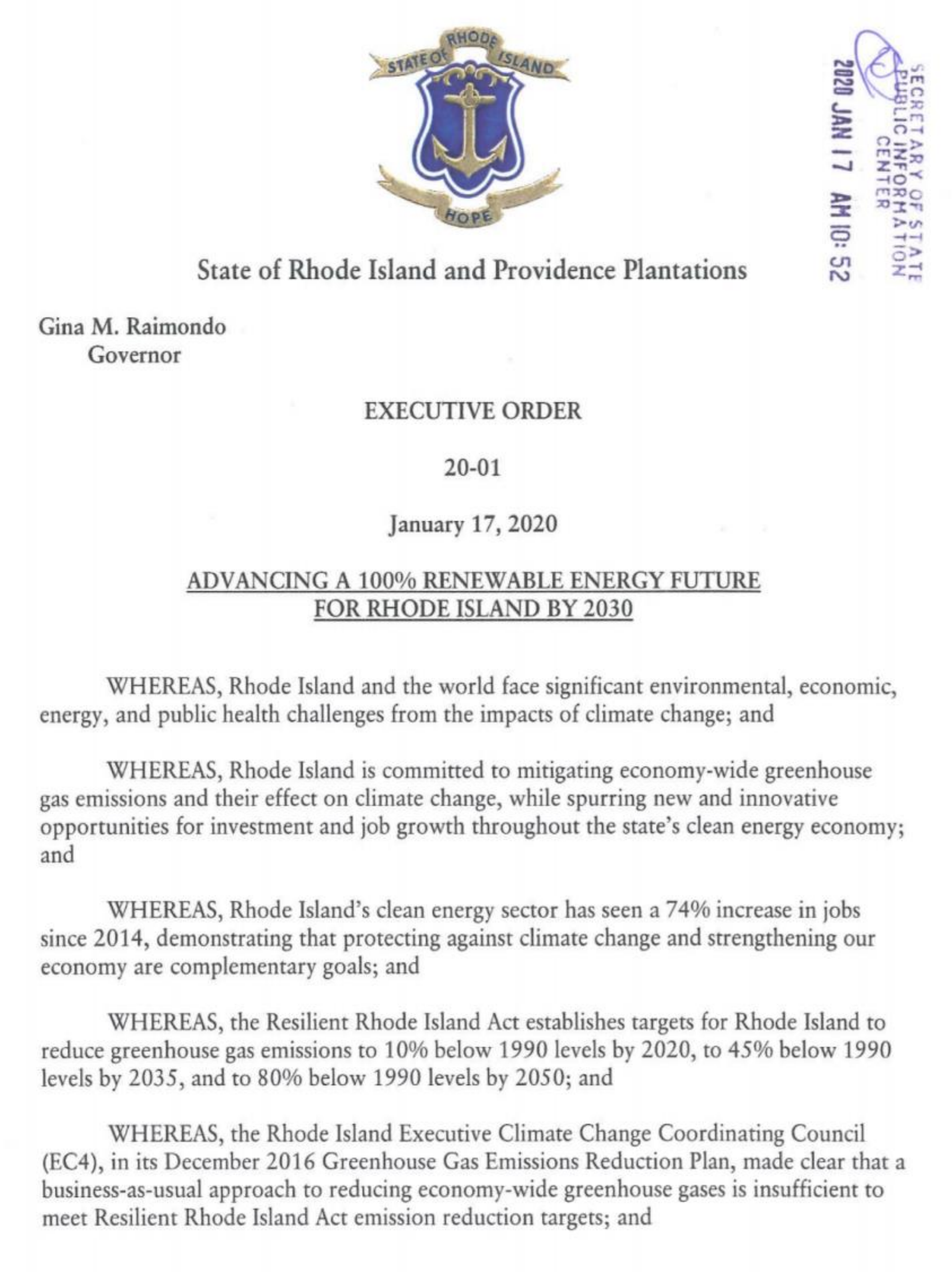
The Road to 100% **Renewable Electricity** 2030



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State of Rhode Island and Providence Plantations

Gina M. Raimondo
Governor

EXECUTIVE ORDER

20-01

January 17, 2020

ADVANCING A 100% RENEWABLE ENERGY FUTURE FOR RHODE ISLAND BY 2030

WHEREAS, Rhode Island and the world face significant environmental, economic, energy, and public health challenges from the impacts of climate change; and

WHEREAS, Rhode Island is committed to mitigating economy-wide greenhouse gas emissions and their effect on climate change, while spurring new and innovative opportunities for investment and job growth throughout the state's clean energy economy; and

WHEREAS, Rhode Island's clean energy sector has seen a 74% increase in jobs since 2014, demonstrating that protecting against climate change and strengthening our economy are complementary goals; and

WHEREAS, the Resilient Rhode Island Act establishes targets for Rhode Island to reduce greenhouse gas emissions to 10% below 1990 levels by 2020, to 45% below 1990 levels by 2035, and to 80% below 1990 levels by 2050; and

WHEREAS, the Rhode Island Executive Climate Change Coordinating Council (EC4), in its December 2016 Greenhouse Gas Emissions Reduction Plan, made clear that a business-as-usual approach to reducing economy-wide greenhouse gases is insufficient to meet Resilient Rhode Island Act emission reduction targets; and

Executive Order 20-01

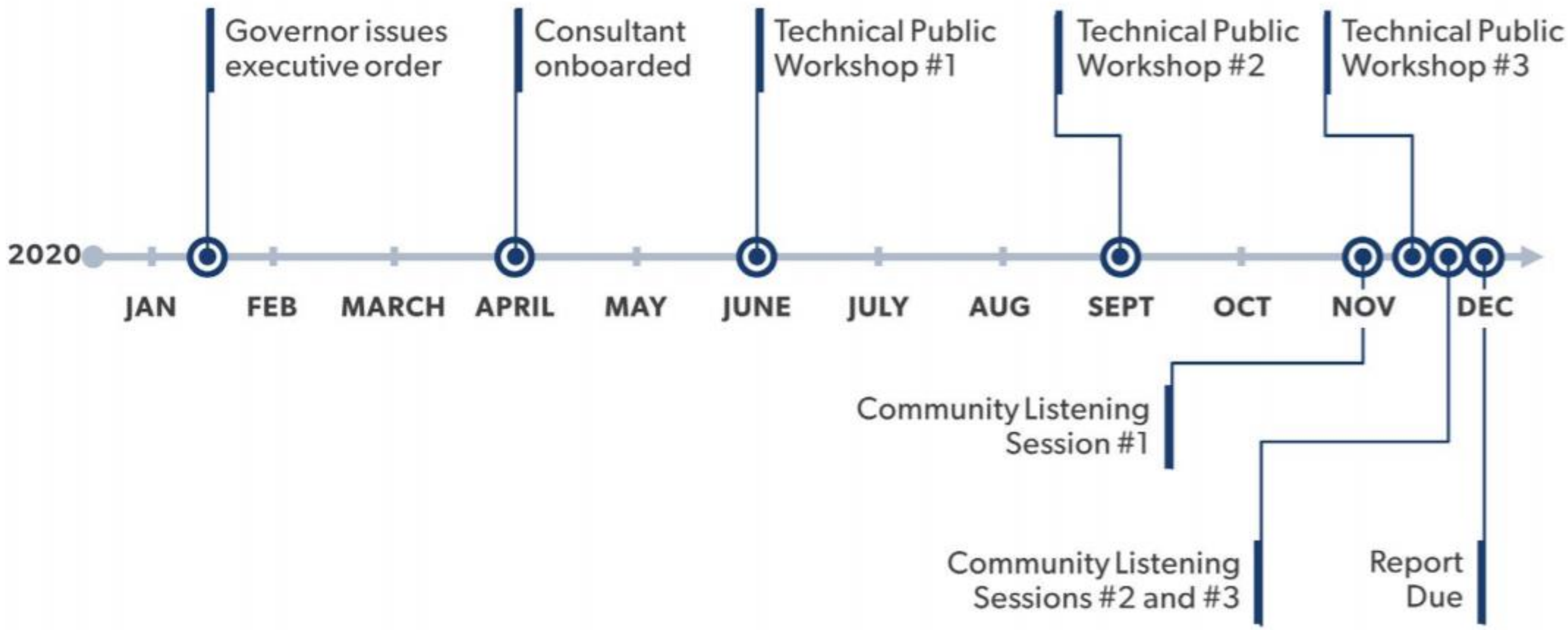
Goal
Meet 100% of the state's electricity demand with renewable energy resources by 2030.

Process
OER shall conduct economic & energy market analysis, and develop viable policy & programmatic pathways.

Results
Implementable action plan by December 31, 2020.

Led by OER with consultant The Brattle Group with input from state agencies and public stakeholders.

Timeline



Project website: www.energy.ri.gov/100percent

Putting the pieces together...

There are four integrated components of the 100% Renewable by 2030 effort:

Foundational principles, developed by the project team to align with the Governor's executive order and informed by stakeholders.

Technical analysis, informed by principles and stakeholder input, illuminated the costs and benefits of hypothetical resource portfolios.

Stakeholder input, informed the foundational principles, analytical inputs and assumptions, and shaped policy recommendations – thank you!

Policy and programmatic recommendations, developed to satisfy the goals of the Executive Order in a manner consistent with the principles, technical analysis, and stakeholder input.

Guiding Principles for 100% Renewable Goal - Summary

Decarbonization Principles

- Exemplify climate leadership
- Create incremental power sector decarbonization
- Facilitate broader decarbonization

Economic Principles

- Pursue cost-effective solutions
- Improve energy and environmental equity
- Create economic development opportunities

Policy Implementation Principles

- Ensure solutions are robust and sustainable beyond 2030
- Build upon RI's existing renewable energy mechanisms
- Be consistent with other RI priorities and policies

Forecasting Demand

We forecasted demand in 2030 accounting for energy efficiency, behind-the-meter PV, thermal and transportation electrification, and trends in electricity consumption.

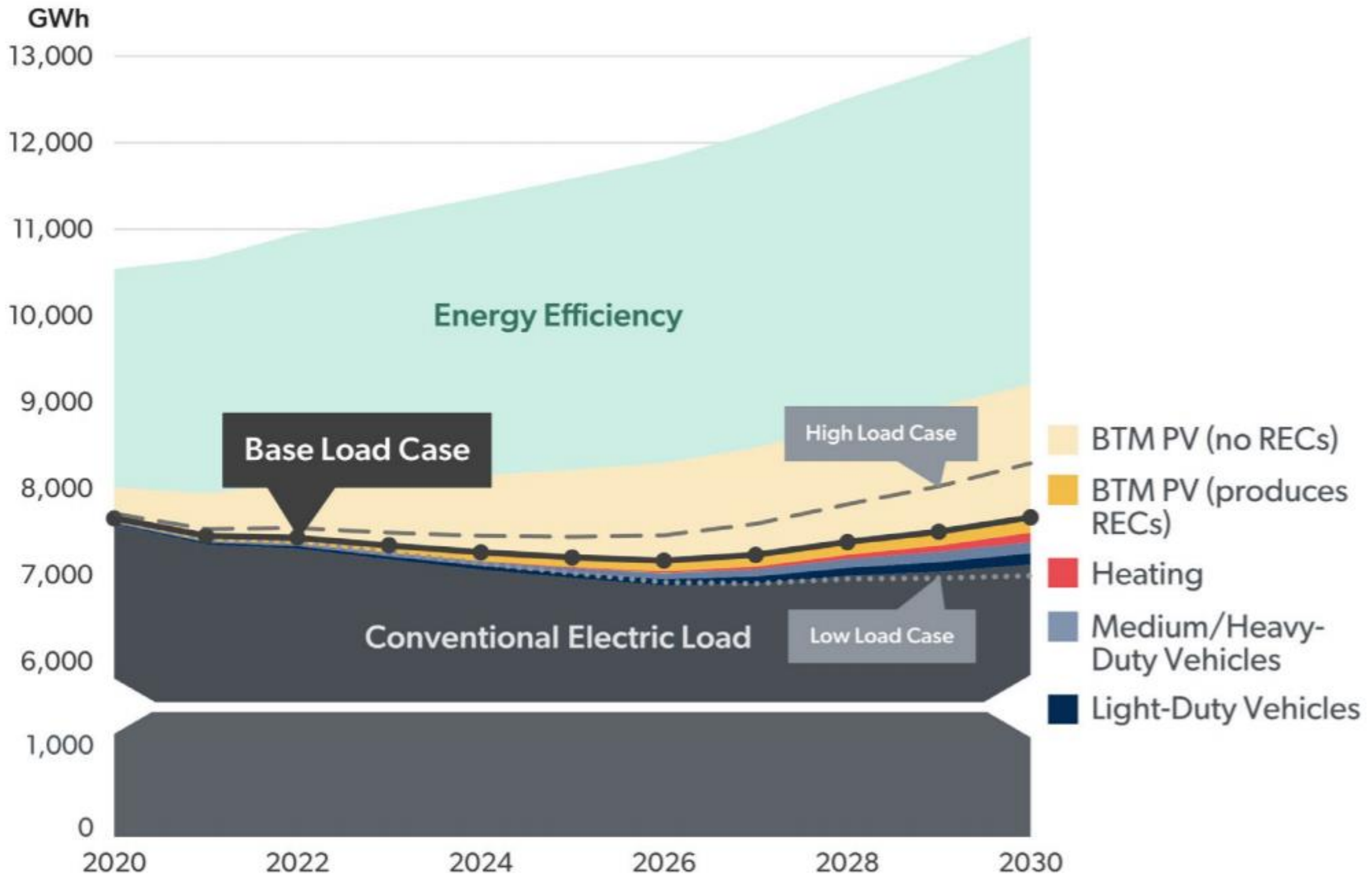


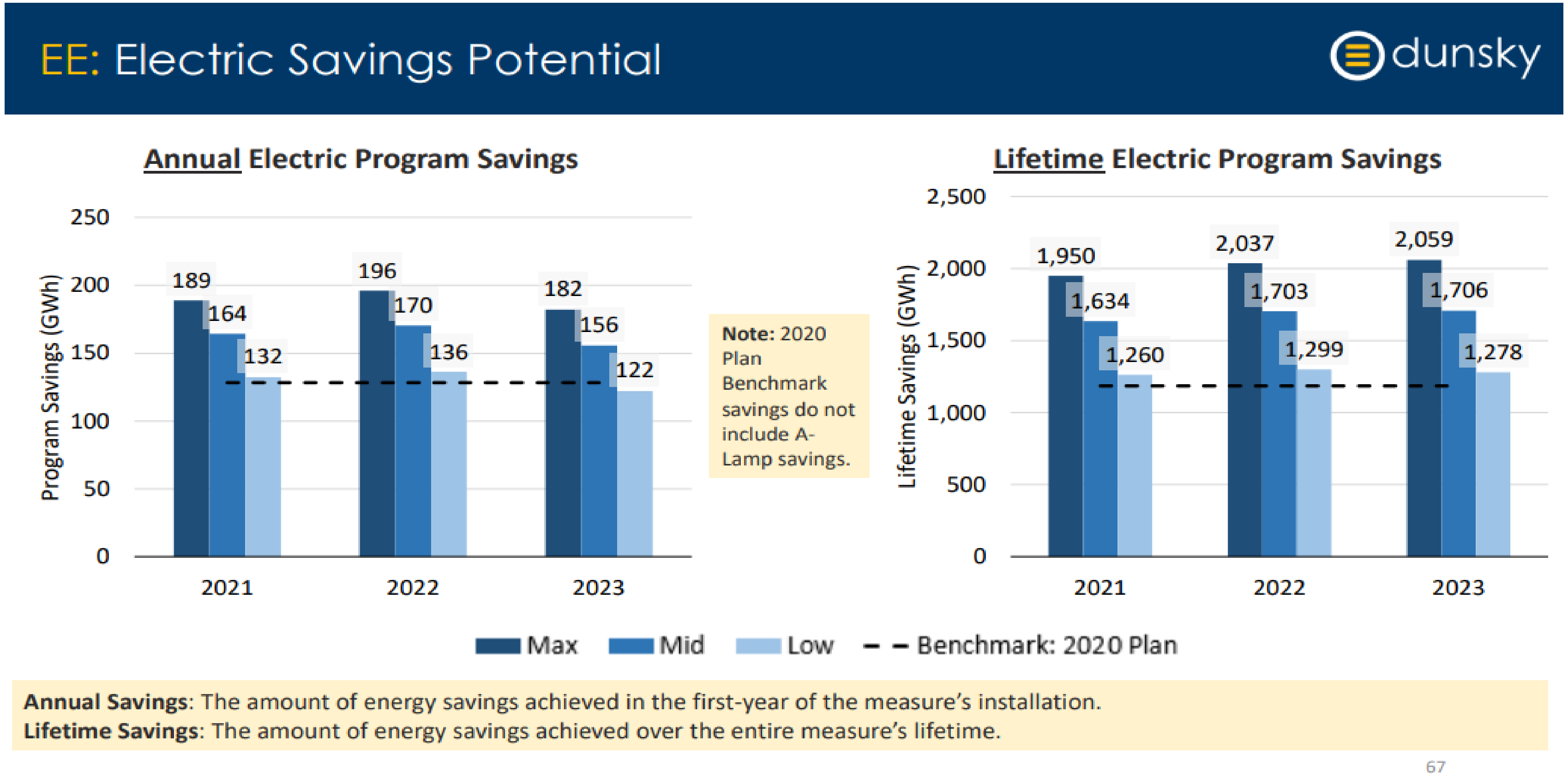
FIGURE 2: PROJECTED RHODE ISLAND ELECTRICITY DEMAND (2020–2030)

Note: "BTM PV" is Behind-the-Meter solar photovoltaic generation

Forecasting Demand – Energy Efficiency

The 100% Analysis assumes 150 GWh/year of energy efficiency savings.

For context, EE programs and investments in recent years have delivered the following:



	Annual Plan Year					
	2015	**2016**	**2017**	**2018**	**2019**	**2020***
Annual GWh Saved (Electric Only)	222.822	214.329	232.023	206.209	190.159	156.847

*Only Q4 data report currently available. All other data sourced from Year-End Reports

Estimating the Gap

We forecasting renewable energy growth from existing programs and contracts. The difference between demand and renewables is the gap: we will need to build or procure ~4,600 GWh of renewable energy by 2030

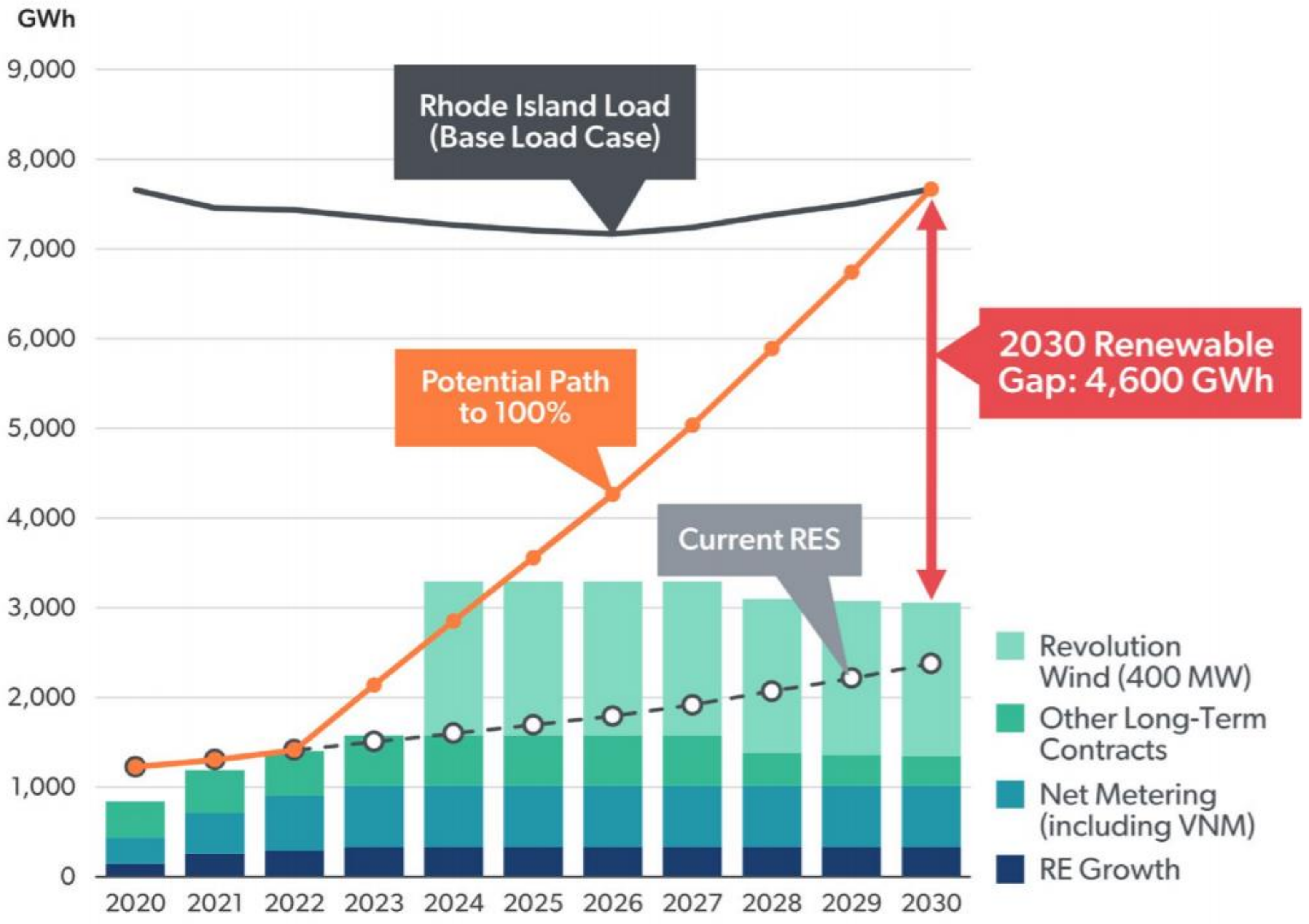


FIGURE 3: RENEWABLE ELECTRICITY GAP TO ACHIEVE 100% RENEWABLES

Filling the Gap in 2030

We considered four renewable energy resource types, first as "technology bookends" and then as pieces of mixed resource portfolios.

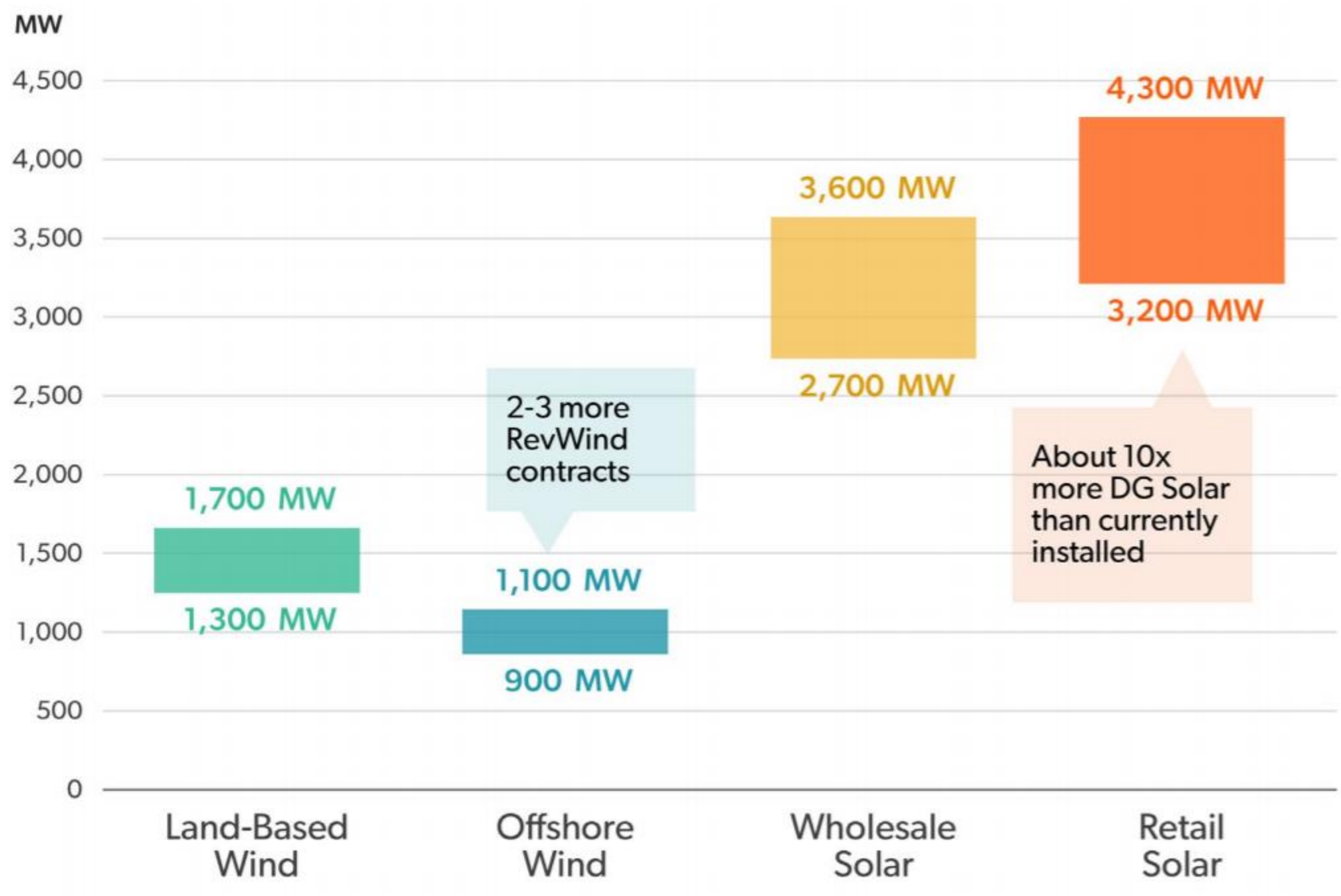


FIGURE 5: CAPACITY OF EACH TECHNOLOGY NEEDED TO FILL 2030 RENEWABLE ENERGY GAP

Sustainable through 2050

Note that continued thermal and transportation electrification will add load and grow the gap from 2030-2050.

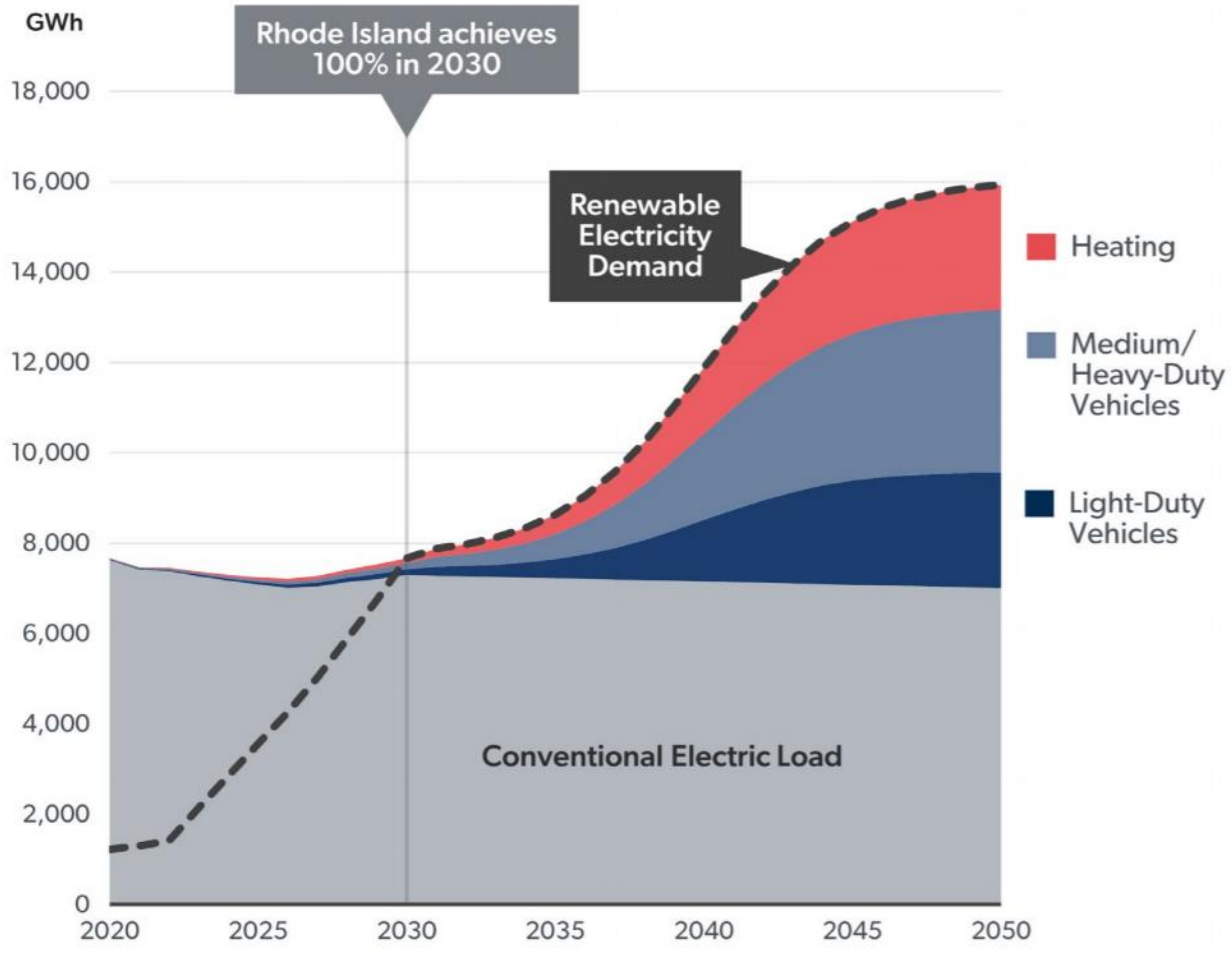
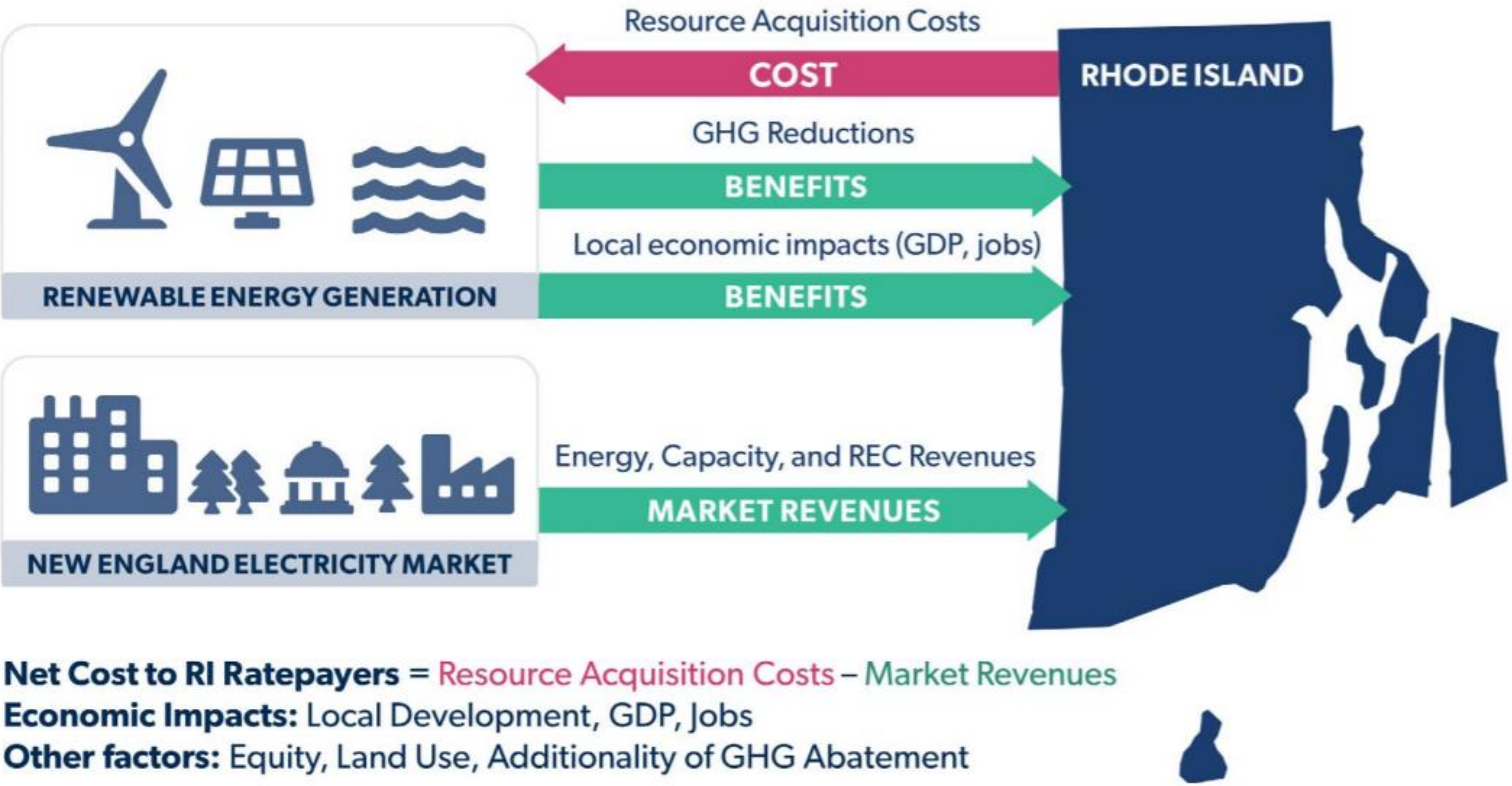


FIGURE 4: POTENTIAL RHODE ISLAND ELECTRICITY DEMAND PROJECTION TO 2050

Pieces of the Model



Net Cost to RI Ratepayers = Resource Acquisition Costs – Market Revenues
Economic Impacts: Local Development, GDP, Jobs
Other factors: Equity, Land Use, Additionality of GHG Abatement

FIGURE 12: IMPACTS OF PROCURING RENEWABLE ENERGY TO ACHIEVE 100% BY 2030

Resource Acquisition Costs

Using input from developers, market data, and cost trends developed by the National Renewable Energy Lab, we projected costs to acquire each type of renewable energy resource.

FIGURE 6: PROJECTED RESOURCE ACQUISITION COSTS THROUGH 2030

Portfolio Costs

These bars represent net costs, after accounting for market revenues, to achieve each portfolio.

Technology bookend costs are compared to meeting the 100% goal by purchasing RECs in lieu of developing local renewable energy resources.

FIGURE 13: NPV OF ABOVE-MARKET COSTS (2020–2040) OF ACHIEVING 100% RENEWABLES; BOOKENDS
(NET OF ENERGY AND CAPACITY REVENUES, NOT RECS)

Note: Ratepayer costs reflect the total incremental costs of achieving 100% net of energy and capacity revenues.

Ratepayer Costs

Portfolio costs will flow to ratepayers through electricity rates, assuming continuation of current policies and programs.

Meeting 100% renewables will result in incremental costs relative to 2020 rates.

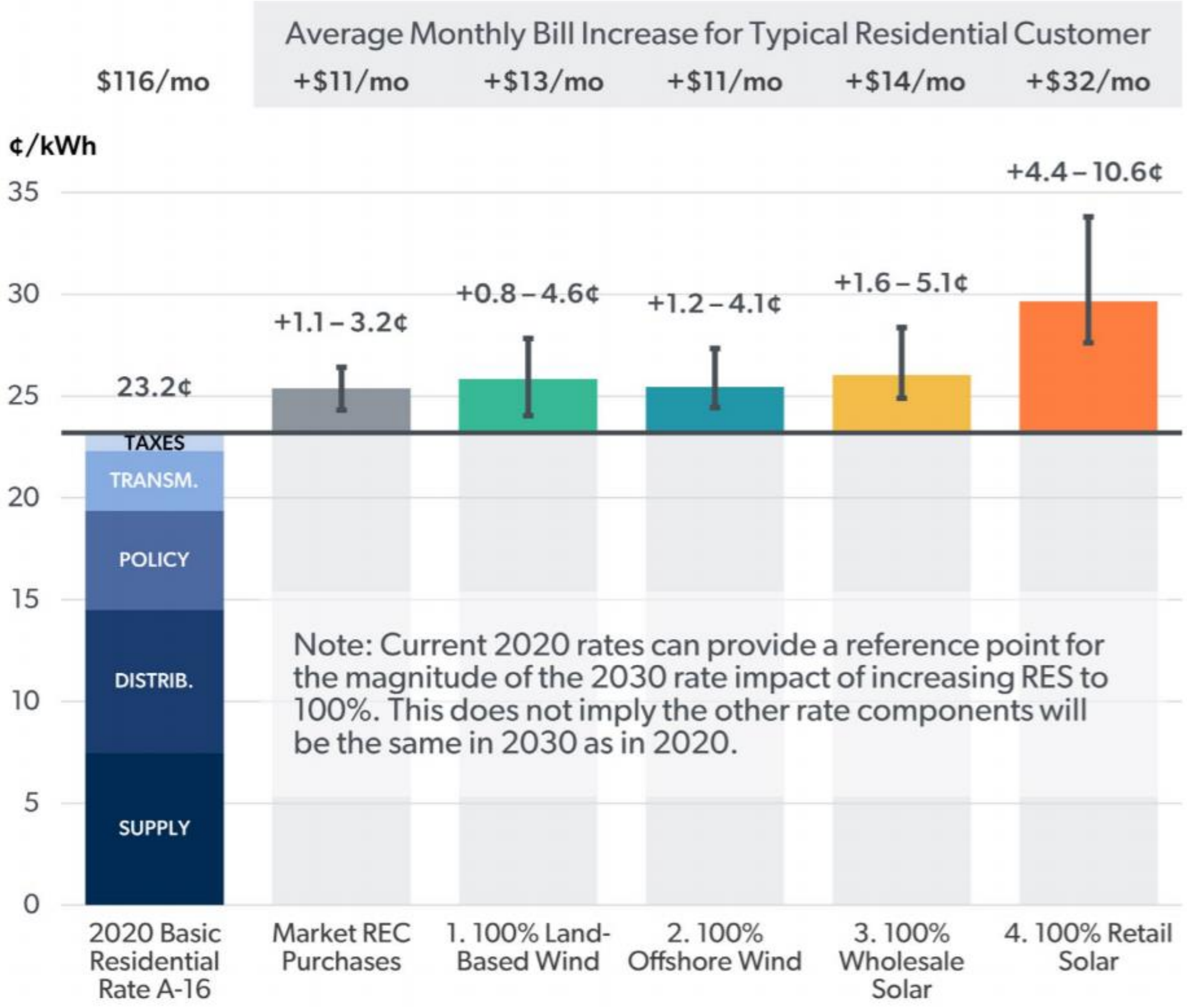


FIGURE 15: 2030 RATE IMPACTS OF 100% RENEWABLE ELECTRICITY

Notes: Assumes typical residential customer consumes 500 kWh/mo.

Macroeconomic Impacts – Single OSW Project GDP

Annual GDP and job impacts were estimated for a single, representative project using IMPLAN, a macroeconomic modeling tool.

Project impacts were layered together based on capacity required in each portfolio.

In-state construction boosts GDP in beginning years, while O&M and tariffs drive impacts in later years.

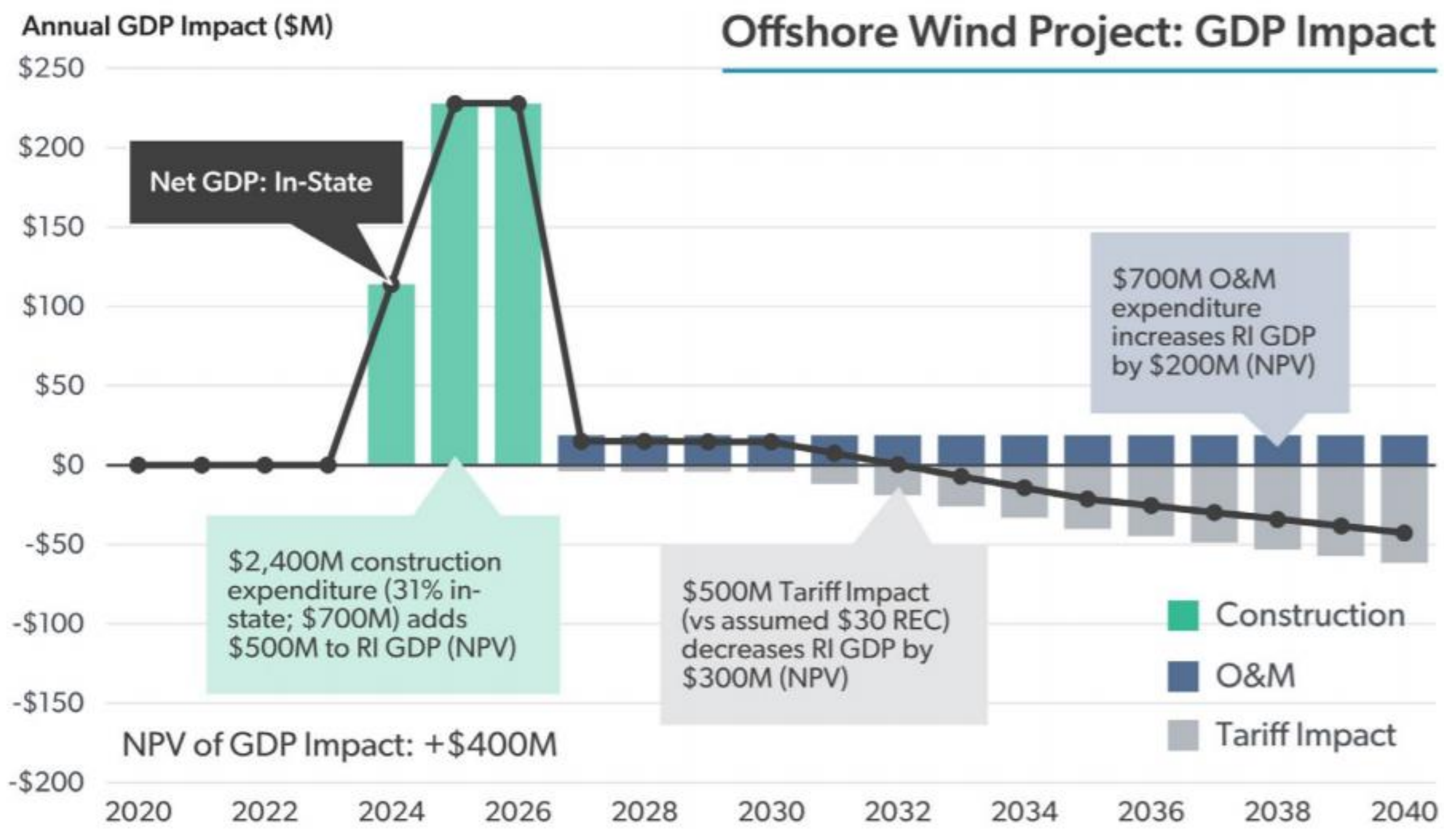


FIGURE 16: GDP AND EMPLOYMENT IMPACTS OF 600 MW OFFSHORE WIND PROJECT

Note: NPV of GDP impact shows the net present value (3% real discount rate) of GDP impacts from 2020 through 2040.

Macroeconomic Impacts – Single OSW Project Jobs

This figure shows the estimated annual and net jobs impact of a hypothetical 600 MW OSW project procured by Rhode Island, with a portion of construction expenditures made in-state.

One job-year is a full-time job for one year.

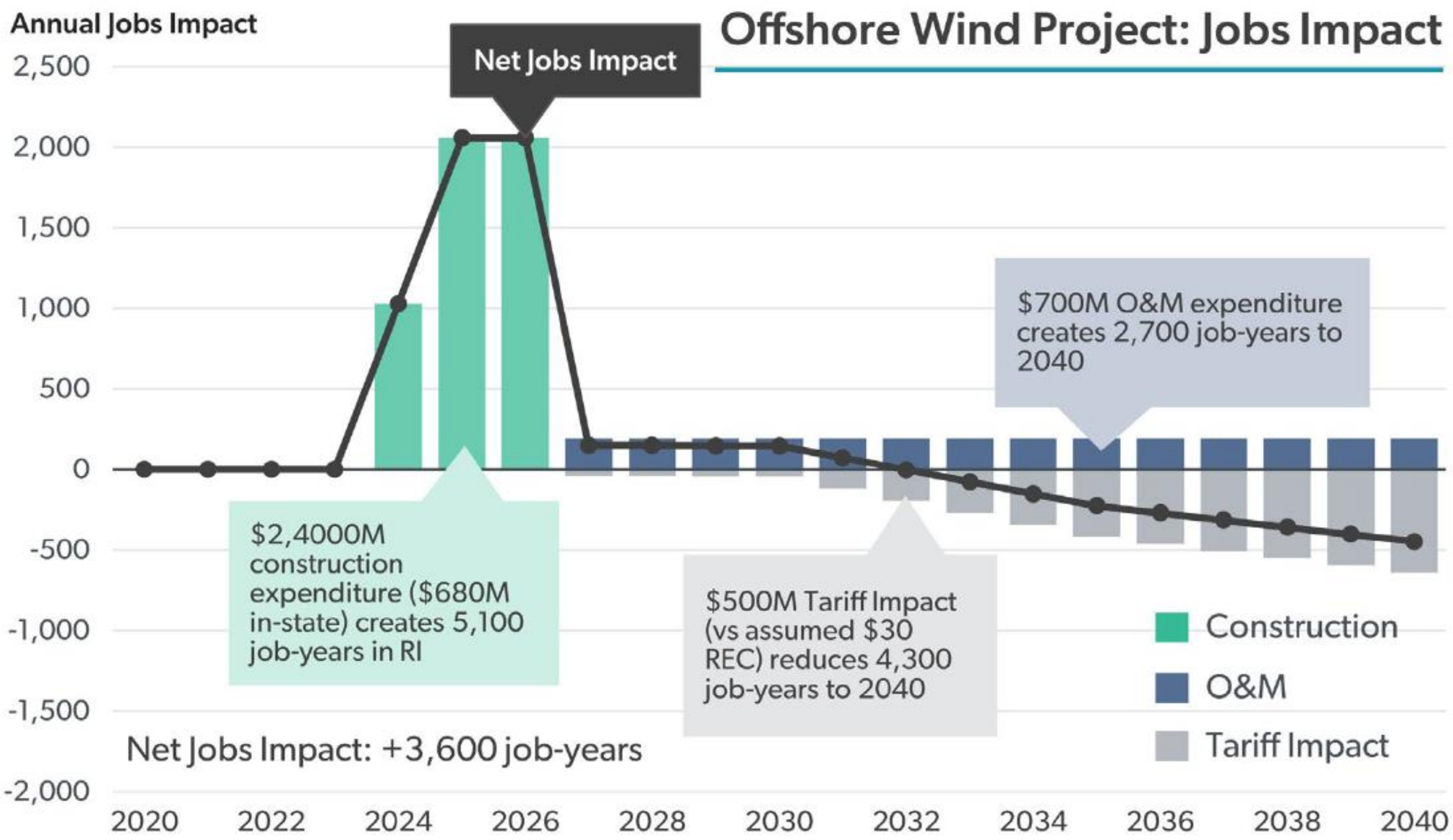


FIGURE 16: GDP AND EMPLOYMENT IMPACTS OF 600 MW OFFSHORE WIND PROJECT

Macroeconomic Impacts – Bookend OSW GDP

This figure shows the GDP impact of utilizing an all-OSW portfolio rather than just procuring market RECs.

Note that GDP is calculated through 2040, however, O&M and tariff impacts would continue beyond that timeframe.

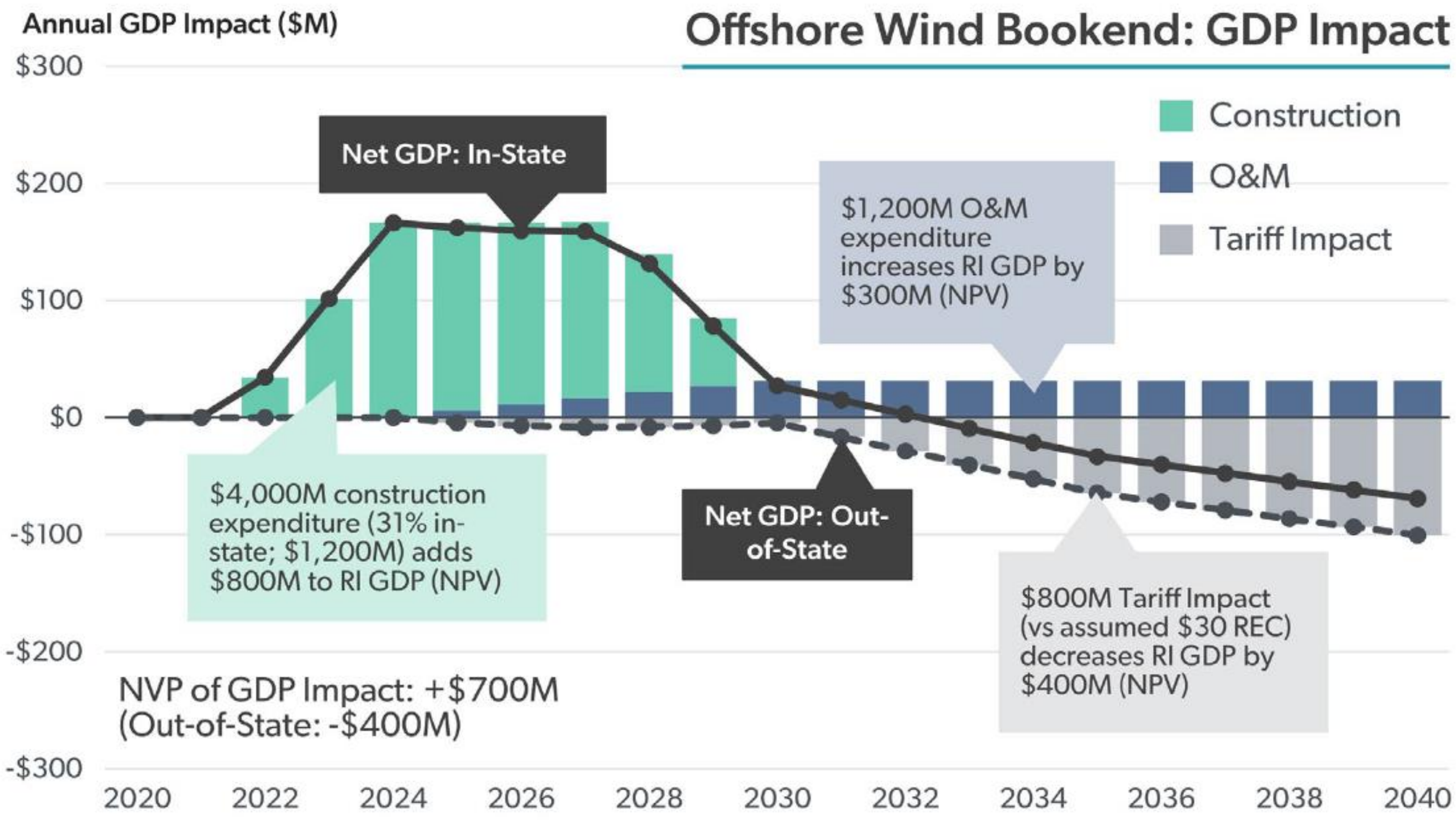


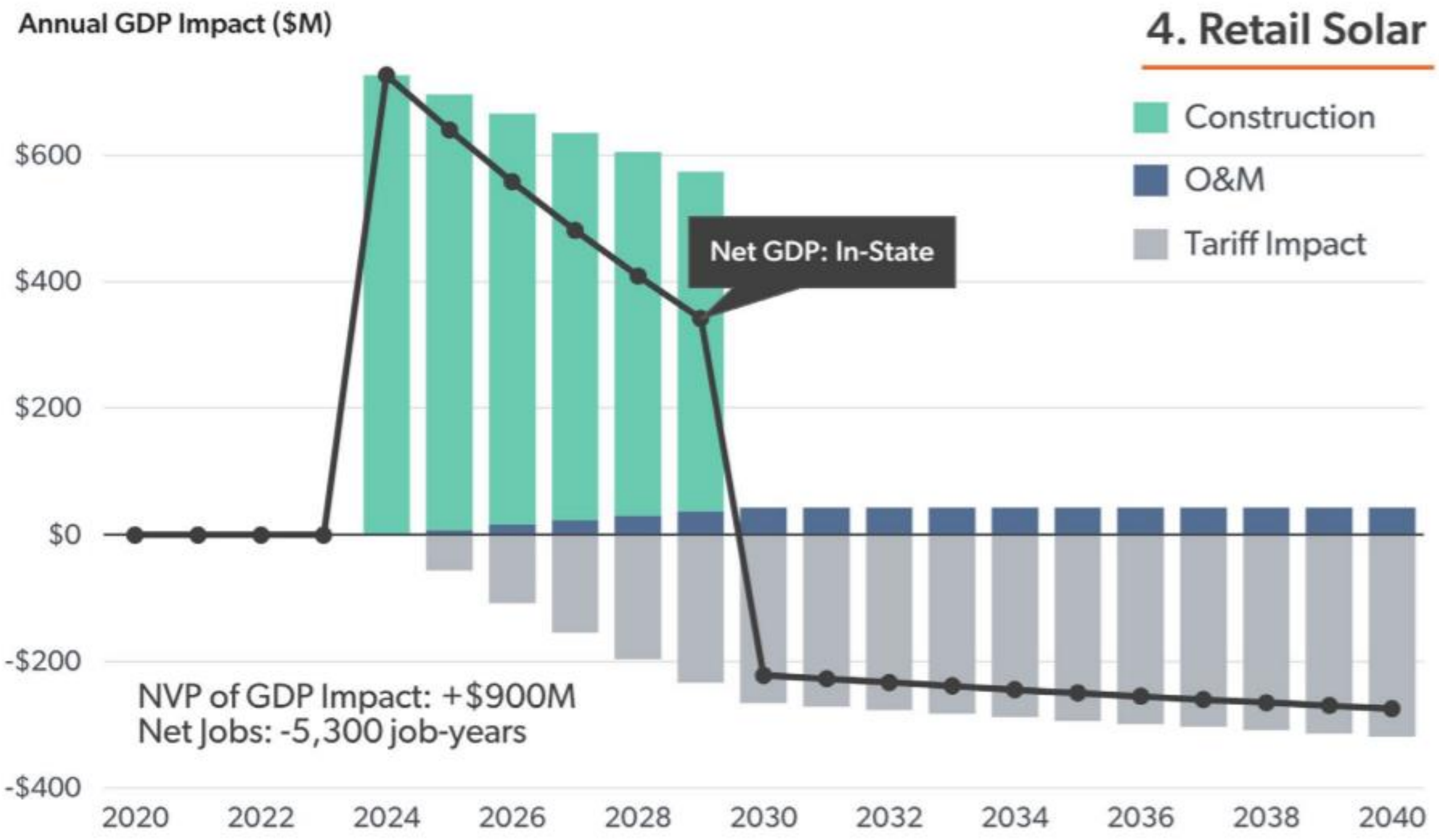
FIGURE 17: RHODE ISLAND GDP IMPACT OF OFFSHORE WIND TECHNOLOGY BOOKEND

Note: O&M and Tariff Impact continue until the off-shore wind plants shut down (or the contract terminates), but are not forecasted here beyond 2040, due to the challenges and uncertainties associated with projecting such distant periods. NPV is calculated for 2020-2040.

Macroeconomic Impacts – Bookend Retail Solar GDP

Retail solar has a larger impact on GDP. This is due to the local nature of retail solar and positive impacts of associated jobs during construction, as well as to the higher costs and tariff impacts following construction.

Net jobs, however, are shown to be substantially negative, as money is take out of general spending to pay for solar tariff costs.



Macroeconomic Impacts

Each renewable resource type will have unique macroeconomic impacts over time, although land-based wind, offshore wind, and wholesale solar impacts are generally clustered.

Impacts are sensitive to REC prices and resource costs, among other parameters.

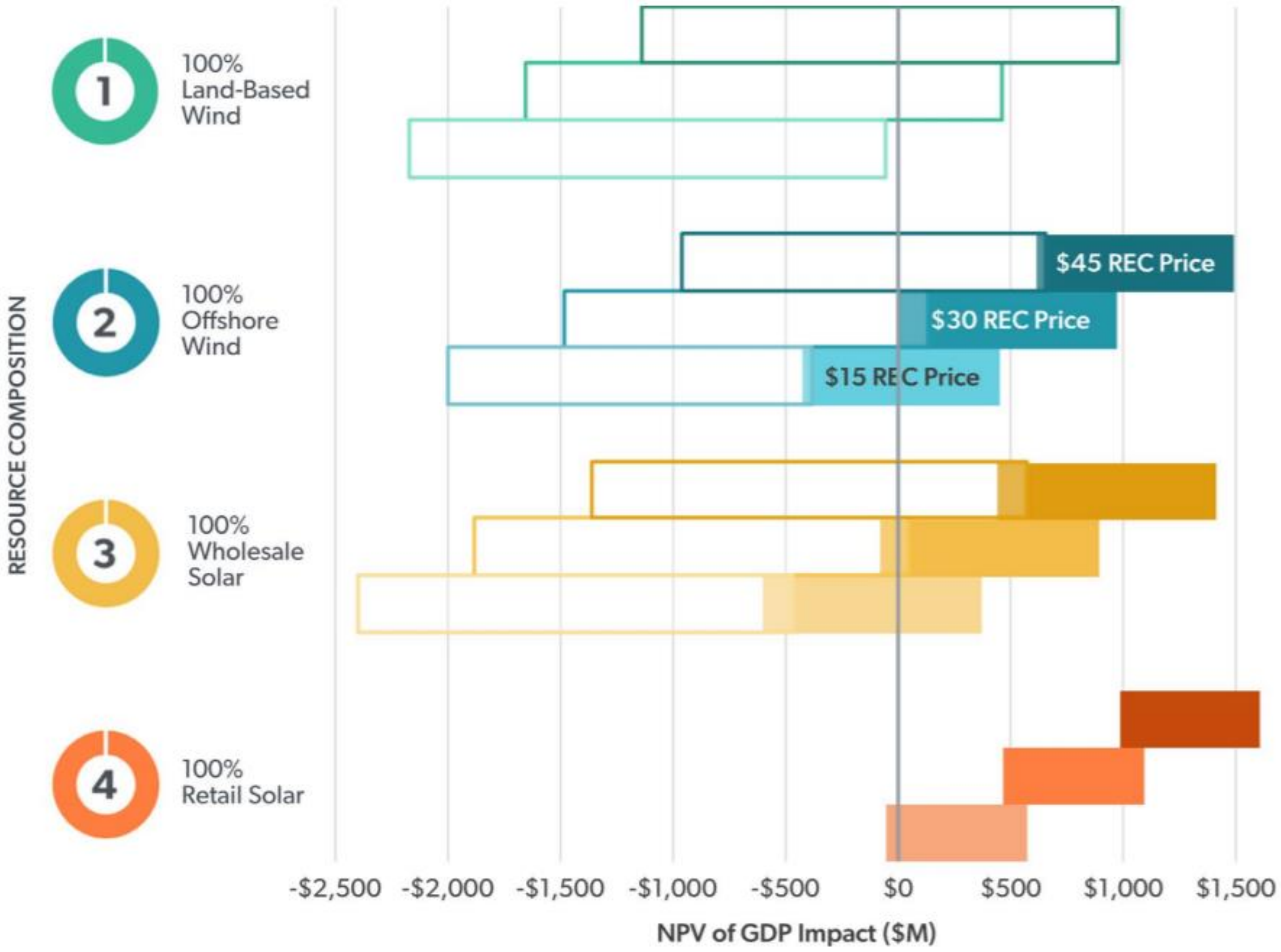


FIGURE 20: NPV OF RHODE ISLAND GDP IMPACT (2020–2040) WITH UNCERTAINTIES; BOOKENDS
(REFLECTING RESOURCE COST & REC PRICE UNCERTAINTY)

Building Mixed Portfolios

Rhode Island's clean energy future will almost certainly contain a mix of renewable energy resource types.

We constructed hypothetical, mixed portfolios that attempted to balance resource diversity, affordability, and local economic development opportunities, in line with our guiding principles.

	Description	Land-Based Wind	Offshore Wind	Wholesale Solar	Retail Solar
5	Max OSW, plus Wholesale Solar	--	600 MW (2,750 GWh)	Fill remaining gap (1,850 GWh)	--
6	Max OSW, RE Programs Maintained	--	600 MW (2,750 GWh)	Fill 50% of remaining gap (925 GWh)	Fill 50% of remaining gap (925 GWh)
7	Robust OSW, RE Programs Maintained	--	400 MW (1,825 GWh)	Fill 66% of remaining gap (1,850 GWh)	Fill 33% of remaining gap (925 GWh)
8	Robust OSW, RE Programs Doubled	--	400 MW (1,825 GWh)	Fill 33% of remaining gap (925 GWh)	Fill 66% of remaining gap (1,850 GWh)
9	Incremental OSW, RE Programs Doubled	--	200 MW (900 GWh)	Fill 50% of remaining gap (1,850 GWh)	Fill 50% of remaining gap (1,850 GWh)
10	Solar Heavy, Some LBW, No New OSW	100 MW (300GWh)	--	Fill ~60% of remaining gap (2,600 GWh)	Fill ~40% of remaining gap (1,700 GWh)

FIGURE 21: TECHNOLOGY PORTFOLIOS – DEFINITIONS

Portfolio Cost Comparison

NPV of above-market costs rise from $2B in Portfolio 5 to $3B for Portfolio 10 (assuming Base Resource Costs), and the cost uncertainty also increases.

Cost uncertainty is primarily driven by the range of resource acquisition costs and results in significant overlap across portfolios.

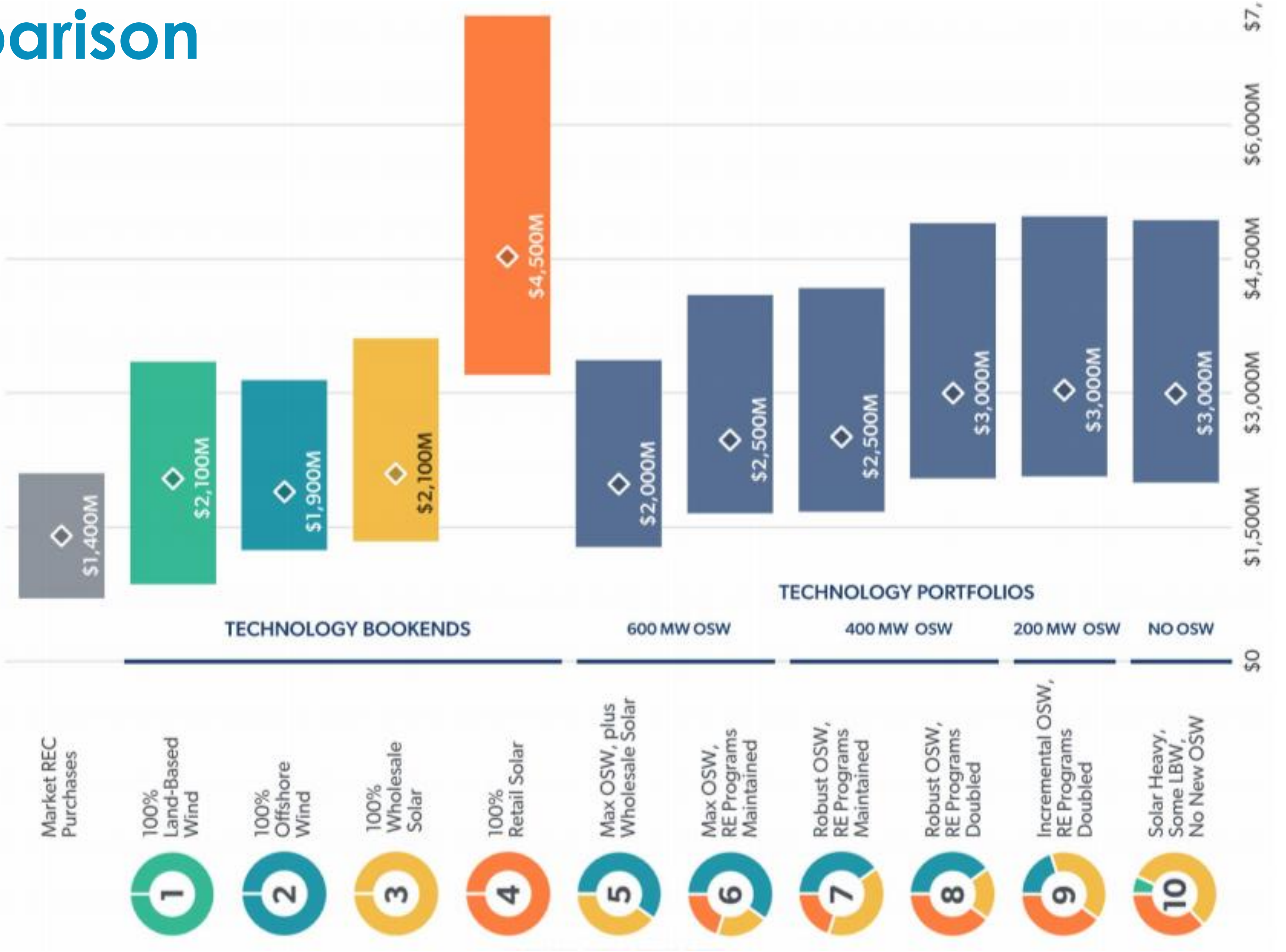


FIGURE 22: NPV OF ABOVE-MARKET COSTS (2020–2040) OF ACHIEVING 100% RENEWABLES; BOOKENDS AND PORTFOLIOS (NET OF ENERGY AND CAPACITY REVENUES, NOT REC REVENUES)

Note: Ratepayer costs reflect the total incremental costs of achieving 100% net of energy and capacity revenues.

Portfolio Macroeconomic Impact Comparison

GDP impacts are similar across mixed resource portfolios, and the uncertainty in the impacts is much greater than the differences across the portfolios.

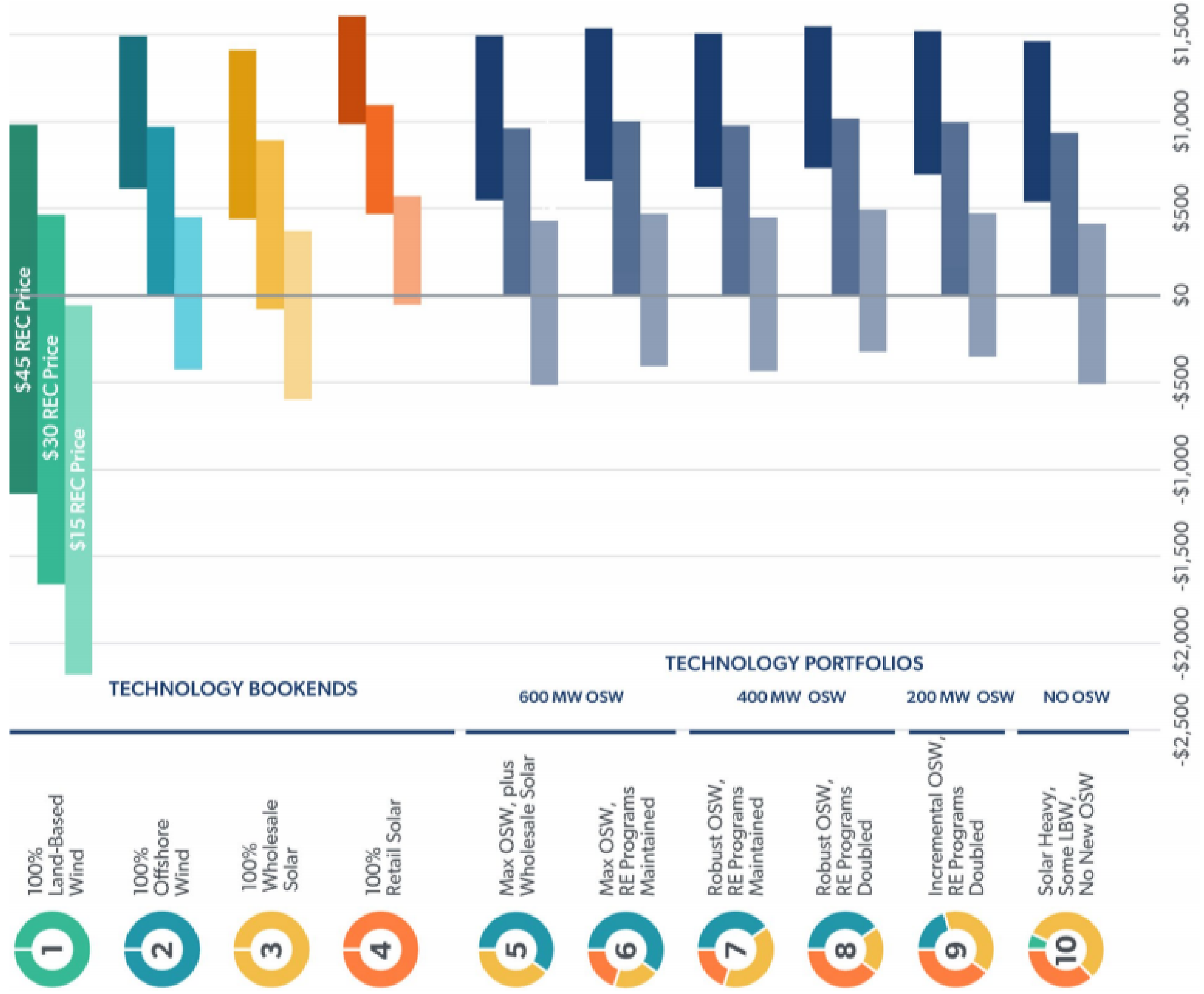


FIGURE 23: NPV OF RHODE ISLAND GDP IMPACT (2020–2040) WITH UNCERTAINTIES; BOOKENDS AND PORTFOLIOS (REFLECTING RESOURCE COST & REC PRICE UNCERTAINTY)

GHG Emissions Impacts [Initial Estimates]

Initial calculations show that achieving this goal will help reduce statewide GHG emissions by ≈ 2.4 million tons of CO2 in 2030.

This corresponds to roughly 19% of our 1990 baseline – a significant step, and timely considering the state's 45% by 2035 interim target.

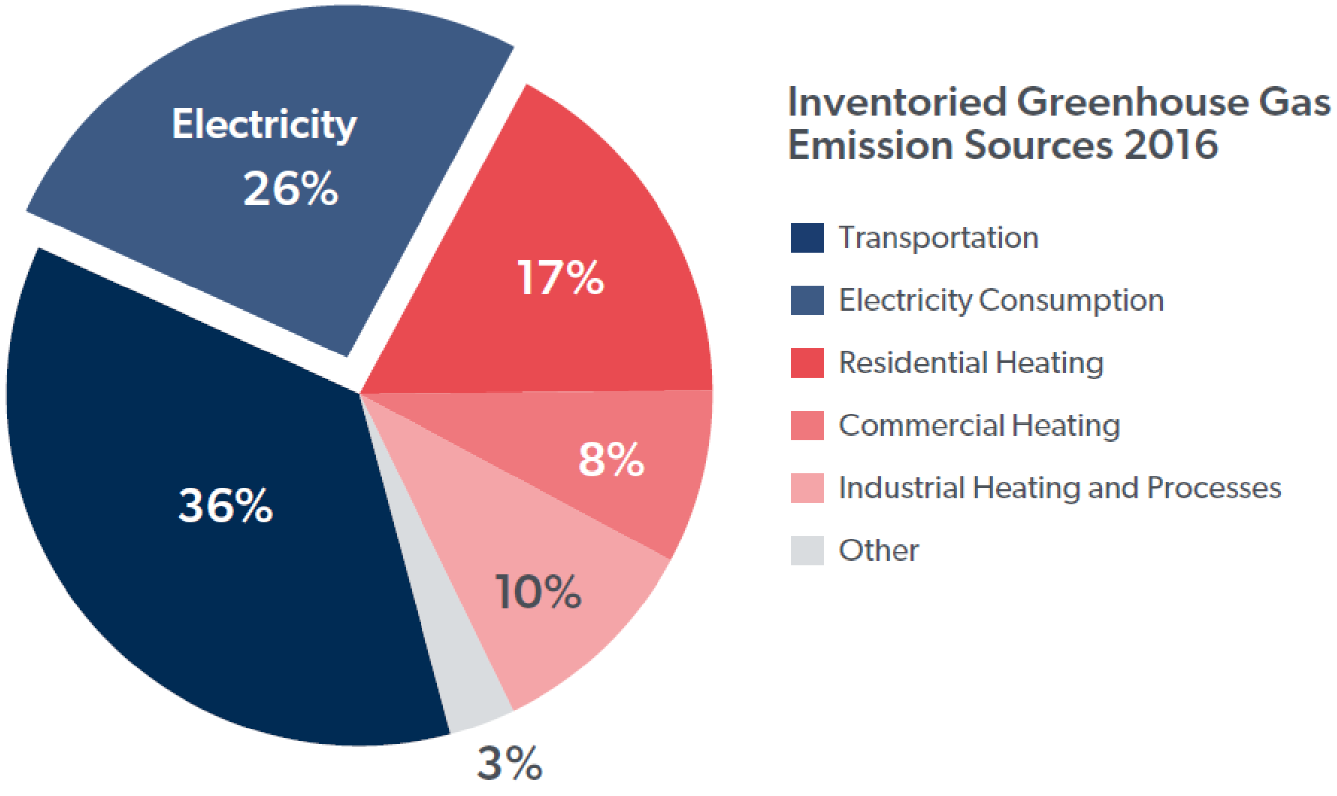


FIGURE 1: COMPOSITION OF RHODE ISLAND GHG EMISSIONS

Source: Rhode Island Department of Environmental Management, Rhode Island's 2016 Greenhouse Gas (GHG) Emissions Inventory Update, EC4 Meeting, September 12, 2019.

Project Insights

- 100% renewable electricity is achievable with in-state and surrounding resources.
- This will require ratepayer support, and net energy and economic benefits will be determined by the resource portfolio.
- Transparent accounting is paramount.
- All portfolios will require planning and investment to build out the resources themselves and the electric grid, though different portfolios will require different (and as-yet unknown) investments.
- Balancing supply and demand will become increasingly important as regional states decarbonize.

See full summary of project insights on pages 54-55 of the final report

Policy and Programmatic Recommendations

Study insights inform three categories of recommendations:

Policy

Recommendations for defining, achieving, and procuring 100% renewable electricity.

Planning & Enabling

Recommendations on ways to reduce risk, increase flexibility, and optimize renewable energy integration.

Equity

Recommendations on ways to foster equitable outcomes developed in partnership with frontline communities.

Policy Recommendations

Policy is needed to establish a strong, statewide framework and reach our goals in ways that align with our foundational principles.

We must ensure we meet our clean energy goals by advancing a **100% Renewable Energy Standard.**

Continued efforts to decrease energy consumption necessitate extension of **Least-Cost Procurement and Nation-Leading Energy Efficiency Programs.**

Maintaining continued support for in-state development, while supporting **programmatic evolution** to deliver more affordable and sustainable outcomes.

Planning and Enabling Recommendations

We need to advance innovative, integrated, and collaborative **planning** to **enable** interconnection of clean energy onto the grid while minimizing costs and optimizing land use.

Optimize the electric grid through collboraative, **integrated grid planning**.

Facilitate integration of distributed energy resources by advancing **Power Sector Transformation** and **Grid Modernization**.

Build out a strategic role for **energy storage** technologies.

Continue **regional collaboration** on wholesale markets and interstate transmission.

Equity Recommendations

We must center **equity** and include community engagement in program design to improve access to clean energy benefits for all Rhode Islanders. Throughout this effort, we will identify and address systemic racism and historic inequities.

Partner with trusted community organizations to listen, learn, support, and establish foundational definitions.

Based on foundational definitions, develop **equity metrics** with the community to track and monitor progress towards equitable outcomes.

Improve **outcomes** identified and prioritized by commuities through rate design, program adjustments, and policy.

Thank You!

www.energy.ri.gov/100percent

Energy.Resources@energy.ri.gov