NERA
ECONOMIC CONSULTING

April 2023

Renewable Generation In ERCOT:
Providing Reliable Capacity Contributions

NERA
ECONOMIC CONSULTING

Renewable Generation In ERCOT:
Providing Reliable Capacity Contributions

The Analysis:

» The impact from renewables on the ERCOT system was studied by Astrapé Consulting who has significant experience performing reliability studies for FERC, ERCOT, and other independent system operators across North America. Astrapé's results were then analyzed and summarized by NERA Economic Consulting who is a leader in market design analysis.

» The impact of renewables on ERCOT reliability and costs were modeled across three scenarios:

1. No Renewables
2. Projected 2024 Renewables
3. Projected 2024 Renewables + 20 GW More Renewables

» Each scenario:

- Established system reliability to the widely used one-day-in-ten-years loss of load expectation ("1:10 LOLE")
- Calculated generator profitability from energy prices as well as determined the additional amount of generator profits required to maintain a 1:10 LOLE (for purposes of this paper, additional generator profits are described as "capacity premiums")
- Determined the quantities and costs of ancillary services needed to support reliability in each scenario

» Each scenario's total costs (energy, capacity premiums, and ancillaries) were compared to determine the net impact of renewables

- For Projected 2024 Renewables, the modeling isolated near-term and long-term projected impacts. In the near-term view, capacity premiums were based on the generator profits required to keep existing units from retiring. In the long-term view, capacity premiums were based on the generator profits required to incentivize new resources to enter the market.

The Conclusions:

» Regarding the impact of renewables on total ERCOT system costs:

- **Projected 2024 Renewables:**
- Near to medium-term cost savings of approximately $6 billion per year.
- Long-term cost savings of approximately $2 billion per year.
- **Projected 2024 + 20 GW Renewables:**
- Long-term cost savings of approximately $3 billion per year.
- Savings from lower energy costs always significantly exceeded the combined cost of additional ancillary services and additional capacity premiums required to meet a 1:10 LOLE
- Savings were consistent across a range of gas price scenarios.

» Regarding the impact of renewables on total ERCOT system reliability:

- Adding renewable capacity always results in reliable capacity contributions which in turn reduce the LOLE

» Based on these findings as well as the directives of Texas Senate Bill 3, ancillary service costs should continue being charged to load

- Firm load drives the need for ancillary services and so they are the true cause of ancillary service costs
- Load buys a bundled electricity product that includes energy and ancillary services, so any evaluation of renewable generation on costs needs to be based on the cost of the bundled product
- Charging ancillaries to generation is impractical, and may well be impossible to attribute ancillary volumes to a single source.
- Charging ancillaries to renewable generation is inefficient as it would discourage the efficient development of technologies that clearly lower cost and provide reliability contributions.
- Charging ancillaries to only renewables is discriminatory.

NERA
ECONOMIC CONSULTING

Renewable Generation in ERCOT:

Saving Texans Billions in Annual Electricity Costs and Providing Reliable Capacity Contributions

Introduction

NERA Economic Consulting ("NERA") and Astrapé Consulting ("Astrapé") prepared this White Paper at the request of NextEra Energy Resources ("NextEra") with the goal of objectively evaluating the impact of renewable energy generation on ERCOT system reliability and the prices consumers in the ERCOT region pay for electricity.[1]

NERA, a leader in the design of competitive wholesale power markets, has a long history of providing utilities, independent power producers and government entities with market design analysis and implementation strategies. For more than 30 years, NERA has contributed significantly to the development of power pools and trading systems in virtually every electricity market in the world.

Astrapé is widely known for their expertise in complex reserve margin and reliability studies. Astrapé has conducted engagements for the Federal Energy Regulatory Commission ("FERC"), the Electric Reliability Council of Texas ("ERCOT"), and other major Independent System Operators and electric utilities across North America and Asia.

Astrapé uses the Strategic Energy and Risk Valuation Model (SERVM) to objectively measure and quantify complex resource adequacy risks, determining not only if a reliability event could happen, but also quantifying the likelihood, magnitude, and economic cost. To perform this analysis, SERVM utilizes historical weather, economic load growth forecast error, historical hydro and other energy-limited resource data, and unit outage history to perform hundreds of thousands of independent hourly chronological simulations. The model delivers a full distribution of expected reliability outcomes and the associated system costs.

The results and conclusions that follow are derived from sophisticated SERVM modeling of the ERCOT system that calculates consumer cost and reliability outcomes across a wide range of scenarios. The scenarios vary key drivers that individually affect total system costs and reliability outcomes, such as renewable generator and energy storage capacity levels, generator outages, weather, and fuel prices. The authors and sponsor of this White Paper seek to assist policymakers by quantifying the valuable reliability contributions and energy cost savings renewable energy provides to the ERCOT system. An accurate understanding of the reliability contributions and energy cost savings renewable generation provides is essential to identify which market reforms compensate renewables fairly based on the value they provide for Texas consumers.

Reforms should encourage efficient development of technologies that provide consumers with reliable electricity at the lowest possible cost.

Additionally, market reforms must comply with the legislative requirement that the design, procurement, and cost allocation of ancillary services in the ERCOT region be consistent with principles of cost-causation and non-discrimination, as well as encourage the efficient development of technologies that provide consumers with reliable electricity at the lowest possible cost. An accurate understanding of the effect renewable generation has on consumer costs and system reliability will help to ensure that market design changes meet Texas' post Winter Storm Uri electric policy objectives: the delivery of reliable, affordable power to consumers.

[1] Those at NERA who prepared this white paper are Laura T.W. Olive, Associate Director, Eugene T. Meehan, and Hamish Fraser, Affiliated Consultants.

Key White Paper Findings:

The Effect of Renewable Generation on ERCOT System Costs

The projected benefits of 2024 renewable generation on ERCOT system operating costs and capacity sufficiency include:

- $6 billion in net system operating cost savings in 2024
- $2 billion in sustained, annual long-term net system operating cost savings
- Savings from lower energy prices that are orders of magnitude higher than any ancillary service cost increases associated with integrating renewable generation
- Significant savings are realized across a range of gas prices and future renewable generation additions
- Over 18,000 MW of reliable capacity contributions[2]

Executive Summary

Reliable, affordable electricity is a public necessity that is vital to the functioning of a modern society. As such, the objectives of ERCOT electric market reforms should be to provide Texans with reliable, affordable, clean power that supports public safety, a strong economy, and a high standard of living. As this White Paper explains, the addition of renewable generation capacity to the ERCOT system contributes significantly to these objectives.

The impact of renewable generation on the ERCOT system was calculated by Astrapé using the comprehensive hourly dispatch, system production cost, and reliability modeling capabilities of the SERVM model. Using publicly available data, Astrapé conducted over 700,000 Monte Carlo simulations of the annual hourly dispatch of the ERCOT system across scenarios that varied system load, generator outages, fuel prices, generator technology mix, energy storage additions, and other inputs. The SERVM model and its use of Monte Carlo simulation generates robust results that provide an effective way to analyze and understand the complex interdependencies that affect cost and reliability of electric systems like ERCOT.

Astrapé's modeling calibrates ERCOT system reliability to a 1:10 Loss of Load Expectation ("LOLE") and calculates the associated cost of meeting that standard over the long-term by adjusting the quantity of ancillary services and installed capacity, setting a proxy capacity value (the "capacity premium") to a level at which the combined profits for the marginal dispatchable generation technology from the energy market, ancillary services market, and capacity premium is equal to the cost of new entry ("CONE"). In near to medium-term (transitional) scenarios, the capacity premium was calibrated to meet the forward-looking cost of existing marginal units that would otherwise retire because they do not recover their costs from the energy only market. When calculating the cost of meeting a 1:10 LOLE, the capacity premium is assumed to be paid to all capacity resources.

The costs of serving ERCOT system load at the 1:10 LOLE standard with and without renewable generation capacity were compared to determine the effect of renewable capacity on system costs and reliability.

To determine the effects of renewables on the ERCOT system this White Paper focuses on three main scenarios:

---

[2] Based on allocated 2024 renewable ELCCs as calculated in the ERCOT 2022 ELCC Study, Final Report, p. 50 available at: https://www.ercot.com/files/docs/2022/12/09/2022-ERCOT-ELCC-Study-Final-Report-12-9-2022.pdf. Separate analysis performed by Astrapé identified approximately 16GW of aggregate reliability value as documented in Figure 3. The difference is driven by different input assumptions but each result confirms the finding that the renewable portfolio supplies significant reliability value.

A base case with no renewables (“No Renewables”).

A case using the 2024 renewable capacity forecast aligned with ERCOT’s May 2022 Report on Capacity, Demand, and Reserves (“2024 Renewables”);[3] and

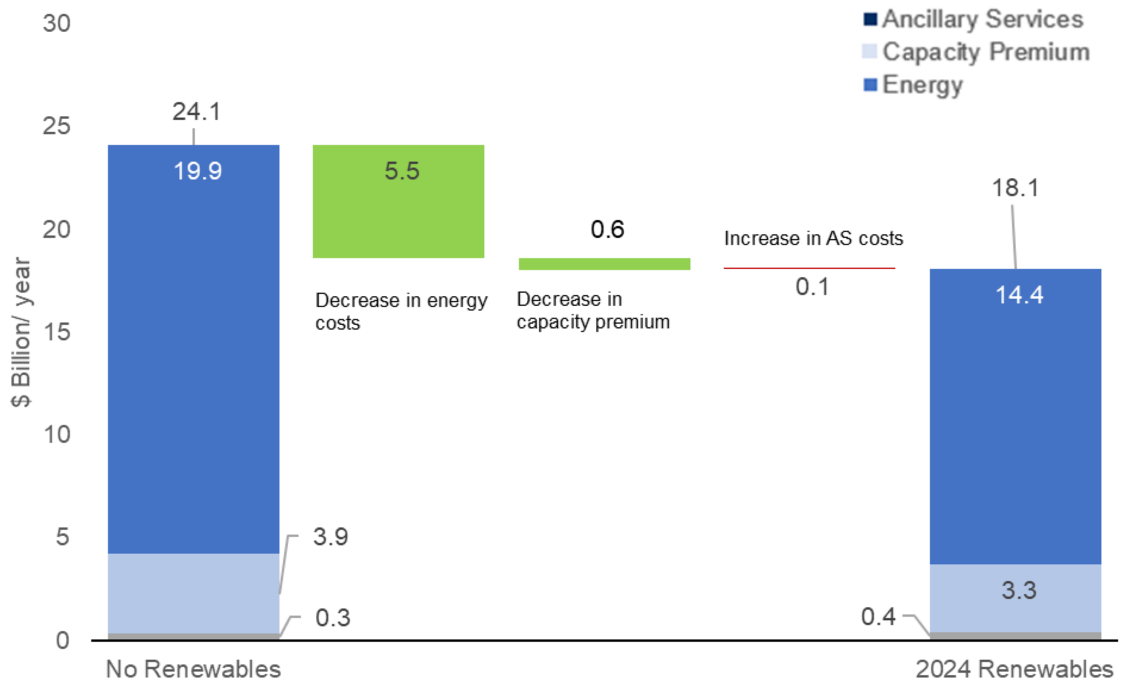
A case that adds 10 GW of solar generation resources, 10 GW of wind generation resources, and 5 GW of energy storage resources to the 2024 Renewables case (“20 GW More Renewables”).

Overview of Modeling Results

Astrapé’s results demonstrate that adding renewable generation to the ERCOT system reduces the cost of reliable electric service (including the cost of energy, ancillary services, and capacity premiums required to maintain a 1:10 LOLE) for Texas consumers and contributes to overall system reliability without imposing additional reliability costs.

Compared to the No Renewables case, the near to medium-term cost savings of the 2024 Renewables case for Texas consumers is approximately $6 billion per year.

Figure 1: Renewable Energy Reduces the Total Cost of Reliable Electric Service for Consumers in the Near to Medium-Term



These savings reflect the benefits that forecasted 2024 renewable generation capacity will provide as of that year. However, as older dispatchable capacity is retired over the remainder of the 2020s, the benefits from the level of renewable generation capacity in the 2024 Renewables case will decline and the annual cost savings that these renewables provide will level out at approximately $2 billion.

This transition from $6 billion in annual cost savings to $2 billion in annual savings occurs as the market adjusts to the higher level of renewable capacity in the 2024 case and inefficient units such as coal and steam gas units retire as they reach the end of their economic lives and/or they retire for regulatory reasons such as environmental upgrade requirements. The retiring steam gas units tend to be the marginal source of capacity during this transition, and they require lower capacity premiums to remain in the market than new resources require to enter the market. Eventually, given current

[3] 2024 renewable and other system generation data is based on ERCOT May 2022 Capacity Demand Reserve Report (CDR) available at: https://www.ercot.com/files/docs/2022/05/16/CapacityDemandandReservesReport_May2022.xlsx.

technology and cost, efficient gas turbine units will be the marginal source of capacity in ERCOT and will enter the market, but this will not occur as long as existing capacity is able to provide the required reliability at a lower cost. Because the new gas turbine generation capacity requires higher capacity premiums to enter the market and maintain a 1:10 LOLE equilibrium reserve margin, the cost savings attributable to existing renewable generation gradually declines from 2024 levels as older, existing plants reach the end of their economic lives.

To reflect long-term, steady state savings renewable generation provides when the market is in equilibrium, additional scenarios and sensitivity analyses presented herein calculate the long-term annual consumer savings associated with new renewable capacity, rather than the near-term to medium-term savings, which tend to be higher because lower capacity premiums are required to retain existing resources which are transitory due to the evolving mix of generation resources.

For example, cost savings from renewable generation in the 20 GW More Renewables case were evaluated using long-term assumptions. The consumer cost savings in the 20 GW More Renewables case is more than $3 billion annually in the long term. At the individual consumer level, this reduction in total ERCOT system costs equates to nearly $100 of annual savings for the average residential consumer.[4]

Breaking these savings down by cost component:

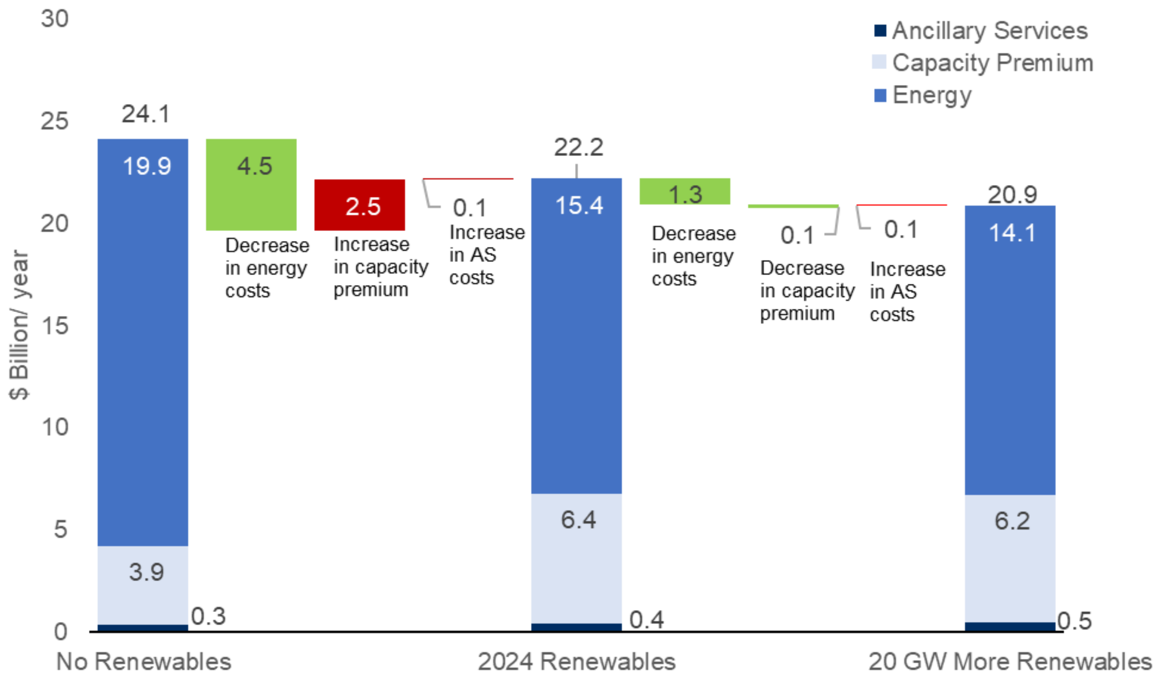
- **2024 Renewables (Near to Medium-Term):** Projected 2024 renewable generation capacity delivers approximately $5.5 billion in gross energy cost savings to consumers and $0.6 billion in capacity premium savings. These savings are partially offset by approximately $60 million in increased ancillary services costs. The total annual benefit relative to the No Renewables case is therefore $6.0 billion.

- **2024 Renewables (Long Term):** Projected 2024 renewable generation capacity delivers approximately $4.5 billion in long-term gross energy cost savings to consumers. These savings are partially offset by approximately $2.5 billion in capacity premiums and $60 million in increased ancillary services costs. The total annual benefit relative to the No Renewables case is therefore $1.9 billion.

- **20 GW More Renewables (Long Term):** Adding 20 GW of renewable generation and 5 GW of storage to the 2024 Renewables case delivers additional long-term gross energy cost savings to consumers of about $1.3 billion – with negligible changes in the capacity premiums and ancillary services costs. The total annual benefit relative to the No Renewables case is therefore $3.2 billion.

[4] Residential cost savings estimate in the 20 GW More Renewables case based on 2022 forecast total ERCOT load (423,333,035 MWh) and 2021 average residential consumption in Texas (1,094 kWh). Annual Savings of $99.23 = (($3,200,000,000 / 423,333,035 MWh) / 1000) * (1,094 kWh * 12). Refer to: ERCOT Forecast of Monthly Peak Energy, 2022, available at https://www.ercot.com/gridinfo/load/forecast and EIA 2021 Average Monthly Bill – Residential, available at https://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf.

Figure 2: Renewable Energy Reduces Total Costs of Reliable Electric Service for Consumers in the Long Term



Reliability Impacts

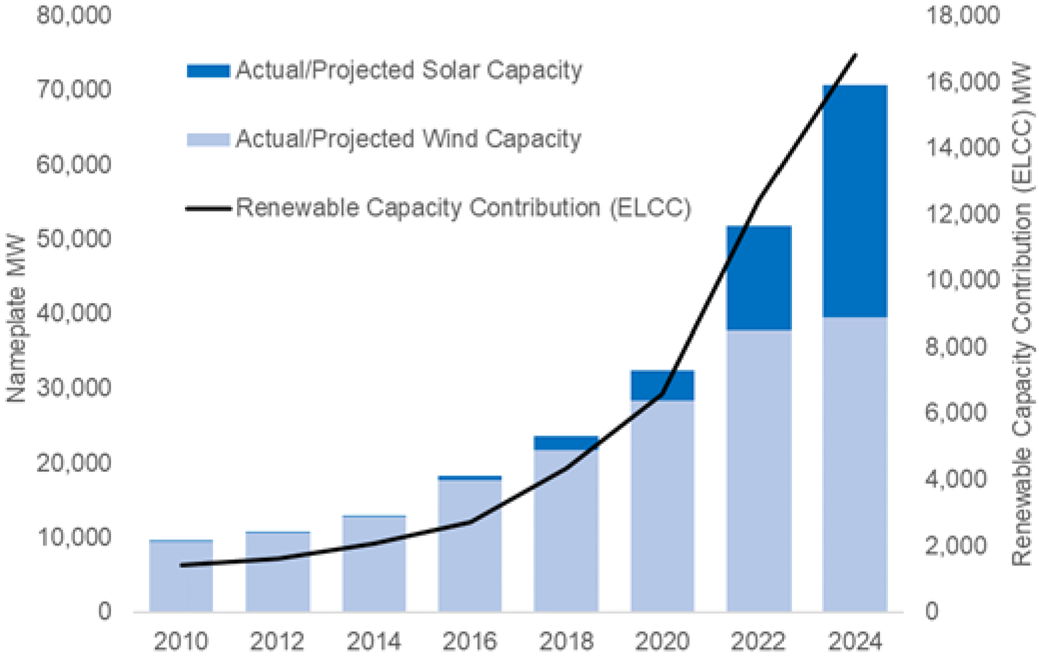
Renewable capacity improves reliability by reducing the LOLE as the total quantity of renewable capacity increases. Figure 3 below summarizes renewable generation resources' capacity contribution to the ERCOT system over time, based on the ability of renewable generation to reliably serve a megawatt of consumer load, as measured by the Effective Load Carrying Capacity ("ELCC") of each renewable generation resource.[5]

Renewable capacity contributions to reliability are always positive. Although the reliable capacity contribution of a megawatt of renewable capacity is less than that of a megawatt of thermal capacity, adding renewable capacity to the system always improves reliability and contributes to meeting a 1:10 LOLE reliability standard.

The positive impact of adding renewable capacity to the ERCOT system can be observed clearly in what has transpired over the last few years. In 2020, wind and solar capacity were 28 GW and 4 GW, respectively. By 2024, wind and solar capacity is projected to have grown to 39 GW and 31 GW. The results of SERVM simulations in Figure 3 indicate this additional capacity provides reliability contributions equal to of 8 GW of conventional thermal capacity. With the inclusion of additional renewable capacity, reliability in 2024 is expected to be more reliable than the 1:10 LOLE standard. Despite assertions that renewables make the grid less reliable, the reliability contributions of renewables are real, and as more renewable capacity has been developed, ERCOT reliability has improved.

[5] An introduction to ELCC and its importance in capacity adequacy discussions is available here: https://www.nerc.com/pa/RAPA/ra/Reliability Assessments DL/IVGTF1-2.pdf

Figure 3: The Reliability Contribution of Renewable Capacity is Always Positive[6]



Ancillary Service Impacts

The large net decrease in energy prices from additional renewable capacity more than offsets the cost of additional ancillary services required to manage increased net load volatility from renewables. The increase in ancillary services costs from the No Renewables base case to the 2024 Renewables case is only about $60 million per year, using either short-term or long-term marginal capacity technology assumptions, and both cases maintain the same 1:10 LOLE reliability standard. By way of contrast, the annual cost savings to consumers of about $2 billion to $6 billion in the 2024 Renewables case, as shown in Figures 1 and 2, are orders of magnitude higher.

Across additional scenarios that Astrapé modeled in which the mix of additional renewables, fuel prices, and energy storage capacity additions were varied, the incremental ancillary service costs required to meet a 1:10 LOLE ranged from a low of $45 million to a high of $313 million. The consumer cost-savings renewables provide through lower energy prices always remained orders of magnitude higher than the cost of any additional ancillary services required to maintain a 1:10 LOLE.

Conclusions and Market Design Implications

Astrape's modeling demonstrates that, across a wide range of scenarios, adding renewable capacity to the ERCOT system reduces overall consumer costs and reduces the amount of dispatchable capacity required to meet a 1:10 LOLE reliability standard. Proposals to allocate reliability costs to renewables based on a "cost-causation" rationale are flawed because renewables do not add reliability costs. Instead, they contribute to reliability and reduce the total cost of reliable power for consumers.

Proposals to allocate ancillary services costs to renewable generation are similarly flawed. More generally, it is counter-productive and against the interest of consumers to discriminate against any class of resources, renewables included. It is especially counterproductive when it can be

[6] Reliability contribution based on SERVM simulations performed by Astrapé using capacity values identified in the following source: ERCOT, Capacity Changes by Fuel Type Charts, August 2022, available at: www.ercot.com/files/docs/2022/09/08/Capacity%20Changes%20by%20Fuel%20Type%20Charts_August_2022.xlsx

demonstrated with certainty that renewables provide consumers with lower overall energy, ancillary service, and capacity premium costs.

Arguments in favor of allocating ancillary service costs to renewables and not to other generation types are discriminatory because other forms of generation also contribute to the need for ancillary services. For example, the potential loss of the two largest nuclear units in ERCOT creates the need for 2,800 MW of certain contingency reserves.[7] Allocating costs to only one category of generators (in this case, renewables) would violate the non-discrimination requirement of Texas Senate Bill 3 (87R) ("S.B. 3")

Finally, last year the Public Utilities Commission of Texas ("PUCT") released a report[8] s in which potential long-term market design reforms pursuant to Phase II of the PUCT's Blueprint for Wholesale Market Design were evaluated.[9] Several of the market design alternatives set forth in the report involve a Resource Accreditation Methodology which establishes the volumetric basis for reliability payments. While this White Paper was not written in response to the PUCT's report, the same point is made here regarding reliability and cost-causation. Renewable capacity does not cause reliability costs, nor does it have an adverse impact on reliability. Rather, renewable capacity contributes positively to system reliability. A Resource Accreditation Methodology that excludes certain technologies – effectively assuming the technologies had no reliability impact – would be discriminatory and inefficient. All resources should be evaluated on the basis of their contribution to system reliability. Discriminating against any class of technology with respect to compensation for their reliability contribution would be counterproductive and would raise costs to customers in the long term by not providing proper investment incentives.

Introduction

In reaction to Winter Storm Uri and the ensuing reliability concerns, reforming the ERCOT electricity market became a priority for both the Texas Legislature and the Governor. Legislation enacted during the 2021 legislative session and Executive direction provided the PUCT with guidance on the goals of ERCOT market reforms. As Governor Abbott stated in his July 6, 2021, letter to the PUCT Commissioners, "(T)he objective … is to ensure that all Texans have access to reliable, safe, and affordable power . . ."[10]

Good market design ensures reliable, clean power is provided at the lowest possible cost. Texas opted to give private investors the responsibility for generation investment decisions and to not burden consumers with the long-term investment risks of such decisions when the electric industry was restructured with the passage of Texas Senate Bill 7 in 1999. Therefore, care should be taken to ensure market design reforms currently under evaluation do not inadvertently frustrate investment in electric generation resources. Investment in renewable capacity is particularly important because it is the largest source of new investment in the Texas electric grid and renewables further the stated policy goals of providing reliable energy at the lowest possible cost to consumers.[11]

The impact that solar generation and wind generation ("renewable capacity") have on the reliability of the ERCOT system and on the price that consumers pay for reliable electricity is an important

---

[7] Refer to: https://www.ercot.com/files/docs/2021/07/12/SCT_Directive9_AncillaryServices_Whitepaper_ROS_07082021.docx ERCOT's current Resource Loss Protection Criteria of 2805 MW is based on the two South Texas Project Nuclear units, which are currently rated at approximately 1,400 MW each.

[8] Energy+Environmental Economics, Assessment of Market Reform Options to Enhance Reliability of the ERCOT System, November 2022. Refer to: https://interchange.puc.texas.gov/Documents/54335_2_1251719.PDF

[9] Refer to: https://interchange.puc.texas.gov/Documents/52373_268_1172004.PDF

[10] Governor Greg Abbott letter to Public Utility Commission of Texas, 6 July 2021, available at https://gov.texas.gov/uploads/files/press/SCAN_20210706130409.pdf.

[11] ERCOT, Capacity Changes by Fuel Type, September 2022, available at https://www.ercot.com/files/docs/2022/10/05/Capacity%20Changes%20by%20Fuel%20Type%20Charts_September_2022_PlannedMonthly.xlsx

consideration underlying the current review of the ERCOT market design. This White Paper seeks to shed light on those issues by providing an objective analysis of the reliability and price impacts renewable generation have on the ERCOT system for policymakers to consider as they evaluate and adopt market design reforms.

This paper is structured to answer the following questions:

1. How does renewable generation affect energy and ancillary service costs for Texas consumers?

2. How does renewable generation affect capacity adequacy, the amount of capacity Texas needs to provide reliable electric service, and the cost of attracting that capacity?

3. How does renewable generation affect the overall cost to consumers of reliable electricity in Texas?

4. What market design complies with S.B. 3's directive to allocate ancillary services costs on a cost causation basis and properly recognizes that renewable generation reduces consumer cost for reliable electric supply?

How does renewable generation affect energy and ancillary service costs for Texas consumers?

The market-based components of the price Texas consumers pay for electricity includes the cost of energy and ancillary services. While ancillary services are a small proportion of the total cost of reliable electric service, they are essential to maintain a continuous and secure supply of electricity. Absent the need to provide a continuous, uninterrupted supply of electricity, the ERCOT electric system could be operated securely with very low quantities of ancillary services by changing the amount of load that is being served (i.e., reducing non-essential load in lieu of the current framework in which extra generation is reserved and made available on short notice to balance the supply and demand of electricity). However, in practice, the value of continuous supply outweighs the costs of additional reliability caused by procuring ancillary services.

Most ancillary service costs are incurred to manage relatively common events that are expected to occur, but the exact timing at which they occur is unpredictable. These events include predictable hourly changes in demand or generation, abrupt fluctuations in demand or generation, failures of components on the electric delivery system, failures of generating equipment, and combinations of these events. These events are typically managed with quick responses from synchronized capacity (responsive reserves) or offline reserves that are available on short notice (non-spin).

Unavailability that is predictable is not the primary driver for ancillary services. They are mainly required to manage unpredictable unavailability.

Renewable capacity can contribute to the need for ancillary services when they are present in significant quantities because renewable generator output, while predictable on average, cannot be forecasted perfectly and energy production may fluctuate faster than available ramping capacity from online dispatchable generation can address. The fact that renewables are not available "all of the time," or that their output varies over the course of a day, however, is not a primary contributor to ancillary services costs. Unpredictable unavailability, like sudden outages of major thermal generators, is a much greater contributor to the need for ancillary services than predictable unavailability, such as solar unavailability during the night.

As renewable capacity increases, ancillary services quantities and associated costs can increase, but the relationship between renewable capacity and ancillary services costs is complex. A balanced mix of solar and wind generation requires lower ancillary service quantities than a mix tilted toward either technology alone.

Additionally, a significant amount of fast-response storage capability that engages in intra-day energy price arbitrage and responds quickly to energy price changes may reduce or eliminate the need to increase ancillary services quantities associated with renewable development by offsetting the impact of both predictable and unpredictable fluctuations in availability.

However, because the ancillary service capacity required for reliable grid operations is small relative to the amount of energy being supplied at any point in time, and because the per-unit cost ancillary services is generally less than that of energy, the total cost of energy is many times higher than the total costs of ancillary services. Therefore, changes in energy prices have a much larger impact on consumer electricity costs than changes in ancillary service prices or quantities. For example, the ERCOT Independent Market Monitor's 2020 State of the Market Report shows that total real-time costs for energy and ancillary services costs during 2020 were about $10.2 billion. Of that amount, $9.8 billion, or 96% was attributable to energy costs.[12]

Market design is optimal when it minimizes the total cost of reliable electric service, not when an individual cost is reduced at the expense of total consumer costs.

The disproportionate importance of energy prices to consumers can be illustrated by a hypothetical example in which renewable generation serves the entire ERCOT system load and energy prices are zero or negative. In this case, there would still be ancillary services costs and such costs may, in isolation, be higher than would otherwise be required absent the renewable generation, but the total cost to consumers would be significantly lower due to the much larger impact of energy prices on consumer costs.[13]

Because consumers pay the combined cost of energy and ancillary services, and in return receive a reliable supply of energy as a single integrated product, they are not concerned about separately minimizing either energy or ancillary services costs. That is, the product consumers purchase is the mix of generation resources and ancillary services that minimizes the total cost of reliable energy. Market reforms must focus on minimizing the total cost of providing reliable electricity service to consumers, not on any one component of the cost of reliable electricity.

How does renewable generation affect capacity adequacy and the cost of attracting that capacity?

Loss of Load Expectation and Market Equilibrium Reserve Margin

The ability of installed generation to reliably serve load is measured probabilistically and described based on the likelihood of shedding firm load over a given period of time. ERCOT does not currently have an official resource adequacy objective, however the criteria used by a majority of system operators and reliability coordinators across the United States and Canada is the 1:10 LOLE resource adequacy standard. In electric systems that use this metric, a system is considered to have adequate capacity when there is an expectation that load would be curtailed due to insufficient generation availability one day in every 10 years; that is, a loss of load expectation ("LOLE") of 0.1 days per year or a "1:10 LOLE".

Bi-annually, ERCOT commissions a Market Equilibrium Reserve Margin (MERM) study to evaluate capacity conditions in the ERCOT region. The MERM study identifies the reserve margin that the market can be expected to support in equilibrium conditions, and it also identifies the reserve margin

[12] Potomac Economics, Independent Market Monitor for ERCOT, 2020 State of the Market Report for the ERCOT Electricity Markets, May 2021, page 131, available at https://www.puc.texas.gov/industry/electric/reports/ERCOT_annual_reports/2020annualreport.pdf.

[13] ERCOT dispatches resources using a bid-based system to optimize costs. To the extent that a high level of renewable generation might exist in which ancillary costs would increase by more than which energy costs would decrease, then ERCOT should not be dispatching at that level of renewable generation.

required to meet a 1:10 LOLE level of reliability. “Equilibrium conditions” occurs, in the long-term, when the energy market margins are equal to the margin required to support development of the marginal capacity technology, otherwise known as the Cost of New Entry (CONE). This information is important because in an energy only market with no mandatory minimum reserve margin, identifying the economic equilibrium reserve margin allows the system operator to calculate the expected future LOLE and understand the level of reliability the energy only market is likely to support.

The reserve margin under market equilibrium conditions is almost always lower than the reserve margin at 1:10 LOLE. This is in part because market prices, in even the most extreme situations, typically do not support operating margins that the last megawatt of capacity, which runs only once every 10 years, requires to recover its costs. It follows then that system reliability at MERM is also almost always worse than 1:10 LOLE. Under base case assumptions, the most recent ERCOT reserve margin study (January 15, 2021) projected a LOLE of 0.5 days per year (or a 1:2 LOLE) using expected 2024 conditions[14]. This means that, under equilibrium conditions, energy prices are not high enough to stimulate development of sufficient capacity to meet the level of reliability most system operators and policy makers strive to maintain.

If policy makers in Texas adopt a reliability standard such as the 1:10 LOLE, and associated market reforms require a minimum reserve margin that meets the reliability standard, costs to consumers will tend to be higher than if no reliability standard is in place. This is simply the natural outcome of meeting the reliability standard and providing more reliable power than the energy only market would otherwise provide.

Policymakers may choose the reliability standard and make the decision to incur the associated costs on behalf of consumers, but as the beneficiaries of the added reliability, it is logical that consumers should always bear the cost of meeting the reliability standard.

Effective Load Carrying Capability

The contribution of a generator’s capacity to meeting a reliability standard the generator’s Effective Load Carrying Capability (“ELCC”). ELCC measures the amount of load that a megawatt (MW) of generation capacity can reliably serve as part of the ERCOT system. For example, renewable generation with a nameplate rating of 1 MW and an ELCC of 0.15 can reliably serve 0.15 MW of load and a dispatchable generator with a nameplate rating of 1 MW and an ELCC of 0.90 can reliably serve 0.9 MW of load. Determining the ELCC of a generation resource requires an empirical evaluation.

Astrapé conducted such an evaluation, which shows that as solar and wind increase to the levels in the 2024 Renewables case, the combined solar and wind portfolio contributes an ELCC of 0.21 MW of reliable capacity for each MW of installed capacity, while one megawatt of combustion turbine (CT) capacity provides an ELCC of 0.89 MW of reliable capacity for each MW of installed capacity, based on historical availability and outage data.[15] Therefore, while renewable capacity contributes less to

---

[14] Refer to Executive Summary: https://www.ercot.com/files/docs/2021/01/15/2020_ERCOT_Reserve_Margin_Study_Report_FINAL_1-15-2021.pdf

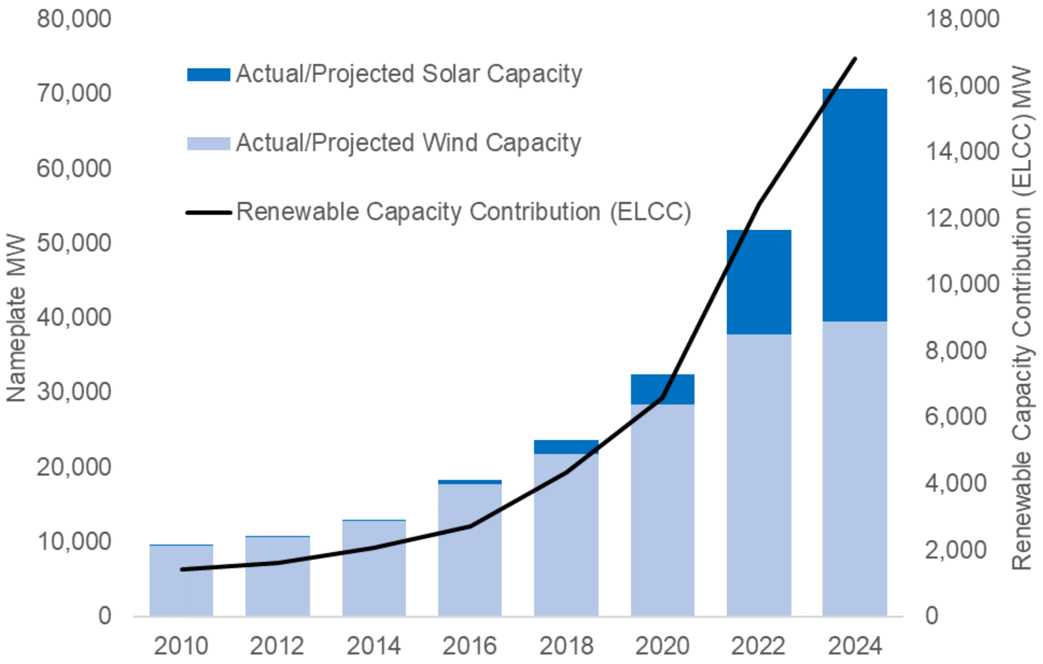
[15] It is not always intuitive how generators contribute to reliability, especially renewable generators, so consider the following situation:

- ERCOT is exactly at the target reliability standard of 1:10 LOLE. This means there is a group of “scarcity hours” with higher probability of load outage than others. When we add up the loss of load expectation across these hours, we get to the value of 1.
- Now assume that some of these scarcity hours are daylight hours. It might not be all of them, it might not be most of them, it might only be a small number of them.
- Now, compared to the situation in the first bullet, consider that ERCOT has an extra MW of solar capacity. That MW won’t contribute to reliability in any of the scarcity hours that occur during darkness. So, we don’t get a 1 for 1 ELCC from solar. But it will help contribute to reliability in the daylight scarcity hours. The amount of load expected to be lost in daylight hours will reduce by some amount. Rather than being curtailed, that amount of load will be served by the extra solar instead.

reliability per unit of installed capacity than conventional dispatchable capacity, renewable capacity does make a positive contribution to reliability, and the addition of more renewable capacity results in a more reliable system.

Figure 4 shows the growth in reliability capacity contribution from renewable capacity as it has been added to the ERCOT system over time. As the amount of renewable generation increased, the amount of more expensive thermal capacity required to meet the 1:10 LOLE decreased by the equivalent ELCC adjusted amount. That reduction in required thermal capacity clearly demonstrates the reliability value renewable generation provides and it is a significant contributing factor to lower consumer costs.

Figure 4: The Reliability Contributions of Renewable Capacity is Always Positive



Renewable Generation Impacts on the Market Equilibrium Reserve Margin and Reliability Costs

There exists a perception that renewable generation makes the ERCOT system less reliable and increases the cost of meeting a resource adequacy standard like the 1:10 LOLE. This is simply untrue. Renewable generation provides positive ELCC contributions, which reduce the amount of thermal capacity required to provide reliable electric service and reduce the overall cost that consumers incur to achieve a specific level of reliability.

- Now consider the same original situation, but this time assume scarcity hours could occur when the wind is blowing. Scarcity won't be limited to just windy hours, but there will be some scarcity hours when it is also windy.
- Astrapé has done the analysis and it turns out that the ELCC for the 2024 Renewables case is 0.21 across all wind and solar.
- Astrapé also did the analysis for gas-fired CTs and the equivalent number is 0.89. Dispatchable units like CTs don't have an ELCC of 1 because there is a chance, they too will be unavailable during a scarcity hour, but their ELCC is certainly closer to 1 than for wind and solar.
- In sum, all generation types have an ELCC greater than zero and less than 1. This is not surprising.

This means, as renewable capacity on the ERCOT system increases, it has the following three effects on capacity adequacy:

1. Increases the aggregate reliable capacity of the ERCOT system.
2. Decreases the amount of thermal capacity required to reliably serve load; and
3. Increases any existing gap between the MERM and the amount of capacity needed to meet a reliability standard like the 1:10 LOLE.

As more renewable generation is added to the system, the MERM will decline in response to lower energy prices. As stated in the third point above, this increases the gap between the MERM, and the reserve margin required to meet a 1:10 LOLE standard.

The misunderstanding regarding the impact renewable generation has on the cost of meeting a reliability standard like the 1:10 LOLE likely arises when the increase in the cost of closing the reserve margin gap between the MERM and the target reserve margin required to meet the reliability standard (the capacity premium) is confused with an increase in the total cost of meeting a resource adequacy standard. While adding renewable generation to the ERCOT system does decrease the MERM relative to the target reserve margin, it does not raise the total cost of meeting the resource adequacy standard.

There is a perception in the public discourse that renewables make the ERCOT system less reliable and increase the cost of providing adequate capacity. This is simply untrue.

The correct way to determine the impact of renewable generation on reliability costs is to compare the total system costs of a system with no renewables at the desired reliability level to the total system costs of a system with renewables at the same desired level of reliability. The difference in total system costs is the cost impact of the renewables.

Since renewable capacity on the ERCOT system contributes positively to system reliability and reduces the total amount of more expensive thermal capacity required to meet a reliability standard, it follows that less thermal capacity needs to be supported by the market than would be the case absent renewable capacity. As a result, the overall cost to consumers decreases as renewable generation is add to the ERCOT system, despite the increase in the gap between MERM and the target reserve margin.

As Astrapé's analysis below quantifies, consumers pay less than they otherwise would be due to the addition of renewable generation to the ERCOT system. Although the cost of closing the gap between MERM and the target reserve margin increases as renewable penetration increases[16] this cost increase is more than offset by reduced energy prices that consumers face. The total cost to consumers for a reliable electricity system is what matters and this includes all energy, ancillary service, and capacity costs required to achieve the reliability standard.

In sum, increased renewable capacity contributes to a key objective of the market: providing reliable electricity at the lowest possible cost to consumers.

---

[16] A gap between the MERM and the 1:10 LOLE level of reserve margin exists with or without any renewable capacity. For this reason, energy prices in ERCOT include a scarcity adder (ORDC) which increases energy prices based on available operating reserve levels.

How does renewable generation affect the overall cost of reliable electricity to consumers?

As the previous sections on ancillary services and capacity dynamics explain, the objective of effective market reform should be to provide reliable electric services at the lowest possible *total* cost to consumers, rather than focusing on individual cost components that are not visible to consumers.

NERA and Astrapé examined and quantified the impact of renewable development in ERCOT on both reliability and total cost to consumers. Astrapé used the SERVM model that is used in reliability studies commissioned by ERCOT and the PUCT for this purpose.[17]

Two initial scenarios were considered as follows:

1. A base case with 2024 assumptions, but no renewables ("No Renewables"); and
2. A case using 2024 assumptions including the 2024 renewable capacity forecast aligned with ERCOT's May 2022 Report on Capacity, Demand, and Reserves ("2024 Renewables").[18]

It was recognized in the first instance that the ERCOT system is not in equilibrium. The ERCOT system is currently in a state of significant transition, with the system currently having excess capacity relative to the 1:10 LOLE reliability standard. In the time since the 2020 ERCOT Reserve Margin study was conducted, a considerable amount of renewable capacity has been added to the ERCOT system or is under development in ERCOT. Much of the recent capacity additions have been from solar resources.

The large reliability contributions from these solar capacity additions will cause ERCOT to exceed the 1:10 LOLE in the near to medium term. Under these conditions, some conventional resources will not earn an economic return and will therefore retire. Accordingly, the SERVM iterative Monte-Carlo simulation capabilities were used to quantify the total near and medium-term ERCOT system costs, for the two initial scenarios, as follows:

The entire ERCOT system was modeled for the No Renewables case using 2024 assumptions from ERCOT's May 2022 Report for all non-renewable inputs. The MERM and the target reserve margin required to meet the 1:10 LOLE were identified. This scenario entailed retiring all coal resources and a significant amount of inefficient gas resources, and then adding new efficient thermal capacity to meet the target reserve margin.

For the 2024 Renewables case, the entire ERCOT system was again modeled with 2024 assumptions, including renewable capacity expected by 2024, and uneconomic capacity was retired until the reserve margin required to meet the 1:10 LOLE was reached.

The quantities of ancillary services needed to support the ERCOT system in each of the scenarios were determined via intra-hour simulations of the projected net load volatility of each scenario. Each scenario was then modeled with the appropriate ancillary service quantity and associated costs.

Total ERCOT system energy and ancillary services costs to consumers were calculated and capacity premiums required to retain marginal resources were calculated. In the No Renewables case this was based on the net cost of the least-cost marginal dispatchable generation technology needed to enter the market to maintain the 1:10. In the 2024 Renewables case, this cost was calculated as the otherwise-unrecovered avoidable fixed cost of the marginal retiring technology (steam gas). I.e., the net revenues for a marginal gas steam unit were subtracted from the assumed go-forward costs to identify the necessary capacity premium that all accredited capacity would receive to prevent further

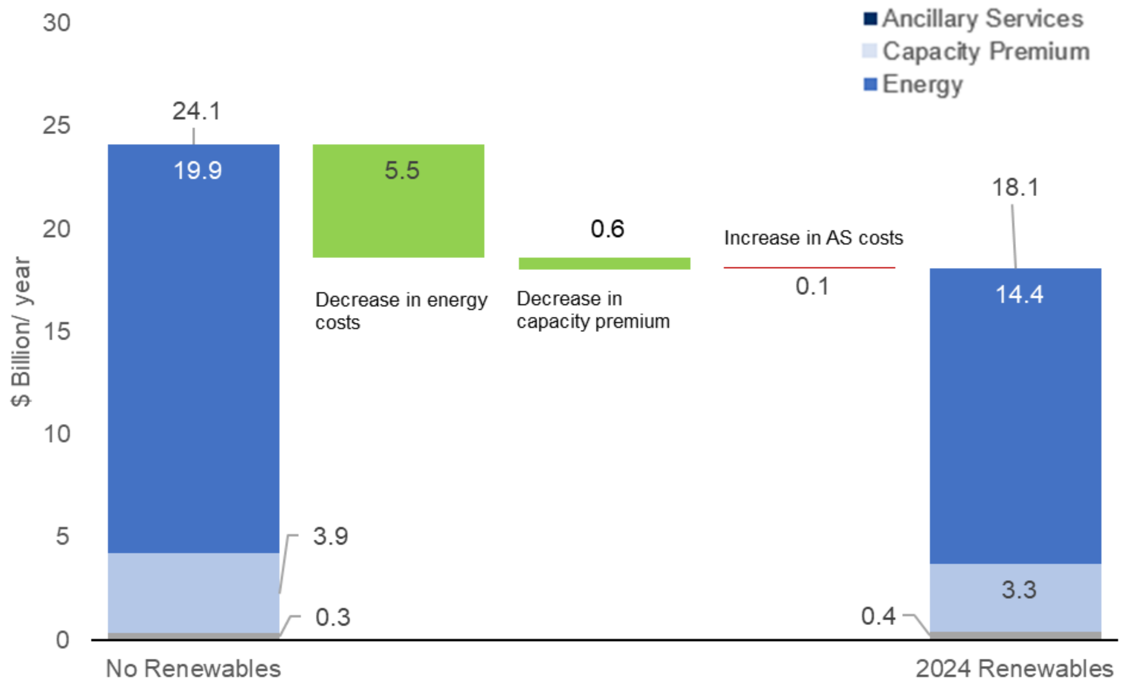
[17] Astrapé calibrated the SERVM model developed the inputs for these SERVM simulations with publicly available data to produce MERM results and did not use data proprietary to ERCOT or ERCOT participants.

[18] 2024 renewable and other system generation data is based on ERCOT May 2022 Capacity Demand Reserve Report (CDR) available at: https://www.ercot.com/files/docs/2022/05/16/CapacityDemandandReservesReport_May2022.xlsx

retirements.[19] Accordingly, in either case the payment rate was set at the net revenue required by the marginal capacity resource at the 1:10 LOLE reserve margin. Accredited capacity ratings were based on the ELCC of each generator.

When compared to the No Renewables case the analysis, the analysis showed the near and medium-term annual cost saving for Texas consumers from the renewable generation in the 2024 Renewables case is approximately $6 billion.

Figure 5: Renewable Generation Reduces the Total Cost of Reliable Electric Service in 2024



The consumer cost savings reflected in the 2024 Renewables case shows the savings renewables will provide in just that one year. However, it is recognized that, eventually, load growth and the retirement of older units should move the system back toward equilibrium conditions. As older dispatchable capacity is retired over the remainder of the 2020s, the longer-term annual benefits from renewable capacity in the 2024 Renewables case will likely decrease. The transition to lower annual savings should occur as the market adjusts to the new renewable capacity, and inefficient steam gas units (in particular) retire over time as they reach the end of their economic lives. These retiring units are the marginal source of capacity during the transition. Eventually, new entry of efficient gas turbine units will be the marginal source of capacity in ERCOT, and the higher capacity premiums required to attract and retain those generators reduce the overall cost savings attributable to renewable capacity.[20]

The additional scenarios and sensitivity that follow investigate the long-term annual consumer savings, rather than the near- to medium-term annual savings which tend to be higher for reasons previously explained.

---

[19] Whenever additional generator profits were required to either maintain existing generation resources or support the addition of new marginal resources as part of calculating the ERCOT system costs at a 1:10 LOLE reliability standard, those additional profits are described as “capacity premiums.” The authors recognize that the ERCOT market is an “energy only” market and currently does not compensate generation resources for a traditional resource adequacy capacity product.

[20] In the long run NERA and Astrapé expect conditions to revert to a situation where the marginal capacity decision is a new CT or CC.

To model the more conservative long-term, steady state impact of renewable generation Astrapé further applied the SERVM model as follows:

As in the preceding analysis, the entire ERCOT system was modeled in the No Renewables case using 2024 assumptions for all non-renewable inputs. The MERM and the target reserve margin to meet the 1:10 LOLE were identified. Then, due to the price lowering effect of renewables, all coal resources and significant older gas resources were retired, which in turn required the addition of new, modern thermal capacity to meet the target reserve margin.

For the 2024 Renewables case, the entire ERCOT system was modeled with 2024 assumptions including renewable capacity expected by 2024, but otherwise as in Step 1.

The quantities of ancillary services needed to support the assumed renewable portfolios in each of the scenarios were determined via intra-hour simulations of the projected net load volatility of each scenario. Each scenario was then modeled with the appropriate ancillary service quantity and associated costs.

Total energy and ancillary services costs to consumers were calculated and required capacity premiums were calculated. The capacity payment rate was set at the net revenue required by the marginal capacity resource at the 1:10 LOLE reserve margin. Accredited capacity ratings were based on the ELCC of each generator.

This analysis showed that, compared to the No Renewables case, the long-term annual cost saving for Texas consumers from the 2024 Renewables case is approximately $2 billion.

Astrapé then extended the analysis beyond the No Renewables and 2024 Renewables cases to include a new case that adds 10 GW of solar, 10 GW of wind, and 5 GW of energy storage resources to the 2024 Renewables case (“20 GW More Renewables”).

Table 1: Renewable Capacity Assumptions Modeled in the Main Scenarios

Case	Wind Capacity (MW)	Solar Capacity (MW)
No Renewables	0	0
2024 Renewables	39,512	31,194
20 GW More Renewables	49,512	41,194

Figure and Table summarize the results of these cases.

Figure 6: Adding More Renewable Generation Provides Additional Cost Savings in the Long Term

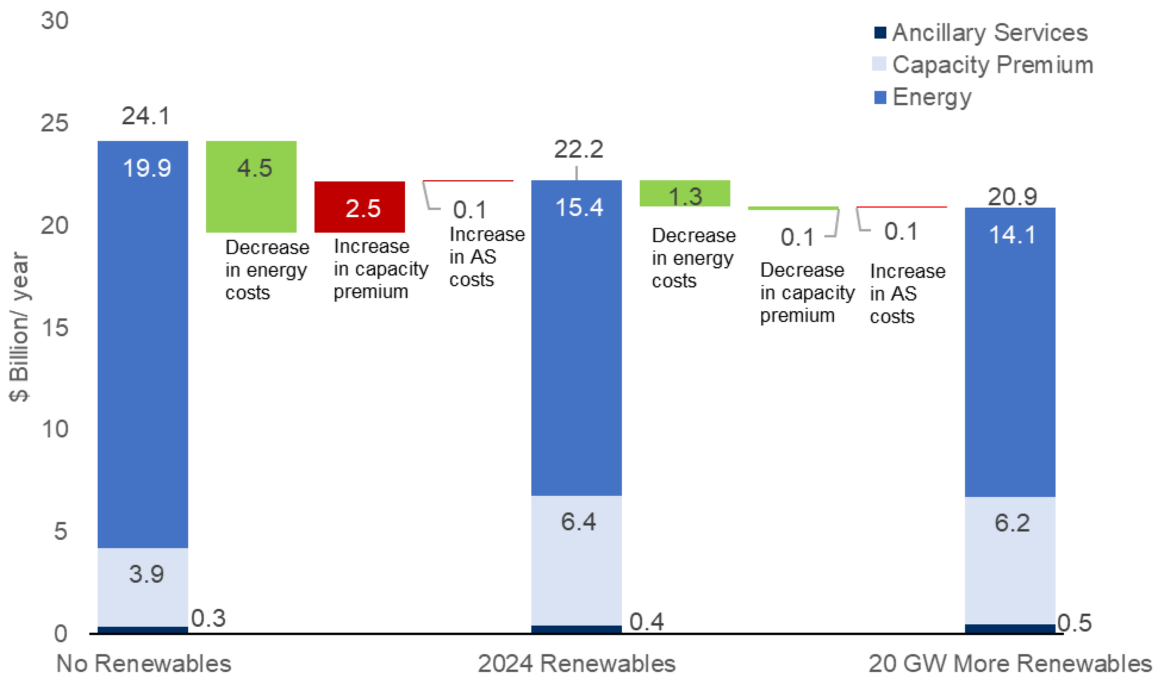


Table 2: Renewable Energy Saves Consumers Billions of Dollars Every Year

Case	Energy	Capacity Premium	Ancillary Services	Total Consumer Cost	Cost Savings from Renewables
No Renewables	$19.9	$3.9	$0.3	$24.1	$ -
Near- to Medium-Term Impact: 2024 Renewables	$14.4	$3.3	$0.4	$18.1	$6.0
Long-Term: 2024 Renewables	$15.4	$6.4	$0.4	$22.2	$1.9
Long-Term: 20 GW More Renewables	$14.1	$6.2	$0.5	$20.9	$3.2

The results show that adding more renewable generation continues reducing the total cost consumers pay for reliable electricity supply across a range of time periods and renewable generation penetration levels:

Energy costs to consumers (the largest cost component) drop substantially due to the low marginal cost of renewable generation capacity.

The addition of renewable generation to the ERCOT system increases the reserve margin gap between the MERM and the reserve margin at a 1:10 LOLE but this gap ultimately needs to be closed to achieve the policy goal of providing reliable power. The capacity premium represents the additional revenue required to close the gap, but it does not result in net additional costs to consumers because it is more than offset by the reduction in energy prices. (Note that in all scenarios modelled by

Astrapé, all accredited capacity – including renewables – receives the same net revenue needed to recover the net cost of the marginal provider of capacity that meets the reliability target.)

Ancillary services costs increase to reflect the short-term variability of renewable output, but these increases are also substantially less than the decline in energy costs.

Breaking these savings down by component in the long-term:

2024 Renewables: Projected 2024 renewable generation capacity delivers approximately $4.5 billion in gross energy cost savings to consumers per year. These savings are partially offset by approximately $2.5 billion in capacity premiums and $60 million in ancillary services costs.

20 GW More Renewables: Adding 20 GW of renewable generation and 5 GW of storage to the 2024 Renewables case delivers an additional annual gross energy cost savings to consumers of about $1.3 billion – with a negligible change in the capacity premiums and ancillary services costs.

At the individual consumer level, a $3.2 billion reduction in total ERCOT system costs results in nearly $100 of annual savings for the average residential consumer.[21]

Sensitivity Analyses

The gas prices used in the above cases were based on the current forward prices at the time of writing, which averaged about $4.68/MMBTU for 2024. To determine how gas prices affect the cost savings renewable generation provides, Astrapé conducted scenario analyses of the No Renewables and 2024 Renewables long-term cases, respectively with low gas prices ($3/MMBTU) and with high gas prices ($7/MMBTU):

- **Low Gas Prices:** In the low gas price sensitivity the benefit in the 2024 Renewables case is broadly similar to the benefit observed at current gas prices. Energy benefits are naturally lower, but the increase in the capacity premium is also lower.

- **High Gas Prices:** In the high gas price sensitivity, the benefit in the 2024 Renewables case is also similar to the benefit observed at current gas prices. Energy benefits are higher, but the increase in the capacity premium is also higher.

In either case the long-term benefits remain in the $2 billion per annum range. In sum, the modeling demonstrates that the benefits renewable generation provides by reducing the total cost of reliable electric service are significant over a range of gas prices.

[21] Residential cost savings estimate in the 20 GW More Renewables case based on 2022 forecast total ERCOT load (423,333,035 MWh) and 2021 average monthly residential consumption in Texas (1,094 kWh). Annual Savings of $99.23 = (($3,200,000,000 / 423,333,035 MWh) / 1000) * (1,094 kWh * 12). See ERCOT Forecast of Monthly Peak Energy, 2022, available at https://www.ercot.com/gridinfo/load/forecast and EIA 2021 Average Monthly Bill – Residential, available at https://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf.

Figure 7: Total Cost to Consumers - Low Gas Price Scenario

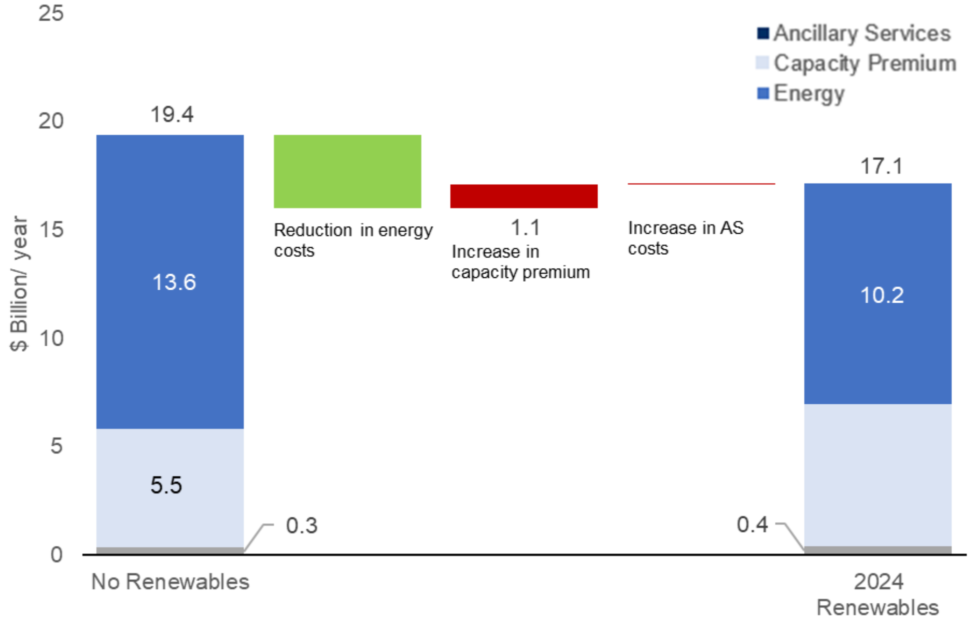
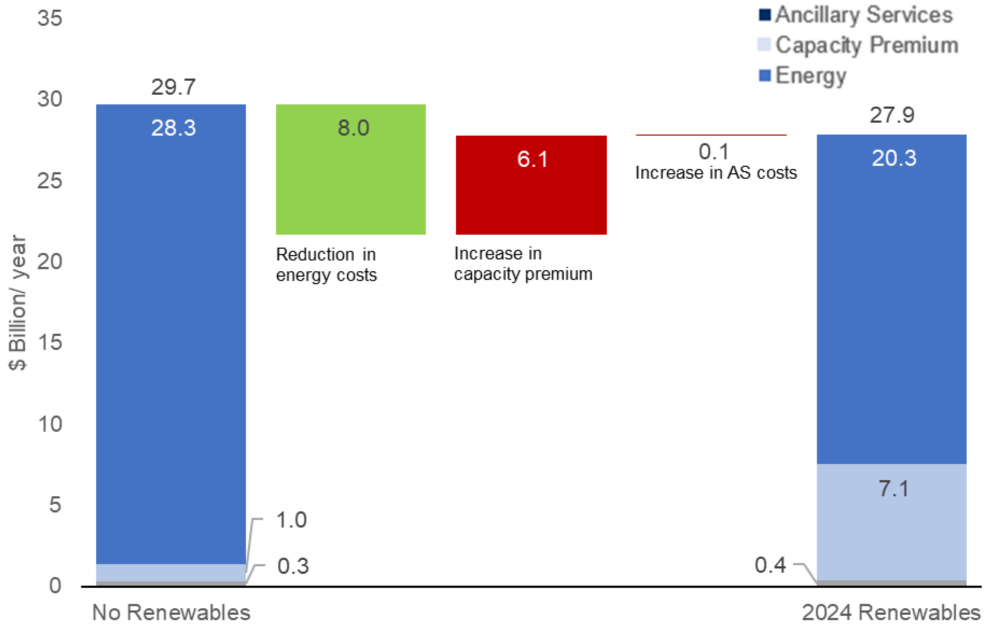


Figure 8: Total Cost to Consumers - High Gas Price Scenario



Astrapé also analyzed an alternative version of the 20 GW More Renewables scenario in which all the additional renewable capacity was wind. The results demonstrated the same pattern: significant cost savings for consumers of over $3.5 billion per year compared to the No Renewables case. Again, the scenario was constructed to ensure a 1:10 LOLE was met.

Finally, Astrapé evaluated the impact of different levels of energy storage resource additions on both the 2024 Renewables and 20 GW More Renewables cases. Energy storage resources are complementary to renewables because energy storage will enter the market to take advantage of energy arbitrage opportunities created by the addition of renewable generation. Again, the benefits were robust across range of storage capacity assumptions.

How can ERCOT comply with the S.B. 3 direction to allocate ancillary services costs on a cost causation basis while recognizing that renewables lower consumer cost for a reliable electric supply?

Texas Senate Bill 3 (87R) ("S.B. 3") requires that ERCOT modify the design, procurement, and cost allocation of ancillary services in a manner consistent with cost allocation principles and in a non-discriminatory manner. The most reasonable way to comply with this requirement is by continuing the common practice of allocating all ancillary services costs to consumer load. This methodology is standard practice in electricity markets because the reliability requirements of firm load drive the need for ancillary services and all other costs grid operators incur to ensure reliability. Firm load requires service to be continuous and uninterrupted, and this is the ultimate reason why ancillary services costs are incurred. Therefore, continuing to allocate ancillary services and any other reliability costs to load is fully consistent with cost allocation directive in S.B. 3.

The allocation of ancillary services and any other reliability costs to load is fully consistent with cost causation principles.

Charging load for ancillary services is appropriate for two primary reasons:

1. Providing consumers with continuous, uninterrupted electric supply requires ancillary services. Charging generation resources for costs that consumers cause by requiring firm, uninterrupted service that can only be provided if ancillary services are procured is contrary to the S.B. 3 requirement to allocate costs based on cost causation principles.
2. Electric consumers purchase and consume a single integrated product when they buy electricity. The price consumers pay for that integrated product reflects the combined cost of ancillary services and energy, and consumers want the combined cost of all the components of reliable electricity service as low as possible. By way of example, assume a scenario in which a consumer is charged separately for the components of their electricity, but still pays for the total cost of reliable electricity. A consumer who is presented with a choice of paying $50/MWh for energy and $3/MWh for ancillary services or $45/MWh for energy and $4/MWh for ancillary services will select the latter, but the technology that enables the lower energy costs may also require somewhat higher ancillary services costs.

Impracticality of Charging Generation

It may initially seem reasonable to evaluate ancillary services cost causation by looking at each type of ancillary services ERCOT procures and attempt to allocate costs based on the operational contingencies each service insures against and allocating costs based on the source of the underlying contingency. For example:

- Synchronous reserves are typically required to account for the largest system contingency or contingencies – the sudden loss of the largest unit(s) or most critical transmission line, or both simultaneously; and
- Regulation up or regulation down service could be attributed to natural load variations or ramping including those related to renewables changing energy production.

However, evaluating cost-causation this way is too simplistic and ignores the challenges that arise when attempting to use this approach to allocate costs in a non-discriminatory manner. In many cases attribution to a single source may well be impossible.

For example, if 2,000 MW of synchronous reserve is required to accommodate the largest thermal contingencies, and 500 MW of synchronous reserve would be required to account for potential deviations of renewable supply from the short-term forecast, there is no clear answer how those ancillary service costs should be allocated. The reserve needed for thermal contingencies would cover the required renewable reserve and in the extreme the entire 2,000 MW could be allocated to the largest thermal units operating, with renewables not causing any incremental ancillary services costs. Some may view it differently and propose to allocate a proportion of the 2,000 MW to thermal units and a proportion to renewables.

The task of allocating ancillary services quantities and costs each hour to generators based on specifically what is causing the market operator to acquire a specific level of each ancillary service is extremely complex and cannot result in a clear answer. It may also be impossible to allocate such costs to generators in a non-discriminatory manner as S.B.3 requires because any allocation will be based on numerous assumptions. True non-discriminatory allocation of ancillary service costs requires a full evaluation of all operational events that lead to the use of ancillary services. If ancillary service costs were to be allocated to generation in addition to firm load, a portion of ancillary service costs would need to be assigned to short-term load uncertainty, a portion to large units which form the largest contingency, a portion to smaller operating units which also require synchronous reserve capacity be available, but for which the need falls within the quantity required by the larger thermal units. For example, a large nuclear unit may require 1,200 MW of synchronous reserve. But the next largest unit may require 900 MW of synchronous reserve. Allocating all 1,200 MW to the nuclear unit fails to recognize that even without that unit there would be a requirement for 900 MW of synchronous reserve.

In the end, any allocation to generating units is inappropriate, unnecessarily complicated, and discriminatory when firm load is actually the ultimate "causer" of all ancillary services and load does not purchase ancillary services separately from energy. Load only purchases bundled energy and ancillary services and is only interested in the bundled price.[22]

Inefficiency of Charging Generation

Charging incremental ancillary services costs to renewable generators would also be economically inefficient. It would tilt the playing field and in so doing discourage the efficient development of technologies that provide Texas consumers with reliable electricity at the lowest possible cost. The Astrapé SERVM analyses validate empirically that renewables are required to provide the lowest cost reliable power. ERCOT market reforms can best comply with S.B.3 while providing incentives that result in the least cost supply mix for consumers by allocating all ancillary services costs to consumer load.

Non-discrimination

Allocating costs to renewables and not to other generation types would be discriminatory, as other forms of generation capacity also involve integration costs. For example, the potential loss of the two largest nuclear units in ERCOT creates the need for 2,800 MW of certain contingency reserves. Allocating costs to one subset of generators (in this case, renewables) would violate the non-discrimination requirement of Texas S.B. 3.

Conclusion

Policy reforms should recognize the beneficial price impact renewable generation has on consumer costs and system reliability to ensure changes in market design focus on the aspects of the market that require reform to meet the state's electric policy objective: delivery of reliable, affordable power to consumers. The analysis conducted by Astrapé shows that adding renewable generation to the ERCOT system reduces the price paid by electricity consumers — including the cost of energy, ancillary services, and capacity premiums required to maintain a 1:10 LOLE. Furthermore, renewable capacity makes a positive contribution to system reliability and does not impose a reliability cost.

As such, the notion of determining cost-causation is not only impractical, inefficient and discriminatory, but is also inapplicable in the case of renewable capacity because renewable generation reduces the cost of reliable electric service for consumers.

[22] ERCOT purchases energy and ancillary services and can purchase them separately but, it can control its purchases so that it only pays more for ancillary services when the combined energy and ancillary service cost is lower.