States in Sync

The Western Win-Win Transmission Opportunity

Report / April 2024

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RMI

About RMI

RMI is an independent nonprofit, founded in 1982 as Rocky Mountain Institute, that transforms global energy systems through market-driven solutions to align with a 1.5°C future and secure a clean, prosperous, zero-carbon future for all. We work in the world's most critical geographies and engage businesses, policymakers, communities, and nongovernmental organizations to identify and scale energy system interventions that will cut greenhouse gas emissions at least 50 percent by 2030. RMI has offices in Basalt and Boulder, Colorado; New York City; Oakland, California; Washington, D.C.; and Beijing.

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Executive Summary

The Western transmission system has been central to the region's economic development since 1889, when the first long-distance transmission line brought hydropower 14 miles from Willamette Falls to provide electric lighting to downtown Portland, Oregon. Since that first line, utilities and federal agencies have connected coal, hydroelectric, gas, wind, and solar power across the West through transmission lines, enabling the growth of the region's largest cities and industries. Through the 1960s to 1980s, the Western grid grew an average of 5% per year.[i]

Today, we are on the cusp of a new economic development opportunity and once again need to expand the West's transmission system. However, the status quo has been ineffective at West-wide regional planning. In the past few decades, we have built very few transmission lines, and most of the lines we have built are local and within a single state.

In this analysis, we show that Western regional transmission expansion is a win-win economic opportunity for all Western states — Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming — and that the most expansive planning leads to the greatest benefits. Additionally, we describe how the West will fail to seize these economic opportunities if we continue planning in silos.

We first focus on the immense economic opportunity for Western energy export states, including Colorado, Montana, New Mexico, and Wyoming. We find that the coming Western electricity market, based on legislated public policy goals and reasonable estimates for load growth, will grow to **over $40 billion per year in 2050**. But to access this opportunity, energy export states will need increased interstate transmission capacity. Without increased transmission capacity, these states will be able to access only **7% of the market ($3 billion per year)**. West-wide transmission planning is key for energy-exporting states to develop a dominant position in this new energy market.

"We find that the coming Western electricity market, based on legislated public policy goals and reasonable estimates for load growth, will grow to over $40 billion per year in 2050."

Second, we find that states with clean energy standards can significantly reduce their energy costs by collaborating with their neighbors. Our analysis reveals a direct correlation between the amount of economic savings a state can realize in meeting its clean energy goals and the distance beyond its borders that it includes in its planning. The most expansive planning could lead to **cost reductions of over 30%** compared with building out generation only within a state. Thus, to ensure that states meet their goals in an affordable manner, they should do the most expansive planning possible and aim to connect the edges of the West.

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i The total West-wide annual load growth was an average of 4.6% per year from 1960 to 1989 (*EIA-861 Annual Electric Power Industry Report*, US Energy Information Administration [US EIA], October 2023, www.eia.gov/electricity/data/state/).

The 11 Western states have a unique opportunity to lead and advance West-wide transmission planning and seize economic and sustainability opportunities. Governors and their staff can take seven key actions:

1. Ensure that economic opportunities and cost savings are fully included in transmission planning.
2. Collaborate with other governors to support regional transmission planning.
3. Leverage ongoing transmission planning efforts to prioritize West-wide planning.
4. Lead the West to a consensus on a cost allocation framework.
5. In existing regional transmission planning conversations, prioritize West-wide transmission planning.
6. Ensure that regional transmission is considered as part of in-state planning.
7. Ensure that state values, policy, and perspectives are integrated into any regional plan.

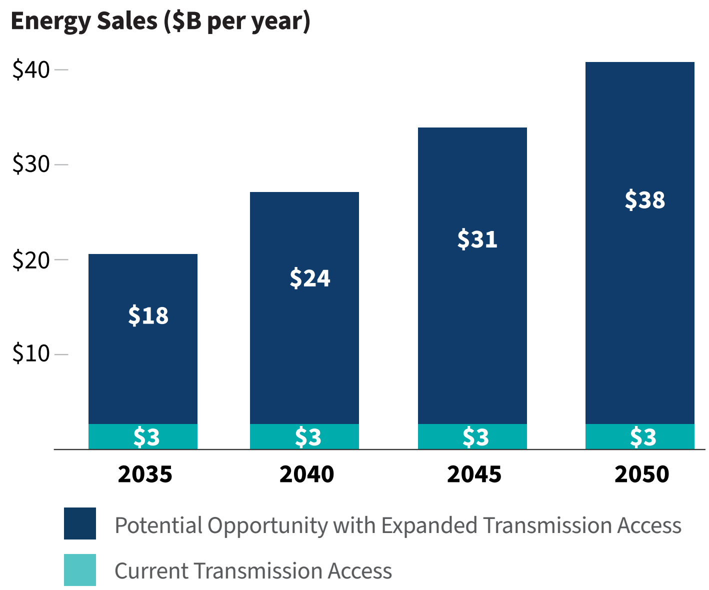
Win #1: Colorado, Montana, New Mexico, Wyoming, and others have an opportunity to access massive new energy markets.

The Western clean electricity market will double by 2030 and increase sixfold by 2050, even with modest load growth estimates. Given the West's rich resources, all Western states can seize this economic opportunity. Our analysis focuses on how the West's four energy export states — Colorado, Montana, New Mexico, and Wyoming — could access out-of-state markets if they expand transmission. Current transmission constraints limit access to the coming opportunity in the Western electricity market (see Exhibit ES1).[1]

Exhibit ES1

Transmission currently constrains access to the coming Western electricity market

Size of opportunity in the Western clean electricity market based on legislated clean energy targets and modest load growth



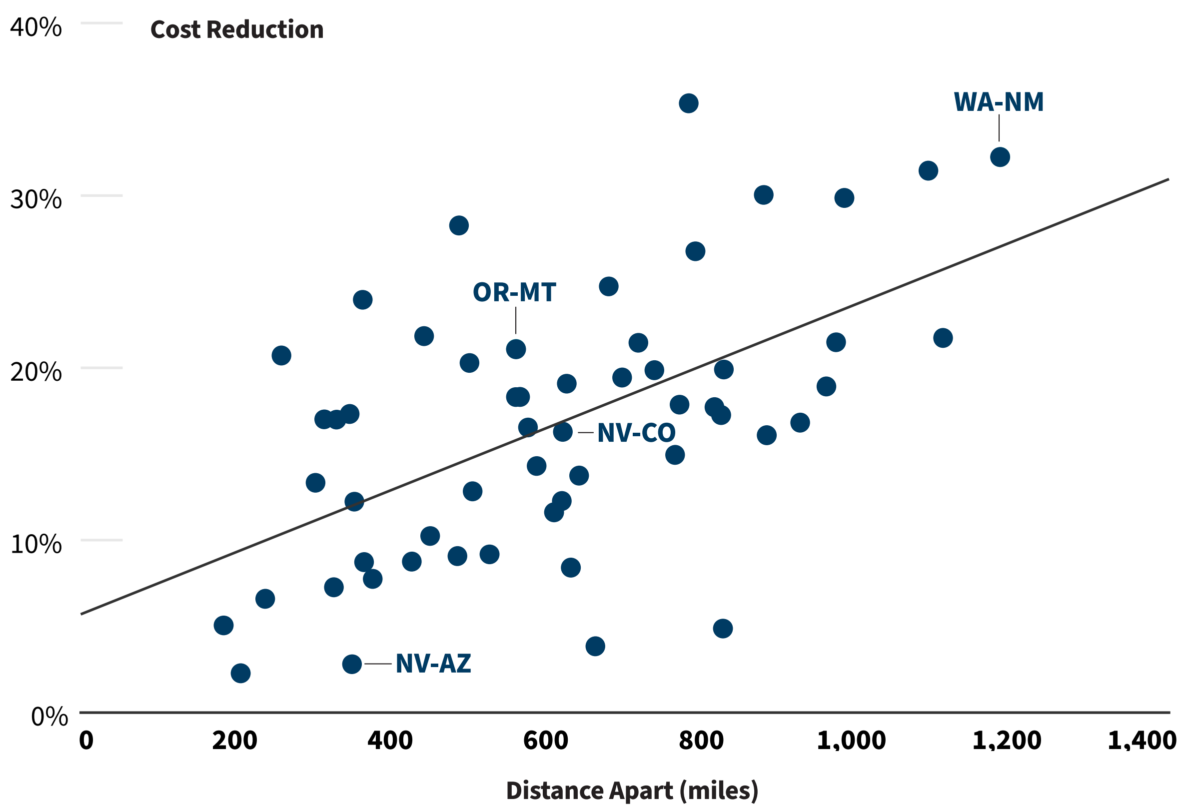
RMI Graphic. Source: RMI analysis, Lawrence Berkeley National Laboratory, Energy Innovation, and the Western Electricity Coordinating Council (WECC)

Win #2: The most expansive regional planning would maximize the savings in meeting clean energy goals.

Planning across the larger geographies maximizes transmission's benefits. The West includes geographically diverse loads and generation resources that complement one another. The greater the geographical distance between states, the more diverse they tend to be, resulting in greater benefits. Our analysis assesses the cost reductions of planning among pairs of Western states and compares those savings with in-state-only planning (see Exhibit ES2).[2]

Exhibit ES2 **The most wide-reaching planning could result in cost savings over 30%**

Total portfolio cost reduction when states plan as pairs relative to planning in isolation for all 55 state pairs



Note: Distance between states is calculated based on each state's geographic population center.

RMI Graphic. Source: RMI analysis and the National Renewable Energy Laboratory (NREL)

Introduction

The Transmission Planning Status Quo Will Not Meet the Needs of the Coming Decades

We need expansive and proactive transmission planning to capitalize on two opportunities: access to immense new energy markets and reduced costs to meet clean energy mandates and commitments. However, today's regional transmission planning process is gridlocked. In the past 20 years, regional transmission planning groups have not built a single transmission line outside of California. Outside of the official planning groups, proposed lines have been fraught with delays and cancellations. Barriers across the "three Ps" — planning, paying, and permitting — are the root cause of these failures:

Planning: The West lacks an effective centralized venue to plan transmission. Transmission planning is largely done by the region's 38 individual balancing authorities (most operated by individual utilities). This isolated, bottom-up planning fails to capture the value of coordinating beyond each balancing area's footprint. Unfortunately, Northern Grid and West Connect — the two groups responsible for regional planning outside of California, as envisioned by the Federal Energy Regulatory Commission (FERC) in Order 1000, have defaulted to conducting box-checking exercises and have failed to capture the full value of regional planning.[ii]

Paying: Regional transmission lines are, of course, large capital investments, and their benefits are dispersed among numerous beneficiaries. Regulators, therefore, understandably worry about who pays up-front costs and who will benefit. The West lacks an effective centralized cost allocation forum and methodology to decide who pays for regional transmission. In the current system, the regional planning groups (California Independent System Operator (CAISO), Northern Grid, and WestConnect) decide the default cost allocation for regional lines. This power has never been used, in part because the utility members worry that regulators could deem their share of costs to be imprudent and unjust. Instead, utilities negotiate costs outside of a centralized system. This process impedes the development of lines by introducing uncertainty in cost recovery and creates an additional hurdle to lines that might be largely beneficial to all parties. Furthermore, it presents the potential for a free-rider problem where certain beneficiaries do not pay for the benefits they receive.

Permitting: Projects in the West are especially vulnerable to permitting delays and project cancellations because of Western environmental sensitivities, expansive federal lands, and the fact that transmission

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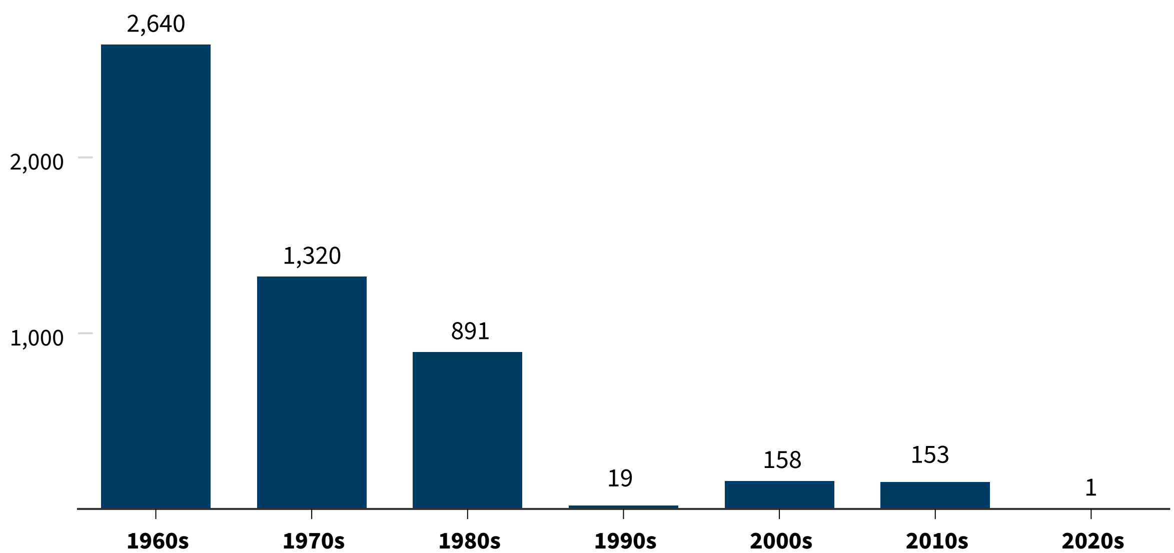
ii Multiple reports have covered the ineffectiveness of the regional transmission planning organizations and the barriers to transmission development in the West (Gridworks, *Barriers to Backbone Transmission Development in the West*, November 2023, **gridworks.org/wp-content/uploads/2023/12/Gridworks_Tx-Barriers-Primer-FINAL.pdf**; Center for the New Energy Economy and Gridworks, In Support of Western Regional Resource and Transmission Planning Coordination, October 2021, **cnee.colostate.edu/wp-content/uploads/2021/11/Western_Resource_Transmission_Planning_Coordination_Rev_1.pdf**; Comments of Western Public Interest Organizations, "Building for the Future Through Electric Transmission Planning and Cost Allocation and Generator Interconnection Regional," Docket No. RM21-17-000, Federal Energy Regulatory Commission, August 2022; and Americans for a Clean Energy Grid, *Transmission Planning and Development Regional Report Card*, June 2023, **www.cleanenergygrid.org/wp-content/uploads/2023/06/ACEG_Transmission_Planning_and_Development_Report_Card.pdf**).

lines to connect resources to load must often traverse long distances through multiple states. The permitting process is the most significant obstacle in developing new lines in the West and has led to project time lines exceeding 20 years.

Overall, today's transmission planning system will not unlock the transmission needed to seize economic opportunities. Exhibit 1 shows how little transmission the West's largest transmission operator, Bonneville Power Administration, has built in the past 30 years within its system compared with the past.[3] Other transmission operators in the West show similar trends.

Exhibit 1 — Western transmission investments have been minimal over the past four decades

Bonneville Power Administration 500-kilovolt circuit, miles built per decade



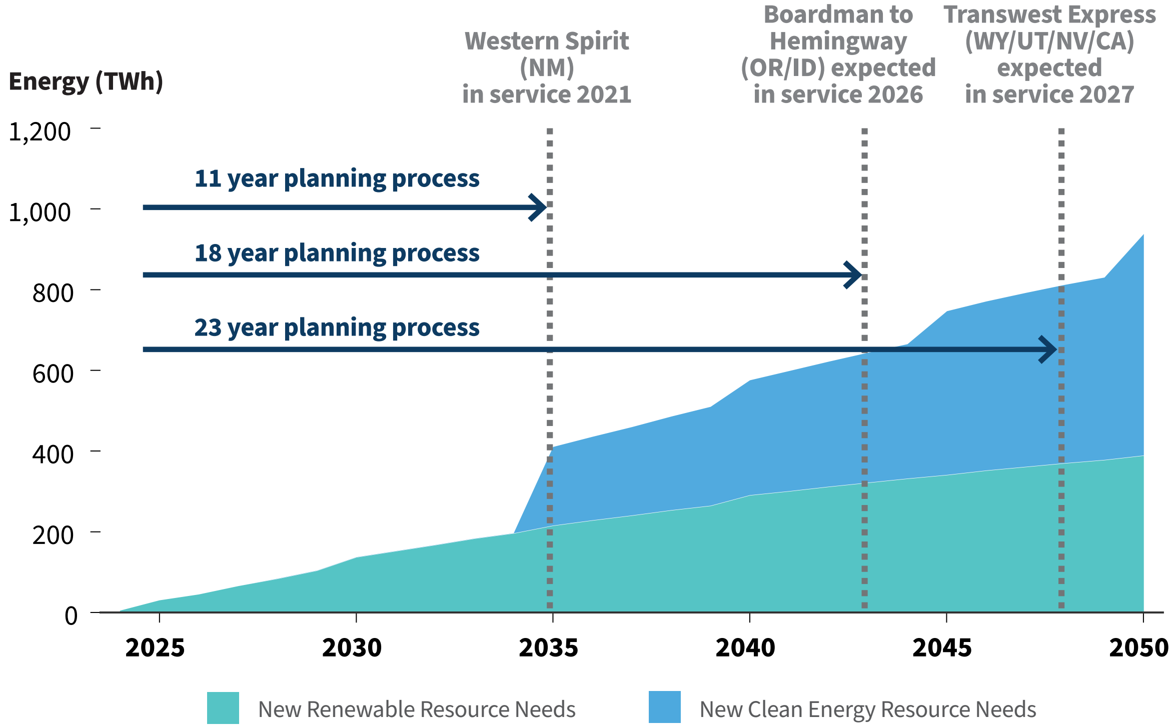
RMI Graphic. Source: Bonneville Power Administration

To Seize the Transmission Opportunity, We Must Begin Planning Today

It has been said that the best time to plan transmission was 20 years ago and the second best time is today. This certainly applies in today's West. To seize coming economic opportunities, planning should begin today. Even if we can accelerate permitting time lines, we should act quickly to seize the coming economic opportunities. Exhibit 2 (next page) compares permitting time lines for three major interstate Western projects with coming Western clean energy demand, based on legislated public policy goals and modest load growth assumptions.[4]

The largest transmission project in the past 30 years, the Transwest Express project, aims to connect Wyoming wind to California, Nevada, and Utah and was first conceived in 2004. Originally anticipated for completion in 2014, numerous delays have pushed the expected on-line date to 2027. If a similar project were proposed today, the expected on-line date would be 2048, far too late to meet the goals that three Western states — California, Oregon, and Washington — have set for 2045. Even “faster” and smaller projects, like Western Spirit connecting New Mexico wind to California, took 10 years to plan and permit.

Exhibit 2 **Timelines for existing transmission projects compared with clean energy needs**



RMI Graphic. Source: RMI analysis and Lawrence Berkeley National Laboratory

We Assessed the Economic Opportunities that Proactive West-Wide Transmission Planning Can Unlock

In this report, we find that expansive and proactive Western transmission planning can unlock large new economic opportunities. First, we show that traditional energy export states can seize a tremendous new economic opportunity, an opportunity larger than today’s Western coal and gas industries. Second, we show how enabling interstate transmission will reduce the cost of meeting state and corporate clean energy goals. We conclude with recommendations for how states, regulators, and industry can seize today’s opportunity.

The West's Next Energy Opportunity

In today's West, a network of railroads, pipelines, and transmission lines serve as energy highways connecting rich Western energy sources with demand in the West and across the United States. Without these highways, the economic vitality of the West's energy production would be like a heart without arteries.[5]

For example, Wyoming combines rich raw resources with energy transportation infrastructure to power its energy economy. Wyoming's oil and natural gas industries doubled their production after the first major investment in pipeline export infrastructure.[iii] Further expansion has positioned the state as the eighth and ninth largest producer of oil and gas in the United States, respectively.[6] Similarly, railroads allow the state to ship its coal across the country, powering 47% of US coal power plants.[iv] Finally, Wyoming leverages transmission lines to send electricity across the West, generating almost three times as much electric power as it uses.[v]

Colorado, Montana, New Mexico, and Wyoming have all profited by building energy highways to move their coal, oil, and natural gas. These states have cultivated strong economic (and cultural) ties with the energy sector, often identifying as energy export states. Exhibit 3 (next page) shows each Western state's energy production as a fraction of its consumption, with the energy export states highlighted in blue.[7] Wyoming leads the way, producing 12 times as much energy as it consumes.

In the future, these same states can profit immensely from the energy transition because they are rich in clean energy resources as well as fossil fuels. Further, states that have not traditionally been

iii The oil industry in Wyoming has seen significant growth since the 1950s, after the Platte pipeline was constructed. Over the next decade, oil production more than doubled. Likewise, the natural gas sector experienced a similar surge when the Kern River pipeline was built in 1992, which opened up new gas reserves and led to a doubling of Wyoming's gas production over the following 15 years. (Tom Mast, "Oil to Market: A History of Pipelines in Wyoming," December 19, 2014, **www.wyohistory.org/encyclopedia/oil-market-history-pipelines-wyoming**.)

iv Wyoming produces about 40% of all coal and 47% of coal used in power plants. Additional detail about where coal is produced in the Western states and where it is shipped to can be found on pages 3–4 of the *Appendix*. (Wyoming Mining Association, "Coal," **www.wyomingmining.org/minerals/coal/** and "EIA-923 Monthly Generation and Fuel Consumption Time Series File," US EIA, 2021, **www.eia.gov/electricity/data/eia923/**.)

v In 2002, Wyoming power plants produced 43.5 TWh of electricity while Wyoming's retail sales were only 15.8 TWh ("State Electricity Profiles," US EIA, November 2022, **www.eia.gov/electricity/state/archive/2021/**).

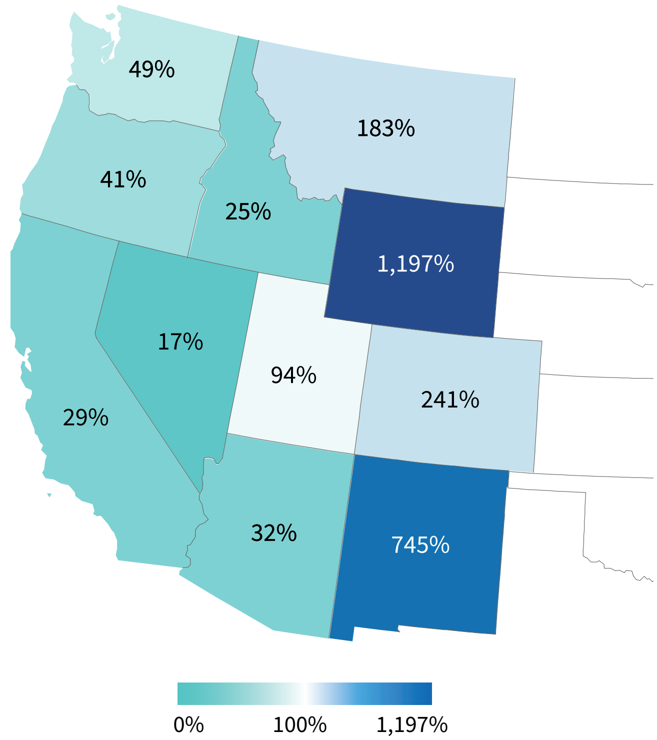
energy export states can also profit from the coming transition because many regions, although not rich in fossil fuels, are rich in clean energy resources. However, as with oil and coal exports, these states will need interstate transmission to transport their energy to where it is needed.

Today, public policies and the declining cost of switching from fuel-powered to electricity-powered end uses are rapidly changing Western energy markets. State policies, including renewable portfolio and clean energy standards, and voluntary corporate commitments are creating large demand for new electric power. Together, policies and commitments for clean power now account for 90% of future Western electricity demand.[8] Furthermore, state economy-wide decarbonization policies, federal incentives for hydrogen and electrification, and declining costs for electric vehicles and heat pumps are all expected to contribute to substantial load growth in the coming decades. Recently, new proposals for data centers and manufacturing plants have begun to unexpectedly increase projections for short-term electricity demand (before 2030).[9]

Exhibit 3

Colorado, Montana, New Mexico, and Wyoming are the leading energy export states of the West

Total energy production as a percentage of energy consumption in 2021



Note: The total state energy production and consumption includes primary energy from fossil fuels, nuclear electric power, and renewable energy sources. There is no double counting of fossil fuel production or consumption with electricity production from the same source.

RMI Graphic. Source: RMI analysis and US EIA

Given that most clean power produces electricity, it is reasonable to expect the energy export path of tomorrow will be transmission. Critically, Western states will need to build regional transmission to access these new markets. Similar to today's energy economy, to leverage the West's abundant resources in wind, solar, geothermal, uranium, and fossil generation with carbon capture, the West will need to build new energy highways: transmission lines.

Establishing the Scale of New Energy Markets

We quantify the growth of new Western energy markets by examining two drivers: (1) state energy policies and utility commitments and (2) likely load growth from electrification. We then quantify the ability of today's energy export states, Colorado, Montana, New Mexico, and Wyoming, to access these new markets using current transmission infrastructure. Together, these insights show the extent that transmission constrains access to this new economic opportunity. Finally, we review options for paying for transmission to show that transmission can be shared fairly across Western ratepayers. In addition, we explore as a case study how New Mexico recently used the creation of a transmission authority to propel its new energy economy at zero cost for New Mexico ratepayers.

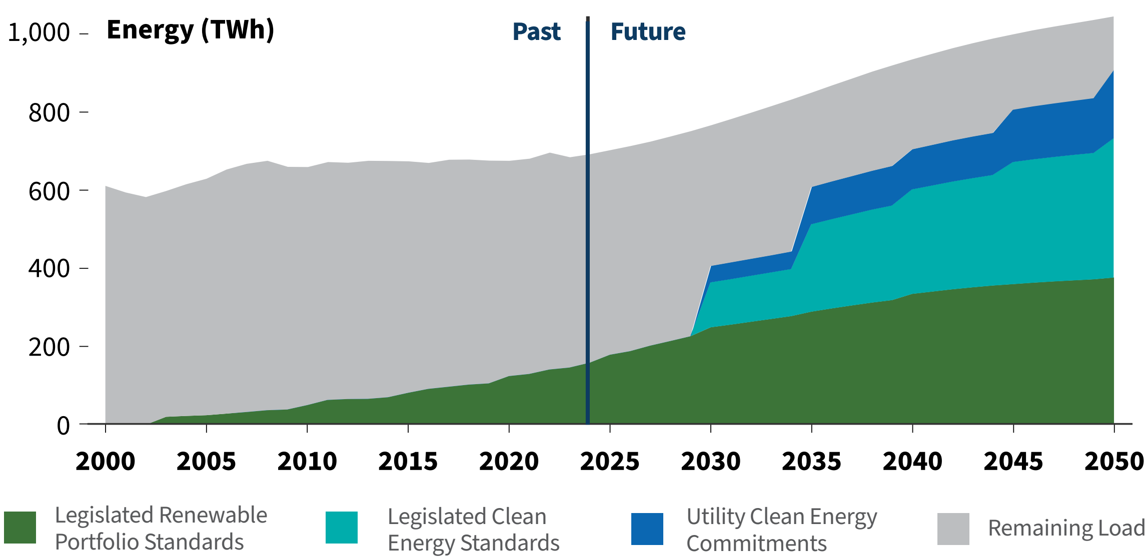
Finding #1: The demand for new energy markets will double by 2030 and increase sixfold by 2050, even with conservative load growth estimates

Legislative targets and utility commitments are driving a significant increase in the demand for clean energy in the Western United States. Six Western states have enacted legislation mandating 100% clean energy goals for their utilities and customers.[vi] These goals can be achieved through a variety of technologies, including carbon capture and sequestration, geothermal, hydroelectricity, nuclear, solar, wind, or any other technology capable of generating electricity while remaining carbon neutral. Separately, several large utilities have committed to clean energy goals.[vii] Finally, six states have established renewable portfolio standards that require their utilities and customers to procure renewable energy such as biomass, geothermal, solar, and wind.

Exhibit 4 shows the cumulative demand for new clean electricity together with total Western load, assuming a conservative 1.6% per year load growth.[10] In this conservative scenario, legislated clean energy and

Exhibit 4 **Western load by type of goal or standard**

Low Electrification Case



RMI Graphic. Source: RMI analysis, Lawrence Berkeley National Laboratory, and Energy Innovation

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vi California and New Mexico have set a goal of 100% carbon-free electricity by 2045. Colorado and Nevada have set a goal of 100% carbon-free electricity by 2050. Oregon has set a goal of 100% reduction in greenhouse gas emissions in the electricity sector by 2040. Washington has set a goal of 100% zero-emissions electricity by 2045. (Clean Energy States Alliance, "Table of 100% Clean Energy States," **www.cesa.org/projects/100-clean-energy-collaborative/guide/table-of-100-clean-energy-states/**.)

vii Idaho Power, Avista, Arizona Public Service Company, Tucson Electric Power, and Salt River Project have committed to voluntarily meet clean energy goals ranging from 65% to 100% of electricity generated. Other smaller utilities throughout the West have set similar goals but were not included in this analysis.

renewable standards will comprise more than half the Western electricity market by 2035 and expand sixfold more above 2023 levels by 2050.[viii]

Finding #2: Electrification will likely supercharge demand in new energy markets

In addition to their clean electricity goals, six Western states have established economy-wide emissions reduction targets.[ix] Because the most economic emissions reduction technologies use electricity, economy-wide emissions targets will spur rapid adoption of electrified end uses, such as electric vehicles and heat pumps. In addition, many consumers are choosing electric end uses because they have rapidly decreased in cost and improved in performance. Further, state and federal policies are incentivizing electrification. As electrification continues, it will combine with clean energy standards to rapidly increase demand in new energy markets.

To estimate the impact of electrification, we used Energy Innovation's Energy Policy Simulator to create three load projections from 2022 to 2050.[11] The simulator includes technology improvements and different policy options to estimate load demand for each of the 11 states. We used the simulator's pre-populated business-as-usual and high electrification scenarios to construct three cases:[x]

1. In the **Base Electrification Case**, in states with economy-wide emissions reduction targets, end uses electrify according to the high electrification scenario, and in states without targets, load grows according to the business-as-usual scenario.

2. In the **High Electrification Case**, all states experience end-use electrification according to the high electrification scenario.

3. In the **Low Electrification Case**, all states experience load growth according to the business-as-usual scenario.

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viii Demand projections for renewable portfolio standards (RPS) and clean energy standards (CES) are derived by applying percentage targets to projected retail electricity sales by obligated entities, accounting for utilities or customers exempt from RPS and CES obligations (Galen L. Barbose, Lawrence Berkeley National Laboratory). Retail sales projections are derived by applying state-level growth rates from Energy Innovation's Energy Policy Simulator to the most recent available state-level retail sales data. Voluntary clean energy goals include those announced by large utilities in Arizona and Idaho. In addition, voluntary clean energy goals include utilities and customers that are exempt from RPS and CES in Colorado and Oregon. Those exempt utilities and customers are assumed to follow clean energy standard pathways in those states.

ix California and Colorado have set legislated net-zero requirements by 2050. Washington has set a legislated requirement of 95% reduction by 2050. Nevada has set a legislated requirement of 45% reduction by 2030 and has set a goal of net zero by 2050. Oregon has set a goal of 80% reduction in greenhouse gas emissions by 2050. New Mexico has set a goal of 45% reduction in greenhouse gas emissions by 2030. (*US states with binding economy-wide climate targets*, Environmental Defense Fund, February 2023, **blogs.edf.org/climate411/wp-content/blogs.dir/7/files/2023/02/US-States-with-Binding-Economy-Wide-Targets.pdf**; *States with net-zero carbon emissions targets*, The Council of State Governments Eastern Regional Conference, March 2023, **csg-erc.org/states-with-net-zero-carbon-emissions-targets/**; Office of the Governor State of Oregon, *Executive Order No. 20-04*, March 2020, **www.oregon.gov/gov/eo/eo_20-04.pdf**; and Office of the Governor State of New Mexico, Executive Order No. 2019-003, January 2019, **www.governor.state.nm.us/wp-content/uploads/2019/01/EO_2019-003.pdf**.)

x The business-as-usual scenario assumptions are aligned with current state and national policies, with the exception of the Inflation Reduction Act. The high electrification scenario assumptions are aligned with the US's nationally determined contribution under the Paris Agreement, detailing what each state will do to help meet the global goal to pursue 1.5°C. A full list of assumptions for each scenario can be found at **docs.energypolicy.solutions/us-state-eps-methodology**.

Exhibit 5 shows annual electricity load growth in each Western state, in each case.[12, xi]

Exhibit 5 Annual load growth across cases (% per year)

State	Economy-wide target	Low electrification case	Base electrification case	High electrification case
West-Wide		1.6%	2.8%	3.2%
Arizona	No	1.0%	1.0%	2.6%
California	Yes	2.3%	3.5%	3.5%
Colorado	Yes	1.7%	4.0%	4.0%
Idaho	No	1.0%	1.0%	2.7%
Montana	No	1.1%	1.1%	3.9%
New Mexico	Yes	1.3%	3.7%	3.7%
Nevada	Yes	0.8%	2.4%	2.4%
Oregon	Yes	1.0%	2.6%	2.6%
Washington	Yes	1.2%	3.8%	3.8%
Utah	No	1.0%	1.0%	2.5%
Wyoming	No	0.8%	0.8%	4.3%

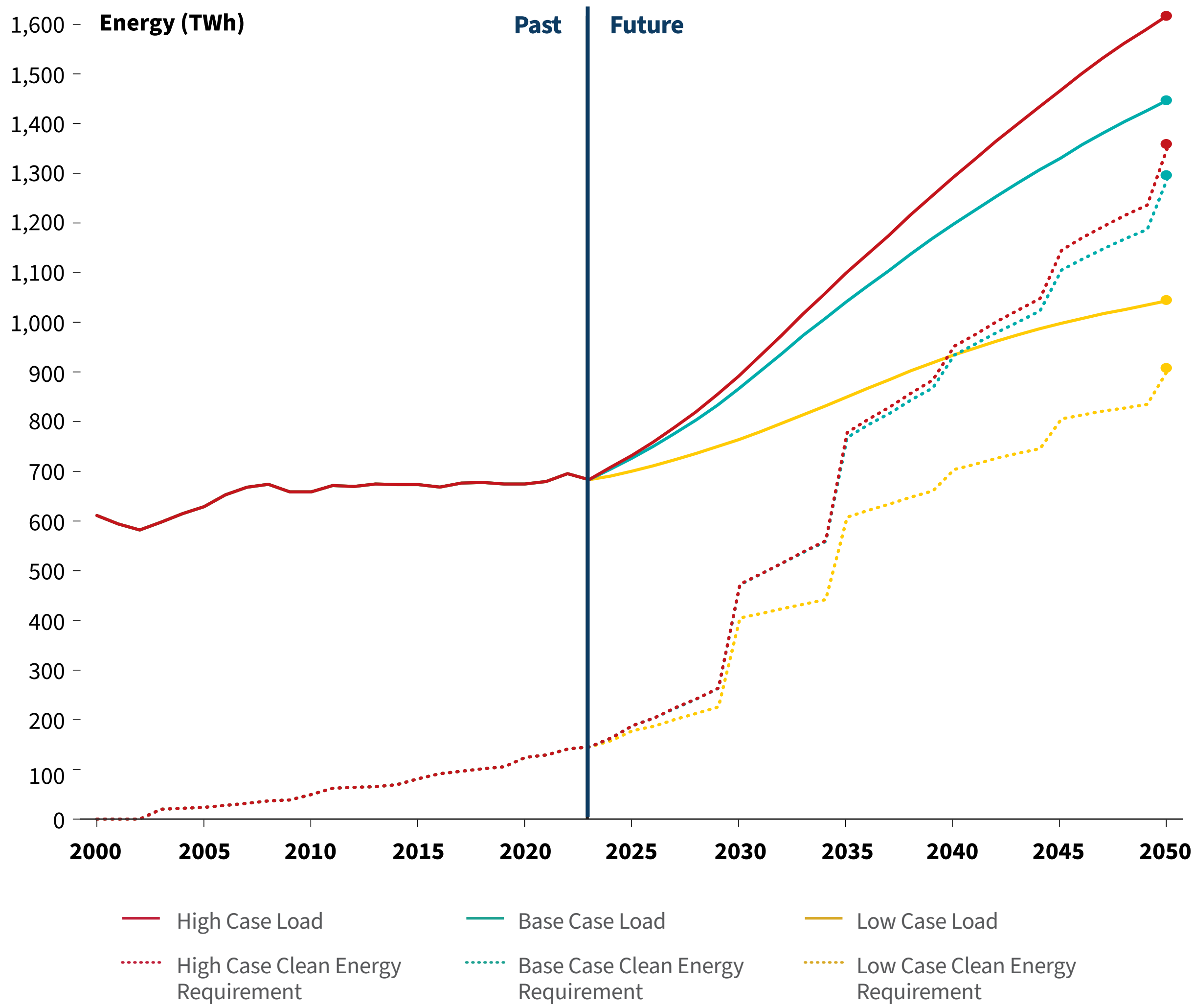
RMI Graphic. Source: RMI analysis and Energy Innovation

As shown in Exhibit 6 (next page), economy-wide electrification supercharges Western energy demand.[13] In the Base Electrification Case, electrification grows load 39% faster than in the Low Electrification Case, requiring 43% more clean electricity by 2050. In the High Electrification Case, where the entire West adopts electrified end uses, load grows 55% faster and requires 50% more clean electricity by 2050 than in the Low Electrification Case.

We acknowledge that these cases may be conservative because they do not include recent load growth from data centers (supporting artificial intelligence) and new manufacturing facilities (spurred in part by the Inflation Reduction Act). Grid Strategies has shown that these new loads could grow demand even more. As noted by the consulting firm Grid Strategies, "In just one year, the forecast of cumulative electricity growth over the next five years increased from 2.6% to 4.7%."[14] In the West, Arizona Public Service's 2028 peak load projection grew by over 10% between 2022 and 2023.[15]

xi States differ in their load growth because of the nature of their economies. For example, in the High Electrification Case, Colorado's and Wyoming's loads grow faster than Oregon's and Nevada's because their economies are more energy intensive today.

Exhibit 6 Western load and clean energy requirements across three load cases



RMI Graphic. Source: RMI analysis, Lawrence Berkeley National Laboratory, and Energy Innovation

Finding #3: New energy markets in the West will grow rapidly, soon eclipsing today's coal and natural gas markets

As a result of ambitious state clean energy policies and electrification-driven load growth, the West will demand more energy investments. In the Base Electrification Case, the West will need 410 terawatt hours (TWh) of new electricity by 2035, a 114% increase from all the clean energy that exists on the Western grid today. By 2045, it will be 747 TWh. By 2050, it will be 938 TWh, larger than the entire size of the Western electricity markets today (see Exhibit 7, next page).[16, xii]

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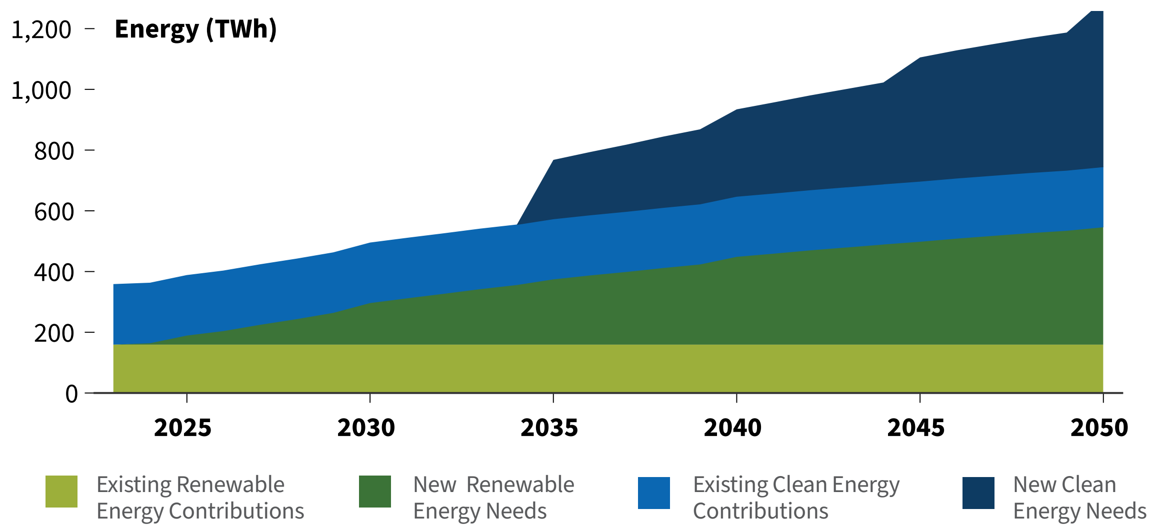
xii New electricity demand is calculated based on the renewable and clean energy existing contributions and needs in the Base Electrification Case load scenario from 2023 to 2050. Existing energy contributions are based on 2021 net generation of renewable and clean sources. Renewable sources are defined as solar, biomass, wind, wood, and geothermal. Clean sources are defined as renewables sources, hydroelectric, and nuclear. New renewable and clean energy needs are calculated as the difference between the renewable and clean requirements and the existing renewable and clean contributions.

Exhibit 7 **New electricity needs from 2023 to 2050**

Base Electrification Case



RMI Graphic. Source: RMI analysis, Lawrence Berkeley National Laboratory, Energy Innovation, and US EIA

To meet the new energy needs of tomorrow, the West will need to make large energy investments. In our calculations, we assume that tomorrow's electricity markets will deliver at similar per-megawatt hour (MWh) prices as today. Specifically, we used 2021 Western electricity market day-ahead spot prices at Mid-C, Mead, and Palo Verde — major Western US electricity pricing hubs in Washington, Nevada, and Arizona, respectively — to estimate a price of $50 per MWh (in 2024 dollars). We chose this approximation noting that electricity prices are, of course, uncertain and volatile,[xiii] and that future electricity markets will likely look different than they do today.[xiv] However, the current price continuing into the future is within the range of forecasts for the cost of delivered Western power.[xv] We calculated the undeveloped electricity market by multiplying the quantity of energy needed by the value of each unit of energy. With these assumptions, the size of the undeveloped electricity market in the West **will grow to $21 billion in 2035 and to $47 billion by 2050** in the Base Electrification Case (see Exhibit 8, next page).[17]

The size of this market will almost certainly dwarf today's coal industry by 2035 and be larger than both the coal and natural gas industries by 2050. As with our electricity calculation, we estimated today's coal and natural gas industries using total production and 2021 Western spot market prices for a comparable analysis.[xvi]

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xiii For example, the annual average day-ahead price at Mid-C has ranged from $25 per MWh to $98 per MWh in the past five years ("SNL Day-Ahead Power Prices," S&P Global, accessed on February 29, 2024, **www.capitaliq.spglobal.com**).

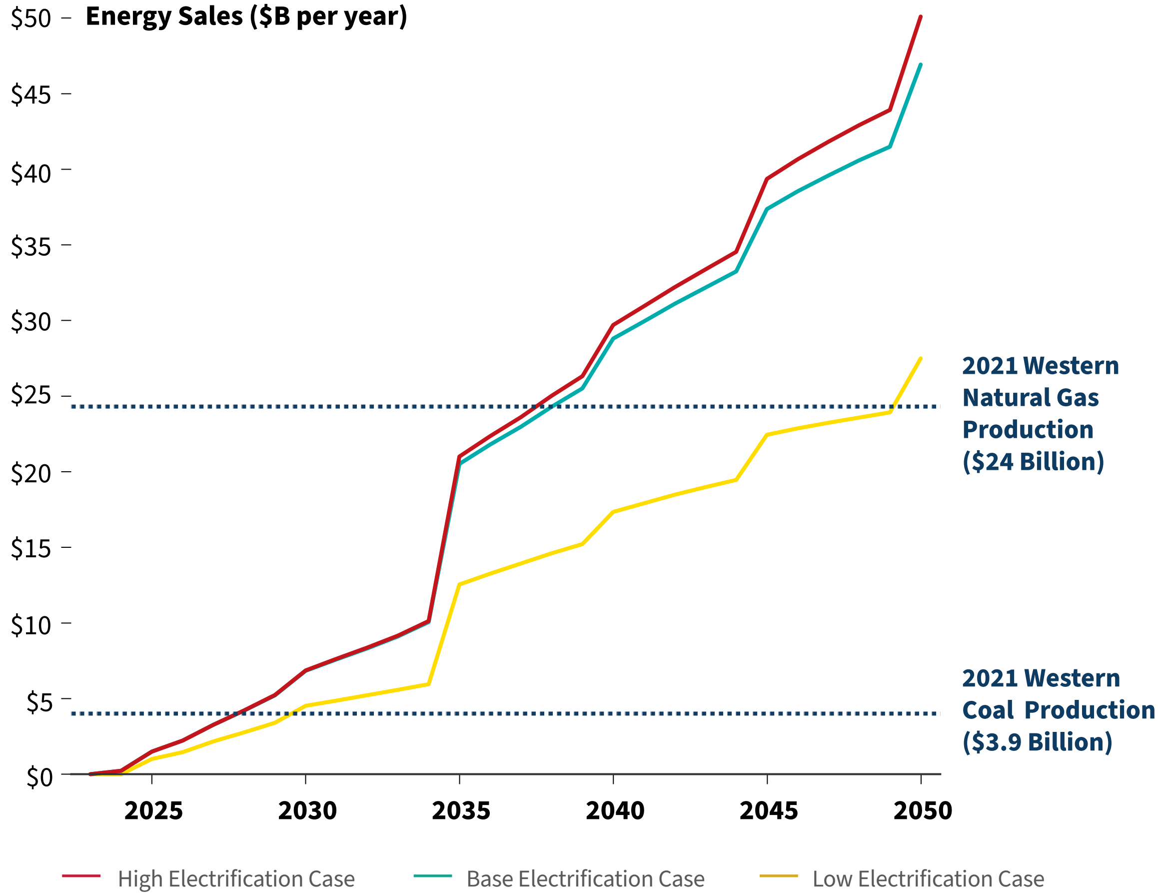
xiv Future Western electricity markets will likely be under a regional transmission organization. In addition, the future electricity grid with a high penetration of variable resources will have a capacity value larger than the energy value.

xv The US EIA's *2023 Annual Energy Outlook* estimates that electricity prices will be flat between today and 2050 (*2023 Annual Energy Outlook*, "Table 1. Total Energy Supply, Disposition, and Price Summary," US EIA, March 2023, **www.eia.gov/outlooks/aeo/**). The 2023–24 California Public Utilities Commission's (CPUC) Integrated Resource Plan estimates that delivered generation costs not including transmission and distribution will range from $77 per MWh to $92 per MWh (in 2020 dollars) from 2026 to 2045 ("2023-2024 TPP RESOLVE Portfolio Package," CPUC, accessed in March 2024, **https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/long-term-procurement-planning/2022-irp-cycle-events-and-materials/portfolios-and-modeling-assumptions-for-the-2023-2024-transmission-planning-process**).

xvi Details about this calculation and where today's Western natural gas and coal are produced and shipped can be found on pages 3–4 in the *Appendix*.

Exhibit 8 **The emerging Western new energy market**

Annual Western energy market sales



RMI Graphic. Source: RMI analysis, Lawrence Berkeley National Laboratory, Energy Innovation, US EIA, and S&P Global

Challenge #1: Currently, the Four Energy Export States Lack Access to New Energy Markets

These new energy markets offer states a tremendous opportunity to drive economic investment. In the four energy export states, there is a recoverable wind capacity of 1,355 gigawatts (GW) at or below $45 per MWh. Additionally, there are thousands of GW of economically recoverable solar capacity that can be harnessed throughout the West.[xvii] Moreover, many states are investing in new technologies necessary for a diverse energy portfolio, including long-duration energy storage, nuclear energy, carbon capture and sequestration, and geothermal power.

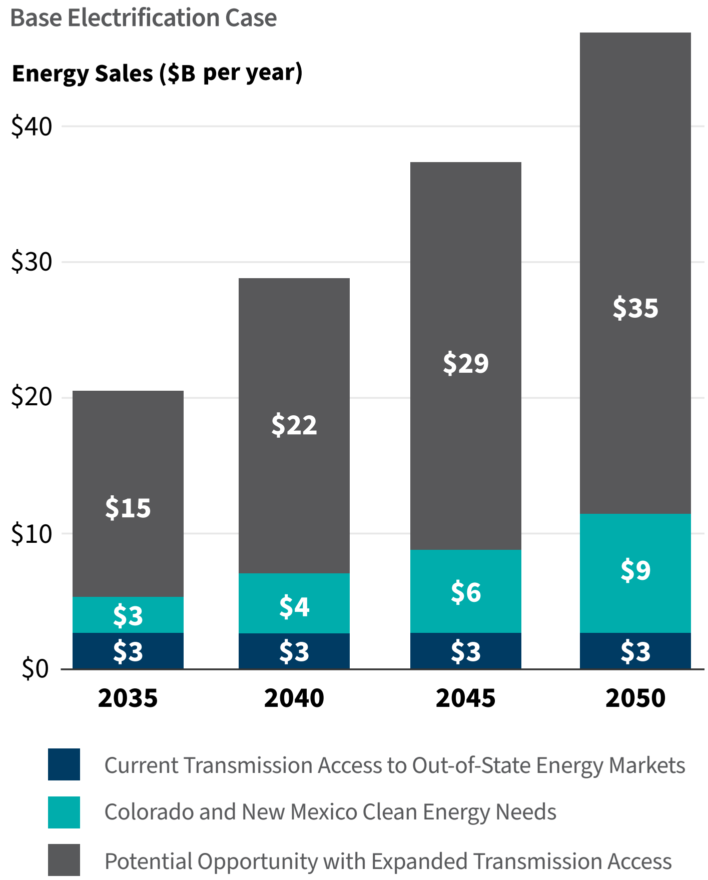
xvii The quantity of economically recoverable wind and solar was estimated using the National Renewable Energy Laboratory's (NREL) renewable energy supply curves data. (Renewable Energy Supply Curves, NREL, accessed March 2024, **https://www.nrel.gov/gis/renewable-energy-supply-curves.html**.)

However, the four energy export states are limited in their access to new energy markets. The total transmission capacity from these states to other markets in the West is only 8.2 GW.[18] This would provide access to only $2.7 billion per year in the markets, as highlighted by the dark blue bar in Exhibit 9.[xviii] Furthermore, only two of the states — Colorado and New Mexico — have their own clean targets, which account for only 13% to 15% of the total Western clean energy market, as highlighted by the teal bar. As a result, a sizable portion of the opportunity to capitalize on these markets is rendered inaccessible, as highlighted by the gray bar.[19]

To transform the new energy markets from mere opportunities into tangible investments, the four energy export states must gain access to the other four Western states — California, Nevada, Oregon, and Washington — committed to achieving 100% clean energy, as well as utilities in Arizona and Idaho, which have committed to clean energy goals. This will require significant regional transmission infrastructure to move power out of the four energy export states, as shown by the arrows in Exhibit 10 (next page).[20]

Exhibit 9

For Colorado, Montana, New Mexico, and Wyoming, existing transmission constrains access to coming energy markets



RMI Graphic. Source: RMI analysis, Lawrence Berkeley National Laboratory, Energy Innovation, and WECC

West-wide transmission planning can play a crucial role in recognizing the necessity for expanded transmission infrastructure. Of course, states will need to collaborate to define and site transmission projects that align with state policies, respect ecologically or socially sensitive areas, and comply with community benefit and labor agreements. Successful transmission planning efforts in some regions have designated energy zones where states and stakeholders can identify areas aligned with their priorities. For instance, the New Mexico Renewable Energy Transmission Authority (NM RETA) identified regions within the state abundant in wind resources, but also considered regions and transmission corridors that were off-limits based on input from local stakeholders and an understanding of the state's ecological sensitivities.

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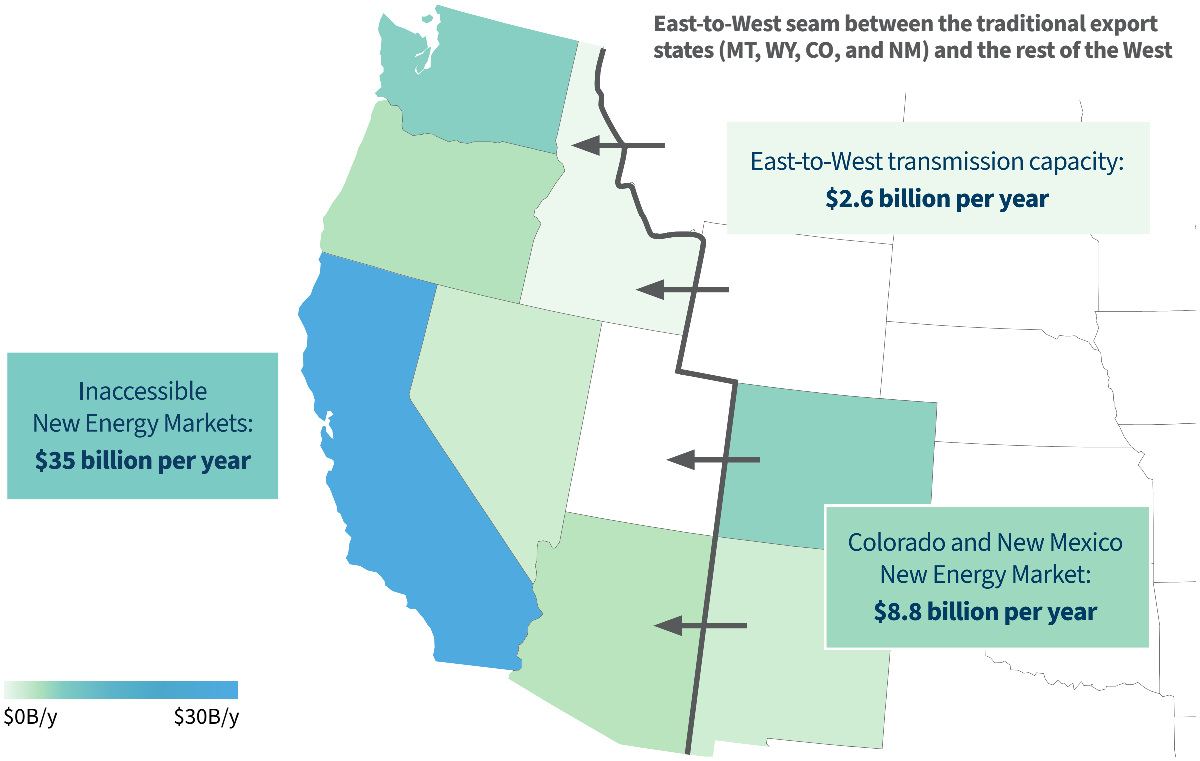
xviii That the transmission lines would be used at a 75% utilization rate is likely a very generous assumption because it assumes that renewables are paired with a future dispatchable or battery storage technology and that existing transmission rights are not already being used by existing resources.

Exhibit 10 **Transmission access to Western new energy markets**

Size of new energy market in base electrification case 2050



RMI Graphic. Source: RMI analysis, Lawrence Berkeley National Laboratory, Energy Innovation, and WECC

Challenge #2: The West Needs to Work to Share Transmission Costs Fairly

For energy-exporting states, it is important to note that regional transmission costs will not be shouldered solely by one state's ratepayers. Additionally, the presence of transmission infrastructure in one state does not necessarily imply that that state's ratepayers will cover the cost. Several options are available to ensure the fair distribution of transmission costs among ratepayers in the Western region.

In this section, we provide a high-level overview of three commonly used cost allocation methods and examples of how they have how they have been used in other regions. These three cost allocation methods are:

1. **Energy based:** Transmission costs are recovered uniformly from all utilities in a region, typically based on peak load (MW) or total energy (MWh) ratio share.

2. **Benefits based:** Transmission costs are allocated to individual utilities using formulas that consider the benefits derived from a project or a portfolio of projects.

3. **Subscriber based (merchant transmission):** Transmission costs are initially covered by the project sponsor or energy developers and are subsequently passed on to the energy off-takers. This is usually accomplished by consolidating energy and transmission costs into a single power purchase agreement (PPA).

These options represent the most common methods for regional cost allocation. However, cost allocation practices vary along a spectrum, and selecting the appropriate methodology can be a contentious and difficult task. Nonetheless, cost allocation is vital for enabling the development of transmission lines and extracting the benefits they offer. State officials should play a significant role in reaching compromises and making informed decisions that are in the best interest of their ratepayers.

Understand the benefits

Before establishing cost allocation principles, it is essential to grasp the benefits of transmission. Cost allocation discussions can become difficult because identifying and reaching a consensus on these benefits can be challenging. Furthermore, transmission infrastructure represents a long-term investment, and the associated benefits can change over time. The most important part of any cost allocation discussion is that all participants understand that their state and ratepayers will receive net benefits under a given cost allocation regime.

Energy-based approach

Under the energy-based approach, transmission costs are allocated to a region's ratepayers based on their share of peak load (MW) or total load (MWh). The fundamental principle of the energy-based approach is that benefits are distributed broadly. It is straightforward, as it does not require states to agree on a specific set of benefits; rather, it assumes that everyone benefits from the transmission.

This approach is commonly used in regions with regional transmission organizations (RTOs). A good example of the approach is used by the Midcontinent Independent System Operator (MISO), in the Midwest. In its most recent transmission portfolio, MISO states and utilities agreed to allocate costs equally based on each utility's share of load. They were able to come to this agreement because the business case showed that all states received significant benefits. Moreover, agreeing on a benefits-based formula approach (discussed next) was proving challenging, as it necessitated agreement from all stakeholders on a defined set of benefits. Using the energy-based approach, every state experienced benefits at least two times higher than the costs. Even Iowa, an energy-exporting state in the region, saw benefits that were 4.5 times higher than its allocated costs.[xix]

In the Western context, this approach would allocate transmission costs among states based on their load. For a portfolio of transmission lines that were broadly beneficial for the West, this would result in a large energy sink state like California paying for 37% of the costs and a smaller energy export state like Wyoming paying for 2%. At the ratepayer level, each ratepayer in the West would pay an equal amount for transmission on a per-kilowatt hour (kWh) basis but would experience varying levels of net benefits (savings) on a per-kWh basis.

Benefits-based approach

Under the benefits-based approach, transmission costs are allocated based on the total benefits received by each state. The costs are not uniformly allocated by MWh but rather based on their identified and agreed-upon benefits. These benefits might include economic benefits like cost savings from reduced transmission

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xviii In MISO's Long-Range Transmission Plan (LRTP) tranche 1 business case, zone 3 received benefits that were 4.5 times the cost. Zone 3 almost entirely encompasses Iowa. (LRTP Tranche 1 Portfolio Detailed Business Case, MISO, March 29, 2022, https://www.misoenergy.org/planning/long-range-transmission-planning/.)

congestion, reliability benefits like avoided risk of load shedding, or public policy benefits like reducing the costs to meeting clean energy requirements. The costs are then allocated formulaically based on the calculated benefits.

As previously mentioned in the energy-based approach section, reaching consensus on a benefits-based approach is challenging because all states must agree on how to calculate total benefits. Although it is more difficult to reach consensus, the benefits-based approach is seen as fairer because all states achieve the same benefit-to-cost ratio for the project or portfolio of projects.

In the Western context, this approach would likely allocate a higher proportion of costs to states with clean energy goals, because benefits would be proportionally allocated, with additional benefits related to achieving clean energy targets allocated to those states with such goals. In contrast to the energy-based approach, under the benefits-based approach, California might pay more than 37% of the total costs and Wyoming might pay less than 2%. At the ratepayer level, California ratepayers would pay more for the transmission than Wyoming ratepayers on a per-kWh basis, but the net benefits (savings) per kWh would be same or similar for both state's ratepayer.

Subscriber-based approach (merchant transmission)

Under the subscriber-based approach, transmission costs are allocated to the highest bidder for the right to transmit energy along the transmission line. Typically, the highest bidder is a power plant developer in the source state. That developer pays for the transmission rights from the source state to the sink state. These costs are then integrated with the energy costs from the power plant into a single PPA price. A load-serving entity, such as a utility in the sink state, agrees to the PPA price. The developer recoups the total costs of the transmission line, the energy from the power plant, and a profit margin from the load-serving entity.

This approach has been employed by independent transmission developers in the West, as exemplified by the Western Spirit transmission project in New Mexico. In this case, an independent developer built a transmission line that connected wind energy in New Mexico to California's load. The developer owned the transmission rights and sold the energy to the Los Angeles Department of Water and Power and other load-serving entities in California under a PPA. The project's costs were recouped through a fixed per-MWh price for delivered energy. New Mexico ratepayers did not incur any costs for the transmission line but received direct economic investments in the state.

For a portfolio of transmission lines in the West, there may be a subset of lines identified as targeted investments for transporting clean energy to load centers with clean energy goals. In such cases, the subscriber-based approach could be the most suitable to ensure that those who receive the most benefits cover the costs. This means that ratepayers in sink regions, such as California, would bear the costs of those lines, while source regions like New Mexico or Wyoming would not incur any of these costs.

Case Study: New Mexico Renewable Energy Transmission Authority

New Mexico is a leader in capturing energy investment opportunities and much of its success can be attributed to the Renewable Energy Transmission Authority (RETA). In 2007, the state created RETA through legislative action. The goal was to facilitate the development of renewable energy projects and the associated transmission infrastructure within the state. The authority is an independent agency of the state government and has the ability to:

1. Issue renewable energy transmission bonds
2. Finance or plan, acquire, maintain, and operate eligible facilities
3. Provide a tax deduction for certain receipts relating to electric transmission projects
4. Enter into partnerships with public or private entities
5. Identify and establish corridors for the transmission of electricity within the state
6. Exercise the power of eminent domain for acquiring property or rights of way

These actions have been critical to lowering the risk and costs of developing projects and have led to important new projects since 2017. So far, the agency has facilitated development of 0.9 GW of transmission, which exports an estimated 3.4 TWh of energy per year to new energy markets. Future planned projects amount to 8.6 GW of transmission capacity by 2028, which have the potential to export 34.9 TWh of energy per year. This would increase the value of exported electricity from New Mexico by almost 400% compared with 2024 levels (see Exhibit 11, next page).[21, xx]

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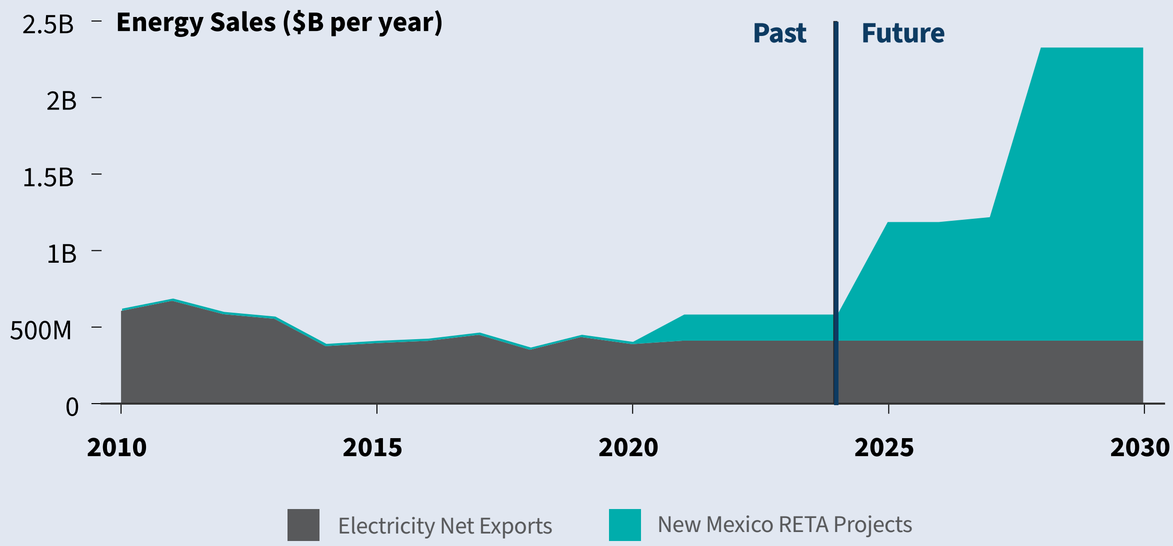
xx NM RETA has spurred significant investment in transmission and energy infrastructure in the state. Between 2024 and 2030, the state is expected to increase its electricity exports by almost 5x. The value of electricity exports was calculated by multiplying the historic and projected quantity of electricity exports by $50/MWh. The projected exports for the NM RETA projects were calculated using an individual project's capacity and projected in-service year and a New Mexico-specific wind capacity factor. More details can be found on page 6 of the *Appendix*.

Exhibit 11 **Value of New Mexico electricity exports**



RMI Graphic. Source: RMI analysis, NM RETA, and US EIA

NM RETA's most recent project, Western Spirit in 2021, is a 345,000-volt transmission line that links 800 MW of wind farms located in central New Mexico to the transmission system of the Public Service Company of New Mexico. Western Spirit enables New Mexico to export wind energy to California customers. The $360 million project was fully financed through a subscription-style cost allocation mechanism. The transmission costs, as well as the expenses associated with the wind farms, were entirely recovered through PPAs with California customers. **No costs were borne by New Mexico ratepayers.**

Transmission authorities are one way for energy export states to facilitate the development of transmission and gain access to the enormous opportunity in new energy markets. States have the opportunity to create these authorities through legislative action similar to what New Mexico did in creating NM RETA.

Transmission's Role in Reducing Costs for an Emissions-Free Western Grid

Six Western states — California, Colorado, Nevada, New Mexico, Oregon, and Washington — have set ambitious 100% clean electricity goals. In addition, five large Western utilities outside of these states have also set ambitious decarbonization goals. These six states and others have sponsored decarbonization studies that assessed how to best decarbonize their power systems. Here, we build on those studies by showing how West-wide transmission eases decarbonization.

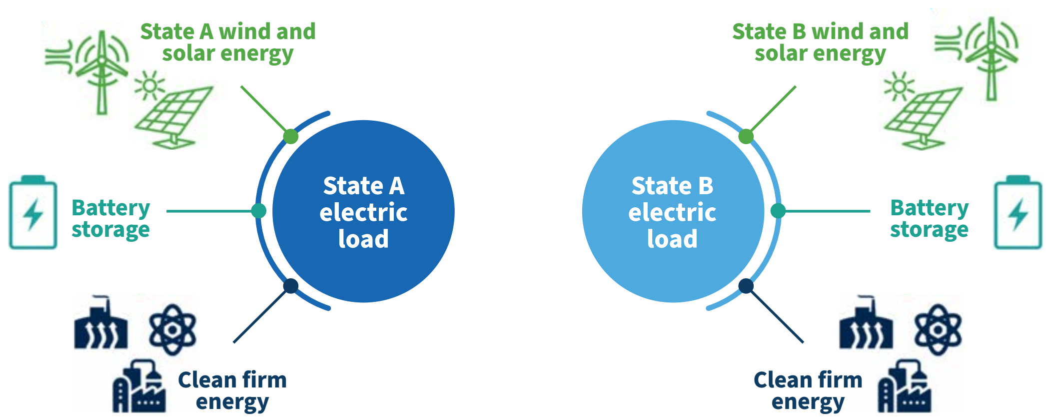
In our analysis, we assess the value of transmission that connects the various Western states. We optimize a portfolio of clean energy generation that includes wind, solar, battery storage, and clean firm power plants in two scenarios (*clean firm* refers to an unspecified electricity generating technology that would meet the six Western states' 100% clean electricity goals and can be dispatched like a traditional power plant):[xxi]

xxi We developed a model using R software to ensure that load is met in each hour of the year from the lowest cost portfolio with a combination of wind, solar, battery storage, and clean firm resources. More details about the model and assumptions can be found in the *Methodology* (page 26) and pages 7–11 of the *Appendix*.

1. **Isolated:** where two states (A and B) meet their own load and a 100% clean energy goal by only optimizing their own in-state generation (see Exhibit 12).

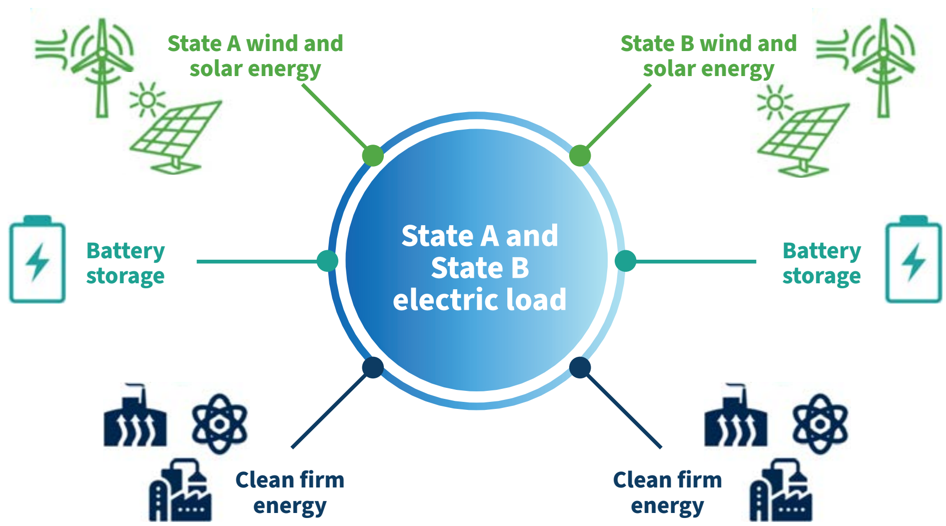
2. **In combination:** where two states (A and B) meet their cumulative load and a 100% clean energy goal by optimizing different generation options from either state (see Exhibit 13).

Exhibit 12 Illustration of isolated scenario for two states (A & B)



RMI Graphic. Source: RMI analysis

Exhibit 13 Illustration of in-combination scenario for two states (A & B)



RMI Graphic. Source: RMI analysis

Methodology

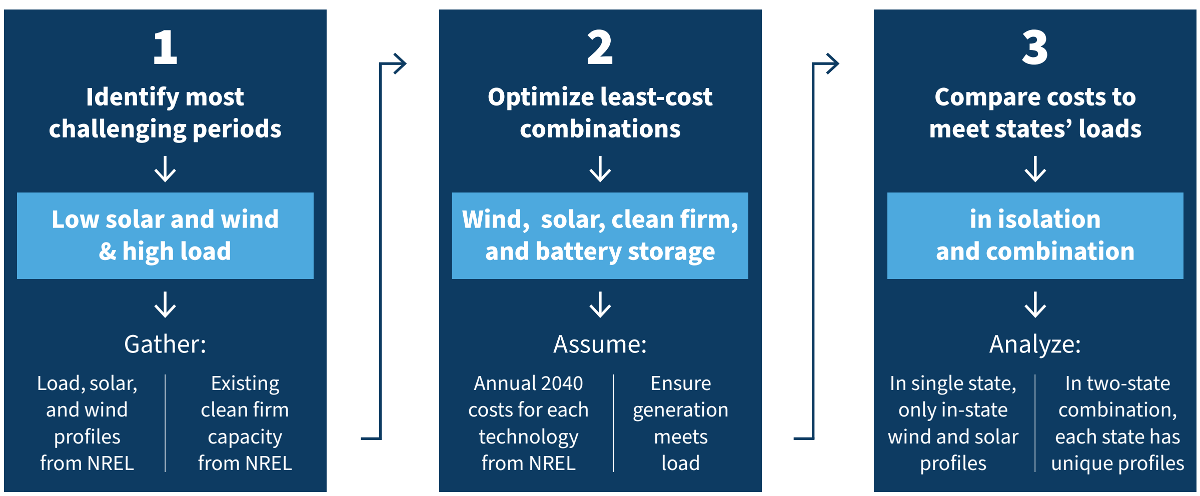
The model uses a three-step approach to compare the costs of a clean energy portfolio in two scenarios (see Exhibit 14):

1. **Isolated:** where states only optimize in-state generation to meet their own load

2. **In Combination:** where two states collectively optimize their different generation options to meet their combined loads.

First, the model identifies the most challenging periods for the grid to meet demand over the course of the year. Second, it calculates the optimal combination of wind, solar, battery storage, and clean firm to meet demand in that period and over every hour of the year. Finally, we compare the total annual costs of the optimal solution in the two scenarios.

Exhibit 14 **Visual summary of RMI's analytical model**

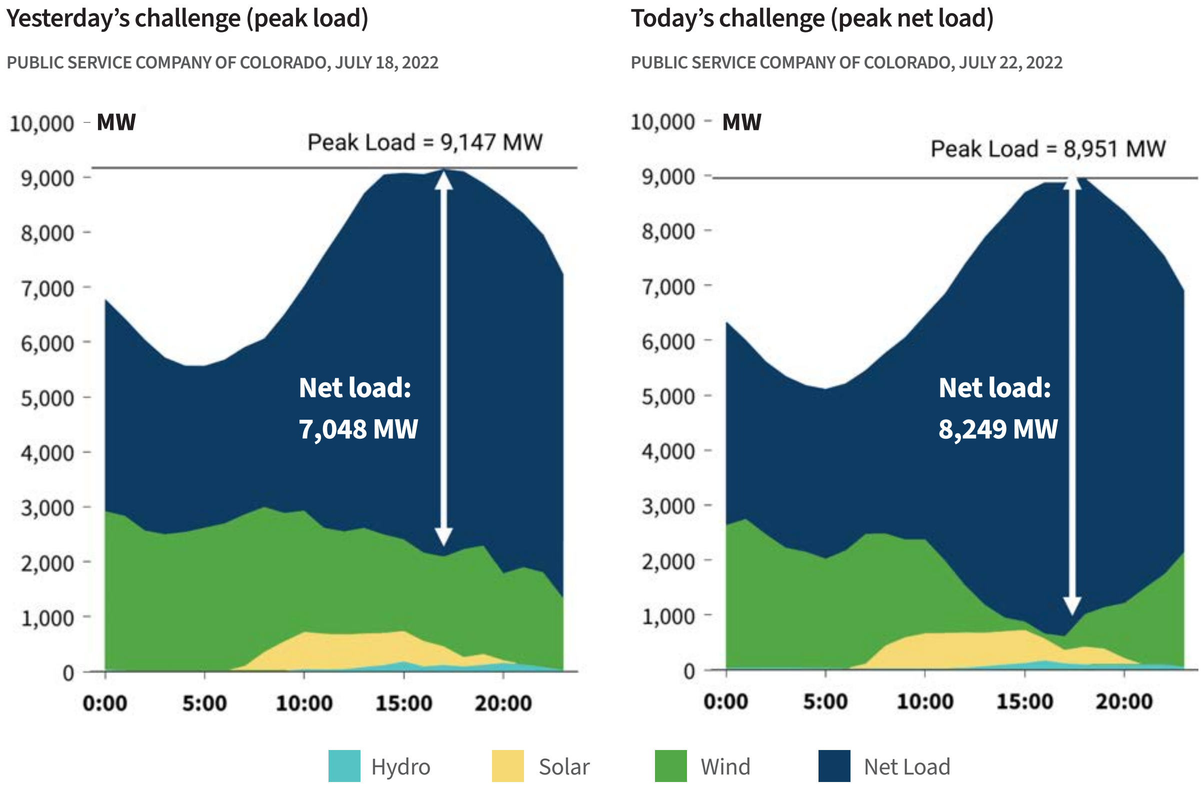


RMI Graphic. Source: RMI analysis

Step #1: Identify most challenging periods when load and weather will stress the grid

Planners are used to focusing on how to meet peak loads, and they use a simple term, reserve margin, to estimate how much extra generation they have beyond expected load. In a wind- and solar-dominated system, planners need to also consider the peak net load — the difference between load and wind and solar output. On an emissions-free grid, clean firm or batteries must fill the net load gap. Already, in certain states with significant renewable build-out, the peak net load days stress the power system more than the peak load day. In 2022, the Public Service Company of Colorado's peak load day had a maximum net load of 7,048 MW, and a few days later the state hit its peak net load day at 8,249 MW, despite lower total load (see Exhibit 15, next page).[22]

Exhibit 15 In the past, planners faced their most challenging periods during peak load days, whereas today, it's during peak net load days



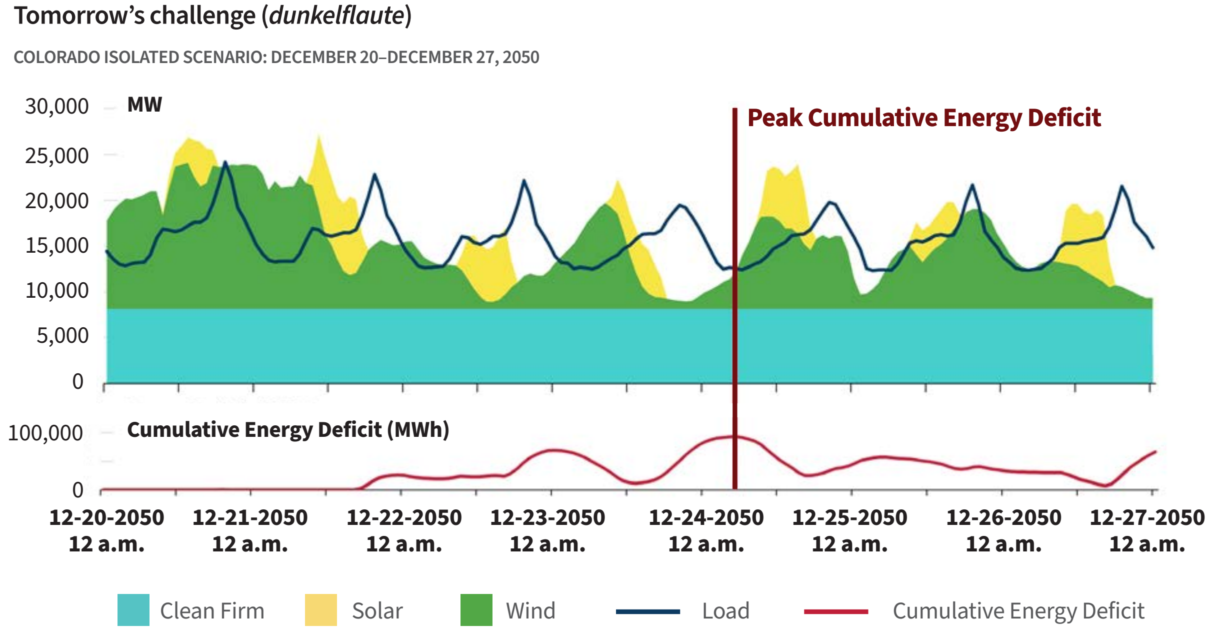
RMI Graphic. Source: RMI analysis and US EIA

However, in a wind- and solar-heavy system, planners must also consider extended periods when wind and solar are low, often called *dunkelflautes*, a German word for depressing weather. *Dunkelflautes* present serious challenges for grid planners because extended periods of low wind and solar imply that batteries will struggle to have enough charge. When load is high but wind and solar are low, an energy deficit builds; operationally, the grid would see batteries continuously discharging over a sustained period, with few moments with excess generation to charge them. For a given load and a specific wind, solar, and clean firm portfolio, we can calculate the extent of the energy deficit. We sometimes label the year's peak energy deficit the dunkelflactor, which represents the battery capacity (in MWh) required to keep the lights on.

Dunkelflautes are the most challenging times for the future grid and, therefore, the key moments that future clean energy portfolios must be designed to meet. Exhibit 16 (next page) shows the most extreme *dunkelflaute* period for the Colorado grid.[23, xxii] The state's ideal future portfolio comprises the least-cost combination of clean energy technologies that meets the load in each hour of the year, including battery storage. The amount of battery storage required is equal to the peak cumulative energy deficit. With this battery capacity, the fully charged batteries and clean firm will be able to meet load even during the worst energy deficit (and every other hour of the year).

xxii In the future, Colorado's worst *dunkelflaute* event occurs between December 20 and December 27, 2050. At 5:00 a.m. on December 24, the cumulative energy deficit reaches its highest point in the year, at close to 100,000 MWh.

Exhibit 16 Planners will encounter new challenges in the future due to *dunkelflaute* periods with low wind and solar generation



RMI Graphic. Source: RMI analysis and NREL

Step #2: Optimize least-cost combinations of wind, solar, battery storage, and clean firm

We use a linear programming-based optimizer to compute the least-cost combination of clean energy technologies that meet load in each hour of the year, including during the worst *dunkelflaute*. The load forecast, sourced from the National Renewable Energy Laboratory (NREL), assumes load growth aligned with electrification to the year 2050. The model can choose from four technologies — wind, solar, battery storage, and clean firm — that have different annual costs on a per-MW basis. The cost assumptions were derived from NREL's annual technology baseline. For clean firm, we assumed a rough estimate based on future projections of geothermal and nuclear costs. In addition to these four technologies, we assume that existing hydro, geothermal, nuclear, and biomass plants stay on line. The four technologies have only

Exhibit 17 Key technology assumptions for RMI's model

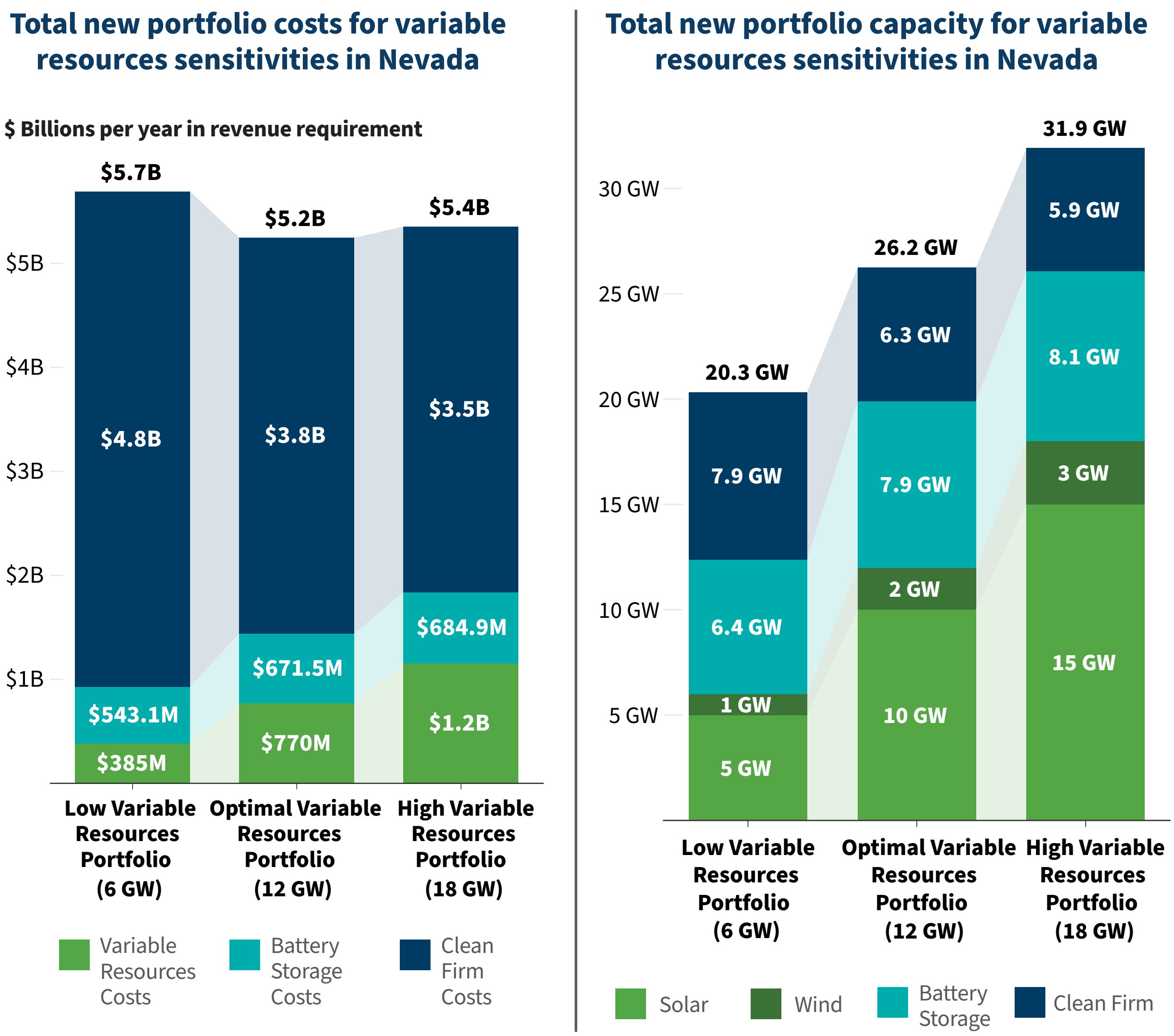
	Wind	Solar	Battery storage	Clean firm
Annual costs per MW-year	**$85,000**	**$60,000**	**$85,000**	**$600,000**
Variable costs per MWh	$0	$0	$0	$0
Generation profile	State specific	State Specific	Energy limited	Up to full capacity
Levelized cost of energy at capacity factor (%)	$21/MWh at 45%	$22/MWh at 30%	N/A	$75/MWh at 90%

RMI Graphic. Source: RMI analysis

capital and fixed costs, with no variable operating costs. We describe each technology option in Exhibit 17 (previous page) and discuss our assumptions further at the end of this section.[24, xxiii]

Because wind and solar — which we collectively refer to as variable resources — are the lowest cost energy sources, they play a crucial role in achieving an affordable portfolio. This is evident in Exhibit 18, where we compare the three Nevada portfolios, each of which would meet all hours of demand in the state.[25] The low variable resources portfolio (furthest to the left) is more expensive than the optimal variable resources portfolio. By doubling the variable resources in the low variable resources portfolio, the optimal variable resources portfolio significantly reduces its dependence on clean firm resources and increases its reliance on lower-cost variable resources and battery storage. As a result, overall costs decrease by $500 million per year (9%).

Exhibit 18 Variable resources play a crucial role in achieving an affordable portfolio



RMI Graphic. Source: RMI analysis and NREL

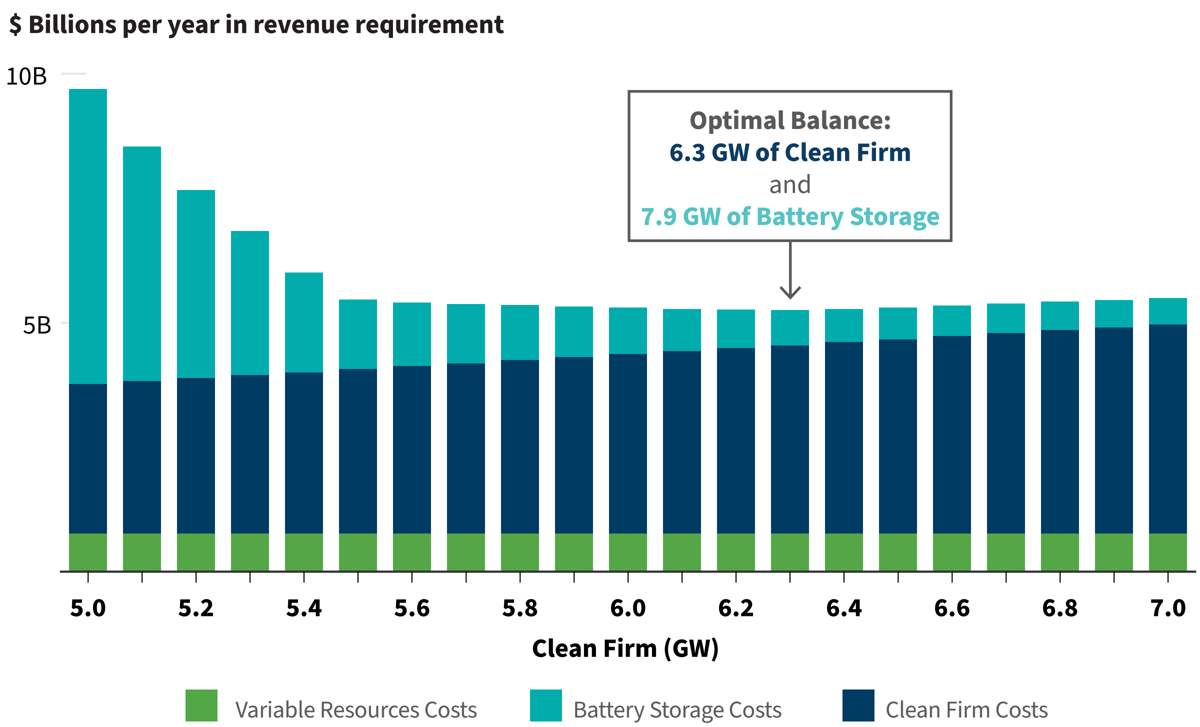
xxiii More detailed information on the cost assumptions can be found on pages 8–9 of the *Appendix*.

However, this trend does not continue when we compare the optimal variable resources portfolio to the high variable resources portfolio. In this scenario, the increased use of variable resources only slightly reduces the portfolio's reliance on clean firm resources. This marginal reduction in clean firm resources is insufficient to offset the increased costs associated with the expanded use of variable resources. The inability to substantially reduce reliance on clean firm resources is attributed to the lack of diversity within the isolated Nevada portfolio. The additional variable resources have the same generation profile as the existing variable resources. Thus, during *dunkelflaute* periods, they are also producing little power and do not reduce the need for batteries and clean firm.

Similar to variable resources, there is a trade-off between clean firm and battery storage resources. In Exhibit 19, we compare various portfolios of new clean firm capacity ranging from 5.0 to 7.0 GW with the same quantity of variable resources (12 GW).[26] At the low end (left side), the portfolio requires significant amounts of battery storage to ensure that load is met in each hour. As we add clean firm capacity, the reliance on battery storage diminishes significantly, eventually reaching an optimal portfolio of 6.3 GW of clean firm and 7.9 GW of battery storage.

However, as we continue to add clean firm, the increase in clean firm capacity only slightly reduces the portfolio's reliance on battery storage. This marginal reduction in battery storage is insufficient to offset the increased costs associated with the expanded use of clean firm.

Exhibit 19 **Total portfolio costs for clean firm sensitivity in Nevada**



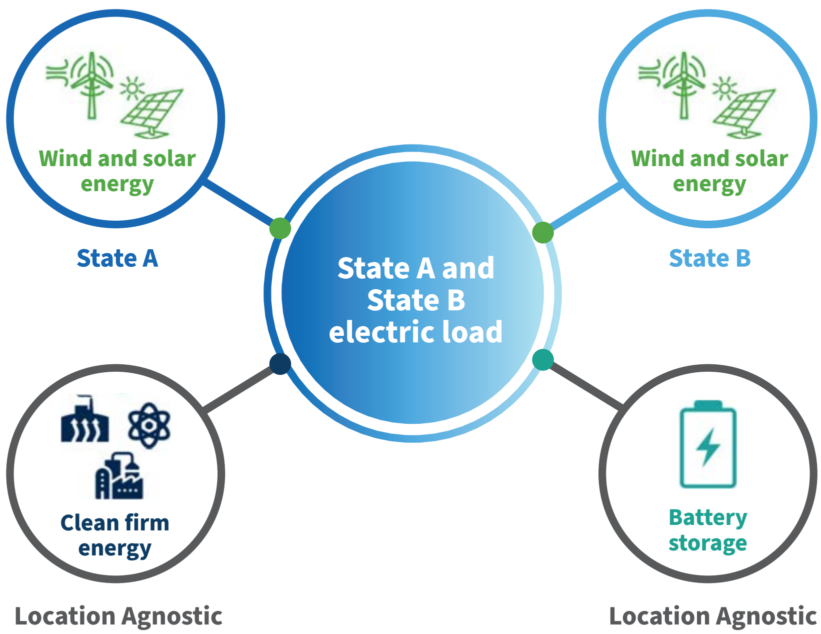
RMI Graphic. Source: RMI analysis and NREL

Ultimately, the isolated Nevada portfolio requires an optimal balance of all four resource types to ensure load is met in each hour. In this portfolio, a significant amount of clean firm resources is required to maintain reliability and it comes at a high cost. The new clean firm resources make up 73% of costs but only 24% of capacity. In the next section, we show how we model a combination of two states to increase resource diversity, lower reliance on clean firm, and ultimately lower costs.

Step #3: Compare results for an isolated state and for different combinations of states

Using the same model, we compute a least-cost combination of clean energy technologies to meet load for a combination of two states (A and B). The model differs from the isolated scenario in two ways: it adds solar and wind from state B alongside solar and wind from state A, and it adds load from state B (see Exhibit 20). The model can now choose from six types of resources to meet the cumulative load in each hour of the year, including the worst *dunkelflaute* period. Otherwise, the model is the same as used for the isolated state analysis.

Exhibit 20 **Illustration of modeling for the in-combination scenario of two states (A & B)**



RMI Graphic. Source: RMI analysis

By simply adding the states together, we assume that there are no transmission constraints between them, and that clean firm and battery storage resources are location agnostic. For each state, we calculate the optimal combined portfolio for that state with each of the other 10 Western states. We compare the total cost of the isolated state A portfolio to each of the combination pairs to identify savings that state A could realize by planning with other states. The results identify how planning with neighbors allows states to maximize their low-cost variable resources through diversity in load and resources.

Findings

The findings below are centered on Nevada's results but they are transferable to other Western states.

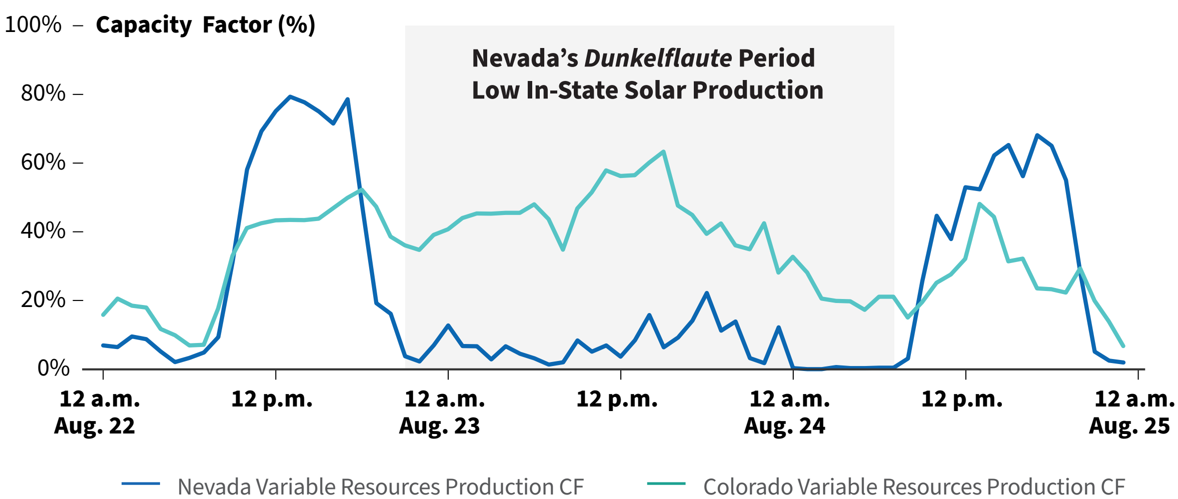
Finding #1: Regional transmission harnesses variable resource diversity to mitigate extended periods of low in-state variable resources production.

Regional transmission mitigates or eliminates the most challenging grid periods for a single state by leveraging West-wide resource diversity. Given the West's vast geography, we find it likely that variable generation in one part of the region will be abundant even when such generation in other Western regions is low.

In Exhibit 21, we show an example of the most challenging period for Nevada in our model between August 22 and 24, 2050.[27] During this period, Nevada's least-cost generation mix (10 GW of solar and 2 GW of wind) provides very little energy with an average capacity factor of just 7.9% over the 24-hour period. At 2:00 a.m. on August 24 in the isolated scenario, Nevada's battery storage resources are depleted. However, during this same period, Colorado's least-cost portfolio (13 GW of wind and 12 GW of solar) in the isolated scenario performs comparatively well, with an average capacity factor of 46%. For reference, Nevada's and Colorado's annual average variable resources capacity factors are 32% and 39%, respectively. By combining the two states' load and generation profiles (assuming adequate regional transmission), Colorado's wind production makes it much easier to meet the combined loads, despite Nevada's sustained low solar production. Together, the two states can rely more heavily on low-cost wind and solar and less on more-expensive clean firm generation.

Exhibit 21 Colorado has high power generation during Nevada's most challenging day (*dunkelflaute* period)

Nevada's and Colorado's variable resources capacity factor (CF)



RMI Graphic. Source: RMI analysis and NREL

In Exhibit 22, we show that during Nevada's *dunkelflaute*, several Western states, not just Colorado, have well-performing wind and solar portfolios.[28, xxiv] For reference, the West-wide annual portfolio capacity factor is 38%.

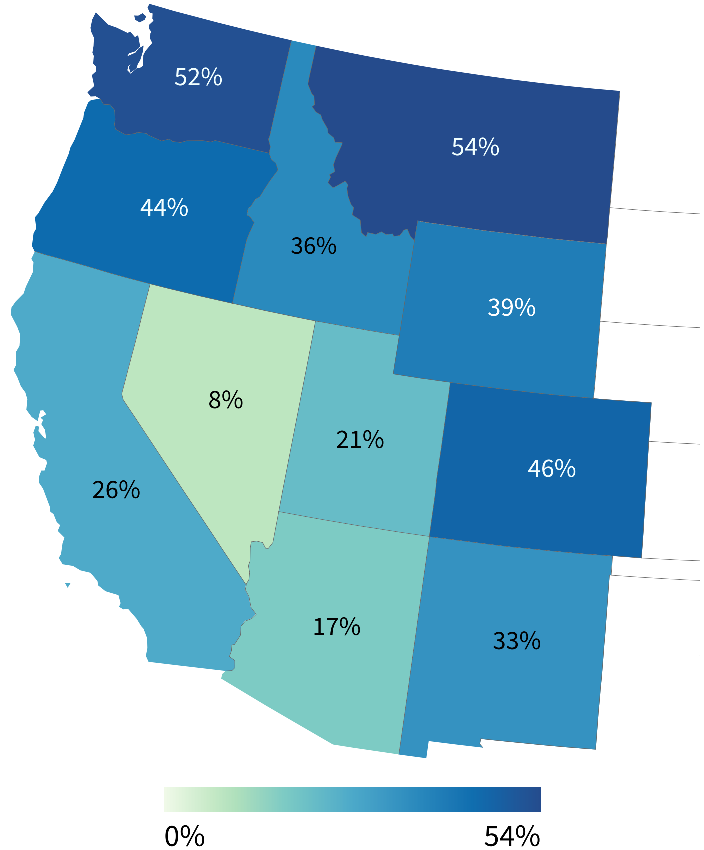
Finding #2: Regional transmission capitalizes on load diversity and reduces total resource needs.

Differences in weather and economic activity cause the timing of high-load events to vary from state to state. If one state is experiencing a high-load event, it is likely that there are excess resources in other states that are not experiencing their own high-load events at that time. Thus, regional transmission improves resource sharing and lowers the total generation requirement. For example, when states' loads peak during opposite seasons (winter versus summer), there are significant reductions in the total resource requirements. Even for states with the same seasonal peak, excess resources are likely available in other states during challenging periods.

Exhibit 22

Other states have high-performing variable resources generation during Nevada's most challenging day (*dunkelflaute* period)

Average variable resources capacity factor on August 23, 2050



RMI Graphic. Source: RMI analysis and NREL

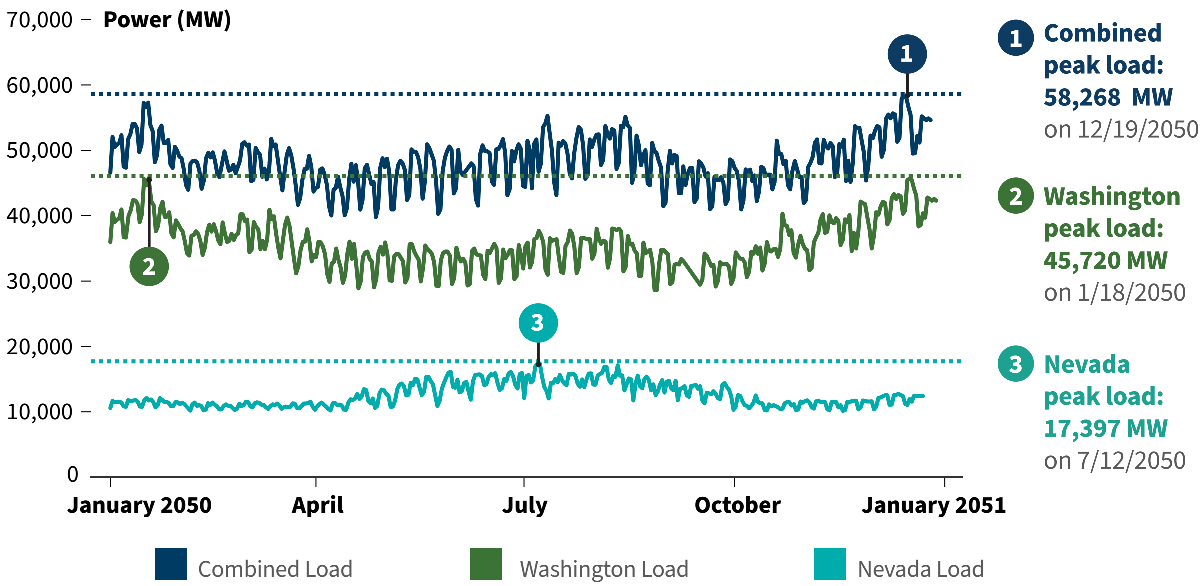
According to 2050 load forecasts used in our modeling, Washington and Montana will have load peaks in winter (17% of Western load); Oregon, Utah, and Wyoming will have similar summer and winter peaks (15% of Western load); and the remaining six states will peak in summer (68% of Western load).[29] Regional transmission would enable the West to leverage these seasonal differences and significantly reduce the amount of resources each state would need to meet load compared to meeting load on its own. For example, regional transmission between Washington (winter peaking) and Nevada (summer peaking) would reduce the resource requirement by 8% compared with those states each procuring resources on their own (see Exhibit 23, next page).[30]

Given the diversity in load and variable resource patterns, it is likely that during the most challenging periods for one state, excess resources are available in other Western states. Regional transmission would enable the West to share these resources and lower the total amount that each state would need to procure.

xxiv The average variable resources capacity factor is calculated as total generation from both solar and wind on August 23, 2050, divided by total maximum generation from both solar and wind based on their total capacity. The maximum capacity factor is 100%.

Exhibit 23 Seasonal load diversity lowers total capacity requirements

Nevada's and Washington's daily peak load in 2050

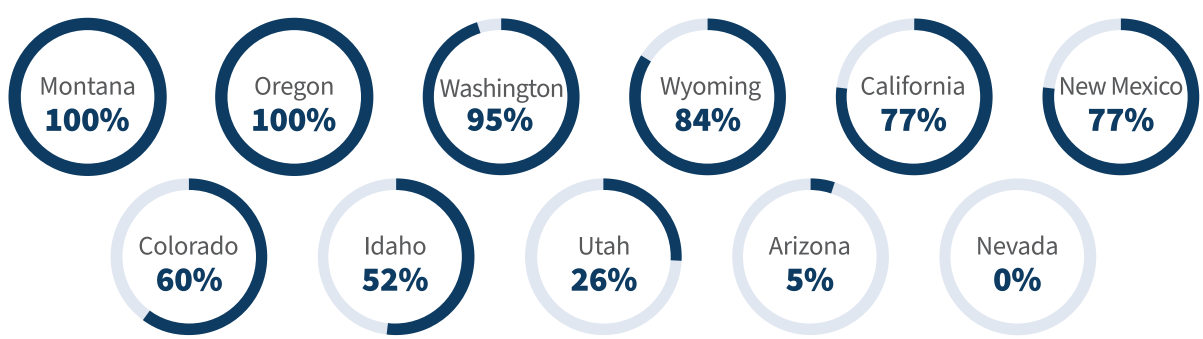


RMI Graphic. Source: RMI analysis and NREL

For example, the most challenging period for Nevada in the isolated scenario occurs between August 22 and 24, 2050, when Nevada's battery storage reserves are depleted, and all its clean firm resources are utilized to their maximum capacity. During these same three days, many of Nevada's Western neighbors have excess battery storage capacity (see Exhibit 24).[31, xxv] In fact, Montana and Washington do not use their battery storage reserves at all during this period. However, without regional transmission, these resources cannot be shared.

Exhibit 24 Other states have excess energy stored during Nevada's most challenging day (*dunkelflaute* period)

Minimum percentage of full battery storage between August 22 and 24, 2050



RMI Graphic. Source: RMI analysis and NREL

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xxv During Nevada's most challenging 2050 grid conditions, a *dunkelflaute* between August 22 and 24, the modeled resource portfolio would deplete Nevada's battery capacity to meet load. During this same period, many of Nevada's Western neighbors have excess energy stored in their battery storage resources.

If each state were to independently develop resources to address its peak loads and its most challenging periods, the overall resource requirements and associated costs would be higher. Collaborative planning with neighboring states and resource sharing allows for a reduction in resource requirements and cost savings.

Finding #3: Regional transmission reduces the need for clean firm technology, lowering costs for ratepayers.

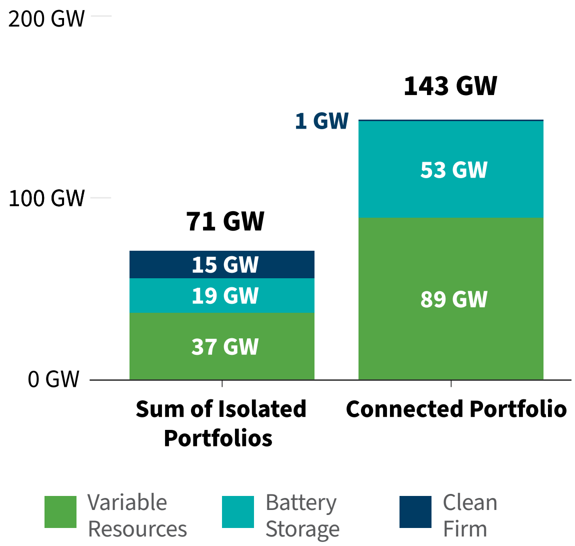
Regional transmission infrastructure enables states to increase their reliance on cost-effective variable renewables and battery storage by leveraging the benefits of load and resource diversity. This, in turn, reduces their dependence on clean firm resources. There are a number of potential clean firm resource options — the cost estimates are based on geothermal and nuclear technologies — but all technologies are expected to be relatively expensive and are, so far, unproven at scale. Although clean firm resources will almost certainly be needed for full decarbonization,[32] strategies that reduce the need for clean firm generation both reduce technological risk and almost certainly will reduce costs. **Our modeling clearly shows that regional transmission between Western states reduces the need for clean firm generation and allows the West to get more value from the clean firm generation it already possesses**:[33]

- In 17 of 55 state pairs, the combination scenario eliminates the need for new clean firm capacity.
- In 52 of 55 state pairs, the combination scenario reduces the need for new clean firm capacity by more than 10%.
- Given today's costs assumptions for clean firm resources, regional transmission could decrease total portfolio costs by as much as 35% across all the state pairs.

Exhibit 25 Regional transmission reduces the need for clean firm generation

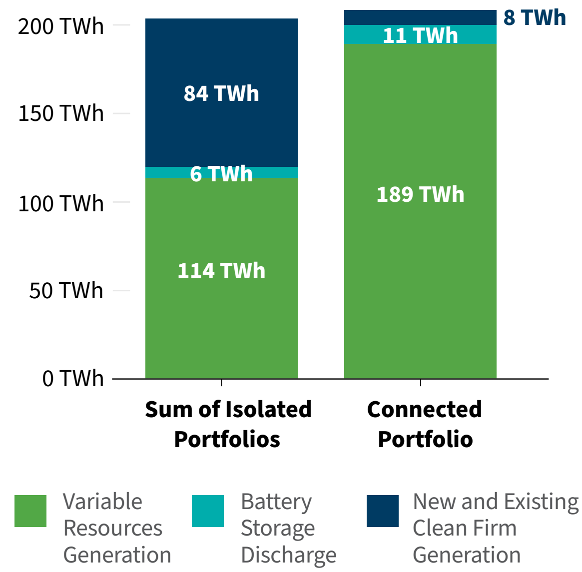
As a pair, Nevada and Colorado reduce their reliance on clean firm by over 90%

Total new portfolio capacity for isolated and connected pairing of Nevada and Colorado.



As a pair, Nevada and Colorado increase generation from variable resources

Generation by technology for isolated and connected pairing of Nevada and Colorado.



RMI Graphic. Source: RMI analysis and NREL

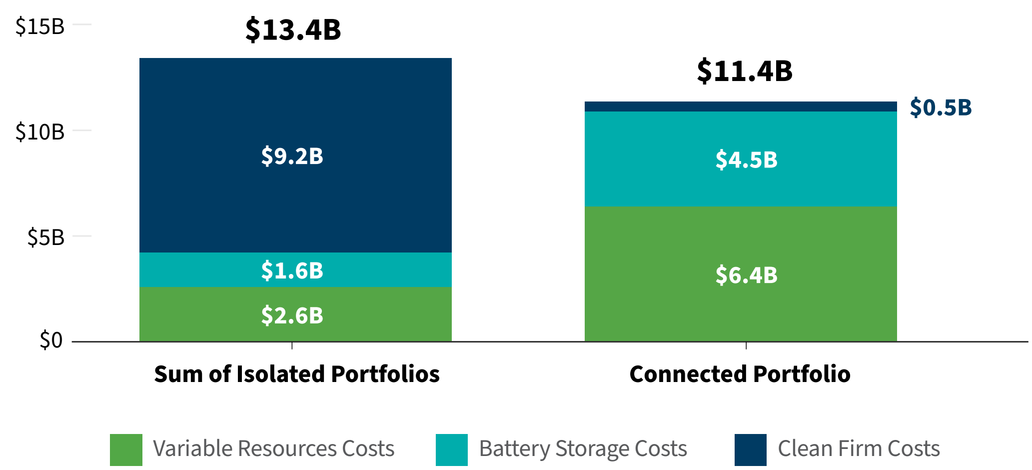
In Exhibits 25 and 26 (next page), we show an example of the total portfolio generation, installed new capacity, and total new portfolio costs for Nevada in the isolated scenario and an in-combination scenario with Colorado.[34] Our modeling indicates that Nevada and Colorado can jointly develop a 100% clean energy portfolio at a cost that is 16% lower than if each state pursued this goal independently. This collaborative approach would reduce the rate impact of achieving their 100% clean energy targets by $2 billion annually and reduce both systems' dependency on clean firm resources from 15 to 1 GW. Meanwhile, it would still result in economic development benefits for both states, with 42% of the variable resources capacity built in Nevada and 58% built in Colorado.

> **"... Nevada and Colorado can jointly develop a 100% clean energy portfolio at a cost that is 16% lower than if each state pursued this goal independently. This collaborative approach would reduce the rate impact of achieving their 100% clean energy targets by $2 billion annually and reduce the systems' dependency on clean firm resources from 15 to 1 GW."**

Exhibit 26

As a pair, Nevada and Colorado reduce their total new portfolio costs by 15%

Total new portfolio cost for isolated and connected pairing of Nevada and Colorado ($ billions per year in revenue requirement)



RMI Graphic. Source: RMI analysis and NREL

Finding #4: Regional transmission is needed to leverage existing clean firm resources.

On top of reducing states' dependence on expensive new clean firm resources, regional transmission would also allow states to leverage their existing clean firm resources by sharing those resources. This is particularly important given that a significant portion of existing clean firm resources exist in just a few states.

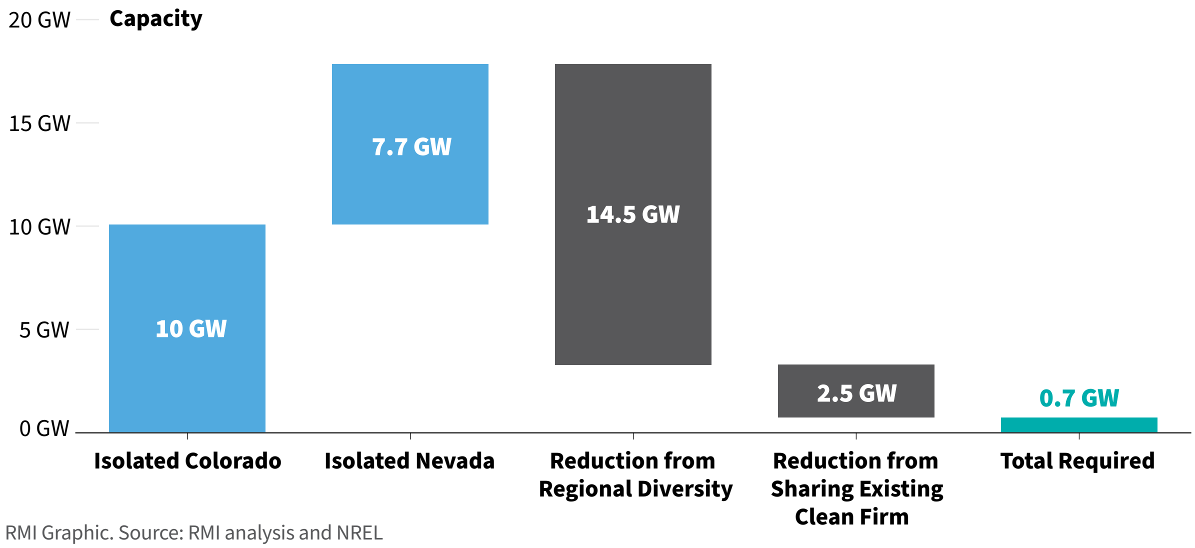
In Exhibit 27, we show an example of the total clean firm required for Colorado and Nevada, in isolation and in combination.[35, xxvi] A significant portion of the reduction in total clean firm comes from diversity in load and variable resources. However, the ability to share existing clean firm resources also has an impact on reducing the total new clean firm required. Around 85% of the reduction comes from regional diversity and 15% from sharing existing clean firm resources. Compared with the total amount of clean firm resources needed in the isolated scenarios (18 GW), only a fraction of that needs to be new clean firm (0.7 GW).

The ability to share existing clean firm resources is particularly important because 84% of the West's clean firm capacity is located in just four states (Arizona, California, Oregon, and Washington) — most of which is hydroelectric and nuclear power.

xxvi In Exhibit 27, the total clean firm capacity required for the connected scenario between Colorado and Nevada is broken down by the total required in the isolated scenarios and the reduction in capacity from regional diversity and sharing existing clean firm resources.

Exhibit 27 **Total clean firm capacity required for connected scenario**

Nevada and Colorado in combination



RMI Graphic. Source: RMI analysis and NREL

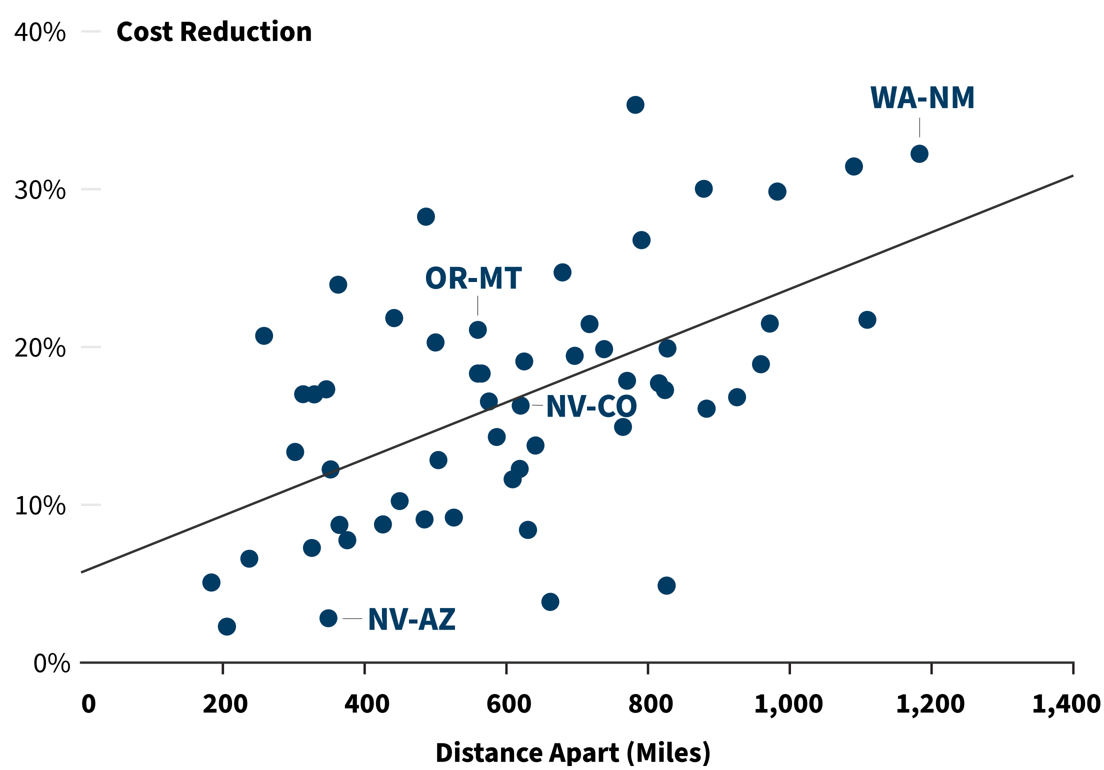
Finding #5: The most significant benefits come from the most wide-reaching planning. To maximize benefits, planners should interconnect the entire West.

The benefits of regional transmission planning are maximized by planning across the largest possible area. The West has an array of geographically diverse loads and variable resources that can complement one another. The farther geographically the connections, the more diverse they are and the larger the benefits.

In Exhibit 28, we show results for all 55 state pairs in the West.[36] Regional planning among immediate neighbors with similar resources provides modest benefits, like Nevada and Arizona with 3% savings. By contrast, planning among neighbors further afield with more diverse resources provides more significant benefits, like Oregon and Montana with 21% savings. Stretching across the West, Washington and New Mexico could see benefits on the order of 32%.

Exhibit 28 The most wide-reaching planning could result in cost savings over 30%

Total portfolio cost reduction when states plan as pairs relative to planning in isolation for all 55 state pairs



Note: Distance between states is calculated based on each state's geographic population center.

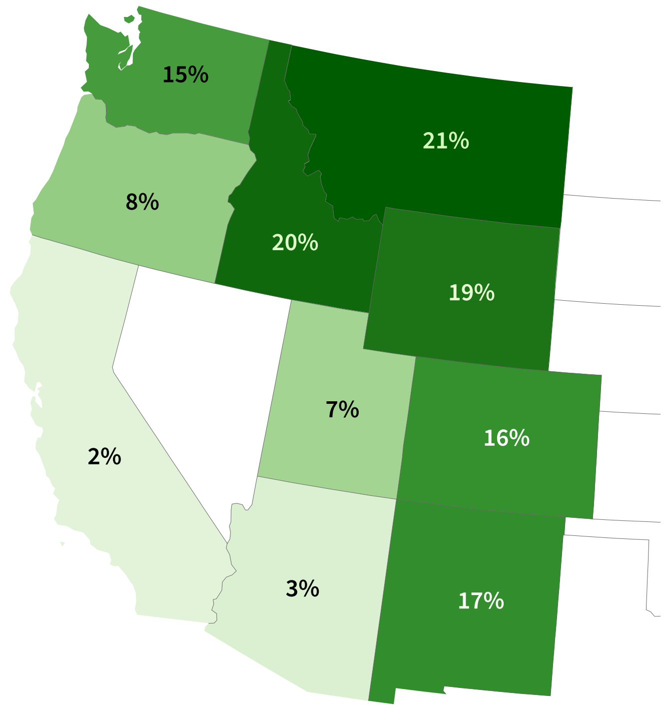
RMI Graphic. Source: RMI analysis and NREL

In Exhibit 29, we show an example of the total portfolio costs savings Nevada could realize by planning with each of the 10 other Western states.[37] The farther Nevada goes geographically, the greater the benefits. For instance, in the example described above in Finding #3, collaboration between Nevada and Colorado harnessed complementary wind and solar resources, leading to substantial cost reductions for both states (16%). By contrast, Nevada partnering with Arizona, with their similar solar resources and load profiles due to geographic proximity and shared weather patterns, resulted in more modest cost savings for both states (3%).

Exhibit 29

Nevada can maximize savings using wide-reaching planning with windy Western states

Total portfolio cost reduction when Nevada plans as a pair relative to planning in isolation with each Western state



RMI Graphic. Source: RMI analysis and NREL

To Identify the Best Transmission Investments, We Must Plan West-Wide

In this section, we highlighted that transmission allows the West to meet its clean energy goals more reliably and more affordably. We identified benefits associated with generation capacity savings for meeting load and with public policy goals in the West. In addition, there are many other benefits of regional transmission that we did not quantify, including improved resilience to extreme events like droughts and winter storms, jobs and economic development, lower production costs, and more.[xxvii]

Of course, transmission also has costs. A full evaluation of the appropriate transmission needs in the West requires a cost-benefit analysis of the region to identify the best investments. Unfortunately, to date, no entities has done this type of region-wide planning.

In the next section, we discuss ongoing efforts to support West-wide transmission planning and describe examples of other successful transmission planning efforts in the midwestern states, Texas, New York, and California. In each of those examples, transmission benefits far outweighed the costs, sometimes by over 400%.

xxvii The consulting firm The Brattle Group has two reports on the benefits of electric transmission that take a deep dive on this topic: Judy W. Chang, Johannes P. Pfeifenberger, and Michael Hagerty, *The Benefits of Electric Transmission: Identifying and Analyzing the Value of Investments*, July 2013, **www.brattle.com/wp-content/uploads/2021/06/The-Benefits-of-Electric-Transmission-Identifying-and-Analyzing-the-Value-of-Investments.pdf** and Johannes P. Pfeifenberger, *The Benefits of Interregional Transmission: Grid Planning for the 21st Century*, March 2022, **www.brattle.com/wp-content/uploads/2022/03/The-Benefits-of-Interregional-Transmission-Grid-Planning-for-the-21st-Century.pdf**.

Assumptions and Limitations of the Model

Cost, generation, and constraint assumptions of the model can be found in Exhibit 30 and on pages 7–11 of the *Appendix*.[xxviii]

Exhibit 30 Model assumptions for cost, generation, and constraints

Issue	Assumption	Source
Capital Costs	Calculated using NREL's Annual Technology Baseline (ATB) moderate cost scenario in 2040 for all technologies. Details can be found on page 9 of the *Appendix*.	NREL ATB 2023
Load	We used an 8,760-hour load forecast from NREL's Cambium model for each Western state. We used 2050 as a reference year and the electrification scenario, which assumes an annual growth rate of 3.0% West-wide. The weather year was 2014.	NREL Cambium 2022
Variable Generation Profile	We used an 8,760-hour generation profile from NREL's Standard Scenario model for each Western state. The weather year was 2014.	NREL Standard Scenario 2021
Existing Clean Firm	We used NREL's Cambium model to calculate the existing clean firm capacity expected to still be online in 2050. The technologies included were hydro, geothermal, nuclear, biomass, and Canadian imports.	NREL Cambium 2022
Maximum Wind Capacity	We assumed that each state had a maximum amount of economically recoverable land-based wind resources. We used NREL's Wind Supply Curve data from the 2021 NREL Standard Scenario Report. We used the reference access siting regime and a maximum of $45 per MWh total levelized cost of electricity.	NREL Standard Scenario 2021
Offshore Wind	We assumed 26.5 GW of offshore wind would be located in California based on NREL's Cambium model results. We did not optimize for offshore wind.	NREL Cambium 2022
Battery Storage Duration & Behavior	In battery dispatch, we assumed perfect foresight and 100% round-trip efficiency. The 100% round-trip efficiency is a limitation of the modeling software. We assumed four-hour battery storage (meaning energy capacity [MWh] was four times maximum power output [MW]), consistent with today's Li-ion batteries.	RMI Analysis
Contribution of Energy Efficiency and Demand Flexibility	The Cambium load assumptions were developed from NREL's Electrification Futures Study. Some energy efficiency and demand flexibility are included in the load curve. However, demand flexibility is not included in the model as an independent resource.	NREL Cambium 2022
Inflation Reduction Act (IRA) Tax Credits	Given the time frame of the study, which extends well past the IRA's influence, we did not include tax credits or other subsidies in our capital cost assumptions.	RMI Analysis

Note: Additional details can be found on pages 7–11 of the *Appendix*.

RMI Graphic. Source: RMI analysis, NREL Annual Technology Baseline 2023, NREL Cambium 2022, and NREL Standard Scenario 2021

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xxviii The model used data from various NREL studies: *2023 Annual Technology Baseline*, NREL, 2023, https://atb.nrel.gov/; Gagnon Pieter, Cowiestoll Brady, and Schwarz Marty, *Cambium 2022 Data*, **https://scenarioviewer.nrel.gov**; and Wesley Cole and J. Vincent Carag, *2021 Standard Scenarios Data*, **https://scenarioviewer.nrel.gov**.

Limitations of our approach

We designed our analysis to estimate one of transmission's key values — reducing the total generation capacity required to meet hourly load. Below, we summarize key limitations of our analytical approach to provide context (see Exhibit 31). We detail our approach further on pages 7–9 of the *Appendix*.

Exhibit 31 Model limitations

2050 snapshot	• We only optimize the resource portfolio for 2050 given **starting resource quantities** from 2023. • However, we expect that **decisions made in intermediate years** will impact the resulting 2050 portfolio.
Same in-state wind and solar profile	• We provide each state with a **single wind and solar profile** that is created from an aggregation of different individual sites. • However, we expect that states will **better leverage** in-state diversity impacting the resulting portfolio.
Operating reserves	• We do not account for **operating reserves** or a planning reserve margin. The model optimizes to meet load exactly for each hour of the year. • Of course, grid operators should plan for **reserve margins**. Given the goal of our analysis, to understand the costs of a clean energy grid in isolation and in cooperation, we are confident that our findings would remain unchanged if we were to add reserve margins. • That said, today's rapidly increasing levels of wind, solar, storage, and load flexibility will require the industry to **rethink reliability planning and resource adequacy methods**. The Energy Systems Integration Group (ESIG) has a great report taking a deep dive into how we rethink reliability planning and resource adequacy methods, see Energy Systems Integration Group, "Redefining Resource Adequacy for Modern Power Systems," 2021.
Clean firm uncertainty	• We assumed that the clean firm technology of the future will be an **expensive, high-capital-cost, and low-operating-cost** resource. • However, there is a lot of **uncertainty** about the characteristics and feasibility of this technology. On page 8 of the *Appendix*, we will discuss some implications of these characteristics.

Note: Additional details on assumptions can be found on pages 7–8 of the *Appendix*.

RMI Graphic. Source: RMI analysis

States Can Support Proactive West-Wide Transmission Planning

To seize the economic opportunities outlined in the previous sections, states need to push transmission planning beyond today's status quo. In this section, we outline encouraging progress in Western transmission planning, describe the valuable leadership that states and governors have provided in other regions, and recommend actions that states and governors can take to seize the economic opportunity at hand.

Encouraging Progress in Western Transmission Planning

As the need for transmission has become clear across the United States, some stakeholders have begun working toward better planning processes.

Western Power Pool's Western Transmission Expansion Coalition (WestTEC)

The Western Power Pool provides several regional services for its Western utility members, including the Western Resource Adequacy program. On October 2, 2023, Western Power Pool released a concept paper to "discuss approaches to address a widely recognized concern that current transmission planning frameworks in the West do not result in sufficient transmission solutions to support the needs of the future energy grid."[38] This concept paper emerged in response to a request from the major stakeholders for

West-wide transmission planning and garnered support from leadership in multiple industry entities and utilities. The concept paper developed into an initiative called WestTEC, which aims to develop an actionable transmission plan for the entire Western region.[39]

Western Power Pool is forming the three committees that will inform and drive the transmission planning process and has hired external consultants to facilitate the energy system modeling required. Although still in a preliminary phase, this proposal shows promise as a utility-driven solution to the deficiency in transmission planning within the region.

Committee on Regional Electric Power Cooperation (CREPC) Transmission Collaborative

The CREPC Transmission Collaborative is a collaboration of Western regulators and state energy office staff working to improve approaches to transmission planning and cost allocation in the Western Interconnection. The collaborative started during summer 2023 as the Western States Transmission Initiative and involved one-on-one meetings with Western leaders, webinars and trainings, and convenings with participating regulators and policy leaders. The initiative's original goals were to build understanding of transmission issues among Western regulators and state energy policy leaders and identify actionable steps for CREPC to address transmission development opportunities. In early October 2023, the initiative released several recommendations for CREPC to take.

CREPC formed the transmission collaborative to take up these recommendations. Initial work of the CREPC Transmission Collaborative will focus on facilitating US state and Canadian provincial input into WestTEC (described above) as it develops a West-wide transmission plan, and to coordinate state and provincial input for a CREPC-led effort to explore transmission cost allocation frameworks for the West. Although still in a preliminary phase, the CREPC Transmission Collaborative shows promise as a regulator-driven solution to the deficiency in transmission planning and cost allocation in the West.

Regional transmission organization incrementalism

The West has a long history of trying to develop a West-wide RTO. CAISO, which covers most of California, is currently the only RTO in the West. CAISO operates energy markets and coordinates resource adequacy and transmission planning within its region. Until 2014, in the rest of the West, local utilities (with small footprints[xxix]) operated their grids mostly independently. Since 2014, the rest of the West has incrementally been adding RTO-like services through energy imbalance markets, day-ahead markets, real-time markets, and resource adequacy programs offered by CAISO, the Southwest Power Pool (SPP), and Western Power Pool. The goal of the incremental approach is that these building blocks allow utilities to get more comfortable with regionalization and the changes that come with an RTO's structure. A full RTO would unlock further benefits, including crucial transmission planning.

There is still a long road to get to a full RTO in the West, and there are several outstanding issues to sort out. Certain utilities in the West are in the process of joining SPP;[40] however, it is unlikely that major utilities in the West will enter an RTO until at least the late 2020s or early 2030s. Because transmission is urgently needed today, we cannot wait to finalize RTO decisions before starting transmission planning.

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xxix Most Western utilities cover small footprints confined to a single state. Notably, a handful of utilities cover larger multistate footprints, such as PacifiCorp and Bonneville Power Administration.

Merchant developers, transmission authorities, and CAISO's subscription model

Independent merchant transmission developers have already developed and are planning to develop several lines through the West. In recent years, these developers have been operating under a business case of bringing low-cost renewable energy to load centers that have valuable renewable energy credits and high energy prices. Although this model has had some success, developers still struggle with permitting and defining a business model that integrates with the West's many monopoly utilities.

There are two transmission authorities in the West, NM RETA (described above) and the Colorado Electric Transmission Authority (CETA).[xxx] New Mexico and Colorado state legislators created these authorities to facilitate transmission development in their states. NM RETA and CETA can use eminent domain, have exemptions from gross receipt tax, can take on debt, and can identify and establish transmission corridors, among other tools. NM RETA has partnered with merchant developers and accelerated a number of projects by mitigating hurdles associated with the "three Ps." CETA was created more recently and is currently conducting a study to identify transmission needs in the state.[41]

CAISO is developing a subscription-based transmission owner model for projects developed by merchant transmission developers. This will help developers navigate the payment barrier to developing projects by allowing the project owner to assign costs to users without dealing with cost allocation bottlenecks.

Overall, merchant developers' models and the programs that assist them are work-arounds for the lack of comprehensive regional transmission planning and interregional cost allocation barriers. The new lines are important additions to the Western transmission system, but, in our view, not replacements for comprehensive planning.

States Can Lead in Regional Transmission Planning

Regional transmission planning has been successful in the United States when a clear political mandate exists. We have seen success in a handful of regions where a state or a group of states clearly identified the need for transmission.

MISO multi-value project process and long-range transmission planning process

On November 5, 2007, the governors of Illinois, Iowa, Minnesota, North Dakota, Ohio, South Dakota, and Wisconsin sent a letter to the CEO of MISO. This letter showed that the region was in unanimous agreement about the need for transmission across the midwestern states and was a clear political mandate to advance better transmission planning in the region.[42]

The letter was a lightning bolt to MISO and dramatically raised the profile of the transmission problem in the Midwest. After a four-year process, MISO developed its first portfolio of transmission lines in 2011 as part of the MISO multi-value project process (MISO MVP). The MISO MVP portfolio of 17 lines was approved and resulted in an estimated net benefit to the region of $655 million per year.[43] Subsequently, in 2022, the MISO

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xxx There are also infrastructure authorities in Idaho and Wyoming, but they have not played the same role.

long-range transmission planning process tranche 1 portfolio was approved for an additional 18 lines to be completed between 2028 and 2030, with an estimated benefit-to-cost ratio of 1.8 to 3.1 across the region.[44]

Texas competitive renewable energy zones

In 2005, the Texas state legislature and governor passed Senate Bill 20, which ordered the Public Utility Commission of Texas to establish competitive renewable energy zones (CREZs) in the state and plan for related improvements in transmission infrastructure. The bill kicked off a multiyear process of selecting zones, determining the transmission needs, and selecting and siting the lines. Together the Public Utility Commission of Texas and the Electric Reliability Council of Texas established five CREZs in Western Texas and approved 3,600 circuit miles of transmission, which has resulted in $1.7 billion in production cost savings per year for the state.[45]

New York and California public policy-driven transmission projects

In New York and California, the regional transmission planning process identified new transmission lines needed to meet state public policy. In New York, the transmission planning process identified a public policy need for three transmission lines to meet the state's Climate Leadership and Community Protection Act, which requires electricity to come from carbon-free sources by 2040.[46] In California, the transmission planning process is integrated with the resource planning process to identify transmission needs to meet the state's Senate Bill 100, which requires electricity to come from carbon-free sources by 2045. In California's latest 2022–23 and 2021–22 transmission plans, the California Independent System Operator (CAISO) identified 27 projects (21 and 6, respectively) that were public policy driven.[47]

Recommendations for Action by Western States and Governors

Western states can unlock the next era of transmission development that is needed in the West. Engagement from governors, state energy offices, energy advisors, and commissioners is needed to advance West-wide transmission planning and development. They need to play an active role in this process to represent their state's values and perspectives, ensure economic development for their states, and help define a vision for their role in the future Western electric grid.

Specifically, governors can:

Ensure that economic opportunities and cost savings are fully included in transmission planning. The regional transmission planning status quo in the West is solely focused on ensuring a reliable system and meeting any violations with upgrades. States must ensure that any future transmission planning effort also includes their state's economic export goals and their clean energy vision for an affordable 100% clean future.

Collaborate with other governors to support regional transmission planning. In other regions, transmission planning has worked best when states collaborated. Given the benefits to all Western states, governors should collaborate to define win-win transmission projects.

Leverage ongoing transmission planning efforts to prioritize West-wide planning. States can aid and accelerate the Western Power Pool's WestTEC and regulators' CREPC Transmission Collaborative efforts by publicly supporting their efforts, ensuring that their state's regulators prioritize their work, and indicating to the state's utilities that it is important to participate.

Lead the West to a consensus on a cost allocation framework. The CREPC Transmission Collaborative is taking the first steps to developing a cost allocation framework for the West. However, it is likely to be a difficult process to reach consensus. States can support these efforts by understanding the broad benefits that regional transmission provides and by working with their representatives (commissioners and state energy office staff) to ensure negotiations succeed and that the perfect does not become the enemy of the good.

In existing regional transmission planning conversations, prioritize West-wide transmission planning. As mentioned in the *Introduction*, the existing regional planning groups — CAISO, Northern Grid, and West Connect — are not properly aligned to capture the value of West-wide planning as identified in this and many other studies. States could push these organizations to collaborate on interregional modeling and simulations to start identifying the needs of the West as a whole.

Ensure that regional transmission is considered as part of in-state planning. Many states are creating plans to fulfill their legislative clean energy requirements. However, most states are only incorporating in-state resources in those plans, neglecting the broader regional system. It is crucial to ensure that state plans align with a regional transmission planning process to make informed decisions on these substantial investments and to guarantee that each state is equipped to achieve its goals and other objectives.

Ensure that state values, policy, and perspectives are integrated into any regional plan. A regional transmission plan achieves success only when it comprehensively incorporates the entire spectrum of values and perspectives that states envision for themselves. It is imperative for states to ensure that their commissions, utilities, and state energy offices engage in these planning processes with a thorough understanding of their state's goals and values. Societal, environmental, and economic goals for a region can be considered in a regional transmission planning process, but this can only occur if they are included.

Conclusion: Unlocking the Value of Regional Transmission for All

In this analysis, we show that regional transmission is a win-win economic opportunity for all Western states and that the most expansive planning leads to the greatest benefits for all. For the West's traditional energy export states (Colorado, Montana, New Mexico, and Wyoming), regional transmission is an opportunity to gain access to massive new markets for clean electricity. By 2050, these states will have the opportunity to supply a market that will exceed $40 billion per year — but only if they have the interstate wires to access it. For the clean energy states of the West (states like New Mexico, Nevada, and Oregon), regional transmission is an opportunity to reduce the costs of meeting clean energy goals. Planning across the widest area possible could lead to cost reductions for ratepayers by as much as 36% compared with building generation only within a state.

States have a unique role and opportunity to recognize these economic opportunities in regional transmission and ensure they are accounted for in West-wide planning. Governors and their staff can take seven key actions to drive this initiative:

1. Ensure that economic opportunities and cost savings are fully included in transmission planning.
2. Collaborate with other governors to support regional transmission planning.
3. Leverage ongoing transmission planning efforts to prioritize West-wide planning.
4. Lead the West to a consensus on a cost allocation framework.
5. Prioritize West-wide transmission planning in existing regional transmission planning conversations.
6. Ensure that regional transmission is considered as part of in-state planning.
7. Ensure that state values, policy, and perspectives are integrated into any regional plan.

Endnotes

1 RMI Analysis; "Energy Policy Simulator – version 3.4.8," Energy Innovation, **www.energypolicy.solutions**; Galen L. Barbose, *US State Renewables Portfolio & Clean Electricity Standards: 2023 Status Update*, Lawrence Berkeley National Laboratory, June 2023, **emp.lbl.gov/publications/us-state-renewables-portfolio-clean**; *EIA-923 Report - Monthly Generation Data by State, Producer Sector and Energy Source*, US EIA, accessed September 22, 2023, **www.eia.gov/electricity/data/eia923/**; "SNL Day-Ahead Power Prices," S&P Global Market Intelligence, accessed September 22, 2023; and WECC, "Western Assessment of Resource Adequacy - Transmission Topology Maps," November 2022, **www.wecc.org/Reliability/WARA%20Transmission%20Topology%20Maps%202022.pdf**.

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9 John D. Wilson and Zach Zimmerman, *The Era of Flat Power Demand is Over*, December 2023, **gridstrategiesllc.com/wp-content/uploads/2023/12/National-Load-Growth-Report-2023.pdf**.

10 RMI Analysis; "Energy Policy Simulator – version 3.4.8," Energy Innovation, **www.energypolicy.solutions**; and Galen L. Barbose, *US State Renewables Portfolio & Clean Electricity Standards: 2023 Status Update*, Lawrence Berkeley National Laboratory, June 2023, **emp.lbl.gov/publications/us-state-renewables-portfolio-clean**.

11 RMI Analysis; "Energy Policy Simulator – version 3.4.8," Energy Innovation, **www.energypolicy.solutions**; and Galen L. Barbose, *US State Renewables Portfolio & Clean Electricity Standards: 2023 Status Update*, Lawrence Berkeley National Laboratory, June 2023, **emp.lbl.gov/publications/us-state-renewables-portfolio-clean**.

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