High Voltage, High Reward Transmission

Breaking Down RMI's New Report on Transmission Cost Savings

Tyler Farrell and Celia Tandon

March 2025

Agenda

- Introduction to RMI
- High Voltage, High Reward Transmission Part 1: Background, Methodology, Case Study
- Questions
- High Voltage, High Reward Transmission Part 2: Key Findings, Discussion
- Questions

RMI's mission is to transform the global energy system to secure a clean, prosperous, zero-carbon future for all

Sector Focus Areas

- Carbon-Free Industry
- Carbon-Free Mobility
- Carbon-Free Buildings
- Carbon-Free Electricity

Market Catalysts

- Policy
- Finance
- Business Models
- Data & Transparency
- Technology
- Education & Capacity

Global Geographies

Cities

China

India

U.S.

Developing Economies

Our team works to ensure transmission supports the energy transition

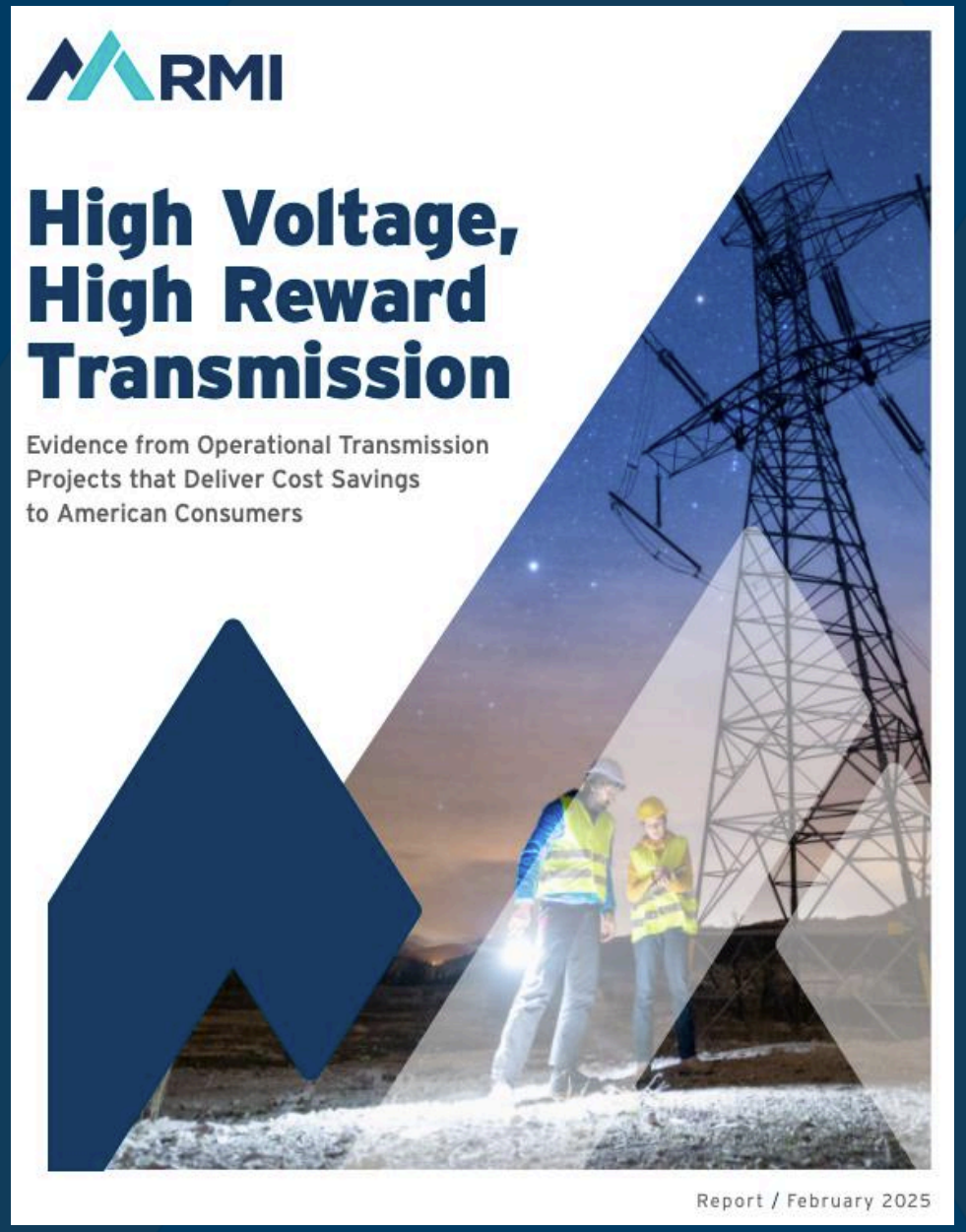
We actively participate in Western and PJM transmission processes

We publish insights on grid solutions: regional transmission planning, grid-enhancing technologies, impacts of new large loads, and more

We collaborate with public utility commissions, energy offices, legislators, and utilities

Source: RMI, "Building Clean, Competitive Grids," rmi.org/our-work/electricity/building-clean-competitive-grids/.

High Voltage, High Reward Transmission

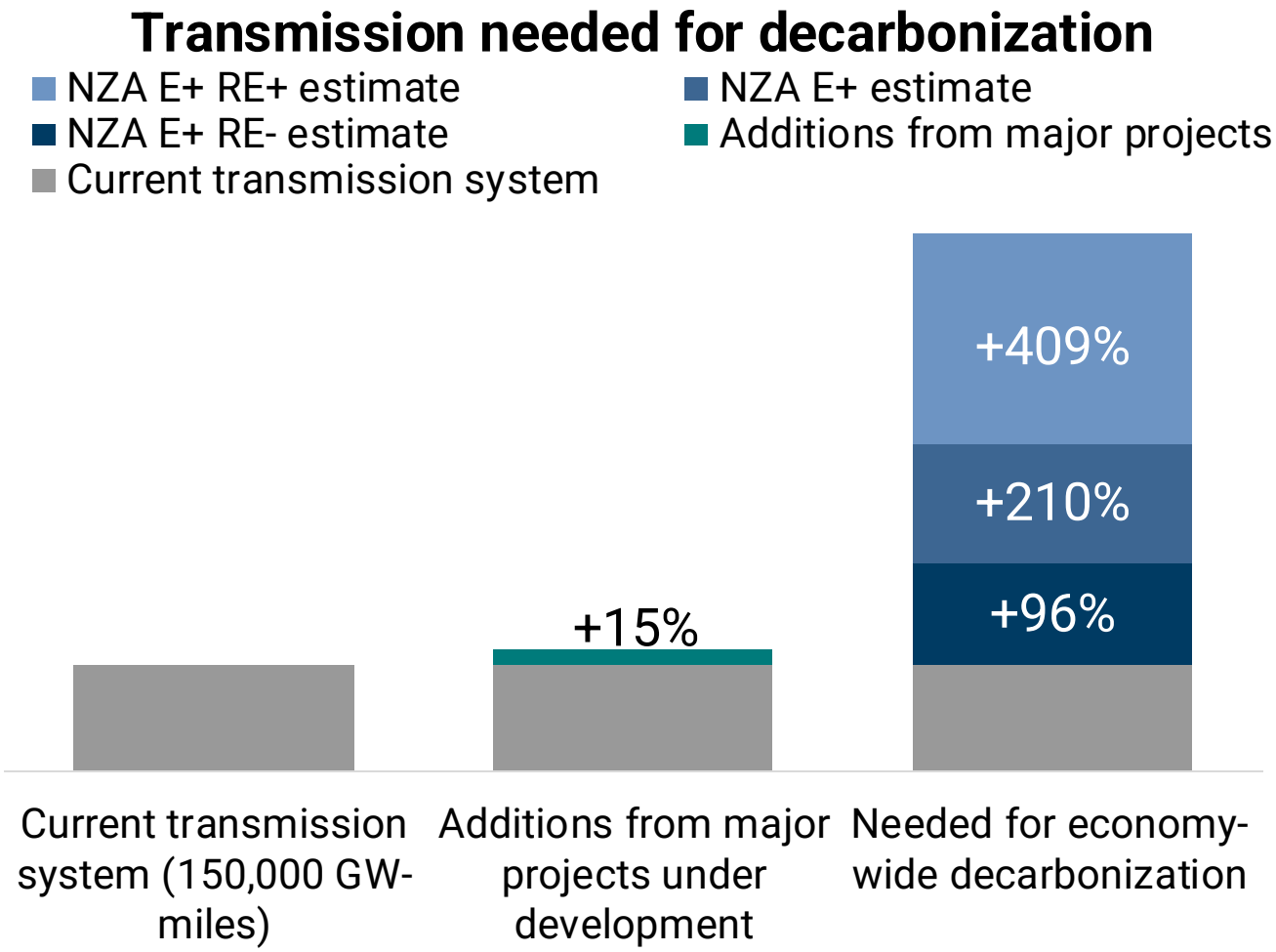


Background on Transmission Investments

The need and scale for transmission investment is rapidly rising

Key drivers:

- Growing electricity demand
- Resilience to extreme weather
- Compliance with FERC Order 1920
- Decarbonization goals



Source: "Net-Zero America," Princeton University, October 2021.

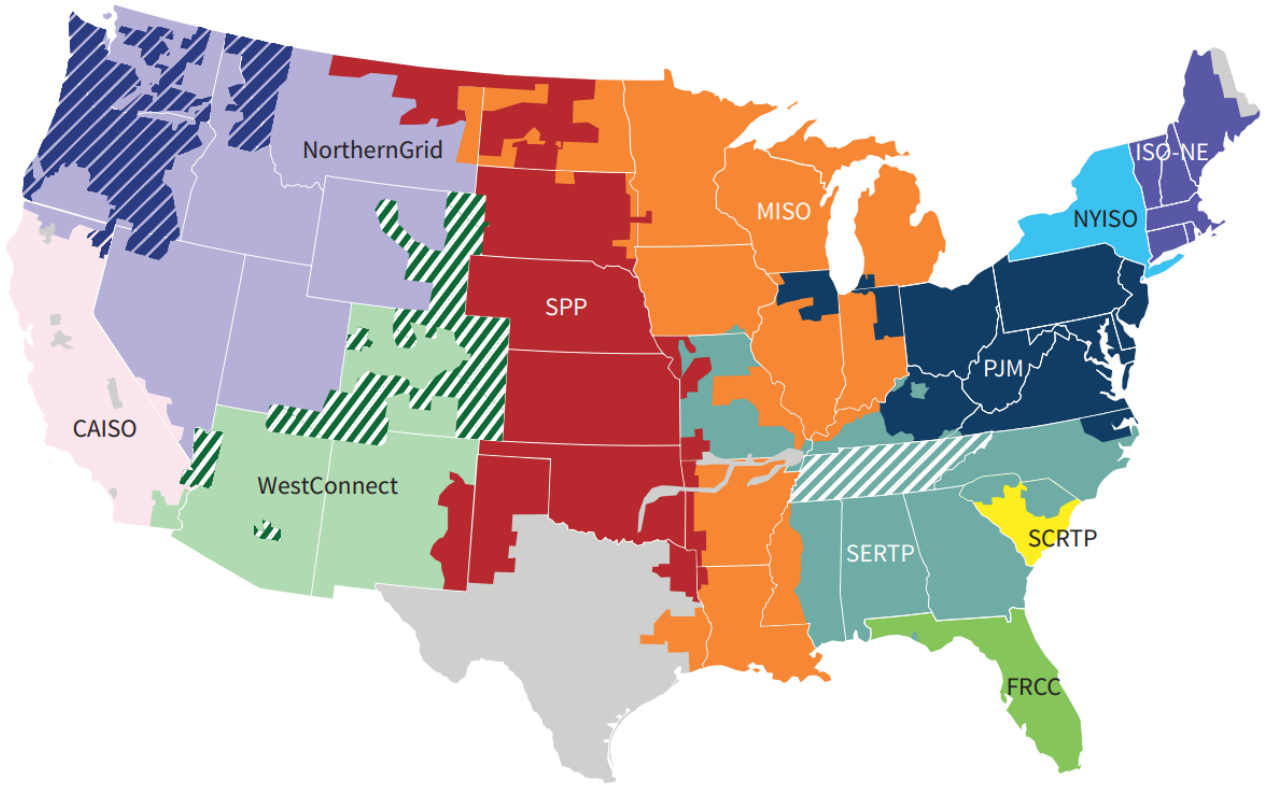
As ratepayer concerns increase, investment in cost effective transmission is critical

Local Projects are planned and built by a single utility to meet the needs within the utility's footprint.

Regional Projects are planned at the regional level by regional planning entities that may span multiple utilities' footprints.

Interregional Projects are planned by multiple regional entities that span multiple regions' footprints.

Regional Planning Entities in the United States



Source: Claire Wayner, Kaja Rebane, and Chaz Teplin, Mind the Regulatory Gap: How to Enhance Local Transmission Oversight, RMI, 2024, https://rmi.org/insight/mind-the-regulatory-gap. .

Current planning process is primarily reliability-focused

Local Reliability Projects
Meet local standards & interconnection requests

↓

Regional Reliability Projects
Address remaining reliability needs

↓

Regional Economic & Public Policy Projects
Address a narrow set of remaining needs

↓

Interregional Projects
Scope of remaining needs is often narrow

Over 90% of transmission investments are driven **solely by reliability** needs, **without assessing cost savings.**

Source: "A Roadmap to Improved Interregional Transmission Planning," Brattle, November 2021.

Multi-benefit regional transmission planning is an afterthought

Local Reliability Projects
Meet local standards & interconnection requests

↓

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Regional Economic & Public Policy Projects
Address a narrow set of remaining needs

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Interregional Projects
Scope of remaining needs is often narrow

Regional planning for economic & public policy needs account for **less than 10%** of transmission investments.

Source: "A Roadmap to Improved Interregional Transmission Planning," Brattle, November 2021.

Interregional transmission planning is almost non-existent

Local Reliability Projects
Meet local standards & interconnection requests

↓

Regional Reliability Projects
Address remaining reliability needs

↓

Regional Economic & Public Policy Projects
Address a narrow set of remaining needs

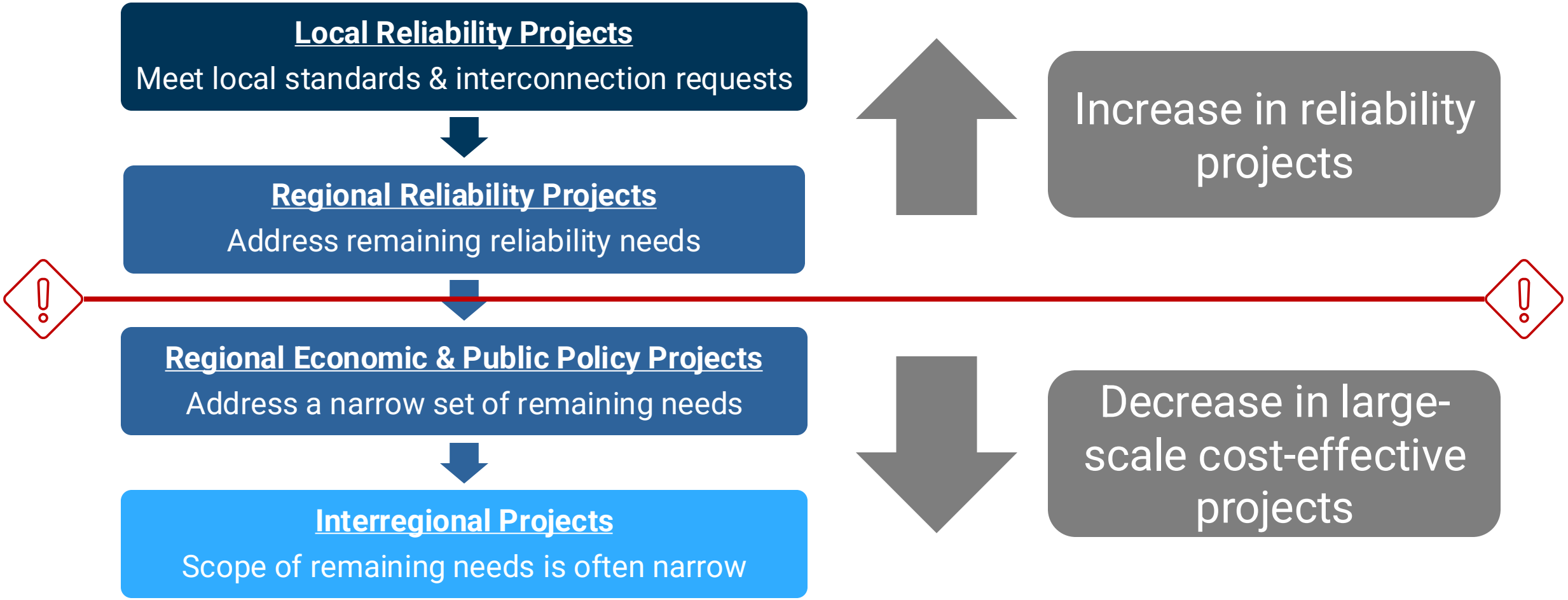
↓

Interregional Projects
Scope of remaining needs is often narrow

Very few major interregional projects have been built in the past few decades

Source: "A Roadmap to Improved Interregional Transmission Planning," Brattle, November 2021.

Utilities are planning transmission using two separate frameworks that are not well-integrated

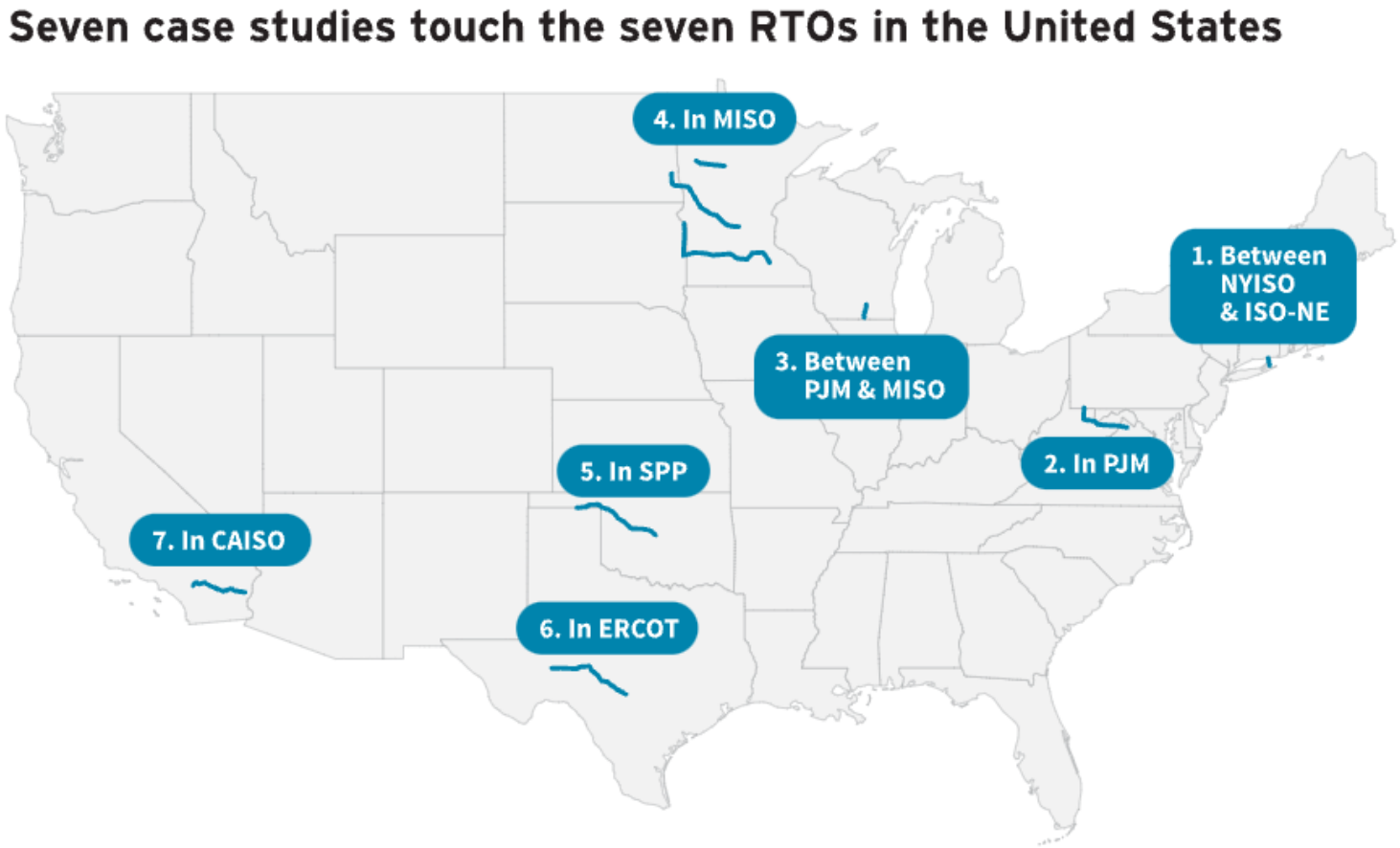


Source: "A Roadmap to Improved Interregional Transmission Planning," Brattle, November 2021.

Utilities can lower costs and improve reliability through coordinated multi-benefit regional planning

Our report shows that **large-scale transmission projects deliver significant savings for American consumers and businesses.**

We analyzed seven regional and interregional projects operating across the country—from California to Oklahoma



Source: Department of Homeland Security

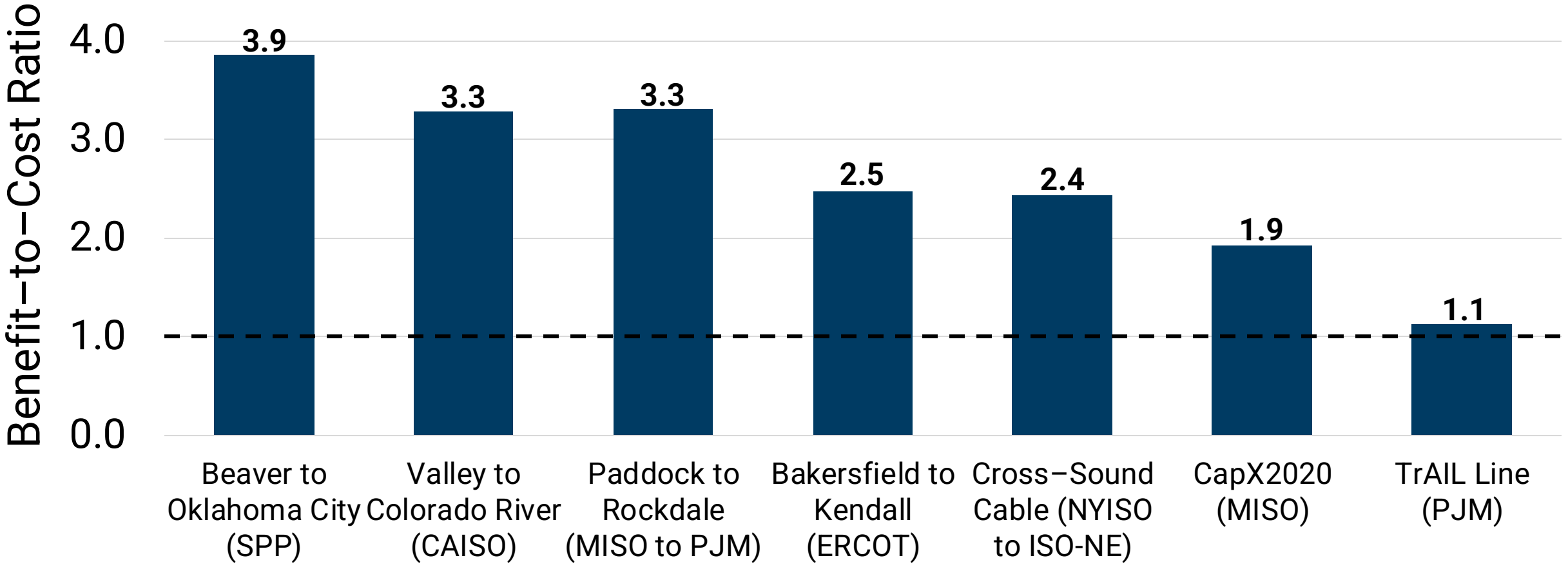
The seven case studies were selected to:

- Showcase regional and interregional transmission projects
- Touch each of the seven regional transmission organizations (RTOs)
- Provide 10 years of operational data
- Showcase a variety of development drivers

Project	Type of Line	RTO	Online Year	Primary Development Driver
Cross-Sound Cable	Interregional	NYISO & ISO-NE	2003	Multi-Benefit
TrAIL	Regional	PJM	2011	Reliability
Paddock to Rockdale	Interregional	MISO & PJM	2010	Multi-Benefit
CapX2020	Regional	MISO	2011	Reliability
Beaver to Oklahoma City	Regional	SPP	2010	Public Policy
Bakersfield to Kendall	Regional	ERCOT	2013	Public Policy
Valley to Colorado River	Regional	CAISO	2013	Multi-Benefit

Source: See Appendix C of High Voltage, High Reward Transmission.

All seven projects delivered savings to ratepayers



Source: See Appendix C of High Voltage, High Reward Transmission.

Quantifying ratepayer cost savings from operational large-scale transmission projects

We conservatively assess four ways transmission saves money for consumers

Congestion Relief Savings

Resource Adequacy Savings

Public Policy Savings

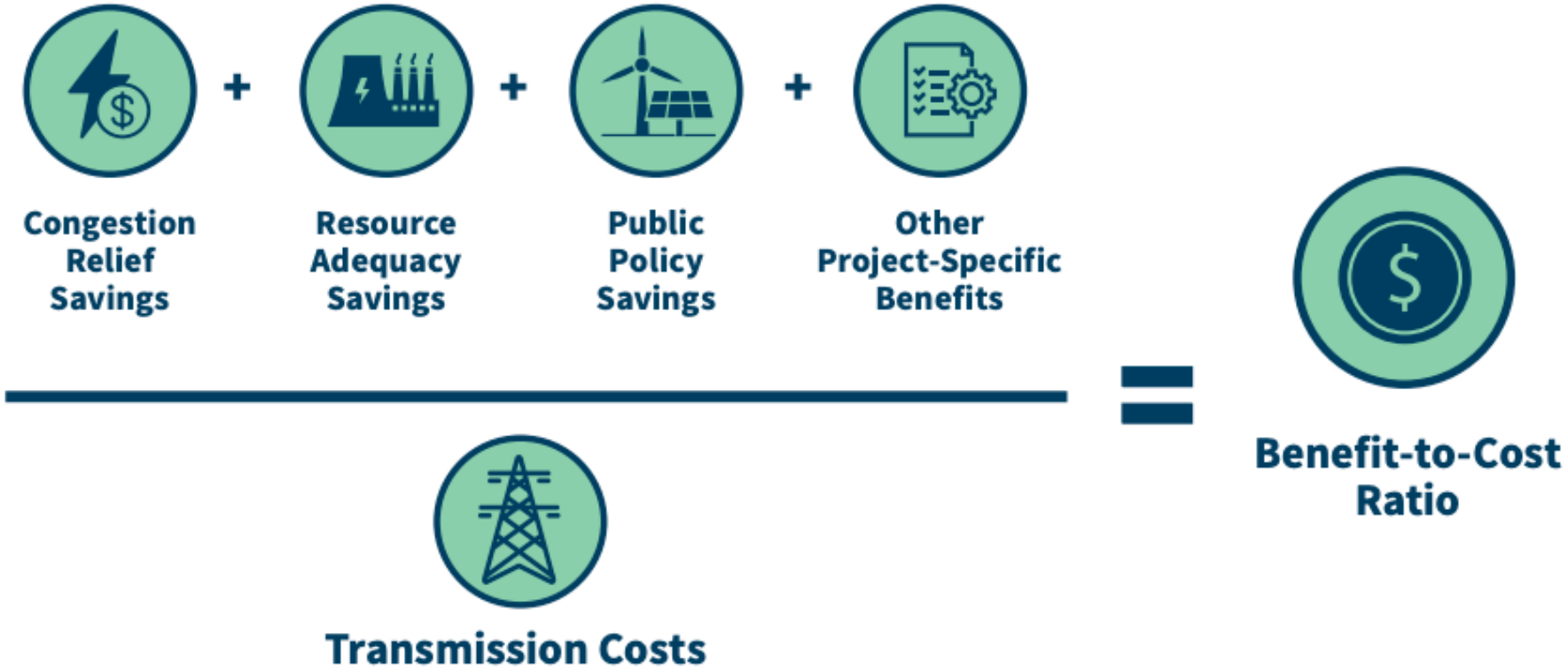
Other Project-Specific Benefits

We considered benefits on a project-by-project basis

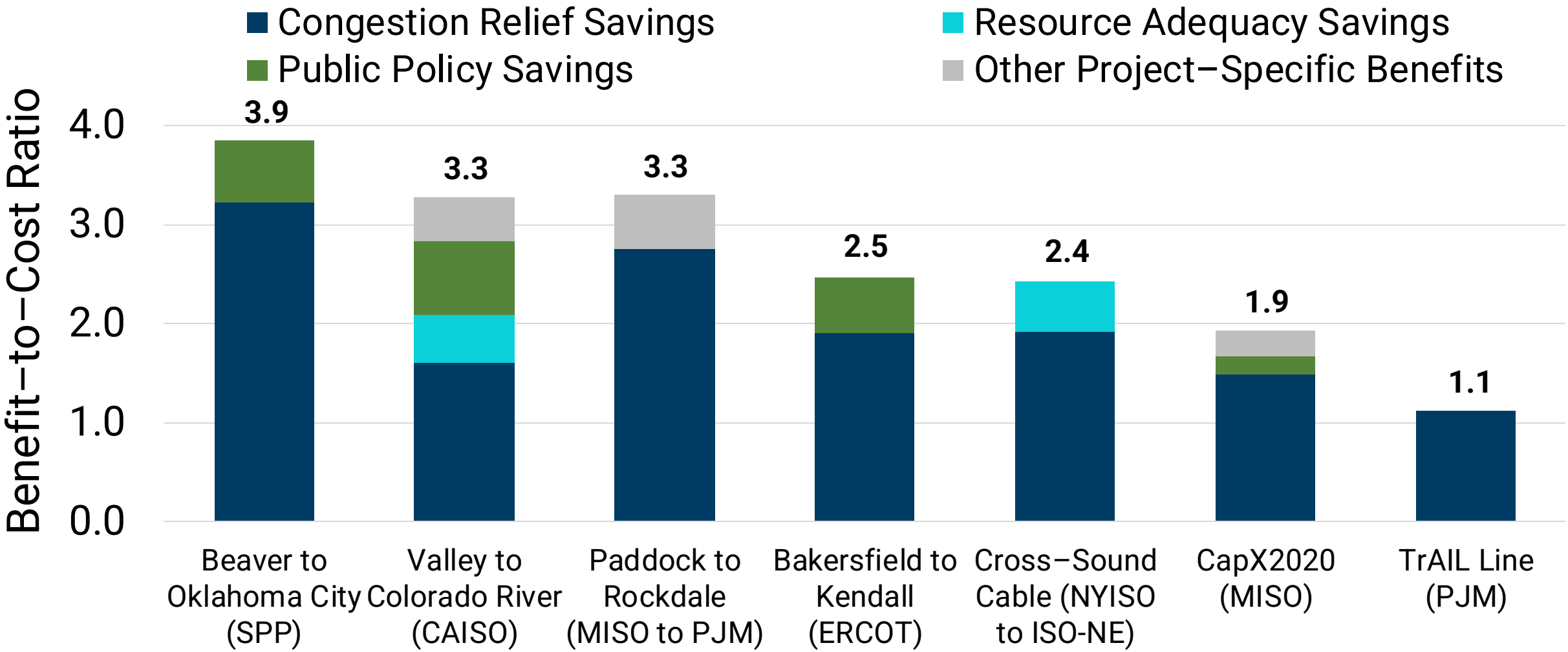
Project	Congestion Relief Savings	Resource Adequacy Savings	Public Policy Savings	Other Project-Specific Benefits
Cross-Sound Cable	X	X		
TrAIL	X	X*		
Paddock to Rockdale	X	X*		X
CapX2020	X	X*	X	X
Beaver to Oklahoma City	X	X*	X	
Bakersfield to Kendall	X		X	
Valley to Colorado River	X	X	X	X

Note: An X indicates that benefits were evaluated. Resource adequacy savings were evaluated for six projects, but savings were not identified for the four marked with an asterisk.

Our benefit-cost analysis (BCA) is consistent with other BCAs conducted by transmission planners in the U.S.



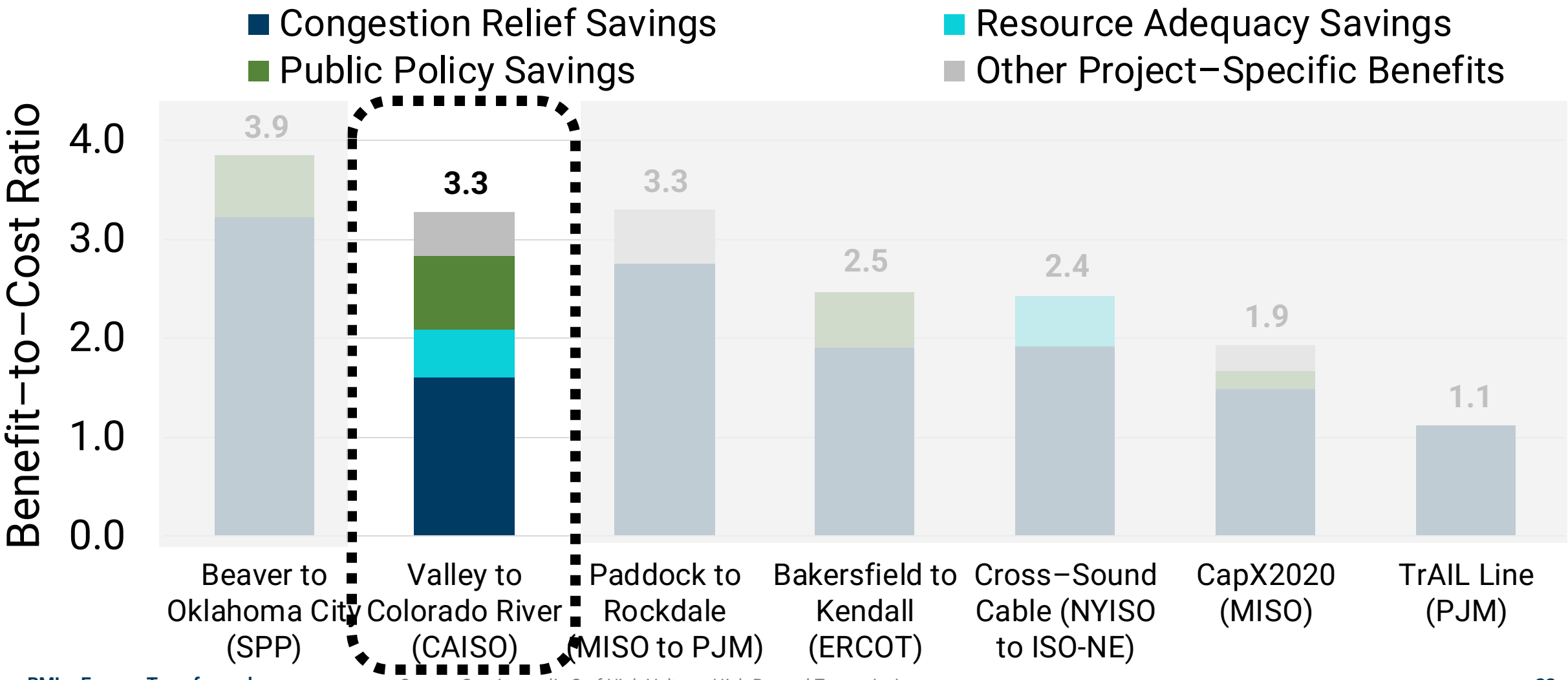
Across all seven projects, ratepayer savings exceeded costs



Source: See Appendix C of High Voltage, High Reward Transmission.

Case Study: Valley to Colorado River (CAISO)

This project showcases all four benefits



Source: See Appendix C of High Voltage, High Reward Transmission.

Valley to Colorado River key details:

Length: 153 miles

Voltage: 500kV

Developer: Southern California Edison

In-Service Date: 2013

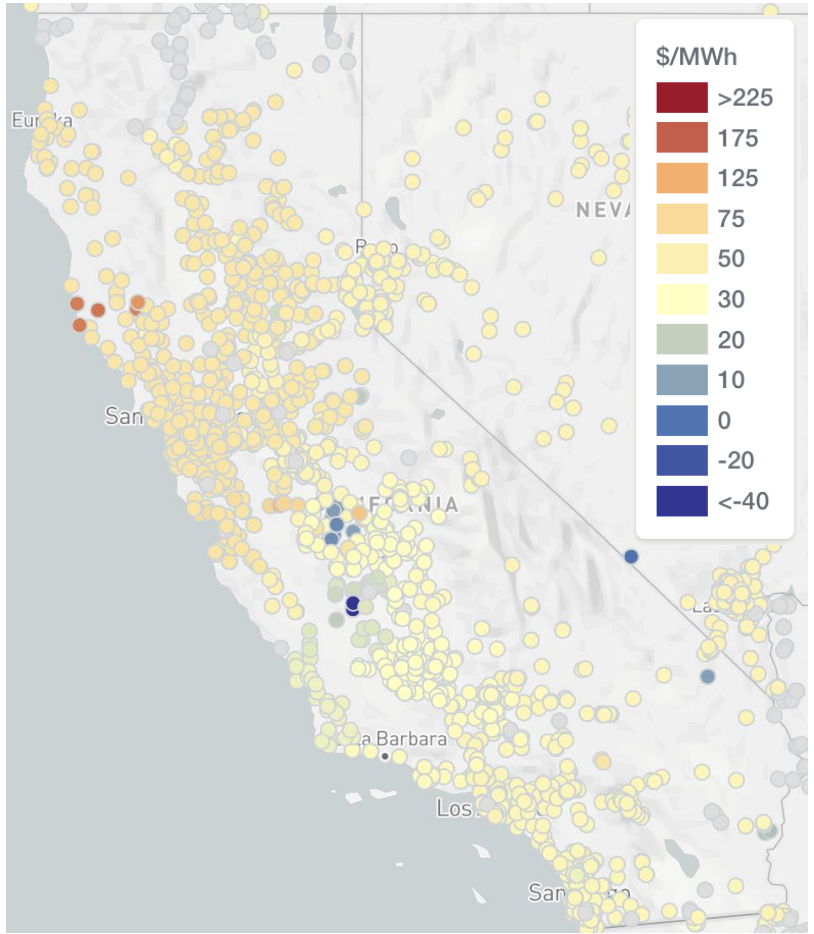
Valley to Colorado River Map

Source: Department of Homeland Security; Southern California Edison, "Application of Southern California Edison Company for a Certificate of Public Convenience and Necessity to Construct the Devers—Palo Verde No. 2 Transmission Line Project, April 2005; Public Utilities Commission of the State of California, "Decision Modifying Decision 07-01-040 Granting a Certificate of Public Convenience and Necessity," November 2009; S&P Global Market Intelligence

Enabling cheaper power flow drives congestion relief savings

- Congestion occurs when transmission bottlenecks force reliance on higher-cost, local generation, while lower-cost resources are idle or curtailed.
- Expanded transmission capacity relieves congestions enabling lower-cost generators to displace higher-cost generators.

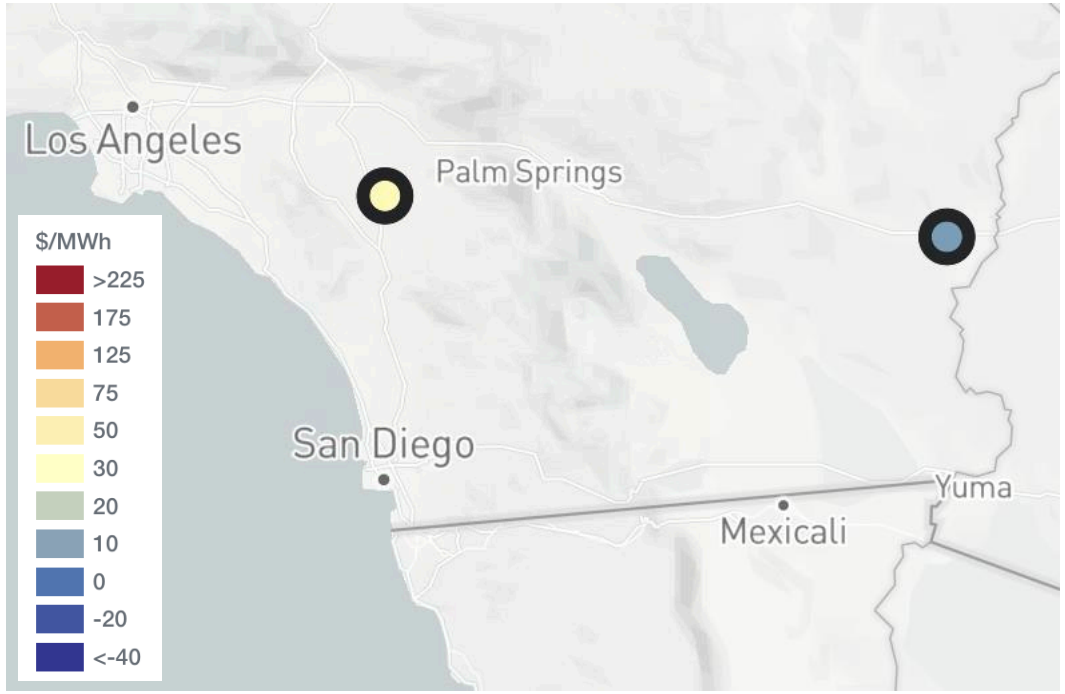
California energy prices
Oct 28, 2022 at 11am



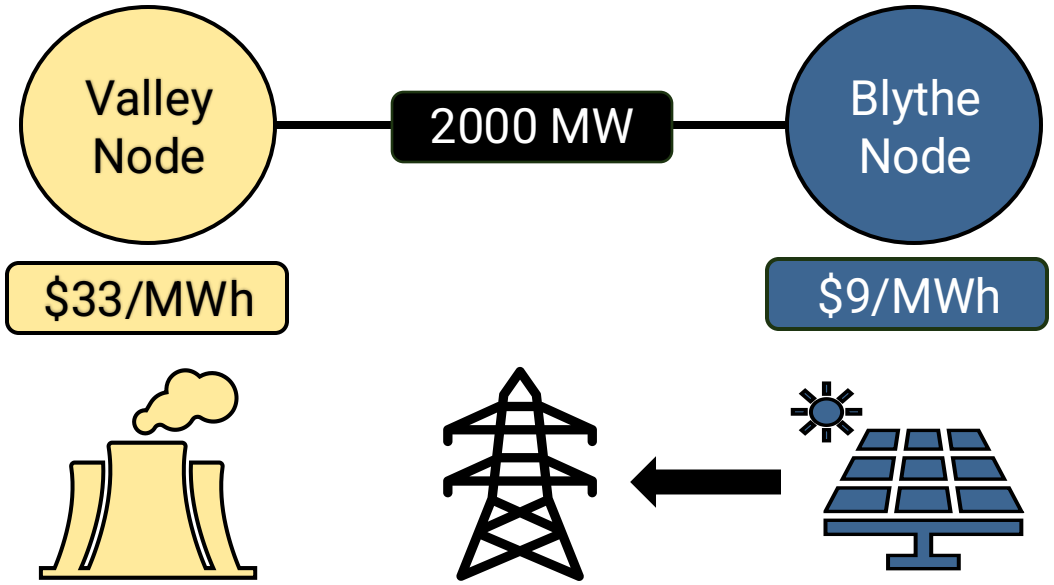
Source: Grid Status

Enabling cheaper power flow drives congestion relief savings

Valley to Colorado River line energy prices Oct 28, 2022 at 11am



A single hour of congestion relief savings calculation:



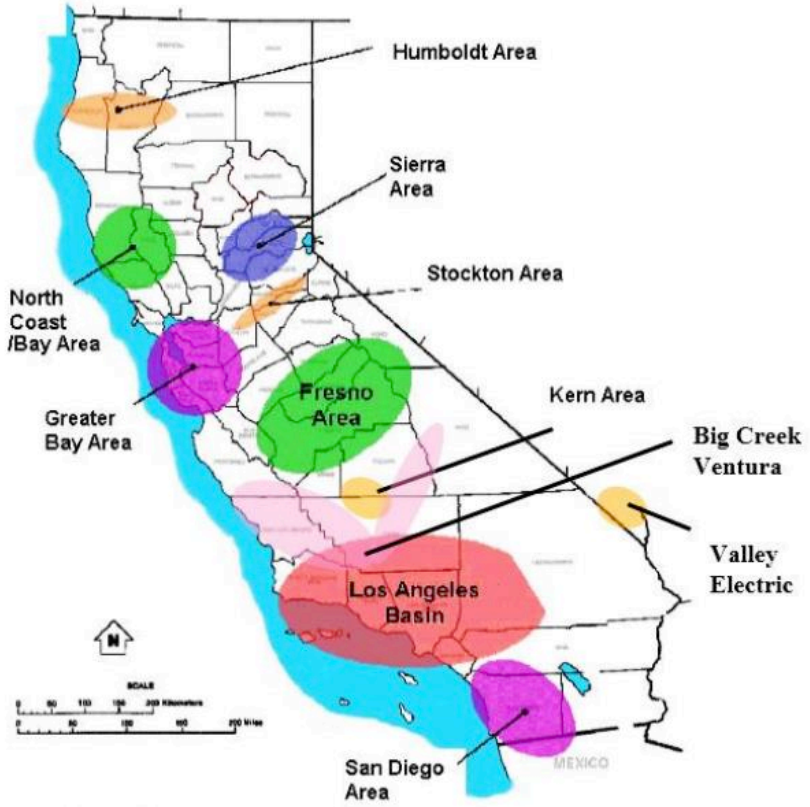
Savings = 2000 MW x ($33 - $9) = $48,000

Source: Grid Status

Access to cheaper sources of capacity drive resource adequacy savings

- Utilities must secure enough generation capacity to meet peak-hour demand.
- Resource adequacy programs set annual capacity standards to ensure grid reliability.
- The cost of procuring capacity is location dependent.
- Transmission helps grid operators meet these standards more cost-effectively by providing access to cheaper sources of generation capacity in other areas.

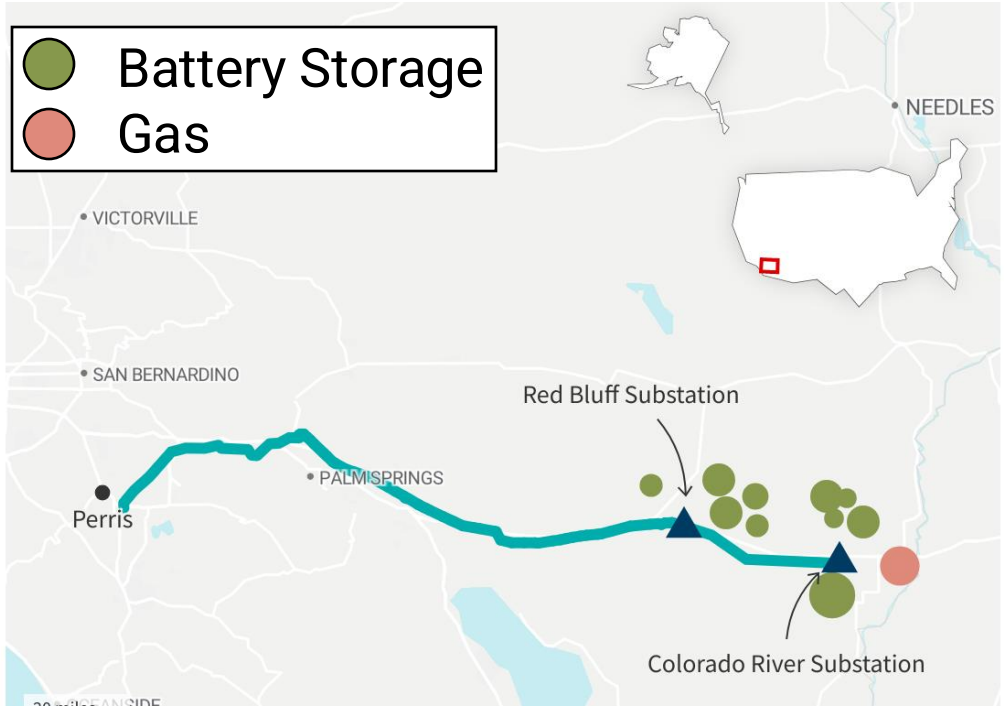
CAISO local capacity requirement areas



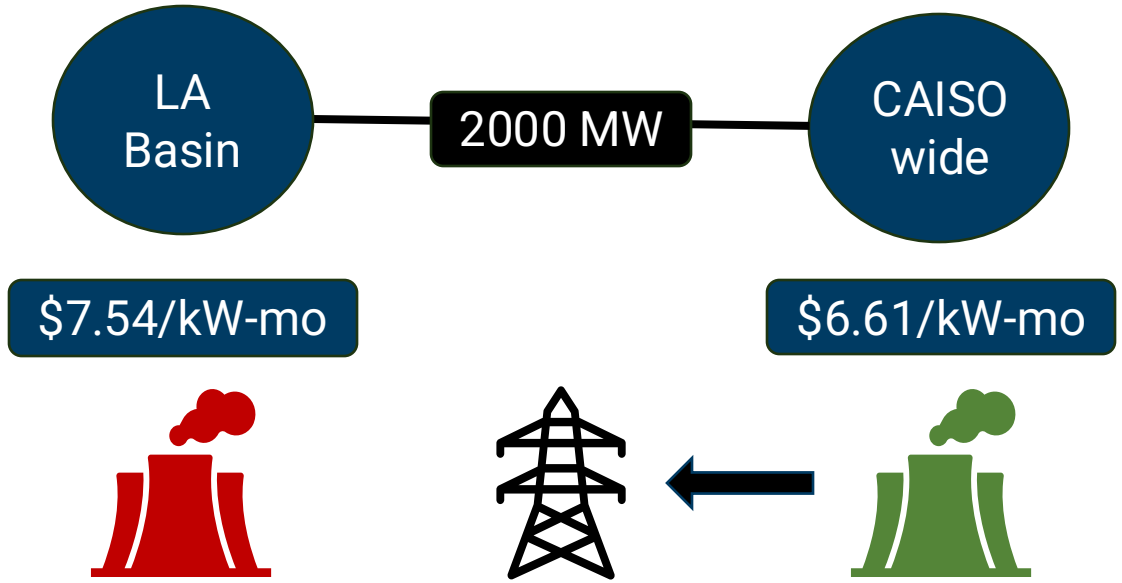
Source: California Independent System Operator, "Regional Resource Adequacy," 2015.

Access to cheaper sources of capacity drive resource adequacy savings

Over 2.2 GW storage and 500 MW of NG plants enabled by the Valley to Colorado River transmission line



2022 annual resource adequacy savings calculation:



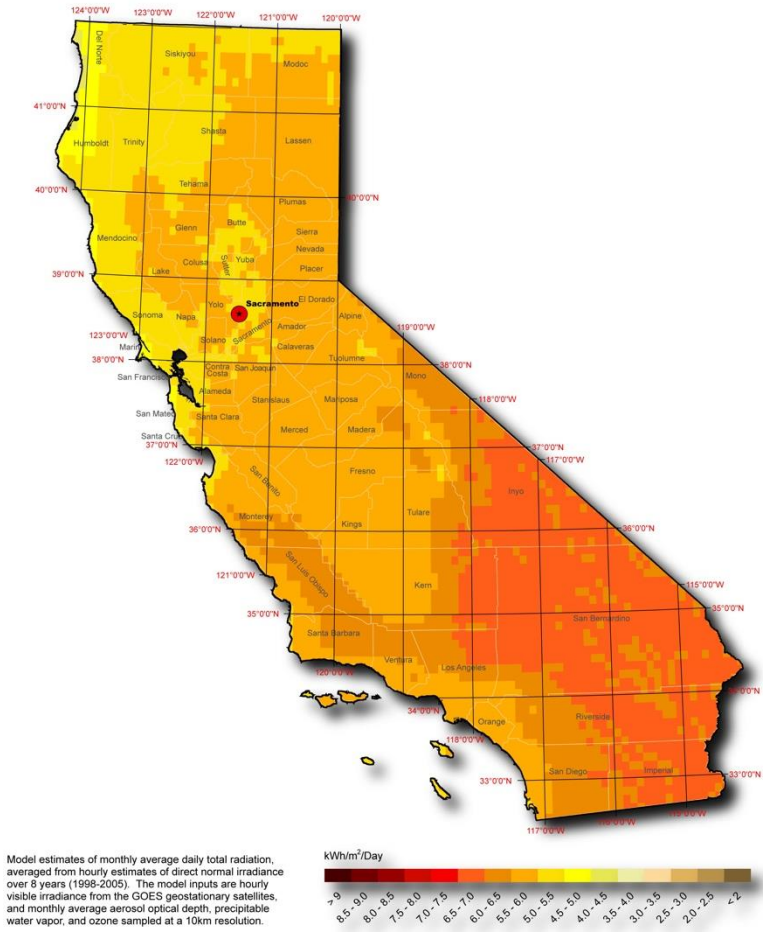
Savings = 2000 MW x ($7.54 - $6.61) x 12 mo = $22M

Source: California Public Utilities Commission, "2022 Annual Resource Adequacy Report."

Access to lower-cost generation sources that support state goals drive public policy savings

- Many states have public policy goals for clean energy procurement.
- The cost of procuring renewable energy is heavily influenced by location.
- Transmission helps meet these goals more cost-effectively by enabling access to lower-cost clean energy from resource-rich areas.

California solar irradiation



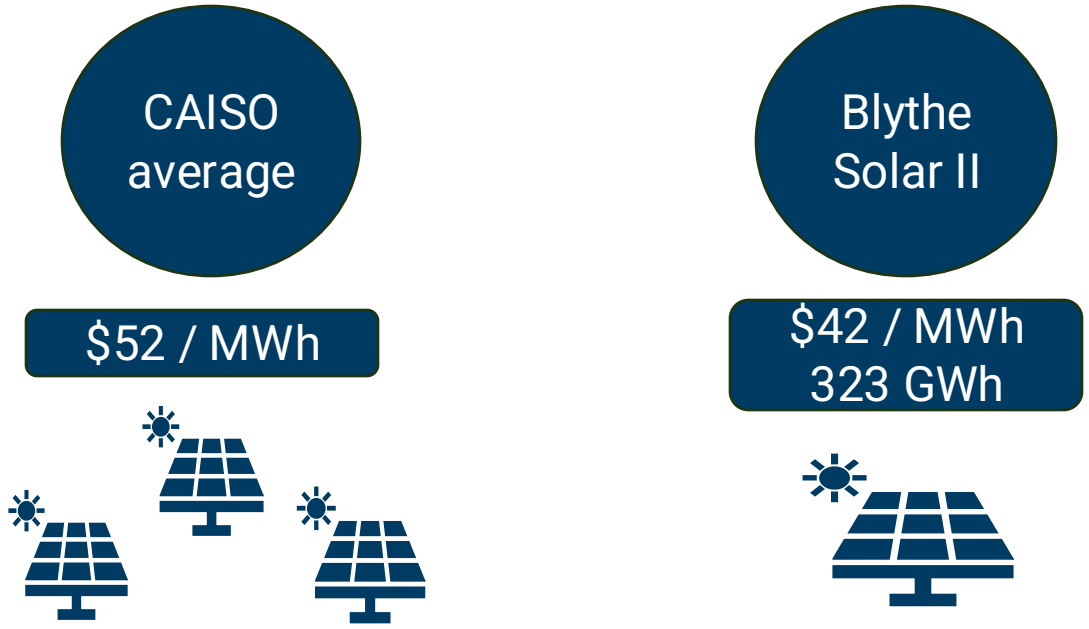
Model estimates of monthly average daily total radiation, averaged from hourly estimates of direct normal irradiance over 8 years (1998-2005). The model inputs are hourly visible irradiance from the GOES geostationary satellites, and monthly average aerosol optical depth, precipitable water vapor, and ozone sampled at a 10km resolution.

Source: NREL

Access to lower-cost generation sources that support state goals drive public policy savings

Over 3.9 GW of solar plants enabled by the Valley to Colorado River transmission line

Blythe Solar II annual public policy savings calculation:



Yearly savings = 323 GWh * ($52 - $42) = $3.2M

Source: Department of Homeland Security; S&P Global Market Intelligence; National Renewable Energy Laboratory; National Regulatory Institute; Lawrence Berkeley National Lab

Other project-specific benefits deliver savings to ratepayers

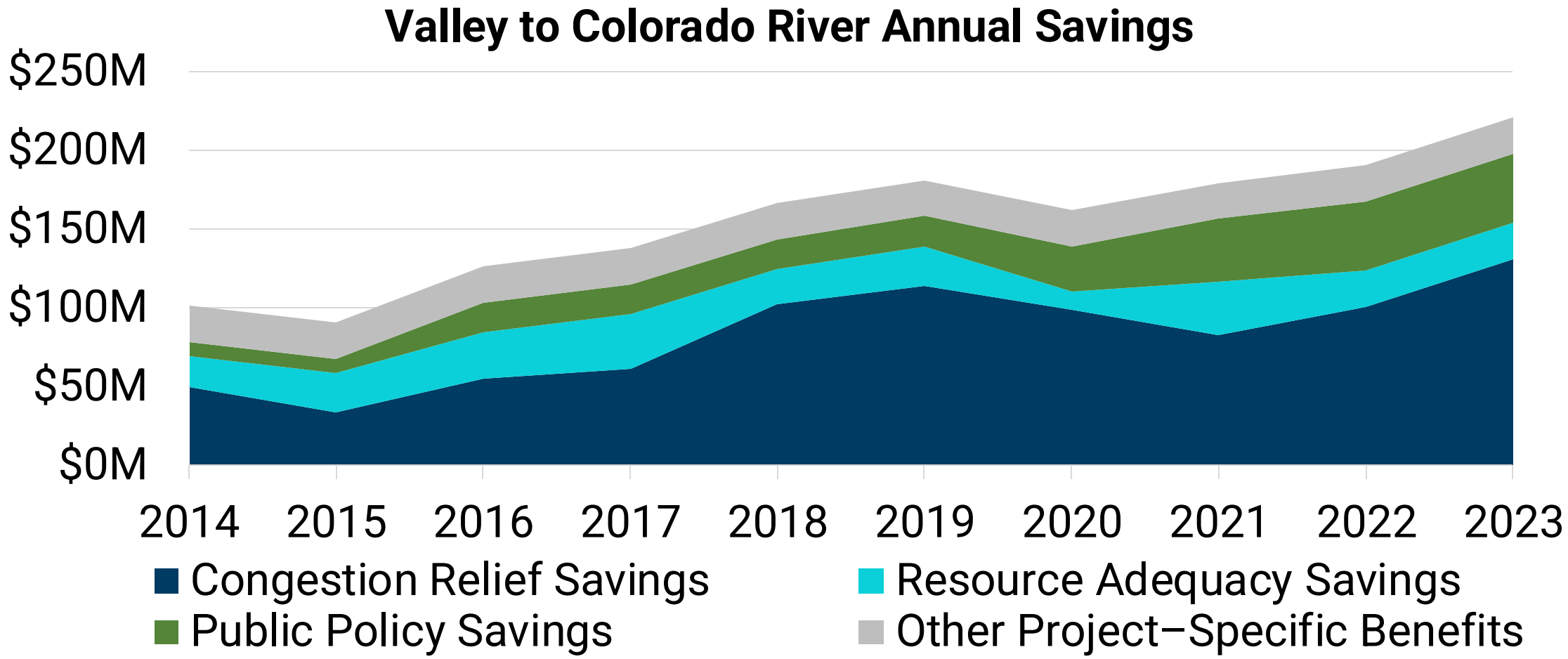
Valley to Colorado River project-specific benefit	Annual savings
Operational savings	$20M
Non-CO_2 emissions benefits	$1M
Reduced transmission losses	$2M
Enhanced resilience to extreme heat and wildfires	Not quantified

California 2018-2021 Wildfires

Increased transmission connectivity was critical to keeping the lights on, as rising temperatures drove up demand and wildfires triggered outages across California.

Source: "Opening Brief on Behalf of the California Independent System Operator," 2006; and Awad, "Economic Assessment of Transmission Upgrades," 2010.

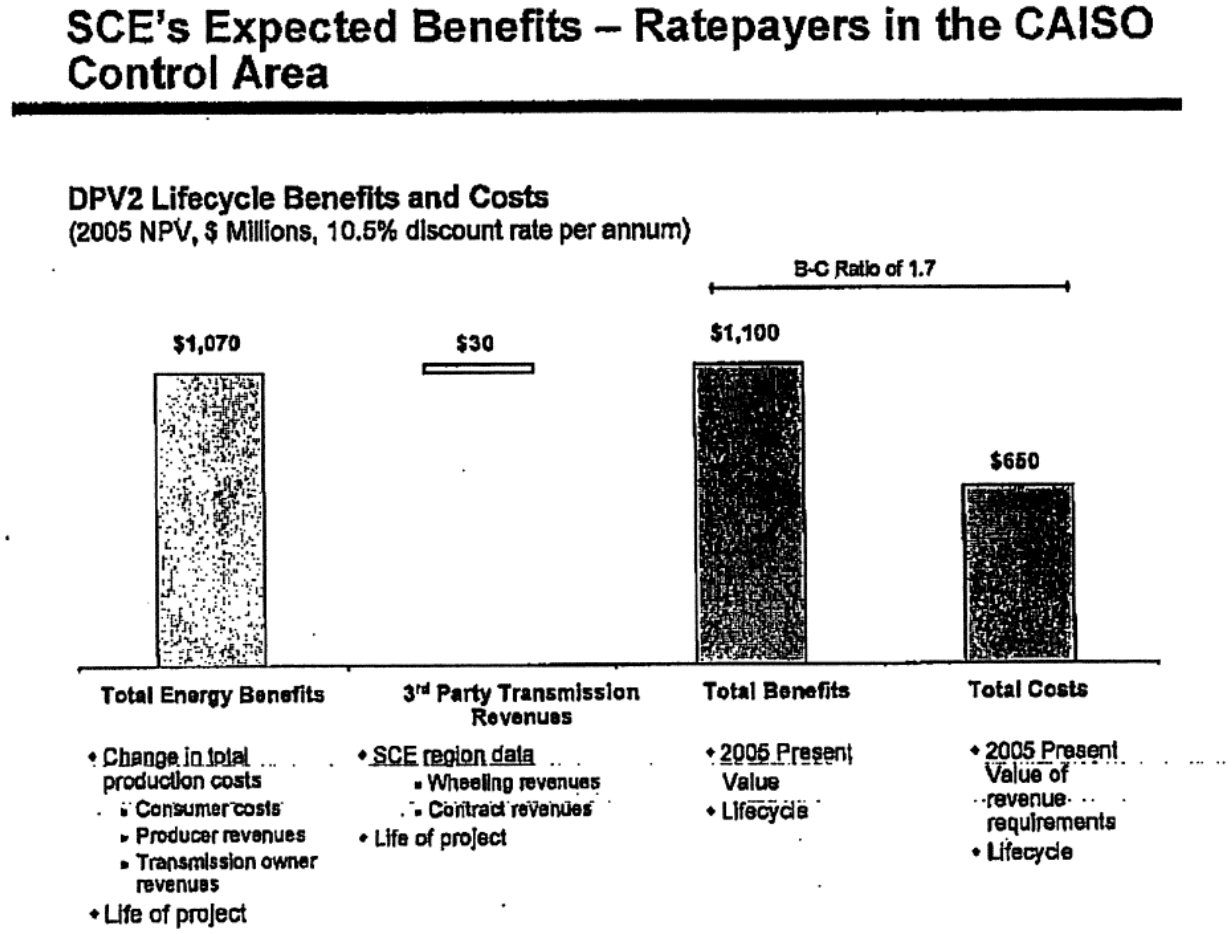
The Valley to Colorado River project has delivered an average of $156 million in total savings per year



Source: See Appendix C of High Voltage, High Reward Transmission.

The Valley to Colorado River project was expected to deliver multiple benefits to California ratepayers.

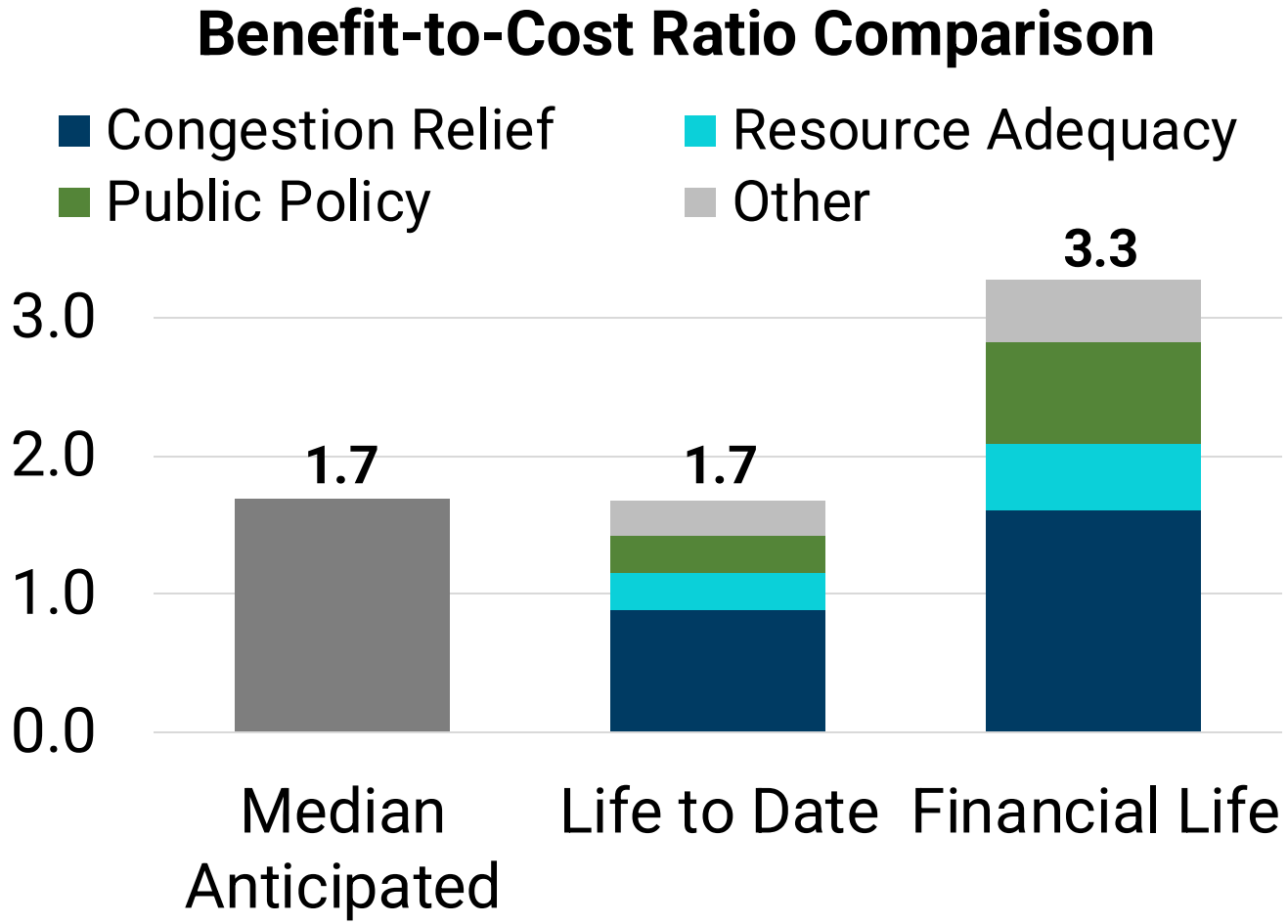
- Southern California Edison assessed multiple benefits—including congestion relief and fuel price savings—using CAISO's Transmission Economic Assessment Methodology.
- Original planners anticipated a benefit-to-cost ratio of **1.2 to 3.2,** with a **median ratio of 1.7**.



Source: Stanford University, "Economic Assessment of Transmission Upgrades: Application of the California ISO Approach," 2010; Southern California Edison, "Opening Brief on Behalf of the California Independent System Operator, Application 05-04-015," 2006.

The Valley to Colorado River Project delivered significant savings to ratepayers, surpassing planners' expectations.

- The project was **projected to deliver $1.70 in savings per dollar invested**, but **actually delivered $3.30**, nearly double projections.
- The project will **recoup its full $2 billion in ratepayer lifetime cost within 11 years**—and will continue to deliver savings for decades to come.

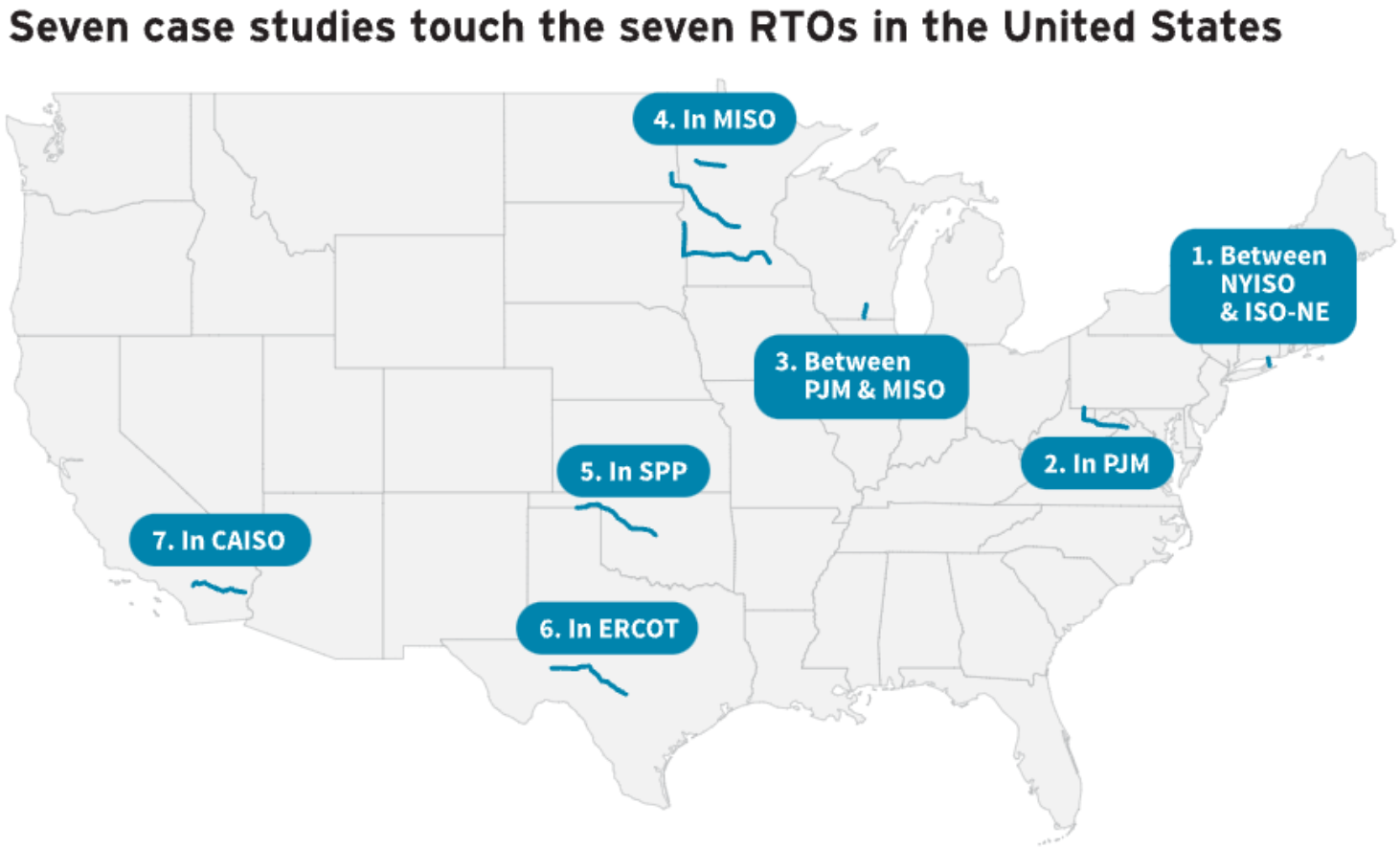


Source: See Appendix C for High Voltage, High Rewards Transmission.

Questions?

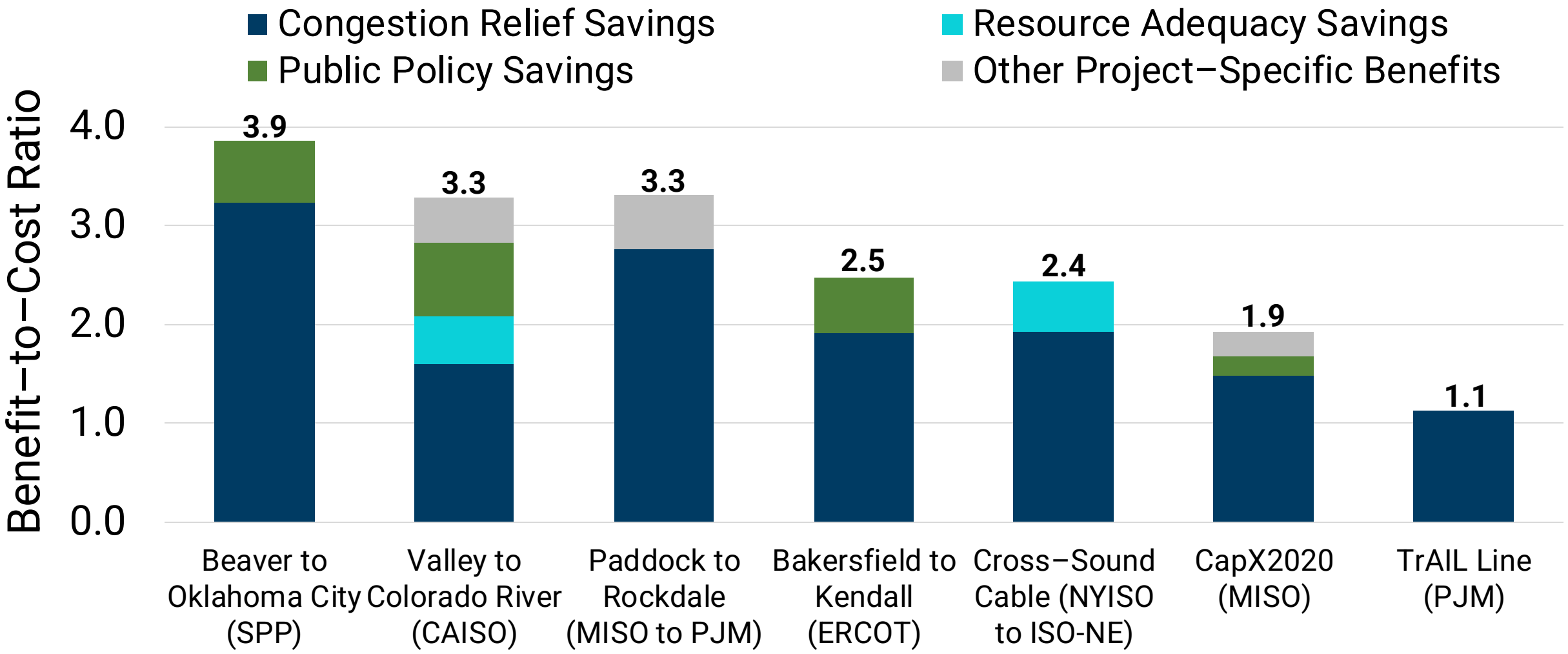
All seven transmission projects delivered significant savings to American consumers and businesses.

We analyzed seven regional and interregional projects operating across the country—from California to Oklahoma.



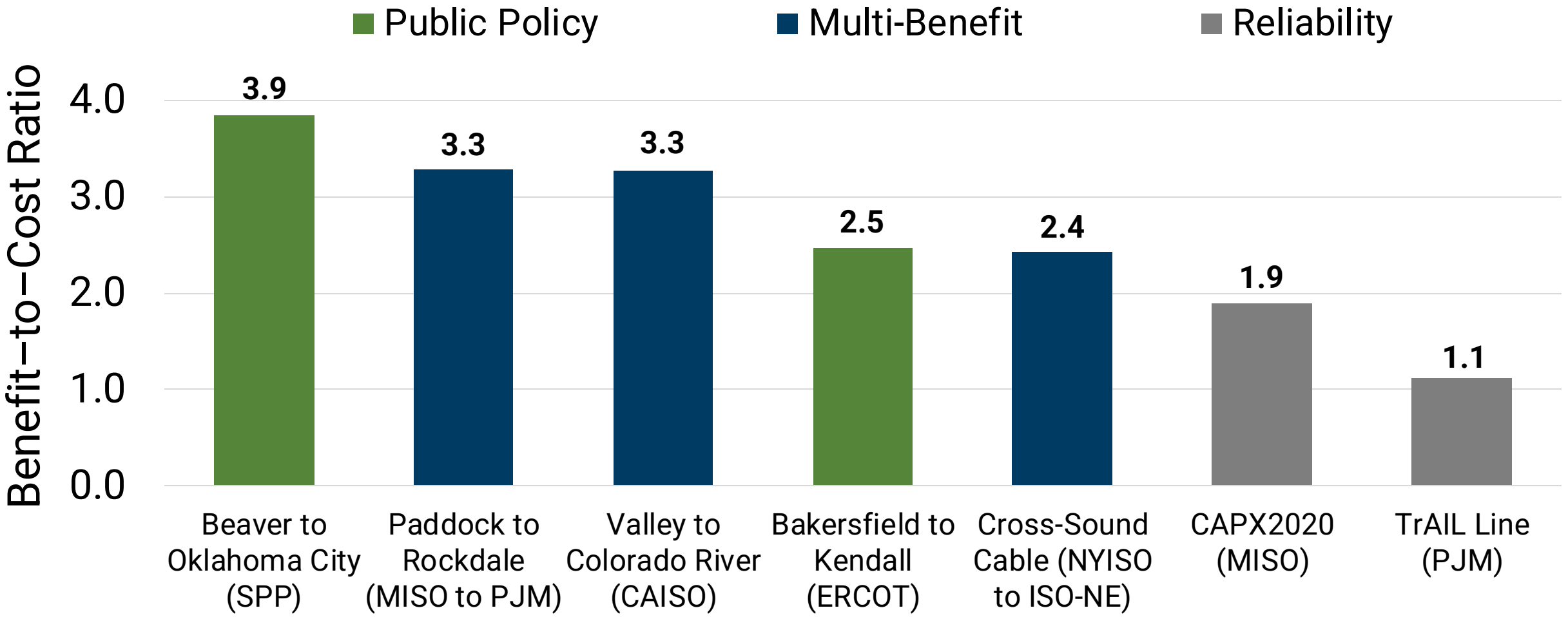
Source: Department of Homeland Security

Finding 1: Ratepayer savings exceed costs



Source: See Appendix C of High Voltage, High Reward Transmission.

Projects showcase a variety of development drivers



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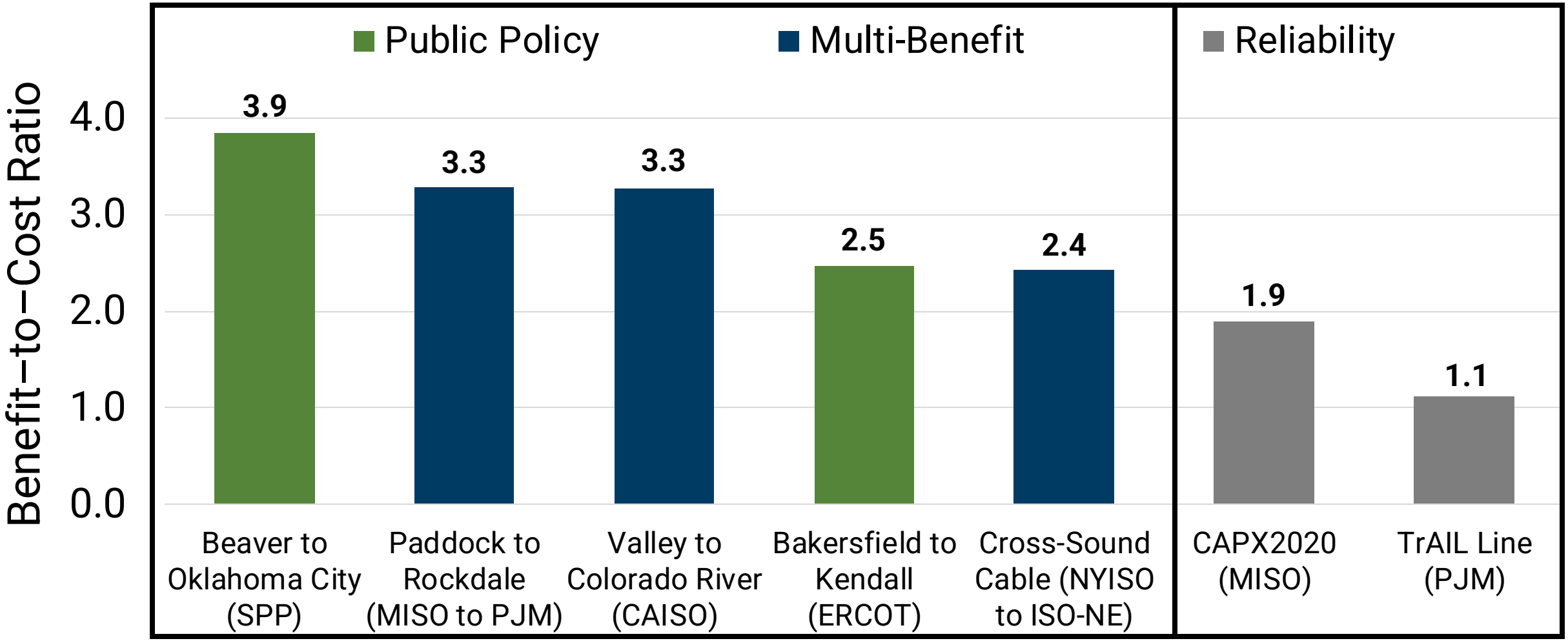
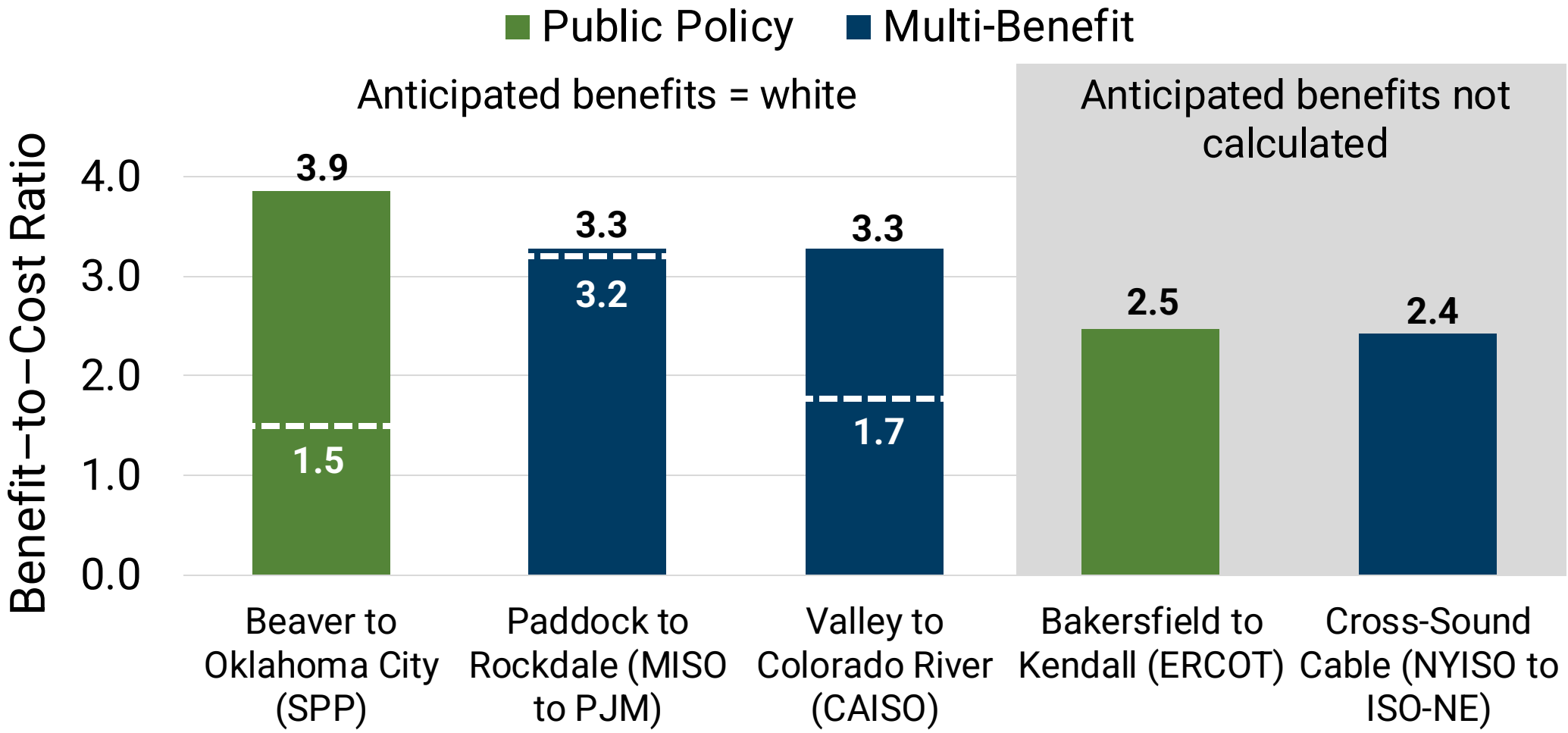


Source: See Appendix C of High Voltage, High Reward Transmission.

Finding 2: Projects aimed at delivering economic benefits exceeded planners' expectations



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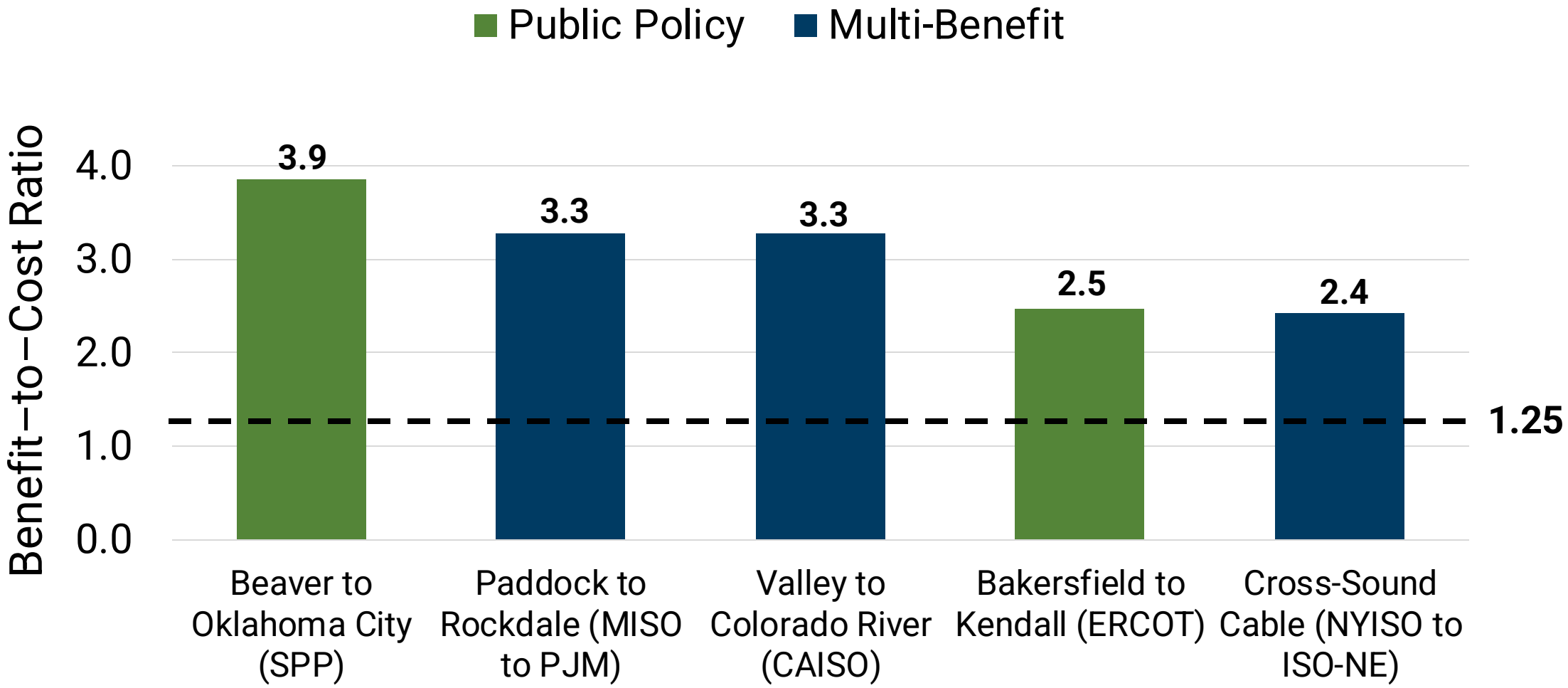
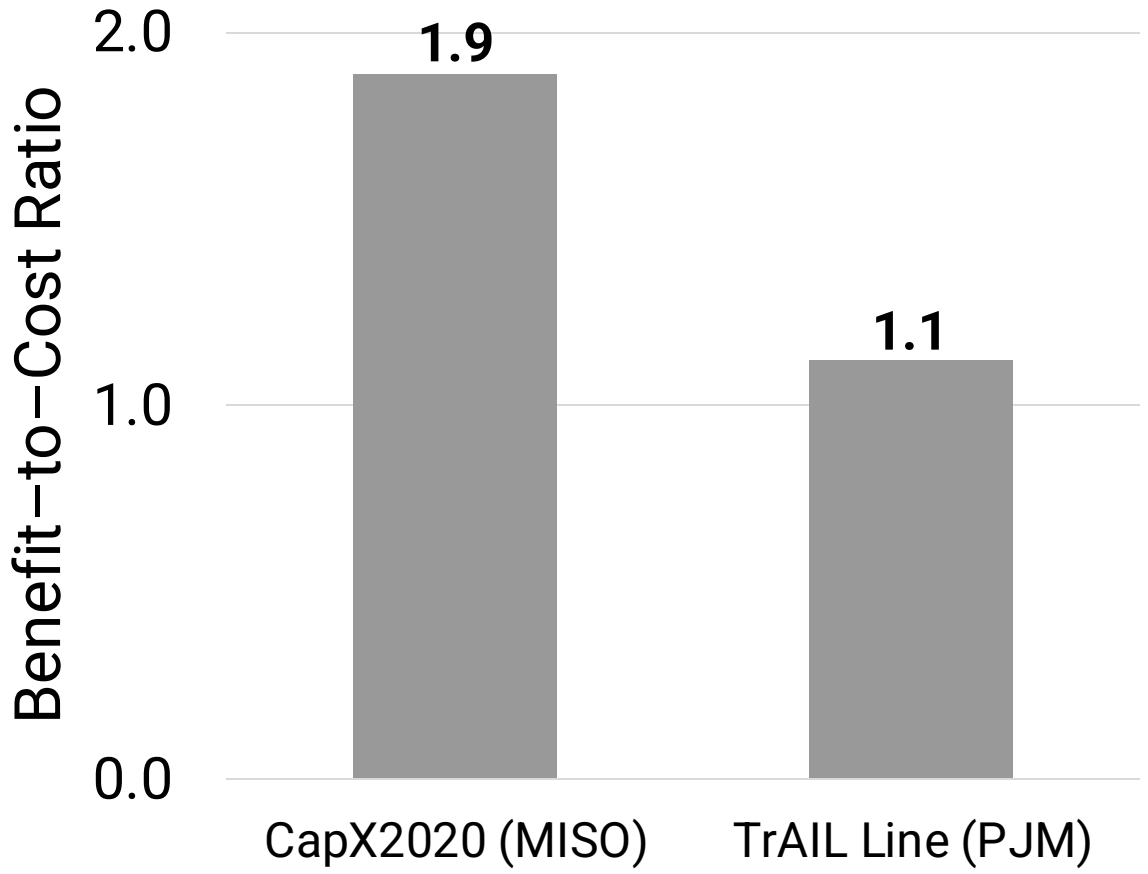
Finding 2: Projects aimed at delivering economic benefits exceeded planners' expectations



Source: See Appendix C of High Voltage, High Reward Transmission

Finding 3: Reliability-driven projects delivered unintended economic benefits

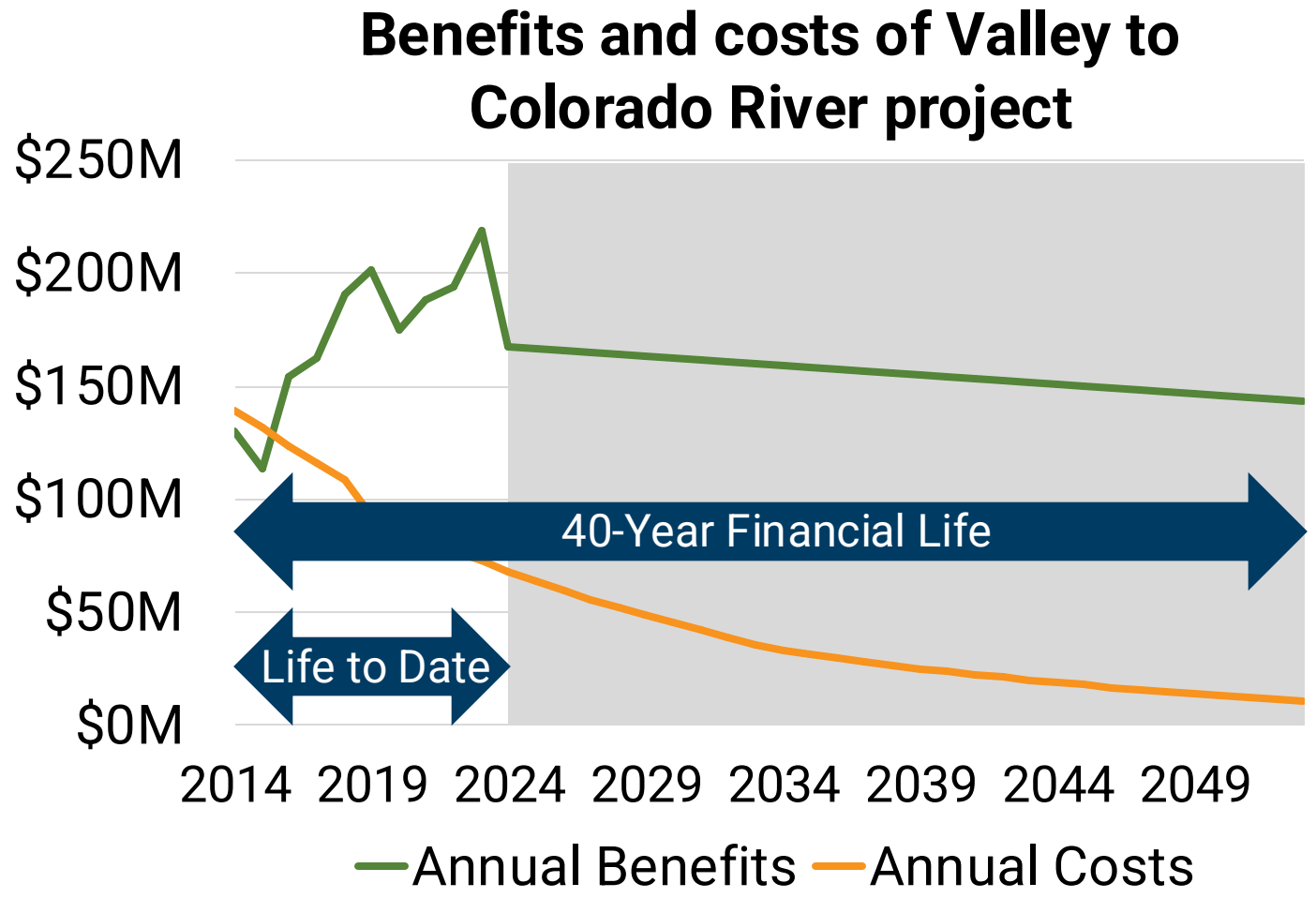
- Reliability-driven projects are not required to factor economic benefits during planning.
- While not required to meet FERC 1.25 benefit-to-cost standard, they approached or exceeded the threshold.
- These projects paid for themselves through unintended economic benefits alone.



Source: See Appendix C of High Voltage, High Reward Transmission.

Finding 4: Transmission is a long-term investment, delivering enduring savings over time

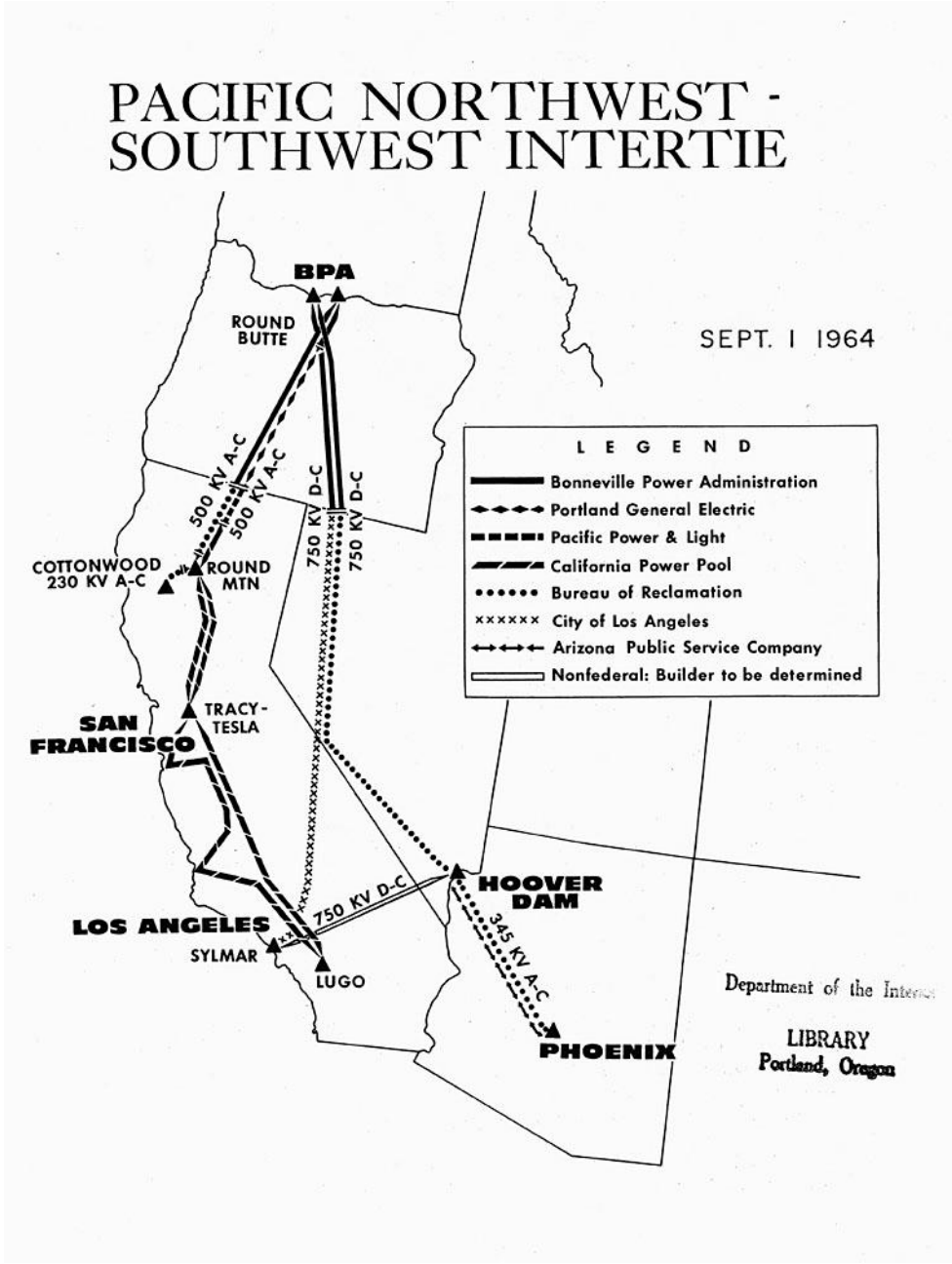
- All projects paid for themselves within 8 to 34 years.
- Benefit-to-cost ratios grow over time, as costs depreciate and benefits remain stable.
- Savings will continue for decades beyond project financial lifespans.



Source: See Appendix C of High Voltage, High Reward Transmission.

Case Study: Pacific Intertie

One of the most critical arteries of the Western grid, the Pacific direct current (DC) and alternating current (AC) intertie has been in operation for over **54 years** and has paid for its original **$700 million price** tag **many times over.**



Source: Bonneville Power Administration, 1994; Northwest Power Planning Council, "Pacific Intertie: The California Connection on the Electron Superhighway," May 2001; Orkas Energy Endurance, "The Future of Electric Transmission," February 2019.

How can we seize the large-scale transmission investment opportunity across the U.S.?

Seizing the large-scale transmission opportunity

Local Reliability Projects
Meet local standards & interconnection requests

↓

Regional Reliability Projects
Address remaining reliability needs

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Regional Economic & Public Policy Projects
Address a narrow set of remaining needs

↓

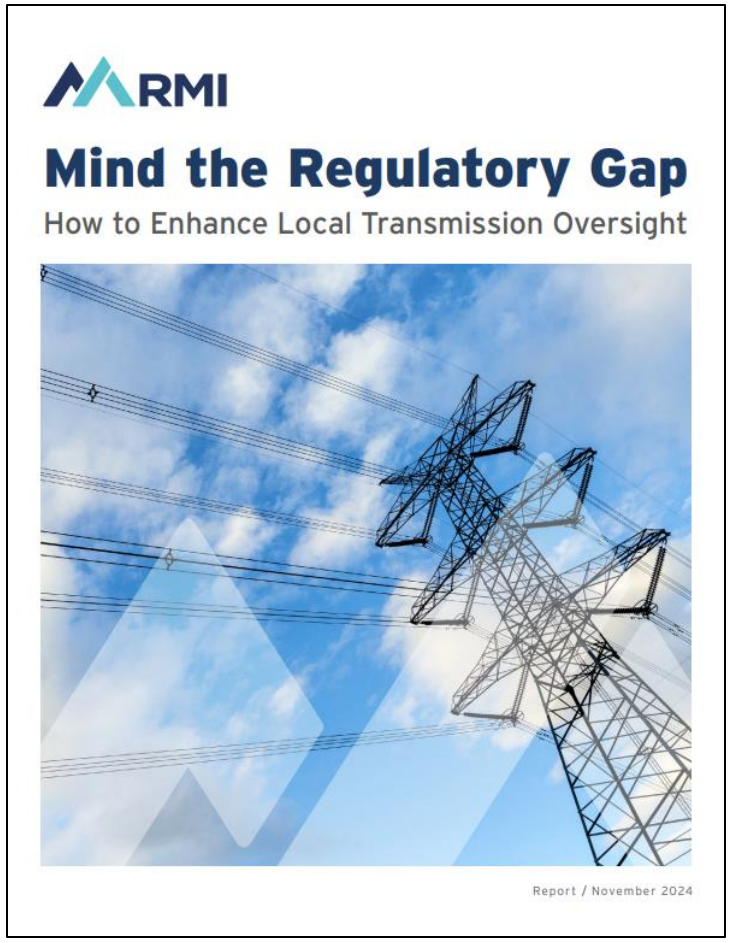
Interregional Projects
Scope of remaining needs is often narrow

1. We should better integrate local and regional planning.

2. We should improve regional planning practices.

Source: "A Roadmap to Improved Interregional Transmission Planning," Brattle, November 2021.

We should better integrate local and regional planning.



Region-first Planning

Utilities submit proposed local needs. Transmission owners submit anticipated local needs at the start of each regional planning cycle, whether it involves planning over the short term or the long term.

Planning entity identifies the region's needs. The regional planning entity determines all regional needs holistically in addition to submitted local needs

Planning entity identifies the best solutions. The regional planning entity determines the best solutions to the identified local and regional needs, including whether local projects can be right-sized to meet regional needs and whether alternative transmission technologies can be utilized.

Transmission owner optionally submits additional local projects. Following the regional planning entity's identification of solutions, each transmission owner can propose additional local projects for consideration if they feel there are unmet local needs. Such projects must still undergo state and federal review and may be held to a higher standard.

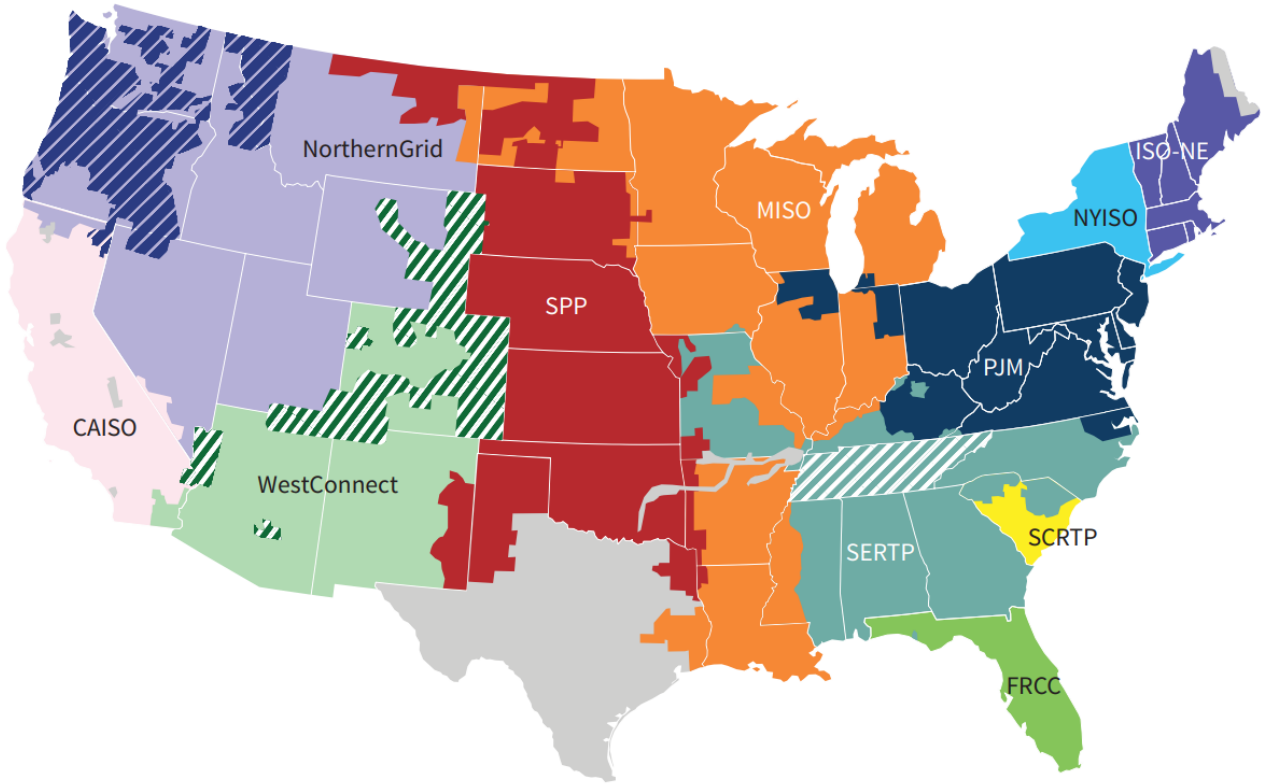
Source: Claire Wayner, Kaja Rebane, and Chaz Teplin, "Mind the Regulatory Gap", November 2024

We should improve regional planning practices.

FERC Order 1920 creates a clear pathway for multi-benefit regional planning

- Requires list of seven quantified benefits
- Requires at least three “plausible and diverse” scenarios
- Requires consideration of Alternative Transmission Technologies (ATTs)
- Requires consideration of “right sizing” options

Regional Planning Entities in the United States



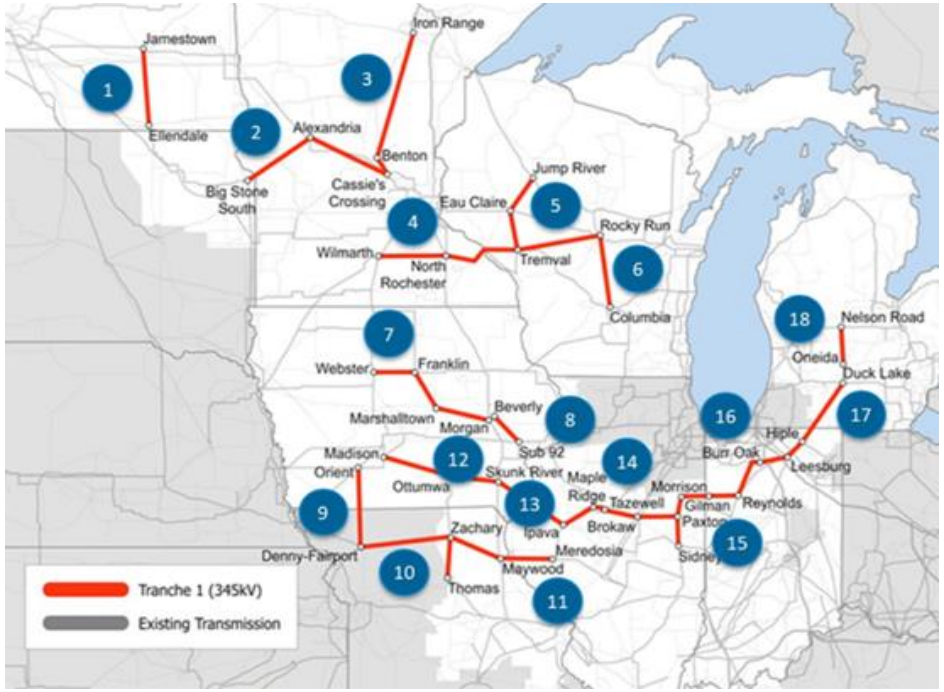
Source: Claire Wayner, Kaja Rebane, and Chaz Teplin, “Mind the Regulatory Gap”, November 2024

MISO Long Range Transmission Planning is an example of Order 1920 principles already in action.

Since 2019, MISO has approved two cost-effective transmission portfolios:

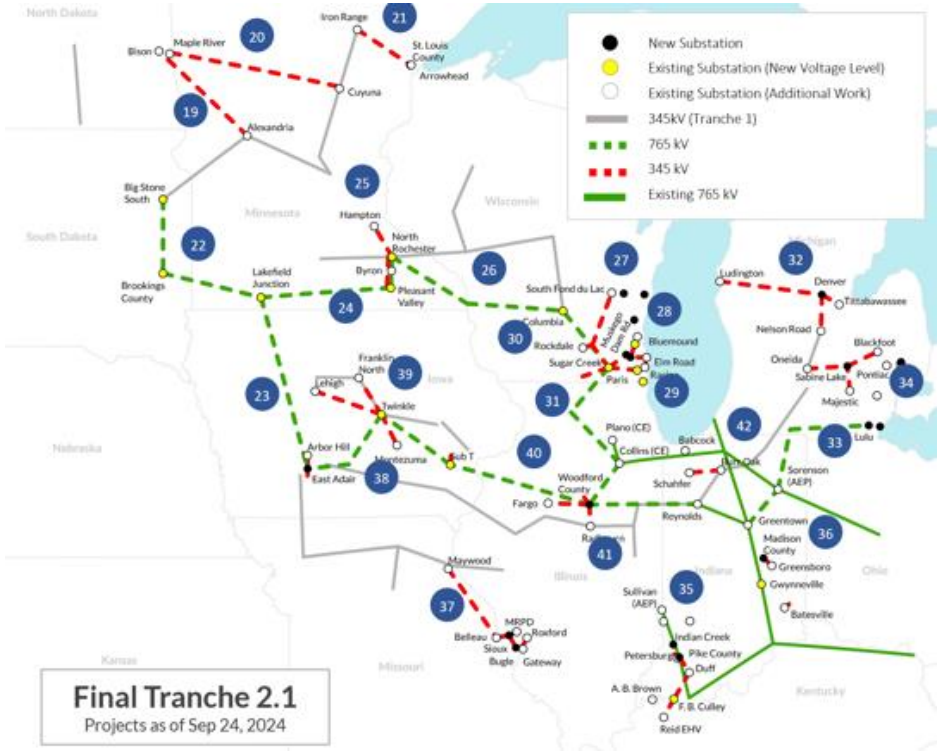
Tranche 1

2.6 – 3.8 benefit-to-cost ratio



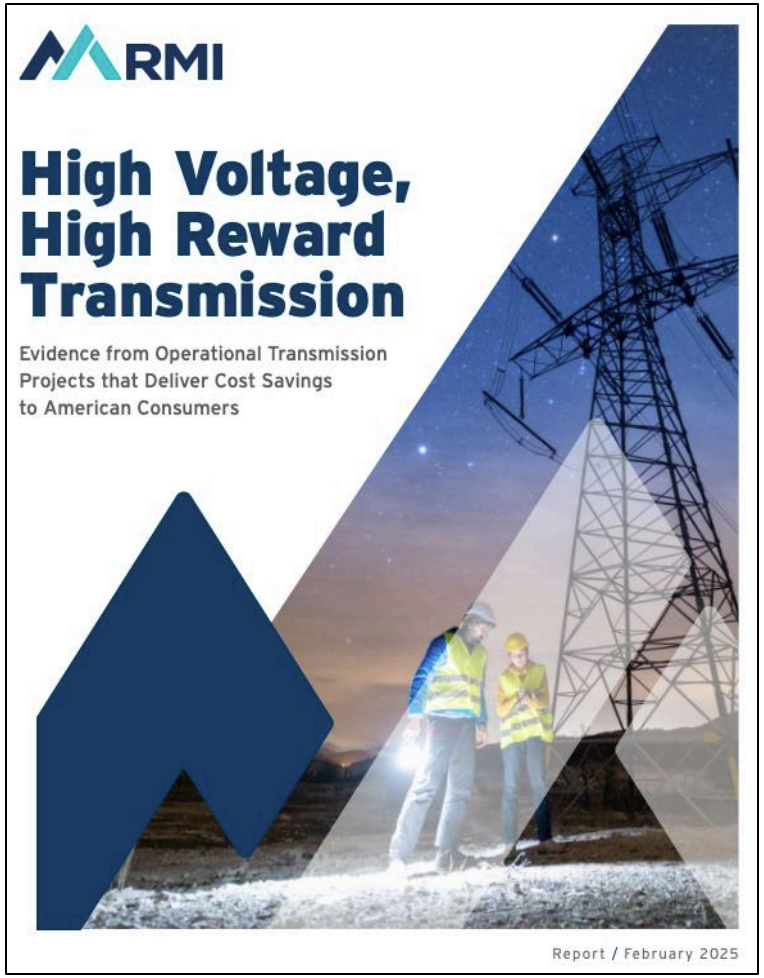
Tranche 2.1

1.8 – 3.5 benefit-to-cost ratio



Source: MISO, "Transforming the Grid: MISO's $21.8 Billion LRTP Tranche 2.1 Portfolio," September 2024; Minnesota Public Utilities Commission, "Tranche One Transmission Projects"; MISO, "Long Range Transmission Planning."

Delivering cost savings to American consumers



Finding 1: Ratepayer savings exceed costs

Finding 2: Projects aimed at delivering economic benefits exceeded expectations

Finding 3: Reliability-driven projects delivered unintended economic benefits

Finding 4: Transmission is a long-term investment

Thank you!

Questions?

Thank you!

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