Potential Cost Savings Offered by Competitive Transmission

PRESENTED TO

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PRESENTED BY
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THE Brattle GROUP

Table of Contents

This presentation, prepared for LSP Transmission Holdings, is based on the authors' analyses of publicly-available transmission data reported to FERC and ISO/RTO transmission project tracking reports, as assembled for prior client engagements and conference presentations

Background

Focus of our analysis: An examination of transmission investment trends and current experience with competitive transmission planning in ISO/RTO regions as mandated under FERC Order 1000

- U.S. transmission investments by FERC-jurisdictional transmission providers increased from $2 billion/year in the 1990s to $20 billion/year in last 5 years
- We project $120-160 billion of investments over the next decade (for reliability, to integrate new resources, upgrade/replace aging existing facilities built in 1950-70s)

Why competition? In 2011, FERC Order 1000 mandated competition in transmission planning to promote "more efficient or cost-effective transmission development"

- We examine competition in ISO/RTO transmission planning to date and the criteria that set the scope of competitive processes
- We assess the extent to which the experience to date yield potential customer savings and how these savings would increase if the scope of competitive processes can be expanded

Competition for Regulated Transmission

Transmission investment remain largely regulated, based on utility (state) or regional planning with cost recovery at regulated rates

Transmission is a public good, with regulated cost recovery:

- Benefits are broad, wide-spread geographically, diverse in impacts on market participants, and occurring over many decades
- Owners are unable to capture sufficient portion of benefits
- Will tend to lead to under-investment and over-use without regulated cost recovery

Competition is mostly for transmission investments with regulated cost recovery

- Competition in transmission typically refers to between established and alternative transmission developers
- In some jurisdiction, "Right of First Refusal" (ROFR) of incumbent transmission owners are removed for new projects approved through regional plans as required by Order 1000

Some competitive across "merchant" transmission projects but not the scope of this presentation

- Merchant transmission are mostly HVDC lines between areas with sustained wholesale electricity price differentials, resource needs, and ineffective interregional planning of regulated transmission

Experience with Competition for Transmission

In the U.S., **opportunities for competing developers are limited** to:

- A few regionally-planned projects in FERC-jurisdictional RTO/ISO regions

  U.S. ISO/RTOs are at different stages of using various frameworks for competitive planning processes, largely as a result of FERC Order 1000

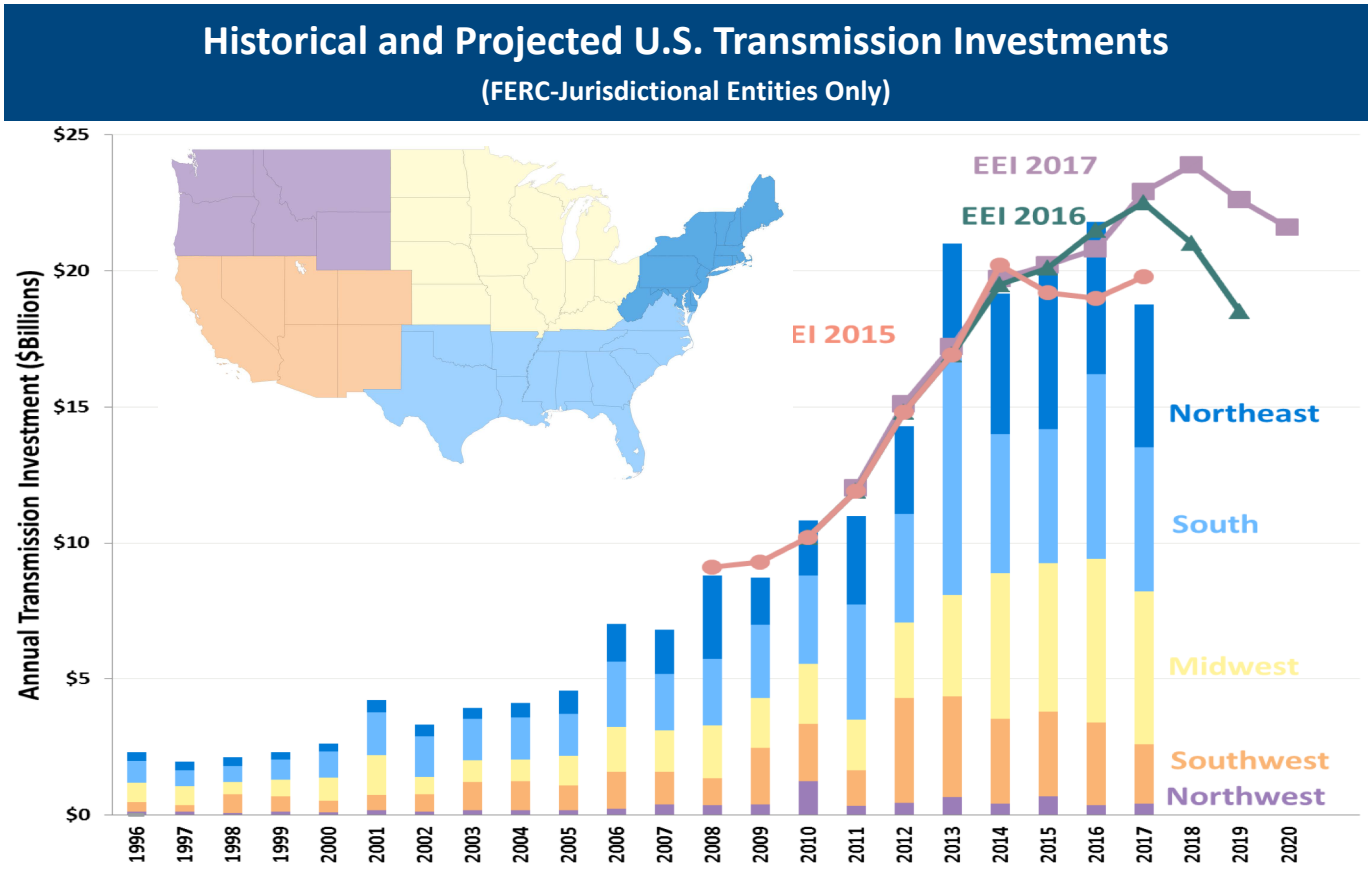
- ERCOT's transmission for competitive renewable energy zones (CREZ)

International experience with competition for regulated projects:

- Alberta: Developed a competitive process for major new projects; assigned first $1.4 billion project
- Ontario: Two competitive solicitations for transmission to date
- Brazil: Since 1999 all transmission projects have been auctioned off (similar processes in other Latin American countries, such as Chile)
- UK: Tenders for offshore grid projects; based on positive experience, competition is now being introduced for on-shore grid investments

Historical and Projected U.S. Transmission Investment by FERC-Jurisdictional Entities

Annual U.S. transmission investments are approximately **$20 billion/year** in the last five years, increasing from $2 billion/year in 1990s



Sources and Notes:

The Brattle Group © 2018. Regional Investment based on FERC Form 1 investment compiled in Ventyx's Velocity Suite, except for ERCOT for years 2010 - 2017, which are based on ERCOT TPIT reports. Based on EIA data available through 2003, FERC-jurisdictional transmission owners estimated to account for 80% of transmission assets in the Eastern interconnection and 60% in WECC. Facilities >300kV estimated to account for 60-80% of shown investments. EEI annual transmission expenditures updated December 2017 shown (2011 -2020) based on prior year's actual investment through 2016 and planned investments thereafter.

Majority of U.S. Transmission Investments in ISO/RTO Regions

Transmission investments in markets operated by FERC-jurisdictional **ISO/RTOs and ERCOT account for 85%** of current transmission investments

Transmission investments in ISO/RTO regions have grown by 10-16% annually compared to those in non-ISO/RTO regions of 6-10% annually

U.S. Annual Transmission Investments (2010–2017) and Growth Since 1999

	1999	2010	2011	2012	2013	2014	2015	2016	2017	2013-2017 Total	1999-2017 CAGR
CAISO	$0.33	$1.7	$0.9	$3.5	$3.2	$2.6	$2.5	$2.4	$1.8	**$12.6**	**10%**
ISO-NE	$0.09	$0.7	$0.6	$1.4	$1.8	$1.4	$1.7	$1.4	$1.2	**$7.5**	**15%**
MISO	$0.34	$1.4	$1.0	$1.3	$2.5	$2.7	$3.0	$4.0	$3.3	**$15.5**	**14%**
NYISO	$0.08	$0.5	$0.7	$0.3	$0.4	$0.5	$0.5	$0.5	$0.6	**$2.6**	**12%**
PJM	$0.46	$1.9	$3.4	$2.9	$4.1	$6.6	$7.3	$7.1	$6.4	**$31.5**	**16%**
SPP	$0.11	$0.8	$0.6	$1.2	$1.0	$2.1	$0.9	$1.4	$0.9	**$6.2**	**12%**
Subtotal FERC-jurisdictional ISO/RTOs	**$1.43**	**$7.0**	**$7.3**	**$10.6**	**$12.9**	**$15.9**	**$15.8**	**$16.9**	**$14.4**	$75.9	**14%**
ERCOT	$0.14	$0.8	$1.2	$1.0	$5.3	$0.9	$0.9	$2.0	$1.1	**$10.2**	**12%**
Subtotal U.S. ISO/RTOs	**$1.56**	**$7.8**	**$8.4**	**$11.7**	**$18.2**	**$16.8**	**$16.8**	**$18.9**	**$15.5**	$86.1	**14%**
Other WECC	$0.32	$1.7	$0.7	$0.8	$1.2	$0.8	$1.3	$1.0	$0.9	**$5.2**	**6%**
Southeast & Other	$0.43	$1.3	$1.8	$1.8	$1.6	$1.6	$1.9	$1.9	$2.3	**$9.4**	**10%**
Total US Reported to FERC and in ERCOT	**$2.31**	**$10.8**	**$11.0**	**$14.3**	**$21.0**	**$19.1**	**$19.9**	**$21.8**	**$18.8**	$100.7	**12%**

Scope of ISO/RTO Oversight in U.S. Transmission Investments

Of $75 billion in transmission investments by FERC-jurisdictional TOs in ISO/RTO regions between 2013 to 2017, **~47% was made without comprehensive ISO/RTO and stakeholder engagement** through the regional planning process

- Investments based on local planning by incumbent TOs not subject to full ISO/RTO review
- FERC's August 31 Order (Docket No. EL17-45, still subject to rehearing): only transmission "expansion" activities are subject to full regional planning requirements

Transmission Investments Subject to Full or Limited Review in ISO/RTO Regional Planning Processes

	Years Reviewed	FERC Jurisdictional Additions by Transmission Owners (nominal $million, *based on FERC Form 1 Filings*)	Investments Approved Through Full ISO/RTO Planning Process (nominal $million)	% of Total FERC Jurisdictional Investments Approved Through *Full* ISO/RTO Planning Process	% of Total FERC Jurisdictional Investments with *Limited* ISO/RTO Review
CAISO	2014 - 2016	$7,528	$4,043	54%	46%
ISO-NE	2013 - 2017	$7,488	$5,300	71%	29%
MISO	2013 - 2017	$15,530	$8,068	52%	48%
NYISO	2013 - 2017	$2,592	**n/a**	**n/a**	**n/a**
PJM	2013 - 2017	$31,469	$14,458	46%	54%
SPP	2013 - 2017	$6,202	$4,226	68%	32%
Total	-	**$70,810**	**$36,095**	**53%**	**47%**

Sources & Notes: *Data based on FERC Form 1 and ISO/RTO Tracking Reports. CAISO data reflects only select transmission additions/approved investments of PG&E, SCE, and SDG&E for 2014 -2016, based on available data. Aggregate Investment for each ISO/RTO reflects total FERC Form 1 transmission additions over indicated time periods. Investments approved by ISO/RTO reflects total value of transmission additions placed in-service over indicated time periods, approved through ISO/RTO processes.*

Competition Models in Transmission Planning

Competitive Sponsorship Processes

Developers compete to provide and build innovative solutions to meet needs

- Planning entities identify needs and solicit competitive proposals/solutions
- Planning entities select preferred solution; selected developers finance, build, own, and operate projects
- **Examples: PJM, ISO-NE, NYISO**

Competitive Bid-Based Processes

Developers compete to finance, build, own, and operate specified projects

- Planning entities identify need and specify solutions and projects
- Planning entities select developer to finance, construct, and own project based on factors including bid prices
- **Examples: CAISO, MISO, SPP, ERCOT, Brazil, Alberta, Ontario,**

Experience with Competitive Solicitations for Transmission in U.S.

Across the U.S., **only 2% of FERC-jurisdictional transmission investments has been subject to full competitive processes** between 2013 through 2017.

- On average, ~$340 million/year out of $2 billion/year of transmission investment has been subject to full competitive process in the U.S.
- CAISO and NYISO present slightly more investments through the competitive processes

Competitively-Developed Projects in FERC-Jurisdictional Regions In 2013-2017 (Project costs in nominal $ million)								
	CAISO	**ISO-NE**	**MISO**	**NYISO**	**PJM**	**SPP**	**Non-RTO**	**All Six FERC Jurisdictional ISO/RTOs**
2013	$144	$0	$0	$0	$0	$0	$0	$144m
2014	$148	$0	$0	$0	$0	$0	$0	$148m
2015	$425	$0	$0	$0	$283	$0	$0	$425m
2016	$133	$0	$50	$0	$320	$8	$0	$794m
2017	$0	$0	$0	$181	$0	$0	$0	$181m
Total Estimated Competitive Project Costs 2013 – 2017 ($million)	**$851**	**$0**	**$50**	**$181**	**$603**	**$8**	**$0**	**$1,693m**
Total Reported Investment 2013-2017 ($billion)	$12.6b	$7.5b	$15.5b	$2.6b	$31.5b	$6.2b	$14.6b	**$90.5b**
Total Estimated Competitive Project Costs (% of Total RTO Spend)	**6.8%**	**0.0%**	**0.3%**	**7.0%**	**1.9%**	**0.1%**	**0.0%**	**1.9%**

Projects Selected Through Competitive Process by ISO/RTOs (as of Oct 2018)

Experience to date shows strong competition across many companies

- 16 projects in the U.S. and 3 in Canada
- From 2013-17, PJM received 794 proposals, competing to meet needs
- PJM approved 139 projects of which 132 were upgrades; 2 awarded to non-incumbents

Processes Completed

ISO/RTO	Processes Completed	Process Type	Awards Involving Non-Incumbent Developers
CAISO	10	Projects	4
MISO (through 2018)	2	Projects	2
SPP	1	Projects	0
PJM	16	Solutions	2
NYISO	1	Solutions	1
ISO-NE	0	Solutions	0
All Regions	30		9

Competitive Transmission Project Summary

ISO/RTO	Project	Decision Year	Selected Developer	Include Incum-bent?
CAISO	Gates-Gregg	2013	PG&E/MidAmerican Citizen Energy	Yes
CAISO*	Imperial Valley	2013	Imperial Irrigation District	Yes*
CAISO	Sycamore-Peñasquitos 230 kV	2014	SDG&E w/ Citizen Energy	Yes
CAISO	Delaney-Colorado River	2015	DCR Transmission	No
CAISO	Estrella Substation	2015	NextEra	No
CAISO	Wheeler Ridge Junction	2015	PG&E	Yes
CAISO	Suncrest Project	2015	NextEra	No
CAISO	Spring Substation	2015	PG&E	Yes
CAISO	Harry Allen-Eldorado	2016	Desert Link	No
CAISO	Miguel Substation	2014	SDG&E	Yes
MISO	Duff-Coleman 345 kV	2016	LS Power w/ Big Rivers	No
MISO	Hartburg-Sabine Junction 500 kV	2018	NextEra	No
NYISO	Western NY Public Policy	2017	NextEra	No
PJM	Artificial Island	2015	LS Power	No
PJM	ApSouth Market Efficiency	2016	Transource, BGE, and Allegheny Power	No
SPP	North Liberal – Walkemeyer 115 kV	2016	Mid Kansas Electric	Yes
AESO	Fort McMurray West 500 kV	2014	Alberta PowerLine	Yes
IESO	East West Tie Line	2013	NextBridge	No
IESO	Wataynikaneyap Power	2015	Fortis Inc.	No

* IID is not a CAISO PTO but the incumbent in the Imperial Valley Region

Criteria for Entering Competitive Processes in ISOs/RTOs

ISO/RTO qualifications and exclusion criteria greatly reduce the scope of projects eligible for competitive processes. Experience shows scope can be expanded.

	CAISO	ISO-NE	MISO	NYISO	PJM	SPP
Types of Projects Eligible for Competition	Reliability, Economic, Public Policy	Reliability, Economic, Public Policy	Market Efficiency, Multi-Value (MVP)	Reliability, Economic, Public Policy	Reliability, Economic, Public Policy	ITP, High Priority, Interregional
Exclusions						
Exclusions for Reliability Projects		✓ (Based on Need Date)	✓*		✓ (Based on Need Date)	✓ (Based on Need Date)
Exclusions for Local Cost Allocated Projects (per Order 1000)	✓	✓	✓	✓	✓	✓
Exclusion of Upgrades (per Order 1000)	✓	✓	✓	✓	✓	✓
Exclusions Based on Voltage						
Voltage > 300 kV						
Voltage 200-300 kV			✓** (For MEP)			
Voltage 100-200 kV	✓		✓** (For MEP)		✓***	
Voltage < 100 kV	✓	✓	✓**		✓***	✓

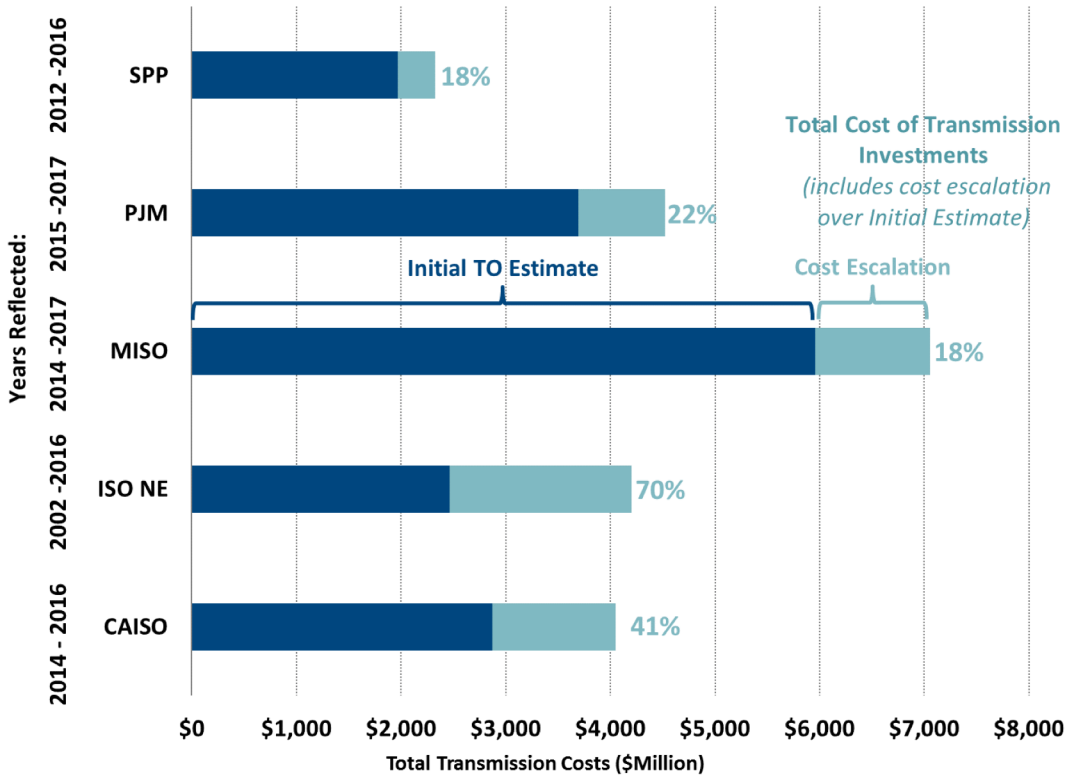
Notes: Additionally, competitive transmission may be precluded in certain states, due to state Right of First Refusal (ROFR) provisions. *In MISO, projects that are only classified as Baseline Reliability Projects are locally allocated (regardless of voltage), making them ineligible for competitive processes. Projects designated as Baseline Reliability Projects and MEPs/MVPs are cost-allocated as though they are MEPs/MVPs. **MISO limits competition to MEPs and MVPs; MEPs must have a total cost of at least $5 million and a minimum voltage of 230 kV; MVPs must have a total cost of at least $20 million and a minimum voltage of 100 kV; see MISO Tariff Attachment FF, Sections II.B, and II.C. ***PJM has exceptions to these exclusions on lower voltage facilities for specific types of reliability violations. These exceptions are detailed in PJM Manual 14F Section 5.3.4.

Cost Escalations of Traditionally-Developed ISO/RTO Transmission Projects

Many transmission projects experience cost escalations:

- Comparing initial estimates and final project costs of transmission projects shows **cost escalations average 34%**
- Average cost escalations range from 18% for projects in MISO and SPP to 33%–70% for projects in CAISO and ISO-NE
- These escalations reflects inflation, routing or project changes, and siting complications
- The absence of cost-tracking mechanisms in some ISO/RTOs (CAISO and NYISO) makes it difficult to analyze project cost increases
  (CAISO data from FERC Complaint, EL17-45)
- More consistent and transparent project cost tracking and reporting is needed

Historical Cost Escalations of Traditionally-Developed Projects in FERC-Jurisdictional ISO/RTOs



* Weighted average based on *competitively selected transmission investments* in each ISO/RTO. ISO-NE has yet to select any transmission project through its competitive planning processes. Therefore, the weighted average of historical cost escalation of traditionally-developed *projects* shown above excludes ISO-NE projects' observed historical cost-escalation.

Potential Cost Savings from Competitive Transmission Processes

Experience with 16 projects selected through the ISO/RTO competitive planning processes show potentially large cost advantages of competition

- On average, the winning bids of these 15 competitive transmission projects have been priced **40% below** the ISO/RTOs' or incumbent TO's initial project cost estimates
- Similar bid cost advantages observed in Alberta
- All 16 projects are still under development (in-service dates post-2019), so final costs are not yet known
- Selected developer offer **cost caps or cost-containment** measures, reducing the risk of significant cost increases

Differences in Competitive Bids and Initial Cost Estimates
for Competitive Processes of FERC-Jurisdictional ISO/RTOs

RTO	Number of Competitive Projects	ISO/RTO or Incumbent Estimate of Project Cost ($million)	Winning Bid of Competitive Projects ($million)	Average Cost Advantage of Competitive Bids
CAISO*	10	$1,180	$833	29%
ISO-NE	0	n/a	n/a	n/a
MISO	2	$181	$154	15%
NYISO	1	$232	$181	22%
PJM*	2	$692	$280	60%
SPP	1	$17	$8	50%
Total	**15**	**$1,948**	**$1,171**	**40%**

* Note: The only competitively selected project in NYISO project is not reflected in the average cost advantage. Additionally, just 1 of 2 competitively selected projects in PJM projects are reflected in the average cost advantage.

Cost advantage calculated as:

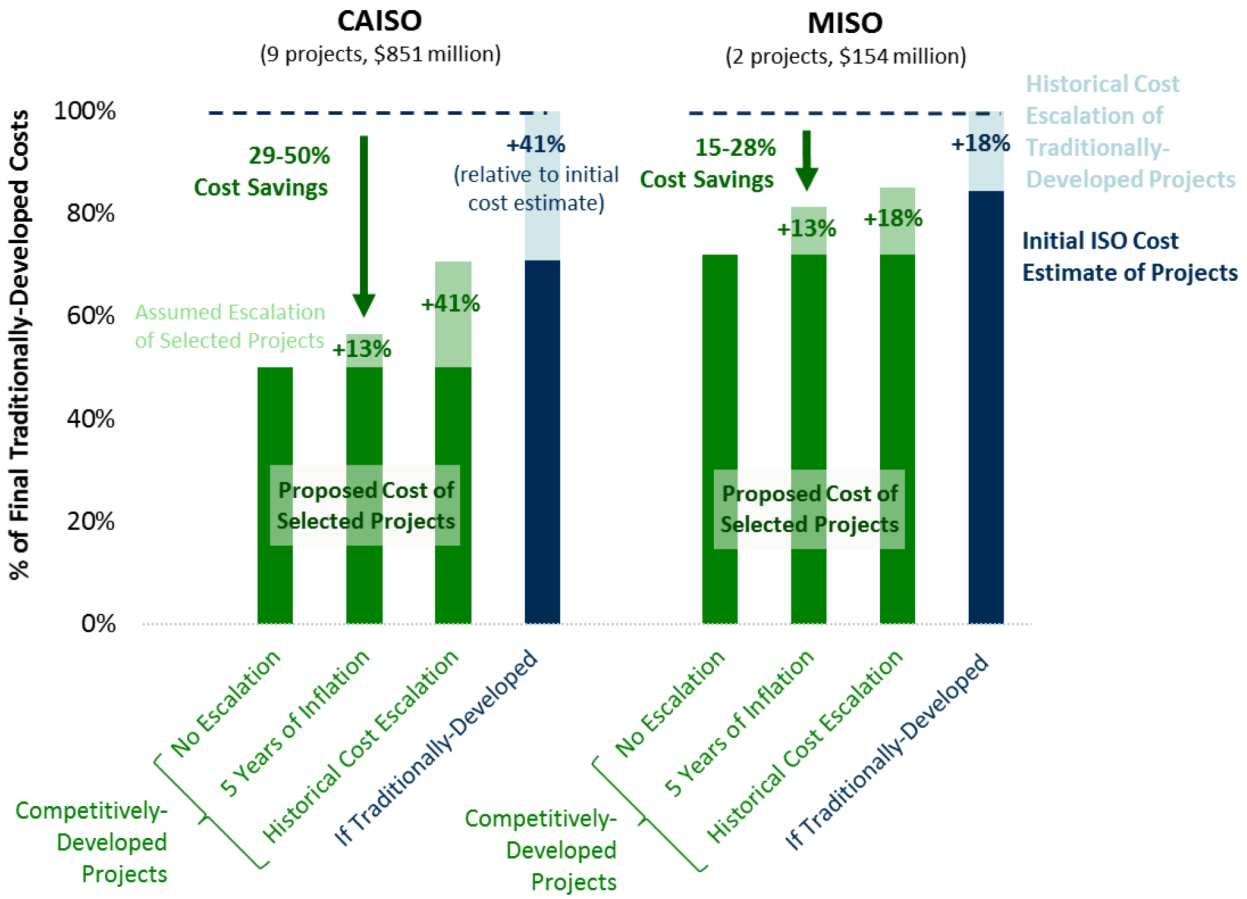
- Bid-based processes (MISO, SPP, CAISO): cost difference = between costs of winning bids and ISO/RTO's or TO's initial reference cost estimate for the project
- Sponsorship-based processes (PJM and NYISO): cost difference = between winning bid and lowest-bid of incumbent TOs

Potential Customer Savings from Competitive Transmission Planning Processes

The experience in U.S. indicates a significant potential for customer savings

- If competitive projects can be developed as bid (without further cost escalations), savings would be 28%-50% relative to the costs had this projects been traditionally-developed
- If costs of competitive projects escalate like traditionally-developed projects, the savings would still be between 15%-30%

Illustration of Potential Cost Savings from Competition



Customer Savings from U.S. and International Experience with Competitive Processes

The potential cost savings from expanding competitive processes in the U.S. could range from approximately 20% to 30%, consistent with savings achieved with similar competitive transmission processes in Canada, the U.K., and Brazil.

Region	Estimated Cost Savings	No. of Projects	Estimated Cost of Winning Proposal	Notes
CAISO	29–50%	9	$833 million	Winning proposal costs compared to CAISO initial cost estimate; assumed range of cost escalation of winning bid from no escalation to escalation of traditionally-developed projects in CAISO (+41%)
MISO	15–28%	2	$154 million	Winning proposal costs compared to MISO initial cost estimate; assumed range of cost escalation of winning bid from no escalation to escalation of traditionally-developed projects in MISO (+18%)
PJM	60–67%	1	$280 million	Winning proposal cost (including necessary incumbent upgrades) compared to lowest-cost solution offered by incumbent in the initial proposal window; assumed range of cost escalation of winning bid from no escalation to escalation of traditionally-developed projects in PJM (+22%)
SPP	50–58%	1	$8 million	Winning proposal cost compared to SPP initial cost estimate; assumed range of cost escalation of winning bid from no escalation to escalation of traditionally-planned projects in SPP (+18%); project cancelled following selection
NYISO	22%	1	$181 million	Winning proposal cost compared to lowest-cost bid from incumbent
IESO	16%	1	CAD$1,614 million	Winning proposal cost compared to bid from incumbent
AESO	18%	1	CAD777 million	Winning proposal cost compared to AESO initial cost estimate; costs of the winning bid later increased due to changes in route
U.K.	23–34%	15	~£3,000 million	Winning bid cost estimate compared to merchant and regulated counterfactuals estimated by Ofgem
Brazil	~25% (20–40%)	Many	$28 billion	Based on Brazil's experience since 1999 holding auctions for all projects over 230 kV; over 50,000 km of lines built through this process

Costs of Competitive Transmission Planning Processes

Costs for implementing and administering competitive processes for the ISOs/RTOs

- SPP reports internal costs of the competitive process for the North Liberal–Walkemeyer 115 kV project ~$500,000, ~3% of the relatively small project's $17 million cost estimate
- As of December 2017, PJM covered 97% of its $1.7 million of total 2016–2017 evaluation costs
- PJM approved 39 projects from these proposal windows, which amounts to ~$44,000 of evaluation costs per approved project

PJM Submission Fees to Cover Implementation and Administrative Costs

Project Size	Submission Fee
<$20 million	$0
$20 – $100 million	$5,000
>$100 million	$30,000

- Project developers incur additional costs when developing proposals
  - Both ISO administrative costs and developer costs are absorbed by developers (and will ultimately be reflected in bids)

Implications for Customers and Electric Industry

As documented in many other studies, making valuable transmission investments provide significant overall cost savings through a wide range of benefits.

Increasing the scope of competition would provide additional benefits:

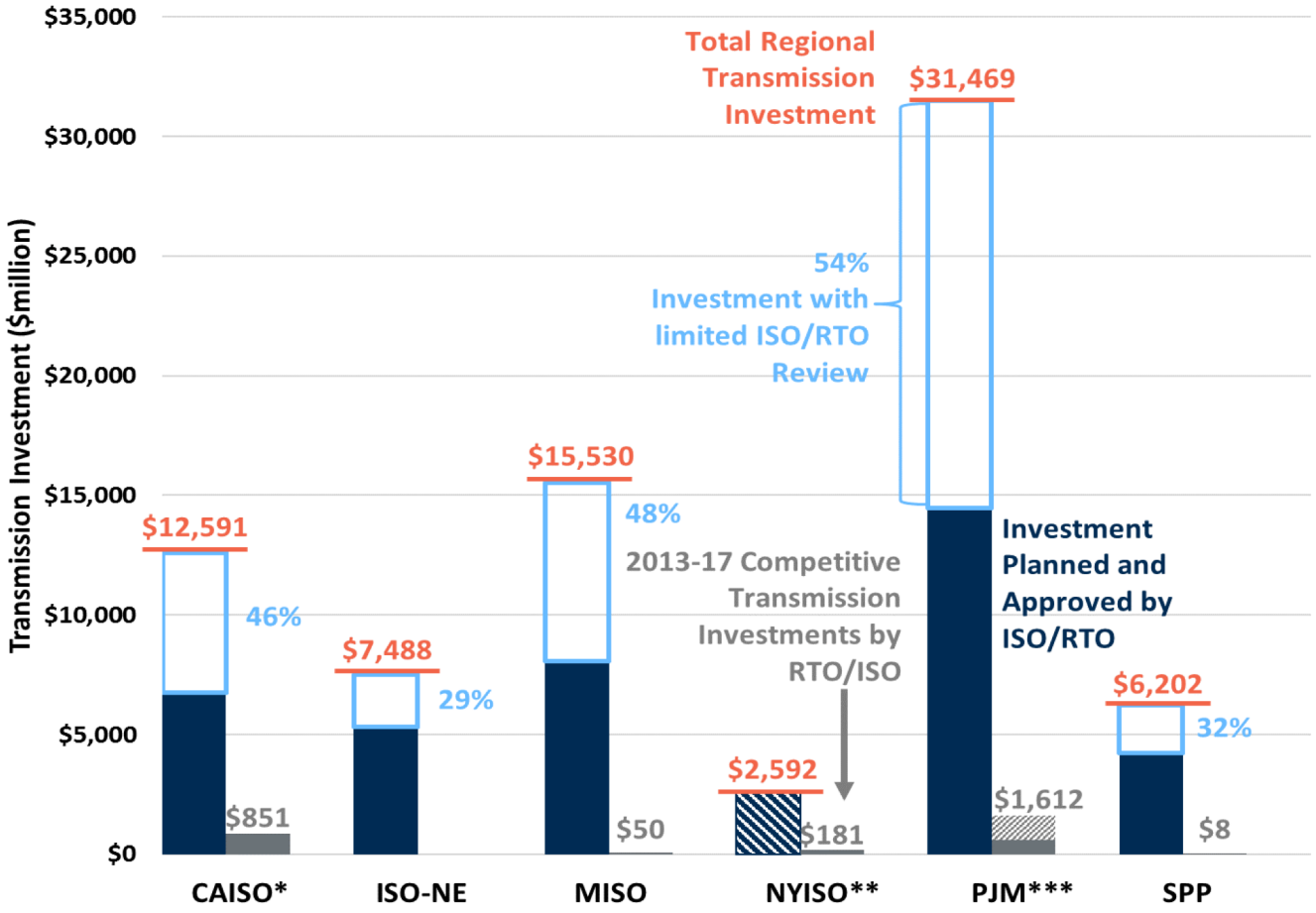
- **Customer Benefits**: With average savings of 20%-30%, expanding the scope of competition from 2% to 33% of total transmission investments would yield **customer benefits of $6-$9 billion over five years**
- **Innovation brings long-term advances** to the electric industry, which will further benefit customers and transmission providers

Estimated Savings from Competitive Processes (% of Transmission Costs)	**20%**	**30%**
Estimated 5-year US-wide Transmission Investment	$100 billion	$100 billion
Current Share of Competitive Projects (% of Total Investment)	2%	2%
Estimated Cost Savings over 5 years		
25% of Transmission Investment Subject to Competition	$4.6 billion	$6.9 billion
33% of Transmission Investment Subject to Competition	$6.2 billion	$9.3 billion

Summary

Limited Scope of Full ISO/RTO Planning Review (47%) and Competitive Projects (2%)

2013-17 Transmission Investments: (1) with Full/Limited Review in Regional Planning Processes (2) Subject to Competitive Bidding

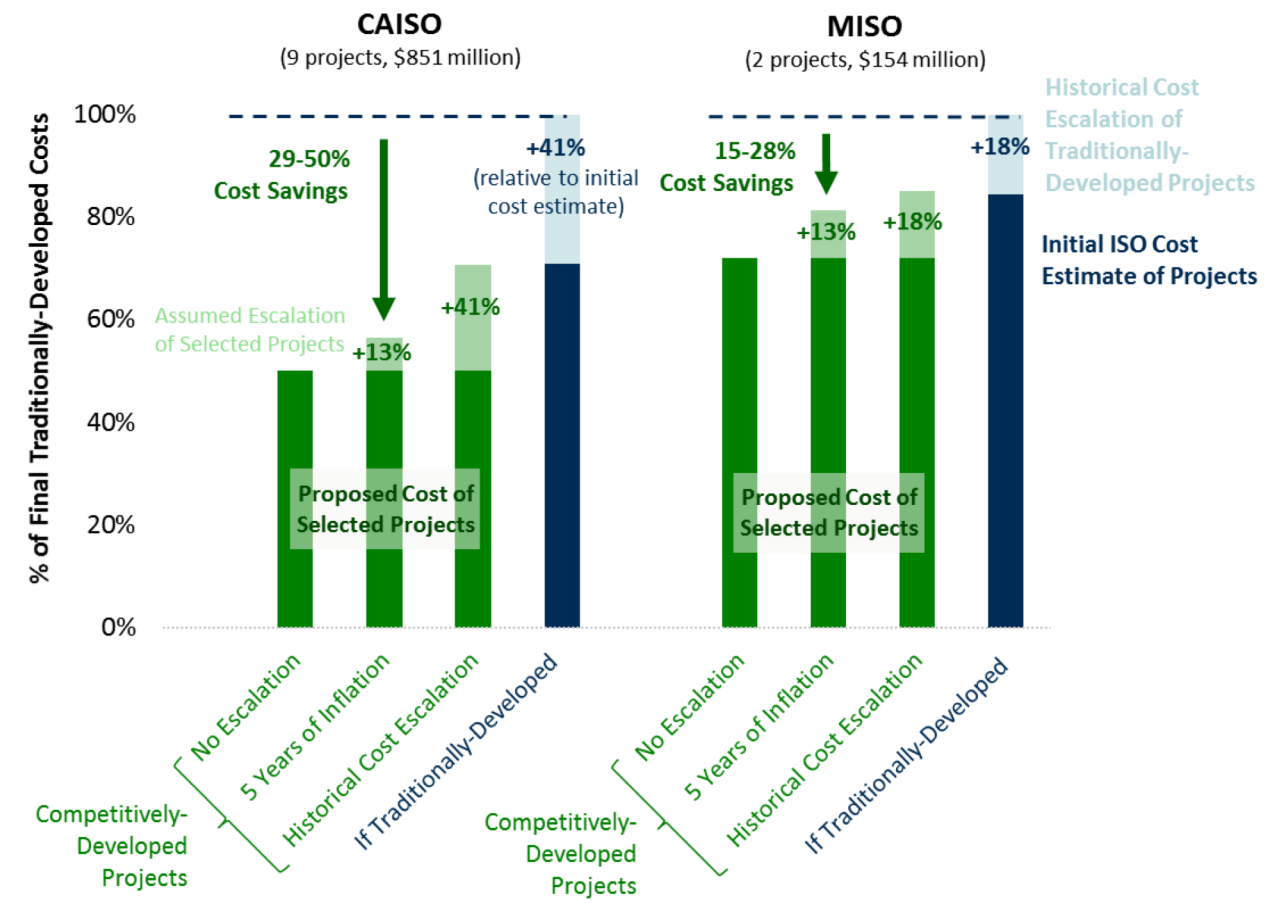


- 47% of total transmission investments across ISO/RTO regions are not subject to full ISO/RTO and stakeholder review in regional planning processes
- Since 2013, sixteen competitively-bid transmission projects account for only 2% of U.S.-wide transmission investments

* CAISO Investment Planned and Approved by ISO percentage reflects data from 2014-2016 period. Percentages have been applied to total CAISO Transmission Investment over the 2013-2017 period.
**NYISO data on Investment Planned and Approved by ISO is not available.

Potential Savings from Competitive Transmission Planning

Competitive Bids vs. Escalated Project Costs



At savings of 25%, expanding competition from 2% to 33% of total transmission investments would yield **customer benefits of approx. $8 billion over five years**

Cost reductions benefit both customers and transmission owners:

- **Customers** see lower overall rates
- **Transmission owners** benefit by keeping transmission a more attractive option in world with low gas prices and declining cost of wind and solar generation, batteries, and DER technologies

Conclusions and Recommendations

Experience with competitive transmission shows **large potential benefits**

- **Winning bids average 40% below initial cost estimates**, typically with added cost caps or cost-control measures
- **Traditionally-developed projects have been significantly above initial cost estimates**
- Large potential for **long-term customer cost savings** even if competitive projects were to be completed with cost escalations
- U.S. experience, while still limited, is consistent with international experience
- Beyond benefitting customers, lower costs and innovative solutions are expected to provide long-lasting benefits to the electricity industry

Recommendations:

- **Expand scope of competitive process** through consistent criteria, drawing from best practices from least-restrictive RTOs
- **Improve tracking of project costs** across all regions

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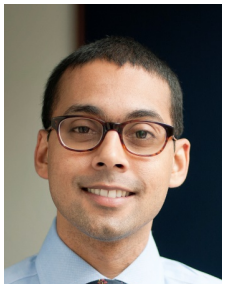

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