Economic Considerations in the Matter of Electric Transmission Incentives

(FERC Docket No. RM20-10-000)

prepared for WIRES

July 1, 2020

LONDON
ECONOMICS

London Economics International LLC
717 Atlantic Avenue, Suite 1A
Boston, MA 02111
Tel: (617) 933-7200
Fax: (617) 933-7201
www.londoneconomics.com

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1 Executive summary

In March 2020, the Federal Energy Regulatory Commission ("FERC" or the "Commission") issued its Electric Transmission Incentives Notice of Proposed Rulemaking ("Electric Transmission Incentives NOPR"). This paper examines two of the return on equity ("ROE") incentives being proposed therein, from the perspective of a transmission owner or investor in transmission assets (who is taking on the risks), and the beneficiary of transmission, namely the electric consumer (who will be paying for the incentives and compensating the investor for the risks taken).

According to the financial theory of risk and return, higher risk must be accompanied by a higher expected return in order to motivate a rational entity to engage in an economic activity.[1] This paper examines how the theory relates to the justification for ROE incentives for:

1. transmission owners ("TOs") operating within a regional transmission organization ("RTO") or independent system operator ("ISO") (the RTO-Participation Incentive); and

2. TOs looking to deploy advanced technologies[2] (the Transmission Technology Incentive).

1.1 Benefits and risks of RTO participation

Over the years, the benefits of transmission investment have been investigated by many different parties and exhaustively studied.[3] Similarly, the benefits of RTOs are widely touted.[4] The competitive markets that RTOs administer for the sale and purchase of wholesale power and associated commodities would not work properly if transmission was not available to support the underlying competition between power suppliers. Transmission is therefore a necessary ingredient to the customer benefits created by RTOs.

The Commission has recognized that these benefits have increased over time and, as such, proposes to increase the RTO-Participation Incentive in the Electric Transmission Incentives NOPR to reflect this.[5] Specific benefits mentioned by FERC include: providing access to large

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[1] Modigliani, Franco and Gerald A. Pogue. "An Introduction to Risk and Return: Concepts and Evidence." 646-73 (March 1973).

[2] Section 4.1 explores in detail what is meant by advanced technology in the transmission space.

[3] For example: WIRES. *Smart Transmission: Modernizing the Nation's High Voltage Electric Transmission System.* January 2011; WIRES. *The Benefits of Electric Transmission: Identifying and Analyzing the Value of Investments.* July 2013; WIRES. *Well-Planned Electric Transmission Saves Customer Costs: Improved Transmission Planning is Key to the Transition to a Carbon Constrained Future.* June 2016; NERC. *2016 Long-Term Reliability Assessment.* December 2016.

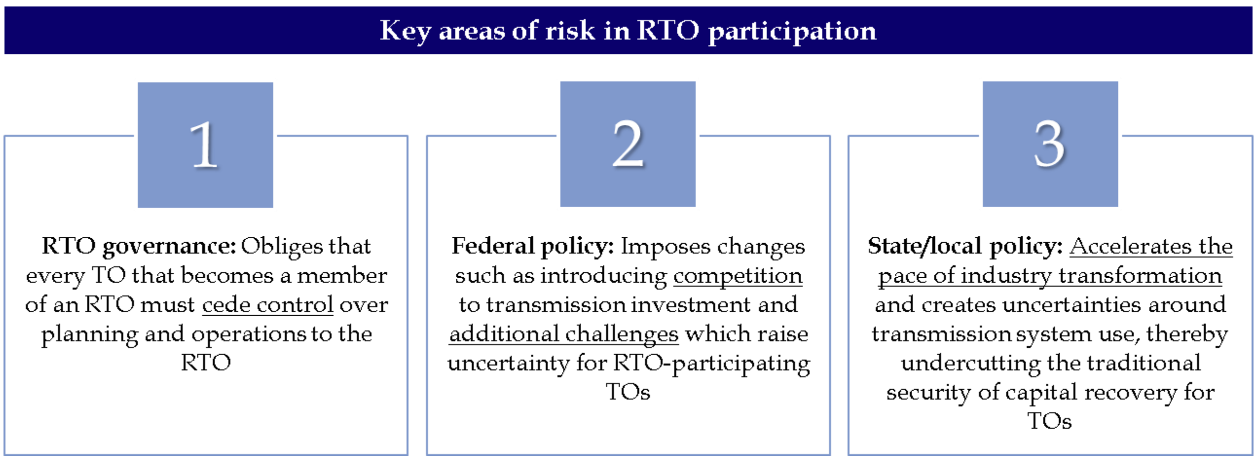
[4] *See* US Government Accountability Office. *Electricity Restructuring: FERC Could Take Additional Steps to Analyze Regional Transmission Organizations' Benefits and Performance.* September 2008; FERC Staff Report. *Common Metrics Report: Performance Metrics for Regional Transmission Organizations, Independent System Operators, and Individual Utilities for the 2010-2014 Reporting Period.* August 2017.

[5] FERC. *Notice of Proposed Rulemaking: Electric Transmission Incentives Policy Under Section 219 of the Federal Power Act, Docket No. RM20-10-000.* March 20, 2020. (referred to herein as the "Electric Transmission Incentives NOPR")

competitive markets and promoting the integration of various generation resources, as well as regional transmission planning that supports more efficient and cost-effective transmission development.[6]

However, we cannot forget that participation in RTOs also increases risks for TOs. Section 3 of this report will delve deeper into three areas of risk for TOs associated with RTO participation, which are highlighted in Figure 1.[7]

Figure 1. Risks associated with RTO participation for TOs



The presence of these risks requires a commensurate ROE incentive, so that investment in transmission can continue to support competitive markets. This report will explain how these three categories of risk have increased in recent years and why FERC's recommendation for a proposed increase in the ROE adder from 50 basis points ("bp") to 100 bp is warranted.

1.2 Benefits and risks for the deployment of advanced technology

On the technology front, research and development ("R&D") and innovation ultimately benefit the electric consumer. Specifically, widespread adoption of advanced transmission technologies can reduce costs and improve the productivity and quality of electric service, as FERC noted in its Electric Transmission Incentives NOPR.[8] However, technological advancement and innovation are risky. In Section 4 of this report, we present the eight categories of risk commonly

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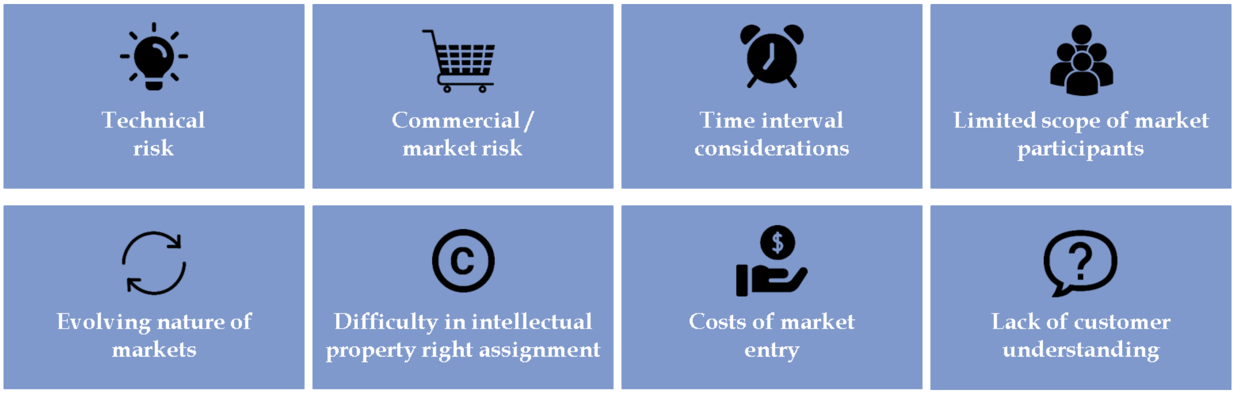
[6] Ibid.

[7] In the Electric Transmission Incentives NOPR, FERC itself acknowledges that some of these risks have been increasing over time, noting "the increased duties and responsibilities associated with RTO/ISO membership." (p. 64)

[8] The Commission has proposed the Transmission Technology Incentive "to encourage the deployment of innovative and cost-effective technologies that will bring consumer saving through congestion relief and increased efficiency of the transmission system." (p. 70)

associated with innovation and technology, which are depicted in Figure 2.[9] These areas of risk correlate closely to the actual experiences of technology evolution in the transmission sector.

Figure 2. Risk factors associated with innovation and technology



Due to these risks, as well as the nature of R&D and innovation as a "public good,"[10] private sector deployment of advanced technologies is likely to be insufficient without financial support. Government support for R&D and commercialization of advanced technology has been demonstrated to be successful in overcoming this problem, by stimulating investment and benefits for consumers – within and outside of the electricity sector. The proposed Transmission Technology Incentive is essentially a way for consumers to support investment in R&D and innovation that is likely to benefit them in the medium to long term. In Section 4.4, we provide a few examples that highlight the wide-ranging benefits that can stem from government support, which are summarized below.

- **Pharmaceutical industry:** The use of government grants, cooperative funding, and the assignment of intellectual property rights in the pharmaceutical industry has accelerated the discovery and commercialization of new medical treatments;

- **Solar photovoltaic ("PV") industry:** R&D funding and renewable subsidies have been credited with reducing the capital costs associated with solar PV installations, which has inevitably encouraged their deployment; and

- **Transmission sector:** Government grants have facilitated the installation of phasor measurement units ("PMUs") in the transmission sector, which as a result have become standard issue devices on electric transmission systems.

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[9] Link, Albert N. and John T. Scott. *Public Goods, Public Gains: Calculating the Social Benefits of Public R&D.* New York: Oxford University Press, 2011. Print.

[10] A public good is one that satisfies the conditions of non-rivalry and non-excludability. Because of these features, economic theory states that private investors would be unable to supply efficient (sufficient) quantities of a public good, and as such warrants the need for government/financial support. This concept is explored further in Section 4.2.

2 Introduction

To provide useful context for the rest of this paper, we begin with a brief background on FERC's Electric Transmission Incentives NOPR. Specifically, we explain the details of the two ROE incentives which will be the focus of this paper, namely the RTO-Participation Incentive and the Transmission Technology Incentive. We conclude this section with an overview of the structure for the rest of the paper.

2.1 Background

Under the Energy Policy Act of 2005, the Commission was required to "promulgate a rule providing incentive-based rates for electric transmission for the purpose of benefitting consumers by ensuring reliability and reducing the cost of delivered power by reducing transmission congestion."[11] The Commission's corresponding transmission incentives policy was established through Order 679 issued on July 20, 2006, and advanced in FERC's 2012 Policy Statement issued on November 15, 2012.[12]

Since the 2012 Policy Statement, the Commission has not reviewed or otherwise adjusted its transmission incentives policy. However, over the past decade, the electricity sector has undergone considerable change, which has, in the words of the Commission, altered the "landscape for planning, developing, operating, and maintaining transmission infrastructure."[13] Generally, change in the electricity sector has been driven by two factors:

1. **Technology:** Improvements in generation technology and the evolving nature of consumer technology have shepherded along the widespread changeover in the power generation resource mix. Specifically, technological advancements in natural gas drilling have helped to bring down costs and improve the commercial viability of shale natural gas, which has put pressure on conventional power plants that are not able to take advantage of this cheaper fuel source. In addition, the decreasing capital costs of utility-scale renewables has brought them in line with the economics of fossil fuel-fired power. At the same time, the variable generation profile of many renewables has created challenges for managing and optimizing the grid. Furthermore, the proliferation of distributed energy resources ("DERs"), such as behind-the-meter ("BTM") solar and energy storage solutions, has also affected the profile of electricity consumption; and

2. **Economy and industry-specific policies:** Many states and municipalities have prioritized reducing their carbon emissions. This has resulted in policies that decarbonize power generation, and also that potentially increase electricity demand through efforts to electrify transport and buildings.

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[11] FERC. *Notice of Proposed Rulemaking: Electric Transmission Incentives Policy Under Section 219 of the Federal Power Act, Docket No. RM20-10-000.* March 20, 2020. p. 7.

[12] Ibid.

[13] Ibid. p. 3.

Taken together, technological change and policy evolution have made large-scale investment in transmission projects riskier, while also making the investment all the more necessary. In the Electric Transmission Incentives NOPR, FERC itself recognizes significant changes to the electricity sector since the 2012 Policy Statement, which are summarized in the textbox below.

Industry changes referenced in the Electric Transmission Incentives NOPR

The Commission highlights that we are now on the brink of:

- an evolution of the resource mix, including generally increasing shares of natural gas-fired and renewable generation, and a declining use of coal and oil in energy production;
- an increase in the number of new resources seeking transmission service, driven especially by the interconnection of new renewables and DERs; and
- shifts in load patterns, where peak load growth may actually be increasing (rather than decreasing) as other sectors of the economy decarbonize (and electrify).

Source: FERC. *Notice of Proposed Rulemaking: Electric Transmission Incentives Policy Under Section 219 of the Federal Power Act, Docket No. RM20-10-000.* March 20, 2020.

2.2 Focus of this paper

On March 20, 2020, FERC issued the Electric Transmission Incentives NOPR, which proposed incentives for:

- transmission projects that provide sufficient economic benefits;
- transmission projects that provide significant and demonstrable reliability benefits;
- transmitting utilities or electric utilities that join and/or continue to be a member of an ISO, RTO, or other Commission approved Transmission Organization; and
- transmission technologies that, as deployed in certain circumstances, enhance reliability, efficiency and capacity, and improve the operation of new/existing transmission facilities.

This paper will focus on the latter two ROE incentives, where the concept of risk is critical to understanding the need for these incentives.[14]

For the **RTO-Participation Incentive**, the Commission proposes a fixed 100 bp incentive for transmitting utilities that turn over operational control of their wholesale facilities to a Commission-approved Transmission Organization. Currently, the incentive is set at 50 bp. The proposed 100 bp incentive would be applicable to transmitting utilities newly joining an

[14] This paper's focus on two of the four incentives in the Electric Transmission Incentives NOPR should not be interpreted to mean that the other elements being proposed in the NOPR are meritless. Rather, given the project-specific nature of those other incentives, the theoretical discussion around risk is less relevant.

RTO/ISO, as well as those that are already receiving the 50 bp ROE adder. At a high level, the incentive is designed to recognize the benefits to customers from TOs participating in RTOs, as well as the fact that continuing membership is generally voluntary.

For the **Transmission Technology Incentive**, the Commission proposes a new 100 bp ROE adder on the costs of a specified transmission project, and separately, a two-year specialized regulatory asset treatment for the deployment of advanced transmission technology. The incentives are proposed in light of FERC's recognition that "there is currently no standalone incentive for advanced technology" which "has not been effective in encouraging deployment of such improvements."[15] To apply for the 100 bp advanced technology incentive, FERC has proposed that transmission projects with costs over $25 million may only qualify for the ex-ante incentive if they surpass a net benefit ratio of 3.98.[16] For smaller transmission projects with costs at or below $25 million, the proposed benefit-to-cost ratio threshold is materially higher at 33.91.[17] Although implementation details of the ROE incentives will be refined in subsequent phases of the NOPR and follow-on regulations, this paper will discuss how the proposed benefit-to-cost ratios are incongruent with the very nature of deploying advanced transmission technologies, where the benefits are not yet fully understood, and concurrently, the costs are not easily quantified.

2.3 Structure of the paper

The rest of this paper is structured as follows:

- Section 3 presents the risks and benefits of TO participation in an RTO. This section includes a discussion of the financial theory of risk and return, as well as the ways in which the ROE adder could attract capital to the transmission sector;
- Section 4 then goes on to examine the Transmission Technology Incentive. The section explores the risks inherent in the development of advanced technologies, as well as the benefits that stem from financial support to encourage their accelerated deployment;
- Section 5 offers concluding remarks with regards to the two transmission incentives discussed throughout the paper; and
- Finally, Sections 6 through 8 include appendices, comprising of a list of acronyms used throughout this paper, a list of works cited, as well as a brief summary of LEI's expertise as it relates to the transmission sector.

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[15] FERC. *Notice of Proposed Rulemaking: Electric Transmission Incentives Policy Under Section 219 of the Federal Power Act, Docket No. RM20-10-000.* March 20, 2020. p. 67.

[16] Ibid. p. 36.

[17] Ibid. p. 37.

3 Comments on the RTO-Participation Incentive

The RTO-Participation Incentive proposed in FERC's Electric Transmission Incentives NOPR is consistent with economic theory regarding risk and adequate compensation of such risk. We begin with an analysis of the risks faced by TOs operating within an RTO. Next, we consider whether an ROE incentive to compensate such risks is likely to leave consumers in an overall beneficial position.

3.1 Theory of risk versus reward

A relationship between risk and return was first theorized in the 1950s by Harry Markowitz, a Nobel Prize winning economist.[18] Since then, it has evolved into one of the main building blocks of modern finance, by way of the realization that "higher risk must be accompanied by a higher expected return."[19] Franco Modigliani,[20] winner of the Nobel Memorial Prize in Economics, equates risk to "the chance of loss or achieving returns less than expected."[21]

Generally, the risk and return principle is grounded in the observation that investors tend to be risk averse, and hence need to be duly compensated so as to be willing to accept greater levels of risk.[22] Today, these observations regarding investor behavior have evolved into numerous financial models which seek to quantify the appropriate equity premiums that investors require to take on business risks, such as the capital asset pricing model, and its derivatives, the arbitrage pricing model, or the multi-factor model.[23]

> ***"Financial theory and common sense tell us that investments that are riskier need to make higher returns to compensate for risk."***
>
> - Damodaran, Aswath. "Estimating Risk Parameters." *Stern School of Business.* p. 3.
>
> ***"The evidence shows a significant positive relationship between realized returns and systematic risk."***
>
> - Modigliani, Franco and Gerald A. Pogue. "An Introduction to Risk and Return: Concepts and Evidence." 646-73 (March 1973). p. 45.
>
> ***"The higher the systematic risk of an asset, the higher the expected return investors will demand."***
>
> - Gossy, Gregor. *A Stakeholder Rationale for Risk Management: Implications for Corporate Finance Decisions.* Wiesbaden, Germany: Gabler, 2008. Print. p. 37.

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[18] Gossy, Gregor. *A Stakeholder Rationale for Risk Management: Implications for Corporate Finance Decisions.* Wiesbaden, Germany: Gabler, 2008. Print.

[19] Caldentey, Esteban P. and Matias Vernengo. "Modern Finance, Methodology and the Global Crisis." *University of Utah Department of Economics Working Paper Series* 2010-04: 1-17. p. 4.

[20] Franco Modigliani was the pioneer for the capital asset pricing model ("CAPM") which dictates that the return of an asset above that of a risk-free asset (usually a government bond) is proportional to the asset's systematic risk (as measured by beta). (Source: Caldentey, Esteban P. and Matias Vernengo. "Modern Finance, Methodology and the Global Crisis." *University of Utah Department of Economics Working Paper Series* 2010-04: 1-17.)

[21] Modigliani, Franco and Gerald A. Pogue. "An Introduction to Risk and Return: Concepts and Evidence." 646-73 (March 1973). p. 9.

[22] Caldentey, Esteban P. and Matias Vernengo. "Modern Finance, Methodology and the Global Crisis." *University of Utah Department of Economics Working Paper Series* 2010-04: 1-17.

[23] Damodaran, Aswath. "Estimating Risk Parameters." *Stern School of Business.*

Importantly, the theory dictates that investors should be compensated specifically for systematic risk, which "is unavoidable and has to be borne by the shareholder for investing in the equity market."[24] Essentially, systematic risk is non-diversifiable (i.e., investors cannot diversify their portfolios to eliminate systematic risk).[25] As such, it can be equated to risk that is inherent in the market and for which investors demand to be compensated with a premium.[26]

Above and beyond the basic risk premium proposed under various financial models, practitioners frequently account for additional sources of systematic risk. For example, one can include risk premiums to capture country-specific risk factors, including political stability and government regulations.[27] Other models incorporate risks associated with investing in small companies, including size and value risk.[28] These examples highlight that including adders to risk premiums is common practice, where their inclusion helps to compensate for additional risks faced by investors in a situation where that risk is asymmetric and non-diversifiable.[29] In the transmission space, this aligns with the RTO-Participation Incentive and Transmission Technology Incentive proposed by the Commission in its Electric Transmission Incentives NOPR.

3.2 FERC considerations on risk and return

A selection of financial models which assess risk and return are routinely utilized by the Commission in its determinations and setting of just and reasonable base ROEs. Specifically, FERC relies on three financial models as part of its methodology, including the CAPM, the discounted cash flow ("DCF") model, as well as the risk premium model.[30] FERC has acknowledged that by relying on these various financial models and examination of risk, it aims to set "a more accurate estimate of what ROE is needed to induce investors to invest in a utility – i.e., what ROE a utility must offer in order to attract capital."[31] Generally, FERC has in its

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[24] Gossy, Gregor. *A Stakeholder Rationale for Risk Management: Implications for Corporate Finance Decisions.* Wiesbaden, Germany: Gabler, 2008. Print. p. 36.

[25] Investopedia. *Explaining the Capital Asset Pricing Model (CAPM).* April 16, 2019. <https://www.investopedia.com/articles/06/capm.asp>

[26] Gossy, Gregor. *A Stakeholder Rationale for Risk Management: Implications for Corporate Finance Decisions.* Wiesbaden, Germany: Gabler, 2008. Print.

[27] Wachowicz, Jay. *International Cost of Equity: The Science Behind the Art.* <https://www.stout.com/en/insights/article/international-cost-equity-science-behind-art>

[28] Investopedia. *Fama and French Three Factor Model.* March 5, 2020. <https://www.investopedia.com/terms/f/famaandfrenchthreefactormodel.asp>

[29] For example, Damodaran states that "[t]here is a firm-specific component that measures risk that relates only to that investment or to a few investments like it, and a market component that contains risk that affects a large subset or all investments. It is the latter risk that is not diversifiable and should be rewarded." (Source: Damodaran, Aswath. "Estimating Risk Parameters." *Stern School of Business.*)

[30] FERC. *Opinion No. 569-A, Order on Rehearing, Docket Nos. EL14-12-004 and EL15-45-013.* May 21, 2020.

[31] FERC. *Opinion No. 569, Order on Briefs, Rehearing, and Initial Decision, Docket Nos. EL14-12-003 and EL15-45-000.* November 21, 2019. p. 18.

contact:
Julia Frayer/Stella Mueller
617-933-7200
julia@londoneconomics.com

approaches to date relied heavily on the underlying principle that higher risk should be compensated with relatively higher returns.

FERC's determination of whether allowed ROEs are just and reasonable is also guided by two standards established by the US Supreme Court ("the Court").[32]

1. **The capital attraction standard:** Established through the Bluefield decision rendered in 1923, the Court stated "the return should be reasonably sufficient to assure confidence in the financial soundness of the utility, and should be adequate, under efficient and economical management, to maintain and support its credit and enable it to raise money necessary for the proper discharge of its public duties."[33]

2. **The risk standard:** Established in 1944 through the Hope decision, "the return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks."[34]

The thesis underpinning these legal standards relates back to the financial theory of risk and return, where rates of return must be high enough to attract and motivate investors. In relation to transmission investment, the analogous philosophy is that TOs' overall allowed rate of return, including the ROE incentive, should be high enough to compensate for the various risks that a TO faces – which include general enterprise risk (i.e., risk associated with participating in the transmission sector day-to-day), as well as risks above and beyond this general enterprise risk.

3.3 Risks associated with RTO participation

In order to determine a level of compensation that is consistent with the tenets of financial theory, it is important to consider how RTO participation has created risks for TOs. We have identified three categories of risks that indicate an increasing risk profile for TOs operating within an RTO:

1. **governance of an RTO**, which obliges TOs to relinquish control over regional transmission planning and operations to the RTO;

2. **federal policies and regulatory changes** over the last ten years, which have introduced challenges and uncertainties for RTO-participating TOs; and

3. **emergence of state and local policies** predominantly in RTO franchise areas, which have accelerated the pace of industry transformation and created uncertainties around transmission system use.

For each of these categories of risks, one must recognize that the underlying factors that create the risk for the TO also create customer benefits. For example, turning over operational control

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[32] California Public Utilities Commission, Policy & Planning Division. *An Introduction to Utility Cost of Capital.* April 18, 2017.

[33] Bluefield Water Works & Improvement Co. vs Public Service Commission of West Virginia (1923) 262 U.S. 679.

[34] Federal Power Commission vs. Hope Natural Gas Co. (1944) 320 U.S. 591.

of transmission facilities to an RTO has facilitated more efficient use of the transmission system, trading between utilities, and resulted in lower costs of power for consumers. Additional benefits associated with RTO participation are further explored in Section 3.5.

Similarly, although federal policies have sometimes increased the complexity of utility operations and raised the burden on RTOs and their participating members (as discussed further in Section 3.3.2), the policies have also catalyzed reforms that are intended to benefit customers in the longer term. These benefits will be realized through more accurate energy market pricing, better integration of energy storage and demand response resources in RTO markets, and more accurate accounting of the true beneficiaries of transmission investments.

Lastly, state and local policies have allowed the prioritization of local needs of the consumer, which, while beneficial, raises risks for TOs. Despite what is likely to be a somewhat disruptive transition, the benefits of achieving local policy goals (for example for decarbonization) is likely to be many times greater than the costs of incentives allocated to TOs to compensate for the risk of dealing with state and local policies through RTO participation.

3.3.1 Ceding planning and operational control when joining an RTO

Upon joining an RTO, a TO must cede significant control with regards to transmission design, planning, and operations. The requirement to relinquish significant operational control over one's assets to the RTO was established under FERC Order 2000, issued in December 1999. Order 2000 outlined the characteristics and functions required for RTO eligibility (which are summarized in Figure 3 on the next page). It is these requirements that present numerous risks and uncertainties for a TO.

These requirements act to limit the decision-making ability of TOs within RTOs, where regional investment and operating decisions are carried out by the RTO and/or by the committee involved in the regional planning process. This is in stark contrast to the traditional utility landscape generally found in non-RTO regions of the US, where utilities have direct control over all aspects of their transmission business. For example, in non-RTO regions, a new transmission project is first identified through the TO's own integrated resource planning ("IRP") process, which establishes a need and considers all resource options available to the vertically integrated utility to meet said need.[35] In comparison, because TOs participating in RTOs do not conduct their own IRPs for purposes of regional transmission planning, this examination of a full spectrum of resource options no longer occurs, increasing the uncertainty and challenges that now present themselves in the transmission planning and permitting process.

[35] Navigant Consulting, Inc. for EISPC and NARUC. *Transmission Planning Whitepaper.* January 2014.

Figure 3. Requirements of an RTO as established under FERC Order 2000

Overarching characteristics of an RTO

Independence from market participants: Ensures that an RTO will provide transmission service and operate the grid in a non-discriminatory manner.

Appropriate scope and regional configuration: Whereby the RTO comprises a region of sufficient scope/configuration to permit it to effectively perform its required functions.

Possession of operational authority for all transmission facilities under the RTO's control: The RTO not only has operational authority, but is also the security coordinator. (1)

Exclusive authority to maintain short-term reliability: Which includes interchange scheduling, generation re-dispatching, approving scheduled outages. (2)

Key functions of an RTO

1. Tariff administration and design (3)
2. Congestion management
3. Parallel path flow
4. Ancillary services
5. OASIS
6. Market monitoring
7. Planning and expansion (4)
8. Interregional coordination

Notes:

(1) "[A]t a minimum, the RTO must have operational authority over all transmission facilities transferred to the RTO";

(2) Under this requirement, "when the RTO operates transmission facilities owned by other entities, the RTO must have authority to approve and disapprove all requests for scheduled outages of transmission facilities to ensure that the outages can be accommodated within established reliability standards";

(3) This function requires that the RTO act as "the sole authority making decisions on the provision of transmission service including decisions relating to new interconnections"; and

(4) Under this function, an RTO must "plan and coordinate necessary transmission additions and upgrades."

Source: FERC. *Order No. 2000 Final Rule, Docket No. RM99-2-000.* December 20, 1999.

By joining an RTO, TOs also relinquish control over transmission policy, stakeholder governance, and rate design. On the issue of stakeholder governance, RTO market rules and tariff proposals are often developed and amended through stakeholder engagement processes. These processes involve stakeholders such as TOs, electric generators, end-use customers, marketers and/or brokers, public power entities, consumer advocates, and environmental groups, and were developed in response to FERC Order 719, which essentially required RTOs to demonstrate responsiveness towards their stakeholders.[36] As a result, "some RTOs hold more than 300 meetings per year, which makes maintaining a calendar of events difficult, let alone managing the resources required to participate effectively."[37] This has clearly increased the cost and complexity for entities participating in RTOs, including TOs.

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[36] James, Mark et al. "How the RTO Stakeholder Process Affects Market Efficiency." *R Street Policy Study No. 112* (October 2017).

[37] Ibid.

Other risks and uncertainties associated with RTO participation are often articulated by the state regulators who oversee the utility businesses of TOs and are asked to give their approval for utilities seeking to join an RTO. State regulators rightly realize that not only will the utility cede control, but they too will lose some of their authority to impact and guide the transmission business of the TO and how it impacts end user rates. A classic example of regulatory concerns about RTO membership is provided in the textbox below.

Case study: state regulator concerns over RTO membership for its local transmission-owning utility

In 2013, Entergy Corporation ("Entergy") decided to have its affiliated utilities join MISO. In the lead up to this move, state regulators in four states (where Entergy's utility franchise businesses were located) voiced concerns over the proposed RTO membership. As proviso for approval to join MISO, several state regulators applied an extensive list of conditions.

- **Louisiana Public Service Commission ("PSC"):** The Louisiana PSC was the first of the four states to approve Entergy's request, issuing an order with **33** conditions. For instance, the Commission recognized that "[m]embership in MISO by [Entergy] may impact LPSC jurisdiction over the Companies' transmission assets and operations... The Staff … therefore developed and proposed appropriate protective conditions that can help mitigate the loss of Commission jurisdiction."

- **Arkansas PSC:** The Arkansas PSC issued **19** conditions in its order. Specifically, the Commission mentioned RTO governance as a perceived area of risk, stating its concern "about the lack of … [retail regulatory] decision making authority over cost allocation issues within MISO."

- **Public Utility Commission of Texas ("PUCT"):** Numerous conditions for approval were placed on Entergy's Texas operating company, which "recognize[d] the uncertainties associated with [Entergy] joining MISO", and addressed issues such as retaining the Entergy Regional State Committee's authority to "exercise their rights as transmission owners in MISO to add projects to the MISO transmission expansion plan" for a five-year transition period; and

- **Mississippi PSC:** The Mississippi PSC was the last of the four states to approve Entergy's request, issuing an order outlining **17** conditions. With regards to risks in transmission ownership and operations: "much uncertainty surrounds [Entergy's] request to join an RTO. What we do know, however, makes clear that the projected benefits from RTO membership do not come without a cost... RTOs charge administrative fees, allocate transmission costs, quantify the cost of congestion, and make decisions ultimately independent from the authority and perspective of this Commission, the one entity created and bound by law to protect the public interest of Mississippi."

Sources: Reuters. *TIMELINE – Entergy Transition to MISO Caps Years of Wrangling*. December 10, 2013; Louisiana PSC. *Order No. U-32148, Docket No. U-32148*. May 23, 2012; Arkansas PSC. *Order No. 68, Docket No. 10-011-U*. August 3, 2012; PUCT. *PUC Docket No. 40346*. October 26, 2012; Mississippi PSC. *Docket 2011-UA-376*. November 15, 2012.

3.3.2 Impacts of Federal policies and regulatory changes on RTO operations

Federal policies and regulatory changes create additional uncertainties and risks for TOs participating in RTOs. Arguably the most impactful change in recent years to the transmission landscape stemmed from FERC Order 1000 (issued in July 2011). The objective of Order 1000 was to reform transmission planning and cost allocation requirements for public utility transmission providers.[38]

Although the requirements of Order 1000 were intended to apply to both RTO and non-RTO areas of the US, the two primary elements of the Order – regional and interregional planning involving consideration of alternatives, and cost allocation according to a beneficiary pays model – have had a much larger impact on RTOs because their governance and regional planning processes were already democratized and involved multiple stakeholders.[39] Order 1000 also introduced competition in transmission development, which RTOs implemented more comprehensively than non-RTO transmission providers.[40]

FERC Order 1000 requirements

Order 1000 required changes in:

1. Regional transmission planning, specifically involving the consideration of transmission needs driven by public policy requirements;
2. Non-incumbent transmission development;
3. Interregional transmission coordination; and
4. Cost allocation for transmission facilities that have been selected in a regional transmission plan for purposes of cost allocation.

Source: Lawrence Berkeley National Laboratory. *Regional Transmission Planning: A Review of Practices Following FERC Order Nos. 890 and 1000.* November 2017.

Order 1000 also introduced a level of "customization" in transmission planning processes across RTO jurisdictions, as demonstrated in Figure 4 on the following page. This table compares the various planning processes of RTOs and highlights the wide range of methods adopted by RTOs in the realms of planning cycles, inclusion of project types, as well as the process for the selection of winning bids. This has complicated the business environment for TOs aiming to develop investments across multiple RTOs. Informed stakeholders have also argued that a failure to define the term 'benefit' in Order 1000 created "both an opportunity for creative (and often inconsistent) exercise of state and regional planning and rate approaches and a source of considerable uncertainty and risk in the regional – and especially interregional – planning and cost allocation processes undertaken."[41] One stakeholder has noted that differences across RTOs

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[38] Order 1000 builds on a previous Order 890, which the Commission concluded was inadequate in its existing requirements. (Source: FERC. *Order No. 1000, Docket No. RM10-23-000.* July 21, 2011.)

[39] Comments of the ISO/RTO Council. *FERC Docket No. RM10-23-000: Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities.* September 28, 2010.

[40] Lawrence Berkeley National Laboratory. *Planning Electric Transmission Lines: A Review of Recent Regional Transmission Plans.* September 2016.

[41] Hoecker, Jim. *Transmission Benefits: Filling a Critical Gap in Order 1000.* November 10, 2013. <https://energycentral.com/c/iu/transmission-benefits-filling-critical-gap-order-1000-part-1>

instigated by compliance approaches to Order 1000 has led to "more process, more compliance, more delay, more paperwork, more planning [and] less transmission actually being built."[42]

Figure 4. Regional transmission planning approaches across RTOs/ISOs

	Planning cycle	Project types included		Project selection
CAISO	15 months	• Reliability • Economic	• Public policy • Interregional	Competitive solicitation
ISO-NE	None set – evaluates on an ongoing basis	• Reliability transmission upgrades • Market efficiency transmission upgrades	• Public policy transmission upgrades • Interregional	Sponsorship
MISO	2 years	• Generator interconnection • Transmission delivery service • Market participant funded	• Baseline reliability • Market efficiency • Multi-value	Sponsorship
NYISO	2 years	• Reliability • Economic	• Public policy • Interregional	Competitive solicitation
PJM	12 months	• Reliability • Economic	• Public policy • Interregional	Sponsorship
SPP	12 months	• Transmission service • Generator interconnection • 10-year/near-term assessments	• Balanced portfolio • High priority studies • Sponsored upgrade	Competitive solicitation

Note: **Competitive solicitation** refers to the process whereby the transmission planning region identifies regional transmission needs and solutions, and conducts a competitive solicitation to select a developer for each pre-identified solution. On the other hand, under a **sponsorship** approach, incumbent and non-incumbent transmission developers propose their own transmission projects to address a regional need. The transmission planning entity then selects the most cost-effective or efficient proposal.

Source: Lawrence Berkeley National Laboratory. *Planning Electric Transmission Lines: A Review of Recent Regional Transmission Plans.* September 2016. See also for updates (reflected in the table above): CAISO. *2019-2020 Transmission Plan.* March 25, 2020; ISO-NE. *About Competitive Transmission Projects in New England.* <https://www.iso-ne.com/system-planning/transmission-planning/competitive-transmission-projects/about-competitive-transmission-projects>; MISO. *MTEP19.* 2019; NYISO. *Manual 26: Reliability Planning Process Manual.* December 12, 2019; PJM. *Regional Transmission Expansion Planning.* <https://learn.pjm.com/three-priorities/planning-for-the-future/rtep.aspx>; SPP. *Transmission Planning.* <https://spp.org/engineering/transmission-planning/>

Order 1000 encouraged competition in transmission planning and investment by requiring the removal of a federal right of first refusal for incumbent transmission providers in the development of transmission projects selected to address regional needs.[43] This ushered in the introduction of competitive bidding processes to secure developers or projects to meet said needs.[44] Although the policy change involving competition under Order 1000 was intended to apply across all FERC-jurisdictional entities in the US, the practical reality has resulted in a lot more competition within RTO footprints.[45] Competitive solicitations are time and resource

[42] Clark, Tony. *Order No. 1000 at the Crossroads: Reflections on the Rule and its Future.* April 2018. p. 10.

[43] Ibid.

[44] Ibid.

[45] Since the promulgation of Order 1000, RTOs across the US have completed around 30 competitive transmission project solicitations, resulting in approximately 15 competitive projects to date. In comparison, no regional transmission projects procured through solicitation have moved forward in any of the non-RTO regions of

intensive, and have introduced complexity into the planning process, including lengthy periods between identifying a project need and a winning bidder receiving final approval from an RTO/ISO Board,[46] difficulties associated with aligning planning and delivery timeframes, as well as the coordination of multiple players.[47]

3.3.2.1 Interregional planning

One of the objectives of Order 1000 was to improve interregional planning,[48] which had lagged behind other forms of planning (regional and local). For example, over the 1999-2017 time period, transmission investments within RTOs grew at a compound annual growth rate ("CAGR") of 14% (compared to a CAGR of only 8% in non-RTO regions),[49] while interregional transmission investment projects (between RTOs) have been scarce.[50] The observed paucity of interregional transmission investment is not due to a lack of possibilities (e.g., one study estimated between $50-110 billion of interregional transmission investment will be needed through 2030).[51] Rather, interregional transmission projects tend to be beset by logistical and development challenges.

The RTO-Participation Incentive should compensate developers for the challenges and risks associated with interregional planning,[52] which are summarized in Figure 5 on the following page.

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the country. (Sources: The Brattle Group. *Transmission Competition Under FERC Order No. 1000 at a Crossroads.* October 10, 2018; Concentric Energy Advisors for Ameren, Eversource Energy, ITC Holdings Corp., National Grid USA, and PSE&G. Building New Transmission: Experience to-date Does Not Support Expanding Solicitations. June 2019.)

[46] In a review of 15 recent solicitations, the time involved in transmission procurements with more than one bidder spanned from around 100 days to nearly 1,500 days. (Source: Concentric Energy Advisors for Ameren, Eversource Energy, ITC Holdings Corp., National Grid USA, and PSE&G. *Building New Transmission: Experience to-date Does Not Support Expanding Solicitations.* June 2019.)

[47] National Grid. *Competition in Electricity Transmission: An International Study on Customer Interests and Lessons Learned.* December 2015.

[48] Interregional transmission coordination was first promulgated in Order 1000, through which RTOs improved processes with each of their neighboring transmission planning regions to identify and jointly evaluate possible interregional transmission facilities. (Source: FERC. *Order No. 1000-A, Docket No. RM10-23-001: Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities.* May 17, 2012.)

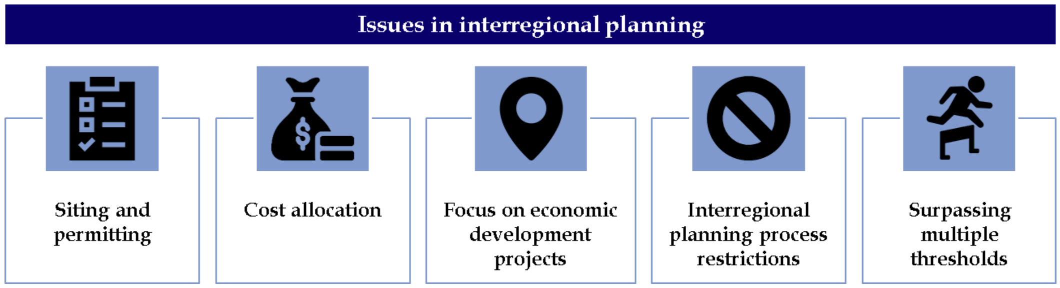
[49] The Brattle Group for WIRES. *Transmission Competition Under FERC Order No. 1000: What we Know About Cost Savings to Date.* October 25, 2018.

[50] *See for example* WIRES. *Informing the Transmission Discussion.* January 2020, which states "Order 1000 interregional processes have not materialized to facilitate broader integration across markets." (p. 19)

[51] Eastern Interconnection States' Planning Council. *Co-optimization of Transmission and Other Supply Resources.* September 2013.

[52] Scott Madden for WIRES. *Informing the Transmission Discussion.* January 2020.

Figure 5. Key challenges associated with interregional planning



Source: WIRES. *Informing the Transmission Discussion.* January 2020.

The key challenges associated with interregional planning are as follows:

- **Siting and permitting:** Interregional projects may span multiple states, and as such require siting and permitting approval from the respective authorities in each jurisdiction at the federal, state, and local levels;

- **Cost allocation:** Cost allocation comprises the process of identifying the beneficiaries of a proposed interregional project and then agreeing on a method of allocating project costs appropriately. This process is made especially challenging when interregional projects span regions that rely on different cost allocation methodologies;

- **Focus on economic development projects:** Projects that meet the economic benefits test tend to connect in-state resources to local load in order to meet renewables targets. This focus on local resources, while encouraging economic development, makes it more difficult for a single interregional solution to be defined and selected;

- **Interregional planning process restrictions:** Interregional planning processes tend to impose restrictions on the types and sizes of projects considered. In terms of project type, only those projects that meet the same category of need (e.g., reliability, public policy, or market effectiveness) in both regions are considered. As for project size, some interregional planning processes set a minimum threshold which projects must pass in order to be considered. Both of these restrictions act to limit the number of beneficial transmission projects that qualify for consideration; and

- **Surpassing multiple thresholds:** As part of some interregional planning processes, projects must not only meet an interregional benefit-to-cost ratio, but must also meet the benefit-to-cost ratio in the regions across which the project spans. This makes surpassing thresholds especially difficult and decreases the likelihood of an interregional project qualifying for approval.

3.3.2.2 Other Federal rulemakings

Apart from Order 1000, other regulatory changes in the past decade that apply only to RTOs/ISOs have raised perceptions of risks further within these regions – a sample of these rulemakings are highlighted below in the textbox. These orders, although not necessarily directly applicable to the transmission sector, increase market complexity and thus expose all entities participating in RTOs to elevated risks, which should be compensated for by the proposed increase to the RTO-Participation Incentive.

Recent FERC rulemakings that apply only to RTOs/ISOs

- Order 745 (issued in March 2011) outlined the compensation requirements for demand response resources to be paid by RTOs/ISOs;
- Order 825, issued in June 2016 with regards to price formation, required all RTOs and ISOs to align their settlement and dispatch intervals; and
- Order 841, issued in February 2018, required RTOs/ISOs to revise their tariffs to facilitate the integration of electric storage resources.

Sources: FERC. *Order No. 745: Demand Response Compensation in Organized Wholesale Energy Markets.* March 15, 2011; FERC. *Order No. 825: Settlement Intervals and Shortage Pricing in Markets Operated by RTOs and ISOs.* June 16, 2016; FERC. *Order No. 841: Electric Storage Participation in Markets Operated by RTOs and ISOs.* February 15, 2018.

3.3.3 Impacts of state and local policies on the transformation of the industry

The combined effect of technological growth and state and local environmental policies seeking "cleaner" energy has accelerated the transformation of the electricity industry in recent years. At the grid-connected level, conventional fossil-fueled power plants are retiring, and installation of efficient gas-fired generation and renewable generation investments is proceeding at a faster pace than ever. The location of the retired assets and new assets is not the same, therefore impacting the architecture of the transmission system. At the customer level, customers are producing more of their own generation, but also in some cases consuming more. More importantly for the transmission system, power flows are no longer following the typical hourly and unidirectional patterns they used to.

The rising levels of uncertainty and risk are well recognized by RTOs, transmission planners, TOs, and a wide array of stakeholders, as highlighted by quotes in the textbox on the following page, and in the discussion in the Electric Transmission Incentives NOPR.[53] Notably, the geographical areas experiencing the greatest influence from state and local policies are highly

[53] FERC. *Notice of Proposed Rulemaking: Electric Transmission Incentives Policy Under Section 219 of the Federal Power Act, Docket No. RM20-10-000.* March 20, 2020. p. 3.

correlated with the location of RTOs, as we discuss further below. This observation supports recognition of an RTO-Participation Incentive to compensate for the risks created by policy action.

Industry perspectives on the pace of industry change

"New technologies and ambitious public policy goals are dramatically transforming how energy is produced and consumed… There is no historical precedent for the ambitious changes on the bulk power system envisioned by policymakers… Driven by public policy, technological innovation, and economic factors, the pace of change is accelerating rapidly."

- NYISO. *Reliability and a Greener Grid: Power Trends 2019.* 2019.

"Transmission planning is even more complex than it has been in the past when utilities planned for reliability based on load growth, local generation and load interconnections. Now transmission planners must not only plan for reliability, but also to relieve market congestion, accommodate ever changing public policy needs and mitigate the uncertainty inherent in those needs."

- Edison Electric Institute. 2016.

3.3.3.1 Correlation between state policies and RTO footprints

Many state regulators are providing funding for various carbon-reducing initiatives, including but not limited to, support for renewable generation investment (including customer-owned generation), demand-side management ("DSM") and energy efficiency programs, and conversion of other energy-intensive activities to electricity ("beneficial electrification"). The policies are diverse, but the cumulative effects are similar: policies are driving changes in the makeup of power generation (supply) and/or changes in system demand.

Data shows that states within RTO footprints generally tend to pursue more aggressive carbon reduction policies, including those centered on DERs, which promote customer self-supply, and energy efficiency policies, which achieve energy savings through DSM programs that typically provide financial incentives to customers to change out equipment or make other behavioral changes to reduce their energy consumption profile. The overlap of state policies with RTO service areas is highlighted visually in Figure 6 and Figure 7. For example, of the 29 states that have mandatory energy efficiency policies in effect, 23 states (79%) fall within an RTO footprint (see Figure 6).

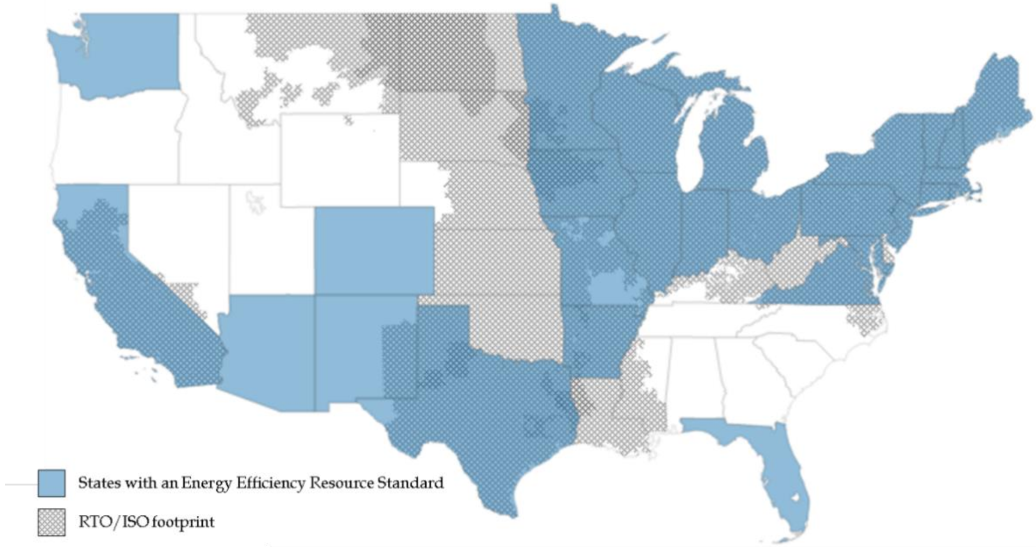
With regards to the deployment of DERs, this effort has been led for the most part by states such as California and New York.[54] California leads the nation in terms of installed DER capacity (see Figure 7, which shows a heat map of installed DER capacity by state and depicts California shaded in the darkest green), and this is only expected to grow due to new policies, such as the requirement for solar panels to be installed on all new homes in the state.[55] New York's DER growth is expected to be driven primarily by its target of installing 6,000 MW of distributed solar

[54] Greentech Media. *5 States Blazing the Trail for Integrating Distributed Energy Resources.* September 9, 2019. <https://www.greentechmedia.com/articles/read/the-top-states-for-distributed-energy-integration>

[55] Ibid.

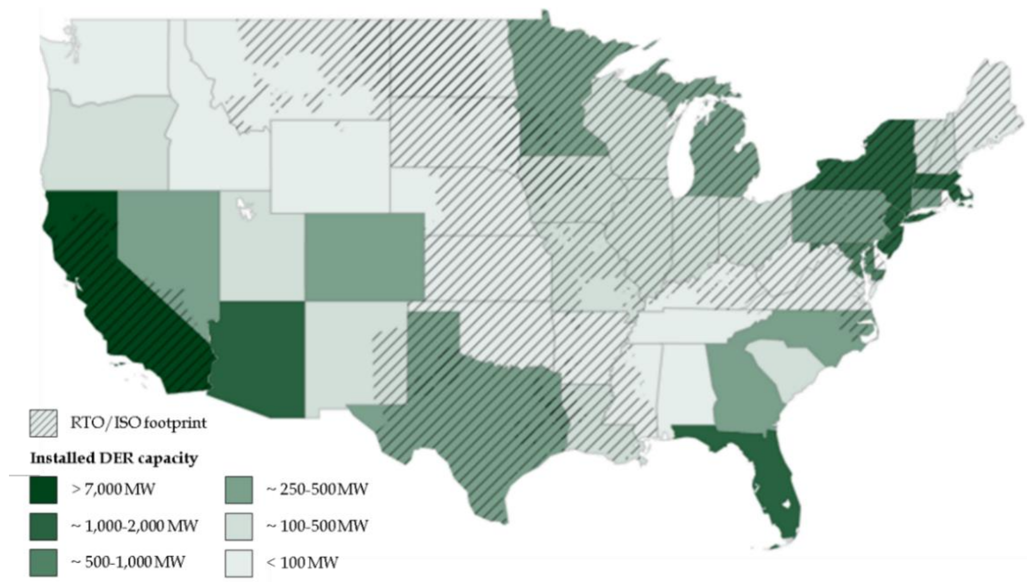
energy capacity in the state by 2025[56] (this is a significant target, which equates to nearly 20% of peak demand forecast for 2025).[57]

Figure 6. RTO footprint overlap with states pursuing energy efficiency standards



Source: DSIRE. *Energy Efficiency Resource Standards*. <https://programs.dsireusa.org/system/program/maps>

Figure 7. RTO footprint overlap with deployment of DERs



Source: FERC Staff Report. *Distributed Energy Resources: Technical Considerations for the Bulk Power System*. February 2018.

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56 NY State Senate. *Senate Bill S6599*. June 18, 2019.

57 NYISO estimates that baseline summer peak demand will reach 31,711 MW by 2025. (Source: NYISO. *2020 Load & Capacity Data Report*. April 10, 2020.)

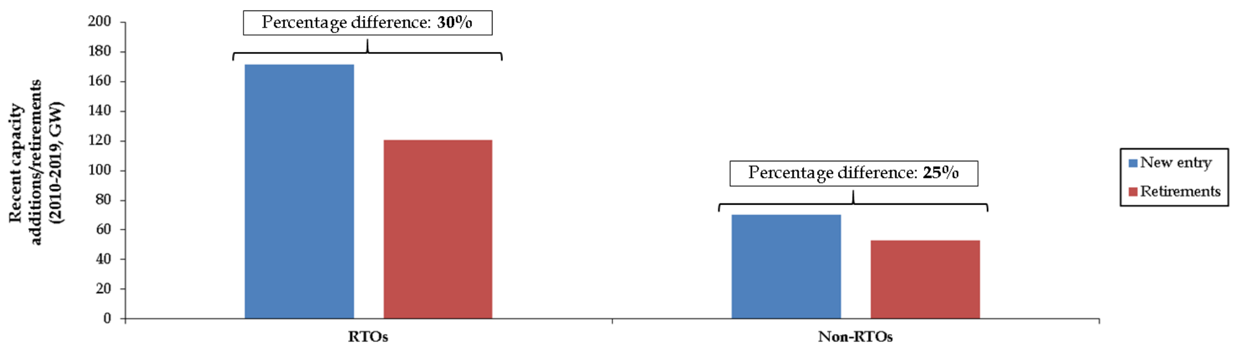
Both of these energy policies result in lower system demand and contribute to a perception of uncertainty and risk for transmission development, by causing stakeholders to question whether investment is "needed" if the system is no longer experiencing major load growth.[58]

3.3.3.2 Changes in supply

Changes in the makeup of grid-connected supply and the rising prominence of customer-owned generation has challenged, and will continue to challenge, grid operators. However, in RTO markets, where the RTO lacks direct control over generation investment and customer-owned generation, the changeover in supply creates significant uncertainties for system planning.

TOs and transmission planners are forced to be reactive to generation changes, as evidenced by the resurgence of reliability-must-run units ("RMRs") and transmission projects in the wake of generation retirements. In a traditional vertically integrated utility setting, the generation retirement and new entry decision would be more closely coordinated. Figure 8 demonstrates that the change in grid-connected supply is greater in RTO regions.

Figure 8. New entry and retirements in RTO versus non-RTO regions, 2010-2019



Notes: New entry includes currently operational plants, with commercial online dates between 2010-2020. Retirements are plants with retirement dates between 2010-2020.

Source: Third party commercial database.

3.3.3.3 Changes in demand

Changes in system demand have also become uncertain: will demand fall due to increasing amounts of energy efficiency programs and expansion of customer-owned supply? Or will it increase due to beneficial electrification and customers' needs to plug in more devices (e.g., electric cars, electric space heating devices)? Figure 9 on the next page summarizes which RTOs are starting to consider DERs (specifically behind the meter ("BTM") solar photovoltaics ("PV")) and/or beneficial electrification in their load forecasts.

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[58] Although load growth is not the only driver for transmission investment, many stakeholders continue to focus on load growth trends. For more information about the fallacies of looking at load growth in isolation, please see LEI's "The Truth About the Need for Electric Transmission Investment: Sixteen Myths Debunked," which can be found at https://wiresgroup.com/wires-library/wires-reports/

Figure 9. Summary of which RTOs are considering DERs in their load forecasts

	CAISO	ISO-NE	MISO	NYISO	PJM	SPP
Energy efficiency	● Considered	● Considered	● Considered	● Considered	● Considered	● Considered
BTM solar PV	● Considered	● Considered	● Considered	● Considered	● Considered	● Considered
Electric vehicles	● Somewhat considered	● Considered	● Somewhat considered	● Considered	● Considered	● Somewhat considered
Building electrification	● Not considered	● Considered	● Not considered	● Somewhat considered	● Not considered	● Not considered

● Considered ● Somewhat considered (see notes) ● Not considered

Notes:

(1) CAISO does not consider electric vehicles ("EVs") in its load forecast. However, the California Energy Commission covers a wide range of electrification in the transportation sector (e.g., airport ground support equipment, port, cargo handling equipment, shore power, truck stops, forklifts, transportation refrigeration, public transit, and high-speed rail).

(2) MISO issued a report on "Quantifying the Potential Electric Vehicles to Provide Electric Grid Benefits in the MISO Area" and included EVs, solar PV, wind, etc., in various scenarios for MISO Transmission Expansion Planning.

(3) NYISO does not consider building electrification in its Baseline forecast, but it is considered in the Congestion Assessment and Resource Integration Study.

(4) In SPP, EVs will be integrated into the 2020 Integrated Transmission Plan.

Source: LEI analysis of various ISO documents/reports.

To deal with this heightened operating risk and planning uncertainty, RTOs such as MISO have been assessing the evolving situation of DERs, and exploring tactics to address these risks, including aiming to better incorporate DER growth into its planning and modeling processes within a five-year timeframe.[59]

In fact, RTOs across the country are taking account of these external risks stemming from policy developments in their transmission planning processes and their development of market and operating protocols, as demonstrated in Figure 10 on the next page. This table summarizes recent RTO strategy position papers with respect to the following issues:

- whether the RTO has published or is developing a grid of the future study; and
- whether the RTO is actively considering state and federal clean energy policies and how these are affecting transmission planning.

[59] MISO. *MISO and DER: Framing and Discussion Document.* 2019.

Figure 10. Overview of RTO strategy position papers

	CAISO	ISO-NE	MISO	NYISO	PJM	SPP
Development of a grid of the future study	✗	✓	✓	✓	✗	✗
Consideration of state clean energy policies in transmission planning	✓	✓	✓	✓	✓	✓

Notes on grid of the future studies:

(1) ISO-NE is currently developing its own grid of the future study (in conjunction with the New England States Committee on Electricity ("NESCOE") and the New England Power Pool ("NEPOOL")) through an initiative titled the "Transition to the Future Grid." The project is currently in its stakeholder engagement phase, where "assumptions and future scenarios will be developed to help identify any operational and reliability needs on the New England power system."

(2) MISO's recent report (issued March 2020) entitled "Utilities of the Future: What Do They Need from a Grid Operator?" incorporates stakeholder-identified solutions to the major trends MISO recognized as changing the energy landscape: de-marginalization, decentralization and digitalization.

(3) NYISO issued its whitepaper in December 2019, titled "Reliability and Market Considerations for a Grid in Transition" which assesses emerging reliability and economic challenges and outlines a potential path forward to overcome these hurdles.

Sources: LEI analysis of various ISO documents/reports, including ISO-NE. *Transition to the Future Grid Key Project.* <https://www.iso-ne.com/committees/key-projects/transition-to-the-future-grid-key-project/>; MISO. *MISO Forward 2020 – Utilities of the Future: What Do They Need from a Grid Operator?* March 2020; NYISO. *Reliability and Market Considerations for a Grid in Transition.* December 20, 2019.

Clearly, the fact that RTOs themselves are working to account for these factors in their internal processes highlights that risks are indeed prevalent in the transmission space. As emphasized in the beginning of this subsection through quotes from NYISO and the Edison Electric Institute, these risks will only grow as the pace of industry change accelerates in the future.[60] As such, the RTO-Participation Incentive as it stands now is not only important, but should be increased as proposed to 100 bp to account for these heightened risks.

3.3.3.4 Risk of transmission asset devaluation and customers bypassing the transmission system

State policies that change the makeup of supply and/or demand in the electricity sector create uncertainty for existing and new investments. Generally, the uncertainty resulting from policies tends to be one-sided for a given investment, where the policy is either damaging or supportive in nature (but not both).[61] This creates several concerns for transmission asset owners.

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[60] *See* NYISO. *Reliability and a Greener Grid: Power Trends 2019.* 2019; Edison Electric Institute. 2016.

[61] For example, tax incentives promulgated for renewable resources are generally helpful for qualified renewables, although given that they are functionally dependent on legislative action, the financial supports are subject to change if political will for granting tax incentives is weakened. Moreover, these tax incentives can lead to negative implications for other resources through eventually crowding out.

For example, it raises the concern around what kind of transmission investment will be needed (in scope and scale) after such transformations in supply and demand are complete. Another concern triggered by state and local policies is whether integrated transmission systems will continue to be used and useful in the same way as they have been historically. Rise of DERs and self-supply creates a perception that customers are "bypassing" the transmission network and other grid-connected infrastructure. This risk is especially elevated in RTOs, where TOs no longer conduct their own IRPs (as discussed in Section 3.3.1), and as such cannot centrally coordinate and plan all aspects of the electricity system within their service territory. Essentially, TOs in RTOs cannot guide customers as to where to install DERs, much in the same way TOs in RTOs cannot force generators to build new power plants in specific locations. This re-distribution of control to the RTO acts to bind the TO with respect to the regional planning process, and hinders autonomy in business and investment decision-making that cater to local customers. This does not occur in non-RTO regions of the country, where utilities maintain direct control over planning and operations, as well as customer engagement and rate design.

> ***"DER growth poses a host of new and significant challenges for the electricity system in the MISO region. These challenges span the realms of reliable operations, efficient markets and forward-looking resource planning. DERs also pose jurisdictional issues at the interface of the MISO-managed, high-voltage transmission system and state-regulated, lower-voltage distribution systems."***
>
> - MISO. *MISO and DER: Framing and Discussion Document.* 2019.

3.4 Increasing the RTO-Participation Incentive may attract more diverse capital to the transmission sector

Capital for transmission investment has generally come from traditional utility financing sources, such as corporate debt and retained earnings. However, an increase in the ROE incentive may trigger interest from new sources of capital, which could also bring innovative financing approaches[62] to transmission.

The generation sector has benefited for many years from an influx of new investors, such as private equity firms and strategic investors (e.g., pension funds). These entities have added liquidity to the sector and improved the climate for investors.[63] A review of data from half a dozen private equity funds that have targeted the generation sector show that over $46 billion of funds were successfully raised over a span of just four years to be deployed in the energy space.[64] Such

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[62] For example, in the generation sector, private equity investors have made use of multi-round funding structures more common with venture capitalists, which has proven to better support the fair valuation of the generation projects as they proceed from development to commercialization.

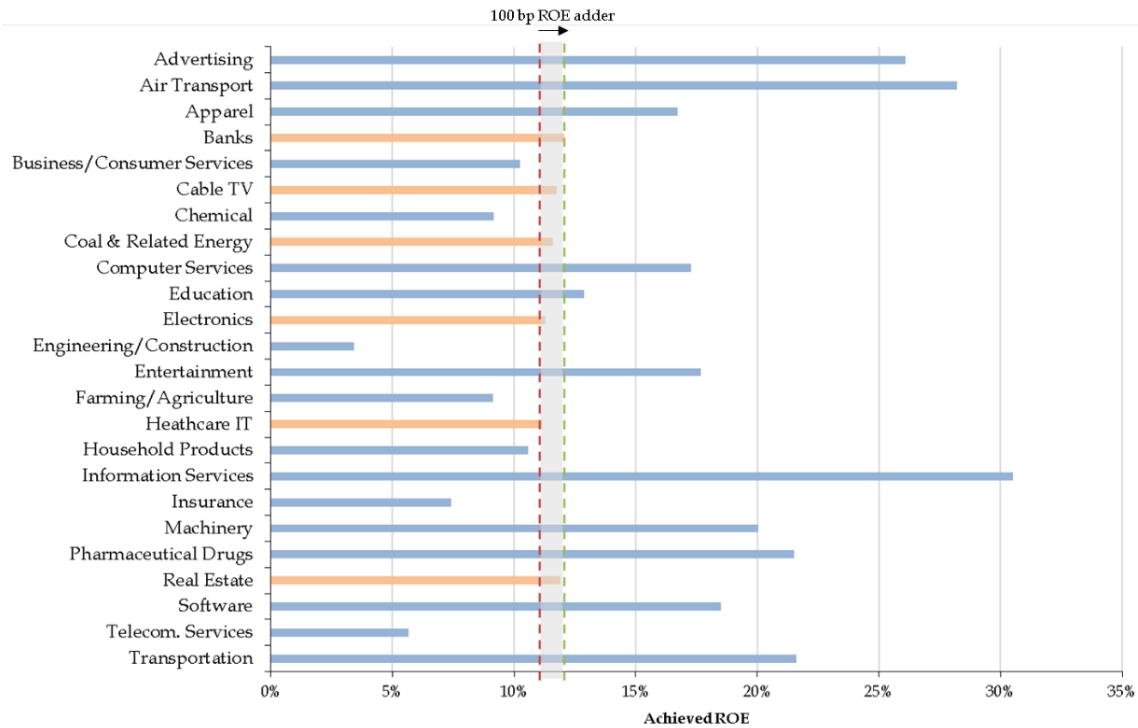
[63] For example, over the past decade, renewable energy investments in the US have amounted to approximately $356 billion, behind only China ($758 billion) and Europe ($698 billion). As a result of this capital influx, 151 GW of renewable energy capacity has been added over the same time period. (Source: BloombergNEF. *Global Trends in Renewable Energy Investment 2019.* 2019.)

[64] Utility Dive. *Challenge for Merchant Generators is Opportunity for Private Equity.* August 9, 2017. <https://www.utilitydive.com/news/challenge-for-merchant-generators-is-opportunity-for-private-equity/448899/>

investors were – and continue to be – attracted to the power generation sector because of the long-lived nature of the assets and the opportunities for competitive returns, possible through the wholesale market mechanisms. Private equity funds have begun to turn their attention to transmission infrastructure, which is an attractive investment opportunity for well-capitalized, risk-averse investors.[65] There are several transmission projects built or proposed for construction that have tapped into private equity funding.

This trend could be driven even further through the addition of a 100 bp incentive on top of base ROEs, which may shift the spotlight onto investment opportunities in transmission and away from other industries. We can test this hypothesis by looking at the relative importance of a 100 bp difference in achieved returns across various sectors of the US economy. Based on data collated by Professor Damodaran of New York University,[66] sector-specific ROEs have ranged from -32% to 95%, while the market capitalization weighted average achieved return was 13.63%.[67] Figure 11 graphs only a selection of sectors with positive ROEs up to 35%.

Figure 11. Comparing achieved returns across different sectors



Source: Damodaran Online. *EVA and Equity EVA by Industry – US.* January 5, 2020.

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65 Energize Weekly. *Transmission Investment Rises Spurred by Aging Infrastructure and a Changing Grid, Survey Finds.* September 13, 2017. <https://www.euci.com/transmission-investment-rises-spurred-by-aging-infrastructure-and-a-changing-grid-survey-finds/>

66 Data as of January 5, 2020.

67 Damodaran Online. *EVA and Equity EVA by Industry – US.* January 5, 2020. <http://pages.stern.nyu.edu/~adamodar/>

The vertical red dotted line in Figure 11 reflects the average achieved ROE for the utility sector,[68] while the green line indicates the increase in returns after adding in the 100 bp incentive. As a result of the 100 bp movement, the utility sector would look more attractive than six other sectors (highlighted in orange): (i) banks, (ii) cable TV, (iii) coal and related energy, (iv) electronics, (v) healthcare information technology ("IT"), and (vi) real estate (operations and services).

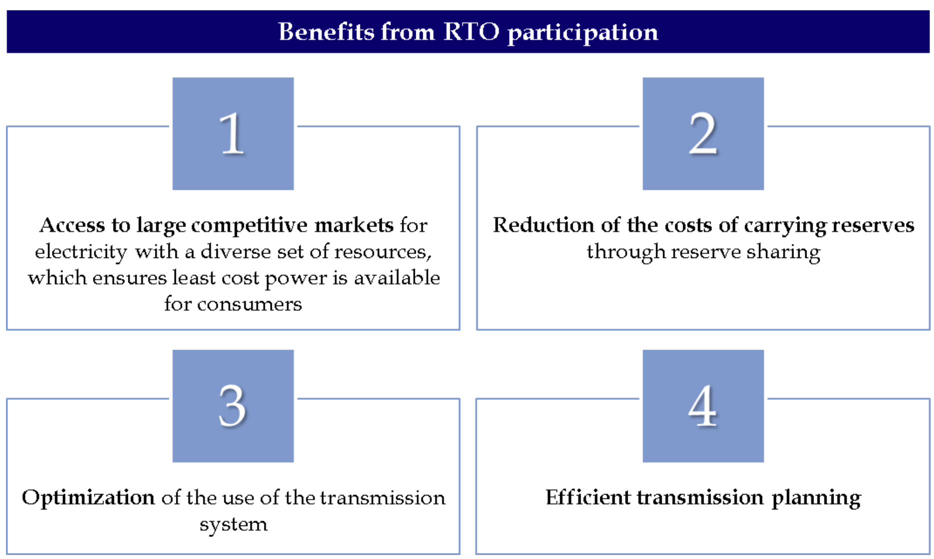
This illustrative example highlights that 100 bp could be a meaningful motivator for investors to shift capital to transmission investment, given the opportunities in other sectors of the economy.

3.5 TOs take on the risks of RTO participation which ultimately benefit customers

Customers will ultimately be paying for any ROE incentives that TOs receive. Therefore, it is also important to examine the benefits associated with RTO participation. The Commission itself supports such an assessment, specifically proposing in its Electric Transmission Incentives NOPR that it would like to validate the use of ROE incentives through the lens of consumer benefits.[69]

Such benefits are well documented by RTOs. Qualitatively, these benefits arise because RTO participation enables functional improvements in operations, supply procurement (energy and reserve markets) and planning, as depicted in Figure 12.

Figure 12. Benefits arising from RTO participation



Source: FERC. *Notice of Proposed Rulemaking: Electric Transmission Incentives Policy Under Section 219 of the Federal Power Act, Docket No. RM20-10-000*. March 20, 2020.

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[68] Damodaran includes 16 companies as part of the 'utility (general)' industry category. This includes utilities providing service in electric transmission, distribution, and generation, as well as other utility franchises (such as natural gas storage, transmission, and distribution). (Source: Damodaran Online. *Data: Breakdown*. <http://pages.stern.nyu.edu/~adamodar/>)

[69] FERC. *Notice of Proposed Rulemaking: Electric Transmission Incentives Policy Under Section 219 of the Federal Power Act, Docket No. RM20-10-000*. March 20, 2020. p. 4.

Although transmission operation and regional planning is only one segment of the responsibilities of RTOs, the existence of a transmission network (facilitated by TO membership) is a foundational element supporting all the benefit streams identified above. The Commission has also emphasized this finding, stating that "[a]ll of these attributes reduce the cost of delivered power by facilitating broader and more robust access to more sources of power, and to the lowest-cost source of power, over a wide geographic footprint."[70]

Access to cost-effective power through competitive wholesale power markets is possible only to the extent that the transmission network supports the unfettered flow of energy from the low cost suppliers to consumers. In other words, lowest-cost supply for consumers is largely achieved through the maintenance of a reasonably uncongested transmission network, because it ensures competition between power plants located in various locations on the grid. Transmission investment is needed from time to time to ensure that the transmission system is providing this valuable service to competitive wholesale markets.

In addition, transmission also enhances the reliability of the power system, especially in the current climate of increasing levels of intermittent renewable generation. In a contributed article, former FERC Commissioner, Tony Clark noted that "[a]s states continue to expand the use of renewables in their utilities' portfolios, it is transmission that often helps ameliorate the intermittency, variability and geographical limitations that arise. Similarly, needed transmission investments can deliver customer value by enhancing outcomes related to reliability and grid resilience."[71]

3.5.1 Benefits of RTO participation versus costs associated with the proposed ROE adder

The RTO-Participation Incentive proposed in the Commission's Electric Transmission Incentives NOPR is set to increase from 50 bp to 100 bp. Although this increase could be material from the perspective of the TO and investors, as discussed in Section 3.4 above, it is not expected to result in significant increases in costs from the point of consumers, especially relative to the size of RTO-related benefits that consumers enjoy.

Figure 13 summarizes the estimated annual benefits that three RTOs (PJM, MISO, and SPP) have released in public studies that quantify the "value propositions" for their customers. For example, MISO estimates it has delivered between $3.2 billion and $4 billion in regional benefits annually, "driven by enhanced reliability, more efficient use of the region's existing assets and a reduced need for new assets."[72] PJM also estimates a value proposition of $3.2 to 4 billion resulting from its operations, markets, and planning,[73] while SPP estimates a $2.2 billion annual net benefit to its

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[70] Ibid. p. 62.

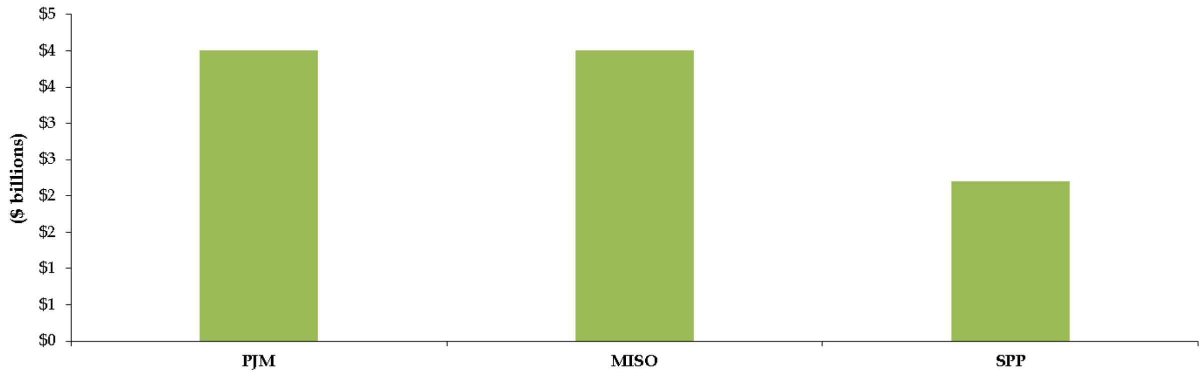
[71] Clark, Tony. *FERC's ROE Conundrum: Finding the Right Number is Harder Than it Looks*. January 6, 2020. <https://www.utilitydive.com/news/fercs-roe-conundrum-finding-the-right-number-is-harder-than-it-looks/569766/>

[72] MISO. *MISO 2019 Value Proposition*. February 14, 2020.

[73] PJM. *PJM Value Proposition*. 2019.

customers.[74] Although these value propositions consider the benefits from all aspects of an RTO's operations, these are all facilitated to one degree or another by the availability of transmission network capacity.

Figure 13. Annual average benefits to consumers from RTOs' value propositions



Sources: PJM. *PJM Value Proposition.* 2019; MISO. *MISO 2019 Value Proposition.* February 14, 2020; SPP. *14-to-1: The Value of Trust.* May 24, 2019.

The costs of the proposed 100 bp ROE adder for the RTO-Participation Incentive is a fraction of these benefits. Another stakeholder had noted in their filing in 2019 in FERC *Docket No. PL19-3-000* that the incremental cost of a 50 bp ROE incentive for TOs in all six RTOs was about $400 million per year.[75] LEI utilized the same methodology to estimate the costs of a 100 bp ROE adder for the three RTOs who have published an estimate of their annual benefits (which we showed in the figure above – namely MISO, PJM and SPP). The cost of the proposed 100 bp ROE adder for TOs in these three RTOs would be approximately $560 million,[76] which is significantly below the aggregate annual benefits for these same three RTOs of $10.2 billion. Given the relative orders of magnitude of these estimates, it is highly unlikely that the proposed increase to the RTO-Participation Incentive by 50 bp would ever make customer net benefits from being part of an RTO negative.

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[74] SPP. *14-to-1: The Value of Trust.* May 24, 2019.

[75] *See footnote 275, p. 97 in* Transmission Access Policy Study Group. *Inquiry Regarding the Commission's Electric Transmission Incentives Policy; Docket No. PL19-3-000.* June 26, 2019.

[76] To estimate the cost of the 100 bp ROE adder to consumers, LEI replicated the methodology used in the comments of the Transmission Access Policy Study ("TAPS") Group (cited above), with minimal changes. As TAPS did in their comments, LEI compiled data from the Regulatory Research Associates, RRA Topical Special Report, *Electric Transmission: Rate Bases, Rate Base Growth and ROEs: 2018 Update*, which reports an aggregate 2017 transmission rate base of $67,830,086,000 for MISO, PJM and SPP. We grew this estimate to 2019 using a simple average of the annual growth rates in MISO, PJM and SPP of 15.5%. To account for federal and state income taxes, LEI then scaled the estimate by 1.3. Assuming leverage of 50% and a depreciation term of 40 years, the increase in the annual capital charge to customers by a 50 bp adder was estimated to be approximately $280 million in 2019, or $560 million for a 100 bp adder for the three RTOs (MISO, PJM, and SPP).

4 Comments on the Transmission Technology Incentive

The Transmission Technology Incentive proposed in FERC's Electric Transmission Incentives NOPR, although novel, is well-grounded in economic theory and best practices in government policy. This section begins with a short introduction to the economic theory that government support is necessary in order to foster the optimal level of R&D and deployment of innovative technologies, which ultimately benefit consumers. We then look at the underlying reasons why innovation is often "under-supplied" by the private sector, all of which relate to perceived risks. After identifying eight categories of risk that may inhibit technological advancement and innovation, we employ several case study examples to demonstrate how such risk factors have manifested themselves with respect to transmission technology. Finally, we discuss the empirical evidence for the benefits of public sector intervention and support of technology.

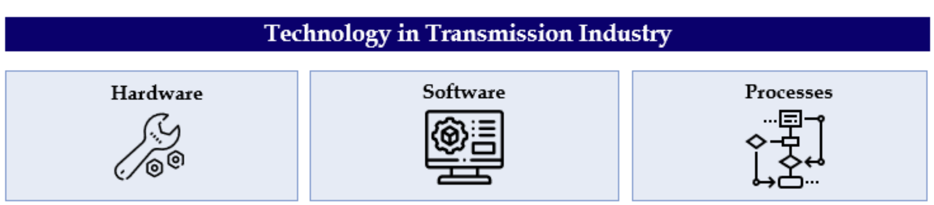
The absence of supporting mechanisms such as the Transmission Technology Incentive may impede the adoption of innovative technologies, which will come at a high opportunity cost for electricity customers.

4.1 Defining 'technology'

Before we step into the economic theory surrounding R&D and deployment of innovative technologies, it may be useful to present a definition of what we mean by "technology." The Merriam-Webster dictionary defines technology as "the practical application of knowledge, especially in a particular area" and the use of "technical processes, methods, or knowledge" to accomplish a task.[77] As such, technology can be thought to have a wide connotation, and can be represented in hardware, software, and even in operational practices and processes. Furthermore, technological innovation can involve the transformation of the use of an existing or established hardware, which when redeployed with some adjustments, may be transformative and innovative to an industry. Thus, technological innovation encompasses both completely new products, as well as the use of existing technologies in novel ways through new methods and processes.

As it applies to the transmission industry specifically, technology includes, but is not limited to, physical infrastructure or devices, optimized software tools, and operational practices and processes, as presented in Figure 14, which can all be considered broadly as technology that yields innovation.

Figure 14. Technology categories in the transmission industry

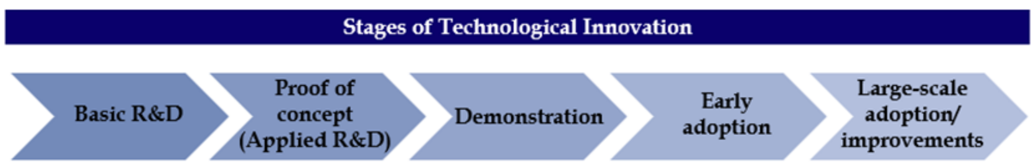


[77] Merriam-Webster. *Technology*. <https://www.merriam-webster.com/dictionary/technology>

The category of "hardware" technologies can be thought to include all the physical assets related to transmission, such as electrical lines and substation devices. "Software" includes the IT products used to support the hardware, while the "processes" in this instance refer to the operational strategies used for decision-making and change management. Taken together, the hardware, software, and operational process technologies enable effective power flow control and transmission optimization, leading to reliable and efficient power transmission.

It is also important to recognize that innovation can occur at multiple points of the technology deployment cycle, for example, during initial stages of basic research (which focuses on knowledge discovery) to initial stages of deployment where research is translated into application, and then finally in later stages of deployment (such as demonstration and early adoption).[78] These stages of the technological innovation cycle are illustrated in Figure 15.

Figure 15. Stages of development of technological innovation



Source: The National Academies of Sciences Engineering Medicine. *The Power of Change: Innovation for Development and Deployment of Increasingly Clean Electric Power Technologies.* 2016.

In the context of these stages of technological innovation, the term "technology" encompasses deployment of conventional resources and existing physical assets, so long as that deployment enhances system operations and planning.

This breadth in the definition of technology is broader than the advanced transmission technologies listed in the Electric Transmission Incentives NOPR. For instance, although FERC provides several examples of initiatives that can be considered as grid-enhancing technologies, such as "power flow control, transmission topology optimization, advanced line rating management, and storage as transmission,"[79] it also explicitly excludes hardware from consideration (i.e., "transmission system assets traditionally associated with the transportation of electric power, such as power lines, power poles, capacitors, and other substation equipment").[80] Exclusion of these types of physical assets does not align with the common definition of technology and, more importantly, may conflict with how innovative projects are actually deployed in the sector. Transmission investment projects tend to be integrative solutions, involving conventional physical assets as well as innovative components. Thus, FERC's proposed criteria may indirectly limit the projects that qualify for the incentive and consequently limit the benefits stemming from this Transmission Technology Incentive.

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[78] The National Academies of Sciences Engineering Medicine. *The Power of Change: Innovation for Development and Deployment of Increasingly Clean Electric Power Technologies.* 2016.

[79] FERC. *Notice of Proposed Rulemaking: Electric Transmission Incentives Policy Under Section 219 of the Federal Power Act, Docket No. RM20-10-000.* March 20, 2020. p. 14

[80] Ibid. p. 68

Although it is outside of the scope of this paper to provide concrete implementation guidelines and comment on specific technologies (and what the qualifications process might be), it is preferable to reconsider the definition of applicable technologies relative to the overarching objective of the Transmission Technology Incentive. Given the primary objective of this incentive is to motivate innovation and technological advancement, a broad definition of qualified "technology" may be preferable.

4.2 Economic theory related to innovation and R&D

4.2.1 Defining a 'public good'

In the field of economics, basic R&D is widely recognized as a "public good."[81] A public good is one that satisfies both the condition of non-rivalry and non-excludability, as defined below:

- a **non-rivalrous** good is one whose supply does not dwindle or lessen in quality as consumption of the good increases. An example of this is access to a new freeware program that can forecast the weather. In this case, all interested customers receive access to the same program, without fear that there may eventually be a shortage in supply; and

- a **non-excludable** good is one which is available to all. Examples include forests, mines, and fisheries. These natural resources are available to all, but may suffer from a supply shortage once there is overconsumption.[82] One common example highlighting the issue of overconsumption is the 1990s collapse of the cod fishery in Atlantic Canada, which had severe economic, social, and cultural effects.[83]

The identification of a good or service as a public good has critical implications for why we have market failures or "incomplete markets." Economic theory states that private investors would be unable to supply efficient (sufficient) quantities of a public good given the existence of non-rivalry (which creates externalities[84]) and non-excludability characteristics (which gives rise to the "free rider" problem[85]). The free rider problem recognizes that because private investors are unable to exclude non-paying customers from benefitting from the public good they produce, investments in public goods by a private company are inherently very risky. Economic theory suggests that the "public good problem" can be ameliorated with public policy and some level of regulation and intervention.

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[81] NARUC Gas Staff Subcommittee. *Utility R&D as a Public Good.* November 2015.

[82] Verschuere, Bram. "Types of Goods and Services." *International Encyclopedia of Civil Society* (2010).

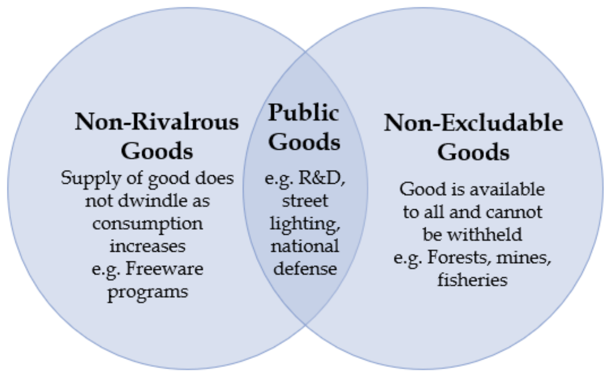
[83] Government of Canada. *Global Consequences of Overfishing.* <http://dfo-mpo.gc.ca/international/isu-global-eng.htm>

[84] In the case of public goods, externalities tend to be positive, given that their benefits to society are greater than the benefits realized by private firms.

[85] Kaul, Inge. "Global Public Goods: Explaining their Underprovision." *Journal of International Economic Law* (September 14, 2012).

As indicated in Figure 16, there are also quasi- or partial public goods that may just be semi-rivalrous or semi-excludable.[86] For example, some economists have noted that AC-based electric transmission systems are typically considered to have some non-excludability traits (i.e., once a customer is connected, there is no way to block them from taking advantage of the transmission system's services), but are rivalrous in consumption once the system reaches its limit (i.e., once congestion occurs).

Figure 16. Definition of a 'public good'



Source: Verschuere, Bram. "Types of Goods and Services." *International Encyclopedia of Civil Society* (2010).

R&D and innovation is a classic example of a public good in economic theory because the knowledge and best practices gained through it are available for use by everyone and will not depreciate as consumption of this knowledge through technology applications increases. For example, if R&D is successful and new knowledge is produced and then disseminated openly, firms and individuals who were not directly involved in the initial R&D can reap the economic benefits, without contributing to any of the initial development costs. As a result, the overall social benefit of R&D tends to exceed the private benefit, largely because only the private firms take on the costs and the risk of failure. For this reason, financial support for R&D and other incentives are commonly deployed by policymakers and governments to ensure efficient levels of R&D and technological innovation.

4.2.2 Curing the "public good problem"

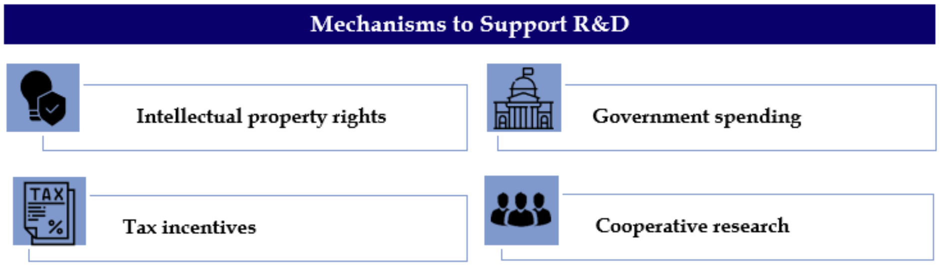
There are many forms of public sector intervention and support mechanisms that help ensure sufficient R&D and spur technological innovation. For example, many countries opt to pass regulations and laws to provide for property rights,[87] such as the granting of patents and

[86] Lambert, Thomas A. *How to Regulate-Chapter 5: Public (and Quasi-Public) Goods*. Cambridge University Press. p. 60-90.

[87] **Intellectual property rights.** These rights enable a private firm to be the sole beneficiary of their R&D efforts, and to earn monopoly profits on a product for a period of time. This mechanism allows private firms to minimize risks by securing a revenue stream, given their monopoly hold on a technology. Intellectual property rights also allow for licensing, through which private firms can increase revenues by allowing the use of their technology for a fee to other companies. These additional market incentives make R&D more attractive, as they help to decrease risks and increase potential profits. (Source: Rice University. *Principles of Economics: How Governments Can Encourage Innovation*. 2016. <https://opentextbc.ca/principlesofeconomics/chapter/13-2-how-governments-can-encourage-innovation/>)

copyright protections. Patents and property rights neutralize the aforementioned "free rider" problem. Other methods of support include cooperative research[88] and government funding through tax incentives[89] or direct monetary supports,[90] as shown in Figure 17.

Figure 17. Four common government mechanisms to support R&D



In the context of R&D and innovation in advanced transmission technologies, the proposed Transmission Technology Incentive does not fall neatly into any one of the aforementioned categories, but instead shares common elements with several mechanisms. Incentives can include mechanisms such as rate design, or the ROE incentive as proposed in the Transmission Technology Incentive. The element of financial relief from a public entity in the form of an ROE adder shares commonalities with direct government spending and tax incentives. The Transmission Technology Incentive has an additional feature whereby it is essentially being funded by the customers that inevitably share in the resulting benefits of deployment of new technologies and associated innovations (which is a more efficient allocation of the costs and benefits, in lieu of relying on taxpayer funding).

4.3 Risks associated with deployment of new technologies

The issues arising around public goods can also be characterized as a risk problem. Without adequate supporting mechanisms (described above) that incentivize development and deployment of new technologies, private companies engaging in R&D and technological innovation face a number risks and uncertainties, which may create misalignment between the investment costs and benefits received by those pursuing innovation. In other words, risks are inherent in any R&D activity or innovative technology initiative because costs must be incurred,

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[88] **Cooperative research.** This involves investing in a coalition of groups that seek funding through federal grants. Government investments are derived from taxpayers who, as a society, benefit from any potential gains from R&D. Monetary incentives increase collaboration and enable the funding to be split into different sub-areas of research. (Source: Ibid.)

[89] **Tax incentives.** Tax incentives tend to be based on the quantity of R&D conducted. Firms that demonstrate certain levels of innovative endeavors may be awarded a reduction in their tax payments. Taxpayers are ultimately responsible for replenishing the foregone tax revenues, otherwise reductions will be experienced in other sectors. These tax incentives only offer cost reductions realized through R&D activity, and as such increase the propensity for firms to innovate. (Source: Ibid.)

[90] **Government spending.** Under direct government expenditure, taxpayer money is re-allocated towards R&D. This could take the form of financial support for non-profit research entities, colleges and universities, government-run laboratories, or private firms. Financial incentives lower private costs and therefore encourage R&D initiatives. (Source: Ibid.)

but success (in the form of compensation and return on investment) is not guaranteed. Based on the research of economists Albert N. Link and John T. Scott, published in their book *Public Goods, Public Gains: Calculating the Social Benefits of Public R&D*, eight common risk factors[91] have been identified that generally apply to industries in the adoption of new technologies and innovation. These risk factors are highlighted in Figure 18 below. TOs deploying innovative transmission solutions and advanced technologies have encountered many of these same challenges and risk factors, as discussed further in the case studies that follow.

Figure 18. Sources of elevated risk factors for advanced transmission technology deployment

Risk Factors for Advanced Transmission Technology Deployment	
1. High technical risk	5. Evolving nature of markets
2. Commercial/market risk	6. Intellectual property rights
3. Time interval	7. Cost of market entry
4. Scope of market participants	8. Lack of customer understanding

The eight risk factors are described in more detail below:

1. **High technical risk**: This delineates how the outcomes of R&D may not be technically sufficient to meet all needs/paradigms. This outcome may occur if a new device or process has been developed but fails to measure up when evaluated based on key performance indicators during the testing phase. Thus, although time, budget, and other resources were spent to develop the new technology, it is deemed technologically insufficient;

2. **Commercial/market risk:** Through the presence of competing substitutes and/or imitations, outcomes of R&D may not be accepted by the market, even if they are technologically viable. This was one of the main factors present in case study #2 below on the Aluminum Conductor Composite Core ("ACCC") Conductor. Consumers may prefer technologically inferior substitutes due to familiarity and a general aversion to change;

3. **Time interval:** Significant time horizons are inherent for complex research initiatives, as well as the development into viable commercial products that are ready for deployment. Companies are required to plan ahead financially for extended periods of time, with uncertainty as to whether cashflows may eventually turn positive;

4. **Scope of market participants:** Private firms generally have a narrower scope of potential market participants than what is actually realized in society, due to their initial inability to recognize all possible applications of their technology. This presents a heightened level of risk as firms take a more conservative approach in evaluating their benefits, often being unable to justify the costs relative to their deflated perceived benefits;

[91] Link, Albert N. and John T. Scott. *Public Goods, Public Gains: Calculating the Social Benefits of Public R&D.* New York: Oxford University Press, 2011. Print.

5. **Evolving nature of markets:** A lack of coordination and centralization in decision-making slows down the pace at which technological innovations can be adapted to a variety of industries and applications. Thus, with the uncertainty of future regulatory requirements and rulings, markets can evolve in unprecedented ways, elevating the risks to technological development in the present;

6. **Intellectual property rights:** The lack of intellectual property rights may present another form of risk for developers of new technologies. Competitors at the application stage may be able to offer competing substitute goods, and the cost of imitation may be low. These products take advantage of the development process of the technology while not having to contribute to any costs and take away market share from the original product without repercussions. Thus, the cost of copycat products from competitors are another form of risk that private companies may experience;

7. **Cost of market entry:** The high cost of market entry is another consideration in terms of risk. High barriers to entry exist for industries where developing a new technology raises concerns of its interoperability with existing systems, as was the case in the initial integration of voltage-sourced converters ("VSCs"), discussed in case study #1 below. This is especially applicable in the advanced transmission industry, where any new technology must be able to integrate seamlessly with existing infrastructure; and

8. **Lack of customer understanding:** This can be another significant risk and barrier to the deployment of advanced technologies. Industries with high science and technical content such as transmission may find it difficult to effectively communicate new developments to potential users. Though the technology may be perfectly viable and a vast improvement from existing products or processes, consumers may be unable to comprehend the technical underpinnings and reasonings, thus hindering its widespread adoption.

Case study #1: Voltage-sourced converters ("VSCs")

The development and commercialization of VSCs in the late 1990s faced high technical risk, commercial/market risk, costs of market entry, and a lack of customer understanding (risk factors #1, #2, #7, and #8 mentioned above).

The first VSC appeared in high-voltage direct current ("HVDC") in 1997. Prior to that point, HVDC lines exclusively used line-communicated converters ("LCCs"), which rely on the line voltage of alternating current ("AC") systems to switch from one device to another. The radical idea of the VSC, which generates AC voltage from DC voltage through the inverter technology, raised many questions from system planners and engineers, including concerns around technical viability, and interoperability. Commercial acceptance through customer understanding took up to 10 years, according to Pedro Rodriquez and Kumars Rouzbehi in their book titled "Applications of Power Electronics in Power Systems." Today, VSCs are growing in popularity due to their ability to interconnect weak AC systems and incorporate large-scale offshore wind resources to the grid.

Source: Pedro Rodriquez and Kumars Rouzbehi. "Multi-terminal DC Grids: Challenges and Prospects." *Applications of Power Electronics in Power Systems* (2011).

Case study #2: The Aluminum Conductor Composite Core ("ACCC") Conductor

The development of the ACCC Conductor by CTC Global faced commercial/market risk, significant costs related to market entry, as well as a lack of customer understanding (risk factors #2, #7, and #8 mentioned above).

The ACCC Conductor is a hybrid carbon fiber core wire, which serves to replace traditional steel core wires in overhead conductors. According to the manufacturer, these wires are 50% stronger and 70% lighter, reducing line losses by 25-40%, and can carry two times the amount of current as the conventional conductor. However, the ACCC Conductor is also two to three times more expensive than conventional conductor wires, which presents a major obstacle in commercialization and market acceptance of the product in place of conventional alternatives.

The lack of customer understanding in the benefits of the ACCC Conductor may be a challenge to product acceptance as the explanation as to the benefits of this more expensive wire can be highly technical. In addition, due to the connectivity of the transmission system, the interoperability between these new wires and existing substations is another risk, especially given that it would be unrealistic to replace all existing infrastructure.

Since its initial commercialization in 2005, ACCC Conductor wires have been implemented in 800 projects in 52 countries, with over 62,000 miles of power lines installed to date.

Sources: CTC Global. *ACCC Conductor.* <https://www.ctcglobal.com/accc-conductor/>; Utility Products. *High Cost vs. High Performance.* December 15, 2014. <https://www.utilityproducts.com/test-measurement/article/16002161/high-cost-vs-high-performance>; Utility Dive. *5 Reasons Utilities are Switching to High-Performance Overhead Conductors.* December 12, 2019. <https://www.utilitydive.com/spons/5-reasons-utilities-are-switching-to-high-performance-overhead-conductors/568808/>; CTC Global. *ACCC Conductor Installations.* <https://www.ctcglobal.com/project-map/>

In line with the financial theory of risk and return presented earlier, a higher rate of return in the form of an ROE adder is thus warranted. In this sense, the incentive would act as compensation to entities who choose to conduct R&D and innovate transmission technology in spite of these risks. The absence of such incentives would lead to insufficient quantities of innovation and investment, hindering technological advancement and the associated benefits to consumers in the long run.

4.3.1 Comments on FERC's proposed benefit-to-cost thresholds for the Transmission Technology Incentive

FERC's Electric Transmission Incentives NOPR proposes benefit-to-cost thresholds for determining the applicability of the Transmission Technology Incentive. Therein, qualifying projects (which exclude certain physical assets responsible for the transportation of electricity) must surpass a cost-benefit ratio of 3.98[92] if project costs exceed $25 million, or separately, a ratio

[92] FERC. *Notice of Proposed Rulemaking: Electric Transmission Incentives Policy Under Section 219 of the Federal Power Act, Docket No. RM20-10-000.* March 20, 2020. p. 36.

of 33.91[93] if project costs are at or below $25 million. These ratios were derived from the 75th percentile of a sample of ratios from 41 transmission projects located in various energy markets which FERC considered.

Given the risk factors for technological innovation, specifically those relating to the scope of market participants and evolving nature of markets (risk factors #4 and #5 mentioned previously), the proposed cost-benefit ratios can significantly curtail the applicability of the incentive. This is due to the fact that there may be more market participants than originally perceived, and the evolving nature of markets may result in other unrealized benefits. The ratio for some projects may be deflated compared to reality. Thus, the high threshold for project eligibility based on solely these ratios may unintentionally hinder the deployment of beneficial advanced transmission technology.

The benefit-to-cost requirement fails to recognize a few inherent factors and risks, which may detract from its intended purpose:

- benefits are especially difficult to predict for an advanced technology, where its various applications may not yet be fully understood. This is in line with the fourth risk factor identified in the framework (scope of market participants), where it has been widely recognized that firms may not capture all of the economic benefits from all potential market applications of an R&D outcome. This limits investment decisions to only the benefits which a firm can realize, which is often less than the benefit to society as a whole; and

- costs are also difficult to predict accurately at such an early stage of development, where cost savings may only be realized once a technology has reached commercial deployment.

In light of these difficulties, high benefit-to-cost thresholds as proposed in the Electric Transmission Incentives NOPR may unnecessarily disqualify and limit useful advanced transmission technologies, which negates the original purpose of incentivizing their development. FERC may want to reconsider applying a cost-benefit ratio that is so constraining and contrarian to the original intent of the incentive.

4.4 Case studies: how incentives and support mechanisms can amplify the deployment of innovative technologies that benefit consumers

There are numerous examples where government support for R&D and deployment of advanced technology in the various stages of commercialization has been credited with creating societal benefits. In this section of the report, we highlight three examples of how supportive mechanisms can promote innovative technologies and create benefits for consumers. These examples comport with the Transmission Technology Incentive because they demonstrate:

[93] Ibid. p. 37.

- even mature industries such as the pharmaceutical industry may still require supportive mechanisms in order to leverage their existing expertise and introduce beneficial and innovative drug technologies to society; and

- the cases of the deployment of solar PV and phasor measurement units ("PMUs") further illustrate that when supportive mechanisms are put in place, innovations upon existing technologies may allow for more efficient and cost-effective implementation, which lead to widespread deployment.

4.4.1 Pharmaceutical industry

The pharmaceutical industry is a prime example of the value of incentives and R&D support to the overall innovation cycle. In particular, R&D support is provided to the sector through government grants, cooperative funding, tax incentives, and indirectly through intellectual property rights for the discovery and commercialization of new treatments, such as new medicines and vaccines.[94] The development lifecycle of a novel medicine can span over a decade, from the stages of initial laboratory research and pre-clinical testing, to clinical trials, and finally regulatory approval. This process is undoubtedly expensive, and failure to complete any stage successfully proves extremely costly to private firms due to the presence of high sunk costs.

Pharmaceutical companies can also utilize federal R&D tax credits, classified under Internal Revenue Code ("IRC") §§41 and 174, which act to further incentivize investments and relieve costs in various stages of drug development. These tax incentives allow companies to claim tax credits on a wide range of qualifying research expenses, such as employee wages, contracted research expenses, costs of supplies, and qualified clinical testing expenses.[95]

Another type of support mechanism in the pharmaceutical industry is the assignment of intellectual property rights. In the absence of any patent restrictions, competitors in the market would be able to make copycats of drugs (termed "generics" in the industry) for a much cheaper price, as these competitors would not have had to invest years of research and millions of dollars in basic R&D, testing, and marketing. These "generics" would be able to take away market share from the firm undertaking the initial R&D, without contributing to any of the pre-commercialization activities. Hence, the assignment of patents is an absolute necessity in the pharmaceutical industry, guaranteeing that firms are able to enjoy a temporary period of time where they are the sole provider of the drug (and therefore benefit from sales to recoup the investment costs incurred).

Together, these mechanisms have provided private companies with a relatively manageable risk profile, and incentivized countless beneficial advances in medicine. As of 2019, large

[94] Na, Blake. "Protecting Intellectual Property Rights in the Pharmaceutical Industry." *Chicago-Kent Journal of Intellectual Property* (April 2019).

[95] Corporate Tax Incentives. *Capturing Pharmaceutical R&D Tax Credits. 2016.* <https://cdn2.hubspot.net/hubfs/432161/offers/phase2/camp_nro_2/CTI_NRO2_PharmaceuticalRD.pdf?t=1476467594349>

pharmaceutical companies spent upwards of 17% of their annual revenues on R&D,[96] resulting in, on average, 37 new drugs being introduced in the US every year from 2010-2019.[97]

These new drugs have benefits such as increasing life expectancies, speeding up recovery times, reducing symptoms, and preventing future adverse effects for their users. Additional benefits to society can also be attributed indirectly to these innovations, such as reduced medication costs, medical visits, laboratory tests, and hospitalizations.[98] Thus, pharmaceutical innovations encouraged by various incentives have led to substantial improvements in the overall quality of life and health of society.

4.4.2 Deployment of solar photovoltaic arrays

Government support mechanisms – namely R&D funding and the prevalence of renewable subsidies in various forms – have generally been credited with the significant reduction in the capital costs of solar PV installations. Such government supports have originated across many countries.

For example, China has invested a significant amount of funding into improving the efficiency of solar technologies, which has driven a reduction in solar prices by 80% from 2008 to 2013, and thus has "fundamentally [changed] the economics of solar all over the world."[99] Since 2008, China has also supported domestic deployment of solar through programs such as the Golden-Sun feed-in-tariff (introduced in 2009), which has allowed manufacturers to improve the equipment. Similarly, Germany has also subsidized solar adoption through its 20-year feed-in-tariff program established in 2000 under the Erneuerbare-Energien-Gesetz ("EEG" or Renewable Energy Act). As a result, German solar capacity has risen from only 114 MW in 2000 to over 49 GW in 2019.[100] Following many iterations of global research initiatives and investments, the efficiency of solar PVs has grown from 1% to almost 25%.[101] The economics of such support programs stimulated

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[96] Investopedia. *Average Research & Development Costs for Pharmaceutical Companies.* August 8, 2019. <https://www.investopedia.com/ask/answers/060115/how-much-drug-companys-spending-allocated-research-and-development-average.asp>

[97] FDA: Center for Drug Evaluation and Research. *New Drug Therapy Approvals 2019.* <https://www.fda.gov/drugs/new-drugs-fda-cders-new-molecular-entities-and-new-therapeutic-biological-products/new-drug-therapy-approvals-2019#noveldrugs>

[98] Zozaya, Neboa, Bleric Alcala, and Jhon Galindo. "The Offset Effect of Pharmaceutical Innovation: A Review Study." *SAGE Journals* (September 14, 2019).

[99] Scientific American. *Why China is Dominating the Solar Industry.* December 19, 2016. <https://www.scientificamerican.com/article/why-china-is-dominating-the-solar-industry/>

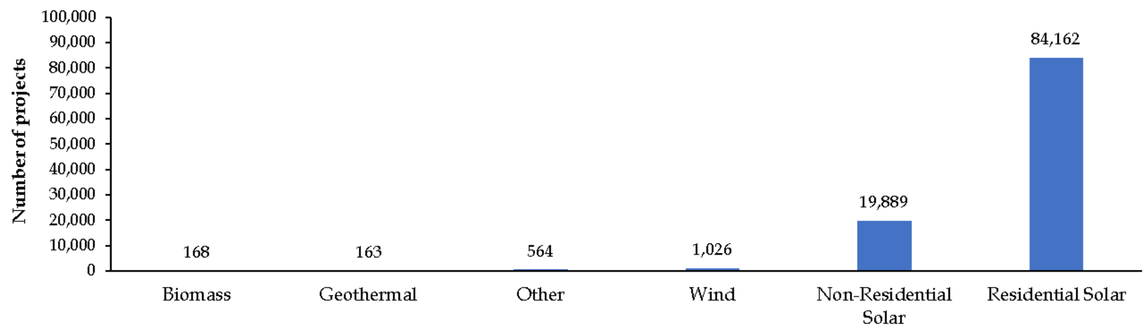
[100] PV Magazine. *German Grid Agency Reports 375 MW of New Solar in January but Revises Down Cumulative Figure 360 MW.* March 2, 2020. <https://www.pv-magazine.com/2020/03/02/german-grid-operator-reports-375-mw-of-solar-in-january-but-revises-down-total-figure-360-mw/>

[101] Bellini, Emiliano and Max Hall. *International Consortium Claims 25% Efficiency for Perovskite CIGS Solar Cell.* February 27, 2020. <https://www.pv-magazine.com/2020/02/27/international-consortium-claims-25-efficiency-for-flexible-cigs-solar-cell/>

technological development of the solar PV equipment to its higher efficiencies with lower costs, leading to more widespread implementation today.

In the US, government support of the solar PV industry has come in various forms, including: tax incentives such as the Investment Tax Credit ("ITC") enacted in 2006, which can be claimed on up to 30% of the costs of a solar installation; cooperative research (through laboratories funded by the US Department of Energy ("DOE")); legislation for providing local governments with tools to streamline, simplify, and expedite permitting of solar installations through the 2019 American Energy Opportunity Act;[102] and government grants. For example, the American Recovery and Reinvestment Act of 2009 ("ARRA") committed $25.7 billion dollars[103] as of 2017 to the development and deployment of renewable energy projects, comprising of primarily non-residential and residential solar projects (see Figure 19). This funding included cash payments to energy developers, and grants for up to 30% of the projects' total eligible costs.

Figure 19. Number of projects awarded ARRA funding by project type (2009-2017)



Source: US Department of Treasury. *Overview and Status Update of the § 1603 Program.* April 1, 2017.

Such international support for solar PV technology has had a significant payoff, as demonstrated by the technology's falling costs (see Figure 20 on the next page) and its increased adoption rate. According to the International Renewable Energy Agency ("IRENA"), the cost of solar PV has declined by 82% over the last ten years (2010-2019), from an average of $0.378/kWh in 2010 to $0.068 /kWh by 2019.[104] IRENA has also projected that by 2020, "solar PV will be a less expensive source of new electricity than the cheapest fossil fuel alternative."[105]

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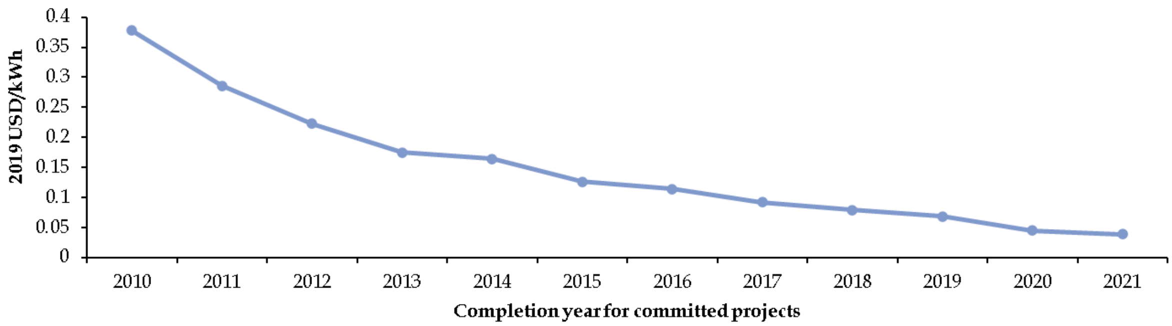
102 US Congress. *S. 2447 – American Energy Opportunity Act of 2019.* September 9, 2019. <https://www.congress.gov/bill/116th-congress/senate-bill/2447>

103 US Department of Treasury. *Overview and Status Update of the § 1603 Program.* April 1, 2017.

104 IRENA. *How Falling Costs Make Renewables a Cost-effective Investment.* June 2, 2020. <https://www.irena.org/newsroom/articles/2020/Jun/How-Falling-Costs-Make-Renewables-a-Cost-effective-Investment>

105 IRENA. *Falling Renewable Power Costs Open Door to Greater Climate Ambition.* May 29, 2019. <https://www.irena.org/newsroom/pressreleases/2019/May/Falling-Renewable-Power-Costs-Open-Door-to-Greater-Climate-Ambition>

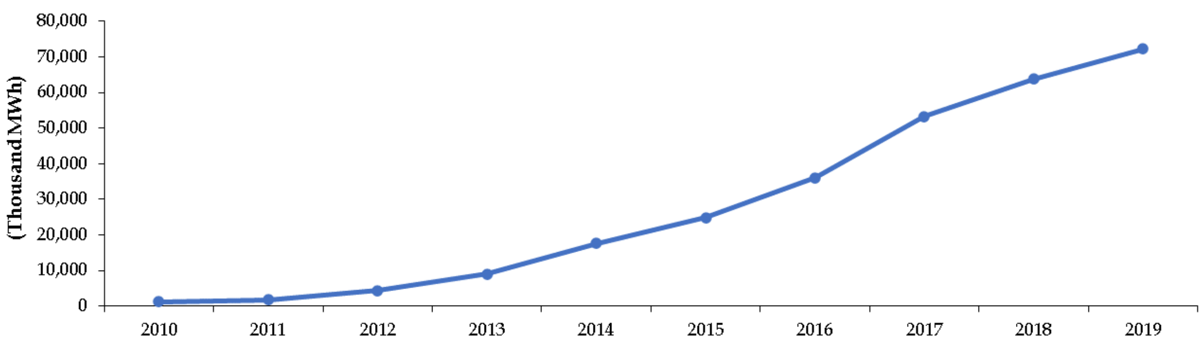
Figure 20. Declining costs of solar photovoltaic arrays



Source: IRENA. *How Falling Costs Make Renewables a Cost-effective Investment.* June 2, 2020.

In addition, according to the US Energy Information Administration ("EIA"), utility-scale solar installations have experienced an average growth rate of 72% per year from 2010 to 2016, making it the fastest-growing generating technology during this time period.[106] Net generation for all utility-scale solar has also experienced an annual growth rate of 50% over the last decade, as shown in Figure 21. Solar capacity in the US is expected to continue to grow, as the EIA projects that the electric power sector will add 12.6 GW of utility-scale solar capacity in 2020.[107]

Figure 21. Net generation for all utility-scale solar (2010-2019)



Source: US EIA. *Net Generation for All Utility-Scale Solar, Annual.* <https://www.eia.gov/electricity/data.php>

The increased deployment of solar could have widespread environmental benefits for society. According to the US Office of Energy Efficiency and Renewable Energy, the increased deployment of solar could meet up to 14% of US electricity demand in 2030, and 27% by 2050,

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[106] US EIA. *Utility-scale Solar has Grown Rapidly over the Past Five Years.* May 4, 2017. <https://www.eia.gov/todayinenergy/detail.php?id=31072#:~:text=Utility%2Dscale%20solar%20installations%E2%80%94including,than%20any%20other%20generating%20technologies>

[107] US EIA. *Short-Term Energy Outlook (STEO).* June 2020.

which "could reduce cumulative power-sector GHG emissions by 10% between 2015 and 2050, resulting in savings of $238–$252 billion."[108]

4.4.3 Widespread adoption of phasor measurement units

The history surrounding the widespread adoption of phasor measurement units ("PMUs") provides another useful example – specific to the electricity transmission space – where government support was instrumental in bringing about technological innovation to benefit consumers. PMUs were developed in the mid-1980s, and the first commercial sales occurred in the early 1990s, but it was only with funding support in the late 2000s (through the ARRA) that this device became standard issue on electric transmission systems.[109]

PMUs monitor synchrophasors many times faster than the traditional supervisory control and data acquisition ("SCADA") system. Because of these data reporting capabilities, this technology creates valuable reliability benefits for customers. In particular, PMUs allow for "early warning of grid events and dynamic behavior, fast identification of failing equipment and asset problems, and better models of equipment, generators, and power system."[110]

Technology overview: PMUs

Year developed: 1988

Year first installed: 1992

Number currently installed in the US: More than 1,350 PMU devices and 780 PMU substations

Benefits: Higher data reporting rates, rapid identification of oscillations and voltage instability, creating high-value operational and planning information for system operators

Sources: Phadke, A.G. *Synchronized Phasor Measurements: A Historical Overview*; IEEE/PES. *Transmission and Distribution Conference and Exhibition*. 2002. p. 476-479.

Through a smart grid investment grant worth $4.5 billion dollars[111] from the US DOE (under the ARRA), over 1,500 production-grade PMUs have been deployed over a period of 5 years, totaling over 1,350 PMU devices installed at 780 PMU substations across the US. The grant was directly provided to support utility projects to facilitate these installations.

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108 Office of Energy Efficiency and Renewable Energy. *The Environmental and Public Health Benefits of Achieving High Penetration of Solar Energy in the United States*. <https://www.energy.gov/eere/solar/downloads/environmental-and-public-health-benefits-achieving-high-penetration-solar>

109 US Department of Energy. *Recovery Act: Synchrophasor Applications in Transmission Systems*. <>https://www.smartgrid.gov/recovery_act/program_impacts/applications_synchrophasor_technology.html>

110 North American Synchrophasor Initiative. *Synchrophasors & the Grid*. September 13, 2017.

111 US Department of Energy. *Recovery Act: Smart Grid Investment Grant (SGIG) Program*. <https://www.energy.gov/oe/information-center/recovery-act-smart-grid-investment-grant-sgig-program>

The US DOE continues to support PMUs in order to incentivize further advancement and deployment. Future enhancements include incorporating machine learning and autonomous system protection schemes to further utilize transmission data and optimize the transmission system for energy providers and customers.

The access and visibility of data provided by PMUs allows many grid operators and transmission owners to gain insights on their assets in unprecedented ways. Benefits include being able to assess the health, status, and life expectancy of their generation and transmission equipment, including power transformers and measurement transformers. The information provided through this data may also help utilities introduce preventive measures to better optimize their operations and enhance their assets' power quality and life.[112]

[112] Usman, Muhammad U. and M. Omar Faruque. "Applications of Synchrophasor Technologies in Power Systems." *Journal of Modern Power Systems and Clean Energy* 7:211-226 (October 26, 2018).

5 Concluding remarks

According to the financial theory of risk and return, investors should be compensated with higher returns for taking on higher levels of risk. This aligns with the intent of the two ROE incentives proposed by FERC in its Electric Transmission Incentives NOPR – the RTO-Participation Incentive and the Transmission Technology Incentive. Because both endeavors (participating in an RTO and deploying advanced transmission technology) incur elevated levels of risk, TOs should be compensated for deploying projects with such incremental risk profiles.

Ultimately, the additional compensation offered through the RTO-Participation Incentive could stimulate investment and attract diverse capital to the transmission sector, thereby enhancing transmission investment in the future. Similarly, the Transmission Technology Incentive could facilitate deployment of projects that advance technological innovation, leading to lower costs over the longer term and enhanced reliability, operability and planning of the power grid. And, from the customer perspective, the beneficiaries of transmission investment and RTO participation, the proposed incentives are not so large as to surpass the significant benefits that are achievable through RTO participation and innovation.

5.1 The RTO-Participation Incentive is warranted

RTOs serve approximately 67% of the country's load, and thus form an integral part of the nation's electric system.[113] However, participating in an RTO creates risks for member utilities and TOs, which only appear to be increasing because of: (i) the basic construct of an RTO, as well as actions being taken by (ii) the federal government and associated institutions, and (iii) state and local policymakers. This is not to say that the actions being taken by federal and state policymakers are unwarranted – indeed, they are intended to drive a more efficient, more environmentally-compliant, more customer-centric, and more sustainable power system. As such, the risks faced by TOs are a byproduct of change that will ultimately benefit consumers.

First, the basic construct of an RTO dictates that TOs must relinquish regional planning and operational control to an RTO upon membership. Understandably, this significantly limits the decision-making ability of the TO, as issues related to transmission policy, stakeholder governance, and rate design become responsibilities of the RTO as a whole. However, it should be recognized that RTO participation enables wide-ranging benefits for customers, including facilitating more efficient use of the transmission system, providing access to large competitive markets, and ultimately achieving lower costs of power for consumers.

FERC has also promulgated numerous orders and rulemakings over the last ten years which have created additional challenges and uncertainties for RTO-participating utilities and TOs. For example, Order 1000, while seeking to improve planning and cost allocation processes, has also introduced some new complexities for TOs, which are more frequently experienced within RTO markets. Separate from Order 1000, FERC has promulgated rules that apply only to RTOs/ISOs, and thus further raised perceptions of risk in these regions.

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113 FERC. *Electric Power Markets.* <https://www.ferc.gov/market-assessments/mkt-electric/overview.asp>

Finally, state and local policymakers are pursuing decarbonization through the deployment of DERs and enhanced energy efficiency. These efforts, in spite of the challenges they have imposed on TOs, have created benefits for local customers as they have allowed the prioritization of their needs. These efforts are being implemented more aggressively in states that overlap with RTO footprints. Irrespective of the long-run benefits for consumers from local policy evolution, RTO-participating TOs continue to be exposed to an accelerated pace of industry change and raises uncertainties and risks in transmission development.

To encourage more efficient and effective transmission investment in the future, the increased risk perceived by investors has to be accounted for when thinking about the optimal rate of return, so that the industry can attract capital. The factors presented above provide ample evidence that elevated risks do indeed exist within RTOs, which should be duly compensated for through the proposed 100 bp RTO-Participation Incentive.

5.2 The Transmission Technology Incentive addresses risks of innovation

Deployment of innovative technology has its risks and rewards. The risks and obstacles to R&D and early stage adoption of new products and services has been well documented. As is the case for many other industries, use of innovative technology in the transmission space has faced issues such as technical risk, commercial/market risk, high costs of market entry, as well as a lack of customer understanding. FERC's proposed Transmission Technology Incentive is appropriate and necessary given such risks. Indeed, economic theory suggests that optimal levels of innovation may require, in many cases, government support. This is due to the market failures associated with the discrepancy between the risks faced by innovators, and the expected financial compensation from deployment of their innovative products and services – this is the well-known "public good" problem. At the same time, it is also well established that innovation creates significant benefits for consumers. As such, the Transmission Technology Incentive is justified.

It is also important to note that the concept of "technology" is critical to this specific incentive. Technology has a broad and inclusive meaning. For example, technology can involve hardware (e.g., physical assets and devices), information technology and software that are critical tools in the operation of transmission systems, and operational practices and processes. Moreover, it is well recognized that innovation may involve novel uses of technology components that already are in wide use today. New applications of existing resources, when deployed, will benefit consumers and therefore are inherently consistent with the underlying thesis for the Transmission Technology Incentive. As such, we recommend that the Commission's advanced technology incentive policy adopt a broader definition of technology and associated eligibility criteria, for purposes of driving innovation in the transmission sector.

6 Appendix A: List of acronyms

AC	Alternating Current
ACCC	Aluminum Conductor Composite Core
ARRA	American Recovery and Reinvestment Act of 2009
ATRR	Annual Transmission Revenue Requirement
bp	basis points
BTM	Behind-the-meter
CAGR	Compound Annual Growth Rate
CAISO	California Independent System Operator
CAPM	Capital Asset Pricing Model
CELT Report	Capacity, Energy, Loads, and Transmission Report
DCF	Discounted Cash Flow
DER	Distributed Energy Resource
DOE	Department of Energy
DSM	Demand-side Management
EEG	Erneuerbare-Energien-Gesetz (or Renewable Energy Act)
EIA	Energy Information Administration
EV	Electric Vehicle
FERC	Federal Energy Regulatory Commission
GW	Gigawatt
HVDC	High-voltage Direct Current
IRENA	International Renewable Energy Agency
IRP	Integrated Resource Plan
ISO	Independent System Operator
ISO-NE	ISO New England
IT	Information Technology
ITC	Investment Tax Credit
LCC	Line-communicated Converter
LEI	London Economics International LLC
MISO	Midcontinent Independent System Operator
NEPOOL	New England Power Pool
NESCOE	New England States Committee on Electricity

NOPR	Notice of Proposed Rulemaking
NYISO	New York Independent System Operator
OASIS	Open Access Same-time Information System
PJM	Pennsylvania-New Jersey-Maryland Interconnection
PMU	Phasor Measurement Unit
PSC	Public Service Commission
PUCT	Public Utility Commission of Texas
PV	Photovoltaic
R&D	Research and Development
RMRs	Reliability-must-run units
ROE	Return on Equity
RTO	Regional Transmission Organization
SCADA	Supervisory Control and Data Acquisition
SPP	Southwest Power Pool
TAPS	Transmission Access Policy Study Group
TO	Transmission Owner
US	United States
VSC	Voltage-sourced Converter

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8 Appendix C: LEI's qualifications

8.1 About the expert

Julia Frayer is a Managing Director at London Economics International LLC ("LEI"), with more than 20 years of experience providing expert insight and consulting services to a diverse set of clients in the power sector and associated infrastructure industries.

In the area of transmission, Julia has provided advisory services on a variety of subject matters, ranging from economic valuation to cost-benefit analysis, macroeconomic impact studies to revenue forecasting, and transmission tariff design. Specifically, Julia has worked with utilities, independent investors, financial institutions, regulators, RTOs/ISOs, and policymakers. She has authored numerous studies and performed expert testimony on issues regarding transmission and generation investment, wholesale market design, energy procurement, renewable investment strategies, and policy analysis.

Over the past decade, Julia has led numerous projects involving the blending of practical commercial business sense, economics, and state of the art application of analytical techniques, including econometrics, game theory, options analysis, and simulation modeling.

8.2 Background on the firm

LEI is a global economic, financial, and strategic advisory professional services firm specializing in energy and infrastructure. The firm combines detailed understanding of specific network and commodity industries, such as electricity generation, transmission and distribution, with a suite of proprietary quantitative models to produce reliable and comprehensible results. LEI's areas of expertise are briefly described in Figure 22.

Figure 22. LEI's areas of expertise

The firm has its roots in advising on the initial round of privatization of electricity, gas, and water companies in the UK. Since then, LEI has advised private sector clients, market institutions, and governments on privatization, asset valuation, deregulation, tariff design, market power, strategy, and strategy development in virtually all deregulated markets worldwide, including the United States, Canada, Europe, Asia, Latin America, Africa, and the Middle East. LEI is active across the power sector value chain and has a comprehensive understanding of the issues faced by investors, utilities, and regulators.

8.3 LEI's expertise related to transmission assets

LEI has extensive, in-depth experience in the transmission sector, spanning a broad array of regulatory, market and economic topics. LEI has worked with a variety of stakeholders and institutions on electric transmission engagements including RTOs/ISOs, state regulators, vertically-integrated utilities and transmission owners, merchant transmission developers, independent power producers, environmental groups, and coalitions of consumers. LEI principals have also testified on a variety of transmission related topics before state policymakers, regulators, and siting organizations. LEI's key areas of work in the electricity transmission sector include:

- ***Policy design:*** LEI's regulatory economics practice examines the universe of economic and financial issues facing regulators, market institutions, regulated companies, and consumers. Whether advising on regulatory strategy for a wires company, tariff design, or implementation of market reform for a regulator, LEI's ability to balance the needs of various stakeholder groups ensures durable, long-term, and cost-effective solutions to difficult regulatory conundrums.

- ***Valuing transmission assets:*** LEI creates meaningful simulations of transmission investment impact using proprietary tools such as Valuation of Transmission Augmentation Links (ViTAL), a modeling framework specifically designed for regulators and transmission system owners and operators. Other tools employed in LEI's cost-benefit analysis work include POOLMod, a network simulation model which is used to forecast electricity prices and quantify benefits of new transmission capacity. In addition, LEI provides advice and analysis related to the valuation of congestion contracts across North America using real options coupled with POOLMod. Finally, LEI has performed a number of economic development studies to investigate the positive externalities of infrastructure investment on local and regional economies, including estimation and measurement of labor sector (employment) benefits, environmental policy compliance (decarbonization), tax revenue implications, and more generally, the longer term value added contributions to the economy from the impact that new infrastructure has on lower overall costs of electricity.

- ***Transmission tariff design:*** LEI has extensive experience analyzing transmission rate design and developing new transmission tariffs using well established techniques for cost of service ratemaking, including empirically supported analysis of cost of capital, and efficient cost allocation. In the US and abroad, LEI has provided advisory and expert services on the theoretical and practical requirements of performance-based ratemaking and performed extensive empirical analyses necessary to support performance-based ratemaking schemes. LEI has also applied concepts of demand elasticity and customer-oriented market analysis in order to consider rate impacts for transmission companies and regulators.

- ***Procurement process and contract design:*** LEI applies fundamental economic principles and an exhaustive knowledge of electricity markets to help governments, regulators, and private companies create effective, rational, and transparent procurement processes including competitive solicitations for transmission capacity, and independent management of open seasons and open solicitations. LEI's support for procurement processes includes proposing selection criteria, drafting contracts, publicizing the procurement, communicating with stakeholders, monitoring the opening and examination of bids, and creation of an analytic and modeling framework to evaluate bids.

- ***Evaluating transmission alternatives:*** LEI's expertise includes assessing and quantifying the value of conventional and distributed energy resources as non-transmission alternatives to regulated transmission solutions, through analysis of the different generation technologies' costs, siting requirements, generation patterns, reliability implications to the system, and practical factors related to policy compliance and alignment with timing of needs. LEI has authored several studies related to non-transmission alternatives and the dynamic between transmission and market resource alternatives.