UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Avista Corp.	)	Docket Nos. ER26-2793-000
	)	
PacifiCorp	)	ER26-2795-000
	)	
NorthWestern Corp.	)	ER26-2802-000
	)	
Portland General Electric Company	)	ER26-2809-000
	)	
Puget Sound Energy, Inc.	)	ER26-2812-000
	)	
Idaho Power Co.	)	ER26-2813-000
	)	
Nevada Power Company and Sierra Pacific Power Company	)	ER26-2818-000
	)	
MATL LLP	)	ER26-2821-000

MOTION TO INTERVENE AND COMMENTS OF RENEWABLE NORTHWEST, ADVANCED ENERGY UNITED, INTERWEST ENERGY ALLIANCE, MONTANA ENVIRONMENTAL INFORMATION CENTER, NATURAL RESOURCES DEFENSE COUNCIL, NW ENERGY COALITION, AND SUSTAINABLE FERC PROJECT

Pursuant to Rules 211 and 214 of the Federal Energy Regulatory Commission's (Commission) Rules of Practice and Procedure,[1] Renewable Northwest,[2] Advanced Energy United,[3] Interwest Energy Alliance (Interwest),[4] Montana Environmental Information Center

[1] 18 C.F.R. §§ 385.211 & 214.

[2] Renewable Northwest is a non-profit 501(c)(3) regional advocacy group that works to facilitate the expansion of responsibly developed renewable energy, storage, and transmission lines in the Northwest United States, including Oregon, Washington, Idaho, and Montana. Renewable Northwest's members include renewable energy project developers and manufacturers, public and consumer interest groups, and others. The common goal of Renewable Northwest's members is to promote the development of a cost-effective, reliable, and clean energy system for the betterment of the Northwest economy and environment.

[3] Advanced Energy United is a national association of businesses that are making the energy we use secure, clean, and affordable. Advanced Energy United is the only industry association in the United States that represents the full range of advanced energy technologies and services, both grid-scale and distributed. Advanced energy includes energy efficiency, demand response, energy storage, wind, solar, hydro, nuclear, electric vehicles, and more. Advanced Energy United's members are active on the NorthernGrid transmission system.

[4] Interwest is a non-profit 501(c)(6) trade association representing leading renewable energy, transmission, and energy storage developers and manufacturers in Utah, Wyoming, Arizona, Colorado, Nevada, and New Mexico. Interwest has been actively engaged in the Order No. 1920 stakeholder meetings convened by the NorthernGrid Transmission Providers. Interwest's members are actively engaged in developing projects that rely on cost-effective

(MEIC),[5] Natural Resources Defense Council,[6] NW Energy Coalition (NWEC),[7] and Sustainable FERC Project[8] (collectively, the Clean Energy Organizations) respectfully submit comments requesting expeditious action by the Commission to the substantively identical Order No. 1920[9] compliance proposals filed by NorthernGrid enrolled transmission providers (NorthernGrid Transmission Providers).[10] Renewable Northwest, Interwest, MEIC, and NWEC also submit motions to intervene.[11]

transmission availability in NorthernGrid Transmission Providers' territories and will be directly impacted by the outcome of this proceeding.

[5] MEIC is a non-partisan, non-profit, and membership-based environmental advocate with thousands of members and supporters across Montana. Clean energy, increased interregional transmission capacity, and a unified western energy market that allows for a more efficient, affordable, and reliable energy system are central focuses of MEIC's advocacy to ensure clean air, clean water, and livability for Montanans now and into the future. MEIC's work is dependent on a robust transmission system connecting NorthernGrid Transmission Providers in Montana to the rest of the Western Interconnection.

[6] Natural Resource Defense Council is a national non-profit membership organization with more than 3 million members and engaged community participants worldwide. Natural Resource Defense Council has members throughout the United States. Natural Resource Defense Council is committed to the preservation and protection of the environment, public health, and natural resources.

[7] NWEC is a 501c(3) nonprofit membership organization based in Seattle, Washington, with operations in Idaho, Montana, and Oregon. For decades, NWEC has engaged in energy policy and regulatory matters throughout the Northwest to promote our interests in affordable, reliable, and efficient energy that minimizes and mitigates negative impacts on our natural environment and communities.

[8] The Sustainable FERC Project is an education and advocacy initiative that represents a consortium of national and regional environmental, consumer, and energy policy non-governmental organizations with members throughout the United States. Sustainable FERC Project focuses on accelerating the deployment of renewable energy by advocating electric regulatory policies that remove discriminatory barriers for these resources and ensure just and reasonable rates.

[9] *Building for the Future Through Electric Regional Transmission Planning and Cost Allocation*, Order No. 1920, 187 FERC ¶ 61,068, at P 379, *order on reh'g & clarification*, Order No. 1920-A, 189 FERC ¶ 61,126 (2024), *order on reh'g & clarification*, Order No. 1920-B, 191 FERC ¶ 61026 (2025).

[10] NorthernGrid Transmission Providers include Avista Corporation (Avista), Idaho Power Company (Idaho Power), MATL LLP (MATL), NorthWestern Corporation (NorthWestern), Nevada Power Company and Sierra Pacific Power Company (collectively, NV Energy), PacifiCorp, Portland General Electric Company (Portland General), and Puget Sound Energy, Inc. (Puget Sound). Because NorthernGrid Transmission Providers' explain that their proposed changes to Attachment K are "jointly-proposed" and their filings are substantially identical, we cite to Avista's filing throughout as representative of the filings submitted by the NorthernGrid Transmission Providers.

[11] Renewable Northwest, Interwest, MEIC, and NWEC have actively engaged in the Order No. 1920 stakeholder meetings convened by the NorthernGrid. Their members are developing projects and supporting solutions that rely on cost-effective transmission availability in NorthernGrid Transmission Providers' territories. They will therefore be directly impacted by the outcome of this proceeding. Their interests cannot be adequately represented by another party. Intervention is therefore in the public interest. Advanced Energy United, Natural Resource Defense Council, and Sustainable FERC Project do not submit motions to intervene because they have each already filed doc-less motions to intervene in these proceedings.

NorthernGrid Transmission Providers have put forth a proposal that makes significant progress toward regional long-term planning. Clean Energy Organizations file these comments to urge the Commission to act quickly on the compliance filing. Expeditious action would allow NorthernGrid to start planning as soon as possible under just and reasonable requirements. In addition, we highlight that the Commission has the authority to accept the Relevant State Entities' *ex ante* cost allocation proposal, which meets the requirements of Order No. 1920.

I. THE COMMISSION HAS AUTHORITY TO ADOPT THE COST ALLOCATION PROPOSAL PUT FORTH BY THE RELEVANT STATE ENTITIES

The Commission has authority to adopt the Relevant State Entities' proposed method, which is consistent with Order No. 1920's requirements. In Order Nos. 1920-A and 1920-B, the Commission expressly provided an opportunity for the Commission to consider as an alternative to the transmission provider's proposed *ex ante* cost allocation method any *ex ante* cost allocation method and/or State Agreement Process that is agreed to by the Relevant State Entities but not proposed by the transmission provider.[12] As the Commission explained, when acting under FPA Section 206, the statute "does not necessarily require the Commission to adopt the transmission provider's proposal on compliance, even if that proposal complies with the final rule's requirements."[13] "Rather, the Commission need only select a replacement rate the complies with the final rule and that is adequately supported in the record, and then intelligibly explain the reasons for its choice."[14] The Commission explained that there are good reasons for considering the alternatives agreed to by Relevant State Entities, because "States play a unique role" in that state policies are key drivers for the needs for Long-Term Regional Transmission

[12] Order No. 1920-A, 189 FERC ¶ 61,126 at P 654; Order No. 1920-B, 191 FERC ¶ 61026 at PP 25, 45 (sustaining the determination to require consideration of the RSE alternative on rehearing).
[13] Order No. 1920-A, 189 FERC ¶ 61,126 at P 658.
[14] *Id*.

Facilities, and Relevant State Entities typically have the responsibility for siting, permitting and construction of the facilities selected in a plan.[15] Giving careful consideration to the state-developed cost allocation methods and State Agreement Process has "heightened importance," because state buy-in to the transmission planning process, the transmission solutions it identifies, and the methods for paying for those facilities can help to mitigate the challenges and "inherent uncertainty" in planning for long-term transmission needs.[16] Thus, while there is no "generic or *per se*" preference for the alternative agreed to by Relevant State Entities, the Commission is authorized to adopt such an alternative in whole or in part, as may be supported by the entire record, consistent with the Commission's discretion to "determine and fix the replacement rate" under FPA Section 206.[17]

To their credit, NorthernGrid Transmission Providers have included the State Agreement Process put forward by the Relevant State Entities within their proposed cost allocation method.[18] While NorthernGrid Transmission Providers have not similarly elected to adopt the *ex ante* cost allocation method put forward by the Relevant State Entities, they have included it with their transmittals, as required by Order No. 1920-A.

The proposals put forth by the States reflect historic collaboration between states in the region. They were developed through a process facilitated by the Committee on Regional Electric Power Cooperation (CREPC), which includes utility regulators and state energy officials

[15] *Id*. P 659.
[16] *Id*.
[17] Order No. 1920-B, 191 FERC ¶ 61026 at P 68; *see also Entergy Ark., LLC v. FERC*, 40 F.4th 689, 701–702 (D.C. Cir. 2022) (upholding the Commission's rejection of a transmission provider's compliance filing—and imposition of a new cost allocation method not proposed by transmission provider—pursuant to the Commission's Section 206 authority).
[18] *See* Avista Transmittal Letter, at 58-60.

throughout the West.[19] Every Relevant State Entity that chose to vote on the proposals endorses them; not a single Relevant State Entity has expressed any reservation with the proposal.[20]

The proposed State Agreement Process meets the requirements of Order No. 1920.[21] While NorthernGrid Transmission Providers take issue with certain aspects of the proposed *ex ante* cost allocation method, it also meets the requirements of Order No. 1920. The Relevant State Entities proposed *ex ante* cost allocation method is a just and reasonable approach to allocate the costs of Long-Term Regional Transmission Facilities. The hybrid cost allocation method is a reasonable way to mitigate the inherent uncertainties of a longer-term, forward-looking planning process.

First, the capacity subscription component provides opportunities for entities to contract firm transmission service of new facilities through an open-season, therefore allowing for costs to flow first to entities that have already identified a valuable use case for the transmission capacity, whether that be to address resource adequacy concerns, enable competitive generation to access new markets, or resolve the potential for future reliability concerns. The inclusion of an initial subscription-based component is valuable because it likely affords Relevant State Entities greater confidence that the selected transmission facility will bring immediate value, even as the facility also is a more efficient or cost-effective means to address transmission needs that arise over longer-term horizons. As such, adopting the Relevant State Entities' preference to include such a subscription-based approach as part of the *ex ante* cost allocation may increase such entities' buy-in and confidence in Long Term Regional Transmission Planning process, and

[19] *See* Ex Ante Cover Letter and Proposal and SAP Letter (filed by each of the NorthernGrid Transmission Providers on June 12, 2026).
[20] *Id.*
[21] *See* Motion to Intervene and Protest of Interwest Energy Alliance, Docket No. ER26-2801 et al., at 31-33 (Aug. 5, 2026). The NorthernGrid proposed State Agreement Process is substantively identical to the process proposed by the Relevant State Entities in WestConnect, and meets the requirements of Order No. 1920 as explained in the Motion to Intervene and Protest of Interwest Energy Alliance in those dockets.

reduce some of the barriers to development of more efficient or cost-effective Long-Term Regional Transmission Facilities.

Relevant State Entities propose costs to be allocated in part on solution based DFAX analysis (25% for facilities > 300kV and 10% for facilities between 200 and 300 kV) and in larger part based on the measured benefits of the selected facility (75% and 90% respectively) is a just and reasonable approach to allocating the remainder unsubscribed costs of a selected Long-Term Regional Transmission facility.

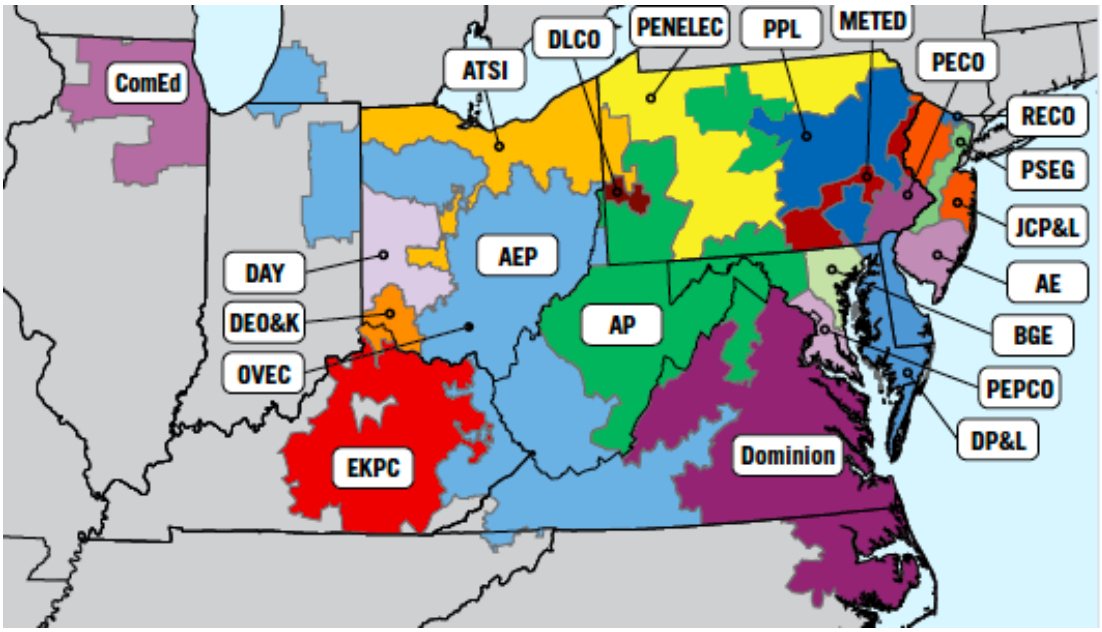
Solutions-based DFAX is a way of measuring utilization across a new transmission facility based on load withdrawn at any location. As such, it helps to track the value of a transmission facility to deliver power to load. [22] Solutions-based DFAX will thus tend to appropriately identify beneficiaries of addressing thermal and voltage violations on the transmission system that arise, in large part, based on changes the magnitude or pattern of demand for power.[23] DFAX therefore can in some circumstances be a just and reasonable complement to the Order No. 1920 benefits measurements, which do not directly measure the value of delivering power to load. The hybrid cost allocation proposed by the Relevant State Entities is just and reasonable because it will ensure zones with high load growth that benefit from a Long-Term Regional Transmission Facility will bear a component of its cost reflective of that value.[24]

NorthernGrid Transmission Providers contend that the "(DFAX)-based approach to cost allocation does not align with the interconnected nature of NorthernGrid, where it is difficult to

[22] Attachment A Affidavit of Dr. Adria Brooks on Behalf of Interwest Energy Alliance (Brooks Aff.) at 9.
[23] *Id.* at 13.
[24] *Id.* ("The addition of a load-informed cost allocation method like solution-based DFAX, as proposed by the [Relevant State Entities], helps ensure the costs of transmission solutions selected to resolve needs caused, in part, by load growth are allocated to those zones with high loads.").

create clear zones for the region without overlapping areas."[25] But as Dr. Brooks explains, NorthernGrid Transmission Providers already use the software and have access to the information needed to implement the Relevant State Entities' proposal. Dr. Brooks notes that the Western Electric Coordinating Council (WECC) already hosts power flow and production cost models for the entire Western Interconnection, which NorthernGrid utilities use in their regular near-term planning activities.[26] In addition, because NorthernGrid Transmission Providers propose to use production cost modeling software to calculate benefits, Dr. Brooks concludes that it would be straightforward to pull the zonal Power Transfer Distribution Factors matrix from the production cost modeling software—which use nodal or user-defined zonal Power Transfer Distribution Factors as its network representation—directly.[27] As a result, the same network representation of their footprints would therefore apply to all production cost savings and DFAX analysis,[28] allowing for implementation of the Relevant State Entities' proposal. Other utilities' experience also shows that interlinked transmission zones need not preclude DFAX: In PJM, for example, where DFAX is used, the ATSI and AEP transmission zones interlink in a complex manner:

[25] Avista Transmittal Letter at 61.
[26] Brooks Aff. at 15 (citing NorthernGrid, "Draft Final Regional Transmission Plan for the 2024-2025 NorthernGrid Planning Cycle" (Sept. 24, 2025), https://www.northerngrid.net/private-media/documents/NG_Study_Scope_2022-2023_Approved.pdf).
[27] *Id.* (citing Avista Proposed Tariff Att. K, § 3.4.3. (noting that Required Benefits 3 and 5 "will be measured using production cost modeling simulations")).
[28] *Id.*



[29]

And DFAX, by its nature, allows for assessment of load flows across a web of facilities and enables assignment to the entities that own or use those facilities.[30] Dr. Brooks explains that transmission providers can represent multiple facilities that have different owners but that are in the same geographic or electrical location nodally to retain utility ownership characteristics.[31] The result of such modeling would be a user-defined, hybrid zonal-nodal representation of the NorthernGrid territory in production cost modeling software.[32] If needed, Dr. Brooks notes that commercial software vendors regularly work with users to customize model cases to meet specific needs.[33] If the production cost modeling software licensed by the NorthernGrid Transmission Providers is for some reason unable to utilize a user-defined, hybrid representation of the system, however, then the production cost model could be solved using a nodal

[29] PJM, *PJM Zones*, https://www.pjm.com/-/media/DotCom/about-pjm/pjm-zones.pdf.
[30] Brooks Aff. at 14.
[31] *Id.*
[32] *Id.*
[33] *Id.*

representation of the system, with the resulting nodal benefits aggregated to the Transmission Provider level rather than facility level in post-processing.[34]

In addition, NorthernGrid Transmission Providers must have a means of tracking the transmission customers that benefit from the measured benefits under their proposed cost allocation method and identifying how to flow those charges appropriately to each individual Transmission Provider. It is unclear why the NorthernGrid Transmission Providers cannot use the same or a similar mechanism for doing so with the Relevant State Entities cost allocation method, whether that entails naming the cost allocation division "zones" or some other moniker. Further, the cost allocation mechanisms put forth by NorthernGrid and the Relevant State Entities both involve calculating the seven minimum benefits for each Transmission Provider.[35] As such, NorthernGrid Transmission Providers must necessarily develop methods for assigning benefits despite the overlapping nature of the transmission system within the NorthernGrid region. If anything, the fact that there are established methods for calculating DFAX will make carrying out this analysis and assigning it to transmission provider-specific zones an easier task than allocating the seven minimum benefits across overlapping transmission providers, and doing so will be complementary to the work needed to assign the minimum seven benefits to distinct beneficiaries.

II. CONCLUSION

For the foregoing reasons, the Clean Energy Organizations respectfully request that the Commission act expeditiously on the compliance filings put forth by the NorthernGrid

[34] *Id.* at 14-15.
[35] *See, e.g.*, Proposed Tariff § 3.6.4.1 (allocating benefits based on the "the dollar amount of Required Benefits, determined under section 3.6.4, to the specific Long-Term Enrolled Party Beneficiary").

Transmission Providers, and accept as a just and reasonable replacement rate the Relevant State Entities *ex ante* cost allocation method.

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document upon each person designated on the official service list compiled by the Secretary of the Commission in this proceeding.

Dated: August 5, 2026

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Attachment A

TESTIMONY OF DR. ADRIA BROOKS
ON BEHALF OF INTERWEST ENERGY ALLIANCE

I. BACKGROUND

Please describe your background.

My name is Adria Brooks. I currently work as Director of Transmission Planning at Grid Strategies LLC, where I provide advisory services on federal, regional, and state energy policy, transmission system planning, transmission technologies, reliability, and power system modeling. In this capacity, I provide strategic guidance to utilities, developers, public interest organizations, and government agencies to accelerate energy infrastructure deployment and improve system planning.

I have over 15 years of experience in the energy sector, including five years at the U.S. Department Energy (DOE) where I advised senior DOE and White House staff on transmission system planning and operations issues. During my time at the DOE, I served in the Energy Efficiency and Renewable Energy Office, the Office of Electricity, and the Grid Deployment Office. I co-authored several agency and national laboratory reports on national transmission system needs, impacts of federal policy reform on system costs, power system reliability, and national transmission planning studies. I oversaw several dozen research and funding programs all related to power system developments.

Prior to my role at the DOE, I served as a transmission planning engineer with the Wisconsin Public Service Commission. In this role I advised numerous Commissioners on transmission issues and developments at the Midcontinent Independent System Operator (MISO), the North American Electric Reliability Corporation (NERC), and Federal Energy Regulatory Commission (FERC). I worked closely with policy and economic experts to delivery internal reports and analysis of most relevant to the Commissioners. Like at the DOE, my time

with the Wisconsin regulator spanned multiple Administration changes, each of which had different energy priorities.

I earned a Bachelor of Science Degree in Engineering Physics from the University of Arizona in 2011, a Master of Science Degree in Electrical Engineering with a certificate in Energy Policy and Analysis from the University of Wisconsin—Madison in 2018, and a Doctor of Philosophy Degree in Electrical Engineering from the University of Wisconsin—Madison in 2020. My dissertation evaluated how a reformulation of the security-constrained economic dispatch problem used in power system modeling to account for generation variability would impact the wholesale market clearing practices of the Regional Transmission Organizations. My career has been marked by numerous awards and honors recognizing my contributions to advancing the field of power system engineering.

My curriculum vitae is enclosed at the end of this testimony. I submit this testimony in support of the Comments of Clean Energy Organizations. Unless otherwise noted, the statements in this testimony are based on my personal knowledge.

What is the purpose of your affidavit?

This affidavit clarifies that the *ex ante* cost allocation method proposed by the Relevant State Entities in the NorthernGrid region is based on decades of sound practice in other parts of the country and how it is related to the cost causation and beneficiary pays principles. I also discuss how the solution-based distribution factor component of the *ex ante* cost allocation method proposed by the Relevant State Entities can be easily evaluated for zones based on transmission ownership. To establish this, I provide an example of how the solution-based

distribution factor cost allocation method works. This is covered in Section II. Cost Allocation Method for Long-Term Regional Transmission Facilities.

II. COST ALLOCATION METHOD FOR LONG-TERM REGIONAL TRANSMISSION FACILITIES

Briefly describe what the NorthernGrid Transmission Providers proposed as the cost allocation method for Long-Term Regional Transmission Facilities.

The NorthernGrid Transmission Providers propose to allocate the costs of Long-Term Regional Transmission Facilities solely on zonal benefit evaluation. Under this proposal, the total facility costs would be split among the enrolled Transmission Providers in proportion each Transmission Provider's share of the sum of all seven benefits evaluated for the facility.

Briefly describe the Relevant State Entities' (RSE) alternative cost allocation method for Long-Term Regional Transmission Facilities proposal.

The RSEs in the NorthernGrid regions propose an alternative *ex ante* cost allocation method for Long-Term Regional Transmission Facilities to that proposed by the NorthernGrid Transmission Providers. The RSEs' proposal is based on decades of sound practice in other parts of the country.

The RSEs propose a hybrid cost allocation method that combines the following:

- Capacity subscription: the opportunity for entities to contract for firm transmission service using the new facility(ies) via an open season;
- Solutions-based distribution factor (DFAX) cost allocation: costs allocated based on the proportional power flow use of the new facility(ies) to meet zonal load measured using linear distribution factors; and

- Granular benefits-based cost allocation: costs allocated to zones based on granular zonal benefit evaluation of the new facility(ies).

Please describe the three components of the RSEs' cost allocation proposal in more detail.

The first component, capacity subscription, requires developers of selected Long-Term Regional Transmission Facilities to offer capacity on the Facility(ies) in an open season. The costs of whatever proportion of total facility capacity is purchased at auction are allocated via the open season to those participating.

The second and third components allocate the proportion of remaining costs after the open season concludes, with some costs allocated using the solutions-based DFAX method and some costs allocated using the granular benefits-based method depending on the nominal voltage rating of the facility. An illustrative example of the RSEs' proposed hybrid method is shown in Figure 2.

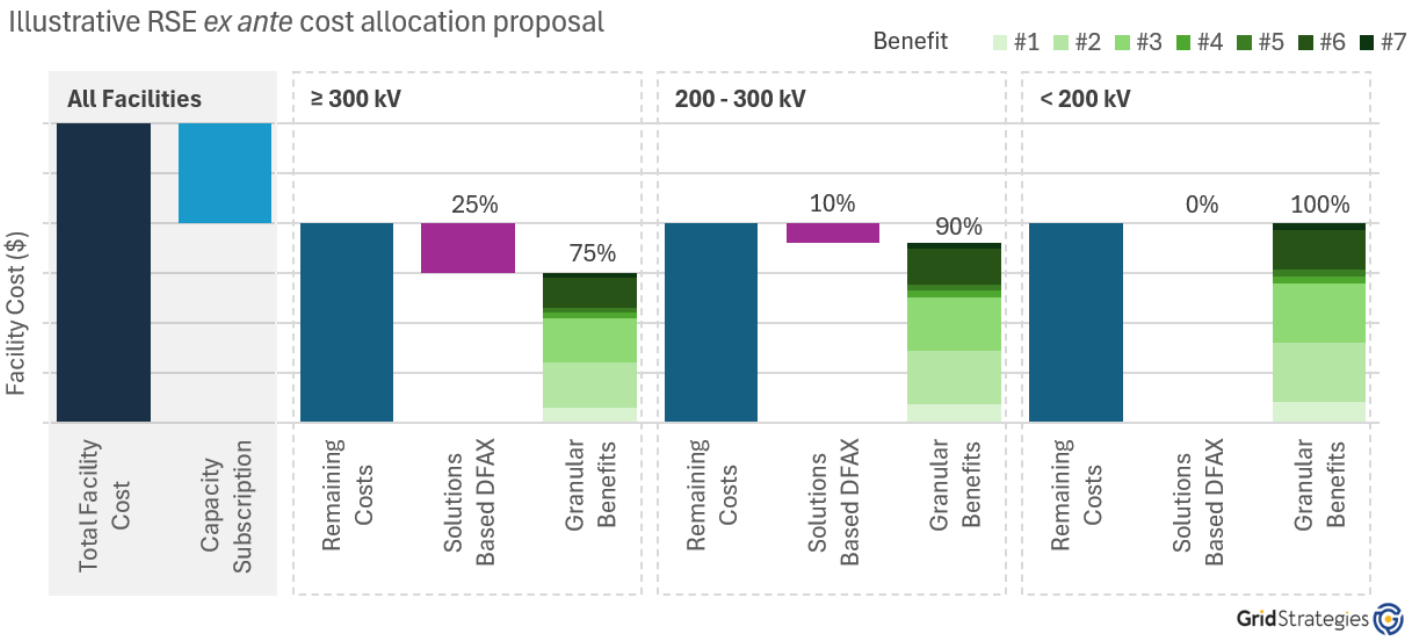

Figure 2. Illustrative example of RSEs' proposed ex ante cost allocation method for selected Long-Term Regional Transmission Facilities. The exact formulation depends on the nominal voltage rating of the facility.

Is there precedent for hybrid cost allocation methods like the RSEs propose and, if so, why?

Numerous regions allocate the costs of regional transmission facilities using a combination of cost allocation methods,[1] where the methods are applied differently based on facility voltage level. As the voltage rating of transmission facilities increases, more benefits are shared among the entire footprint. These benefits can be hard to fully capture via granular benefits evaluation only.[2] Acknowledging this, several existing cost allocation mechanisms tend to shift toward the use of a load-sensitive cost allocation mechanism, such as load ratio share or DFAX, for higher-voltage facilities.[3]

SPP's highway/byway cost allocation method, for example, allocates the costs of regional high-voltage facilities (≥ 300 kV) to every utility in the footprint based on its load ratio share, but allocates the costs of low-voltage facilities (≤ 100 kV) only to utilities in the zone where the facility is physically located (the "host" zone).[4] The PJM Interconnection (PJM) similarly allocates the costs of regional high-voltage transmission facilities (≥ 500 kV for AC and ≥ 345 kV for Direct Current facilities) using a combination of solution-based DFAX and load ratio

[1] Gretchen Kershaw et al., "Federal Transmission Pricing: The Evolution of Current Policies and Practices," Grid Strategies, at 29, 33-34 (May 2026), https://cleanenergygrid.org/wp-content/uploads/2026/05/GS_Federal-Transmission-Pricing-Vol-1.pdf.
[2] *Sw. Power Pool*, 131 FERC ¶ 61,252, at P 79 (2010) (noting high-voltage transmission provides benefits that are difficult to quantify, such as enhanced "reliability by reducing loading on existing lines and circuits which increases their capacity to withstand emergency situations"—benefits that accrue to all SPP members).
[3] Gretchen Kershaw et al., "Federal Transmission Pricing: The Evolution of Current Policies and Practices," Grid Strategies, at 27 (May 2026), https://cleanenergygrid.org/wp-content/uploads/2026/05/GS_Federal-Transmission-Pricing-Vol-1.pdf.
[4] Sw. Power Pool, Inc., Open Access Transmission Tariff, Attach. J, § III (21.0.0).

share,[5] and allocates the costs of lower-cost and lower-voltage facilities directly to the host zone. The tiered cost allocation mechanisms based on nominal voltage rating included in the RSEs' proposal follows this general practice, which recognizes that the benefits of higher-voltage facilities tend to be more geographically widespread than the benefits of lower-voltage facilities.

Please explain how DFAX relates to production cost modeling.

To calculate production costs, transmission planners must first build a reproduction of the electrical system—all generators, loads, and the transmission system connecting them—in the production cost modeling (PCM) software. The transmission planners then use the PCM software to model power flows from all generators across all transmission lines to all loads. Determining the actual alternating current (AC) power flow across the reproduced transmission system in the PCM software is a complicated, non-linear mathematical problem. Identifying the least-cost, optimal set of generators to operate without overloading any one transmission facility, as economic dispatch requires, further complicates the exercise.[6]

To make power system modeling *tractable* (meaning the modeling can be solved efficiently and scaled to large, complicated networks like the U.S. power grid), the AC optimal power flow problem can be simplified into a linear problem. Linear distribution factors are a common mathematical technique to define power flow on an electrical system and are the basis of many power system engineering studies. They are a useful tool for power system studies because they approximate AC power flows across the entire electrical network.

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[5] PJM, *Manual 14B: PJM Regional Transmission Planning Process*, Rev. 59 (Apr. 2026), https://www.pjm.com/-/media/DotCom/documents/manuals/m14b.ashx.

[6] Mary B. Cain et al. , "History of Optimal Power Flow and Formulation: Optimal Power Flow Paper 1," FERC Staff Paper, at 4 (rev. Aug. 2013), www.ferc.gov/sites/default/files/2020-04/acopf-1-history-formulation-testing.pdf.

There are several different distribution factors used in power system studies,[7] the most relevant to this discussion are Power Transfer Distribution Factors (PTDFs). PTDFs measure the incremental change of real power flow across every transmission line in the system given a change in demand for power. DFAX is equivalent to PTDFs.[8]

All PCM simulators use a simplified, linearized model of the electric network to find solution faster than would be possible using the full AC power flow representation.[9] These PCM software tools can provide the PTDF matrix used to represent the network as an output.[10]

PCM software also reduces the size of the transmission system by grouping like facilities together to calculate production cost savings faster. The use of network reduction techniques can reduce the size of modeled power grid from tens of thousands of individual transmission facilities to more like tens or hundreds, substantially simplifying modeling.[11] Common grouping characteristics include facilities that share similar electrical characteristics, are located close to one another, and share common ownership. While facility ownership is irrelevant to the

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[7] Tom Overby, "ECEN 615 Methods of Electric Power Systems Analysis. Lecture 14: Power Flow Sensitivities," Texas A&M University, Department of Electrical and Computer Engineering (2020), overbye.engr.tamu.edu/wp-content/uploads/sites/146/2020/10/ECEN615_Fall2020_Lect14.pdf.

[8] I will refer to "PTDF" when discussing the distribution factors used in modeling software and "DFAX" when referring to their application in cost allocation methods. For modeling purposes, they are interchangeable.

[9] Iowa State University, "Production Cost Models," Lecture notes from class EE 552, at 4 (March 2024), https://home.engineering.iastate.edu/jdm/ee552/ProductionCostModels.pdf ("The network may be represented using DC flow and branch limits" note to distinguish some PCM software's improvement over models that have a less sophisticated network representation.); Omar J. Guera et al., "Electric Power Grid and Natural Gas Network Operations and Coordination" National Laboratory of the Rockies, at 45 (Sept. 2020), https://docs.nlr.gov/docs/fy20osti/77096.pdf ("The unit commitment and economic dispatch problems are formulated in PLEXOS as mixed integer linear programming (MILP) models based on the DC-OPF"); Haifeng Liu et al., "Locational Marginal Pricing Basics for Restructured Wholesale Power Markets" IEEE 2009 Power & Energy Society General Meeting (Aug. 2009), https://ieeexplore.ieee.org/document/5275503.

[10] PowerWorld Corporation, "Power Transfer Distribution Factors," Software help documentation (2026), https://www.powerworld.com/WebHelp/Content/MainDocumentation_HTML/Power_Transfer_Distribution_Factors.htm.

[11] Dan Tylavsky et al., "Attribute-Preserving Optimal Network Reductions," Consortium for Electric Reliability Technology Solutions R&M Lecture Notes, Cornell University (2015), https://www.energy.gov/sites/prod/files/2015/09/f26/16-RM2015-Tylavsky.pdf; Florian Dorfler and F. Bullo, "Kron Reduction of Graphs with Applications to Electrical Networks," IEEE Circuits and System Society (2012) https://ieee-cas.org/media/kron-reduction-graphs-applications-electrical-networks.

underlying power system equations, this characteristic is important in practice when benefits and costs must be allocated to such owners. Following network reduction, only a handful of representative transmission facilities (created by grouping numerous actual facilities) should be left between each "zone." In practice, zones are made up of either individual or combinations of Transmission Owners, which greatly simplifies cost allocation based on zonal modeling results.

PCM software often leaves the choice of nodal (full network representation) or zonal (reduced network representation) modeling to the software user. Each software user can define zones as they need for their use case.[12]

Please explain solution-based DFAX and how it can be used as a cost allocation method.

As previously explained, DFAX is a measure of relative annual utilization of a transmission facility given load withdrawn at a particular location on the grid. Solution-based DFAX simply focuses the attention of the model on the distribution factors associated with the new transmission facility—the *solution*—rather than all transmission facilities that appear in a PTDF matrix. PJM first introduced solution-based DFAX as a regional cost allocation method (accepted by the Commission in Docket No. ER13-90 in 2013).[13] As the only transmission planning region to currently use DFAX as a regional cost allocation method, it is instructive to compare the RSEs' proposal to the solution-based DFAX method that PJM uses.

PJM defines solution-based DFAX as "decimal values or percentages, which express the portions of a transfer of energy from a defined source to a defined sink that will flow across a

[12] DIgSILENT, "PowerFactory – Texas Grid – Network Reduction – Regional Equivalent," (2025), https://www.youtube.com/watch?v=6JGZyeRsMbk (user help video demonstrating network reduction of ERCOT grid to a few nodes).
[13] *PJM Interconnection, L.L.C.*, 142 FERC ¶ 61,074, at PP 1-3 (2013).

particular transmission facility or group of transmission facilities."[14] PJM derives the distribution factor values using "a computer model of the electric network and using power flow modeling software."[15] As evident in this definition, PJM engineers derive the DFAX values from the PCM software using planning simulations rather than calculating them manually. As previously described, the PTDF/DFAX values representing the electric network are readily available from commercial PCM software.

To determine the power transfer distribution factors, PJM runs its PCM software for the future generation and load conditions and transmission topology anticipated in the future planning year. PTDFs describe physical characteristics of transmission facilities and are independent of the amount of incremental power transfer tested,[16] so the load and generation conditions used during the test (e.g., peak load or shoulder season) do not matter. PJM then runs the PCM again by increasing the load of an individual zone to determine the resulting power flow across the new facility to meet increased demand. The PTDF is the difference in this power flow across the facility, normalized by the amount of new load served.

An illustrative example of the PTDF calculation across a new transmission facility for four zones is shown in Fig. 3. The initial state of the power system is shown in Fig. 3(a). The PTDF (labeled "DFAX" in the figure) calculated across the new transmission facility given an additional MW of load in each Zone A–D is shown in Figs. 3(b)–3(e).

[14] PJM, Open Access Transmission Tariff Schedule 12 Section (b)(iii)(A) (17.0.0).
[15] *Id*.
[16] Tom Overby, "ECEN 615 Methods of Electric Power Systems Analysis. Lecture 14: Power Flow Sensitivities," Texas A&M University, Department of Electrical and Computer Engineering, at 6 (2020), overbye.engr.tamu.edu/wp-content/uploads/sites/146/2020/10/ECEN615_Fall2020_Lect14.pdf.

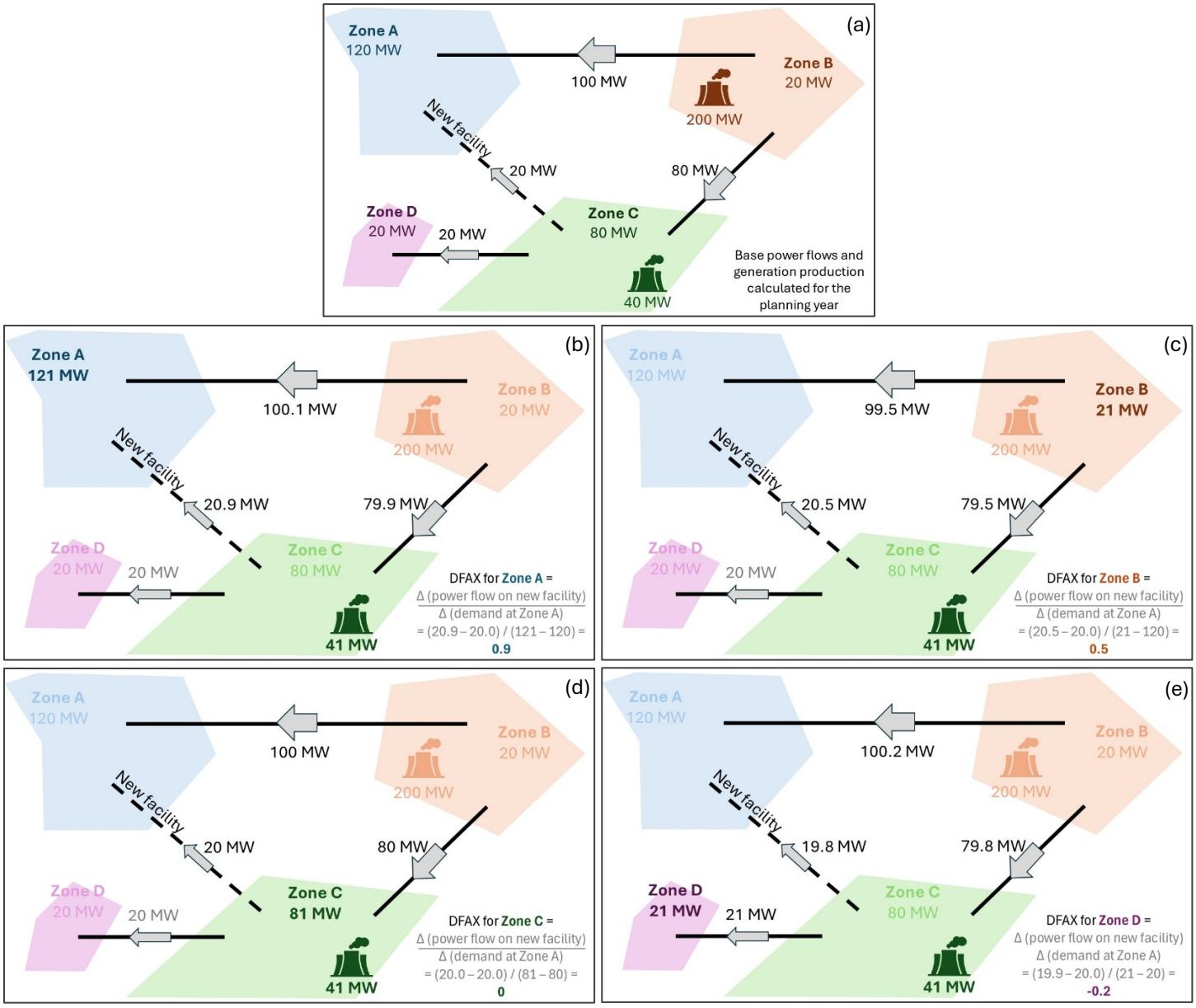

Figure 3. Illustrative example of PTDF/DFAX calculation across a new transmission facility for four zones. Panel (a) describes the initial test state of the system while panels (b) – (e) show the change in flow across the new facility given an additional 1MW of load withdrawn in Zones A – D, respectively.

Once PJM determines the PTDFs of the new transmission facility for each zone, PJM undertakes several steps to determine zonal cost responsibility.[17] These steps are illustrated in Fig. 4 for the example provided in Fig. 3. After determining the peak load for each region (Step

[17] PJM, Open Access Transmission Tariff Schedule 12 § (b)(iii) (17.0.0).

1), PJM calculates the DFAX and tests the *de minimis* threshold exception in Step 2.[18] In Step 3, PJM calculates each zone's absolute usage (in MW) of the new facility to serve its peak load by multiplying the zonal PTDF by the non-coincident peak load of each zone. Next, PJM calculates each zone's relative usage (in %) of the new facility by dividing the absolute usage from the previous step by the total usage of all zones. In Step 4, PJM calculates each zone's relative annual usage (in %) of the new facility by estimating how often power will flow across the new facility over the course of the future planning year given production cost modeling. This combination of steps will result in a final percentage of expected annual usage of the new facility by each zone to serve its peak load. PJM allocates costs based on this final percentage. This cost allocation method assigns cost responsibility to zones in direct proportion to their usage of the new transmission facility.

Total new facility cost ($M): **$300**

Step 4a: PCM Result: Percentage of annual power flow over facility in [+] direction: 80%

Step 4b: PCM Result: Percentage of annual power flow over facility in [-] direction: 20%

	Step 1: Zonal Load	Step 2: Calculate DFAX		Step 3: Calculate zonal usage of new facility				Step 4: Calculate annual zonal usage of new facility		Step 5: Allocate costs
Zone	Peak Load (MW)	2. DFAX	2a: Apply de minimus	3a: Absolute in [+] Direction (MW)	3b: Absolute in [-] Direction (MW)	3c: Relative in [+] Direction (%)	3d: Relative in [-] Direction (%)	4a: Relative in [+] Direction (%)	4b: Relative in [-] Direction (%)	Cost ($M)
A	135	0.9	0.9	121.5		90%		72%		$ 215
B	28	0.5	0.5	14.0		10%		8%		$ 25
C	100	0	0	0		0%		0%		$ 0
D	25	-0.2	-0.2		5.0		100%		20%	$ 60
All	288	N/A	N/A	135.5	5	100%	100%	80%	20%	$ 300
									100%	

Step 2a	
if	|DFAX| ≤ 0.01
then	0
else	DFAX

Step 3a	
if	DFAX > 0
then	(Peak Load) x DFAX

Step 3b	
if	DFAX < 0
then	(Peak Load) x |DFAX|

Step 3c	
if	DFAX > 0
then	3a / Σ(3a)

Step 3d	
if	DFAX < 0
then	3b / Σ(3b)

Step 4a	
if	DFAX > 0
then	3c x (PCM [+] result)

Step 3d	
if	DFAX < 0
then	3d x (PCM [-] result)

Figure 4. Solutions-based DFAX cost allocation steps given illustrative example in Fig. 3.

[18] For the sake of illustration, if the *de minimis* threshold had been set at 25%, then the DFAX for Zone D would have been set to 0 and no costs would have been assigned to that zone. Zones A and B instead would split full cost responsibility.

How is solution-based DFAX related to the cost causation and beneficiary pays principles?

Thermal and voltage violations on the transmission system arise as demand for power grows in magnitude and usage patterns change. New generation and transmission investments are needed to overcome these system violations. That is, new demand and usage patterns "cause" the need for new transmission investments.

As previously described, solution-based DFAX calculates usage of new transmission facilities based on both a zone or utility's peak load and estimated hourly demand. This is an approximation of the extent to which a zone or utility "caused" the need for the new transmission facilities. Cost allocation using solution-based DFAX assigns cost responsibility to zones based on their usage to reflect this estimate of cost causation. Cost allocation frameworks that true-up estimates of solutions-based DFAX over time, as in PJM,[19] capture both peak and hourly demand changes due to load additions in any zone, such that costs will increase in areas that use the transmission facilities more.

The addition of a load-informed cost allocation method like solution-based DFAX, as proposed by the RSEs, helps ensure the costs of transmission solutions selected to resolve needs caused, in part, by load growth are allocated to those zones with high loads.

How are zones defined for production cost modeling and DFAX calculations?

NorthernGrid Transmission Providers propose to distinguish benefits among different Transmission Providers, essentially defining modeling zones based on utility ownership and not

[19] Gretchen Kershaw et al., "Federal Transmission Pricing: The Evolution of Current Policies and Practices," Grid Strategies, at 45 (May 2026), https://cleanenergygrid.org/wp-content/uploads/2026/05/GS_Federal-Transmission-Pricing-Vol-1.pdf.

just geographic location.[20] This is common practice. All Regional Transmission Organizations (RTOs)/Independent System Operators (ISOs) have broken their service territories into zones based on desired system characteristics, chief among them the transmission provider footprints. For example, SPP defines its PCM modeling zones based on utility ownership.[21] PJM similarly defines zones based on both facility ownership[22] and electrical constraints that make power delivery non-trivial between the zones.[23] PJM redefines zones occasionally to account for changes in facility ownership, indicating the ease with which this can and should occur to account for contractual and physical changes on the electric grid.[24]

In cases where all facilities in one geographic—or more importantly for modeling, an *electric*—location are all owned by a single Transmission Provider, these can usually be represented together as a single electrical zone rather than representing each facility. Where multiple facilities in the same geographic or electric location have different utility owners, these facilities could be represented nodally to retain utility ownership characteristics. This would result in a user-defined, hybrid zonal-nodal representation of the NorthernGrid territory in the PCM software. Commercial software vendors regularly work with users to customize their model cases to meet specific needs. If the PCM software licensed by the NorthernGrid

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[20] Proposed Tariff Att. K, § 3.6.4 ("The Cost Allocation Task Force shall identify each Enrolled Party Beneficiary for which the Long-Term Eligible Cost Allocation Project produces a quantifiable share of the Required Benefits determined under Section 3.6.3 (each, a 'Long-Term Enrolled Party Beneficiary')").

[21] SPP, "Glossary Page" (2026), https://spp.org/glossary/?term=Zone (Definition of Zone as "The geographic area of the facilities of an SPP Transmission Owner (TO) or a specific combination of the TO as specified in the SPP Regional Tariff.").

[22] PJM, Open Access Transmission Tariff, Att. J (8.0.0) (defining each transmission zone as the territory of different transmission service providers).

[23] PJM, Open Access Transmission Tariff, Schedule 12, § (b)(iii) (17.0.0) ("In the DFAX analysis, Transmission Provider shall model generation both external and internal to individual Responsible Zones to reflect (a) the boundaries of Locational Deliverability Areas ('LDAs'), and (b) limitations with respect to the reliability objective for moving generation capacity across the transmission system.")

[24] PJM, Open Access Transmission Tariff, Schedule 12, § (b)(iii) (17.0.0) ("'Zone' or 'Zonal' shall mean an area within the PJM Region, as set forth in Tariff, Attachment J and RAA, Schedule 15, or as such areas may be (i) combined as a result of mergers or acquisitions or (ii) added as a result of the expansion of the boundaries of the PJM Region.").

Transmission Providers is unable to utilize a user-defined, hybrid representation of the system, then the PCM could be solved using a nodal representation of the system and the resulting nodal benefits would be aggregated to the Transmission Provider level rather than facility level in post-processing.

As previously described, all PCM software includes a nodal or user-defined zonal PTDF as its network representation. The Western Electric Coordinating Council (WECC) already hosts power flow and production cost models for the entire Western Interconnection, which NorthernGrid utilities use in their regular near-term planning activities.[25]

Given that NorthernGrid Transmission Providers will use PCM software to calculate benefits, it would be straightforward to pull the zonal PTDF matrix from the PCM software directly.[26] The same network representation of their footprints would therefore apply to all production cost savings benefits and the DFAX analysis.

III. CONCLUSION

This affidavit clarifies that the *ex ante* cost allocation method proposed by the Relevant State Entities in the NorthernGrid region is based on decades of sound practice in other parts of the country. It also explains how this proposal is related to the cost causation and beneficiary pays principles. Finally, I find that it should be trivial to calculate the DFAX contribution of each NorthernGrid enrolled Transmission Provider.

[25] NorthernGrid, "Draft Final Regional Transmission Plan for the 2024-2025 NorthernGrid Planning Cycle" (Sept. 24, 2025), https://www.northerngrid.net/private-media/documents/NG_Study_Scope_2022-2023_Approved.pdf.
[26] Avista Proposed Tariff Att. K, § 3.4.3. (noting that Required Benefits 3 and 5 "will be measured using production cost modeling simulations").

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Skilled Analyst with a broad range of experience in leading energy research and over 15 years of experience in the power systems and renewable energy sectors. Knowledgeable in technical project requirements including programming and engineering, with expertise in national power system models. Strong team leader and author of several different reports and peer-reviewed articles. Dedicated to supporting the evolution of the Nation's power grid. Skilled in effective written and oral communication, presenting technical material to diverse audiences, data visualization, programming in multiple languages, and bridging the divides between policy and engineering.

Areas of Expertise

- Electric Transmission Planning
- Power System Modeling
- Electricity Markets
- Clean Energy
- Data Center Integration
- Energy Equity & Justice
- Research & Analysis
- Policy & Regulation
- Team Leadership
- Stakeholder Relationships
- Presentations & Report Writing
- Data Visualization

Professional Experience

Grid Strategies, Bethesda, Maryland **February 2025 – present**
Director of Transmission Planning

Advises clients on regional transmission planning processes, contributing to data analysis, stakeholder comments, and regulatory filings. Contributes to and authors reports on system planning best practices, transmission benefit evaluation, resource adequacy, and grid enhancing technologies. Maintains good relations with a broad client base, including utilities, infrastructure development, power system modelers, environmental organizations, and consumer advocates.

- Authored or contributed to three technical affidavits and seven technical reports on regional transmission planning at the Federal Energy Regulatory Commission within first 18 months of employment.
- Consistently leads or contributes to more than one dozen projects at a time with different clients
- Has brought in and/or led contracts totaling $800,000 in revenue within first 18 months of employment.

U.S. Department of Energy, Washington, D.C. **October 2021 – February 2025**
Senior Technical Advisor in Transmission Planning

Key member of Grid Deployment Office with goal of enhancing the efficiency and reliability of the nation's power grid to meet decarbonization goals. Portfolio included national transmission planning given different policy and reliability constraints, analysis of power grid congestion and reliability concerns, management of several simultaneous research projects, technical stakeholder engagement, data center integration, and briefing leadership on grid needs.

- Led and advised research projects, including the *2023 National Transmission Needs Study*, which requires expert knowledge of the national power system modeling landscape and extensive stakeholder engagement. The *Needs Study* won "Best Published Research for a General Audience" from the American Energy Society.
- Led and participated in cross-cutting research teams on topics of interest to the White House and Secretary of Interest, including national transmission, data centers, and grid-enhancing technologies.
- Trusted subject matter expert and advisor to external transmission system studies, such as the NERC *Interregional Transfer Capability Study* and providing expert testimony at FERC technical conferences.
- Provided over one hundred briefings on technical transmission topics to the public, media, industry, and government leadership across the U.S. Briefings were frequently applauded by attendees as clear and engaging.

U.S. Department of Energy, Washington, D.C. **September 2020 – October 2021**
AAAS Science and Technology Policy Fellow

Provided analysis on top national renewable energy priorities, managed national lab research, and responded to Congressional or DOE leadership information requests. Projects included energy justice, electric transmission planning, electricity markets, and demand-side grid modeling.

- Facilitated more than a dozen workshops with 50+ attendees each, which involved developing workshop materials and coordinating schedules.
- Authored two reports for Congress within a few months and reviewed several dozen articles for leading power system journals.
- Managed a dozen projects simultaneously across different research groups.
- Developed a new energy justice roadmap project, which re-envisions a new suite of energy analysis tools focused on equity and justice.

Public Service Commission of Wisconsin, Madison, Wisconsin **January 2019 – August 2020**
Public Service Engineer

Spearheaded research projects and advised leadership regarding transmission planning and wholesale electricity market policies including issues with transmission planning, distributed energy resources, energy storage, and electric vehicles.

- Led multiple analyst and research projects.
- Advised Commissioners on transmission and renewable energy policy once per week.
- Wrote weekly internal policy memos to communicate transmission system material.

University of Wisconsin, Madison, Wisconsin **September 2015 – August 2020**
Graduate Research Fellow

Researched topics including electric power systems, electricity markets, optimal dispatch with variability, microgrids, renewable energy, and distributed energy resources. Oversaw a student project with the Midcontinent Independent System Operator (MISO) states to quantify the existence of distributed energy resources and to compare grid interconnection policies of other regional transmission organizations.

- Authored and published three peer reviewed papers and four conference papers.
- Led a weekly peer research group to produce a high quality report for a regulatory client.
- Coded for modeling research in four different programming languages.
- Reviewed several dozen articles for leading power system journals.

University of Arizona, Tucson, Arizona **May 2010 – September 2015**
Research Specialist

Led a team of eight students and post-graduate researchers. Installed and evaluated new photovoltaic (PV) systems throughout Southern Arizona, and analyzed system technologies for the benefit to electric utility companies, product developers, and the scientific community.

- Initiated 20+ different research projects to report performance and reliability measures of PV systems across Southern Arizona.
- Liaised with leaders of 12 utilities and solar energy companies to understand research needs.
- Authored four peer reviewed journal articles and 15 conference papers.
- Wrote three grant/contract applications awarding $395K to lab group.

Additional Experience

Research Fellow, Arizona Research Institute for Solar Energy, Tucson, Arizona
Engineering Intern, Semprius, Inc., Durham, North Carolina
Intern, National Renewable Energy Laboratory, Golden, Colorado
Environmental Conservation Intern, Student Conservation Association, AmeriCorps, Hawley, Massachusetts
Student Deputy Principal Investigator, Lunar and Planetary Laboratory, Tucson, Arizona
Research Fellow, National Space Science and Technology Center, Huntsville, Alabama

Education

Master of Science and Ph.D. in Electrical Engineering, August 2020
University of Wisconsin, Madison WI

Energy Analysis and Policy Certificate, December 2018
University of Wisconsin, Madison WI

Bachelor of Science in Engineering Physics, May 2011

Publications

Technical Reports

[R1] **Brooks, A.** "Capacity Value of Interregional Transmission." Grid Strategies. (Jul 2026)

[R2] **Brooks, A.** "Review of NERC's 2026 Summer Reliability Assessment." Grid Strategies. (Jul 2026)

[R3] **Brooks, A.** "Modeling the Order 1920 Benefit Metrics." Grid Strategies. (May 2026)

[R4] **Brooks, A.** "Review of NERC's 2025 Long-Term Reliability Assessment." Grid Strategies. (Mar 2026)

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[R8] "National Transmission Needs Study." U.S. Department of Energy (Oct 2023). *[Served as Principal Investigator]*

[R9] **Brooks, A.E.** "Renewable Energy Resource Assessment Information for the United States." U.S. Department of Energy Office of Energy Efficiency and Renewable Energy (Mar 2022).

Textbook Chapters

[T1] **Brooks, A.E.,** "Solar Energy: Photovoltaics." *Future Energy, 2nd Ed*. Ed Trevor Letcher. New York: Elsevier, 2014. 383-404. Print.

Journal Articles

[J1] Mai, T., Brown, P.R., Palchak, D., Brinkman, G., **Brooks, A.E.,** Denholm, P., Gramlich, R. Homer, J.S., Lew, D., Kuna, J., Okullo, J., Pfeifenberger, J., Rose, A., Simeone, C., and Wright, J. "What can we learn from US national transmission studies?" Joule *10*, 102339 (Feb 2026)

[J2] Frew, B., Anwar, M.B., Dalvi, S., **Brooks, A**., "The interaction of wholesale electricity market structures under futures with decarbonization policy goals: A complexity conundrum." Applied Energy. Vol 339 (Mar 2023).

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[C19] Cronin, A.D., Castillo, J.E., Hauser, P., Rosenberg, G.A., Kumar, R., Kostuk, R.K., Zhang, D., Russo, J.M., Vorndran, S., Lonij, V.P.A., **Brooks, A.E**. "Holographic CPV Field Tests at the Tucson Electric Power Solar Test Yard." 37th IEEE Photovoltaic Specialists Conference, Seattle, Washington, June 19-24, 2011.

[C20] Cronin, A.D., **Brooks, A.E.**, Cormode, D., Hardesty, G., Lonij, V.P.A. "Performance Reviews from the Tucson Electric Power Solar Test Yard." 37th IEEE Photovoltaic Specialists Conference, Seattle, Washington, June 19–24, 2011.

[C21] Ghosal, K., Burroughs, S., Lily, D., Gabriel, J., Cronin, A.D., **Brooks, A.E.**, Lonji, V.P.A., Krause, M.F., Lindsey, C., Metzger, S. "On-sun Performance of a Novel Microcell-Based HCPV System Based in Tucson: Comparison with Conventional Systems." 37th IEEE Photovoltaic Specialists Conference, Seattle, Washington, June 19–24, 2011.

Awards & Distinctions

Secretary of Energy Achievement Award (2) Department of Energy, Washington DC (Jan 2023 and Jan 2024)

Science and Technology Policy Fellowship Program American Association for the Advancement of Science, Washington DC (Aug 2020 – Oct 2021)

Grainger Power Engineering Award University of Wisconsin-Madison, Madison WI (April 2019)

Graduate Research Fellowship Program National Science Foundation, Washington DC (March 2016)

Wisconsin Distinguished Graduate Fellowship University of Wisconsin-Madison, Madison WI (August 2015)

Bill of Rights Award American Civil Liberties Union of Tennessee, Nashville TN (December 2008)

NASA Motivating Undergraduates in Science & Technology Award University of Arizona, Tucson AZ (May 2008)

First Place in Undergraduate Engineering Research University of Arizona, Tucson AZ (April 2008)

Academic Distinction Award University of Arizona, Tucson AZ (October 2006)

Arizona Excellence Scholarship for Undergraduate Studies University of Arizona, Tucson AZ (August 2005)

Professional Activities

Memberships

- IEEE Power and Energy Society & Women in Engineering (2019 – 2022, 2025-present)
- New England Women in Energy and the Environment (2022 – 2024)
- American Association of the Advancement of Science (2019 – 2023)
- National Science Policy Network (2019 – 2020)

Activities

- Evergreen Data Visualization Academy (2020 - 2021)
- Invited editor, IEEE and Elsevier on papers related to transmission planning and system modeling (2018 - 2022)
- Diversity Equity and Inclusion in the Workplace Certificate, University of South Florida Muma College of Business (2021)
- Data Visualization for Storytellers short course, University of California Berkeley (2021)
- Influencing Virtually short course, Georgetown University McCourt School of Public Policy (2021)
- Mentor with TryEngineering (2019 – 2020)
- Televised interview with Arizona Public Media for "Metro Week: Solar Energy Advances in the Southwest" (June 2015)
- MSHA Part 46 Surface Miner Certification (2011 – 2013)
- Solar Energy International Solar Electric Design and Installation Workshop, Guemes Island WA (2011)

Grants & Contracts

- Photovoltaic Crystalline-Silicon System Field Performance Comparative Study, SunPower Corporation, $150,000 (2013)
- FRV PV Heat-Islanding Monitoring Project of Interest, Fotowatio Renewable Ventures, $100,000 (2012)
- Photovoltaic System Field Performance Comparative Study, Rosemont Copper, $145,000 (2011)

Leadership and Community Service Activities

- Southern Arizona Rescue Association, Mountain Wilderness Rescuer (2024 - present)
- Teaching Assistants' Association, South Central Federal of Labor Delegate (2018 – 2020), Co-President (2016 – 2018), departmental steward (2015 – 2020)
- *The WEMPECKER* (departmental annual satirical paper), Lead Editor (2016 – 2018)
- Mountain Vista Unitarian Universalist religious education Chairperson (2014) and Youth Director (2012 – 2014)
- EON Youth Lounge volunteer (2005 – 2006 and 2011 – 2014)
- Camp Wildcat Vice-Chairperson (2010 – 2011), Secretary (2007 – 2008), youth counselor (2005 – 2011)
- One-In-Teen Youth Services Board Member (2003 – 2005)

References

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