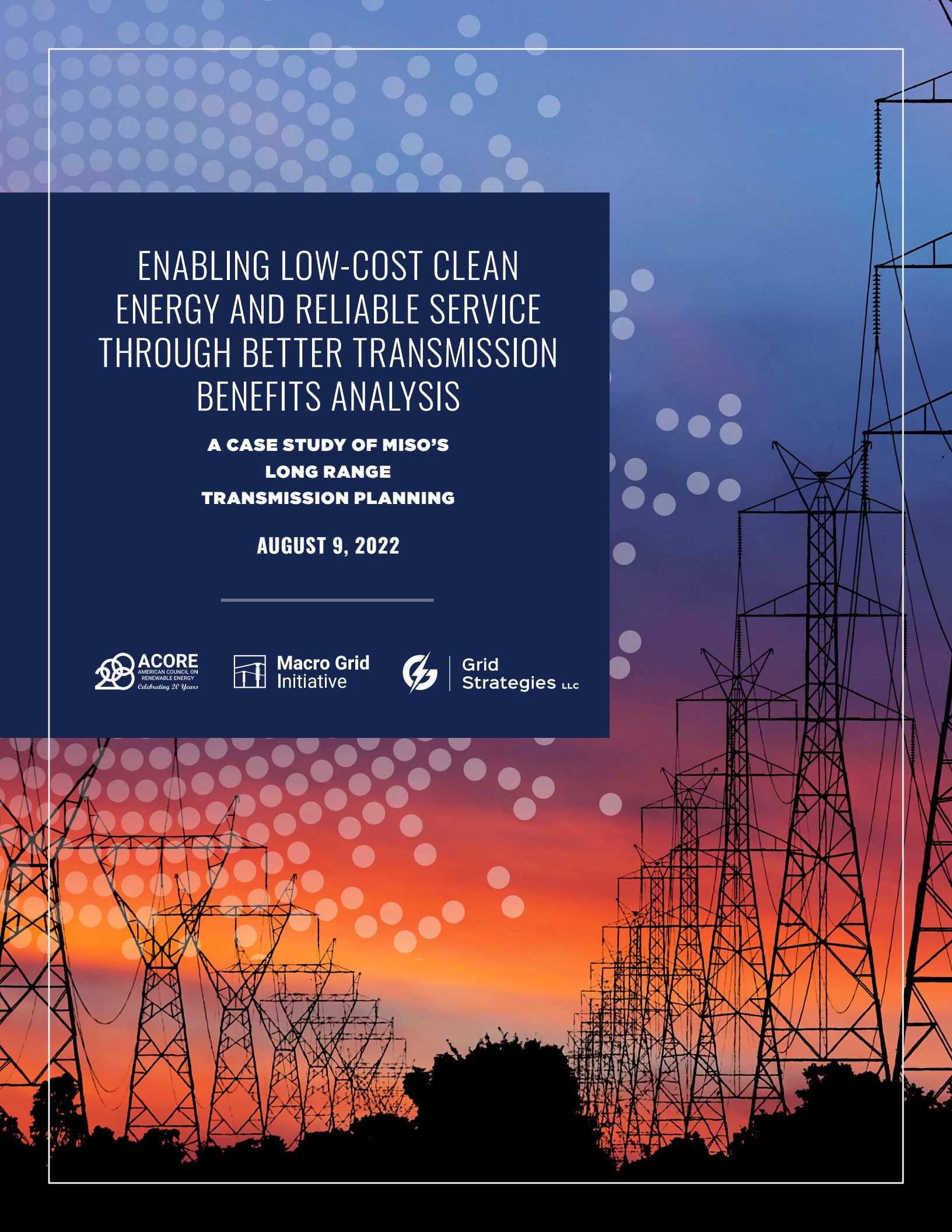
ENABLING LOW-COST CLEAN ENERGY AND RELIABLE SERVICE THROUGH BETTER TRANSMISSION BENEFITS ANALYSIS

A CASE STUDY OF MISO'S LONG RANGE TRANSMISSION PLANNING

AUGUST 9, 2022



AUTHOR

Rob Gramlich

Grid Strategies LLC

For ACORE and the Macro Grid Initiative

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Large-scale regional transmission plays a key role in ensuring low costs for consumers and electric system reliability, resilience, and decarbonization. Yet investment has lagged in recent years for high-capacity, long-distance lines in all regions of the United States. Over the last few years, the Midcontinent Independent System Operator (MISO) developed a new plan for a set of lines (known as Tranche 1) in its region that would enable around 56 gigawatts (GW) of new renewables. This plan was based on scenario modeling of state and utility emissions reduction goals that showed carbon emissions falling by more than 60% in 2040 from 2005 levels. The Tranche 1 portfolio was approved by the MISO Board of Directors on July 25, 2022.

To achieve regulatory approval and sufficient stakeholder support for such plans, it is important to measure the various benefits, and determine who receives those benefits. While the US Federal Energy Regulatory Commission (FERC) has jurisdiction over transmission planning and cost allocation, it has no standards in place on the types of benefits of or how to measure them to date. MISO worked with stakeholders and developed support for a set of benefits and methods, identifying approximately $37.3 billion worth of benefits delivered from a portfolio with $14.1 billion in 20-year total revenue requirement.

This analysis finds that MISO's methodologies generally follow best practice benefits estimation, with some areas that could be improved. Other planning entities and FERC could follow MISO's approach, along with the potential improvements, in their work on transmission planning. Similarly, electricity customers in MISO's footprint could benefit from potential improvements described in this paper as the region proceeds to the next phases of transmission development to meet additional expected changes in resources and load in the region.

INTRODUCTION

Transmission infrastructure expansion is critical for electric system reliability, accessing low-cost resources, and meeting climate and clean energy goals. After a wave of transmission expansion in some regions of the United States from 2008-2013, there has been an unfortunate lull for the last decade.[1] Failure to proactively plan and stay ahead of the resource transition has led to clogged interconnection queues, congestion, and frequent and costly curtailment of operating generators in most regions of the country. When regional planning entities have worked with states and stakeholders to proactively plan regional transmission networks and allocate costs broadly to all beneficiaries, it has generally been successful, even in getting these projects permitted, because of the consensus and evidence of benefits from the planning process. A central part of this successful approach to transmission expansion is to include multiple types of needs and benefits in the assessment and compare aggregate benefits to costs.[2]

Multi-value transmission planning sums the multiple benefits of proposed transmission, as opposed to many regions' standard practice of putting transmission projects into economic, reliability, or public policy siloes and only evaluating benefits within that silo, ignoring the project's other benefits. Like MISO's previous success with the Multi-Value Projects (MVPs), and similar success in ERCOT, SPP, and CAISO, in its most recent planning effort MISO used proactive transmission planning to identify the transmission need for the generation resources needed under state policies and utility generation plans. As it did with the MVPs, MISO planned a portfolio of networked facilities that provide benefits across the MISO North and Central footprint, which helps secure broad political support from all states. That support is essential for overcoming the hardest obstacle to building transmission — securing buy-in from each state to broadly allocate the cost of the transmission across the region.

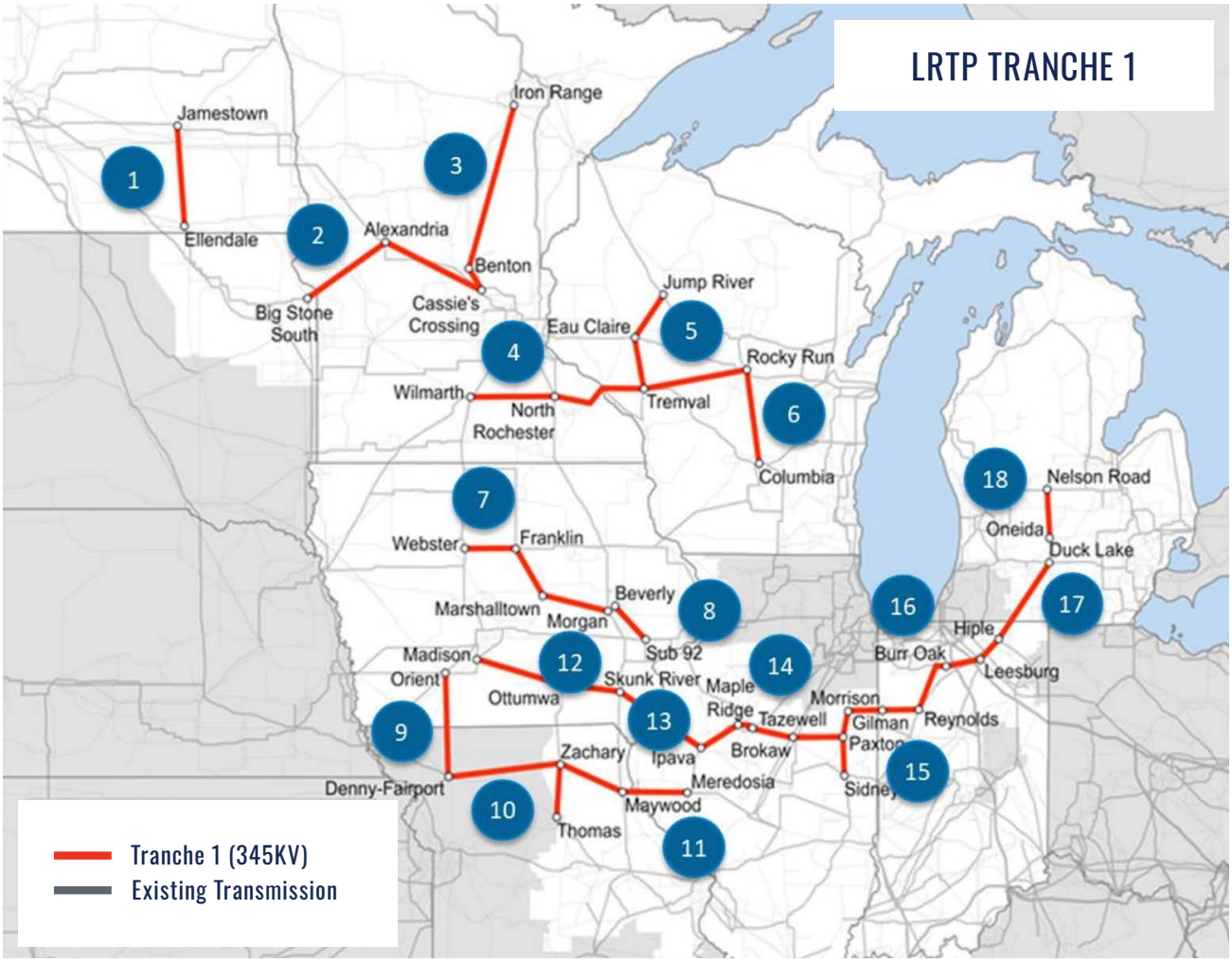
While this general approach of authorizing investment when benefits exceed costs is standard practice in the 100-year history of public utility regulation across many regulated industries, it is not yet standard practice in the US transmission sector. One area where practices still vary widely across the country is choosing the benefits to include in regional transmission assessments and determining how to quantify them. This paper seeks to further the development of consensus best practice benefits assessment by reviewing the benefits assessment in MISO's Long Range Transmission Plan (LRTP) "Tranche 1" portfolio.

In the spring of 2022 MISO released its LRTP Tranche 1 and in July the board unanimously approved the set of projects it proposes to move forward with in the near term. The MISO Board-approved projects are as follows:

1 See, e.g., Pfeifenberger, Gramlich, Spokas, Goggin, Hagerty, Caspary, Tsoukalis, Schneider, "Transmission Planning for the 21st Century: Proven Practices That Increase Value and Reduce Costs."

2 Pfeifenberger, Gramlich, Spokas, Goggin, Hagerty, Caspary, Tsoukalis, Schneider, "Transmission Planning for the 21st Century: Proven Practices That Increase Value and Reduce Costs."

FIGURE 1. *MISO LRTP Map of Tranche 1 Projects and Estimated Costs*[3]



MISO notes that this plan was "the culmination of two years of Futures development, modeling, and engineering and represents the most complex transmission planning study effort in MISO's history."[4] The plans help to achieve 60 percent decarbonization goals (saving 639 MMT of CO2 emissions over 40 years) and facilitate the development of 70 GW of new renewables.[5]

Achieving sufficient regional support is critical for such plans to secure agreements on cost allocation and ultimately gain siting permits from states. In pursuit of such regional support, MISO undertook a general high-level effort with its states and stakeholders called its "Reliability Imperative," aimed at ensuring reliability with the rapidly evolving grid needs. The Reliability Imperative followed a focused analysis on the impacts of renewable energy growth in its Renewable Integration Impact Assessment, which highlighted the need for changes to

3 "Reliability Imperative: Long Range Transmission Planning," 7.
4 Ibid.
5 "MISO Futures Report," 3–4.

transmission, resource adequacy, market design, and other areas of MISO's grid management.[6] MISO performed scenario analysis through its MISO Futures Report, outlining three "futures," representing a low, medium, and high degree of clean energy expansion, decarbonization, and load growth driven by electrification.[7] MISO is now in the process of turning these "futures" into transmission plans, beginning with the Tranche 1 portfolio corresponding to "Future 1." Future 1 is a scenario that is 63% decarbonized, with 70 GW of new renewable capacity additions, 10% energy growth based on meeting most (but not all) of utility clean energy targets in the region.[8]

In many ways, MISO's planning is like what other grid planners around the world are now doing as they all face similar changing grid needs. For example, this year the California Independent System Operator released its 20 Year Transmission Outlook[9] and the Australia Energy Market Operator released an Integrated System Plan.[10] However, in three key ways MISO is on the cutting edge of this work and ahead of most US regional planning entities:

1. by proactively planning for a future resource mix based on many states' and utilities' projections,
2. performing multi-benefit analysis including the incidence of benefits to different beneficiaries,
3. and identifying specific portfolios of transmission projects.

As a pioneer in this work, MISO is having to blaze a new trail in certain areas. Benefits assessment is one area where there is no standard path. As of the date of this report, there are no standards provided by FERC. MISO has noted in comments to FERC that "identifying

6 "Renewable Integration Impact Assessment."
7 "MISO Futures Report."
8 "LRTP Business Case," 6.
9 "20 Year Transmission Outlook."
10 "2022 Integrated System Plan for the National Electricity Market."

additional benefit metrics has proved challenging. The process to identify the two new benefit metrics for [Market Efficiency Projects] required years of stakeholder review."[11] Benefits assessment for MISO's Market Efficiency Projects has been discussed and debated for much of the last decade and has been the subject of contested proceedings at FERC and litigation in courts. Different regional planning efforts around the country have used somewhat different categories of benefits. One review of benefits assessments showed the following set of somewhat varying categories:

FIGURE 2. *Benefits assessments in previous planning studies*[12]

	SPP *2016 Regional Cost Allocation Review, 2013 Metrics Task Force*	MISO *2011 Multi Value Projects Analysis*	CAISO *2007 Team Analysis of Devers–Palo Verde No. 2 Transmission Line Project*	NYISO *2015 Study of Proposed AC Transmission Upgrades*
QUANTIFIED	1. production cost savings value of reduced emissions reduced AS costs 2. avoided transmission project costs 3. reduced transmission losses capacity benefit energy cost benefit 4. lower transmission outage costs 5. value of reliability projects 6. value of meeting policy goals 7. increased wheeling revenues	1. production cost savings 2. reduced operating reserves 3. reduced planning reserves 4. reduced transmission losses 5. reduced renewable generation investment costs 6. reduced future transmission investment costs	1. production cost savings and reduced energy prices from both a societal and customer perspective 2. mitigation of market power 3. insurance value for highimpact low-probability events 4. capacity benefits due to reduced generation investment costs 5. operational benefits (RMR) 6. reduced transmission losses* 7. emissions benefit	1. production cost savings (includes savings not captured by normalized simulations) 2. capacity resource cost savings 3. reduced refurbishment costs for aging transmission 4. reduced costs of achieving renewable & climate goals
NOT QUANTIFIED	8. reduced cost of extreme events 9. reduced reserve margin 10. reduced loss of load probability 11. increased competition/liquidity 12. improved congestion hedging 13. mitigation of uncertainty 14. reduced plant cycling costs 15. societal economic benefits	7. enhanced generation policy flexibility 8. increased system robustness 9. decreased nat. gas price risk 10. decreased CO_2 emissions 11. decreased wind volatility 12. increased local investment and job creation	8. facilitation of the retirement of aging power plants 9. encouraging fuel diversity 10. improved reserve sharing 11. increased voltage support	1. production cost savings (includes savings not captured by normalized simulations) 2. capacity resource cost savings 3. reduced refurbishment costs for aging transmission 4. reduced costs of achieving renewable & climate goals

11 "Comments of the Midcontinent Independent System Operator," 24.

12 Pfeifenberger, Gramlich, Spokas, Goggin, Hagerty, Caspary, Tsoukalis, Schneider, "Transmission Planning for the 21st Century: Proven Practices That Increase Value and Reduce Costs." P. 31.

To achieve the current level of agreement on benefits, MISO, its stakeholders, and the Organization of MISO States (OMS) engaged in lengthy discussions about which benefits to include and how to estimate them. Stakeholders wanted to compare the benefits to the $10.3 billion estimated overnight cost[13] of the Tranche 1 transmission portfolio, both in aggregate and in terms of benefits and costs accruing to load in each zone. MISO's MVP tariff requires "The project must generate total financially quantifiable benefits, including quantifiable reliability benefits, in excess of the total project costs based on the definition of financial benefits and Project Costs."[14] MISO's board also directs it to "[m]ake benefits of an economically efficient electricity market available to customers by identifying transmission solutions that enable access to the electricity at the lowest total electric system cost."[15] MISO ultimately arrived at a set of benefits to incorporate and quantified them to be $37.3 billion,[16] thus estimating a 3.6 benefit-cost ratio.

In this paper we review the set of benefits in MISO's LRTP Tranche 1 and how they were measured, to inform ongoing national discussions about how benefits assessments should be performed. This paper does not evaluate in any depth other aspects of the LRTP such as planning methods. On the surface it appears this plan and future tranches could be improved by better coordination with neighboring regions. On the positive side, the use of existing corridors is impressively high, near 90 percent for the lines,[17] but that is not the subject of this paper either. We now turn to the benefits assessment.

13 "MTEP21 Report Addendum: Long Range Transmission Planning Tranche 1 Portfolio Report," 4.
14 "LRTP Tranche 1 Portfolio Detailed Business Case," 7.
15 Ibid, 3.
16 "MTEP21 Report Addendum: Long Range Transmission Planning Tranche 1 Portfolio Report,"5.
17 "Reliability Imperative: Long Range Transmission Planning," 19.

MISO LRTP BENEFITS AND THEIR QUANTIFICATION

MISO analysis and distribution of benefits involved extensive stakeholder discussions in its Regional Expansion Cost and Benefits Working Group.[18] Minutes from this committee show that frequently over 150 people participate. Stakeholder input is received in these meetings as well as in writing, and MISO provides public oral and written responses to these comments, much like FERC does in its orders.[19]

In parallel to MISO's stakeholder group, **OMS ran a Transmission Cost Allocation Work Group (TCAWG) and a Cost Allocation Principles Committee (CAPCom) to develop a set of cost allocation principles.**[20] **OMS, for example, recommended zonal determination of benefits:**

"The OMS TCAWG believes that LRTP projects will generate multiple benefits, and each benefit will accrue to a particular geographic area or zone. While some project attributes might benefit the entire MISO region, others might accrue only to smaller regions."[21]

18 "MISO Regional Expansion Criteria and Benefits Working Group."

19 "RECBWG: Granular Benefits Identification and Cost Allocation (20220228)." . Responses provided here: https://cdn.misoenergy.org/20220527%20PAC%20Item%2002a%20MTEP21%20Addendum%20Appendix%20F%20-%20LRTP%20Tranche%201%20Substantive%20Comments624805.pdf

20 "Organization of MISO States Statement of Principles: Cost Allocation for Long Range Transmission Planning Projects."

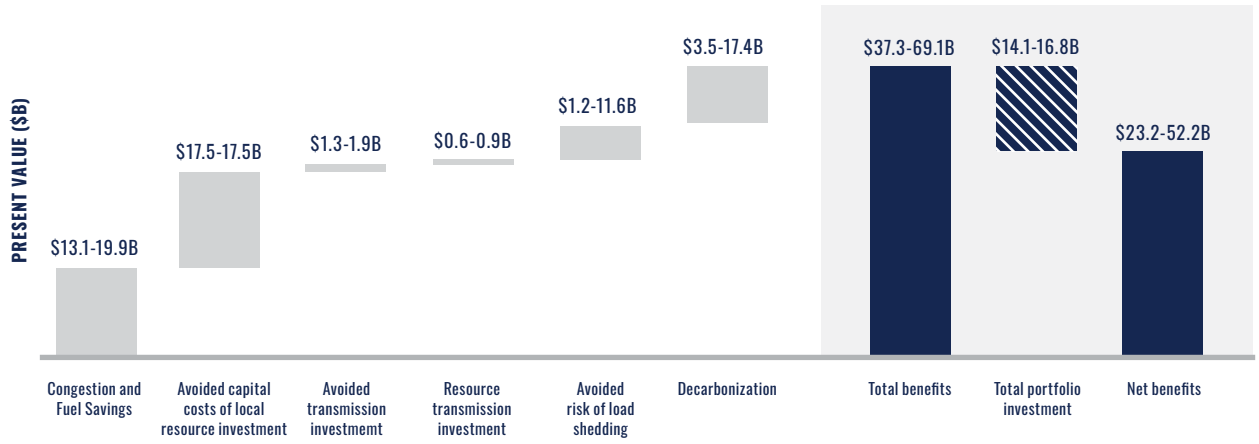
21 "RECBWG: Granular Benefits Identification and Cost Allocation (20220228)."

MISO's resulting set of benefit categories for LRTP Tranche 1 benefit-cost analysis includes the list below. Items A-D were included in previous MISO Multi-Value Project assessments, while items E and F were new categories or updated from the MVP methods:

A. Congestion and fuel savings
B. Avoided capital costs of local resource investments
C. Avoided transmission investment
D. Reduced resource adequacy requirements
E. Avoided risk of load shedding
F. Decarbonization
G. Reliability issues addressed by LRTP
H. Other qualitative and indirect benefits.[22]

The benefit of categories A-F in MISO's analysis are listed below.

FIGURE 3. *Benefits by category compared to cost, MISO LRTP Tranche 1*[23]



22 "LRTP Tranche 1 Portfolio Detailed Business Case," 10 Summarized from MISO Tariff - Attachment FF, II.C.5.
23 "Reliability Imperative: Long Range Transmission Planning," 8.

MISO noted there were stakeholder views in both directions—suggesting the benefits were either over-stated or under-stated. MISO stated, "In developing the methodology for each of the six benefit metrics, MISO was mindful to avoid overstating the value of benefits attributed to each metric, and most stakeholders broadly have agreed this transmission portfolio provides various benefits captured in the metrics."[24]

We compare the MISO LRTP Tranche 1 benefits assessment with best practice benefits assessment in the next section.

COMPARISON TO BEST PRACTICE BENEFITS ASSESSMENTS

Discounting approach

A general comment on each of MISO's estimates is that the discount rate and asset life should be changed to reflect standard economic welfare analysis. Standard economic policy analysis would include benefits over the life of the asset,[25] so the 40-year benefits would be the proper number to use. Ratepayers' valuation of future benefits is closer to the social discount rate of 3% than the cost of borrowing for investments of 6.9%, so the lower number should be used for discounting future benefits. Use of the lower discount rate approximately doubles the benefits.[26]

Benefits categories

The closest to a best practice, standard set of benefits can now be found in FERC's Notice of Proposed Rulemaking.[27] This set of benefits tracks closely with recommended practices in recent papers summarizing various multi-benefit planning efforts.[28] The exact definitions and organization of issues into distinct categories provided in FERC's taxonomy is slightly different from other approaches. As a FERC proposal, the taxonomy fits neatly within FERC's authority. There may be other benefits such economic development, environmental quality, and public health that may also be useful information to provide to stakeholders, but these benefits could be subject to challenge by parties to whom costs are allocated under authorities in the Federal Power Act. Ultimately, a cost allocation tariff must be approved by FERC based on its authority before any transmission plans can move forward, and specific allocations can be challenged at FERC.

24 "Planning Advisory Committee Summary of Review and Advice to Advisory Committee and Board of Directors MISO Transmission Expansion Plan (MTEP21) Addendum Appendix F."

25 Zerbe and Scott, "A Primer for Understanding Benefit-Cost Analysis," 20.

26 See each benefit category in "LRTP Tranche 1 Portfolio Detailed Business Case."

27 Building for the Future Through Electric Regional Transmission Planning and Cost Allocation and Generator Interconnection, 179 FERC ¶ 61,028 (2022).

28 Pfeifenberger, Gramlich, Spokas, Goggin, Hagerty, Caspary, Tsoukalis, Schneider, "Transmission Planning for the 21st Century: Proven Practices That Increase Value and Reduce Costs."

This section compares MISO LRTP benefits assessment with the 12 categories of benefits described by FERC.

(1) "Avoided or deferred reliability transmission projects and aging infrastructure replacement."[29]

This benefit is important because there are so many aging assets requiring replacement to comply with reliability standards, yet it is often more efficient to replace them with regionally planned portfolios. This benefit has been incorporated into a number of planning studies and plans.[30]

LRTP incorporated this benefit, estimating it at $1.3 billion to $1.8 billion.[31] This estimate includes 836 miles of expected asset replacements.

Based on benefits over the 40-year asset life discounted at the social discount rate of 3 percent, this benefit category should be reported as MISO's estimate of $3.7 billion.[32]

(2) "Either reduced loss of load probability or reduced planning reserve margin."[33]

This benefit is important because generation capacity is so expensive for consumers. Transmission can reduce the system-wide reserve requirements. As suggested by the name of the category, one can measure it in terms of the value of avoided loss of load or the reduced required reserve margin savings. Reduced loss of load expectation can be estimated by the value of lost load. Valuing averted load loss has been done in a number of cases.[34] One can also measure this same value in terms of the generation capital cost savings achievable through transmission. The alternative means of calculating this benefit of the generation cost savings from a lower Planning Reserve Margin has also been used in multiple cases.[35]

As MISO stated in its stakeholder process, "transmission is the enabler of reserve sharing for the MISO pool so that each load serving entity does not need to cover its own reserves but can share those resources when needed most."[36]

LRTP estimates this benefit at $624-893 million.[37]

It is not clear that MISO's analysis fully considers the capacity cost savings that result when

---

29 Building for the Future Through Electric Regional Transmission Planning and Cost Allocation and Generator Interconnection, 179 FERC ¶ 61,028 at P 189-193 (2022).

30 Order No. 1000, 136 FERC ¶ 61,051 at P 81; See, e.g., S.C. Elec. & Gas Co., 143 FERC ¶ 61,058, at 232 (2013); Pfeifenberger et al., "Transmission Planning for the 21st Century: Proven Practices That Increase Value and Reduce Costs," Pfeifenberger, Gramlich, Spokas, Goggin, Hagerty, Caspary, Tsoukalis, Schneider, "Transmission Planning for the 21st Century: Proven Practices That Increase Value and Reduce Costs." p. 37; SPP Engineering, SPP Benefit Metrics Manual, at 15 (2020); Newell et al., "Benefit-Cost Analysis of Proposed New York AC Transmission Upgrades," 114.; "Proposed Multi Value Project Portfolio," 42-44. "2022 Integrated System Plan for the National Electricity Market," 64.

31 "MTEP21 Report Addendum: Long Range Transmission Planning Tranche 1 Portfolio Report," 55.

32 Ibid.

33 179 FERC ¶ 61,028 at P 194-197

34 "Benefits for the 2013 Regional Cost Allocation Review," 25; Frayer et al., "How Does Electric Transmission Benefit You?: Identifying and Measuring the Life-Cycle Benefits of Infrastructure Investment."

35 "Proposed Multi Value Project Portfolio: Business Case Workshop," at 36-38; "Benefits for the 2013 Regional Cost Allocation Review," Section 5.1. ; Public Service Commission (PSC) of Wisconsin (WI), Order, re Investigation on the Commission's Own Motion to Review the 18 Percent Planning Reserve Margin Requirement, Docket 5-EI-141, PSC REF#:102692, dated October 9, 2008, received October 11, 2008, p 5; Southwest Power Pool (SPP), The Value of Transmission, January 26, 2016, p 16; "MISO Value Proposition 2020," Detailed Circulation Description, n.d., p 22.; "PJM Value Proposition," 2.; "2022 Integrated System Plan for the National Electricity Market," 64.

36 "Planning Advisory Committee Summary of Review and Advice to Advisory Committee and Board of Directors MISO Transmission Expansion Plan (MTEP21) Addendum Appendix F," 4.

37 "MTEP21 Report Addendum: Long Range Transmission Planning Tranche 1 Portfolio Report," 55.

the renewable energy portfolio is geographically diversified, as is enabled by transmission expansion. That benefit is not mentioned in its business case. The geographic diversification effect was about 5% capacity value increase in the Eastern Wind Integration and Transmission Study.[38] On-peak import capacity should be increased by the LRTP lines, yet it appears to be fixed at 2,331 MW ("unforced capacity," or UCAP).[39]

At a minimum the $1.6 billion based on a 3% discount rate and 40 year asset life should be used.

(3) Production cost savings.[40]

Production cost savings is the most basic and widely used type of benefit. It can be studied relatively easily with standard production cost software and data. It is proposed in the FERC NOPR and has been used in a number of planning efforts.[41] The category includes fuel and variable operating cost savings, and adjustments for imports from neighboring regions.

MISO LRTP incorporates this benefit, using the term "Congestion and Fuel Savings."[42] MISO reports benefits in this category of $13.1 billion over 20 years and $19.9 billion over 40 years at based on a discount rate of 6.9% to reflect the Weighted Average Cost of Capital.[43]

While these are significant benefits, using the 13.1-19.9 billion under-reports the benefits. MISO estimates 40-year benefits discounted at 3% are $38.2 billion, so that number should be used.

MISO also incorporates the value of carbon emissions reductions. Carbon cost savings can be included in the production cost category because it is the expected savings based on future environmental regulations. It is standard practice in RTOs to consider SOx and NOx permit costs as a standard operating cost of generators, used for market power monitoring and mitigation purposes. MISO LRTP estimates carbon savings to be $3.5 billion to $17.4 billion but includes this value under a separate metric.[44]

MISO LRTP's congestion and fuel savings analysis is very conservative due to the use of low natural gas prices. The sensitivity cases raise prices 20 and 60%.[45] Yet actual natural gas prices have doubled just in the last year.[46] While they could decline, the volatility itself in natural gas prices poses costs. A higher range for sensitivity analysis would show greater benefit.

(4) Reduced transmission energy losses.[47]

These are real operational savings from the lower losses that result from greater transmission

38 "Eastern Wind Integration and Transmission Study," 54.

39 "Planning Year 2022-2023 Loss of Load Expectation Study Report," 22

40 179 FERC ¶ 61,028 at P 198-201.

41 MISO, FERC Electric Tariff, Attach. FF, Benefit Metrics § (I)(A)(1) (33.0.0). See PJM Interconnection L.L.C.,142 FERC ¶ 61,214, at P 416 (2013) (PJM First Regional Compliance Order); New York Independent System Operator Corp.,143 FERC ¶ 61,059 at PP 268, 269, n.516 (2013) (NYISO First Regional Compliance Order); NYISO, NYISO Tariffs, OATT, attach. Y, § 31.5 (27.0.0), § 31.5.4.3.2. Pub. Serv. Co. of Colo., 142 FERC ¶ 61,206, at P 314 (2013); ATC, Planning Analysis of the Paddock-Rockdale Project, Docket No. 137-CE-149, app. C, Ex. 1, at 34-38 (Wisc. Pub. Serv. Comm'n Apr. 5, 2007). "Regional Cost Allocation Review (RCAR II)," 5; "2022 Integrated System Plan for the National Electricity Market," 64.

42 "MTEP21 Report Addendum: Long Range Transmission Planning Tranche 1 Portfolio Report," 47.

43 Ibid.

44 Ibid.

45 Ibid, 69-71.

46 "Natural Gas Weekly Update."

47 179 FERC ¶ 61,028 at P 202-204

capacity.[48] This has been calculated in various studies.[49]

LRTP did not explicitly estimate or report potential benefits in this area.

(5) Reduced congestion due to transmission outages.[50]

This is important because in the real world congestion tends to be much higher than it is in planning models, which assume all facilities are in service. In terms of benefits taxonomy, this could be considered as part of Adjusted Production Cost, or as a separate category as FERC does. As stated by MidAmerican in the LRTP process, "MidAmerican believes the production cost models used for this analysis provide conservative values for the congestion benefits because the transmission system is, for nearly all periods of time, in a state with more outages than the N-1 conditions assumed in MISO's models (i.e., there is nearly always multiple planned and forced outages at any given point in time which can have significant impacts on congestion)."[51]

LRTP does not explicitly calculate benefits from this category. MISO does note that the analysis is conservative because "the adjusted production cost value is understated because the model begins with a system intact state, which seldom is the case in MISO (i.e., there is nearly always multiple planned and forced outages at any given point in time which can have significant impacts on congestion)."[52]

---

48 179 FERC ¶ 61,028 at P 202

49 ATC, Planning Analysis of the Paddock-Rockdale Project, Docket No. 137-CE-149, app. C, Ex. 1, at 34-38 (Wisc. Pub. Serv.; "Regional Cost Allocation Review (RCAR II)," 5.

50 179 FERC ¶ 61,028 at P 205

51 "Planning Advisory Committee Summary of Review and Advice to Advisory Committee and Board of Directors MISO Transmission Expansion Plan (MTEP21) Addendum Appendix F," 3.

52 Ibid.

(6) Mitigation of extreme events and system contingencies.[53]

This category is increasingly important as weather changes present new conditions that should be included in planning. FERC defines this benefit as "reductions in production costs resulting from reduced high-cost generation and emergency procurements necessary to support the transmission system during extreme events (such as unusual weather conditions, fuel shortages, or multiple or sustained generation and transmission outages) and system contingencies."[54]

MISO includes this benefit but estimates it based on reduction of emergency events rather than reduction of production cost.

LRTP estimates this type of benefit to be $1.2 billion to $11.5 billion.[55] The wide range reflects the difference between the $3500/MWh and $23,000/MWh Value of Lost Load (VOLL), with the latter being recommended by the Independent Market Monitor (IMM).

Using the IMM recommended VOLL, 3% discount rate, and 40-year asset life in MISO's estimates yields a benefit in this category of $21.1 billion. Thus, $21 billion should be incorporated into the benefits assessment and reporting.

The analysis is also very conservative in several respects. As stated by the Environmental Sector in its comments on the plan, "MISO's methodology for estimating this benefit is limited to extreme winter weather events, both winter storms and extreme cold temperatures. This narrow perspective is a highly conservative measure of the total LRTP benefits of avoided loss of load. Extreme heat, hurricanes, drought, and flooding are all projected to impact the MISO territory as climate change impacts worsen."[56] A more thorough assessment of conditions could be drawn from National Oceanic and Atmospheric Administration and other authorities. MISO noted that "the adoption of reliability/resiliency benefits such as avoided risk of load shedding was intentionally limited in scope due to the challenges not only in analyzing the future weather impacts, but also in monetizing the value to the customer."[57] The description of the estimate should at a minimum characterize it as very conservative given this stated approach.

(7) Mitigation of weather and load uncertainty.[58]

This is an additional benefit stemming from the uncertainty associated with load and generation, and the value of transmission to integrate areas with load, generation, and "net load" diversity.[59] It has been incorporated in certain cases.[60]

MISO discusses these benefits in two qualitative categories: "reliability issues" and "other qualitative benefits." Neither category was quantified. But MISO explains, "Regional energy transfers increase in magnitude and become more variable, leading to a need for increased

53 179 FERC ¶ 61,028 at P 206-207

54 179 FERC ¶ 61,028 at P 206.

55 "MTEP21 Report Addendum: Long Range Transmission Planning Tranche 1 Portfolio Report," 64.

56 "Planning Advisory Committee Summary of Review and Advice to Advisory Committee and Board of Directors MISO Transmission Expansion Plan (MTEP21) Addendum Appendix F," 29.

57 Ibid.

58 179 FERC ¶ 61,028 at P 208-209.

59 Ibid.

60 ERCOT, Economic Planning Criteria: Question 1: 1/7/2011 Joint CMWG/PLWG Meeting, at 10 (Mar. 4, 2011). The $57.8 million probability-weighted estimate is calculated based on ERCOT's simulation results for three load scenarios and Luminant Energy estimated probabilities for the same scenarios.

extra-high voltage transfer capabilities."[61]

(8) Capacity cost benefits from reduced peak energy losses.[62]

This is also a distinct benefit category included by FERC.[63] It has been measured before.[64]

LRTP does not measure benefits in this category. MISO staff shared that the benefits were expected to be too small to factor in, given they were calculated in the 2011 MVP Portfolio and amounted to <1% of the total benefits.

(9) Deferred generation capacity investments.[65]

This benefit reflects the substitution of transmission for generation, which may result in savings.[66] These savings can be calculated and have been.[67] FERC defines this as transmission that "either defers or negates the need to invest in generation capacity resources within a transmission planning region by increasing import capability from neighboring regions into resource-constrained areas."[68] Thus it is a more localized concept, and separate from the system-wide resource adequacy benefit defined above.

LRTP does not explicitly use this category, though it is at least partially covered by the category below: access to lower cost generation. Specifically, MISO looked at how the Tranche 1 lines optimized renewable energy siting across the region and avoided more costly local development.[69] Other benefits that MISO could track include higher renewable energy capacity value due to geographic distribution and the import and export benefits. More explanation of this category would help stakeholders understand whether this benefit is incorporated.

(10) Access to lower-cost generation.[70]

This benefit is widely recognized though rarely actually incorporated. Generation capacity cost savings are separate from production cost savings described above. It is included in FERC's list[71] and has been included in a number of transmission valuation efforts.[72] There is often a tradeoff between more remote low-cost generation delivered with transmission, and more local higher cost generation that requires less transmission. Remote generation is not only typically higher quality resources in terms of resource adequacy contributions, but also are more diverse resources which also improves their capacity value contribution. Planners should assess this

---

61 "LRTP Tranche 1 Portfolio Detailed Business Case," 47.

62 179 FERC ¶ 61,028 at P 210-212.

63 179 FERC ¶ 61,028 at P 210-212.

64 ITC Holdings Co., Joint Application, Docket No. EC12-145-000, at Ex. ITC-600, 77-78 (Test. of Pfeifenberger) (filed Sept. 24, 2012); Southwest Power Pool, SPP Priority Projects Phase II Report, Rev. 1, April 27, 2010, p 26.; ATC, Planning Analysis of the Paddock-Rockdale Project, April 5, 2007 (filed in PSCW Docket 137-CE-149, PSC Reference # 75598), pp. 4, 63; Midwest ISO (MISO), "Proposed Multi Value Project Portfolio," 25 and 27.

65 179 FERC ¶ 61,028 at P 213-215.

66 Ibid.

67 ITC Holdings Co., Joint Application, Docket No. EC12-145-000, at Ex. ITC-600 (Test. of Pfeifenberger) (filed Sept. 24, 2012) at 58-59.; "2022 Integrated System Plan for the National Electricity Market," 64.

68 179 FERC ¶ 61,028 at P 214.

69 "Reliability Imperative: Long Range Transmission Planning," 20.

70 179 FERC ¶ 61,028 at P 216-218.

71 Ibid.

72 Opinion Granting Certificate of Public Convenience and Necessity, In the Matter of the Application of Southern California Edison Company (U 338-E) for a Certificate of Public Convenience and Necessity Concerning the Devers-Palo Verde No. 2 Transmission Line Project, Application 05-04-015 (Cal. Comm'n Jan. 27, 2007); Midwest ISO, RGOS: Regional Generation Outlet Study, November 19, 2010, p. 32 and Appendix A.; Billo, "The Texas Competitive Renewable Energy Zone Process."; "2022 Integrated System Plan for the National Electricity Market," 64.; American Transmission Company LLC (ATC), Arrowhead-Weston Transmission Line: Benefits Report, February 2009, p 7.

tradeoff. As available local sites are used up over time, it is reasonable to expect a greater need for and reliance on remote resources, justifying more transmission.

MISO's Regional Generation Outlet Study in 2010 was innovative in this area, showing a "bathtub" curve with higher prices for high reliance on only local or only remote generation, with a lower middle sweet-spot of an optimal combination of transmission, remote, and local generation.[73] This benefit is realized by accessing more productive renewable resource areas, so a comparable amount of renewable energy generation (measured in MWh) can be obtained with a smaller investment in the amount of installed renewable capacity (measured in MW). By accessing some amount of remote, cheaper generation, MISO's initial analysis found that its MVP portfolio reduced the present value of wind generation investments by between $1.4 billion and $2.5 billion, offsetting approximately 15% of the transmission project costs.[74]

MISO LRTP incorporates this benefit and values it at $17.5 billion.[75]

This benefit should be reported as $18.4 billion which is what MISO estimates using the social discount rate.

(11) Increased competition.[76]

This category is important because transmission can broaden the "geographic market," enabling more suppliers to compete and preventing the exercise of localized market power in both energy and capacity markets, driving down prices. FERC described a few ways to analyze this benefit.[77] It has been incorporated in some instances.[78]

LRTP does not mention or incorporate this benefit.

Increased market liquidity.[79]

This distinct benefit relates to the increased number of transactions when more trade is possible, reducing the variation in prices and increasing the transparency of the market.[80]

LRTP does not mention or include benefits in this area.

73 "Multi Value Project Portfolio: Results and Analysis," 16.

74 "Proposed Multi Value Project Portfolio," 25 and 38-41.

75 "MTEP21 Report Addendum: Long Range Transmission Planning Tranche 1 Portfolio Report," 53.

76 179 FERC ¶ 61,028 at P 219-224.

77 179 FERC ¶ 61,028 at P 219-224, citing Pfeifenberger et al., "Transmission Planning for the 21st Century: Proven Practices That Increase Value and Reduce Costs," 46-47, and Wolak, F. A., "Managing Unilateral Market Power in Electricity," 8.

78 Opinion Granting Certificate of Public Convenience and Necessity, In the Matter of the Application of Southern California Edison Company (U 338-E) for a Certificate of Public Convenience and Necessity Concerning the Devers-Palo Verde No. 2 Transmission Line Project, Application 05-04-015 (Cal. Comm'n Jan. 27, 2007); ATC, Planning Analysis of the Paddock-Rockdale Project, at 44-49 (Apr. 5, 2007). CAISO, Transmission Economic Assessment Methodology, Chapter 4, 1-12 (2004).

79 179 FERC ¶ 61,028 at P 225

80 Ibid.; Pfeifenberger, Gramlich, Spokas, Goggin, Hagerty, Caspary, Tsoukalis, Schneider, "Transmission Planning for the 21st Century: Proven Practices That Increase Value and Reduce Costs." P. 50.

GENERAL ASSESSMENT OF LRTP BENEFITS ASSESSMENT

MISO's LRTP for its Tranche 1 portfolio is a sound approach generally, reflecting the main benefits of transmission. The method reflects a conservative view of the types of benefits to include and the methodologies and assumptions used to calculate them. Seven of FERC's 12 categories are not included.

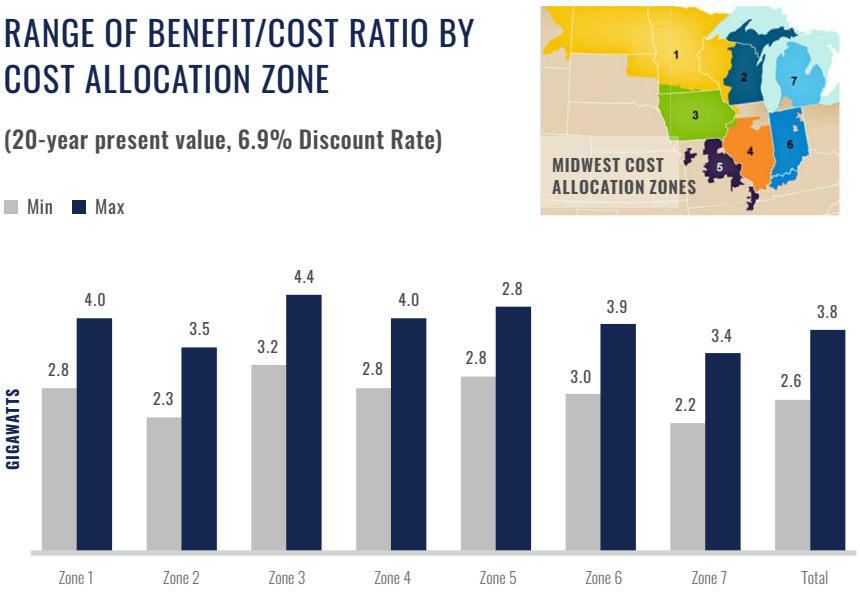
More explanation is required to understand why resource adequacy benefits were estimated to be so low. It is not clear why that category is not in the billions of dollars of value along with the other categories.

BENEFITS INCIDENCE ANALYSIS

What really matters for each stakeholder's support for transmission investment plans is the amount of costs assigned to them. MISO's LRTP Tranche 1 did estimate how much each load zone benefitted from the plans.

A common aspect of multi-benefit plans is that when multiple benefits are incorporated, the benefits tend to be pretty evenly spread, as the figure below illustrates.

FIGURE 4. *Incidence of Benefits*[81]



81 "Reliability Imperative: Long Range Transmission Planning," 9.

As a result of the wide distribution of benefits, all regions were estimated to have greater than 2 benefit-cost ratios. Courts' interpretations of the Federal Power Act require cost assignment that is roughly commensurate with benefits. Determining which customers should pay how much for transmission tends to be less contentious when benefits happen to be widely distributed. Because securing broad cost allocation across the region is essential for transmission projects to move forward, it is important to measure and report the benefits by load zone, even when the benefit estimates come out evenly spread.

IMPLICATIONS

MISO's effort of working with stakeholders to determine an acceptable set of benefits to include, and means of calculating them, will be very beneficial for future benefits analysis in the Midwest and around the country.

MISO and its stakeholders should consider the seven other benefit categories listed by FERC, and at least evaluate whether any of them might lead to a significant change in the results. The new categories can also be included as MISO proceeds to the next tranches of transmission including focusing on drivers from Futures 2 and 3 in its Futures Report.

It is important to consider all the benefits from every portfolio of lines. Transmission provides a varied array of benefits but not every line or set of lines provide benefits in the same categories. Recent work suggests that any given line or group of lines may have different types and magnitudes of benefits than others. A recent report by Telos for the Energy Systems Integration Group finds "different transmission projects can show large differences in the types of value they bring."[82] Since some of these categories can be difficult and resource intensive to quantify, a good practice would be to screen each category initially for every set of lines in a plan, then spend time and modeling resources to thoroughly evaluate both the benefits and the incidence of benefits on those categories where benefits are likely to be significant.

It is arguably unjust and unreasonable to completely ignore known and quantifiable benefits from the benefit-cost equation. Now that a few regional planning entities are settling on a relatively common set of benefits and benefit calculation methodologies, and FERC is increasing its guidance to each region, it should be easier for each regional planner to determine categories of benefits and methodologies of calculation.

82 Stenclik and Deyoe, 6.

BIBLIOGRAPHY

"20 Year Transmission Outlook." California Independent System Operator, May 2022. http://www.caiso.com/InitiativeDocuments/20-YearTransmissionOutlook-May2022.pdf.

"2022 Integrated System Plan for the National Electricity Market." Australian Energy Market Operator, June 2022. https://www.aemo.com.au/-/media/files/major-publications/isp/2022/2022-documents/2022-integrated-system-plan-isp.pdf?la=en&hash=D9C31A16AD6BF3FB2293C49AA97FE1EA.

American Transmission Company LLC (ATC), Arrowhead-Weston Transmission Line: Benefits Report, February 2009

ATC, Planning Analysis of the Paddock-Rockdale Project, Docket No. 137-CE-149, app. C, Ex. 1, at 34-38 (Wisc. Pub. Serv. Comm'n Apr. 5, 2007).

"Benefits for the 2013 Regional Cost Allocation Review," Southwest Power Pool, Sept. 13, 2012, https://www.spp.org/documents/18175/20120913%20mtf%20report_approved.pdf

Billo, Jeff, "The Texas Competitive Renewable Energy Zone Process," September 2017, https://cleanenergysolutions.org/sites/default/files/documents/jeff-billo_webinar-ercot-crez-process.pdf

Building for the Future Through Electric Regional Transmission Planning and Cost Allocation and Generator Interconnection, 179 FERC ¶ 61,028

Comments of the Midcontinent Independent System Operator, 179 FERC ¶ 61,028 (2022)

Corbus, David, Jack King, Tom Mousseau, Robert Zavadil, Brandon Heath, Liangying (Lynn) Hecker, John Lawhorn, et al. "Eastern Wind Integration and Transmission Study," January 2010. https://www.nrcm.org/wp-content/uploads/2013/10/DOE_Eastern-Wind-Integration-and-Transmission-Study_2010.pdf.

Eastern Wind Integration and Transmission Study, National Renewable Energy Laboratory (U.S. Department of Energy), NREL/SR-550-47078, January 2010. https://www.nrcm.org/wp-content/uploads/2013/10/DOE_Eastern-Wind-Integration-and-Transmission-Study_2010.pdf

ERCOT, Economic Planning Criteria: Question 1: 1/7/2011 Joint CMWG/PLWG Meeting, at 10 (Mar. 4, 2011).

Frayer, J., Wang, E., Wang, R., et al.(London Economics International, Inc.), "How Does Electric Transmission Benefit You?: Identifying and Measuring the Life-Cycle Benefits of Infrastructure Investment," WIRES, January 8, 2018.

"LRTP Business Case." Presented at the Long Range Transmission Planning Workshop, Virtual, January 21, 2022. https://cdn.misoenergy.org/20220121%20LRTP%20Workshop%20Item%2004%20Business%20Case%20Presentation619895.pdf.

"LRTP Tranche 1 Portfolio Detailed Business Case." Presented at the LRTP Workshop, Virtual, March 29, 2022. https://cdn.misoenergy.org/20220329%20LRTP%20Workshop%20Item%2002%20Detailed%20Business%20Case623671.pdf.

ITC Holdings Co., Joint Application, Docket No. EC12-145-000, at Ex. ITC-600, 77-78 (Test. of Pfeiffenberger) (filed Sept. 24, 2012)

Miland, Jarred, and Matt Tackett. "Long Range Transmission Planning: Tranche 1." Presented at the LRTP Workshop, Virtual, March 25, 2022. https://cdn.misoenergy.org/20220325%20LRTP%20Workshop%20Item%2002%20Tranche%201%20Portfolio%20and%20Process%20Review623633.pdf.

MISO, FERC Electric Tariff, Attach. FF, Benefit Metrics § (I)(A)(1) (33.0.0)

"MISO Futures Report." Midcontinent Independent System Operator, December 2021. https://cdn.misoenergy.org/MISO%20Futures%20Report538224.pdf.

"MISO Regional Expansion Criteria and Benefits Working Group." Accessed July 27, 2022. https://www.misoenergy.org/stakeholder-engagement/committees/regional-expansion-criteria-and-benefits-working-group/.

"MISO Value Proposition 2020," Detailed Circulation Description, n.d.

"Multi Value Project Portfolio: Results and Analysis," Midcontinent Independent System Operator, January 10, 2012, https://cdn.misoenergy.org/2011%20MVP%20Portfolio%20Analysis%20Full%20Report117059.pdf

"Natural Gas Weekly Update." U.S. Energy Information Administration, July 7, 2022. https://www.eia.gov/naturalgas/weekly/archivenew_ngwu/2022/07_07/.

New York Independent System Operator Corp.,143 FERC ¶ 61,059 n.516 (2013) (NYISO First Regional Compliance Order)

NYISO, NYISO Tariffs, OATT, attach. Y, § 31.5 (27.0.0), § 31.5.4.3.2.

Newell, Sam, Bruce Tsuchida, J. Michael Hagerty, Akarsh Sheilendranath, Nicole Irwin, and Lauren Regan. "Benefit-Cost Analysis of Proposed New York AC Transmission Upgrades." The Brattle Group, September 15, 2015. https://www.brattle.com/wp-content/uploads/2017/10/5721_benefit-cost_analysis_of_proposed_new_york_ac_transmission_upgrades.pdf.

Opinion Granting Certificate of Public Convenience and Necessity, In the Matter of the Application of Southern California Edison Company (U 338-E) for a Certificate of Public Convenience and Necessity Concerning the Devers-Palo Verde No. 2 Transmission Line Project, Application 05-04-015 (Cal. Comm'n Jan. 27, 2007).

Order No. 1000, 136 FERC ¶ 61,051 (2011)

"Organization of MISO States Statement of Principles: Cost Allocation for Long Range Transmission Planning Projects," January 25, 2021. https://www.misostates.org/images/PositionStatements/OMS_Position_Statement_of_Principles_Cost_Allocation_for_LRTPs.pdf.

Pfeifenberger, Johannes, Kasparas Spokas, J. Michael Hagerty, John Tsoukalis, Rob Gramlich, Michael Goggin, Jay Caspary, and Jesse Schneider. "Transmission Planning for the 21st Century: Proven Practices That Increase Value and Reduce Costs," October 2021. https://www.brattle.com/wp-content/uploads/2021/10/2021-10-12-Brattle-GridStrategies-Transmission-Planning-Report_v2.pdf.

"Planning Advisory Committee Summary of Review and Advice to Advisory Committee and Board of Directors MISO Transmission Expansion Plan (MTEP21) Addendum Appendix F." Midcontinent Independent System Operator, May 20, 2022. https://cdn.misoenergy.org/20220527%20PAC%20Item%2002a%20MTEP21%20Addendum%20Appendix%20F%20-%20LRTP%20Tranche%201%20Substantive%20Comments624805.pdf.

PJM Interconnection L.L.C.,142 FERC ¶ 61,214 (2013) (PJM First Regional Compliance Order)

"PJM Value Proposition," 2019, https://www.pjm.com/about-pjm/~/media/about-pjm/pjm-value-proposition.ashx#:~:text=%241.1%E2%80%931.3%20billion%20a%20year&text=PJM's%20efficient%20generation%20interconnection%20process,efficient%2C%20less%20costly%2C%20plants.

"Planning Year 2022-2023 Loss of Load Expectation Study Report," Midcontinent Independent System Operator Loss of Load Expectation Working Group, November, 2021. https://cdn.misoenergy.org/PY%202022-23%20LOLE%20Study%20Report601325.pdf

"Proposed Multi-Value Project Portfolio," Midcontinent Independent System Operator, Technical Study Task Force and Business Case Workshop, August 22, 2011.

"Proposed Multi-Value Project Portfolio: Business Case Workshop," Midcontinent Independent System Operator, Sept. 19 & 29, 2011. https://nocapx2020.info/wp-content/uploads/2014/04/20110919-MVP-Proposed-Portfolio-Business-Case.pdf

Pub. Serv. Co. of Colo., 142 FERC ¶ 61,206, at P 314 (2013).

Public Service Commission (PSC) of Wisconsin (WI), Order, re Investigation on the Commission's Own Motion to Review the 18 Percent Planning Reserve Margin Requirement, Docket 5-EI-141, PSC REF#:102692, dated October 9, 2008, received October 11, 2008, p 5

"RECBWG: Granular Benefits Identification and Cost Allocation (20220228)." Accessed July 27, 2022. https://www.misoenergy.org/stakeholder-engagement/stakeholder-feedback/recbwg-granular-benefits-identification-and-cost-allocation-20220228/.

"Reliability Imperative: Long Range Transmission Planning," Midcontinent Independent System Operator Board of Directors Meeting, July 25, 2022. https://cdn.misoenergy.org/20220725%20Board%20of%20Directors%20Item%2002a%20Reliability%20Imperative%20LRTP625714.pdf

"Regional Cost Allocation Review (RCAR II)." Southwest Power Pool, July 11, 2016. https://www.spp.org/documents/46235/rcar%202%20report%20final.pdf.

"Renewable Integration Impact Assessment." Accessed July 27, 2022. https://www.misoenergy.org/planning/policy-studies/Renewable-integration-impact-assessment/#nt=%2Friiatype%3AReport&t=10&p=0&s=Updated&sd=desc.

S.C. Elec. & Gas Co., 143 FERC ¶ 61,058, at 232 (2013)

Southwest Power Pool, SPP Priority Projects Phase II Report, Rev. 1, April 27, 2010

SPP Engineering, SPP Benefit Metrics Manual, at 15, Nov. 6, 2020.

Stenclik and Deyoe, "Multivalue Transmission Planning for a Clean Energy Future," Energy Systems Integration Group, June 2022, https://www.esig.energy/wp-content/uploads/2022/07/ESIG-Multi-Value-Transmission-Planning-report-2022a.pdf

Transmission Economic Assessment Methodology, CAISO Chapter 4, 1-12 (2004).

"The Value of Transmission," Southwest Power Pool (SPP), January 26, 2016

Wolak, F. A., "Managing Unilateral Market Power in Electricity," Policy Research Working Paper; No. 3691. World Bank, Washington, DC, (2005).

Zerbe, Richard O., and Tyler Scott. "A Primer for Understanding Benefit-Cost Analysis." Benefit-Cost Analysis Center, The Daniel J. Evans School of Public Affairs University of Washington, September 2015. July 27, 2022.