



CONGESTION-DRIVEN BASIS RISK

A CHALLENGE FOR THE
DEVELOPMENT OF CLEAN
ENERGY PROJECTS

Congestion-Driven Basis Risk

A Challenge for the Development of Clean Energy Projects

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U.S. renewable generation installations have increased at a steady pace, driven by states' clean energy targets (i.e., Renewable Portfolio Standards or RPS) and corporate sustainability goals. In many areas, the rate of clean energy build has been higher than the expansion of the transmission grid under Regional Transmission Organizations' (RTO) planning and interconnection processes. Renewable energy growth with limited grid capacity has led to extreme congestion in many areas of the country. Although new renewable projects must complete interconnection studies to identify potential network upgrades required for reliable interconnection to the grid, these studies do not ensure that those generation projects will not be unduly impacted by congestion throughout their operational lives.

Transmission congestion can result in two main types of cost exposure for clean energy projects—

curtailment and/or basis—dependent upon a project's contractual arrangements. Curtailment represents a reduction in a project's energy output that cannot be delivered to the grid because of transmission limitations or because the market cannot absorb all the available supply of low-cost energy in a market interval. The emergence of Commercial & Industrial customers (C&I) in the clean energy customer base over the last few years has led to more corporate Power Purchase Agreements (PPA), which are virtual contract-for-differences arrangements that require price settlement at a market hub. Under such arrangements, the generator typically wears the risk of any price differential between its point of interconnection and the market hub. This price differential or "basis" is largely driven by transmission constraints between areas with renewable energy resources and the hub where load is concentrated.

Both the curtailment of clean energy generation and market congestion costs have materially increased across many RTOs over the last three years. For example, in their State of the Market 2021 report¹, SPP's Market Monitoring Unit noted how monthly average curtailment increased from 136 megawatt hours (MWh) in 2019 to 725 MWh in 2021, an increase of over 400% in unused available clean energy. SPP congestion costs were also reported to have increased from \$450 million in 2020 to \$1.2 billion in 2021.

In this context of increasing and sometimes extreme congestion levels across many regions, three main concerns arise regarding basis risk: (1) the ability to appropriately forecast basis risk; (2) the available mitigation strategies to reduce basis risk exposure, and (3) the contractual terms that are equitable considering 1 and 2.

¹ 2021 annual state of the market report.pdf (spp.org)



1) Forecasting Basis Risk

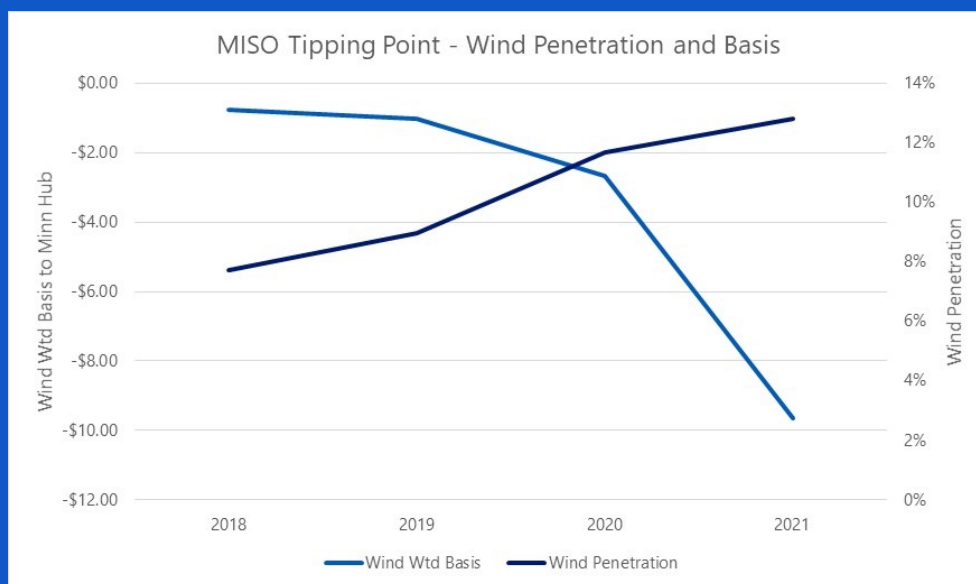
Sophisticated production cost simulation models that mimic nodal wholesale markets are typically used to project future basis risk. Detailed assumptions are modeled to simulate market dispatch under future conditions. This is a standard approach to projecting basis risk and provides some assurance to vested parties that basis is appropriately assessed and forecast. However, the reality is that many drivers of basis risk are outside of a generator's control—future siting and development of additional clean energy projects, grid outages, natural gas prices, future load, and load patterns, etc. Uncertainty around these variables increases greatly beyond a 5-year forecast window. After this, it is very difficult to predict with high confidence the exact location and size of future projects, as well as where, when, and for how long transmission outages will occur. Even natural gas prices, which had been relatively stable for many years until unprecedented events like the COVID-19

pandemic and Russia's invasion of Ukraine, have contributed to extreme price volatility that could persist for several years.

Basis can become unpredictable and extreme very suddenly, as shown below in a chart of annual average system wind-weighted basis from MISO West generators to Minnesota Hub², and presented against annual average wind penetration³ in MISO. The chart shows that the MISO West grid reached a “tipping point” in 2020 when wind-weighted basis began to increase dramatically as wind penetration levels also increased. While MISO recently approved a Long-Range Transmission Plan with \$10 billion for new 345kv lines that will significantly increase the transmission capacity in MISO West, those upgrades are not expected to be completed until around 2030.

² Uses MISO LMP and production data via Yes Energy

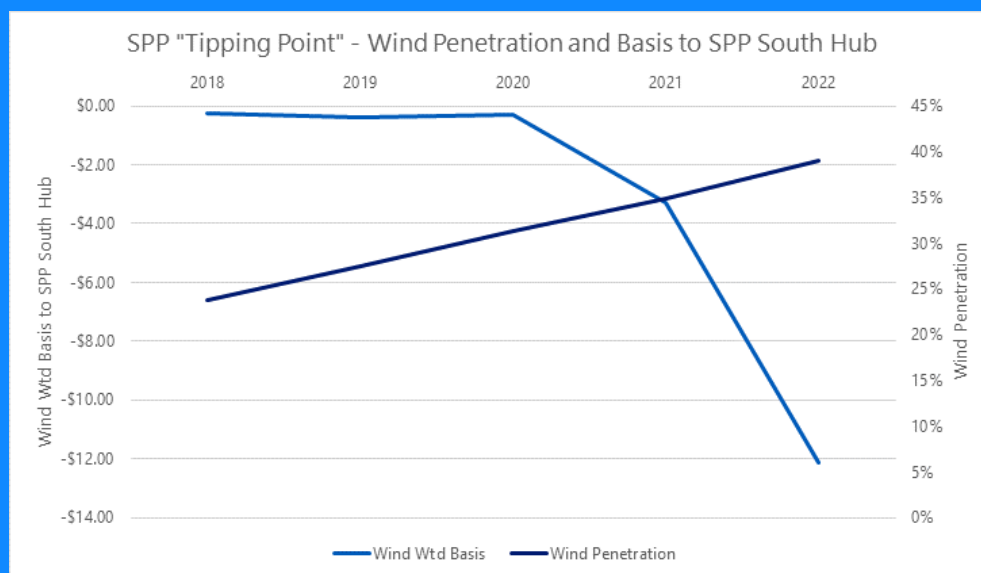
³ Wind penetration is defined as total wind generation (MWh) as % of load (MWh)



Average wind-weighted basis of all MISO West generator nodes to Minnesota Hub vs wind penetration over time (MISO West zones are defined as ALTW, DPC, GRE, MDU, MEC, MP, MPW, NSP, OTM, SMP)

A similar tipping point is observed in SPP, where annual average system wind-weighted basis from SPP generators to SPP South Hub⁴ trended negative starting in 2020.

- ERCOT is another market where basis expectations for clean energy projects were generally low outside known overbuild pockets (e.g., Texas Panhandle). For many ERCOT wind



Average wind-weighted basis of all generator nodes to SPP South Hub vs wind penetration over time (2022 is year-to-date through 8/9/22)

To further illustrate how quickly basis expectations can deteriorate in a market, we compare project-specific basis projections from 2017-2018 to actual basis levels today. The data demonstrate a general under-estimation of basis risk by multiple dollars per MWh for many regions.

- For example, industry projections for basis to Minnesota Hub for many MISO West wind projects in 2017 were in the (\$2.00-\$4.50)/MWh range. By 2019, Minnesota Hub basis projections had increased to up to (\$6.00-\$9.00)/MWh for some MISO West wind projects. While the 2019 study captured more congestion than the 2017 study with more wind on the system, both estimates fell far short of the (\$20-\$30)/MWh realized basis seen by many wind projects in MISO West today.

projects, industry basis risk projections for 2018-2020 were in the (\$1.00-\$4.00)/MWh range. Stability-driven Generic Transmission Constraints (GTCs) now result in realized basis levels over (\$10.00)/MWh annually for many ERCOT wind projects, and some of these GTCs were implemented with little to no notice to market participants.

While these observations point to specific examples, currently realized basis is several times higher than what was reasonably expected only a few years ago across many market areas. This can become especially detrimental for a project when basis costs exceed the fixed price a project receives for energy under its offtake contract. Across many regions with high congestion, a comparison of actual versus projected conditions generally shows that key variables driving

⁴ Uses SPP LMP and production data via Yes Energy and Velocity

the higher than predicted basis are: (i) lagging transmission system expansion compared to regional or local renewable build, (ii) grid outages, which further limit grid capacity and can last for many months, and (iii) new constraints or sudden derates of grid facilities, further lowering the capacity of the grid. None of these variables can be predicted with high confidence on the long term.

Furthermore, even more clean energy generation capacity is expected to be placed in service over the next decade, incentivized by the tax provisions in the recently enacted Inflation Reduction Act (IRA). The pace of transmission expansion needs to be accelerated for IRA's emission reduction potential to be achieved while minimizing congestion and curtailment risk for clean energy projects.

2) Mitigating Congestion-Driven Basis Risk

There are some congestion mitigation options available, but each provides only partial solution. A few examples are discussed below:

- **Financial Transmission Rights (FTRs)** are fixed-cost financial instruments, with clearing prices that typically follow actual congestion trends and settle on the day-ahead congestion component of basis in monthly, seasonal, or/and annual auctions. FTR congestion coverage can only offer partial basis mitigation, providing a net benefit only if realized congestion costs are higher than the cost of the FTR.

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- **Sponsored upgrades** are transmission upgrades paid for by a market participant who voluntarily agrees to fund the cost of an upgrade to reduce expected congestion. While such upgrades can help address a specific constraint, they can be very expensive and there is no guarantee that the relief will be permanent. Other generators could saturate the additional grid capacity with new generation, or different constraints could become binding (aka, the “Whac-A-Mole” constraint game)—which could offset the basis improvement from the sponsored upgrade.
- **Grid Enhancing Technologies (GETs)** such as topology optimization, dynamic line rating, and advanced power flow controllers can be deployed to maximize the capacity of the existing grid at relatively little cost. Although GETs can be implemented—within short lead times—as temporary, bridge, or permanent solutions to many transmission constraints, they have yet to be broadly considered due to poor processes and lack of incentives to boost their deployment.
- **Improved transmission planning processes** including a more comprehensive assessment of longer-term transmission needs can fundamentally mitigate basis risk. The Federal Energy Regulatory Commission (FERC) has begun reforms in this area, which are critical to the clean energy transition, especially given the long lead time required for transmission upgrades. A new 345kv backbone line can easily take 7-10 years to be permitted and built. And to be effective, the identification of transmission needs must occur before extreme congestion materializes. This improvement in the transmission planning processes is even more critical considering the coming IRA-driven renewable boom that will compound congestion problems in the market due to more renewables bidding into the market at negative prices.

While the mitigation factors above can contribute to a reduction in basis, they do not provide sufficient protection against high and sustained congestion. There remains a risk of severe congestion driven by grid outages or mismatches between generation and transmission expansion.



3) Contractual arrangements on basis risk

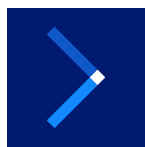
The current extreme congestion levels across several areas of the grid demonstrate that, despite sophisticated modeling tools and some opportunities for mitigation, clean energy generators face high basis risks whose costs can be much worse than initially forecast. Post-IRA, congestion risk is likely to get worse unless there is a dramatic and immediate expansion of the transmission grid. Faced with this reality, both clean energy buyers and sellers should be mindful of intrinsically high basis risk and find ways for more equitable risk sharing in offtake structures. A contractual standard that puts uncapped basis exposure on generators is inefficient and inequitable given that generators have no control over key drivers of basis risk.

Historically, the complexity and magnitude of basis risk has been underestimated by the industry. Going forward, negatively skewed basis risk must be acknowledged in transactions and shared accordingly when output is settled at a different location than a renewable project's point of interconnection.

In summary, increased transmission congestion levels observed across many RTOs highlight the unprecedented basis risk in what has become a typical offtake structure for clean energy projects. The complexity and uncertainty of uncapped basis exposure, as well as the challenge of expanding the transmission system to keep up with large-scale deployment of clean energy projects, particularly in a post-IRA environment, require a more realistic and equitable sharing of basis risk in contractual arrangements with market hub settlement.

With focused efforts at the FERC and RTO levels for more robust and comprehensive planning for the grid of the future, the transmission system will be more able to integrate large-scale renewables while reducing basis risk, which in turn will make sharing this risk less of an industry headwind in the fight against climate change.





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