

POWERING THE FUTURE: Harnessing Industrial Demand Flexibility to Reduce Emissions and Integrate Renewables

Power grids are undergoing a paradigm shift—spelling fresh opportunity for industrial leaders to partner with grid operators to manage energy costs, support grid reliability, reduce carbon emissions, and help integrate more renewable energy.

With this in mind, industrial customer Hemlock Semiconductor (HSC), utility Consumers Energy, and environmental tech nonprofit WattTime teamed up to explore how much industrial demand could shift on various time scales. Together, we investigated implications for factors such as emissions reductions and renewables integration—both now and as grids across the country and around the world further decentralize and decarbonize.

Based on our analysis for HSC in MISO's grid today, we found that emissions reductions through demand flexibility were negligible (0.74%) via a cost-based approach similar to real-time pricing (RTP). An emissions-based approach to demand flexibility, such as via WattTime's Automated Emissions Reduction (AER) technology, was better. Using AER, load shifting could reduce associated emissions 1.7–3.4% relative to the baseline for the flexible load, translating to annual emissions reductions up to ~2,500 metric tons of CO₂.

These results are largely due to two interrelated factors: 1) fossil-fueled power plants currently make up roughly two-thirds of electricity generation in Michigan and MISO more broadly, and 2) natural gas power plants also tend to be the

marginal generating unit, resulting in the marginal emissions rate having relatively little variability on a daily basis and thus offering limited opportunity for time-based arbitrage of marginal emissions rates.

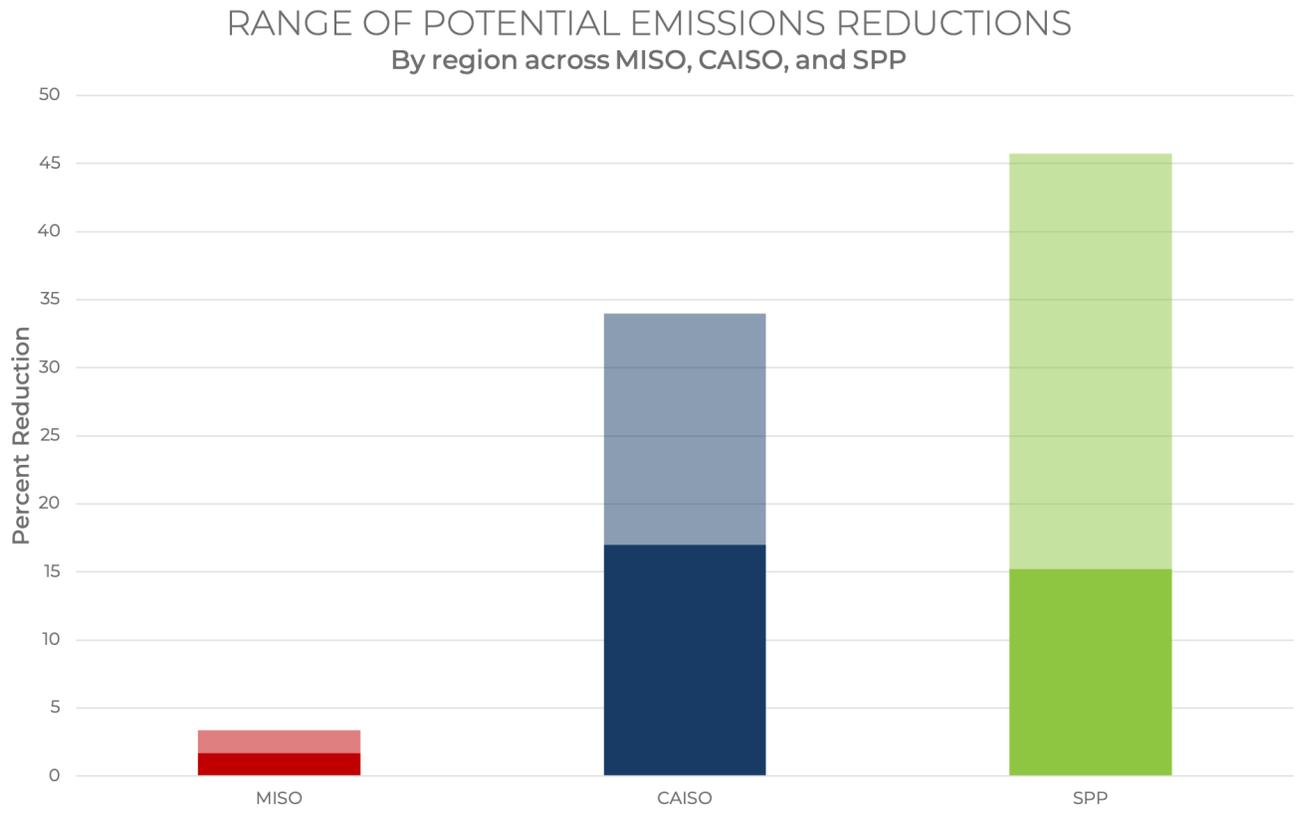
Although today's grid in MISO yielded only small opportunities for incremental emissions reductions through industrial demand flexibility, times are changing. By 2030, variable renewable generation (i.e., solar, wind) is expected to grow 5x, from 8% in 2019 to nearly 40% by 2030. In parallel, fossil-fueled generation is expected to decline substantially, from nearly 70% in 2019 to 40% by 2030.

With this context in mind, we also analyzed the emissions-reduction potential of AER applied to HSC's demand flexibility in other markets—CAISO and SPP—that reflect current grids in different parts of the country, as well as which represent a 'postcard from the future' for what Michigan and MISO might expect in the years ahead.

We found substantial emissions-reduction potential on the order of 15–34% vs. baseline emissions associated with the shifted load, approximately 10x greater emissions savings on a percentage basis and 8x on an absolute basis than what is achievable in MISO today. This suggests an enormous opportunity if adopted for industrial customers' flexible loads across a range of power grids that are increasingly becoming the norm as the U.S. continues its energy transition.

FIGURE ES-1

The range of emissions-reduction potential for AER with industrial customers in SPP and CAISO today suggest exciting opportunities for what will be possible in MISO in the near future tomorrow.



BASED ON THESE RESULTS, WE DRAW SEVERAL CONCLUSIONS:

- 1. For remaining fossil-heavy grids** (and/or grids where fossil generation is often marginal), industrial demand flexibility primarily supports cost and grid reliability, plus some future proofing for the coming energy transition.
- 2. For grids in transition** (mix of fossil and clean generation), industrial demand flexibility spells new opportunity for emissions arbitrage. Thanks to AER, industrial facilities can prioritize clean energy use and avoid fossil-fueled energy, resulting in deeper and faster emissions reductions. Industrial demand shifting today also lays the groundwork increasing impact as grids evolve with a greater mix of renewables.
- 3. For grids rich in renewables**, industrial demand flexibility has become a crucial tool for supporting the paradigm shift from load-following generation to generation-following load. Industrial leaders can now sync up with renewable generation profiles and help their respective grids move to a higher percentage of renewables and reduce renewable curtailment.

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