

#### Renewable Integration Impact Assessment

Finding integration inflection points of increasing renewable energy

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## Renewable energy is growing; will it significantly impact the grid?



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## Renewable Integration Impact Assessment (RIIA) seeks to find inflection points of renewable integration complexity







#### **RIIA Wind, UPV, and DPV Modeled Expansion**



### As renewable penetration increases, the risk of losing load shifts and compresses to a smaller number of hours



- Probability of losing load is targeted at one day in ten years over all penetration levels.
- While aggregate risk remains constant, the risk in particular hours increases.

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## Changes to net load shapes are seasonal, however the risk of losing load still occurs during the summer at higher penetration levels

**Wind** 

Solar



\*Profile shapes represent seasonal hourly averages across the 6 study years. \*Summer includes May, June, July, and August; Winter includes January, February, November, and December



### Diversity of technologies improves the ability of renewable resources to mitigate the risk of losing load





#### Geographic diversity improves the ability of renewable resources to mitigate the risk of losing load



Sites	ELCC
10% sites scaled to 100% level*	11.1%
50% sites scaled to 100% level*	13.4%
100% sites	14.0%

\*Generation at sites selected for 10% and 50% penetration levels was scaled to match the generation needed for the 100% penetration level.



# **Conventional generation is dispatched down as renewable penetration increases**



9 DRAFT RESULTS

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## The direction of ramping needs from conventional resources reverses as renewable penetration increases



#### Daily gas and coal generation for the peak renewable day

Due to input assumptions, coal and gas have similar costs in the RIIA model. This causes their similar behavior.



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## Traditional points of transmission stress are changing as renewable penetration grows

MISO Renewable Generation vs. MISO Load (30% case)





## Energy flow patterns change dramatically as renewable penetration increases





System fix complexity is concentrated in areas of high renewable deployment, but is moderate at the 20% penetration level

 Quantifies the magnitude of integration complexity in terms of approximate costs from all transmission fixes needed for steady state thermal and voltage issues up to the 20% renewable milestone.





#### By examining increasing penetrations of renewables, several key takeaways have been thus far found

- 1. Risk of losing load compresses into a small number of hours and shifts to later in the day
- 2. As a result of the shift in risk of losing load, the available energy from wind and solar during high risk hours decreases
- 3. Diversity of technologies and geography improves the ability of renewables to meet load
- 4. The direction of ramping needs from conventional resources reverses as renewable penetration increases
- 5. Under RIIA assumptions for renewable penetration levels up to 20%, the integration complexity is mild



### Thanks!

**Questions?** 

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All RIIA-related documents can be found on MISO's web page. https://www.misoenergy.org/planning/transmission-studies-and-reports/

### Phase 2 will continue looking at higher penetration levels and is expected to be completed by the end of the year



