

# Transmission Value Assessment based on Energy Market Prices

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Energy Technologies Area  
**BERKELEY LAB**

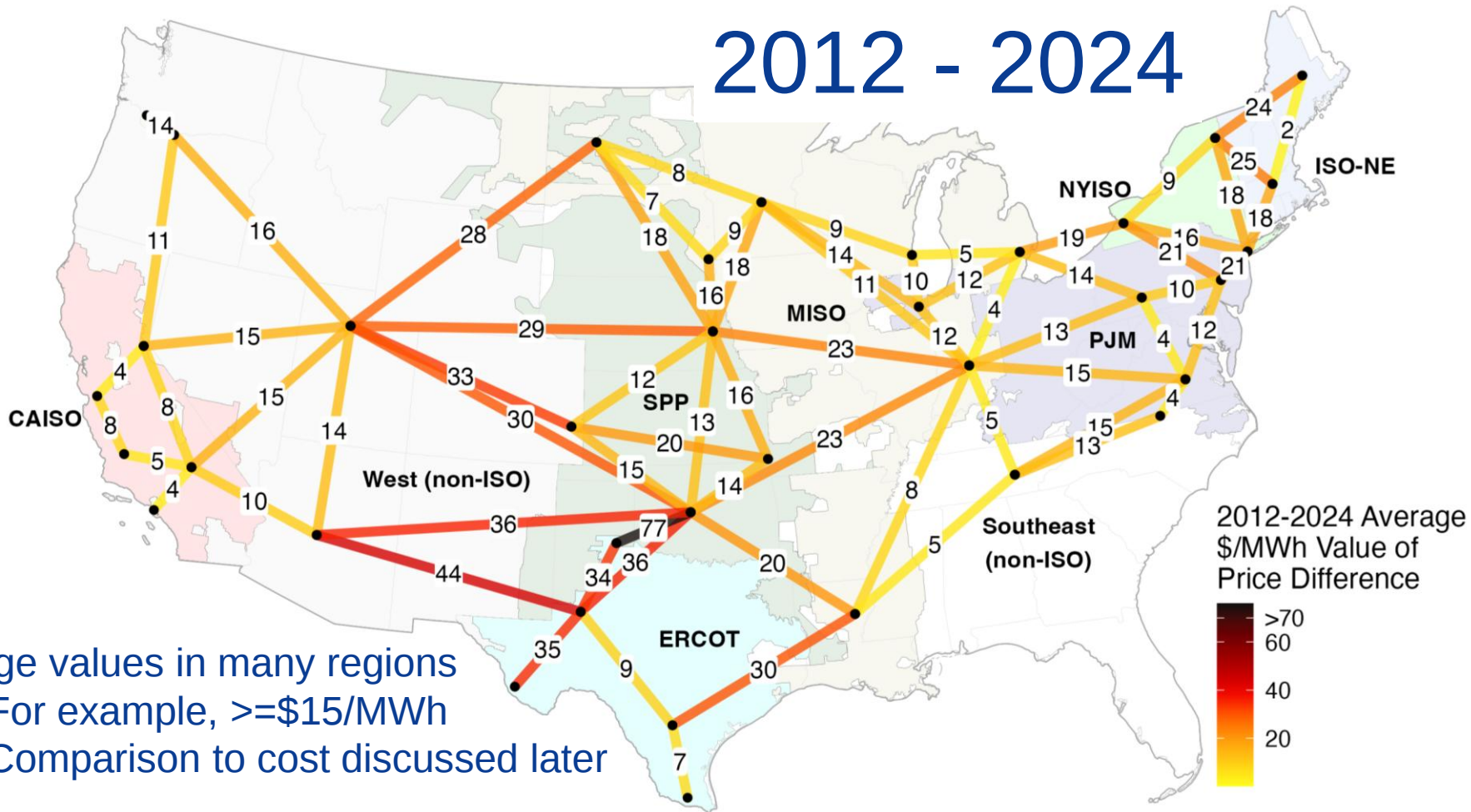
$$\text{Marginal Value Metric} = \frac{1}{n} \sum_{t=1}^n |price_t^A - price_t^B|$$

Simple in concept but leads to a host of interesting conclusions...

*Notes:*

- Can calculate this with real time or day ahead locational marginal prices (LMPs)
- Hub-nodes or zonal nodes ensure we are assessing larger market areas
- This value metric is a *subset* of transmission value
- *Not* equal to production cost value
- Assumption: Frictionless transfer of energy from low price node to high price node
- No AC complications considered

# 2012 - 2024

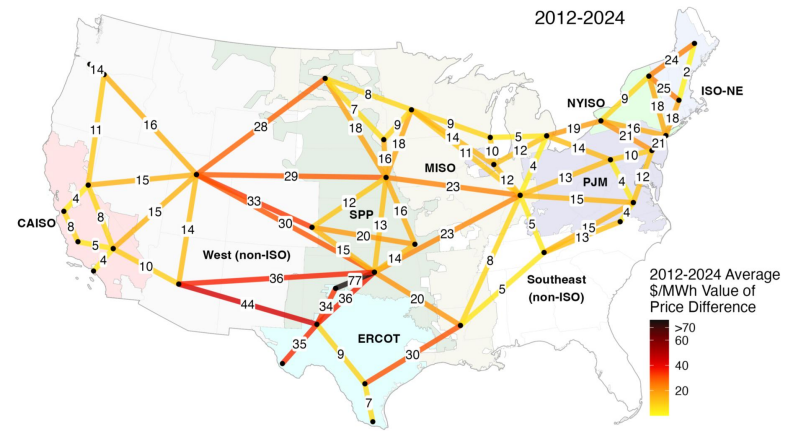


## Large values in many regions

- For example,  $\geq \$15/\text{MWh}$
- Comparison to cost discussed later

Note: Some links have data only back to 2015

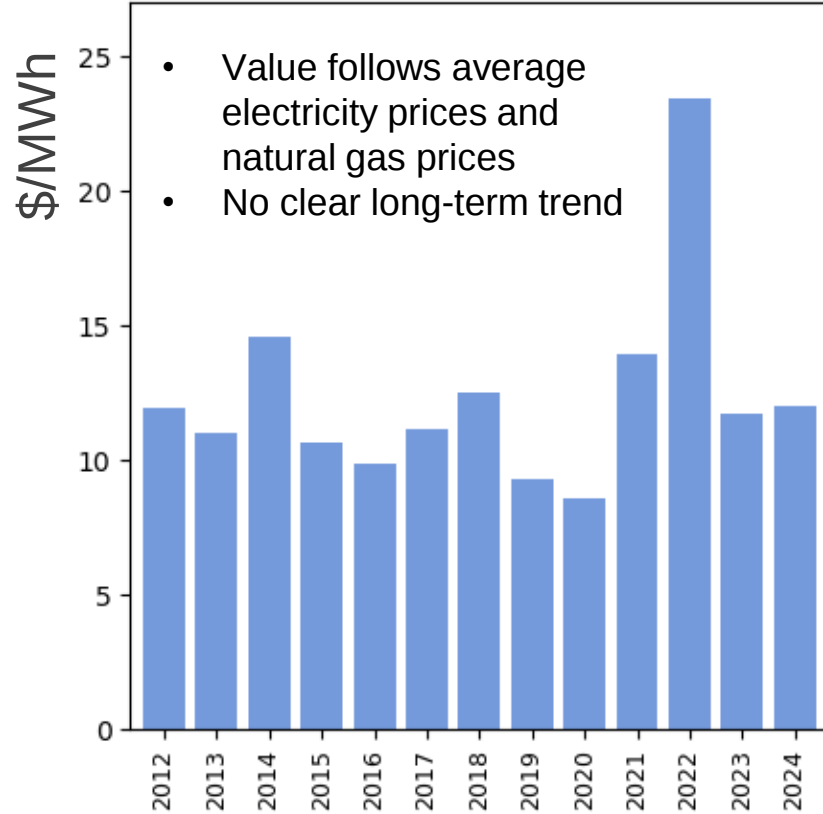
# Exploring transmission value:



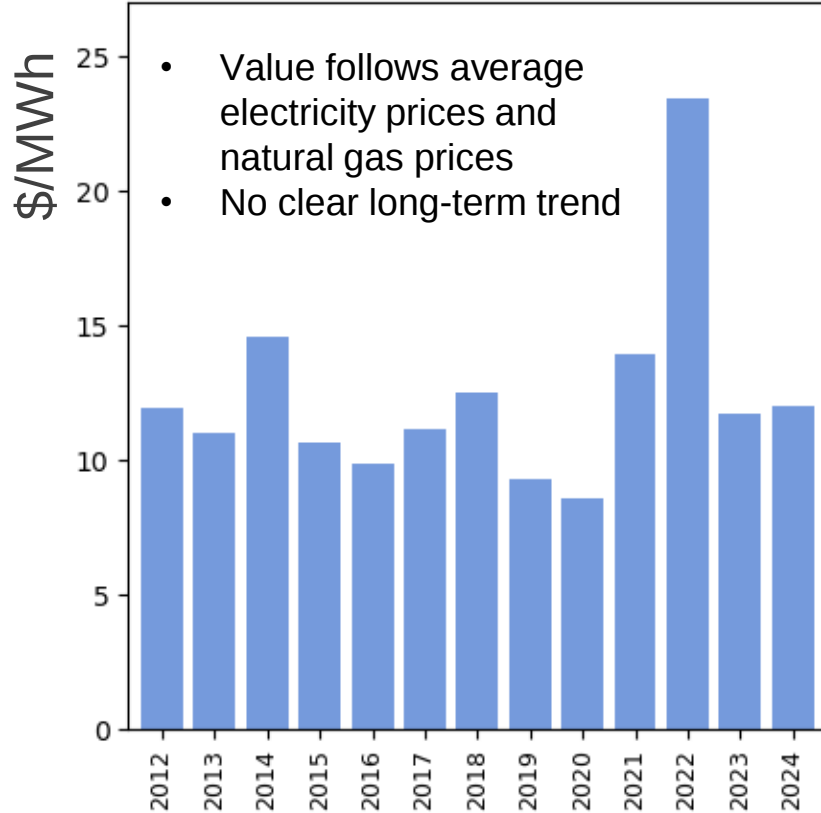
1. When and where is transmission valuable?
2. What drives transmission value?
3. Beyond marginal value, comparisons to costs

**When and where is transmission  
valuable?**

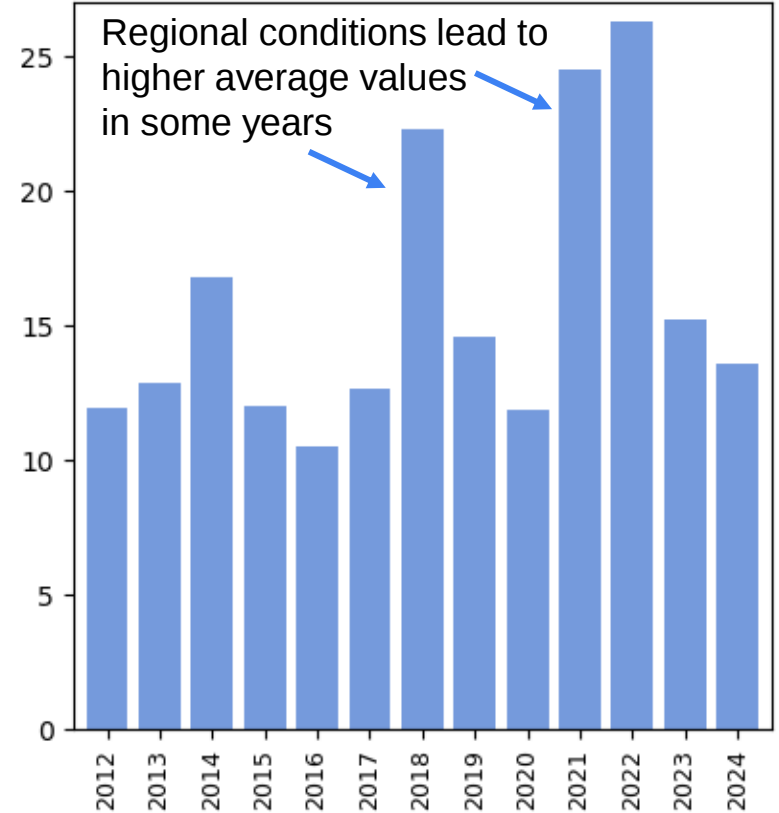
## Median Value

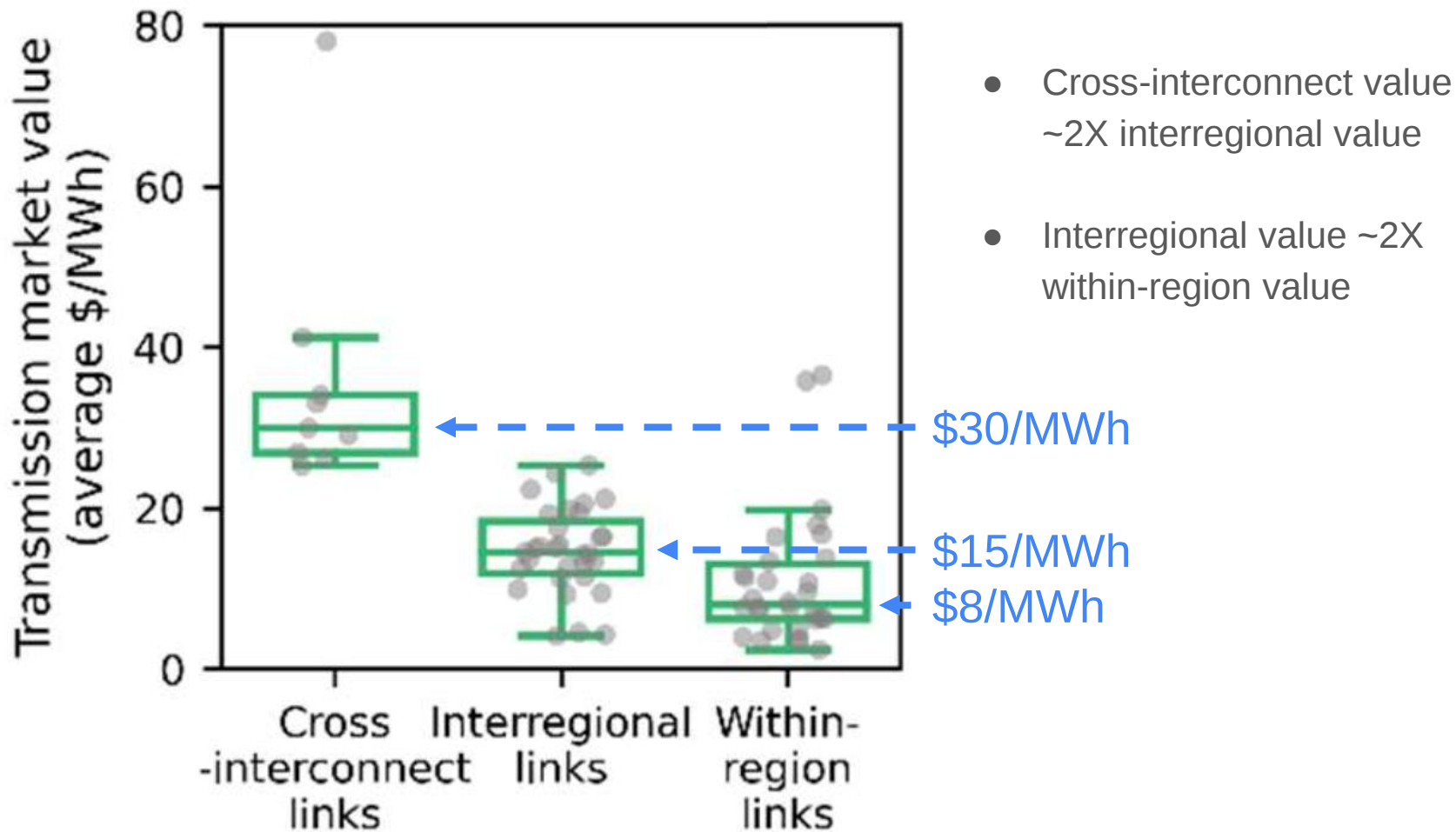


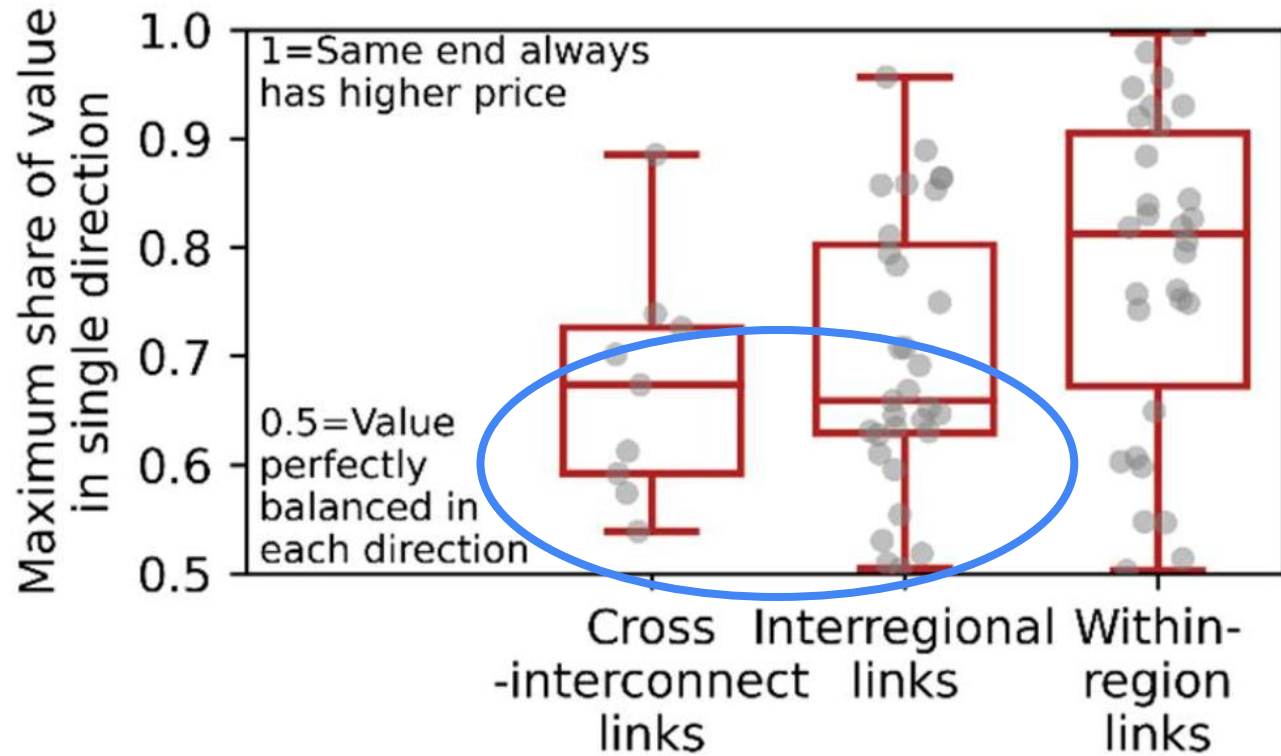
## Median Value



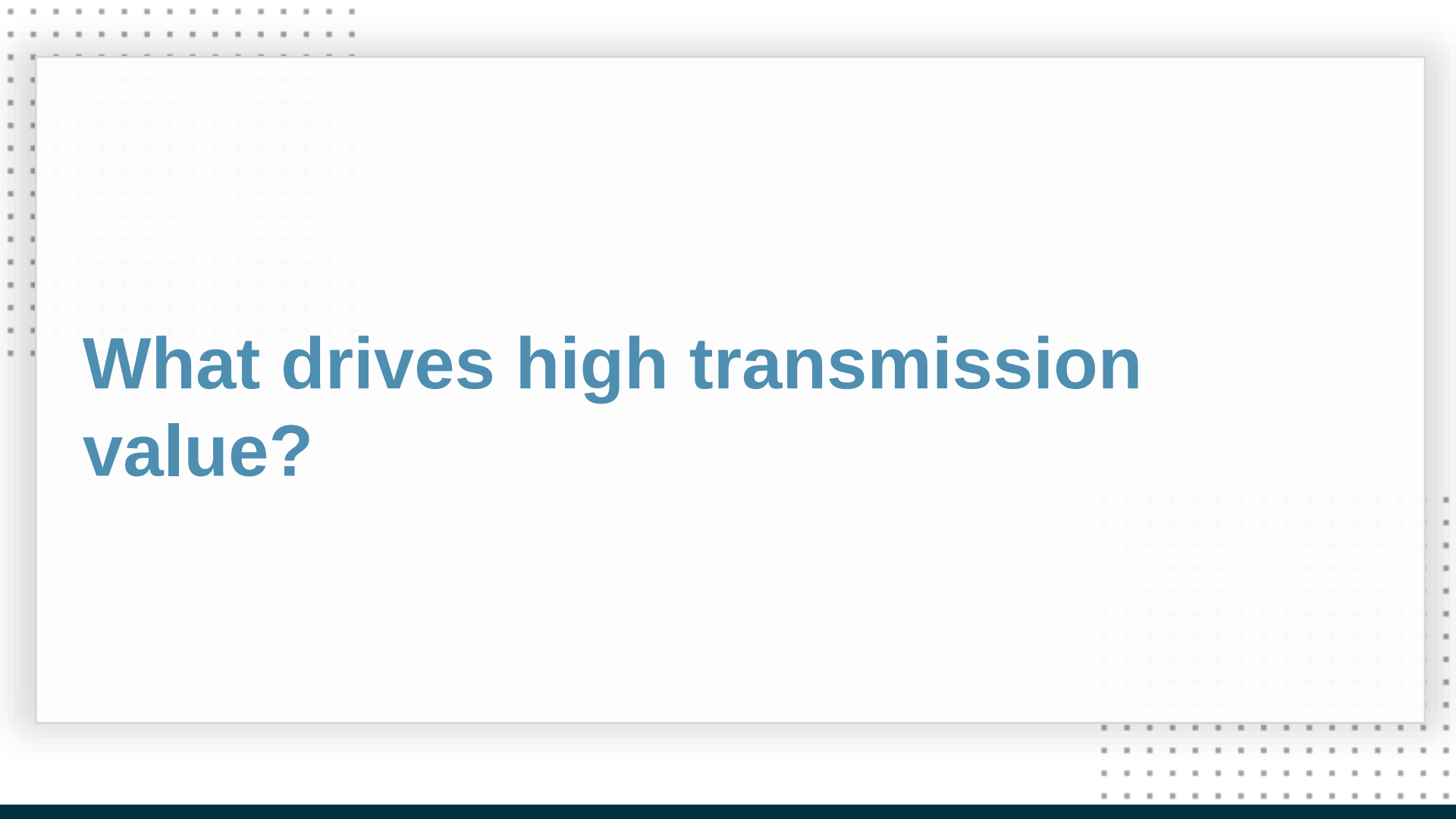
## Average Value



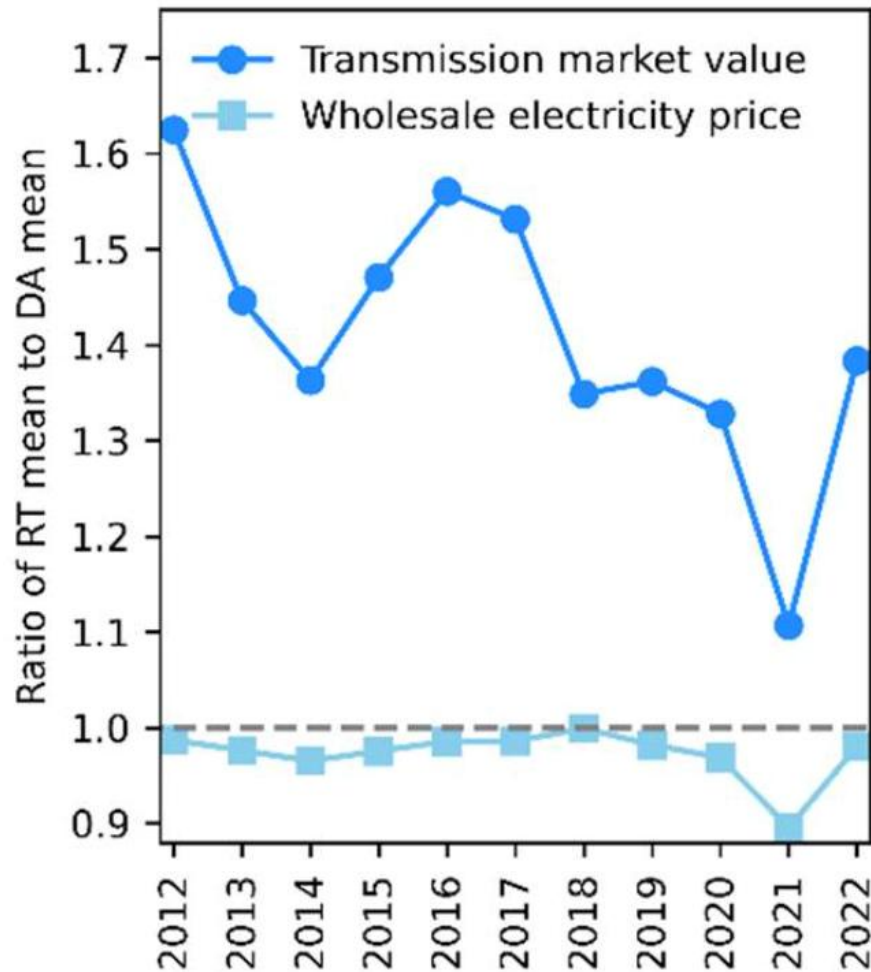




- Cross-interconnect and interregional links often directionally balanced
  - That is, both sides of the link experience high prices at separate times from each other
  - Median balance for those categories is ~0.65



**What drives high transmission value?**

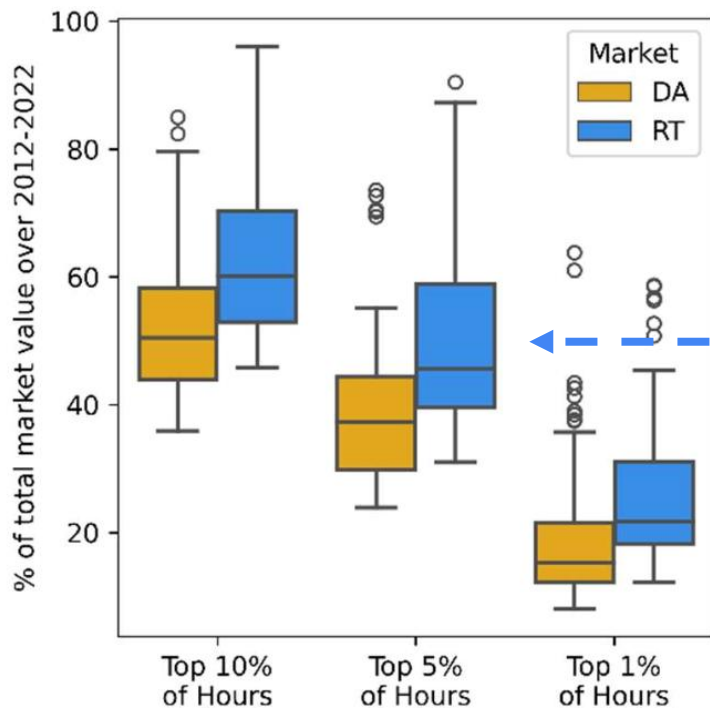


**Transmission value:**

Real-time value > day-ahead value

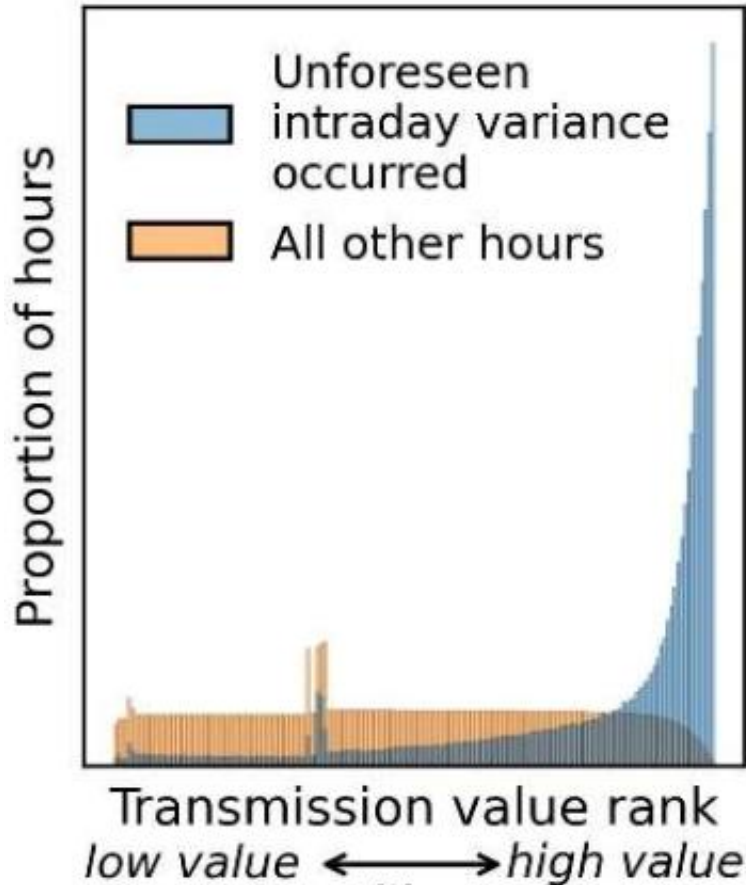
**Electricity prices:**

Real-time prices are slightly lower than day ahead prices



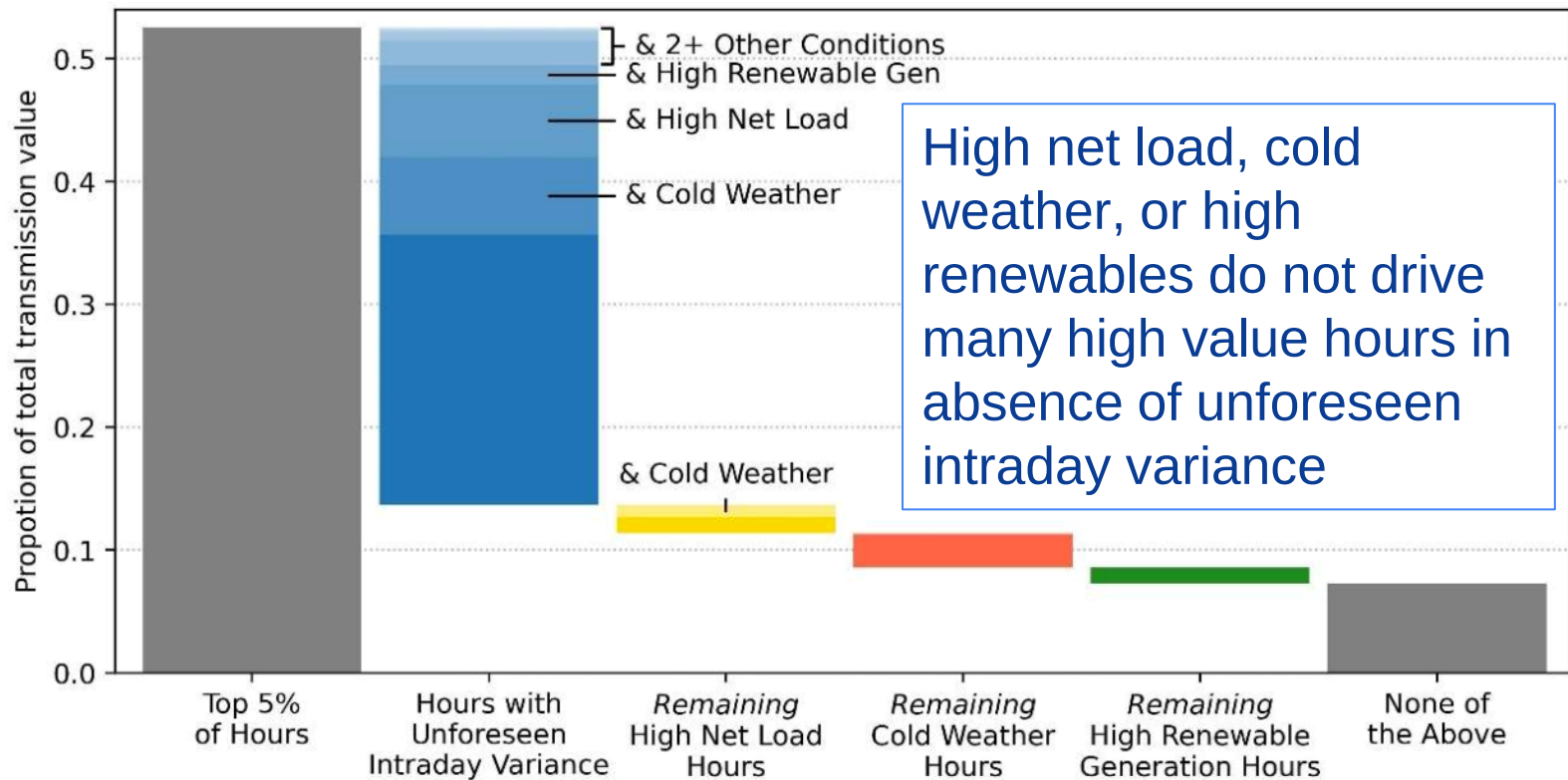
Real time value is concentrated in time:  
~50% of value derives from 5% of hours

Day-ahead value is also  
concentrated in time, but not as  
concentrated: ~40% of value in top  
5% of hours



**Unforeseen intraday variance =**  
A large change in the LMPs  
between the day-ahead and real-  
time markets on either side of a link

← **The highest value hours for  
transmission are associated with  
unforeseen intraday variance**

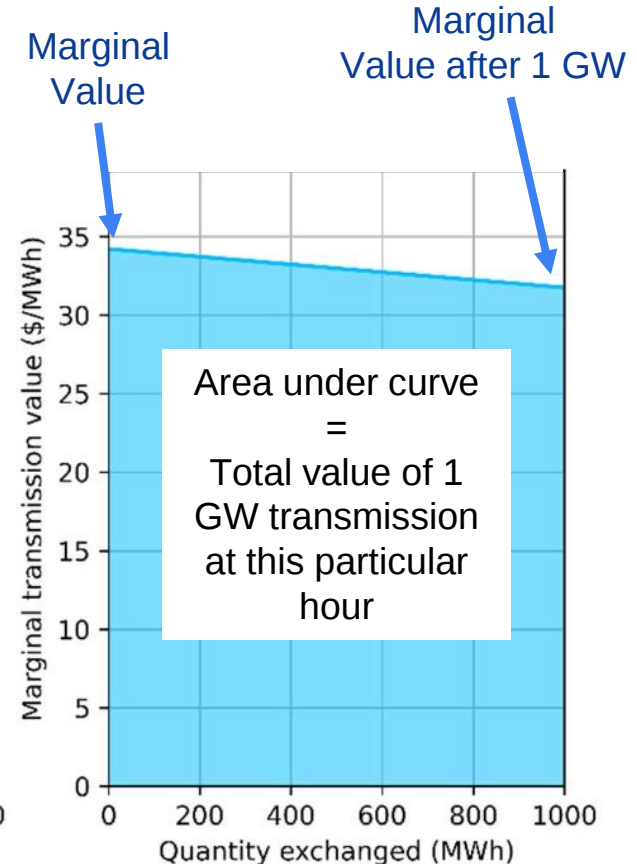
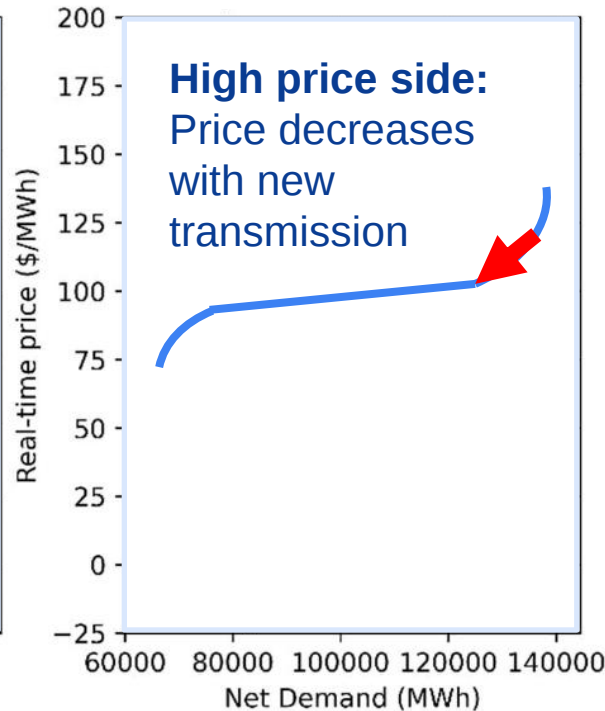
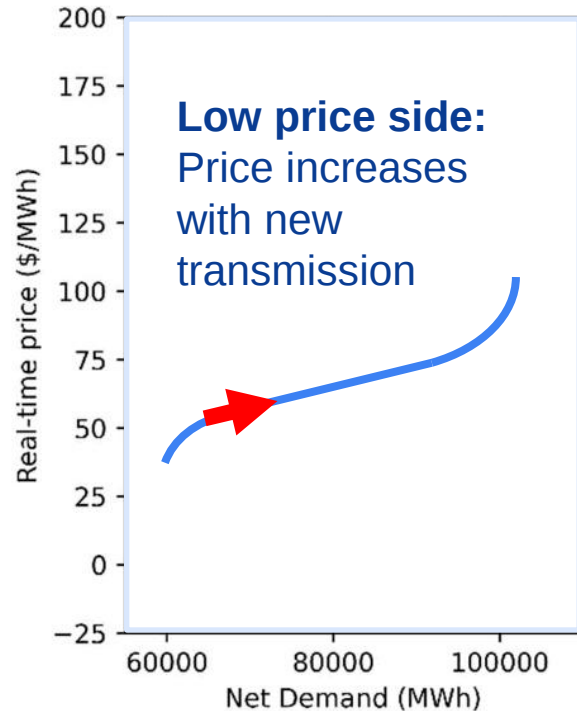


## Key conclusions so far

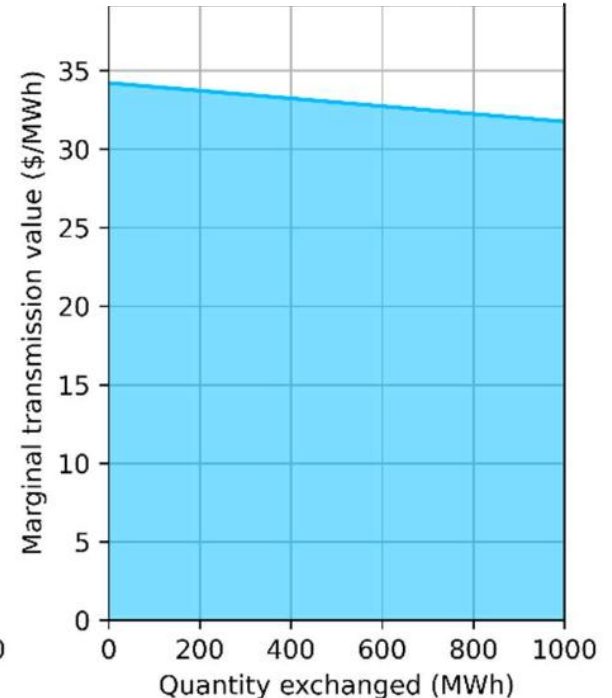
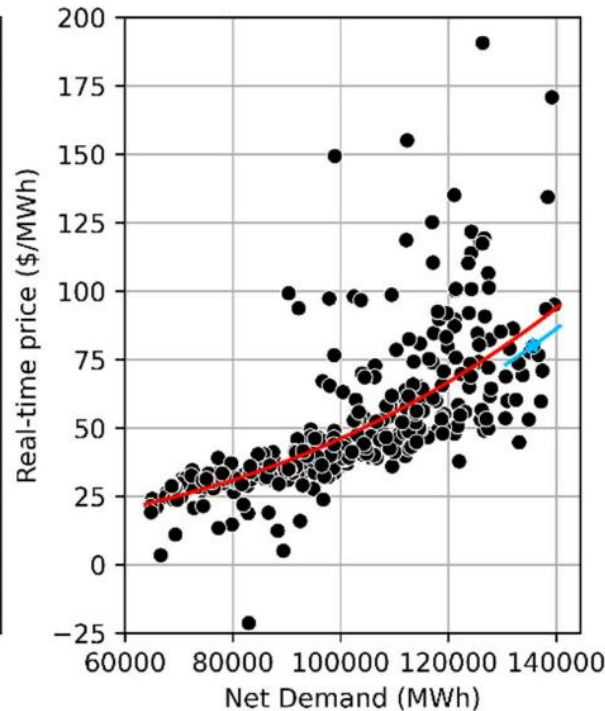
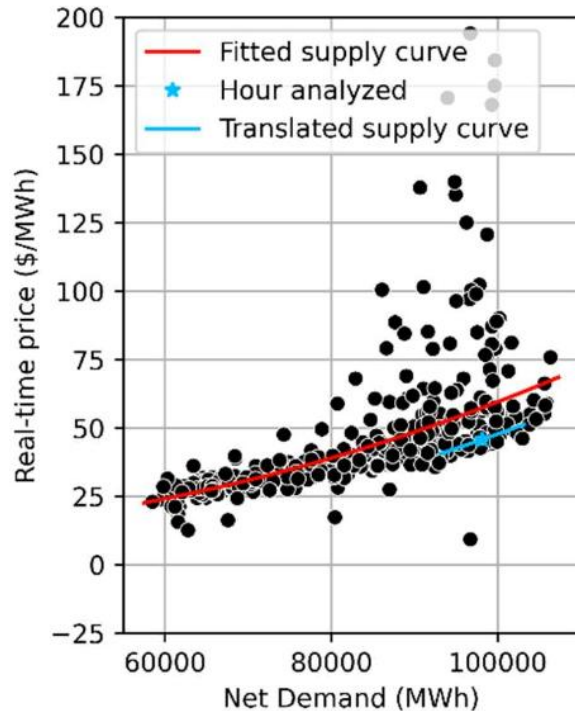
- **When and where is transmission valuable?**
  - Highest value for cross-interconnect and interregional links
  - Value varies annually with average prices, no evidence for long term trend
- **What drives transmission value?**
  - A small portion of high value hours (5% of hours ~ 50% of value)
  - High value periods are associated with unforeseen intraday variance
  - Other conditions such as high net load, cold weather, or high renewables rarely drive high transmission value periods unless they are combined with some unexpected variance occurring

# Beyond marginal value, comparisons to costs

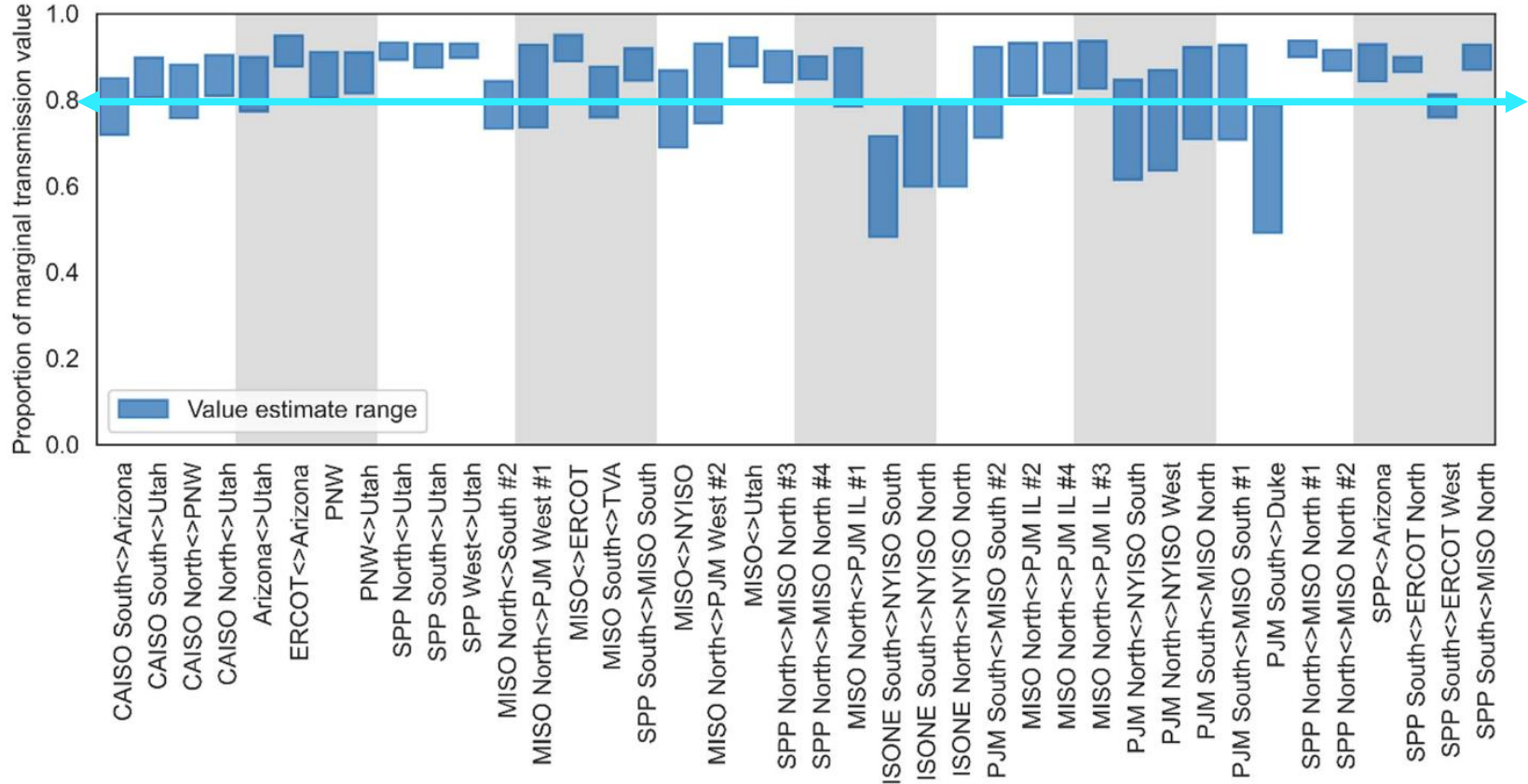
- We use empirical supply curves to estimate marginal price convergence with additional transmission

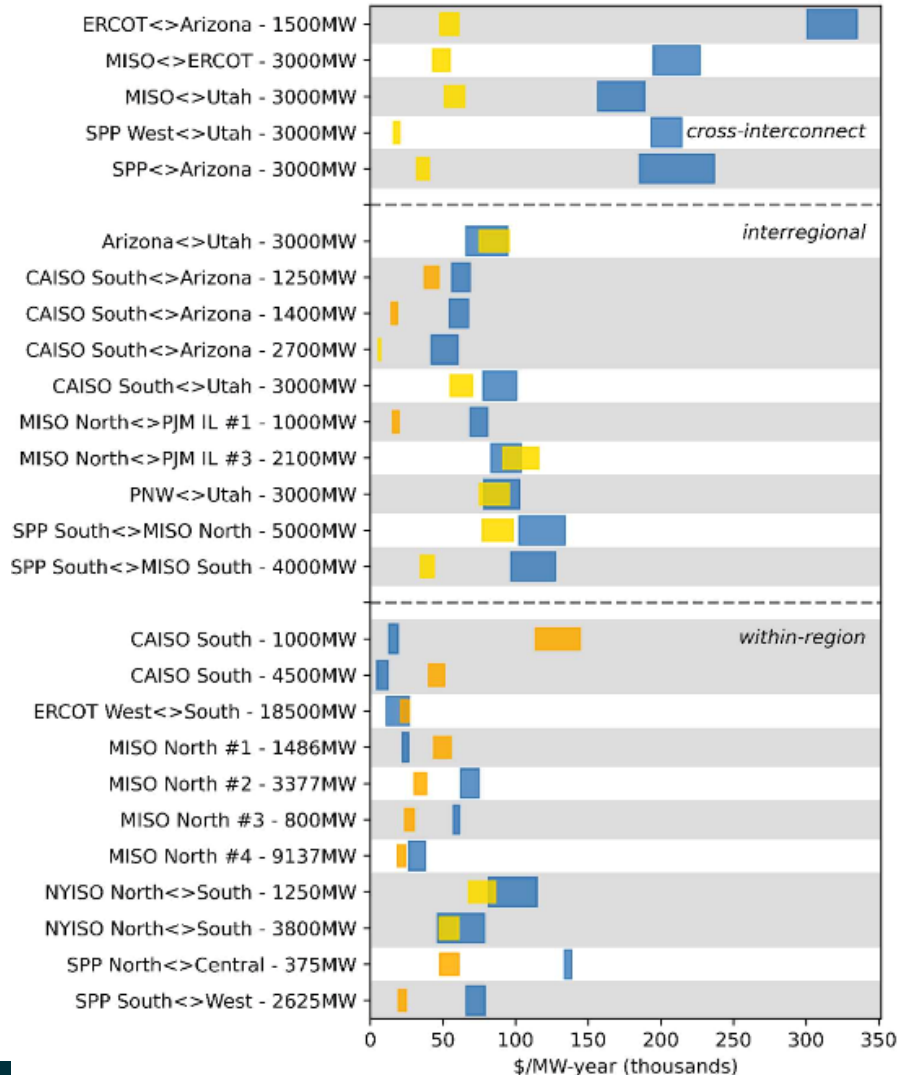


- Example shown for MISO <-> PJM, 2014-06-16
- Supply curves built based two-week periods
- Outlier points treated with a bounding approach
  - See details in forthcoming paper, Kemp et al. “Electric transmission value and its drivers in United States power markets”



With 1 GW of transfer capability, total value ~ 80% of original marginal value

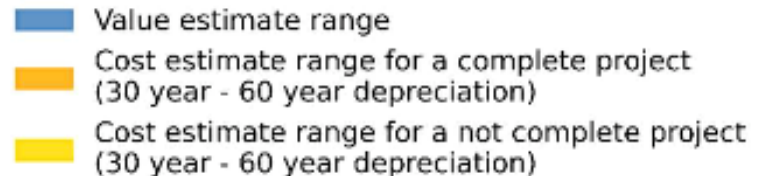




**Cross-interconnect value estimates**  
3 – 10X larger than cost estimates

**Interregional value estimates**  
1 – 5X larger than cost estimates

**Within-region value estimates**  
0.2 – 5X cost estimates



# Conclusions

- Many transmission links have significant value as indicated by market prices
  - Not just marginal value, but total value after accounting for price convergence with new trade
- Interregional links (those crossing market or grid seams) are especially valuable
- Our scoping-level comparison of transmission costs to historical energy market values finds greater value than cost for majority of links, including *all cross-interconnect links*
- Ongoing research is exploring:
  - The causes of unforeseen intraday variance
  - More sophisticated empirical techniques to understand price convergence with new transmission
  - Electric system modeling techniques and their impact on transmission value estimates

# Acknowledgements

This material is based upon work supported by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) under Lawrence Berkeley National Laboratory Contract No. DE-AC02-05CH11231. The authors thank Patrick Gilman and Gage Reber of the Wind Energy Technologies Office and Paul Spitsen of the Strategic Analysis Team for supporting this work. The US Government retains, and the publisher, by accepting the article for publication, acknowledges, that the US Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce the published form of this manuscript, or allow others to do so, for US Government purposes.