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Maximizing Forecast Value

Why electric power systems are weird

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The public knows that the power grid is important…

Q18-24. Do you agree or disagree with the following statements?	All Showing Total Agree (Strongly Agree)
Investing in the electricity transmission grid will ensure reliable access to power, especially during severe storms, for consumers and businesses.	93% (50%)
Investing in the electricity transmission grid will help America's economy by promoting job creation and economic growth.	91% (42%)
Investing in the electricity transmission grid will help regional local, regional and national businesses grow and succeed.	91% (38%)
Investing in the electricity transmission grid will increase competition by facilitating access to more efficient forms of energy and thereby reducing costs.	89% (36%)
Investing in the electricity transmission grid is important to national security.	89% (43%)
Everyone benefits from investments in the electricity transmission grid.	89% (44%)
Investing in the electricity transmission grid will accelerate access to all types of power.	88% (36%)

Source: The Economic Case For Grid Investment, ITC Holdings White Paper, February 2014

But they don't know much about how it works!

Who is primarily responsible for investing in transmission?

President Obama

Consumers

Private Investors

Government (56%)

Electric Utilities (25%)

Source: The Economic Case For Grid Investment, ITC Holdings White Paper, February 2014

Interesting Things about Regulated Utilities

Regulated utilities serve ~67% of consumers

Utilities are closely regulated by each state, with the primary mandates being to maintain reliability and keep prices low

The biggest “business” of utilities is investing capital, and ratemaking has traditionally incentivized large capital investments

Building a transmission line requires becoming a utility (in each state)

Non-fuel costs are ~90% fixed costs for the utility, but residential bills are ~90% variable based on energy usage (and fuel costs are often passed through to ratepayers)

On the distribution system, GTM Research estimates that there are 42 million secondary transformers with an average age of 42 years

Interesting Things About Power Markets

Electricity is a strange commodity, as it is instantly perishable and the system requires tight balance of supply and demand

Selling energy is only a portion of the power plant revenue stream

Payments for capacity (not energy) are significant, and several ISOs now have multiyear capacity markets

Ancillary service markets (regulation, reserves, flexibility) are fragile, and having “too much” will often cause the price to collapse

Flexible dispatch and reserves are often quite inexpensive, and if you have enough flexibility available at low cost, then reasonable amounts of uncertainty and variability have little or no cost

Cost of Forecast Error - Is It Intuitive?

Assume a wind plant operator uses a day-ahead wind forecast to offer 100 MW in the day ahead (DA) market for hour ending 1300

The wind plant is only able to produce at 50 MW during that hour

To make whole on the day ahead commitment, the wind plant must buy 50 MWh at the real time (RT) price

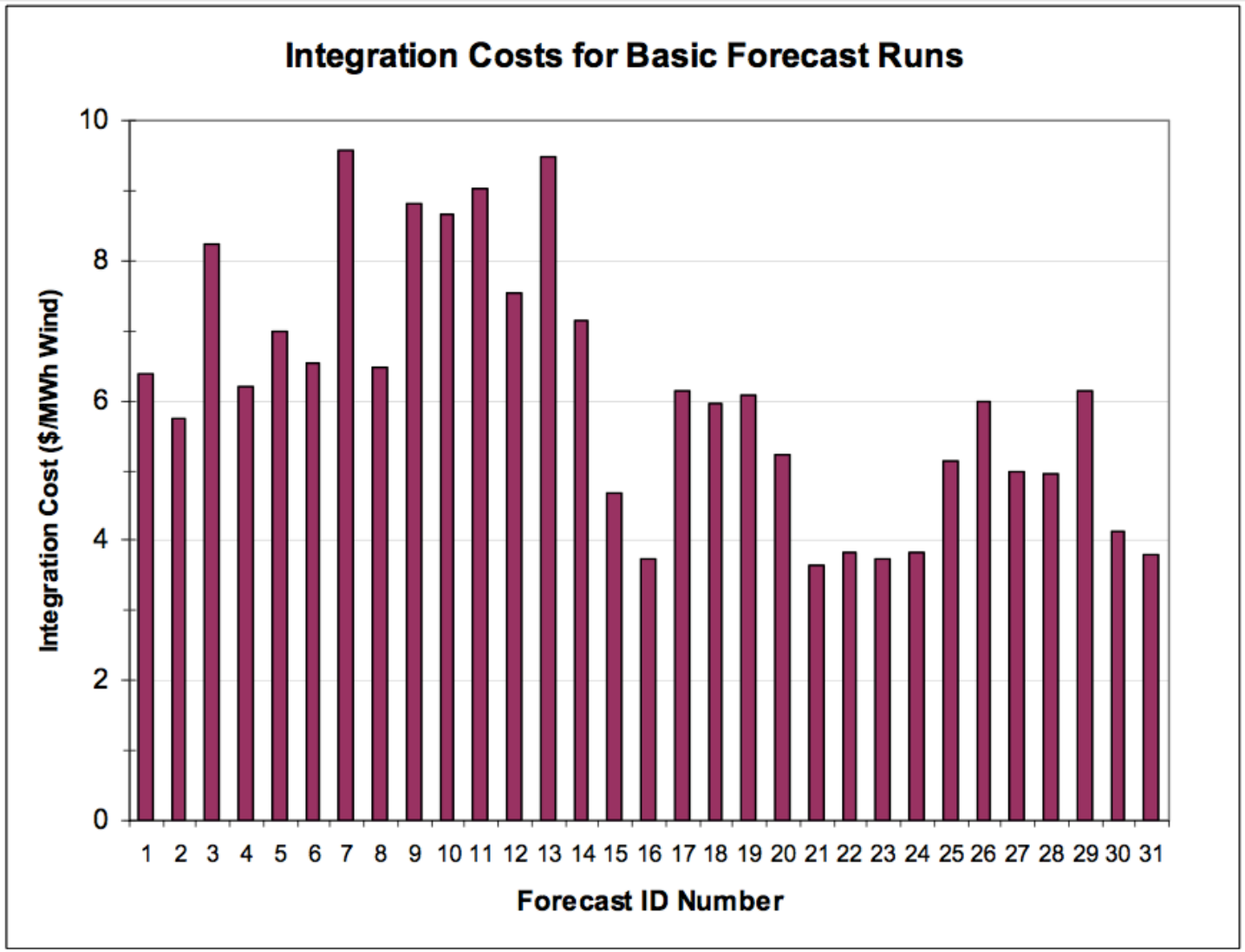
The cost of that purchase is the forecast error cost, right?

Wrong! - The plant was paid for 100 MWh at the day ahead price, and on most days the DA and RT price are about the same

There is more risk, because sometimes the RT price does spike

- But that means that it is more important to forecast when the RT price might spike than to forecast the output of the wind plant

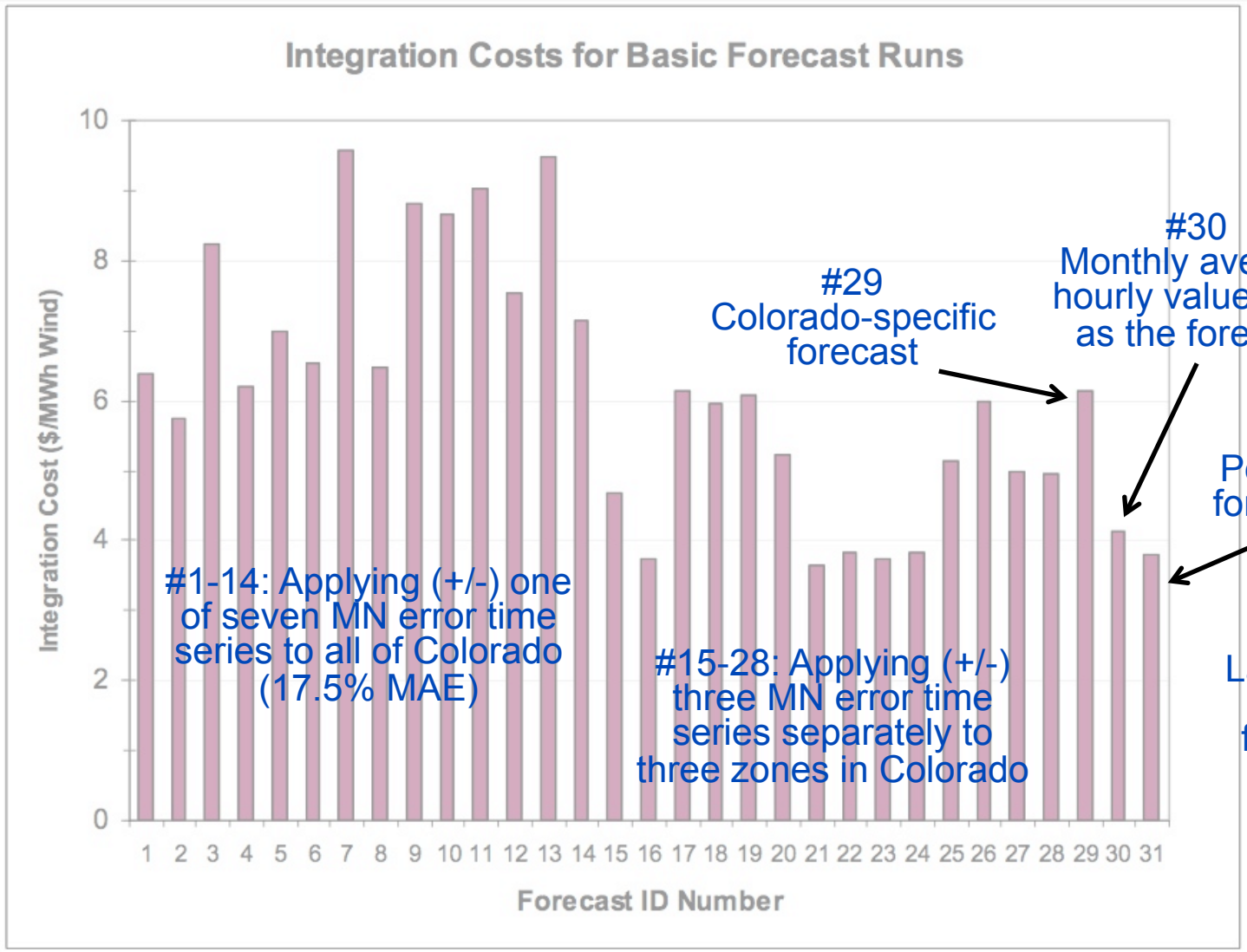
Integration Cost - Many Complex Moving Parts



Source: Wind Integration Study for Public Service of Colorado, EnerNex, December 1, 2008

http://variablegen.org/wp-content/uploads/2013/01/CRPWindIntegrationStudy.pdf

Various Types of Forecasts Used



Source: Wind Integration Study for Public Service of Colorado, EnerNex, December 1, 2008

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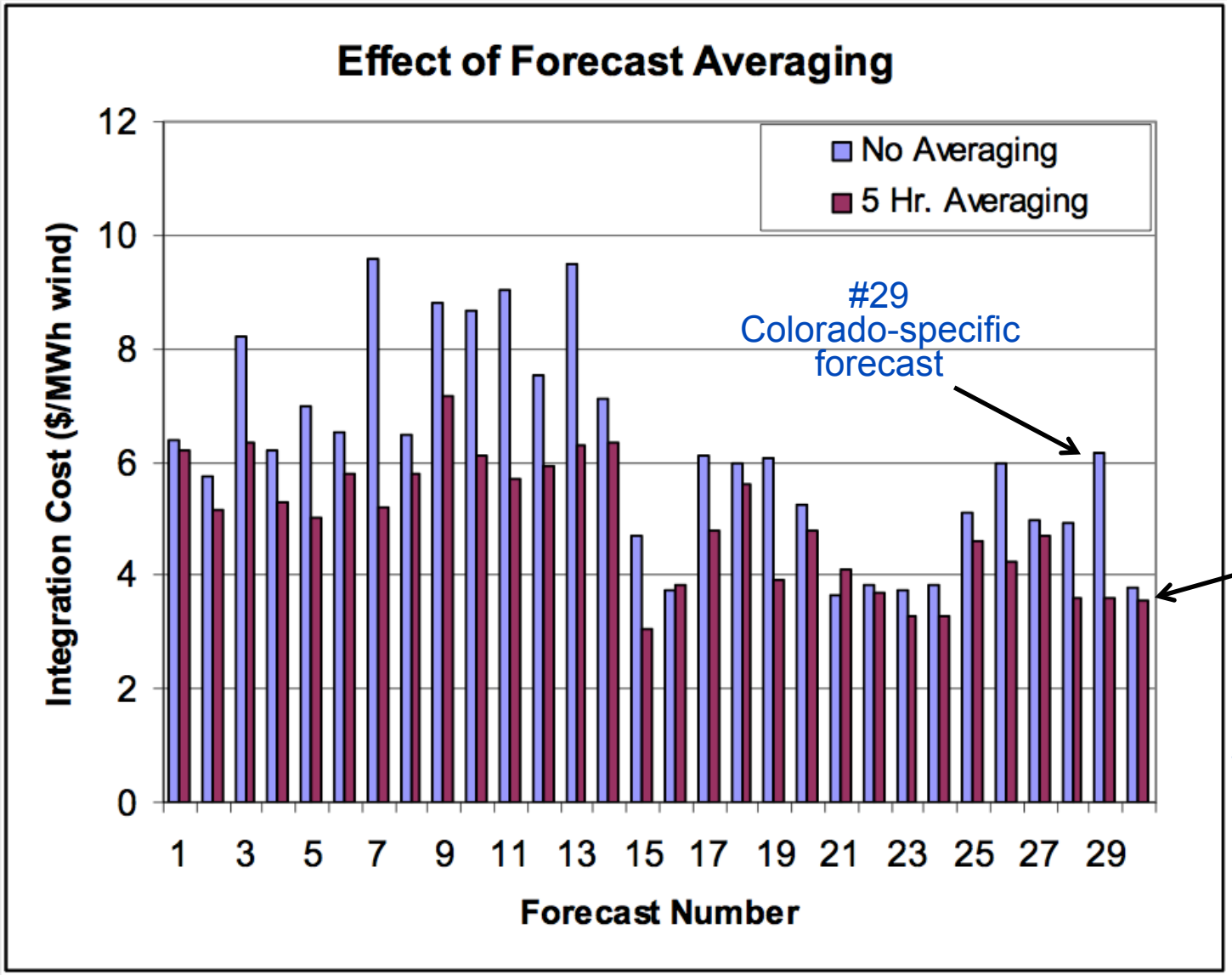
Forecast Smoothing Reduced Integration Cost (??)



Source: Wind Integration Study for Public Service of Colorado, EnerNex, December 1, 2008

http://variablegen.org/wp-content/uploads/2013/01/CRPWindIntegrationStudy.pdf

Very Unexpected Results - Why?

The 2008 study report speculated on possible explanations:

- The day ahead unit commitment assumed that all forecasts were perfect, then created an optimal plan considering the start costs, minimum run time, minimum down time, ramp rates and costs of all generators
- Did it “over-optimize” to a state where forecast error is more expensive to handle (even if the wind forecast is perfect and only the load forecast error perturbs the plan)
- With smoothing, did it take a “middle path” that is more economic than following the variability of a perfect forecast
- Was this a limitation of the tool used, or a general result?

Is this like a control problem, where trying to “over control” the system will increase costs?

How do we make perfect forecasts more valuable?

If more sophisticated models continue to show similar results, we need to study what "perfect" really means

Will probabilistic unit commitment models help?

Perhaps…

A probabilistic forecast, used correctly, should provide better results than a deterministic forecast

But if you don't know how to optimally use the forecast, then a smoother forecast may be better than a perfect forecast

Are "forecast-only metrics" meaningful in this context?

Regulated Utilities & Solar

Remember:

- The biggest “business” of utilities is investing capital
- Non-fuel costs are ~90% fixed costs for the utility, but residential bills are ~90% variable based on energy usage (and fuel costs are often passed through to ratepayers)

Changes that reduce retail energy sales, like distributed solar with net metering, are a challenge to the traditional utility business model

- For PV owners, their net variable energy usage is reduced
- If fixed costs are recovered through variable energy sales, then those costs are shifted toward customers without PV

What About Solar Forecasting?

At a large ISO system level, aggregate solar is extremely smooth

At a local or constrained regional level, solar forecasting and variability will be important, however…

- Utilities may still have a preference for capital investment rather than paying for services
- Operators plan for the extreme events, so forecast confidence is critical and the bar is high
- Operators love having ample amounts of control and flexibility
- Will utilities pay to forecast it, or prefer to invest capital to manage it?

How can forecasts be used to optimize system operations and costs

System impact gets smoother with more solar and larger power systems. With growth, what happens to the marginal value of better forecasting?

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Discussion

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