



# Resource Availability and Need

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# KEY FACTS ABOUT MISO

99.99% system reliability

42 million end-use customers

400+ market participants

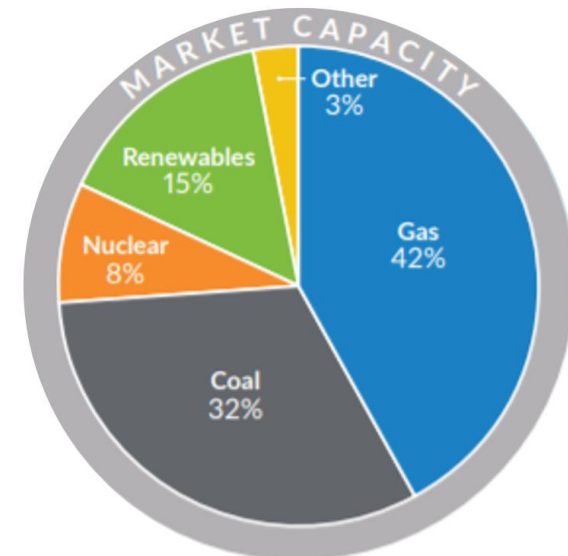
\$30 billion energy market

5-minute dispatch to over 6,000 electric generating units

MISO's reliability footprint and locations of regional control centers



- 68,000 miles Transmission miles >69 kV
- 127,000 MW Peak Load (Market)
- 174,000 MW Generation capacity
- 290,000 SCADA data points
- 15 states
- One Canadian province
- Historic Wind Peak (January 17 , 2018) 15,038 MW





# Three major trends are driving new opportunities challenges and needs for reliable grid operations

## Three Identified Key Needs



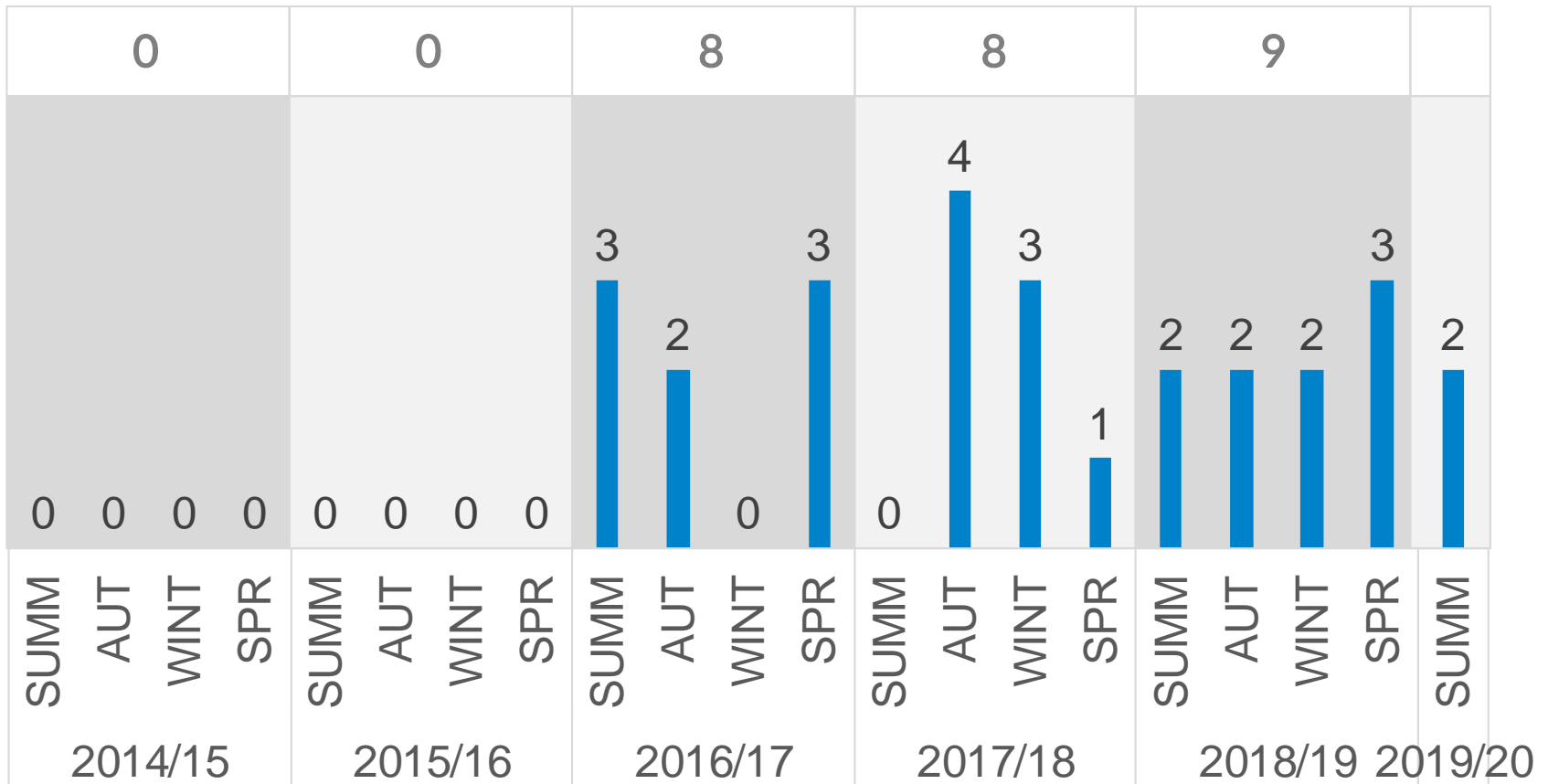
How do resource adequacy approaches need to evolve to meet these needs?

# Historically, MISO's Resource Adequacy Construct has shown risk only during the summer season

- MISO's Planning Reserve Margin (PRM) analysis focuses on the summer-peak period when demand is the highest
- Modeling assumptions are currently tailored towards the summer timeframe
- However, given the increase in MaxGen emergencies in other seasons the last three years, MISO is now evaluating whether a summer focus continues to be prudent

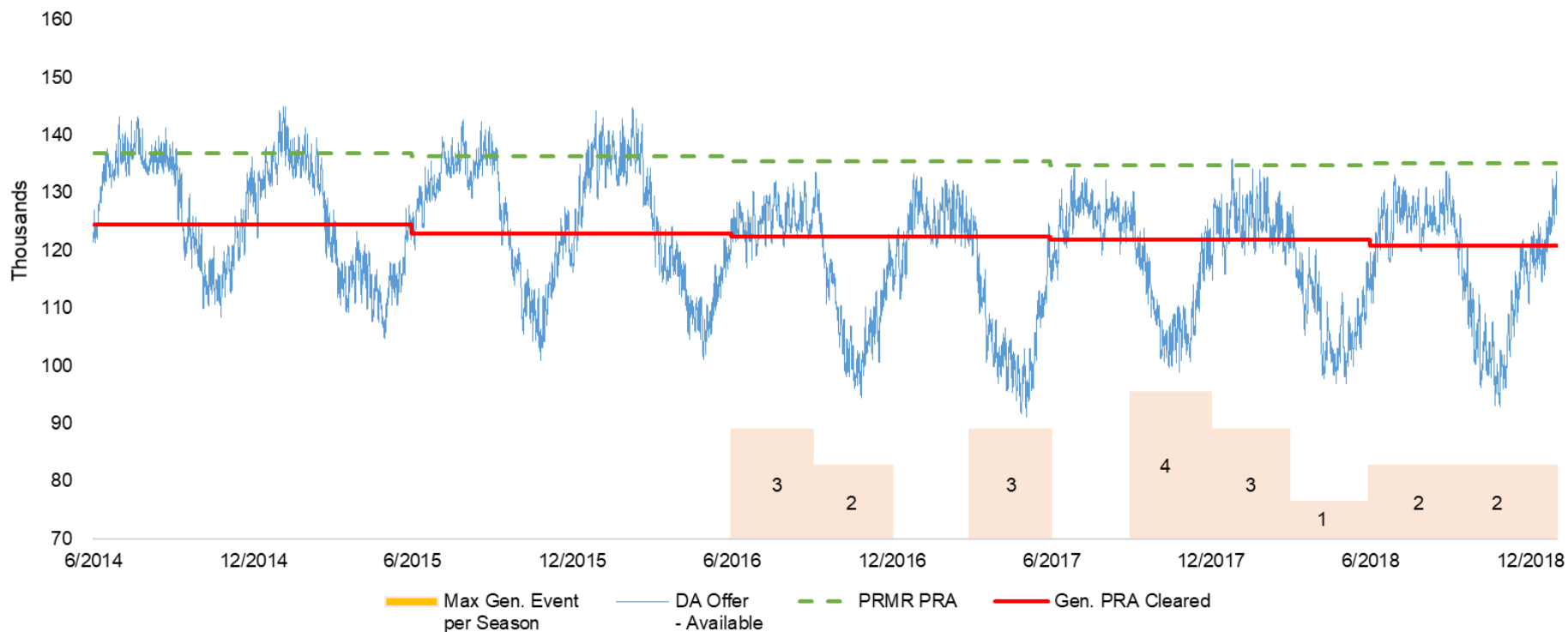
# Maximum generation events are occurring in all seasons

Maximum Generation Alerts – Count by Season and Year



# Day-ahead offers have been trending downward the last few years in relation to the generation cleared in the annual Planning Resource Auction (PRA)

Historical Hourly Day-Ahead Offer  
(MISO System, MW)



In response to these trends, MISO improved the availability of LMRs by reducing notification times and ensuring access outside summer ...

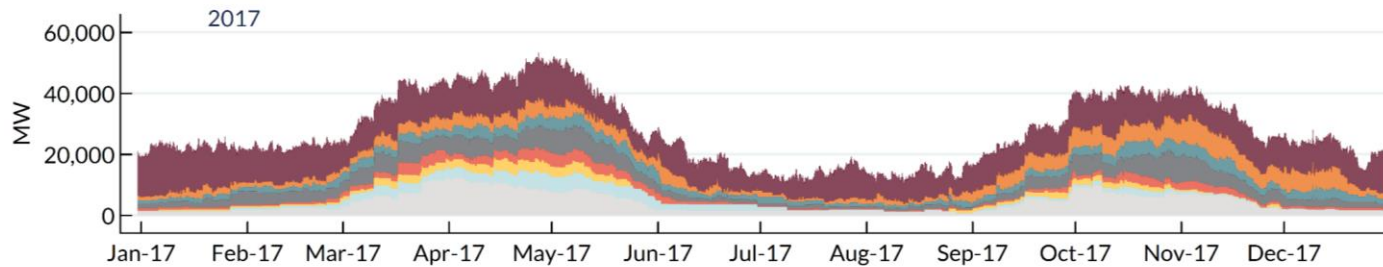
Notification Time	19-20 PY	18-19 PY
$\geq 6$ Hours	2,192	4,127
$> 2$ Hours and $< 6$ Hours	2,523	1,970
$\leq 2$ Hours	6,150	4,473
Total MW	10,865	10,570

~9.5 GW of LMRs registered with 12-month availability in the 19-20 Planning Year

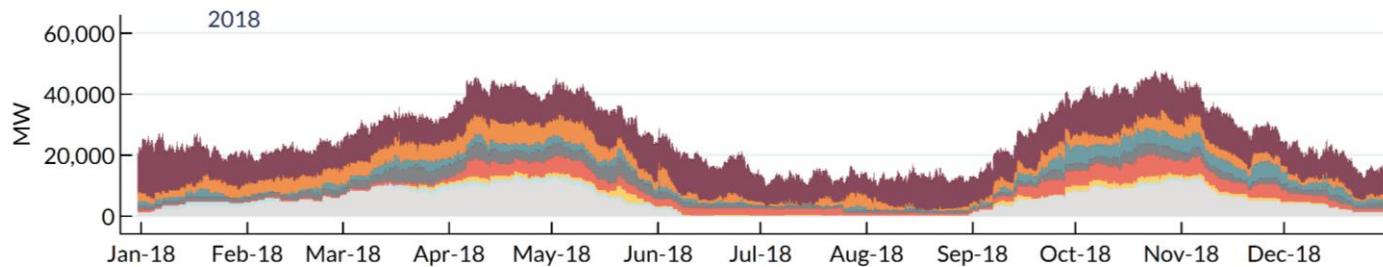


# ... Increased notification time and enabled better use of margin for outage scheduling

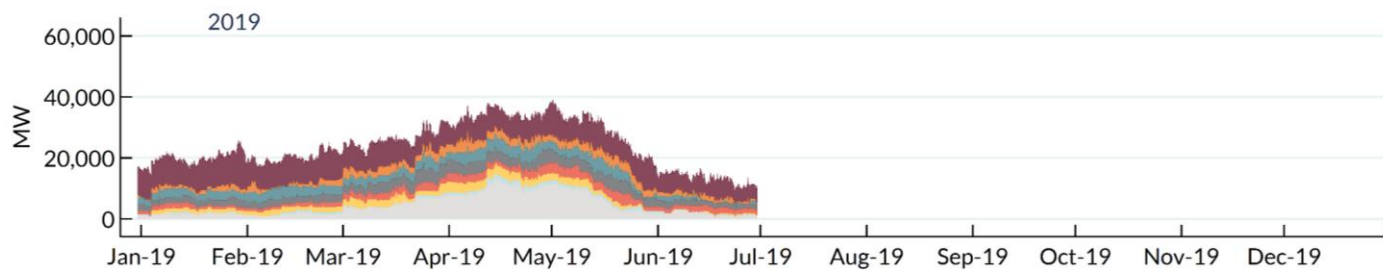
MISO System Resource Outage-OOS Jan 2017- Jun 2019: by outage leadtime



2017 outages reached 50 GW and only ~1/3<sup>rd</sup> provided >120 days notice



2018 outages down slightly but only half gave >30 days notice



2019 outages down a bit more due primarily to fewer short notice outages (<1d, 1-3d)

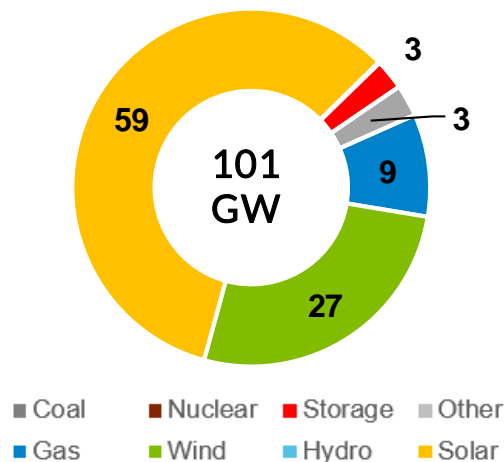


# However, as the fleet continues to evolve and age, complexity of operations increases at an accelerated pace

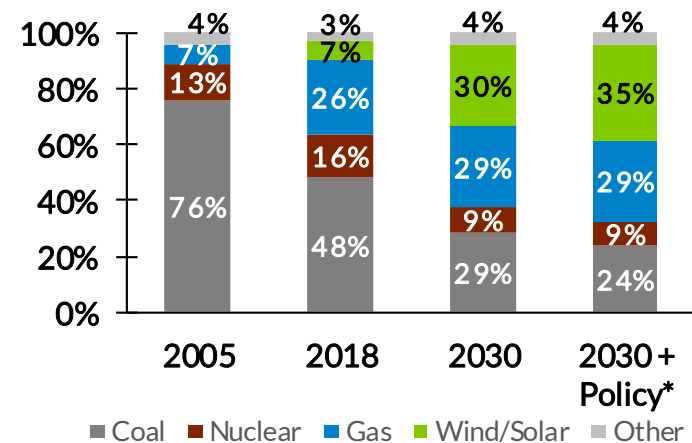
## Longer-term Issues to Further Evaluate:

- Ensuring sufficient attributes to meet requirements every hour
- Aligning broad regional and local reliability requirements
- Sequencing and aligning enhancements to not only address near-term issues but also provide an effective progression of changes over time

MISO Total Interconnection Queue

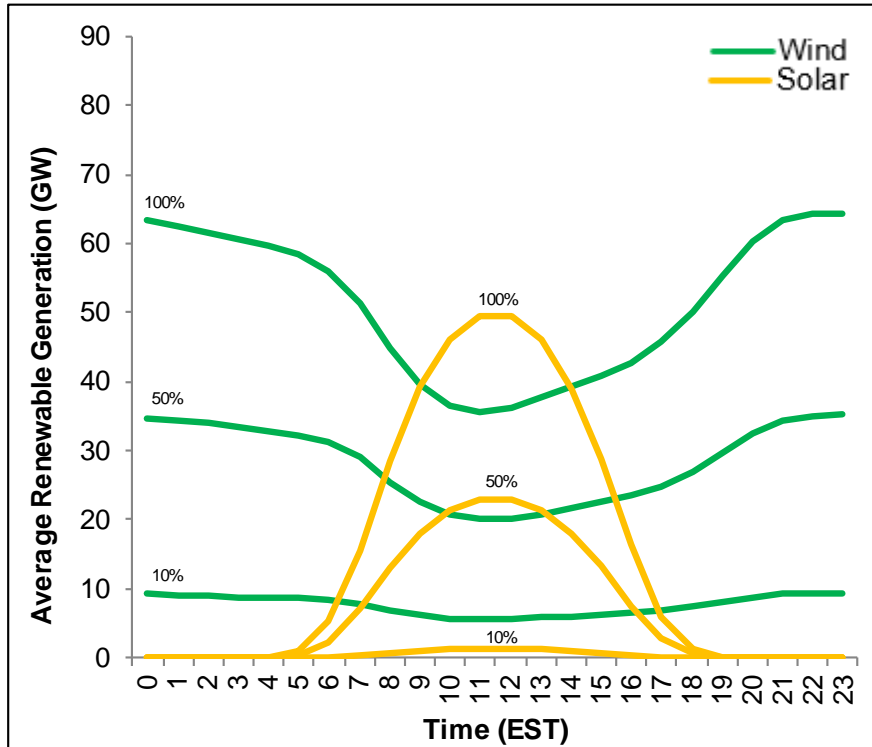


Portfolio Change (energy mix %)  
(Based on utility and state announcements)

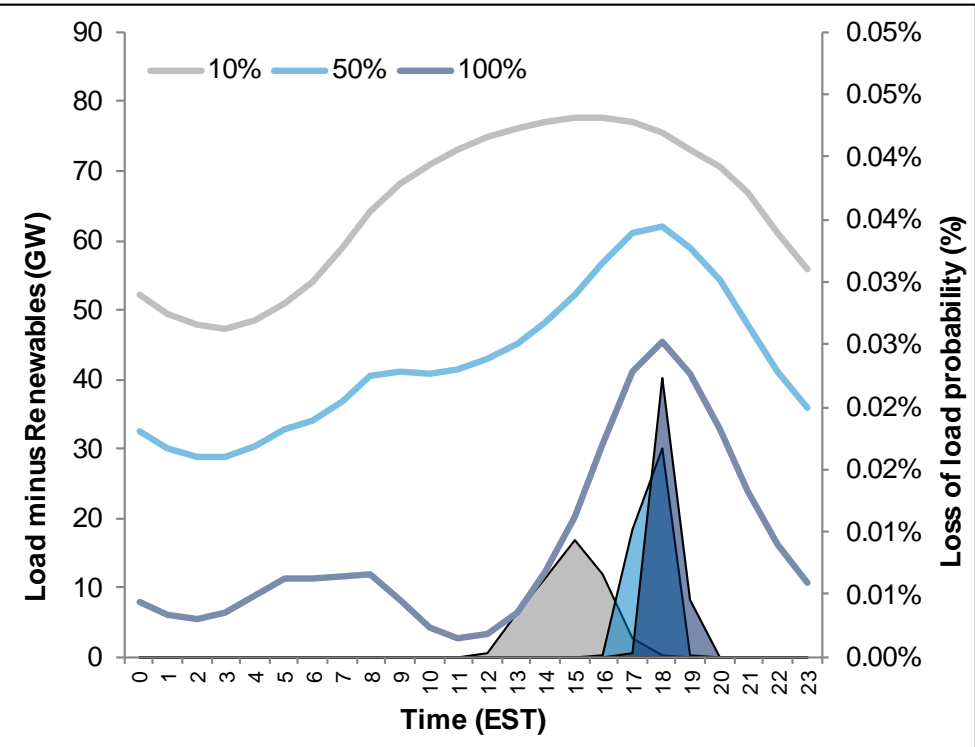


# For example, the amount of up/down ramp capability increases as more wind and solar comes online

Average Daily Renewable Production (GW)



Average Daily Load minus Renewables (GW)



Approaches to resource adequacy needs to accommodate greater diversity of utility resources and efficiently address reliability needs across all hours

## 2020 MISO Forward: Utilities of the Future What do they need from a system operator?



New Mix



High Wind



Self-Supply if  
Sunny



Traditional



Wireless

# MISO's Resource Availability and Need Program's guiding principles help ensure reliability for a transforming grid

## Guiding Principles

- 1) **Reliability Needs and Requirements:** Reliability criteria must reflect required attributes in all horizons – “all hours matter”
- 2) **Reliability Contribution:** Members are responsible for meeting reliability criteria with resources that will be accredited based upon the resource's ability to deliver those attributes
- 3) **Alignment with Markets and Infrastructure:** Market prices must be reflective of underlying system conditions and resources must be appropriately incentivized for the attributes they provide; infrastructure should enable efficient utilization of resources

# Goal is to meet future reliability needs during all operational timeframes throughout the year

<b>Progress, To Date</b> Improve resource transparency and performance for spring 2019 and subsequent planning year	<b>In Flight</b> Continued refinements for 2020 Planning Resource Auction (PRA), progress on market-based solution	<b>Next Focus</b> Continued improvement in availability and flexibility
<b>Load Modifying Resources (LMRs):</b> <ul style="list-style-type: none"><li>• Create transparency and better align LMR obligations with other resources</li></ul> <b>Outage Coordination:</b> <ul style="list-style-type: none"><li>• Improve forward-looking transparency for stakeholders and MISO</li><li>• Increase early outage notification and flexibility during emergencies</li></ul>	<b>PRA Inputs:</b> <ul style="list-style-type: none"><li>• Improve PRA inputs, focus on LMR</li><li>• Create rules outlining reasonable expectations for availability or replacement during the planning year</li></ul> <b>Visibility:</b> <ul style="list-style-type: none"><li>• Multi-day Operating Margin forecast</li></ul>	<b>Resource Adequacy Construct:</b> <ul style="list-style-type: none"><li>• Reflect risks throughout year</li><li>• PRA reliability value reflected in auction results</li></ul> <b>Resource Accreditation:</b> <ul style="list-style-type: none"><li>• Align with attributes based on all-hours reliability criteria</li><li>• Deliverability improvements</li></ul> <b>Market Incentives:</b> <ul style="list-style-type: none"><li>• Prices reflect operating conditions</li><li>• Incentivize needed system attributes (e.g., multi-day market mechanism)</li></ul>

# Questions?