

# Non-Emitting Resources and Implications for IESO's Market Renewal Program



December 7, 2017



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IESO MRWG NERSC Meeting

# Today's Discussion

## 1. Context for Increasing Uptake of Non-Emitting Resources

Prepared for IESO MRWG NERSC

December 7, 2017

## 2. Challenges for Wholesale Electricity Markets Relating to Non-Emitting Resources

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## 3. Design Considerations for Market Renewal Program Relating to Non-Emitting Resources

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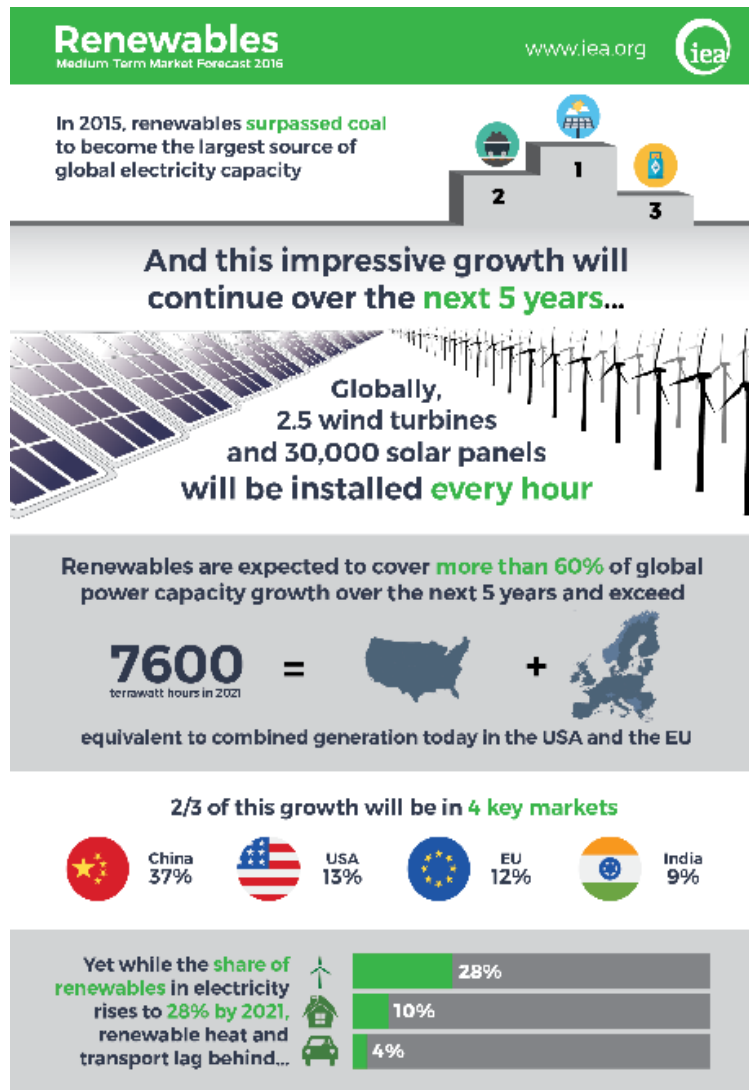
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# 1. Context for Increasing Uptake of Non-Emitting Resources

# Increasing Renewable Generation Supply

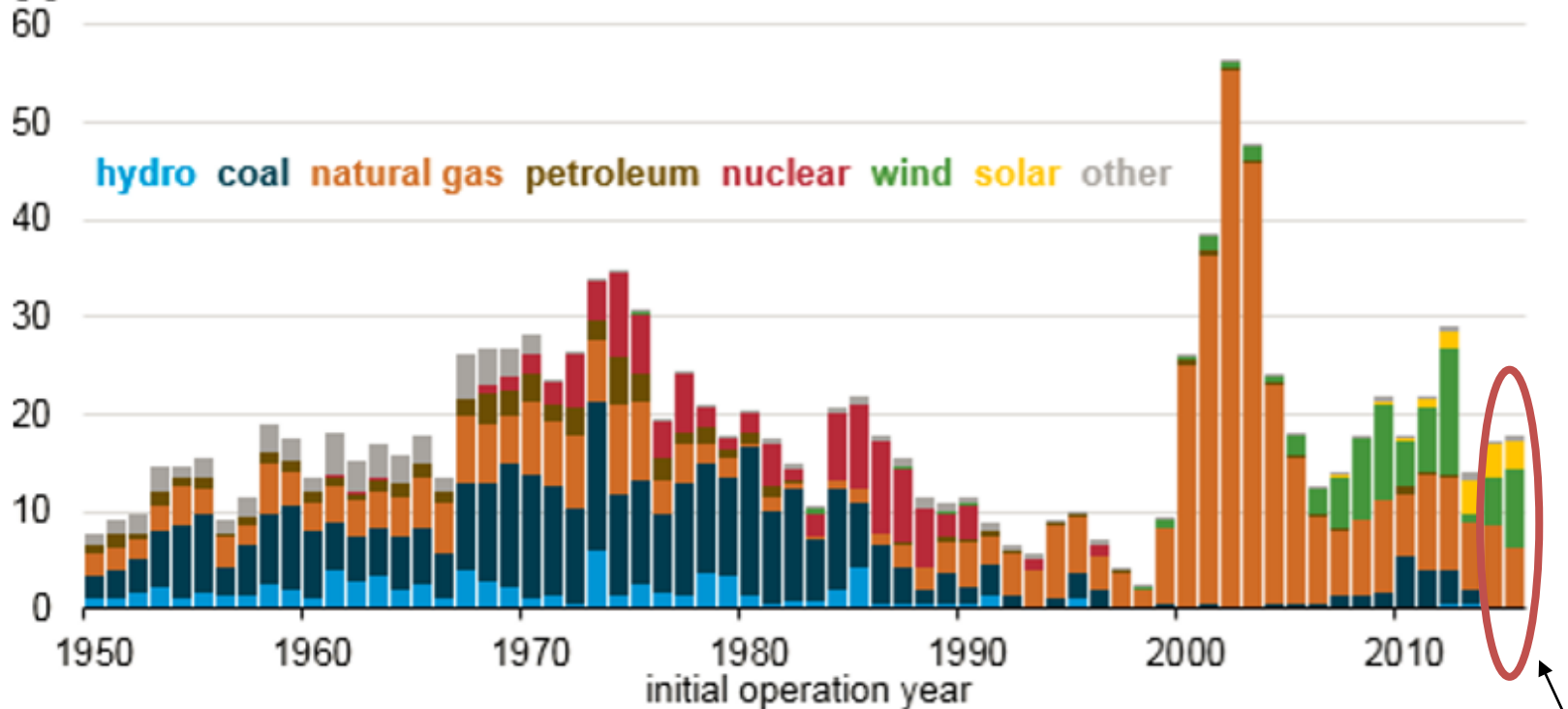


- Renewable generation growing faster than any other energy source, costs becoming competitive with fossil fueled generation (IEA)
- Renewable generation projects to account for half of growth in global energy supply over next 20 years
- Changing supply mix towards low carbon emitting resources is forcing new thinking, re: wholesale electricity market design and rules

# Increasing Renewable Generation Supply

Electric generation capacity additions by technology (1950-2015)

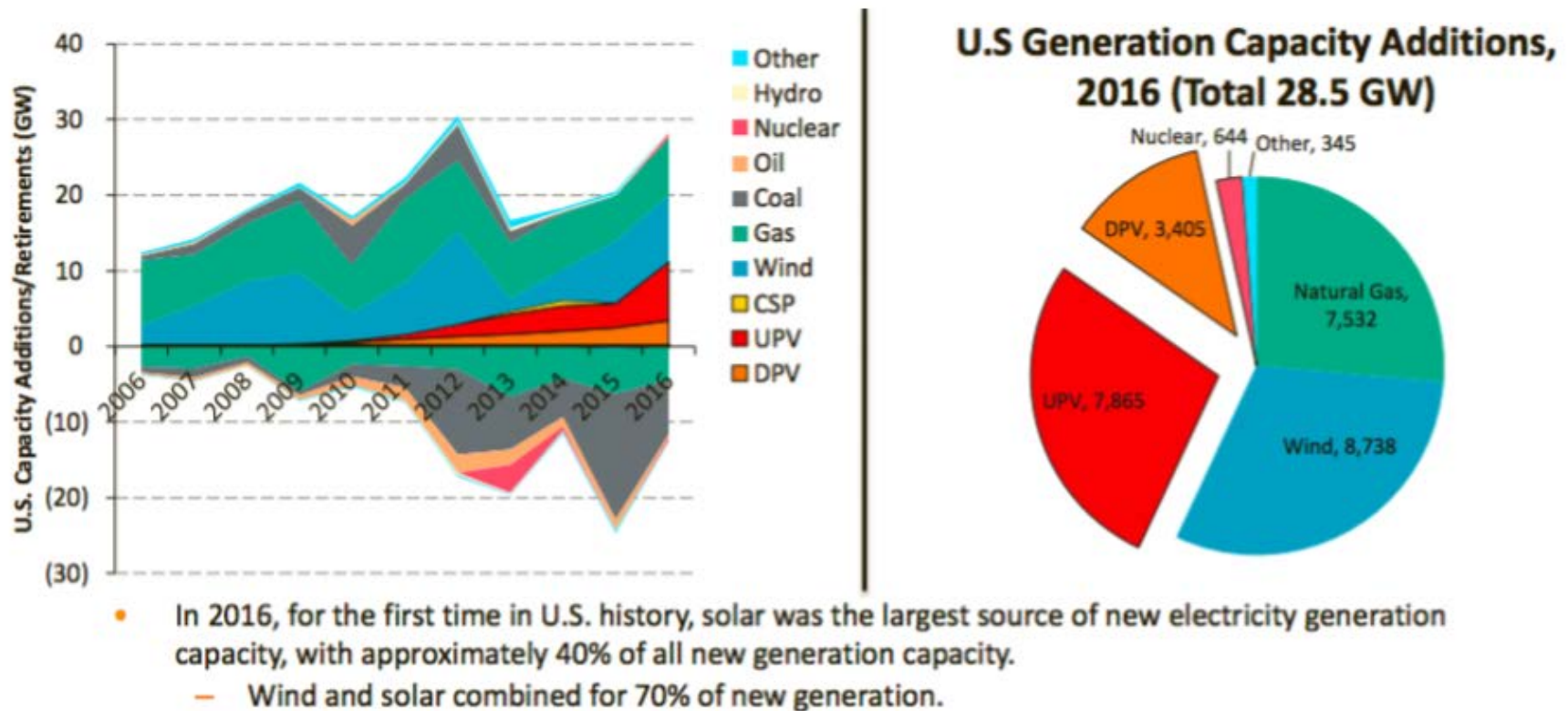
gigawatts



2015: gas fell to second place behind wind / solar – new era in US capacity additions.

- Supply trends: coal (1950s-1980s) → nuclear (1970s-1980s) → natural gas (1990s-2000s) → renewables (2010s+)

# Increasing Renewable Generation Supply

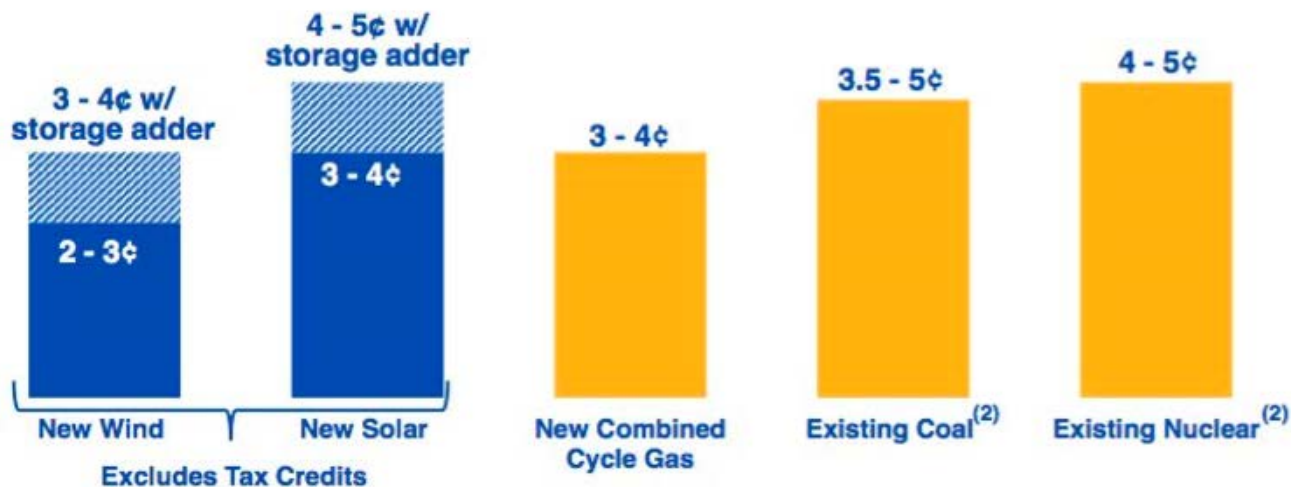


- Increasing variable (i.e., wind and solar) generation supply partially driving increasing energy storage development



# Supply Resource Cost Projections – NextEra Energy June 22, 2017 Investor Conference

## Estimated Costs of Generation Resources Post – 2020<sup>(1)</sup> (cents/kWh)



**Wind and solar combined with storage to firm and shape production is expected to compete economically with other generation in the next decade**

- Some U.S. jurisdictions project some non-emitting resources (NERs) (e.g., wind+storage, solar+storage) to be on par with 'conventional' generation (i.e., natural gas, coal, nuclear) on a levelized cost basis → projects to continue increasing development of these NERs

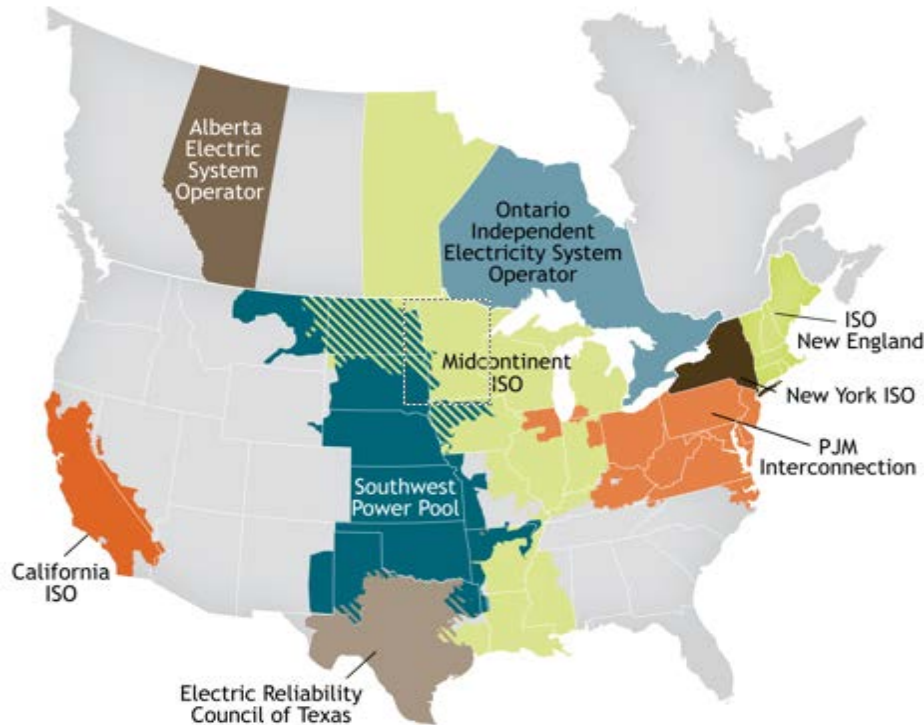
# Increasing NERs Leads to 'Clean Energy Paradox'

- Clean Energy Paradox (Rolando Fuentes, Kapsarc)
  - Global 'vicious circle' – 'out of market' mechanisms (e.g., contracts, production tax credits, etc.) and declining costs lessening need for 'out of market' mechanisms supporting development of NERs
  - Therefore, depressing wholesale energy spot prices, increasing need to financially support all generation resources
- Paradox facilitated by these factors
  - Technological advances and declining costs
  - Customer choices and economics leading to declining electricity demand (e.g., distributed energy resources (DERs), conservation and demand management (CDM), etc.)
  - Government policies, objectives, programs
  - Wholesale market design and wholesale energy spot prices structured around marginal costs (i.e., fuel costs)



## 2. Challenges for Wholesale Electricity Markets Relating to Non-Emitting Resources

# Wholesale Electricity Market Design – Evolution to a New Paradigm?



9 wholesale electricity markets characterized by:

- Real-time energy (day-ahead in U.S.)
- Ancillary services
- Transmission/congestion rights
- Capacity (Northeast U.S.)

Emerging major and long-term issues without consensus:

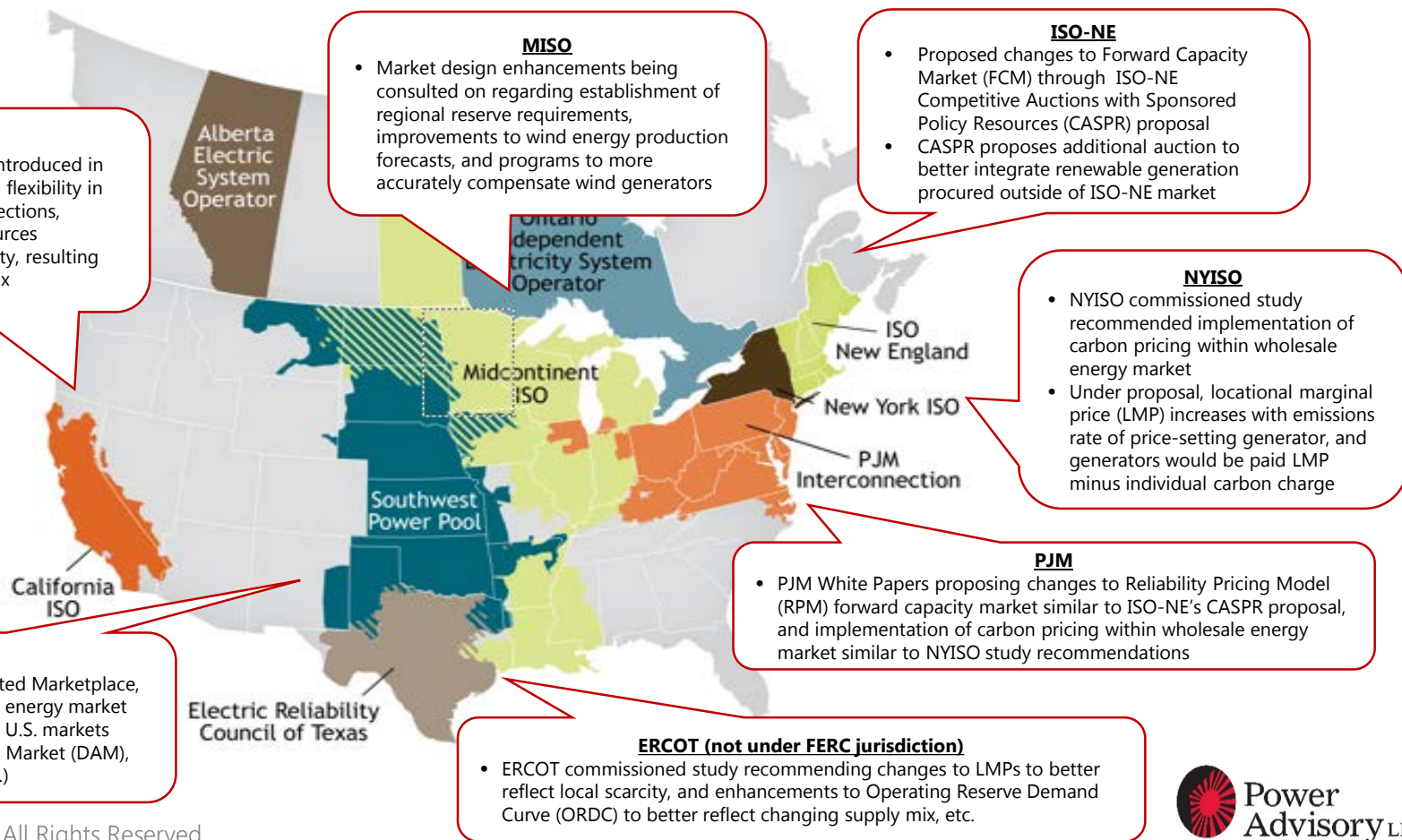
1. Are markets adequately accommodating public policy goals, and what potential market design changes would further enable deployment of resources that achieve goals of reliability, affordability, and resource mix?
2. What are the market impacts of environmental regulations that further constrain deployment of fossil-fueled generation?
3. What are the market impacts of integrating higher levels of NERs with low marginal costs?
4. Are today's market designs adequate to acquire flexible resources needed to better integrate increasing levels of variable generation at reasonable costs?

# Leadership from Government and Regulators

- U.S. Department of Energy (DOE) (see Forward in *The Future of Centrally-Organized Wholesale Electricity Markets* (March 2017))
  - "...provision of electricity ... undergoing significant changes ... implications are unclear ... current level of discussion and debate surrounding these changes is similar in magnitude to ... discussion and debate in ... 1990s on ... electricity industry restructuring ... today's discussions ... arisen from a range of challenges and opportunities created by new and improved technologies, changing customer and social expectations and needs, and structural changes ... key factors driving current discussions include continued low load growth ... and policies and regulations ... approaches may require reconsideration and adaptation to change"
- U.S. Federal Energy Regulatory Commission (FERC) May 1-2, 2017 technical conference scope
  - States' policy objectives prioritizing certain resources or resource attributes
  - Can objectives be achieved through existing or modified market mechanisms
  - Policy implications for wholesale electricity markets depending on whether policy objectives can be achieved through markets, focusing on market outcomes and market participants' ability to make long-term decisions
  - Long-term alternatives to reconcile competitive market framework with state policies, including objectives that such solutions seek to achieve and market design principles that should guide wholesale market rules needed to implement those solutions

## Jurisdictional Stakeholder Consultations – Potential Changes to Wholesale Electricity Market Design

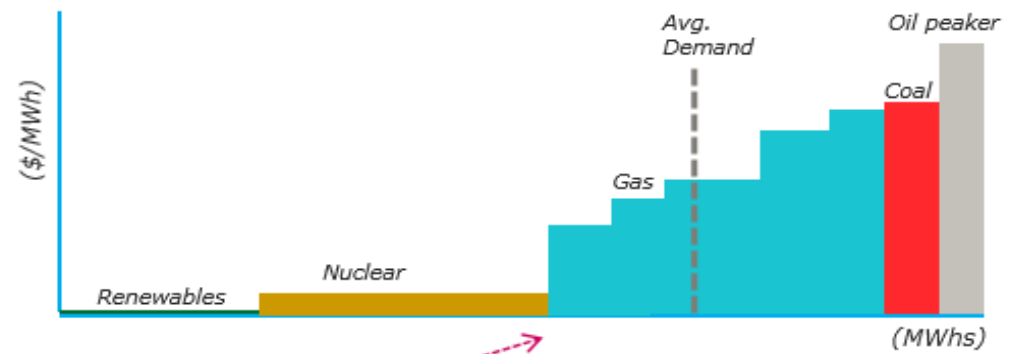
- Focus on U.S. markets, keeping in mind: i) all with significant fossil-fueled generation; and ii) use of 'out of market' mechanisms (e.g., contracts, regulated rates, etc.) generally less 'controversial' outside of Northeast U.S.



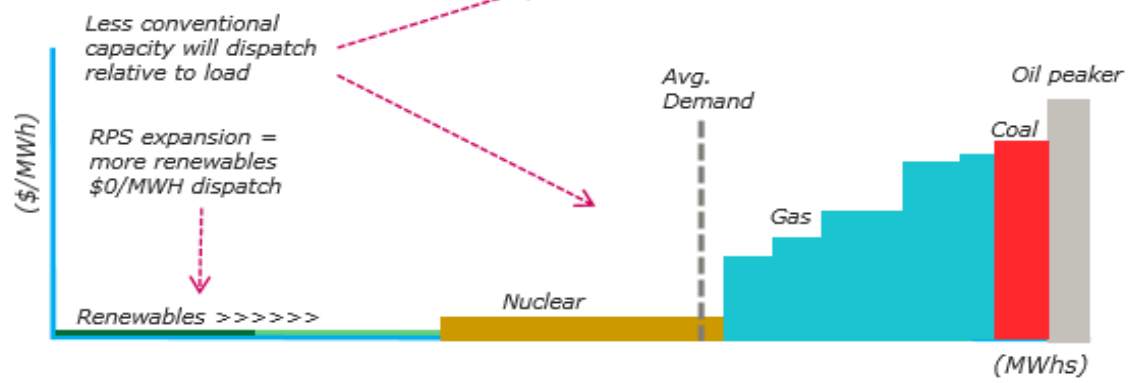
# Dispatch and Energy Spot Price Implications – nrg Aug 11, 2016 Presentation to NEPOOL IMAPP Meeting

- New England Power Pool's (NEPOOL's) Integrating Markets and Public Policy (IMAPP) consultation assessing potential changes to ISO-NE's wholesale electricity markets towards advancing state public policy objectives
  - Graphs below show implications of Clean Energy Paradox through depressed wholesale energy spot prices leading to revenue adequacy issues for all generators

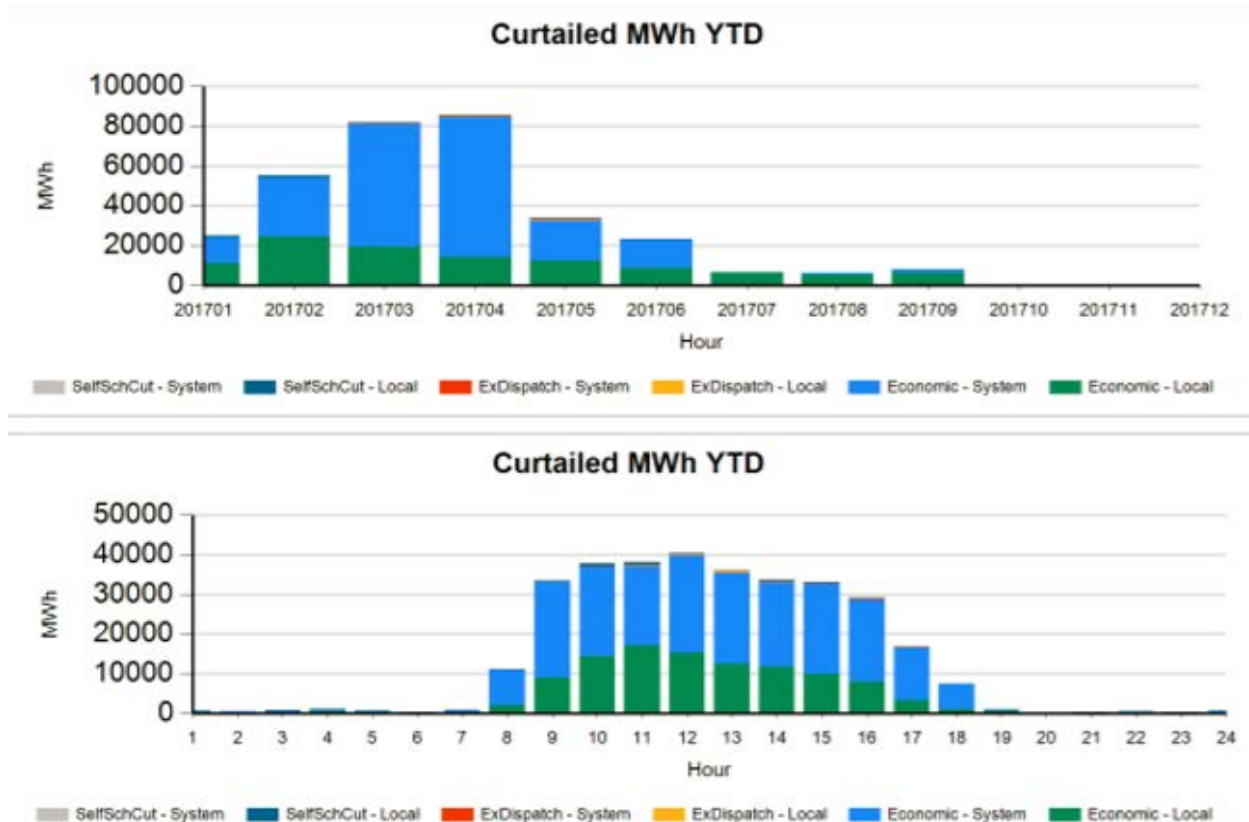
**Today:**  
Status quo  
daily dispatch



**Tomorrow:**  
Ever-expanding  
RPS 'merit  
order' impact  
on daily  
dispatch



# CAISO Curtailed Over 325 GWh of Energy Production from Variable Generation in 2017



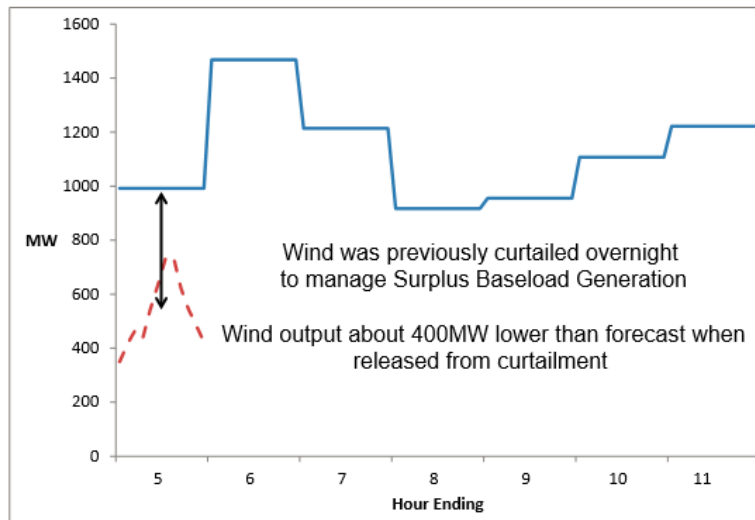
- Changing supply mix due to penetration of NERs in California resulting in interesting outcomes: 7:00 am curtailment of solar energy in June; electric vehicle (EV) charging on-peak; peak demand hours occurring off-peak; need for increased system flexibility



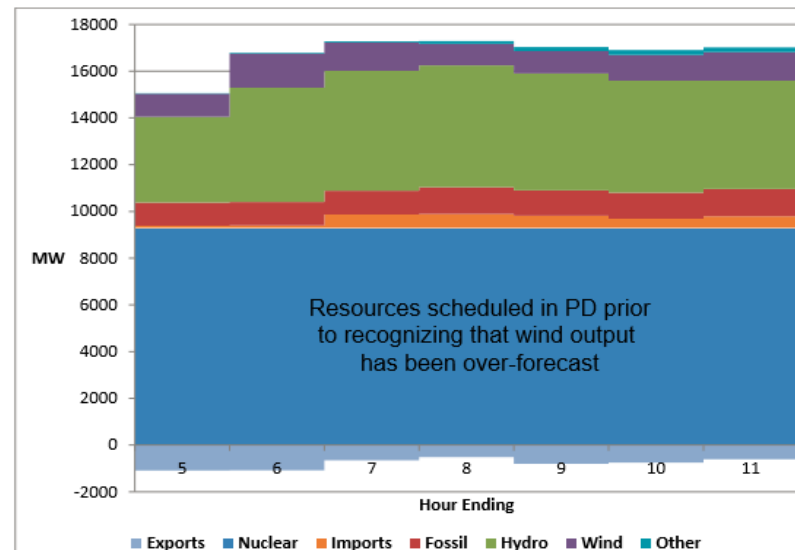
# Implications for Real-Time Operations Resulting from Changing Supply Mix within IESO-Administered Markets

- Mainly resulting from increased variable generation, power system conditions are becoming increasingly more challenging to forecast and manage
  - e.g., April 21, 2016 operations, see IESO Enabling System Flexibility: Stakeholder Engagement (June 24, 2016)

## April 21: Wind Over-forecast HE5 PD

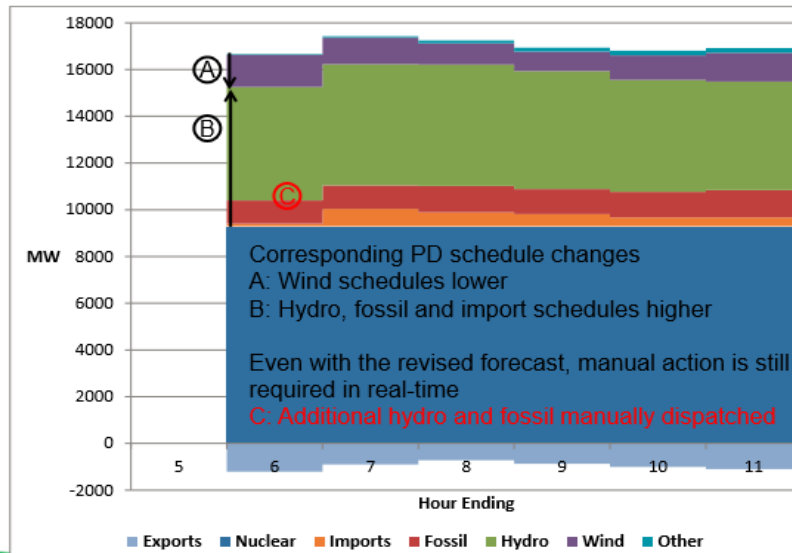


## April 21: HE5 Pre-dispatch Schedules

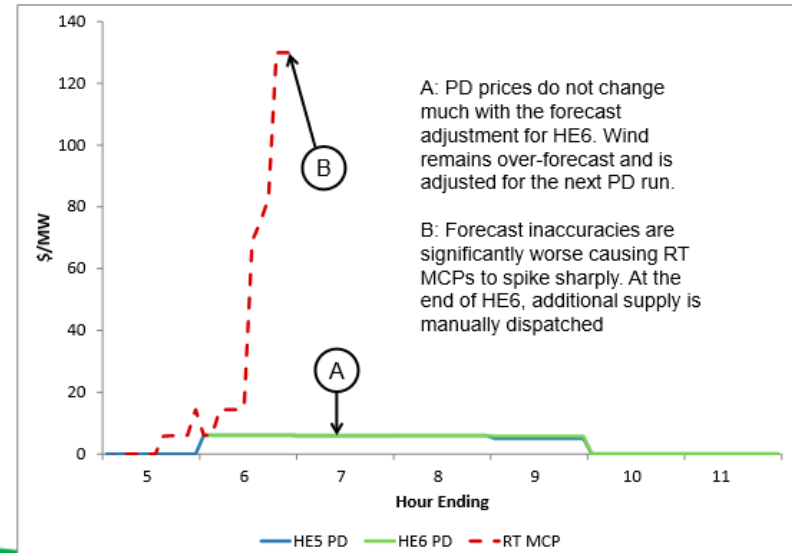


# Implications for Real-Time Operations Resulting from Changing Supply Mix within IESO-Administered Markets

## April 21: HE6 Pre-dispatch Schedules



## April 21: Market Impact HE6 PD and RT



- Despite IESO making wind energy production forecast adjustments to improve scheduling of generators for real-time dispatch, issues remain
  - At times, scheduling/dispatch process requires manual dispatch of generators needed to resolve energy shortfalls
  - Example of need for additional mechanisms (e.g., unit commitment) to manage power system operations and resources with operability/flexibility attributes

# 3. Design Considerations for Market Renewal Program Relating to Non-Emitting Resources

# Market Renewal Program Stakeholder Consultations

- Total of 9 present and planned Market Renewal Program stakeholder consultations – all with differing timelines for deliverables (e.g., High-Level Design (HLD), etc.) and implications for NERs
  - A. Working Groups and Sub-Committees
    - 1. MRWG
    - 2. Non-Emitting Resource Sub-Committee (NERSC)
  - B. Workstreams
    - 3. Single Schedule Market (SSM)
    - 4. Day-Ahead Market (DAM) and Enhanced Real-Time Unit Commitment (ERUC)
    - 5. Enhanced System Flexibility (ESF)
    - 6. More Frequent Intertie Scheduling (MFIS)
    - 7. Incremental Capacity Auction (ICA)
    - 8. Capacity Trade (CT)
  - C. Other
    - 9. Contract Amendments

# Market Renewal Program Design Considerations Relating to NERs

- Table below provides initial design considerations relating to NERs – requiring coordination with NERSC and other Market Renewal Program Workstreams/Initiatives

Market Renewal Program Workstream/Initiative	Design Considerations and Linkages to NERs
<b>I. Energy</b>  SSM  DAM/ERUC  ESF MFIS	<ul style="list-style-type: none"> <li>Barriers/rules to participate (e.g., definitions in Market Rules, etc.)</li> <li>Flexible resource classification (e.g., market participant/facility registration (e.g., ‘bundled’ resources), etc.)</li> <li>Potential negative energy price implications (e.g., operations, regulatory requirements)</li> <li>Valuing and pricing system attributes (e.g., ramp, etc.)</li> <li>Enhanced integration of energy and ancillary services (e.g., extending co-optimization)</li> <li>Exploration of re-defined and/or new ancillary services</li> <li>Valuing and pricing environmental attributes</li> <li>Obligations (or not) within DAM and ERUC, including energy production forecasts</li> <li>Improvements to accuracy of variable generation energy production forecasts</li> <li>Linkages between wholesale prices and regulated rates</li> <li>Appropriate application of charges where applicable (e.g., energy storage)</li> </ul>
<b>II. Capacity</b>  ICA  CT	<ul style="list-style-type: none"> <li>Traditional definition of capacity (e.g., unforced capacity (UCAP)) will not yield sufficient capacity revenues for some NERs (e.g., wind, solar, etc.)</li> <li>Relative short commitment period (e.g., 1-year of capacity revenues at respective ICA clearing price) exacerbates capacity definition issues, therefore revenue adequacy issues</li> <li>Without fundamental changes to present ICA HLD components, additional mechanisms will be needed to cost effectively ensure maintenance and/or development of most NERs</li> </ul>
<b>III. Contract Amendments</b>	<ul style="list-style-type: none"> <li>Where applicable, provisions to negotiate contract amendments resulting from Market Renewal Program changes to IESO Market Rules should be discussed in parallel with design changes contemplated within the Market Renewal Program</li> </ul>



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