

Our Work on Grid Integration in China

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Exeter Associates, Inc.

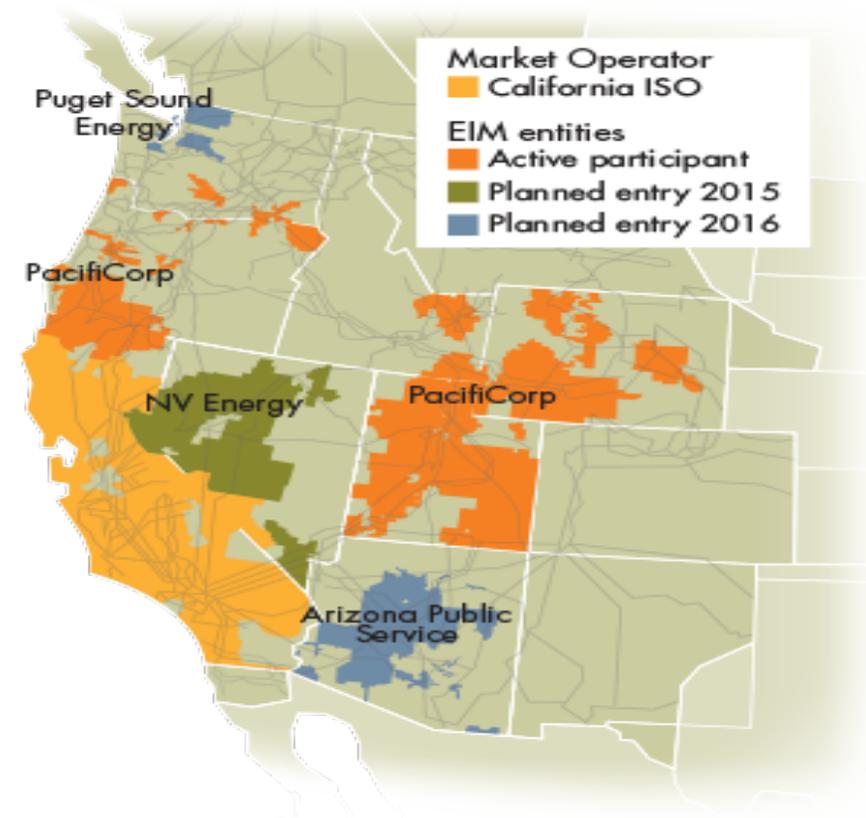
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Exeter's Work in China

- Two activity areas
 1. Renewables (Center for Resource Solutions, or CRS)
 2. Electric power and power sector reform (Regulatory Assistance Project, or RAP)
- Exeter's role is primarily grid integration
 1. Renewables: DG, renewable energy policies, resource assessment, and others
 2. RAP: Air quality, demand side management and demand response, electric vehicles, and others
- Primarily funded by the Energy Foundation
- This presentation was not reviewed in advance, so these observations are only my own and not of the Energy Foundation, RAP or CRS

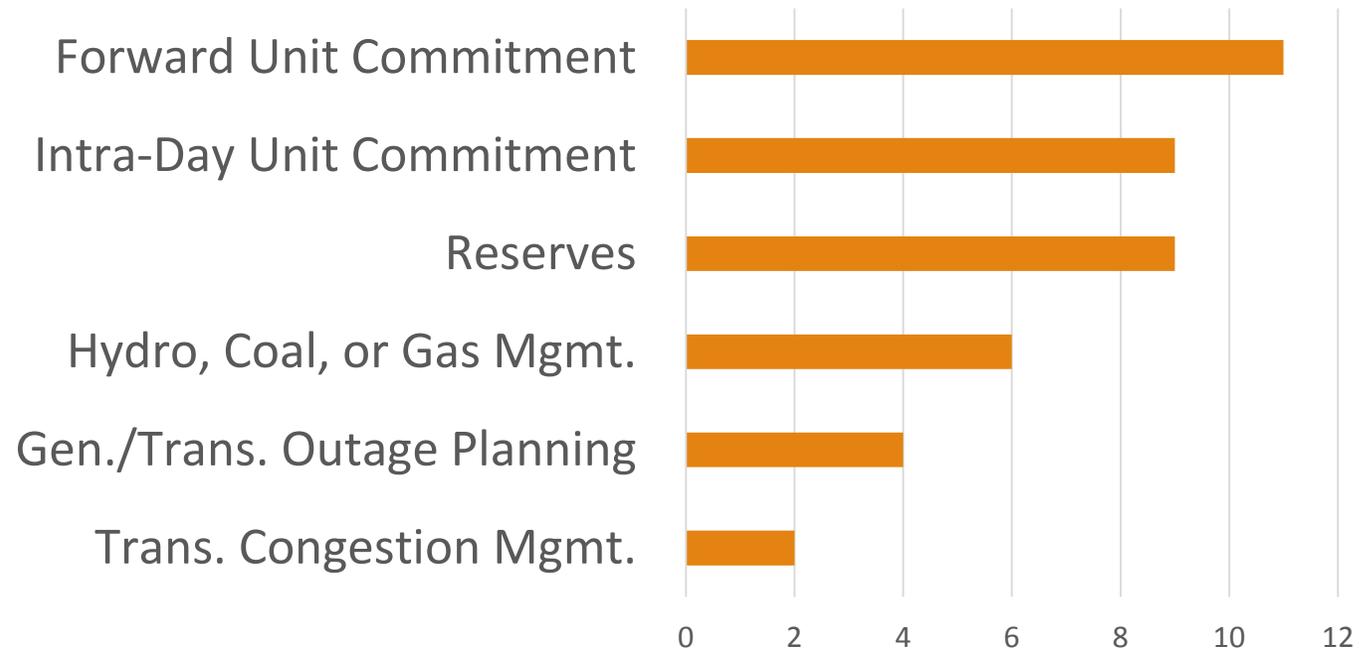
Updates on Integration of Variable Generation in the United States

- More experience (and confidence) being gained with wind forecasting
- Solar forecasting is at an earlier stage
- More and more grid operators, especially RTOs, are dispatching wind at fast time intervals
- Wind and solar have grid-friendly capabilities but you have to ask for it
- GE study suggesting West can meet transient stability and frequency response requirements with 33% wind and solar if good engineering practices are followed
- Development of publicly available mesoscale wind and solar datasets continues
- Possible market measures to access flexibility (CAISO, MISO)
- Implementation of energy imbalance market in parts of the western United States



U.S. Integration Status—Wind and Solar Forecasting, Dispatch, and Flexibility

Applications of Forecasting:
An Illustrative Survey of Western U.S. Entities



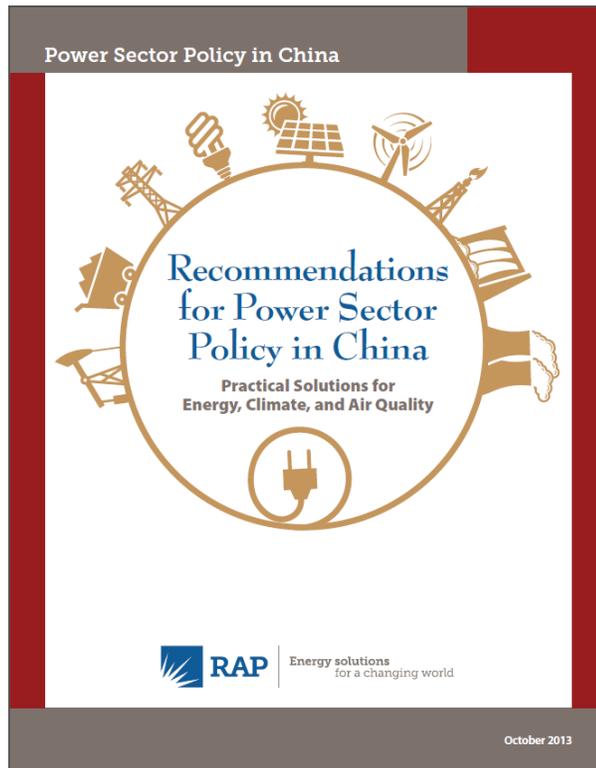
Source: Exeter, 2013

Regional Trade Org.	Dispatch Wind?
PJM	Yes
NYISO	Yes
ISO-NE	No*
MISO	Yes
SPP	Yes
ERCOT	Yes
CAISO	Yes
*Plans to dispatch by 2016	

Source: UVIG, 2015

Collaboration—Regulatory Assistance Program

(focus on adapting international best practices to China)



- Recommendations for Power Sector Policy in China (2013)
 - power sector planning, resource acquisition, generator dispatch, retail pricing, renewable energy, demand side management regulation, coal quality
- Integrating Renewable Energy Into Power Systems in China: A Technical Primer (2014)
 - planning, scheduling, and dispatch; ancillary services; interregional power exchange and dispatch
- Low Carbon Power Sector Regulation (2015)
 - planning, end-use energy efficiency, generation operations and pricing, renewable resources, retail pricing, and emissions pricing

US-China Collaboration—Center for Resource Solutions

(focus on technical assistance for renewable integration)

- Information Exchange

- Multiple delegations to the U.S. for Utility Variable-Generation Integration Group (UVIG) meetings
- Planned delegation to Denmark and Ireland, in collaboration with University College of Dublin (Ireland)



- Workshops

- Wind Forecasting
- DG
- Grid integration
- Resource planning and dispatch models
- High penetration renewable energy modeling

- Policy Review

- Comments on China's wind forecasting requirements when it was proposed
- Comments on China's proposed renewable energy quota

- Other forms of Technical Assistance

- Unit commitment modeling
- Northeast China Wind Integration Study
- Upcoming Solar Grid Integration Study
- Solar DG
- 2050 High Penetration Renewables Study
- Sources of Wind Resource and Forecasting Data
- Flexibility of HVDC and UVHDC

US-China Collaboration—China VG Integration Group

(focus on strengthening peer network in China)

- Launched in 2014
 - Inspired by U.S. UVIG, evolving to meet China's unique needs
 - Mission is to create a platform for greater communication among stakeholders
- Leadership
 - Wang Si Young – Director, Secretary
 - Zhao Yongqiang
 - Lu Hong
- Activities
 - Annual meeting, roundtables, newsletter
- Membership
 - Free (fees waived for three years)
- Executive Committee
 - CEPRI, SGERI, SGCC, Hydro China, Tsinghua University, Longyuan, NCEPU, CWEA, and the Electric

Some Personal Observations on Grid Integration of Variable Generation in China (my opinion only)

- Gratified by recent government decrees on power sector reform and the integration of variable generation, but the devil is in the details
- Data availability access continues to be a huge and frustrating issue
- Because of concerns over accuracy, wind forecasting does not appear to affect dispatch
- Consolidation of balancing areas and faster scheduling will help
- Finding and accessing greater flexibility an important step going forward
- Learn from international experience with integrating variable generation, but different measures may be necessary in China
- China may teach the world on how it integrates variable generation
 - HVDC/UHVDC transmission
 - Storage
 - Making coal plants flexible
 - Relying on demand response

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Sources

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