

## Summary of China Power System Modeling Workshop: Enabling Transformation Held on 20 October 2018 in Suzhou, China

On 20 October 2018, a workshop took place on power system modeling aiming to better connect the modeling community with decision-makers. The event was co-organized by the “21st Century Power Partnership (21CPP)” initiative and “Long-term Energy Scenarios (LTES) for the Clean Energy Transition” campaign of the Clean Energy Ministerial, and with critical support from China National Renewable Energy Centre, State Grid Energy Research Institute, and State Grid (Suzhou) City & Energy Research Institute. The goal of this workshop was to build an international exchange on best practices for power sector transformation modeling. The one-day event was attended by approximately 60 participants including policy makers, government representatives, power system operators, researchers and representatives of international organizations.

The workshop aimed to build greater understanding of how the transition to clean electricity systems is empowered by advanced power sector modeling tools, with the specific goal of building stronger bridges between the modeling community and policy makers. The rise of renewables, demand response, and electrification, for example, often leads to more complex interactions between end-use sectors and energy sector stakeholders. As more powerful tools have been developed to simulate desired outcomes in electricity sectors, greater attention is needed to ensure the quality of the model findings and the relevance of the outcomes for decision making.

An agenda of the day’s workshop sessions is reproduced at the end of this document.



### SESSION SUMMARIES

In a keynote a representative of the National Energy Administration of China outlined the Chinese energy policy priorities.

The workshop then opened with a policymaker dialogue to highlight the importance of modeling for informing today’s power system decision-making.

In the dialogue it was stressed that inadequate planning results can result in costly mis-investments. Data quality is a main concern that determines the quality of model findings, this quality is often not clear to policy makers. The gap between idealized model conditions and real-world markets was stressed. The phrase “modeling for insights, not for numbers” was stressed. While models are widely used for policy making in China, it is important they are used in a context of long-lasting trusted relations. Rapid innovations such as digitalization, vehicle-to-grid and the emerging role of minigrids create new challenges for modelers. The trend is towards more complex models and scenario techniques (e.g., probabilistic approaches to deal with variability). More attention is needed for distributional effects of policies, and their social and environmental impacts. While models are well suited to extrapolate past trends they are less suited to assess paradigm shifts.

The technical panels that followed took a subject-based approach, focusing on three key issues pertinent to many countries actively seeking to transform their power sectors:

- Integrating variable renewable electricity (VRE) options,
- Planning of transmission systems, and
- Incentivizing an appropriate amount of flexibility.

### **Modeling to Inform Renewable Energy Integration**

In the renewables integration session, speakers presented on the use of modeling for long-term nation-wide renewable planning and special consideration for the variable characteristics of VRE in operational analysis. Han Xue and Lars Bregnbæk from CNREC gave a presentation of CNREC power system model EDO and results from the Centre’s China RE Outlook 2018. The EDO model is a least-cost dispatch model and least-cost investment model for the Chinese power system at the province level. Hence, it gives good opportunity for modelling the integration of variable production from wind and solar power plants and also to model the impact of the development of Chinese power markets, based on least-cost marginal pricing. The EDO model is based on the Balmorel model, which is used for many scenario analyses on a global basis and available as an open-source model.

Zhang Ning, Department of Electrical Engineering, Tsinghua University, introduced the department’s RE modelling and power system operation simulation, using their self-developed Grid Optimal Planning Tool (GOPT). The model optimises the power system, taking into account operational uncertainty, forecast uncertainty and spatial-temporal dependency. The model is able to do detailed dispatch of the power system taking these uncertainties and dependencies into consideration. It has been used for detailed studies in a number of provinces in China.

He Gang, Department of Technology and Society, Stony Brook University, presented on the SWITCH-China model, which optimises the power costs with generation and transmission constraints. The model calculates generation mix, transmission expansions, carbon dioxide emission and power costs for the Chinese power system in the future.

During the discussion it was emphasised that the presented models are very useful tools for the policy makers in the Chinese energy transition process and the results from the analyses should be disseminated to a larger audience. It would also be beneficial to have a more close cooperation between the different institutions involved in power sector modelling regarding data, assumption and evaluation of results.

### **Modeling Transmission Planning**

In the transmission planning session, speakers presented on the transmission planning process and models used in Europe and transmission planning with VRE and demand-side consideration in China. Yuan Bo, SGERI and Randi Kristiansen, Energinet, illustrated how power system models are used in transmission planning in China and Europe.

Yuan Bo gave an example of joint optimisation of generation and transmission expansion for China with a high share of RE, using SGERI's power system model GESP combined with the commercial software Gridview for a more detailed production simulation.

Randi Kristiansen showed how the European transmission system operators use power market models in a coordinated planning for the whole of Europe. Power market models are the starting point for scenarios for the development of future power production in different regions, and the results are used to evaluate the value of new transmission lines from the benefit of integrating RE, enhancing the power market function and improving the security of supply.

The session showed how modern transmission planning needs to adapt to the development of the energy system and take into account the impact of power markets and increasing amounts of variable energy production from wind and solar. The European approach has been formalised through regulation and comprehensive involvement of the stakeholders, while the Chinese planning is more based on State Grid's internal need for a decision basis.

### **Modeling Power System Flexibility**

In the flexibility session, speakers highlighted the role of thermal plant flexibility, storage and demand-side management availability, and power markets in supporting power systems with high levels of VRE penetration.

Wang Shunchao (EPPEI), Simon Müller (IEA), Dan Wetzel (RMI), and Lars Bregnbæk (CNREC and Ea Energy Analyses), presented the use of different models to deal with power system flexibility.

Wang Shunchao showed how a generic module for modelling different combinations of power production and power demand can be used to simulate flexibility and integration of RE in the power system. EPPEI has used the model for simulation of flexible load and variable energy production in the Dongbei (Northeast) region for a scenario for 2050.

Simon Müller introduced NREL's grid integration study for India, based on the Plexos power production cost model. The model has a detailed representation of the power system, including the transmission system in India, as well as a detailed representation of the solar and wind resources in India. The analyses show that it is possible to avoid curtailment of RE production through enhanced flexibility of thermal power plants and through coordinated operation of the power system across states. Batteries do not add value to RE integration from a scheduling/dispatch perspective under the scenarios analyzed.

Dan Wetzel gave an example of how modelling and scenarios can illustrate the cost and benefits for different stakeholders of the introduction of a power market in the Dongbei region in China. Using State Grid's dispatch model, the analyses looked into producer bidding behaviour, market revenues, and additional market design scenarios to balance reliability, efficiency, and political goals. This could help market designers and policy makers to understand the market impact on different stakeholders and to clarify the needed market implementation and transitional arrangements.

Lars Bregnbæk gave a number of detailed examples on how EDO and Balmorel can model flexibility, e.g. thermal power plant flexibility, and RE technology for better integration through modelling of different wind turbines and solar tracking systems.

The session showed the variety of targeted analyses that are possible to conduct with the same types of models, and also illustrated that the models have to be quite detailed and with good data to give useful results in many cases. The presentations showed the possibilities to inform the different stakeholder and policy makers on important issues that would be difficult or impossible to illustrate without the modelling tools.

### **Wrap-up**

Going forward, the sponsoring organizations thought it would be fruitful to expand the modeler-decisionmaker community discussions to other fields outside of electricity to include transportation, climate change and other potential topical platforms. This is a specific focus of the CEM scenarios campaign.

In conclusion the event provided a valuable overview of Chinese modeling and scenario building trends and an opportunity to network with the community. At the same time, it gave Chinese modelers an opportunity to receive feedback and get a better understanding of international modeling trends.

## Agenda: China Power System Modeling Workshop: Enabling Transformation

**Venue:** Suzhou Qingshan Hotel, 35 Jiaxian Rd, Huqiu Qu, Suzhou, Jiangsu, China  
苏州清山会议中心, 中国江苏省苏州科技城稼先路 35 号

**Date:** October 20, 2018

Time	Subject	Speakers
8:30 - 9:00	Registration	
9:00 – 9:10	Welcome and Introductions	WANG Yaohua (SGERI)
9:10 – 9:25	Opening Remarks: China’s Energy Transition	AN Fengquan (NEA)
9:25 – 09:40	Power system modelling for policy decisions – overview and purpose of the workshop	Simon Mueller (21CPP) Dolf Gielen (LTES)
09:40 – 10:40	Policymaker Dialogue: What Do Decision-makers Need from Modeling Analysis?	ZHAO Yongqiang (NDRC ERI/ CNREC) Yanqin Song (World Bank) Søren Dupont Kristensen (Energinet)
10:40 – 11:15	Plenum discussion	Moderated by Dolf Gielen (IRENA)
11:15 – 12:00	Modeling to Inform Renewable Integration into Power Systems	HAN Xue (NDRC ERI/ CNREC) ZHANG Ning (Tsinghua University) Gang He (Stony Brook University)
12:00 – 12:30	Q&A and Discussion	Moderated by AN Ning (CEPRI)
12:30 – 14:00	Working Lunch	
14:00 – 14:45	Modeling Power System Flexibility	WANG Shunchao (EPPEI) TBD Simon Mueller (IEA) Dan Wetzel (RMI) Lars Bregnbæk (Ea Energianalyse)
14:45 – 15:15	Q&A and Discussion	Moderated by Kaare Sandholt (CNREC)
15:15 – 15:30	Coffee Break	
15:00 – 15:45	Modeling Transmission Planning	YUAN Bo (SGERI) Randi Kristiansen (Energinet)
15:45 – 16:15	Q&A and Discussion	Moderated by Lei Xiaomeng (CEC)