21st Century POWER PARTNERSHIP
Accelerating the transformation of power systems

The 21st Century Power Partnership

Accelerating the transition to clean, efficient, reliable and cost-effective power systems.

The 21CPP is a multilateral effort of the Clean Energy Ministerial (CEM) that serves as a platform for international efforts to advance integrated policy, regulatory, financial, and technical solutions for the deployment of renewable energy in combination with large-scale energy efficiency and smart grid solutions.

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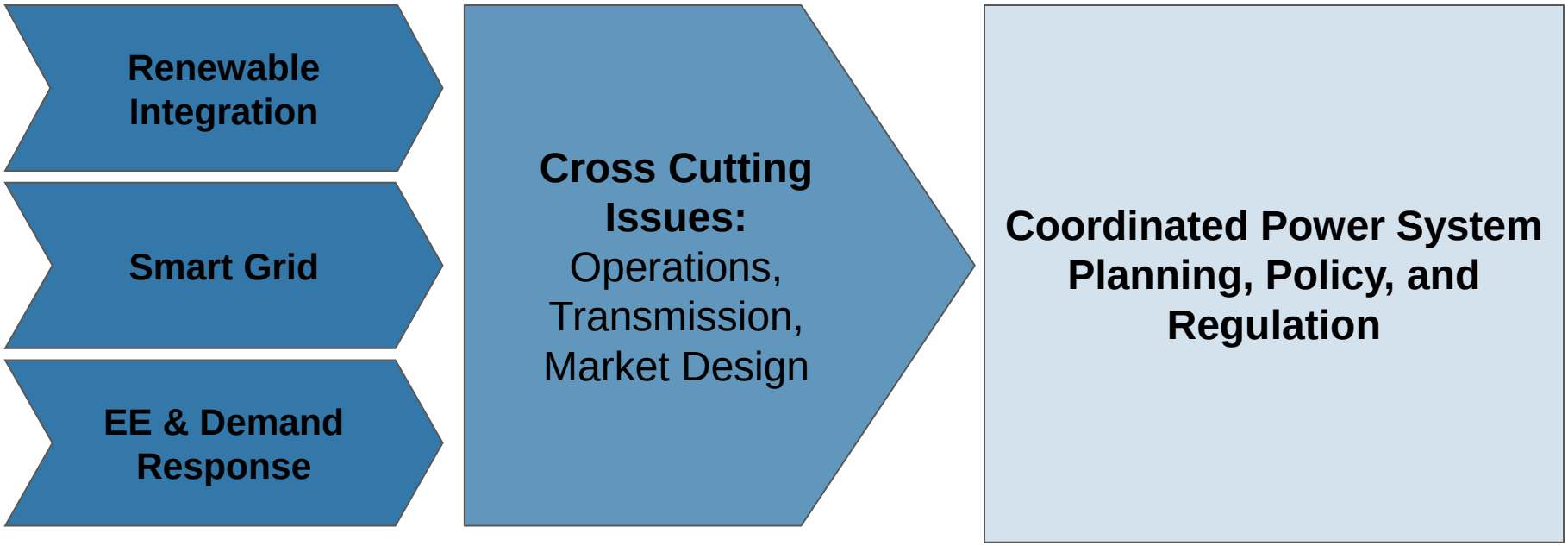
Elements of Power System Transformation



There is an urgent need to advance comprehensive power system policy frameworks.

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Core 21CPP Resources & Capabilities

Synergies across CEM Initiatives

Multilateral Solar and Wind Working Group
International Smart Grid Action Network
Super-Efficient Equipment and Appliance Deployment
Global Superior Energy Performance Partnership
Clean Energy Solutions Center

Analysis and Thought Leadership

Market Evolution: Wholesale Electricity Market Design for 21st Century Power Systems
Flexible Coal: Evolution from Baseload to Peaking Plant
Accelerating the Global Transformation to 21st Century Power Systems
Flexibility in 21st Century Power Systems

Expert Consultations

Global affiliate network of technical and policy experts
Research, policy, and technical tool library
Clean Energy Regulators Initiative (with Leonardo Energy)

International Private-Sector Advisory Council

Alstom Grid	IBM
CISCO	ICA
Deutsche Bank	Impax AM
Duke Energy	KEMCO
Johnson Controls Inc.	PensionDanmark
EPRI	Schneider Electric
Eskom	Shell
	Siemens

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Current Range of Technical Assistance

INDIA

Key Stakeholders: Planning Commission, CERC, MOP, MNRE, CII

Priority Topics: 1) Forecasting, scheduling, and dispatch for wind integration; 2) Market design for hour ahead and real-time markets; 3) Demand response participation in power markets; 4) Transmission planning in support of Green Corridors

MEXICO

Key Stakeholders: SENER, CRE, CENACE, CFE, IIE

Priority Topics: 1) "Next generation" transmission planning for 2030; 2) Supporting evaluation and expansion of smart grid pilot projects; 3) Technical assistance in grid operational practices for wind integration

SOUTH AFRICA

Key Stakeholders: SA DOE, Eskom, NERSA

Priority Topics: 1) Technical issues associated with PV integration at low-voltage networks; 2) Regulatory treatment of distributed PV; 3) Integrated planning methodologies in support of 2030 Integrated Resource Plan

INTERNATIONAL

Key Stakeholders: 21CPP Steering Group and private sector advisory council members

Priority Topics: Wholesale market design, Power system flexibility, Utility business model evolution

See all publications, webinars, and events at www.21stcenturypower.org

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Recently Published Analysis

Integrating Variable Renewable Energy in Electric Power Markets: Best Practices from International Experience

Documents diverse approaches to integration of variable RE among 6 countries—Australia (South Australia), Denmark, Germany, Ireland, Spain, and the US (Colorado and Texas)—and summarizes policy best practices. ***[www.nrel.gov/docs/fy12osti/53732.pdf]***

Market Evolution: Wholesale Electricity Market Design for 21st Century Power Systems

Reviews the international suite of wholesale power market designs in use and under consideration to ensure adequacy, security, and flexibility in a landscape of significant variable renewable energy. ***[http://www.nrel.gov/docs/fy14osti/57477.pdf]***

Flexible Coal: Evolution from Baseload to Peaking Plant

This case study reviews how power plants intended to run at baseload can evolve to serve other system needs. The CGS case illustrates the types of changes that may occur in global power systems, especially those with legacy plants. ***[http://www.nrel.gov/docs/fy14osti/60575.pdf]***

Flexibility in 21st Century Power Systems

Flexibility of operation—the ability of a power system to respond to change in demand and supply—is a characteristic of all power systems. Flexibility is especially prized in twenty-first century power systems, with higher levels of grid-connected variable renewable energy (primarily, wind and solar). ***[http://www.nrel.gov/docs/fy14osti/61721.pdf]***

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CHP in 21st Century Power Systems

Known benefits:

- Significant improvements to total plant efficiency
- Pillars of urban energy system integration

21CPP perspective on priority areas of collaborative research for 2014-2015:

1. What are the potential benefits of CHP/DHC in power system flexibility and balancing?
2. What are the potential flexibility limitations of CHP/DHC?
3. How can flexibility benefits be fully realized? What technologies policies, and regulations enhance CHP contribution to power system flexibility?

CHP in 21st Century Power Systems

Increasing requirements for power system flexibility

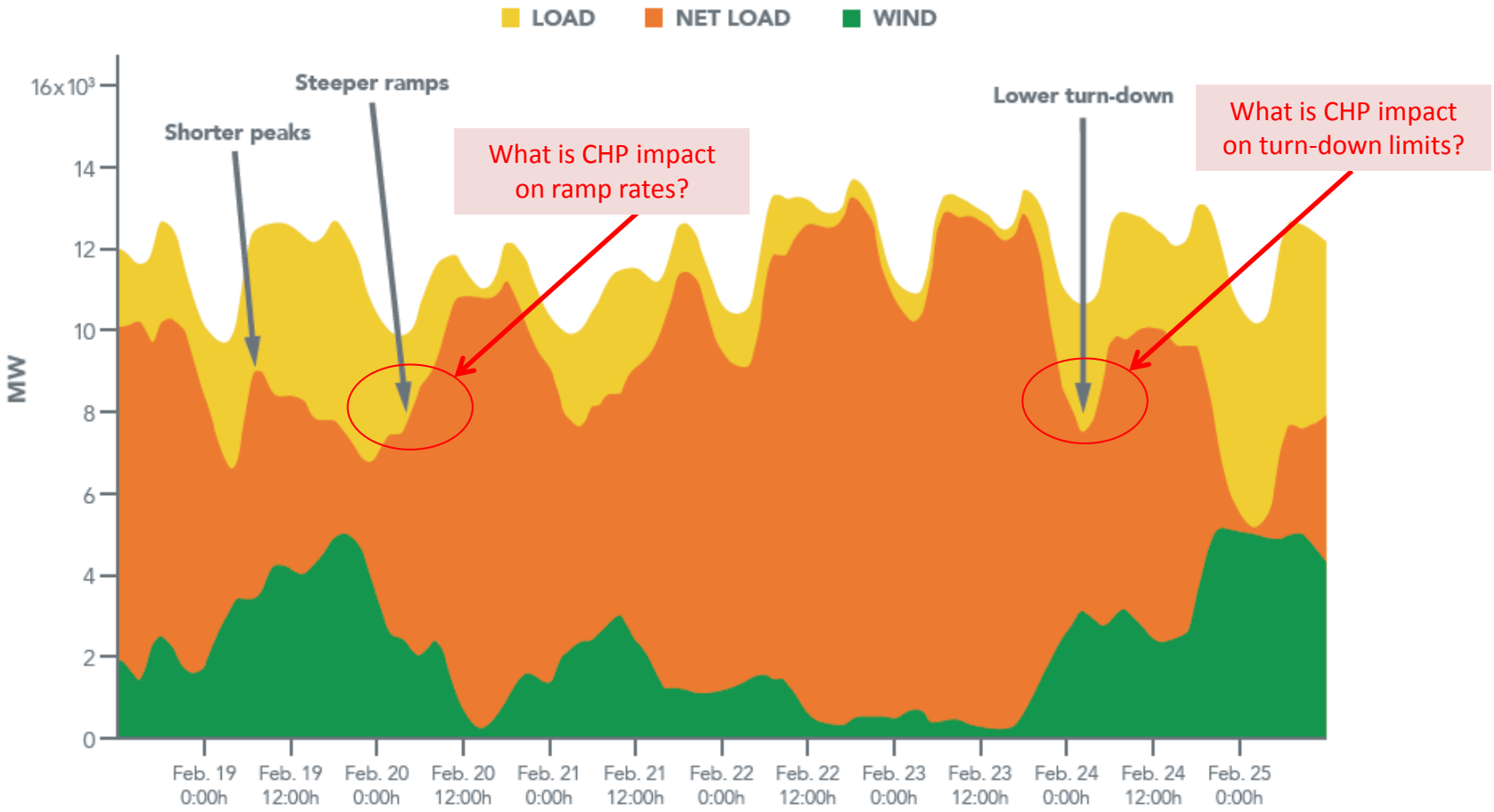

Image source: NREL/21CPP 2014 “Flexibility in 21st Century Power Systems“

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CHP in 21st Century Power Systems

Potential flexibility benefits:

- Coupled to the electricity system, and enabled with bi-directional energy flow, CHP/DHC represents a very low-cost (thermal) storage medium (e.g. Denmark), enabling lower turn-down limits and greater system flexibility.

Potential flexibility limitations:

- Absent such system coupling and bi-directional energy flow, CHP turndown limits can ‘raise the floor’ of power system flexibility, adding curtailment pressure to VRE during very low demand periods.

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CHP in 21st Century Power Systems

Keys to unlocking CHP flexibility benefits

- Enhance **plant turndown limits** (e.g. down to 10% of maximum capacity, as in many Danish CHP plants, instead of 50% of maximum capacity, as in many China CHP plants.)
- Invest in **heat storage and bi-directional energy flow** to enable greater decoupling of heat and power production
- **Establish market signals** to incentivize optimal utilization of CHP capabilities, especially **dynamic prices** that more accurately reflect hourly or sub-hourly supply and demand balance

Central opportunity and challenge:
achieving "smart CHP"

QUESTIONS?