21st Century POWER PARTNERSHIP
Accelerating the transformation of power systems

NREL
Transforming ENERGY

Fifteenth Annual Symposium on Energy: Around the World in 20 Minutes

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CLEAN ENERGY MINISTERIAL
Advancing Clean Energy Together

Advancing Clean Energy Systems Globally

NREL works with partners around the world on clean energy systems analysis, research, and deployment, with the goal of accelerating global transitions to advanced energy systems.

90+
Current Partner Nations

Bilateral and multilateral programs support:

Energy systems integration & grid modernization	Advanced power, transport, buildings, and industrial energy systems
Low emissions development	Microgrids for isolated settings, disaster recovery

Lessons from international experience benefit our research and work at home.

What is The Clean Energy Ministerial?

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- Annual gathering of energy ministers from the world's 25+ largest energy consumers
- Two-dozen "work streams" conduct year-round work on "energy transition" priorities
- Strong focus on sharing lessons-learned and best practices among all countries
- NREL, IEA, IRENA and others help run many of the work streams
- Secretariat moved from USDOE to IEA about two years ago to improve multilateralism
- www.cleanenergyministerial.org

WHAT IS THE 21CPP?

POWER SYSTEM TRANSFORMATION

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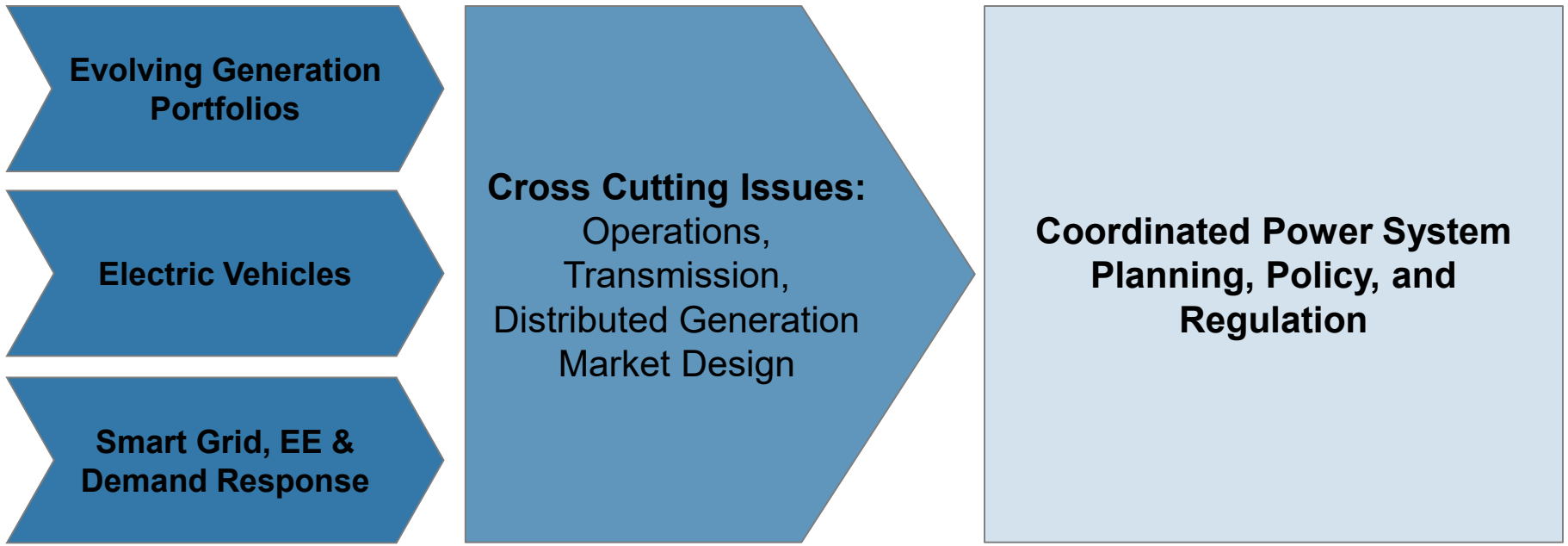
Accelerating the transition to clean, efficient, reliable, and cost-effective power systems.



Coordinating with other CEM Campaigns

NREL is the Operating Agent for 21CPP and several other work streams

NORWAY

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- Large oil and gas producer/exporter, although no “curse of oil”
- Power sector is 95% hydro generation
- State owned generation and transmission companies, with strong interconnections to neighbors
- EV sales will surpass 50% of all vehicles sold this year due to strong incentives
- Poster child for cross-sector coupling/electrification since power sector is very clean

CHINA

- Known for superlatives (coal, RE, storage, etc.)
- Enormously successful at raising incomes and services since 1980, but with a variety of social, environmental and political costs
- Installed nearly 100 GW of PV in 2017 and 2018 alone
- Curtailed VRE becoming less problematic
- National carbon emissions trading scheme
- Vision of national HVDC transmission system +
- Currently facing economic headwinds largely due to non-performing state-owned enterprise loans and increasing trade disputes with EU, US, and others
- Where to next for China?

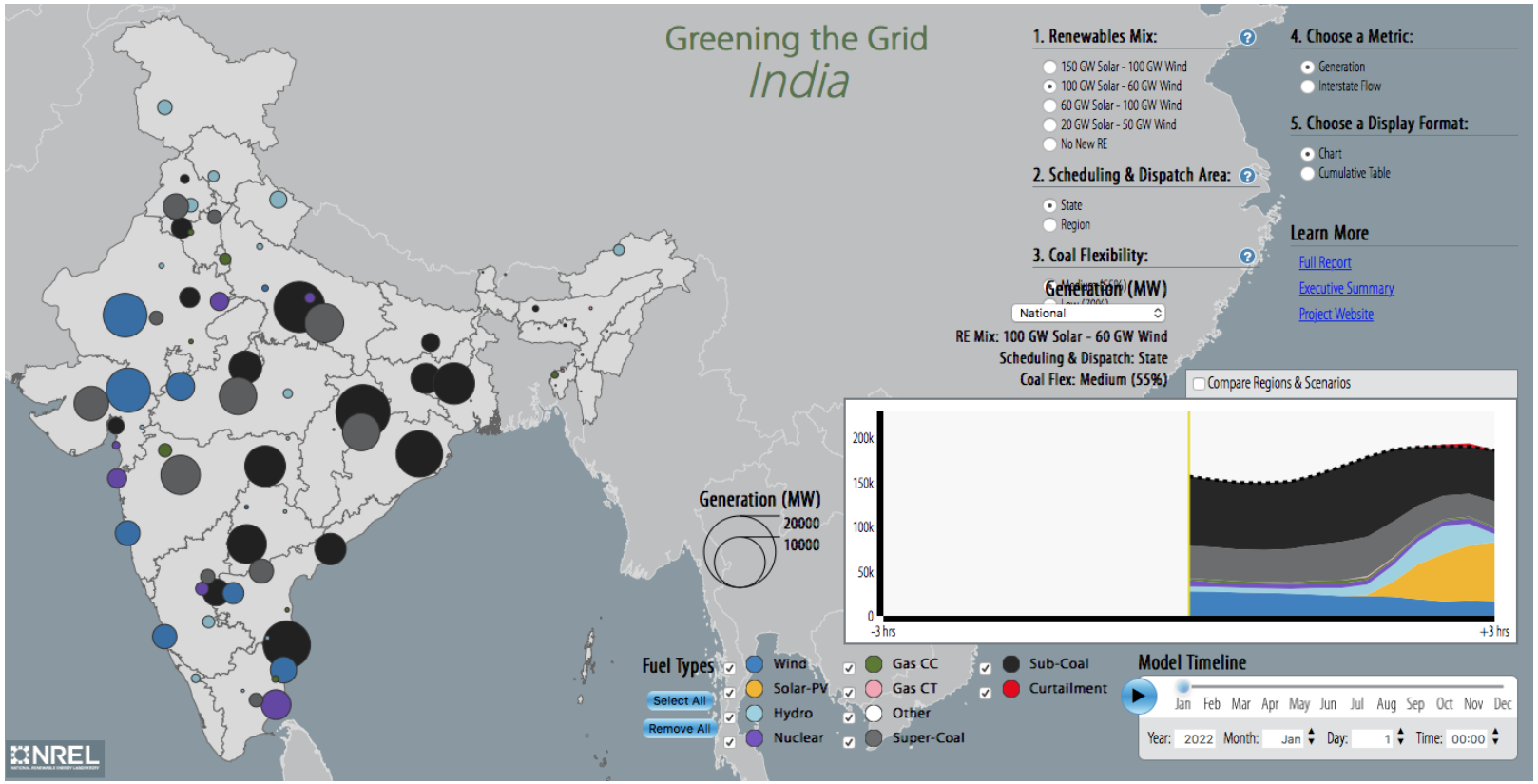
South Africa

- Country to watch
- Long-standing promise and hope since Apartheid-era ended, but mired in difficulties
- Heavily dependent on coal with powerful state-owned utility (Eskom)
- Surging electricity prices; municipalities constitutionally prevented from signing their own (large) power purchase agreements
- New “integrated resource plan” drops nuclear and strengthens focus on RE and natural gas
- Eskom in process of being broken up
- Political willpower key

INDIA

- Heavily dependent on poor-quality coal
- Distribution company revenue shortfalls due to ”non-technical losses” and low tariffs
- Ambitious 2022 goals to deploy
  - 100 GW PV
  - 60 GW Wind
  - 15 GW Bio and hydro
- NREL-led “Greening the Grid” study to understand technical and financial challenges of integrating this much VRE
- Long-term stakeholder process to ensure ownership of, and confidence in, results
- Builds ambition

India’s power system with 160 GW wind and solar—Achieving system balance every 15 minutes



See full video and project description at:
http://www.nrel.gov/india-grid-integration

GOVERNMENT OF INDIA
MINISTRY OF POWER

USAID
FROM THE AMERICAN PEOPLE

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WORLD BANK GROUP

ESMAP
Energy Sector Management Assistance Program

ARGENTINA

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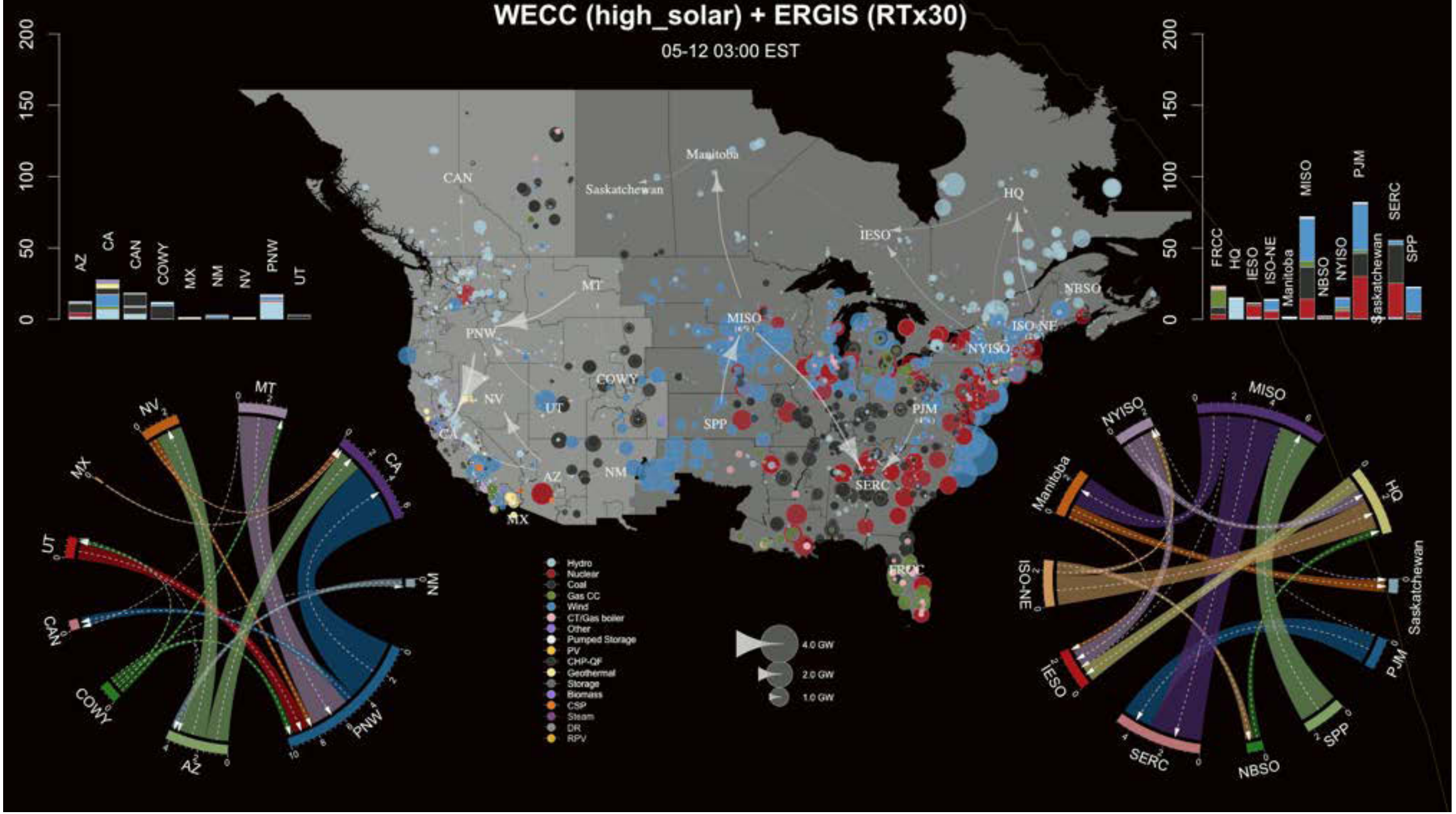
- Country to watch
- Historically, one of the wealthiest developing countries, but cyclical economic meltdowns
- Inflation rate currently exceeds 40%
- Relatively conservative Macri government has tried to reduce distortionary energy subsidies since 2015
- Strong promotion of domestic oil and gas production; Vaca Muerta field is enormously promising
- Strong RE auction program over past 18 months
- Potentially transformative elections in 3Q 2019

New York

- Leader, along with CA, in demonstrating low-carbon future
- Pledged 100% carbon-free power by 2040
- 50% RE goal by 2030 in Clean Energy Standard
- Currently has most ambitious energy storage goal of any state (3 GW by 2030)
- Potentially transformative Reforming the Energy Vision (REV) program



See a version of this video at https://www.youtube.com/watch?v=DH5dez6vHB4

SYNTHESIS

- Despite a variety of challenging political contexts, many countries are pursuing energy transformation at a rapid pace
- Driven in part by technology breakthroughs and in part by policy directives
- Advanced technology cost and performance (VRE, storage, demand-side smart equipment, etc) is likely to continue undercutting traditional options, and new breakthroughs could accelerate this
- Electrification could enable a <2° C future, but enormous global cooperation required since conditions and endowments are so varied.

Thank you.

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