

# LESSONS LEARNED FOR RAPID DECARBONIZATION OF POWER SECTORS: KEY MESSAGES FOR ENERGY MINISTERS

## Background

This report covers key lessons learned for the rapid decarbonization of power sectors, emphasizing best practices in **planning, building, and operating** electricity systems.

This report is the result of a collaborative effort among various Clean Energy Ministerial (CEM) workstreams and partner initiatives:

- 21st Century Power Partnership (21CPP)
- Carbon Capture, Utilization and Storage (CCUS)
- Global Power System Transformation Consortium (G-PST), a partner to CEM
- Industrial Deep Decarbonisation Initiative (IDDI)
- International Energy Agency Digital Demand-Driven Electricity Networks Initiative (IEA 3DEN), a partner to CEM
- International Smart Grid Action Network (ISGAN)
- Long Term Scenarios for the Energy Transition (LTES)
- Nuclear Innovation: Clean Energy Future (NICE Future)
- Super-Efficient Equipment and Appliance Deployment (SEAD)

The contents are not intended to be comprehensive of all power sector topics, and there may be overlap between content in each section due to the nature of this first-of-its-kind collaborative effort to deliver unified messaging on power sector decarbonization to energy ministers. **This work is intended to complement other work at the Clean Energy Ministerial and offers options for consideration, not specific policy recommendations.**

## Overarching Themes

Overarching themes for energy ministers, within the categories of **planning, building, and operating** are highlighted in Figure 1 from the compilation of detailed lessons learned for rapid power sector decarbonization.

## Collaborating Workstreams



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<https://www.nrel.gov/docs/fy22osti/83951.pdf>

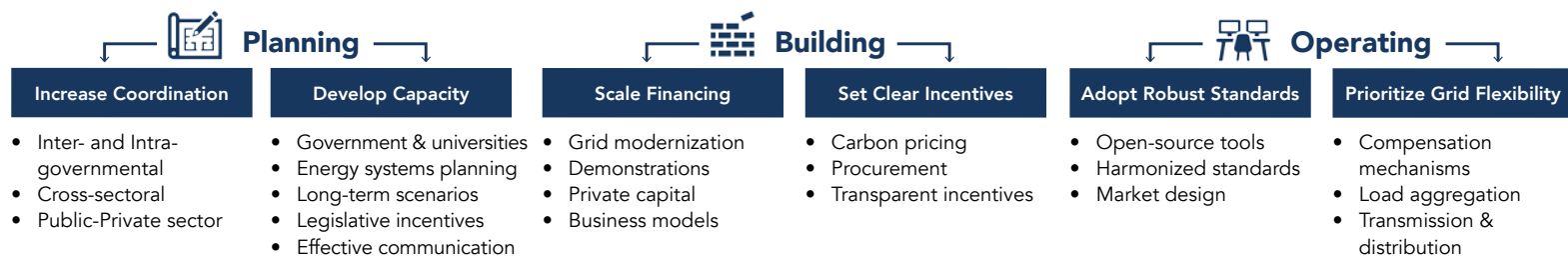


Figure 1. Overarching themes for rapid power sector decarbonization

## Planning

### Increase Coordination

- Inter-governmental and intra-governmental: Initiate sharing of data, tools, methodologies, and lessons learned
- Cross-sectoral: Drive integrated planning of generation and transmission, transportation and grid, and industry and grid, including distributed energy resources
- Public-Private sector: Embrace inclusive processes with private sector and NGOs in government-led planning

### Develop Capacity

- Champion capacity building in the government and at supporting universities and organizations
- Integrate energy systems planning capabilities across disciplines
- Promote transparent and robust long-term scenarios based on rigorous studies
- Create enabling environment for zero-carbon legislative incentives
- Effectively communicate to the public on the energy transition

## Building

### Scale Financing

- Allocate sufficient funding for electricity grid modernization, digitalization, and resilience
- Finance pre-commercial demonstration projects (e.g., advanced nuclear, carbon capture, advanced storage, etc.)

- Leverage private sector capital to finance zero-carbon technology (e.g., green bonds)
- Enable new business models to deploy zero-carbon products and services (e.g., energy service companies, aggregation, etc.)

### Set Clear Incentives

- Champion carbon pricing and other zero-carbon incentives
- Develop ambitious procurement mechanisms (e.g., auctions)
- Design incentives that are transparent, accessible, and inclusive

## Operating

### Adopt Robust Standards

- Champion use of open-source operational tools to monitor real-time grid performance
- Include harmonized standards for technology interoperability and materials
- Promote operational efficiency through innovative market designs

### Prioritize Grid Flexibility

- Develop mechanisms to compensate the flexibility of assets (e.g., grid-edge and utility-scale)
- Commission efforts to enable aggregation of flexible and efficient end-use loads (e.g., demand response)
- Enable flexible transmission and distribution infrastructure (e.g., via digitalization and grid-enhancing technologies)

[www.21stcenturypower.org](http://www.21stcenturypower.org)

The 21st Century Power Partnership is a multilateral effort of the Clean Energy Ministerial and serves as a platform for public-private collaboration to advance integrated policy, regulatory, financial, and technical solutions for the large-scale deployment of clean energy in combination with deep energy efficiency and smart grid solutions.

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