CLEAN ENERGY MINISTERIAL

Accelerating the Transition to Clean Energy Technologies

Power System Transformation in Emerging Economies

Pre-Read for Public-Private Roundtable

Clean Energy Ministerial
14:15 - 15:45
17 April 2013
Taj Palace
New Delhi, India

Outline

1. **Objective**
2. Current Landscape
3. Barriers
4. Potential Solutions
5. Opportunities for Progress

SCOPE

Presentation: Participants in this session will consider the key policy, regulatory, and market design elements that have allowed some countries to accelerate the rapid build out of efficient, clean, modern electric-grid power systems.

CEM Roundtable: Provides an important opportunity to synthesize the lessons learned from history, and bring together practitioners and policymakers to cooperatively address the barriers faced today that include technical, regulatory, financial, and policy issues.

The information in this presentation is based on the work conducted by the National Renewable Energy Laboratory, Regulatory Assistance Project, and affiliates in India, USA, Denmark, Germany, Spain, and Finland.

THE TIME IS RIGHT FOR COMPREHENSIVE POWER SYSTEM TRANFORMATION POLICY FRAMEWORKS.

ROUNDTABLE CONCEPT

In this roundtable, participants will address 6 key questions relevant to achieving power system evolution in emerging economies:

1) What are practices that have emerged to achieve coordinated deployment of renewable energy, energy efficiency, smart grids, and demand-side?
2) How can emerging countries best design system solutions that expand renewable energy, energy efficiency, and smart grids to deliver reliable power while also expanding grid access?
3) How can regulators and policy makers create better incentives for utilities to move rapidly to a clean and modern electrical grid and to deploy energy efficiency and demand-side management?
4) How can regulators properly, and fairly, address the issue of cost recovery, especially in emerging countries?
5) What unique innovation opportunities arise in emerging economy contexts?
6) What are priority areas for public-private coordination?

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The Global Challenge

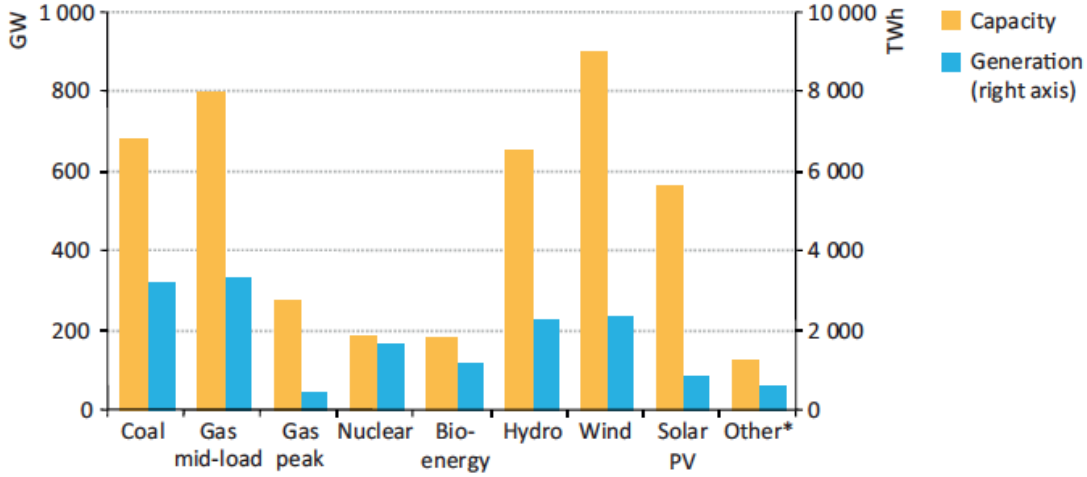
Rapidly accelerating energy access in emerging economies, while simultaneously **decarbonizing power systems globally.**

The Scale of the Challenge

2012-2035:
5,891 GW new capacity.
3,804 GW non-OECD.
2,087 GW OECD.
2,377 GW non-hydro RE.

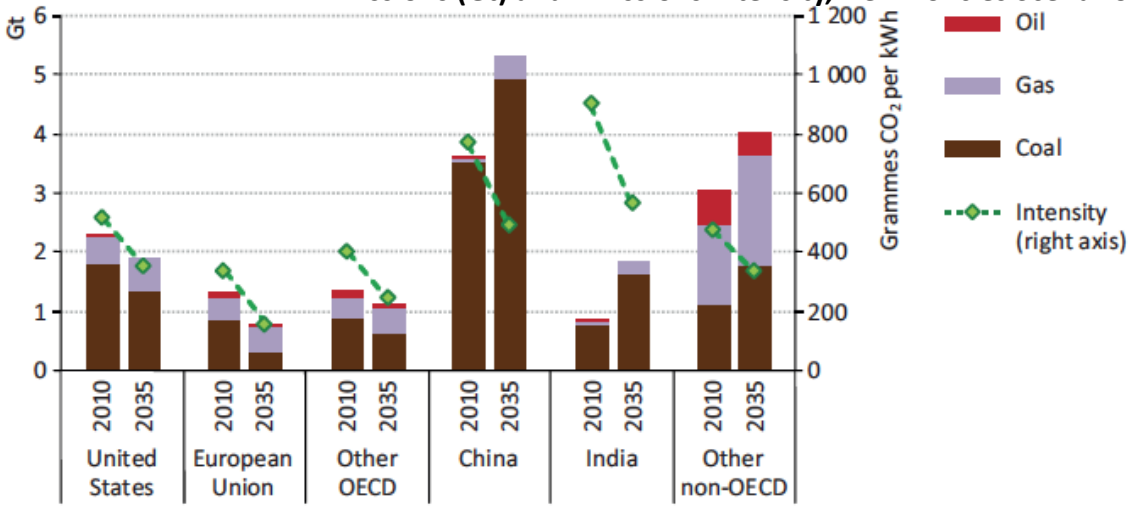
Massive investment in energy efficiency and low-carbon electricity systems will be required to achieve economic growth while reducing CO2 intensity of energy.

World Net Incremental Capacity Additions by Type, New Policies Scenario



* Other includes geothermal, concentrating solar power and marine.

Emissions (Gt) and Emissions Intensity, New Policies Scenario



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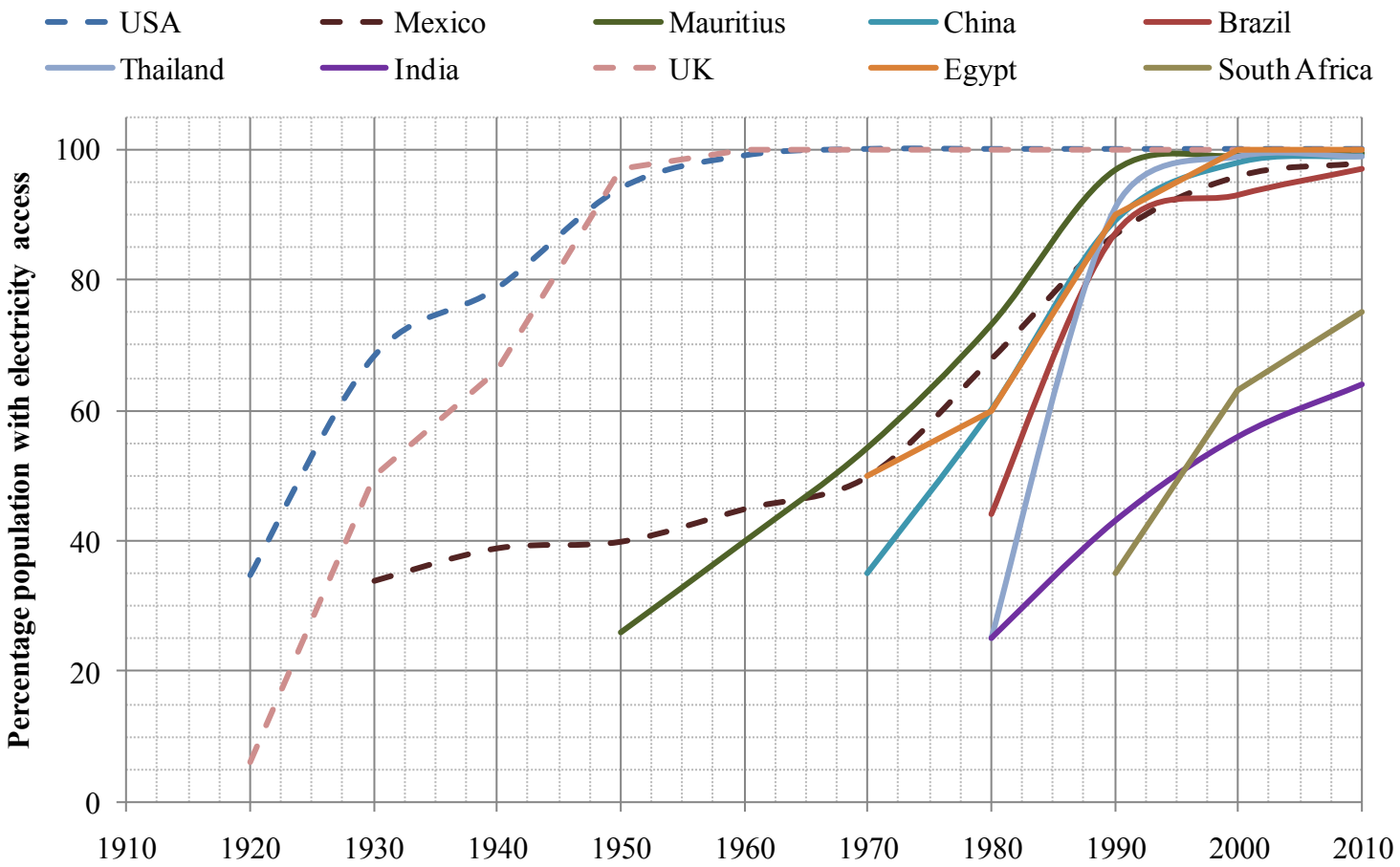
IEA WEO 2012 New Policies Scenario

The Scale of the Challenge

Achieving Energy Access



Pachauri, S. *et al.* 2011

The Role of Emerging Economies

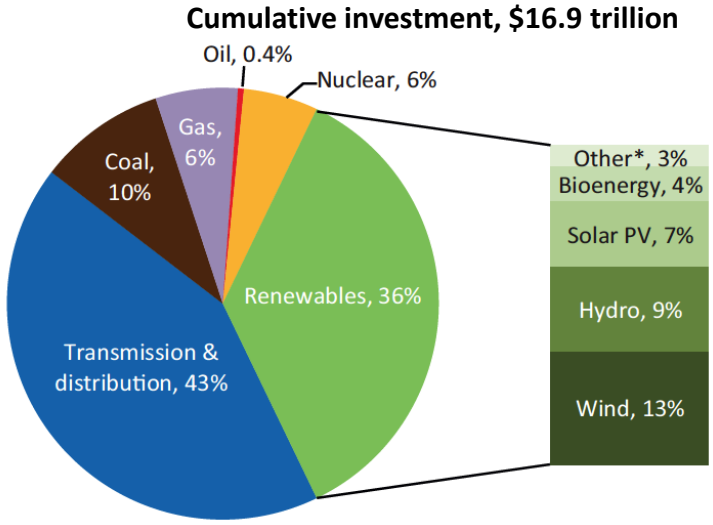
Cumulative power system investment 2012-2035 is estimated to be USD 16.9 trillion.

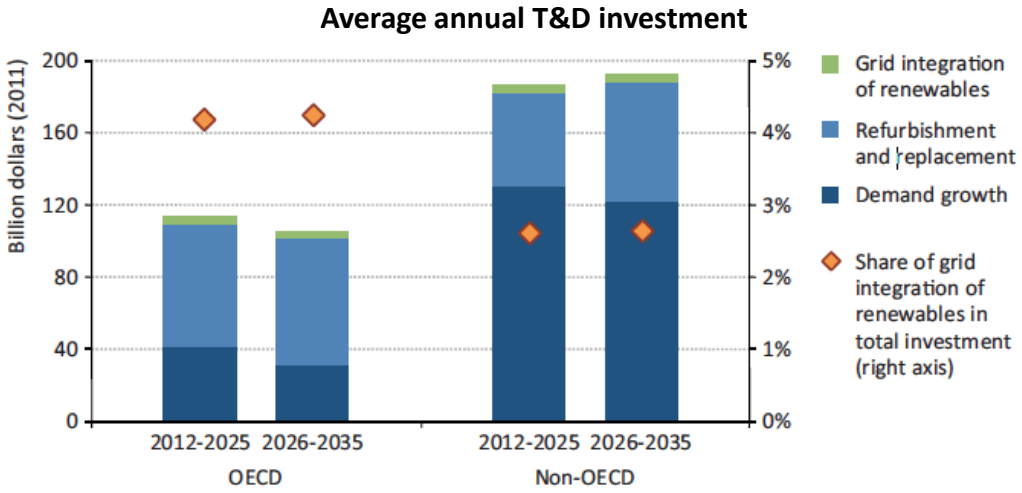
43% T&D and 57% new generation, 36% of which is renewables.

Non-OECD countries account for 60% of cumulative investment, and more than 64% of cumulative T&D investment.

T&D investment in non-OECD countries projected at ~USD 180 billion annually.

HOW CAN POLICY MAKERS ENSURE THESE INVESTMENTS ARE MADE QUICKLY AND COST-EFFECTIVELY?





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IEA WEO 2012 New Policies Scenario

Global Trends

8 macro trends reshaping power system evolution:

1. **Renewable energy costs have come down quickly**, and variable supply is becoming a larger share of total generation.
2. **Distributed generation is growing**, and increasing frequency of extreme weather events is motivating an emphasis on power system resilience.
3. **Deep end-use efficiency opportunities** across all sectors are creating new business opportunities and challenging the need for continued investments in generation capacity.
4. **Demand response** is becoming a viable flexibility for grid operators, making it easier to integrate variable generation and avoid building new supply.
5. **Information technology advances** are resulting in new abilities for sensing, communication, and networked control of the power system.
6. **Increased electrification of the transportation sector** will open new opportunities and pose new challenges for grid operators.
7. **Utility business models are under stress**, as demand levels off in industrialized nations, and emerging economies seek to dramatically accelerate network investment.
8. **New roles have emerged for power system optimizers** at every scale – from the building to the city to the national and international.

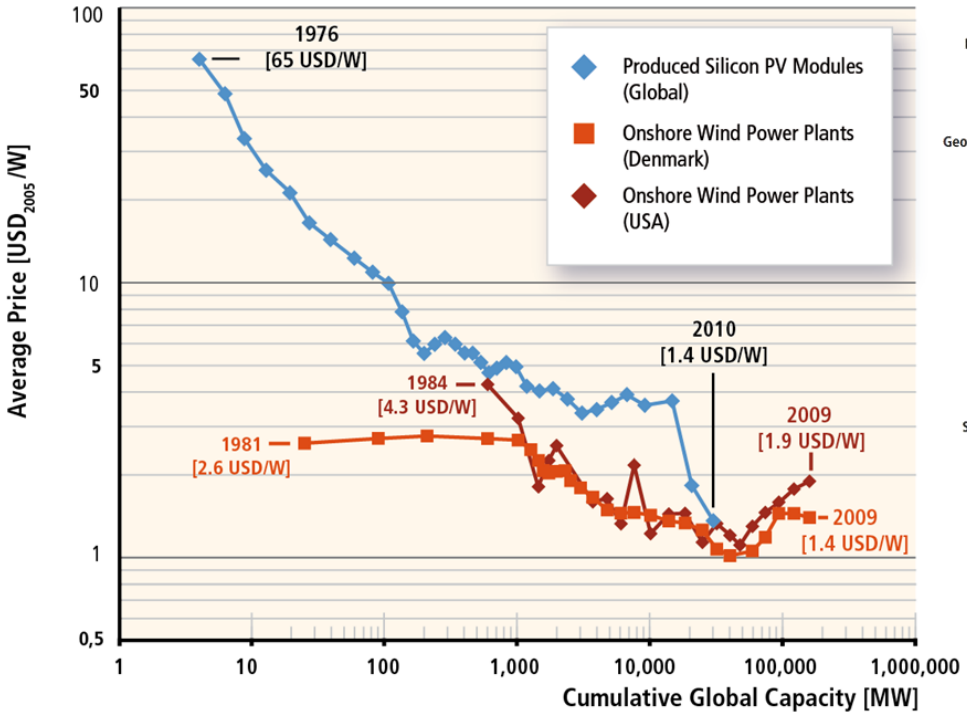
Global Trends

The concrete benefits of power system transformation hold the most value to policy makers and the public:

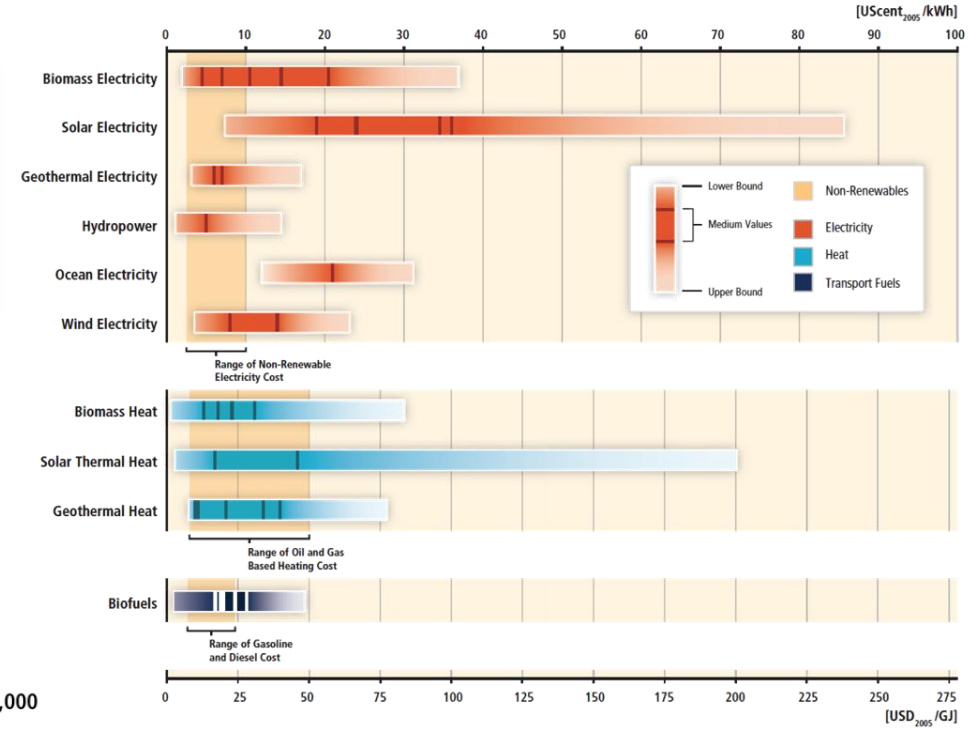
1. **Rapid expansion of access** to clean, affordable energy.
2. **Efficient use of constrained resources**, including fuel and water.
3. **Dramatic de-carbonization** of power systems in industrialized countries.
4. **Improved health** due to reductions in particulate pollution from the power sector.
5. **Reduced geopolitical tension** from competition for conventional energy commodities.
6. **Reduced volatility** of energy prices.
7. **Greater resilience** in the face of power system outages and extreme weather events.
8. **More rapidly expanding opportunities for innovation** and value creation in the power sector than at any time since the beginning of the 20th century.

Global Cost Trends

Steady Wind and Solar Cost Reductions



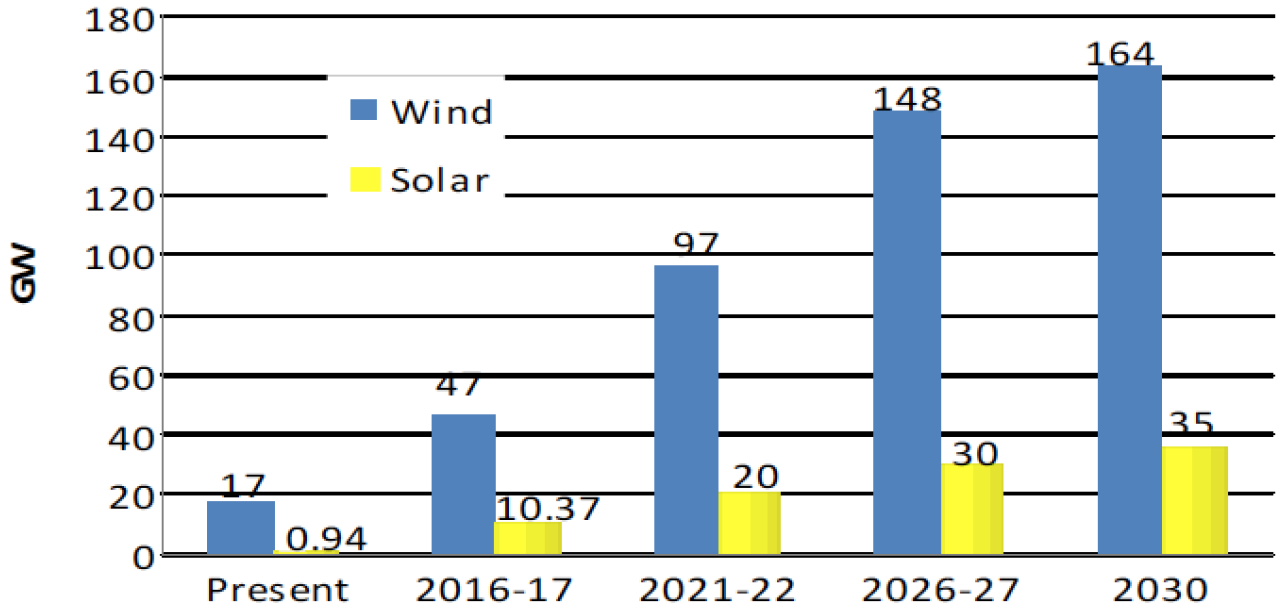
RE Technologies are Becoming More Competitive



India RE Landscape

Aggressive capacity growth targets for wind and solar

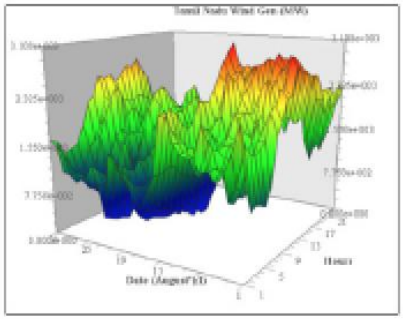
Resource	Present (GW)	2016-17 (12th plan) (GW)	2021-22 (13th Plan) (GW)	2026-27 (14th Plan) (GW)	2030 (mid 15th plan) (GW)
Wind	17	47	97	148	164
Solar	0.92	9.45	20	30	35

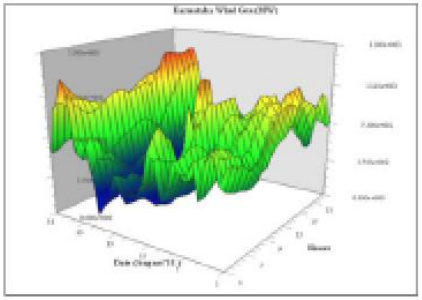


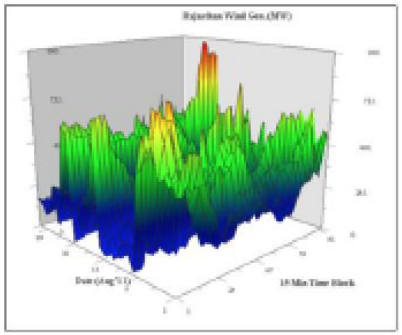
India RE Landscape

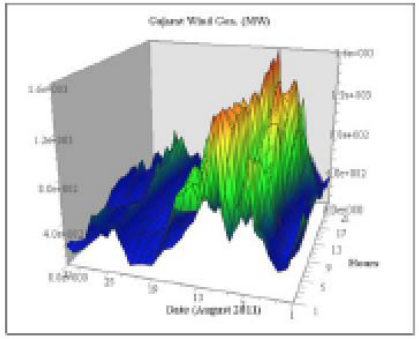
Visionary grid expansion plans →

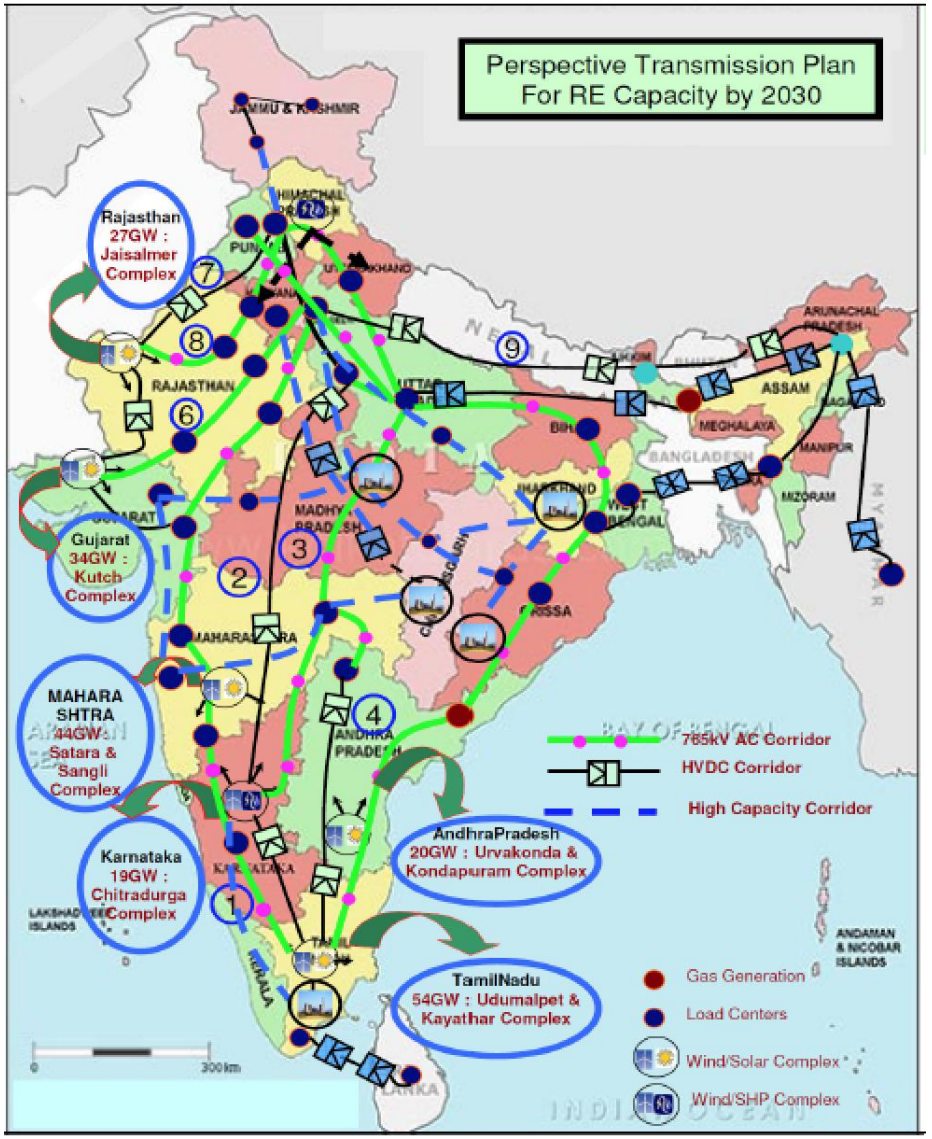
Significant analytical and planning efforts to prepare for RE integration











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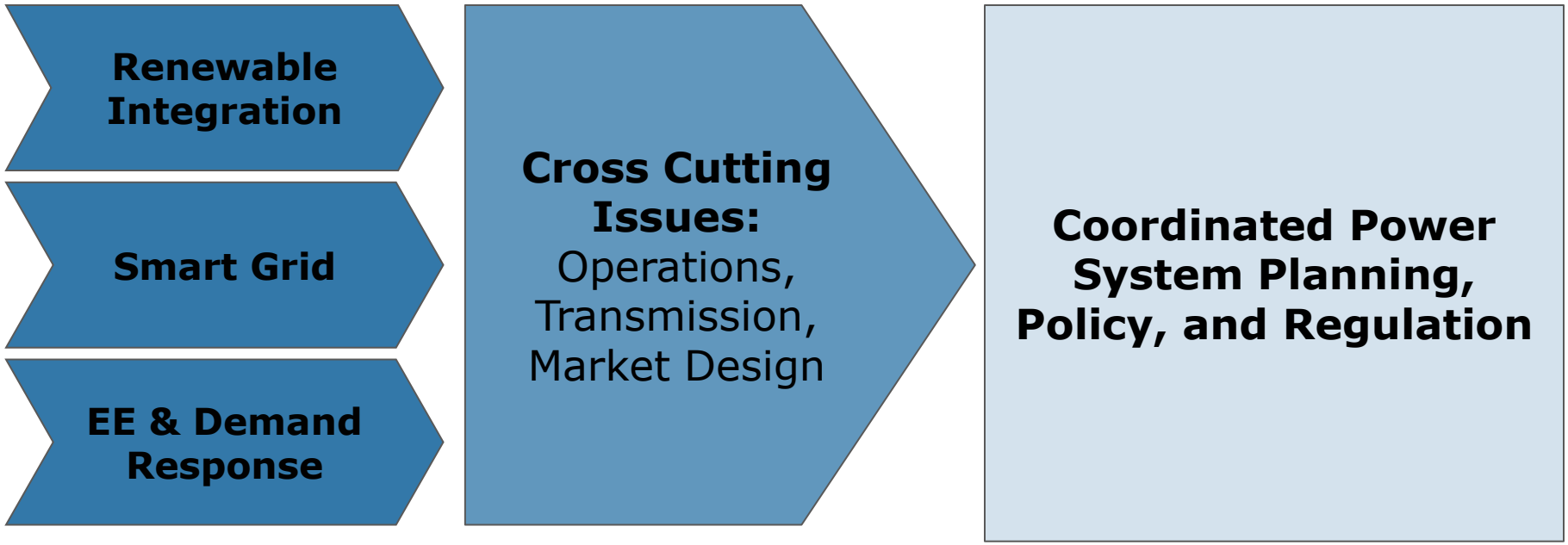
BARRIERS TO POWER SYSTEM TRANSFORMATION: *POLICY AND REGULATORY*

- **Uneven playing field –** IEA estimates $523 billion in annual fossil fuel subsidies globally (2011). Dynamic and often competing subsidies for different technologies creates an uneven playing field and distort market incentives for energy efficiency and renewable energy.
- **Externalities –** Health, environmental, and climate costs are rarely reflected fossil fuel prices.
- **Policy complexity and uncertainty –** Fiscal challenges dominate policy discussions; maintaining clear and consistent policy incentives is often difficult.
- **Lack of coordination –** Increasing dynamism and interdependency requires coordinated legal, market, and institutional ecosystems.

Barriers to Power System Transformation: *Innovation, Support, and Investment*

- **Experience –** Cumulative experience in operating 21st century power systems is growing rapidly, but still limited. 20th century power systems have a 100-year head-start.
- **Diversity –** There is no one-size-fits-all solution. Countries need to determine the most appropriate combination of approaches.
- **Attracting Investment –** Solutions must meet the stringent technical and economic validation requirements of global finance, insurance, and project development communities.
- **Gaining public support –** The public may not understand or support actions necessary, especially insofar as public expenditure is involved.

Barriers to Power System Transformation: *Comprehensive Planning*



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

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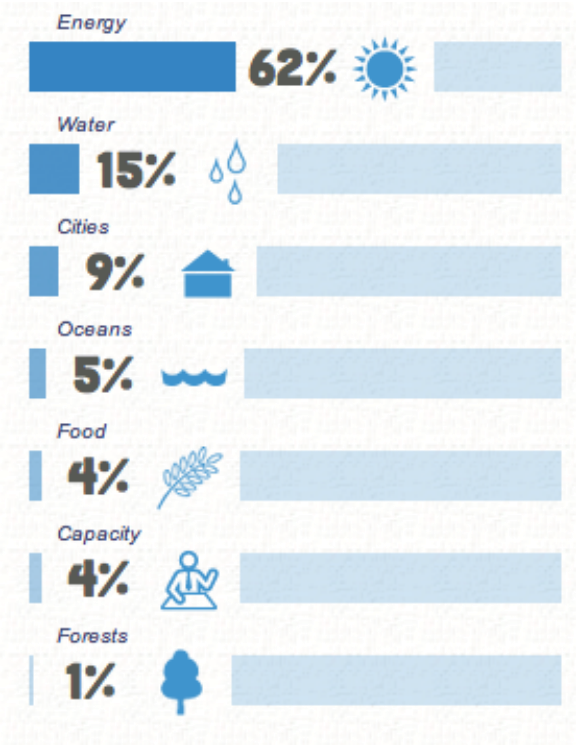
A Wave of Financial Commitments

Relative to other sectors, the energy sector has received the largest global share of public commitments by corporations, national governments, and international financial institutions.

Out of a total of USD $633 billion tracked by the Rio+20 initiative, more than USD **$457 billion** has been pledged toward support for cleaner energy.

Opportunity for consultation, coordination, and technical assistance.

Number of Commitments by Category (%)



Source: http://www.cloudofcommitments.org

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THRIVING NETWORKS OF EXPERTISE: *UN SUSTAINABLE ENERGY FOR ALL INITIATIVE*

By 2030, the Sustainable Energy For All Initiative aims to:

- Ensure universal access to modern energy services
- Double the global rate of improvement in energy efficiency
- Double the share of renewable energy in the mix

The Sustainable Energy for All initiative convenes a broad network of IFIs, development organizations, and corporations both as members of the High-Level Group and as network partners.

Opportunity to innovate solutions for achieving sustainable energy access.

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THRIVING NETWORKS OF EXPERTISE: *IEA ELECTRICITY COORDINATION GROUP*

The ECG convenes broad coverage of a range of technical and policy domains: Demand-Side Management, Energy-Efficient Equipment, RE Deployment, Ocean Energy Systems, High-Temperature Superconductivity, Smart Grids, Wind Integration, Energy Storage, GHG R&D, Hybrid Electriv Vehicles, and PV Power Systems

Opportunity to link technical and policy expertise to applied engagements.

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THRIVING NETWORKS OF EXPERTISE: *CLIMATEWORKS POWER SECTOR BEST PRACTICE NETWORK*

Pursuing interlocking policy and regulatory strategies to:

- End the use of unabated coal-fired power plants
- Promote energy efficiency
- Expand market share for clean energy technologies that reduce or eliminate carbon emissions

The Power Sector BPN is active in Brazil, China, India, and other major emerging economies.

RAP Energy solutions for a changing world

Opportunity to link regulatory and policy expertise to applied technical engagements.

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THRIVING NETWORKS OF EXPERTISE: *GLOBAL GREEN GROWTH FORUM*

The Governments of Denmark, Korea, Mexico, China, Ghana, and Qatar organize the annual 3GF event to encourage large-scale **public-private action** to accelerate the transition to a green economy.

The 3GF provides a platform for the creating of public-private partnerships (PPPs) aimed at advancing coherent investment frameworks in key green-growth domains, including power system transformation.

Opportunity to leverage public-private coordination to accelerate power system transformation.

3GF
Global Green Growth Forum

SIEMENS
McKinsey&Company
Vestas
Danfoss
ABB
GE

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THRIVING NETWORKS OF EXPERTISE: *GLOBAL LEARNING & KNOWLEDGE SHARING*

Greater coordination and collaboration between established and emerging clean energy knowledge platforms – especially Leonardo Energy, the IRENA RE Learning Platform, the European RE Research Centers Agency, and the Clean Energy Solutions Center – promise to make relevant technical and policy information more freely available to decision makers around the world.

Leonardo ENERGY

irelp IRENA Renewable Energy Learning Partnership

CLEAN ENERGY SOLUTIONS CENTER

Opportunity to leverage knowledge platforms accelerate power system transformation.

EUREC AGENCY

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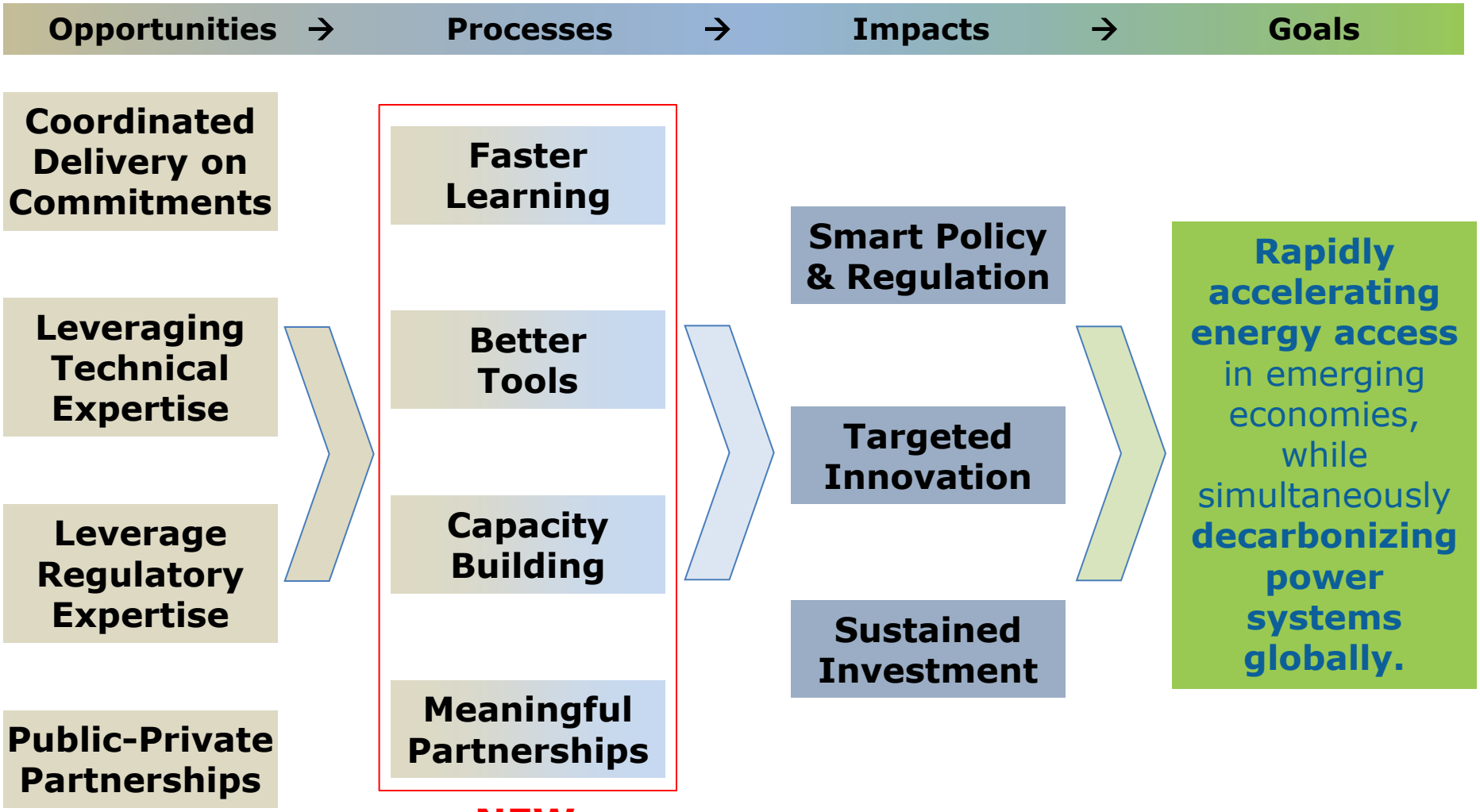
Pathways to Power System Transformation



The 21st Century Power Partnership

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

21st Century POWER PARTNERSHIP

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.

The 21st Century Power Partnership

Integrated Approaches to Power System Transformation

Cleaner Supply	Smarter Grids	Efficient and Intelligent Demand
Multilateral Solar and Wind Working Group (MSWWG)	*International Smart Grid Action Network (ISGAN)*	*Global Superior Energy Performance Partnership (GSEP)*
		Super-Efficient Equipment and Appliance Deployment (SEAD)

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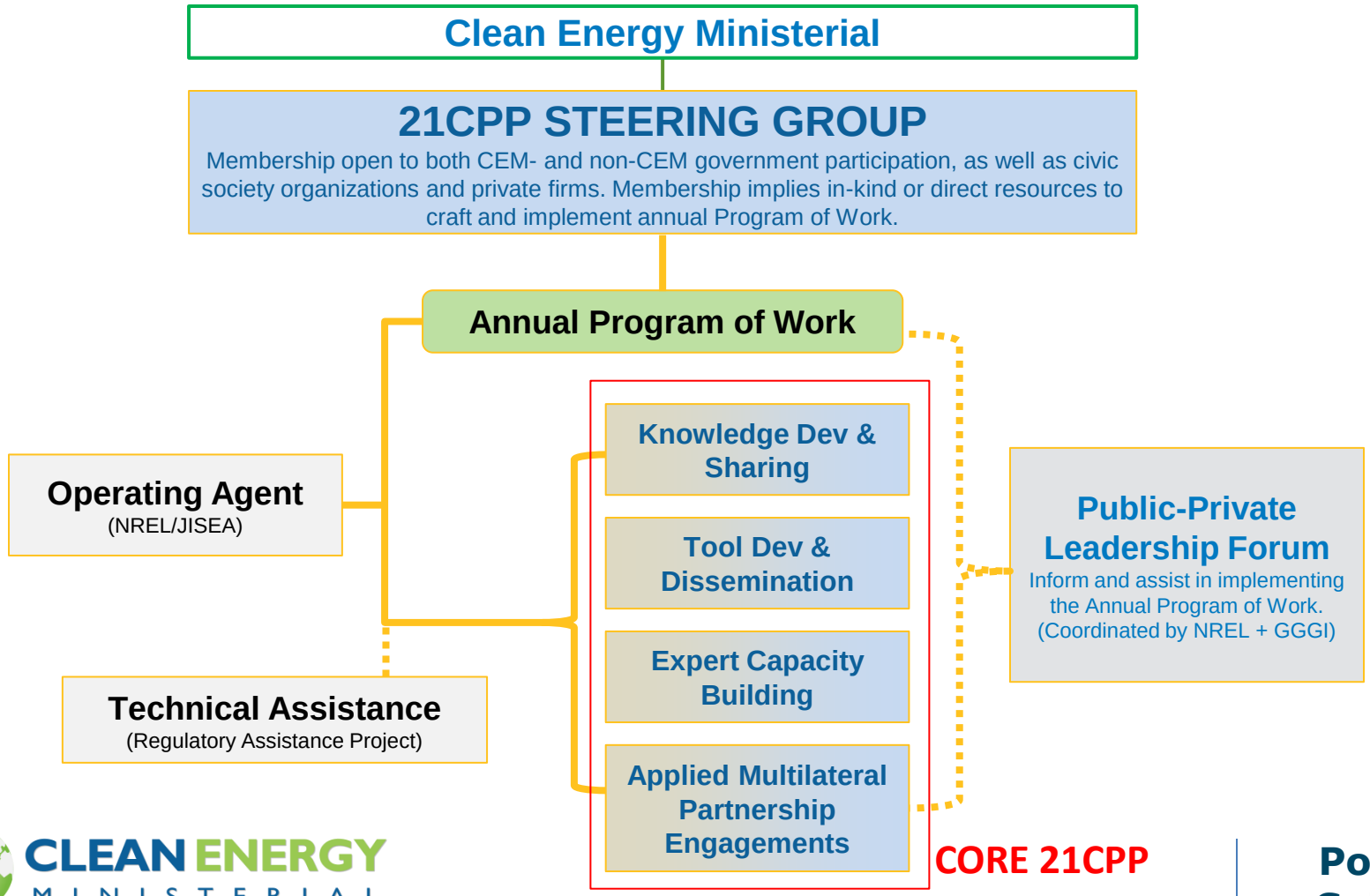
Clean Energy Solutions Center (CESC)

The Partnership aims to synthesize lessons learned from various Clean Energy Ministerial initiatives, and advance integrated policy development through four areas of activity:

Faster Learning	**Developing and sharing knowledge** on key topics related to power system transformation.
Better Tools	**Strengthening and disseminating technical tools** to accelerate policy and regulatory analysis.
Capacity Building	**Bolstering the capacity of experts** to advance the policies, programs, and practices.
Meaningful Partnerships	**Establishing applied multilateral partnership engagements** to leverage knowledge, tools, and capacity.

21CPP Organization and Activities

The 21CPP is guided by a multilateral steering group, in consultation with a Public-Private advisory board, and collaborates in the development of an annual program of work.



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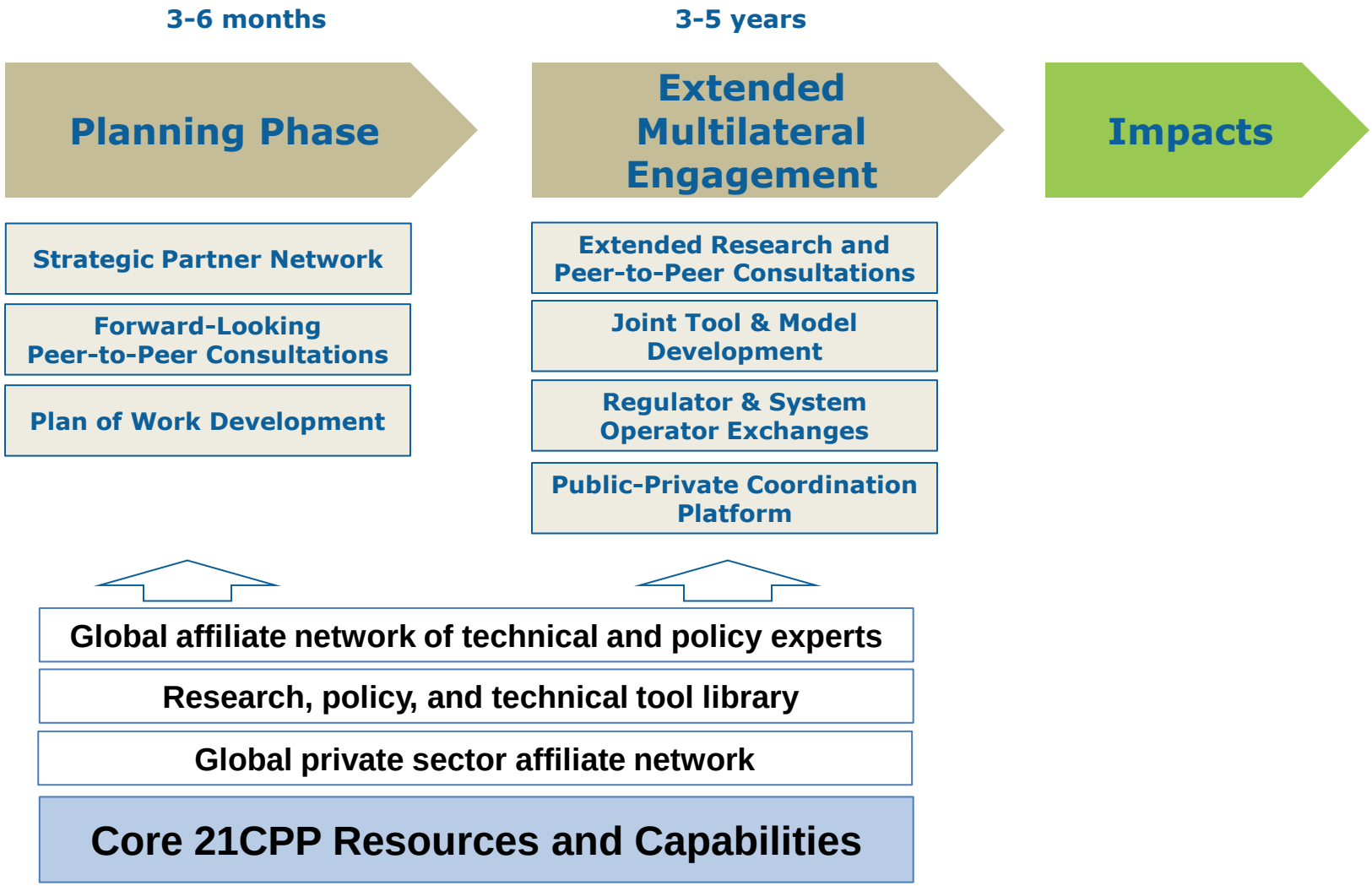
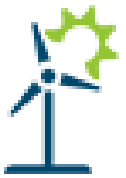
Potential Solutions

Indicative Applied Multilateral Engagement

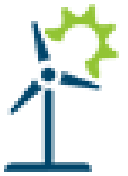


Current Range of Initial Consultations

Reports and Workshops on Evolving Approaches to Grid Management and Market Operations for Integrating Variable Renewable Energy
GEOGRAPHIC SCOPE: INDIA



Large-scale Grid Integration Of PV In Low- And Medium-Voltage Networks
GEOGRAPHIC SCOPE: CHINA



Workshops for State-Level Policy Makers on Evolving Approaches to Energy Efficiency
GEOGRAPHIC SCOPE: SOUTH AFRICA

Multilateral Knowledge Exchanges on Reliability and Non-Technical Losses
GEOGRAPHIC SCOPE: UNDER DEVELOPMENT

Detail: Initial consultations with Government of India

A series of multilateral peer-to-peer consultations on issues of near-term mutual interest:

Integrated power system operations

- Regulation and Market Design – e.g. ancillary services in a supply constrained power system, dynamic pricing, demand response
- Grid integration – managing variability with supply, demand, and interconnection options
- Forecasting, scheduling, and dispatch

Integrated power system planning

- Capacity planning considering conventional, energy efficiency, renewables, demand response, and transmission

Expected Deliverables: Strategic partner network; Peer-to-peer relationships; Draft plan of work for multi-year engagement

Detail: Initial consultations with Government of India

Timeline: April 2013 and ongoing

Participating Organizations:

- **India:**
  Planning Commission; Central Electricity Regulatory Commission; Ministry of Power; Ministry of New and Renewable Energy; Central Electricity Authority; POSOCO; PowerGrid; National Load Dispatch Center; State Load Dispatch Centers

- **Spain:**
  Red Eléctrica de España

- **EU:**
  ENTSO-E; IEA

- **US:**
  Department of Energy; National Renewable Energy Laboratory; Lawrence Berkeley National Laboratory

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4. Potential solutions
5. **Opportunities for progress**

Potential Areas for Collaboration: *Core Resources & Capabilities*

1. ***Strengthening Global Affiliate and Private Sector Networks***
   Coordinating the growing diversity of international experience and expertise will enrich the research, tools, and expert assistance available to key decision makers in emerging economies.

2. ***Implementing Coordinated Programs of Work***
   Coordinating programs of work across the network of affiliate organizations will enhance the resources and leadership on critical power sector topics.

3. ***Establishing a Global Research, Policy, and Technical Tool Library***
   Organizing resources will accelerate the use of best practices in power sector policy making. Easily searchable library offerings might include power system modelling tools, power market design legislation, tariff-setting proceedings, energy efficiency legislation, smart grid regulatory proceedings, grid interconnection plans, and demand response technical specifications.

Potential Areas for Collaboration: *Applied Multilateral Engagements*

1. *Extending Partnership to New Countries*

The community of expertise is growing -- opportunities to partner are always welcome.

2. *Joint Development and Enhancement of Analytical Tools*

In conjunction with private-sector partners, there is an opportunity to identify and address needs for new tools (or for enhancements to existing tools) commonly used for analysis, planning, and management in the electricity sector.

3. *Innovating Policies to Support Novel, Viable Power System Business Models*

Opportunities for existing businesses and new entrepreneurs will be significantly enabled (or possibly constrained) by local and regional policy regimes. Understanding policy regimes that support and accelerate the transition to clean, smart, efficient, affordable, and reliable electricity will help inform decisions that enable innovative solutions (and in some cases disruptive innovations).

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Slides below provide additional details

Charting a path for Integrated Policy Frameworks

Renewable Energy	Smart Grids	Energy Efficiency
• Prioritize investment in low-carbon generation • Implement market mechanisms to incentivize investment in RE, flexible capacity, and advanced net load forecasting • Develop strategic interconnection plans	• Reinforce incentives for local smart grid infrastructure • Establish clear goals and timetables for implementing smart grids • Remove barriers to market participation by smart grid-enabled demand resources	• Remove market barriers to energy efficiency investment • Convert non-binding EE goals into firm requirements • Mandatory minimum energy performance requirements based on 'best available technology' and a 'frontrunner approach'

Cross Cutting

- Ensure that finance and insurance incentives are appropriately aligned to support investment in appropriate infrastructure (energy generation and delivery networks)
- Review government budget allocation to ensure appropriate investment in RE, energy efficiency and network infrastructure.
- Review wholesale market arrangements to ensure that incentives promote investments in EE, demand-side resources, flexible capacity, interconnection, and low-carbon generation.
- Review the mandate of grid operators and regulators to ensure an investment framework that enables the upgrade and roll-out of smart infrastructures at transmission and distribution levels.
- Align environmental and land-use laws to support generation and grid goals.

Core 21CPP Resources & Capabilities

Leveraging 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

Networking External Resources:

Global affiliate network of technical and policy experts
Research, policy, and technical tool library
Global private sector affiliate network

Indicative 21CPP Activities

Developing and Sharing Knowledge	Strengthening and Disseminating Tools	Bolstering the Capacity of Experts	Applied Multilateral Engagements
• Review of policies and market design elements • Case studies of energy-sector transformation strategies • Review of challenges and best practices • Review of RE, EE, and smart grid integration methodologies	• Cost-benefit analysis tools • Modeling efforts focused on capacity-constrained grids • Enhanced resource forecasting, demand response, and variable renewable control tools.	• Grid operator exchanges to share case studies • Multi-stakeholder regulatory exchanges, focusing on utility-sector and consumer issues • Financial sector exchanges to examine critical factors in promoting investment	• Multi-year, multi-lateral consultations • Leverage global team of experts to support national and subnational policy and regulatory developments. • Provide ongoing, tailored decision support