21st Century Power Partnership

An Initiative of the Clean Energy Ministerial

An Overview and Key Activities

National Renewable Energy Laboratory

Operating Agent for the 21CPP

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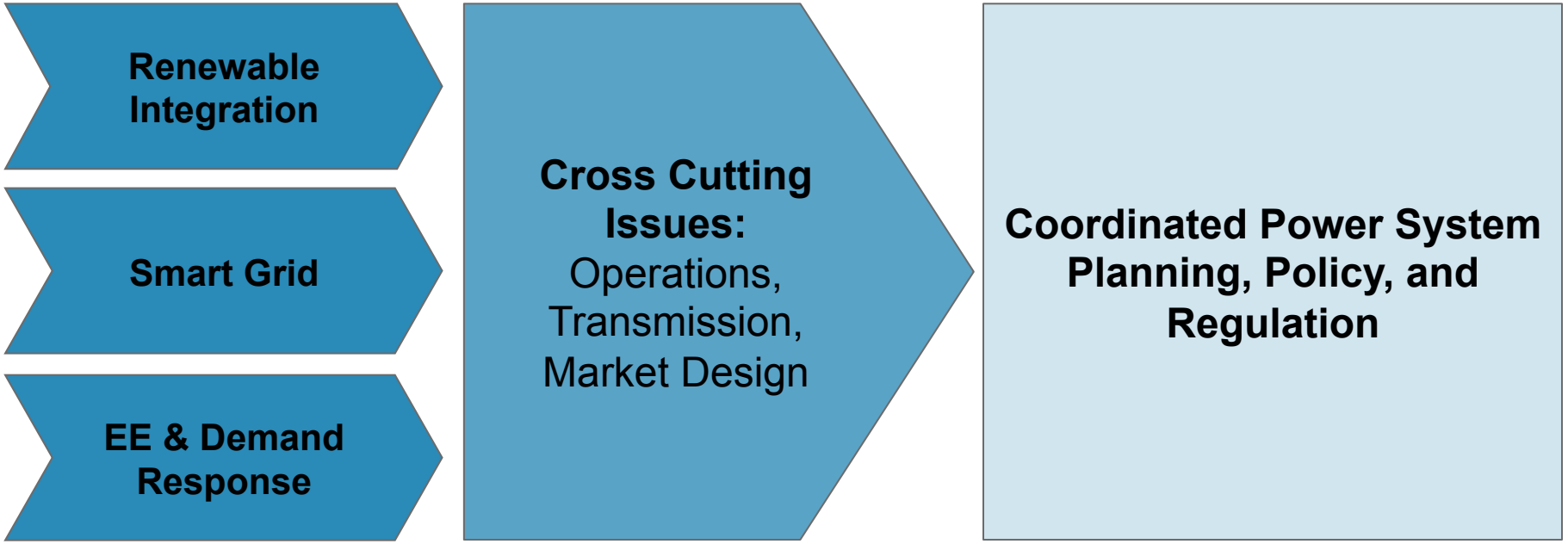
CLEAN ENERGY
MINISTERIAL
Accelerating the Transition to Clean Energy Technologies

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



Elements of Power System Transformation (PST)

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21CPP Activities

The Partnership aims to 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.

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Processes → **Impacts** → **Goals**

- **Faster Learning**
- **Better Tools**
- **Capacity Building**
- **Meaningful Partnerships**

KEY AREA OF FOCUS

- **Smart policy & regulation**
- **Targeted Innovation**
- **Sustained investment**

Rapidly accelerating sustainable energy access in emerging economies, while **rapidly decarbonizing power systems** in developed economies.

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21CPP Organization

Clean Energy Ministerial

21st Century Power Partnership Steering Group (PPSG)

Membership open to both CEM- and non-CEM government participation, as well as civic society organizations and private firms. Membership implies in-kind or direct resources to craft and implement annual Program of Work.

Annual Program of Work

Operating Agent
(NREL/JISEA)

Public-Private Leadership Forum (PPLF)

Private sector participation to inform and assist in implementing the Annual Program of Work.

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PROGRAM OF WORK

Annual Program of Work Includes:

- "Thought-Leadership" studies that focus on generic power system transformation topics across the world

- In-country technical assistance, often as part of a larger development assistance effort, focused on policy, regulatory, and technological progress; grid integration studies often highlight this work.

- Information exchange, capacity building, fellowship programs, and other exercises to share lessons-learned and knowledge transfer.

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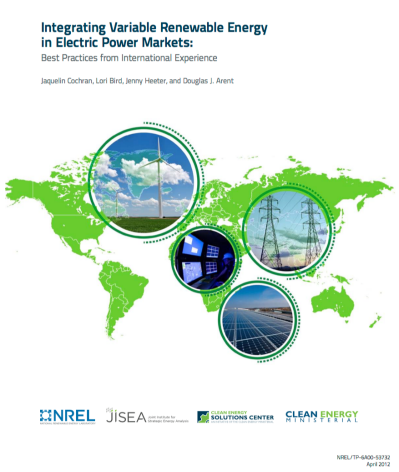
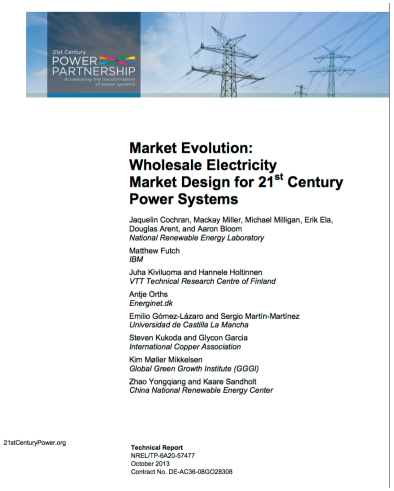
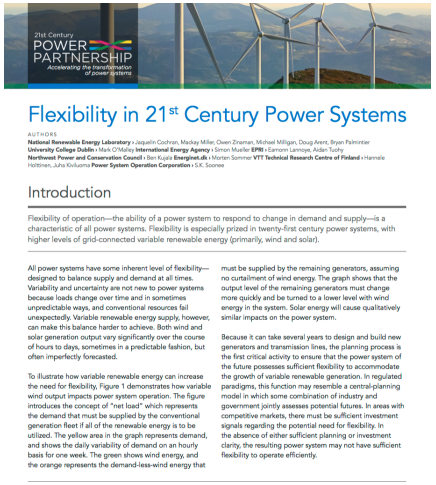
SELECT 21CPP THOUGHT-LEADERSHIP REPORTS



2012



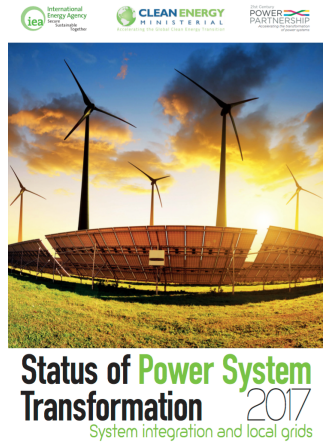
2013



2014

2015

2016



2017

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Policies for Enabling Corporate Sourcing of Renewable Energy Internationally

- Employed Stakeholder Advisory/review committee
- Interviewed more than a dozen corporations on what policies they need to enable greater purchasing of RE
- Final report completed by May 2017
- Actively seeking follow-on opportunities

Input from: Google, Apple, GM, P&G, Allotrope, APX, Intl Finance Corp., EDF Renewables, Microsoft, Autodesk, Akamai, Facebook, etc.

Paper Contributors:

NREL | IRENA

WRI | CRS

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Next-Generation Performance-based Regulation: Emerging Regulatory Strategies to Leverage Power Sector Innovation

- Continuation of *Power Systems of the Future* report series
- How can PBR be utilized to seize opportunities and mitigation issues presented by emerging technology drivers?
- Review of real-world experiences and proposals
- Final report completed September 2017
- Webinars summarize findings

Paper Contributors:

RAP

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Power System Transformation Status Report

- Updates 2015 PST Status Report work conducted by IEA and NREL in a new collaborative partnership
- Focuses on transformation pathways, implications of variable RE, and local grids in PST
- Provides case studies of Australia, Indonesia, Mexico, and South Africa
- Final report completed June 2017

Paper Contributors:

IEA

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COUNTRY UPDATES

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Brazil also Recently Joined the 21CPP and A Program of Work is Now Being Compiled

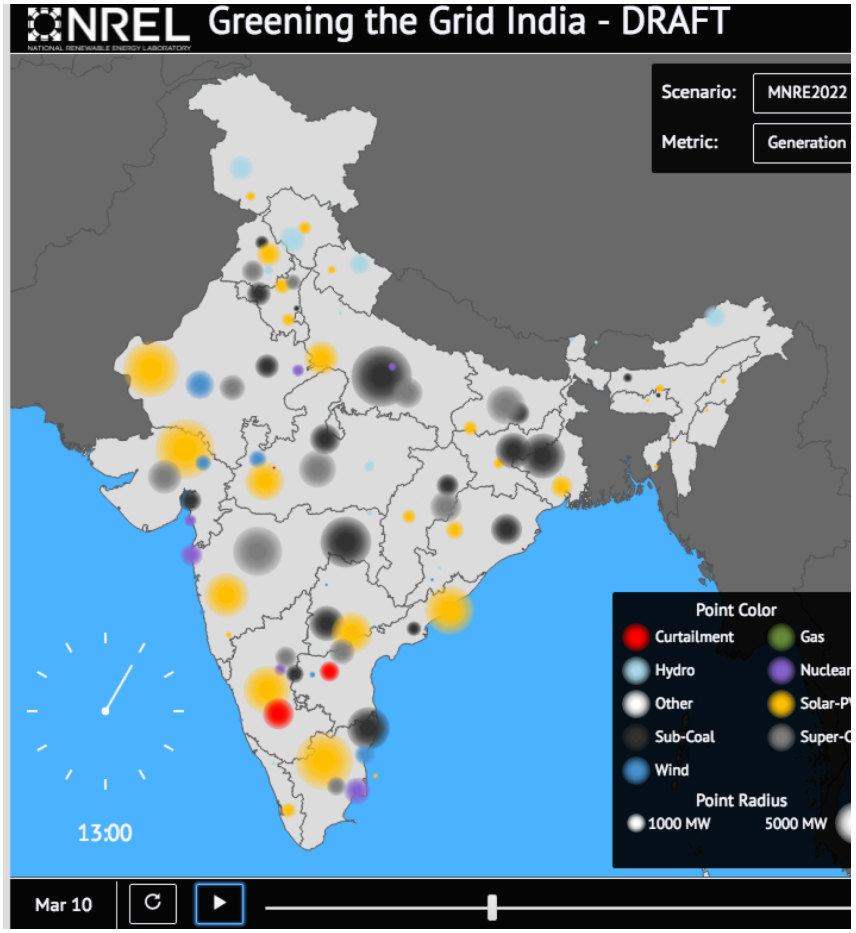
India RE Grid Integration Study

Project Goals:

- Identify impacts of operating India power grid with 175 GW of RE (goal for 2022)
- Inform actions needed to help integrate wind and solar generation

Strong stakeholder engagement:

- Capacity building: Modeling team represents 10+ Indian institutions (system operators and planners)
- Three technical stakeholder review committees representing over 150 Indian experts

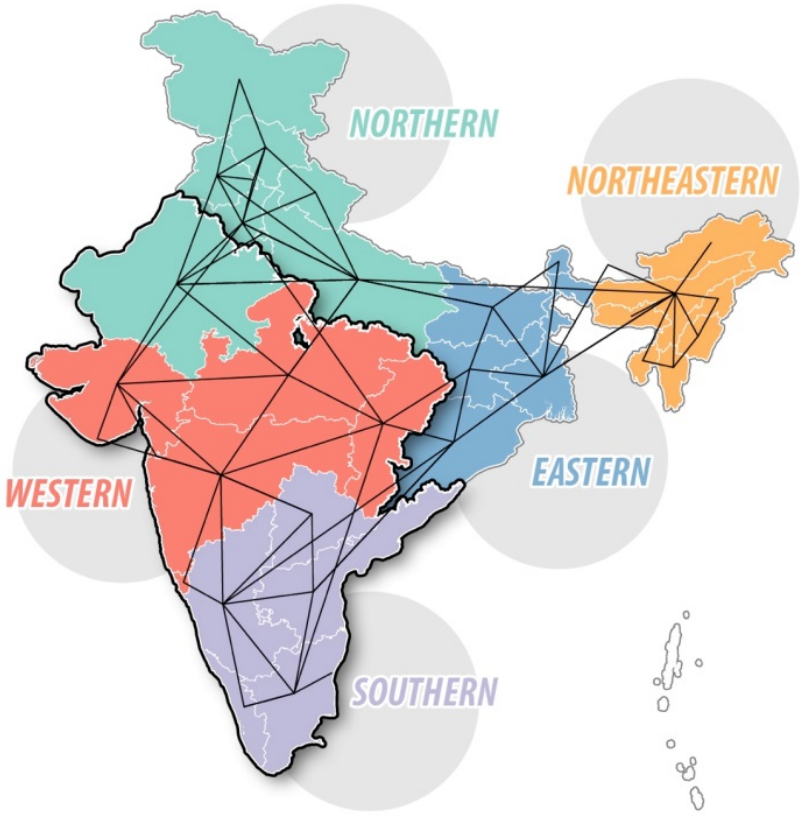


India: "Greening the Grid" Integration Study

National model features

- Production cost model
- High-resolution wind and solar resource data (both forecasts and actuals)
- Unique properties for each generator
- Government projections of new lines and power plants for 2022
- Enforced state-to-state transmission flows
- Interregional transmission limits that adhere to reliability standards
- Final report available here:

https://www.nrel.gov/analysis/india-renewable-integration-study.html



India: "Greening the Grid" Integration Study

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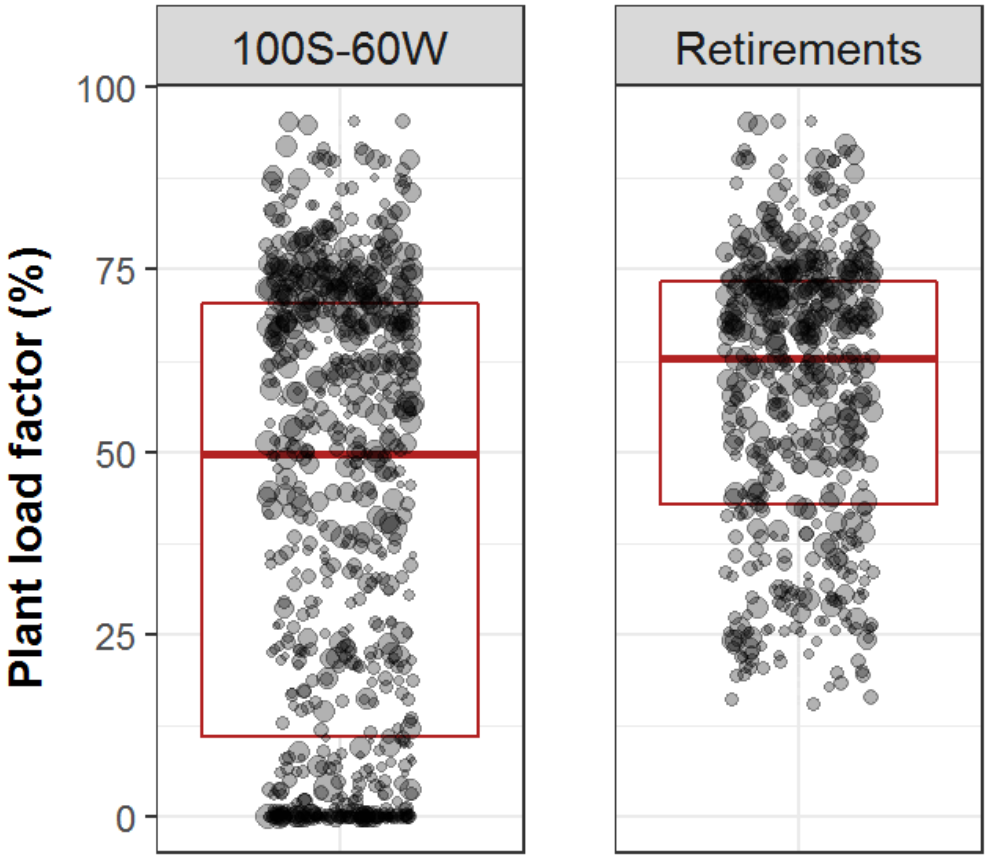
Example finding: Retiring 45 GW of coal in a 2022 system with 175 GW RE does not adversely affect system flexibility

- 45 GW coal (198 plants) operate on average less than 15% capacity and contribute just 1% to annual coal generation
- System still operates effectively without these plants, based on adequate intrastate transmission
- Plant load factors of remaining plants increase from 49% to 61%



Change in coal plant load factors after 45 GW of coal plants are retired

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COUNTRY UPDATES: SOUTH AFRICA

21CPP's South Africa program connects South African government stakeholders with an international network of expertise and a demand-driven technical assistance program with an emphasis on:

1) Assisting South Africa's technical capacity to conduct medium- and long-term power system planning
2) Address technical, regulatory and policy challenges of distributed energy resources
3) Market design and power sector restructuring
4) Other high priority topics as identified by key stakeholders such as Eskom, NERSA, SADOE, SANEDI, and National Treasury.

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COUNTRY UPDATES: SOUTH AFRICA

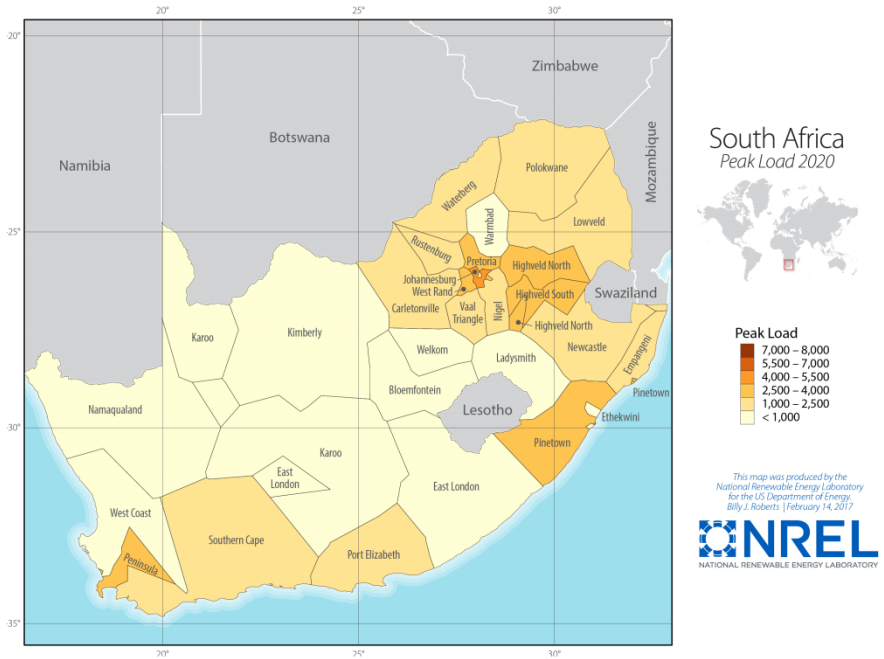
Comprehensive South Africa Grid Integration Study

State-of-the-art, multi-component grid integration study to examine the South African grid's ability to support high penetrations of variable renewable energy.

Developing advanced medium- and long term planning capabilities with Eskom in line with international best practice

Hosted Eskom technical team at NREL September 2016 and February 2017

Creating first-of-its-kind renewable energy "supply curve" data set for South Africa with Council for Scientific and Industrial Research



*Future Activities

Eskom-NREL Technical Collaboration Agreement; Forthcoming MOU with SA-DOE; SAPP regional planning exchanges; NREL-CSIR Technical Collaboration Agreement

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COUNTRY UPDATES: MEXICO

Accelerate “next generation” power system planning for 2030.

Providing technical assistance to Mexico for the integration of variable, intermittent renewable energies into the grid to meet its clean energy 35% goal by 2024

- Renewable Energy Grid Integration Studies
- Analysis of Priority RE Zones
- Evaluation of Expansion plans

Provide operational policy and regulatory support for grid integration

- Renewable Energy Forecasting Models
- Use of Storage Technologies
- Demand Control Technologies

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MEXICO: LONG-RANGE PLANNING

- Drive the development of a strategic policy framework to support the high penetration of renewables, and to support the acceleration of “next generation” planning around scale-up and integration of renewables”

Mexico’s Regulatory Engagement in Bulk Electric Power System Planning: An Overview of U.S. Practices and Tools

Barbara O’Neill, David Hurlbut, Ivonne Pena, Douglas Gagne, Jeff Cook, and Ricardo Bracho
National Renewable Energy Laboratory

NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy
Operated by the Alliance for Sustainable Energy, LLC

This report is available at no cost from the National Renewable Energy Laboratory (NREL) at www.nrel.gov/publications.

Technical Report
NREL/TP-5D00-66103
June 2016

Contract No. DE-AC36-08GO28308

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Capacity Expansion Studies	Production Cost Modeling	Power Flow Studies
Optimization of capacity, localization and operation of generation and transmission to meet with future demand and system restrictions	Simulation of the operation of the power system (optimization of production costs)	Technical viability and analysis of reliability

Future generation and transmission scenarios

Periods of stress in the power system

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Assist the government of Mexico with the implementation of its energy reform directives.

- Structure of MMU Options
- Market Analysis Tools
- Real Time Information Systems
- Surveillance and Reporting
- New Regulation
- Market Manuals
- Fuel Indices

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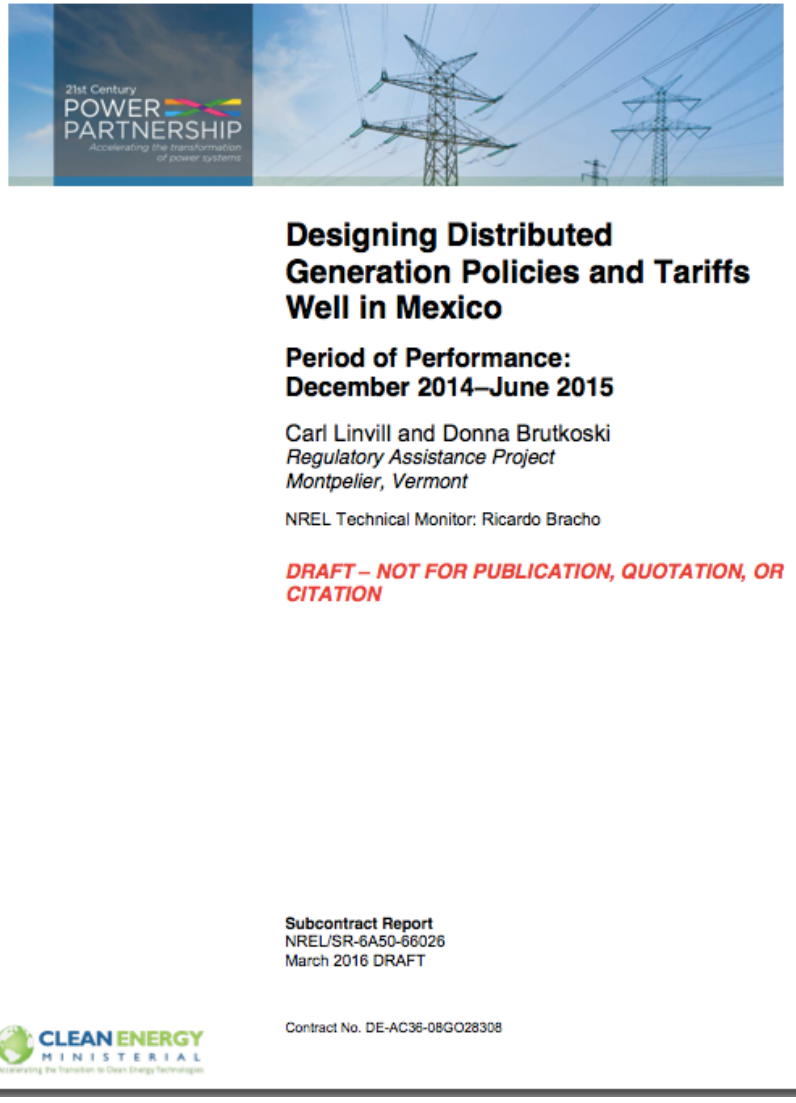
MEXICO: SMART GRID AND DISTRIBUTED GENERATION

Evaluate and expand smart grid and distributed generation deployment via enhancement of public policies and regulation

- DG Policy Paper
- Smart Grid Deployment Pathways for Mexico



Designing Distributed Generation Policies and Tariffs Well in Mexico

Period of Performance: December 2014–June 2015

Carl Linvill and Donna Brutkoski
Regulatory Assistance Project
Montpelier, Vermont

NREL Technical Monitor: Ricardo Bracho

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Subcontract Report
NREL/SR-6A50-66026
March 2016 DRAFT

Contract No. DE-AC36-08GO28308

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Boosting Renewable Energy as Part of China's Energy System Revolution

- Five-year program with work streams on power system modeling, grid development, power system flexibility, and distributed generation
- China Renewable Energy Outlook (CREO) 2016 released in September 2016
- CREO 2017 released in October 2017, with model improvements, updates on China's power sector reform and carbon policies, and regional power markets

Key partners: NREL | CNREC | DEA | GIZ | AGORA | DENA | Energinet

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FELLOWSHIPS AND KNOWLEDGE SHARING

- The 21st Century Power Partnership has hosted dozens of fellowships, study tours, and technical events focused on building capacity, sharing lessons-learned, and enabling power system transformation.

- Visit https://www.21stcenturypower.org/fellowship.html to find out more about potential fellowships.

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POTENTIAL COLLABORATION

We'd Like to Hear From You:

1. ***Extending Partnership to New Countries***
   Opportunities to partner are always welcome.

2. ***Joint Development and Enhancement of Analytical Tools***
   In conjunction with private-sector partners, the Partnership aims 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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Contact Us

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