CLEAN ENERGY MINISTERIAL

Accelerating the Transition to Clean Energy Technologies

MULTILATERAL COOPERATION TO MAKE THE POWER SECTOR SMART

WORK UNDER THE CLEAN ENERGY MINISTERIAL

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Brookhaven National Laboratory • 17 April 2015

AGENDA

- Clean Energy Ministerial
- Why Focus on Electricity?
- International Smart Grid Action Network
- 21st Century Power Partnership

CLEAN ENERGY MINISTERIAL

ACCELERATING THE TRANSITION TO A GLOBAL CLEAN ENERGY ECONOMY

1 High-Level Policy Dialogue **2 Technical Cooperation**

3 Engagement with the Private Sector and Other Stakeholders

Sixth CEM ministerial meeting (CEM6): Mérida, Mexico, May 27-28, 2015


Australia


European Commission


Brazil


Canada


China


Denmark


Finland


France


Germany


India


Indonesia


Italy


Japan


Korea


Mexico


Norway


Russia


South Africa


Sweden


Spain


United Arab Emirates


United Kingdom


United States

> 75% of Global Clean Energy Investment **> 75% of Global GHG Emissions**

CEM INITIATIVES

ISGAN IS ONE OF TWELVE

Clean Energy

- Multilateral Solar and Wind Working Group
- Sustainable Development of Hydropower Initiative
- Bioenergy Working Group

Energy Efficiency

- Super-Efficient Equipment and Appliance Deployment (SEAD) Initiative
- Global Superior Energy Performance Partnership (GSEP)

Human Capacity

- Clean Energy Solutions Center
- Global Lighting and Energy Access Partnership (Global LEAP)
- Clean Energy Education & Empowerment (C3E) women's initiative

Integration

- 21st Century Power Partnership
- **International Smart Grid Action Network (ISGAN)**
- Electric Vehicles Initiative (EVI)
- Global Sustainable Cities Network (GSCN)

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THE CHALLENGE
ELECTRICITY MATTERS

- **A <u>Safe and Reliable Supply of Electricity</u> is a Key Precondition for Economic Prosperity.**
  - Electricity is a key input to many commercial and industrial processes
  - Electricity costs are a key element in consumer prices

A 2008 World Bank paper found that electricity outages cost Sub-Saharan Africa 2%+ in GDP!*

- **A <u>Clean Supply of Electricity</u> is a Key Precondition for Environmental Sustainability.**
  - Power generation is a principal source of air pollution and GHG emissions
  - Clean electricity can help "de-oil" transportation (without emissions)

*Eberhard, A., V. Foster, C. Briceno-Garmendia, F. Ouedraogo, D. Camos, and M. Shkaratan, May 2008. Underpowered: The State of the Power Sector in Sub-Saharan Africa. Africa Infrastructure Country Diagnostic Background Paper. World Bank, Washington DC, May 2008.

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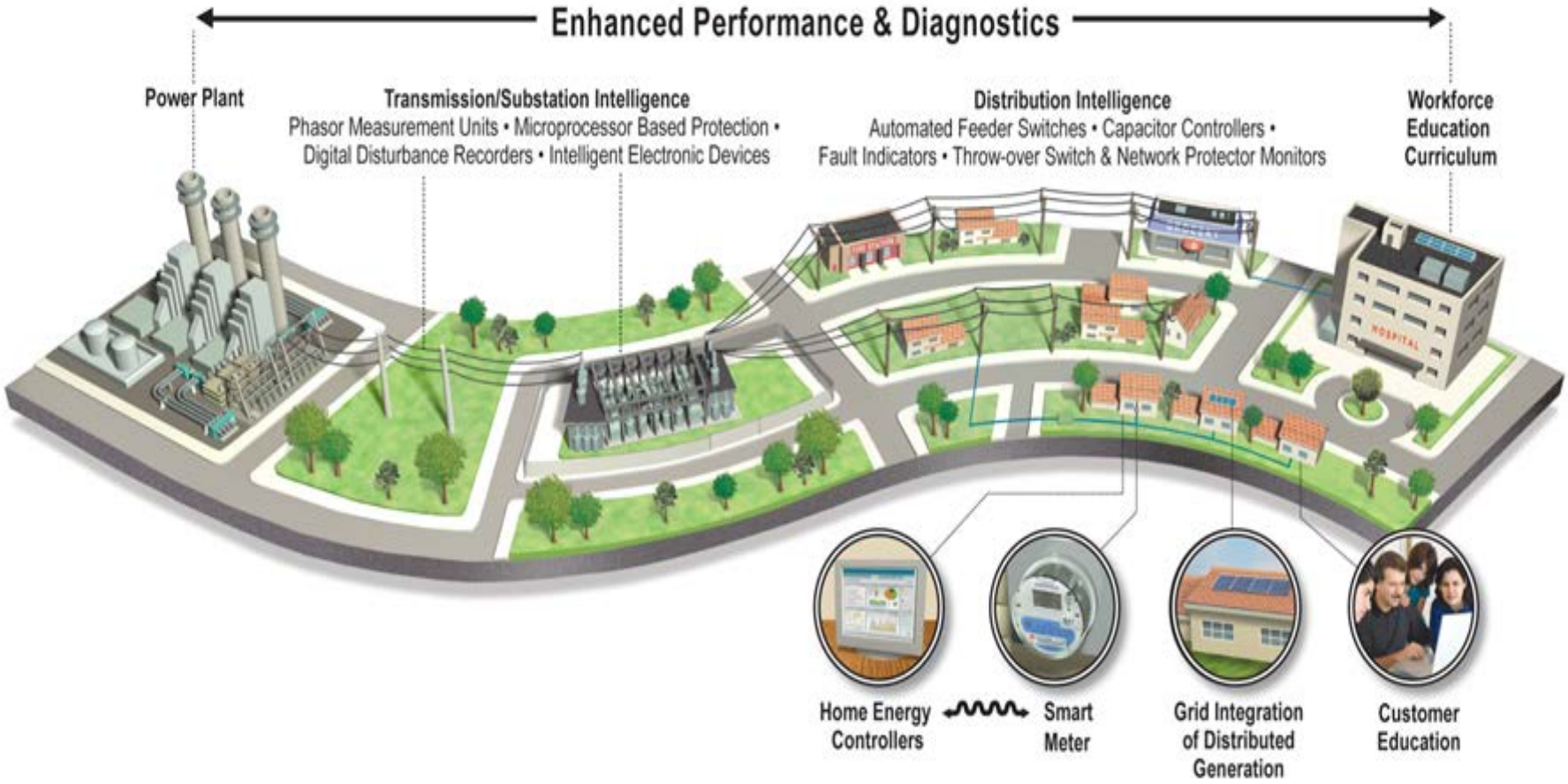
THE CHALLENGE
GRIDS UNDER STRESS

Around the world, power grids are increasingly under stress:

- Sources and demands for electric power are progressively more varied and complex
- Declining demand (in some economies)
- Aging or inadequate infrastructure (in many economies)
- Aging power sector workforce (in many economies)
- Rapid demand growth / rapidly increasing consumer expectations (in many developing and emerging economies)
- Policy and regulatory changes v. Policy and regulatory paralysis

AND historical business and operational models are proving inadequate

SMART GRIDS
ONE VIEW (OUT OF MANY)



Source: Florida Power and Light; modified by U.S. Department of Energy

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SMART GRIDS
KEY "ENABLER" FOR CLEAN ENERGY

True smart grids dynamically integrate all sources of power supply with all sources of energy demand for power systems that are…

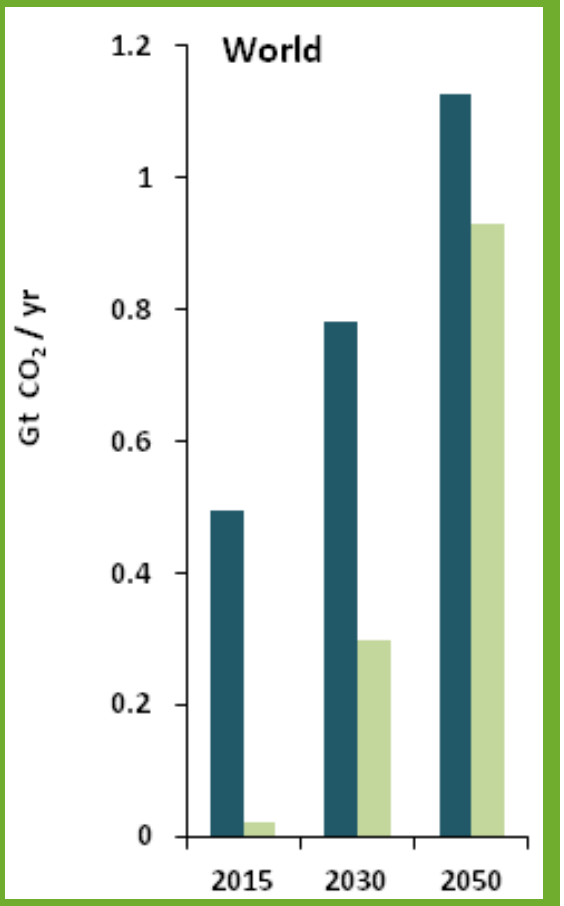
- Cleaner
- More reliable
- More resilient
- Affordable*

Deployed globally, smart grids have the potential to help reduce global CO_2 emissions by over two gigatonnes per year by 2050.

*Direct Reductions (dark green) : Energy savings from peak load management, continuous commissioning of service sector loads, accelerated deployment of energy efficiency programs, reduced line losses, and direct feedback on energy usage

Enabled Reductions (light green): Greater integration of renewables and facilitation of EV and PHEV deployment

*Potential GHG Reductions from Global Smart Grids**



Source: IEA Smart Grids Roadmap Insights, 2011

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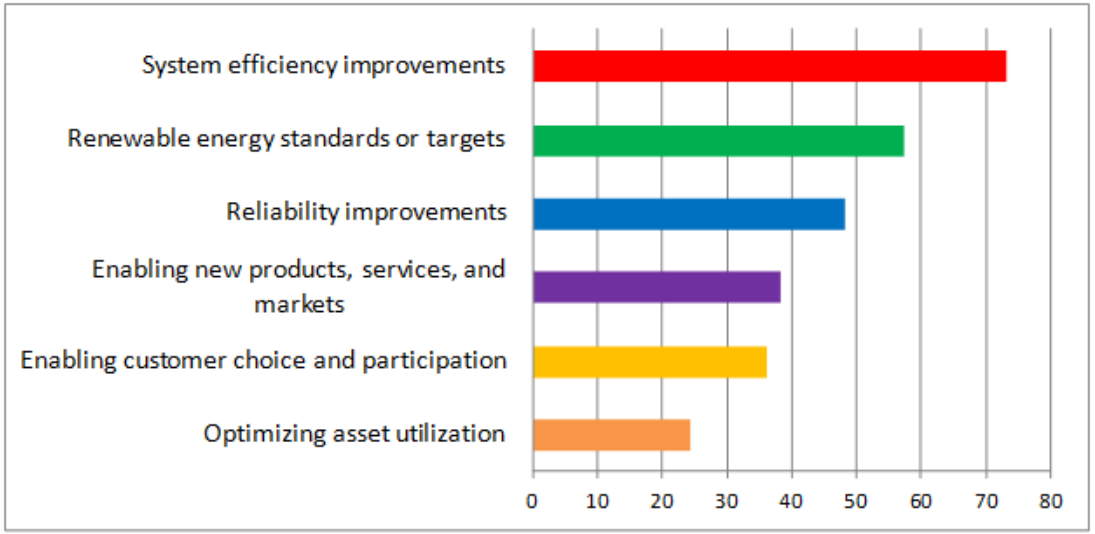
*especially taking externalities into account

WHY MULTILATERAL COOPERATION ON SMART GRIDS

Diverse Systems, Common Drivers:

- Electricity grids differ greatly from country to country, market to market, in technical characteristics, market structures, and governance.
- Yet, countries are asking the **same questions** about grid modernization and drawing from **similar pools of technologies, policies & standards**.
- **Multilateral cooperation** increases the likelihood of brokering **meaningful connections** across the specific areas of synergy.

Top 6
Motivating Drivers
for Smart Grids
from ISGAN analysis of 22 national-level survey results



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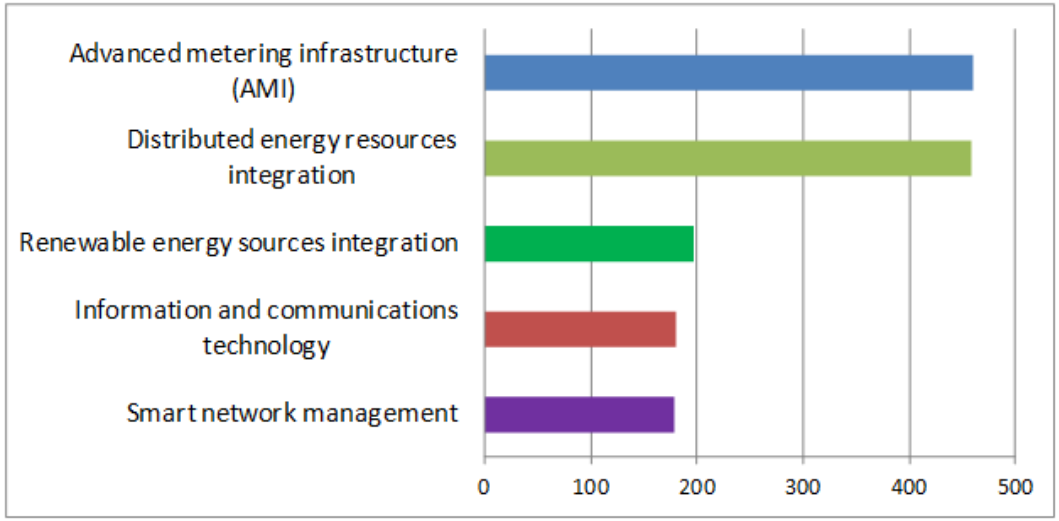
Top 5
Technologies
across All Drivers
from ISGAN analysis of 22 national-level survey results



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ISGAN

Visit **iea-isgan.org**

International Smart Grid Action Network =

Strategic platform to support high-level attention and action for the accelerated development and deployment of smarter, cleaner electricity grids around the world.

ISGAN activities are meant to…

- call attention to the importance of electricity grids for clean energy
- build a better global understanding of smart grids
- improve peer-to-peer exchange
- address gaps in knowledge and tools
- recognize excellence
- support replication of proven ideas

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Member of the iea Energy Technology Network

ISGAN STRENGTHS

- **Broad Expert Network**:
  ISGAN leverages expertise from governments, national laboratories and research institutions, transmission and distribution system operators, power generators, and others from **25 countries across five continents**.

- **Partnerships with Thought Leaders:**
  ISGAN engages leading governmental and private sector initiatives *(e.g., ELECTRA, Global Smart Grid Federation)*, the IEA Energy Technology Network, and other Clean Energy Ministerial initiatives *(e.g., 21st Century Power Partnership, Electric Vehicles Initiative)*

- **Diverse Portfolio:**
  ISGAN implements a wide range of knowledge exchange and technical activities to capture international experience and advance systems perspectives on power grids and grid integration.

PARTICIPANTS

Contracting Parties: 25
Withdrawn: UK
Expression of Interest: Indonesia
Recent Inquiry: Cyprus

BROADER NETWORK

… and more

ISGAN Work Program

Foundational Projects *(Global Understanding & Tools)*

U.S. Operating Agent

Annex 1: Global Smart Grid Inventory

U.S. Participates (Limited)

Annex 2: Smart Grid Case Studies

U.S. Participates (Limited)

Annex 3: Benefit-Cost Analyses and Toolkits

U.S. Co-leads

Annex 4: Synthesis of Insights for Decision Makers**

Technical Projects

U.S. Leads Some Subtasks

Annex 5: Smart Grid International Research Facility Network (SIRFN)

U.S. Participates

Annex 6: Power T&D Systems

Other Projects

Annex 7: Smart Grid Transitions – Institutional Change

U.S.Co- leads

ISGAN Award of Excellence

Virtual Training Academy (approved)

**Knowledge sharing by design

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ISGAN Priorities

Capture Experiences, Build Global Understanding & Tools, Foster Peer Exchange

Annex 1:

- Biennial assessments of smart grid drivers and technology priorities
- Smart grid project webinars

Annex 2:

- Periodic case books:
  - DSM
  - AMI *(updated)*
  - Consumer engagement *(in development)*
- Best practice wkshops

Annex 5:

- Comparative evaluation of smart inverter test protocols
- Smart distribution simulation platform
- Advanced test. mthds.
- Technical workshops

Annex 7:

- Online network of professionals in social sciences for grids
- Data analysis of key "gatekeepers" & themes
- Social license for grids

Annex 3:

- Comparison of cost-benefit methodologies
- Tool to assess grid technology maturity
- Tools to assess value of specific smart grid technologies

Annex 4:

- Discussion papers on *(for example)*
  - RE integration
  - Smart grids in islands
  - Consumer engagement
- Outreach & comms strategies

Annex 6:

- Discussion papers & briefs *(for example)*
  - EU & US policy
  - Smart & strong transmission
- Best practice case book *(forthcoming)*
- Technical workshops

ISGAN **Award of Excellence**

Virtual Training Academy (in development)

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WHAT IS SIRFN?

(BESIDES BEING A BETTER ACRONYM THAN ISGAN)

The Smart Grid International Research Facility Network (SIRFN) is a ***coordinated network of smart grid research and test-bed facilities and relevant projects in the field*** in countries participating in ISGAN.

SIRFN's collaborative testing/evaluation capabilities are meant to be leveraged by the international community to enable improved design, implementation, and testing of smart grids.

Operating Agent: DERlab

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CURRENT SIRFN PARTICIPANTS

AIT Austrian Institute of Technology

RSE Ricerca Sistema Energetico

G2Elab Grenoble Génie Électrique / Grenoble Electrical Engineering

Fraunhofer IWES

VTT

AIST National Institute of Advanced Industrial Science and Technology (AIST)

seai Sustainable Energy Authority of Ireland

Sandia National Laboratories

tecnalia Inspiring Business

Central Power Research Institute

Brookhaven National Laboratory

NREL National Renewable Energy Laboratory

DNV·GL

DERlab

University of Toronto

KATS

Korean Agency for Technology & Standards

Soon! →

sanedi South African National Energy Development Institute (SOC) Ltd.

Eskom

And maybe more in RSA.

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SIRFN OBJECTIVES

- **Share Capabilities:**
  Comprehensive catalogue of engaged facilities, including their infrastructure, equipment, etc.
  – *will be available soon on new SIRFN website*

- **Share Knowledge:**
  Active information sharing among facilities to include:
  - Non-proprietary results of current research
  - Best practices, novel & emerging methods, etc.

- **Coordinate Joint Evaluation/Testing:**
  Extend and expand smart grids testing and evaluation by identifying international testing gaps, implementing joint efforts

Areas of Collaboration

Smart Grid International Research Facility Network

Test Protocols for Advanced Inverter Functions

- *Goal*: Develop / demonstrate a consensus-based interoperability certification standard for IEC 61850-90-7 advanced distributed energy resources (DERs)
- "Round robin" evaluation of test protocols among facilities
- Meant to inform/accelerate adoption of the protocols by international standards organizations / grid code bodies
- *Example:* SIRFN results are informing updates to UL 1741 certification standard

Advanced Laboratory Testing Methods

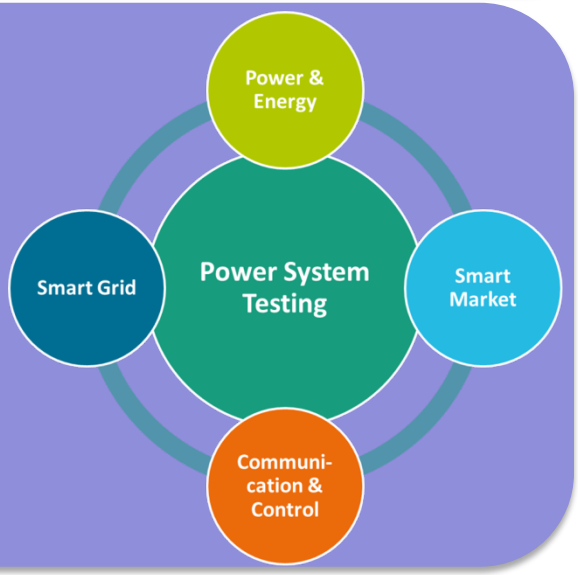
- Utilize novel ideas and novel methods (PHIL, CHIL, MD/Co-Sim)
- Creation of a work basis for future contributions to
  - Rapid prototyping and manufacturing
  - Standardized testing procedures (writing, testing)
  - Novel research areas in the electrical domain

Areas of Collaboration

Smart Grid International Research Facility Network

Power Systems Testing

- Numerous interdependencies in power system control
- Testing components only may miss such interactions/interdependencies
- Seeks to define requirements for true systems testing, applying state-of-the-art adv. lab testing methods



Smart Grid Modeling

- Developing model server for use by SIRFN facilities
- One-to-one replica utility systems – using real-world data and network topologies wherever possible – allowing holistic looks at system effects
- Evaluation of alternative designs against policy goals

AWARD OF EXCELLENCE

- **International competition to showcase global excellence, leadership and innovation in smart grid projects.**
- Theme for 2014: "Consumer Engagement & Empowerment"
- Winning project, runner up and finalists were announced in May 2014 in Korea at the Fifth Clean Energy Ministerial

Congratulations to Entergy New Orleans' "SmartView" AMI Pilot! Winner!

- Winner selected by independent international jury of smart grid experts (e.g., Patty Durand, Smart Grid Consumer Collaborative)

The ISGAN Award of Excellence competition is supported by GSGF Global Smart Grid Federation

AWARD OF EXCELLENCE

2015 Competition is now in judging process.

2015 Awards Theme:

Excellence in Smart Grids for Renewable Energy Integration

- **14 Submissions from 10 Countries**
  France (2), Italy (2), Germany (1), Ireland (1), Sweden (1), Korea (2), India (1), Japan (1), Vietnam (1), U.S. (2)
- Jury led again by GSGF Executive Director Ronnie Belmans (also includes Becky Harrison, CEO, GridWise Alliance)
- Winners to be announced at Sixth Clean Energy Ministerial in May

The ISGAN Award of Excellence competition is supported by GSGF Global Smart Grid Federation

THROUGH CEM6*

*Mérida, Mexico – May 27-28, 2015

- **Completion of 2015 Award of Excellence competition** focused on excellence in **smart grids for variable renewable energy integration**, in partnership with the Global Smart Grid Federation
- **Online version of the AMI & DSM case books** to make the info and lessons learned more accessible and encourage direct engagement with experts
- **New case book on Power T&D Systems** (also in development: case book on **Consumer Engagement**, based on 2014 Award of Excellence competition results)
- **Rooftop PV integration workshop**, in partnership with CEM 21CPP, with goal to inform South Africa policy development (Johannesburg, South Africa, March 23-24)
- **Technical workshop on microgrids** at India Smart Grid Week (Bangalore, March 3)
- **Webinar on smart grids for DSM and demand forecasting** in the residential sector, in partnership with the CEM Clean Energy Solutions Center (April 22; see www.cleanenergysolutions.org/training/smart-grid-demand-side-management)
- **Discussion paper on RE integration** in distribution networks

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21st Century POWER PARTNERSHIP
Accelerating the transformation of power systems

India (co-lead) | United States (co-lead) | Denmark | Finland | Mexico | South Africa | Spain

21CPP = A FOCUS ON POWER SYSTEM TRANSFORMATION

The Power Partnership aims 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.

CORE PARTNERSHIP ACTIVITIES

On-demand Expert Consultation: Targeted consultations between policy makers and a global network of technical, policy, and regulatory experts.

Peer-to-Peer Workshops and Exchanges: Workshops to convene grid operators, regulators, utility staff, and policy makers with their international peers groups.

High-level Roundtable Events: Roundtable events convening public and private sector leaders to examine critical issues of power system transformation.

Thought Leadership: Research and analysis on key issues to advance international understanding of key power system issues.

21st Century POWER PARTNERSHIP
Accelerating the transformation of power systems

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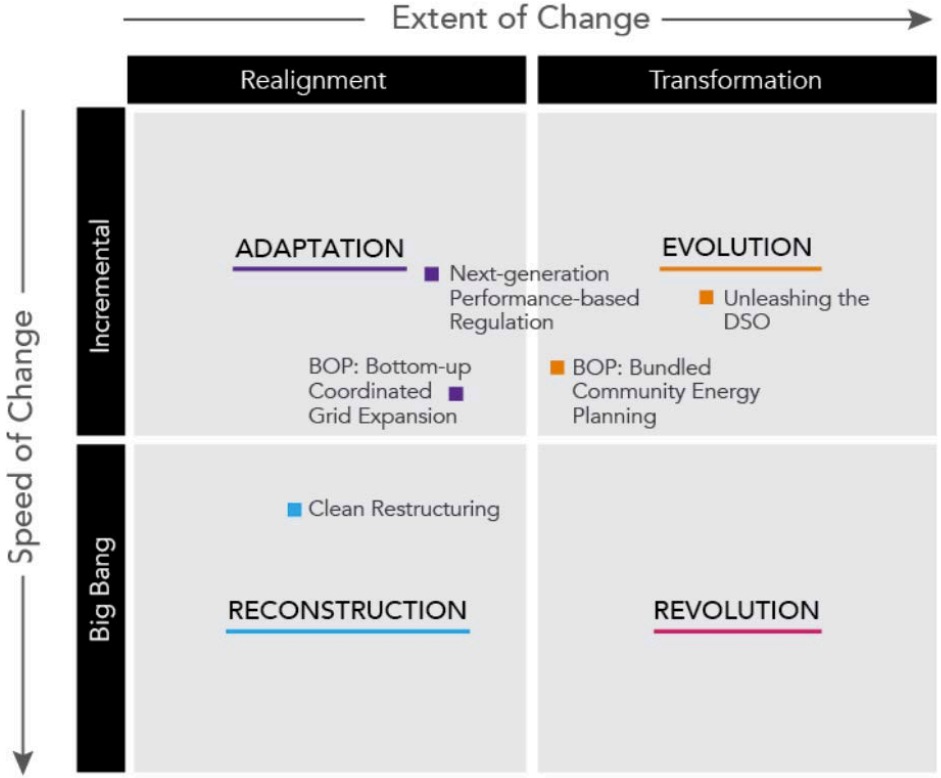
RECENT THOUGHT LEADERSHIP

Power Systems of the Future – January 2015
A Keystone 21st Century Power Partnership Publication

Five Archetype Pathways Toward Power System Transformation

- Next-generation Performance-based Regulation
- Clean Restructuring
- Unleashing the DSO
- Bottom-up Coordinated Grid-expansion
- Bundled Community Energy Planning



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21st Century POWER PARTNERSHIP
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ACTIVE TECHNICAL ASSISTANCE PROGRAMS

INDIA

Key Stakeholder

CERC, MOP, MNRE, PGCIL, NLDC, CEA, NITI AAYOG

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, CFE, CENACE

Priority Topics:

1.“Next generation” transmission planning for 2030;

2.Evaluation and expansion of smart grid pilot projects;

3.Grid operational practices for wind integration

SOUTH AFRICA

Key Stakeholders:

SADOE, Eskom, NERSA

Priority Topics:

1. PV integration on low-voltage networks;
2. Plexos modeling for integrated resource planning

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POWER SYSTEMS ARE CHANGING NOW!

The questions CEM participants – and workshops like this – are asking are *not* academic… *but you knew that*

Energy ministers, regulators, and other decision makers are asking questions *right now* and want/need insights *right now* to support policy change and clean energy / smart grids deployment.

- *India's National Smart Grid Mission*
- *South Africa's "War Room"*
- *Mexico's Energy Reforms*
- *NY PSC's Reforming the Energy Vision (REV)*

…and (many) more!

THANK YOU!

For more information, please visit:

- Clean Energy Ministerial: www.cleanenergyministerial.org
- IEA Energy Technology Network: www.iea.org/techno/index.asp
- ISGAN: www.iea-isgan.org
- ISGAN Partners:
  - 21st Century Power Partnership (CEM): www.21stcenturypower.org
  - Global Smart Grid Federation: www.globalsmartgridfederation.org
  - Electric Vehicles Initiative (CEM): www.worldevcities.org
  - Clean Energy Solutions Center (CEM): www.cleanenergysolutions.org

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BACK-UP

IEA Implementing Agreements

ISGAN is one of 11 IAs in The IEA Electricity Coordination Group

Part of the…

ECG Coverage: DSM, Energy-Efficient Equipment, RE Deployment, Ocean Energy Systems, HTS, Smart Grids, Wind Integration, Energy Storage, GHG R&D, HEVs, PV Power Systems