A co-operative programme on Smart Grids

Michael Hübner
ISGAN EXCO Representative Austria

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A CLEAN ENERGY MINISTERIAL INITIATIVE

CLEAN ENERGY MINISTERIAL
Accelerating the Transition to Clean Energy Technologies

Energy Efficiency

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

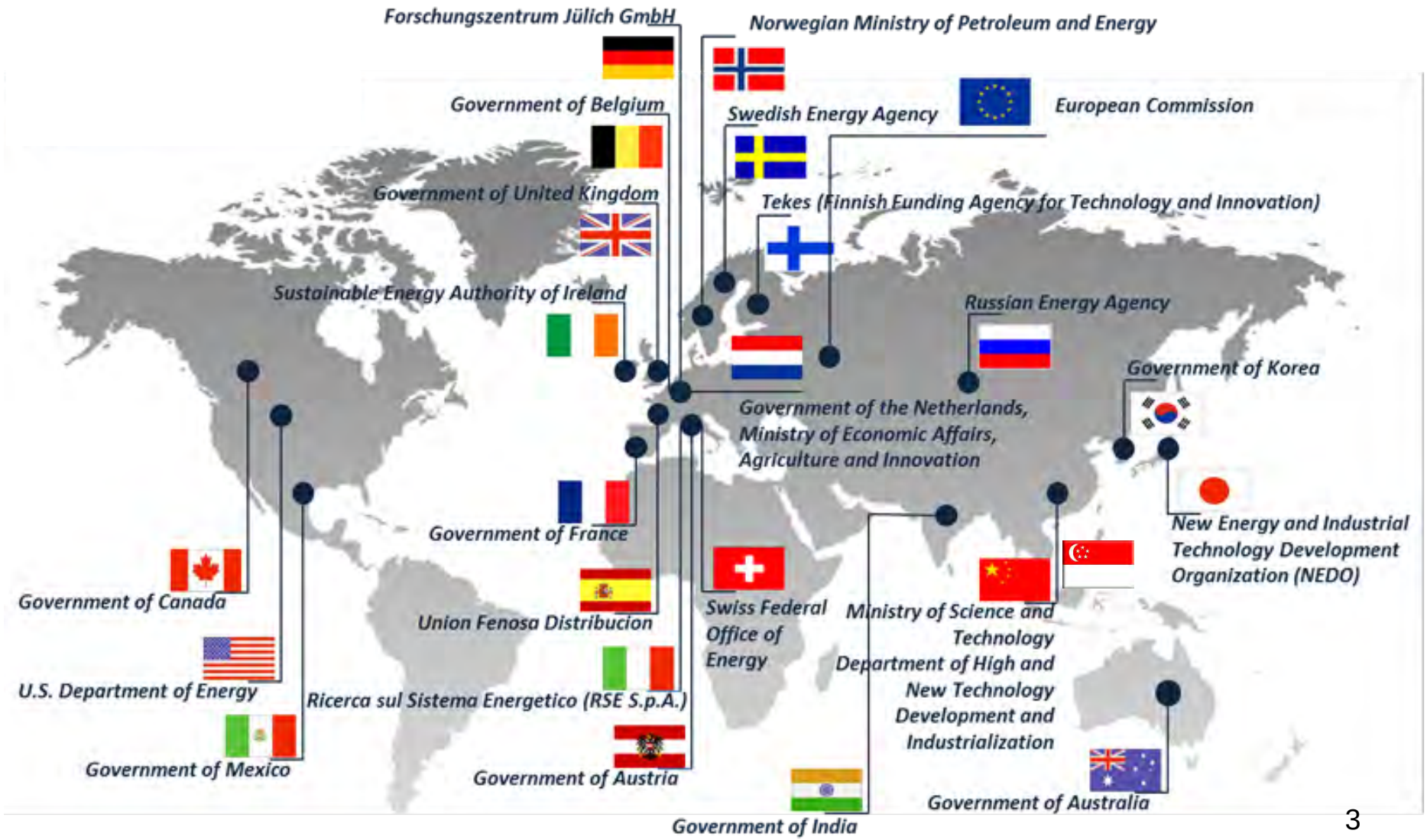
Clean Energy Supply

- Bioenergy Working Group
- 21st Century Power Partnership
- Sustainable Development of Hydropower Initiative
- Multilateral Solar and Wind Working Group

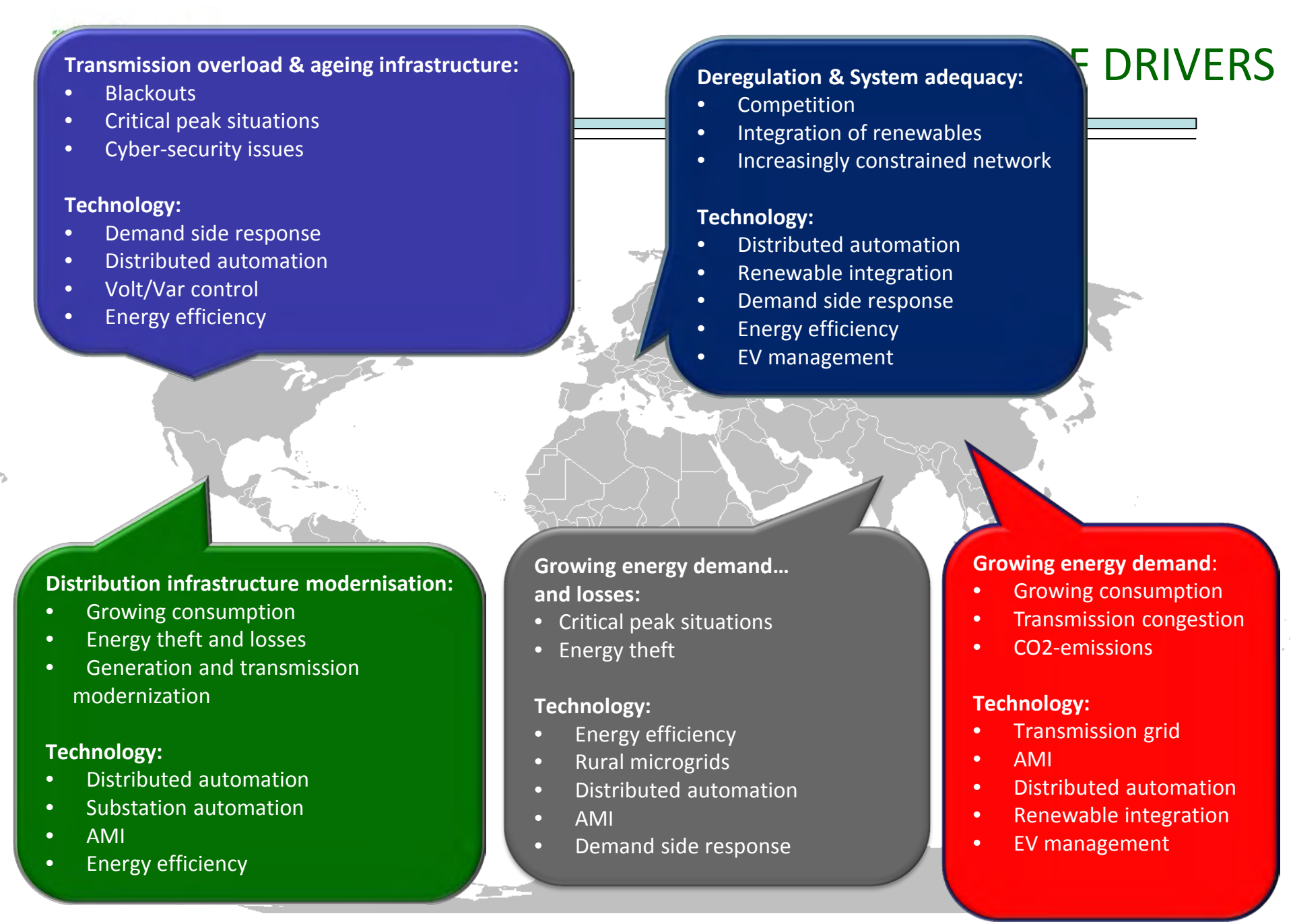
Crosscutting

- **International Smart Grid Action Network (ISGAN)**
- Solar and LED Energy Access Program (SLED)
- Clean Energy Solutions Center
- Global Sustainable Cities Network (GSCN)
- Clean Energy Education & Empowerment (C3E) women's initiative

GEOGRAPHY OF ISGAN



F DRIVERS



Transmission overload & ageing infrastructure:
- Blackouts
- Critical peak situations
- Cyber-security issues

Technology:
- Demand side response
- Distributed automation
- Volt/Var control
- Energy efficiency

Deregulation & System adequacy:
- Competition
- Integration of renewables
- Increasingly constrained network

Technology:
- Distributed automation
- Renewable integration
- Demand side response
- Energy efficiency
- EV management

Distribution infrastructure modernisation:
- Growing consumption
- Energy theft and losses
- Generation and transmission modernization

Technology:
- Distributed automation
- Substation automation
- AMI
- Energy efficiency

Growing energy demand… and losses:
- Critical peak situations
- Energy theft

Technology:
- Energy efficiency
- Rural microgrids
- Distributed automation
- AMI
- Demand side response

Growing energy demand:
- Growing consumption
- Transmission congestion
- CO2-emissions

Technology:
- Transmission grid
- AMI
- Distributed automation
- Renewable integration
- EV management

POWER SYSTEMS ARE CHANGING NOW!

The question ISGAN projects are asking are *not* academic.

Energy ministers, regulators, and other decision makers are asking questions right now and want and need insights to support policy change and deployment.

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

…and more!

CLEAN ENERGY MINISTERIAL

Energy Technology Network

Drivers for Smart Grid in India

Example

- **T&D loss reduction and efficiency improvements:** Reduce Transmission & Distribution network losses (including commercial) which is around 27%. Can be Mitigated through smart metering, modernization of lines and substations, automation systems
- **Access to energy for the masses:** Rural electrification of 100% households by 2017 by implementing micro-grids, rooftop solar, DER etc.
- **Renewable integration to grid:** Roof top solar, micro-grids, wind energy integration into the grid.
- **Peak load management:** Demand response, Demand Side Management enhancement in energy efficiency etc.
- **System improvements:** Reduction in outages/power cuts, improvements in reliability and quality of supply
- **Customer service:** Improved customer service and **"prosumer"** enablement.

SG Roadmap – Distribution

Ministry of POWER
GOVERNMENT OF INDIA

Example

Availability of an indigenous low cost smart meter by 2014.

Integrated technology trials through a set of smart grid pilot projects by 2015.

Electrification of 100% households by 2017 and continuous improvement in quality and quantum of supply.

Extending fiber link to all the 33/11 kV & above substations to build a backbone comm. network for power sector by 2017.

Reduce AT&C losses to below 15% by 2017, below 12% by 2022, and below 10% by 2027.

Development of Microgrids, EV integration, storage options, solar PV2G and B2G technologies.

Modernization of distribution sub-stations

Policies for mandatory roof top solar power generation for large establishments

Development of Smart Cities

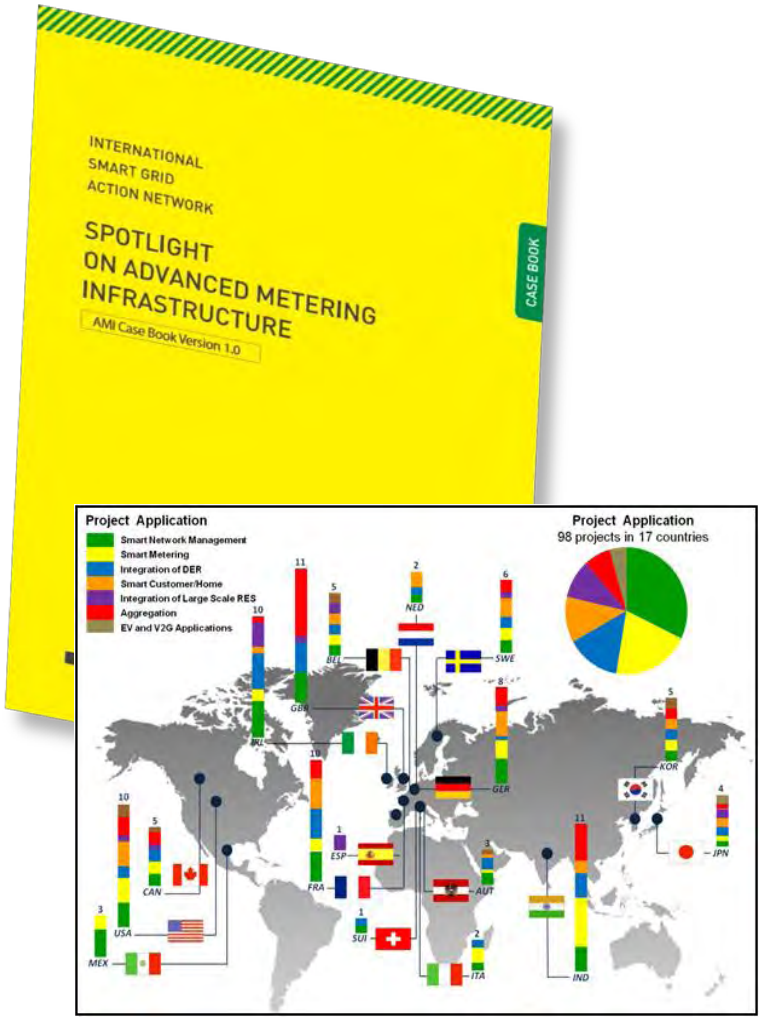
SHARING KNOWLEDGE

ISGAN collects and shares best practices and lessons learned, informing peer-to-peer exchange and contributing to the wider application of smart grid solutions.

- International casebooks on **Advanced Metering Infrastructure** (AMI) and **Demand Side Management (DSM)** identify emerging **best practices**
- **Online database** catalogues **smart grid activities** underway around the world mapped to motivating drivers.

98 projects, 17 countries… so far

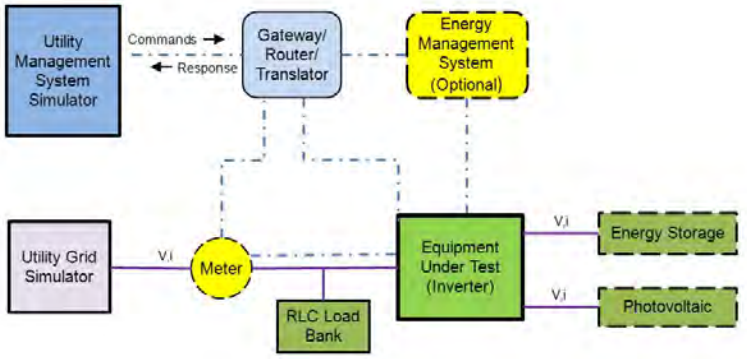
- Frequent **webinars** highlight **lessons learned** in specific projects.



SHARING KNOWLEDGE

ISGAN technical cooperation identifies core transmission and distribution system needs as well as supports joint evaluation of emerging smart grid concepts through a network of test bed and research facilities.

ISGAN Evaluation of Tests for Advanced Inverter Functions



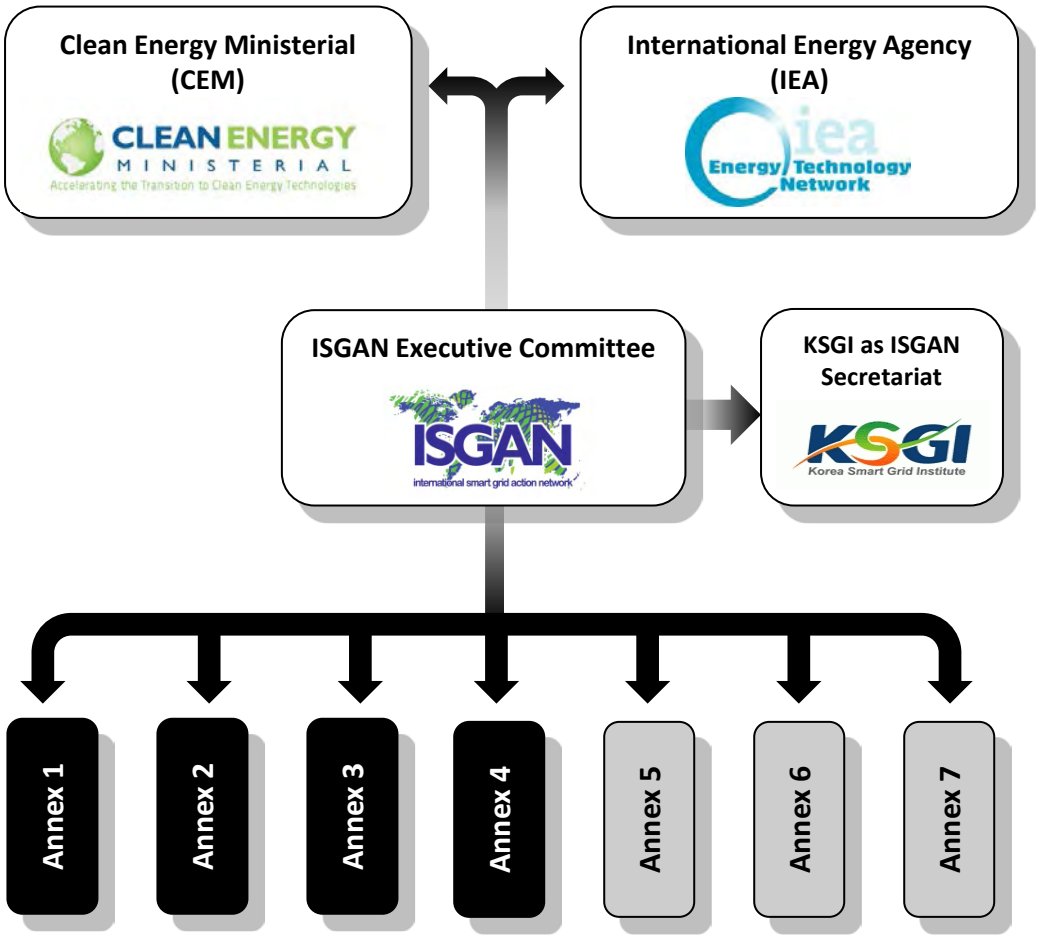
ISGAN recognizes that smart grid is not a single solution; it's a portfolio of tools and technologies.

- Technical activities create a framework for experts to share emerging **best practices**, develop and share new **test methods** and capabilities, and enhance **lab and test bed performance**
- **Joint evaluation** of advanced PV **inverter test protocols** underway

A smart and strong electrical infrastructure contributes to energy, economic and environmental goals.

ISGAN Structure

Organization



- ***Annex 1: Global Smart Grid Inventory***
- ***Annex 2: Smart Grid Case Studies***
- ***Annex 3: Benefit & Cost Analyses And Toolkits***
- ***Annex 4 : Synthesis of Insights for Decision Makers***
- ***Annex 5: Smart Grid International Research Facility Network (SIRFN)***
- ***Annex 6: Power T&D Systems***
- ***Annex 7: Smart Grid Transitions***

WORK PROGRAM

ISGAN

Foundational Projects *(Global Understanding & Tools)*		Technical Projects	Other Projects
Annex 1: **Global Smart Grid Inventory**	Annex 2: **Smart Grid Case Studies**	Annex 5: **Smart Grid International Research Facility Network (SIRFN)**	Annex 7: **Smart Grid Transitions – Institutional Change**
Annex 3: **Benefit-Cost Analyses and Toolkits**	Annex 4: **Synthesis of Insights for Decision Makers****	Annex 6: **Power T&D Systems**	ISGAN **Award of Excellence** **Virtual Training Academy**

***Knowledge sharing by design*

CLEAN ENERGY MINISTERIAL

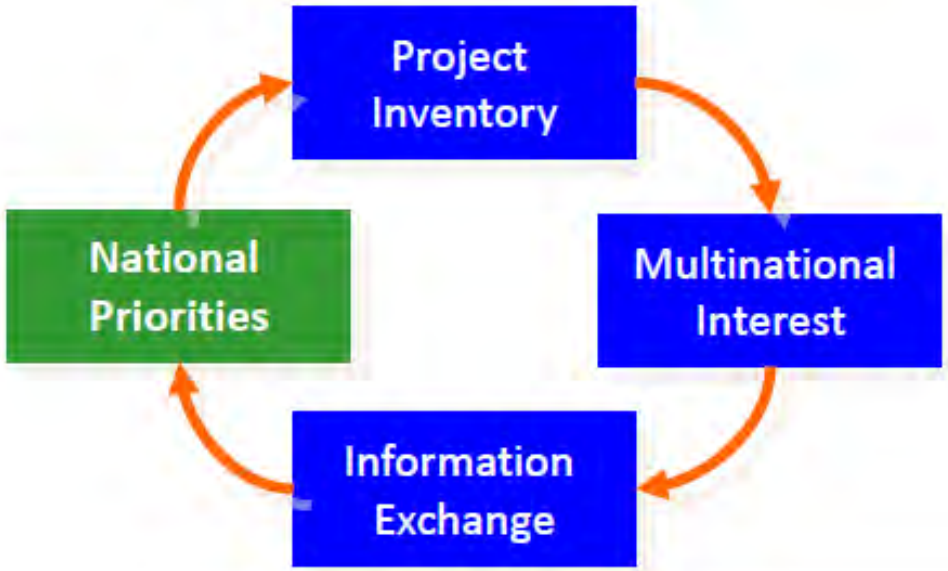
Accelerating the Transition to Clean Energy Technologies

tea Energy Technology Network

Annex 1 – Strategy and Impact

Strategy

Build knowledge bases (SG drivers, technologies, projects) with identified national experts to promote international SG development



Expected Impact

- Learning from lessons learned, best practices, and use/business cases
- Building synergy among smart grid applications internationally
- Avoiding unnecessarily duplicative efforts
- Mining existing projects to identify gaps for international collaboration
- Building communities of smart grid developers, decision makers, and business entities to advance smart grids internationally

Annex 2 - Workstream

- **Task 1: AMI Case Book ver2.0 update**
  - AMI Case Book Ver2.0 was published and delivered to CEM5 last June as Annex 2 deliverables
  - Plans to add more cases, such as Spain, China
  - Moves to online format. Prototype online format (on WordPress platform) is now available for ExCo review

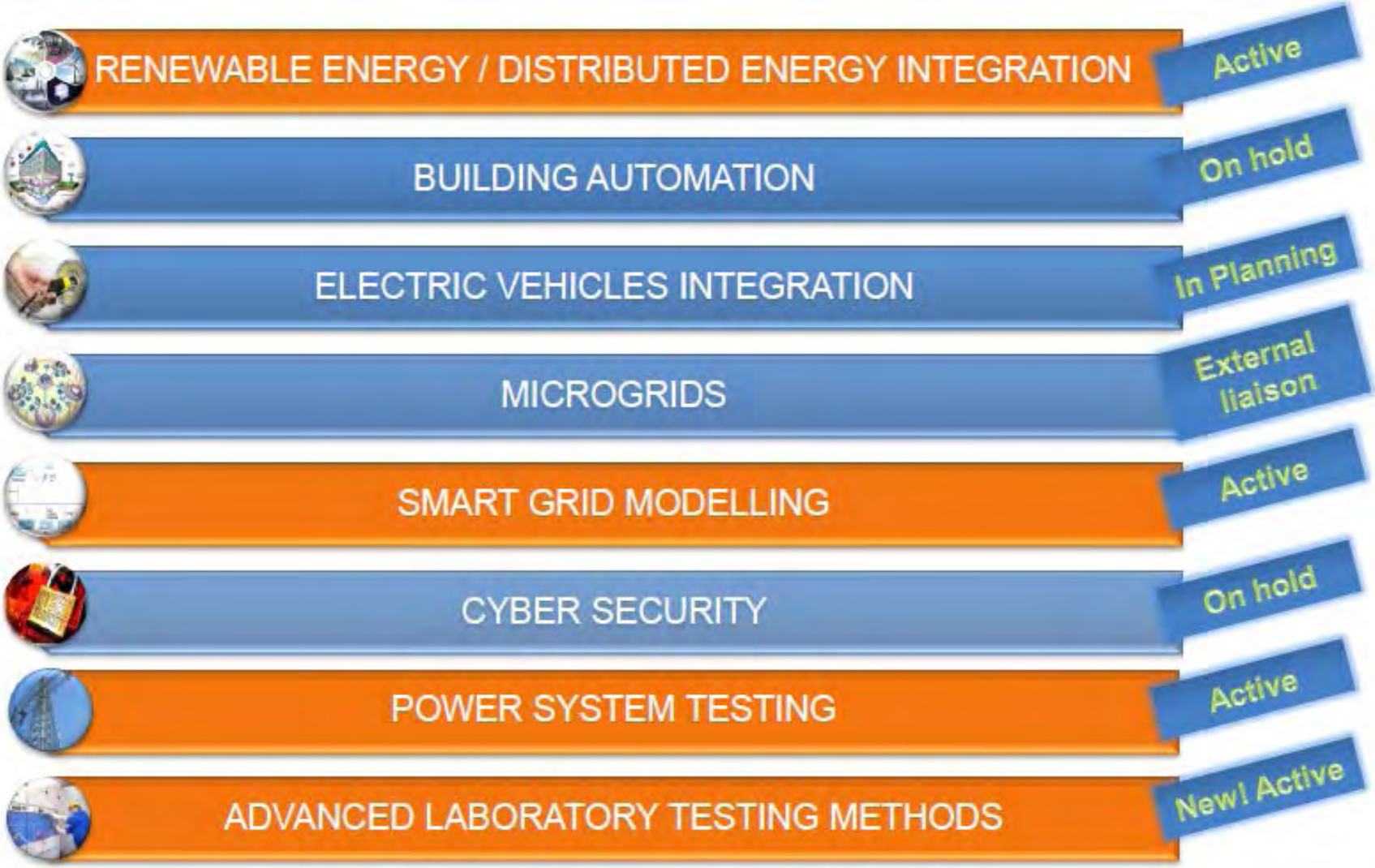
- **Task 2: DSM Case Book ver1.0 update**
  - DSM Case Book Ver1.0 was published and delivered to CEM5 last June as Annex 2 deliverables
  - Plans to add more cases targeting China, Norway, India and Spain
  - Revise Executive Summary to address key topics, themes, takeways, etc.

Annex 2 - Workstream

- **Task 3: Create 'Consumer Engagement & Empowerment' Case Book**
  - Assessment and review of ISGAN Awards of Excellence 2014 Finalists materials
  - Plans to structure a template format
  - Analysis and identify gaps and lessons learned
  - Develop online format Case Book like AMI Case Book
  - Targets to launch in India Smart Grid Forum next March

- **Task 4: Developing summary presentations of case studies ready for outreach**

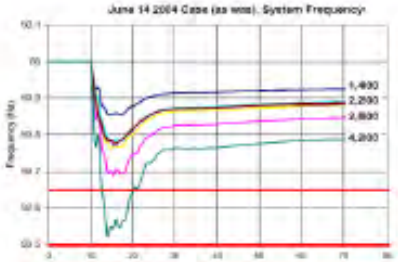
Annex 5- SIRFIN Areas of collaboration



Planned Catalogue

Why Advanced Inverter Functions?

- High intermittent renewable energy penetrations are leading to grid voltage and frequency stability concerns.
- Inverters and power conditioning systems (batteries) have the ability to help stabilize the grid.
  - Techniques for providing these benefits were standardized in IEC Technical Report 61850-90-7.
- Advanced DER functionality and interoperability are required in Europe (Germany, Austria, Italy, etc.) and could be mandated for the investor-owned utilities in California soon.
- Certification laboratories need a new procedure to ensure grid interconnected devices will perform appropriately.
- Sandia National Labs has created the Advanced Interoperability Test Protocols to provided a basis for the UL and other international certification standards.
- SIRFN laboratories are excising the test protocols to verify and improve them.



What are the SIRFN Labs doing?

- Constructing and comparing advanced interoperability test beds
- Testing the advanced functions of multiple PV inverters
- Comparing results, communications methods, and automation procedures.

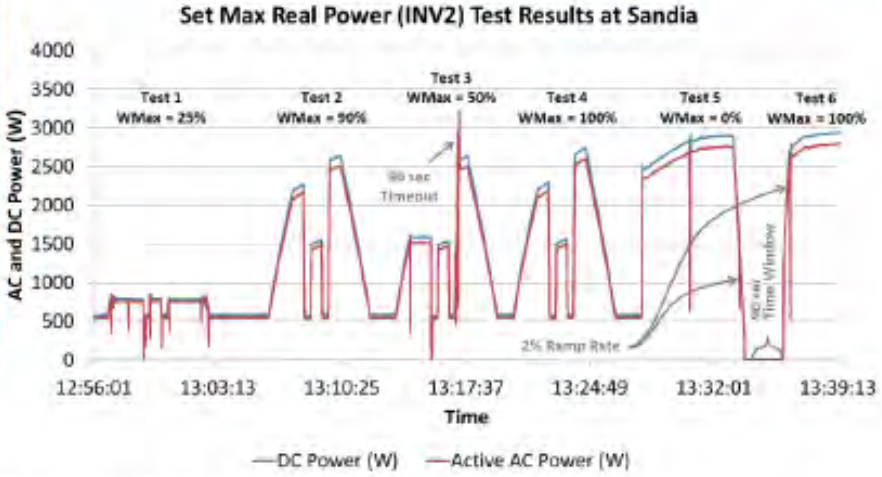
Command	Function
INV1	Connect/Disconnect
INV2	Adjust Max Generation Level
INV3	Adjust Power Factor
INV4	Request Active Power
INV5	PV/Storage Functions
VV11	Volt-Var mode
VV12	Volt-Var mode
VV13	Volt-Var mode
VV14	Volt-Var mode
FW21	Set maximum power output
FW22	Set maximum power output
TV31	Dynamic reactive power support
L/H VRT	Stay connected/disconnect settings
WP41	Power factor settings
WP42	Power factor settings
VW51	Set output to smooth voltage
VW52	Set output to smooth voltage
TMP	Temperature mode behavior
PS	Signal mode behavior
DS91	Modify DER Inverter Settings
DS92	Event/History Logging
DS93	Status Reporting
DS94	Time Synchronization

Implementation Successful

Implementation Partly Successful

Implementation Unsuccessful

Near-term Implementation



Annex 6 - Goals

- Facilitate the use of smarter and stronger power grids given significant trends in the industry (integration of large amounts renewable energy sources, aging infrastructure, integration of information technology systems, etc)
- Condense to conclusions and recommendations for policy makers

The main objective of this Annex is to establish a long term vision for the development of "Smarter and Stronger Power T&D Systems". The Annex shall consist of efforts to improve understanding of Smart Grid technologies applicable to or influencing power system performance, transmission capacities and operating practices; accelerate their development and deployment; and promote adoption of related enabling regulatory and government policies.

From "OBJECTIVES" in the PoW for Annex 6

Annex 6 Workplan

- Publication of an extended Power T&D Case Book;
  - SPOTLIGHT ON STRONG AND SMART POWER in collaboration with GSGF
- Extended work with the discussion paper on T&D Interaction
  - Focusing on regulatory learning
  - Flyer for CEM6
- Two international workshops
  - Together with cooperating organizations
  - Contribution from the common fund for arranging one outside Europe/NA
- Discussion paper on
  - Energy Storage
  - The rapidly expanding power systems in the growing economies
  - Wide Area Monitoring and Control
  - Storage and balancing as key elements for future planning and electricity markets

Danke

für ihre Aufmerksamkeit !

michael.huebner@bmvit.gv.at