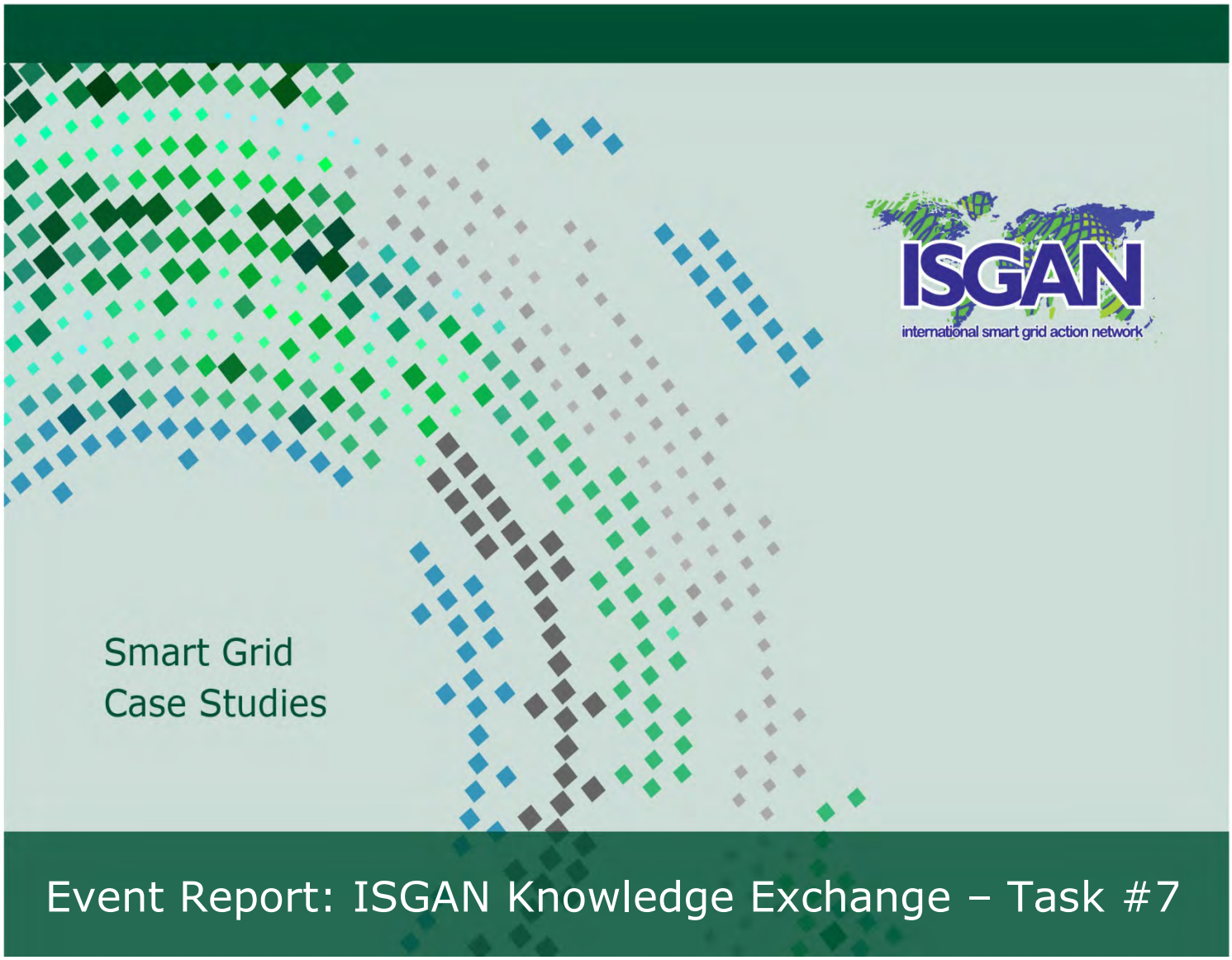

Event Report: ISGAN Knowledge Exchange – Task #7

Executive Summary of ISGAN Knowledge Exchange on Distributed Generation, Microgrids, and Smart Metering in Bengaluru, India 13–15 November 2017

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CLEAN ENERGY MINISTERIAL
Accelerating the Transition to Clean Energy Technologies

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1 Introduction

Smart grid solutions are an enabler for a smarter electrical system supporting more renewables, better quality of service, and prosumer enablement. The International Smart Grid Action Network (ISGAN) creates a mechanism through which stakeholders from around the world can collaborate to accelerate the development and deployment of smarter electric grids.

This report summarizes an international event organized by ISGAN; the National Smart Grid Mission; the Ministry of Power, Government of India; and the Central Power Research Institute, titled "Knowledge Exchange on Distributed Generation, Microgrids, and Smart Metering." This report describes the programme of events and gives a summary of conclusions from an interactive knowledge exchange workshop and public conference that took place 13-15 November 2017 in Bengaluru, India, with 100 participants of which c. 20 international experts.

1.1 Background

1.1.1 *The Theme and Choice of Location for the Event*

The three-day event facilitating dynamic knowledge sharing was organized by ISGAN in collaboration with National Smart Grid Mission; Ministry of Power, India; and the Central Power Research Institute.

The Indian electricity sector has witnessed tremendous growth in its energy demand, generation capacity, and transmission and distribution networks. The Government of India has also set a target of 175 GW renewable power installed capacity by the end of 2022. This includes 60 GW from wind, 100 GW from solar, 10 GW from biomass, and 5 GW from small hydropower. Such ambitious targets regarding addition of renewable capacity not only require advanced technological systems that can aid in efficient integration into the grid, but also the development of a viable ecosystem of capacity, processes, and policies, including those that enable prosumer engagement in "local" grids (i.e., distribution grids that take into account new technologies and business models that provide for two-way energy flows). Utilities will need to transform their business by applying innovative smart metering, microgrids, and distributed generation solutions.

The theme of the event was selected after a survey among Indian stakeholders who recommend a focus on distributed generation, microgrids, and smart metering. The theme was also considered to be of interest for the international smart grid society. Thereby, the three-day event was defined as an international gathering with India chosen as a suitable location due to its progressive development in these areas.

The conference addressed, in particular, two of the primary drivers for broader power system transformation, namely the integration of distributed generation into the distribution system and the improvement of system efficiency and reliability through prosumer empowerment.

The workshop target was to accomplish two goals: 1) between international and Indian stakeholders, share experiences, lessons learned, and emerging best practices for distributed generation, microgrids, and smart metering development; and 2) facilitate an exchange of stakeholder viewpoints regarding the technical, regulatory, and institutional implications in support of the attainment of energy goals.

1.1.2 *Event Organizing Team*

The project organization was carried out in partnership between the following countries and organizations under the auspices of ISGAN programmes:

- India (National Smart Grid Mission; Ministry of Power, India; and the Central Power Research Institute)
- Sweden (Swedish Energy Agency; LightSwitch; and Swedish Energy Institute)
- United States (U.S. Department of Energy and the National Renewable Energy Laboratory)

2 Summary of Events 13-15 November 2017

The three-day event was divided into three parts: (1) a networking site visit and briefing, (2) a public conference, and (3) an interactive knowledge exchange workshop. The ISGAN smart grid experts and practitioners participated, including representatives from Australia, Belgium, Canada, India, Italy, Japan, Mexico, Netherlands, Norway, Russia, South Korea, Sweden and United States.

2.1 Networking site visit and briefing on 13 November

Before arrival, the international participants received reading material about the background and state of play of the Indian electricity system and smart grid strategy.

The event participants visited the Mysore Chamundeshwari Electricity Supply Corporation (CESC Mysore) Smart Grid Project and were given a briefing on deployment of smart grid technologies in India. CESC Mysore has deployed Advanced Metering Infrastructure (AMI) and the pilot project objectives include reduction of aggregated technical and commercial losses, peak load management, outage management, and distribution transformer failure reduction. The pilot project involved 25 000 customers.

The participants also visited a smart grid control centre and conducted a site visit to a Mysore neighbourhood where smart meters and a distribution transformer monitor have been deployed. They were also given a tutorial on a software system the smart grid control centre is piloting for monitoring and managing the distribution system.

Figure 1. Group photo during site visit at Mysore.

2.2 Public conference on 14 November

This one-day forum was set out to accomplish two goals:

1. To share international experience, lessons learned, and emerging best practices for smart grids development with focus on distributed generation, microgrids, and smart metering.
2. To facilitate an exchange of stakeholder knowledge regarding the technical, regulatory, and institutional implications of smart grids in support of distributed generation, microgrids, and smart metering.

Figure 2. Joint Secretary Dr. Arun Kumar Verma during his welcome address at the public conference.

The conference contained brief presentations and panel discussions on best practices for managing smart metering, as well as distributed generation and microgrids, highlighted national experiences and shared key learnings.

The conference discussions covered the following topics:

Smart metering/AMI

- Regulatory perspective for implementing AMI for demand-side management and distributed generation
- Experience of various communication technologies for large scale rollout – interoperability and performance levels
- Steps to mitigate cybersecurity challenges
- Information and communications technology architecture and effective data management to enable multi party analysis
- Data handling in the distribution sector for operational efficiency, planning efficiency, and decision making
- Implementation challenges for AMI success
- Tariff as enabler of AMI/load management and consumer participation

Best practices for managing distributed generation and microgrids

- Role of the distribution system operator for rooftop generation management
- Change in distribution grid protection requirements
    - Voltage regulations – for managing rooftop photovoltaic
    - Limit on capacity allowed per distribution transformer for rooftops
    - Measurement and management of total harmonic distortion
- Standards for grid-connected and hybrid/smart inverters
- Use of household inverter as storage – managing distributed storage
- Tariff structures for managing distributed generation

Figure 3. Dr. Johanna Hoffken (Netherlands) and Brian Spak (Australia) from the final panel discussion.

Dr. Arun Kumar Verma, Joint Secretary, India Government and Dr. Luciano Martini, ISGAN Vice-chair were the distinguished guests. Speakers included:

Brian Spak, Australia
Geert Deconinck, Belgium
Ravi Seethapathy, Canada
Luciano Martini, Italy
Takamasa Murakami, Japan
Junghyo Bae, Korea
Gunbae Park, Korea
Vishal Kapoor, India
Vivek Goel, India
Rahul Tongia, India
Johanna Höffken, Netherlands
Geert Verbong, Netherlands
Kjell Sand, Norway
Arun Kumar Verma, India
S. K. Soonee, India
Kanti Bhuva, India
Arun K. Mishra, India
Magnus Olofsson, Sweden
Johan Söderbom, Sweden
Senja Nordström, Sweden
Rajib Das, India
Rajesh Bansal, India
Shravana Kumar Musunuri, India
Sandip Sinha, India
Emilio Ghiani, Italy
César Angeles Camacho, Mexico
V. S. NandaKumar, India
John Cronin, United Kingdom

Key takeaways from the public conference are:

- Smart metering is an opportunity to minimize non-technical revenue losses.
- The cost of smart metering varies significantly between different countries. This is partly driven by local conditions such as average geographical distance between customers and economies of scale.
- Control of devices at customers dwellings is in many cases best done using direct internet connection and not via metering itself.
- Market conditions is the most demanding issue for the development of smart grids; not easy to adopt one solution directly to different market.
- Users' awareness of flexibility has a strong potential if appropriately remunerated.
- There is need of much more clarity about the new role of the distribution system operator and the development of policies and regulation in medium- and low-voltage distribution systems, so that the new scenario can trigger a concrete development of true smart grids.
- Energy as bulk commodity will be less important in the future when power rather than capacity will be in focus, i.e., access to electric energy in the very moment. Hence flexibility is key.
- Smart Grids in India is about introducing monitoring and control over the grid up to consumer level (mainly to reduce T&D losses and improvise billing efficiency); access to the grid for nearly everyone (including at village level) seems to be eminent India.

2.3 Interactive Knowledge Exchange Workshop on 15 November

2.3.1 *Background*

At the sixth Clean Energy Ministerial (CEM) meeting in Merida, Mexico in May 2015, the ministers issued the Power System Challenge Joint Statement[1], essentially urging the various CEM initiatives (including ISGAN) to explore and deploy more efficient methods for knowledge sharing and dissemination of experience and examples of good practices between countries on matters relating to clean energy.

To put words of the Joint Statement into action, ISGAN Annex 2 took the initiative to create a concept for more deep-dive and interactive dialogue to take place between peers from the policy, academic, and business communities within the ISGAN network. After a successful pilot project in 2016, focusing on Mexico's pathways to implement smart grids, and a consecutive project concentrating on matters related to public funding of smart grid RD&I, the *Knowledge Transfer Project* (KTP) concept has now become an established practice within ISGAN.

The approach emphasizes individual learning and active contribution from all participants in a highly structured workshop format, co-creating concrete results informed by an inter-disciplinary group of people with complementing competences in regard to key smart grid topics. By creating an informal atmosphere for the peer knowledge exchange, participants feel comfortable sharing experiences and lessons learned not only about success stories, but also about challenges and barriers to development.

2.3.2 *Workshop structure*

The workshop was designed to explore key challenges and solutions in regard to how public and private sector stakeholders can best enable smart local (distribution) grids including active prosumers.

Firstly, the participants worked to identify, define and prioritize challenges, taking a *stakeholder perspective*[2]. Secondly, these prioritized challenges were then the focus for international knowledge exchange discussions in smaller groups concentrating on experiences and lessons learned in the various countries represented in the workshop. Finally, based on the new insights from the knowledge exchange, the participants were tasked with generating concrete ideas for solutions and actions that smart grid stakeholders could take to meet the identified challenges.

[1] http://www.cleanenergyministerial.org/Portals/2/pdfs/CEM6-CEMPowerSystemChallenge-JointStatement.pdf
[2] In a complex system, such as the electricity sector, challenges are often shared by many different types of stakeholders (policy makers, utilities, consumers, etc.), however their individual responses to the challenges differ. I.e. to overcome a common sector challenge, different stakeholders need to act in different ways taking into account their respective roles and responsibilities in the sector eco-system.

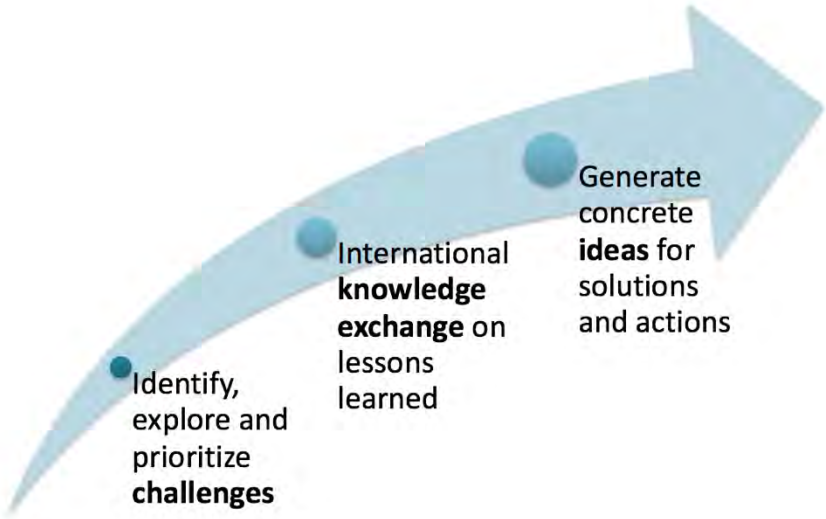

Figure 4. Workshop structure.

Figure 5. Group activity during the workshop.

To encourage open and honest discussion amongst participants, the workshop did not involve any commercial stakeholders; only government and research actors were present and the conversations were conducted under the Chatham House Rule.

Figure 6. Group work during the workshop.

2.3.3 *Workshop Results*

In the first part of the workshop, 31 “challenge statements” were formulated, covering a wide spectrum of challenges associated with the transition to smarter local grids. Below are some examples:

- Power distribution companies (DISCOMs) need policies in place for framing the regulation to promote smart grids.
- Innovations are needed in sustainable business design on technology in order to get aggregators online and to allow consumers to offer their flexibility (load and generation) to the market (DISCOM).
- Utilities need to ensure interoperability because of existing legacy technology in the grid and lack of standardisation of new smart devices.
- Utilities needs certified vendors because competent vendors are rare and the technology is still not mature.
- System integrators need to ensure interoperability of interconnected devices from consumer premises up to control centre.

- Utilities need a separate cyber security cell for threat management, data protection and privacy.
- Prosumers want solutions to sell retail power in their neighbourhoods.
- Utilities need to reorganize existing capacity and build new capacity to handle the smart grid.
- Grid expansion without the right enabling environment presents risks for investors and consumers/prosumers.

Based on the results of the morning group work, the international knowledge exchange discussion came to focus on the following main themes:

1. Business models
2. Regulation
3. Interoperability and standardization
4. Capacity, skills and tools
5. Consumer engagement

Inspired by the challenge statements formulated during the morning session, and informed by the international knowledge exchange discussion, a total of 62 solutions and/or calls to actions were formulated by the participants in the final part of the workshop. Below are some examples:

- Communication technology should be standardized based on important geographic/climatic conditions and feasibility to match utilities' needs.
- Industry and utility associations should design and implement a certification scheme to identify qualified smart grid technology providers.
- Governments need to allow regulations that enable utilities to recover risk premiums for new, disruptive innovative solutions that address defined goals for smart grids.
- To keep costs and tariffs down, utilities need to devise methods for providing ancillary services and cost optimization. In this context, regulators need to allow implementation of innovative pricing mechanisms to make for viable business models.
- Policy-makers should set up groups of experts to define grid codes to incentivise smart grid deployment.
- Research centres should implement smart grid related courses to develop skilled human resources for planning and operation of smart grids and to develop applications and innovative tools that can accelerate deployment.

- Utilities need to develop cyber security cells/functions in the organization.
- To ensure accuracy and correct decisions, utilities need to have a data log of various connected end points for at least 2-3 years before developing analytics for load forecasting and other grid management tools.
- Utilities need to identify interoperability requirements, and evaluate and adopt standardization architecture with open technologies to address interoperability between legacy and new devices.
- To ensure interoperability, utilities should carry out end-to-end listing of requirements – data validation is the solution.
- Utilities need to keep minimum specifications to vendors generic and use updated specifications as projects progress. And, specifications should be flexible to be implementable within time frame provided by vendors.
- Utilities should procure devices on mass scale to drop down the cost to a reasonable level.
- Utilities should insist on Device Language Message Secification (DLMS)[3] compliance of all equipment and use communication services from a service provider as operational expenditures (OPEX) to overcome the challenge of interoperability.
- Since some technologies are not yet mature and standards are not fully in place, utilities should put stringent payment clauses in contracts to ensure vendor completes the project.
- Utilities should implement a human resources skills roadmap for initiating requisite digital, information technology, and power system skills upgrade in field operations and substation operation/maintenance activities.
- Government should support the SME sectors' innovation activities in smart grid products/services.
- Policy-makers should take demonstration projects one step further into business models by relaxing regulations and legal requirements in test areas.

[3] "Device Language Message specification" is a generalized concept for abstract modelling of communication entities.

Key takeaway points from the workshop are:

1. Incentives for investment in early smart grid technology and research and development should be considered in regulation design.
3. Regulation is key to make smart grid developments going – incentives must be there.
4. Depreciation is much faster on smart grid devices and thus this should be considered in regulation for network companies.
5. Utilities require business models based on public and private partnership which are viable and sustainable and provide reasonable profit to the investors as value to the end consumers.
6. There is a need for efficient load management and forecasting tools due to the ever-increasing penetration of renewable energy generation.
7. Priority areas for skill management & capacity building of utility officials should be identified and prioritized and continuously improved upon in the areas of smart grid technologies as well as those related to data privacy, cyber security etc., through international collaboration.
8. Smart devices are to be standardized to ensure interfacing among consumer/prosumer technologies.
9. Communication technologies should be selected depending on geographical location, speed required, actual topology, and economic & climatic conditions.

3 Conclusion

Both formal and informal feedback suggested the three-day event was successful at enabling constructive conversation across international and Indian energy institutions on the selected theme. The events also provided a meaningful forum for exchanging best practices on identifying and implementing smart grid projects from several country perspectives, including those of the public, private, and academic sectors. A feedback form was circulated after the interactive workshop with an overall score of 4.5 on a 1-5 scale. Qualitative feedback was generally also very positive.

4 Contact

If you are interested in learning more about the ISGAN Knowledge Transfer Project or being involved in future events, please contact:

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