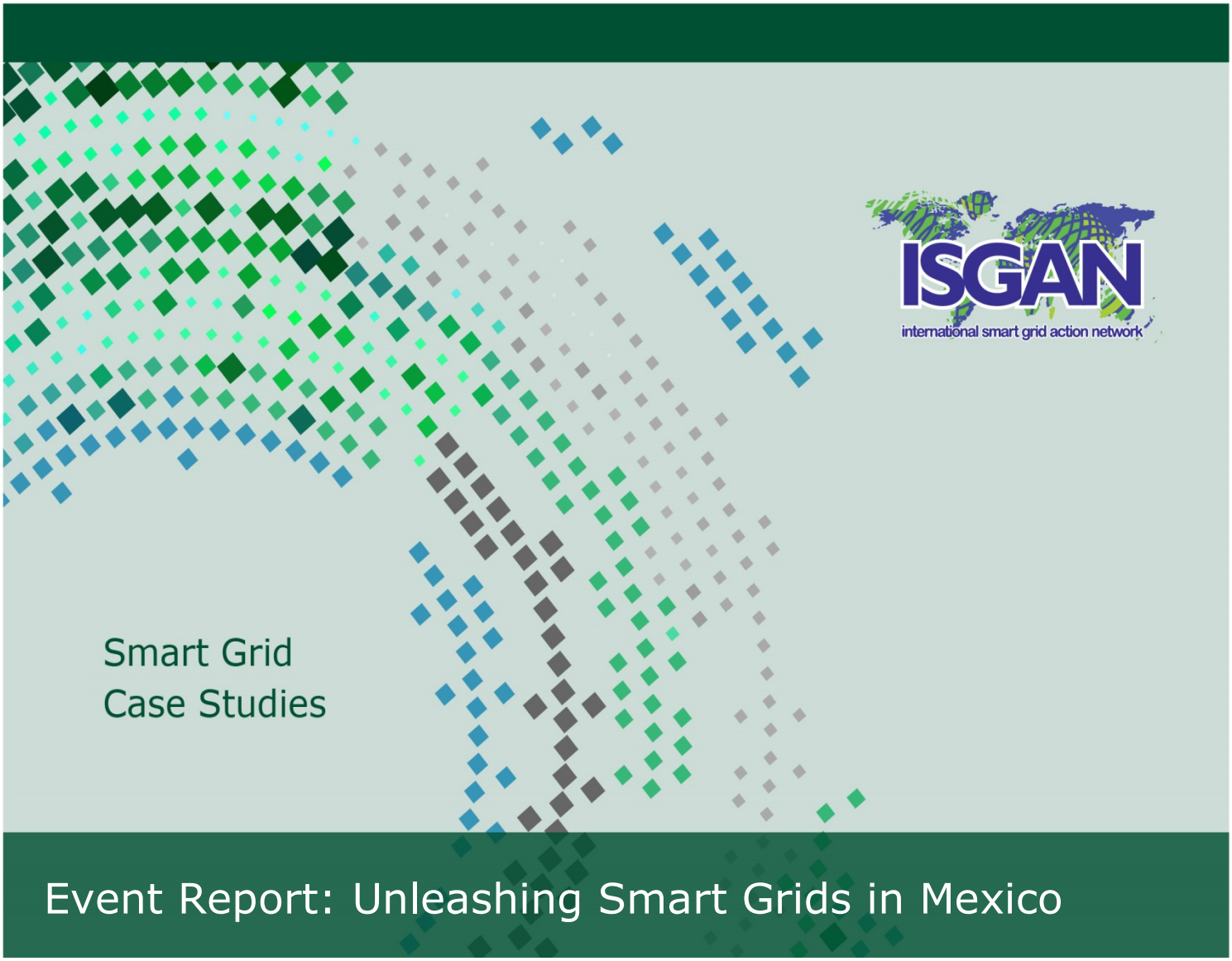

Event Report: Unleashing Smart Grids in Mexico

Executive Summary of Smart Grid Events in Mexico City 17–19 August 2016

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ISGAN Annex 2

Task #7

CLEAN ENERGY MINISTERIAL
Accelerating the Transition to Clean Energy Technologies

iea Energy Technology Network

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1 Introduction

The purpose of this report is to give an account of a collaborative International Smart Grid Action Network (ISGAN) and the 21st Century Power Partnership (21CPP) project focusing on Mexico's path towards smart grids and grid modernization. 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 17–19 August 2016 in Mexico City.

1.1 Background

1.1.1 *The Mexican Energy Transition*

Mexico has embarked on a once-in-a-lifetime transition of its power system. Building on a foundation of transformative legislation and regulatory reform, Mexico is introducing strong market forces to the system, improving the efficiency, reliability, and rational management of its electricity grid. Simultaneously, Mexico is rapidly increasing the integrated share of variable renewable and distributed energy resources—with the objective to do this affordably. Mexico is now pursuing the deployment of advanced energy, information, sensor, communications, and control technologies, collectively labeled "Smart Grids" or "Redes Eléctricas Inteligentes."

The Energy Transition Legislation (LTE) in Mexico became effective on 28 December 2015. The LTE replaces major sections of prior energy law and creates new clean energy standards. The LTE mandates the following:

> *Article 37: The Smart Grid program aims to support the modernization of the National Transmission Network and General Distribution Networks, to maintain a reliable and secure grid infrastructure to meet electricity demand in an economically efficient and sustainable manner. The smart Grid program should also facilitate the incorporation of new technologies to achieve electricity cost reductions, the provision of additional services through the electric network, and promotion of Clean Energy and Clean Distributed Generation by allowing greater interaction between end user devices and the electrical system.*
>
> *Article 38: The Smart Grid Program shall identify, evaluate, design, establish and implement strategies, actions and projects related to the electricity grid*

The LTE also stipulates that the resulting development programmes for smart grid solutions and technologies must take into account experiences and lessons learned from deployment in other countries.

To ensure that the deployment of smart grids in Mexico is effective and cost-efficient, the Secretaría de Energía/the Ministry of Energy (SENER) and other participants in the interagency

Comité Consultivo de Redes Eléctricas Inteligentes (Consultative Council for Smart Grids) are working to develop the knowledge, tools, and guidelines needed to evaluate the value and impact of smart grid technologies and approaches. Therefore, SENER, with the support from 21st Century Power Partnership (21CPP) and ISGAN, is currently writing a report[1] analyzing how international experience with smart grid solutions could be incorporated and applied in Mexico. An important objective of the activities of 17–19 August was to further promote the sharing of knowledge and lessons learned between Mexican and international peers from the ISGAN network around issues relating to smart grid technologies and solutions.

1.1.2 *ISGAN Annex 2 Knowledge Exchange Pilot*

At the sixth Clean Energy Ministerial (CEM) meeting in Merida, Mexico in May 2015, the ministers issued the *Power System Challenge* Joint Statement,[2] essentially urging the various CEM initiatives (including 21CPP and 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.

Against this backdrop, ISGAN Annex 2 started planning to put the words of the Joint Statement into concrete action. At the ISGAN Executive Committee meeting (ExCo 11) in March 2015 in Yokohama, Japan, the Executive Committee approved ISGAN Annex 2 to carry out a pilot project to introduce a method for interactive international knowledge transfer between peers in the ISGAN network. Sweden took the responsibility for leading this Task (#7) in the framework of Annex 2. Given the scale and pace of smart grid development in Mexico, the technical assistance work already underway with support from 21CPP, and the interest shown by SENER, ISGAN Annex 2 decided that the first knowledge transfer pilot would focus on the knowledge needs of Mexico.

Annex 4 provided support in development of this workshop, including working with the organizing team on the strategic approach, developing workshop materials (including logistical items as well as a summary article that is forthcoming), and identifying ways in which the Ask an Expert service can provide ongoing support to the knowledge exchange pilot.

1.1.3 *Event Organizers*

The project was carried out in partnership between the following countries and organizations under the auspices of the Clean Energy Ministerial's 21st Century Power Partnership and the International Smart Grid Action Network programmes:

- Mexico (SENER)
- Sweden (Swedish Energy Agency, LightSwitch, and Swedish Energy Institute)
- United States (U.S. Department of Energy and the National Renewable Energy Laboratory)

[1] The report's main author is Ron Binz, moderator for the International Knowledge Exchange Workshop and involved in the organization of the Mexico-ISGAN-21CPP activities.
[2] http://www.cleanenergyministerial.org/Portals/2/pdfs/CEM6-CEMPowerSystemChallenge-JointStatement.pdf

2 Summary of Events 17-19 August – Unleashing Smart Grids in Mexico

The package of events was divided into three parts: (1) A preparatory meeting, (2) an interactive knowledge exchange workshop, and (3) a public conference. The ISGAN smart grid experts and practitioners, including representatives from the United States, Sweden, Canada, Korea, and Spain, participated in all three parts.

2.1 Preparatory Meeting for International Participants and SENER, 17 August

Before arrival, the international participants received reading material about the background and state of play of the Mexican grid modernization process. The Preparatory Meeting, hosted by SENER, was arranged to provide the international participants with an opportunity to ask questions and get a good understanding of the context and key issues ahead of their in-depth discussion with their Mexican peers the following day.

2.2 Interactive Knowledge Exchange Workshop, 18 August

The interactive knowledge exchange workshop was the core activity related to the ISGAN Annex 2 pilot project mentioned above. The workshop was designed to encourage interaction and learning for all participants. It was the first meeting of its kind in which the key Mexican stakeholders tasked with managing the transition of the power sector, as envisaged in the Programa de Desarollo del Sistema Eléctrico (PRODESEN), were brought together for an in-depth dialogue with international peers with valuable smart grid development experience.

Through structured and facilitated dialogue, the workshop promoted the sharing of lessons learned in other ISGAN countries regarding pathways and technologies for grid modernization.

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. On the Mexican side the following institutions were represented:

- Secretaría de Energía (SENER): The Mexican Ministry of Energy, responsible for issuing the Mexican energy policy.
- Comisión Federal de Electricidad (CFE): The state-owned utility active in generation, transmission, and distribution of electricity.
- Comisión Reguladora de Energía (CRE): The Mexican energy regulatory body.
- Centro Nacional de Control de Energía (CENACE): the autonomous government grid operator responsible for planning and operation of the wholesale electricity market and maintaining reliability.
- Centro Nacional de Metrología (CENAM): The national meterological agency working with development of standards, etc.
- Universidad Nacional Autónoma de México (UNAM): The National Autonomous University of Mexico.

2.2.1 *Workshop Objectives and Structure*

The workshop set out to achieve the following objectives:

- Encourage open and informal dialogue between Mexican stakeholders and international peers about lessons learned from grid modernization in other ISGAN countries.
- Promote cross-organizational dialogue and the formation of a common long-term vision for the Mexican institutions involved in the grid modernization process, inspired by experiences and results achieved in other countries.
- Create a forum for interactive learning where all participants could genuinely contribute to, and benefit from, the collective thinking process focused on the development of smart grids in Mexico.

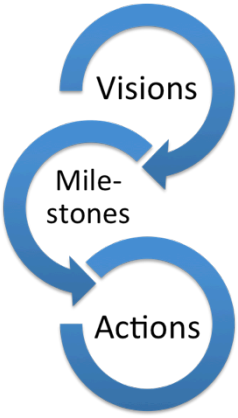
To achieve these objectives, the workshop design was inspired by backcasting.[3] To encourage closer dialogue between the different stakeholders the starting point for the dialogue was the societal perspective rather than the needs of the respective organizations.

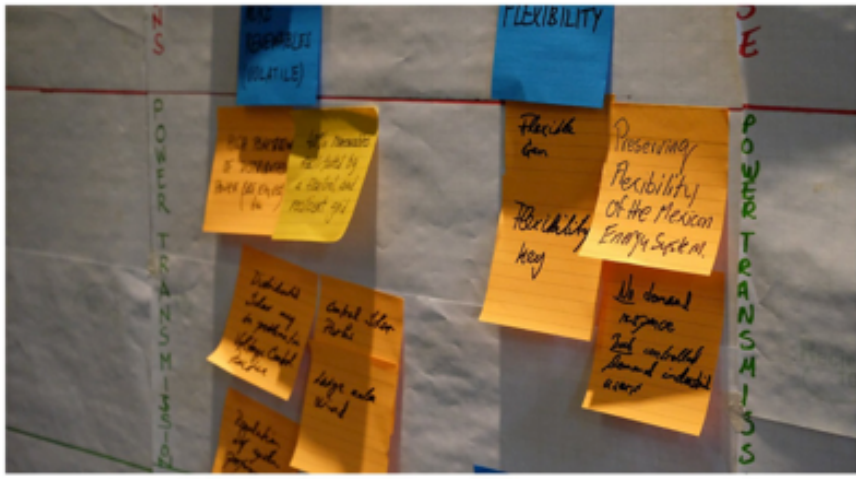
Discussions and idea generation took place in five smaller groups (where the participants were mixed from different organizations in Mexico as well as international representatives) as well as in moderated[4] *in plenum* discussions.

[3] Backcasting is a method in which the future desired conditions are envisioned and steps are then defined to attain those conditions, rather than taking steps that are merely a continuation of present methods extrapolated into the future. (http://journals.sfu.ca/int_assess/index.php/iaj/article/viewFile/253/225).

[4] Workshop moderator was Ron Binz, main author of the Smart Grid Report mandated by the Mexican Energy Law (to inform the development of the Mexican Smart Grid Programme).

An important aspect of the workshop was the role of the international participants. Because the focus of the workshop was on the needs of Mexico, the international experts were instructed to help customize the experience and learning from their respective countries to what they deemed to be relevant for their Mexican peers.





The workshop was structured into three inter-related exercises:

1. Vision 2030: Based on the intent and context of the Energy Transition Legislation the participants were asked to explore, imagine, and describe the desired characteristics of the electric power system of 2030. "What does the smart grid look like in 2030?" and "What expectations do Mexican society and the users have for the grid?"

2. Milestones: Participants were asked to generate ideas for milestones that must be met to achieve the desired characteristics of the 2030 power system vision (i.e., the result of the "Vision 2030"exercise). To help structure the dialogue, the milestones were placed on a large 2017–2030 timeline spanning one of the walls of the room and categorized according to the following themes: market design, demand response, power transmission, power distribution, and "other."

3. Actions and roles: Having painted a picture of some major milestones that must be achieved from the present day to 2030, the participants were asked to identify concrete actions (defined in the previous exercise) and suggest which stakeholders should contribute or be responsible for them to happen.

The final part of the workshop consisted of a moderated "Questions & Answers" session in which the Mexican participants were invited to ask questions to the international participants about experiences of smart grid related issues in the United States, Canada, Sweden, Spain, and South Korea.

2.2.2 *Workshop Results*

Step 1: Vision 2030

Visions for year 2030 were derived based on roundtable discussions. Here, the term vision is defined as desired and achievable targets. Several tentative visions were identified. It should be noted that these ideas were identified during multilateral discussions within a short timeframe. Naturally, the work to form a solid and well-anchored vision for Mexico must continue and involve stakeholders at more levels of the Mexican institutions present at the workshop. The workshop results summarized below should hence be considered in this light.

The following tentative visions were identified:

1. Customers – empowering consumers by focusing on the value being provided and the relationship with the consumer
2. More renewables – adequately managing variability.
3. Flexibility – using demand response including storage and flexible generation.
4. Regulation & market – keeping the grid market competitive for users based on effective regulation and accommodating future needs of stakeholders.
5. Energy security – interconnecting the Mexican grid to regional grids and while enabling self-sufficient generation within the Mexican system.
6. Reliability and loss reduction – developing adequate grid codes, advancing monitoring and control, and mitigating technical and operational losses.

Step 2: Milestones

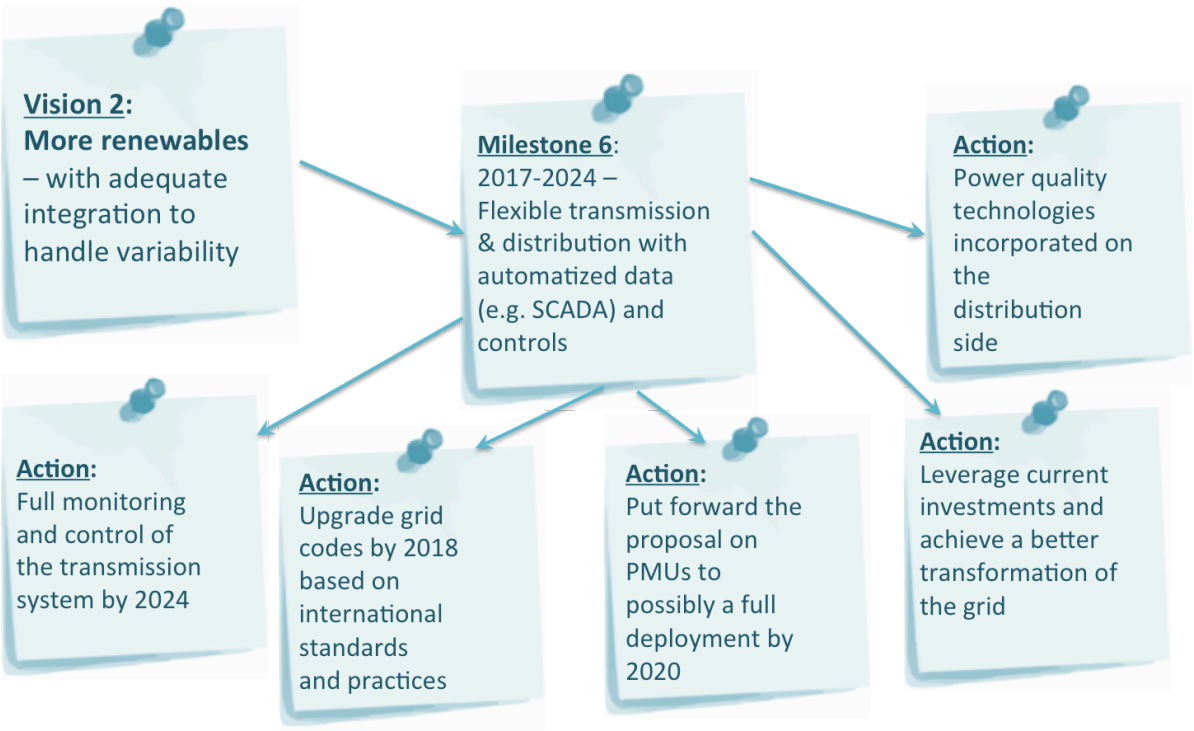
Based on the result of the vision exercise, the roundtable discussions focused on milestones. The following milestones along the route to year 2030 were identified:

1. 2018 – Complete demand characterization; Design a market for demand response.
2. 2018 – Create a national center of excellence on renewable energy integration.
3. 2018−2022 – Address nontechnical losses through regulations.
4. 2016–2030 – Continue developing and improving customer information programmes, policies, and data to support real-time decisions.
5. 2017–2024 – Automate flexible transmission and distribution with data (e.g., SCADA[5]) and controls.
6. 2020–2027 – Deploy smart meters and receive data.
7. 2030 – Consider volatile characteristics when integrating renewable energy.

[5] Supervisory Control and Data Aquisition

Step 3: Actions and Roles

The final task was to identify actions in line with the milestones and visions. An example of a group of actions with link to a milestone and vision is presented below.



Key takeaway points from the workshop are:

1. Find means to reduce non-technical and technical network losses.
2. Optimize introduction of smart meters in customer segments and phased implementation.
3. Define adequate grid codes and standards.
4. Understand where and what type of new generation will be added.
5. Assess future energy security needs in relation to a grid development plan.
6. Keep network power competitive to avoid grid defection and achieve goal of power to all.

2.3 Unleashing Smart Grids in Mexico Public Conference, 19 August

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

1. To share international experience, lessons learned, and emerging best practices for smart grids development with Mexican stakeholders
2. To facilitate an exchange of stakeholder viewpoints regarding the technical, regulatory, and institutional implications of smart grids in support of the attainment of Mexico's vision for its energy transition.

The forum addressed, in particular, two of the primary drivers for broader power system transformation in Mexico, namely the integration of clean energy into the electricity system and the improvement of system efficiency and reliability.

The conference was a public event that brought together the private sector, public sector, and academia to share their ideas for Mexico and smart grid deployment experiences primarily through panel discussions along with a few brief presentations. Panel discussions included those on "Smart Grids to Support Clean Energy Integration;" "Smart Grids for Reliable, Efficient Electricity;" and "Making Smart Grids Work for Mexico."

Speakers included:

- Efraín Villanueva Arcos (Secretaría de Energía)
- Hector Artze (Navigant)
- Sara Bargi (Swedish Energy Agency)
- Ron Binz (Public Policy Consulting)
- Edmundo Gil Borja (Secretaría de Energía)

- Ricardo Bracho (National Renewable Energy Laboratory)
- César Ángeles Camacho (Instituto de Ingeniería, UNAM)
- Gustavo Villa Carapia (Centro Nacional de Control de Energía)
- Manuel Romero Castellanos (Comisión Federal de Electricidad)
- Michael Coddington (National Renewable Energy Laboratory)
- Russ Conklin (U.S. Department of Energy)
- Salvador Acha Daza (Centro Nacional de Control de Energía)
- Sergio Alejandro Peraza García (Comisión Reguladora de Energía)
- Chris Irwin (U.S. Department of Energy)
- Prithpal Khajuria (Intel)
- Jeffrey M. Lines (AutoGrid)
- Bo Normark (Royal Swedish Academy of Engineering Sciences)
- César Emiliano Hernández Ochoa (Secretaría de Energía)
- Magnus Olofsson (Swedish Energy Institute)
- David Owens (Edison Electric Institute)
- Jeff Thomas Pavlovic (Secretaría de Energía)
- Asoos Rasool (Mälarenergi, Swedish Distribution System Operator)
- Kenneth Schisler (EnerNOC, Inc.)
- Kevin Schneider (Pacific Northwest National Laboratory)
- Johan Söderbom (Technical Research Institute of Sweden)
- Karin Widegren (Swedish Energy Markets Inspectorate)

Distinguished guests included César Emiliano Hernández Ochoa – Undersecretary of Electricity, Secretaría de Energía, who provided a brief overview of Mexico's smart grid legal context and David K. Owens, the Executive Vice President, Business Operations Group and Regulatory Affairs, Edison Electric Institute on modalities for grid modernization, compensation models, and key considerations for smart grid service markets.

The key takeaways from the public conference are:

- Mexico already has a functioning grid in most parts of the country. What needs to happen now is to automate the grid, include new energy resources, and foster the adoption of renewable energy.
- The needs to increase flexibility, resilience, and reliability in the grid are focused on providing satisfaction via new services such as demand response, new billing services, and tariffs. Building a real-time information platform can help with achieving flexibility.
- Mexico seeks to increase the penetration of renewable energy without affecting supply and distribution of electricity. This could be done by promoting incentives to increase distributed generation and through the automation of the grid. New and more advanced information software can be a helpful tool to provide real-time information and address the technical requirements of the system.
- There is a need to manage voltage conditions, mainly at the end of the electric lines, and through the adoption of renewable energy and storage systems in areas that require more stability.
- Those responsible for the Mexico electricity system seek to increase and develop the participation of different smart grid actors. This includes the adoption of investigation centers for renewable energy research and development; increasing cooperation with other counties; and promotion of interconnection with neighboring countries.
- There is interest in increasing smart meter adoption and developing economic considerations to encourage more distributed generation. This can also foster the decarbonization of the electricity grid by reducing centralized generation through fossil fuels.
- Mexico seeks to reduce technical and nontechnical losses by addressing the robbery of electricity and losses produced by over congestion of the distribution and transmission lines.
- There is a need to enable forecasting accuracy for the integration of solar and wind technologies into the grid.
- The Mexican government (Ministry of Economy) and industry can jointly develop standards in order to achieve incentives and technological development.
- Mexico can learn from the lessons learned in other countries: the opportunity presented by the reformulation of the electricity sector after the Energy Reform of 2013, opens the path for a Smart Grid development that avoids the mistakes from other countries. Although there is no one-size-fits-all solution, lessons learned are fundamental for smart grid development.
- The main drivers of the smart grid development in Mexico are customer satisfaction; empowerment and reliability of the system operator; a coherent and adequate separation of the tasks of CFE; reduction of technical and nontechnical losses; a coherent vision of what the smart grid must look like in the future; an adequate regulatory framework to address the roles of the participants in the market; and increasing participation of renewable energy.

3 Conclusion

Both formal and informal feedback suggested the events were successful at enabling constructive conversation across Mexico energy institutions about how to envision and plan for a smarter grid. 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.

Near-term next steps for ISGAN's and 21CPP's collaboration with Mexico include development of the smart grid report on analyzing how international experience with smart grid solutions could be incorporated and applied in Mexico. SENER has also agreed to participate in ISGAN's Annex 2 on Case Studies and perhaps there is an opportunity to develop a case study on the Mexico electricity sector context and initial lessons in smart grid deployment. ISGAN can also provide some ongoing support through peer exchanges between Mexico energy institutions (e.g., SENER, CRE, CFE, and CENACE) and national experts within the ISGAN community to exchange ideas on approaches and experiences with instilling smart grid operational practices and technologies via ad hoc phone calls, webinars, and email exchanges.

ISGAN Annex 2 will discuss the outcomes from this event with the ISGAN Executive Committee at the 12th semi-annual meeting taking place in October, 2016, in Paris, France. Annex 2 will seek guidance from the ExCo and gauge interest from Annex 2 participants on the potential for conducting similar knowledge exchange events with other countries as well as the possibility of doing a follow-on event with Mexico.