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The Context of the Grid Edge Transformation

What is the grid edge transformation?
The electricity system is a prime example of the impact of the Fourth Industrial Revolution, becoming more complex, with rapidly evolving technologies, innovative business models emerging and shifting regulatory landscapes. The so-called grid edge transformation is taking the form of three trends, driven by the introduction of new (grid edge) technologies:

1. Electrification of certain energy uses, such as light transportation driven by the advent of electric vehicles, and heating
2. Decentralization of the system's active resources, with increasing penetration of distributed energy resources like distributed storage, distributed generation and energy management systems
3. Digitalization driven by the advent of the internet of things and power-consuming connected devices, smart metering and other digital electricity network technologies (automation, remote control, smart sensors)

What benefits can this transformation bring to the industry and broader society?
The three trends act in a virtuous cycle, enabling, amplifying and reinforcing developments beyond their individual contributions. They can help to build a better, more resilient, secure, sustainable and efficient electricity system, also creating new services for customers and new jobs:

- With the system becoming fully digitalized, operations can be fully automated and capable of managing and exploiting the new flexible and mobile resources, such as distributed renewable generation or electric vehicles
- Customers will be able to select the distributed energy technologies of their choice, connect them to the centralized grid and even transact electricity and related services with other distributed and centralized resources with real-time interactions
- The role of the electricity network evolves beyond supplying electricity, becoming a platform that exploits and maximizes the value of distributed energy resources and the economic potential of retail services

The World Economic Forum has identified that, over the next 10 years, the transformation of the electricity system can unlock more than $3 trillion of value for industry and for society by reducing carbon emissions, increasing the efficiency of infrastructure, creating jobs and increasing options to consumers.

Why are grid edge technologies expected to become highly relevant?
The potential of grid edge technologies is fuelled by three elements:

- Cost is exponentially decreasing
- Innovative business models are emerging, built around empowered customers
- Significant improvement to the electricity system utilization rate – currently usually lower than 60% – by reducing peak demand, shifting and flattening the load profile

Grid edge technologies will likely follow an adoption rate (S-curve) similar to other innovative products in the past; after initial linear progression, adoption will grow exponentially.

How to take advantage of this transformation?
The World Economic Forum has gathered and analysed practical examples and best practices of grid edge innovations from mature electricity markets worldwide, with the objective of providing an Actionable Framework that will support various other geographies in making an effective transition to the new electricity system, unlocking the value of grid edge technologies. This framework addresses four main areas relevant to the transformation: redesigning the regulatory paradigm; deploying the enabling infrastructure; redefining the customer experience; and embracing new business models.

First Colombia Grid Edge Transformation Workshop – Summary of the Discussion

The workshop gathered the highest representatives of the public and private electricity sector to discuss the grid edge transformation and the opportunities for Colombia, and eventually define a roadmap for cooperation during 2017.

Relevant themes for Colombia

Four big themes emerged as relevant for Colombia:

1. Accelerating the adoption of demand-side management and distributed generation, particularly increasing speed of penetration of smart metering
2. Define specific actions to drive consumer involvement, particularly on clear information and price signals that will clearly show the benefits in the adoption of new edge technologies
3. Drive (segmented) action to increase speed of electrification of transport
4. Innovate around business models and interactions across industry players

For Colombia, the opportunity from grid edge technologies lies mostly in accelerating the progress along the lines already laid out in "Colombia Inteligente" and the "Smart Grids Colombia Visión 2030" developed by UPME (Unidad de Planeación Minero Energética). Some elements of that programme are working well and should serve as the basis for a common understanding of future action. Notwithstanding that, complementary ideas emerged from the workshop:

- The public and private sectors need to align on priorities for action.
- Action – in terms of new policy or new public-private partnerships – needs acceleration, especially to keep up the pace of the rapidly evolving technological landscape and around four main themes (smart metering and distributed resources, customer engagement, electrification of transport, new business models)
- The Actionable Framework developed by the World Economic Forum can support public and private stakeholders to converge on the main strategic lines for action.

Why is the grid edge transformation relevant to Colombia?

Colombia is well-positioned among other non-OECD countries in terms of:

- Current organization of the electricity sector, with well-established independent entities in charge of planning and regulation, UPME and CREG (Comisión de Regulación de Energía y Gas), as well as strong electric corporations in the private sector in charge of infrastructure and service
- Relevance of grid edge technologies to solve current challenges in a cost- and time-effective manner, preparing the path for the future electricity system
- Overall development of the energy system (Colombia is ranked eighth out of 126 countries in the World Economic Forum Global Energy Architecture Performance Index 2016)

Context elements to consider

The working group should consider the following:

- The Colombian electricity system has a very low load factor.
- Colombia is a large country and the status and opportunities of the electric sector vary by region.
- Colombia has already started on the road towards smart grid/digital technologies.

Suggested next steps and approach

- Creation of a Working Group as the vehicle for delivering the expectations set by the stakeholders
- In-depth working session in early 2017 to establish the common starting point (leverage the existing base of work) and the plan and agenda for the theme-based working streams
- Continued strong leadership by the Ministry of Energy and Mines is critical for the success of the Working Group, as well as a multistakeholder approach to incorporate different actors from the electricity ecosystem
- Focused approach, with a clear deadline and a limited number of topics
- Use of "design thinking" as a development method to keep action innovative and to the point
- Process will need a high level of coordination and "drum-beating"

Colombia Grid Edge Transformation Working Group –Terms of Reference (draft)

Purpose of the Working Group
Under the leadership of the Ministry of Energy and Mines, the Working Group aims to provide input and jointly develop concrete measures that will contribute to accelerating the adoption of grid edge technologies in Colombia, either in terms of specific policy proposals or the creation of public-private partnerships.

Term and expected outcomes
The first phase of the initiative will be a one-year effort, starting in March 2017 and delivering results no later than March 2018. The specific expected achievements are:
- Agreement and commitment from the leadership of the sector on the priority areas for action
- A set of specific policy recommendations on the identified priority themes (that later will have to be developed, detailed and implemented by the relevant regulatory bodies)
- Identification and launch of at least one public-private partnership initiative in one of the key themes
- Creation of a case study from the Colombia experience that will serve as the reference for other emerging economies in the World Economic Forum Annual Meeting 2018 in Davos-Klosters

Colombia will have the opportunity to foster public-private sector cooperation, solve current sector issues quickly, enhance its electricity system and provide an example for other countries.

Scope and work methodology
Based on the outcomes of the 7 December workshop, the proposed scope for the subgroups is as follows:
- Demand-side management and digital technologies, particularly smart metering
- Driving consumer involvement, particularly on clear information/education and price signals
- Acceleration of the electrification of transport (light-duty vehicles)
- Innovation in business models and interactions across industry players
- Potential of grid edge technologies for accelerating energy access in off-grid areas

The Forum suggests creating theme-specific subgroups that will be the main working units to undertake the bulk of the analysis and development of proposals.
- Each subgroup will have a group leader, responsible for driving the agenda and coordinating the interactions of the group.
- Stakeholders will appoint a relevant expert, with enough seniority, as the delegate who will contribute in those subgroups relevant for each organization.
- Much of the work will be conducted virtually (i.e. conference calls, emails, offline work). Each group will determine the cadence and frequency of interactions.
- Each subgroup will present the outcomes of their work during the planned workshops for the year.
- The Forum project team will coordinate the activities from each subgroup with the overall Working Group agenda.

The World Economic Forum will support the initiative by:
- Sharing the Actionable Framework, relevant worldwide expertise and best practices on the theme
- Supporting the group in project management tasks
- Supporting the establishment of public-private partnerships
- Making available a digital platform for interaction
- Developing the case for the World Economic Forum Annual Meeting 2018

Tentative calendar
- *March* (1.5-day workshop): *Sharing, Commitment and Organization*
  - *Sharing*: Colombia Inteligente (TBD); “Mapa de Ruta” (UPME); Innovative regulation (CREG); Actionable Framework and relevant case studies/ business cases (World Economic Forum)
  - *Commitment*: The group to agree on the key achievements for 2017 (as delineated above)
  - *Organization*: The group to discuss and agree on the governance model, working groups and overall timeline
- *March-July*: Working groups operational and working on proposals for PPPs or policy
- *July* (1.5-day workshop): *Assessment, Decision and Action*
  - *Assessment*: Discuss and review proposals elaborated by the working groups
  - *Decision*: Consolidate a short list of the most promising proposals
  - *Action*: Define the steps for action on the selected initiatives

- *July-November:* Working groups to activate the selected initiatives
- *November-December* (one-day workshop): *Check the Progress, Draft the Case*
    - Check the progress on the steps for action
    - Developing the case study for Davos 2018
- *January 2018* (Davos): Minister of Energy and Mines shares the initiative and announces the actions taken/ initiatives launched

Suggested governance model

Create a Steering Committee that will act as the relevant decision-making authority.

- To be composed of the highest-level executives from key private sector organizations, with the involvement of heads of public bodies, and chaired by the Ministry of Energy and Mines.
- The objectives of the Steering Committee will be twofold:
- Provide strategic guidance and steering on the Working Group's workstreams of the Working Group
- Act as decision-maker for the prioritization and implementation of the final proposals
- The Steering Committee will meet quarterly, with at least one of the meetings being in person.

Grid Edge Transformation discussion in the Annual Meeting in Davos

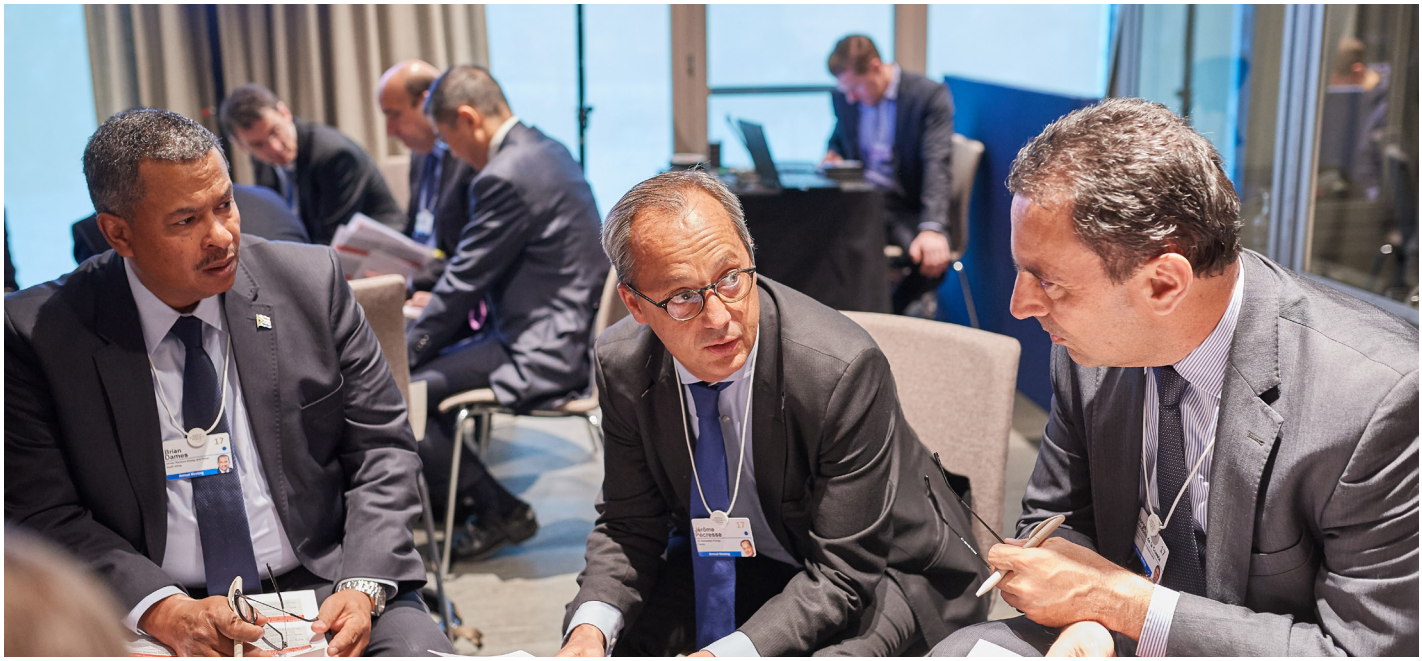
The trends and the actionable framework of recommendations were discussed in January 2017 at the Forum's Annual Meeting in Davos in a high level round table including policy-makers, technology innovators and pioneers, automakers and utilities leaders. The discussion revolved around two main themes: the potential and the impact of grid edge technologies on the electricity system and how to design new policy and innovative initiatives to unlock their value.

Some elements clearly emerged out of the discussion as key pieces of the transition:

- introduction of dynamic price signals and tariff designs able to send the right signals to customers and enable investment in the grid for digitalization;
- digitalization of the grid, both on the hardware and software side, as vital to enable the transformation, increase flexibility, and ensure the ability to protect customer data;
- clear rules for storage and its remuneration;
- harmonized regulatory frameworks and fostered cross border energy markets;
- Public-Private Partnerships for the deployment of the charging infrastructure of electric vehicles and for smart city projects are identified as priorities.

Worldwide, several grid edge innovations are taking place: innovative regulation and policy are redesigning roles, rules and responsibilities, like the European Commission Energy Winter Package and its reform of the retail markets; new alliances are made to deliver the enabling infrastructure; digitization and electrification initiatives are taking place, such as those of Denmark and Jeju Island in South Korea. These examples highlighted clear elements needed for an effective transition: introduction of dynamic pricing, harmonization of regulatory frameworks and fostered cross border energy markets, the need to invest for flexible electricity networks, and the need to create an industrial ecosystem able to govern the transition.

The implementation of the actionable framework in specific markets will require a preliminary analysis of the problems the market aims to solve. The Forum intends to continue on this work and collaborate with various countries to examine the adoption of grid edge technologies in emerging markets and implementation of the recommendations in greater depth. A first step forward is leveraging on the actionable framework to accelerate the path towards smart grids in Colombia, under a grid edge transformation initiative led by the Colombia Ministry of Energy and Mines and supported by the relevant private and public sector stakeholders. Countries such as Argentina, Brazil, China, Malaysia, Mexico, Peru, Saudi Arabia, and Vietnam could all take advantage of the deployment of grid edge solutions, to solve current electricity system issues and to be ready to face the future electricity system challenges and needs.



Workshop 7 December 2016 – Participant List

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