

## IRENA INNOVATION DAY: URUGUAY

### SUMMARY OF KEY INSIGHTS FROM THE DISCUSSIONS

#### EVENT OVERVIEW

Building on IRENA's biennial [Innovation Weeks](#), **IRENA Innovation Days** are taking place in different countries and regions around the world aiming to connect national, regional and international innovators and policy makers to share their experiences and showcase emerging innovations to inspire broader and faster uptake of renewable energy to help deliver a renewable-powered future.

4 sessions

31 expert speakers

Over 180 participants

Over 25 countries  
including 12 countries  
from Latin America

On **17 July 2019** over 180 delegates from the International Renewable Energy Agency (IRENA) member countries gathered in **Montevideo, Uruguay** for the **first IRENA Innovation Day**. Discussions drew upon the experiences of governments and innovative companies across Uruguay, Latin America and further afield, and upon global insights captured in IRENA's report [Innovation landscape for a renewable-powered future](#).

#### SESSION 0: SETTING THE SCENE

In addition to global trends, regional and local conditions are important drivers of power and end-use sectors' transformation. How these trends intertwine was presented by IRENA, Latin American Energy Organisation (OLADE) and the Ministry of Industry, Mining and Energy of Uruguay together with opportunities and challenges for the power systems with higher shares of variable renewables and unfolding electrification of end-use sectors, whilst emphasizing enabling aspects of innovations.

**The global perspective: Dr Paul Durrant** (Head of Innovation Strategies and Engagement, **IRENA**) provided an overview of a global progress of the past 10 years mostly in renewable power driven by a rapid decrease of costs of wind and solar and showed how they are outperforming non-renewables in the additional power capacity with a gap widening each year. He argued that IRENA analysis recognizes this progress as tremendous yet insufficient due to a lack of progress in end-use sectors and the energy efficiency and calls for a six-fold increase in renewables growth to meet climate commitments. To enable this change, Dr Durrant presented a systemic approach to innovations in the power sector and sector coupling, where innovations are divided into four dimensions, i.e. enabling technologies, business models, market design and system operation, and then combined into innovative solutions. He then warned that the optimal mix of innovations needs to be context and country-specific.

**The regional perspective: Alfonso Blanco** (Executive Secretary, **OLADE**) pointed out that since 2017, still 3% of the Latin American population lacks access to electricity, mostly due to challenges of the 'last mile' of electrification, lack of resilience of electrical systems to extreme events or affordability in the electricity access. In the existing regional installed capacity and electricity generation, renewables amount to 56.8% and 55.6% respectively with the highest percentage coming from hydro, followed by thermal biomass, wind, and solar. Mr Blanco warned of the deficient growth of renewable electricity generation and called on countries to develop more ambitious policies and roadmaps. In the context of innovation, he commented on unfavourable indicators if innovation was measured in terms of technology export and intellectual property rights, including patents, but highlighted several regional examples of innovations in biofuels, biomass use, and energy crops. He affirmed that OLADE recognizes a need for a systemic approach to innovations and will develop a regional agenda to scale-up innovations in the region.

**The perspective of Uruguay: Ruben García** (National Director of Energy, **Ministry of Industry, Energy and Mining of Uruguay**) showed Uruguay's successful energy transition over the past 9 years. In 2018, with no subsidies and with targeted and quickly implemented energy policies, Uruguay generated over 97% of its electricity from renewable energy sources with leading contributions from hydro (44%) and wind (33%), followed by thermal biomass (17%) and solar PVs (3%). To address new challenges including demand-side

management, complementarities between hydro-wind-solar (both intra-day and annual) and energy surpluses, the Ministry has put forward a list of priority areas covering batteries, EVs, green hydrogen, and power-to-X solutions.

### SESSION 1: SOLUTIONS FOR SMART AND FLEXIBLE GRIDS

The session explored innovative solutions for smart grids that allow higher levels of flexibility and help effectively integrate renewable energy into power systems. Discussions focused on changing roles of energy actors as well as emerging challenges and opportunities in operating innovative smart grids. The panel was **moderated by Dr Fernando Paganini Herrera** from the University ORT Uruguay, the scene was set by Elena Ocenic, IRENA's Programme Officer. **Presenters** shared their regional and international experience:

#### **Presentation 1: Smart Grids and Distributed Generation: Key Elements of Future Networks**

**Alfonso Blanco** (Executive Secretary, **OLADE**) presented various innovations to address challenges to effectively deploy distributed energy resources (DERs) in smart grids, including regulatory frameworks and business models. While stressing how smart grids allow better control, monitoring, and automation, he warned of a security risk as an existing issue that requires protocols, regulation, and standards. The integration of DERs and development of smart grids involve also several other aspects that must be considered, and which constitute new regional challenges, including financing, energy prices reflecting costs, compensation regimes, access to technology and capacity building, as well as technical conditions of the grid. Mr Blanco then provided an overview of strategies that promotes the development of smart grids from Argentina, Brazil, Chile, Colombia, Mexico, Panama and Peru.

#### **Presentation 2: Utilities in smart grids environment**

**Dr Ing Gonzalo Casaravilla** (President, National Administration of Power Plants and Electrical Transmission (**UTE**) of Uruguay) stressed that for UTE as a vertically integrated utility, generating electricity from 97% of renewables increases pressure on the grid's flexibility. To address that and to better control, process and manage the information generated by these new energy sources, UTE undertook a broad implementation of digital technologies (AI, IoT as well as blockchain) they see as the cornerstone for all other activities on generation and demand-side, which they then use to design better tariffs and other policy measures.

#### **Presentation 3: Digital trust for smart grids**

**Rafael Presa** (Market Developer Brazil, **IOTA Foundation**) presented TANGLE, a type of distributed ledger technology specifically designed for the IoT environment to allow secure data transfer and collection as well as dissemination of sensor-based and other data. TANGLE offers a grid to connect all devices to an area of the grid along with a transformer supplying energy and allows grids to autonomously balance themselves by securely sharing data and by letting devices decide for themselves if they want to balance the grid load or not.

#### **Presentation 4: Dynamic Line Rating solutions for renewable power integration**

**Juan-José Zapata** (Commercial Manager, **Ampacimon**) presented a dynamic line rating (DLR) innovation that assists system operators to actively manage electricity grids. It is made of stand-alone sensors installed on high-voltage lines that are coupled with software to measure key parameters (vibration, temperature or wind speed and direction) that influence line's maximum thermal capacity, so-called ampacity. DLR systems then allow to reliably forecast this capacity up to two days in advance. Mr Zapata presented several benefits of DLR, as a rapidly deployable solution that increases capacity in congested areas, avoids costly dispatching, allows for better grid planning and brings significant investment savings. As such, DLR allows higher integration of variable renewables, whilst minimizing curtailment of their production.

The following **panelists** joined the discussion:

- Dr Ing Gonzalo Casaravilla, President UTE
- MSc Ing Alexandra Arias, Regional Coordinator, Comision de Integracion Energetica Regional (CIER)
- Rafael Presa, Market Developer Brazil, IOTA Foundation
- Ing Juan Carrasco, Director, Fenix Energy
- Pablo Alvarez, Sales Manager Argentina, Uruguay and Paraguay, Jinko Solar

**Highlights from the discussion:**

- » **Collaboration between various stakeholders crucial to advance smart grids.** The power sector is increasingly integrated and defined by numerous new actors. Panelists argued that a collaborative and participatory dimension among this broad group of stakeholders is often neglected, which hinders progress. The inclusion of various stakeholders into policy-making, and broader understanding of their challenges and opportunities will help to design an enabling environment, develop inclusive business models, and improve the system operation by coordinating system operators' roles.
- » **Digitalisation of smart grids as the cornerstone of all activities on the supply and demand side.** With demand and supply of power becoming more dynamic and uncertain, grids require much faster and better situational analytics, control and management to increase their flexibility and maintain stability. Various digital technologies are complementary and panelists argued for their joint implementation.
- » **Smart meters unlock the potential of active demand-response and enable new energy services.** With increased intermittent renewables, up-to-date information is necessary to balance demand and supply and mitigate network bottlenecks. In this light, Uruguay has been installing 10.000 smart meters weekly, aiming to reach full coverage across the country over the next 4 years, which would benefit both consumers and the grid.
- » **Data integrity and security need to be addressed.** Panelists argued that digitalisation needs to be addressed hand-in-hand with suitable measures for data and information protection not only from cyberattacks but also from the uncontrolled use of consumer data.
- » **Regulatory rather than technological issues halt progress in smart grids development.** Panelists argued that progress in smart grids requires better tariff structure, policies, and regulation, which must be complemented by better coordination between various stakeholders and which addresses the use of their data. They also discussed how regulations, if designed uncarefully, can undermine incentives and discourage the development of new business models by system operators.
- » **Companies as leaders of the energy transition.** Panelists stressed that it is the companies that are building infrastructure, developing new services and inventing technologies of tomorrow to support the transition in a proactive and commercially advantageous way and therefore need to be adequately incentivised to continue doing so.

**SESSION 2: SOLUTIONS FOR ENERGY STORAGE**

The session explored innovative use and integration of large- and small-scale energy storage solutions, e.g. flexible hydro, utility-scale and behind the meter batteries, pumped hydro storage and other energy storage options. The panel was **moderated by Fernando Schaich, Founder of SEG Ingenieria**, whilst the scene was set by Dr Paul Durrant, IRENA's Head of Innovation Strategies and Engagement. **Presenters** shared their regional and international experience:

**Presentation 1: Value of energy storage as a filter of the variability of renewable energies in Uruguay**

**Ing Ruben Chaer** (Manager, National Energy Dispatch Centre (NDC) of Uruguay) presented NDC's approach towards the optimal investment planning with refined models that capture a new system variability, and which they weight with other sources of risk. He then outlined how NDC directly relates the average time necessary to obtain the expected energy to the volume of storage necessary to filter the variations. He also emphasized that wind and solar require less filtering efforts than hydropower and that in the future, when the filtering capacity of the hydroelectric subsystem is exhausted, battery storage will be key to filter the variations of energy availability.

**Presentation 2: The binational hydropower plants of Parana River to support regional electricity market**

**Dr Victorio Oxilia** (Director of Research, Universidad Nacional de Asuncion) presented binational hydropower plants of Parana River (between Argentina-Paraguay and Argentina-Brazil) as virtual storage systems helping to integrate more variable renewables into the power systems and playing a supporting role in regional markets. He referred to this market design innovation as a 'soft innovation'. He also emphasized a need to

correctly implement electromobility in the region, and given abundant natural resources, he encouraged the region to consider focusing on batteries development (Bolivia and Argentina).

### Presentation 3: Role for Hydrogen in Energy Systems and Beyond

**Tim Karlsson** (Executive Director, National Partnership for Hydrogen and Fuel Cells in the Economy (IPHE)) outlined many hydrogen benefits in the power and end-use sectors that support the integration of variable renewables, including the energy security, resilience, and stability of the grid, enable economic growth and decarbonise end-use sectors. He reported that in the transport sector, more than \$1bn was spent on RD&D in IPHE countries, which brought 11 thousand fuel cells electric vehicles on the road particularly in Japan, France, Germany, and the Netherlands.

### Presentation 3: Energy Storage and E-mobility

**Adalberto Maluf** (Director of Sustainability, Marketing and Governmental Affairs, BYD) presented BYD activities in the energy storage, integrated PVs with energy storage systems, EVs, commercial vehicles, and rails in their efforts to integrate more renewables in the power and end-use sectors. He outlined that their current focus is on batteries, particularly iron-phosphate battery production (they hold 20% of global capacity) and emphasised many benefits of using iron-phosphate batteries including its thermal stability. He also stressed that with increasing EVs on the roads, batteries will keep playing an important role across multiple applications (micro-grids, frequency regulation, etc.). He closed his presentation with a presentation of an integrated solution that combines solar with B-box and a charger.

Following **panelists** joined the discussion:

- Ing Ruben Chaer, Manager, National Energy Dispatch Centre (DNC) Uruguay
- Tim Karlsson, Executive Director, International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE)
- Ing Ignacio Aguirre, Business Development Manager, LAS Region, Wartsila Argentina S.A.
- Jorge Asturias, Freelance Consultant

### Highlights from the discussion:

- » **While hydropower is mostly used as a baseload, it can also offer other services.** Hydropower has distinct advantages over most of other technologies in that it is a far more flexible source of power. In addition to providing baseload power in the region (from nearly 100% in Paraguay to 9% in Mexico and averaging 50% for the whole region), it can provide peaking power, spinning reserve and energy storage.
- » **Social acceptance of new hydroelectric projects has to be addressed.** While hydropower is a mature technology and one of the largest sources of clean energy in the region, it has been subject to environmental and social conflicts. Panelists argued that there are available measures that need to be taken to address social acceptance including raising awareness, respecting procedures, such as having fair, participatory planning processes, as well as conducting environmental impact assessments.
- » **The regional market as important market design innovation in integrating variable renewables by harvesting hydropower opportunities.** Panelists argued that hydropower benefits are being harvested locally (from the increased flexibility of the grid to significant operating costs savings), and in some instances (Parana River) also bilaterally. Some panelists, however, called for increased cooperation in developing regional markets as a cost-effective way to allow the use of wider geographic diversity of renewable energy resources to balance demand and supply. Other panelists argued that focusing solely on trading halts progress in developing a business case for behind the meter batteries, as it is easier to solve demand bottlenecks by trading than developing new business models.
- » **Need for a business case to drive the deployment of behind the meter batteries.** Behind the meter batteries can bring benefits to industry and large consumers. Various challenges halt progress in Latin America, where some countries lack an enabling regulatory market for storage and where the intermittent grid often causes interruptions leading to large economic losses for industries. But to create a business case, the quantification and assessment of losses from interruptions are required. Panelists also added that there are still many uncertainties regarding the technology.

- » **Batteries and hydrogen are complementary rather than competing technologies.** Particularly in terms of different transport modes, batteries have a role to play in EVs for short distances in light transport vehicles, while heavy-duty vehicles could rely increasingly on hydrogen.
- » **Hydrogen is seen as a feasible solution to mitigate climate change.** Just a decade ago, hydrogen was considered too expensive. Political commitments, changes in policies and investments in R&D that have remained high over the years led to costs decrease and have made hydrogen a realistic alternative with its increasing necessity to help mitigate climate change and support higher integration of wind and solar.
- » **Hydrogen production requires proper certification to ensure it is clean and environmentally friendly.** There are over 120 tons of hydrogen produced around the world today, from which two-thirds are green while the rest is a mixture with other gases. In light of this, Europe is piloting a certification protocol to track the production of hydrogen from renewable sources. Panelists emphasised this approach as crucial and called on regulators, governments and broad society to demand this approach also in the region.

### SESSION 3: SOLUTIONS FOR RENEWABLE-POWERED END-USE SECTORS (TRANSPORT, BUILDINGS, AND INDUSTRY)

The session explored how electrification of end-use sectors with renewable electricity can help decarbonise transport, buildings (heating and cooling) and industry, while becoming a flexibility source to integrate more renewables in power systems, including the potential role of power-to-hydrogen. The session was **moderated by Antonella Tambasco**, Advisor from the Ministry of Industry, Energy and Mining of Uruguay, the scene was set by Elena Ocenic, IRENA's Programme Officer. **Presenters** shared their regional and international experience:

#### Presentation 1: Hydrogen in the energy transition

**Marta Jara Otero** (President, Administración Nacional de Combustibles, Alcoholes y Portland (**ANCAP**)) presented data from Uruguay on the transport industry: transport presents 28% of final energy consumption, relies on 70% of imported oil and contributes to 64% of CO<sub>2</sub> emissions. To decarbonise transport (in addition to EVs) and use effectively renewable energy sources, ANCAP focuses on hydrogen, with companies now aligning their strategies with public policies to work jointly towards a common vision for hydrogen in Uruguay. To demonstrate the impact, ANCAP has launched a pilot to produce green hydrogen and deploy 10 hydrogen fuel cell trucks and buses with a range of 900 km and 250 km respectively and install charging stations mostly in Montevideo.

#### Presentation 2: Innovative solutions for renewable power generation

**Giovanni Tula** (Head of Innovation and Sustainability, **ENEL Green Power**) highlighted that delivering 100% renewable future driven by digitalisation, decentralization, and electrification requires significant innovation and customer engagement. In the context of electrification, Mr Tula emphasised the importance of batteries, but listed also other solutions that enable electrification including long-duration storage (REDOX flow batteries, liquid air energy storage or energy vault gravity) and grid stability (synthetic inertia, flexibility). He presented several ENEL's hybrid projects in Chile and the US (various combinations of solar PV or CSP, wind, hydrogen, geothermal and batteries) and stressed how hybridization helps to better predict renewables generation including both forecasting (+72h for day-ahead markets) and 'nowcasting' (+24h for intraday markets), but underlined difficulties they encounter with long-term forecasting.

#### Presentation 3: Supermarkets acting as active flexible energy prosumers in the energy grid

**Javier Alejandro Korenko Chmielewsko** (Sales Manager for Argentina, Uruguay and Paraguay, **Danfoss Cooling Segment**) focused in his presentation on the supermarkets' role in smart and integrated energy systems to act as flexibility resources, while requiring modest investments. He particularly focused on refrigeration, heating, air conditioning, and ventilation as an integrated solution with a high potential of energy savings and which turns supermarkets into energy prosumers. Supermarkets use refrigeration compressors for heat pump purposes where the cooling load is low and heating load is high (in winter), install heat/cooling storage units and sell excessive heat from refrigeration system into the district heating system and combine PV and refrigeration/heating into a local "micro-grid power system." He stressed that automated control is a

prerequisite to integrate such an innovation. He also emphasised the importance of buildings and the revision of their codes to facilitate the integration of renewables into the grid.

#### **Presentation 4: H<sub>2</sub> Energy at the heart of the energy transition**

**Gabriel Schmitd** (Commercial Manager, **Air Liquide**) outlined an increasing role of hydrogen as a clean and versatile energy carrier with large application use: it can be transported over long distances allowing distribution of energy between countries, can be produced without a carbon footprint through electrolysis, biomethane, and CCS, it is suitable for long term storage. As such, it enables large-scale renewables integration and power generation and increases system resilience. Technologies exist and are ready to be deployed, with an estimated 30 million jobs generated in the industry by 2050.

The following **panelists** joined the discussion:

- Marta Jara Otero, President, Administración Nacional de Combustibles, Alcoholes y Portland (ANCAP)
- Tim Karlsson, Executive Director, International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE)
- Adalberto Maluf, Director of Sustainability, Marketing and Governmental Affairs, BYD
- Gonzalo Bravo, Researcher/Analyst, Fundacion Bariloche

#### **Highlights from the discussion:**

- » **Electrification is key to decarbonise end-use sectors and make these sectors sustainable.** Panelists argued that both direct and indirect electrification play a crucial role in decarbonising end-use sectors, i.e. transport, industry, and buildings, and called on policy makers to design ambitious roadmaps across Latin American region that incentivise various technologies.
- » **The systemic approach helps to scale-up all technologies' deployment, regardless of their levels of maturity.** Panelists agreed that an enabling environment that helps technologies to thrive is missing. Technologies need an adapted market, that enables trade, and can sustain over time, and business models, enabling digital technologies, etc. so that the investments into the RD&D of these technologies can be recouped.
- » **The cooperation and motivation of various actors need to be thought-through.** To sustain the enabling environment for innovations, panelists argued incentives to engage actors and encourage their cooperation need to be analysed. Panelists also discussed a need for the assurances for the future in terms of how subsidies will evolve, how a business model will change over time and how all this will affect the market.
- » **Integrated urban transport policies need to be addressed from all perspectives.** Cities have developed significantly in the past few decades, including all major Latin American cities and require proper planning that considers transport in the process. Panelists argued that urban transport policies should integrate grid planning, infrastructure, the complementarity of different modes of transport and also address behavioural and other socio-economic issues. They agreed that whilst electric vehicles will become more prevalent in the future, they warned of the rebound effect observed in other parts of the world and called on policy makers to equally encourage other modes of transport, particularly public transport.
- » **Electric vehicles take priority in global markets and Latin America should not fall behind.** Panelists emphasized that the society in Latin America is all aware of the priority electric vehicles have been receiving around the world and how it has helped to increase performance, range, etc. and reduce prices which in turn scaled up their deployment. EVs are economically viable and an efficient way to decarbonise cities and facilitate the integration of variable renewables. They, therefore, called on the important stakeholders in Latin America to cooperate to bring the same trend to the region.
- » **Role of hydrogen in niche sectors.** Electric vehicles deployment is much further advanced and more economically viable than hydrogen and will keep dominating the market for some time. Hydrogen could, however, become relevant in niche sectors such as buses and heavy-duty vehicles. Panelists all stressed the importance to scale-up hydrogen deployment to decrease its costs and they see heavy-duty vehicles

and particularly buses that are being increasingly operated in many Latin American cities as a great way to kickstart the growth of the sector.

#### SESSION 4: SOLUTIONS FOR ENGAGED CONSUMERS

The session explored digitalization-enabled business models for managing demand and providing flexibility to the grid, such as blockchain, internet of things or artificial intelligence enabling innovative solutions for distributed generation and demand-side management. The session was **moderated by Eduardo Bergerie**, Smart Grid Project Director at the National Administration of Power Plants and Electrical Transmission (UTE) of Uruguay, while the scene was set by Martina Lyons, IRENA's Consultant. **Presenters** shared their regional and international experience:

##### **Presentation 1: An overview of the current state of distributed energy resources in Colombia**

**Johanna Koolemans-Beynen** (Senior Programme Coordinator, **U.S. Energy Association**) showcased the importance of distributed energy resources (DERs) in deferring grid investments and ensuring energy security in Colombia, that produces a majority of its electricity from hydropower and where events such as El Niño are putting hydropower increasingly under pressure. Ms Koolemans-Beynen noted regulations and population growths often make it difficult to expand the transmission system, which would otherwise increase the potential of DERs deployment. Another limiting factor to allow DERs deployment is a lack of incentives, regardless of benefits DERs provide to the grid including flexibility. The exceptions are the accelerated depreciation allowances and relatively high electricity prices, which are also being used in Mexico or the US. In one of its steps to address the situation, the Colombia government is currently designing a plan to broadly deploy digital technologies such as AMI (advanced metering infrastructure) with a target of 95% in cities and 50% in rural areas by 2030.

##### **Presentation 2: Machine learning application in demand response**

**Santiago Garabedian** (Investment Planning Specialist, National Administration of Power Plants and Electrical Transmission (UTE) of Uruguay) presented how a large amount of data generated by smart devices, then captured and analysed can be useful to improve the design of demand response by recognising the pattern, forecasting demand and detecting behaviour anomaly. This, in turn, brings numerous benefits including improved services, reduced peak consumption, financial benefits to the consumers as well as system operators, and efficient use of renewables. As an example, UTE showcased its current project on the use of Artificial Intelligence for the electric water heaters, which represent 33% of residential consumption, and their connection to a remote timer.

##### **Presentation 3: Blockchain solutions for the energy sector**

**Doug Miller** (Market Development Manager, **Energy Web Foundation**) showed blockchain's ability to unlock consumers' participation through enabling, managing and automating mass energy device participation. Mr Miller outlined how market participants can use blockchain to create new relationships with assets, and deploy advanced solutions leveraging dispersed customers and devices through automatization. As such, it brings numerous benefits including creating secure, unique digital identities for any person, organizing assets, leveraging an open, low-cost, plug-and-play infrastructure that is interoperable by design, using cryptographic signatures for verification and giving participants a guaranteed record of events over time.

##### **Presentation 4: Blockchain and energy from a regional perspective**

**Eduardo Soto** (CEO, **Phineal**) presented blockchain and its wide application uses to realise energy transactions safely and economically. Mr Soto outlined three areas of use cases Phineal is currently engaged in: (1) industrial applications (production of copper) to incorporate the value of clean energies into final products; (2) tracing energy generated by public solar rooftops (a project of the World Bank, Ministry of Energy in Chile and Phineal); and (3) creating local value by incorporating solar energy into products and services in SMEs (a project of Chile, Mexico and Peru). Mr Soto stressed a need to empower consumers, which is possible only if blockchain is secure and economically viable.

The following **panelists** joined the discussions:

- Santiago Cuccorese, Technical Advisor Distributed Generation, Ministry of Energy Argentina
- Francisco Contreras, Advisor, GIZ-German-Mexican Energy Partnership
- Johanna Koolemans-Beynen, Senior Program Coordinator, the U.S Energy Association (USEA)
- Doug Miller, Market Development Manager, Energy Web Foundation
- Dr. Jose Horta, Chief Innovation Officer and Blockchain Lead, SimpleTech

#### **Highlights from the discussions:**

- » **Distributed Energy Resources (DERs) offer additional flexibility potential on distribution and transmission levels.** DERs can provide flexibility and other services to the grid through demand-response, storage or sector coupling. Their potential is yet not fully tapped and one of the ways is to couple them with digital technologies. Digital technologies will simplify and thus facilitate the use of DERs by consumers which in turn will increase their engagement.
- » **Digital technologies enable the physical integration of DERs but need to be implemented together.** Decentralised systems face challenges in maintaining grid reliability and stability, which requires system operators to measure, forecast and trade electricity in different ways. Digital technologies are key enablers to facilitate the physical integration of DERs in efficient and cost-effective ways. Panelists, however, underlined the complementarity of these technologies and called for their joint implementation and use as they support the system in different ways.
- » **Simplicity and automation will be trailblazing for higher engagement of consumers.** It is important to provide consumers with user-friendly options. Panelists argued that utilities should offer different energy services similar to services offered by the telecommunication industry. Regardless of the software used, utilities should assure the grid is used in the most efficient way and brings flexibility, stability, financial savings, etc.
- » **Innovations in business models coupled with enabling market design crucial in unlocking consumers' participation, including low-income households.** Dynamic pricing enabled by digital technologies (e.g. time-of-use tariffs) incentivises behavioural change in consumers (using their appliances, charging their EVs, etc.), which brings them real financial benefits. It is however not sufficient to introduce various tariffs without educating consumers. Panelists agreed that it is important to keep business models simple and give the users the options on the level of engagement. They also argued that the entire discussion should not disregard DERs' social implications and must assure the inclusion of low-income households.
- » **To enable broader support for blockchain, it is important to understand its benefits but also limitations.** Panelists listed many blockchain benefits, such as it enables transactions between parties without intermediaries in a low-cost way, maintains privacy and security of data and transactions, and allows for greater transparency. While its current contribution is mostly in the field of traceability and peer-to-peer trading, panelists discussed how companies are already investigating other uses. Panelists also acknowledged that the disruptive potential of blockchain is only in the beginning to be fully understood.
- » **Blockchain helps to create energy communities by empowering consumers and prosumers.** Panelists noted how blockchain furthers social value by allowing the creation of energy communities. Particularly in Latin America, this could help to bridge social gaps and empower users through the ownership of energy technology. While Mexico, Chile or Uruguay are already deploying blockchain in various application cases, Argentina is currently investigating the possibility of blockchain and seeks lessons learned from other countries to ensure best practices are being followed.

#### **CONCLUSION**

The Latin America region continues making remarkable progress in its energy transition, with different levels of success across the countries. The region has abundant renewable energy resources, and it is estimated that renewables amount to 56.8% in regional installed capacity and 55.6% in electricity generation, with the highest contribution coming from hydropower, thermal biomass, wind and solar (OLADE, 2019). However, the growth of renewable electricity generation is not sufficient, and countries continue to face various



challenges, some to provide modern energy services to all, while many to maintain the stability of their grids. Discussions emphasised that **challenges are beyond technological** and are characterised by a lack of ambitious policies and targets and a missing enabling environment for technologies to thrive, business models to be created and consumers to be engaged.

In efforts to respond to a **decentralisation** trend and dynamic and uncertain demand and supply of power, countries recognise a need to **advance smart grids to allow faster and better situational analytics, control and management**, which in turn will facilitate the integration of higher shares of renewables. To tackle the challenge, a collaboration between various stakeholders, incentivisation of the private sector, effective use of various digital technologies, whilst addressing data integrity and security, and design of enabling policies were recognised as priorities.

To integrate higher shares of variable renewables into the power systems, the **innovative solutions for the energy storage** were discussed. Countries across the region are advancing in their integration of energy storage solutions and are open to sharing best practices. Particularly, the hydro was recognised as a critical solution and discussions outlined its many benefits including flexibility services. Discussants also called for the creation of regional markets, as a cost-effective solution to integrate variable renewables into the grids and considering diverse energy resources across countries. Discussions addressed the social and environmental issues of new hydroelectric projects. While hydro was recognised as a focus area, a need to step up regional ambitions in batteries and hydrogen was acknowledged as equally important.

Decarbonisation and particularly the **electrification of end-use sectors** is a hot topic globally, and discussions recognized a lack of progress in the region. There are several ambitious projects at the country levels, particularly in electrifying transport and buildings. But there is a lack of ambitious roadmaps and integrated policies across countries to incentivise RD&D of technologies, while creating an enabling environment to deploy them and shift behaviour of society was acknowledged multiple times. With the rapid development of cities in the region, integrated urban transport policies and ways to unlock potential and complementarities between EVs, hydrogen fuel cell vehicles (buses and trucks) but also biofuels should be prioritised.

To respond to these trends and challenges, many countries across the region have concentrated considerable efforts to develop and deploy **digital technologies** in various applications. The energy sector is seeing various applications of distributed ledger, AI or IoT which in turn have created business and employment opportunities and helped to integrate higher shares of renewables into the grid while maintaining its stability, and flexibility. However, consumer engagement, particularly from low-income households, is being neglected and addressing that could open a new area of opportunities.

Discussions recognized that, despite significant efforts underway across various countries in the region, progress is stagnating, and more needs to be done. Discussants called on policy makers to **develop policies that leverage existing knowledge, skills, and technologies** to facilitate prompt scale-up of innovative solutions. The systemic approach was multiple times emphasised as the right pathway forward.

Challenges are not intrinsic to any national power system alone and sharing best practices and seeking opportunities for replicability of existing innovations and innovative solutions encourage broader and faster uptake of renewable energy resources. Discussions emphasized that **innovations across the power sector will continue to play a crucial role with a systemic approach as key to deliver impactful solutions**. Attendees stressed the importance of experience sharing and cooperation and welcomed the organisation of the IRENA Innovation Day that gathered policy makers and innovators, discussed challenges and shared insights, whilst exploring potential partnerships and collaborations between local and international stakeholders.