



**Asia-Pacific  
Economic Cooperation**

**Advancing** Free Trade  
for Asia-Pacific **Prosperity**

# **Workshop on Distributed Energy Resources Regulation and Rate Design**

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**APEC Energy Working Group**

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Produced by  
Carlos Rojas Zanol  
Ministry of Energy, Chile

For  
Asia-Pacific Economic Cooperation Secretariat  
35 Heng Mui Keng Terrace  
Singapore 119616  
Tel: (65) 68919 600  
Fax: (65) 68919 690  
Email: [info@apec.org](mailto:info@apec.org)  
Website: [www.apec.org](http://www.apec.org)

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## Executive Summary

The APEC Workshop on Distributed energy resources regulation and rate design was proposed by the Chilean Ministry of Energy in order to support the achievement of the APEC goal of doubling the share of renewables by 2030.

The project comprised a workshop and a seminar, where expert speakers and APEC representatives could discuss distributed energy resource integration, including the distribution sector challenges, tariff design, benefits, technical challenges, policies, and regulations.

On the first day, a seminar focused on expert presentations with an invited audience from the Chilean energy sector was carried out. The seminar contemplated three sessions: the first focused on the future perspectives of distributed energy resources in power systems, the second focused on how to capture the value of distributed energy resources and the technical challenges and opportunities, and the third session focused on policies and regulations aimed to promote distributed energy resources. In this event, six experts gave presentations, followed by panels discussion with Chilean experts.

A workshop was held on the second day in order to share information on best practices within APEC economies, as well as to facilitate a dynamic discussion among APEC representatives, international expert speakers and representatives from the Chilean Ministry of Energy.

On the second-day workshop, Malaysia and Peru representatives shared their experiences with the group. Afterwards, an open discussion was held among all the workshop participants (APEC representatives, international expert speakers and representatives from the Chilean Ministry of Energy). The main aspects discussed were: the regulatory challenges of Distributed Energy Resources related to promotion and rate design, the benefits of Distributed Generation, the grid planning and adoption to allow more Distributed Energy Resources in the system, the technical challenges, and others aspects related to the topic.

Thirty-two and fourteen attendees participated in the first and second day, respectively. The women's participation was 34% and 33% in the first and second day, respectively. According to the survey results, in both events, the participants increased their level of knowledge of the topic discussed after participating in them.

The participants appreciated the opportunity to exchange views on distributed energy resources, as well as international experiences and best practices on market regulation and policies aimed to promote distributed generation in power systems.

# Introduction

This document has been prepared by the Chilean Ministry of Energy to present a summary of the results of the workshop “Distributed energy resources regulation and rate design”, held on October 23rd and 24th, 2019, in Santiago Chile.

The Chilean Ministry of Energy proposed to APEC a project to conduct a workshop and a seminar, where expert speakers and APEC representatives could discuss distributed energy resource integration, including the distribution sector challenges, tariff design, benefits, technical challenges, policies, and regulations. This project intends to support the achievement of the APEC goal of doubling the share of renewables by 2030.

On the first day, a seminar focused on expert presentations with an invited audience from the Chilean energy sector was carried out. In this seminar, six experts performed presentations, followed by panel discussions with Chilean experts.

A workshop was held on the second day in order to share information on best practices within APEC economies, as well as to facilitate a dynamic discussion among APEC representatives, international expert speakers and representatives from the Chilean Ministry of Energy.

The following chapter presents the background of the project. The fourth chapter presents the workshop overview, including the project objectives and a brief description, the summary of the first and second day, and an analysis of the results. The fifth chapter contains the main conclusions obtained from the workshop. Finally, the last chapter corresponds to the appendix of this document.

## Background

The Asia-Pacific Economic Cooperation (APEC) has set two energy-related regional aspirational goals. The first seeks to reduce APEC's aggregate energy intensity by 45% from 2005 levels by the year 2035 (established in the 2011 APEC Economic Leaders Declaration), and the second seeks to double the share of renewables in the APEC energy mix by 2030 (established in the 2014 APEC Economic Leaders Declaration).

These regional goals contribute to the arrival of a new economy based on an increasingly low-carbon energy matrix. In this context, the new low prices of renewable and variable energy sources require a change in how the market and sector are structured. The demand side of the system can now participate and contribute to ancillary services and generation, changing the way grids are organized and operated.

Latin America has been a pioneer in regulating the energy sector and the broader arrival of renewables has made analyzing how the distribution sector is regulated top priority. Understanding the future challenges that energy distribution will face and how to address them is a top priority to modernize the energy sector in Chile and other developing and developed economies, as well as to meet the global and economy-specific goals in the decarbonization of the energy matrix.

# Workshop Overview

## Project objectives and brief description

The objectives of the project proposed by the Chilean Ministry of Energy were the following:

- Understand the new regulatory and tariff design context and challenges in the distribution sector.
- Review comparative experiences about distribution regulation innovation based on case studies presented during the seminar.
- Gain insight into successful regulatory practices and lessons learned, based on past international experiences in initiatives such as metering programs.

The project was comprised of two events: a seminar focused on expert presentations with an invited audience from the Chilean energy sector and a workshop focused on a more dynamic discussion among APEC representatives, international expert speakers and representatives from the Chilean Ministry of Energy. These events were carried out on October 23rd and 24th, 2019, in Santiago Chile.

## First-day summary: Seminar

A seminar focused on expert presentations was carried out on the first day. In this event, an invited audience from the Chilean energy sector attended.

The general structure of this event was the following:

- ❖ Welcome remarks
- ❖ First session: Beyond the meter: The future of distributed energy resources
  - Two presentations
  - Panel discussion and questions
- ❖ Second session: Adapting the grid to the new market players
  - Two presentations
  - Panel discussion and questions
- ❖ Third session: Regulation schemes for new distributed energy resources
  - Two presentations
  - Panel discussion and questions

The agenda for this event can be found in the Appendix of this document.

The seminar began with the welcome remarks by Mr Gabriel Prudencio, Head of Sustainable Energy Division at the Chilean Ministry of Energy, who highlighted the energy transition facing power systems around the world and also in Chile. This transition includes decarbonization of the energy matrix,

distributed energy generation development, demand response, storage, electromobility, more participation of variable renewable energy, and other elements.

In this context, Mr Prudencio presented the two Chilean commitments: the target of carbon neutrality by 2050 and the retirement of coal power plants by 2040. Mr Prudencio noted that several measurements are needed in order to achieve these commitments, such as increasing non-conventional renewable energies, electromobility, energy efficiency, and distributed energy generation.

Regarding Distributed Energy Resources, Chile established a Net Billing Law in 2014, in order to allow final customers to install and generate their own energy. In 2018 this law was modified to improve the regulatory framework of Distributed Energy Resources.

Additionally, Mr Prudencio highlighted that in 2018 the Chilean Ministry of Energy launched the Energy Road Map 2018-2022, aimed to guide the government's work on energy generation and distribution. In this Road Map, ten Mega Energy Commitments were articulated. He pointed out that one of these commitments corresponds to quadrupling the current capacity for small-scale distributed renewable generation by 2022.

Finally, Mr Prudencio noted these seminars support moving forward to a sustainable energy matrix and help to overcome the technical and regulatory challenges of Distributed Energy Resources.

## **First session: Beyond the meter – The future of distributed energy resources**

The first presentation was given by Mr Enrique Gutiérrez, Energy Analyst at the International Energy Agency (IEA). The presentation began by showing some IEA's projections that concluded solar photovoltaic drives strong growth in the renewable capacity expansion (renewables expand by 50% through 2024), and clean electricity sources have the potential to become the largest source of electricity generation by 2040.

He mentioned that commercial buildings and industries are leading the distributed photovoltaic growth given economies of scale and a better match between photovoltaic output and electricity demand in commercial/industrial applications. Also, the continuing decline of solar photovoltaic costs widens the gap with retail electricity prices, increasing distributed photovoltaics' economic attractiveness for private investors.

The distributed photovoltaic installed capacity has increased due to improved policies, lower costs, and rapid adoption. The total distributed photovoltaic capacity more than doubles by 2024. However, this represents only 6% of the global technical potential.

Nonetheless, distributed photovoltaic rapid growth must be managed through new policies and market reforms aimed at finding a balance between the opposing interests of distributed photovoltaic owners, energy & distribution companies, and electricity consumers in general.

Then, Mr Gutierrez mentioned two drivers for future electricity demand: space cooling and electric vehicles. On one hand, renewables can meet almost two-thirds of the global increase in capacity needs for space cooling to 2050. This will require matching variable renewable energy profiles with space cooling through demand-side programs. On the other hand, electricity demand from electric vehicles is expected to reach 640TWhs in 2030.

There are a variety of approaches for unlocking the value of Distributed Energy Resources at the distribution level such as distributed resources for reinforcement deferral, distributed resources for congestion avoidance, and Emerging uses (provision of reactive power, offer DSO-TSO balancing services).

Transmission system operators are evaluating the potential of electric vehicles in ancillary services given Distributed Energy Resources can cost-effectively contribute to ancillary services, but prequalification, reporting and registration processes need to be streamlined to reduce transaction costs.

Regulators have a crucial role in securing a level playing field. Whichever policy objective is considered (lower system costs, adequacy, and increased variable renewable energy penetration), the potential of Distributed Energy Resources should always be considered and various measures exist to enable them.

Some aspects are needed to enable conditions for Distributed Energy Resources: regulations to ensure market access, reducing barriers to entry, regulatory validation of Distributed Energy Resources capabilities, updating prequalification requirements and service specifications, improving price signals at the retail level, and unlocking network value.

Finally, Mr Gutiérrez presented some takeaways:

- Distributed energy resources have the ability to contribute to a variety of power system services but there are a number of barriers that still need to be overcome.
- The demand-side response is already mainstream for industrial customers, the balance between enabling costs and prospective revenues still play a major barrier for small consumers.
- Regulators have a crucial role to play removing entry barriers and facilitating a level playing field for distributed energy resources.
- Administrative and implementation barriers still represent a hindrance to the widespread deployment of distributed energy resources, these range from settlement procedures, to metering.

- A better understanding of the link between rate design, distributed flexibility potential, and the system's flexibility requirements is still required.

The second presentation was given by Mr David Watts, Associate Professor at Pontificia Universidad Católica de Chile. The presentation began by showing that the key regulatory goals for developing countries are reducing tariffs and prices. In the case of Chile, electricity is quite expensive for some families, and the effective use of electricity is often quite limited. In this context, Distribute Energy Resources must cope with these challenges.

The structure of the Chilean transmission bill, its evolution, and the electricity auction results to supply regulated customers were presented. Additionally, the four main elements in the Chilean electricity bill were described.

Mr Watts gave some reflections about the prior and the current regulation in Chile: in the past Chile has focused strongly on economic efficiency, equity has not been a target of regulation, and Chile is slowly leaving cost causality behind. Additionally, he noted the main roles of the regulator are: enabling new business models, reducing the barriers and costs of those business models, enabling the changes at a minimum cost, sometimes without really committing with a particular future, reducing the risk of the business to an efficient minimum, and transferring the reduced costs to customers.

Flexible tariffs are needed to fully exploit low cost photovoltaic. Currently, in Chile, there is no flexible tariff available. These tariffs can be Time of Use, critical peak pricing, real-time pricing, residential and industry offer, and peak time rebate.

Afterwards, Mr Watts presented the reforms proposed to the Chilean Ministry of Energy in the study requested from Pontificia Universidad Católica de Chile. In this study, the key goals were to increase quality (setting a higher standard and enforcing it), push cost-effectiveness, transfer economic efficiency to clients such as fair prices, and enable new services, businesses, agents and technologies to add value.

In the abovementioned proposed reforms, the following aspects were considered: rely on centralized auctions for adequacy and economic supply at generation side; enable competition where it adds value and is efficient; three-layer conceptual and regulatory separation among Infrastructure, Operator (Technical & Commercial), and Energy services; identify information as key for new services, entrants and new business; and flexible planning to exploit economies.

Finally, Mr Watts presented some final remarks:

- Today's discussion should be about paths to reduce final customer rates.

- Distributed Energy Resources deployment should reduce the final customer's rates.
- Enabling Distributed Energy Resources different business models to allow capturing part of their value.
- Electric vehicles deployment requires a better tariff design.
- Interoperability of Distributed Energy Resources at low cost is fundamental.
- Some sort of simplified commercialization is needed and requires correct and transparent electricity prices.
- The principles for financing the grid are simple, but their real application is more complex.

Afterward, a panel discussion was made up, composed of Mr Gutiérrez, Mr Watts, and Ms Daniela Martínez, lawyer and energy-expert consultant. Furthermore, questions from the audience to the panel were received. The main aspects discussed on the panel were: the approaches for unlocking the value of Distributed Energy Resources, the benefits of Distributed Energy Resources, the value of Distributed Energy Resources in rates, barriers that face Distributed Energy Resources, flexible tariffs, the coming Distribution reforms in Chile, and others aspects related to this topic.

## **Second session: Adapting the grid to the new market players**

The third presentation was given by Mr Max Luke, Consultant at NERA Economic Consulting. The presentation began by showing that Distributed Energy Resources provide “stacks” of value to electricity systems and New York was the first State to adopt a value stack for Distributed Energy Resources.

Some values of Distributed Energy Resources are local and others are system-wide. On one hand, regarding locational values, Distributed Energy Resources can defer or avoid distribution network upgrades and avoid distribution losses. On the other hand, regarding system-wide values, Distributed Energy Resources can avoid environmental costs (specifically CO<sub>2</sub> emissions), avoid generation and transmission capacity expansion, and zonal marginal value of energy.

Mr Luke noted that Distributed Energy Resources can avoid distribution investment, considering distribution “hotspots” are uncommon in low-growth systems, the locational value decreases as more Distributed Energy Resources are added, and “Flexible” Distributed Energy Resources are likely to provide the greatest locational network relief over time. Also, he mentioned that Distributed Energy Resources can also provide reliability, but different customers value reliability differently.

In addition, Mr Luke noted that Distributed Energy Resources compete directly with larger resources for the provision of system-wide values. Larger resources tend to be cheaper than equivalent Distributed Energy Resources on a per-unit basis due to economies of scale. In this context, regulators and policymakers

must consider the “Distributed opportunity cost” when developing Distributed Energy Resources support policies.

Finally, Mr Luke emphasized getting Distributed Energy Resources prices right has important cost and equity implications for society and ratepayers.

- Policy prioritization of Distributed Energy Resources could leave on the table significant economies of scale associated with larger installations of the same types of resources.
- Prices that do not reflect locational values could incentivize Distributed Energy Resource investment in the wrong locations.
- Pricing the wrong values, such as certain types of reliability, could subsidize certain customers at the expense of others.

The fourth presentation was performed by Mr Michael Coddington, Principal Electrical Engineer at National Renewable Energy Laboratory. Firstly, the presentation highlighted that high penetration of photovoltaic and Distributed Energy Resources creates the need to update much more about standards, technology, tools, and rules.

Particularly, in the United States, high levels of photovoltaic and Distributed Energy Resources deployment required significant changes in 60 Hz interconnection standards & codes. In this context, IEEE 1547 “Standard for interconnection and Interoperability of distributed energy resources with associated electric power systems interfaces” had to be revised.

On one hand, the original standard IEEE 1547, published in 2003, established that Distributed Energy Resources shall not actively regulate voltage and shall trip on abnormal voltage/frequency. On the other hand, the new standard IEEE 1547, published in 2018, establishes that Distributed Energy Resources shall be capable of actively regulating voltage, shall ride through abnormal voltage/frequency events, shall be capable of frequency response/support, and may provide system inertia support.

The new IEEE 1547-2018 Standard and requests from high photovoltaic penetration states required the UL 1741 SA “Smart Inverter Standard”. Some autonomous functions established in the standard are as followings:

- High/low voltage ride-through
- High/low frequency ride-through
- Dynamic volt/VAr control
- Ramp rate function
- Soft start function
- Improved anti-Islanding
- Fixed Power Factor capability

Then, Mr Coddington noted that smart inverters can work together to support the Bulk Power System. Also, he presented the result of an experiment carried

out by NREL which demonstrated that photovoltaic plants (and wind power plants) can deliver essential grid services.

Finally, he described Preconfiguring and Controlling Inverter Set Points tool (PRECISE). This tool allows utility engineers to quickly determine inverter settings. Many energy regulators and utilities require advanced inverters to be used for new interconnections. PRECISE enables utilities to leverage these advanced inverter modes, help utilities identify optimal set-and-forget advanced inverter modes prior to installations, and can be used on 50 & 60 Hz distribution systems.

Afterward, a panel discussion was made up, composed of Mr Luke, Mr Coddington, and Paola Hartung, Regulatory Affairs Director Chile-Colombia at AES Gener. Furthermore, questions from the audience to the panel were received. The main aspects discussed on the panel were: Distributed Energy Resources values of defer or avoid distribution network upgrades, the competition with larger resources for the provision of system-wide services, prices to reflect locational values, the required changes in interconnection standards and codes, the smart inverter standards, and others aspects related to this topic.

### **Third session: Regulation schemes for new distributed energy resources**

The fifth presentation was performed by Eric O'Shaughnessy, Renewable Energy Research Analyst at Clean Kilowatts. The presentation began by showing the implicit incentives in rates in the context of "solar plus".

Then, the results of a study were presented. In that study the economics of "solar plus" was modeled using the U.S. National Renewable Energy Laboratory's Renewable Energy Optimization Tool, this tool could configure any optimal combination of photovoltaics, lithium-ion battery, smart water heater, and smart AC unit. Modeled economics under three rate structures that are generally less favorable to photovoltaic: Net billing (below-retail net metering), Time-of-use rates (non-coincident), and Demand charges (non-coincident).

In this context, Mr O'Shaughnessy presented some takeaways: rate design is incentive design in the context of solar plus; any net billing rate below retail contains an implicit incentive for solar plus, the magnitude of the incentive correlates to the gap between the retail rate and the export compensation rate; non-coincident time-of-use rates contain implicit incentives for solar plus technologies that facilitate load shifting from peak into off-peak periods, and demand charges contain implicit incentives for solar plus technologies that help customers reduce their demand charge payments.

Finally, the value of solar rate design in the United States was presented. A value of solar tariff is a rate structure where distributed solar output is credited

at a rate that reflects the value of that output to the grid and society. The value of solar tariffs can contain implicit or explicit incentives to push distributed solar to where and when that solar has the greatest value. The values of solar tariffs are in various stages of design and implementation in California, Minnesota, and New York. Particularly, in New York, the Value of Distributed Energy Resources (VDER) tariff is arguably the most advanced United States value of solar tariff. The tariff contains several implicit incentives, e.g., the demand reduction credit, and it also contains several explicit incentives, e.g., location system relief value, community credit.

The sixth presentation was performed by Daniel Olivares, Assistant Professor at Pontificia Universidad Católica de Chile, and Associate Researcher at Institute Complex Engineering Systems. The presentation began by mentioning the study prepared by the Institute Complex Engineering Systems for the Chilean Ministry of Energy, aimed to provide technical support in the development of a regulatory modification for the electricity distribution sector. Different aspects of the regulation were analyzed in the study, and specific proposals were developed regarding the structure of the sector, rate making, and operation and planning procedures. The different proposals were discussed and improved in several instances of participation, with representatives from the industry, government agencies, and society in general.

Then, Mr Olivares gave a future vision of the distribution grid, which included the following changes: more Distributed Energy Resources, a new role y expectations from consumers, a new role and expectations for companies and new market players, information and communication technologies, decarbonization, integration of variable renewable energies, and integration with other infrastructures. All these changes imply more complex, uncertain and dynamic distribution grid given new technology and resources available in the distribution grid, new players and roles, new services, products, markets, an upgrade of planning and y operation procedures, consumers with more supply alternatives, and increasing volume of information.

Additionally, Mr Olivares described the four main challenges for distributed generation in Chilean regulation. First, information transparency: distribution companies have an advantage over their competitors in the provision of distributed generation installation and related services, limiting the development of competition. Second, uncertainty in revenue streams: distributed generation, and distributed energy resources in general, face uncertainty regarding the markets that they will be able to access, and therefore the value of their investment. Third, coordinated and efficient planning: increasing penetration of distributed generation in certain areas of the system requires coordinated planning the ensure efficiency in network upgrades. Fourth, connection and use of system charges: current procedures do not guarantee transparent connection charges, and do not consider the use of system charges. Furthermore, there is room for speculative behavior in connection requests.

Finally, Mr Olivares presented some final remarks:

- Distributed generation, and Distributed Energy Resources in general, can have multiple benefits for the electricity grid.
- Information transparency is key for the development of a competitive market for distributed generation deployment.
- In order to maximize the benefits from Distributed Energy Resources, and facilitate their integration, barriers should be reduced for the participation of distributed generation in the different markets for electricity and associated products.
- Individual assessment of distributed generation connection requests is not practical for the massive integration of distributed generation, and will not facilitate the efficient expansion of the distribution network. Instead, periodical assessment in batches should be preferred.

Afterwards, a panel discussion composed of Mr O’Shaughnessy, Mr Olivares, and Ms Daniela González, Director Partner at Domo Legal. Furthermore, questions from the audience to the panel were received. The main aspects discussed on the panel were: how rates that incentivize “solar plus” could affect users without distributed energy resources, the New York Value of Distributed Energy Resources, the implicit and explicit incentives in tariffs, the opportunity of distributed energy resources to provide services to the grid, the Chilean challenges of the distribution sector, the next changes in the Chilean regulatory framework, and others aspects related to this topic.

## Second-day summary: Workshop

The objective of the second-day workshop was sharing information on best practices within APEC economies, as well as to facilitate a dynamic discussion among APEC representatives, international expert speakers and representatives from the Chilean Ministry of Energy. In this event, Malaysia and Peru representatives shared their experiences with the group.

The general structure of this event was the following:

- ❖ Welcome remarks
- ❖ Presentations by APEC representatives
  - Malaysia
  - Peru
- ❖ Open discussion

The workshop began with the welcome remarks by Mr Francisco Martínez, Head of the Regulatory Support Unit at the Chilean Ministry of Energy, who highlighted the energy transition are facing power systems in the world and also in Chile. This transition includes decarbonization of the energy matrix, distributed energy generation development, demand response, storage, electromobility, more participation of variable renewable energy, and other elements.

Mr Martínez noted that regarding Distributed Energy Resources, Chile established a Net Billing Law in 2014, in order to allow final energy customers installing and generating their energy. In 2018 this law was modified to improve the regulatory framework of Distributed Energy Resources.

Additionally, Mr Martínez highlighted that in 2018 the Chilean Ministry of Energy launched the Energy Road Map 2018-2022, aimed to guide the government's work on energy generation and distribution. In this Road Map, ten Mega Energy Commitments have been defined. He pointed out that one of these commitments corresponds to quadrupling the current capacity for distributed renewable generation of small-scale by 2022.

Afterwards, Malaysian and Peruvian representatives gave presentations to the group.

The Malaysian presentation was performed by Mr Mohd Azhar Ismail, Principal Assistant Secretary at the Ministry of Energy, Science, Technology, Environment and Climate Change, Malaysia. The presentation began by showing an overview of the Malaysia economy, agencies related to the energy sector, and energy utility companies.

Some energy-related Malaysian policies were described, from the National Petroleum Policy of 1975 to the recent National energy-efficient action plan and the Malaysian plan. Additionally, an overview of the energy sector in Malaysia was presented, including the primary energy supply by sources, the renewable energy contribution, the electricity generation mix by type and year, the installed capacity, the peak demand, and the reserve margin.

Afterwards, renewable energy in Malaysia was presented. In this context, Malaysia has the target of achieving 20% renewable energy in capacity by 2050 (excluding large hydro greater than 100 MW), nuclear is not an option as an energy source, and they want to give focus on energy efficiency and demand-side management. Regarding the potential of renewable energy, they have solar photovoltaic, bioenergy, and small hydro (lower than 100 MW). It is important to mention that, based on the preliminary study for Renewable Energy Transition Roadmap 2035, solar is the best renewable energy resource with a technical potential greater than 200 GW.

Developing large scale solar, net energy metering, and considering feed-in tariff are the key strategies of Malaysia to achieve 20% of renewable energy in 2025. The enablers to achieve this goal are the Green Technology Financing Scheme, Green Investment Tax Allowances, Green Income Tax Exemption, Green Tariff, and Renewable Energy Certificates.

Finally, Mr Azhar presented the future challenges of the Malaysian Electricity Supply Industry (MESI), which includes electrification, digitalization, and decentralization. Additionally, the key reform initiatives were described, that correspond to efficiency, customer experience, green/sustainability, and security.

The second presentation was delivered by Ms Krizia Herrera, APEC Specialist at the Ministry of Foreign Affairs of Peru. The presentation began by showing the relevant actors in the Peruvian energy sector that correspond to the Ministry of Energy and Mines, and the Supervisory agency for energy and mining investment.

Afterward, how the distributed generation is considered in the Peruvian regulatory framework was presented. The Law 28832 defines Distributed Generation as the generation facility connected to the networks of an electricity distribution concessionaire. Legislative Decree 1002 establishes that the development of electricity generation through renewable energy resources is declared of national interest and public necessity. This norm defines renewable energy resources for non-conventional renewable energies such as biomass, wind, solar, geothermal, tidal wave and hydroelectric plants that are less than or equal to 20 MW in size. This decree establishes generators with renewable energy resources that have characteristics of cogeneration or distributed generation must pay for the use of distribution networks.

The National Energy Policy of Peru 2010-2040 establishes, as a first objective, to have a diversified energy matrix, with emphasis on renewable sources and energy efficiency. To this end, it has established a policy guideline to promote the intensive and efficient use of conventional and non-conventional renewable energy sources, as well as distributed generation.

It is important to mention that there is an initiative by the Peruvian government to promote distributed generation in their national electricity system. In July 2011, the Draft Distributed Generation Regulation was presented with the objectives of promoting energy efficiency, diversifying the generation offer, providing a reliable and timely supply and reducing energy losses due to transmission.

Legislative Decree 1221 establishes that users of the public electricity service that have non-conventional renewable power generation equipment or cogeneration equipment up to the maximum power established for each technology, have the right not only to dispose of them for their own consumption but also to inject their surpluses to the distribution system. This is subject to the condition that it does not affect the safety of the distribution system to which it is connecting.

Afterwards, Ms Herrera described the initiatives by the Peruvian government to encourage the introduction of Smart grids in the national electricity system.

In 2012, OSINERGMIN Rate Regulation Management prepared a study to determine the costs and benefits of implementing Smart grids in the Peruvian electricity system. The results were obtained from the implementation of smart grids in distributed generation. In addition, this study proposed alternatives to incorporate this new technology in the Peruvian electrical system networks, based on the knowledge and end-to-end experience of smart grids. Finally, it

proposed an action plan for the implementation of intelligent electricity networks and showed a political and strategic vision for the modernization and positioning of the Peruvian electricity sector in terms of incorporating this technology for the next 5, 10 and 15 years.

Finally, Ms Herrera showed the challenges of installing smart grids and distributed generation, which corresponds to: it is necessary to establish an efficient management of investments for the deployment of the smart grids and distributed generation; an appropriate regulatory framework should be established for the deployment of the smart grid and distributed generation, particularly to establish the rate system (real-time rates) that is compatible with its operation; the creation of a Research Institute for the development of the smart grid needs to be promoted; it is important to develop programs that allow consumers to know the benefits of implementing smart grids and distributed generation; and improving financing options (government subsidy, public-private partnership, financing of some international organizations).

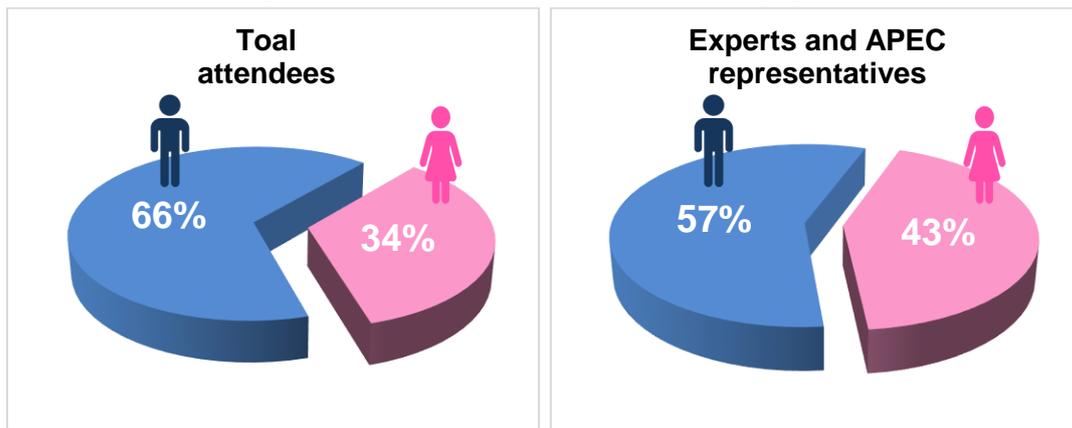
Afterwards, an open discussion was held among all the workshop participants (APEC representatives, international expert speakers and representatives from the Chilean Ministry of Energy). The main aspects discussed were: the regulatory challenges of Distributed Energy Resources related to promotion and rate design, the benefits of Distributed Generation, the grid planning and adoption to allow more Distributed Energy Resources in the system, the technical challenges, and others aspects related to the topic.

## Results analysis

### First-day seminar

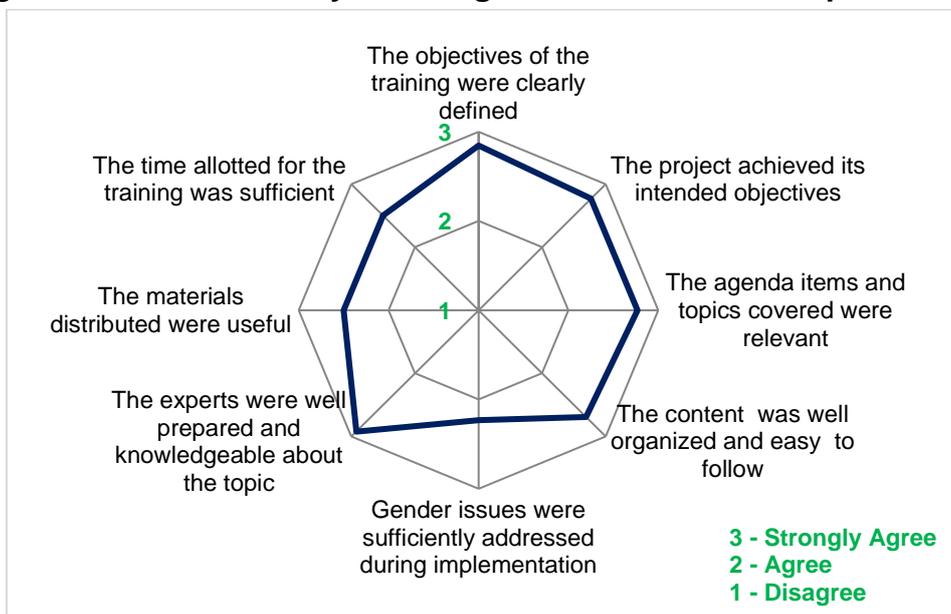
Thirty-two attendees participated in the first day, including five APEC representatives (Chile, Malaysia, Thailand, Viet Nam, and Peru), nine experts (international and Chilean), and an invited audience from the Chilean energy sector. Regarding participation by gender, on one hand, considering APEC representatives and experts, 43% were women and 57% men. On the other hand, considering the whole attendees, 34% were women and 66% men. The following figure shows these results.

**Figure 1: Seminar – Participation by gender**



During the seminar, an evaluation survey was circulated among the attendees. The following figure shows the average answers to some aspects asked on the survey.

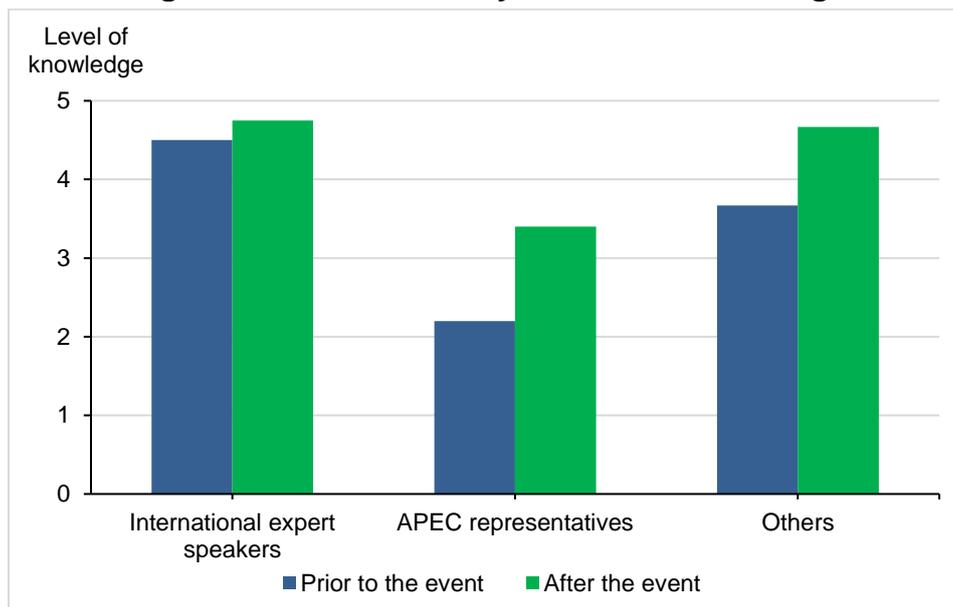
**Figure 2: Seminar survey – Average answers to some aspects asked**



The survey asked, “How relevant was this project to you and your economy”. The answer options to this question were: not much, a little, somewhat, mostly, and very. APEC representatives answered mostly and very, which indicates the topic is quite relevant to the APEC economies.

Additionally, the level of knowledge of the topic prior to and after participating in the event was asked to the participants. All attendees increased their level of knowledge on the topic after participating in the event, as can be seen in the following figure.

**Figure 3: Seminar survey – Level of knowledge**



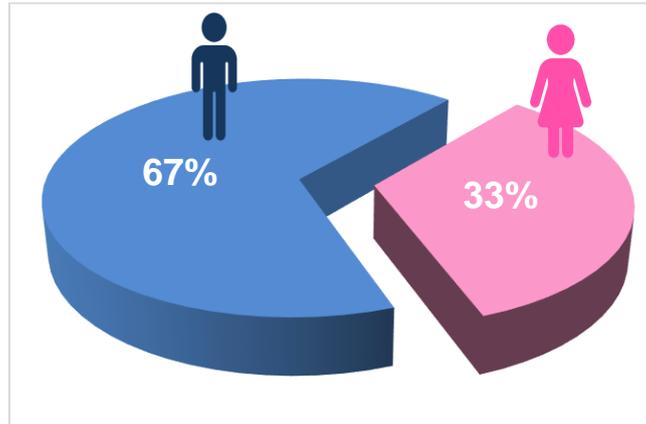
Links to the answered surveys can be found in the Appendix of this document.

## Second-day workshop

Fourteen attendees participated in the second day, including five APEC representatives (Chile, Malaysia, Thailand, Viet Nam, and Peru), four international experts, and five representatives from the Chilean Ministry of Energy.

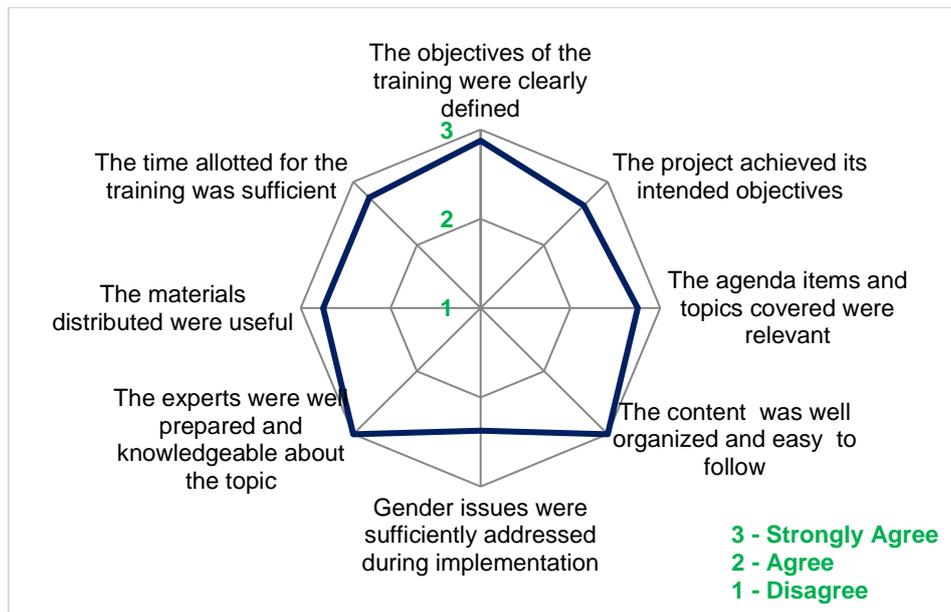
Regarding participation by gender of active participants in the discussion (APEC representatives and international experts), 33% were women and 67% men. The following figure shows this result.

**Figure 4: Workshop – Participation by gender**



During the event, an evaluation survey was circulated among the active participants in the discussion (APEC representatives and international experts). The following figure shows the average answers to some aspects asked on the survey.

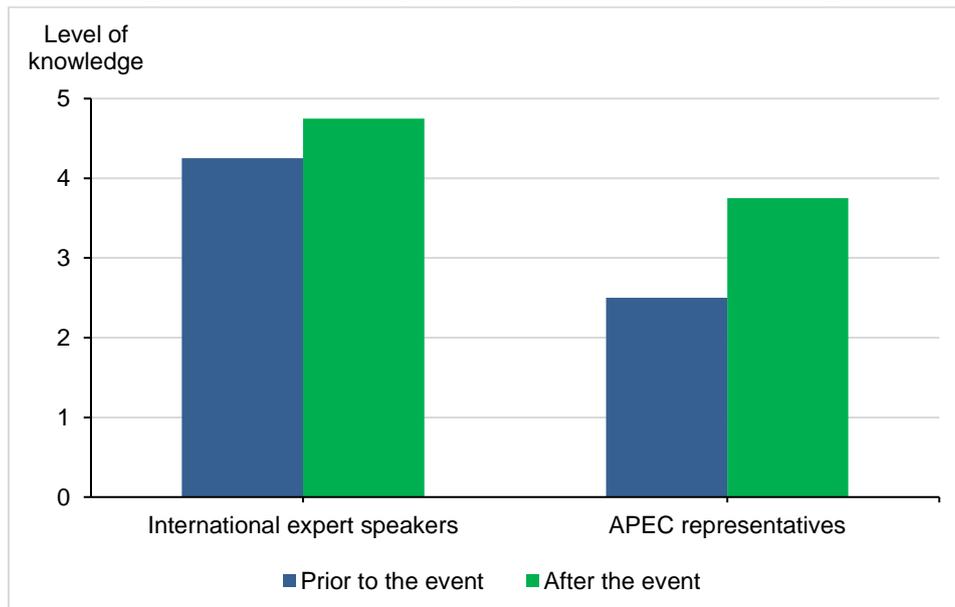
**Figure 5: Workshop survey – Average answers to some aspects asked**



The survey asked, “How relevant was this project to you and your economy”. The answer options to this question were: not much, a little, somewhat, mostly, and very. APEC representatives answered mostly and very, which indicates the topic is quite relevant to the APEC economies.

Additionally, the level of knowledge of the topic prior to and after participating in the event was asked to the participants. Both APEC representatives and international experts increased their level of knowledge on the topic after participating in the event, as can be seen in the following figure.

**Figure 6: Workshop survey – Level of knowledge**



Links to the answered surveys can be found in the Appendix of this document.

## Conclusion

In summary, the workshop on Distributed energy resources regulation and rate design was carried out smoothly, where expert speakers and APEC representatives could discuss distributed energy resource integration, including the distribution sector challenges, tariff design, benefits, technical challenges, policies, and regulations.

The participants of the workshop and seminar shared knowledge and experience about cross-cutting distribution regulation innovation based on some study cases presented during the seminar. Besides, they could review the best practices and experiences of economies and share the learnings about the deployment of solutions related to distributed energy resources.

According to the survey results, in both events, the participants increased their level of knowledge of the topic discussed after participating in them. Regarding participation by gender, woman participation was 34% and 33%, on the first and second day, respectively.

The participants appreciated the opportunity to exchange views on distributed energy resources, as well as international experiences and best practices on market regulation and policies to promote distributed generation in power systems.

Also, the participants expressed a strong desire to maintain the contacts they had established during the workshop and seminar, and their deep appreciation to the organizers of the events for the efficient organization and the warm hospitality extended to them.

# Appendix

The following appendix contains links to the presentations exposed during the seminar and workshop, links to the answered surveys in the seminar and workshop, and the seminar agenda.

## Links to presentations

- Presentations exposed during the seminar (October 23rd) can be found in the following link:  
<https://www.dropbox.com/sh/exkh4ouknnr42n7/AABcK0MPJMyP9aPpeht92y3ga?dl=0>
- Presentations exposed during the workshop (October 24th) can be found in the following link:  
<https://www.dropbox.com/sh/tmjhzj9aajl9r85/AAB9VZ4zyjbSZuH0rlvrTBGaa?dl=0>

## Links to surveys

- Answered surveys for the seminar (October 23rd) can be found in the following link:  
<https://www.dropbox.com/s/rcf04wec46ktkbd/EWG%2016%202018%20-%20Survey%20-%20October%2023rd.pdf?dl=0>
- Answered surveys for the workshop (October 24th) can be found in the following link:  
<https://www.dropbox.com/s/bjjc4fkmrw6857z/EWG%2016%202018%20-%20Survey%20-%20October%2024th.pdf?dl=0>

## Seminar agenda

Agenda - October 23rd		
09:00 – 09:30	Registration	
09:30 – 09:40	Welcome remarks Gabriel Prudencio, Head of Sustainable Energy Division, Ministry of Energy	
Beyond the meter: The future of distributed energy resources		
09:40 – 10:40	<p><b>Expert speaker presentations and panel discussion</b></p> <ul style="list-style-type: none"> <li>• <b>Luis Enrique Gutiérrez Tavarez</b> Energy Analyst – System Integration of Renewables International Energy Agency</li> <li>• <b>David Eduardo Watts Casimis</b> Associate Professor Pontificia Universidad Católica de Chile</li> <li>• <b>Daniela Martínez</b> Lawyer, energy expert Independent consultant</li> </ul>	
	10:40 – 10:50	Coffee break
	Adapting the grid to the new market players	
10:50 – 11:50	<p><b>Expert speakers presentations and panel discussion</b></p> <ul style="list-style-type: none"> <li>• <b>Max Luke</b> Consultant NERA Economic Consulting</li> <li>• <b>Michael Coddington</b> Principal Electrical Engineer National Renewable Energy Laboratory</li> <li>•  <b>Paola Hartung Martinez</b> Regulatory Affairs Director Chile Colombia AES Gener</li> </ul>	
	11:50 – 12:00	Coffee
	Regulation scheme for new distributed energy resources	
12:00 – 13:00	<p><b>Expert speakers presentations and panel discussion</b></p> <ul style="list-style-type: none"> <li>•  <b>Eric O'Shaughnessy</b> Renewable Energy Research Analyst Clean Kilowatts</li> <li>• <b>Daniel Olivares</b> Assistant Professor – Researcher Pontificia Universidad Católica de Chile – ISCI</li> <li>•  <b>Daniela González Durán</b> Director Partner Domo Legal</li> </ul>	
	13:00 – 13:05	Closure