1 SMART GRID

# Digitalization in the energy sector in Chile

**Smart Substation**

**Feeder Automation**

**Microgrids**

**The communication support schemes and real-time measurement techniques of smart grid enhance resiliency and forecasting as well as offer protection against internal and external threats.**

## Application presence by country

| Uses/Applications | Germany | Finland | Japan | China | USA | UK | Sweden | France | South Korea | Singapore |
|---|---|---|---|---|---|---|---|---|---|---|
| Smart Substation | | ■ | | | | | | | | |
| Feeder Automation | | | | | ■ | ■ | ■ | ■ | ■ | ■ |
| Microgrids | ■ | | ■ | ■ | ■ | ■ | ■ | | | ■ |

## Application potential by sector

| Uses & Applications | Transportation | Industry | Buildings | Electricity Generation | Finance | Public Sector | Main type of energie |
|---|---|---|---|---|---|---|---|
| Smart Substation | | ■ | | ■ | | | Electricity |
| Feeder Automation | | | | ■ | | | Electricity |
| Microgrids | ■ | ■ | ■ | ■ | | ■ | Electricity |

## Enabling Technologies

| Technologies | Load monitor | In home display | Smart thermistat | Smart light | Smart plug/switch | Smart appliance | Hub | Smart meters | AMR/AMI | V2G | EV/PHEV | IED (relays, SCADA... | PMU | WAMS | Smart Sensors | Sensor and actuator | LAN/HAN/NAN/WAN | Cloud | 5G | Machine learning | Data mining | Nature inspire | ANN | Multi-agent systems | Clustering | NLP | Digital twin | Autonomous vehicle | Blockhain | Actuators | 3D printers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Uses & Applications** | Smart home & Smart building | | | | | | | Smart grid | | | | | | | IoT & IoE | | | | | Big data, machine learning & AI | | | | | | | | | | Physical action |
| Smart Substation | | | | | | | | ■ | ■ | | | ■ | ■ | ■ | | | ■ | | | | | | | | | | | | | |
| Feeder Automation | | | | | | | | | ■ | | | ■ | ■ | ■ | | | ■ | | | | | | | | | | | | | |
| Microgrids | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | ■ | | | | | | | | | | | | |

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# Digitalization in the energy sector in Chile



## 1.1 Smart Substation

**In this kind of substation, the workstation, protection devices, and low-level transducers are connected together on an optical fiber communications backbone.**

### Common examples

- In the future it's expected to have a high penetration of distributed resources, which leads to a scenario of bidirectional flows which could bring stability and protection problems. This is why the installation of smart substation is crucial to have a better control and monitoring of the grid.

### Opportunities

By improving control and monitoring of substation, its's possible to reduce maintenance and operation costs, reduce the physical space needed, improve personell safety and collect more accurate information.

Better and faster communication technologies allow an adequate response to contingencies.

### Information, infrastructure and regulation requirement

- Infrastructure needed for the communication systems.
- It's necessary that National Energy Commission include this technology in its transmission planning plans and in the technical normative.

### Barriers

**Economic:** high investment cost; incentives are required.

**Security:** system operation information must be safeguarded.

**Others:** lack of quantification of potential benefits.

### Application synergies

- Smart substations are crucial to applications like DER (2.4), Energy storage (2.2) and Microgrids (1.3), in order to have a more reliable and fast communication system.

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# Smart Substation



## International real application

Iberdrola, one of the world's largest electricity utilities, joined forces with Intel and six other actors to create a new intelligent, open standard for secondary substations. The consortium is embracing the need for better efficiency by developing a Secondary Substation Platform reference architecture that uses Intel CPUs to facilitate the deployment of a standards-based, open, interoperable, and more secure architecture[1].

[1] "Iberdrola anuncia una alianza para acelerar la digitalización de las subestaciones secundarias" Iberdrola, November 11, 2019.

## Examples of international goals

The Smart Grid Enablers project of the British public utility Northern PowerGrid seeks to modernize all its 8,000 substations by 2023.

The objective is to achieve the joint modernization of the grid to increase the use of renewable energy and abandon the use of fossil fuels.

## National key partners and resources

## Public policies recommendations to Chile

- Include this kind of projects in the transmission planning plans.
- Define sovereignty of the data explicitly in the regulation.

### CURRENT STATUS OF THE APPLICATION IN CHILE

LOW | MEDIUM | HIGH

### FORECAST OF FUTURE DEMAND FOR THE APPLICATION

LOW | MEDIUM | HIGH

# Digitalization in the energy sector in Chile



## 1.2 Feeder Automation

**FA is the ability to monitor and control the distribution network remotely, to collect and provide information to consumers in a useful manner.**

### Common examples

- In case of an emergency, like the fall of a tree on a transmission line, thanks to feeder automation it's possible to have a faster detection and perform the necessary procedures (open switches, call emergency institutions, etc.)

### Opportunities

Reliability and resilience can be improved by better control and communications systems.

It's possible to recognize the origin of a contingency, which could generate a faster response for its clearance and reduction of failure time.

The information about the state of the grid could be useful to generate changes in DERs configuration according to the needs of the grid.

### Information, infrastructure and regulation requirement

- It's necessary to give economic incentives to distribution companies in order to implement this type of equipment.
- There's a lack of regulation that aims to improve quality standards and supply security.

### Barriers

**Economic:** current level of digitalization is low, so it becomes very expensive in terms of investment.

**Others:** the need to collect information requires infrastructure that costumers may not want to accept.

### Application synergies

- Thanks to the technological advances in the implementation of FA, it's possible to use applications such as DER (2.4) and Energy storage (2.2).

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# Feeder Automation



## International real application

The Easergy T300 of the European company Schneider, is a remote terminal unit used in low and medium voltage distribution systems. It can reduce outage time by advanced fault detection, communication and automation. It allows to decrease up to 5 times the System Average Interruption Duration Index (SAIDI) and Frequency Index (SAIFI)[2].

[2] "A powerful Remote Terminal Unit for feeder automation". Available on https://www.se.com/ww/en/product-range-presentation/62399-easergy-t300/

## Examples of international goals

- No specific targets were found

## National key partners and resources

Ministerio de Energía – Gobierno de Chile; COORDINADOR ELECTRICO NACIONAL; SEC SUPERINTENDENCIA DE ELECTRICIDAD Y COMBUSTIBLES; empresas eléctricas A.G.

## Public policies recommendations to Chile

- Modernize technical normative: adopt common data architecture, tools and standards.
- Encourage investment by private parties in projects associated with digitalization: recognize value-added services.

### CURRENT STATUS OF THE APPLICATION IN CHILE

LOW | MEDIUM | HIGH

### FORECAST OF FUTURE DEMAND FOR THE APPLICATION

LOW | MEDIUM | HIGH

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# Digitalization in the energy sector in Chile



## 1.3 Microgrids

**A group of interconnected loads and distributed energy resources (DERs) with clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid and can connect and disconnect from the grid to enable it to operate in both grid-connected or island modes.**

### Common examples

- When there is a very remote area, it is expensive to build transmission lines to reach the place, so it is more convenient to build a microgrid that can be self-sustaining.
- Asia Pacific leads the world in microgrid with 9,9 GW installed capacity, followed by North America with 8,8 GW and the Middle East & Africa with 3,6 GW.
- Remote, commercial and industrial microgrids represent nearly 70% of all microgrid capacity globally[2].

[3] "Interesting statistic on global microgrid projects" June 16, 2019, Availabe on https://www.smart-energy.com/renewable-energy/interesting-statistics-on-global-microgrid-projects/

### Opportunities

- They are capable of isolating during contingencies, giving continuity of electricity supply to consumers.
- They can provide electricity to rural places that are currently disconnected from the main grid.
- They can help to reduce electricity bills, by operating in islanded mode in peak demand hours.

### Information, infrastructure and regulation requirement

- Installation of distributed resources is required, as well as control and protection devices.
- It's necessary to objectively define the microgrid concept.

### Barriers

- **Infrastructure:** new infrastructure is needed due to bidirectional power flows, stability and protection problems, coordination with centralized gid, safety, etc.
- **Regulatory:** lack of clear definition of microgrid and its obligations.
- **Economic:** it depends on the reduction of production costs of renewable generation, storage technologies and energy management systems.

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# Microgrids



## Application synergies

- Participants of the microgrid could be in a Demand response (2.1) program to operate in island mode in certain hours of the day to get revenues for it.
- By aggregating and coordinating distributed resources it's possible to form a VPP (2.3) and compete with conventional generators.
- It's possible to commercialize energy between microgrids connected to the main grid (P2P (3.1))

## International real application

The Renewable Energy Integration Demonstrator – Singapore (REIDS) is the largest hybrid microgrid test and research platform in the tropics. Launched by the Nanyang Technological University Singapore (NTU), supported by the country's Economic Development Board (EDB) and National Environment Agency (NEA), REIDS aims to study, and demonstrate the ability to achieve sustainable, affordable energy access to all parts of Southeast Asia. The REIDS initiative will serve as a model for the planning, deployment, and operation of physical microgrids tapping into the renewable potential in the region.

## Examples of international goals

The target for 2020 is to develop commercial scale microgrid systems (capacity<10MW) capable of reducing outage time of required loads by >98%, while reducing emissions by >20% and improving efficiency by >20%.

Not specific goal tied directly to microgrids, but they are considered to be an important factor in the energy transition.

## National key partners and resources

## Public policies recommendations to Chile

- Encourage investment by private parties in projects associated with digitalization: recognize value-added services.

### CURRENT STATUS OF THE APPLICATION IN CHILE

LOW | MEDIUM | HIGH

### FORECAST OF FUTURE DEMAND FOR THE APPLICATION

LOW | MEDIUM | HIGH