Non-Conventional Renewable Energies in the Chilean Electricity Market

Edition 2020

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Por encargo de:

Ministerio Federal de Medio Ambiente, Protección de la Naturaleza y Seguridad Nuclear de la República Federal de Alemania

Ministerio de Energía
Gobierno de Chile

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Internationale Zusammenarbeit (GIZ) GmbH

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Registration of Intellectual Property, ISBN: 978-956-8066-40-6. Fourth edition: November 2021

Appointment:
Title: Non-Conventional Renewable Energies in the Chilean Electricity Market
Author(s) fourth edition: GIZ and Ministry of Energy
Author(s) first edition: Rodrigo Palma Behnke, Guillermo Jiménez Estévez, Ignacio Alarcón Arias and GIZ
Review and modification: GIZ and Ministry of Energy
Edition: GIZ and Ministry of Energy
Santiago de Chile, 2021
195 pages
Energy - Renewables - NCRE - Electricity market

Clarification:
This publication has been prepared on behalf of the "Decarbonization of the Energy Sector in Chile" project implemented by the Ministry of Energy and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH within the framework of intergovernmental cooperation between Chile and Germany. The project is financed through the International Climate Initiative (IKI) of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety - BMU. Notwithstanding this, the conclusions and opinions of the authors do not necessarily reflect the position of the Government of Chile or GIZ. In addition, any reference to a company, product, brand, manufacturer or other similar in no case constitutes a recommendation by the Government of Chile or GIZ.

Santiago de Chile, 30 de noviembre de 2021

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The first edition of the book of the year 2009 was elaborated by Rodrigo Palma Behnke, Guillermo Jiménez Estévez and Ignacio Alarcón Arias of the Foundation for Technological Transfer (UNTEC) and the University of Chile. This publication was then complemented in 2012 and developed in a context where the NCRE had very limited participation in the national electric system and in a context of market totally different from the current one. Thissecond edition updatedd and replacedd the previous one, building on it the inclusion of regulatory changes that have revolutionized the national electricity market, making the NCRE the dominant sources in the expansion of the national energy matrix. This update is carried out by GIZ and the Ministry of Energy.

Preface

Following the approval of the General Law of Electrical Services (Ley General de Servicios Eléctricos - LGSE) in 1982, Chile laid the basis for the creation of a competitive electric system that was pioneering at international level. The associated regulatory framework has been improved over the years, maintaining its original goal as a system operated at a minimum global cost, although the interpretation of this principle was evolving over time. This framework remained relatively stable until 2004, when through a change to the LGSE, made official by Law 19.940, modifies a set of aspects of the electricity market that affect all means of generation and others applicable exclusively to the Non-Conventional Renewable Energies (NCRE), improving its conditions of access to the market, providing the right to evacuate energy through distribution networks, granting exemptions from transmission charges to smaller scale NCRE projects, among other notable changes.

Later, in 2008, Law 20.257 became effective, which obliges electricity companies that sell to final customers provide a percentage of the energy marketed through NCRE projects, generating a fundamental change in the national electricity market. This Law was updated by Law 20.698 of 2013, which increased the obligation percentages.

Even more profound changes have been experienced in the electricity market in recent years, with the regulation and refinement of new markets such as distributed generation of up to 9 MW (Supreme Decree N°244 of 2005/2006 and Decree N°101 of 2015), residential and commercial distributed generation (Law 20.571 of 2012/2014, and Law 21.118 of 2018), refinement to the system of regulated customers energy blocks bidding (Law 20.805 of 2015), structural reform to the planning, expansion and payment of transmission systems and the creation of a single independent coordinator of the electric system (Law 20.936 of 2016). This law consolidates the efforts undertaken by the Chilean State to remove barriers to the incorporation of the NCRE to the national electricity generation matrix as a way to contribute to the objectives of economic efficiency, security of supply and environmental sustainability which govern Chile's energy policy.

Finally, it is worth mentioning the new commitments in recent years related to the integration of NCRE, among them, the retirement and / or reconversion schedule of the coal-fired thermoelectric plants, the flexibility strategy and the green hydrogen strategy.

All these commitments, modifications to the national electric system and market have represented price signals and business models that are quickly captured by different decision makers in the electricity market. These signals are also perceived by potential investors of NCRE projects, both those currently present in the national electricity market and other potential new investors. This has led to an explosive development of NCRE projects in the national electric systems during the last 10 years, raising Chile as a Latin American leader in the development of projects of this type of technologies.

The aim of this document is to contribute to this process, providing an analysis of relevant aspects to the development of NCRE projects from the perspective of an investor or project developer, foreign and national, who may not necessarily have detailed knowledge of the Chilean electricity market. The analysis focuses on the process of integration and operation of NCRE in the market, without delving in great depth into aspects such as the evaluation of natural resource potential, technology selection, or financing schemes. This publication aims to be a guide and provide a conceptual basis for investors, project developers and other interested parties.

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Abreviaturas

BT	Low voltage
Cmg	Marginal cost
CNE	National Energy Commission
Coordinador	Independent Coordinator of the National Electric System
CORFO	Corporation for the Promotion of Production
DFL	Decree with force of law
D.S.	Supreme decree
EAE	Strategic Environmental Assessment
ERNC	Non-Conventional Renewable Energies
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH - German Technical Cooperation
ICC	Connection criteria report
IFOR	Forced Generator Failure Rate
kW	Kilowatt
kWh	Kilowatt hour
LGSE	General Law of Electrical Services
MGNC	Non-Conventional Generator
MP	Power range
MRT	Theoretical reserve margin
MT	Medium voltage
MW	Megawatt
MWe	Electric Megawatt
MWh	Megawatt hour
MV	Megavolt
MVA	Megavoltamp
NTCO	Technical Standard for Connection and Operation of Small Generation Distributed at Medium Voltage
NTSyCS	Technical Standard for Security and Quality of Service
O&M	Operation and Maintenance
PMG	Small Generator
PMGD	Small Distributed Generator
PN	Node Price
RME	Exemptive Ministerial Resolution
SCR	Network Connection Request
SEC	Superintendency of Electricity and Fuels
SEIA	Environmental Impact Assessment System
SEN	National Electric System
SIC	Central Interconnected System
SINEA	Andean Electric Interconnection System
SING	Large North Interconnected System
SpotG	Generator spot price
SpotL	Load spot price
SSCC	Ancillary services
UTM	Monthly Tax Unit
VAD	Added Value of Distribution

1 Introduction

1.1 Motivation and justification

The structural change observed on a global scale in the ownership and management of the electricity industry has been particularly strong since the second half of the 1990s. Chile was a pioneer in introducing free competition in the generation segment and in the separation of generation functions, transmission and distribution of electric energy. In 1982 was enacted the DFL N° 1/1982, it introduced competition and privatization of the Chilean electricity sector. An operating model is established at a minimum global cost, and it is encouraged that generation companies can freely subscribe to supply contracts with free customers and distribution companies, which supply regulated customers.

For more than 20 years, the Chilean electricity market has been improved through the creation of regulations and standards, a situation that is beginning to change when Chile faces a major energy crisis, which over time combines several conditions, including gas supply restrictions Argentine natural, an important drought that limits the contributions of hydroelectric plants, slowing of the investments in the sector, etc. Thus, the changes to the General Law of Electrical Services (LGSE), made official in March 2004, through Law 19.940, modified a set of aspects of said market that affects all means of generation, also introducing

elements especially applicable to non-conventional renewable energy (NCRE). It is worth mentioning the possibility of small-scale generation to participate in the electricity market, and partial or total exemption of charges from transmission systems for small-scale NCREs.

Likewise, Law 20.257 came into effect on April 1, 2008, which establishes that electricity companies that sell energy to final customers must prove that a percentage of the energy sold comes from non-conventional renewable energy sources. This establishes a progressive increase of the NCRE participation until reaching 10% in 2024. This obligation was increased in 2012, through Law 20.698, establishing a new NCRE obligation of 20% for 2025. The electric company which does not comply with this obligation, must pay a tax for each MWh of deficit in respect of its obligation, which in practice has rapidly strengthened interest in the search and development of cost-effective NCRE projects.

Beyond the same regulation, one of the unpublished processes that has driven the sector development was carried out in 2014 and consisted of a participatory planning process for the long-term energy policy denominated Energy 2050, a process that extended for more than 18 months with significant national impact. As part of this process, a number of instances of discussion were held and an Advisory Committee was formed composed of different actors from both the public and private sectors and scholars. As a result, 34 strategic guidelines were established with their respective action plan, both for the year 2030 and for 2050, generating an unprecedented policy and road map in the country. In the field of renewable energies, one of the most radical goals was established, by 2035, reaching at least 60% of the national electricity generation comes from renewable sources and by 2050 this value increases to 70%. A summary of these and other goals established in the participatory planning process is presented in Figure 1.

Figure 01

Main goals for the year 2035 and 2050 Energy Policy 2050

PRINCIPAL ENERGY GOALS – 2035

Figure 1: Main goals for the year 2035 and 2050 Energy Policy 2050

Figure 01

Main goals for the year 2035 and 2050 Energy Policy 2050

(Continuation)

PRINCIPAL ENERGY GOALS - 2050

1

Electricity outages **do not exceed 1 hour/year in any locality in Chile**, except in cases of force majeure.

2

The GHG emissions of Chile's energy sector are consistent with the thresholds defined by international guidelines and with the corresponding national emissions reduction goal, making an important contribution to achieving a low-carbon economy.

3

Ensure universal and equitable access to modern, reliable and affordable energy services for the entire population.

4

Regional and local territorial planning and land-use instruments are in line with the guidelines of the Energy Policy.

5

Chile is among the 3 OECD countries with the lowest average residential and industrial electricity prices.

6

At least 70% of the electricity generated in Chile comes from renewable energy sources.

7

Growth of energy consumption is decoupled from GDP growth.

8

100% of new buildings meet OECD standards for efficient construction, and are fitted with intelligent energy control and management systems.

9

100% of the major categories of appliances and equipment sold in Chile are energy-efficient.

10

Energy culture is installed at all levels of society, including energy producers, distributors, consumers and users.

Source: Energy 2050 Energy Policy of Chile. Ministry of Energy

Once again in the area of regulation, Law 20.571 became effective in 2014, which regulated the payment of electric tariffs of generators in regulated customer facilities, thereby enabling distributed generation. This Law is known as Netbilling or Distributed Generation or Residential Generation and has allowed the installation of self-sufficiency projects with the possibility of injecting their surplus into the network, receiving payment for them. With the Law 21.118 of 2018, the power limit of the projects increased from 100 to 300 kW.

In 2015 and 2016 new laws of great relevance for the national electric sector have been approved and became effective. Law 20.805, which improved the system of tendering for electricity supply for customers subject to price regulations, has made it possible to considerably improve competition in these tenders. Also, the barriers that renewable energy projects had to participate have reduced, allowing them to concentrate their offers in the blocks where they effectively have their resources available and thereby pushing the prices offered downwards.

On the other hand, Law 20.936, which establishes a new electric transmission system and creates an independent coordinator of the National Electric System (SEN), enacted in July 2016, introduces structural changes that modify the expansion, planning, payment of the transmission, providing a robust transmission network, with great capacity of integrating NCRE projects throughout the country. It also establishes the empowered figure and the guidelines for the operation of the Coordinator as a technical and independent body responsible for coordinating the operation of all the SEN, replacing the former Economic Load Dispatch Centers (CDECs), adding new functions, attributions and obligations.

It is worth mentioning the latest commitments announced by the Ministry of Energy that encourage the integration of NCRE. Among these, the agreement signed by the companies that own the coal-fired thermoelectric plants, who committed to the completion of the development of new coal-fired plants in the country that do not have carbon capture systems, and the establishment of a Roundtable each five years, which will analyze the effects of the phase-out and/or conversion of units to coal on the safety and economic efficiency of the SEN, the local economic activity and the environmental aspects that have an impact. After the first Roundtable and as a result of the Ministry's negotiations with the coal-fired thermoelectric companies, in June 2019 a schedule was agreed for the phase-out and/or conversion of 8 units to coal by 2024, and the total phase-out of the existing units by 2040. Following this announcement, the closure of some units was brought forward, in addition to adding 7 new units to the schedule and the reconversion of 3 more units by 2025.

On the other hand, in September 2020, the Ministry of Energy together with the CNE launched the Flexibility Strategy, which defines the guidelines for modifications of the regulatory framework in order to address the new operational challenges that the SEN with the massive integration of ERNC projects.

Also, in November 2020, the national green hydrogen strategy was launched for public consultation, which is a long-term policy that establishes the ambitions to create a new hydrogen industry from renewable energies.

The new commitments, laws, regulations and standards associated with these changes translate into price signals and fundamental changes in business models for NCRE. These changes have been quickly captured by decision-makers in the electricity market and especially by potential investors in NCRE projects, both those currently present in the national electricity market and new national and international investors. This has been manifested in a dynamic process of development of NCRE projects in national electric systems, which in has resulted in an explosive development of NCRE projects, boosting Chile as a Latin American leader in the development of projects in this type of technologies, especially in large-scale photovoltaic solar andand wind power.

1.2 Objectives and scope

Due to the characteristics of the Chilean electricity market model and the regulatory changes associated with the electricity sector and the NCRE, the need to have an updated publication on the electricity market in Chile from the perspective of unconventional renewable energies arises. Moreover, following a significant number of legal modifications made in recent years and especially during 2015 and 2016, changing fundamental aspects for the integration, evaluation, development and operation of NCRE projects. For this reason, this document updates all the contents, including the latest regulatory changes, highlighting their impact on NCRE.

The purpose of this document is to contribute to the development and integration process described in the previous section, providing an analysis of different aspects relevant to the development of NCRE projects from the perspective of a foreign and national investor. It seeks to provide a comprehensive description and analysis of the Chilean electricity market, to guide legal and regulatory fundamentals, business opportunities, obligations and risks associated with market participation, and operational aspects, including costs and payment.

It should be noted that the document does not dwells into aspects of evaluation of the potential of natural resources, selection of technologies and financing schemes. Similarly, it is important to clarify that the scope of this document includes the integration and operation in the market of the NCRE in the SEN, which is conformed by the old SIC and SING systems, since other smaller systems operate under a different economic regime.

In this way, the document aims to guide potential developers of NCRE projects and other stakeholders who do not necessarily have a thorough knowledge of the operation and functionality of the electric system in Chile.

1.3 Structure of the document

Chapter two presents an overview of the Chilean electricity sector, considering both available supply and demand and regulatory treatment of different types of consumers. In addition, it describes the regulatory treatment of the infrastructure of the electric system, transmission, storage and distribution to finally describe the institutionality of the sector.

Chapter three describes the operation of the Chilean electricity market, including its economic design and technical elements to consider. It also includes a brief description of the emerging market of distributed generation, targeting residential customers, commercial customers, agricultural producers, small industrialists, etc.

Chapter four describes the stages of development that involve a NCRE project, taking into account the different elements needed to be considered at each stage and describing more technical and specific aspects of the current requirements that are made to NCRE projects to be integrated into the transmission system. It also describes the NCRE laws that establish a minimum generation quota and presents the current state of compliance with this limit.

Chapter five presents an analysis of the elements to be considered in the integration of NCRE into the market, including regulatory, technical and economic aspects. This chapter places particular emphasis on Small Distributed Generation Systems (PMGDs) corresponding to projects of up to 9 MW that connect to distribution networks. In addition, the information platforms available for the evaluation of NCRE projects throughout the country are described.

Meanwhile, chapter six describes the operation in the market of this type of projects, detailing the alternatives of business models, and the payments for use of the transmission and distribution systems.

2

Overview of the Chilean electricity sector

2. Overview of the Chilean electricity sector

This chapter details specific aspects of the Chilean electricity sector, starting with the general description of the country's electric systems. Then the current supply of energy and electric power, besides its technological composition are described. Subsequently, the classification of the types of customers established in the current regulation is detailed. Next, a description of the transmission systems (with special emphasis on access, payment and planning, all aspects modified in 2016) and distribution systems are presented. Finally, the institutional structure of the electricity sector in Chile is described.

2.1 Electric systems

In the national electricity industry, private companies are involved in the generation, transmission and distribution sectors. In generation, as in most systems at the international level, the Chilean electricity sector has a high level of market concentration. That is, few companies have a significant participation and leadership in the generation sector. However, the latest legal changes have been especially relevant to mitigate this reality. The regulatory changes, described throughout this book and that can be found chronologically ordered in Annex 1, are allowing to break down a series of barriers to entry into the generation sector, especially for non-conventional renewable generation. With this, new companies are able to enter the market and form part of the national electric system, expanding supply, increasing competition and reducing supply prices.

An electric system consists of the whole set of power plants, transmission lines, electrical sub-stations and distribution lines, all of them interconnected, enabling the generation, transmission and distribution of electricity[1]. In Chile, these interconnected systems are classified according to their size. Therefore, an interconnected system will be classified as National Electric System if it has an installed capacity of generation of 200 MW[2] or more. Medium-sized systems have an installed capacity of over 1.5 MW and less than 200 MW[2] and small ones have an installed capacity of 1.5 MW or less. The main Chilean electric systems are the following: The National Electric System (SEN), the Aysén Electric System and the Magellan Electric System. These systems are briefly described below:

[1] Article 225 letter a), DFL No 4

[2] Article 225 letter b), DFL No 4

[3] Article 173 DFL No 4.

▸ The National Electric System (SEN): it is the national system that supplies the north and center of the country, from Arica in the north to Quellón in the south. This system was formed by the interconnection of two systems as of November 2017, the North Grande Interconnected System (SING) and the Central Interconnected System (SIC). The SEN constitutes 99.31% of the total installed capacity of the country.
▸ Aysén Electric System (SEA): in practice it corresponds to five medium sub-systems located in the southern zone of the country: Palena, Hornopirén, Carrera, Cochamó and Aysén. Its joint capacity represents 0.2626% of Chile's installed capacity.
▸ Magallanes Electric System (SEM): Consists of four medium-size systems: Punta Arenas, Puerto Natales, Porvenir and Puerto Williams, that supply the cities with the same names. It is located in the southernmost extreme of Chile. Its joint installed capacity represents 0.4343% of Chile's installed capacity.

Although the focus of this book is on the SEN, previously described, it is worth mentioning that in the smaller scale systems, such as the medium systems of Aysén and Magallanes, the tariff structure is based on the determination of average costs per segment (generation, transmission, distribution) and supply is mainly through a regulated monopoly, so the opportunities for NCRE projects are fundamentally different from those presented in this book.

2.2 Electricity supply

Table 1 summarizes the installed capacity in December 2020 in each of the systems indicated above, disaggregated in conventional sources and non-conventional renewable energy (NCRE). In turn, Figure 2 shows the installed capacities of the systems by December 2020. Updated information on national electricity sector statistics can be found in the website "Energía Abierta"[4].

Table 01 **Installed capacity in the country by system (in MW)**

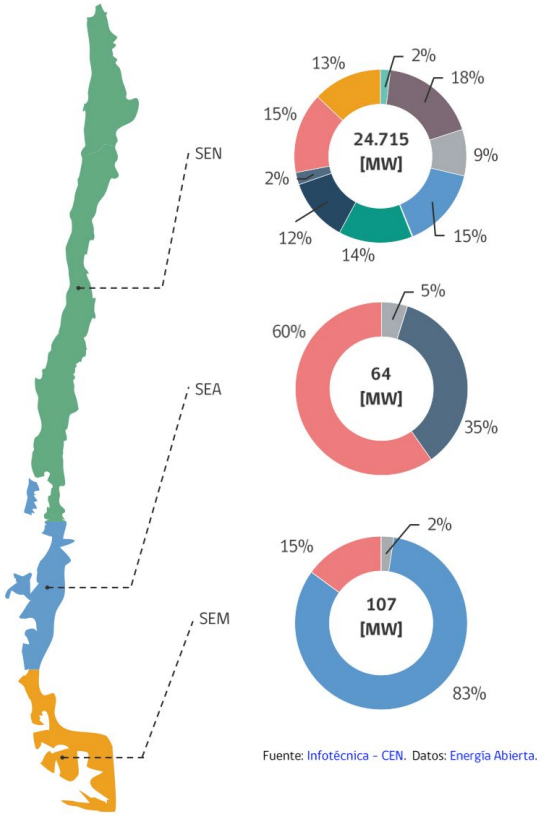
Fuente	SEN	Magallanes	Aysén	Total
Hydraulic > 20 MW	6160	0	0	6346
Fossil Fuels	11951	105	38	12094
Conventional Total	**18297**	**105**	**38**	**18440**
Hidráulica < 20 MW	562	0	23	585
Solar PV	3206	0	0	3206
Wind	2143	3	3	2149
Biomass	466	0	0	466
Geothermal	40	0	0	40
NCRE Total	**6417**	**3**	**26**	**6445**
Total	**24714**	**107**	**64**	**24885**

Source: Elaboration from Monthly Energy Sector Report. January 20212021. CNE

[4] In this link http://energiaabierta.cne.cl/.

Figure 02 Installed capacity by electric system in Chile

Net installed capacity by technology



Fuente: Infotécnica - CEN. Datos: Energía Abierta.

Net installed capacity by system

System	Capacidad [MW]	Capacidad [%]
SEN	24.715	99,3%
SEA	64,02	0,3%
SEM	107,39	0,4%
Total	**24.886**	**100%**

Fuente: Infotécnica - CEN. Datos: Energía Abierta.

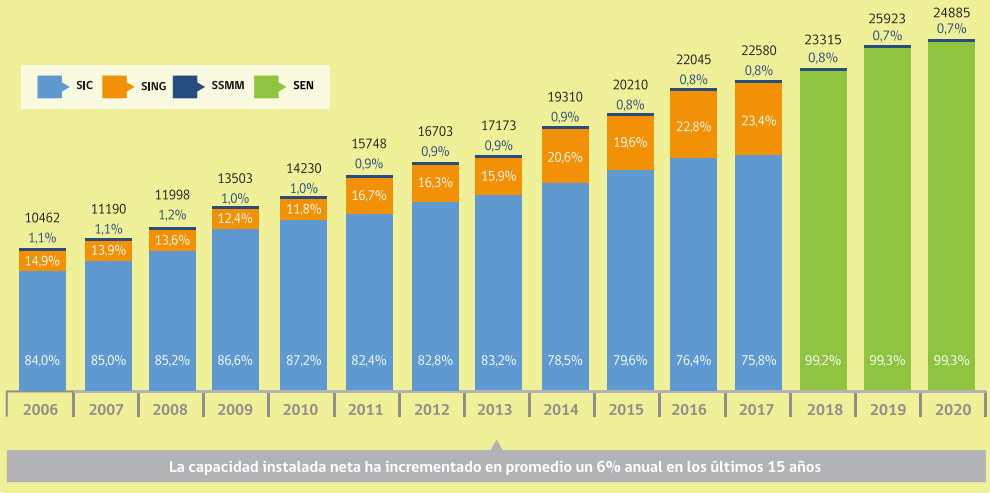
Source: Monthly Energy Sector Report. January 20212021. CNE.

The generation offer, expressed both in terms of installed capacity and the contribution of energy in the Chilean electricity sector, is presented in this section and is mainly due to the investments made by private agents and companies. Lately, this offer has been expanding rapidly from NCRE projects. Since 2014, photovoltaic solar technology has considerably increased its installed capacity, mainly due to the great solar resource present in the north of the country, the low costs of this technology, the regulatory changes made to be able to integrate these new resources to the electric system and the management of the fiscal lands to facilitate its installation[5]. On the other hand, investments in wind and solar generation continue to increase considerably in the next years.

2.2.1 Installed capacity

The expansion of the national electricity generation plant is presented in Figure 3 in terms of its installed capacity by system. The SEN concentrates 99,3% of the installed capacity and medium-sized systems account 0,7% of the total installed capacity. On average, national installed capacity has increased on average by 6% annually per year over the last 15 years.

Figure 03 **Evolution of installed generation capacity in Chile**



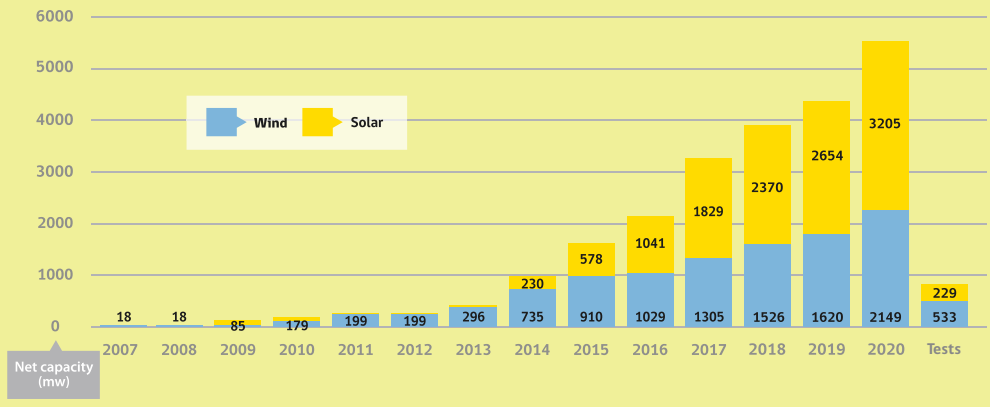
Sources: Own elaboration from Statistical Yearbook of Energy 2005 - 2015 and Monthly Report January 2021. CNE.

[5]For example, in 2019, 6,537 hectares were delivered to develop NCRE projects, which represents an increase of 244.2% compared to the 1,898 arranged the previous year. 67% of these concessions in force for these purposes correspond to photovoltaic solar generation initiatives. The facilitation of public land for the development of renewable energy projects has occurred mainly in the north of the country (Atacama to the north). In addition, 11,986 hectares will be reserved in Diego de Almagro (Atacama) and will incorporate new reserve areas for green hydrogen projects.

During the last 4 years there has been a significant increase in NCRE installed capacity, especially solar and wind power, displacing biomass and mini-hydraulics as the country's main NCRE sources. It is especially photovoltaic solar technology that has seen the fastest rise, since it has gone from 230 MW installed in 2014 to 3205 MW as of December 2020. Similarly, there are 2,149 MW of wind power installed (see Figure 4). On the other hand, it is expected that 7,557 MW of solar and 3,422 MW of wind will be incorporated in projects under test and declared under construction during 2021.

The dizzying solar development is due in part to the very good conditions of this resource that presents the north of the country, with the highest radiation in the world, availability of tax land for its development, the low cost of this technology in addition to favorable economic and social conditions of the country.

Figure 04 **Evolution of solar and wind installed capacity**

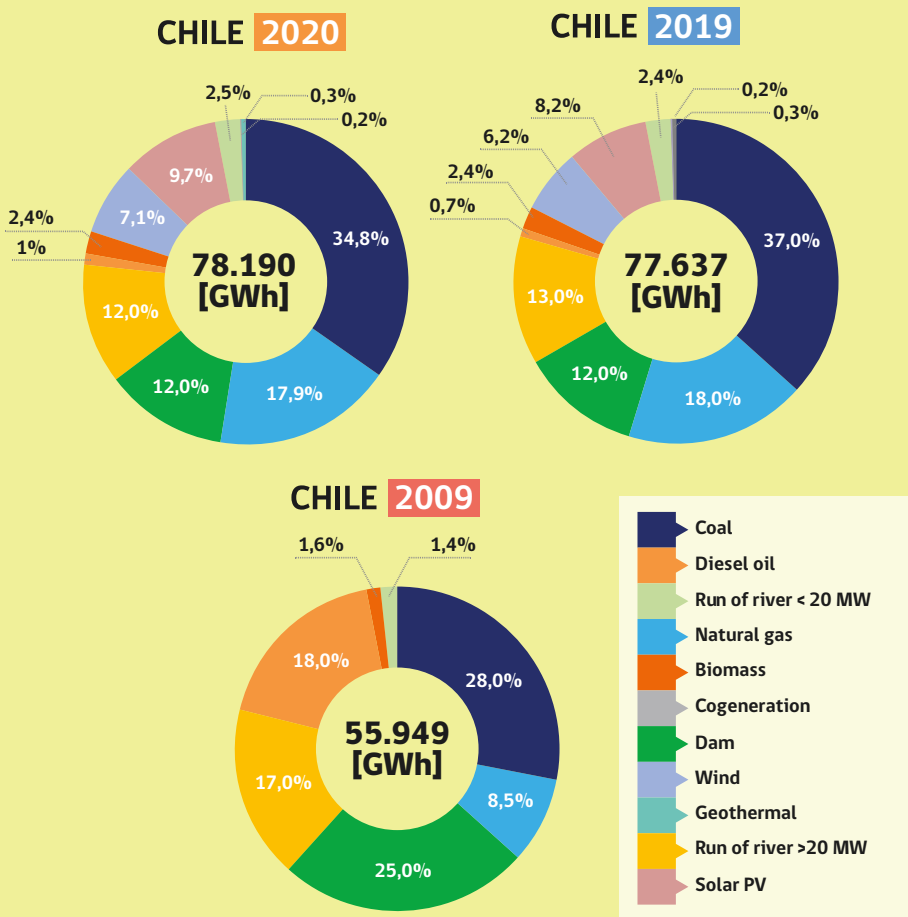


Source: Own elaboration based on information from the National Electrical Coordinator and the Monthly Report NCRE. January 2021. CNE.

2.2.2 Generated energy

Despite the explosive growth of unconventional renewable technologies of the last time, the supply of electric energy in Chile still mainly consists of sources of conventional type (see Figure 5). In general terms, in Chile a plant is called conventional when it uses traditional technologies and that normally correspond to technical and commercially very mature solutions.. In the case of Chile, these include coal-fired power plants, combined cycle power plants, diesel engines, gas/oil turbines and dam and run-of river hydroelectric plants over 20 MW. Considering the thermal power plants (coal, natural gas and diesel oil, totaling 24%) and hydroelectric plants (dam and run-of-river, totaling 54%) conventional generation accounts for about 78% of the national generation. On the other hand, non-conventional renewable energy sources correspond to those that use the following primary energy sources: biomass, hydropower less than 20 MW, geothermal, solar, wind and sea. More details on these technologies and generation statistics are described in section 4.

Figure 05 Electricity generation by type of technology during 2020, 2019 y 2009

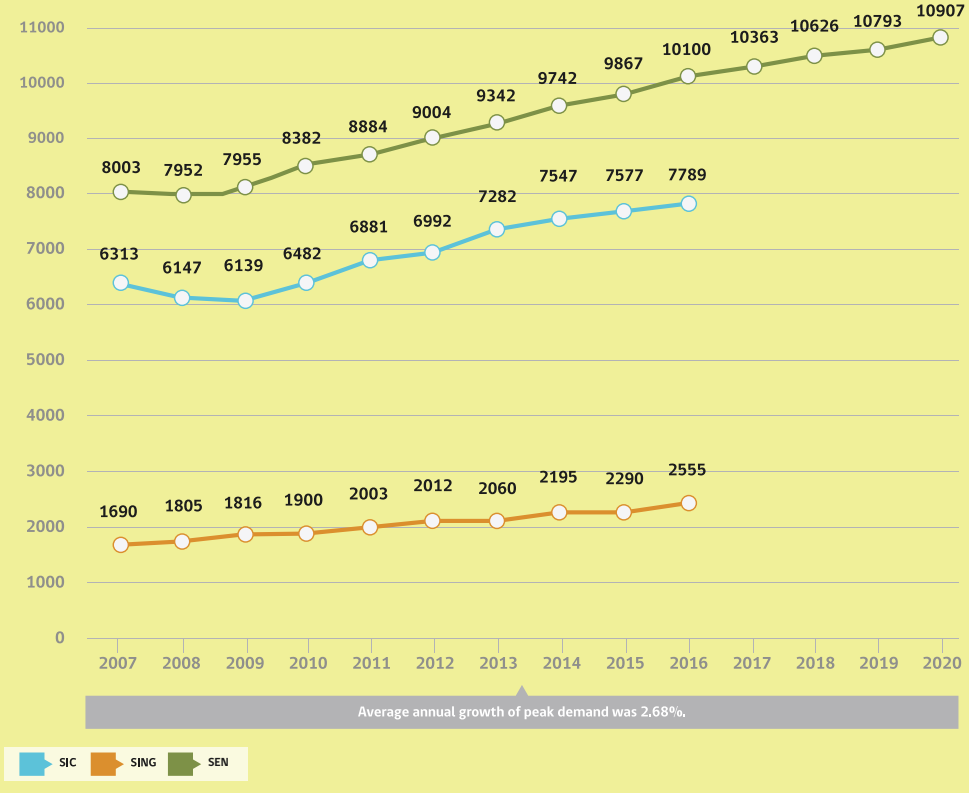


Source: Own elaboration from Statistical Yearbooks of Energy. CNE.

2.3 Consumption and customers

On average, in the last decade, demand for power has grown on average to 2,7% yearly in the SEN. Figure 6 shows the evolution of the maximum demand of electric power in the country in the period 2007-2020. The continuous growth of energy and power demand allows us to assume large investment requirements for the following decades, not only because of the economic growth of the country, but also because of the growing intensive use of electrical appliances in homes, shops and industries and the imminent penetration of electric transport in the main cities of the country.

Figure 06 **Maximum historical power demand**



Source: Own elaboration from of the history of maximum demands. National Electrical Coordinator

The General Law of Electrical Services in Chile (DFL N° 4 of 1982) divides electricity consumption into two main segments, regulated customers and free customers:

2.3.1 Regulated customer

The regulated customer segment is made up of consumers with a connected power of 5 MW or less, with the possibility of power between 500 kW and 5 MW, which are located in the concession area of a distribution company, to be chosen free customers. For 2020, regulated consumers account for 38% of the total consumption in the SEN[6]. The payment of fee is described in the section 4.

In this market, the sales of the generating companies are directed to the distribution companies, which acquire the energy through a process of regulated tenders, whose resulting prices are denominated "long-term node prices", as the biddings adjudge blocks of energy for lengthy terms (15 and 20 years in the last tenders). These tenders were introduced via legal changes in 2005 (Law 20018 of 2005), to start in 2010 with the supply. However, after a series of tenders resulted in high award prices and the total supply of demand was not achieved, it was decided to perfect this system. The bidding system was improved by the CNE by modifying bidding rules in 2014, allowing for the first time to make supply offers for a limited number of hours of the day (previously the energy blocks tendered had to compromise supply by the 24 hours of the day). This allowed the NCRE to vary and with certain periodic patterns of resource and production, to compete in the schedules that more produce, expanding the supply and pushing the prices down, becoming a competitive and economic alternative of supply. Subsequently, new perfections were made in 2015[7] to increase competition. Some of the most important modifications were the following:

- A more flexible scheme is established to define supply blocks that allows for long-term (5 years ahead) and short-term tenders that allow adjustment to more immediate needs.

- It incorporates clauses that allow new projects to cancel or delay their sale of energy in the event that their initiatives are delayed due to facts that can not be attributed to the offeror.

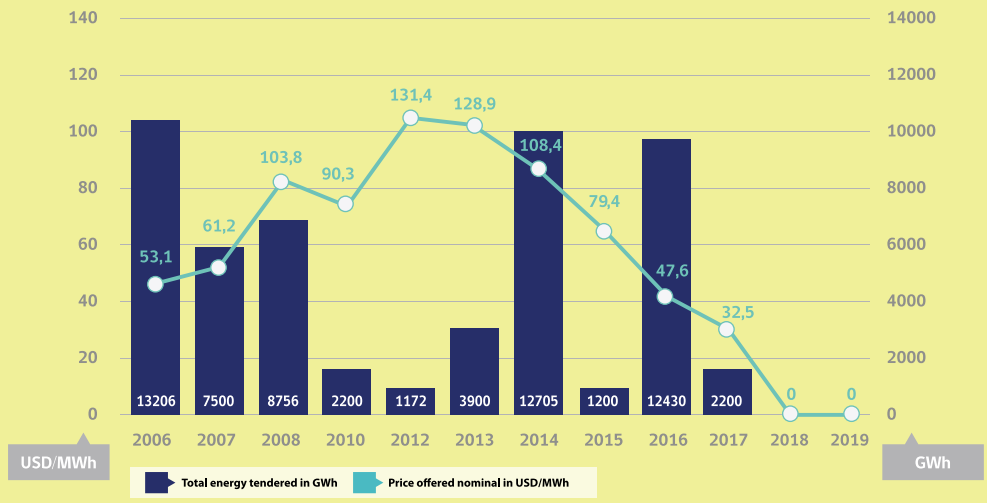
- It is given a role of greater importance to the CNE, being responsible for elaborating the bidding rules, realizing the demand projections and thus also having the responsibility, control and conduct of the process.

[6] According to Energia Abierta website: http://datos.energiaabierta.cl/dataviews/251699/retiros-de-energia-electrica-en-gwh/.

[7] Law 20.805 of 2015 "Improves the system of electric power tendering for customers subject to price regulations"

Figure 7 presents a summary of the results of the regulated bidding processes and clearly shows the consistent decline in the average award price until 2017 due to the greater competition achieved. It is worth mentioning that in the years 2017 and 2020 no public bids for electricity supply were held due to a lower estimate of the demand of the system, therefore there are no requirements for new energy contracted. However, in 2021 there were tenders that will be published in the next update of this book.

Figure 07 **Average prices and volumes of energy contracted in regulated tenders**



Source: Own elaboration from Statistical Yearbook of Energy 2016 and 2018. CNE.

Before these tenders for regulated customers were established, the contracts between generation and distribution companies were made at "short-term node price", which corresponds to a price calculated twice a year (in April and October) by the CNE and represented an average projection of marginal costs for the next 48 months adjusted for market prices of free customer contracts. In the period in which both types of supply contracts coexist (the former at the short-term node price and the most recent at the long-term node price), the price for energy and power that distribution companies must transfer to its regulated customers corresponds to the "average node price[8]" which is equal to the

[8] The latest average node price fixes can be found at the following CNE website: http://www.cne.cl/tarificacion/electrica/precio-nudo-promedio/

weighted average of long-term node prices and short-term node prices. It should be noted that the average node price is calculated for each distribution company initially separately and then an adjustment procedure is applied to a band, so that the energy price of any distribution company exceeds the average price by more than 5% of the entire system.

At these energy and power prices, from the generation-transport sector, a component associated with the cost of distribution must be added, and then from these costs to form the regulated customer tariff. Thus, at the energy and power prices, the so-called VAD (Added Value of Distribution) is added, calculated in tariff processes based on average distribution costs that are carried out every 4 years.

In these processes, models based on the concept of model companies (efficient theoretical companies) are estimated to cover efficient distribution costs, including costs of operation, maintenance, operation and losses, as well as to provide a return on investments. It is worth mentioning that, in December 2019 (Law N°21,194), the profitability rate was modified from 10% before taxes to a range between 6% and 8% after taxes. The model companies are generated from a sample of real reference companies, representative of the different realities of density and consumption, from the most rural to urban.

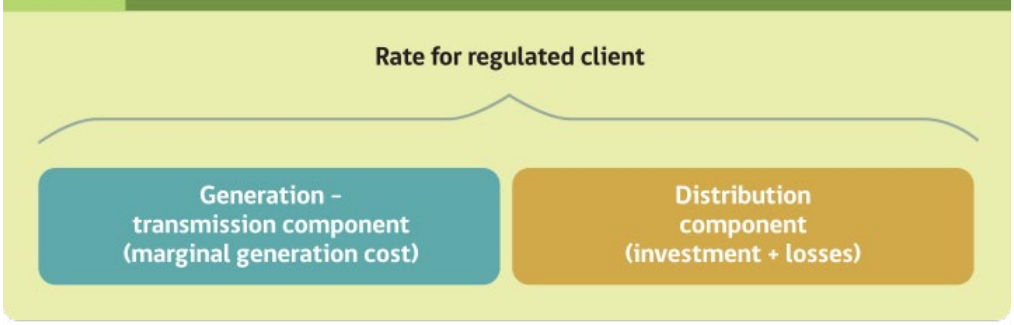
Based on the above, the CNE proceeds to set maximum prices at the end user level (except free customers), considering three basic elements:

- A fixed charge per connection, regardless of size and usage.
- A variable charge for energy consumed, which integrates the components of generation-transmission costs (reflects the marginal cost of supply at the withdrawal point) and distribution (investment plus distribution losses component).
- A charge for power or variable charge for energy consumed at peak times, depending on the rate option[9].

The most important charges are the last two, which reflect the energy consumption and customer power demand, while the fixed charge is a minor component. Structured regulated tariffs are based on these elements, which depend on the level of voltage and size of customers. Figure 8 shows the general structure of the regulated tariff that adds the two components described above.

[9] The peak hours of the system are defined semi-annually (in April and October) in the report of short-term node price published on the website of the National Energy Commission.

Figure 08 **Components of regulated customer tariff**



Source: Own elaboration (Edition 2009 of this book).

The Electric Portability Law is currently in the first process, it separates the energy marketing service from the distribution service, the former being competitive and the latter a natural monopoly that is maintained with price regulation. Therefore, the project seeks to establish the right to electric portability, that is, to enable all end users to choose their electricity supplier, so that they can obtain prices lower prices, along with differentiated and personalized offers, as well as a better quality of commercial service. In addition, a body called Information Manager is created, of a private and tendered nature, whose purpose will be to guarantee total independence in the handling of information, the protection of customer data and controlled and symmetrical access for the different interested parties. Also, the project establishes a mechanism for gradual implementation of the provisions of this law, where the first communes will be determined where portability will come into force, the possibility of carrying out pilot projects, and the gradualness with which the other communes will enter the regime. proposed.

2.3.1.1 Residential rate equity and recognition of local generation

Law 20928 was enacted in 2016, which "establishes mechanisms of equity in electricity tariffs" in systems greater than 200 MW of installed capacity, that is to say, in the SEN. One of the amendments incorporated in this Law is that it equalizes residential rates among different distribution companies, through the Tariff Equity mechanism, preventing a residential customer from facing differences greater than 10% of the national average account. In low-density rural areas, the distribution cost component was sometimes very high, as it was distributed among few customers, resulting in very high rates. This law limits

these high rates and are financed by all customers subject to price regulation, and in the case of residential customers, those that are below the national average and with a consumption that does not exceed 200 kWh/month are excluded.

In addition, other amendments incorporated by this new law are discounted to the price of electricity in municipalities that are intensive in electricity generation through the Local Generation Recognitionmechanism (RGL). The discount applied on the energy price distributed by the distribution companies to their customers is determined by a factor of intensity calculated as the installed power divided by the number of regulated customers that have the commune. The applicable discount ranges from 4.38% to 50% for communes with intensities from 2.5 kW to 2000 kW per regulated customer, as shown in Table 2.

Table 02 Discount in the price of electricity to communes according to intensity factor

Intensity Factor kW / Nº Regulated Customers		Discount (%)
Maximum	Minimum	
>2.000		50,00%
2.000	>1.500	45,00%
1.500	>1.000	40,00%
1.000	>350	35,00%
350	>75	17,50%
75	>15	8,75%
15	2,5	4,38%

Source: Law 20928 of 2016.

Likewise, in those communes in which power plants are located whose generation of energy, as a whole, is greater than 5% of the total generation of the power plants of the SENSEN, an additional discount is applied, ranging from 15% to 25%, according to Table 3.

Table 03 Discount in the price of electricity to communes according to percentage of contribution

% of contribution on the generated energy		Discount (%)
Maximum	Minimum	
>15%		>25%
15%	>10%	20%
10%	>5%	15%

Source: Law 20928 of 2016.

It is worth mentioning that in October 2019 Law 21.185 was enacted, which created a temporary mechanism to stabilize electricity prices for regulated customers, setting a Stabilized Price to Regulated Customer (PEC) until December 2027, taking the fixed prices as a basis. by Decree 20T/2019. In this way, during the validity of the mechanism, the discounts for the RGL mechanism will not be recalculated.

2.3.1.2 Regulated customers and generation

Finally, it should be noted that Law 20.571 of 2012 or Netbilling Law, modified in 2018 with Law 21.118, enabled regulated customers to inject their surplus energy into the grid through renewable generation equipment or efficient cogeneration, valuing their energy at the avoided cost of energy, that is to say, the same price at which distribution companies buy it from large generation companies plus the average losses that are avoided. More details on this law are presented in section 3.6.

2.3.2 Free Customer

The term free customer is designated in Chile to final customers with high power installations, consuming above a minimum threshold. These large customers freely agree prices and conditions with their suppliers.

This segment is made up of all consumers whose connected power exceeds 5 MW. In addition, optionally customers whose connected power is greater than 500 kW can choose to be a free customer. Usually the free customer is of industrial or mining type. These are customers not subject to price regulation, who freely negotiate prices and conditions of electricity supply with generatiion or distribution companies. In the SEN, customers in this category, in 2020, concentrate approximately 61,3% of the total consumption[10].

In Chile there is no retail market operated through trading companies, however, the Electric Portability Law that seeks to establish this figure is in the first process. Sales of energy and power to free customers are made directly by the generating companies through bilateral financial contracts or by the distribution companies, which can also be sold to free customers, buying generators. In this sense, the distribution companies have advantages over the generators in their respective areas of concession for the knowledge of the customers and their levels of consumption. However, this can be mitigated if the free customers coordinate and carry out private tenders to add their consumptions and obtain supply contracts with the generating companies. This happened for the first time during 2016 in the region of Biobío where nine companies were grouped and made a bidding, which allowed them to improve the conditions of their contracts.

2.4 Transmission and distribution systems

Transmission systems are used to transfer large volumes of electricity from generation centers to consumption centers, while distribution systems have traditionally been used to bring such energy to final consumers[11]. In addition to their different function or purpose, from the electrical point of view distribution facilities differ from those of transmission mainly at the voltage levels used as will be seen below.

2.4.1 Transmission systems

Transmission systems consist of installations enabling the transport of electricity from centers with surplus generation to those with a deficit, operating at the highest voltage levels. In Chile the European standard of 50 Hz nominal frequency is used.

[10] According to Energia Abierta website: http://datos.energiaabierta.cl/dataviews/251699/retiros-de-energia-electrica-en-gwh/. 202021

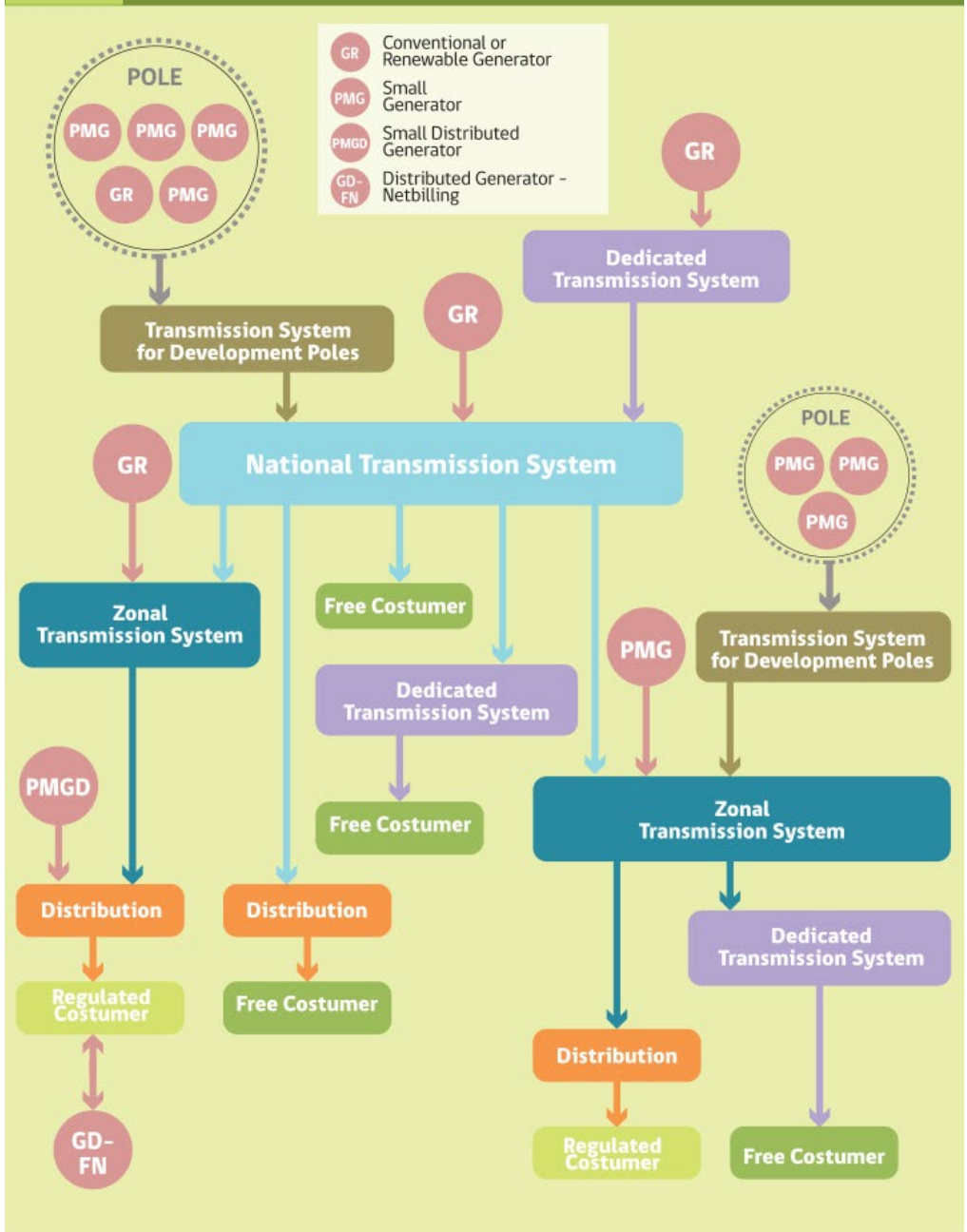
[11] Distribution systems are rapidly changing as more generation is integrated in these networks and therefore the traditional definition that only considers as its only function to bring energy to the end customer is already becoming obsolete.

These installations, which allow the transportation of electrical energy, mainly correspond to transformers, protection equipment, control and maneuvers (located in substations) and electric lines. These have been growing in capacity and in voltage, as it is required to transmit more energy at greater distances. Voltage levels used in the National Transmission sector currently cover the range of voltages between 23 kV and 500 kV.

In Chile, the transmission system is divided into four segments known as National Transmission, Zonal Transmission, Transmission for Development Poles, and Dedicated Transmission. International interconnection systems, which are subject to special rules, are also part of the transmission system. It is important to note that the segments named above correspond to the new transmission segments defined by the Law 20.936 of 2016 and therefore replaces the commonly used name (trunk system, subtransmission systems and additional systems). The new transmission segments and their relationship with generators and consumers are presented in Figure 9. Subsequently, the formal definition of each of these systems is presented.

Figure 09

New classification of transmission systems



Source: Own elaboration as of Edition 2009 of this book.

The rating of the facilities, i.e. the process of associating each transmission installation to the different segments (national, zonal, polos and dedicated), is carried out by the CNE every 4 years.

National Transmission System

According to what is defined by the new Law 20.936 of 2016[12], the National Transmission System is one that allows the creation of a common electricity market, interconnecting the other segments of the transmission. It is constituted by the electric lines and substations that allow the development of this market and make possible the supply of the total demand of the electric system, in the face of different scenarios of availability of the generation facilities, including situations of contingency and failure, considering the requirements of quality and safety of service established in the law, regulations and technical standards. These facilities include those formerly known as trunk transmission facilities.

Zonal Transmission System

According to the new Law 20.936 of 2016[13], the Zonal Transmission System consists of those electric lines and substations arranged essentially for the current or future supply of regulated, territorially identifiable customers, without prejudice to the use by free customers or generation means connected directly or through transmission systems dedicated to said transmission systems. Zonal Transmission Systems operate at voltage levels greater than 23 kV and commonly less than or equal to 110 kV, a large part of this segment operates at even 66 kV. These facilities include those formerly known as subtransmission facilities.

Transmission Systems for Development Poles

The Transmission Systems for Development Polesintroduced by the Law 20.936 of 2016[14], are systems that will be constituted by the electric lines and/or substations, destined to transport the electrical energy produced by means of generation located in the same pole of development, towards the transmission system, making an efficient use of the national territory. The Ministry of Energy is responsible for establishing the new Development Poles in long-term energy planning (see section 2.4.2.3). The definition of Development Poles within the Law[15] is the following:

[12] Article 74° DFL No 4.
[13] Article 77° of DFL No 4.
[14] Article 75° of DFL No 4.
[15] Article 78° of DFL No 4.

"Development Poles will be understood as those areas that are territorially identifiable in the country, located in the regions in which the National Electric System is located, where there are resources for the production of electrical energy from renewable energies, whose use, using a single system of transmission, it is in the public interest to be economically efficient for electricity supply, having to comply with environmental and land use laws. The identification of these zones will take into account the fulfillment of the obligation established in Article 150°bis, that an amount of energy equivalent to 20% of the total withdrawals allocated in each calendar year has been injected into the electric system by non-conventional renewable generation."

If, due to coordination problems between different generation project owners, all or part of the production capacity of one or more Development Poles defined by the Ministry of Energy can not materialize, the CNE may consider in the plan of annual expansion of transmission systems for such Development Poles. Likewise, the CNE may incorporate in this plan the change of Dedicated Transmission Systems, new or existing, to Transmission Systems for Development Poles. This in order to allow its use by new projects of generation.

Dedicated Transmission Systems

The Dedicated Transmission Systems are constituted by radial electric lines and substations, which are interconnected to the electric system, are arranged essentially for the supply of electric energy to users not subject to price regulation or to inject the production of the generating plants to the electric system[16]. These facilities include those formerly known as additional transmission facilities.

International Interconnection Systems

International interconnection systems[17] are made up of electric lines and substations designed to carry electrical energy to enable its export or import, to and from the country's electric systems. Within these systems, the law distinguishes between international interconnection

[16] Article 76° of DFL No 4.

[17] Article 78° of DFL No 4.

facilities of public service and private interest. International public service interconnection facilities are those that facilitate the conformation or development of an international electricity market and complement the supply of the demand of the electric system in the national territory against different scenarios of availability of generation facilities, including situations of contingency and failure, considering the requirements of quality and security of service established in the law, regulations and technical standards.

2.4.2 Access, payment and planning of the transmission

The Law 20.936 of 2016 introduced important changes regarding access, payment and transmission planning. The following are the most important general aspects of these issues:

2.4.2.1 Access to the transmission

The installations of the transmission systems are subject to an open access regime and can be used by third parties under non-discriminatory technical and economic conditions. Owners of installations of transmission systems, with the exception of dedicated systems, may not deny access to the transmission service to any interested party due to technical capacity. The connection must be allowed to the installations without discrimination of any kind, and if it is necessary to carry out the extensions, adjustments, modifications and reinforcements that are necessary for such connection then they shall be carried out. In the case of dedicated systems, the owners of these systems will not be able to deny the service to any interested party when there is available technical capacity of transmission and the coordinator will be able to determine the technical capacity available of the Dedicated Transmission Systems.

2.4.2.2 Payment of the transmission

The Law 20.936 of 2016 made structural changes to the payment of transmission systems, seeking to simplify methodologies of calculation and transparency of transmission costs. Therefore, this new law allows a transition from a scheme of allocation of costs by use of the network to a scheme based on a single charge to the demand, better known as "postage stamp". For this purpose, the principles of the payment methodology prior to the Transmission Law are described below. The principles of the methodology subsequent to the Transmission Law, besides the principles that will be applied in the transition period in which both methodologies are applied and that will last until 2035, when the contracts expire under the system of payment previous to the Law of Transmission. It is worth mentioning that these methodologies coexist in the electricity market.

In both systems, before of the legal change of 2016, the annual value of the corresponding transmission is always sought annually from the owner companies. The calculation of the annual value of the national transmission, zonal, poles and the payment for use of dedicated transmission facilities used by users subject to price regulation will be made by the CNE every 4 years based on the evaluation of these facilities. This is a relevant change for the Zonal Transmission (formerly known as subtransmission), since previously only the economically adapted facilities were paid and not the actual value of the facilities made.

It should be noted that the legal change of 2016 establishes that the discount rate to be used to determine the annuity of the investment value of the transmission facilities may not be less than 7% and not more than 10%. The rate is determined by the CNE every 4 years through a study following a standard methodology, publicly tendered and with appeals to the Panel of Experts in case of discrepancies. Regulation S.D. N°10 of 2019 establishes the provisions applicable to the processes of qualification, valuation, pricing and remuneration of the facilities of the transmission systems.

Principles of the payment system of the transmission following the Transmission Law
For each of the National and Zonal Transmission Systems, a single charge for use with charge to the demand will be established, so that this revenue constitutes the complement to the real tariff revenues in order to collect in total the annual value of the transmission of each section of the system. Tariff revenue is understood as the difference that results from the application of the marginal costs of the actual operation of the system, with respect to the injections and withdrawals of power and energy in said segment. Likewise, a single demand charge will be established for the payment of the Dedicated Transmission used by users subject to price regulation. Finally, in the case of transmission for poles, a single charge will be established to the demand that pays the proportion of the facilities not used by the existing generation. The yearly value of the transmission not covered by said charge shall be given to generators injecting their production into the corresponding pole in proportion to their installed generation capacity and their location.

In summary, payment of the above single charges will be charged to free and regulated final consumers, and will be calculated every six months by the CNE.CNE This system of simple charges on demand apply from 2019 to all new supply contracts. However, contracts previously concluded and whose parts do not agree to change to the new system will remain under the old system until its expiration.

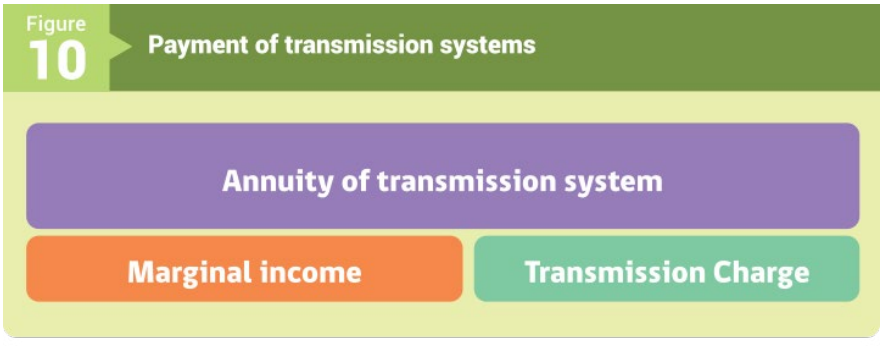
Principles of the old payment system

One of the fundamental principles of the old payment system of the transmission is the direct allocation of costs, so the methodologies used are quite complex and detailed, since it is necessary to estimate how much each segment of the transmission used each participant of the market, simulating a large number of different scenarios, conditions, hydrology, etc.

In the national transmission (formerly trunk transmission), the payment under the old system is made through two main revenues received by the transmission companies: tariff revenue and charges. The charge corresponds to the value resulting from subtracting from the annuities recognized to the transmission companies (in the process of valorization of the system), the resulting tariff revenue. In this way, a system with high transmission losses will have high tariff revenues (large differences in the marginal costs of injection and withdrawal), and therefore, lower charges. Otherwise, a system with low transmission losses will have lower tariff revenues and higher charges. The charge is assigned to generations and consumptions according to a proration scheme based on the expected electrical use that each facility makes of the system. This scheme has different treatments depending on whether it is National, Zonal or Dedicated Transmission Systems.

It is not common to use the concept of tariff income at the international level. In fact, in systems with uninodal energy bags, this income does not exist and all transmission costs are covered, for example, through stamped payments among the different agents in the market. Also, unlike what happens in European countries, this payment does not depend on the contractual relations that generators and consumers have. The following figure summarizes the situation described.

Figure 10 Payment of transmission systems



Source: Own elaboration (Edition 2009 of this book).

It should be noted that the payment of transmission charges involves all generators, regardless of the level of voltage or subsystem to which it interconnects. The amount of the payment depends on the result of applying the methodology of evaluation of the use of the corresponding system.

Transition from the old payment system to the new payment system

Due to the great change that it means to move from a cost allocation system to a demand-stamped system, the Law considers a transition period in order to gradually allow the actors to absorb these changes. For this reason, the system of collection, payment and remuneration of the national transmission will have a long transition period that will last until December 2034, as follows[18]:

- All national transmission facilities that start operating from 2019 and the interconnection between SIC and SING will be subject to the new regime, i.e., will be paid through a single charge by the final consumers.
- Until December 2018 all national transmission facilities will be payed under the old compensation system.
- During the period between January 2019 and December 2034, payments for use of the transmission system by generating companies for injections and withdrawals associated with contracts signed prior to the entry into force of the law (July 2016) shall be applied with the principles of the old payment system, with some modifications, being the most important a progressively reducing payment of charges of generators, which will be passed on to the final consumers. Thus, in 2035, 100% of the national transmission infrastructure will be paid by final consumers through a single charge.

Similarly, regarding the payment of Zonal Transmission Systems, the Law 20.936 of 2016 eliminates the payment of generators and charges completely of final customers, which began to take effect once the Law[19] was approved.
It is worth mentioning that for purposes of remuneration, the use of the facilities of respective transmission system by the companies that inject or withdraw energy; and the payment by transmission to the companies that own or operate the national transmission system, are calculated as a single electric system (SEN) without distinction of the old SIC and SING[20].

[18] Transitional article twenty-fifth, Law 20.936 of 2016.

[19] Transitional article Eleventh, Law 20.936 of 2016.

[20] See "Dictamen N°9 - 2018" of Panel of Experts.

2.4.2.3 Transmission Planning

The Law 20.936 of 2016 also makedd substantial changes to the transmission planning process. Among the main changes are the following:

- Introducedd a new long-term energy planning process carried out by the Ministry of Energy.
- It extended the annual transmission planning process maked by CNE to some transmission segments[21] (previously the process was limited to the expansion of the national system) and incorporates new criteria for planning.
- It gavegave new powers to the Ministry of Energy to define territorial corridors in order to facilitate the development of certain transmission works and the definition of paths.

Under this new regulatory framework, every five years the Ministry of Energy must develop a planning process for the different energy scenarios of expansion of generation and consumption with a horizon of at least 30 years. This process should include scenarios of projection of energy supply and demand and in particular electric, considering the identification of Development Poles, international exchanges of energy, environmental policies that have an impact on the sector and energy efficiency objectives, among others. For each identified development pole, the Ministry must prepare a technical report distinguishing each type of generation source. For this, the Ministry must carry out a strategic environmental assessment in each province where one or more Development Poles are located.

The energy planning regulation[22] establishes the conditions, characteristics, deadlines and stages by which the long-term energy planning to be developed by the Ministry of Energy will be governed.

On the other hand, the CNE will carry out annually the process of transmission planning that should consider a 20 years horizon. For this, the coordinator will send an annual expansion proposal for the different segments of the transmission. Subsequently, CNE must convene a stage for the presentation of proposals for transmission expansion projects where promoters of the same must present their respective proposals.

Using the guidelines of the long-term planning carried out by the Ministry of Energy, the coordinator's annual proposal and the project proposals presented by its promoters, the

[21] This provision will cover the necessary expansion works of the National Transmission System, the Development Poles, the zones and those dedicated to concessions of public service distribution for the provision of users, Law 20.936 of 2016.

[22] S.D. N°134 of 2016, Ministry of Energy.

Commission must carry out a planning covering the job necessary for the expansion of the National, Development Poles, Zonal and Dedicated Transmission System used by public distribution service concessionaires. This planning may receive comments from the interested participants and institutions that will have to be reviewed and answered (accepting or rejecting them) by the Commission that will finally issue a definitive technical report of the expansion plan. Finally, participants and interested parties may present discrepancies regarding the expansion plan to the panel of experts who must issue an opinion within 50 concurrent days. The S.D. N°37 of 2021 approves the regulation of transmission systems and transmission planning, which contains the provisions for the planning process, as well as the stages and deadlines.

Once the final technical report of the Commission has been received, the Ministry of Energy will be able to fix the expansion work of the transmission systems that are to start the tendering process in the next twelve months in accordance with what is indicated in S.D. N°37 of 2021. Likewise, jobs that require corridor studies will be determined by the Ministry of Energy based on criteria such as voltage levels, purpose of use, difficulties of access to or from generation Development Poles, the complexity of its implementation and the magnitude of the same.

The preliminary study of the corridor to be tendered, accepted and supervised by the Ministry of Energy must be accompanied by a Strategic Environmental Assessment (EAE)[23]. The study should contemplate alternative corridor, the collection of information on matters of land use, of protected areas, socio-economic information of communities, besides geological and geomorphological aspects. Likewise, it should include alternative engineering designs that allow identifying alternative ranges and the economic cost of these corridors and an overall analysis of social and environmental aspects, among other aspects. Likewise, it must undergo a process of consultation or indigenous participation when appropriate. The regulation that establishing the procedure for the determination of preliminary corridors, sets in greater detail the stages and deadlines for the execution of the study.

As a result of the study of corridors and Strategic Environmental Assessment, the Ministry of Energy will fix the preliminary corridors, which because of public utility may be taxed with one or more assesments.

[23] Article 93 of DFL N°4.

2.4.3 Distribution Systems

The distribution systems are made up of the lines, substations and equipment that allow the provision of the electricity distribution service to final consumers, located in explicitly defined and limited geographical areas. The distribution companies operate under a public service concession regime in these areas, with an obligation to service and regulated tariffs for the supply to regulated customers under certain standards defined by technical standards. In the distribution sector, two voltage ranges are established:

- High voltage in distribution: defined for voltages higher than 400 V and up to 23 kV, often known as medium voltage.
- Low voltage in distribution: defined for voltages below 400 V.

According to these definitions, the feeders of the distribution systems (high voltage in distribution) operate at different voltages between the specified ranges, such as: 12, 13.2, 15 and 23 kV. On the other hand, low voltage distribution networks in Chile operate at 220/380 V. It is important to note that voltage levels used in Chile are different from those defined in European countries where distribution systems can reach voltages of 60 kV or higher.

Regarding to regulated customer, it pays a fee calculated by the authority, and in general terms is obtained by adding the purchase price of energy and power by the distribution company, which is currently defined by a bidding process led by CNE, plus the costs associated with a model distributor operating efficiently. The latter component is determined with the elaboration of a single study that will be mandated by the CNE and will be carried out by an independent consultant in accordance with what is determined in the bidding conditions that can be observed by the companies and interested third parties. The latter is one of the changes introduced by Law N ° 21.194 promulgated in December 2019. Additionally, the cost determination process allows citizen participation, generating incentives for discussion and decision-making based on technical and legal arguments. and economical.

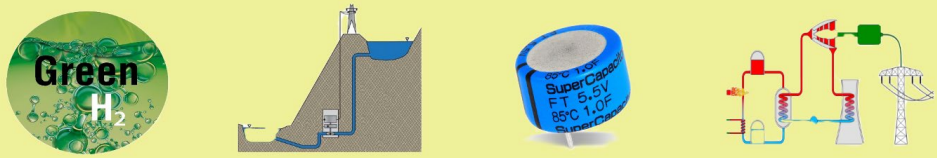
2.5 Storage Systems

The Law 20,936 of 2016 added for the first time in Chilean legislation aspects related to energy storage, including Energy Storage Systems to the list of coordinated by the SEN. The definition presented regarding storage systems is as follows:

> "Technological equipment capable of withdrawing energy from the electrical system, transforming it into another type of energy (chemical, potential, thermal, among others) and storing it with the aim of, through an inverse transformation, injecting it back into the electrical system, contributing to safety , sufficiency or economic efficiency of the system ".

In general, storage systems are categorized by the type of energy they store, such as: electrochemical, mechanical, electrical and thermal. Figure 11 shows the main types of energy and storage technologies.

Figure 11 **Categories of Storage Systems according to type of stored energy**

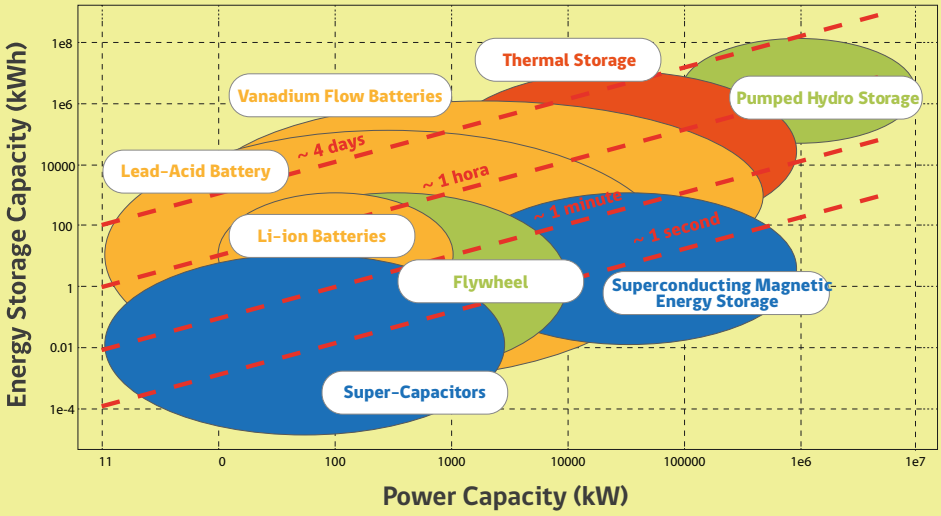


Chemicals	Mechanics	Electrical	Thermal
- Batteries - Hydrogen	- Flywheel - Compressed air - Pumping station	- Supercapacitors	- Concentrated Solar Power - Carnot Battery

Source: Own elaboration

Another way of characterizing the different storage technologies is by their energy and power storage capacity. In this way, technologies that are capable of storing large amounts of energy and with a high energy injection such as Carnot batteries[24] are differentiated from smaller technologies with less storage capacity such as lithium batteries. Figure 12 shows the types of technology distributed according to storage capacity and power. The red lines refer to the typical regulatory capacity of these technologies. That is, how long can they maintain the maximum power injection using previously stored energy.

Figure 12 **Categories of storage systems according to storage and power capacity**



Source: NREL

Regulation D.S. N°125 of 2019 of the Coordination and Operation of the SEN establishes the provisions to integrate storage systems and centrals with pumped storage in the programming and operation of the system. This regulation allows storage systems to be used for the provision of ancillary services, price arbitration or incorporation as infrastructure associated with transmission systems.

[24] Information about this technology can be found at the following link: https://www.4echile.cl/publicaciones/reconversion-de-centrales-a-carbon-en-plantas-de-almacenamiento-termico-con-energia-renovable -in Chile/

The two modes of operation of these systems are withdrawal and injection:

The two modes of operation of these systems are withdrawal and injection:

- In withdrawal mode, the electrical energy withdrawn from the electrical system is transformed into another type of energy for storage.
- In injection mode, previously stored energy, coming from energy withdrawals for storage, is transformed into electrical energy for injection into the electrical system.

With regard to withdrawals, the Coordinator and the storage system operator must propose withdrawal programs, the Coordinator's will be considered efficient while the other will determine the definitive withdrawal program. In actual operation, hours that do not contribute to the economic and safe operation of the system will be classified as those hours in which the respective installation has implied a higher level of hourly power withdrawal than that defined in the designated efficient program for said hour.

Law 20,936 establishes that withdrawals made in the storage process will not be subject to the charges associated with end customers, nor to the obligation to prove that at least a percentage of these come from renewable sources.

Regarding the injection mode, the Coordinator must choose one of the following methodologies:

- Consider injection in the priority list with a variable cost determined by the Coordinator; or
- Determine the placement of the stored energy in storage, or in a certain time horizon, minimizing the total cost of operation and failure, and preserving the safety of the system. The cost assigned to the stored energy must not be less than the variable cost referred to in the previous point.

The variable cost will be equal to the quotient between the recovery of energy withdrawn from the electrical system, for the storage process during the recovery window, to the marginal cost of the respective withdrawal bar, and the energy withdrawn for storage in the same period, adjusted by a factor that reflects all the energy losses incurred in the energy withdrawal, storage and injection processes.

The withdrawals and injections of energy made for price arbitration will be valued at the marginal cost of the corresponding bar, in this way the storage systems participate in the energy balance.

Regarding the ancillary services market, Law 20,936 is technologically neutral. Therefore, any facility that meets the standards required for the provision of each type of service is a possible provider. Currently there are storage systems enabled to provide primary frequency control to the SEN.

As for the contract market, storage systems are allowed to support bidding in energy tenders for regulated customers. This was for the first time allowed in the bases of the energy tender dated May 2021 (which was postponed but not carried out). The purpose of this tender is to auction 2,310 GWh to supply the energy needs of the regulated clients of the SEN starting in 2026 for 15 years.

However, with respect to the trading of energy with distributors or free clients, the storage systems may not make withdrawals of energy to trade with them.

On the other hand, D.S. N°37 of 2021 presents general guidelines to include storage systems in the planning of the transmission system. This establishes that storage systems may be incorporated that allow to increase the safe transmission capacity or supply the demand of end customers where, it is verified that a solution through conventional transmission infrastructure alternatives is not adequate, either due to economic efficiency or chance.

For the purposes of the above, only those that have the following characteristics and purposes may form part of the project portfolios of the different stages of transmission planning:

a) Power-intensive energy storage systems: those whose purpose is to increase the safe transmission capacity and whose quotient between their energy storage capacity and their nominal power is less than or equal to 0.5.
b) Energy-intensive energy storage systems: those whose purpose is to allow the supply of the demand of a specific area, belonging to one of the Zonal Transmission Systems, and whose quotient between its energy storage capacity and its nominal power is less than or equal to 5.

The storage systems may provide other services that are compatible with the transmission service required in the expansion plan. For this, the owner can build it with higher levels of power and energy assuming its cost. The operation that is made of the proportion not awarded must at all times, allow the provision of the transmission services required in the expansion plan. The design of the system awarded must be such that its operation does not impose restrictions on the transmission system that requires additional investments.

Regarding renewable power plants with storage capacity, the D.S. N°125 of 2019 defines how these technologies should be integrated into the coordination of the operation. The definition presented is the following:

> "Renewable generation plant that uses variable primary resources, composed of a generation component and a storage component, both with the same connection point to the electrical system. The generation component corresponds to the technological equipment to transform primary energy into electrical energy, while the storage component is that equipment capable of transforming the electrical energy produced by the generation component into another type of energy and storing it with the aim of, by means of an inverse transformation, to inject it into the electrical system".

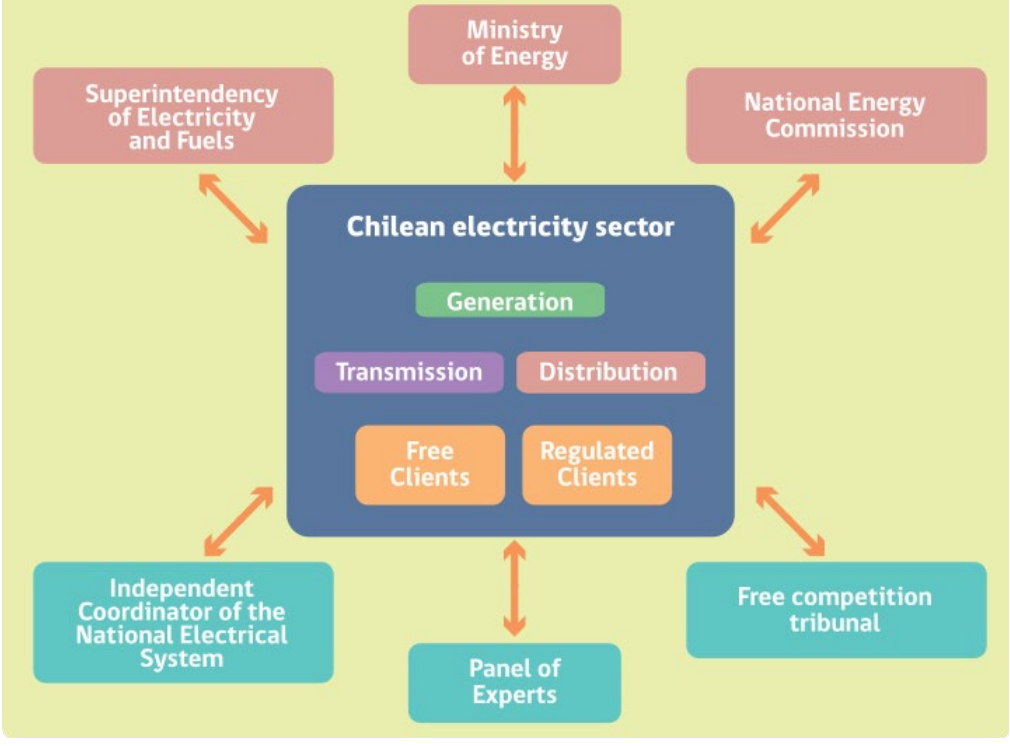
Unlike storage systems, these plants should not make withdrawals from the system to store energy, since the storage process will be carried out exclusively with energy inputs from their own generation. Unless for security reasons the Coordinator instructs such action. Another great contrast is that they can trade energy with free customers or distributors. This action is not possible for non-self-generated storage system owners.

On the other hand, the temporary energy management capacity of renewable power plants with storage capacity is recognized in the remuneration of the capacity market. Therefore, a renewable plant can increase its recognition of contribution to the sufficiency of the system by adding a storage system to its generating plant.

2.6 Institutional framework of the electricity sector

The Chilean electricity sector is closely linked to different public and private sector institutions. These institutions and market agents may inter-relate through coordination, direct dependency, contractual, property and binding relationships, among others, and are detailed in this chapter. Figure 11 shows some of the main interactions of the electric sector actors with these institutions.

Figure 13 Electricity sector and institutions



Source: Own elaboration as of Edition 2009 of this book.

The main institutions linked to the regulation of the Chilean electricity sector are the following:

- The Ministry of Energy.
  - The National Energy Commission (CNE).
  - La Superintendencia de Electricidad y Combustibles (SEC).
- The Independent Coordinator of the National Electric System
- The Panel of Experts of the General Law of Electrical Services.
- The Court of Defense of Free Competition.

Other institutions linked to the sector that see specific aspects are the Chilean Nuclear Energy Commission (CCHEN), the Ministry of the Environment, the Ministry of National Assets, the the Energy Sustainability Agency (ASE), the Corporation for the Promotion of Production (CORFO) and the Ministry of Mining, among others.

The functions of the main institutions linked to the electricity sector are described below.

2.6.1 The Ministry of Energy

The Ministry of Energy, an entity created by Law 20.402 and which came into force on February 1 of 2010, is the highest organ of collaboration of the President of the Republic in the functions of government and administration of the energy sector.

Its general objective is to prepare and coordinate the plans, policies and standards for the proper functioning and development of the sector, ensure compliance with them and advise the Government on all matters related to energy.

For the purposes of the competence of the Ministry of Energy, the above mentioned Law establishes that the energy sector comprises all activities of study, exploration, exploitation, generation, transmission, transportation, import and export, storage, distribution, consumption , efficient use, and any other concerning electricity, coal, gas, oil and derivatives, nuclear, geothermal and solar energy, and other energy sources.

In addition, the creation of the Ministry of Energy reorganized the powers of the public sector in relation to the energy sphere, concentrating the functions of the sector, which previously

were in the Ministries of Mining and Economy, Development and Tourism, and modified the dependence of the National Energy Commission (CNE), the Superintendency of Electricity and Fuels (SEC) and the Chilean Nuclear Energy Commission (CCHEN), which came to interact with the President of the Republic through the Ministry of Energy.

The conduction of the Ministry corresponds to the Minister of Energy and the internal administration to the Undersecretary of Energy, who is the Superior Head of the Service and coordinates the action of the public services of the sector. In addition, it has the presence of a Regional Ministerial Secretariat in each of the regions of the country

2.6.1.1 National Energy Commision (CNE)

The CNE is a public legal entity, functionally decentralized, with its own assets, which is related to the President of the Republic through the Ministry of Energy, created by Decree Law 2224 of 1978, as amended by Law 20.402 which created the Ministry of Energy.

It is the technical body in charge of analyzing prices, tariffs and technical standards to which companies of production, generation, transport and distribution of energy must be adhered, in order to have a sufficient, safe and quality service, compatible with the more economical operation. Their functions are:

- Technically analyze the structure and level of prices and tariffs of energy goods and services, in the cases and forms established by the Law.
- Establish the necessary technical and quality standards for the operation and operation of energy facilities, in the cases indicated in the Law.
- Monitor and project the current and expected functioning of the energy sector, and propose to the Ministry of Energy the legal and regulatory rules that are required, in matters within its competence.
- Advice the Government, through the Ministry of Energy, in all matters related to the energy sector for its better development.

The Electrical Department of the CNE conducts indicative planning of investments in generation and transmission, prepares the regulations and technical standards, and calculates tariffs for regulated customers, amongst other activities described in the Law.

Administration of the CNE corresponds to the Executive Secretary, who is the Chief of the Service and has legal, judicial and extrajudicial representation.

2.6.1.2 Superintendency of Electricity and Fuels (SEC)

The Superintendency of Electricity and Fuels is related to the President of the Republic through the Ministry of Energy. It was created as such in 1985, through Law 18.410, organic of the SEC, according to which its mission is to monitor the proper operation of electricity, gas and liquid fuel services, in terms of safety, quality and price, when these are regulated.

Responsibility of the SEC is to monitor compliance with legal, regulatory and normative provisions, grant gas and electric provisional concessions, and impose sanctions, among other matters.

2.6.2 The Independent Coordinator of the National Electric System

The Independent Coordinator of the National Electric System (Coordinator) is a technical and independent body created by the new Law 20.936 of 2016 responsible for coordinating the operation of the set of installations of the SEN that operate interconnected with each other. The Coordinator replaces the old Economic Load Dispatch Centers (CDEC) of SIC and SING.

The Coordinator is an autonomous corporation of public law, non-profit, with its own equity and indefinite duration. The Coordinator is not part of the State Administration, however, must comply with strict guidelines on transparency, and must keep publicly available the applicable regulatory framework, its organizational structure, financial statements, the composition of its board of directors, The consolidated information of its personnel, any payment received in the year by each member of its Board of Directors and the Executive Director and the annual public account that accounts for the fulfillment of management objectives. Likewise, the Coordinator must provide all the information requested, except for any of the causes of secrecy or reservation established by law or the Constitution, or that its publicity, affects the proper fulfillment of the functions of the Coordinator or rights of the people.

The direction and administration of the Coordinator will be in charge of a Board of Directors, composed of five directors, who will be chosen separately, in public and open processes, by a Special Nomination Committee. The directors and the President shall serve for five years in office and may be re-elected once, but may be removed from office by the Special Committee on Nominations, for abandonment of functions, negligence or lack of suitability.

The Special Nominating Committee shall be composed of the following members: the Executive Secretary of the CNE, a Counselor of the High Public Management Council, the Chairman of the Panel of Experts or one of its members, and the President of the Free Competition or one of its Ministers.

Unlike the old CDECs, financed entirely by generators, the financing of the Coordinator is established through an annual budget, financed through a public service charge made to all end users, free and regulated, fixed annually by the CNE.

2.6.3 The Panel of Experts of the General Law of Electrical Services

The Panel of Experts of the General Law of Electrical Services is an organ created by Law 19.940 of 2004 exclusively for the electricity sector. It has limited power and is composed of a group of expert professionals. Its function is to pronounce, by means of opinions of binding effect, on those discrepancies and conflicts that arise due to the application of the electrical legislation and that must be submitted to its consideration according to the Law. It also pronounces on the controversies between two or more companies in the electricity sector that, by mutual agreement, submit to their decision.

The institution is comprised of seven professionals with a long and wide ranging professional or academic experience. Five of them must be engineers or possess a degree in economic sciences, they may be nationals or foreigners, and two must be lawyers. Panel members and a Lawyer-Secretary are appointed for six-year periods by the Tribunal for the Defense of Free Competition, through a public tender process. The panel's composition is partially renewed every three years.

Prior to the legal change of 2016, the operating costs of the Panel of Experts were financed by the electricity generation, transmission companies and public service concessionaires, on a prorate basis. Its gross fixed assets. However, that law changed this and the Panel of Experts is now funded by all end users through a public service charge.

2.6.4 The Court of Defense of Free Competition

Another important institution to mention is the Court of Defense of Free Competition, an institution created by Law 19.911 of 2003. Although it is not only linked to the electricity sector, it is very important in it, since one of the motivations of the regulation of the electricity sector is precisely to foster competition.

This is a special collegiate Court, similar to an Appeals Court, devoted exclusively to competition matters, comprised of three lawyers and two economists, all experts in competition and with the rank of ministers.

This court is a special and independent jurisdictional entity; subject to the directional, correctional and economic supervision of the Supreme Court, whose main function is to prevent, correct and sanction violations of free competition.

3

Operation of the Chilean electricity market

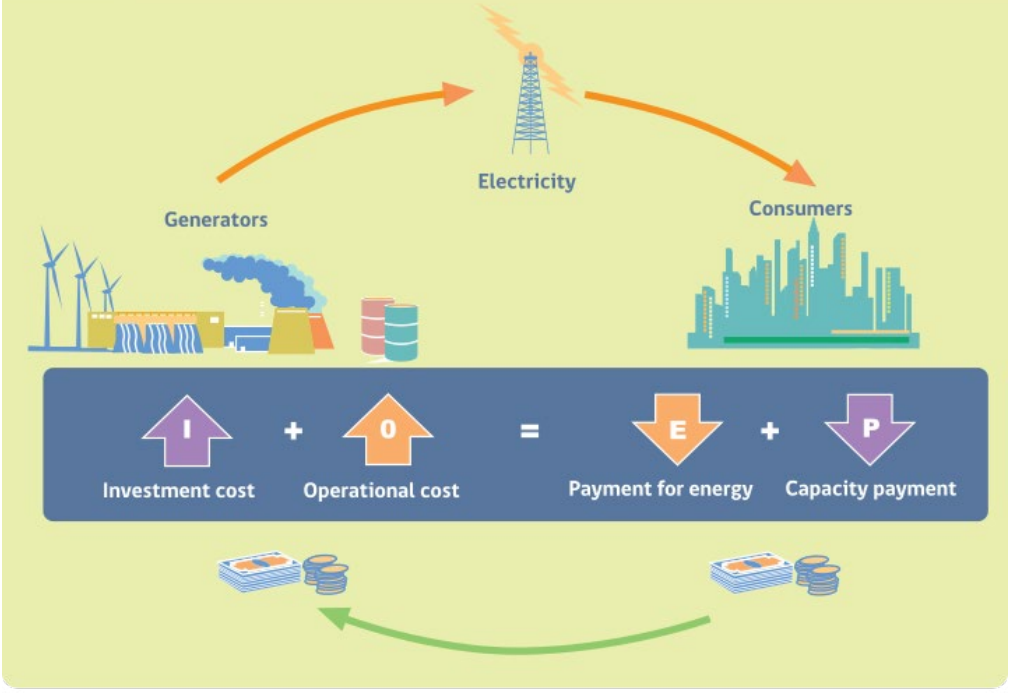
3. Operation of the Chilean electricity market

This chapter describes fromgeneral aspects of the Chilean electricity market to more specific aspects. It starts with the economic fundamentals of the market, then presents the electricity market model in Chile and the main markets to trade power: the spot market and the contract market. Subsequently, it describes the treatment given in Chile to the adequacy and safety of the system and how they are financed according to the current legislation. Next, it describes the operation of generation in the residential, commercial and small industries sector and, finally, the regulatory treatment that is currently given to the import and export of electric energy is presented.

3.1 Economic fundamentals of the electricity market

The electricity market in Chile has been designed in such a way that investment and operation of the energy infrastructure is carried out by private operators, promoting economic efficiency through competitive markets in all the non-monopolistic segments. Thus, generation, transmission and distribution activities have been separated in the electricity market, each having a different regulatory environment. Distribution and part of the transmission segments are both regulated, and have service obligations and prices fixed in accordance with efficient cost standards. In the generation segment a competitive system has been established based on Peak Load Pricing. Whereby consumers pay a price for energy and a price for power associated with peak demand hours (see Figure 14).

Figure 14 Financial equilibrium in the marginal model



Source: Own elaboration (2009 edition of this book).

In theory, the Peak Load Pricing System ensures that, whenever the structure of the pool of generators is adequate to meet demand, revenues from electricity sales at the marginal cost of electricity (E)[25], plus revenues from the sale of capacity at the cost of developing peak power (P), exactly cover investment costs (I), plus operational costs (O) of producers, considered as a whole.

The operation of the Chilean market is characterized by the existence of a spot market in which the price of electric energy corresponds to the short-term marginal cost resulting from the instantaneous balance between supply and demand. In Chile, the National Electric System is operated by the the Coordinator.

[25] The definition of marginal cost is included in the glossary of terms, see Annex 6.

3.2 Model of the electricity market

In Chile the wholesale market model[26] has been migrating from a pool type[27] structure with mandatory participation of the different generators to an ISO[28] type structure, where an independent coordinator is in charge of the coordinated operation of the system. In both models, two main markets have coexisted: a spot market associated with the coordinated short-term operation of the system and bilateral financial contracts.

The Coordinator, by means of procedures and mechanisms regulated and well known by all agents, determines the short-term market price of electricity ("clearing price" or "spot price"), which is the clearing price of the market (Spot market). This price results from the implementation of a centralized economic operation by the coordinator and can be different in each zone of the system, according to various conditions, such as losses and congestion.

The centralized economic dispatch by the Coordinator is based on the declaration of operating costs by the generating companies (costs that can be audited) and not in offers, as is done in other markets in the US, Europe, Colombia, etc. As a consequence, the economic hourly dispatch of the system is obtained, which corresponds to a merit[29] order in function of the variable cost of operation, which results in the marginal cost of operation and transfers or commercial exchanges of energy between the companies that generate more or less than their contract levels. The design of the market does not explicitly contemplate the figure of a tradertrader, however, the Portability Law, that is the first process, will create this agent. Nowadays, it is the generation and distribution companies that exercise this role of interaction with customers, but not at the spot market level, but rather through contracts.

In the wholesale electricity market in Chile, the generating companies trade energy and power among themselves, which depend on the supply contracts that each one has signed, because the real demand of their customers will be assigned as withdrawal of energy from the generator.

For each hour, the amount to be traded will be determined as the difference between the energy injected into the electrical system valued at the marginal cost (Cmg) of the injection bar, and the energy withdrawals assigned to the generating company valued at the marginal cost of the bar of retirement.

[26] Definition of the wholesale market is found in the glossary of terms, see Annex 6.

[27] Definition of pool is found in the glossary of terms, see Annex 6.

[28] Definition of ISO can be found in the glossary of terms, see Annex 6.

[29] Definition of order of merit is found in the glossary of terms, see Annex 6.

From the resulting amounts, the coordinator must determine the economic transfers of energy, in such a way that the companies that have negative total balances in a period (deficit companies), must pay those companies with positive total balances in the same period (surplus companies).

The balance of power transfers between generators occurs in a similar way. The physical and monetary transfers (sales and purchases) are determined by the system coordinator and are valued at the short-term node price of the power of the corresponding injection or withdrawal bar.

Figure 15 summarizes the basic interactions observed in the wholesale market in Chile. In the case of bilateral financial contracts, blue lines represent contracts that are defined by direct and free negotiation between the parties (G1 with Free Customer 1), while red lines represent contracts that are regulated, for example the case of G3 with the distribution company. It is also important to note that Figure 13 shows that the spot market is closed to generators, and that there may be some of them whose business is only sales to this market, as is the case of G2. The sale of generators in the spot market is represented by the green arrows.

Figure 15 **Chilean wholesale market**

Source: Own elaboration as of Edition 2009 of this book..

It should be noted that supply contracts that can establish a distribution company with free customers are not part of the spot market or the concept of wholesale market described above. TheT contract between the distribution company and the Free Customer 3 does not directly participate in the wholesale market and is only part of the energy and power transfers through the supply contract between the distributor company and the generators G1 and G3.

3.3 The spot market

The design of the Chilean electricity market is based on the above described marginalist theory, which contemplates a scheme of marginal prices of energy (operation) and power (development) to be paid by consumers according to the principles of the Peak Load Pricing theory.

The spot wholesale market is closed to generators, but is managed by the Coordinator under an ISO structure, where generators are obliged to participate, presenting their variable cost statements based on their actual generation costs, with the possibility of being audited by the Coordinator. This aspect distinguishes the Chilean market from others based on energy bags or centralized operation with free purchase and sale offers. Figure 14 shows the interactions of the different agents in the Chilean market scheme. It should also be noted that in the Chilean electricity market there is no concept of physical bilateral contracts, still present in some electricity markets such as the European one, where supply contracts between private agents have the right to be informed to the system operator and translated in a physical dispatch. In Chile, private supply contracts only have a financial character, the Coordinator being the entity that performs the physical dispatch hour by hour, based on the information of operating costs of each of the generating units seeking the most economic operation possible without being restricted by these contracts.

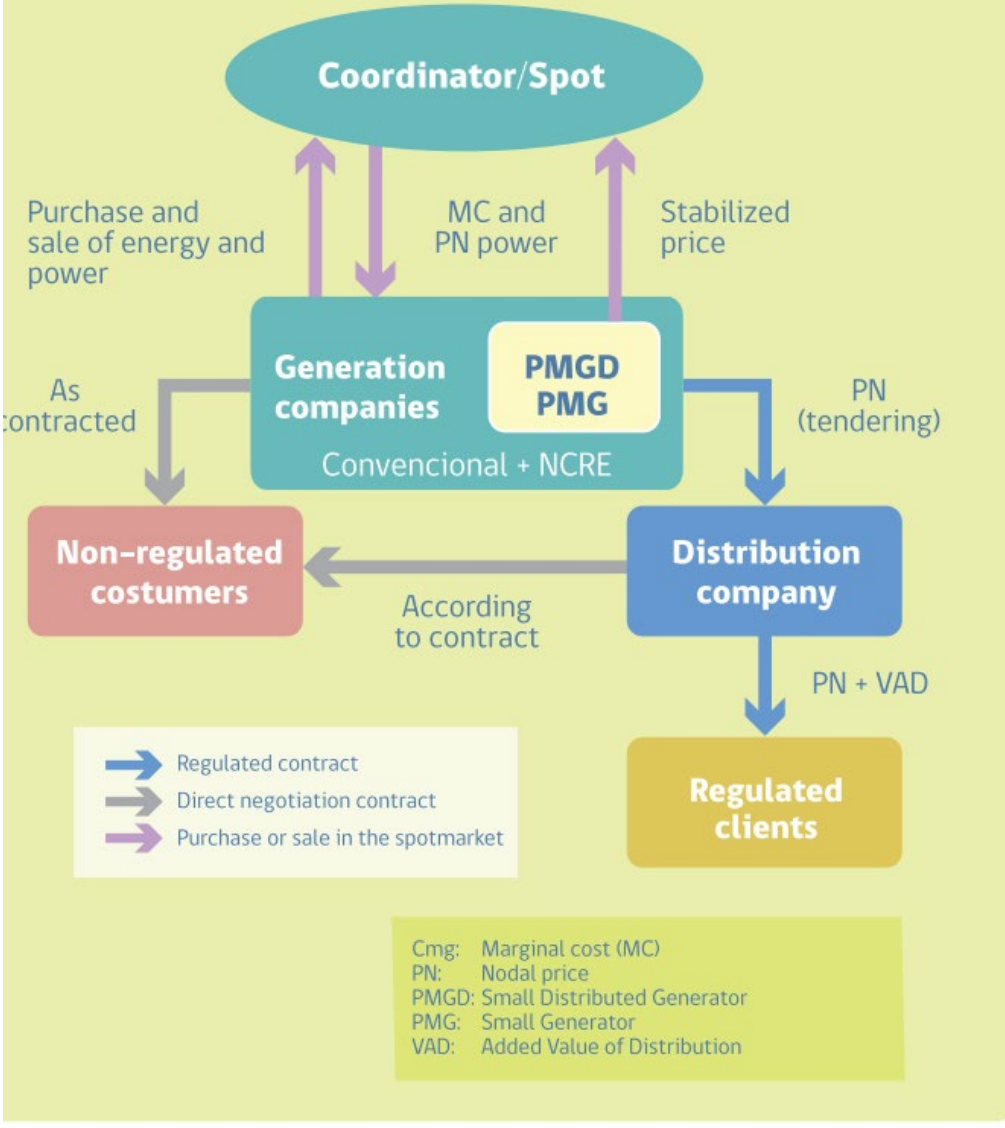
The Chilean electricity market focuses on competition in the execution and development of efficient generation projects (investment and operating costs) and the good commercial management of bilateral contracts with free and regulated customers[30]. This differs from what is observed at the international level, since Chile does not have a short-term supply scheme for the office, but a communication of generation costs, the definition of bid strategies for the purchase and sale of energy does not correspond to a critical element in competitive performance.

[30] The different types of customers are described in detail in sections 2.3.1 and 2.3.2.

Figure 16 shows a general outline of the functioning of the national market. It shows that the generating companies are related to the spot market through purchases and sales of energy and power, at the marginal cost of energy (Cmg) and price of power respectively. This scheme is also applicable to PMG (Small Generator), PMGD (Small Distributed Generator) and other NCRE projects. However, as will be seen later, in the case of PMGs and PMGDs it is also feasible to access a stabilized price in energy sales (see S.D. N°88 of 2020).

In turn, generating companies have contracts with free customers at freely agreed prices (non-regulated customers) and with distribution companies at a price resulting from a regulated supply bid process (regulated customers) for contracts and at a node price determined by the authority (semi-annual calculation of the CNE using the indicative works plan and estimating marginal costs for the next 48 months) for those supply contracts subscribed prior to Law 20018 of 2005. For its part , the distribution companies sell their energy to regulated customers, making use of the different regulated tariffs for final customers, or to free or unregulated customers located in their concession area.

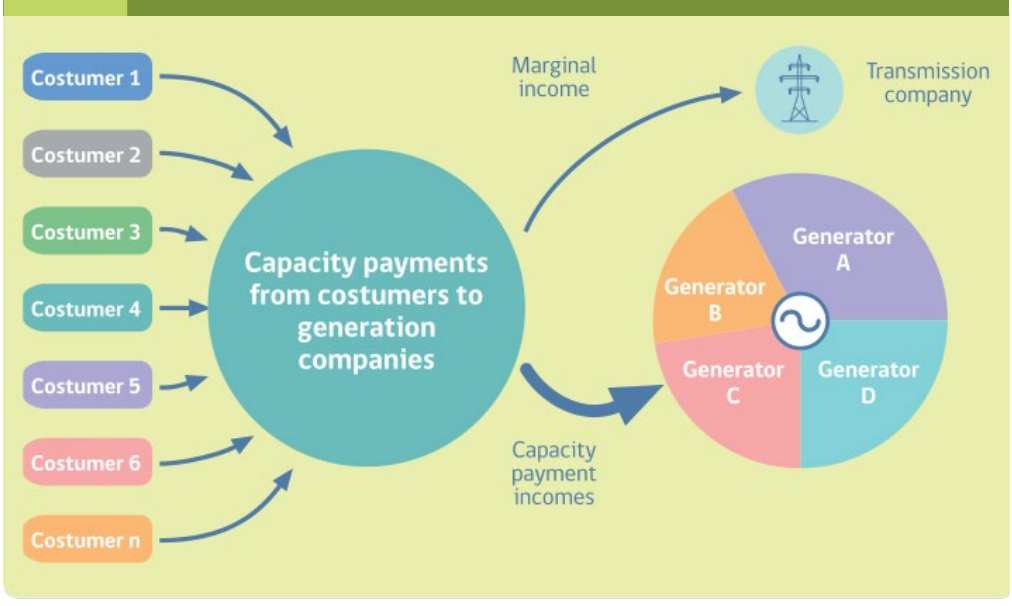
Figure 16 **Concept of payment in the electricity market**



Source: Own elaboration (Edition 2009 of this book)

The nodal price (PN) of capacity shown in Figure 16 is determined every six months by the authority as the cost of development of the cheapest technology to supply electricity during peak hours of demand. For each generation unit, depending on the characteristics of its primary energy source, its rate of forced failures, scheduled outages and joint contribution to the system, a capacity is recognized, which is used to determine its capacity revenues (sale of capacity). This kind of mechanism is known in international literature as "administrative type capacity payment", because it is not determined by the market, but by an administrative body that evaluates and determines prices and quantities, being in the case of Chile, the CNE and the Coordinator, respectively. Likewise, each generation company, in accordance with its supply contracts and the behaviour of this consumption under peak load conditions is responsible for making capacity purchases in the system. Capacity purchases are transferred by generators as capacity charges to their non-regulated and regulated customers. In this case the procedure is regulated. Figure 17 summarizes capacity transfers between different market agents in the spot market.

Figure 17 **Spot market power transfers**



Source: Own elaboration

It can be seen that in theory, capacity charges to final customers cover the capacity revenues of power plants. The surplus or deficit capacity condition of a generation company will depend on its supply contracts. For instance, a company with no supply contracts will always be a surplus company in capacity transfers, since it has no declared obligations and these will not be discounted from its balance.

Although the Chilean price scheme considers the cost of expansion through the development value of peak power, it also contemplates the payment of energy at the cost of failure in the condition of shortages. In fact, the marginal cost of energy corresponds to the cost of energy not supplied during the rationing periods, and both the regulated customer pricing models and the operation planning models incorporate the cost of energy not supplied to the customer when the operation of the system has been optimized.

3.4 Contract market

The contract market is a financial-type market with contracts freely agreed between the parties. The contract market has the following characteristics:

- Generators can enter into contracts with distribution companies and free customers.
- The contracts with distribution companies can be established for the supply of regulated customers or for free customers.
- Contracts are confidential; details about supply point and quantities must be reported to the Coordinator for their administration. However, the CNE and the Ministry in their monitoring role can request information of these contracts.
- In the contract market a supply and a purchase obligation is established at a predetermined price. Normally, measurements are performed on an hourly basis.
- Contracts are financial, i.e. generators always buy in the spot market to sell at the contract market, whether dispatched or not. The financial contract provides price stability to purchasers and sellers, in accordance with their expectations of the evolution of marginal costs.
- Sales contracts to distribution companies for regulated customers must consider the price resulting from public tenders regulated and directed by the CNE.
- The sale of power is made at a price resulting from the study of node price calculated semi-annually by the CNE in the months of April and October.

3.5 Adequacy and safety of the electric system

The legislation distinguishes the concepts of adequacy and safety of the electric system; deriving the latter to the implementation of ancillary services (SSCC). These concepts are explicitly defined in the current legislation[31].

- **Adequacy:** attribute of an electric system whose facilities are adequate to supply its demand.
- **Service security:** responsiveness of an electric system, or part of it, to support contingencies and minimize consumption loss through backups and ancillary services.
- **Ancillary Services (SSCC):** benefits that allow the coordination of the operation of the system. At least ancillary services include frequency control, voltage control and service recovery plan, both under normal operating conditions and before contingencies. These services will be provided by means of the technical resources required in the operation of the electric system, such as the capacity of active power generation, capacity of injection or absorption of reactive power or connected power of users, among others, and by the infrastructure associated to the provision of the technical resource.

In other words, adequacy corresponds to the ability of the system to supply the entire electrical demand and the energy requirements of the consumers at all times, considering programmed outputs of components and outputs that are not programmed but reasonably expected. Safety, on the other hand, is understood as the ability of the electric system to withstand surprising disturbances such as electric short-circuits or unexpected loss of system components or disconnection operations.

The adequacy attribute recognizes through capacity payment, this payment focuses on the recognition, in terms of power, of the contribution of the different generators to the tip demand of the system and is valued in terms of the investment costs of the generation unit used for the system's peak hours. In the security attribute, its payment should be through the recognition of Ancillary Services.

Until January 2016 in the Chilean electricity sector, the attributes of safety and adequacy, were grouped under the concept of firm power. This is despite the fact that the LGSE differentiates both concepts since the regulation to define the recognition of the adequacy attribute (S.D. N° 62 of 2006[32]) has been published since 2006. However, it was necessary

[31] Artículo 225°, DFL N° 4.

[32] S.D. N°62 of 2006 of the Ministry of Economy, Development and Reconstruction. Approves Regulation of Power Transfers between Generating Companies established in the General Law of Electrical Services. Published in the Official Gazette of June 16, 2006.

to wait until ancillary services were defined and implemented to achieve to separate both concepts in practice. This happened in January 2016, with the publication of the Technical Standard of Power Transfer between Generating Companies.

3.5.1 Power of adequacy

The S.D. N°62 of 2006 defines the guidelines for determining power transfers between generating companies. Those that will be determined from the generation capacity compatible with the adequacy and the existing peak demand commitments. In such a way that each owner of generation means must be in a position to satisfy their own commitments for peak demand, considering their adequacy power and that acquired from other generating companies. These transfers will be valued at the power's short-term node price in the corresponding bar.

Each generating unit will be assigned a definitive adequacy power based on:

- The uncertainty associated with the availability of the generation input,
- Forced unavailability of the unit, and
- The supply of power from the generating park.

The general scheme of the adequacy power calculation procedure established by the S.D. N°62 is illustrated in Figure 18. The stages and concepts used in the adequacy power calculation process for each type of plant are described in greater detail in Annex 3.

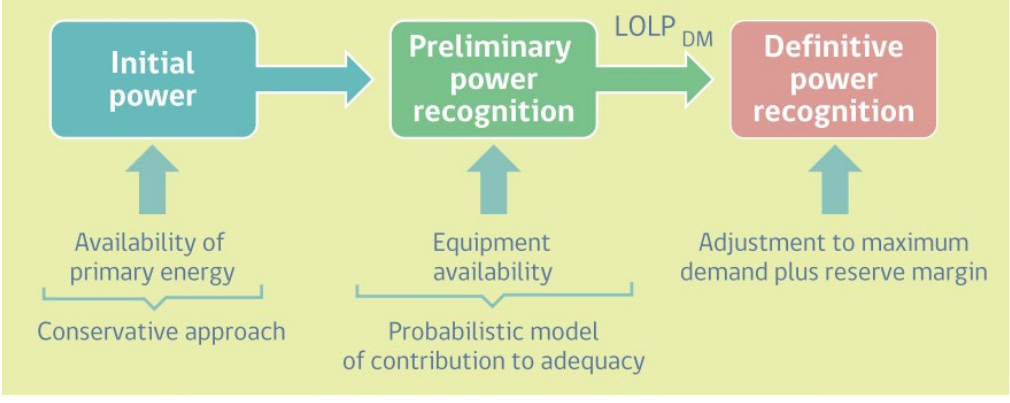
On the other hand, the S.D. N°42 of 2020 introduces the State of Strategic Reserve for generating units that begin the process of phase-out from the SEN, in the context of the decarbonization program of the energy matrix. These units will only be summoned to the dispatch by the Coordinator if he foresees significant generation deficits or conditions affecting the security of the system. Once convened, the unit must be in a position to inject energy within a period of no more than 60 days.

Units in a Strategic Reserve Status will be remunerated by concept of sufficiency. For the calculation of the contribution to the sufficiency of the electrical system, an equivalent powerno greater than 60% of the maximum power of the corresponding unit will be recognized.

The Ministry of Energy in conjunction with the CNE are developing a participatory work associated with the development of a new Power Regulation. For this purpose, working groups have been formed with different actors of the national electricity sector in order to discuss, analyze and propose the best alternatives for adequate regulation in matters associated with the treatment of power in the National Electric System.

Among these alternatives, the application of probabilistic methodologies (such as Effective Load Carrying Capability, ELCC) to determine the contribution to the sufficiency of the system by the units stands out. In addition, it is proposed that the value of the power injection decreases depending on the over-installation of generation of the electrical system and the inefficiency (variable cost) of the unit that performs said injection. Among other improvements to the process of determining power transfers.

Figure 18 **Methodological approach to the adequacy power of S.D. N°62**



Source: Own elaboration

3.5.2 Ancillary services

Ancillary services are those benefits that make it possible to preserve the security of the service in the electrical system and guarantee the most economical and quality operation for all the SEN facilities. Through these services, the security provided by the facilities to the system is recognized and remunerated.

The CNE is the body in charge of defining, after a report from the Coordinator, the ancillary services and their categories. Ancillary services are frequency control, voltage control, contingency control and the service recovery plan.

Ancillary services are organized into categories and subcategories, depending on the contribution they make to compliance with the standards defined in the Technical Standard for Safety and Service Quality.

Table 04 Categories of ancillary services

ANCILLARY SERVICES	CATEGORY	SUB-CATEGORY
Frequency control	Fast Frequency Control	Fast Frequency Control by Underfrequency
		Fast Frequency Control by Overfrequency
	Primary Frequency Control	Primary Frequency Control by Underfrequency
		Primary Frequency Control by Overfrequency
	Secondary Frequency Control	Secondary Frequency Control by Underfrequency
		Secondary Frequency Control by Overfrequency
	Tertiary Frequency Control	Tertiary Frequency Control by Underfrequency
		Tertiary Frequency Control by Overfrequency
Voltage control	Voltage control	Voltage control
Contingency control	Load Disconnection	Underfrequency
		Undervoltage
		Specific Contingency
		Manual Load Disconnection
	Generation Disconnection	Underfrequency
		Specific Contingency
	Defense Against Contingency	Defense Plans Against Critical Contingencies
		Defense Plans against Extreme Contingencies
Service Recovery Plan	Autonomous Party	Autonomous Party
	Fast isolation	Fast isolation
	Bonding equipment	Bonding equipment

Source: SSCC 2020 Report Coordinator

For its part, the Coordinator must prepare an Ancillary Services Report each year indicating the services required by the electrical system, the technical resources necessary for the provision of this services, the infrastructure that must be installed for its provision and its useful life. In addition, the report must indicate for each of the services required the mechanism through which its provision will be materialized, which must be appropriate to the condition of competition in the offer of this service, always selecting auction and bidding mechanisms when there is one competition, and direct instruction mechanisms when this is not the case.

For this, Law 20,936 of July 2016 authorized the Coordinator to carry out bids or auctions when the requirement is very short-term. Exceptionally and only when market conditions are not competitive or tenders or auctions are declared void, the provision could be directly instructed. In other words, a mixed regime of free market and provision via requirement was proposed.

Subsequently, in March 2019, a new regulation of ancillary services was approved (S.D. N°113 of 2017). This regulation establishes the way in which the services required by the SEN and its provision and installation mechanisms will be defined. It also establishes how the auctions, tenders and direct instruction of said services will be carried out. In addition, it defines the general conditions for the completion of the Ancillary Services Report and Cost Study.

The valuation of the ancillary services that are auctioned or tendered will correspond to the value awarded in the respective tender or auction. In the event that an auction is declared void, the service will be remunerated at the maximum price of said process. In relation to the services that must be provided or installed directly (without a bidding process), these will be valued through a Cost Study.

Exempt Resolution No. 442 of November 2020 establishes the components that must be added to the value offered in the frequency control auctions, to make up the price awarded in them. This awarded value will be made up of the sum of the value offered and awarded in the auction, opportunity costs for not selling energy destined for reserve, over costs for operating at a marginal cost lower than the variable cost of the unit and inefficiency costs for operating at a suboptimal point.

In other words, frequency control auctions present an ex-post payment scheme. Which allows reducing economic risks that affect potential service providers. Therefore, the value offered

in the auction should only assume wear and tear costs. However, after Resolution No. 442 became effective, the remuneration associated with the value offered represents an average 1.88% of the total payment of ancillary services per auction, between December 2020 and April 2021. Therefore, the payment of cost overruns, opportunity costs, infrastructure and remuneration at the maximum price for direct instruction represents 98% of the total payments by ancillary services.

To determine the bid awarded in the frequency control auctions, the Coordinator must carry out the joint energy and reserve co-optimization process one day in advance, which must guarantee the efficient and safe operation of the SEN.

The assignment of the facility providing an ancillary service is technologically neutral. This allows new players to enter the ancillary services market without discrimination. In this way, ERNC technologies have provided ancillary services in the categories of frequency control, voltage control, automatic generation disconnection scheme and fast isolation, for example, in August 2020, NCREs awarded services for underfrequency.

Table 05 **Percentage of reserve allocation by NCRE technology**

TECHNOLOGY	CTF-	CSF-
Wind	1,0%	0,0%
Photovoltaic solar	3,7%	7,9%
Geothermal	0,1%	0,0%
Small Run-of-river	0,2%	0,0%
Total allocated reserve* [MW]	141.253	88.763

Source: Own elaboration based on data from the Coordinator.
* Including conventional technologies.

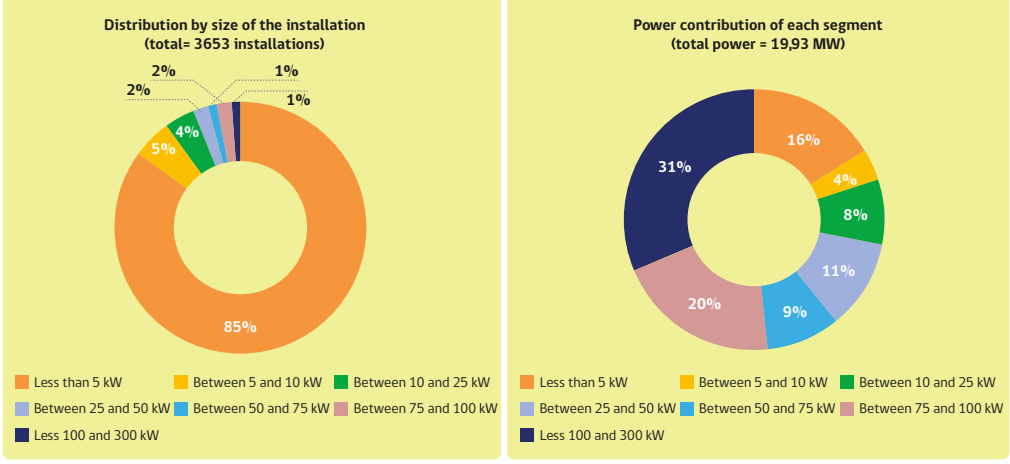
The payment of an ancillary service depends on whether the provision was through new infrastructure or existing technical resource. In the latter case, it will be the generating companies in proportion to their physical withdrawals who will have to pay for the service. On the contrary, if it is necessary to install new infrastructure in the system, it will be the end users who will have to contribute to the payment through the charge of ancillary services.

3.6 Netbilling Law

Law 20.571 of 2012, which came into force in September 2014, after the promulgation of the regulation approved with S.D. N° 71 of 2014 and its changes Law 21.118, , and finally the update of the regulation with the S.D. N°57 of 2020. This Law allows the injection and sale of surplus to end users subject to price regulation, who have equipment for the generation of electric energy by non-conventional renewable means or, individually or collectively efficient cogeneration of up to 300 kW of power, both for its own consumption and for the injection of surpluses into the distribution network. This law allows the development of projects to self-supply the demand of a single installation or estate, or larger systems to supply the demand of several installations of the same owner through a surplus transfer mechanism or to supply the installations or estate of several users through a joint ownership model or also called "community systems". All instalations or estates must be located in the distribution network of the same distributor.

Laws 20.571 and 21.118 have allowed the development of a widely accepted distributed generation market, the projects total a capacity of approximately 56.2 MW, with 6946 projects throughout the country. The vast majority are very small projects with installed powers of less than 5 kW. Figure 17 presents the distribution of projects according to their power range, both in quantity and in their contribution to total capacity of December 2020.

Figure 19 **Distribution of generation projects associated to the Netbilling Law by size and power input of each segment.**



Source: SEC.

The payment of energy injections is based on a Netbilling system, in which the excess energy injected into the network and the energy consumed from the grid are measured and valued separately, then subtract both valued amounts and determine the net amount to invoice.

The surplus energy injected is valued at the energy node price that the distribution companies transfer to their regulated customers plus a component associated with the lower losses of the distributor due to these injections.injections This amount is then deducted from the billing corresponding to the month in which the injections are made. The price of valorization of the injected energy does not consider the cost of investment and operation of the distribution network, which is charged to customers when consuming energy from the network. In the case of residential customers with capacity equal to or less than 10 kW, this charge is made at an energized rate, which, added to the price of the energy that is transferred by the distribution company, makes up the final energy consumption rate. The rest of the non-residential tariffs charge this distribution value through charges for power demanded or contracted by the customer. Therefore, depending on the type of consumer regulated rate, the energy injection price will be less than or equal to the energy withdrawal price[33]. The additional works and adjustments that are necessary to allow connection and injection of surplus of the means of generation must be paid by each owner.

The Regulation of Law 21.118[34] establishes in greater detail the procedure to carry out the connection of the generation equipment and the times in which the distribution company and the consumer must respond, the costs of the additional works that are required for the connection, responsibilities for the measurement and valuation of injections, among other aspects. The injection rates are published by each distribution company through a public platform, and the costs of studies and applications are borne by the user but at very low costs. More information on distribution generation projects oriented towards self-consumption can be found in Annex 4.

[33] Energy injection and energy prices are different for residential customers BT1, as this type of customer in its energy tariff finances both the energy it occupies and its demand for power, which finances the infrastructure of the network that supplies it (mainly the distribution network).

[34] D.S. N°57 of 2019 of the Ministry of Energy. Approves Regulation of Distributed Generation for Self-consumption. Published in the Official Gazette of September 24, 2020.

3.7 Import / Export of electricity

The Law 20.936 of 2016 incorporates for the first time in the Chilean electric legislation, the export and import of electricty and electrical services. To export or import must have the authorization of the Ministry of Energy, which must be granted by supreme decree, following a report by the Superintendency, the CNE and the Coordinator.

In the aforementioned decree, it is necessary to define the regulatory aspects applicable to the energy destined to the exchange, to establish the general conditions of the operation, including at least the term of duration and the specific conditions in which it is authorized. The operating conditions established in the permit must ensure the most economical operation of all the electric system installations and ensure compliance with the safety and quality of electrical service standards. In addition, as described in Section 2.4.1, the new Law 20.936 of 2016 establishes a segment of the transmission, specially oriented to enable the export or import and therefore the regulation of this type of lines will be independent of the other lines in the country.

Currently, Chile has an electrical interconnection with the Argentine Interconnection System through the Antofogasta region, which is used for sporadic exchanges of energy, through a decree published by the Ministry of Energy that regulates exports (S.D. N°7 of 2015). In addition, in 2016 public and private initiatives were completed to materialize an interconnection with Perú, and in October 2019, a feasibility study was completed, confirming the technical and economic feasibility of the first interconnection with Peru.

In addition to the great potencial of natural resources that Chile has, the perfection of the electrical ligislation, the good climate for investment and the investment promotion instruments have allowed the country to stand out as the leader in the region due to the integration of NCRE to its energy matrix.

4

The NCRE in the Chilean electricity market

4. The NCRE in the Chilean electricity market

This chapter describes the integration of NCRE into the Chilean market. It provides the general context for the development of NCRE in Chile and describes the stages of development of a project. The relevant regulatory framework, the minimum connection requirements for NCRE projects, the price system and the market balance of a generator and the recognition of the adequacy of this type of generators are detailed in the development stages of a project. Finally, it describes the requirements of NCRE that has imposed Chile in terms of annual quotas of generation.

4.1 General context of the NCRE

In recent years the conditions of market for the development of NCRE in Chile have significantly improved, which has resulted in an accelerated implementation of this type of projects. In addition to the technological maturation in conjunction with the reduction of the costs of NCRE technologies and Chile's great resource potential, the improvement of the Chilean electricity legislation in recent years, the good climate for investment, easy and economic access financing and the development of instruments to promote investment have allowed Chile to stand out as the leader in the region for the integration of renewable energies.
The measures undertaken by the State of Chile in removing the barriers that limit the development of NCRE projects have played a fundamental role in accelerating the development of the market associated with these projects in the country.

The improvement of the regulatory framework seeks to ensure that the rules of the electricity market take into consideration the characteristics of NCRE so that they can be harmoniously incorporated into the electricity market and systems. Likewise, the legal amendments seek to establish the conditions to materialize a folder of NCRE projects to accelerate the development of the market eliminates common barriers faced by innovation and generate trust in the electricity market with this type of technologies.

This chapter presents aspects of the current regulation relevant to the development of NCRE. In particular, the legal name of the NCRE projects is detailed (by their size and place of connection to the system), the technical requirements of connection to the system and operation, the price system of the electricity sector and the separation between the dispatch of the units and the commercial balance and finally the treatment that gives the current regulation to the concepts of adequacy and security provided by the NCRE.

4.2 Definition of means of NCRE generation in the regulation

According to the LGSE[35], renewable non-conventional generation means (NCRE) are those that have any of the following characteristics:

1) Those whose primary energy source is biomass, obtained from organic and biodegradable matter, which may be used directly as fuel or converted into other liquid, solid or gas biofuels. The biodegradable fraction of residential and non-residential solid waste is also included.
2) Those whose primary energy source is hydraulic energy and whose maximum capacity is less than 20 MW.
3) Those whose primary energy source is geothermal energy, understood as the energy obtained from natural heat inside the earth.
4) Those whose primary energy source is solar energy, obtained from solar radiation.
5) Those whose primary energy source is wind power, representing the kinetic energy of the wind.
6) 6) Those whose primary source of energy is the energy of the sea, representing all forms of mechanical energy produced by the movement of tides, waves and currents, as well as that obtained from the thermal gradient of the seas.
7) Other types of generation justifiably determined by the CNE, that use renewable energy for the generation of electricity, contribute towards the diversification of sources of energy supply in the electric systems and cause low environmental impact, in accordance with the procedures established by the regulations.

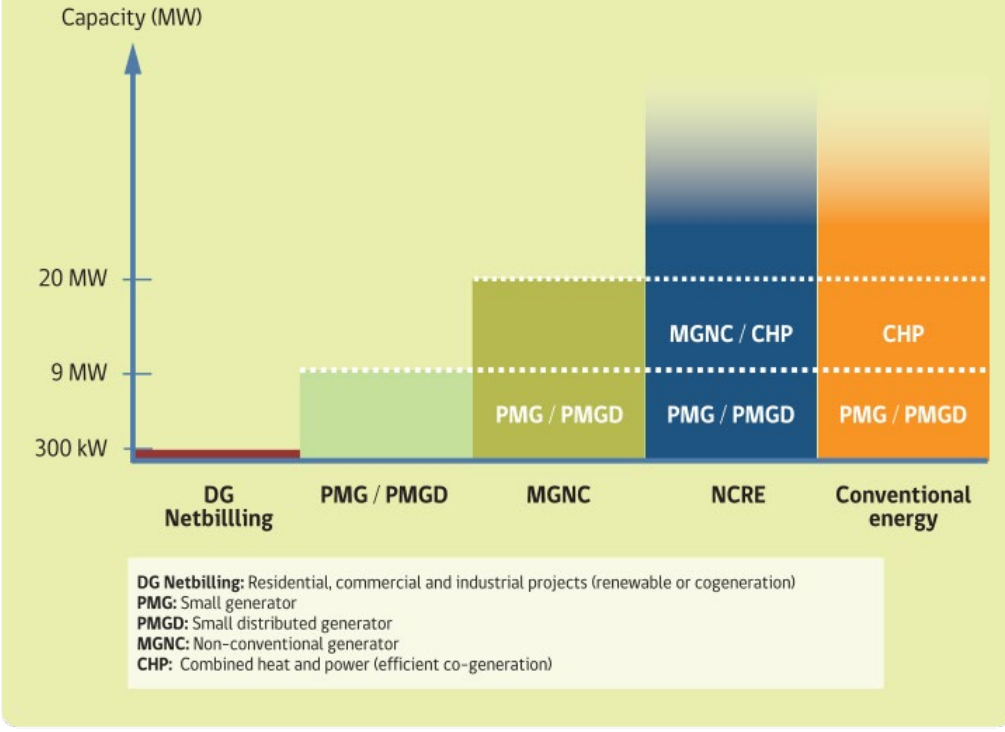
Likewise, the following concepts are defined:

- Non-conventional renewable energy: electricity generated using renewable non-conventional generators
- Efficient co-generation installation: a facility where electricity and heat is generated in a single high energy yield process whose maximum capacity supplied to the system is lower than 20000 kW and that also complies with the requirements to be established in a future regulation. It is important to note that these efficient co-generation facilities are not classified as NCRE unless they use biomass or other renewable energy as their primary fuel.

[35] Article 224 (a), DFL N°4

The classification of non-conventional renewable generators presented in the previous section, groups a set of sub-classifications to which Law 19.940, Law 20.257, Laws 20.571 and 21.118, and regulation S.D. N°88 (which replaces S.D. N°244) have conferred particular rights and obligations. Figure 19 schematically shows the different generation means and their interrelations.

Figure 20 **Classification of non-conventional renewable generation**



Source: Own elaboration as of Edition 2009 of this book.

Clasificación:

1) 1) DG-Netbilling: Renewable generation means or efficient power cogeneration of less than or equal to 300 kW, connected to facilities of a distribution concessionaire, or to facilities of a company that owns electricity distribution lines using national public use. Projects under the Netbilling Law aimed at residential, commercial and industrial customers are given the right to inject their surpluses into the distribution networks and to value them.

2) PMGD: Generators whose capacity surplus is lower or equal to 9.000 kW, connected to the installations of a concessioned distribution company, or to the installations of a company that owns electricity distribution lines using public national assets. PMGDs are given the right to connect to distribution networks.

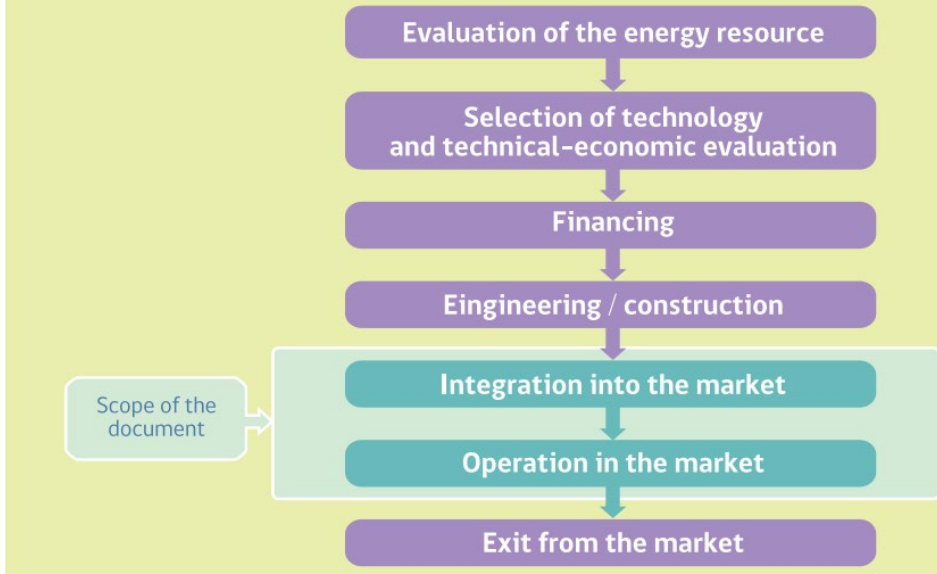
3) PMG: Generating means whose surplus power available to the system is less than or equal to 9.000 kW connected to installations belonging to the National Transmission System, to a Zonal Transmission System or Dedicated Transmission System.

4) MGNC: Generators whose source is non-conventional and whose capacity surplus injected into the system is lower than 20 MW. The MGNC category does not exclude the previously described categories. Together with NCRE projects under 20 MW, this category also includes efficient co-generation projects less than 20 MW based on fossil fuels.

4.3 Definition of means of NCRE generation in the regulation

Overview of stages of NCRE project developmentintegration and operation of NCRE in the market is necessarily conditioned by the design of the electricity market in which they intend to operate. In order to understand the different steps involved in a NCRE generation project, it is worth considering the different stages and elements that condition their development. Thus, it is possible to identify different criteria and elements to be considered for each one of the specific objectives proposed. Figure 21 summarizes the main steps in analysing a NCRE project. This document describes the integration and operation of NCRE projects in the electricity market.

Figure 21 **Stages of development of a NCRE project**



Source: Own elaboration (Edition 2009 of this book).

Market integration brings together various aspects of sectoral policies and the legal and regulatory framework. On one hand, it considers the technical elements required from a NCRE project to inject electricity to an interconnected electric system (certifications, environmental impact assessments, construction permits, tests, measurements and protection measures). On the other hand, integration refers to the connection costs that a project may face, that could depend on the location (for example: distribution, dedicated and zonaltransmission), type of technology to be used (for example, with or without surplus regulation capacity) and power levels to be injected into the network (i.e. lower or greater than 9 MW). These factors are closely related to defined payment schemes for transmission and distribution.

Operation in the market refers to the price system a NCRE project shall face in order to estimate its revenues and costs during operation. It is necessary to know the commercial

alternatives for each project, or the different feasible business models. For example, one needs to know the way in which way energy sales prices are determined, the price of capacity, the sale of ancillary services and the prices of possible contracts. This analysis also includes possible charges that may be paid individually or as a group, and other items of expenses or revenues.

As an example, in order to contrast this process for different market designs, in a system based on bilateral physical contracts, common in Europe, the self-unloading condition is a prerogative of generators that have supply contracts. However, as will be seen later, in systems such as the Chilean, the concept of self-dispatch is restricted to only some agents, since they conflict with the operation at a minimum overall cost of the system.

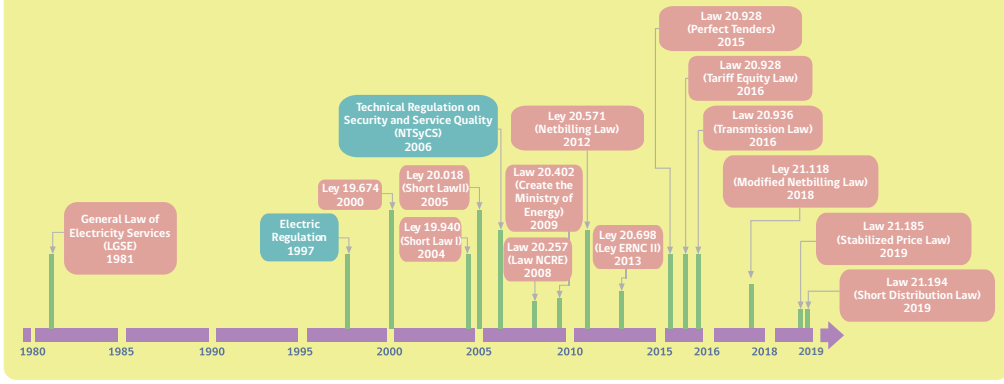
Finally, the market exit stage refers to the conditions that an agent from the sector must comply with to stop operating in the electricity market. In this aspect it is necessary to comply with administrative processes that ensure an adequate end to a NCRE project or its transfer to another market agent.

According to Figure 18, the scope of this document focuses on the stages of integration and operation in the market of a NCRE project. While elements to be considered in the other stages are illustrated, the detailed treatment is restricted to the two areas indicated.

4.4 The regulatory framework for NCRE

The regulatory framework of the Chilean electric system originally made no regulatory distinction for non-conventional renewable energies. The main milestones linked to NCRE are outlined in Figure 22 and in Annex 2.

Figure 22 Chronology of the normative process



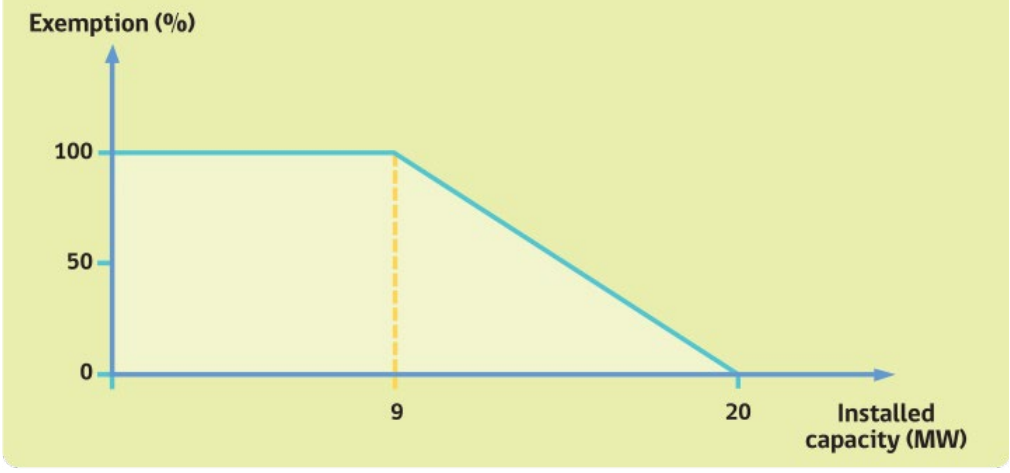
Source: Own elaboration as of Edition 2009 of this book.

However, changes to the LGSE, introduced in March, 2004 through Law 19.940, modified a number of aspects of the electricity generation market that affects all generators, introducing elements specifically applicable to NCRE. The spot market is opened and the right to connection to the distribution networks is ensured for small power plants. Many NCRE projects are normally of this size, thus increasing the commercial options for selling energy and power of such power plants.

Additionally, a charge payment exemption for the main transmission system[36] is established for MGNCs (with a differentiated treatment for units less than 9 MW and those between 9 MW and 20 MW). For units from 9 to 20 MW capacity, the charge exemption is calculated as a proportional adjustment ranging from 100% for 9 MW and zero for 20 MW or more. Figure 23 shows the application of this scheme. The foregoing, besides being a benefit for these generation sources, is a recognition of their positive externality due to the low impact that they will have on transmission systems and on the investments associated with their expansion.

[36] The Law 20.936 of 2016 changed the name to system of transmission systems for a more functional one. Details on the new transmission segments and basic infrastructure of the high voltage transmission system are shown in section 2.4.1

Figure 23 **Exemption of trunk charge for non-conventional generation as a function of excess power**



Source: Own elaboration (Edition 2009 of this book).

It is important to note that according to the legal modifications made by the Law 20.936 of 2016, as of January 1, 2019, new injections (associated with contracts after the entry into force of the Law) will be exempted from the payment of transmission charges. On the other hand, injections associated with contracts concluded prior to the entry into force of this law, will be applied a payment system similar to the old one. Section 6.3 of the book explains in greater detail the payment of charges from generators under these conditions.

4.4.1 Price systems in the electricity sector

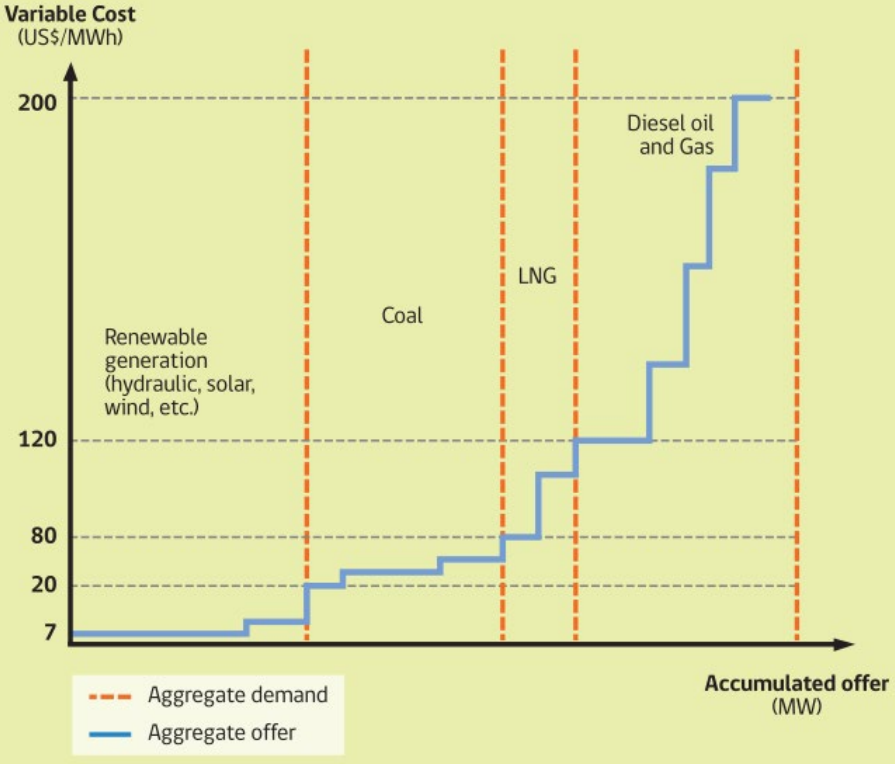
As discussed in Sections 3.3 and 3.4, a NCRE project in the wholesale market can access the spot and contract markets as the case may be. It is important to note that spot market transactions and contracts are financial and not physical. This means that the physical dispatch of the units is guided primarily by minimizing the operating costs of the system for a given security level and not by the supply contracts established between the parties. However, in order to give greater clarity on the dispatch of units and valuation of transfers, a brief description of the dispatch of the units is given and the general commercial balance of NCRE generators is presented later.

4.4.1.1 Dispatch and NCRE

The dispatch of generation units in the electric system is carried out by the Coordinator, which through optimization tools determines the operation at the lowest cost of the system. This optimization determines, besides the dispatch of each unit, the marginal cost per hour (spot price) for each bar of the system.

For a given time, the pool establishes an economical system operation, which results in marginal costs on the injection and withdrawal bars of the system. In its simplest version, the economic operation of the system is achieved by dispatching the generation units in increasing order of variable generation costs, until they can cover the required demand at a given time. In this way, the null or low variable cost units are dispatched first. This type of generation, common among renewable energies (run-of-river, solar, wind, etc.), is called base generation units. Figure 22 shows the relationship between increasing variable costs of generation by technology and the aggregate demand of the system. At higher demand, the variable cost of system generation rises as more expensive technologies are required.

Figure 24 **Example of aggregate supply curve**



Source: Own elaboration

4.4.1.2 Commercial balance of a NCRE generator

For a NCRE generator that participates in energy and power transfers in the electric system, the commercial balance is composed of: its injections and withdrawals in the spot market, energy and power sales according to its supply contracts, its NCRE attribute sales (however, given that currently there is a large supply of NCRE projects that exceed the quota established by Law 20.257, the NCRE attribute has no great value in the market), its fixed and variable generation costs and other payments that may correspond charges and payment for ancillary services. It should be noted that the payment of charges is eliminated by the Law 20.936 of July 2016. For more information, refer to section 2.4.2.

The following expression represents, in a simplified way, the commercial balance of a NCRE generator:

BalCom = BalSPOT + VentasCBF + ExcedentesERNC – CostosGen – OtrosPagos

Where:

BalCom	Commercial balance
BalSPOT	Difference between injections and withdrawals valued energy and power. Calculation made by the Coordinator according to the information provided by the companies.
ExcedentesERNC	Sale of NCRE attributes of compliance with Law 20.257
VentasCBF	Sales of energy and power agreed in bilateral financial contracts.
CostosGen	Fixed and variable costs of energy production.
OtrosPagos	Charges

A NCRE generator may also have income from providing ancillary services. Which in accordance with the regulation (DS N°113 of 20199) will be remunerated according to the value awarded in the auction or tender. In the case, the services that must be provided and/or installed directly will be valued and remunerated according to a Cost Study conducted by the Coordinator.

4.5 Non-Conventional Renewable Energy Law (Law 20.257 and Law 20.698)

On April 1, 2008, Law 20.257 entered into force, which established an obligation for electricity companies that a percentage of the energy marketed come from NCRE sources[37] and defined a target of 10% a year 2024. However, in October 2013, this was modified to the goal to 20% by 2025 (Law 20.698 of 2013).

Thus, for contracts concluded after August 31, 2007 and before July 1, 2013, the obligation was 5% for the years between 2010 and 2014 (Law 20.257), increasing by 0.5% per year from 2015 until reaching 10% in 2024. However, for contracts entered into after July 1, 2013 (Law 20.698), the obligation was 5% in 2013, with increases of 1% from 2014 until reaching 12%

[37] In international terminology this model is known as a quota model.

by 2020, and increases of 1.5% from 2021 to 2024, and an increase of 2% to 2025 to reach 20%. The above requirements are presented in Table 6.

Table 06 **Annual obligations established in Law 20.257 and Law 20.698**

Year	Law 20.257	Law 20.698
2010	5.0%	
2011	5.0%	
2012	5.0%	
2013	5.0%	5.0%
2014	5.0%	6.0%
2015	5.5%	7.0%
2016	6.0%	8.0%
2017	6.5%	9.0%
2018	7.0%	10.0%
2019	7.5%	11.0%
2020	8.0%	12.0%
2021	8.5%	13.5%
2022	9.0%	15.0%
2023	9.5%	16.5%
2024	10.0%	18.0%
2025	10.0%	20.0%

Source: Own elaboration.

Other important provisions of these laws are presented below:

▸ The electricity company that does not prove compliance with the obligation on March 1 following the corresponding calendar year, must pay a fee, whose amount is 0.4 UTM[38] per MWh of deficit in relation to its obligation. If, within the following three years, it again fails to comply with its obligation, the charge is 0.6 UTM for each MWh of deficit.

▸ Any electricity company that exceeds its non-conventional renewable energy injection obligation may agree to the transfer of its surplus to another electric company, which may be done even between companies of different electric systems.

▸ It is important to note that compliance with this law is only valid for NCRE produced by installations that have been connected to the SEN as of January 1, 2007.

▸ Only for the purposes of the accreditation of the obligation established in the law, are also recognized part of injections from hydroelectric plants whose maximum power is equal to or less than 40 MW, even when hydroelectric projects with a maximum power equal to or greater than 20 MW are not defined as NCRE in the Law. This recognition corresponds to a proportional factor that is null for powers equal to or greater than the indicated power. Figure 25 summarizes the scheme applicable to hydroelectric plants in relation to the recognition of NCRE:

Figure 25 **NCRE accreditation mechanism for hydraulic units**

Source: Own elaboration (Edition 2009 of this book).

[38] The value of the UTM in December 2020 is $ 5151.029, equivalent to US $ 71.77 (considering value of each dollar to $ 711711). So, 0.4 UTM / MWh is equivalent to US $ 1717.29 / MWh. The monthly value of the UTM is available online at http://www.sii.cl

► It should be noted that the accreditation of NCRE is not limited to projects of less than 20/40 MW and that hydroelectric plants are a case of private treatment. As an example, for a 100 MW wind farm the recognition is for the total energy injected into the system.

Finally, it is important to note that if the target is not met due to lack of investments in renewable projects, the Ministry of Energy must to carry out annual public tenders for the provision of non-conventional renewable energy blocks to cover the part of the missing obligation[39]. However, as will be seen in the next section, given the strong non-conventional renewable penetration in Chile, the tender is very likely that it will not be necessary to carry out these bids.

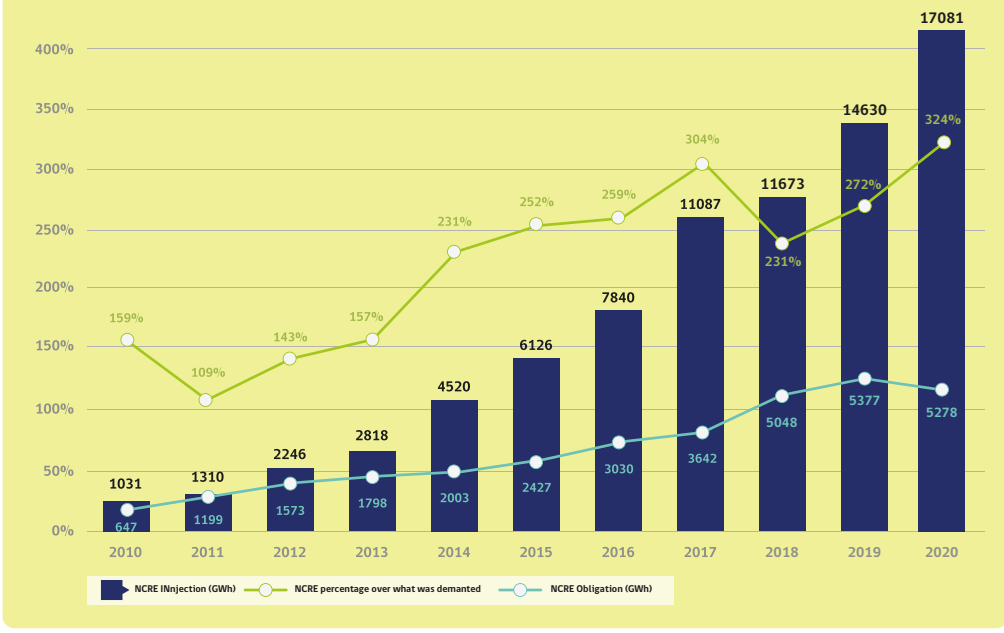
4.5.1 Compliance with the NCRE obligation

Non-conventional renewable generation has far exceeded the quota imposed by the regulation, as shown in Figure 24. For example, the NCRE quota for 2020 is 8% for the supply contracts entered into between August 31st 2007 and July 1, 2013 and 12% for contracts signed after July 1, 2013. In December 2020, these obligations resulted in a goal of 5377 GWh of NCRE energy. However, the actual and recognized NCRE injection by law was much higher, reaching 14634 GWh, that is, 272% over what was demanded[40]. This surplus in relation to the NCRE obligation has resulted in a price collapse of the NCRE attribute, which is no longer a significant source of project financing. Figure 26 presents the annual obligations NCRE and as these have been systematically surpassed in each year.

[39] Article 150° of the LGSE incorporated with Law 20.698.

[40] The NCRE injection of each month can obtain from the monthly statistical report of the CNE that can be downloaded from http://energiaabierta.cl/reportes/

Figure 26 Compliance with NCRE laws



Source: Own elaboration from Statistical Yearbook of Energy andand Monthly Reports. CNE

4.6 Recognition of adequacy power to NCRE plants

The adequacy power of generators for unconventional sources, such as geothermal, wind, solar, biomass, tidal, small hydroelectric plants and cogeneration plants will be determined based on the type of input used. In accordance with Article 35 of the S.D. N° 62 to determine the initial power of the NCRE generators, the Coordinator will use the statistical information of the primary input provided by each owner, considering the worst scenario of average annual availability of said input in the last five years. In the case of solar thermal power plants, the primary input will correspond to the stored fluid for the thermal process.

The initial power of thermal NCRE plants (biomass, geothermal, thermosolar and biogas) and hydroelectric will be determined according to the same procedures of conventional thermal and hydroelectric plants respectively. For all other generation technologies classified ERNC,

such as wind and solar plants, the initial power will be determined according to the value resulting from multiplying its maximum power by the minimum of the following values:

1. Lower annual plant factor of the last 5 years prior to the year of calculation.
2. Simple average of the plant factors registered for each of the 52 highest hourly values of the annual load curve of each system or subsystem for the year of calculation.

The Coordinator, using a public and technologically neutral probabilistic model, must calculate the contribution of each plant to the adequacy of the system, using as criteria: the initial power of the generator, the statistics of the unit's operating states (available, not available, deteriorated), maintenance period and own consumption. Both the own consumption and the maintenance period (major maintenance) will be represented by factors that proportionally reduce the value of the initial power.

As a result of the Coordinator's probabilistic model, the preliminary adequacy power of the unit will be obtained, which must be adjusted by the peak demand of the system to assign the definitive adequacy power to the corresponding unit.

In summary, the recognition of adequacy power will vary mainly according to the generation resource available, the availability of the unit at the time of dispatch, its maximum power and the supply-demand of adequacy of the electrical system. This procedure is discussed in more detail in Annex 3.

Regarding the recognition of adequacy power of the PMGD. The initial power of the PMGDs will be determined according to the same methodologies used in conventional or unconventional generating plants, depending on the main input they use.

4.7 Minimum technical requirements for NCRE projects contained in the NTSyCS

The technical regulation applicable to the connection and operation of the NCRE generator differs according to the selected connection system, as discussed in section 5.2 of the book, which delves into the requirements for a PMGD. In this chapter, we present the most relevant articles of the Technical Standard for Security and Quality of Service (NTSyCS)[41] that refer to the technical requirements of connection and operation in the interconnected systems of NCRE projects. It is emphasized that the NTSyCS defines the technical requirements applicable to all generation units whose level of connection to the electric system exceeds 23 kV[42], and that there are certain provisions that specifically apply to NCRE technologies, especially wind and solar generation. Moreover, it imposes requirements for its participation in secondary frequency control and voltage control.

The installations and equipment of generators that operate interconnected in the national electric system must comply with certain requirements indicated in the NTCySC. Table 7 summarizes those provisions and the corresponding articles of the NTSyCS applicable to NCRE projects.

[41] Technical standard updated to December 2019.

[42] While the PMGDs are coordinated by the Coordinator, the NTSyCS would be applicable to them in relation to requests for information. The coordination of its operation focuses on the respective distribution company according to the Technical Standard for Connection and Operation of Small Generation Distributed at Medium Voltage (NTCO).

Table 07 Technical requirements applicable to NCRE technologies according to NTSyCS

Theme	Technology	Provision	Article
Minimum requirements for design of generation facilities (Title 3-3)	Synchronous machine	The design of synchronous generating units shall consider a nominal inductive power factor of 0.92.	3-7
	Wind / Photovoltaic	In the event of a voltage drop or a failure of other events, the units must be designed to ensure that at least they remain connected to the system when the phase-to-ground voltage at the connection point varies between 0.8 and 1.	3-8
	Wind / Photovoltaic	The design of the parks must ensure that they can operate by delivering or absorbing reagents for voltages in the normal state range. The standard defines the operating areas for both types of parks.	3-9
	Wind / Photovoltaic*	Stable operating times are allowed for frequency variations, after which switching off is permitted.	3-10 y 3-11
	Wind / Photovoltaic*	The requirement for generation units and wind or photovoltaic farms greater than 50 MW is established for a reactive power / voltage control system.	3-13
	Wind / Photovoltaic*	The type of connection of the windings of the transformers on the connection side to the network is indicated.	3-15
	Wind / Photovoltaic*	It indicates the minimum requirements that must be met by the frequency / power controller and the maximum load take-up rate at start-up and operation.	3-17
Quality of supply in generation and transmission facilities (Title 5 -12)	Wind / Photovoltaic*	It sets the limits for the programmed and forced generation unavailability indices for each technology and indicates how to calculate them.	3-54
Electrical Product Quality Standards (Title 5-14)	Wind / Photovoltaic*	It establishes the limits of contamination to the network in terms of voltage harmonic distortions, current harmonics, voltage fluctuations, and flicker severity.	3-70
Technical information on facilities and equipment (Title 6-2)	Wind / Photovoltaic*	It indicates for each generation technology the information that must be made available to the Coordinator regarding technical data, operating parameters and the additional information requested in the Technical Annex. It indicates contents of the "Quality Report of Supply and Product Quality" to be sent monthly to the Coordinator.	6-13 and 6-15
Forecasting (Title 7-3)	Wind / Photovoltaic	It indicates the information that must be elaborated and made available to the Coordinator and the periodicity with which it is required (generation forecasts and ramps, meteorological forecast).	7-13

* The article in question also regulates for other technologies.

Source: Own elaboration from the NTSyCS.

4.8 Information platforms and resources available

Before the installation of a renewable generator in a certain place, the available energy resource must be appropriately evaluated. To this end, the State, in parallel with the development of the regulation for these projects, has made an effort to raise public and free information to reduce barriers to access. Likewise, the State has allocated large tracts of fiscal land for the development of renewable energy projects. In the particular case of geothermal energy, the State has authorized exploration or exploitation of geothermal energy in many areas of the country.

4.8.1 Information platforms for assessing energy resources

One of the pillars of the Program of Support to the Development of the NCRE carried out by the Ministry of Energy is the generation of public information on the natural resources present in Chile, which will guide, through an up-to-date background both to its development policy and to potential investors.

In this context, the Ministry designed tools such as "Exploradores de Energía", which are designed to assess the energy potential of renewable resources in the country and also maintain campaigns for wind and solar resources in the country. In addition, it has implemented information platforms that allow the indirect evaluation of these resources by means of modeling tools, databases, territorial information and updated cadastre of the resources present in the country. All these platforms can be accessed through of the web site of the Ministry[43].

Details of the functionalities of these information platforms can be found in Annex 5.

4.8.2 Tenders for fiscal land

In 2010, through a Framework Agreement of Collaboration between the Ministry of National Assets and the Ministry of Energy, areas for wind projects were reserved in the Great North, which are being granted in concession of onerous use for the development of wind projects by way of bidding public. The purpose of this initiative is to efficiently manage the fiscal wealth and respond to the growing demand for fiscal lands for such projects. Since that

[43] In the following link: http://exploradores.minenergia.clcl

date onwards, there have been multiple tenders for land for non-conventional renewable energy, both wind and solar, and storage systems, specifically, until the year 2021, 40 bidding processes have been carried out, with 5259 MW in operational projects and 2447 MW in projects under construction.

The Ministry of National Assets has prioritized the development of NCRE projects in fiscal properties, located mainly in the country's Great North. This is why the bidding procedure for the concession of use of fiscal land can be initiated by the Ministry, but also at the request of the interested parties[44]. In addition, in October 2020 the Ministries of Energy, National Assets and Corfo signed a collaboration agreement to promote green hydrogen projects in public lands to promote the development of said industry.

4.8.3 Geothermal exploration concessions

One of the tasks of the Ministry of Energy is the administration of Law 19.657 of 1999 on concessions of geothermal energy. Its functions are to grant and deny applications for geothermal concession, to make calls for tenders, when dictated by the Law and its Regulations[45]; And to resolve claims related to the concessions system, among other activities established by the law. It is also responsible for the study, formulation and execution of policies, instruments and regulatory proposals applicable to geothermal energy.

A geothermal concession is an administrative act granted by the State where it is authorized to carry out activities of exploration or exploitation of geothermal energy in a given area. Concessions of geothermal energy can be obtained through applications submitted directly to the Ministry of Energy or through calls for public tenders.

Figure 27 shows the concessions for exploration and exploitation of geothermal energy in force in December 2020.

[44] Decree N°1939 of 1977 regulates the acquisition, administration and disposition of State property.

[45] Decree N°51 of 2021

Figure 27 Concessions for exploration and exploitation of geothermal energy

1. Current exploration concessions

No exploration of current concessions is recorded

2. Current exploitation conssesions

Concession	Company	Region	Province	District	Surface (HA)
Apacheta	Geotérmica del Norte S.A	Antofagasta	El Loa	Ollagüe	8.100
El Tatio	Geotérmica del Norte S.A	Antofagasta	El Loa	Calama	1.280
La Torta	Geotérmica del Norte S.A	Antofagasta	El Loa	Calama-San Pedro de Atacama	3.000
Laguna del Maule	Compañía de Energía Limitada Enerco	Del Maule	Talca-Linares	San Clemente-Colbún	4.000
Olca	Compañía Minera Doña Inés de Collahuasi SCM	Tarapacá-Antofagasta	Del Tamarugal-El Loa	Pica-Ollagüe	2.500
Pellado	Compañía de Energía SPA	Del Maule	Talca-Linares	San Clemente-Colbún	16.000
Peumayén	Transmark Chile SPA	Bío Bío-Araucanía	Bío Bío-Malleco	Quilaco-Curacautín	2.250
Tinguiririca	Energía Andina S.A	Del Libertador General Bernardo O'Higgins	Colchagua	San Fernando	6.175

Source: NCRE Monthly Report. January 2021. CNE (Ministry of Energy).

The integration of a NCRE project to electric systems in Chile starts with the identification of the type of subsystem to which it is intended to connect, since the technical regulations differ depending on the selected system.

5

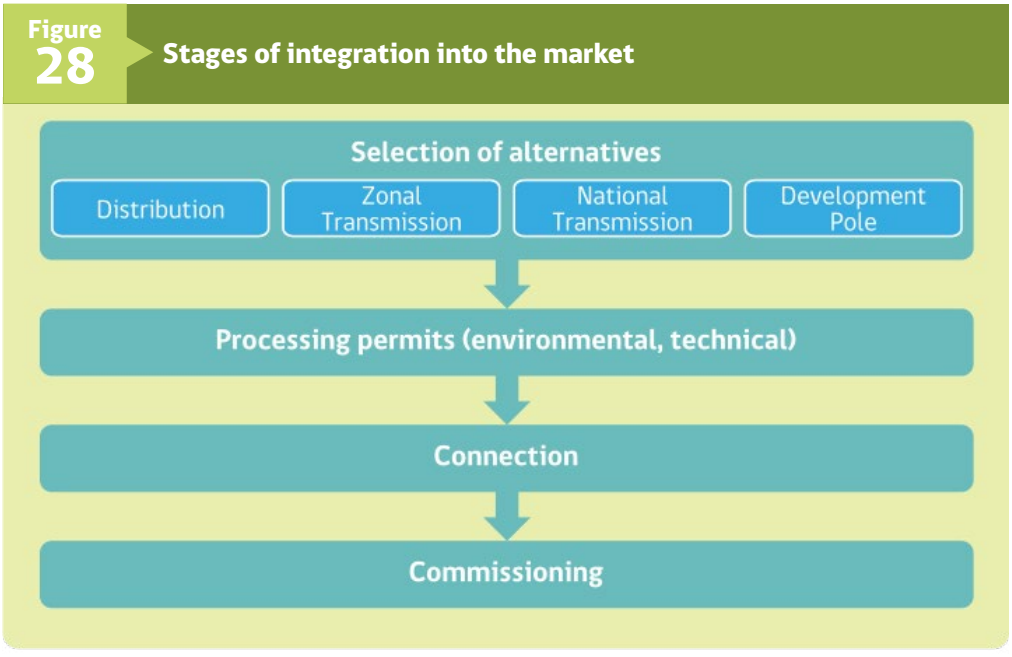
Integration into the NCRE market

5. Integración al mercado de ERNC

This chapter deals with the issue of integrating NCRE into the market. It is important to note that the topics covered in this section are primarily technical issues. Initially, the different integration alternatives available for participating in the market will be described. The legal provisions in force, the obligations of participating in the market, eventual preferential arrangements and their justifications will be considered. These alternatives also refer to the level of voltage in the network (distribution with voltages lower or equal to 23 kV, sub-transmission or transmission with voltages greater than 23 kV) or to Development Poles, to arrange the connection of a NCRE project. Once the project connection location is identified, the necessary procedures to allow for the operation of a NCRE generator are described. Finally, connection costs are discussed. These also depend on connection location, as occurs with the associated procedures and technical regulations.

Figure 28 shows the corresponding stages considered in the NCRE market integration process, these stages are described in detail in the following sections of this chapter.

Figure 28 Stages of integration into the market



Source: Own elaboration as of Edition 2009 of this book.

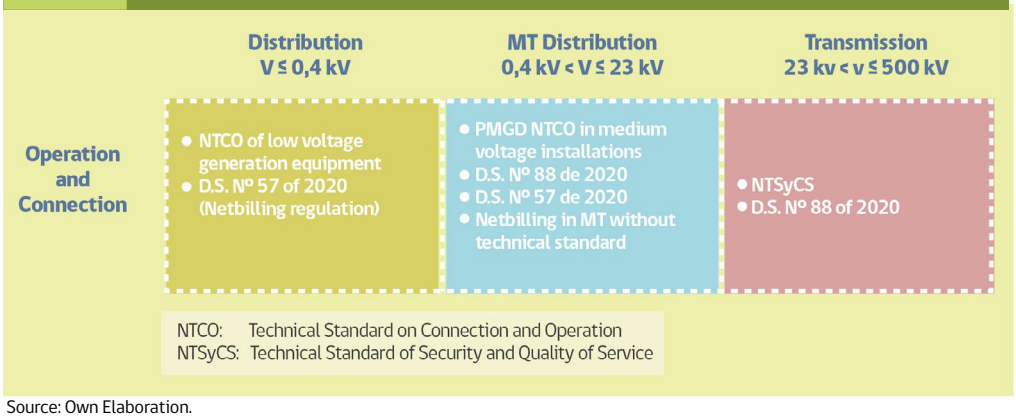
5.1 Integration alternatives to an electric system

Integration to the electric systems is based on the identification of the type of subsystem in which the connection of the NCRE project is sought, since the technical regulations applicable to the connection and operation of the NCRE generator differs depending on the selected connection system. Figure 27 presents the rules applicable to the NCRE project depending of their connection to a distribution system or transmission.
If the project is in accordance with the Netbilling Law, it will be able to connect to low or medium voltage distribution systems. In the first case, the applicable regulation is the Technical Standard of Connection and Operation of equipment of generation in low voltage. If the project aims to connect to medium voltage, there is no specific rule and should be guided by the offices and indications of the Superintendency of Electricity and Fuels (SEC). It is important to highlight that, in these cases, the systems may not be established as companies with an electric turn to sell their energy to the network, and are not coordinated by the Coordinator.

If the project is a PMGD intended for connection to a medium voltage distribution system, the applicable standards are the regulation for Non-conventional Generation Means and Small Generation Means established in the General Law of Electrical Services and the respective the Medium Voltage Connection and Operation Technical Standard.

Regarding to PMG and its connection to transmission systems, the regulation D.S. N°88 of 2020 applies and the technical regulation is that found in the Technical Standard for Security and Quality of Service (NTSyCS), although it applies the same regulation as in the previous case, the technical requirements are different for each case. A clear distinction between the distribution systems and the others is achieved by identifying the operating voltage of the network, since the distribution networks are all those that operate at voltages less than or equal to 23 kV.

Figure 29 Applicable normative in function of the connection sector



Source: Own Elaboration.

5.2 Processing of technical permits

The procedures and formalities necessary to manage the entry into operation of a NCRE project are specified in the regulations indicated above. As described above, the connection procedure and the permission to enter into operation depends on the system in which the NCRE generator is connected.

5.2.1 Connection procedure projects under the Netbilling Law

The connection procedure for a project under the Netbilling Law has 6 stages, which are explained briefly below. This procedure is designed to allow a low cost to the user and be expeditious (can take between 4 to 6 months)

Stage 0: Optional, it corresponds to a request for information to the distribution company.

Stage 1: Connection request to grid (SCR): The user must specify the main characteristics of his generation system (location, installed capacity, etc.).

Stage 2: After receiving response to the connection request from the previous stage, the user must make a statement of compliance to the SEC.

Stage 3: Corresponds to the period of installation and registration of generation equipment in the SEC (TE4 statement).

Stage 4: Notification of connection and signing of contract with the distribution company according to the connection protocol.

Stage 5: The connection to the distribution network occurs.

It is important to note that all forms and the Online Connection Processing platform for each of the communications with both the distribution company and the SEC are available on the website of the SEC[46], as well as the maximum deadlines for response of all parties. on the SEC website[47] presents the procedure of connection and commissioning.

5.2.2 Connection to distribution networks of PMGD

The procedure for connecting and commissioning a PMGD can be found on the SEC website[48] and Annex 4 describes in greater detail each of the stages of connecting a PMGD. It is important to indicate that PMGDs can request to be classified as Not Significant Impact (INS)[49] in which case the connection procedure is different. The stages for connecting a PMGD are as follows:

Stage 0: It is optional, it corresponds to the request for information and response from the distributor.

Stage 1: Sending the Network Connection Request (SCR).

Stage 2: Declaration of admissibility

Stage 3: Response to the Network Connection Request (SCR).

Stage 4: Conformity with the response to the (SCR).

Stage 5: Issuance of the Connection Criteria Report (ICC).

Stage 6: Declaration under construction.

Stage 7: Commissioning and Entry into Operation

[46] The Netbilling project connection forms and platform can be found on the following websites:
https://www.sec.cl/formularios//
https://www.sec.cl/gda/tramitacion-de-conexion-en-linea/

[47] Portal of the Netbilling: https://www.sec.cl/sitio-web/wp-content/uploads/2020/11/Proceso_Ley21118-2018.jpg.pngpng

[48] PMGD connection procedure: https://www.sec.cl/pequenos-medios-de-generacion/

[49] According to article 86 of the S.D. N°88, in the event that the installed capacity of the PMGD reported in the SCR is less than or equal to the capacity of the splice to which it is connected and the Installed Capacity for Expedited Connection, and the injection capacity thereof is less than or equal to Injection Capacity for Expedited Connection, it will be considered that the PMGD classifies as having a non-significant impact, being able to connect through an Expedited Connection Process.

It is important to note that the PMGD technical standard for connection and operation explicitly incorporates the definition of "shared facilities", clarifying the rights and conditions to install PMGD in installations that also have consumptions. That is, for certain projects the standard does not oblige to build a new joint, but allows to take advantage of the existing joint.

Each of these stages has one or more pre-established forms through which communications are made between the customer, the distribution company and the Superintendency. Likewise, the deadlines that the parties have to respond to are also regulated.

5.2.3 Connection to the transmission system

According to what is established in the Law, the installations of the National Transmission Systems and the transmission systems of each electric system are subject to an open access regime and can be used by third parties, under non-discriminatory technical and economic conditions among all users.

Also, Dedicated Systems are also subject to the open access regime, i.e. owners can not deny the service to any interested party when there is available technical capacity of transmission. The Coordinator will reasonably determine the available technical capacity of the Dedicated Transmission Systems.

In accordance with current regulations, the interconnection of all facilities must be communicated to the CNE, the Coordinator and the SEC at least six months in advance. The energization of any facility must be reported to the SEC, at least fifteen days in advance.

The design and information requirements to be delivered by the generators are described in detail in the NTSyCS, which are valid for any generation medium that is integrated into an electric system.

5.3 Connection costs

In general terms, connection costs related to transmission equipment, substation, protection, control and measurement systems must be considered as part of a generation project. This equipment is necessary to safely inject energy from the power plant into the electric system, respecting the minimum technical requirements established in the regulations and standards (time periods, minimum design standards of the installations, security standards and service quality, operation and monitoring of installations). These costs form part of the project and the amounts depend on each specific project.

In addition, in the case of connections to distribution networks, the regulations envisage possible connection costs that are outlined in the following section.

5.3.1 Connection costs to distribution networks

Both PMGDs and projects under the Netbilling Law must pay connection costs to access the distribution networks.

5.3.1.1 Connection costs of PMGD to distribution networks

The text that regulates this matter with regard to PMGD is DFL N°4 of 2007 in its article 149, which states in its sixth paragraph that all additional works that are necessary to allow the injection of power to the networks of distribution are borne by the owners of the means of generation. Specifically, the above article states that the following:

"Concessionaries of the public electricity distribution service, as well as those companies that possess electricity distribution lines that make use of public, national assets, shall allow connection to their distribution installations by generators whose capacity surplus supplied to the electric system does not exceed 9.000 kilowatts, notwithstanding compliance with current security and service quality requirements. The additional works needed to enable the injection of that capacity surplus shall be carried out by the owners of the respective distribution system and their costs will be charged to the generator owners, in accordance with the regulations. To calculate these costs, the additional costs in adjacent zones of the injection point will be taken into consideration as well as the cost savings in the rest of the distribution network, in accordance with the procedures defined in the rules. The value of these additional installations will not be considered as part of the new replacement value of the respective distribution company".

According to the S.D. N°88/2019, the additional works, adjustments or adjustments that are necessary to allow the injection of the excess power of the PMGD must be executed by the corresponding distributors. The costs of said works must be consigned in a connection cost report and will be borne by the owner of a PMGD. By resolution, the CNE will define the unit costs of the various components that make up the works of this nature, as well as their application conditions. Prior to this, the CNE must issue a technical report with the calculations for the definition of said costs.

5.3.1.2 Connection costs of projects under the Netbilling Law to distribution networks

The costs of connecting the projects under the Netbilling Law are solved by the owners of the generation systems. However, these costs should, in general, be considerably less than the connection costs of a PMGD.

In the event that additional works are required for the connection, the distribution company must indicate through electrical studies those additional works and/or adjustments that are

technically necessary for a correct connection of the generation equipment to the distribution network. The CNE will issue a technical report with the unit cost calculations of the various components that make up these works and will be defined by resolution. The valuation of the works must be calculated considering the necessary requirements to maintain the standards of safety and quality of supply in the current standard.

This calculation should consider the values of each of the components of the additional works and/or adjustments, associated assembly costs, and the surcharges established in the procedure for determining the New Value of Replacement (VNR) of the distribution facilities, established by the Superintendency.

Likewise, if the fitting connection of the splice is required, the costs associated with its extension and replacement shall be borne by the owner of the generation equipment.

5.3.2 Connection costs to a transmission system

The current regulations do not include connection costs to the transmission systems. The costs attributable to a generation project are established in the charges that it must pay for the use of the transmission systems[50]. However, the transmission facilities necessary to connect the generation project to the system are the responsibility and cost of the owners of the generation projects themselves. In addition, it should be mentioned that the Coordinator defines a set of technical requirements necessary for the integration of new generation sources, which may result in expansions of transmission systems, which, if considered as necessary works of expansion, will be financed by all users (see Section 2.4.2.2 to review the payment principles of the transmission network). In the case of Dedicated Transmission Systems, their extensions are negotiated between the owner and the user.

[50] Further information on payment for use of the networks in Section 6.3.

6

Market operation in the market

6. Market operation in the market

The market operation of a NCRE project is regulated by the general rules applicable to any generator, described previously in chapter 3. Based on this general description, the different market alternatives for a NCRE project are now set out in greater detail.

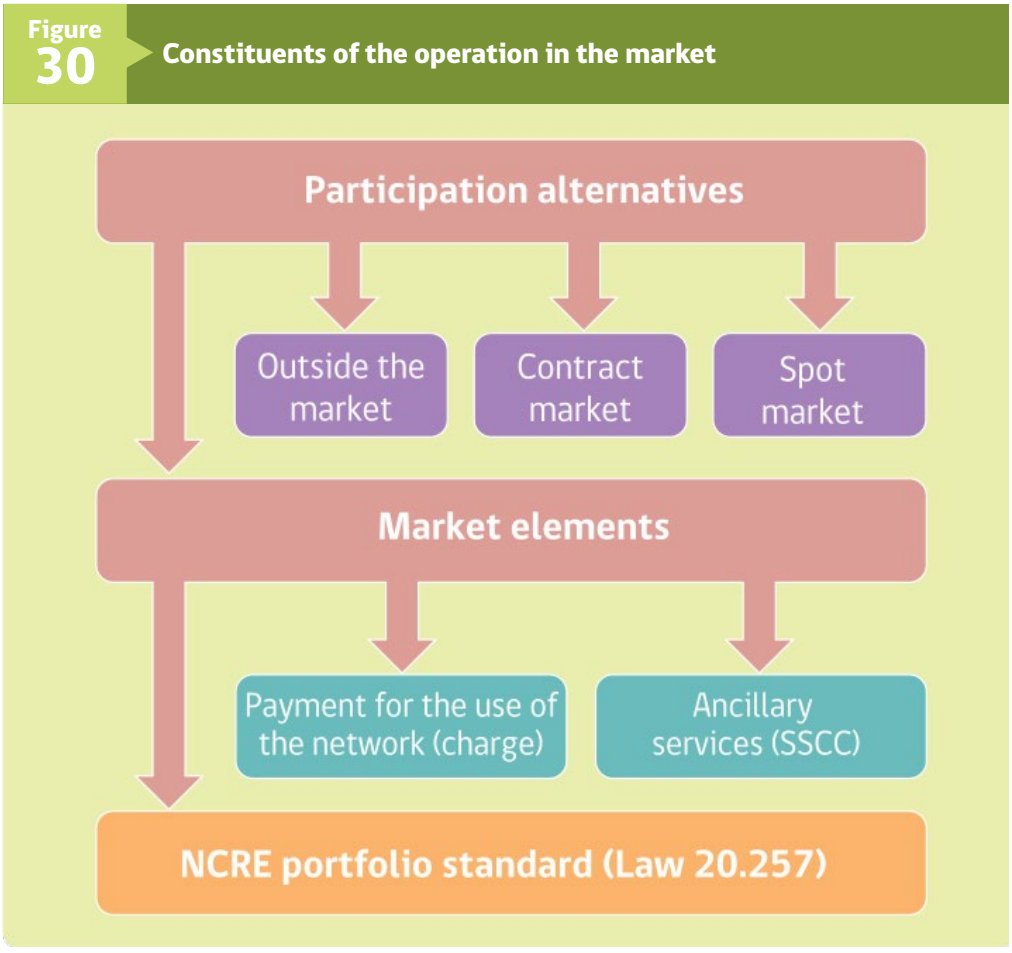
The technical aspects of the operation in an electricity market are covered by the regulations and technical standards of the respective segments. In the case of transmission systems, the NTSyCS defines the operation and measurement requirements of the generating units. At medium voltage levels, the NTCO of PMGD focuses on the operational and coordination aspects of PMGDs.

Figure 30 shows a schematic diagram related to the elements considered in the market operation. In the first place, the different alternatives of participation are presented, among which the three basic ones stand out: "out of the market", spot market and contract market. There are other alternatives that are, in broad outlines, a combination of the aforementioned alternatives. As for the "off-market" alternative, this refers to the direct (and private) negotiation between a small NCRE generator and the distribution company, without being directly part of a more formal market, such as the spot market or one of contracts.

The second stage shows elements of market share, among which the payment for the use of the network (charges) and ancillary services (SSCC) stand out.

Finally, reference is made to other elements to be considered in the market operation of a project, such as NCRE generation quotas (established in Law 20.257 and Law 20.698).

Figure 30 **Constituents of the operation in the market**

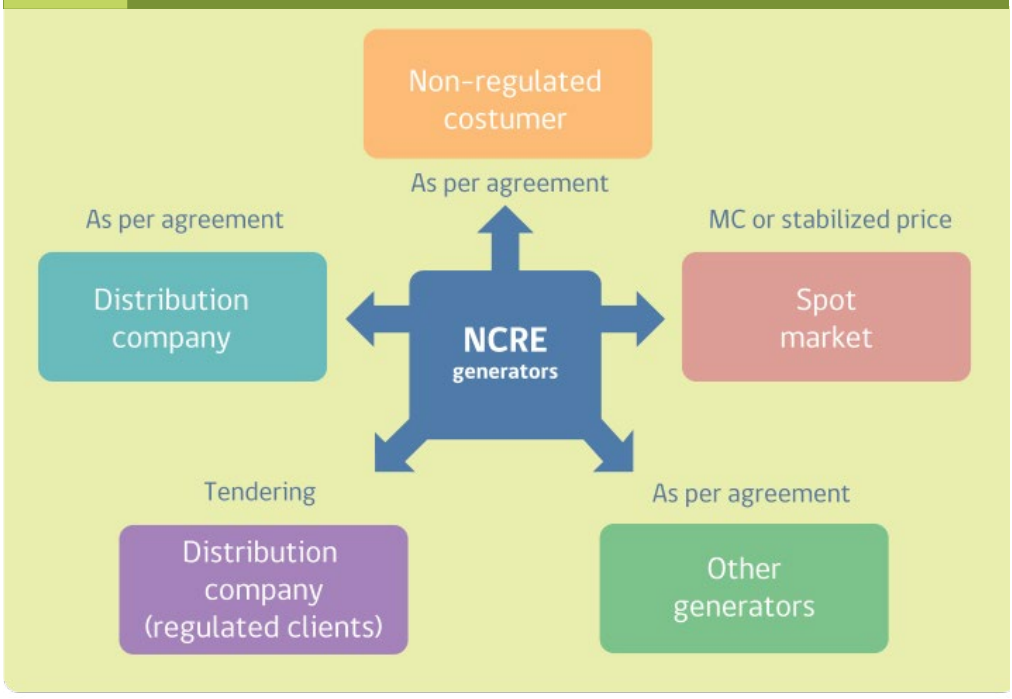


Source: Own elaboration (2009 edition of this book)

6.1 Overview of marketing alternatives

Figure 31 shows, in general terms, the different marketing alternatives of a NCRE. It also illustrates the type of agreement made. For example, with non-regulated customers, contracts are agreed between the parties, whilst in the case of the spot market, transactions are conducted at marginal cost.

Figure 31 **Alternatives of market interaction of a NCRE project**



Source: Own elaboration (2009 edition of this book)

This gives rise to different business models for NCRE projects in the Chilean electricity market, considering the following:

- Sale of energy and power to other generation companies, through the Coordinator, in the spot market to the instantaneous marginal price for energy and the node price of power to other generation companies.
- Sale of energy and power, through the Coordinator, in the spot market at a stabilized price of energy and the node price of power to other generation companies. This mechanism only applies to small-scale generation media according to the S.D. N°88.
- Sale of energy and power to a distribution company, through a regulated tender, where the price of energy corresponds to the stipulated in the tender in case of being adjudicated and the price of power, at the node price of power in force at the time of the tender.

▸ Sale of energy and power to a generating company through a long-term contract at agreed energy and power prices.
▸ Sale of energy and power to a free customer in a long-term contract at prices to be agreed for energy and power.

All previous marketing alternatives correspond to the wholesale energy market; however, it should be noted that there are others business models for self-consumption projects under the Netbilling Law. For these types of projects the model that is envisaged with great potential for development is the ESCO or Energy Service Company model. Under this model, the ESCO makes the investments and recovers them with a fraction of the economic savings that the user produces. That is, the ESCO offers the service of installation and operation of the equipment, which it maintains for some years as property until the entire service is paid and becomes the property of the user. It should be noted that the ESCO can offer its service in concession areas to consumers, since this occurs on private properties. This and other business models for distributed generation projects are explained in greater detail in Annex 4.

Next, different alternatives of business models are described in the wholesale electricity market.

6.1.1 Trading of energy in the spot market

The spot market is the default market of any generator that enters the Chilean system. In this market, only power generation companies generate energy. Its main characteristics are:

▸ In this market each generator sells or buys energy depending on the dispatch of its generating units and the contracts (supply).
▸ Generators sell all their produced energy in the spot market in the bar or injection node.
▸ Generators buy energy in the spot market to supply their contracts in the bar or supply node.
▸ Only generators participate in this market.
▸ Purchase and sale of electricity is conducted at short-term marginal cost (hourly) at the respective busbar or node where the electricity is withdrawn (for consumption) or where generators inject.
▸ The marginal cost is characterized by its volatility associated with short-term supply and demand shifts.
▸ Spot market transactions are calculated monthly by the Coordinator, once the actual values of the transaction are known.

6.1.2 Sale of power in the spot market

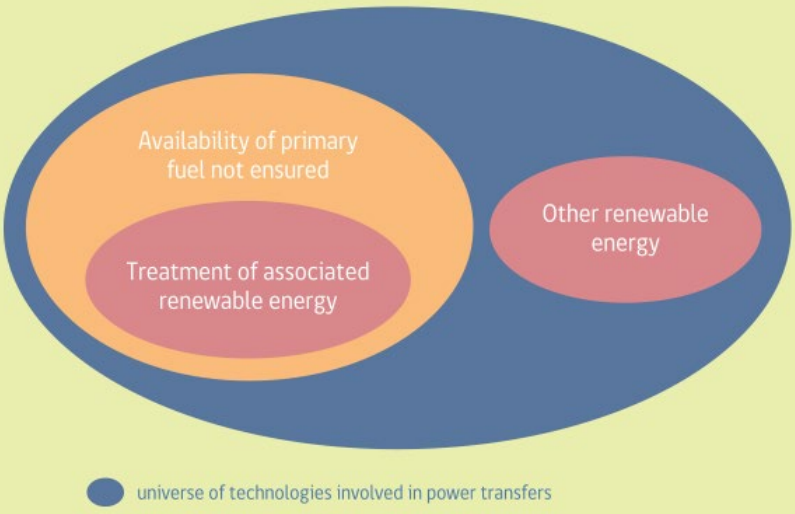
The payment for capacity (or power) corresponds to an instrument to stimulate adequacy in the electricity market, which is also consistent with the two-part marginal pricing scheme, where the peak period prices are different in the market in the rest of the time. Thus, in the case of electricity, part of the price is the energy that is associated with variable costs of production and is charged per unit of consumption. The other part, the capacity or power, is a charge for the availability to provide the service, which is possible through the installation of capacity, i.e. corresponds to an infrastructure development charge. In this way, the capacity charge includes the costs of providing this infrastructure, which corresponds to fixed capital costs, and is allocated among the consumers who demand in the peak conditions of the system.

Regarding to the spot market, the characteristics are as follows:

- Generators sell their recognized power in the spot market in the bar or injection node.
- Generators buy power in the spot market to supply their contracts in the bar or supply node.
- Only generators participate in this market.
- The purchase and sale of power is conducted at the nodal price for power at the respective busbar.
- The nodal price of power is calculated every six months by the CNE, in April and October. According to marginal theory, this price is based on the investment cost and on operational and maintenance costs (O&M) of a generation unit capable of supplying power to the system during peak demand.

The treatment of renewable energies is not decontextualized from the general scheme with which the Chilean system addresses payments for power or capacity, with the associated adequacy and safety requirements. Figure 32 illustrates this situation, where the technologies or generation plants are distinguished without the assured availability of their primary energy source during the analysis period, for example wind power or fossil fuels that show problems in their supply. However, there may be renewable sources that if they guarantee a high availability of their capacity, such as biomass or geothermal.

Figure 32 **Treatment of renewable energies in capacity payments**



Source: Own elaboration (Edition 2009 of this book)

S.D. N°62 of 2006 regulates power transfers between generating companies. Annex 3 describes the methodology for calculating the recognized adequacy power for each type of power plant.

6.1.3 Contract market

The contract market corresponds to a market of the financial type with private contracts freely agreed between the parties. As long as a NCRE project is an electricity company, the valid procedure for any generating company in the sector is applied.

6.1.4 NCRE quotas

The requirement of quotas of generation of NCRE defined in Law 20.257 and Law 20.698 translates into the possibility of marketing, by any electric company that exceeds its obligation of non-conventional renewable energy injections, the transfer of its surplus to another electric company. This transfer can be commercialized bilaterally at freely agreed prices and independently of energy sales.

6.2 Marketing Alternatives

6.2.1 Alternative 1: Sale of energy and power in the spot market

This option is when the NCRE generator participates only in the spot market for energy and capacity sales. It will participate in a closed market, restricted to generators only, and its electricity injections will be valued at marginal cost, while its capacity will be valued at the nodal price of capacity.

For energy sales, the Coordinator will conduct a monthly balance to quantify the electricity injected by the generator into the system, and will value it at hourly marginal cost calculated for the NCRE generator. The above-mentioned hourly marginal cost is calculated for the whole transmission/sub-transmission network. If the generator is operating in a distribution system, i.e. if it is a PMGD, the marginal cost of its injection will be valued according to S.D. N°8888. In this case, S.D. N°88 states that injections by a PMGD are referenced to the nearest primary sub-station to connection point, that is, multiply by a factor, to reflect that it is beyond the National or Zonal Transmission System.

It is important to mention that those generation means with power below 9 MW (PMGD) can opt for a stabilized price regime. This means that instead of quantifying their injections at marginal cost, the Coordinator values them at a price that presents less variation, in this case the stabilized price corresponds to the node price of energy injections in the different time intervals (6 blocks) that represents the projection of marginal costs in a horizon of 4 years, adjusted by a band around the average market price (according to contracts reported by the generating companies to the CNE). It should be noted that the price of injection node does not necessarily coincide with the node price applied in consumption. Both prices must be published in the tariff decrees elaborated semiannually by the CNE. The stabilized regime, as well as sales at marginal cost, have a minimum holding time and correspond to 4 years. If it is desired to change regime, the Coordinator must be notified at least 6 months in advance.

Finally, in the case of power transfers (exchanges), these are done at the power node price. The power node prices are determined by the CNE every six months and only for the National Transmission System. If the NCRE generator is located in Zonal Transmission networks or distribution, the determination of the applicable node price is made by applying multiplier factors to the node price of the nearest national system, which consider the effect of losses

in the system. These multipliers are fixed in the node-pricing decree. A more detailed description of the calculation of energy balances and wholesale market operation is given in Annex 2.

It should be noted that in this market alternative, only the energy and power that the generation medium can produce is traded and there is no obligation to have a pre-established level of production.

6.2.2 Alternative 2: Combination of spot market and contract with a free customer

In this case, the NCRE generator participation is not only composed of its sales to the spot market, but also has a contract with a free customer. The operation of the market, in this case, is similar to the previous one since its sales to the spot market will continue to be valued in the same way. However, when entering into a contract with a free customer, an obligation of a financial nature is established when determining a sale price for the energy supplied with the free customer.

Once the generator declares a contract, it is considered by the Coordinator and will be included in its monthly balance, which will be discounted the energy consumed by the free customer multiplied by the marginal cost calculated for consumption. Thus, in the event that the NCRE generator does not have sufficient energy to supply the consumption, it will also be supplied by other generators, which results in spot market transfers between generators. It is important to note that in any case the generator will have a fixed income corresponding to the sales price agreed with the free customer multiplied by the consumption of the latter. A monthly power balance is also made, in which the power consumed by the free customer is discounted by the node price, and like energy, this generates transfers in the spot market.

6.2.3 Alternative 3: Combination of spot market and contract market with regulated customers

Similar to the previous alternative, this alternative is composed of the participation in the spot market (previously described) and contract with regulated customers. In fact, this refers to the establishment of a contract with a distribution company, as a representative of regulated customers.

The supply contracts with distribution companies are fixed through public tenders in which an auction takes place, in which the distribution company presents different blocks of energy necessary for its supply of its regulated customers. The generators, in turn, present offers for the different blocks and are assigned to the best offer. The bidding process is led and carried out by the CNE, centralizing the needs of the various distribution companies.

6.2.4 Alternative 4: Direct contract with Generation Company

A NCRE project can enter into a contract with a generation company that participates in the wholesale market (energy and power transfers in a long-term contract). In this modality, the NCRE generation company bilaterally negotiates energy and power sales prices and production characteristics with the generation company, and the latter incorporates these products into its marketing offer.

6.2.5 Alternative 5: Outside wholesale market (direct contract with Distribution Company)

The regulatory framework allows the operation of electricity generation units of less than 9 MW in medium voltage networks in distribution systems. This type of generation is coordinated, and can establish contractual relationships directly with the distribution company. In turn, the distribution company remains responsible for the quality of supply and service of the system. In this scheme, usually applied to control consumption at peak times of the distribution company, the NCRE generation company bilaterally pays energy and power sales prices.

6.3 Payment for use of networks

As described in section 2.4.2.2, the payment of the transmission is an aspect that was recently modified by the new Law 20.936 of 2016. The principle of this legal modification was based on the need to move from a payment system based on the allocation of costs and complex to calculate, to a simpler and transparent system of stamp to demand. Due to the great change that this means for the market and the agents, a transitional regime was established that is detailed below and that tries to make a smooth and harmonic transition, while avoiding double payments by the consumers.

6.3.1 Payment of charges for use of the National Transmission System (previously Trunk)

Until December 2018, the National Transmission payment regime maintained the principles of the old system. That is, under the following criteria:

- The charge of the transmission system considers the following two components: payment for use of the facilities corresponding to the common area of influence and for the facilities outside this one.
- In the sections belonging to the common area of influence, generation plant owners will finance 80% of the total charges, in proportion to the expected use of their injections of each segment of the transmission system. The remaining 20% is paid for withdrawals.
- Outside of the common area of influence, when power flow goes towards the common area of influence, transmission cost will be allocated to the owners of plants located upstream of the power flow, prorate according to actual usage of generation assets on different transmission segments. On the other hand, when power flow does not go towards the common area of influence, the payment of the total charge of the transmission segment shall be assigned to the companies that make withdrawals downstream of the power flow, in proportion to their usage.

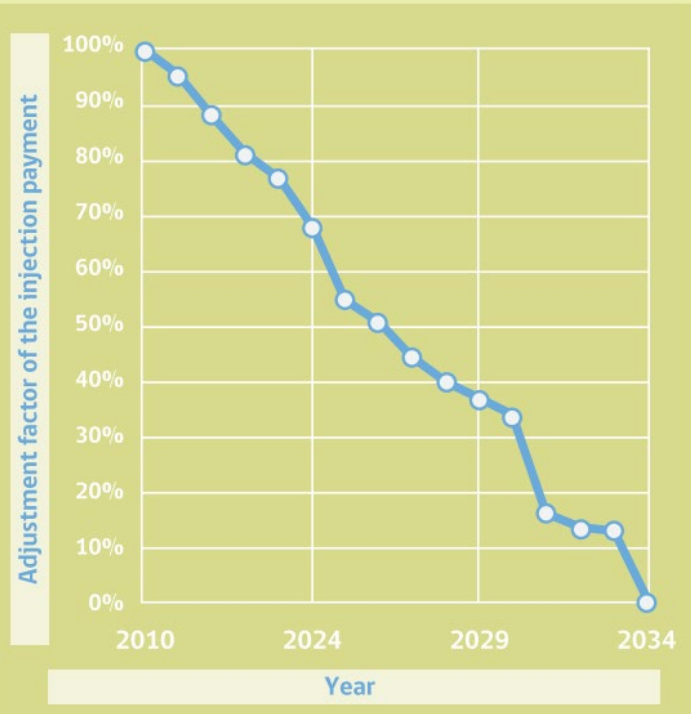
During the period between January 1, 2019 and December 31, 2034, the system of payments for the use of the National Transmission System by the generating companies will differentiate between injections and withdrawals according to the date of the associated contract.

For injections and withdrawals associated with supply contracts entered into prior to the entry into force of the Law 20.936 (July 2016), the same principles of the old system will be applied, but with some adjustments. One of the most relevant adjustments corresponds to an adjustment of the charge to pay for the injections for each year, which will cause a gradual decrease of the payment until completely eliminated in the year 2034, as indicated in Figure 33. The difference will be absorbed by the final customers through a single charge. Likewise, for the calculation of charges during this period, the installations of the national system whose date of entry into operation will not be later than December 31, 2018, nor the facilities associated to the SIC - SING interconnection will be considered. Both will be fully

paid by the final customers through a single charge. The detail of other adjustments for the payment of charges of injections associated with contracts prior to transition period is found in Transitional Article twenty-fifth of Law 20.936.

Figure 33 **Adjustment factor that reduces injection charge payments progressively from 2019 for supply contracts signed prior to the entry into force of the Law 20.936**

Year	Adjustment factor of the injection payment
2019	100,00%
2020	95,52%
2021	88,28%
2022	81,19%
2023	76,88%
2024	67,69%
2025	54,98%
2026	50,93%
2027	44,70%
2028	39,65%
2029	36,89%
2030	33,80%
2031	16,50%
2032	13,46%
2033	12,90%
2034	0,00%



Source: Own elaboration.

The injections associated with supply contracts after the entry into force of the Law will not be subject to the payment of charges for the use of the National Transmission as of January 1, 2019.

6.3.2 Payment of charges for use of the Zonal System (previously subtransmission)

With the amendment of the Law 20.936 of 2016, the use of Zonal Transmission Systems is 100% charged to final customers and therefore generators are released from this payment[51].

6.3.3 Payment of charges for use of the Development Poles

The Law 20.936 of 2016 establishes that the unused capacity of the Transmission Systems for Development Poles will be remunerated by the single charge, and the annual value not covered by this charge, that is, the capacity used of the pole of development will be remunerated by the generators that injected in this system[52].

The single charge is determined with the installed capacity of generation and transmission, and will be calculated up to seven tariff periods, from then on, the existing generation capacity will be calculated[53].

6.3.4 Payment of charges for use of the distribution system

The payment of charges for use of the distribution system is only applicable in the event that a generator has a supply contract with a free customer located in the concession area of a distribution company. This free customer constitutes a retirement for the NCRE generator. In this case, the value of the charge will correspond to the component paid by users regulated by the use of the distribution facilities. This component is known as Value Added Distribution (VAD), and is determined every 4 years. The value of these charges is regulated in S.D. N°99/2005, which establishes the formulas to determine their amount[54].

It is important to note that distributed generation projects of up to 300 kW (Law 21.118) do not pay distribution charges.

6.4 Exemption of charges

There is an exemption from charges for the use of the National Transmission System for non-conventional generation of up to 20 MW. The exemption of charges for use of the National

[51] Transitional Article Eleventh, Law 20.936 of 2016

[52] Article 114, Law 20.936 of 2016

[53] Article 116, Law 20.936 of 2016

[54] Available on the CNE website: www.cne.cl

Transmission System is complete for those MGNCs with power below 9 MW, and for those between 9 and 20 MW, a proportional adjustment is made depending on the surplus power injected into the system. For example, a MGNC of 15 MW would pay 55% of the total charge, while one of 9 MW would pay no charge for use of the National System.

In addition to the previous charge's exemption aimed at non-conventional generation, for the period between January 1, 2019 and December 31, 2034, owners of generators of any type may be subject to a mechanism of elimination of payment of injection charge. To this end, generators, distribution companies and free customers that have current supply contracts at the time of publication of the Law 20.936 of 2016 may elect to modify these contracts and access the payment reduction of transmission, if they deduct from the price of the energy supply the amount for use of National Transmission. The discount of the power supply price that the generator must make is determined by the Commission and the payment of transmission charge eliminated is then absorbed by all final consumers[55].

6.5 Ancillary services and NCRE

As described in section 3.5.2., in the new regulation of ancillary services (S.D. N°113 of 2019) the remuneration of said services is specified, which will be awarded in auctions, tenders or will be provided and/or installed directly.

The remuneration must consider the components associated with the investment, operation and/or maintenance of the facilities for the provision of said services, or alternatively, components associated with their availability and/or activation. In the case of frequency control services that are not provided by the product of a tender, the remuneration must include the availability of the technical resource and/or the activation of said service. The provision of the service that involves the injection of energy to the electrical system, the remuneration for activation will correspond to the injected energy valued at the marginal cost.

It should be noted that the NTSyCS imposes requirements for solar and wind technologies in terms of its participation in frequency control and voltage control. So these technologies are increasingly participating in ancillary services.

[55] Transitional Article Twenty-Fifth Letter E, Law 20.936 of 2016

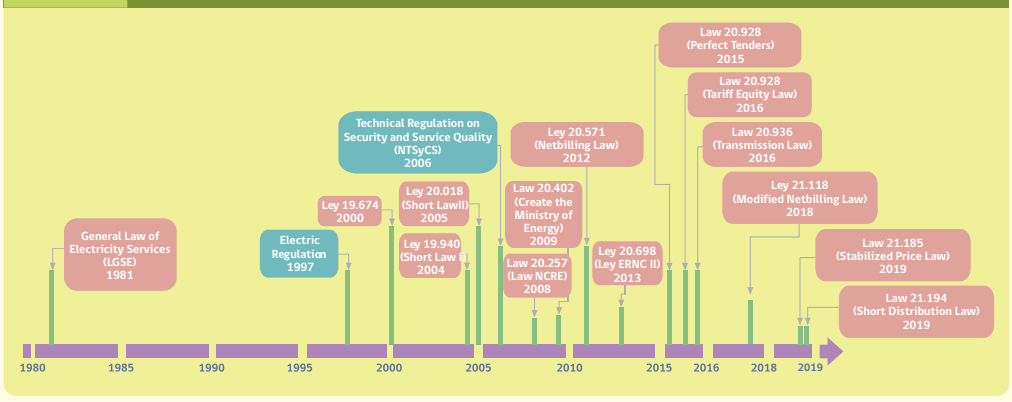
7

Annexes

Annex 1: Regulatory Framework for the Electricity Sector (Emphasis in NCRE)

The following is a description of the key elements of the regulatory framework of the Chilean electricity sector. Figure 1 shows in greater detail the evolution of the Chilean legal framework, with the main legal changes that the sector has suffered.

Figure 01 Chronology of the regulation of the electricity sector



Source: Own elaboration.

1.1 Laws

1.1.1 Decree with Force of Law N°4, General Law of Electrical Services (LGSE)

The legal structure that regulates the activity of the electricity sector is DFL N°4, enacted in May 12, 2006, by the Ministry of Economy, Development and Reconstruction that establishes the consolidated, coordinated and systematized text of DFL N°1, dated 1982, General Law of Electrical Services (LGSE), on electricity matters. DFL N°1 was modified in 2004 and subsequently in 2005 through the enactment of laws 19.940 and 20.028 called Short Law I and Short Law II, respectively. Then, there have been many changes to the Law being the most relevant in 2016 with the Law 20.936. Table 1 lists and describes in general each of the modifications. Then, in the next section, each of them is described in more detail.

Table 01 Laws that have modified DFL N°4 (LGSE)

Law	Description
Law 19.940 of 2004	Short Law I: modifies the payment system of the transmission, modifies the band of node prices making it more stable, widens the unregulated market, introduces ancillary services and creates the Panel of Experts.
Law 20.018 of 2005	Short Law II: arises due to uncertainty regarding the availability of Argentine natural gas, which would make it difficult to estimate future price levels and income levels for energy sales. Creates bidding systems for regulated energy contracts.
Law 20.220 of 2007	Provisional Administration Law: modifies the LGSE regarding the safeguard of the security of supply to regulated customers and the adequacy of the electric systems.
Law 20.257 of 2008	NCRE Law I: Establishes the obligation of annual quotas of NCRE generation with progressive increases up to 10% by the year 2025.
Law 20.402 of 2009	Creates the Ministry of Energy.
Law 20.571 of 2012/ Law 21.118 of 2018	Netbilling Law: enables distributed generation (residential, commercial premises, small industries, agricultural, etc.) of up to 300 kW, as it allows these generators in addition to self-supply to inject their surplus to the network and receive compensation. This law was recently changed in 2018.
Law 20.701 of 2013	Streamlines the granting of Electric Concessions: reduces the processing times of electricity concessions by establishing a new easement granting procedure, simplifying requirements, reducing claims and opposition times.
Law 20.698 of 2013	NCRE Law II: establishes new obligations of annual quotas of NCRE generation with progressive increases to reach 20% by the year 2025.
Law 20.720 of 2013	Law of bankruptcy: modifies in relation to the bankruptcy procedure of liquidation of a generation, transmission or distribution company.
Law 20.726 of 2014	Law of interconnection of electric systems: it empowers the National Energy Commission so that it can incorporate in the plan of expansion of the network the interconnection of interconnected systems as a new work of transmission.
Law 20.805 of 2015	It perfects the system of regulated tenders: it establishes a series of modifications and improvements to the system of regulated tenders to make them more competitive (extending deadlines, allows differentiated maximum prices, etc.)
Law 20.897 of 2016	Franchise solar thermal tax and suspension of works: allows NCRE projects to raise the precautionary measure of suspension of works that could only be done by electricity concessionaires.
Law 20.928 of 2016	Rate Equity Law: equalizes residential rates between distribution companies, preventing differences for a typical consumption of more than 10%.
Law 20.936 of 2016	Law of Transmission and Independent Coordinator of the National Electric System: significant reform to the electricity market in Chile. This Law introduces very profound changes to the remuneration and planning of the transmission network and also creates a new Coordinator replacing the old Economic Load Dispatch Centers (CDECs).
Law 21.185 of 2019	Law of Regulated Customer Stabilized Price: creates a temporary mechanism for stabilizing electricity prices for customers subject to rate regulation.
Law 21.194 of 2019	Law that lowers the profitability of distribution companies and improves the electricity distribution rate process.

DFL N°4 regulates the production, transportation, distribution, concessions and rates of electricity. This legal body includes the regime of concessions, easements, prices, conditions of quality and safety of facilities, machinery and instruments and the relations of companies with the State and individuals.

The General Law of Electrical Services and its complementary regulations, determine the technical and safety standards by which any electrical installation in the country should be governed.

1.1.2 Law 19.940 of 2004 (Short Law I)

The Short Law I was promulgated by the Ministry of Economy, Development and Reconstruction and was published in the Official Gazette of March 13, 2004. The central objectives of the initiative were aimed at providing consumers with higher levels of security and quality of supply at reasonable prices and provide the electricity sector with a modern and efficient regulatory framework that gives the necessary certainty and stability in the rules of the game to a strategic sector for the country's development. The following are central aspects of Law 19.940:

- Reforms are introduced regarding the regulation of the operation and development of the transmission systems, improving the criteria used to allocate resources based on the use of the system by different agents. The procedure to establish transmission charges is specified. This should enable the development and remuneration of 100% of the transmission system to the extent that it is efficient.
- Determination of nodal prices (PN) tends to stabilize values by diminishing the variation of the PN in relation to what is observed in the contract market with non-regulated customers. Previously, the PN was allowed to fluctuate within a band of 10% around the non-regulated price, but the band was modified by the new Law to around 5%.
- Expansion of the non-regulated market, lowering the threshold for non-regulated customers from 2000 kW to 500 kW.
- Specification of charge regulations, allowing suppliers, other than distribution companies, to supply non-regulated customers located in concession zones of distribution companies.
- Introduction of the ancillary services market, allowing the trade and valuation of technical resources that improve service quality and security.
- Reform of the tariff calculation mechanism in medium-sized systems (between 1500 kW and 200 MW of installed capacity). This is especially applicable to the systems in southern Chile, Aysén and Magallanes.

▸ Considerable improvement of conditions for the development of small non-conventional power plant projects, primarily renewable energy, by opening the electricity markets to this type of power plants, the establishment of the right to transfer their electricity through distribution systems and the possible exemption of charges for the use of the main transmission system.
▸ Creation of a conflict resolution mechanism in the electricity sector, both between companies and the authority, and between companies, through the creation of the Panel of Experts.
▸ Through the price and transaction system, it is possible to identify sub-systems within an electric system and independently identify new generation capacity requirements.

1.1.3 Law 20.018 of 2005 (Short Law II)

Enacted in May 19, 2005 by the Ministry of Economy, Development and Reconstruction, it came about as a result of the uncertainty over the availability of Argentinean natural gas that hindered the estimation of future prices and revenue levels from electricity sales. Key aspects of Law 20.018 are the following:

▸ Allows the tendering of long-term contracts by distribution companies at prices above the nodal price, and not subject to its variation.
▸ Expansion of the adjustment band for regulated prices with respect to non-regulated prices.
▸ Creation of a market that allows generators to provide incentives to customers that consume less than 2 MW to regulate their consumption.
▸ The lack of supply of Argentine gas does not constitute force majeure.

1.1.4 Law 20.220 of 2007 to Protect the Security of the Supply to Regulated Customers and the Adequacy of the Electric systems (Provisional Administration Law)

Enacted in September 14, 2007, it modifies the LGSE with respect to safeguarding the security of supply to regulated customers and the adequacy of electric systems. Considers court action for termination of contracts and bankruptcy of companies. In this way, it protects regulated consumers against the lack of economic viability of electricity companies, ordering the transition stage of a bankruptcy company, through the temporary administration of assets that must be kept available to limit the effects of insolvency of the company on the population.

1.1.5 Law 20.257 of 2008 (Law NCRE I)

Law 20.257, enacted in April 1, 2008, modifies the LGSE regarding the generation of electricity using NCRE sources. It establishes annual quotas of NCRE generation with progressive increases until arriving at 10% by the year 2024.

1.1.6 Law 20.402 of 2009 (Creates the Ministry of Energy)

Law 20.402, which was enacted on November 25, 2009, creates the main political entity that represents the State of Chile in the energy sector. In this way, all competencies in matters of policy formulation, legal and regulatory rules, plans and programs are entrusted to the Ministry that is responsible for the rectory of the energy sector in the country. The functions related to technical and economic regulation of the sector remain within the competence of the National Energy Commission.

1.1.7 Law 20.571 of 2012 and Law 21.118 of 2018 (Law of Netbilling)

Law 20.571 enacted on February 20, 2012, but effective in September 2014 and that was recently modified in 2018 with the Law 21.118, allowed very small-scale generators (less than 300 kW) to inject energy into the distribution network, valuing said injections regulating the financial compensation for these and facilitating their connection. With this, residential generation is enabled, in commercial premises and in small industries, as it allows these generators as well as self-supply to sell their surplus to the grid.

1.1.8 Law 20.701 of 2013 (expedited the granting of Electrical Concessions)

Enacted on September 10, 2013, Law 20.701 reduced the processing times of electricity concessions by establishing a new easement granting procedure, simplifying requirements, reducing the time of claim and opposition, and improving the notification process. It also introduces the possibility of dividing the concession, modifies the appraisal procedure of the real estate and establishes an arbitration procedure to resolve conflicts. Likewise, this law allowed the lifting of the precautionary measure of suspension of works before complaints about new works of electricity concessionaires.

1.1.9 Law 2.0698 of 2013 (NCRE Law II)

Law 20.698 was enacted on October 14, 2013, and modified the LGSE regarding the generation of electricity with NCRE sources. It establishes new annual quotas of NCRE generation with progressive increases until arriving at 20% by the year 2025.

1.1.10 Law 20.720 of 2013 (Bankruptcy Law)

Law 20.720, enacted on December 30, 2013, is a General Law on insolvency and reinsurance that establishes time limits for procedures, promotes specialized courts, creates effective reorganization procedures, and improves transparency, among others. As regards Electrical Law, it amends it in relation to the insolvency proceedings for the liquidation of a generating, transmitting or distributing company.

1.1.11 Law 20.726 of 2014 (Interconnection of electric systems)

Law 20.726, promulgated on January 30, 2014, authorized the National Energy Commission to incorporate interconnection into the network expansion plan as a national work. In this way, the State was able to boost the interconnection of the SIC and SING systems that materialized on November 2017.

1.1.12 Law 20.805 of 2015 (Perfect system of regulated tenders)

Law 20.805 was promulgated on January 22, 2015 and established a series of modifications to the system of regulated tenders to make them more competitive. Among the changes are the following: it incorporates longer term tenders according to the required times of new bidders, increasing the maximum term of contracts to 20 years (before they were 15 years), allow short-term tenders to satisfy immediate needs that had not been foreseen in the demand projections, establish maximum prices differentiated by periods. With this Law, the regulatory authority (in this case, the CNE) has a more important role in the process and thus facilitates the coordination of processes and standardization of contracts. In addition, the projection of demand happens to be made by the same authority, instead of the distribution companies, eliminating some potential estimation biases.

1.1.13 Law 20.897 of 2016 (Tax exemption regarding solar thermal systems and benefit of lifting suspension of works for NCRE projects)

Law promulgated on February 1, 2016 whose main purpose is to provide a tax benefit to construction companies which consists in the fact that they can deduct the VAT payment of the amount spent on the panels, also amended the Electrical Law, allowing NCRE projects to boost the precautionary measure of suspension of works that originally could only be done by electricity concessionaires. This way, we avoid the obstruction of the works, mainly by mining concessionaires.

1.1.14 Law 20.928 of 2016 (Tariff Equity Law)

Law enacted in June 2016 that seeks to eliminate the large differences in energy distribution prices throughout Chile. One of the amendments incorporated in this Act is that it equalizes residential rates between distribution companies, preventing differences for a typical consumption of more than 10%. The absorption of the differences is financed by residential users with average consumption of more than 200 kWh/month. In addition, other amendments incorporated by this new Law are a discount on the price of electricity that the distribution companies transfer to their customers in the communes that are intensive in generation. The discount applied will be determined according to an intensity factor according to the generation kW by each regulated customer.

Likewise, in those communes in which power plants are generated whose electrical energy generated, as a whole, is greater than 5% of the electrical energy generated by all the interconnected power stations, an additional discount is applied.

1.1.15 Law 20.936 of 2016 (Law of Transmission and Independent Coordinator of the National Electric System)

This Law, promulgated on July 11, 2016, is a significant reform of the electricity market in Chile. This Law introduces very profound changes to the payment and planning of the transmission network and also creates a new Independent Coordinator of the National Electric System replacing the old Economic Load Dispatch Centers (CDECs). As for the payment of the transmission, it passes from a complex system of allocations of costs between generators and consumers to a system of "stamp" where the final customers pay the transmission system

completely through a predetermined fixed charge for which a transition period is established until 2034. The principle is to make the remuneration of transmission for all actors simpler and more transparent.

Regarding network planning, this Law creates a new long-term planning process, under the responsibility of the Ministry of Energy with a 30-year horizon that must be realized every 5 years. In addition, the commission is in charge of the annual planning that will look at a horizon of 20 years and that will end with the fixing of new works to be tendered by the Coordinator. The Law changes the transmission segments to a more functional definition of transmission. The trunk transmission goes to national transmission, sub transmission to zonal transmission, additional transmission to dedicated transmission and new transmission segments are created oriented towards generation development poles and export/import of electric energy with neighboring countries. The Law entails the development of multiple regulations that were published in 2020 and 2021.

1.1.16 Law 21.185 of 2019 (Law of Regulated Customer Price Stabilized)

Law promulgated in October 2019, created a temporary mechanism for stabilizing electricity prices for regulated customers, setting a Stabilized Regulated Customer Price (PEC) until December 2027, considering as a basis the prices set by Decree 20T/2019. In this way, during the validity of the mechanism, the discounts will not be recalculated by the local generation recognition mechanism of the Tariff Equity Law.

1.1.17 Law 21.194 of 2019 (Short Electricity Distribution Law)

Law enacted in October 2019 lowers the profitability of distribution companies and improves the electricity distribution rate process. The Law establishes a new update rate, representative of the current risks faced by the companies that provide the electricity distribution service, in order to adequately determine the efficient costs of providing the distribution service, avoiding information asymmetries and allowing the participation of stakeholders in a transparent and contestable way, based on technical, legal and economic arguments.

The main change in the regulations consists of moving from the current 10% before taxes of profitability, to a market rate calculated by the authority with a floor of 6% and a ceiling of 8% after taxes. It requires publicizing part of the procedure that the law currently had, and makes substantial modifications to the procedures currently carried out by the CNE.

1.2 Regulations

1.2.1 Supreme Decree N° 327 of 1997 (LGSE Regulation)

Supreme Decree N° 327 officially entitled "Establishes Regulation of the General Law of Electrical Services" was enacted by the Ministry of Mining in December 1997. This is an all-embracing regulation that seeks to include all the aspects regulated by LGSE, repealing provisions contained in disperse and partial regulations.

This regulation includes concessions, permits and easements, relationship between owners of electricity installations, customers and authority, as well as interconnection of installations, and installations and electricity equipment. It also includes service quality aspects, prices, fines and sanctions.

1.2.2 Supreme Decree N°88 of 2020 (PMG y PMGD Regulation)

Supreme Decree N°88 with official title "Approves Regulation for Small-Scale Generation Media" was promulgated by the Ministry of Energy in September 2019 and published in October 2020, replacing the S.D. N°244 of 2006. The decree establishes provisions for companies that have generation means whose power surpluses are less than 9 MW (PMG and PMGD).

The regulation includes the following titles: Small Means of Small-Scale Generation (Interconnection procedures, determination and costs of additional works, operation and coordination regime, remuneration and payments, measurement and billing, price stabilization mechanisms), Small Distributed Generation Means (PMGD) (interconnection, energization and commissioning procedure, associated additional costs and its operation and coordination requirements), Small Generation Means (PMG) (its interconnection, energization and commissioning, and its operational and coordination requirements).

1.2.3 Supreme Decree N° 62 of 2006 (Regulation for adequacy power)

Supreme Decree N°62 officially entitled "Approves Regulation for the Transfer of Capacity between Generation Companies Established in LGSE" was enacted by the Ministry of Economy, Development and Reconstruction in February 1, 2006.

The decree regulates transfers of capacity between companies with generation units synchronized to an electric system, resulting from the coordination of operations established by the LGSE. The chapters of interest are: Definitions, background and information to be used, maximum installed capacity and statistical control, allocation of adequacy power, initial power, preliminary power, definitive power, theoretical reserve margin, balance of injections and withdrawals, demand commitments, physical balance and valued balance.

The regulation was modified by S.D. N°42 of 2020, which introduces modifications that incorporate into the regulation of the electricity sector the State of Strategic Reserve for generating units that begin the withdrawal process of the SEN.

1.2.4 Supreme Decree N°113 of 2017 (Regulation for Ancillary Services)

Supreme Decree N°113 entitled "Approves regulations that establish the provisions applicable to the ancillary services that each electric system must count for the coordination of the operation of the system in the terms referred to in Article 137 of the General Law of Electrical Services" was promulgated on November 28, 2017 and published in March 2019. The regulation of ancillary services was implemented after the approval of the report on the definition of the Ancillary Services Program, a fact that occurred on January 19, 2016. This new regulation establishes the way in which the services required by the National Electrical System and the mechanisms for providing and/or installing them will be defined. It also establishes how auctions, tenders and the provision and/or direct installation of the required services will be carried out.

1.2.5 Supreme Decree N° 86 of 2012 (Regulation for fixing node price)

Promulgated on August 29, 2012, this decree regulates the prices transferable to the regulated customers of the distribution companies. In order to do this, it defines the short-term node prices and establishes the procedure for calculating it (simulation horizon, demand forecast, fuel prices, and availability of primary inputs of thermal power stations, treatment of hydroelectric plants, failure costs and rationing, in other aspects). It also defines aspects regarding the long-term node price (on the maximum value of bids for supply bids, indexation of long-term node prices, among others).

1.2.6 Supreme Decree N° 114 of 2012 (Geothermal Concessions)

The Supreme Decree N° 114 entitled "Approves new regulations for the application of Law 19.657, on concessions of geothermal energy and repeals S.D. N° 32 of 2004, of the Ministry of Mining" was promulgated on November 15, 2012. This regulation eliminated the lack of legal certainty in obtaining concessions for the exploitation of geothermal energy. Thus, it grants the exclusive right to an exploration concessionaire, to obtain an exploitation concession. In addition, it removes requirements to apply for a geothermal exploration concession and expedites the application process. The regulation was modified by S.D. N°51 of 2021 to advance the digital transformation of information.

1.2.7 Supreme Decree N°57 of 2020 (Regulation of distributed generation for self-consumption)

Supreme Decree N°57 entitled "Approves the regulation of distributed generation for self-consumption", promulgated in July 2019 and published in September 2020, replacing the S.D. N°71 of 2014. The regulation establishes the provisions for distributed generation destined for self-consumption, in particular the procedure to carry out the connection of generation equipment and the cost of additional works, adjustments and adjustments for the connection, establish the limits to the connection and the injections of the generation equipment that do not require additional works, adjustments or adjustments for the connection, the measurements and valuation of the injections and the transfers of surpluses of non-conventional renewable energies, as well as other matters necessary for the proper development of distributed generation for self-consumption.

1.2.8 Supreme Decree N°125 of 2019 (Regulation of the Coordination and Operation of the National Electric System)

Supreme Decree N°125 entitled "Approves the Regulations for the Coordination and Operation of the National Electric System", promulgated on December 20, 2019, establishes the provisions applicable to the coordination and operation of the National Electric System, as well as the other necessary matters for the proper exercise of the functions of the Independent Coordinator of the National Electric System, and the rights and duties of the entities subject to said coordination.

In addition, it establishes the provisions for the Energy Storage Systems and the provisions for the Coordinator to implement a centralized forecast of renewable generation with variable primary resources.

1.3 Technical Standards

1.3.1 Technical Standard for Security and Quality of Service (NTSyCS)

Exempt Resolution N° 9 officially entitled "Establishes Technical Standard with Demands for Security and Quality Service for the SING and SIC" was enacted in February 2007.

The resolution establishes the minimum Security and Service Quality requirements associated with the design and coordination of the interconnected electric systems, as established by the LGSE and its current regulations.

The last modification was published in September 2020 and mainly establishes requirements for ERNC generators for the control of frequency and voltage of the grid, in addition to the requirements for sending forecasts.

1.3.2 Technical Standard for Connection and Operation Technical Standard (NTCO) of PMGD at medium voltage

Exempt Resolution N°24 with the official title "Dictates Technical Standard for Connection and Operation of Small Generation Distributed at Medium Voltage" was promulgated in May 2007 and was replaced by Resolution N°501 promulgated on September 23, 2015 under the same title.

The resolution regulates the procedures, methodologies and other requirements for the connection and operation of PMGDs in medium voltage networks of distributor or distribution companies that make use of national public assets.

The modification to the regulation made by Resolution N°537 whose date of enactment was July 11, 2016 and among other changes, introduced new definitions for shared facilities defined as the set of consumer facilities of a customer and a PMGD that are connected to the distribution system through a single splice. The last modification to the regulation was made by Resolution No. 437, whose promulgation date was July 22, 2019.

1.3.3 Technical Standard for Connection and Operation (NTCO) of equipment of generation at low voltage

Exempt Resolution N°338 with official title "Dictates Technical Standard for Connection and Operation of equipment of generation in low voltage" was promulgated May 31, 2019. This regulation determines the requirements that must be fulfilled to connect equipment of generation to the networks and inject surplus energy into them. The regulation provides the measures to be taken for the purpose of protecting the safety of persons and property, and security and continuity of supply, among other.

1.3.4 Technical Standard for Safety and Quality of Service for medium-sized systems

Exempt Resolution N°179 with official title "Provides Safety and Quality of Service for medium-sized systems" was promulgated on March 8, 2018. This regulation determines the minimum requirements related to the limit values that can be reached by the main electrical variables that are observed. in the SM, for each of the states in which it is operating at a given time.

1.3.5 Technical Standard for Service Quality for Distribution Systems

Exempt Resolution N°763 with official title "Dicta Technical Standard of Service Quality for Distribution Systems" was promulgated on December 10, 2019. This regulation determines the requirements that the concessionaires of public electricity distribution service and the companies that are owners, lessees, beneficial owners or that operate, in any capacity, electric power distribution facilities, with respect to: product quality, supply quality and commercial quality.

1.3.6 Technical Standard for Ancillary Services

Exempt Resolution N°786 with official title "Dicta Technical Standard of Ancillary Services" was promulgated on December 18, 2019. This regulation determines the requirements, procedures, methodologies and application conditions with which the provision of Ancillary Services will be governed, the determination of their requirements, and their processes for the verification of facilities, and for the evaluation of availability and performance, in accordance with the provisions of the Ancillary Services Regulation and the Law.

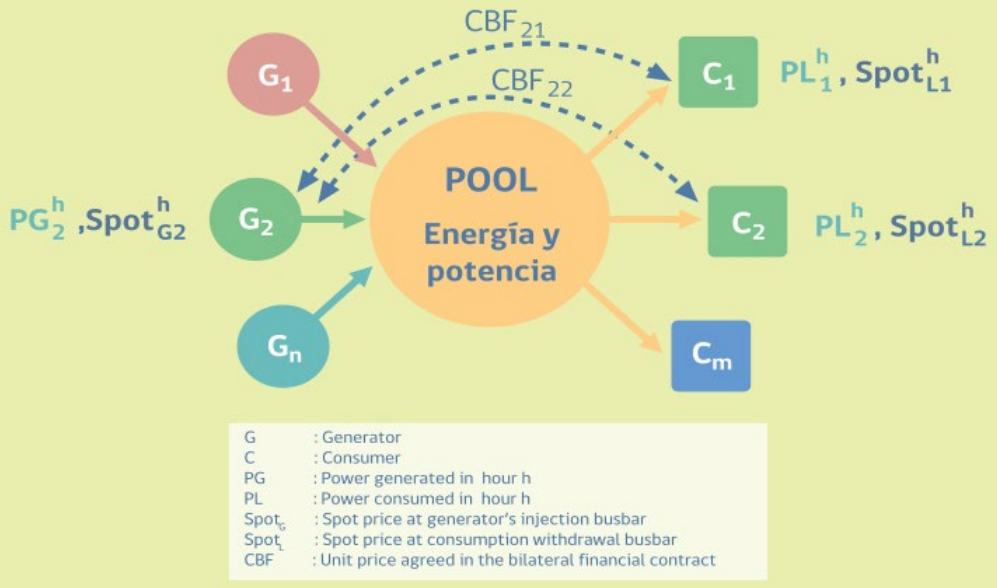
Annex 2: Market operation aspects

2.1 Dispatch

The dispatch of units in the system is performed by the Coordinator, using optimization tools (economic dispatch, pre-dispatch, hydrothermal coordination) and determining system operation at minimum cost. This optimization also determines the hourly marginal cost (spot price) for each busbar of the system.

Figure 2 shows the general scheme of the wholesale electricity market in Chile.

Figure 02 **Chilean wholesale market structure**



Source: Own elaboration.

For a specific hour h, the pool establishes an economic operation of the system that gives rise to marginal costs at both injection and withdrawal busbars of the system (SpotG and SpotL). In its simplest form, the economic operation of the system is achieved dispatching generation units in ascending order of generation cost, until the required demand in a given hour can be covered. Thus, zero or low-cost units are dispatched first. This type of generation, common among NCRE, is called base generation units.

Assuming that all consumption is previously contracted through CBFij-type financial contracts (Bilateral Financial Contracts), each company calculates its balance taking into account revenues for injections at the injection point, energy withdrawals for its customers and customer payments under the bilateral contract in force. Likewise, the generation company considers its variable generation costs in the balance.

The following equation summarizes the situation for generation company G2 that has bilateral contracts with consumers C1 and C2. At hour h, the generator injects into the system PG2 [MWh], while its contracted consumers withdraw PL1 [MWh] and PL2 [MWh], respectively.

$$BalanceE_c^h = \sum_{g=1}^{NG_C} PG_g^h Spot_{G_g}^h + \sum_{l=1}^{NL_C} \left(CBF_{gl} - Spot_{L_l}^h\right) PL_l^h - \sum_{g=1}^{NG_C} Costo\_Gen_g(PG_g^h)$$

$$= PG_2^h Spot_{G_2}^h + \left(CBF_{21} - SpotL_{L1}^h\right) PL_1^h + \left(CBF_{22} - SpotL_{L2}^h\right) PL_2^h - Costo\_Gen_2(PG_2^h)$$

To illustrate the above, let us assume that G2 is a thermal coal-fired generator and at a specific hour (h) injects 100 MW into the system at a marginal cost at the injection busbar of 85 US$/MW. The generator has agreed contracts for electricity sales with C1 and C2 for 62 US$/MW and 70 US$/MW, respectively. The Coordinator determines that the costs at purchase busbars L1 and L2 are 75 US$/MW and 68 US$/MW, while consumption are 35 and 40 MW, respectively. Finally, the variable cost of the generator is 72 US$/MW. Therefore, the balance of G2 is equal to:

$$BalanceE_c^h = 100 \cdot 85 + (62 - 75) \cdot 35 + (70 - 68) \cdot 40 - 72 \cdot 100$$

$$= 8500 - 455 + 80 - 7200 = 925$$

The result of the balance is US$ 925, and for the operating conditions of the example, G2 is surplus. However, there may be other situations when this is not the case, as occurs when its injections into the system are lower than its contractual commitments.

2.2 Spot market power transfers

In the wholesale market[1], according to contractual supply commitments, transfers of energy and power are made between generating companies. The energy is valued at the marginal cost of production, while the power is valued at the node price of the power.

The price of power considers the calculation of the unit cost of the most economical unit to supply an additional power unit in the system, which usually corresponds to a gas turbine, etc. This price is known as the node price of power and is determined biannually by the CNE.. Depending on the characteristics of its primary energy source, its forced failure rate, programmed outputs, and its joint contribution to the system, each power unit is given a power called adequacy power[2] with which its power input is determined (sale of power). This type of mechanism is known in the international literature as "payment for administrative capacity", since it is not the market that determines it, but it is an administrative body that evaluates and determines prices and quantities. In the case of Chile, the agencies are the CNE and the Coordinator of the system, respectively. Likewise, each generating company, according to its supply contracts and the behavior of these consumptions in conditions of peak demand, is responsible for purchasing power in the system.

The surplus or loss of power position of a generation company will depend on the supply contracts that it has. As an example, a company that does not have supply contracts will always be in surplus in power transfers, since it has no declared obligations and these will not be deducted from its balance sheet.

[1] The definition of the wholesale market is found in the glossary of terms, see Annex 5.

[2] The "Annex 3: Adequacy Power (methodology S.D. N°62)" presents the mechanism of calculation of the Adequacy Power that is recognized to each type of generator.

Annex 3: Adequacy power (methodology S.D. N°62 modified by S.D. N°42)

The objective of this section is to show the stages of the process to determine the remuneration of the participants of the power balance. This remuneration is associated with the capacity market (or power market).

In the capacity market, power transfers are made between generators, valued at the short-term node price of the power of each bus. These transfers are determined from the generation capacity compatible with the adequacy and the existing peak demand commitments assigned to each generator.

The participants in the power balance (generators that do not exclude themselves from participating in power transfers[3]) must be in a position to meet their commitments for peak demand[4], considering their own adequacy power and that acquired from other generating companies.

3.1 State-of-the-art demand commitment

The Coordinator carries out a record of the average power consumption in each hour of the customers of the participants in the power balance, using this record the customer's equivalent peak demand (DdPE) is obtained. Which will be calculated as the average of the 52 maximum physical records observed during the control period. Which begins at 6:00 p.m. and ends at 10:00 p.m. on the days between April 1 and September 30. However, this period was reduced in 2019, considering only the days of June and July for the years 2020 and 2021.

To calculate the hourly power withdrawal assigned to each customer, the Coordinator must multiply the customer's DdPE by a single factor, in such a way that the sum of all DdPE equals the peak demand of the system.

$$RP_i = FactorP \cdot DdPE_i$$

Being:

RP_i : Withdrawal of hourly Power from client i, expressed in MW.

$DdPE_i$: DdPE from client i, expressed in MW

[3] Small Generation Means that do not make power withdrawals to supply free customers or distribution companies may be excluded.

[4] Peak Demand is a systemic parameter. This will be calculated as the average demand of the 52 highest hourly values of the system's annual load curve.

Where $FactorP$ is systemic and will be calculated as:

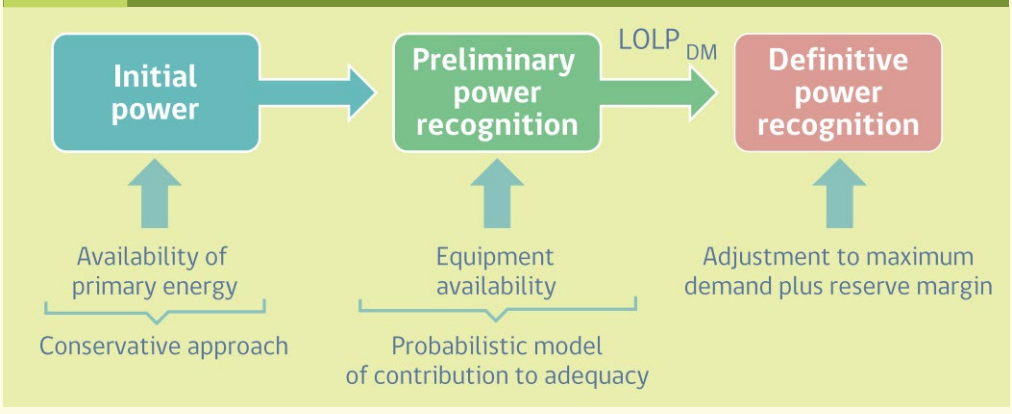
$$FactorP = \frac{Demanda\ de\ Punta}{\sum_{i \in Clientes} DdPE_i}$$

The generator that has entered into a contract to supply power to a client will assume the power withdrawals from said client, as a commitment to the peak demand of the system.

3.2 Generation capacity compatible with sufficiency

Each generating unit is assigned an adequacy power depending on the uncertainty associated with the availability of the input of generation that is used and the unavailability of the unit and the installations that interconnect to grid, characterized by the initial power and the preliminary adequacy power, respectively. The general scheme of the procedure of calculation of adequacy power that establishes the S.D. N°62 is illustrated in Figure 3.

Figure 03 **Methodological approach to the adequacy power of S.D. N°62**



Source: Own elaboration.

The following describes each of the stages and concepts used in the calculation process:

3.2.1 Initial power of NCRE centrals

Each generating unit is assigned an initial power, less than or equal to its maximum power. which will characterize the power that each unit can contribute to the system based on the uncertainty associated with the availability of the generation input that it uses.

For this, the Coordinator uses statistical information on the primary input provided by each owner. In the case of solar thermal power plants, the primary input will correspond to the stored fluid for the thermal process.

The initial power of thermal NCRE plants (such as biomass, geothermal, thermosolar and biogas) and hydroelectric will be determined according to the same procedures of conventional thermal and hydroelectric plants respectively. For all other generation technologies classified NCRE, such as wind and solar plants, the initial power will be determined according to the value resulting from multiplying its maximum power by the minimum of the following values:

a) Lower annual plant factor of the last 5 years prior to the year of calculation.

b) Simple average of the plant factors recorded for each of the 52 highest hourly values of the annual load curve of each system or subsystem for the year of calculation.

In the case of ERNC plants that have an energy storage component, the initial power must adequately recognize the contribution to the adequacy of said units in relation to their temporary energy management capacity.

Initial power hydroelectric plants

For hydroelectric power plants, the inflow statistics corresponding to the average of the two hydrological years with the lowest inflow energy of the available statistics is used. To this end, the regulation (S.D. N°62 of 2006) classifies hydraulic power plants according to their regulation capacity into: plants with daily or higher regulation capacity, plants with intra-daily regulation capacity and plants without regulation capacity[5]. In addition, it distinguishes the hydraulic power plants in series:

[5] S.D. N°62 of 2006 establishes that it will be understood that hydroelectric generating unit has daily or higher regulation capacity when the maximum capacity of its reservoir and the annual average inflow flow for the hydrological condition corresponding to the 2 years with the lowest inflow energy, allow the generating unit operates at full power for at least 24 hours.
It will be understood that a hydroelectric generating unit has intra-daily regulation capacity when the maximum capacity of its pond plus the annual average inflow power for the hydrological condition corresponding to the 2 years with the lowest inflow energy, is sufficient for the generating unit to operate at minus 5 consecutive hours with a power equal to or less than its maximum power.

▶ Generating units belonging to plants with daily regulation capacity or higher are considered an initial energy equal to the average of the energy stored on April 1, during the last 20 years, including the year of calculation.

▶ Generating units with intra-day regulation capacity are considered their regulation capacity, but the initial energy is not considered.

▶ The initial power of the units without regulation capacity is determined as a function of the power equivalent to the annual average generable flow of the 2 hydrological conditions with the lowest inflow energy.

The calculation methodology for plants with regulation capacity is carried out by means of a procedure that seeks to distribute the total hydraulic adjustable energy of the system following a filling of the annual load duration curve. This, respecting the models of the hydrographic basins. The combined initial power (regulation power) obtained at the hour of greatest demand is assigned to the plants with regulation capacity in proportion to the annual regulation energy supplied to the system.

Initial power solar and wind power plants

The initial power will be determined according to:

$$P_{ini} = P_{máx} * Mín(minFP_{5añs}, PromFP)$$

Where:

P_{ini}	:	Initial Power of the thermal power plant, expressed in MW
$P_{máx}$	:	Audited maximum gross power of the plant, expressed in MW
$minFP_{5años}$	:	Lower annual plant factor of the last 5 years prior to the year of calculation.
$PromFP$	:	Simple average of the plant factors registered for each of the 52 highest hourly values of the annual load curve of each system for the year of calculation

Initial power NCRE thermal power plants

It is determined based on the lowest average annual availability observed for the main input for the last 5 years prior to the year of calculation. If the plant demonstrates operating capacity with an alternative input, then the sufficiency power will be calculated as an equivalent generating unit based on the operating characteristics that each unit has with the main and alternative input.

$$P_{ini} = P_{máx}IP * DIP + P_{máx}IA * (1 - DIP)$$

Where:

P_{ini} : Initial Power of the thermal power plant, expressed in MW

$P_{máx}IP$: Maximum gross power associated with the main input of the ther mal power plant, expressed in MW

DIP : Average annual availability of the Main Input, calculated as the lowest value observed during the last 5 years prior to the Calcula tion Year, expressed in units of so much per one..

$P_{máx}IA$: Maximum gross power associated with the alternative input of the thermal power plant, expressed in MW

3.2.2 Preliminary adequacy power

For the calculation of the preliminary adequacy power, the probabilistic model determined by the Coordinator will be used, which must consider for each generating unit its : initial power, unavailability, maintenance period and own consumption.

In addition, the Coordinator must keep a statistical control of the operating states of the generating units, which are grouped into:

a) Available States: when the unit is available for dispatch by the Coordinator without presenting a limitation in its maximum power;

b) Unavailable States: when the unit is not available to be dispatched by the Coordinator; y

c) Impaired States: when its maximum power is limited as a result of restrictions independent of the availability of its generation input.

The equivalent power of a unit will be obtained from the weighted average of the deteriorated states and available states.

$$PE_i = \frac{1}{T} \sum_{k}^{T} Pot_k \cdot t_k$$

Where:

P_E : Equivalent power of unit i.

Pot_k : Power available during period k.

t_k : Duration of period k.

T : Set of periods where unit i was in Available State or Impaired State.

In the case of units that have accumulated statistical information on deteriorated states, to determine the preliminary adequacy power, the initial power of said units will be calculated as the minimum value between the determined initial power and the equivalent power.

$$Potencia\ Inicial = Mín(\ Potencia\ Inicial, Potencia\ Equivalente)$$

The initial power must be reduced by a factor proportional to its own consumption, in such a way that:

$$Potencia\ Inicial = Potencia\ Inicial * \frac{Consumos\ Propios}{Potencia\ Bruta\ Máxima}$$

In the event that the consumptions are not exclusively dedicated to the auxiliary services of a generating unit, they must be considered as a power withdrawal and therefore must be recognized by the corresponding company.

The resulting value of preliminary adequacy power will be reduced by a factor proportional to the longer maintenance period. This major maintenance, whether partial or total, may be carried out at any period of the year and will not affect the forced unavailability of the generating unit, as long as they are carried out within the terms established in the current major maintenance program.

$$Potencia\ Inicial = Potencia\ Inicial * \left(1 - \frac{HM}{HT}\right)$$

Where HM are the total maintenance hours and, HT the total hours of the calculation year.

Forced unavailability will be calculated based on the time that the generating unit was in operation and the time that the generating unit was unavailable, for a rolling window of 5 consecutive years, during all hours of each year.

The forced unavailability will be determined from the following quotient:

$$IFOR = \frac{T_{off}}{T_{on} + T_{off}}$$

Where:

$IFOR$: Forced unavailability.

T_{off} : Average accumulated time in which the generating unit is unavailable due to some programmed or forced disconnection, and this was not the product of a fault external to the installation.

T_{on} : Average accumulated time in which the generating unit is in operation, independent of the dispatch level, for a moving window of 5 years.

The Coordinator must determine the adequacy power of each unit, for this purpose he considers the forced unavailability and the initial power of each reduced generating unit.

$$PSP_i = \frac{1}{1 - LOLP_{dm}} * Pini_i * (1 - IFOR_i) * Pb(P'_{SIS} > D_{punta} - Pini_i)$$

Where:

PSP_i : Preliminary adequacy power of generating unit i.

$Pini_i$: Initial power, after reductions, of generating unit i.

$IFOR_i$: Forced unavailability associated with the generating plant i.

D_{punta} : Peak demand of the system.

$1 - LOLP_{dm}$: Sufficiency power of the system equivalent to $Pb(P_{SIS} > D_{punta})$

P'_{SIS} : Random variable that describes the power supply of the system without considering the ith generating plant.

$Pb(x > y)$: Probability that x is greater than y.

3.2.3 Final Adequacy Power

The final adequacy power of each unit will correspond to the preliminary sufficiency power previously obtained, scaled by a single factor. in such a way that the sum of the final sufficiency power of all the units is equal to the peak demand of the system.

$$PSD_i = \frac{D_{punta}}{\sum_k^{PAR} PSP_k} * PSP_i$$

Where:

PSD_i : Final adequacy power of generating unit i.

PSP_i : Preliminary adequacy power of generating unit i.

k : Participant k of the power balance..

PAR : Set of all participants in the power balance.

3.2.4 Valued balance of injections and withdrawals of power

In each transfer bar, the power injections and withdrawals of each participant from the power balance are determined, which are valued at the Short-Term Power Node Price (PNCPP) of the respective bar.

In order to obtain the PNCPP, the CNE will determine the basic price of peak power, which will correspond to the annual marginal cost of increasing the installed capacity of the electrical system considering the most economical generating units, determined to supply additional power during business hours. Maximum annual demand of the electrical system increased by a percentage equal to the Theoretical Power Reserve Margin (MRPT) of the electrical system.

The MRPT will correspond to the minimum over-equipment in generation capacity that allows supplying the peak power in a system with a determined adequacy. Said margin is calculated from the power margin, which will be calculated as the quotient between the sum of the initial power of all the units in the system and the peak demand of said system.

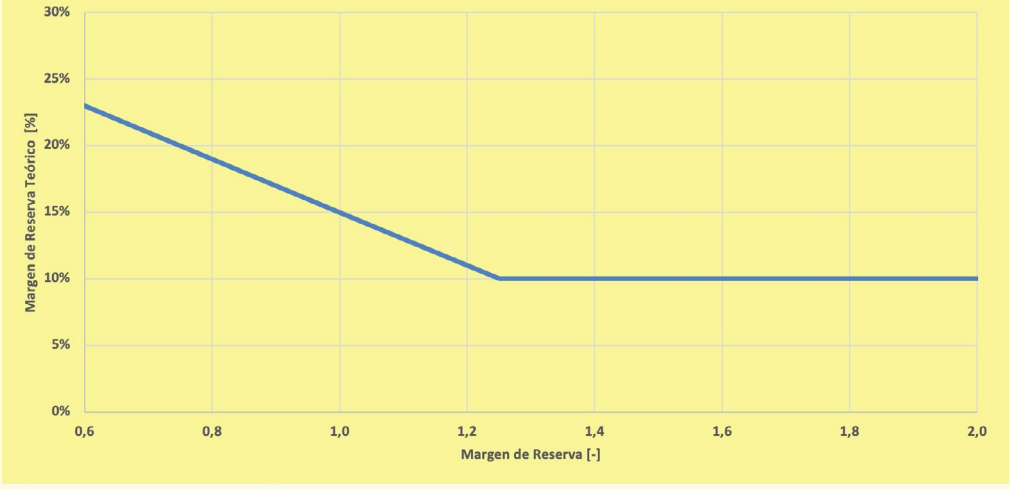
$$Margen\ de\ Potencia = \sum_i^N Potencia\ Inicial_i * \frac{1}{D_{punta}}$$

In the event that the reserve margin is greater than 1.25, the theoretical reserve margin will be equal to 10%. Otherwise, the theoretical reserve margin will be calculated with the following equation:

$$Margen\ de\ Potencia\ Teórico = 0{,}15 - 0{,}2 * (Margen\ de\ Potencia - 1)$$

Theoretical Power Margin = 0.15-0.2 * (Power Margin-1)

Figure 04 **Theoretical Reserve Margin as a function of the Reserve Margin**



Source: Own elaboration.

For each of the substations of the electrical system, a power penalty factor is calculated which, multiplied by the Basic Price of Peak Power (PBPP) determines the PNCPP in the respective substation.

$$PNCPP_{barra} = PBPP * Factor\ de\ Penalización_{barra}$$

For each participant in the power balance, all the valued injections and withdrawals of power are added algebraically (positive sign for injections and negative for withdrawals). The resulting value with its sign will constitute the net balance of each participant in the power balance.

Companies with a negative net balance will pay said amount in twelve monthly installments during the year to which it corresponds, to all companies that have a positive net balance in the proportion in which each of the latter participates in the total positive net balance.

The valuation of power transfers must make explicit the respective income for sections that are generated by such transfers in favor of the respective owners of the transmission system facilities, as appropriate.

Annex 4: Distributed generation

In the distribution network there are an important number of projects of distributed generation whose main vocation is the sale of energy through the distribution network (known as PMGD). However, there is also a growing development of distributed generation projects whose main vocation is self-supply, that is, projects that are developed in the premises of a client or consumer of the distribution network to partially or totally self-supply of electricity and eventually inject their surplus into the network. Self-supply projects can be grouped into three families, according to the type of regulation that applies to them:

a) Self-consumption projects without injection to grid
b) Self-consumption projects with injection to grid with commercial purposes
c) Self-consumption projects less than or equal to 300 kW with surplus injection to grid

These types of projects have been ordered according to a historical order of their regulation and therefore of the maturity and diffusion of the necessary steps for their processing.

In Chile the regulation tries to carry out an efficient transfer of system costs to distribution customers, which creates incentives for self-supply, since reducing consumption from the grid, replacing it with local generation, avoid payments to the distribution company.

This Annex first presents the three types of self-consumption projects mentioned above, but then focuses on the projects with possibility of injection into the network, i.e. projects associated with Netbilling Law and PMGD projects, for which the current state in terms of number of projects and installed capacity is shown, then describes how the injections are valued, then the procedure of connection to the distribution network and finally the available business models.

a) Self-consumption projects without injection to grid

Self-consumption projects without injection of surpluses have been very common for decades, since their use is mandatory as emergency systems in some buildings, hospitals and other facilities. The regulation of this segment contemplates systems of self-generation that are unable to inject energy to the network, so they do not value surpluses (they do not have surpluses).

> Decree 8/2020 approves the Safety Regulation for Electric Power Consumption Installations, which establishes the RIC N°9 regulatory technical specification: Self-Generation Systems. Said regulation establishes the safety requirements that facilities that have self-generation systems must meet that deliver the energy generated to the consumption facility simultaneously with that supplied by the distribution company and that do not inject this energy into the electrical distribution network.

The previous systems are well described in Standard 4, so the remainder of this Annex is intended for self-consumption projects with injection of surplus, which depending on the size of the generation system and its technology are subject to 2 different regulations: Netbilling or PMGD. It should be noted that this reference to the cogeneration term points to projects that are connected to the network and that supply the customer's demand jointly with it, but that are unable to inject energy into the distribution network.

b) Self-consumption projects with injection to grid with commercial purposes

Projects of power generation less than or equal to 9 MW connected to the distribution network correspond to PMGD and are regulated by S.D. N°244 of 2006 and the Technical Standard for Connection and Operation at Medium Voltage (NTCO). This regulation applies to any source of energy (not just renewable) although some of the benefits are exclusive to renewable sources. S.D. N°88 of 2020, replacing the S.D. N°244 of 2006 and S.D. N°101 of 2015, defines the stages, procedures and deadlines to connect to the network as well as the value of injections. The standard that defines technical aspects is the NTCO of PMGD in medium voltage installations. This regulatory framework is oriented to projects that, although they have the mean objective of self-supplying local demand for the property where they are installed, are also interested in entering the business of marketing of energy.

c) Self-consumption projects less than or equal to 300 kW with surplus injection to grid

Renewable or cogeneration projects of less than 300 kW, typically corresponding to a residential, commercial or industrial generation project, are regulated by Law 20.571 of 2012 (modified in 2018 with Law 21.118) and its regulation, S.D. N°57 of 2020, replacing the S.D. N°71 of 2014. This Law empowers consumers who are under a regulated tariff scheme to inject their surplus energy into the grid and value it to reduce their electricity consumption account or eventually liquidate surpluses. The generation can come only from renewable energy or efficient cogeneration. The standard that defines technical aspects is the NTCO of equipment of generation in low voltage. This regulatory model provides simplifications and special conditions for self-consumption projects that do not have the marketing of energy in their turn, while they are able to inject their surpluses and are valued at the average distribution contracts, these surpluses are used to discount the customer's billing and not to market energy to the network.

4.1 Current status of projects under the Netbilling Law and PMGD projects

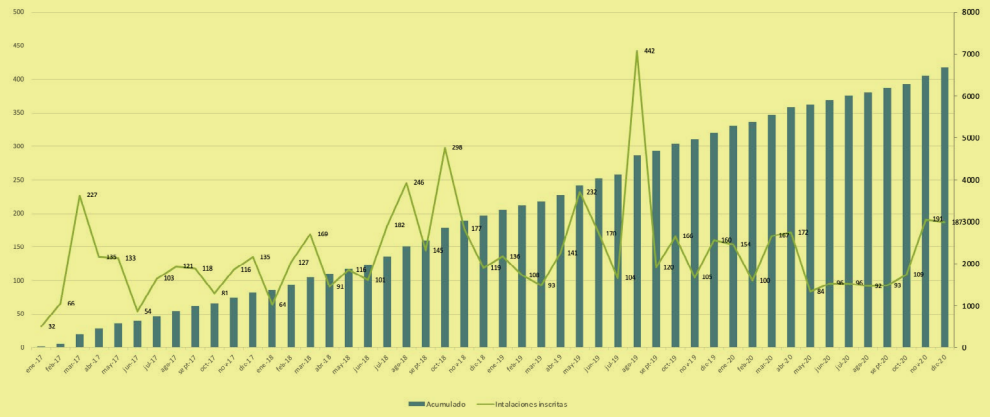
Distributed generation in its various scales has been widely accepted in the Chilean electricity sector, both the generation received under the Netbilling Law and the PMGD have grown substantially since their connection and remuneration were regulated.

4.1.1 Progress in the number of connections and installed capacity of generation projects covered by the Netbilling Law

very new regulation. However, already in February of 2015 it had begun the commissioning of the first projects covered by this Law and its increase has not ceased. The requests for connection to the distribution companies started the same month of publication of the regulation. Likewise, the number of registered installations has increased considerably during these years, reaching a total of 6674 installations in the month of December 2020.

Figure 5 shows declarations of commissioning of the projects from the beginning of the validity of the Netbilling Law until December 2020.

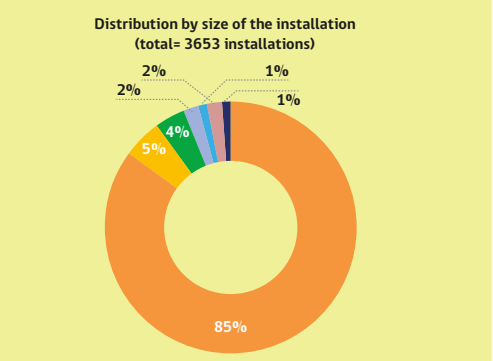
Figure 05 Registered Installations in compliance with the Netbilling Law

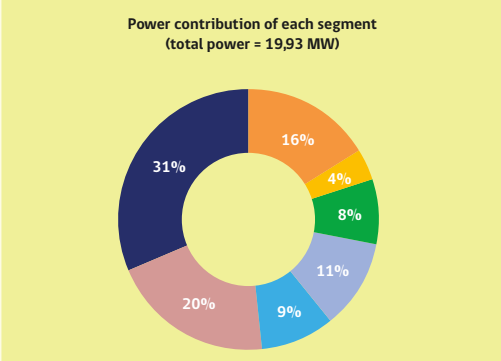


Source: SEC

Figure 6 shows the distribution of facilities according to their power range both in quantity and their contribution to the total capacity December 2020.

Figure 06 Distributed generation projects by size and contribution of power of each segment



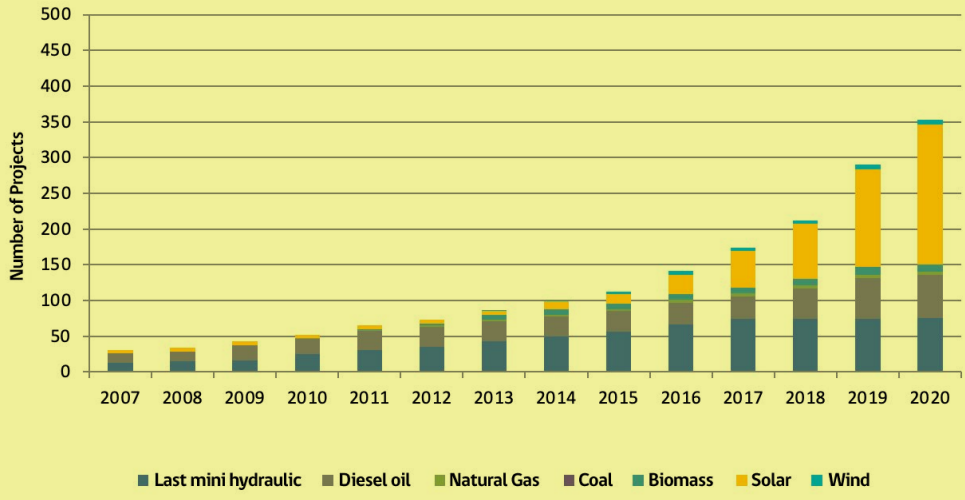


Source: SEC.

4.1.2 PMGD Project number progress

A decade ago there was a significant development of typically hydraulic and diesel PMGD projects, but for 5 years there has been a growing development of wind and solar projects and are projected to continue with this trend. Figure 7 presents the evolution of the number of PMGD projects by technology.

Figure 07 Evolution of PMGD projects by technology



Source: SEC

4.2 Valuing injections of generation surpluses to the grid

The energy and power injected into the network of projects under the Netbilling Law on the one hand and the PMGD on the other hand receive different valuations for the energy and power injected into the distribution network. The principles of valuation for both types of projects are described below.

4.2.1 Valuation of injections of projects under the Netbilling Law

Unlike several developed countries that seek to promote and encourage residential generation through the use of net metering, Chile seeks to establish tariffs that reflect the actual costs of supply to promote efficiency in the system. This is why the Netbilling scheme is used. In this scheme the injected energy is valued at the avoided cost of energy and losses by the distribution company. That is, the average cost that the distribution company fails to pay to buy less energy to large generators (results of regulated supply bids) plus the less losses avoided by the generation closest to consumption or the cost avoided. The energy measurement is performed for injection and withdrawals independently and are valued separately before the monetary balance is made. In fact, energy injection and energy prices are different for residential customers BT1, as this type of customer in its energy tariff finances both the energy it occupies and its power demand, which finances the infrastructure of the network that (mainly the distribution network). This type of project does not receive a payment to compensate its power.

Specifically, according to the S.D. N°57 of 2020, generation equipment may operate in any of the following modes:

- Individual generation.
- Individual generation with remote discounts.
- Joint generation.

The value of the energy injected into the grid is deducted from the charges on the ballot. If the discounts exceed the charges, then the remainders are discounted on the following ballots. Remnants that have not been deducted from the ballots after a certain period defined by contract are liquidated and paid by the distribution company to the customer under the following conditions:

a) That the remnants do not come from a Joint Generation Equipment;
b) That the remnants do not come from an Individual Generation Equipment with Remote Discounts, except in the case of non-profit legal entities;
c) That the Generation Equipment has been sized so that, under normal operating conditions and on an annual basis, its energy injections do not produce remnants that cannot be deducted from billings;
d) That the remainders do not originate from increases in generation capacity that have not met the above condition.

For residential customers with connected power up to 20 kW or non-profit legal entities with connected power up to 50 kW, it will not be necessary to comply with the requirements of paragraphs c) and d).

4.2.2 Valorization of PMGD injections

PMGDs may choose to sell their energy to the system of instantaneous marginal cost (spot price) or a stabilized price regime that allows them to access the node price of the zone where they inject. The latter was modified by the S.D. N°88 of 2020, which calculates the stabilized price differently in six hourly blocks per day. This valorization regime option commonly provides very different economic results and must be communicated to the Coordinator, and must remain a minimum of 4 years in the chosen regime.

If you choose to value the injection at marginal cost, this will correspond to the calculated in the bar of the primary distribution substation that feeds it. Under this regime the PMGD is subjected to a high risk, since the marginal cost variability is high and depends on many factors (water use from dam, congestion and network loss levels, injection of renewable energies, among other aspects). In the case of choosing a stabilized price regime, the injected energy will be valued at the short-term energy node price in the different time intervals (6 blocks) of the trunk bars associated with the bar of the primary injection distribution substation. The short-term node price is calculated semi-annually by the National Energy Commission as an average of the marginal costs of the following 48 months (calculated by simulation of the electric system) and therefore has much lower variability than marginal costs and by both represent a lower risk for PMGD. The power injections are valued at the power node price, regardless of the chosen regime.

4.3 Network Connection Procedure

The stages, procedures and costs of the connection to the grid are fundamental and there are differences for generators under the Netbilling Law versus PMGD, because due to the difference in the size of these types of projects, the stages and procedures for Netbilling projects are simpler and faster. Next, each of the steps for making the connection to the network is described for both types.

4.3.1 Procedure for connecting projects under the Netbilling Law and associated times

The connection procedure for a project under the Netbilling Law has 6 stages:

The connection procedure for a project under the Netbilling Law has 6 stages:

- The initial stage corresponds to an information request to the distribution company will not inject surpluses into the grid.
- Stage 1 corresponds to the connection request to grid (SCR) where the user must specify the main characteristics of his generation system (location, installed capacity, etc.).
- After receiving a response to the connection request, in step 2 the user must make a statement of compliance or express a nonconformity to the SEC if applicable.
- Stage 3 corresponds to the installation and inscription period of generation equipment in the SEC.
- Stage 4 is the notification of connection and signing of contract with the distribution company.
- Finally in stage 5 the connection to the distribution network takes place.

It is important to note that all forms and the Online Connection Processing platform for each of the communications with both the distribution company and the Superintendency are available on the website of the Superintendency[6], as well as the maximum deadlines for response of all parties.

Stage 0: Information Request (optional)

Users may request information from the distribution company regarding the Permitted Installed Capacity associated with the appropriate distribution transformer or feeder. The information must be delivered to the user within no more than 10 working days.

Stage 1: Connection Request to Grid (SCR)

The user must present an SC in which it includes its identification, address where it will be installed, means of contact, installed capacity and injection of the Generation Equipment (GE) and its main characteristics. The distribution company has 5 days to request correction of the SCR in case it has incomplete or erroneous information, and the user has 5 working

[6] Netbilling project connection forms and platform can be found at the following websites:
https://www.sec.cl/formularios/
https://www.sec.cl/gda/tramitacion-de-conexion-en-linea/

days to make the corrections. The calculation of the installed capacity and the injection of surpluses allowed, and the determination of specific technical requirements are specified in the technical standard.

The connection request for the supply of energy or the extension of services made to a distributor may be made jointly with the SCR of a GE. The distributor must evaluate both requests together in 20 days.

The response of the SCR should include the following information: location of the point of connection of the GE, the capacity of the joint, the installed capacity and surplus injection allowed, the additional works and necessary adjustments for the connection together with its valuation, the execution term and mode of payment, the model of connection contract, the cost of the activities necessary to make the connection,, the sum of installed capacity and injection capacity, the amount of SCR associated with the same distribution transformer where it is requested; and the report of additional works.

The distribution company has between 5 and 40 working days to respond to SCR depending on the information provided by the user and if information was requested prior to the SCR.

a) If the capacity of the generating equipment to be connected is less than the capacity of the joint and less than the installed capacity allowed and, that the injection capacity is less than or equal to that allowed, term is 5 working days. If it was not preceded by an information request, the deadline is 10 working days.
b) If the capacity of the generation equipment to be connected is lower or equal to the capacity of the junction and the safety and configuration criteria of the distribution grid are met, in accordance with the required of the technical standard (photovoltaic solar equipment with a capacity of less than 10 kW connected to low voltage and that said capacity added to that of other low-voltage generation plants or in the process of connection do not exceed 10% of the rated power of the transformer[7]), the term is 5 working days.
c) If the installed capacity of the equipment is greater than the installed capacity allowed, that the injection capacity is greater than the allowed surplus injection or requires a change in the capacity of the junction, the term is 20 business days. If the project is located in commune-distribution company pairs classified as very low density, then the

[7] These safety and network configuration criteria are explained in the second transitional article of S.D. N°103 of 2017 and will be valid until the technical standard is adjusted.

term is extended by 10 business days (reaching 30 business days). In the event that the SCR had been preceded by a request for information and the distributor in the response to the SCR indicates lower values with respect to the installed capacity or injection of surpluses allowed to those consigned in the request for information, the Distributor must certify that the conditions for the determination of said parameters have changed.

d) For the connection of Generation Equipment in residential complexes, buildings or the like, and those that are connected to the same distribution transformer, may jointly present a single SCR for the connection of their corresponding generation equipment. The SCR must respond in 20 working days. In case that for a real estate project new networks are required or to make modifications to the existing distribution networks, the term will be of 40 working days.

Stage 2: Demonstration of conformity

The assessment of the activities necessary to carry out the processing and connection of the generation equipment must be carried out by the distributor. The user must express their agreement within 20 days.

The user may increase or decrease the installed capacity to a value less than or equal to the permitted installed capacity and, in the same way, may increase or decrease the injection capacity to a value less than or equal to the allowable injection of surpluses, in such a way that avoid the execution of additional works, adjustments or adjustments that have been informed in the response of the SCR. This must be reported at the time of expressing your agreement within 5 days.

The user has 20 business days to express their agreement in the event that the power of the generation equipment is greater than 40% of the allowed installed capacity. Otherwise, it is not necessary to make the declaration of conformity and you can proceed with the Notification of Connection (NC).

Users may file claims with the Superintendency, if the claim is accepted, the distributor must respond within 10 days and from the response, the user will have 10 days to express their agreement.

In general, the user can demonstrate their conformity with a validity of 6 months (extendable for 6 more months or up to 24 months if the generation equipment is not photovoltaic or

wind power or if the equipment has been acquired with public funds or equipment of joint generation) for the user to make the connection notification.

If it is contemplated to carry out additional works, the deadline for submitting the connection notification must be agreed with the distribution company, but it cannot exceed 5 working days the deadline indicated by the distribution company in the response to the SC.

In the event that the generation facilities are destined to joint rooms, buildings or other similar ones, whether new or extensions thereof, the manifestation of conformity will have a validity of 3 years.

In summary, the validity to present the Connection Notification (NC) will depend on whether additional works must be carried out, from the place of installation of the Generation Equipment (particular place or joint housing, building or similar, new or extensions) and generation technology. Table 2 presents a summary of these deadlines.

Table 02 **Validity to present the Connection Notification according to case**

Cases (depends on technology, additional works, facilities)	Validity for submitting the Connection Notification
▸ Solar or wind generation. ▸ No additional work required. ▸ Installations in a particular place (not jointly housing, buildings or similar) ▸ Generation installations financed with public funds. ▸ Equipment of joint generation	6 months extendable for up to 6 months
▸ Generation of technology other than solar or wind. ▸ No additional work required. ▸ Installations in a particular place (not jointly housing, buildings or similar). ▸ Generation installations financed with public funds. ▸ Equipment of joint generation	6 months extendable for up to 24 months
▸ Joint generation facilities, buildings or similar, new buildings or extensions thereof.	The term is 3 years, but cannot exceed 6 months from the final reception of the work in the Municipality.
▸ Yes there are additional works. ▸ Installations in the particular place (not jointly housing, buildings or similar).	The term must be agreed with the distribution company, but cannot exceed 5 working days the term indicated by this in the SC.

Stage 3: Installation and registration with the SEC (TE4 statement)

The installation must be carried out by electrical installers certified by the Superintendency or by those professionals indicated in S.D. N°93 of 1983, of the Ministry of Economy, Development and Reconstruction. Also, said professionals must report the energization to the Superintendency once the works are completed, who will certify that the installation complies with the regulations and technical standards (TE4 statement).

Stage 4: Connection Notification (NC) and Contract Signing

Within the validity period to present the CN indicated in Table 2, the user must submit it to the distribution company and must accompany with the following antecedents: connection contract signed by the customer, address, identification and class of the installer, the copy of the communication of the commissioning made by authorized installers and accreditation of payment for processing and connection activities.

When the CN presents incomplete or erroneous information, the user must correct it within 5 days. For joint generation, in the case of requesting a correction to the joint ownership contract, this term will be 10 days.

Stage 5: Connection Protocol

Once the CN has been delivered, the distribution company will carry out or supervise the connection of the generation equipment according to the technical standard. The date of connection must be agreed between the parties and may not exceed 5 days from the date and hour of delivery of the connection notification. The connection must be made or supervised by the distributor within the following 10 days. In case it is not done by the user, he must present a new NC.

The connection and commissioning procedure for a distributed generator is presented on the SEC website.

4.3.2 Procedure of connection of PMGD

The connection of a PMGD requires longer deadlines and a somewhat more complex procedure for connection and may require the financing of specialized technical studies. This procedure is on the SEC website[8] can be differentiated in the following stages:

Stage 0: Optional. Request for information and response from the distributor

This stage is optional and corresponds to a request for information from the distribution company through the SEC platform (Form N°1).. This form should indicate the main characteristics of the PMGD, including its point of connection, the main characteristics of the modification in the connection and/or operation of the PMGD, the identification of the interested party, with address or e-mail address, the information request of the facilities of the distribution company, relevant for the design of the change in connection and/or operation of an existing PMGD.

Then within a maximum period of up to 15 days from receipt of the request, the distribution company will respond through Form N° 2 which will include technical information required, and additionally must attach the payroll of other PMGDs in the feeder, list of technical studies required in the case of being classified as PMGD of significant impact and list of the values of preparation and review of studies.

Stage 1: Submit the Network Connection Request (SCR)

The interested party must submit Form N°3, known as the Network Connection Request (SCR) and indicates if it wishes to be evaluated as a PMGD of Non-Significant Impact (INS)[9].

The SCR must include at least the following information:

1) Individualization of the applicant.
2) Individualization of the owner or operator.
3) Contact details.
4) Georeferenced location.
5) Documentation associated with the land.
6) Documentation of the right to use water.
7) Affidavit stating that the land has the necessary characteristics for the location of the project.

[8] Procedure of PMGD:: https://www.sec.cl/pequenos-medios-de-generacion/

[9] According to article 86° of S.D.N° 88, in the event that the installed capacity of the PMGD reported in the SCR is less than or equal to the capacity of the splice to which it is connected and the Installed Capacity for Expedited Connection, and the injection capacity thereof is less than or equal to the Capacity Injection for Expedited Connection, it will be considered that the PMGD classifies as having a non-significant impact, being able to connect through an Expedited Connection Process.
Title 2-2 of the NTCO indicates the application of these criteria to determine whether or not a PMGD produces significant impacts on the network.

8) Installed capacity and injection capacity of the project.
9) Technical characteristics according to the NTCO.
10) Indicate if you will operate as a self-producer
11) Proof of payment of 20% of study costs.
12) Data for refund of money.
13) Project execution schedule.

Stage 2: Declaration of admissibility

The distribution company has a period of 10 days counted from the receipt of the SCR to declare the information admissible according to what is indicated in Form N°4. The distributor must attach the updated information of the SCRs in process associated with the same feeder (connection point, installed capacity, injection capacity and generation technology, order of priority of the SCRs and the contact details of the interested parties) . A SCR that fully or partially shares the location polygon cannot be declared admissible.

Likewise, once the SCR has been received, the distribution company may request the interested party within 10 days, one time only, to supplement the SCR. The interested party has 5 days to answer this request for additional information (Form N°5). Subsequently, the distributor will have a period of 10 additional days to declare the admissibility of the SCR (Form N°6).

Stage 3: Response to the Network Connection Request (SCR)

Within the 10 days following the declaration of admissibility of an SCR, the distribution company must respond to the interested party, using Form N°7. The distributor must update all the information in Form N°1 (Art. 32 of S.D. N°88), in addition to the List of PMGDs that are operating in the area adjacent to the connection point and a list of connection studies to prepare the Connection Criteria Report (ICC).

Stage 4: Compliance with the response to the Network Connection Request (SCR)

The interested party must notify their agreement with the response to the SCR (Form N°8) to the distributor within 5 days. In the event that the interested party is not satisfied with the response to the SCR, they can request a new review within 5 days. The distributor must resolve within the following 10 days, after this period, the interested party must notify their agreement with the response to the SCR in 5 more days.

If the PMGD is not classified as INS, the distribution company will indicate through Form N°8, with this information and within 5 business days after receiving Form N°8, the interested party must notify the distribution company if they decide to reduce the installed capacity and injection capacity values declared in the SCR at a value equal to or less than the installed capacity values for expedited connection and injection capacity for expedited connection to be classified as INS. The interested party who does not reduce the values must update the project execution schedule, informing them within a period of 5 days from the issuance of the SCR response.

Likewise, if the declared installed capacity and injection capacity values are below the installed capacity values for expedited connection and injection capacity for expedited connection, the interested party may increase the installed capacity and injection capacity reported in the SCR. up to the installed capacity values for expedited connection and injection capacity for expedited connection, respectively, and maintain the classification of your project as INS. In this case, the distributor must maintain the classification of the project as INS, a fact that must be informed through a new response to the SCR, within 5 days after the SCR communicated its decision.

Stage 5: Issuance of the Connection Criteria Report (ICC)

In relation to the connection studies, once the response to the SCR has been issued, it must issue an ICC, which must contain a connection cost report. In the event that the distributor has carried out the connection studies, it must deliver the studies together with the respective ICC. For projects that qualify as INS, the distributor must communicate the ICC (Form N°14) to the interested party within 20 days following the issuance of the SCR response. The ICC must also attach the connection or modification contract, the contract to carry out additional works, adjustments and adjustments, and the schedule for the execution of additional works, adjustments and adjustments. For projects that do not qualify as INS, the distributor must communicate the ICC to the Interested Party (Form N°14) within the five months following the issuance of the SCR response.

Once the ICC has been issued by the distributor and within a period not exceeding 20 days, the Interested Party must express their agreement (Form N°15) with it or request modifications or clarifications, which must be answered within 20 days. following. In this case, the Interested Party must express their agreement with the ICC within the following 20 days, attaching the signed contract for additional works, adjustments and adjustments.

The ICC will be valid for 9 months for INS projects, 12 months for projects that do not qualify as INS with installed capacity of less than 3 MW, and 18 months for the rest of the PMGD projects.

Stage 6: Declaration under construction

The interested party must certify the progress and fulfillment of the milestones of the project's execution schedule (Form N°17), for this he must present antecedents to prove the start of environmental processing and sectoral permits, and the resolution to accredit the declaration under construction of the draft.

The owner or operator of a PMGD project declared under construction must inform the CNE of the completion of the progress of the work according to the schedule (Form N°18) and must report any modification that alters compliance with the schedule within a period of 15 days.

Stage 7: Commissioning and Entry into Operation

The commissioning stage is that which begins with the interconnection and energization of the PMGD, with prior authorization from the Coordinator and until the end of the respective tests carried out or supervised by the distributor.

The owner or operator of the PMGD must notify the Coordinator, the CNE and the Superintendency of the estimated date of interconnection within the ICC's term of effect at least three months in advance.

With respect to the Coordinator, the estimated date of interconnection and a request for authorization of commissioning must be submitted (attached with the address, identification of the connection point, the identification and class of the electrical installer and a copy of the communication of the interconnection to the Superintendency). The Coordinator must respond with the authorization within 20 days.

With respect to the distributor, a Notification of Connection (NC) must be submitted in accordance with Form N°19 and attaching the following:

a) Connection Agreement.
b) The address of the property.
c) The identification and class of the electrical installer.

d) Copy of the communication of the PMGD interconnection made by an electrical installer.
e) Monthly resolution of the CNE where the PMGD appears as declared under construction.
f) Authorization by the Coordinator for the start of the commissioning stage.

When the additional and construction works are completed, a commissioning schedule must be set and a date for the commissioning scheduled in agreement with the distributor (Form N°20). This must be informed to the Coordinator and the CNE with 15 days in advance.

The interconnection and energization of the PMGD must be carried out or supervised by the distributor (Form N°21). Once the commissioning stage is completed, the information to verify compliance with the requirements established in the test protocols must be sent to the Coordinator, together with an affidavit of faithful compliance with current regulations. The Coordinator should issue his approval within 20 days.

4.4 Business models for self-supply

The saving of electricity provided by generation can constitute a good business opportunity, depending of the patterns of consumption and the primary generation resource available in the area, the required investment and the cost of financing, the electricity cost of the network and the percentage of self-consumption. There are 3 business models for the self-supply that can be exploited and that are applicable to both small-scale generation under the Netbilling Law and PMGD projects and projects with no surplus to the network and are as follows:

a) The consumer buys the plant or generation equipment.
b) The consumer rents the plant or generation equipment or signs a lease agreement.
c) ESCO Model (Energy Service Company).

Each of these business models with their main advantages or disadvantages is briefly described below.

4.4.1 Buy the Generation Plant

Under this model, the customer or user of energy is the owner and operator of the plant, which is why it is responsible for the electrical production, equipment and maintenance of the

plant. The main barrier of this business model is the initial investment required. In the case of projects under the Netbilling Law, which are aimed at residential, commercial or small-scale generation, customer may often not have the initial capital or simply do not wish to take the risk of the investment. In the case of PMGDs, if it is aimed at self-supply, consumers are often not experts in the development of these projects and do not want to take the risk.

In general, the business model of buying the plant or the generation equipment is oriented to companies with a high degree of knowledge of the electricity sector whose main turn is the sale of energy to the system and not self-supply.

4.4.2 Rent the Generation Plant or Leasing

Under a model of renting the generation equipment the customer pays a monthly fee to the company that owns the equipment. This company makes the initial investment and is responsible for the equipment. However, the customer is responsible for the electrical production. This business model represents less risk than the first model of purchase of generation equipment. In the case of projects under the Netbilling Law, which are aimed at residential, commercial or small-scale generation, this means an additional monthly cost that is often difficult to predict if it will be able to be covered by energy savings.

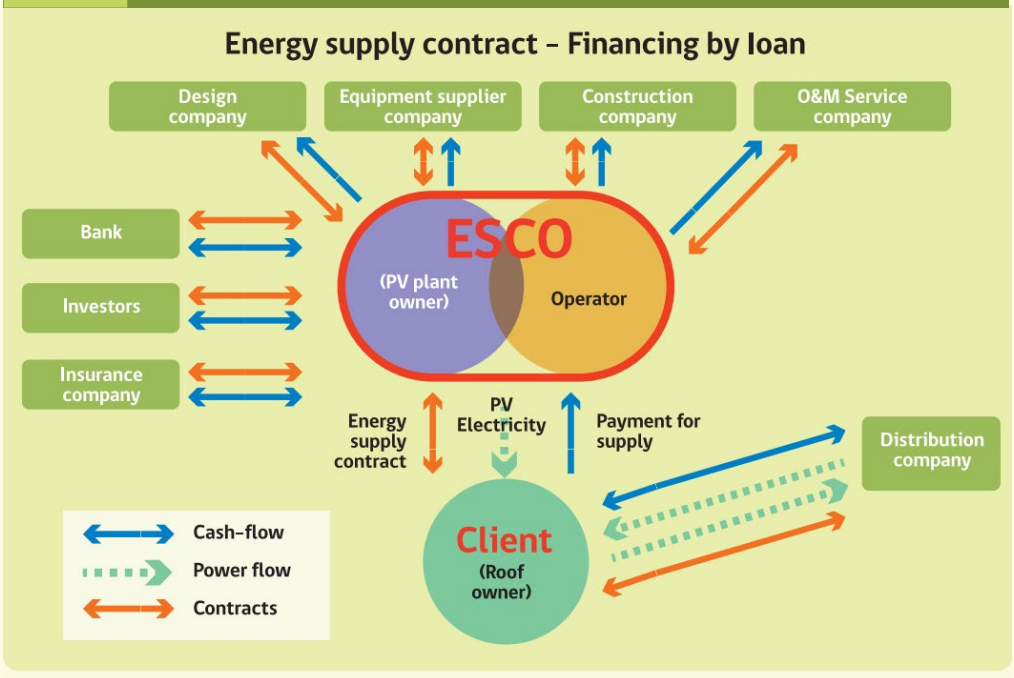
4.4.3 ESCO Model (Energy Service Company)

Energy Service Company or ESCO is a company format whose business is to achieve energy savings. In this way, the ESCO makes the investments and recovers them with a fraction of the economic savings that the user produces. This business model is envisaged with a great development potential because under this framework, ESCO is the owner and responsible for the equipment and the electrical production. In this way the consumer practically does not take risks of investment or operation.

There are 2 variants of the ESCO model, one corresponds to which the company ESCO supplies the energy and therefore the customer buys the energy at a price lower than the one bought in the network and the other variant corresponds to the model in which the income of the ESCO is based on the energy savings achieved by the consumer. The latter is widely used in contracts of companies that perform energy efficiency, but is less frequent in the contracts of generation companies. The ESCO power supply business model is the one that has taken the most force and is described briefly below.

Under the ESCO model of energy supply a long-term energy supply contract (10 to 15 years) is established for a price per kWh determined between the ESCO Company and the consumer. At the same time, ESCO is responsible for the investments, studies, installation and maintenance of the generation equipment. In this way, ESCO acts as an intermediary between the consumer and the design, construction, supplier and operation and maintenance companies and assumes all investment risk. The consumer, owner of the building where the generation project will be built/installed, should only pay energy to the ESCO.

Figure 08 ESCO Company that supplies energy



Source: "Business model for sale of energy generated by photovoltaic plant for self-consumption and injection of surplus energy according to Chilean legislation". Ministry of Energy and GIZ.

Annex 5: Information Platforms

5.1 Prospecting of resources

The Ministry maintains stable measurement campaigns for wind and solar resources in the north of the country. In addition, it has implemented information platforms that allow the indirect evaluation of these resources by means of modeling tools, databases, territorial information and updated cadaster of the resources present in the country. Finally, information resources available for the estimation of water generation, through biomass and using sea energies are also presented in this section.

5.2 Wind and solar measurement campaigns

This program of measurement of renewable resources began in 2006 with the National Energy Commission and then in 2010 with the Ministry of Energy. The objective of the campaign is to have a wind and solar energy survey to better understand the characteristics of these resources.

The results of the measurements have confirmed that the Atacama Desert has one of the largest solar potential in the world, exceeding solar radiation levels of more than 30% in areas of Spain with high presence of generation projects solar. Horizontal global radiation is around 7 kWh / m² per day at most stations, or 2,600 kWh/m2 per year, and normal direct solar radiation (DNI)[10] exceeds 3,000 kWh/m2 per year.

5.3 Wind and solar energy explorers

The Ministry of Energy has promoted the application of numerical modeling tools for the atmosphere for purposes of characterizing the potential of NCRE in Chile. These efforts, which continue today, have enabled the development of interactive tools that provide an indirect assessment of the wind and solar resources in most of the country. Among them are the Wind Energy Explorer and the Solar Energy Explorer, which are available and publicly accessible through the website of the Ministry[11]. Notwithstanding the usefulness of these tools for the identification and evaluation of potential areas for NCRE projects, their results

[10] Calculated by the Fraunhofer ISE Institute of Germany

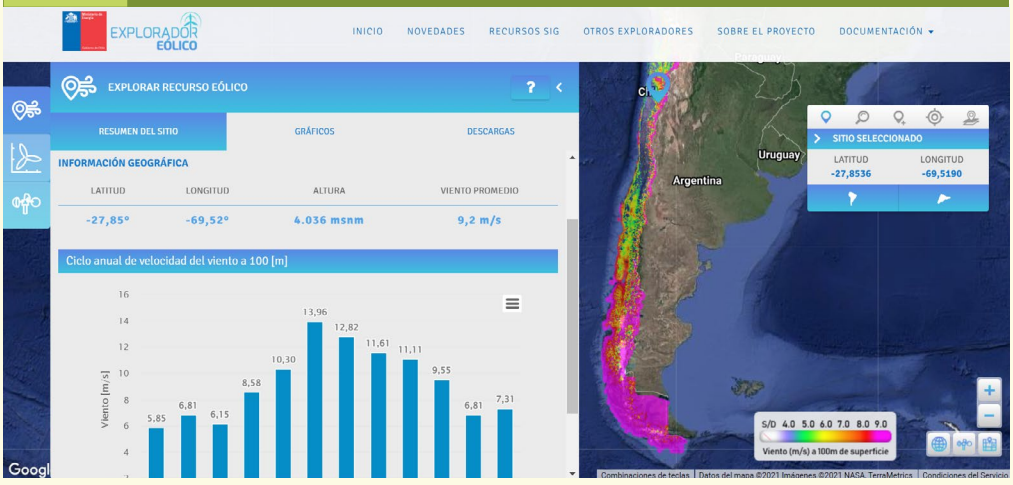
[11] In the following link: http://www.energia.gob.cl/educacion/que-son-las-energia-renovables

should be considered only as preliminary and indicative, and they do not replace the on-site monitoring of the meteorological parameters necessary for the feasibility evaluation of this of type of projects.

The Wind Energy Explorer presented in Figure 10 summarizes the wind data obtained from atmospheric behavior simulations developed using the Weather Research and Forecasting (WRF) model, which is fed with results from global models. The simulations cover the area between the northern border of the country and the Magallanes Region, including Easter Island. The first version had each with a horizontal spatial resolution of 1 km and 41 vertical levels, of which 12 are within the first 200 meters above ground level, useful range for the evaluation of wind power projects. The latter has a variable spacing between 5 and 34 meters above the level of the earth's surface. The new version adds representative WRF data from the year 2015 of 1km spatial resolution that are distributed in only 5 spatial domains that span from Arica to Cabo de Hornos. In addition, it has a weather reconstruction technique that has been improved that allows obtaining better and more extensive results at the hourly level (period 1980-2017). Additionally, it has tools that allow to analyze data collected from meteorological stations.

The Wind Explorer is organized into 3 modules: the exploration of the wind resource module aimed at analyzing the behavior of the modeled wind at a site of interest, the calculation module of the wind turbine aimed at estimating the generation performance of a wind turbine, and the resource measurement module. wind energy for the analysis of variables measured from wind prospecting stations of initiatives related to the Ministry of Energy.

Figure 09 Wind Energy Explorer



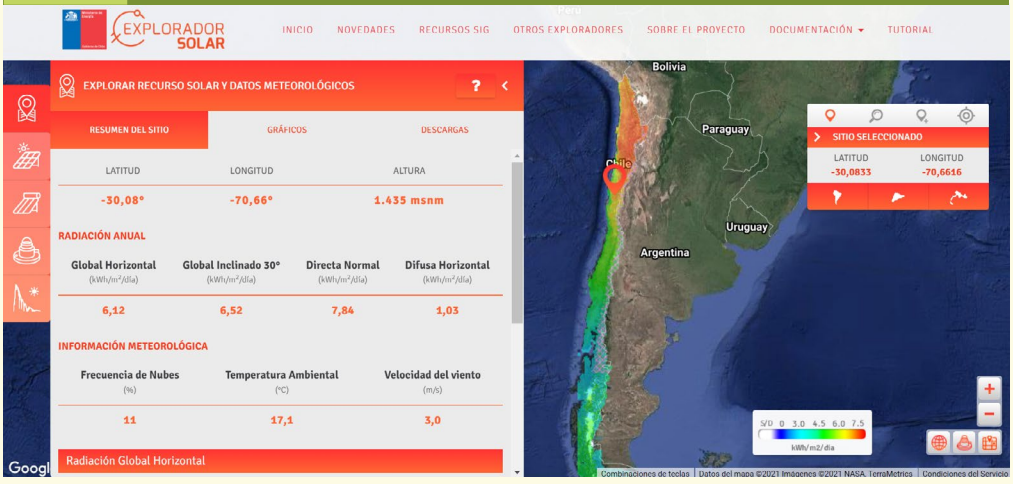
Source: Ministry of Energy.
Web: : http://exploradores.minenergia.cl

On the other hand, the Solar Energy Explorer presented in Figure 11 summarizes the results of the estimation of solar radiation in most of Chile, obtained from a methodology that uses information from satellites that regularly cover the country combined with the modeling of the processes in which the solar radiation is modified as it passes through the atmosphere. To do this, solar radiation is calculated on the surface with clear sky from a radiative transfer model, to be adjusted later by interaction with the different types of clouds, whose characteristics are estimated from images of the geostationary satellite GOES West, through an empirical model based on the network of local observations of surface radiation.

[11] Calculated by the Fraunhofer ISE Institute of Germany

[12] In the following link: http://www.energia.gob.cl/educacion/que-son-las-energia-renovables

Figure 10 Wind Energy Explorer



Source: Ministry of Energy
Web: http://exploradores.minenergia.cl

Along with other information, the Solar Energy Explorer offers maps of the monthly average of horizontal global radiation. The data are generated from atmospheric models and satellite data for the period between 2004 and 2016, with a spatial resolution of 90 meters. The tool allows to generate reports on selected sites that include the characterization of the daily and seasonal cycles of global horizontal radiation and observed cloudiness and of course obtain the data series in plain text files.

5.4 Explorer of rights to use non-consumptive waters

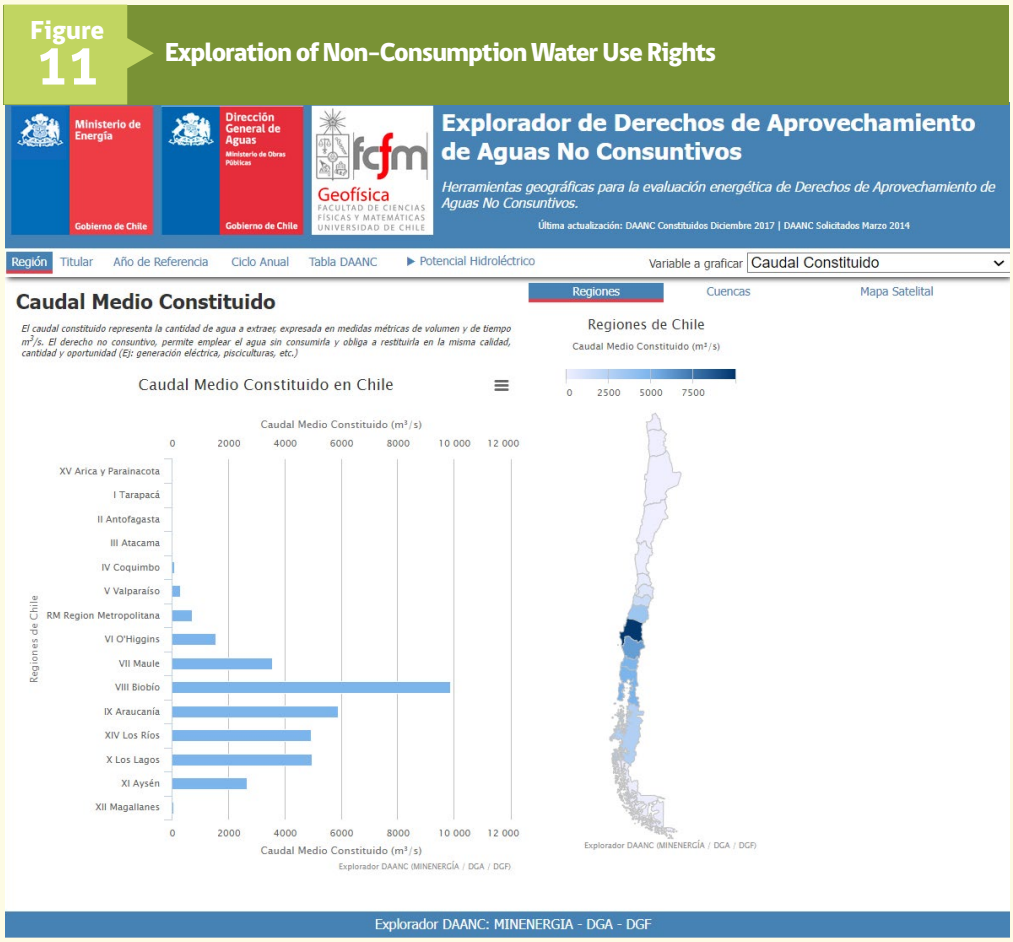
The Ministry of Energy from 2014, and in compliance with the commitments made in the Energy Agenda, has implemented the Exploration of Non-Consumption Water Use Rights (DAANC), with the purpose of maintaining and operating an information platform updated and georeferenced information on the rights of use of non-consumptive waters granted for use in hydroelectricity in the SEN priority basins.

This public information tool allows identifying and characterizing zones in the early stages and prospective for hydroelectric initiatives, along with the spatial visualization of water

rights, holders of water rights, historical information, hydroelectric capacity installed in electric systems, among others. This platform is available on the website of the Ministry[13].

One of the most important applications of this platform is the annual update of the hydroelectric potential at the country level, whose methodology is based on the information provided by non-consumptive rights constituted, as they represent the volume of water that is legally available for hydroelectric development. The calculation methodology is explained in detail on the application web page.

Figure 11 **Exploration of Non-Consumption Water Use Rights**



Source: Ministry of Energy
Web: http://exploradores.minenergia.cl

[13] In the following link: http://walker.dgf.uchile.cl/Explorador/DAANC/

5.5 Forest bioenergy explorer

The CONAF Territorial Information System allows you to consult on-line information on vegetation cadaster updates. In this way, this tool presents the most complete national map of reference information on the potential of forest biomass in Chile. Through this tool you can review interactive maps for each region, analyze different layers (roads, hydrography, water bodies, wilderness areas, agricultural land, meadows and shrublands, native forest, wetlands, non-vegetation areas and a categorization layer of land use), perform operations such as measuring distances, areas and download cartographic covers. The tool also allows access to a catalog of satellite images that can provide additional information to maps already generated in the system.

Figure 12 Forest bioenergy explorer

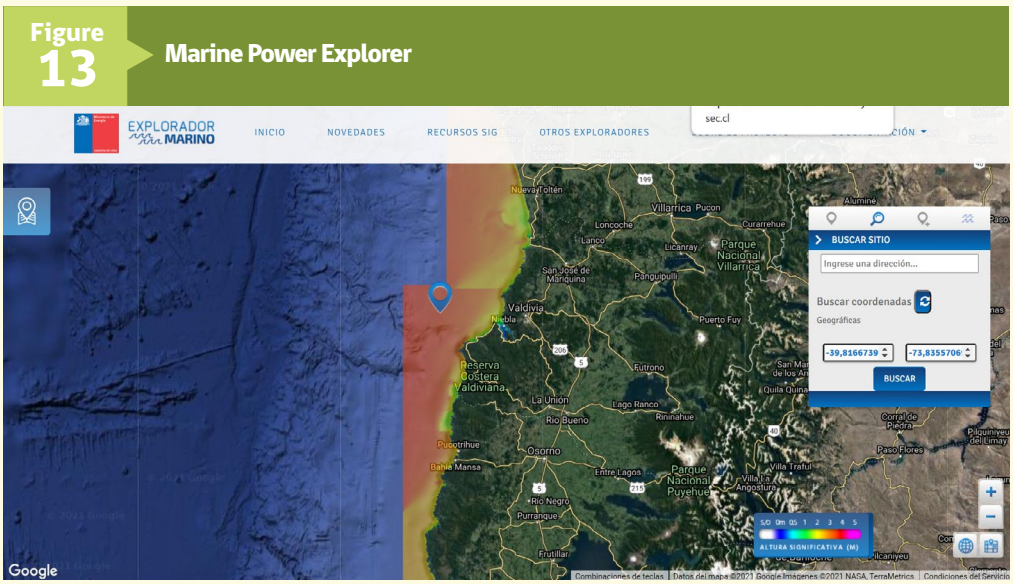
Source: Ministry of Agriculture
Web: http://sit.conaf.cl/

5.6 Marine Explorer

The marine exploration is a tool that allows to visualize and obtain information on Chile's marine energy resource. This information is generated from numerical simulations covering the maritime territory from Arica to the extreme south of the country. The simulations were performed using the Wave Watch III model (WWIII) and SWAN (Simulating Waves Nearshore), the latter in high spatial resolution (100 meters). The height, direction and wave period for a full year (2010) were simulated and the results validated with observations throughout the country.

The tool allows to generate a report for each location designated by the user who presents the basic wave statistic for each month (significant height corresponding to the average height of the third of the highest waves in a set of waves, the average period which corresponds to the average time interval between two waves, the energy power per square meter and the average propagation direction). It also presents the frequency distribution of significant wave height, the time series plot of significant height and power for each month, the interannual variability of height and power, and the direction rose of wave propagation for the full year. Finally the tool allows to download the complete numerical series of the data in format of plain text to carry out own analyzes.

Figure 13 Marine Power Explorer



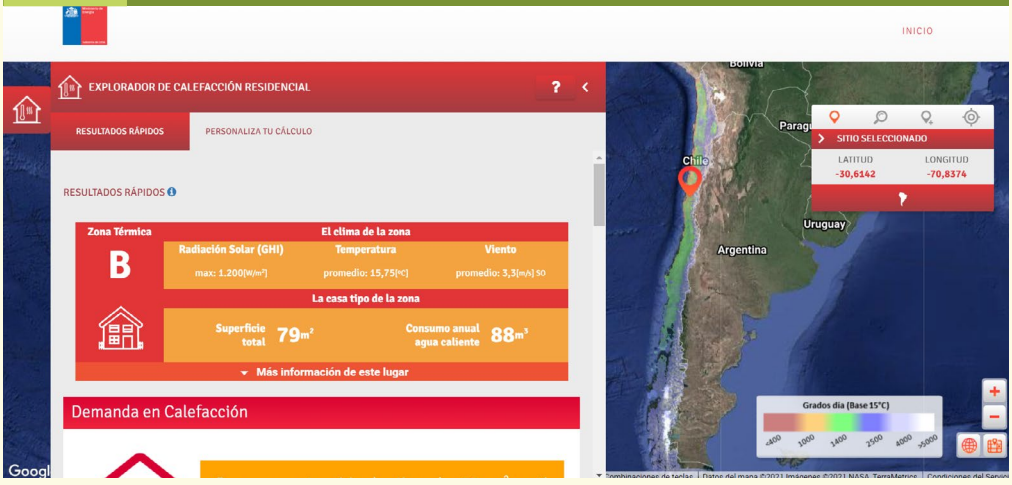
Source: Ministry of Energy
Web: http://exploradores.minenergia.cl/

5.7 Heating Explorer

The Heating Explorer is a tool that seeks to guide consumers regarding the different alternatives that exist, in consideration of the geographic variability associated with heating consumption, the most common heating alternatives that exist, the level of comfort they provide. , and the comprehensive costs of implementing them beyond the initial investment, in consideration of the associated operating costs.

The methodology used corresponds to a simplified energy model based on previous simulation results, which integrates multiple databases of yields, prices and meteorological variables, and also evaluates the comfort that the consumer obtains with their existing solution.

Figure 14 Heating Explorer



Source: Ministry of Energy
Web: http://exploradores.minenergia.cl

Annex 6: Glossary of Terms

Next, definitions are given to different terms and concepts used in the text:

Term	Definition	Section where it appears in the guide
Open access	Capacity of a third party to make use of transportation facilities, in order to supply electricity to the system's customers.	Section 2.4.2.1 Access to the transmission
Common area of influence	Area set for the remuneration of the trunk system, constituted by the minimum set of trunk facilities between two nodes of said system, in which concurrently, the following characteristics concur: 1. That between said nodes is added at least seventy-five percent of the total energy injection of the system; 2. That between said nodes is added at least seventy-five percent of the total demand of the system, and 3. That the density of use, given by the ratio of the percentage of injections within the common area of influence to the total injections of the system and the percentage of the investment value of the facilities of the common area of influence with respect to the value of investment of the total installations of the trunk system, is maximum. Note: With the new Transmission Law of 2016 (Law 20.936) this concept will no longer be used, given the new definitions of the transmission segments and the new form of remuneration will not be necessary.	Section 6.3.1 Payment of charges for use of the national transmission system
Energy balance	Difference between injections (energy generated valued at marginal cost in injection bars to the transmission system) and withdrawals (energy committed in contracts valued at marginal cost in sales bars).	Section 4.4.2.2 Trade Balance of a NCRE Generator

Regulating capacity	It is understood as the capacity of regulation of a hydroelectric plant, the period in which it can sustainably deliver maximum power using the dam or associated regulation pond and taking into account the expected tributaries.	Section 3.5.1 Adequacy Power Annex 3: Adequacy Power
Economic Load Dispatch Centers (CDECs)	Former name of the Independent Coordinator of the National Electric System (See definition of Coordinator)	Section 2.6.2 The Independent Coordinator of the National Electric System.
Free customer	Consumers whose connected power is more than 5 MW and optionally (if the consumer prefers) when it exceeds 500 kW. There may be more than one type of free customer. These consumers have the option of accessing freely agreed prices. It is related to customer in wholesale market.	Section 2.3.2 Free Customer
Regulated customer	Consumers of a connected power equal to or less than 5 MW, with the possibility of those of power between 500 kW and 5 MW, and that are located in the concession area of a distribution company, to choose to be free customers.	Section 2.3.1 Regulated Customer
Bilateral agreement	Direct contract only between the generator of energy and the consumer or broker, carried out outside the centralized generator park	Section 6.2 Marketing alternatives
Coordinator	An independent organization funded by all consumers, that does not own installations and has the responsibility to coordinate the system to operate safely and economically.	Section 2.6.2 The Independent Coordinator of the National Electric System. Mentioned in multiple sections throughout the Book.
Marginal cost	The cost to the system of providing an additional (marginal) unit of energy, not considering sunk costs.	Section 3.3 The spot market

Declaration of commissioning of residential generators (TE4)	It is an Electricity Processing that allows authorized electrical installers to declare non-conventional renewable energy installations (photovoltaic, wind, biomass, etc.) to the SEC and thus obtain the TE4 certificate. The certificate serves to be presented to the electricity distribution company together with the respective documentation, with the aim that it can make the electrical connection of the bidirectional meter, and that the user can finally benefit from the Net Billing Law.	Section 5.2.1 Procedure for connecting projects under the Netbilling Law Annex 4: Self-supply energy projects integrated into the distribution network
Economic dispatch	Distribution of all the generation requirements between the units of the generation park in order to reach the economic optimum of the system. It takes into account both the incremental costs of generation and the incremental costs of transmission.	Section 3.3 The spot market Section 4.4.2.1 Dispatch and NCRE
Distribution Company	It corresponds to the companies with concession in a determined geographical area. They operate and maintain distribution facilities.	Section 2.3.1 Regulated Customer Section 3.6 Netbilling Law
Efficient company/ model	It corresponds to the optimal design (technical/ economic/organizational) of a distribution company, which defines the distribution service costs that are transferred to customers.	Section 2.3.1 Regulated Customer
Distributed generation	Source of electricity generation, connected directly to the distribution system or in the user's indoor installations.	Section 3.6 Netbilling Law Section 5.2.1 Procedure for connecting projects under the Netbilling Law Annex 4: Self-supply energy projects integrated into the distribution network
Rate income	Income obtained by the line based on marginal costs. It is defined as the difference of the products of the flows by the marginal costs at both ends of the line.	Section 2.4.2.2 Remuneration of the transmission

ISO	The ISO in the Chile context corresponds to the model where the system is operated and coordinated by an agent independent of generators and other market participants. It differs from the traditional pool model, because in the latter it is the generators or their representatives that control the operation of the system.	Section 3.2 Model of the electricity market
Non-Conventional Generator (MGNC)	Generators whose source is unconventional, and its surplus power supplied to the system are less than 20,000 kW. Considering efficient cogeneration based on fossil fuels, this category may also include projects classified as conventional energies.	Section 4.3 Definition of NCRE generation means Section 6.4 Exemption of charges
Wholesale market	Purchase and sale of electricity from large consumers to generators, along with the ancillary services required to maintain reliability and product quality at the transmission level.	Section 3.2 Model of the electricity market Section 6.2 Marketing alternatives
Spot market	Market for immediate exchange of electricity at an instant marginal cost. In the case of Chile, it is closed to generators.	Section 3.3 The spot market Section 6.1.1 Marketing of the spot market
O&M	It refers to the costs associated with operation and maintenance applicable to generation plants or transmission facilities.	Section 6.2 Marketing alternatives
Order of Merit	Ordering from lowest to highest generation units according to their variable operating costs. In this way a first approximation of the economic dispatch of the plants for different levels of demand is obtained.	Section 3.2 Model of the electricity market
Peak load pricing	Tariff system based on the marginalist theory where consumers pay a price per energy and a price per capacity (power) associated with the hours of greatest demand.	Section 3.1 Economic fundamentals of the electricity market
Charge	Charge for use of transportation facilities.	Section 2.4.2.2 Remuneration of the transmission Section 6.3 Payment for use of the networks

Small Generator (PMG)	Generators whose surplus power available to the system is less than or equal to 9,000 kW connected to installations belonging to a trunk, subtransmission or additional system, hereinafter small generator or "PMG".	Section 4.3 Definition of NCRE generation means
Small Distributed Generator (PMGD)	Generators whose surplus power is less than or equal to 9,000 kW, connected to the facilities of a distribution concessionaire, or to installations of a company that owns electricity distribution lines that use national assets for public use, hereinafter distributed generator or "PMGD". PMGDs are given the right to connect to distribution networks.	Section 4.3 Definition of NCRE generation means Section 5.2.2 Connection to distribution networks of PMGD Annex 4: Self-supply energy projects integrated into the distribution network
Plan of works	The work plan corresponds to a node-pricing instrument since its definition together with the optimization of the system operation (minimum expected operating cost and system failure) determine the expected marginal costs in the system. The indicative works plan is a reference for the adapted development of the system.	Section 3.3 The spot market
Development poles	Areas that are territorially identifiable in the country, located in the regions where the National Electric System is located, where there are resources for the production of electricity from renewable energies, the use of which, using a single transmission system, is a matter of public interest. Be economically efficient for electricity supply	Section 2.4.1 Transmission Systems
Pool	Rate at which electricity is produced, or consumed. Power is measured in watts (W), or more conveniently in kilowatts (kW) or megawatts (MW). One MW equals 103 kW or 106W.	General concept
Power	Rate at which electricity is produced, or consumed. Power is measured in watts (W), or more conveniently in kilowatts (kW) or megawatts (MW). One MW equals 10^3 kW or 10^6 W.	General concept

Adequacy Power	Power that can guarantee a generator under conditions demand maximum considering the availability of primary energy and the reliability of the generation unit.	Section 3.5.1 Adequacy Power Section 4.4.2 Recognition of adequacy power to NCRE plants Section 6.1.2 Sale of power in the spot market Annex 3 Adequacy Power
Energy node price	Average energy price at which transfers between generators and distribution companies are made to supply regulated customers. This price is determined by the CNE for periods of 6 months.	Section 2.3.1 Regulated Customer Section 3.2 Model of the electricity market
Power node price	Price that is recognized to generators for their contribution to the peak demand of the system. The price of power is estimated considering the investment cost of a gas turbine needed to supply at maximum demand conditions of the system.	Section 3.2 Model of the electricity market Section 6.2.1 Alternative 1: Sale of energy and power in the spot market
Regulator	It determines the regulatory framework that sets the rules, dictates standards and resolves divergences. This entity, which may consist of one or more institutions of the state, is called the regulatory entity.	General concept
Service security	Responsiveness of an electric system, or part of it, to support contingencies and minimize the loss of consumption, through backups and ancillary services.	Section 3.5 Adequacy and safety of the electric system
Ancillary services	Technical resources present in the generation, transmission, distribution and non-price regulated installations that each electric system must count on to coordinate the operation of the system in the terms set out in Article 137.	Section 3.5 Adequacy and safety of the electric system Section 6.5 Ancillary Services and NCRE
Transporters	Refers to companies that operate at specified voltage levels for transmission systems. They transport electricity from generation to consumption centers.	General concept

Annex 7: Links to the main laws, regulations and standards of the electricity sector

The following are the links to the main laws, regulations and standards of the electricity sector where you can find the most updated versions of them.

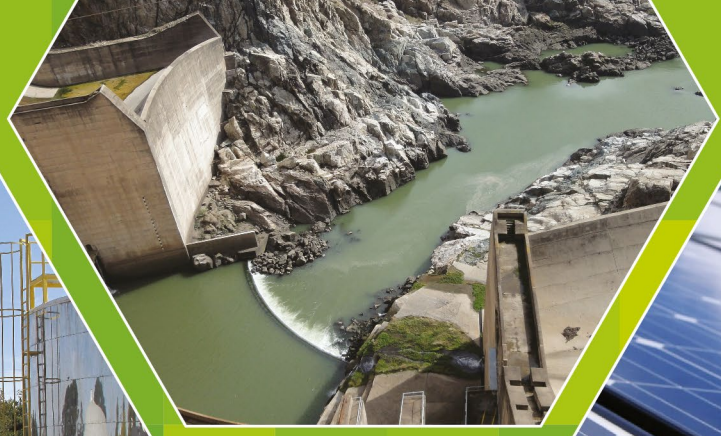
Law	Link
Decree with Force of Law N° 4, General Law of Electrical Services (LGSE)	http://bcn.cl/1uy1n
Law 19.940 of 2004 (Short Law I)	http://bcn.cl/1v19t
Law 20.018 of 2005 (Short Law II)	http://bcn.cl/1uyd9
Law 20.220 of 2007 To Protect the Security of the Supply to Regulated Customers and the Adequacy of the Electric systems (Provisional Administration Law)	http://bcn.cl/1xnvo
Law 20.257 of 2008 (NCRE Law I)	http://bcn.cl/1uw25
Law 20.402 of 2009 (Creates the Ministry of Energy)	http://bcn.cl/1v09a
Law 20.571 of 2012 (Netbilling Law)	http://bcn.cl/1v0bx
Law 20.701 of 2013 (Expedited the granting of Electrical Concessions)	http://bcn.cl/1v5p9
Law 20.698 of 2013 (NCRE Law II)	http://bcn.cl/1uyc4
Law 20.720 of 2013 (Bankruptcy Law)	http://bcn.cl/1uvtk
Law 20.726 of 2014 (Interconnection of electric systems)	http://bcn.cl/1z4yu
Law 20.805 of 2015 (Perfect system of regulated tenders)	http://bcn.cl/1vm95
Law 20.897 of 2016 (Tax exemption regarding solar thermal systems and benefit of lifting suspension of works for NCRE projects)	http://bcn.cl/1w2do
Law 20.928 of 2016 (Tariff Equity Law)	http://bcn.cl/1w9b2
Law 20.936 of 2016 (Law of Transmission and Independent Coordinator of the National Electric System)	http://bcn.cl/1z4yy
Law 21.185 of 2019 (Law of Stabilized Price for Regulated Customer)	https://www.bcn.cl/leychile/navegar?idNorma=1138181
Law 21.194 of 2019 (Short Distribution Law)	https://www.bcn.cl/leychile/navegar?idNorma=1140301

Regulation	Link
Supreme Decree N°327 of 1997 (LGSE Regulation)	http://bcn.cl/1uz8k
Supreme Decree N°88 of 2020 (PMGD Regulation)	https://www.bcn.cl/leychile/navegar?idNorma=1150437&idVersion=2020-10-27&idParte=10166021
Supreme Decree N°62 of 2006 (Power adequacy regulation)	https://www.bcn.cl/leychile/navegar?idNorma=1153949=250604
Supreme Decree N°113 of 2019 (Ancillary Services Regulation)	https://www.bcn.cl/leychile/navegar?idNorma=1129970&idParte=10010150&idVersion=2020-01-01
Supreme Decree N°86 of 2012 (Regulation for fixing node price)	http://bcn.cl/1wxtu
Supreme Decree N°114 of 2012 (Geothermal Concessions)	http://bcn.cl/1vwlv
Supreme Decree N°57 of 2019 (Regulation Netbilling Law)	https://energia.gob.cl/sites/default/files/publicacion_decreto_57_de_2019_0.pdf
Supreme Decree N°125 of 2019 (Regulation of the Coordination and Operation of the National Electric System)	https://www.bcn.cl/leychile/navegar?idNorma=1140253&idParte=10083689&idVersion=2019-12-20

The latest technical standards can be downloaded from the website of the National Energy Commission (CNE) through the following link:

https://www.cne.cl/normativas/electrica/normas-tecnicas/

November, 2021



http://www.minenergia.cl/mercadoernc/