Non-Conventional Renewable Energies
in the Chilean Electricity Market

Edition 2018

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of:
Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety
of the Federal Republic of Germany

Ministerio de Energía
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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 system and in a context of market totally different from the current one. This new edition updates and replaces 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.

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.

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.

All these 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 5 years, raising Chile as a South 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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Abbreviations

BT	Low voltage
Cmg	Marginal cost
CNE	National Energy Commission
Coordinator	Independent Coordinator of the National Electric System
CORFO	Corporation for the Promotion of Production
DFL	Decree with force of law
S.D.	Supreme decree
EAE	Strategic Environmental Assessment
NCRE	Non-Conventional Renewable Energies
GIZ	German Society for International 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

1
Chile's interconnection with the other SINEA member countries, and other South American nations, especially the members of MERCOSUR, is a reality.

2
Electricity outages **do not exceed 4 hours/year in any locality in Chile**, except in cases of force majeure.

3
100% of homes of vulnerable families have continuous quality access to energy services.

4
All energy projects under way in Chile have adopted mechanisms for associativity between communities and the private sector, thereby promoting local development and improving implementation of the projects.

5
Chile is among the 5 OECD countries with the lowest average residential and industrial electricity prices.

6
At least 60% of the electricity generated in Chile comes from renewable energy sources.

7
By 2030, Chile has reduced its GHG emissions by at least 30% compared to 2007.

8
100% of the large consumers of energy (industrial, mining and transportation sectors) make efficient use of energy, with proactive energy management systems and the implementation of energy efficiency measures.

9
By 2035, all local municipalities have adopted regulations classifying forest biomass as a solid fuel.

10
Energy efficiency is one of the aspects evaluated in **tenders for all new vehicles used in public transportation systems.**

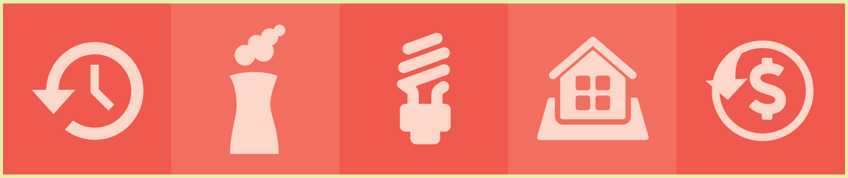
Source: Energy 2050 Energy Policy of Chile. Ministry of Energy.

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 improves 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, 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 National Electric System installations (SEN), replacing the former Economic Load Dispatch Centers (CDECs), adding new functions, attributions and obligations.

The new laws, regulations and standards associated with these changes have been translated 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 potential new national and international investors. This has been manifested in a dynamic process of development of NCRE projects in national electric systems, which in recent years has resulted in an explosive development of NCRE projects, boosting Chile as a South American leader in the development of projects in this type of technologies, especially in large-scale photovoltaic solar energy, followed closely by wind power also in large-scale.

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, both transmission and storage 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 an 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

This chapter details specific aspects of the Chilean electricity sector, starting with the general description of the country's electrical 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 . 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 or more. Medium-sized systems have an installed capacity of over 1.5 MW and less than 200 MW and small ones have an installed capacity of 1.5 MW or less. The main Chilean electric systems are the following: The Northern Interconnected System (SING), the Central Interconnected System (SIC), the Aysén Electric System and the Magallanes Electric System. It should be noted that the SIC and SING systems are

1 Article 225 letter a), DFL Nº 4
2 Article 225 letter b), DFL Nº 4.
3 Article 173, DFL Nº 4.

physically interconnected since November 2017, forming the National Electric System (SEN). These systems are briefly described below:

- Northern Interconnected System (SING): A major system that supplies the northern zone of Chile, from Arica in the north to Coloso in the south. In November 2017, it constituted 23.5% of the total installed capacity in the country. Its generation is mainly thermal and oriented mainly to the mining industry.

- Central Interconnected System (SIC): a national system that supplies the central part of the country, from Taltal to the north to Quellón, on the island of Chiloé, to the south. The distance between the two localities is approximately 2,100 km. It represents 75.8% of the country's total installed capacity.

- 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 0.3% 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 0.4% 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 November 2017 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 2017. 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)

Source	SIC	SING	Magallanes	Aysén	Total
Hydraulic > 20 MW	6.160	0	0	0	**6.160**
Fossil Fuels	7.512	4.651	102	35	**12.300**
Conventional Total	**13.672**	**4.651**	**102**	**35**	**18.459**
Hydraulic < 20 MW	445	17	0	23	**485**
Solar PV	1.322	507	0	0	**1.829**
Wind	1.210	89	3	4	**1.305**
Biomass	466	0	0	0	**466**
Geothermal	0	24	0	0	**24**
NCRE Total	**3.443**	**613**	**3**	**27**	**4.109**
Total	**17.115**	**5.288**	**104**	**62**	**22.569**

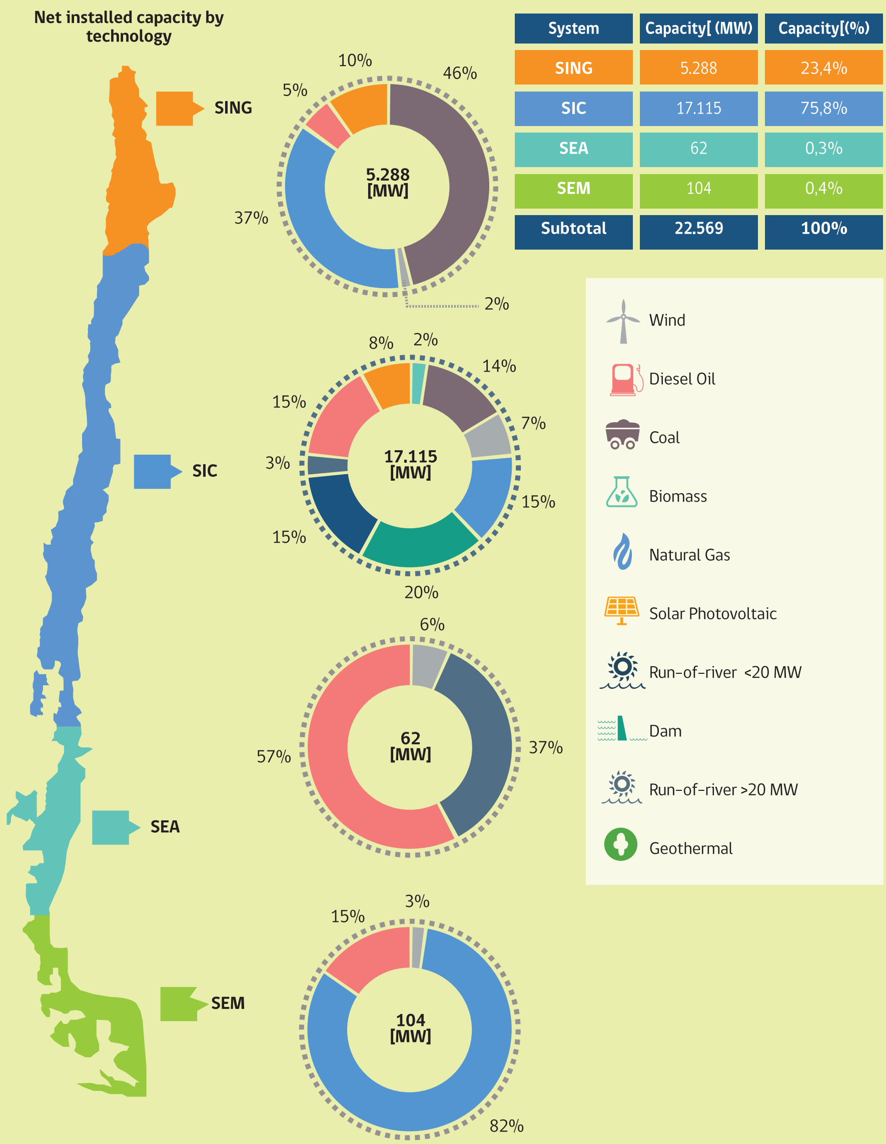
Source: Elaboration from Monthly Energy Sector Report. January 2018. CNE

4 In the link http://energiaabierta.cne.cl/.

Figure 02

Installed capacity by electric system in Chile

System	Capacity[(MW)	Capacity[(%)
SING	5.288	23,4%
SIC	17.115	75,8%
SEA	62	0,3%
SEM	104	0,4%
Subtotal	22.569	100%



Source: Monthly Energy Sector Report. January 2018. 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. In recent years, specifically 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 are expected to increase considerably by 2020, as will be seen later, this type of projects had a successful participation in one of the largest electric power tender for regulated customers in Chile.

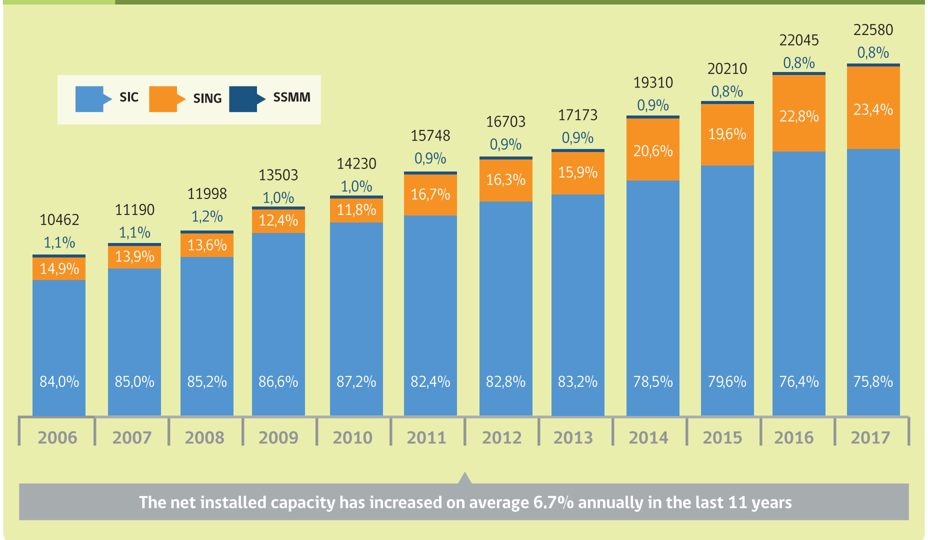
2.2.1. Installed capacity

The expansion of the national electricity generation plant is presented in Figure 3 in terms of its installed capacity by system, from 2006 to 2017. The SEN (SIC y SING) concentrates 98.8% of the installed capacity and medium-sized systems account for less than 1% of the total installed capacity. On average, national installed capacity has increased by 6.7% per year over the last 11 years.

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 in solar photovoltaic technology particularly that it has been the fastest increase since it has moved from 230 MW installed in 2014 to more than 1829 MW by December 2017 and it is expected that very soon more than 281 MW of solar power will be incorporated in tests (projects interconnected in a period prior to entry into operation). Similarly, more than 115 MW of wind power is currently in testing, which would add to the current 1305 MW grid (see Figure 4). In addition, 400 MW of solar and 375 MW of wind power will be incorporated in projects declared in construction.

5 For example, as of September 2017the land used by the photovoltaic projects corresponds to about 77% to fiscal lands. The facilitation of the fiscal lands for the development of renewable projects has occurred mainly in the north of the country (north of Atacama).

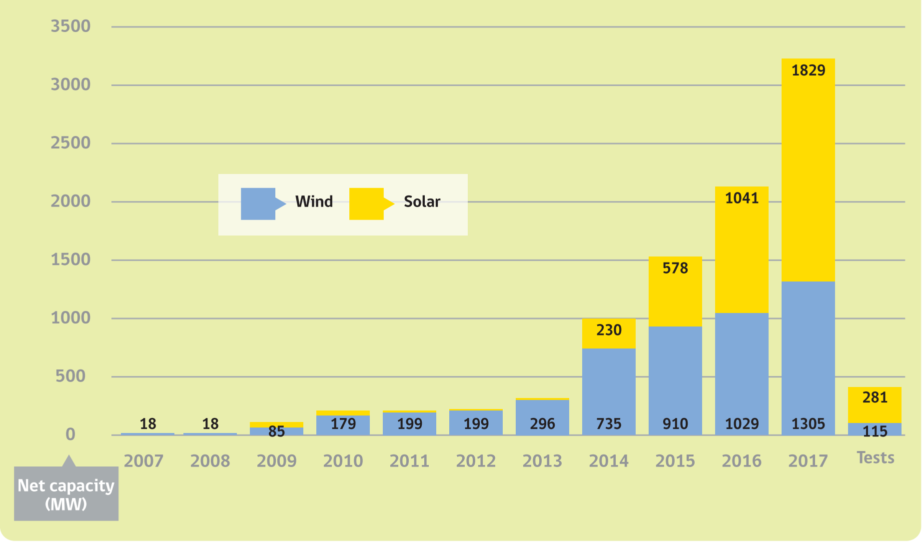
Figure 03 Evolution of installed generation capacity in Chile



Sources: Own elaboration from Statistical Yearbook of Energy 2005 - 2015 and 2017. CNE.

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 fiscal 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

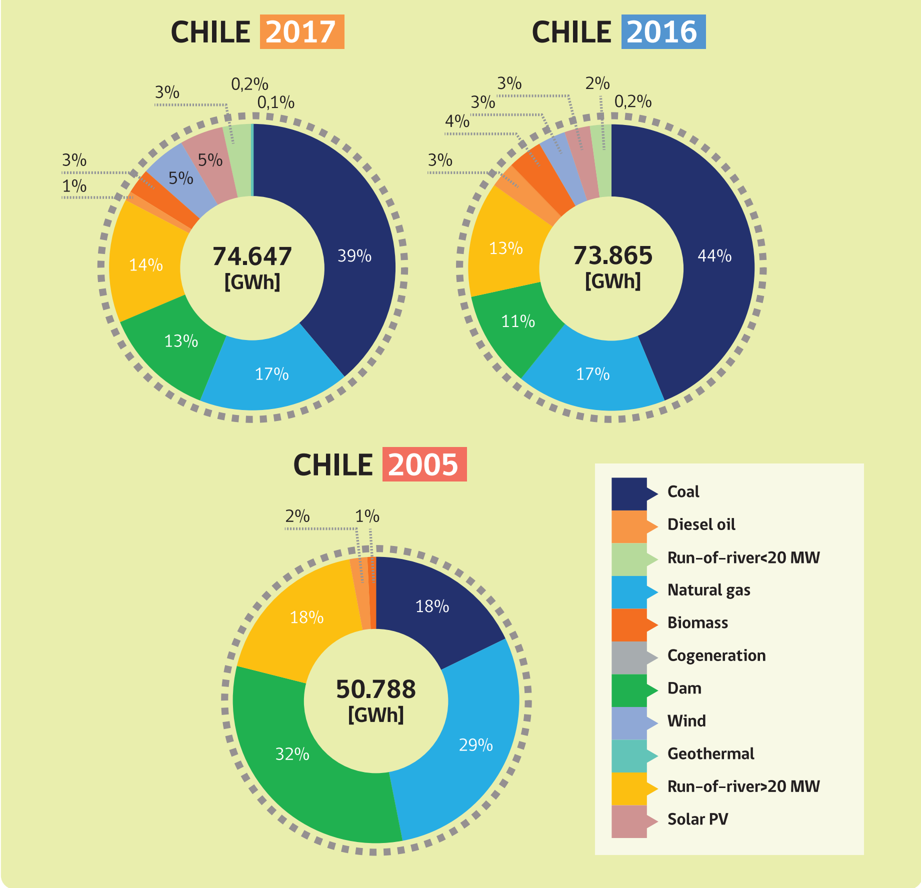


Source: Own elaboration based on report of Installed Generation Capacity and the Monthly Report NCRE. January 2018. CNE.

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). Generally speaking, in Chile a plant is called conventional when it uses technologies that constitute the national or traditional standard and that normally correspond to very mature technical and commercial 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 57%) and hydroelectric plants (dam and run-of-river, totaling 27%) conventional generation accounts for about 84% 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 2017, 2016 and 2005



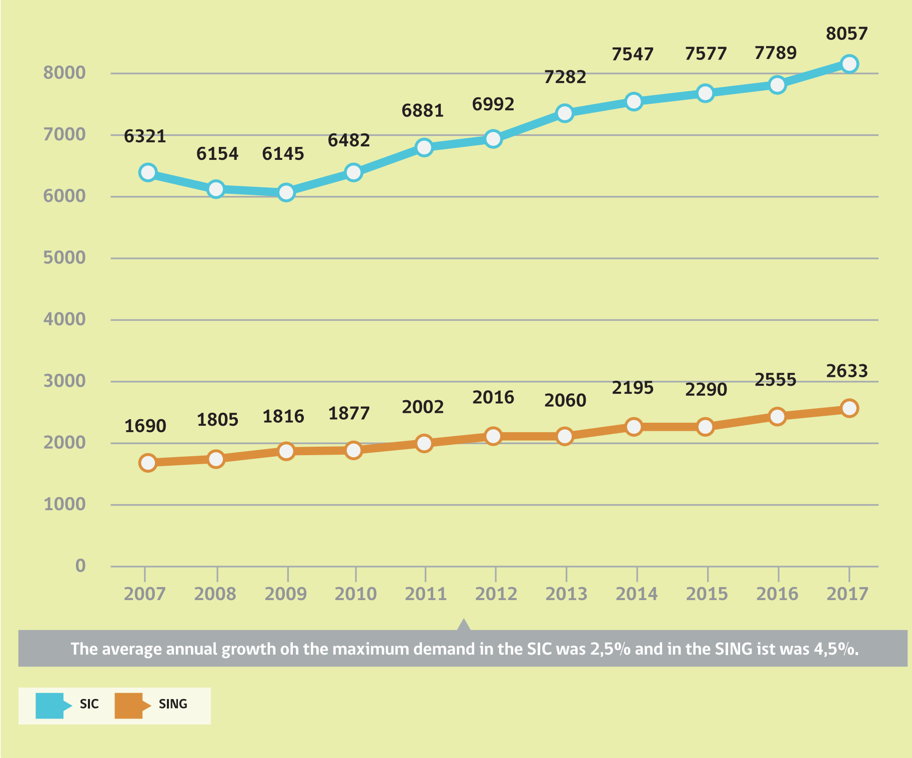
Source: Own elaboration from Statistical Yearbook of Energy 2005 - 2015 and 2017. CNE.

2.3. Consumption and customers

On average, in the last decade, demand for power grows to 2.5% yearly in SIC and to 4.5% in SING. Figure 6 shows the evolution of the maximum demand of electric power in the country in the period 2007-2017 in the SIC and SING. 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.

The General Law of Electrical Services in Chile (DFL Nº 4 of 1982) divides electricity consumption into two main segments: regulated customers and free customers:

Figure 06 **Maximum historical power demand**



Source: Own elaboration from Statistical Yearbook of Energy 2017. CNE.

2.3.1. Regulated customer

The regulated customer is the one who pays a fee calculated by the authority, and that in general terms is obtained by adding the purchase price of power and power by the distribution company, which is currently defined by a bidding process led by The National Energy Commission, plus the costs associated with a model distributor operating efficiently. The latter component is determined periodically through tariff studies carried out on some reference or representative distribution companies.

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 the month of December 2017, regulated consumers account for approximately 49% of the total consumption in the SEN[6].

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.

6 On December 2017 the consumption of regulated customers in the SEN was 2963 GWh. Total consumptions were 5.985 GWh. Source: Electricity Market Bulletin Generation Sector January 2017. Generators of Chile.

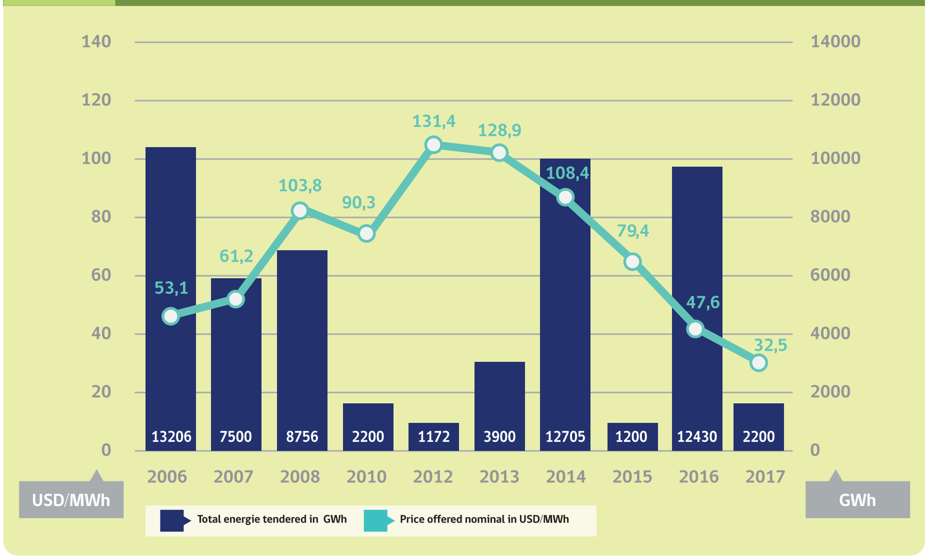
7 Law 20.805 of 2015 "Improves the system of electric power tendering for customers subject to price regulations"

- 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.

Figure 7 presents a summary of the results of the regulated bidding processes and clearly shows the consistent decline in the average award price in recent years due to the greater competition achieved.

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



Source: Own elaboration from Statistical Yearbook of Energy –2016 and 2017. 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 National Commission of Energy and represented an average projection of marginal costs for the next 48 months. 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 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 of 10% on investments. 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.

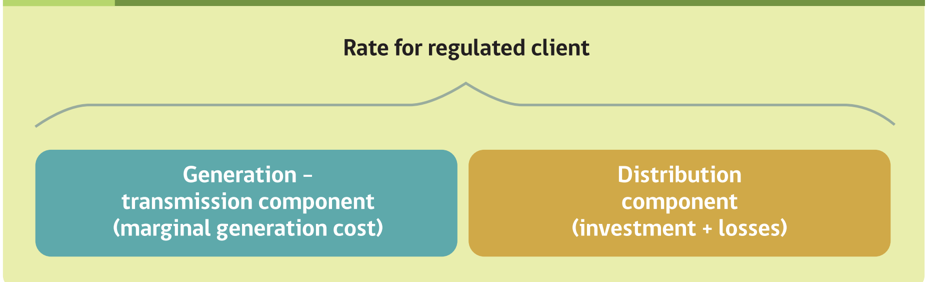
- A variable charge for energy consumed, which integrates the components of generation-transmission costs (reflects the marginal cost of supply at the withdrawal point) and distribution (investment plus distribution losses component).

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

- A variable charge for energy consumed in peak (peak hours)[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.

Figure 08 **Components of regulated customer tariff**



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

2.3.1.1. Rate equity

Law 20.928 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 National Electric System. One of the amendments incorporated in this Law is that it equalizes residential rates among different distribution companies, 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 an average monthly consumption of the calendar year that does not exceed 200 kWh/month are excluded.

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. As of September 2017, the peak hours of the SIC are between 18:00 and 23:00 hours in the months of April to September, except on Sundays, holidays and Saturdays immediately following or prior to a working holiday day of Months.

In addition, other amendments incorporated by this new law are discounted to the price of electricity in municipalities that are intensive in electricity generation. 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 / N° 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 national system, 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 20.928 of 2016.

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 concentrate approximately 50% of the total consumption[10].

10 On December 2017, the consumption of free customers in the SEN was 3,022 GWh. Total consumptions were 5,985 GWh
Source: Electricity Market Bulletin Generation Sector January 2017. Generators of Chile.

In Chile there is no retail market operated through trading companies. 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.

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.

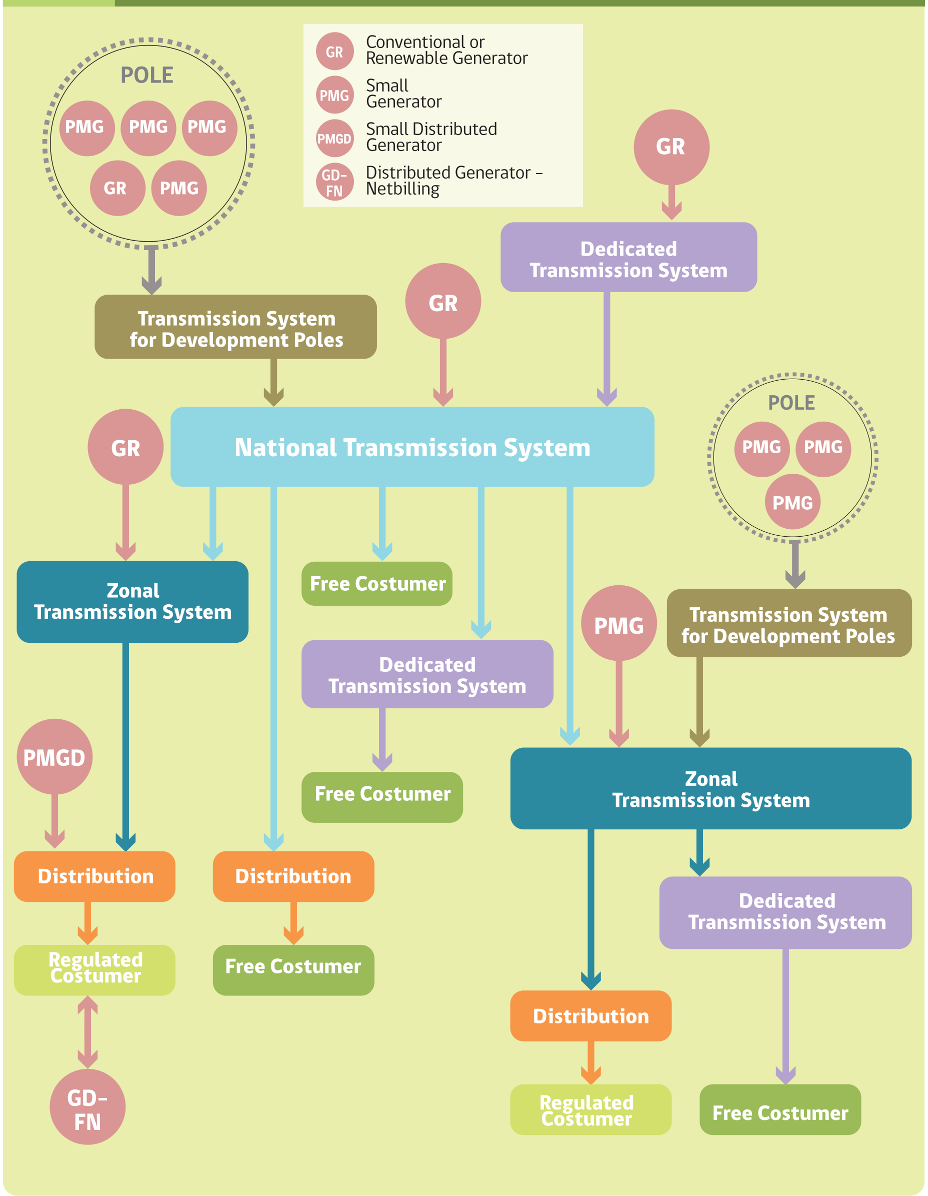
Annex 8 shows a detail of the SEN, identifying the voltage level of their transmission lines, consumption centers and generation centers.

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.

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.

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 National Energy Commission every 4 years.

Figure 09 New classification of transmission systems



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

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 Poles recently introduced by the new 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° of DFL Nº 4.
13 Article 77° of DFL Nº 4.
14 Article 75° of DFL Nº 4.
15 Article 85° 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 National Energy Commission may consider in the plan of annual expansion of transmission systems for such Development Poles. Likewise, the National Energy Commission 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 inter-

16 Article 76° of DFL N° 4.
17 Article 78° of DFL N° 4.

national interconnection 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 has 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 National Energy Commission 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.

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 National Energy Commission. This system of simple charges on demand will begin to 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.

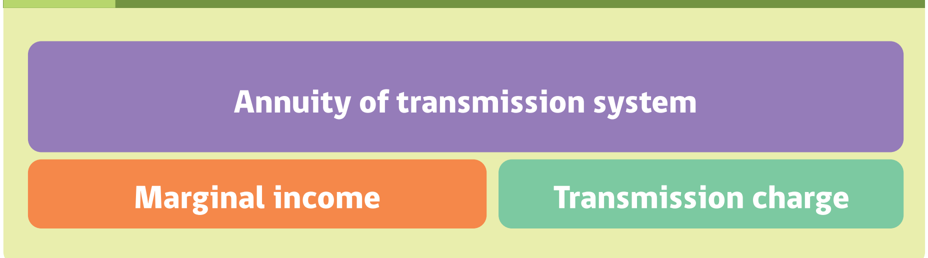
Principles of the old payment system

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]:

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

- 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].

2.4.2.3. Transmission Planning

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

- Introduces a new long-term energy planning process carried out by the Ministry of Energy.

19 Transitional article Eleventh, Law 20.936 of 2016.
20 See "Dictamen N°9 – 2018" of Panel of Experts.

- It extends the Commission's annual transmission planning process to some transmission segments[21] (previously the process was limited to the expansion of the national system) and incorporates new criteria for planning.

- It gives 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 National Energy Commission 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, the Commission 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 Commission must carry out a planning covering the job necessary for the expansion of the National, Development Poles, Zonal and Dedicated Transmission

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.

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 long-term energy planning regulation, more precisely defines 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. Likewise, jobs that require land strip 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 corridors, 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[24], 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 corridor, which because of public utility may be taxed with one or more assesments.

23 Article 93 of DFL N°4.
24 S.D. N°139 of 2016, Ministry of Energy.

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.

2.5. Storage Systems

The Law 20.936 of 2016 adds for the first time in Chilean legislation aspects related to energy storage, defining storage systems and integrating it as part of the power system. The definition presented in the current Chilean Electricity Law regarding storage systems is as follows:

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

The Law further specifies that withdrawals made in the storage process will not be subject to the charges associated with the final customers.

A first regulation on storage is already publicly available and corresponds to that of pumping stations without hydrological variability[25]. This regulation details the rules applicable to the withdrawal of electrical energy by these plants, the procedure to inform the programming of the operation and also the treatment of the power of adequacy recognized to this type of power plants. In this aspect, the current regulation establishes that the energy withdrawals by a Pumping Station will not be considered for the corresponding payment of final customers for use of the transmission systems[26]. However, they must make payments for the use of such transmission systems for their injections in generation mode.

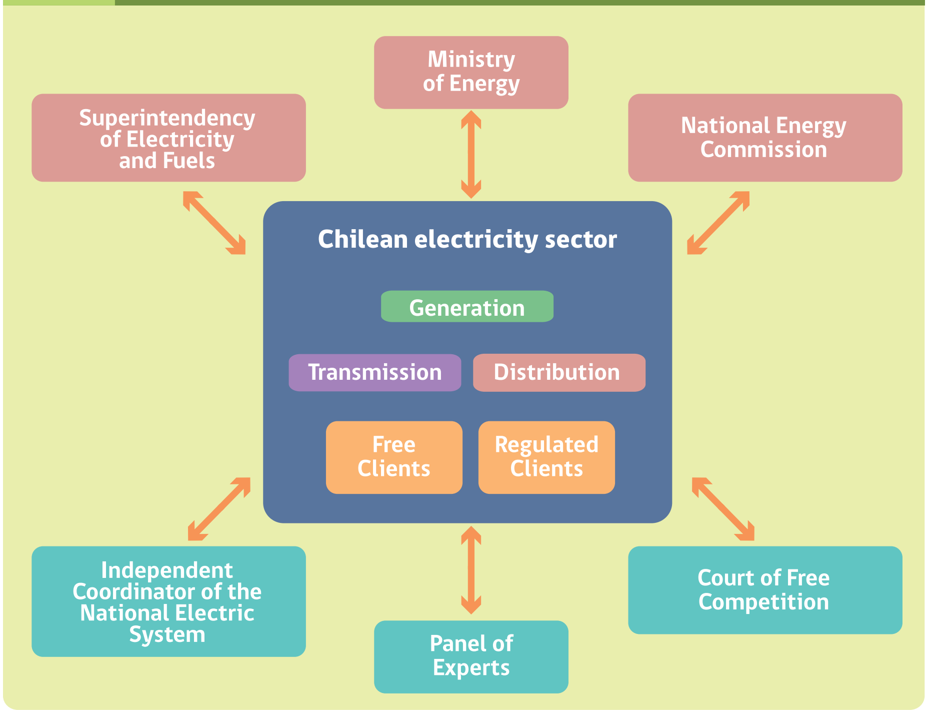
It should be mentioned that the regulation of the coordination and operation of the national electric system is in process, in which the provisions to integrate the storage systems in the programming and operation of the system are established. Specifically, it establishes the obligations of the Coordinator to operate the withdrawals and energy injections of these systems, and defines its participation in the system of arbitration of energy prices. Also, it establishes the methodology to consider these systems within the operation programming, as well as how to determine the variable costs and the recovery window of the storage system.

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.

25 Decree N°128 of 2016, Ministry of Energy.
26 Article 7, paragraph b), Decree Nº 128 of 2016, Ministry of Energy.

Figure 11 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).
  - The Superintendency of Electricity and Fuels (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 Nucle-ar Energy Commission (CCHEN), the Ministry of the Environment, the Ministry of

National Assets, the Energy Efficiency Agency (ACEE), 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 Commission (CNE)

The National Energy Commission 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 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 national electric system that operate interconnected with each other. The Independent Coordinator of the National Electric System 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 National Energy Commission, 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 National Energy Commission.

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 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

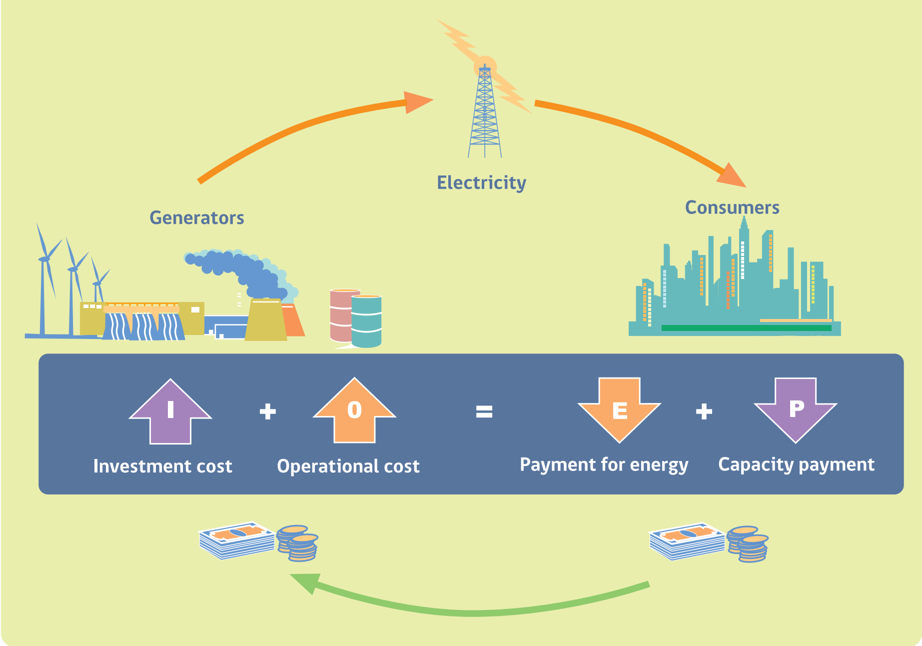
Operation of the Chilean electricity market

This chapter describes from very general 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 12)

Figure 12 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)[27], 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.

27 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[28] has been migrating from a pool type[29] structure with mandatory participation of the different generators to an ISO[30] 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[31] 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 marketer. 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.

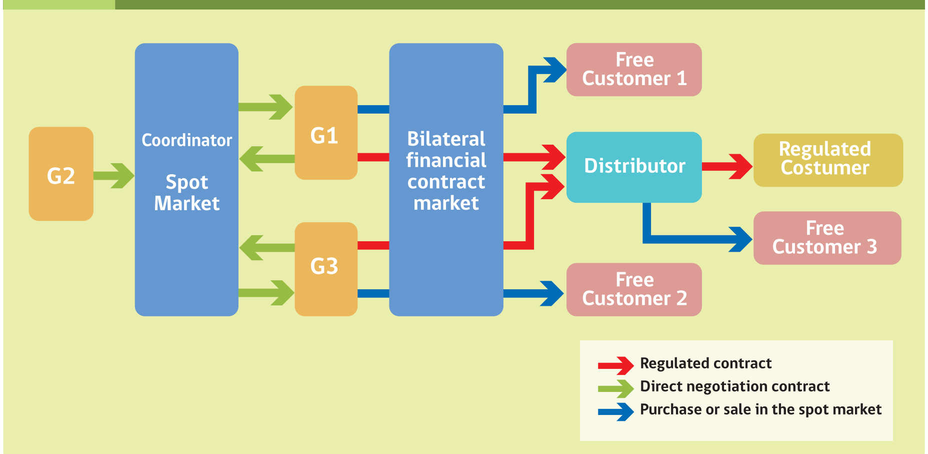
In the wholesale electricity market in Chile, generating companies transfer energy and power to each other, which depend on the supply contracts that each has subscribed. Those that, because of the economic dispatch, result with a generation higher than the one contracted to their customers (surplus companies), sell their energy, and those that, through the real office, have a lower generation than that contracted with their customers (deficit companies), buy energy in the market. In this way the energy balance is realized and in a similar way a balance is also made for the power. Physical

28 Definition of the wholesale market is found in the glossary of terms, see Annex 6.
29 Definition of pool is found in the glossary of terms, see Annex 6.
30 Definition of ISO can be found in the glossary of terms, see Annex 6.
31 Definition of order of merit is found in the glossary of terms, see Annex 6.

and monetary transfers (sales and purchases) are determined by the system coordinator, and are valued, in the case of energy, hourly at the marginal cost (Cmg) from the point in the system in which energy is injected or withdrawn, as appropriate, resulting from the operation of the system at that time. In the case of power, the transfers are valued at the node price of the corresponding power.

Figure 13 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 13 **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. In the case of Figure 13, the contract between the distribution company and the Free Customer 3 does not directly participate in the wholesale market and is only part of 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[32]. 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,

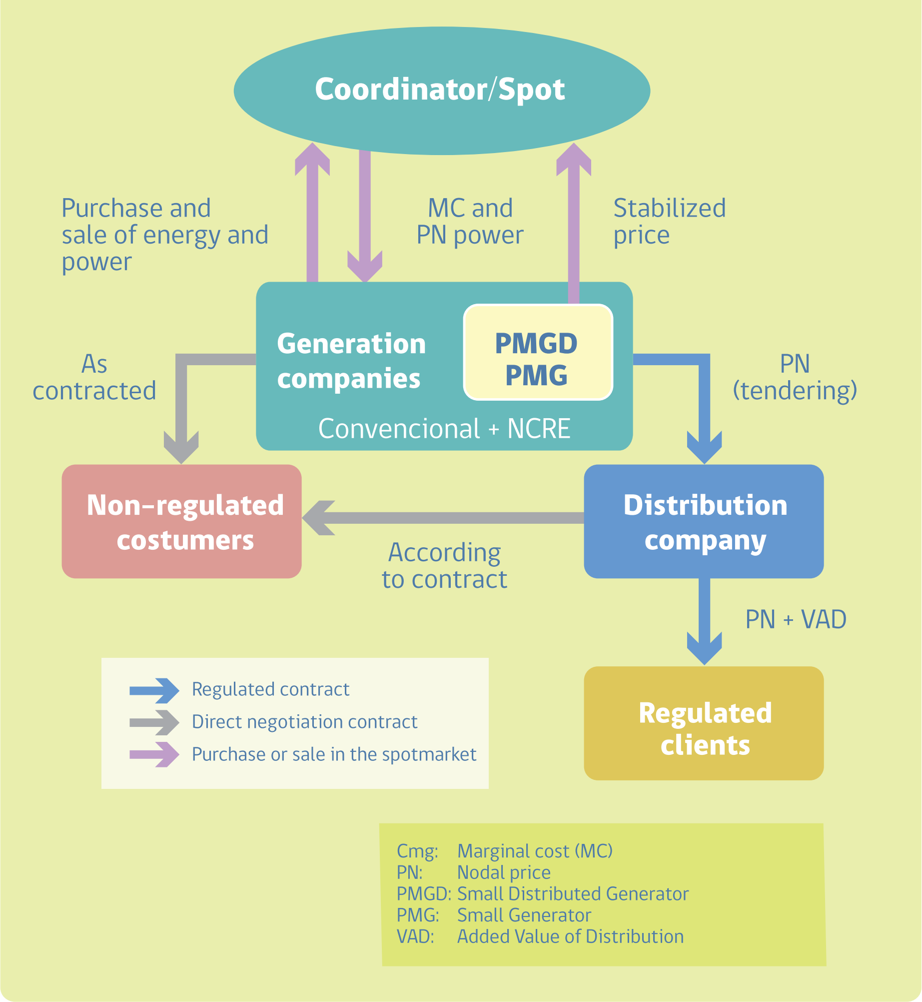
32 The different types of customers are described in detail in sections 2.3.1 and 2.3.2.

the definition of bid strategies for the purchase and sale of energy does not correspond to a critical element in competitive performance.

Figure 14 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 Regulation 244 of 2005).

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 20.018 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.

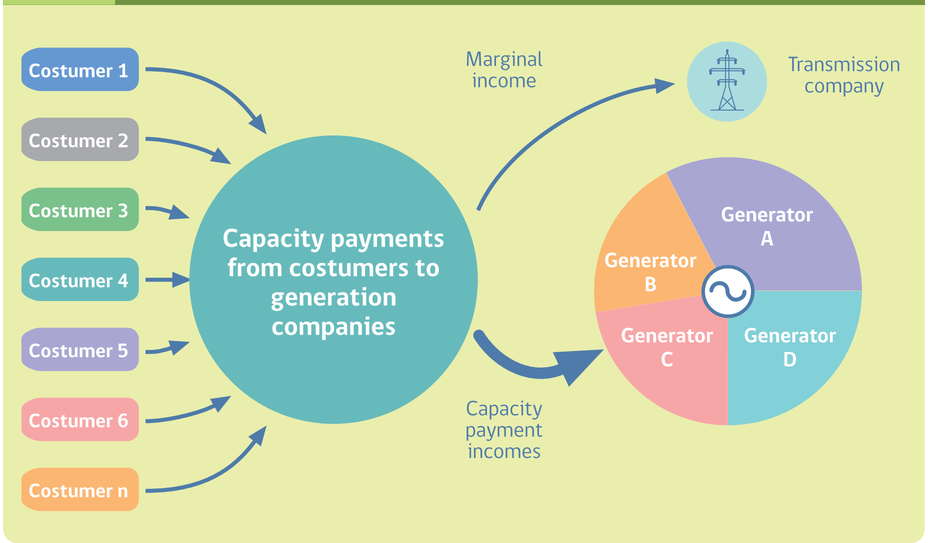
Figure 14 Concept of payment in the electricity market



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

The nodal price (PN) of capacity shown in Figure 15 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 15 summarizes capacity transfers between different market agents in the spot market.

Figure 15 **Spot market power transfers**



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

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.

- Currently, 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[33]:

- **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.

- **Supplementary 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.

33 Article 225, DFL Nº 4.

In other words, adequacy corresponds to the ability of the system to supply the entire electric 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 is associated to a 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[34]) has been published since 2006. However, it was necessary 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. Adequacy power

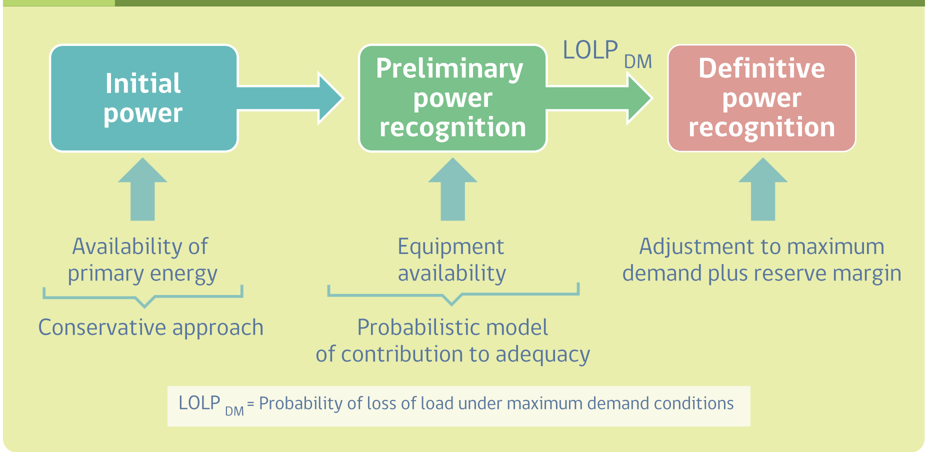
Depending on the type of power plant and the resource used, each power plant will provide different powers for the system. Therefore, S.D. N°62 of 2006 defines the guidelines for determining the adequacy power of each type of power plant and thus power transfers between companies. The latter is determined from the adequacy power and existing peak demand commitments. In this way, each owner of generation means must be able to satisfy his own commitments for peak demand considering its adequacy power and that acquired to other companies.

Each generating unit is assigned an adequacy power depending on the uncertainty associated with the availability of the main input of generation that is used and the unavailability of the unit and the installations that interconnect it, characterized by the initial power and the preliminary adequacy power, respectively. For example, the

34 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 Electric Services. Published in the Official Gazette of June 16, 2006.

adequacy power of hydroelectric plants will depend on their ability to regulate. A plant with a high capacity of regulation can contribute greater adequacy than a hydroelectric plant without capacity of regulation. The general scheme of the procedure of calculation of adequacy power that establishes the S.D. N°62 is illustrated in Figure 16. The stages and concepts used in the calculation process of adequeacy power for each type of power plant are described in more detail in Annex 3.

Figure 16 Methodological approach to the adequacy power of S.D. N°62



Source: Own elaboration (Edition 2009 of this book)

3.5.2. Ancillary services

The National Energy Commission (CNE) is responsible for defining ancillary services and their categories, based on the Coordinator's report, considering the safety and quality requirements of the electric systems and the technological characteristics of these services. At least ancillary services include frequency control, voltage control and service recovery plan, both under normal operating conditions and before contingencies.

For its part, the Coordinator must prepare an annual report stating the services required by the electric system, the technical resources necessary for the provision of these services, the infrastructure that must be installed for its provision and its useful life. In addition, the report must indicate for each of the required services the mechanism through which its service will materialize.

To this end, the Law of July 2016 enabled the Coordinator to conduct tenders or auctions when the request is of a very short term. Exceptionally, and only when the market conditions are not competitive or the tenders or auctions are declared as deserted, the benefit can be directly instructed. That is, in Chile there is a mixed regime of free market and provision by demand or forced. However, the market conditions of these ancillary services are limited and significantly lower than the treatment that has been given in other parts of the world. Therefore, the regulation of these markets and a new regulation of Ancillary Services are being worked on. This regulation establishes the way in which the services required by the system and the mechanisms for providing and/or installing them will be defined. It also establishes how the auctions, tenders and the provision and/or direct installation of the required services will be carried out.

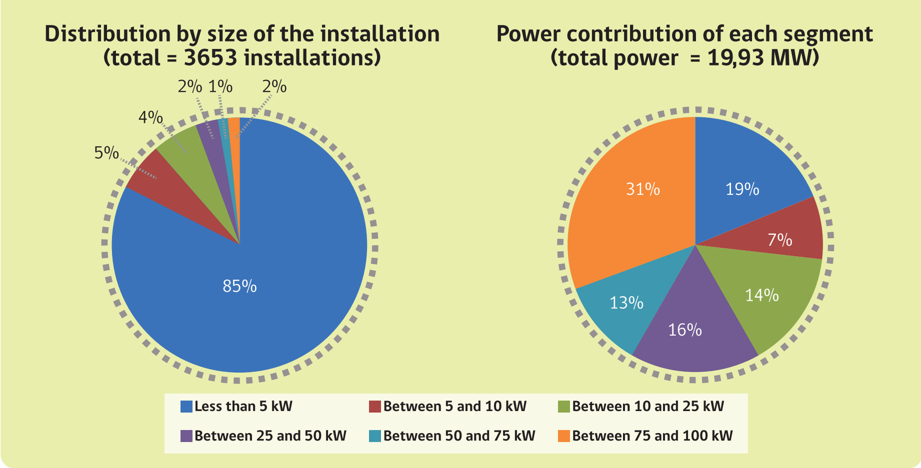
Regarding the payment of services that must be rendered or installed directly (without bidding process), they will be valued by means of a study of efficiency costs whose results can be submitted to the opinion of the Panel of Experts. The valuation of the ancillary services tendered will correspond to the value awarded in the respective tender or auction.

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 of 2016 and later in 2018 with Law 21.118, 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 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.

This Law has allowed the development of a new market for distributed generation and has been widely accepted, although the regulation is relatively new, the projects of up to 100 kW (before of the change of 2018) add a capacity of 19.93 MW with over three thousand projects throughout the country. The vast majority of these projects are very small with installed capacity of less than 5 kW. Figure 17 shows the distribution of projects according to their power range, both in quantity and in their contribution to the total capacity to August 2018.

Figure 17 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 price that the distribution companies transfer to their regulated customers plus a component associated with the avoided average losses or cost avoided. 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[35]. 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 20.571 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 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.

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 electricity 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 National Energy Commission 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 electrical system installations and ensure compliance with the safety and quality of electrical service standards. In addition, as

35 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).

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 the Ministry of Energy currently is carrying out the technical and economic feasibility studies of this interconnection.

In addition to the great potential of natural resources that Chile has, the perfection of the electrical legislation, 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

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 commercial 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.

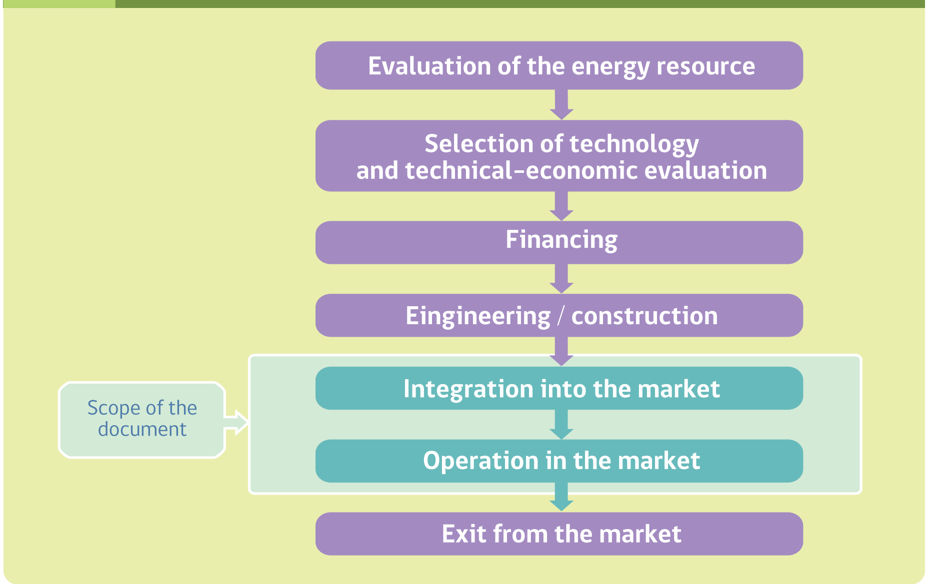
The improvement of the regulatory framework seeks to ensure that the rules of the electricity market take into consideration the characteristics of NCRE so that they can be harmoniously incorporated into the electricity market and systems. Likewise, the legal amendments seek to establish the conditions 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. Overview of stages of NCRE project development

The integration 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 18 summarizes the main steps in analysing a NCRE project. This document describes the integration and operation of NCRE projects in the electricity market.

Figure 18 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 zonal transmission), 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.

4.3. Definition of means of NCRE generation in the regulation

According to the LGSE[36], 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. 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 National Energy Commission, 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.

36 Article 224 (a), DFL N°4

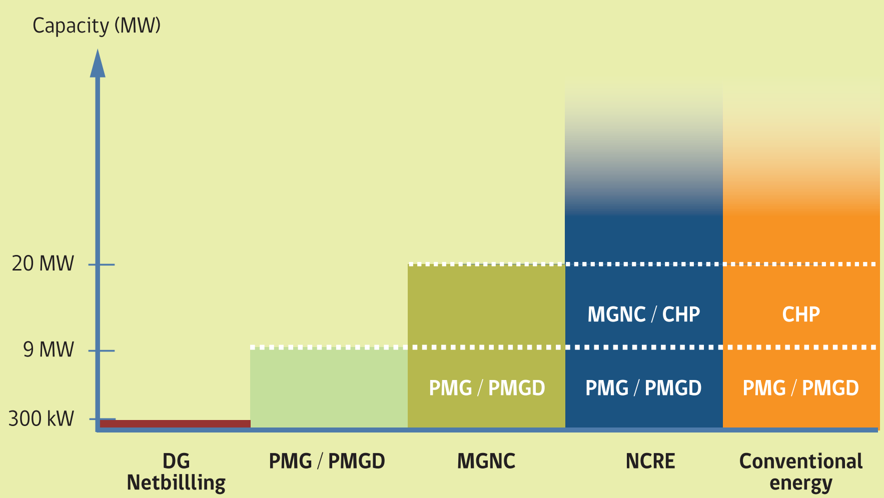
Likewise, the following concepts are defined:

- 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.

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°244 (Regulation for unconventional means of generation and small means of generation) have conferred particular rights and obligations. Figure 19 schematically shows the different generation means and their interrelations.

Figure 19 **Classification of non-conventional renewable generation**



DG-Netbilling: Residential, commercial and industrial projects (renewable or cogeneration)
PMG: Small generator
PMGD: Small distributed generator
MGNC: Non-conventional generator
CHP: Combined heat and power (efficient co-generation)

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

Classification:

1 **GD-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 installa-

tions of a company that owns electricity distribution lines using public national assets. PMGDs are given the right to connect to distribution networks.

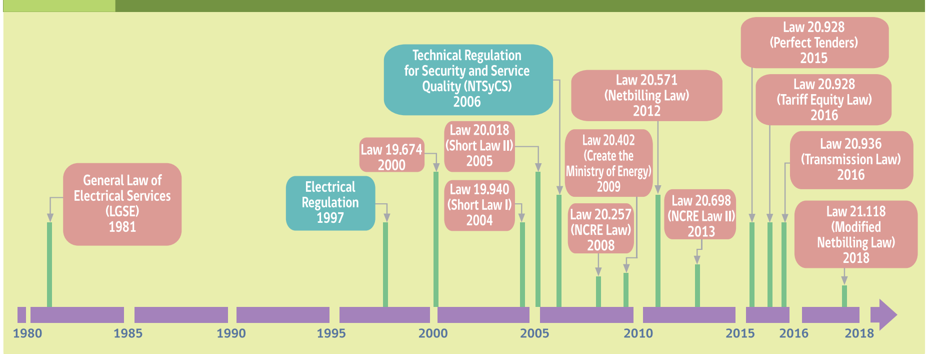
3 **PMG:** Generating means whose surplus power available to the system is less than or equal to 9.000 kW connected to installations belonging to the National Transmission System, to a Zonal Transmission System or Dedicated Transmission System.

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.

4.4. 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 20 and in Annex 2.

Figure 20 Chronology of the regulation of the electricity sector

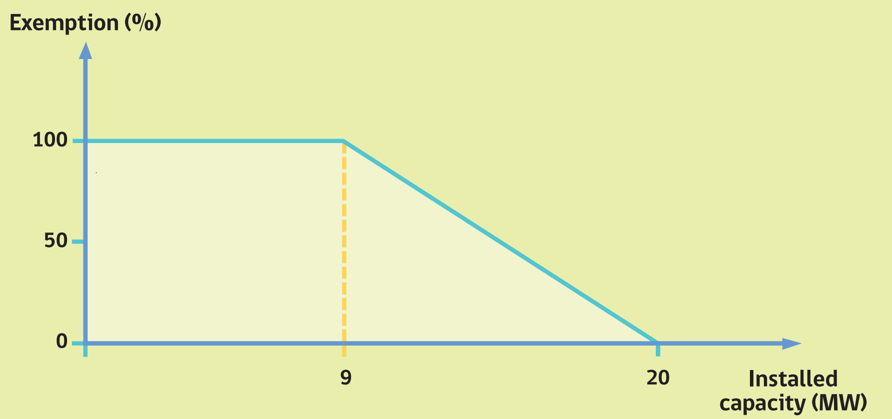


Source: Own elaboration as of Edition 2009 of this book.

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[37] 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 21 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.

Figure 21 Exemption of trunk charge for non-conventional generation as a function of excess power



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

37 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

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

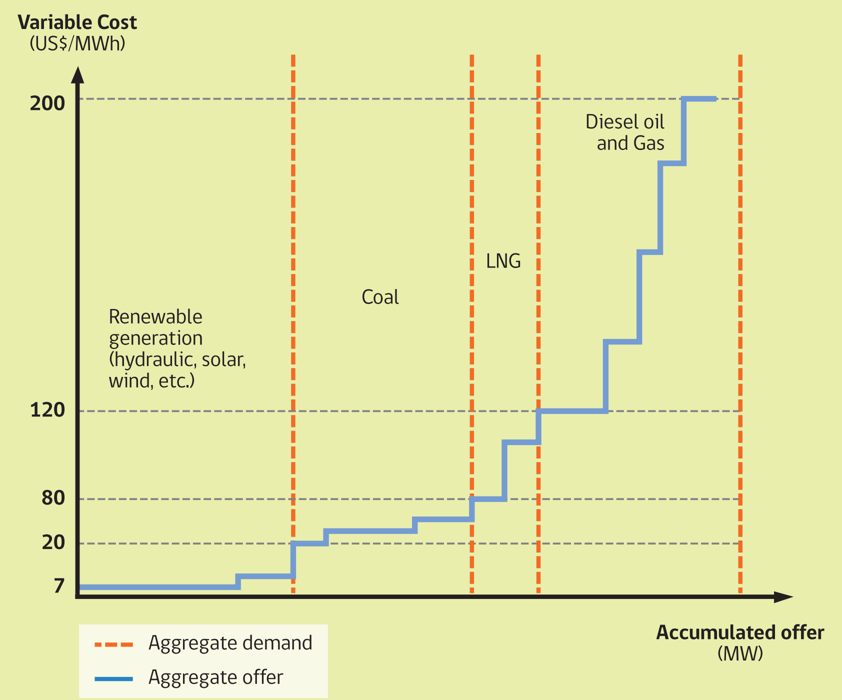
As discussed in Sections 3.3 and 3.4, a NCRE project in the wholesale market can access the spot and contract markets as the case may be. It is important to note that spot market transactions and contracts are financial and not physical. This means that the physical dispatch of the units is guided primarily 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 22 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 atributes 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. However, in the current regulation (S.D. N°130 of 2012) there is no treatment differentiated by technology and these services are defined by a cost study carried out by the Coordinator. Then, the commercial balance for ancillary services would be the following:

BalSSCC = PagoInv + PagoM + PagoOp – CostosSSCC – CostosO&M – PagoSSCC

Where:

BalSSCC	Commercial balance of ancillary services.
PagoInv	Standard payment for investment in the installation and/or authorization of equipment for the provision of ancillary services.
PagoM	Standard payment for additional maintenance of the facilities used for the provision of ancillary services.
PagoOp	Standard payment for operation of equipment exclusively intended for the provision of ancillary services, only if incurred.
CostosSSCC	Cost for investment in the installation and/or authorization of equipment.
CostosO&M	Cost for maintenance and operation for the provision of ancillary services.
PagoSSCC	Payments for ancillary services of the system calculated according to the energy injection.

It is worth mentioning that the new version of the ancillary services regulation, which is being processed, will change the way of remunerating the provision of these services.

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[38] 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% by 2020, and increases of 1.5% from 2021 to 2024,

38 In international terminology this model is known as a quota model.

and an increase of 2% to 2025 to reach 20%. The above requirements are presented in Table 4.

Table 04 **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[39] 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.

- The obligations can be credited with indifference to the interconnected system in which injections are made (SIC or SING), i.e., a company that supplies energy in the SIC can use NCRE produced in the SING for accreditation purposes, for which the law establishes the necessary coordination of the operator.

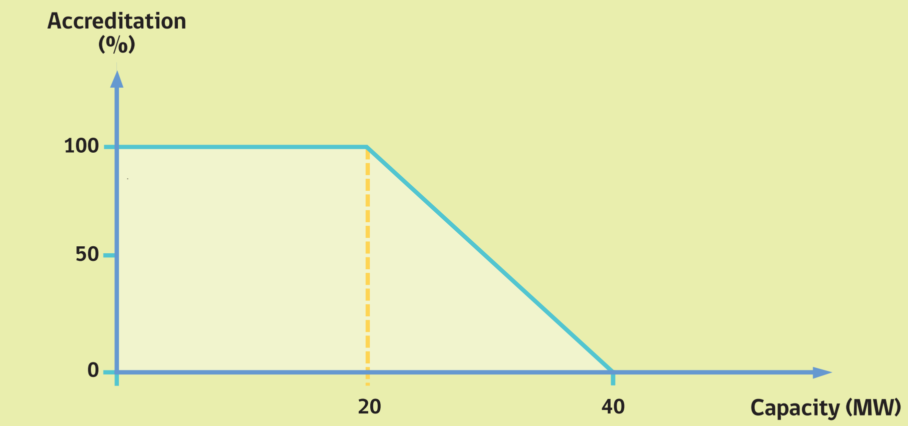
- Any electricity company that exceeds its non-conventional renewable energy injection obligation may agree to the transfer of its surplus to another electric company, which may be done even between companies of different electric systems.

- 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 23 summarizes the scheme applicable to hydroelectric plants in relation to the recognition of NCRE:

39 The value of the UTM in December 2017 is $ 46.972, equivalent to US $ 73.6 (considering value of each dollar to $ 638). So, 0.4 UTM / MWh is equivalent to US $ 29.4.5 / MWh. The monthly value of the UTM is available online at http://www.sii.cl/valores_y_fechas/utm/utm2017.htm

Figure 23 NCRE accreditation mechanism for hydraulic units



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

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 is obliged to carry out annual public tenders for the provision of non-conventional renewable energy blocks to cover the part of the missing obligation[40]. 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.

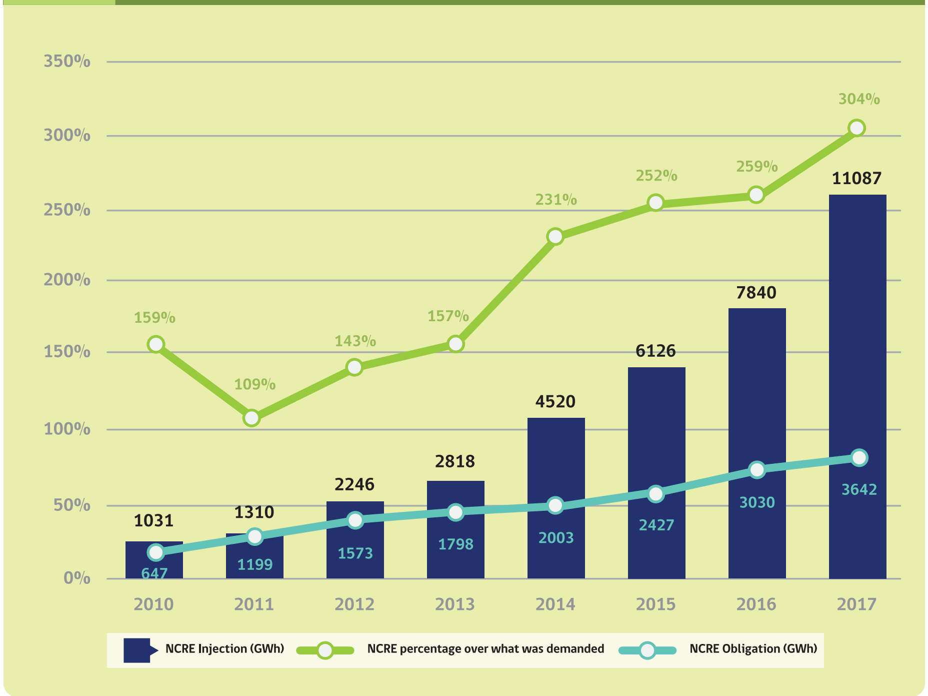
4.5.1. Compliance with the NCRE obligation

Non-conventional renewable generation has far exceeded the quota imposed by the regulation, as shown in Figure 24. For example, the NCRE quota for 2017 is 6.5% for the supply contracts entered into between August 31st 2007 and July 1, 2013 and 9% for contracts signed after July 1, 2013. In December 2017, these obligations resulted in a

40 Article 150° of the LGSE incorporated with Law 20.698.

goal of 313 GWh of NCRE energy. However, the actual and recognized NCRE injection by law was much higher, reaching 1047 GWh, that is, 304% over what was demanded[41]. 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 24 presents the annual obligations NCRE and as these have been systematically surpassed in each year, each time more significantly.

Figure 24 Compliance with NCRE laws



Source: Own elaboration from Statistical Yearbook of Energy 2017. CNE.

41 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/

4.6. Recognition of adequacy power to NCRE plants

The adequacy power of generators for non-conventional sources such as geothermal, wind, solar, biomass, tidal, small hydroelectric and cogeneration plants is determined based on the type of input used. According to Article 9-3 of the NT of S.D. N°62, for this purpose, the statistical information provided by each owner will be used and will be considered the worst scenario of average annual availability. The result is reduced by a factor proportional to own consumption, projected maintenance periods and forced unavailability, as detailed in Annex 3.

In summary, the recognition of the adequacy power will vary mainly according to the available resource and the point of connection, besides its capacity and the potential evolution of the same. For example, to November 2017 in the SIC, photovoltaic and wind power technologies are recognized with an average adequacy power of 14.12% and 12.05% of their maximum capacity respectively, as can be seen in Table 5 and Table 6. It should be noted that some plants have been built in stages, so the growth of their capacity can change these numbers.

Table 05 **Recognized adequacy power of photovoltaic plants in the SIC**

Power Plant	P Max	P Suf	PSuf/PMax
Quilapilún	110	1.59	1%
Luz del Norte	141	28.01	20%
Conejo Solar	104	11.94	11%
L. Llampos	101	23.63	23%
Carrera Pinto	93	7.15	8%
P. Solar Norte	69	6.04	9%
PV Salvador	68	13.89	20%
Javiera	65	9.85	15%
Lalackama	55	11.13	20%
San Andrés	50	6.07	12%

Table 05 (Continuation)

Chañares	35	7.32	21%
D. Almagro	32	4.59	14%
Lalackama 2	17	3.38	20%
La Esperanza II	9	0.43	5%
A. Ovalle	6	0.21	4%
Bellavista	3	0.37	12%
Santa Julia	3	0.54	18%
El Divisadero	3	0.37	12%
San Pedro	3	0.19	6%
El Boco	3	0.07	2%
Solar Las Terrazas	3	0.6	20%
Luna del Norte	3	0.45	15%
Sol del Norte	3	0.42	14%
Lagunilla	3	0.56	19%
Santa Cecilia	2.9	0.5	17%
Tambo Real	2.9	0.3	10%
Solar Esperanza	2.9	0.45	16%
La Chapeana	2.8	0.54	19%
Las Mollacas	2.8	0.42	15%
Hormiga Solar	2.5	0.15	6%
PSF Lomas Coloradas	2.0	0.29	15%
La Silla	1.5	0.19	12%
Cordillerilla Solar	1.4	0	0%
Sdgx01	1.3	0.16	13%
Hornitos	0.3	0.03	9%
Techos Altamira	0.2	0.01	7%
Las Araucarias	0.1	0.02	14%
Total	**1005.0**	**141.86**	**14.12%**

Source: Own calculation based on the report "Final calculation of the adequacy power of the SIC generating plants for the years 2016 - 2017", November 2017. Coordinador

Table
06

Recognized adequacy power of wind plants in the SIC

Power Plant	P Max	P Suf	PSuf/PMax
El Arrayán	115	10.76	9%
Los Cururos	110	10.8	10%
Taltal	98	16.25	17%
Talinay Oriente	90	15.47	17%
Renaico	88	9.77	11%
Talinay Poniente	60	8.82	15%
Canela II	58	4.75	8%
Monte Redondo	48	3.3	7%
Totoral	46	2.9	6%
Punta Palmeras	45	4.37	10%
San Pedro	36	5.57	15%
Cuel	32	7.8	24%
Los Buenos Aires	24	3	13%
Punta Colorada	20	1.18	6%
Canela	18	1.47	8%
Ucuquer 2	11	2.22	21%
La Esperanza	11	0.28	3%
Lebu	10	0.71	7%
Raki	9	1.76	20%
Las Peñas	8	0.45	5%
Ucuquer	7	1.54	22%
Huajache	6	1.26	21%
Total	**949**	**114.43**	**12.05%**

Source: Own calculation based on the report "Final calculation of the adequacy power of the SIC generating plants for the year 2016 - 2017", November 2017. Coordinador

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)[42] 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[43], and that there are certain provisions that specifically apply to NCRE technologies, especially wind and solar generation. Moreover, the recent update of the NTSyCS (January 2016) imposes new 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.

42 Technical standard updated to September 2016.

43 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.	3-6
	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.	3-7
	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.	3-8
	Wind / Photovoltaic*	Stable operating times are allowed for frequency variations, after which switching off is permitted.	3-9 y 3-10
	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.	3-12
	Wind / Photovoltaic*	The type of connection of the windings of the transformers on the connection side to the network is indicated.	3-14
	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.	3-16
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.	5-59
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.	5-75
Technical information on facilities and equipment (Title 6-2)	Wind / Photovoltaic*	Indicates contents of the "Quality Report of Supply and Product Quality" to be sent monthly to the Coordinator.	6-17
Frequency Control (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
Technical information on generating units (Title 9-10)	Wind / Photovoltaic*	Indicates for each generation technology the information to be made available to the Coordinator regarding the power machine, primary energy source, Load Controller / Speed information, Voltage Controller or Reactive Power information.	9-14 9-15 9-16 9-17

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", which are designed to assess the energy potential of renewable resources in the country and also maintain stable measurement 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[44].

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 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.

44 In the following link: http://www.energia.gob.cl/energias-renovables

Since that date onwards, there have been multiple tenders for land for non-conventional renewable energy, both wind and solar.

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[45].

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[46]; 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 25 shows the concessions for exploration and exploitation of geothermal energy in force in December 2017.

45 Decree N° 1939 of 1977 regulates the acquisition, administration and disposition of State property.
46 Decree N° 144 of 2012

Figure 25 Concessions for exploration and explotation of geothermal energy

1. Current exploration concessions

Concession	Company	Region	Province	District	Surface (ha)
Carcote	Serviland Minergy S.A.	Antofagasta	El Loa	Calama-Ollagüe	99.000
Caritaya	Serviland Minergy S.A.	Arica y Parinacota - Tarapacá	Arica-Del Tamarugal	Camarones-Huara-Camiña-Colchane	98.600
Lascar	Transmark Chile SpA	Antofagasta	El Loa	San Pedro de Atacama	24.000
Katarani 1	Energía Andina S.A.	Tarapacá	Del Tamarugal	Colchane -Huara	1.000
Latarani 2	Energía Andina S.A.	Tarapacá	Del Tamarugal	Colchane	800
Linzor	Transmark Chile SpA	Antofagasta	El Loa	Calama	33.000
Timalchaca	Serviland Minergy S.A.	Arica y Parinacota	Arica-Parinacota	Arica-Camarones-Putre	68.000
El Valle	Transmark Chile SpA	Araucanía	Cautín	Pucón-Curarrehue	18.200
Llonquén	Transmark Chile SpA	Los Ríos	Valdivia	Panguipulli	16.200
El Encuentro	Empresa Generadora Egengeo S.A.	Metropolitana	Cordillera	San José	15.600

2. Current exploitation concessions

Concession	Company	Region	Province	District	Surface (ha)
Apacheta	Geotérmica del Norte S.A.	Antofagasta	El Loa	Ollagüe	8.100
Chillán	Emp. Nac. de Geotermia S.A.	Bío-Bío	Ñuble	Coihueco-Pinto	8.400
El Tatio	Geotérmica del Norte S.A.	Antofagasta	El Loa	Calama	4.160
La Torta	Geotérmica del Norte S.A.	Antofagasta	El Loa	Calama-San Pedro de Atacama	5.400
Lag. del Malle	Cia. de Energía Ltda. Enerco	Del Maule	Talca-Linares	San Clemente-Colbún	4.000
Olca	Cía. Minera Doña Inés de Collahuasi SCM	Tarapacá-Antofagasta	Del Tamarugal-El Loa	Pica-Ollagüe	2.500
Pellado	Cía. de Energía SPA	Del Maule	Talca-Linares	San Clemente-Colbún	16.000
Rollizos	Samuel Santa Cruz	De Los Lagos	Llanquihue	Puerto Varas	260
Tinguiririca	Energía Andina S.A.	Del Lib. B. O'Higgins	Colchagua	San Fernando	6.175
Trinidad I	Inversiones Puyehue Ltda.	Los Lagos	Osorno	Puyehue	315
Trinidad II	Inversiones Puyehue Ltda.	Los Lagos	Osorno	Puyehue	243
Trinidad III	Inversiones Puyehue Ltda.	Los Lagos	Osorno	Puyehue	40

Source: NCRE Monthly Report. December 2017. 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.

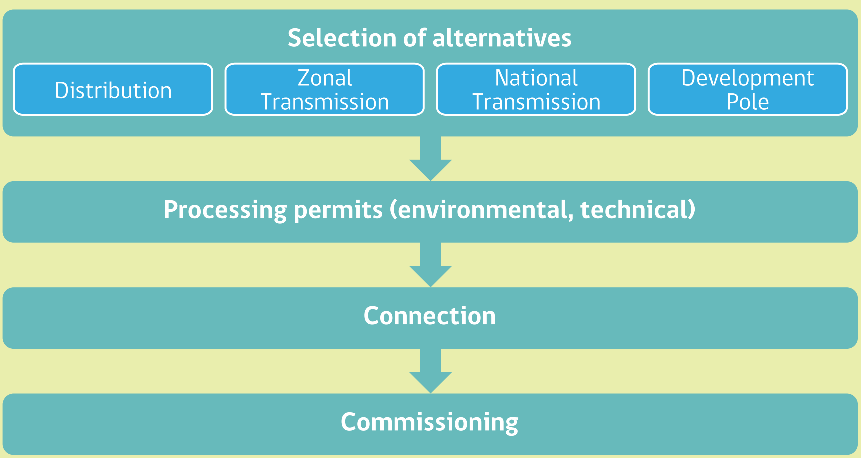
5

Integration into the NCRE market

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 26 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 26 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. If, on the other hand, the connection is to transmission systems, the applicable 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 27 Applicable normative in function of the connection sector

	Distribution V ≤ 0,4 kV	MT Distribution 0,4 kV < V ≤ 23 kV	Transmission 23 kV < V ≤ 500 kV
Operation and Connection	• NTCO of low voltage generation equipment • S.D. N° 71 of 2014 (Netbilling regulation)	• NTCO of PMGD in medium voltage installations • S.D. N° 244 (updated S.D. N° 101 of 2015) • S.D. N° 71 of 2014 (Netbilling regulation) • Netbilling in MT without technical standard	• NTSyCS • S.D. N° 327

NTCO: Technical Standard on Connection and Operation
NTSyCS: Technical Standard of Security and Quality of Service

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. Procedure for connecting projects under the Netbilling Law

The procedure for connecting a project under the Netbilling Law has 6 stages, which are explained briefly below and in more detail in Annex 4. 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 and initial stage corresponds to a information request to the distribution company mainly to know the installed capacity allowed.

Stage 1: Connection request: 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 or express nonconformity to the SEC if applicable.

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

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

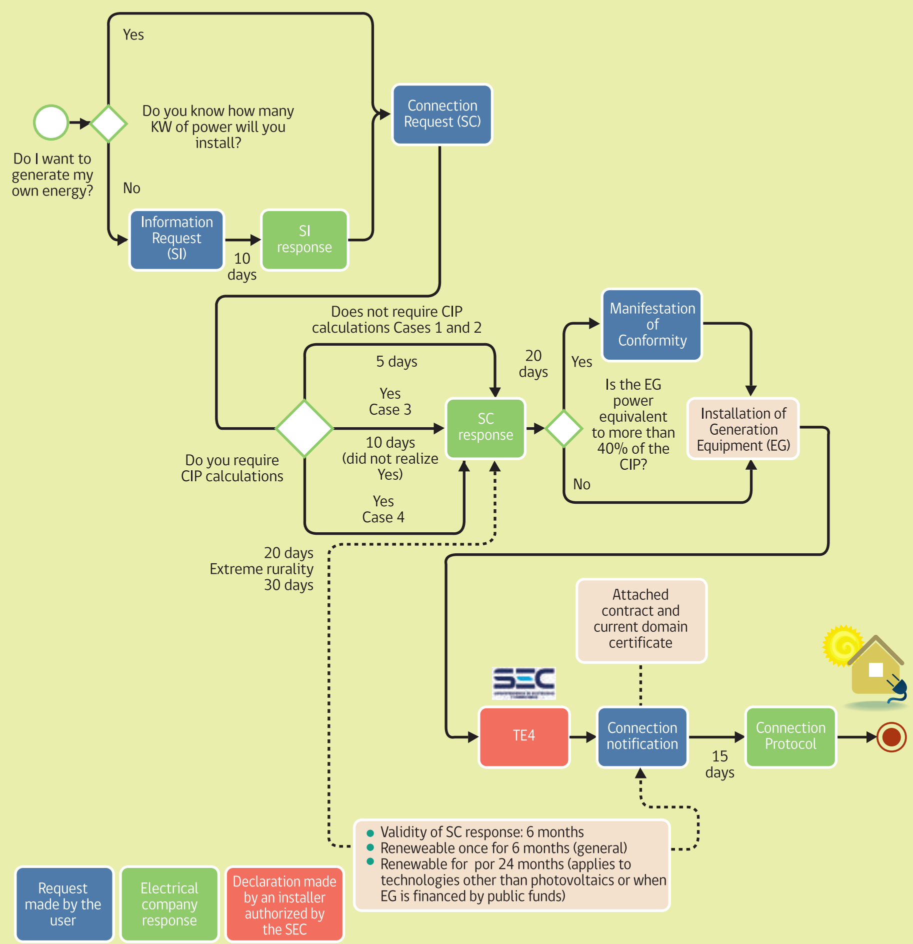
Stage 5: The connection to the distribution network occurs.

It is important to note that all forms for each of the communications with both the distribution company and the SEC are available on the website of the SEC[47], as well as the maximum deadlines for response of all parties. Annex 4 presents in more detail each of the stages and Figure 28 presents the procedure of connection and commissioning.

47 The Netbilling project connection forms can be found on the following website: http://www.sec.cl/portal/page?_pageid=33,5821714&_dad=portal&_schema=PORTAL

Figure 28

Procedure for connecting and commissioning a distributed generator



They do not require calculation of Installed Capacity Allowed (CIP)
(Maximum response time of 5 working days)

Case 1: Applies for photovoltaic system (PV), when the power of the Generation Equipment (EG) is less than 10 kW and the sum of the powers of the Generation Equipment connected to the distribution transformer does not exceed 10% of the power nominal of said transformer. (Article 10, Article 17 bis and Second transitory article).

Case 2: Applies when the user has the "Information Request Response (SI)" and in addition, the power of the Generation Equipment (EG) is lower both to the CIP informed in said response and to the capacity of the splice. (Article 10)

Require Permitted Installed Capacity (CIP) calculation
(Maximum response time of 5 working days)

Case 3: Applies when the user does **not** have the "Information Request Response (SI)" and the power of the Generation Equipment (EG) is less than the CIP and the capacity of the splice. In this case the term is 10 working days. (Article 10)

Case 4: Applies when the installed capacity of the EG is greater than the CIP or the capacity of the splice. In this case, the term is 20 working days. For projects located in extreme rural areas, the deadline is 30 working days. (Article 10)

Source: SEC[48].

48 Portal of the Law 20.571 http://www.sec.cl/portal/page?_pageid=33,5819695&_dad=portal&_schema=PORTAL

The procedure described above has regulated periods in which the distribution company must respond to the different requests of the customer, established the total terms for all the processing of the system, between 30 working days for small projects and 60 working days for the rest of the systems.

5.2.2. Connection to distribution networks of PMGD

Figure 29 summarizes the procedure for connecting and commissioning a PMGD, and Annex 4 describes in more detail each of the 7 connection stages of a PMGD. It is important to indicate that PMGDs of less than 1.5 MW may request to be classified as Not Significant Impact (INS), in which case the connection procedure is shortened and faster, since it requires fewer studies and stages. The stages for the connection of a PMGD are the following:

Stage 1: Presentation of the project and information request.

Stage 2: Response to Presentation.

Stage 3: Submit the Network Connection Request (SCR).

Stage 4: Respond to the Network Connection Request (SCR).

Stage 5: Conducting studies (only for PMGDs whose impact is significant).

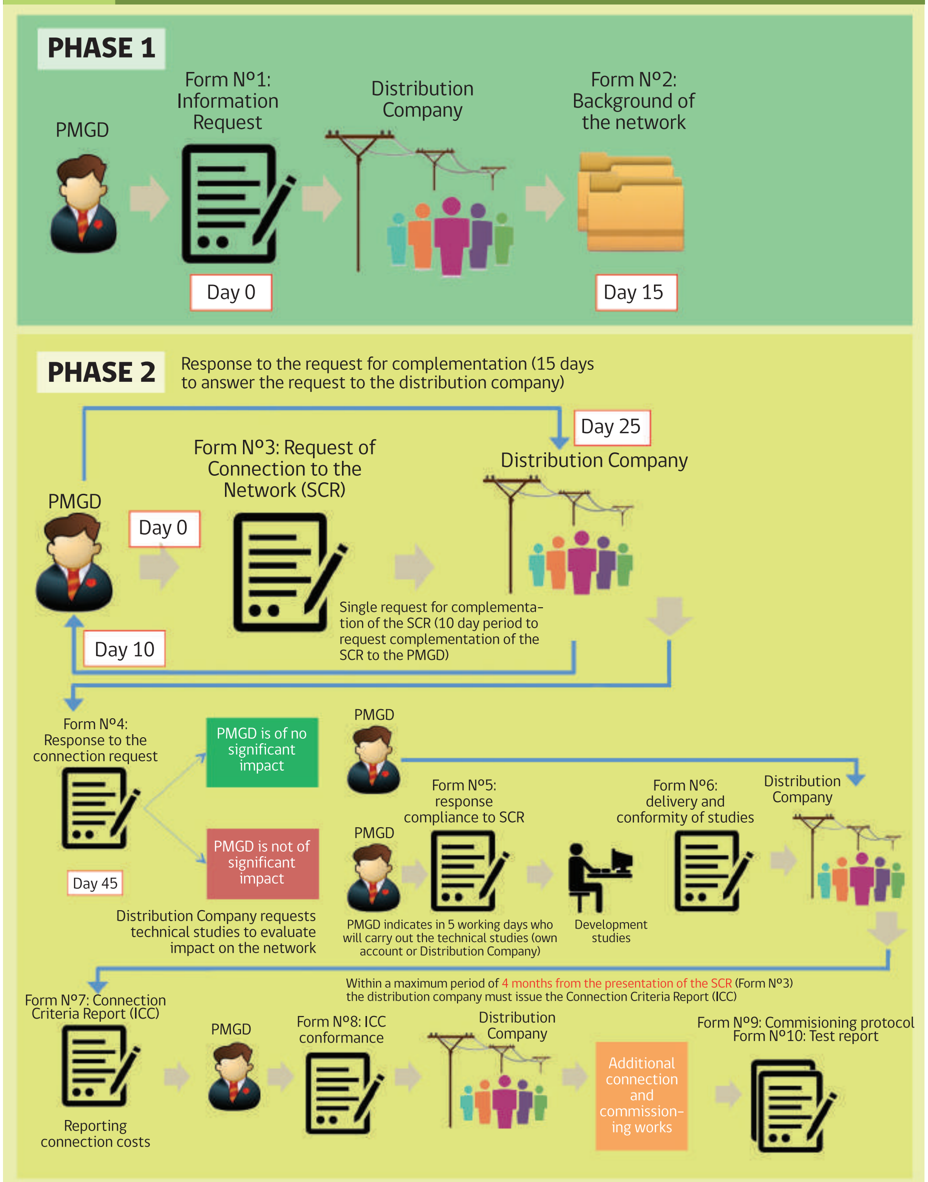
Stage 6: Connection costs study (only for PMGD whose impact is significant).

Stage 7: Additional works and commissioning.

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.

Figure 29 Connection and commissioning procedure for a PMGD



Source: Own Elaboration.

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 Commission, 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.

The distribution company must show, through the Connection Criteria Report (ICC)[49] that the PMGD produces additional costs to its savings to the network and must propose alternatives for payment of these costs. The ICC must have a study of the impact of PMGD on distribution networks. For this, the distribution company must estimate the present value of the investment, operation and maintenance cost without considering the PMGD (this for a period of time equal to the useful life of the PMGD). Then, you must perform the same calculation considering the existence of the PMGD. In this way, the cost of connection will correspond to the sum of the effects produced by PMGD injections in the present value of the investment, operation and maintenance of the distribution company.

It should be noted that the costs and savings reported in the connection costs report should be based on the criteria and evaluation periods established for model companies in the calculation of the Added Value of Distribution (VAD), considering the expected injections of the PMGD. Also, the value of the additional facilities required for the PMGD connection is not considered part of the new replacement value of the corresponding distribution company.

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 distributing company must indicate in detail those additional works and/or adaptations technically necessary for a correct connection of the generation equipment to the distribution network. The valorization of the works must be calculated considering the requirements necessary to maintain the standards of security and quality of supply in the current norm. In the preparation of reports, the distributing company, whatever its condition, must at all times consider the necessary requirements to maintain the standards of quality of supply in its network.

This calculation should consider the values of each of the components of the additional

49 See stage 7 of the connection process in Annex 4

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

Commercial 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 commercial alternatives for a NCRE project are now set out in greater detail.

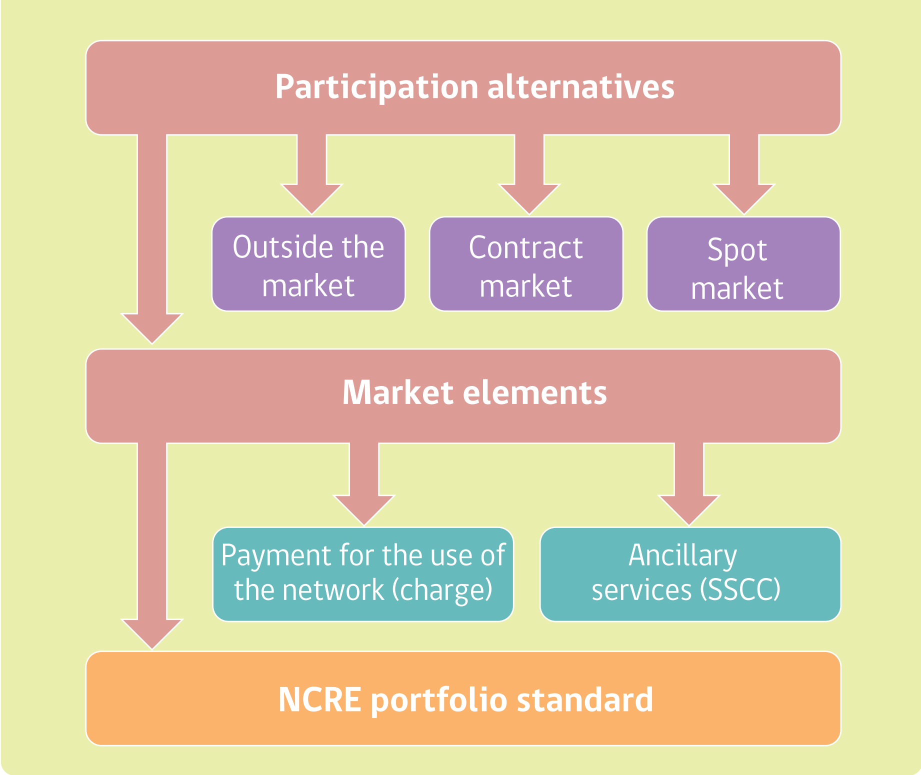
The technical aspects of the operation in an electricity market are covered by the regulations and technical standards of the respective segments. In the case of transmission systems, the NTSyCS defines the operation and measurement requirements of the generating units. At medium voltage levels, the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

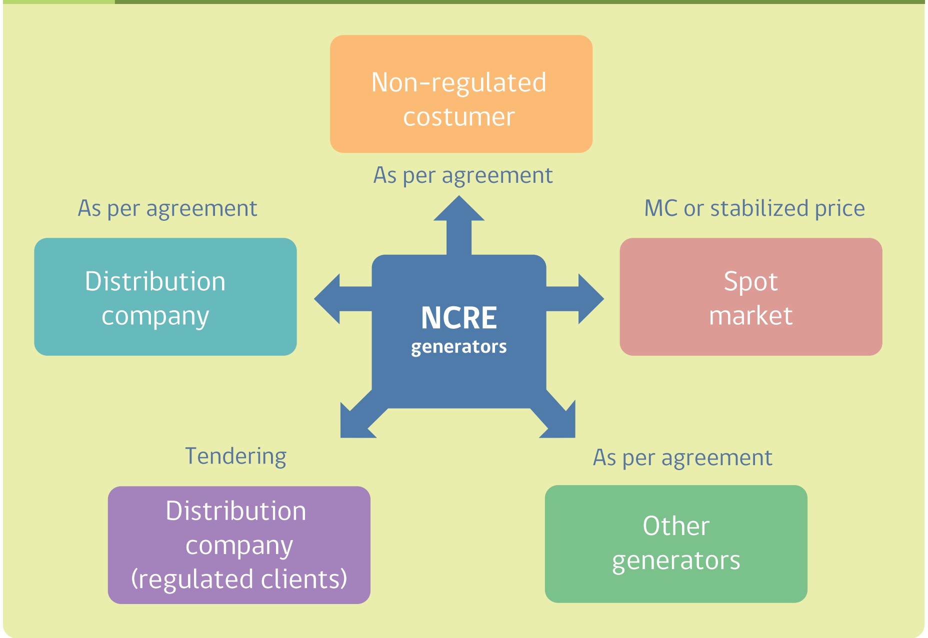


Source: own elaboration (2009 Edition of this book).

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 other generation companies (corresponds to the node price of energy and the node price of power). This applies only to PMGD projects up to 9 MW and connected to the distribution network.

- 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 the 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 is the owner and responsible for the equipment and also the electrical production that then sells to the user at a reduced price. It should be noted that ESCO can supply electric power in concession areas to consumers, since this occurs in private properties. This and other business models for distributed generation projects are explained in more detail in Annex 4.

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

6.1.1. Marketing 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).

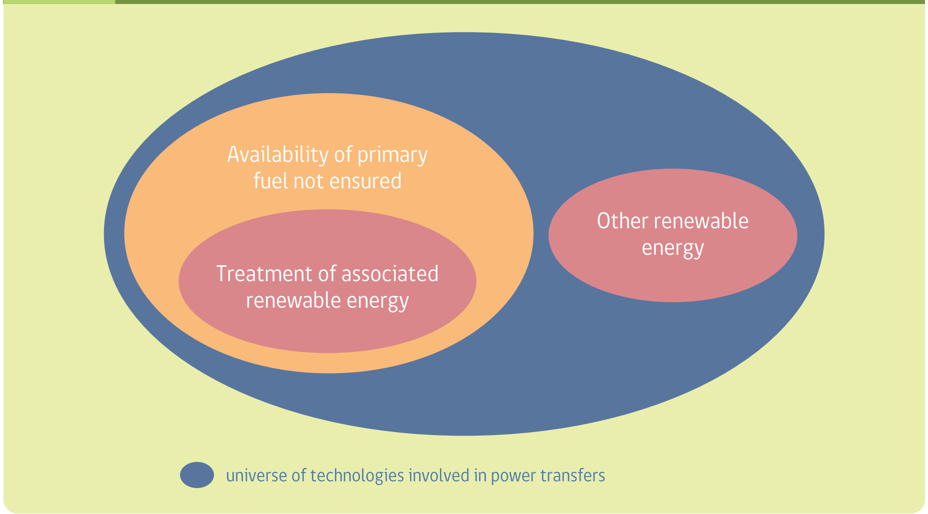
- Generators sell all their produced energy and recognized power in the spot market in the bar or injection node.
- Generators buy (energy and power) in the spot market to supply their contracts in the bar or supply node.
- Only generators participate in this market.
- Purchase and sale of electricity 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.
- The purchase and sale of capacity is conducted at the nodal price for capacity at the respective busbar.
- The nodal price of capacity 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 capacity to the system during peak demand.
- 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.

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 (2009 Edition 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 and section 4.6 presents examples of the adequacy power currently recognized for solar and wind power plants in Chile.

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°244. In this case, S.D. N°244 states that injections by a PMGD are referenced to the nearest primary sub-station, 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 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 12 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.

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 will maintain 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.

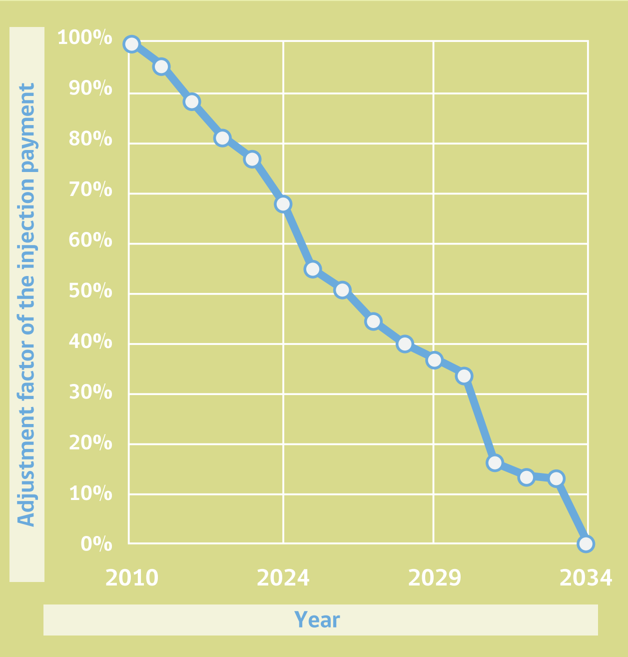
- Outside of the common area of influence, when power flow goes towards the common area of influence, transmission cost will be allocated to the owners of plants located upstream of the power flow, prorate according to actual usage of generation assets on different transmission segments. On the other hand, when power flow does not goes 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.

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

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 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 (see Figure 21).

In addition to the exemption of previous charges 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 reduction of transmission charges, 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 payment of the transmission charge eliminated is then absorbed by all final consumers[55].

6.5. Ancillary services and NCRE

In the current regulation there is no differentiated treatment by generation technology with respect to ancillary services. As described in section 3.5.2., according to the ancillary services regulation (S.D. N°130 of 2012), for the control of primary or secondary frequency the operation and maintenance is paid and in addition to the investment if necessary. The amounts to be paid are defined in a cost study carried out by the Coordinator. Likewise, for the voltage control services and equipment intended for service recovery plan, the Coordinator determines the payment for investment costs per installation and/or authorization and additional annual costs for the maintenance of the facilities.

It should be noted that the update of the NTSyCS (January 2016) imposes new requirements for solar and wind technologies in terms of its participation in secondary

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

frequency control and voltage control. So these technologies are increasingly participating in ancillary services.

Additionally, it is worth mentioning that the ancillary services regulation, whose new version is in process, seeks to make more flexible the definition of the concept of ancillary services by allowing the entry of new services required by the SEN and assign the provision of these services competitively.

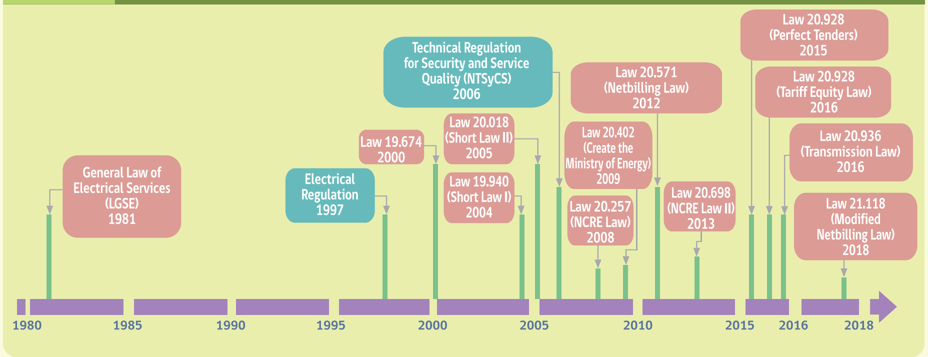
7

Annexes

1 1. 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 regulatory 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 the 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).

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 companys, 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 2025.

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 theseand 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 are in the process of definition.

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° 244 of 2006 (PMGD Regulation)

Supreme Decree N° 244 officially entitled "Approves Regulation for Non-Conventional and Small Generators" was enacted by the Ministry of the Economy, Development and Reconstruction in September, 2005. The decree creates provisions for companies whose generation capacity surplus is less than 9 MW (PMG and PMGD) and/or that operate with a non-conventional energy source (MGNC) with a capacity surplus of less than 20 MW.

The regulation includes the following chapters: Small Distributed Generators (PMGD) (Procedures and conditions for the connection, maintenance and intervention of installations, determination of costs of additional works for connection, operational regime, remuneration and payments, measurement and invoicing), Small Generators (PMG) (Operational regime, remuneration and payments, measurement and invoicing), Non-Conventional Generators (Classification according to source, exemption of payment for the use of main transmission systems, complaints and controversies).

This regulation was perfected to expedite the processing of the connection of the PMGD, especially for small PMGD (of up to 1.5 MW) that are cataloged as of non-significant impact by the S.D. N° 101 of 2015.

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.

1.2.4 Supreme Decree N°130 of 2011 (Regulation for Ancillary Services)

Supreme Decree N°130 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 December 22, 2011 and published in December 2012. However, 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 regulation regulates the payment of fees for the services of frequency regulation, voltage regulation, and service recovery plan, among others.

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 sought to eliminate 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. This regulation was recently perfected by S.D. N°46 of 2015.

1.2.7 Supreme Decree N° 71 of 2014 (Regulation Netbilling Law)

Supreme Decree N° 71 entitled "Approves regulations of Law 20.571, which regulates the payment of electricity tariffs of residential generators" promulgated on June 4, 2014 establishes the connection procedure, deadlines and communications that must exist between the consumer, the electricity distribution company and the Superintendence of Electricity and Fuels. This regulation was perfected to streamline the processes of connection recently by S.D. N° 103 of July 2016.

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 made by Exempt Resolution N°37 whose date of promulgation was January 20, 2016 and mainly establishes new requirements to the NCRE generators for the control of frequency and voltage of the network.

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 last modification to the regulation was made by Resolution N°537 whose date of enactment was July 11, 2016 and among other changes, introduces 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.

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

Exempt Resolution N°513 with official title "Dictates Technical Standard for Connection and Operation of equipment of generation in low voltage" was promulgated October 20, 2014. 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.

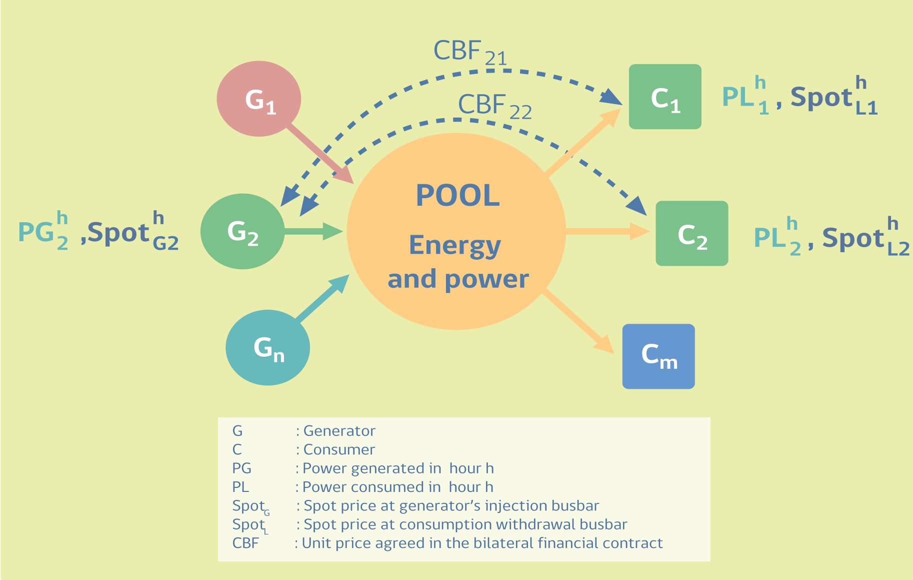
2 Annex 2: Market operation aspects

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.

$$\begin{aligned} BalanceE_c^h &= \sum_{g=1}^{NG_C} PG_g^h Spot_{G_g}^h + \sum_{l=1}^{NL_C} \left(CBF_{gl} - Spot_{L_l}^h\right) PL_l^h - \sum_{g=1}^{NG_C} Costo\_Gen_g(PG_g^h) \\ &= PG_2^h Spot_{G_2}^h + \left(CBF_{21} - SpotL_{L1}^h\right) PL_1^h + \left(CBF_{22} - SpotL_{L2}^h\right) PL_2^h - Costo\_Gen_2(PG_2^h) \end{aligned}$$

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:

$$\begin{aligned} BalanceE_c^h &= 100 \cdot 85 + (62 - 75) \cdot 35 + (70 - 68) \cdot 40 - 72 \cdot 100 \\ &= 8500 - 455 + 80 - 7200 = 925 \end{aligned}$$

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.

To determine the price of peak power, the unit cost of installation of dual gas turbines is used, since this technology generally supplies the tip of the system. At this power price is known as power node price and is determined semi-annually 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.

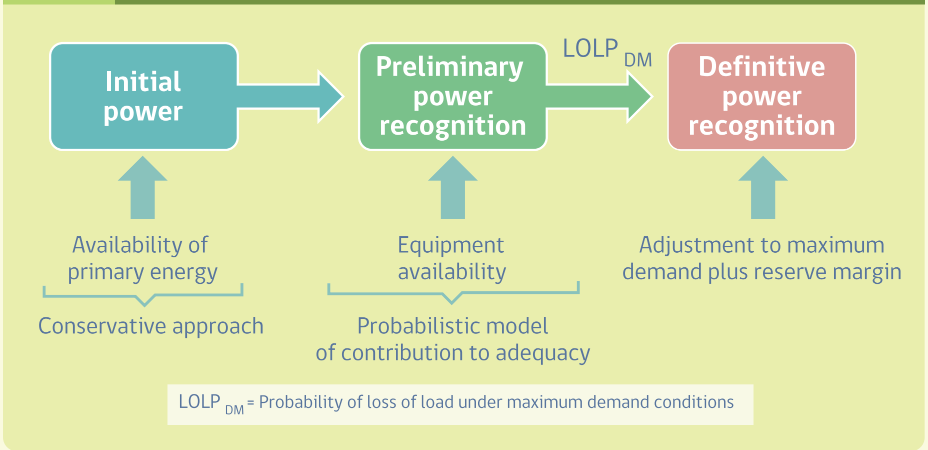
1 The definition of the wholesale market is found in the glossary of terms, see Annex 5.
2 The "Annex 3: Adequacy Power (methodology S.D. N°62)" presents the mechanism of calculation of the Adequacy Power that is recognized to each type of generator.

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

The objective of the method of calculating of the adequacy power is to distribute the annual revenues from the sale of capacity to the customers of a system among the owners of the generating plants and to determine the power transfers between companies. This is determined from the adequacy power and the existing peak demand commitments. In this way, each owner of generation means must be able to satisfy his own commitments for peak demand considering his adequacy power and that acquired to other companies.

Each generating unit is assigned an adequacy power depending on the uncertainty associated with the availability of the main input of generation that is used and the unavailability of the unit and the installations that interconnect it, 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:

Initial Power of generating units whose source is non-conventional

For units such as geothermal, wind, solar, biomass, tidal, cogeneration and small hydropower (up to 20 MW), the initial power will be determined in a way equivalent to conventional, depending on the resource you use. For this, it is considered the worst scenario of average annual availability of main input that corresponds. The information must be given to the Coordinator by each owner. If sufficient statistical information is not available, use available information by zone or region in which the unit is located.

Initial Power of hydroelectric plants

For hydroelectric plants, the statistics of affluent flows corresponding to the average of the two hydrological years of lower energy of the available statistics are used. To do this, the regulation (S.D. N°62 of 2006) classifies the hydroelectric plants according to their capacity of regulation in: central with capacity of daily regulation or superior, central with capacity of regulation intraday and central without capacity of regulation[3]. It also distinguishes hydroelectric plants in series:

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

- Generating units with intraday regulation capacity are considered as regulating capacity but are not considered the initial energy.

- The initial power of the units without regulation capacity is determined according to the equivalent power to the average annual affluent caudal of the 2 hydrological conditions of lower affluent energy.

3 S.D. N°62 of 2006 establishes the following:
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 affluent caudal for the hydrological condition corresponding to the 2 years of lower affluent energy, allow the generating unit to operate at maximum power for at least 24 hours.
It will be understood that a hydroelectric generating unit has in-day regulation capacity when the maximum capacity of its pond plus the average annual affluent power for the hydrological condition corresponding to the 2 years of lower affluent energy is sufficient for the generating unit to operate at least 5 consecutive hours with a power equal to or less than its maximum power.

The calculation methodology for power plants with control capacity is performed by means of a procedure that seeks to distribute the total hydraulic power of the system following a filling of the annual load duration curve. This, respecting the models of the watersheds. The initial joint power (regulation power) obtained at the time of greatest demand is assigned to the plants with regulatory capacity prorate of the annual power of regulation provided to the system.

Thermal Initial Power

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 adequacy power will be calculated as an equivalent generating unit based on the operating characteristics of each unit with the main and alternative input.

Preliminary Adequacy Power

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

In its first part, the initial power is reduced by the following factors that account for its annual availability:

- Own consumption
- Scheduled maintenance
- Failure rates (IFOR) and deteriorated states

The capacity resulting from these reductions are introduced into a probabilistic model that considers “the contribution to adequacy system” of each power plant to determine its preliminary adequacy power.

Definitive Adequacy Power and Theoretical Reserve Margin (MRT)

In this part of the calculation process, the preliminary power of each generator is scaled by a factor – the same for each one – so that the sum of definitive power is equal to the peak demand of the system.

On the other hand, the basic price of capacity, determined by the CNE, incorporates a scaling given by the Theoretical Reserve Margin (MRT) of the system. The MRT corresponds to the minimum over-equipment in generation capacity that allows supplying the tip power in a system with a determined adequacy. This margin is calculated from the Power Margin (MP), equal to the total Initial Power of the system, using a linear function whose result is bounded lower by a minimum MRT of 10%. The function acts in an inverse way so that at higher MP a lower MRT is obtained and vice versa. For usual MP values the MRT will move in a range of 10% to 15%.

4 Annex 4: Self-supply energy projects integrated into the distribution network

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. This Annex focuses on the projects of generation of self-consumption or self-supply to facilitate its development and to understand the alternatives offered by the Chilean market. 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 of surpluses (according to the standard 4 of 2003)
b) Self-consumption projects with surplus marketing (according to PMGD regulation S.D. N°244 of 2006)
c) Self-consumption projects less than or equal to 300 kW with surplus injection (according to the Law 20.571 of 2012 and Law 21.118 of 2018)

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. While the projects under standard 4 are common and their processing is well known, the projects benefiting from Netbilling are more recent, and there is a lack of knowledge about its processing. At an intermediate level of knowledge and maturity are PMGD projects under S.D. N°244 of 2006 that has been recently modified through S.D. N°101 of 2015.

In Chile the regulation tries to carry out an efficient transfer of system costs to distribution customers, which creates incentives for standard, 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 of surpluses (according to Standard 4 of 2003)

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). Its processing requires a declaration to the Superintendency with the respective electric project, following the instructions of Chapter 14 of Standard 4. These systems are classified according to their purpose in the following categories:

- Emergency systems
- Tip cutting system
- Cogeneration systems

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 surplus marketing (according to the PMGD regulation of S.D. N°244 of 2006)

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°244 of 2006 and its subsequent modification 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 (according to the Law 20.571 of 2012 and Law 21.118 of 2018)

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°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 marketin 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

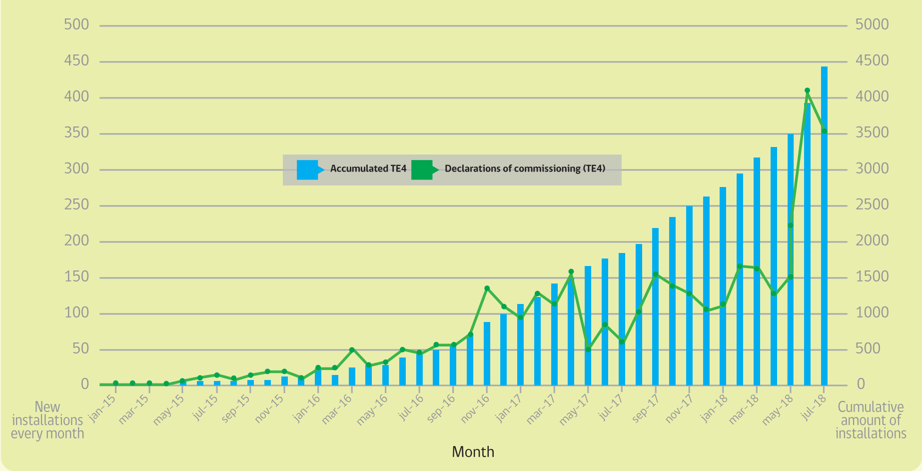
Distributed generation in its various scales has been widely accepted in the Chilean electricity sector, both the generation received under the Netbilling Law and the PMGD have grown substantially since their connection and remuneration were regulated. The Netbilling projects add a capacity of approximately 19,93 MW to August 2018, while PMGDs at the same date total approximately 607 MW.

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

The Netbilling Law in Chile began to operate effectively from October 2014 so it is a 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 monthly commissioning declarations has increased considerably during these years, reaching a total of 3.653 installations in the month of August 2018.

Figure 4 shows declarations of commissioning of the projects from the beginning of the validity of the Netbilling Law until July 2018.

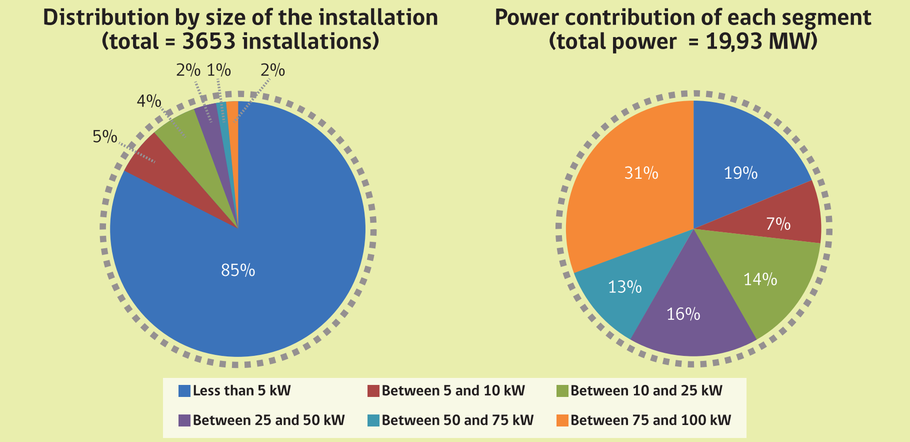
Figure 04 Installations declared in compliance with the Netbilling Law



Source: SEC

The power of the projects covered by the Netbilling Law are mostly very small projects under 5 kW (85% of the installations have a power of less than 5 kW and represent 19% of the total power). Figure 5 shows the distribution of facilities according to their power range both in quantity and their contribution to the total capacity August 2018.

Figure 05 **Distributed generation projects by size and contribution of power of each segment**

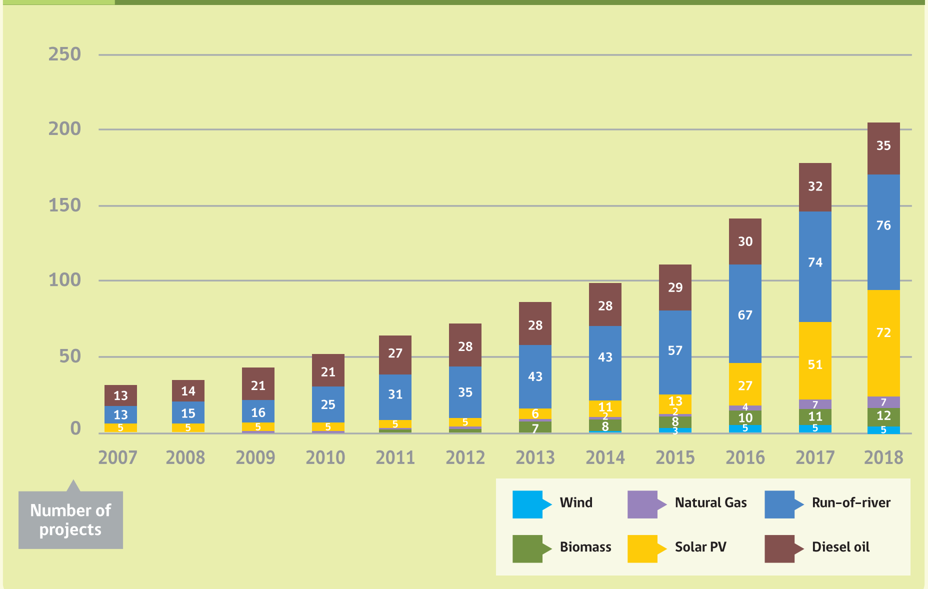


Source: SEC.

4.1.2 PMGD project number progress

A decade ago there was a significant development of typically hydraulic and diesel PMGD projects, but for 4 years there has been a growing development of wind and solar projects and are projected to continue with this trend. Figure 6 presents the evolution of the number of PMGD projects by technology between 2007 and August 2018.

Figure 06 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 average 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.

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:

i. Residential customers with power connected up to 20 kW or non-profit legal entities with power connected up to 50 kW newly paid without additional conditions.

ii. Customers with power connected up to 300 kW that be not in the previous condition, receive payment as long as they demonstrate that their projects were adequately sized so as not to generate surpluses that can not be discounted, that is, that have been designed for self-consumption.

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. 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 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 initial stage is optional and corresponds to an information request to the distribution company mainly to know the installed capacity allowed.

- Stage 1 corresponds to the connection request 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 for each of the communications with both the distribution company and the Superintendency are available on the website of the Superintendency[4], as well as the maximum deadlines for response of all parties.

Stage 0: Information Request (optional stage)

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 (SC)

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

The response of the SC should include the following information: location of the point of connection of the generation equipment, the property or capacity of the joint, the installed capacity 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 distribution company has between 5 and 40 working days to respond to SC depending on the information provided by the user and if information was requested prior to the SC.

4 Netbilling project connection forms can be found at the following website http://www.sec.cl/portal/page?_pageid=33,5821714&_dad=portal&_schema=PORTAL

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 the SC was preceded by an information request, the 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 than the installed capacity allowed and the safety and configuration criteria of the distribution network are met (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[5]), the term is **5 working days**.
c) If the installed capacity of the equipment is greater than the installed capacity allowed or requires a change in the capacity of the joint, the term is **20 working days**. If the project is located in extreme rural areas (type 2[6]), then the deadline is extended by 10 working days (up to 30 working days).
d) For the connection of Generation Equipment in residential complexes, buildings or the like, the SC 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 user has 20 working days to express their agreement in case the power of the generation equipment is greater than 40% of the installed capacity allowed. Otherwise, it is not necessary to carry out the declaration of conformity.

If the SC requires installations and adaptations, the user can reduce their installed capacity to an smaller or equal than allowed capacity, in which case the execution of the works will not be necessary.

If in the SC no additional works are required the user can demonstrate their conformity, which will have 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 equip-

5 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.

6 Resolution N°53, of 2006, of the Ministry of Economy, Development and Reconstruction defines the rural areas of type 2 to all communes that fulfill the following conditions simultaneously:

a) Total population less than 70,000 inhabitants or total population greater than 70,000 inhabitants and relation between urban dwellings and total area of the commune, less than 350 dwellings / km2.
b) Number of customers of the company within the commune less than 10,000 or number of customers of the companies within the commune greater than 10,000 and a ratio between the total power sold and the medium voltage line kilometers, less than 15 kW / Km.
c) Be supplied by a feeder connected through medium voltage lines whose total length is more than 75 km, minimum limit not applicable to island territories.
d) To be supplied by a feeder whose ratio between the sum of the powers of the distribution substations (MT/BT transformation), connected to said feeder by medium voltage lines expressed in kilometers, is less than 50 kVA.

ment has been acquired with public funds) 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. Likewise, in case the generation facilities are financed by public funds, the validity to present the connection notification will also be extended to 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).	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).	6 months extendable for up to 24 more months.
• Generation facilities financed with public funds.	6 months extendable for up to 24 more 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

The installation must be carried out by electrical installers certified by the Superintendency and must be declared the commissioning to the same.

Stage 4: Connection Notification (NC) and Contract Signing

Within the validity period to present the NC 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, certificate of current domain of the property, identification and class of the installer, the copy of the declaration or communication of the commissioning made by the user to the Superintendency.

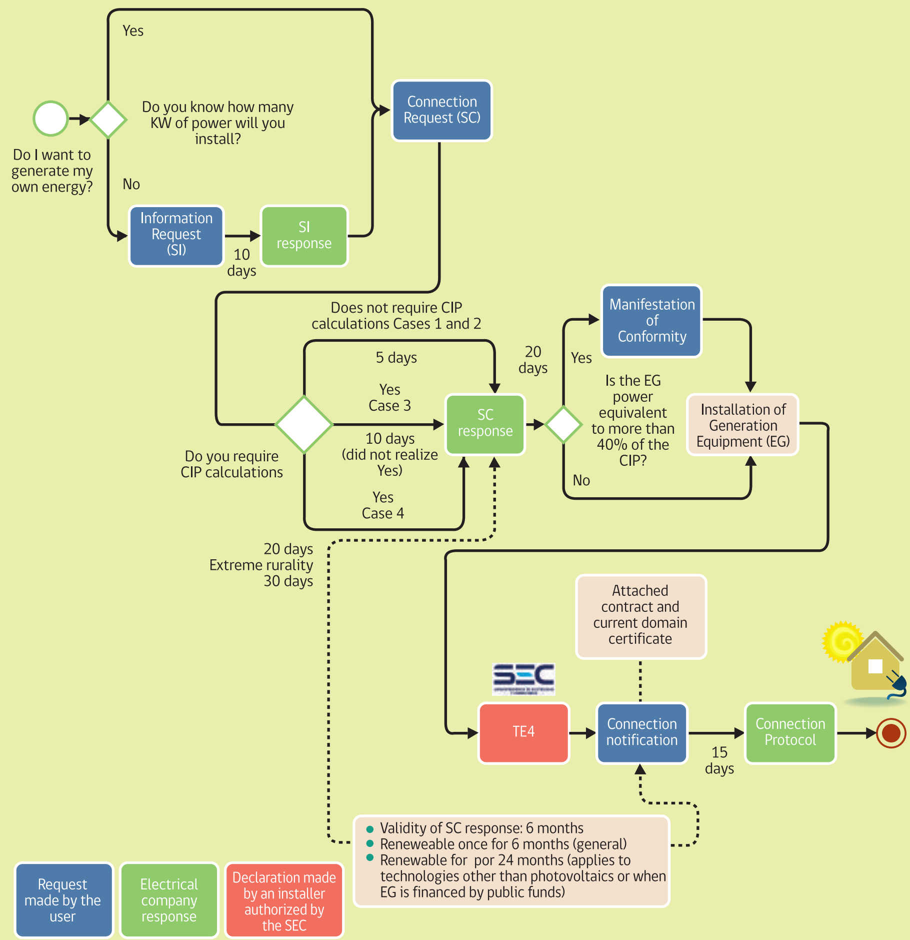
Stage 5: Connection Protocol

Once the NC has been delivered, the distribution company will carry out or supervise the connection of the generation equipment. The date of connection must be agreed between the parties and may not exceed 15 days from the date of delivery of the connection notification.

Figure 7 summarizes the connection and commissioning procedure for a distributed generator.

Figure 07

Connection and commissioning procedure for a distributed generator



They do not require calculation of Installed Capacity Allowed (CIP)
(Maximum response time of 5 working days)

Case 1: Applies for photovoltaic system (PV), when the power of the Generation Equipment (EG) is less than 10 kW and the sum of the powers of the Generation Equipment connected to the distribution transformer does not exceed 10% of the power nominal of said transformer. (Article 10, Article 17 bis and Second transitory article).

Case 2: Applies when the user has the "Information Request Response (SI)" and in addition, the power of the Generation Equipment (EG) is lower both to the CIP informed in said response and to the capacity of the splice. (Article 10)

Require Permitted Installed Capacity (CIP) calculation
(Maximum response time of 5 working days)

Case 3: Applies when the user does **not** have the "Information Request Response (SI)" and the power of the Generation Equipment (EG) is less than the CIP and the capacity of the splice. In this case the term is 10 working days. (Article 10)

Case 4: Applies when the installed capacity of the EG is greater than the CIP or the capacity of the splice. In this case, the term is 20 working days. For projects located in extreme rural areas, the deadline is 30 working days. (Article 10)

Source: SEC[7].

7 Portal of the Law 20.571 http://www.sec.cl/portal/page?_pageid=33,5819695&_dad=portal&_schema=PORTAL

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. It should be noted that if the PMGD is classified as non-significant impact, this can facilitate and streamline the process and save the cost of connection studies. Only projects of up to 1.5 MW may request to be classified as having no significant impact. Figure 8 summarizes the connection and commissioning procedure for a PMGD, without a distinction being made between NCRE and conventional. This procedure can be differentiated in the following stages:

Stage 1: Presentation of the project and information request
The Connection Point must be identified and the intention to connect to a Distribution Network must be stated. This is done through the delivery of Form N°1[8] to the distribution company with a copy to the Superintendency of Electricity and Fuels (SEC). 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.

Stage 2: Response to Presentation
Within 5 days, the distribution company must inform all interested parties about connecting or modifying the conditions previously established for the connection and/or operation of a PMGD, which have made the same communication previously.

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, the draft of the contract of connection and operation and the studies required indicating costs, deadlines and forms of payment.

8 It can be found at the NTCO.

Stage 3: 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]. It should be noted that according to the NTCO, a PMGD can be evaluated as INS, only if the surplus power is less than or equal to 1.5 MW.

The SCR must include at least the following information:

1) Location map with boundaries of the terrain and place of the PMGD.
2) Unilinear of the whole electric installation, with data of the equipment used.
3) Wiring plans, with data on type, manufacturer, connection and function of each of the protections.
4) Description of the type and manner of operation of the power machine and the generator, as well as the way of connection to the network.
5) Project execution schedule.
6) Protocol with the settings of the protections of the PMGD.
7) Daily projection of the generation and injection of the PMGD.

The distributing company has a term of 10 days counted from the reception of the SCR to communicate the presentation of said request to all those interested in connecting a PMGD. Also, once the SCR has been received, the distribution company may request the interested party within 10 days, once, to complement the SCR. The interested party has 15 days to reply to this request for additional information.

Stage 4: Respond to the Network Connection Request (SCR)

Within 20 days after the submission of supplementary information, the distribution company must inform the interested party, through Form N° 4, if the PMGD whose connection is requesting produces non-significant impacts. In that case, no additional works will be required for connection or technical studies. Therefore, the distribution company must issue a Connection Criteria Report (ICC) according to the format established in Form N° 7.

9 According to article 34° bis of S.D.N° 244 the criteria for determining non-significant impacts on the network are as follows:
a) Feeder power flow in megawatt compared to feeder design capacity.
b) The short-circuit-power ratio to determine the impact on the voltage of the feeder.
c) The contribution of PMGD to the short-circuit current of the primary distribution substation and the distribution networks.
d) Compliance with the coordination of protections.
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.

Otherwise, if the PMGD has a significant impact on the network, the distribution company must indicate on Form N°4, the maximum power that the PMGD could have in order to be classified as having a non-significant impact. In turn, the distribution company must indicate the technical studies that must be carried out to evaluate the impact of the connection to the PMGD network.

Stage 5: Conducting studies (only for generators whose impacts are significant)
If the PMGD is not qualified as INS, the distribution company will indicate, through Form N°4, the technical studies that must be carried out to evaluate the impact of the connection. With this information and within 5 working days after receipt of Form N°4, the interested party must notify the distribution company if the technical studies will be carried out on their own account or by the distribution company, using Form N° 5.

The technical studies to evaluate the impact of the connection of the PMGD in the distribution network will be made through an electrical model of the feeder, considering impedances and the lengths of each segment of the same. The generation means existing in the network and those foreseen to connect will be modeled, in addition to the future projects that the distribution company reports. The studies required by the distribution company cannot exceed the following[10]:

1) Power flow study that aims to verify that after the connection of the PMGD, the voltages at the feeder nodes within the ranges of the current regulation are met, that the individual impact of the PMGD by voltage rise complies with the Standard and that the load levels in the feeder elements do not exceed 85% of the thermal capacity.
2) Study of short circuits that aims to verify that, before the connection of the PMGD of the interested party, the breaking capacities of the interrupting equipment of the distribution feeder are not exceeded.
3) Coordination study that will define the criteria and adjustments of the protections associated with the connection of the PMGD, together with verifying the correct coordination of the existing protection system associated with the feeder where it is connected.

10 Further information on studies are specified in Title 2-3 "Technical Studies" of the NTCO.

In the event that the interested party has opted to carry out the technical studies on their own, these must be sent to the distribution company in the terms and stages agreed by both parties, using Form N°6A at each stage. Otherwise, if the distribution company carries out the studies, then once the final results are available, it must be communicated to the interested party through Form N°6B.

Each time the interested party has received the Form N°6B, it must respond indicating its agreement with the results and if there is interest to continue with the connection process. To do this, it will use Form N°6. In case there is disagreement on the part of the interested party, it has a term of 20 calendar days to communicate it to the distribution company with a copy to the SEC. The distribution company will have 10 days to respond to the disagreement presented.

Stage 6: Study of Connection Costs

Within a maximum period of 4 months from the date of submission of the SCR, the distribution company must issue a Connection Criteria Report (ICC) that must contain the connection costs and that must be sent to the interested party with a copy to the SEC. Form N°7 will be used for this purpose.

The study of connection costs should not be made in the event that the PMGD of the interested party has been classified as having a non-significant impact.

The approval of the ICC will be done through Form N°8.

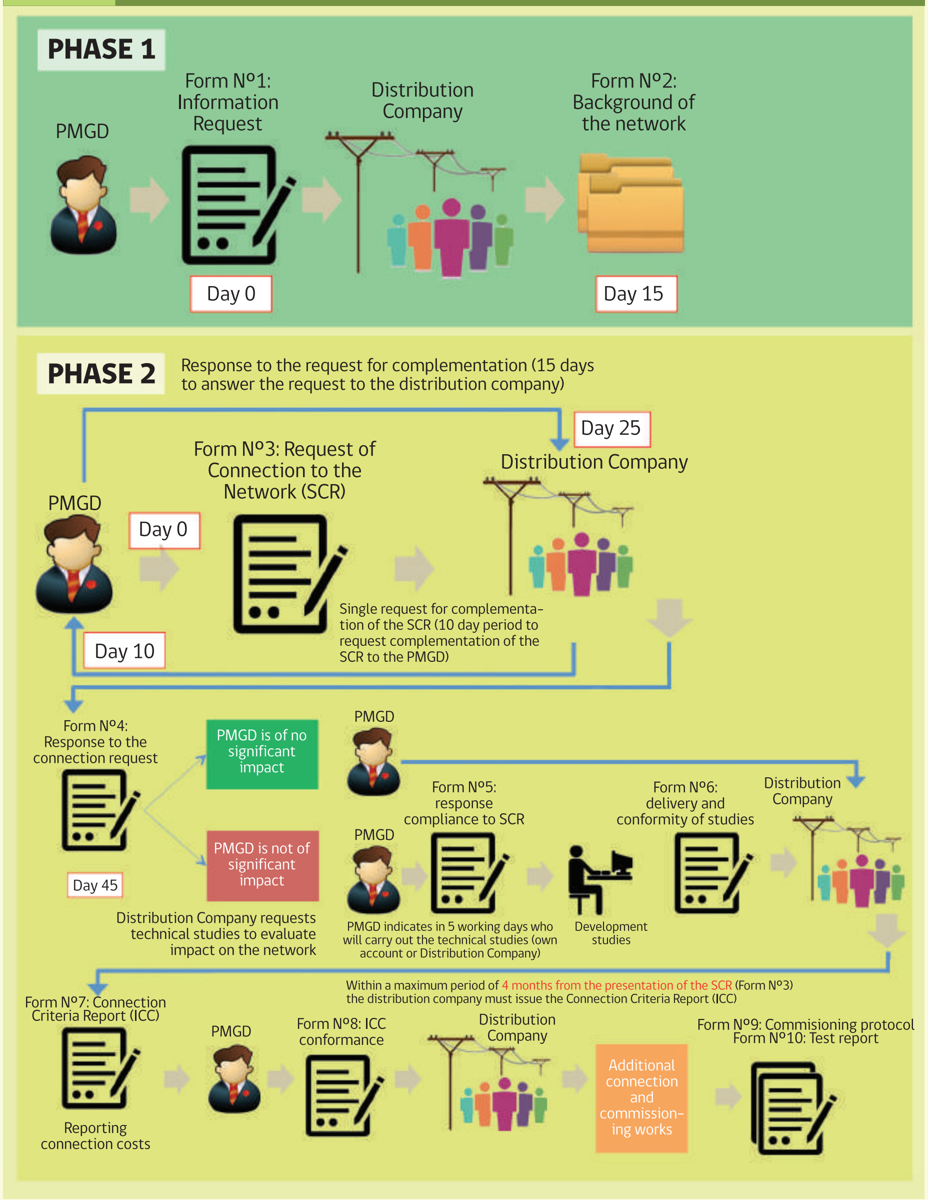
Stage 7: Additional works and commissioning

At this stage, additional works must be performed (if required). The Protocol of Commissioning through Form N°9 and the Report of Tests through Form N°10.

In cases of disconnection, withdrawal, modification or cessation of operation, it was reported through Form N°11.

Figure 08

Connection and commissioning procedure for a PMGD



Source: Own Elaboration.

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.

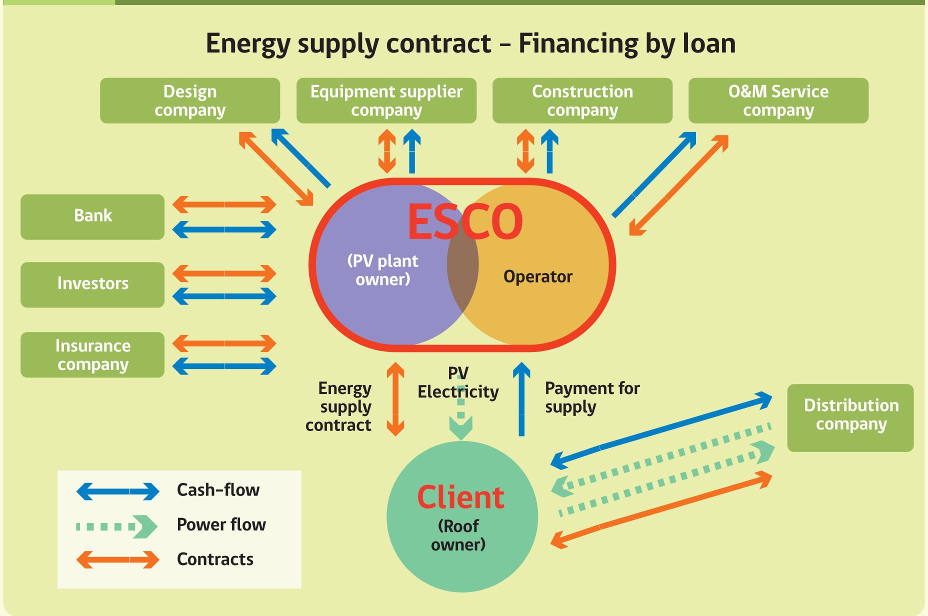
4.5 ESCO Model (Energy Service Company)

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 09 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.

5

Annex 5: Information Platforms

5.1.1 Prospecting of resources

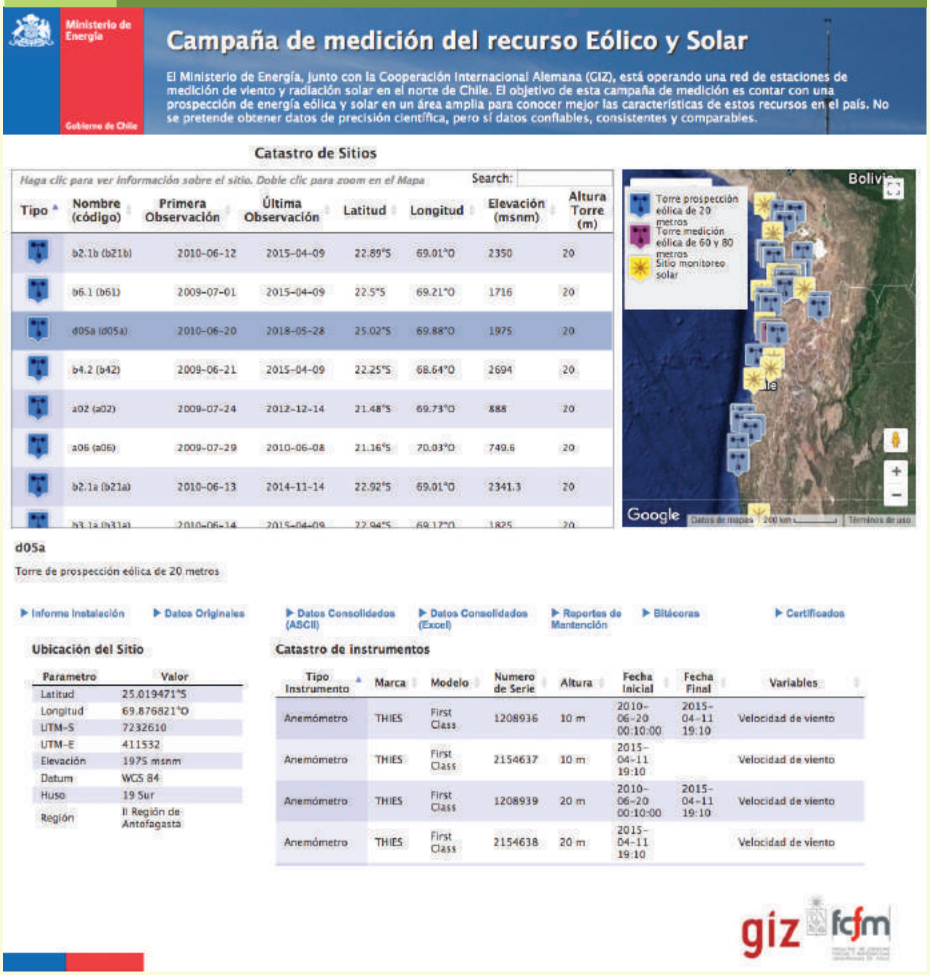
One of the pillars of the Program of Support to the Development of the NCREs carried out by the Ministry of Energy is the generation of public information on the natural resources present in Chile, which will guide, through an up-to-date background both to its development policy and to potential investors.

In this context, the Ministry 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.

5.1.2 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. As of January 2018, the Ministry of Energy maintains more than 80 stations for solar and wind radiation measurements. The data associated with each of these stations are open to the public (see Figure 10).

Figure
10 Web site capture with solar and wind resource measurement database



Source: Ministry of Energy
Web: http://www.energia.gob.cl/energias-renovables

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)[11] exceeds 3,000 kWh/m2 per year.

5.1.2.1 Wind and solar energy explorers

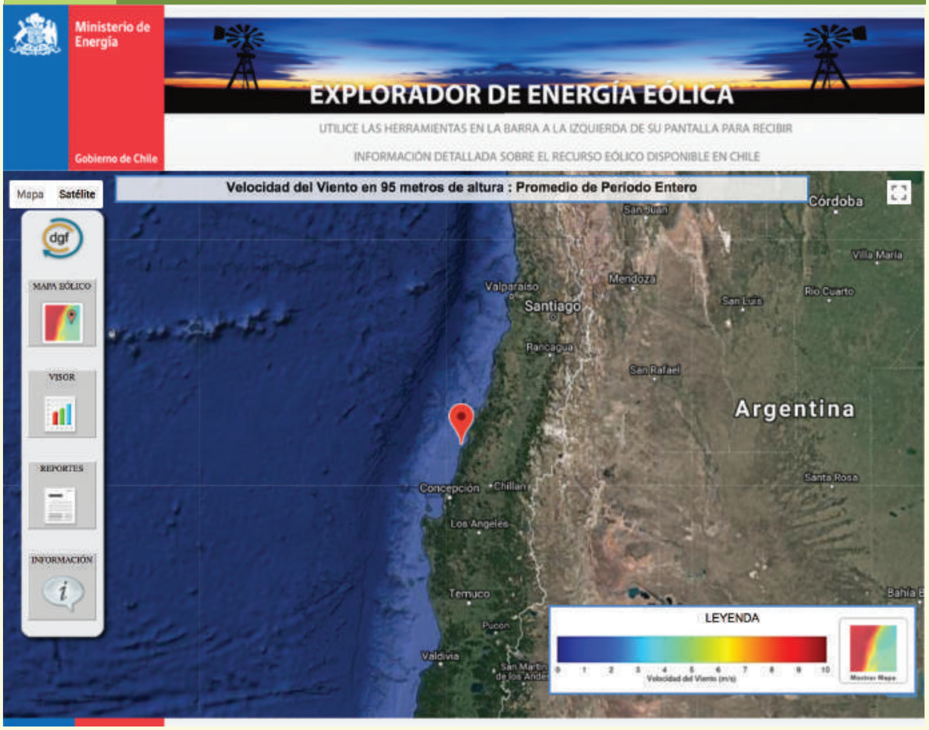
The Ministry of Energy has promoted the application of numerical modeling tools for the atmosphere for purposes of characterizing the potential of NCRE in Chile. These efforts, which continue today, have enabled the development of interactive tools that provide an indirect assessment of the wind and 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[12].

Notwithstanding the usefulness of these tools for the identification and evaluation of potential areas for NCRE projects, their results 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 11 summarizes the wind data obtained from atmospheric behavior simulations developed using the Weather Research and Forecasting (WRF)[13] 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, 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 simulated period includes the 12 months of the year 2010. However, due to the absence of wind records of adequate quality and public access, it has not been possible to evaluate them in all the areas covered by the modeling, where this has been possible. Results of the model have shown a good correspondence with the measurements. The results have been validated with wind observations at more than 350 sites throughout the country.

11 Calculated by the Fraunhofer ISE Institute of Germany
12 In the following link: http://www.energia.gob.cl/energias-renovables
13 WRF is developed and administered by the National Center for Atmospheric Research (NCAR) of the United States of America. It corresponds to an advanced non-hydrostatic mesoscale model that solves the primitive equations that control the atmospheric circulation. The model simulates the behavior of the fundamental variables of the atmosphere in a three-dimensional grid (the three components of wind, temperature, pressure, humidity and several microphysical species representing different phases of the water).

Figure 11 **Wind Energy Explorer**

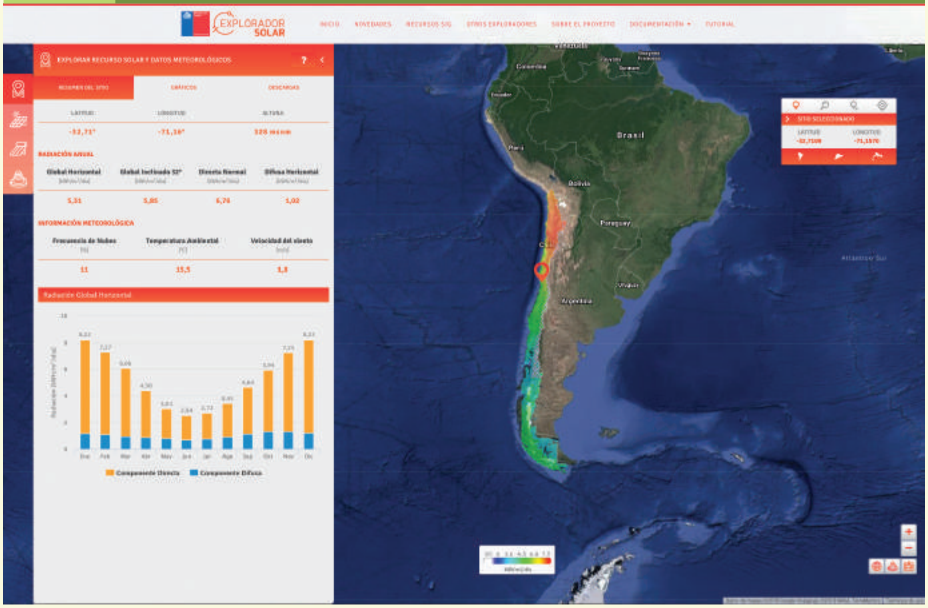


Source: Ministry of Energy.
Web: http://www.energia.gob.cl/energias-renovables

Among the capabilities offered by the Wind Energy Explorer based on the results of the WRF simulations are the representation of the diurnal and seasonal variability of the wind (maps and graphs), the visualization of wind fields in various periods of time and levels over the soil, production estimation for hundreds of types of wind turbines and the extraction in text files of wind time series and simulated wind generation. In addition, it has a tool for the reconstruction of series of winds of daily resolution for a period of 31 years, of interest for the estimation of variability on a year-on-year basis. This climatic reconstruction is based on a statistical analysis of the data modeled by WRF for the period 2010 and the results of analysis of global models for the study period.

On the other hand, the Solar Energy Explorer presented in Figure 12 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.

Figure 12 **Solar Energy Explorer**



Source: Ministry of Energy.
Web: http://www.energia.gob.cl/energias-renovables

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 2015, 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.

5.1.2.2 Explorer of rights to use non-consumptive waters

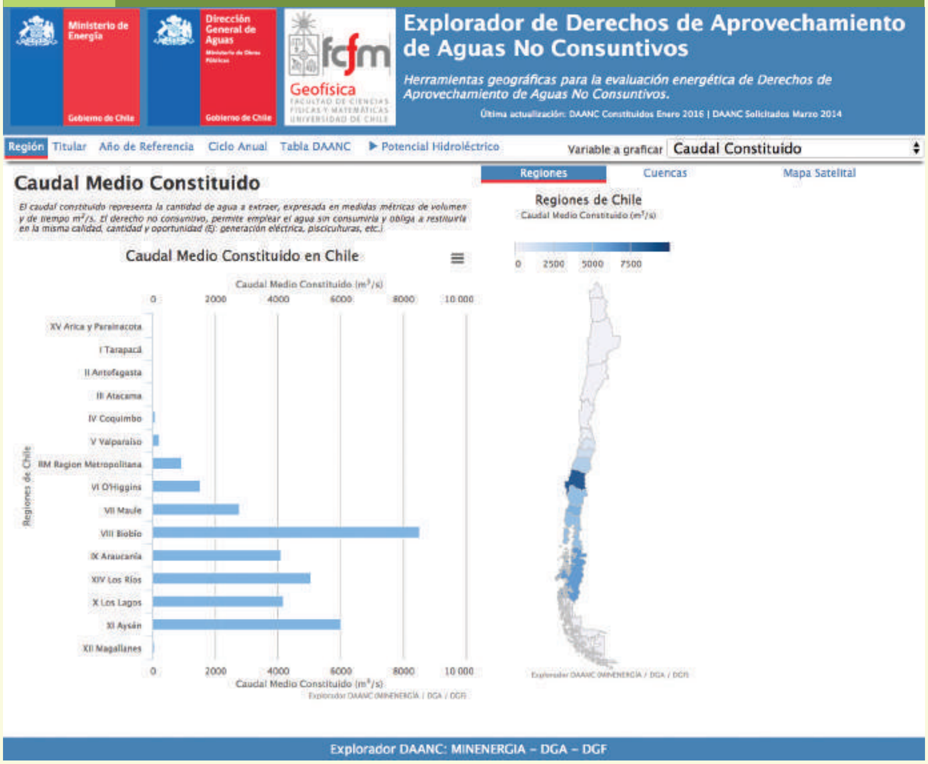
The Ministry of Energy from 2014, and in compliance with the commitments made in the Energy Agenda, has implemented the Exploration of Non-Consumption Water Use Rights (DAANC), with the purpose of maintaining and operating an information platform updated and georeferenced information on the rights of use of non-consumptive waters granted for use in hydroelectricity in the SIC 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[14].

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 13)

14 In the following link: http://walker.dgf.uchile.cl/Explorador/DAANC/

Figure 13 **Exploration of Non-Consumption Water Use Rights**



Source: Ministry of Energy
Web: http://www.energia.gob.cl/energias-renovables

5.1.2.3 Forest Bioenergy Explorer

The CONAF Territorial Information System (See Figure 14) 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 14 Forest bioenergy explorer

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

5.1.2.4 Marine Explorer

The marine exploration (See Figure 15) 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 with a resolution of 1 km. 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 15 **Marine Power Explorer**

Source: Ministry of Energy
Web: http://www.energia.gob.cl/energias-renovables

6 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
Economic Load Dispatch Centers (CDECs)	Former name of the Independent Coordinator of the National Electrical System (See definition of Coordinator).	Annex 3: Adequacy power

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 Coordina-tor of th 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 commis-sioning 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 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 Econoco-mic 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	Short-term electricity market where the sellers offer in the pool the prices and quantities of electricity, and the generators are dispatched to supply the demand. A pool covers the functions of a bag and a system operator. These functions can be performed by a single entity, or alternatively, can be differentiated.	Section 3.2 Model of the electricity market Section 3.3 The spot market
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 companys 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. Ancillary services are those services that allow at least adequate frequency control, voltage control and service recovery plan, both under normal operating conditions and before contingencies.	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

7

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 21.118 of 2018 (modified Netbilling Law)	https://www.leychile.cl/Navegar?idNorma=1125560
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

Regulation	Link
Supreme Decree N°327 of 1997 (LGSE Regulation)	http://bcn.cl/1uz8k
Supreme Decree N°244 of 2006 (PMGD Regulation)	http://bcn.cl/1v8zq
Supreme Decree N°62 of 2006 (Power adequacy regulation)	http://bcn.cl/1vx70
Supreme Decree N°130 of 2011 (Ancillary Services Regulation)	http://bcn.cl/1vz7a
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°71 of 2014 (Regulation Netbilling Law)	http://bcn.cl/1uwk0

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/

Annex 8: Electric Systems of Chile

Figure 16 Electric Systems of Chile

Figure 16

Electric Systems of Chile (Continuation)

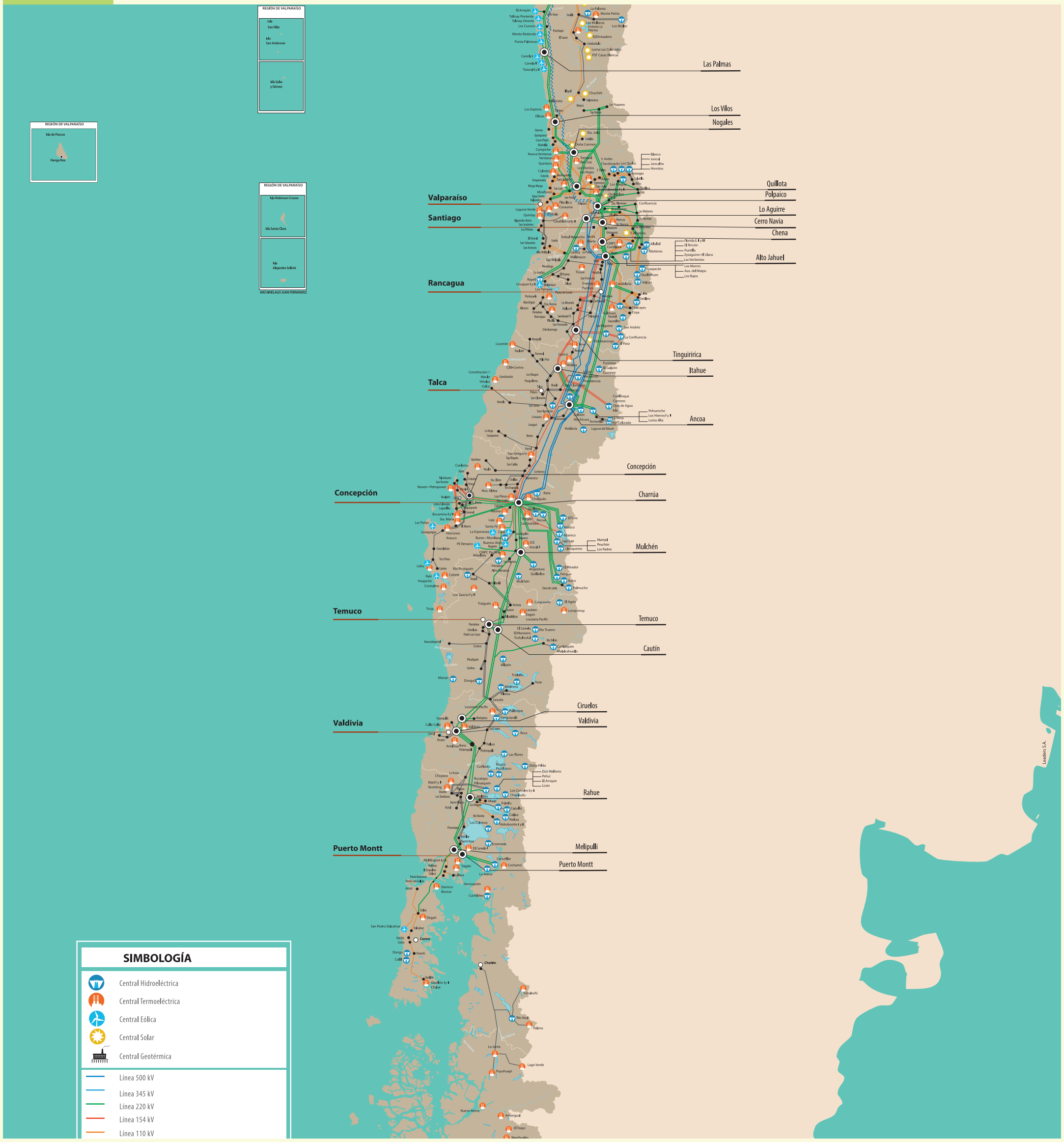


Figure 16

Electric Systems of Chile (Continuation)

Source: Map published by the Coordinator, December 2017.

November, 2018

http://www.minenergia.cl/mercadoernc/