

Chilean Electricity Market



About us



- Systep is a Chilean company specialized in consultancy services in the energy sector
- Systep was founded in 1989 by Dr. Hugh Rudnick, Emeritus Professor at Pontificia Universidad Católica de Chile
- Our main goal is to support our clients in their strategic decisions
- Systep is comprised of four areas that develop a wide range of solutions for the energy industry



Market Intelligence Services



Investment assessment

- Investment decisions
- Project finance
- Merge & acquisitions
- Procurement processes

Market operation projections

- Generation
- Marginal costs
- Generations costs and tolls
- Capacity revenues
- Ancillary services

Monitoring

- CEN and market monitoring
- Prices and demand monitoring

Power purchase agreements (PPAs)

- Modeling
- Negotiation and arbitration
- Procurement



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Electricity Market and Regulation Services

Studies in regulation and pricing

- Added value of distribution
- Transmission pricing
- Pricing in medium systems

Regulatory framework

- Regulatory changes
- Development of the regulatory framework in the energy sector
- Comparative studies of
 international experience

Expert opinion and arbitrations

- Support in arbitrations
- Damage analysis for insurance companies







Feasibility connection studies (Support in conceptual design and project investment decisions)

- Verification of compliance with regulatory requirements of design and operation
- Estimation of interconnection costs

Connection studies

(Support in obtaining approval connection by the authority and third Parties)

- Static and Dynamic Impact, Short Circuit, Harmonics, EMT and other studies
- Protections studies
- Reliability of electrical systems

Others

- Planning and expansion of electrical systems studies
- Technical support services to companies receiving connection requests from third parties
- Standardization of design rules and specification of electrical installations

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Planning and Electrical Studies Services







Research and Development Services and relevant studies





Development of internal tools

- New products development and processes
 improvements
- Software development for internal purposes
 - Hourly electric operation model (HELO) for marginal costs projections
 - Ancillary services model

Major studies

- Projected payments for ancillary services -ENAP
- Hourly marginal costs projection -Solairedirect
- Analysis of the impact of Guacolda technical minimum – Enel Green Power
- Analysis of the impact of GasAtacama
 technical minimum



Some of our clients



Generation

Transmission and Distribution

> Large Consumers

Banking and Investors

Government and Associations



MARGINAL COST, SUPPLY AUCTIONS, TARIFF AND PRICES



During 2022 spot prices showed an upward trend, reverting low prices of previous two years



Riesgos del sector energético: costos marginales tuvieron aumento promedio de 97% en 2021

El reporte de Orrisk señala que en diciembre se detectó «un descenso importante de las horas con vertimiento se notó en la barra P. Montt, presentó un 85% menos de horas en la condición señalada».



Revista Electricidad (January 2022)

Precios de la energía llegaron a US\$309 MWh en Alto Jahuel a mediados de agosto

Reporte semanal de Antuko registró una participación de 64,8% en la generación de combustibles fósieles, siendo el diésel el que tuvo la mayor variación, manteniéndose por encima del 6%



Revista Electricidad (August 2021)

Costos marginales: Alto Jahuel registró mayor promedio desde 2014: US\$144 por MWh

Según reporte semanal de Antuko, esto respondió a indisponibilidades térmicas, menor disponibilidad del recurso hídrico, congestiones en transmisión y a los mayores precios que anotan los combustibles.



Revista Electricidad (July 2021)

Crisis hidroeléctrica: los seis puntos del Plan de acción preventivo que mostró Jobet en el Congreso

El biministro mostró a los diputados de la Comisión de Minería y Energía, la situación del sistema eléctrico y las medidas que están impulsando.



Revista Electricidad (August 2021)



LEYES, REGLAMENTOS, DECRETOS Y RESOLUCIONES DE ORDEN GENERAL

Núm. 43.031

Miércoles 18 de Agosto de 2021

Página 1 de 10

Normas Generales

CVE 1996000

MINISTERIO DE ENERGÍA

DECRETA MEDIDAS PREVENTIVAS QUE INDICA DE ACUERDO A LO DISPUESTO EN EL ARTÍCULO 163º DE LA LEY GENERAL DE SERVICIOS ELÉCTRICOS

Diario Oficial (August 2021)

High marginal costs in 2022 are due to a combination of different factors



There is no single factor that isolated could explain the marginal costs increase during 2022, being rather the combined occurrence of four events at the same time.



Still, not all zones of the system and periods of the day experienced the same trend



Rather than constant high marginal costs, we have been experiencing important prices variability and volatility, either at different periods of the day or geographic zones.

- During daytime hours marginal costs tended to be aligned with values of previous two years, but during night, values tended to increase depending on the availability of base-load generation to replace solar PV production.
- There were transmission congestions at relevant 500 kV and 220 kV transmission lines, mainly visible in the decoupling of prices at Puerto Montt area (extreme south of the system), and between northern/central/southern areas of the SEN in daylight hours.



Real hourly marginal costs for a typical day in selected months of year 2021

Supply auction 2022/01 was only partially awarded





- The 2022/01 auction process awarded only 14.8% of the total energy considered (5,250 GWh/year).
- After four consecutive falls in the average awarded price, the downward trend ended in the 2022/01 auction process(37 USD/MWh).

Supply auction 2022/01 was only partially awarded



Power plant	Injection Node	Company	Technology	Capacity (MW)	Awarded / generation ratio (*)
Tirana Oeste	Nva. Pozo Almonte 220	Fotowatio Renewable	Solar PV	120.4	76%
Loncualhue	Nva. Cauquenes 220	Ventures	Wind	187.2	, 0,0
Zaldívar	Nva. Zaldívar 220	Canadian Solar	Solar + BESS	250 + 35	19%
	ΤΟΤΑ	L		592.6	51%

(*) ratio between awarded energy and total energy production for one year, estimated according to plant's capacity factor.

- In the case of Canadian Solar, the energy awarded represents only 20% of the theoretical production of the supporting projects, so the company could adjust the installed capacity and/or seek additional contracts to reduce spot risk.
- In the case of Fotowatio Renewable Ventures, the awarded energy represents 85% of the theoretical production of the supporting projects.

Upcoming auction processes for regulated customers



- According to the Final auction Report 2021 issued by the CNE in September 2021, within the remainder of the year and in 2023 new bidding processes should be started, mainly due to the expiration of existing contracts.
- The next annual report will be issued in September 2022 (definitive version), defining the energy volume to be auctioned in the next process.
- Given the results of Auction 2022/01, it is possible that the new processes include additional changes in their terms of reference.

Year	Start of supply	Energy to auction (GWh/year)
2022	2027	5,250
2022	2028	2,500
2023	2029	1,180
2024	2030	1,200
2025	2031	1,700

DIARIO FINANCIERO°

Industria

Ministro Huepe: "Nuestras licitaciones tienen que ser mucho más integradas"

Este lunes se realizó el acto de adjudicación del último proceso de suministro eléctrico a clientes regulados. Diario Financiero (August 2022)

Distribution tariffs: VAD 2020-2024 study is already delayed 2 years



The VAD process comprises several stages, led led by CNE.



The ongoing 2020-2024 VAD study started development.

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			Fecha
New	tariffs valid from (retroactiv	e payments)	November 2020
New	tariffs valid until		October 2024
Publi	cation of New tariff Decree	(estimated)	Q1-2023

Customer tariffs paid by end users have been stabilized since 2019 and will remain unchanged until the new Tariff Decree is published. The current tariff process will be the first one using the new discount rate 6% (posttax), introduced with the enactment of the Distribution Short Law in 2019 (previous rate was 10% pre-tax).

Firma pertenece a la gigante asiática State Grid:

CGE reclama ante Contraloría por proceso tarifario y advierte impactos

Desde la distribuidora apuntan a la exclusión de un indicador de calidad de servicio, lo que provocaría rentabilidad negativa para la empresa, y efectos en la operación del sistema y en inversiones.

Economía y Negocios, El Mercurio (August 2022)

Transmission charges: the ongoing Tx valuation process is expected to end with a 3-year delay



The Transmission Valuation Process is led by the CNE.



Currently, Transmission Valuation Study 2020-2023 is being reviewed by the Comptroller General of the Republic.

New Tariffs	Date
Valid since (retroactive payments)	January 2020
Valid until	December 2023
New tariff decree (estimated)	H1 2023

This is the first study under the new transmission law, which changed the discount rate from 10% (pretax) to 7% (post-tax). Transmission charges are stabilized until the publication of the new rate decree.

The valuation of assets was reduced by an average 13% with respect to the current value in dollars.

Comisión Nacional de Energía emite Informe Técnico Definitivo de Valorización de la Transmisión cuadrienio 2020-2023

Consideró la aplicación del dictamen N°12-2021 del Panel de Expertos, el resultado del proceso arrojó una disminución promedio de 13% de la valorización de las instalaciones de transmisión respecto del valor vigente en dólares.

Revista Electricidad (March 2022)

Regulated tariff components

[USD/MWh]

Regulated Tariff components:

- Energy: competitive auction process.
- Capacity: Regulated price (CNE study).
- Transmission: Regulated price (Tx valorization process + Auctions for Tx expansion).
- Distribution: Regulated price (VAD process).

For a typical residential client, energy component accounts for more than half of the total bill (varies depending on the city).



All main tariff components are temporarily stabilized since Q4-2019





EXPANSION OF GENERATION AND TRANSMISSION

Generation expansion for 2022-2030

 Projects under construction over 9 MW, in development with certainty of materializing and decommissioning plants.



(*): Values for 2022 consider only

- Decarbonization process included.
- Dominated by the entry of renewable technologies.
- Reconversion of two units to run on gas: Generadora Metropolitana, Los Vientos (130 MW), and Engie, IEM (349 MW).

Main future generation units will be located in the north of the country





Includes reconversion of plants as a result of decarbonization
 Values for 2022 consider only from April



Main current restrictions of the transmission system

The SEN transmission system has limitations in some areas of the country (June 2022):



Average marginal cost at representative nodes

Main transmission expansion projects for the next 10 years



Main expansions officialized by decrees



In August 2022, the CNE issued the <u>Final Technical Report of the 2021 Transmission</u> <u>Expansion Plan</u>, which contains a total of 38 expansion works, with a total expected investment of USD 537 million.

RECENT AND ONGOING REGULATORY CHANGES TO CHILEAN POWER MARKET





Piñera anuncia creación de mecanismo de estabilización de tarifas eléctricas para anular alza

El mandatario formuló esta medida al dirigirse al país desde La Moneda, donde se refirió a la Agenda Social que impulsará el gobierno junto a los partidos políticos de oposición, como una forma de dar respuestas a las demandas que han surgido en el marco de la crisis de estallido social que vive actualmente el país.

Revista Electricidad (October 2019)

Se superó límite de US\$ 1.350 millones del PEC: Fin de fondo de estabilización presiona al alza cuentas de la luz

Desde el gobierno aseguraron que el 80% de los clientes no verán concretarse esta variación en todo este año, gracias a un nuevo mecanismo de congelamiento.

El Mercurio (May 2022)

Systep advierte necesidad de diseñar otro mecanismo ante agotamiento de los fondos de estabilización de precios

Reporte mensual de la consultora analiza el actual escenario de la pandemia de Covid-19, señalando que el menor flujo de ingresos de las empresas eléctricas, se deberá implementar un nuevo fondo que evite efectos adversos, como alzas de tarifas.

Revista Electricidad (May 2020)

Energía

Alza del dólar e inflación pone a prueba mecanismo de estabilización de las cuentas de la luz

Según los análisis de la consultora Systep, habrá alzas transitorias que podrían ser importantes dependiendo del tipo de cambio o la inflación, siendo la primera en enero del próximo año. Recién el 2028 se experimentarían bajas.

Diario Financiero (November 2021)

Tariff stabilization mechanism reached its max limit



Main rules of the stabilization mechanism are the following:

- Prices are stabilized in nominal values (Chilean pesos) from 2019 to 2020. From 2021 onwards, tariffs are adjusted only by Chilean inflation (IPC).
- The limit for accumulated balances is US\$ 1,350 million.
- If total accrued credits are projected to surpass the limit, regulated client's tariff must be increased in order to avoid that situation.
- Accrued funds can be accumulated until June 2023.
- From 2025 onwards tariffs may increase in order to extinguish all accumulated balances by December 2027.
- From 2026 onwards, accumulated balances will be adjusted by an interest rate.



Accumulated balances (US\$ million)

Source: CNE (June 2022)

In August 2022, the new tariff stabilization mechanism was approved



This new law complements the mechanism of Law 21,185 (known as PEC), given that the original stabilization fund of US\$1,350 million was exhausted earlier than expected. The Law 21,472 has the following main features:

- Injection of new resources to continue stabilizing tariffs, for an amount of US\$ 1,800 million.
- The mechanism cannot last beyond December 2032.
- Customer segmentation to define maximum energy tariff increases, as stated in the following table:

	Maximum energy tariff increase		
Segment	2022	2023 onward	
< 350 kWh	IPC	IPC + 5%	
350 - 500 kWh	IPC + 5%	IPC + 10%	
> 500 kWh	IPC + 15%	PNP	

• Creation of the Tariff Stabilization Fund, whose sole objective is to stabilize the tariffs of regulated customers. This fund will be financed by both free and regulated clients and can reach a maximum of US\$ 500 million.

Segment	CLP/kWh
< 350 kWh	0
350 - 500 kWh	0,8
500 - 1000 kWh	1,8
1000 - 5000 kWh	2,5
> 5000 kWh	2,8

Modification to the capacity recognition mechanism







Revista Electricidad (August 2022)

Different actors in the sector have expressed their concern regarding the correct recognition of the power of solar power plants and storage, which is low in the scenario studied by the authority.

Workshops and public consultation process have raised several questions from market agents:

- Calculation traceability
- Computational time required
- Only few study cases were analyzed
- Relevant aspects will be defined after the modified bylaw is approved

If the new mechanism is approved, the transition will be long lasting



- Modified bylaw will begin four years after its approval (Transitory Article N° 1).
 - The objective is to have enough time to develop the calculation models, collect the necessary data under new classifications, and publish first non-binding calculations.
- After the bylaw becomes active, the initial capacity of each power plant will be calculated as the average of current and proposed methodology over a 5-year mobile window (Transitory Article N°6).
- If the changes are approved during 2022:
 - New bylaw will begin ruling since January 2026.
 - Since January 2030 initial capacity will fully correspond to the ELCC methodology.

More than 5,000 MW of coal-fired capacity to be decommissioned by 2040



By 2019 the installed capacity of coal-fired units was 5,142 MW (28 generation units):



In 2019, generation companies signed voluntary agreements with the Ministry of Energy that consisted in the retirement of part of the coal fleet by 2025, and the remaining units no later than 2040. Since then, companies have accelerated the retirement of some power plants.

Agreement	First Goal	Second Goal
2019 original agreement	1,125 MW (8 units) with decommissioning scheduled until 2024	4,017 MW (20 units) to be decommissioned by 2040
Updated by recent announcements	3,344 MW (18 units) available for decommissioning, or with scheduled decommissioning, or reconversion, by 2025	1,849 MW (10 units) to be decommissioned by 2040

As of August 2022, 676 MW (5 units) have been decommissioned

Status of decarbonization process in Chile as of August 2022



Meta de descarbonización al 2024 se supera con salida de dos centrales esta semana

Se trata de Bocamina II, inaugurada en 2012, con la que Enel abandona por completo el uso del carbón en Chile, y de la

El Mercurio (September 2022)

Energía

Sale el carbón, pero entra el diésel: la paradoja que acompaña la esperada salida de la central Bocamina II

Diario Financiero (September 2022)

- Until July 2022, 6 coal-fired units were decommissioning, totaling 676 MW:
 - CTTAR (Enel Chile): 146 MW
 - U12 (Engie): 87 MW
 - U13 (Engie): 80 MW
 - Bocamina I (Enel Chile): 122 MW
 - Ventanas I (AES Andes): 106 MW
 - U14 (Engie): 136 MW
- For the first half of 2022, the closure of another 3 plants was expected, adding another 584 MW. However, for various reasons they had to be postponed to the second half of 2022:
 - Bocamina II (319 MW) y U15 (130 MW) due to generation supply shortage.
 - Ventanas II (194 MW) while a second 300 MVA transformer does not come into operation at the Agua Santa substation (local sufficiency problems).



Two bills are currently under discussion in Congress:

- Prohibition of installation and operation of coal-fired power plants throughout the country by 2025 ("accelerated decarbonization").
 - Income: 09-01-2020
 - Last citation: 06-23-2021
- Prohibition of injecting electricity from fossil fuels from 2030.
 - Income::21-11-2021
 - Last citation: 04-16-2022 (2 indications were submitted)
- President Boric during his campaign supported the withdrawal of coal plants by 2025, however after taking office he has not made an official statement on the matter.
- On August 17, 2022, the Chamber of Deputies approved <u>Resolution No. 113</u>, where the executive is requested to rule on the issue.



Hoy firmamos un compromiso por la descarbonización, el fin de las termoeléctricas y reparación para las personas afectadas en Quintero y Puchuncaví. Un nuevo modelo de desarrollo con trabajo digno y respeto al medioambiente es posible #ChaoCarbón #NoMásZonasDeSacrificio



Source: Twitter, August 2021 during the presidential campaign

Development and execution of large green hydrogen projects



América

Chile y Colombia encabezan la carrera por el hidrógeno verde en Latinoamérica

Fortalecer la demanda, ir trabajando en la regulación y crear toda una cadena de valor, son los principales desafíos para que esta apuesta se consolide en el mediano plazo.

DF SUD (September 2022)

Claudio Huepe: «En energías renovables e hidrógeno verde queremos mantener la continuidad»

Así lo explicó el futuro ministro de Energía quien participó en el Encuentro Hidrógeno Verde 2022, donde afirmó que buscará un desarrollo integral con algunos elementos de continuidad.

Revista Electricidad (March 2022)

CIENCIA Y ECOLOGÍA

Hamburgo, puerta de entrada del hidrógeno verde chileno

T+ T- 🖨 🕃

El Ministerio de Energía de Chile, el Ministerio de Economía e Innovación de la Ciudad-Estado de Hamburgo y la Autoridad Portuaria de la ciudad firmaron un acuerdo de cooperación para el suministro de hidrógeno verde. DW (September 2022)

Energía

Sigue el boom por el hidrógeno verde: Gigante francesa se suma a la carrera con nuevo proyecto en Magallanes

La empresa Total Eren impulsará "H2 Magallanes", iniciativa a gran escala en la región y que será la más grande de Chile, cuya construcción comenzará en 2025 para iniciar producción en 2027.

Diario Financiero (December 2021)

Desarrolladores de proyectos de hidrógeno verde se unen para crear H2 Antofagasta

La alianza está formada por Air Liquide, AES Andes, Aguas Antofagasta, Atacama Hydrogen Hub, Copec, Centro Científico Tecnológico para la Región de Antofagasta, Enel Green Power, Engie, FCAB, GNA, Inversiones Farías y LM Abogados.

Revista Electricidad (March 2022)

General context of green hydrogen in Chile



In November 2020, the Government announced an ambitious strategy to promote a green hydrogen industry in Chile, which will produce and export hydrogen and its derivatives, enabling both α transformation of energy production and utilization, and reduce country's carbon footprint seeking to reach the net-zero emission goal by 2050.



• In December 2021, a <u>new bill was presented</u> that seeks to promote a national green hydrogen market, through the establishment of hydrogen mixtures in natural gas networks and the authorization of the National Oil Company (ENAP) to participate in its development.

Development and execution of large green hydrogen projects



Generadoras de Chile announced the investments that are committed (by members companies of this association) to the electricity generation and green hydrogen sector over the next five years:

Proyectos de hidrógeno verde	Construcción (mm USD)	Desarrollo (mm USD)	Suma total (mm USD)
Haru Oni	68		68
Hyex		47	47
Faro Sur		500	500
Planta e-fuels Cabo Negro		1.000	1.000
Pauna Greener Future		540	540
Proyecto Andes		1.500	1.500
H2 CSP + PV Cerro Dominador		6	6
Total proyectos hidrógeno verde	68	3.593	3.661

Energy Agenda 2022-2026



In August 2022, the Ministry of Energy published the official "Agenda de Energía 2022-2026", detailing the general guidelines for the energy sector to be followed by the current government.

This agenda focuses on eight axes:





Source: Ministerio de Energía



New bill reforms the regulation regarding storage systems and promotes electromobility



On September 27 and 28, 2022, the discussion of the bill promoting storage systems and electromobility was resumed. Among other topics, the changes proposed are the following:

- Participation of independent storage systems in generation segment (not necessarily associated to a power plant).
- Storage systems with connected capacity up to 9 MW may choose the stabilized price regime to value injections to the grid.
- At end user level, storage systems (including electric vehicles) can inject energy to the network, whose valorization will be deducted from the monthly bill.

Almacenamiento: Systep plantea que la autoridad deberá monitorerar su desarrollo efectivo



Revista Electricidad (Marzo 2022)

Pardow ubica electromovilidad y almacenamiento como "prioridad" para impulsar 25 GW renovables

El nuevo ministro de Energía aseguró que desde el Ejecutivo respaldarán al proyecto de Ley de Almacenamiento y Electromovilidad que está en el Congreso y adelantó que un nuevo impulso al hidrógeno verde.

Energía Estratégica (September 2022)

 Temporarily exemption of annual registration certificate payment for hybrid and electric vehicles.

Storage systems can be tendered by the authority or installed by private initiative



Currently there are three ways to receive incomes by installing storage systems:

- In the private market, storage systems can receive energy arbitrage revenues in addition to capacity payments.
- Storage systems can participate in auctions for the provision of ancillary services. These auctions are carried out by the CEN.
- Storage systems as transmission assets are paid according to the annual value awarded in the corresponding tender. These projects may be considered in expansion plans if (i) they can replace transmission or if (ii) they improve the secure operation of the system (demand supply).

Large storage projects:

- Alfalfal virtual dam (BESS, 10 MW @ 5 hours). In operation.
- Andes Solar IIB (BESS, 112 MW @ 5 hours). Under construction.
- Power flows control system between
 Parinas and Lo Aguirre substations
 (BESS, at least 500 MW @ 15 minutes).
 Referential investment of USD 211
 million was included in the final version of the 2021 Transmission Expansion Plan, estimated COD 2026

DIARIO FINANCIERO[®]

Energía

Panel de Expertos ratifica primera incorporación de una obra de sistema de almacenamiento con baterías en un plan de expansión Diario Financiero (August 2022)

Priorities of the new energy minister, Diego Pardow

On September 14, the new Energy Minister announced in the Senate the legislative priorities for the short and medium term, where the following stand out:

- Storage and electromobility Bill.
- Subsidy to combat energy poverty.
- "Long law" of the gas market
- Modernization of the Superintendency of Electricity and Fuels (SEC)
- Promote the development of green hydrogen

Unlike the previous administration, there is no mention of a reform to the distribution sector through the incorporation of the energy retailers for regulated costumers. Participó ayer de comisión del Senado:

Pardow presentará en 2023 propuesta de subsidio eléctrico

Ministro de Energía expuso agenda legislativa, que incluye proyecto de almacenamiento, reforma del gas, modernización de la SEC, e impulso al hidrógeno.



El Mercurio (September 2022)



Contact



More information on the energy sector



Presentations

Releases

Reports

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