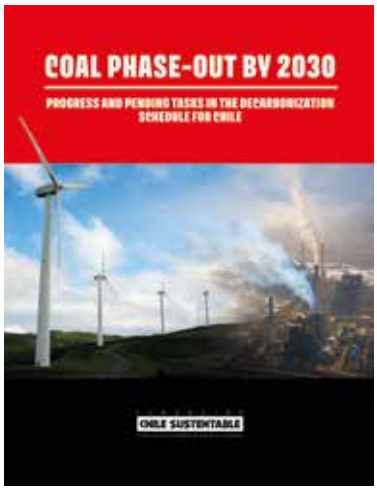
COAL PHASE-OUT BY 2030

PROGRESS AND PENDING TASKS IN THE DECARBONIZATION SCHEDULE FOR CHILE

FUNDACIÓN
CHILE SUSTENTABLE
Propuesta ciudadana para el cambio



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- **ISBN:**
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- **Authors:**
  Sara Larraín and Gonzalo Melej
- **Text editing:**
  Ximena Salinas
- **Translation:**
  Kerry Dudman
- **Diagramming and cover design:**
  Emiliano Méndez

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Authors:
Sara Larraín • Gonzalo Melej

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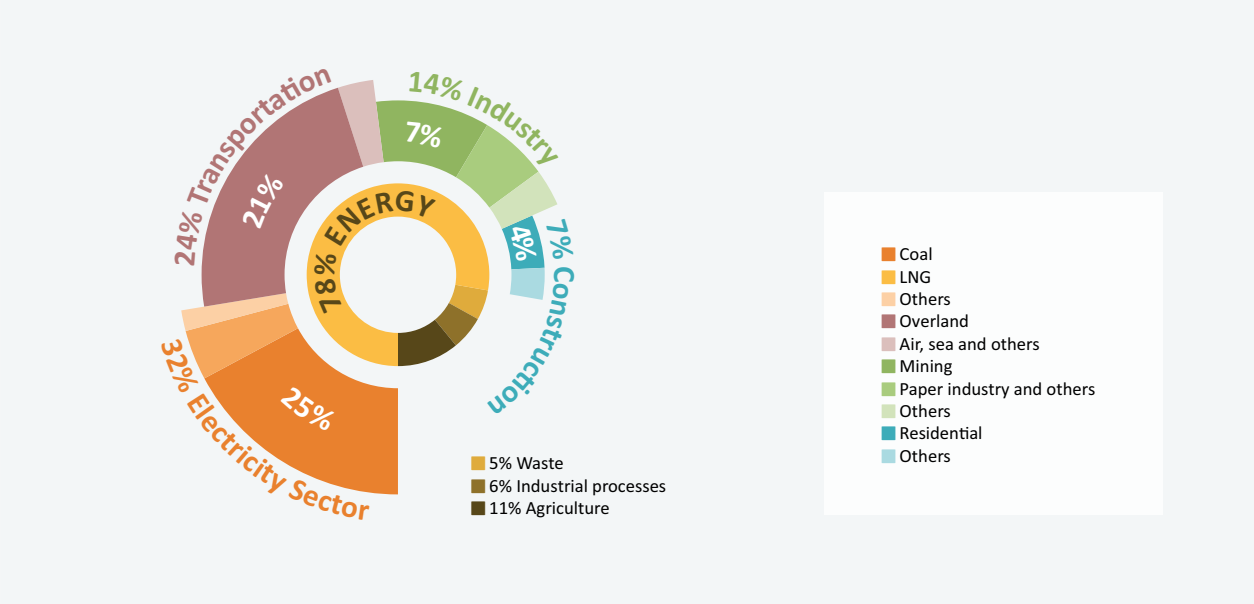
INTRODUCTION

The development of coal-fired power generation in Chile reached 22.5% of installed capacity in 2018.[1] Its expansion was mainly due to the fact that coal-fired generation was virtually the only response of the electricity market players to the restriction in the supply of Argentine gas as of 2003. However, Chile saw the emergence of a different scenario for the development of electricity with the enactment of Law 20,257[2] in 2008, which established mandatory quotas requiring that 10% of electricity come from Non-Conventional Renewable Energy (NCRE) sources by 2020; the subsequent increase of this quota in 2012 to 20% of electricity from NCREs by 2025; as well as public rejection to the construction of new coal plants (Castilla, Barrancones in Atacama) and mega hydroelectric plants (Hidroaysén in Patagonia); along with commitments to reduce Greenhouse Gas (GHG) emissions under the Paris Agreement in 2015.

The 2016 National GHG Emissions Inventory showed that 32% of Chilean Greenhouse Gas (GHG) emissions came from the electricity sector, and that most of them -25% as shown in graph 1- are caused by coal-fired power generation in 28 units, which emitted 30 million tons of CO2 equivalent each year, followed by gas and diesel (7%).

Graph 1: GHG Emissions Inventory in Chile as of 2016



Source: Ministry of Energy 2020[3] based on INGEI 2016.

1 National Electricity Coordinator, 2019. Reporte Anual 2018. https://www.coordinador.cl/wp-content/uploads/2019/07/reporte2018.pdf

2 Library of the National Congress. Ley 20.257; Introduce modificaciones a la Ley General de Servicios Eléctricos respecto de la generación de energía eléctrica con fuentes de energías renovables no convencionales. https://www.bcn.cl/leychile/navegar?idNorma=270212

3 Ministry of Energy, 2020. Carbono neutralidad en el sector energía, proyección de consumo energético nacional 2020. https://energia.gob.cl/sites/default/files/pagina-basica/informe_resumen_cn_2019_v07.pdf

In this context, as COP 25 was approaching in Chile in 2019, the government at the time and the 4 companies that owned the 28 coal-fired thermoelectric plants presented a voluntary commitment to decarbonization and a schedule for the phase-out of 8 coal-fired plants by 2024.[4] The group also proposed that the schedule be reviewed every 5 years to incorporate new commitments and complete coal phase-out by 2040.

Subsequently, in the Framework Law on Climate Change, processed in 2020 and 2021 and enacted in 2022, Chile established the obligation to reach carbon neutrality by 2050 through the establishment of sectoral emission mitigation and adaptation plans. Simultaneously, the updated Nationally Determined Contribution (NDC), submitted by Chile to the Secretariat of the Climate Change Convention in 2020, established a budget of 1,100 MtCO2 for the 2020-2030 period, with a peak in 2025 and a subsequent sustained reduction until carbon neutrality is achieved by 2050.

As of December 2022, fossil thermal generation in Chile reached 37.1% of Chile's electricity generation, ten percentage points less than December 2021,[5] while non-conventional renewable generation accounted for 34% of the generation of the National Electricity System (SEN), 5% more than in 2021. However, although renewable energy is increasingly present in the country's electricity generation, there are still major obstacles and important regulatory challenges for its penetration to achieve the defossilization goals of the electricity sector, which continues to be the main source of GHG emissions on a national level, with 26% according to the latest National GHG Emissions Inventory from 2022;[6] and then move on to industry and transportation, with 14% and 24%, respectively, of CO2 eq emissions.

The purpose of this document is to show the progress that has been made on the implementation of the decarbonization schedule committed by the companies in 2019, and to present an update and announce new dates for the phase-out and reconversion of coal-fired power plants by 2025. It also aims to show that there are companies that have not yet committed to a date for the closure or reconversion of their coal-fired plants. The document also presents the main short- and medium-term social, institutional, regulatory and technological challenges faced by Chile in its progress towards a just and accelerated energy transition that will enable the country to meet the goal of phasing out all coal-fired power plants by 2030, end local pollution in the areas denominated sacrifice zones and simultaneously comply with the climate commitments included in the NDC and the Framework Law on Climate Change.

4 Ministry of Energy, 2020. Plan de retiro y/o reconversión de unidades a carbón. /https://energia.gob.cl/sites/default/files/plan_de_retiro_y_o_reconversion_centrales_carbon.pdf

5 National Electricity Coordinator, 2023. Informe Mensual enero 2023. https://www.coordinador.cl/wp-content/uploads/2023/01/CEN-Informe-Mensual-SEN-ene23.pdf

6 MMA, 2020. Inventario Nacional de GEI serie 1990 - 2020. https://snichile.mma.gob.cl/Documentos/

COAL PHASE-OUT: HOW ARE WE DOING?

In 2018, 28 coal-fired thermoelectric power plants were operating in Chile, which were responsible for 37.6% of all electricity generation in the country.[7] These plants were owned by 4 companies: AES, ENGIE, ENEL and COLBÚN, located in 6 municipalities: Iquique, Tocopilla, Mejillones, Huasco, Puchuncaví and Coronel (See Figure 1).

Figure 1. Coal-fired power plants operating in Chile as of 2018

Company	Number of Plants	Capacity	Location
AES	15 plants	3014 MW	Tocopilla (2), Mejillones (4), Huasco (5) and Puchuncaví (4)
ENGIE	9 plants	1505 MW	Tocopilla (4) and Mejillones (5)
ENEL	3 plants	636 MW	Iquique (1) and Coronel (2)
Colbún	1 plant	370 MW	Coronel (1)
TOTAL	**28 plants**	**5525 MW**	

Source: Prepared with data provided by the Ministry of Energy 2020.[8]

As part of the preparations for the COP 25 Climate Change Summit to be held in Chile, in June 2019 the government announced a voluntary decarbonization schedule for the electricity sector, with the aim of phasing out the 28 power plants and putting an end to coal-fired generation by 2040. In the initial stage, the schedule established the closure of the 8 oldest plants by 2024. The commitment was for the second stage for the medium and long term to be proposed every 5 years until completing the total phase-out of coal-fired generation by 2040.

Photograph: Ventanas Power Plant, Puchuncaví / Source: Chile Sustentable.

7 National Electricity Coordinator, 2019. Reporte Anual 2018. https://www.coordinador.cl/wp-content/uploads/2019/07/reporte2018.pdf

8 Ministry of Energy, 2020. Plan de retiro y/o reconversión de unidades a carbón. Figure 2. /https://energia.gob.cl/sites/default/files/plan_de_retiro_y_o_reconversion_centrales_carbon.pdf

This decarbonization plan began its implementation the same month of the announcement (June 2019), with the closure of ENGIE's Tocopilla U12 and U13 units, and continued in December 2019 with the closure of ENEL's Tarapacá power plant, located in Iquique. In December of the following year (2020), ENEL's Bocamina I plant in Coronel and AES's Ventanas I plant in Puchuncaví were closed. Finally, between June and October 2022, ENGIE's Tocopilla U14 and U15 and ENEL's Bocamina II plants were shut down.

Therefore, between 2019 and 2022, 8 coal-fired thermoelectric units have been closed in Chile: 3 from ENEL (all its plants), 4 from ENGIE and only 1 from AES. During this period, in 2021 AES sold the 5 Guacolda power plants located in Huasco to the investment group Capital Advisors (which has not expressed a commitment to close them) and did not fulfill the commitment to phase out the Ventanas 2 power plant, whose closure was committed for mid-2022 in the decarbonization schedule.

In June 2023, 20 coal-fired thermoelectric units were still operating in the country, with a capacity of 4,327 MW. They represent approximately 30% of the country's electricity generation and are also the main source responsible for CO2 emissions from the entire national energy sector (MMA, 2020).[9] The closure of AES Ventanas 2, located in Puchuncaví, which should have occurred at the end of 2022, is still pending. The justification is that work at the Agua Santa substation in the Valparaíso region has not yet been completed.

Commitments to close by 2025

ENGIE is committed to close the CTM1 and CTM2 plants in Mejillones by 2024. By December 2025, it is committed to the conversion to biomass of the Andina and Hornitos plants and the conversion to gas of the "Infraestructura Eléctrica Mejillones" (IEM) plant, all located in the city of Mejillones.

In July 2021, AES informed the Financial Market Commission (CMF for its acronym in Spanish) and the National Energy Commission (CNE for its acronym in Spanish) of its willingness to cease the operation of its coal-fired power plants Ventanas 3 and 4 (Nueva Ventanas and Campiche) and Angamos 1 and 2, with a combined capacity of 1,097 MW, by January 1, 2025, if permissible under the system's security, sufficiency and economy.[10] In addition, on May 25, 2023, AES also informed the CMF about the definitive disconnection of its Norgener 1 and 2 units (276 MW), as of December 31, 2025[11] (See Figure 2).

9 MMA, 2020. Inventario Nacional de GEI serie 1990 - 2020. https://snichile.mma.gob.cl/Documentos/

10 Informe Hecho Esencial de AES Andes a la CMF, julio 2021. https://www.cmfchile.cl/sitio/aplic/serdoc/ver_sgd.php?s567=3976f41ebe05df-d7a9aea1048f5ba4eaVFdwQmVVMVVRVE5OUkVreVQxUk5lRTFSUFQwPQ==&secuencia=-1&t=1686691657

11 Informe Hecho Esencial de AES Andes a la CMF, mayo 2023. ttps://www.cmfchile.cl/sitio/aplic/serdoc/ver_sgd.php?s567=52c-c0c5330951537457e888780bc25e8VFdwQmVVMTZRVEZOUkVsNVRtcGpNazVSUFQwPQ==&secuencia=-1&t=1686691476

Figure 2. Commitments to close coal-fired power plants in operation as of June 2023 (12 units).

Company	Plant Name	Location	Situation	Capacity
ENGIE	Mejillones CTM1 & CTM2	Mejillones	Commitment to close by Dec 2024.	334 MW
ENGIE	Andinas and Hornitos	Mejillones	Conversion to biomass by Dec 2025.	351 MW
ENGIE	Infraestructura Energética Mejillones	Mejillones	Conversion to Gas by December 2025.	376 MW
AES	**Ventanas 2**	**Puchuncaví**	**Commitment to close by December 2022. *(NOT MET)***	**208 MW**
AES	Norgener NT01 & NT02	Tocopilla	Request to CNE to close by December 2025. *(No response)*	276 MW
AES	Angamos 1 & 2	Mejillones	Request to CNE to close by January 2025. *(No response)*	558 MW
AES	Nueva Ventanas	Puchuncaví	Request to CNE to close by January 2025. *(No response)*	267 MW
AES	Campiche	Puchuncaví	Request to CNE to close by January 2025. *(No response)*	270 MW
TOTAL	**12 units**			**2,640 MW**

Source: Prepared with data provided by CNE, 2023.[12]

If the 12 commitments and closure dates set for 2025 are met, only 8 coal-fired thermoelectric units (owned by the companies COLBÚN, AES and Capital Advisors) would remain without a closure date, and could continue operating until 2040 (according to the 2019 voluntary agreement).

Figure 3: Coal-Fired Thermal Power Plants in operation with no closure commitment as of June 2023 (8 units)

Company	Plant Name	Location	Situation	Capacity
AES	**Cochrane 1 and 2**	**Mejillones**	**No closure commitment**	**550 MW**
Capital Advisors	**Guacolda: 1, 2, 3, 4 and 5**	**Huasco**	**No closure commitment**	**763 MW**
Colbún	**Santa María**	**Coronel**	**No closure commitment**	**374 MW**
TOTAL	**8 units**			**1,687 MW**

Source: Prepared with data provided by CNE, 2023.[13]

12 Energía Abierta del Ministerio de Energía, 2023. Capacidad Instalada. http://energiaabierta.cl/visualizaciones/capacidad-instalada/
13 Energía Abierta del Ministerio de Energía, 2023. Capacidad Instalada. http://energiaabierta.cl/visualizaciones/capacidad-instalada/

Fundación Chile Sustentable continues to affirm that it is possible to close all coal-fired power plants in Chile by 2030, and this goal is also expressed in the demand of Coalición Chao Carbón. However, this requires greater State leadership to eliminate subsidies on fossil fuel generation and remove regulatory obstacles in order to mainstream Non-Conventional Renewable Energy (NCRE) and storage. It also requires addressing the technological, regulatory and operational challenges to ensure the successful operation of an electricity system with variable sources, new technologies and lower costs for the environment and consumers.

On the other hand, the schedule for the closure of coal-fired power plants in Chile also requires addressing social and environmental challenges related to the transformation of industries and jobs, repairing damage to the health of the local population, environmental remediation of the territories and restoration of the environmental liabilities of coal-fired generation.

The following are some of the main challenges that should be addressed by the authorities in the short and medium term to accelerate decarbonization and mainstream NCRE generation in a process that enables a Just Energy Transition.

Photograph: Ventanas Power Plant, Puchuncaví / Source: Chile Sustentable.

MAIN CHALLENGES FOR THE TOTAL PHASE-OUT OF COAL AND A JUST TRANSITION TO CLEAN, RENEWABLE ENERGIES WITH LOW ENVIRONMENTAL IMPACT

1. Conversion of coal-fired power plants to biomass, natural gas and ammonia

1.1 Biomass:

Within the closure and reconversion schedule for coal-fired generation units in the 2024-2025 period, ENGIE has planned to reconvert the Andina and Hornitos plants, which operate in the city of Mejillones, to operate with 100% biomass by the end of 2024.[14] The Environmental Qualification Resolution (RCA), approved in 2022, allows the company and its plants to burn pellets or wood chips to generate energy.

A study by BiofuelWatch and Chile Sustentable estimated that in order to operate both plants, which have a combined generation capacity of 351 MW, 4,800 tons of wood pellets would need to be burned every day, which **would require the logging of more than 250 hectares of eucalyptus trees. This would imply mega logging, equivalent to cutting down approximately 100,000 hectares**[15] **of forest each year,** generating extensive deforestation, impacts on biodiversity and the health of the population, and an increase in net greenhouse gas (GHG) emissions due to the loss of vegetation that captures CO2 from the atmosphere.

If ENGIE's power plants were to choose to use wood chips from southern Chile to operate, this would encourage commercial monoculture, which has already caused serious local ecological damage, intensify conflicts with rural and indigenous communities, aggravate the degradation of water sources and increase poverty in local communities.[16]

On the other hand, if the domestic market cannot supply the quantities of biomass required by Andina and Hornitos -which would be the largest biomass thermoelectric power plants in Chile- pellets would need to be imported from North America. In addition to implying deforestation in the country of origin of the biomass, this could generate some 170,000 tons of CO2 emissions per year through the sea transport of the biomass alone.[17]

14 Environmental Impact Assessment System. Ficha del Proyecto: Operación Unidades CTA/CTH con 100% de Biomasa. https://seia.sea.gob.cl/expediente/ficha/fichaPrincipal.php?modo=ficha&id_expediente=2152626705.

15 Biofuelwatch and Chile Sustentable, 2022. Descarbonización en Chile, desde el carbón a la biomasa: Una falsa solución. https://www.chilesustentable.net/2022/10/convertir-termoelectricas-en-centrales-de-biomasa-una-falsa-solucion-a-la-descarbonizacion/

16 Hofflinger, A. H. Nahuelpan, A. Boso & P. Millalen, 2021. Do Large-Scale Forestry Companies Generate Prosperity in Indigenous Communities? The Socioeconomic Impacts of Tree Plantations in Southern Chile. https://link.springer.com/article/10.1007/s10745-020-00204-x

17 Video: BBC Panorama: The Green Energy Scandal Exposed. https://www.bbc.com/news/av/science-environment-63123774

For these reasons, the conversion of coal-fired power plants to biomass is not an acceptable path to decarbonization, as it would place major pressure on the forests of Chile and other countries, affecting ecosystems, reducing vegetation areas that capture CO2 and other greenhouse gases, and increasing socio-environmental and territorial conflicts.

1.2 Natural gas

In July 2021, ENGIE also submitted its plan for the conversion to natural gas of its power plant, "Infraestructura Energética Mejillones (IEM)", built in 2018, for Environmental Impact Assessment.[18] The Environmental Qualification Resolution (RCA) that approved the project in March 2022 contemplates the conversion of the IEM plant to natural gas, with diesel oil as backup fuel. So far, no other coal plant has presented a plan to convert to natural gas. However, it is a possibility that has been raised as an option, especially by newer plants such as Guacolda's unit 5.

There are currently 20 natural gas-fired power plants operating in Chile's National Electricity System. If coal-fired plants were to be converted to gas, this number would increase. Although CO2 emissions from natural gas-fired power plants are lower than those burning coal and oil, **indirect methane gas emissions associated with the extraction, transport and flaring phase are higher.**[19] The downside of this option is that **methane,** although a shorter-lived greenhouse gas than CO2**, is 29.8 times more potent and detrimental to the increase in global warming.**[20] In addition, considering the high price of natural gas in the global market, using this fuel would mean an increase in the cost of energy.

Photograph: Renca Power Plant, Santiago / Source: Chile Sustentable.

18 Environmental Impact Assessment System. Ficha del Proyecto: Conversión a Gas Natural de IEM https://seia.sea.gob.cl/expediente/expedientesEvaluacion.php?modo=ficha&id_expediente=2152607168

19 The Global Methane Tracker 2022. https://www.iea.org/news/methane-emissions-from-the-energy-sector-are-70-higher-than-official-figures

20 Transport & Environment, 2022. Methane at Sea: Finding the Invisible Climate Killer. https://www.transportenvironment.org/discover/methane-finding-the-invisible/

Therefore, the International Energy Agency (IEA) has recommended that OECD countries with advanced economies phase out natural gas from the electricity sector by 2035, and by 2040 for the rest of the world,[21] in order to stabilize global warming and achieve carbon neutrality by 2050. At the same time, in its recent report, "Is natural gas a good investment for Latin America and the Caribbean?"[22] it warns that incentivizing natural gas as a transition fuel could generate a delay in meeting climate goals.

There is now consensus that encouraging the use of natural gas as a fuel to replace coal for power generation is not the best way to address the climate crisis, achieve carbon neutrality and lower energy costs. Therefore, the electricity sector in Chile should not set out to encourage gas as a "transition" fuel or a replacement for coal in electricity generation. On the contrary, it should aim to **prevent the installation of new natural gas plants in the short term and to schedule their phase-out following coal.**

1.3 Ammonia

Another conversion initiative contemplated by the companies that own coal-fired power plants in Chile is ammonia-coal co-firing, which consists of replacing part of the coal used in the firing process with ammonia. This is a technology that has been promoted as an option for decarbonization, mainly in Japan.

In December 2022, Mitsubishi Heavy Industries and the Guacolda thermoelectric plant signed a memorandum of understanding to initiate feasibility studies for the introduction of co-firing with 30% ammonia in the 5 plants of the Guacolda complex located in Huasco. This study will first aim to analyze the problems associated with co-firing, and then to identify possible solutions to increase this ammonia co-firing ratio in the future.[23]

However, according to reports from TransitionZero, this technology has a very limited ability to directly reduce emissions. A study published by this institution calculated that a coal-fired plant with 20% ammonia co-firing will emit five times more GHGs than the IEA's Net Zero 2030 baseline scenario, and a plant with 50% co-firing will emit three times more than this scenario.[24]

In addition to the increase in emissions, TransitionZero also demonstrates that switching from conventional coal-fired generation to ammonia co-firing implies a higher cost than incentivizing the replacement of coal-fired generation with renewable energy, so there is no economic justification for this.

21 International Energy Agency, 2022. Net Zero by 2050. https://www.iea.org/reports/net-zero-by-2050

22 United Nations Program. 2022. ¿Es el gas natural una buena inversión para ALC?. https://www.unep.org/es/resources/informe/informe-de-la-onu-es-el-gas-natural-una-buena-inversion-para-alc

23 https://www.mhi.com/news/221207.html

24 TransitionZero, 2022. Coal-de-sac: Advanced Coal in Japan. https://www.transitionzero.org/insights/advanced-coal-in-japan.

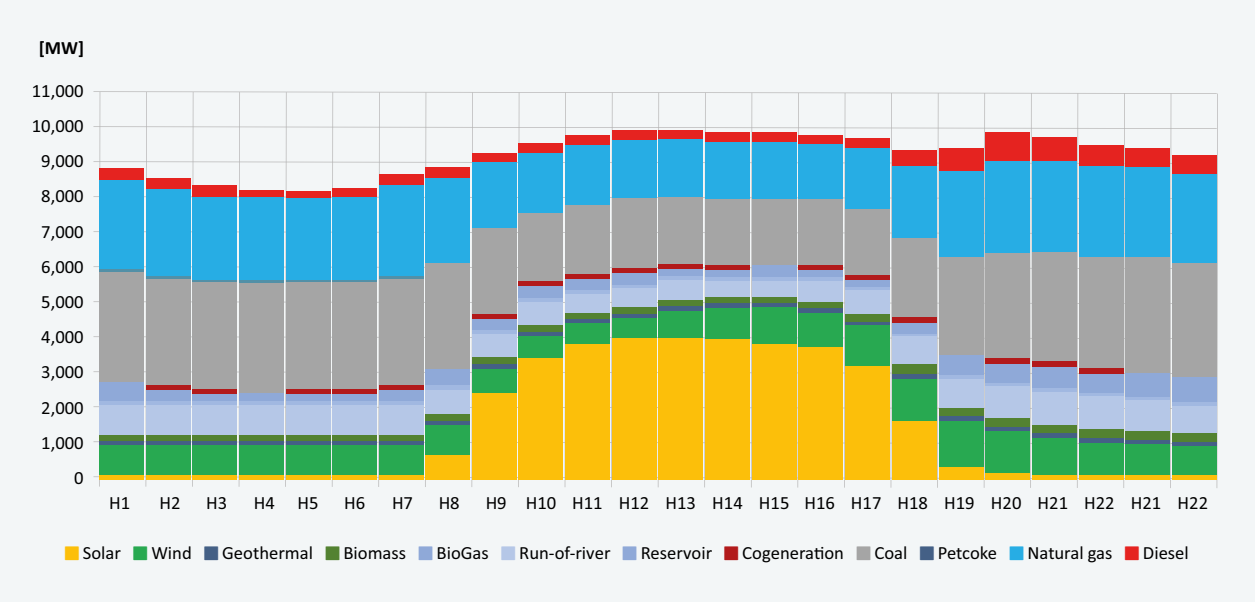
Therefore, opting for co-firing coal with ammonia means a delay in the decarbonization schedule for the electricity sector. In addition to being more expensive, this would mean extending the years of operation of coal-fired power plants, continuing to depend on coal imports for electricity generation and maintaining high levels of greenhouse gas emissions.

2. NCRE dumping due to lack of storage and delay in transmission expansion

Non-conventional renewable energies (NCRE), such as solar and wind energies, are an abundant source of clean, renewable energy for power generation. However, its availability is variable, i.e., it is not possible to generate the same amount of energy 24 hours a day. The solar case is the clearest example, since its availability for electricity generation is enormous during the day, whereas at night and in the early morning its generation is nil.

Figure 3 shows the wide variability of solar availability for generation 24 hours a day, unlike fossil fuel generation, which is constant as long as there is fuel available to be burned. In the case of solar generation, the variable day-night availability in the context of lack of storage and delays in the planning and expansion of transmission, has generated a saturation of the existing transmission systems at peak generation times, and has caused major losses or dumping of clean energy. This has also been perpetuated by the delay in the implementation of automatisms and other flexible operation measures by the National Electricity Coordinator, aimed at forms of operation that prioritize the dispatch of fossil generation. This problem must be addressed through various reforms in the operation and planning of the expansion of the National Electricity System (SEN), as well as transformations in the regulation of the electricity market.

Figure 3: Daily generation curve per fuel, April 2022.



Source: Kas Ingeniería 2022, based on CEN data.

This condition, together with the progressive increase in investments in solar and wind power generation, has led to an ever-increasing dumping (loss) of generated energy. In 2022, the dumping of solar and wind energy was three times the numbers in 2021, with a loss of 1400 GWh of generation, which is equivalent to the annual consumption of 600,000 homes (ACERA, 2023).[25] This loss will only further intensify in 2023, due to the start-up of new NCRE projects, the absence of storage and flexibility in the operation, and the structural delay in the expansion of transmission.

A recent regulation that could lead to a medium-term reduction in the dumping of clean energy in the context of the deficit, delay and uncertainty in the expansion of transmission, is the enactment of the Storage and Electromobility Law[26] in November 2022. This law creates a new segment in the electricity market, enabling the development and remuneration of pure storage infrastructure associated with generation plants, meaning that it will be possible to receive payment for injecting energy into the electricity system and for being available to support the system at times of higher demand.

Although investments in storage will not have the speed required by the system in the very short term -given the delay in the formulation and approval of the regulations to implement this law- at least they make it possible to predict a more resilient infrastructure with fewer clean energy losses from 2025 onwards.

However, the announcement by the Ministry of Energy to hold tenders for storage infrastructure during 2024 is a wise measure that shortens the time frame for the insertion of this essential service for the mainstreaming of variable renewable energies, while solving the problems of distortion in the electricity market and delays in the development of more efficient transmission.

In addition to reducing the dumping of clean energy, the installation of a robust and distributed storage infrastructure will render greater security to the electricity system, providing flexibility and promoting the participation of sustainable renewable energies in hours when their availability for generation decreases. This attribute of displacement in the injection of solar and wind energy into the power system is essential to accelerate the phase-out and dependence on fossil fuel-based generation that today supports variable renewable generation. Likewise, a well-designed storage infrastructure in the electricity system will undoubtedly enable a more efficient development of the future transmission infrastructure.

25 ACERA presentation at the Senate Mining and Energy Committee. April 26, 2023. Bill that promotes the participation of renewable energies in the national electricity matrix.

26 BCN, 2023. Law 21,505 that promotes electric energy storage and electromobility. https://www.bcn.cl/leychile/navegar?i=1184572&f=2022-11-21

3. Accelerating the promulgation of storage regulations and storage pricing

Given the context explained above, an urgent challenge today is the prompt enactment of the regulations of the Storage Law and its pricing, in order to **provide short-term incentives for investments in technologies and infrastructure that enable the storage of variable renewable energy generated during the day. This would shift its injection into the electricity system at night and in the early morning blocks where solar and wind energy provide less electricity generation.** This will make it possible to avoid the loss of clean energy, definitively reduce fossil energy consumption, mitigate GHG emissions, and resolve the impact of dirty energy generation on the health of people and ecosystems, particularly in the areas denominated "sacrifice zones".

4. Restructuring transmission planning and implementing the current Transmission Law (passed in 2016 and not yet implemented by the government authority)

To decarbonize the electricity matrix and move towards a robust Energy Transition that makes carbon neutrality possible, it is not enough to simply increase the generation infrastructure with non-conventional renewable energies (NCRE). There is no point in increasing clean generation if there is no electricity grid capable of transporting it to the places where energy is consumed.

As of March 2023, of the total installed NCRE generation capacity in Chile (11,000 MW), approximately 70% (7,500 MW) will be located from the Coquimbo region and further north. This means that there is a high concentration of generation, which is mainly solar, in the northern zone, although the peak demand in that zone is only 3,500 MW, and the transmission capacity to transport energy from the northern zone to the south is only 2,200 MW.[27] As a result, transmission congestion leads to dumping around 1,800 MW of clean energy equivalent. This large amount of energy that is generated, but is not consumed or transported to the south of Chile, constitutes a structural failure of the electricity system. This translates into market distortions and inefficiencies that seriously threaten the decarbonization of the electricity matrix and its development.

There are several reasons for the lack of transmission infrastructure, such as delays in construction deadlines, poor bidding performance, and halted and abandoned works. Therefore, along with accelerating regulations to provide incentives for investing in storage, it is important **that we improve the planning, design and execution of the electricity transmission capacity.** We must improve planning processes, speed up construction works and streamline administrative bidding processes. Some of these challenges have already been identified and form the Second Part of the Energy Transition Agenda[28]presented by the

27 Presentation by Claudia Rahman, Director of SERC Universidad de Chile, 2023. Seminar Energy, the changes required today. https://www.youtube.com/watch?v=MlGhN2B0Efc

28 Ministry of Energy, 2023. Agenda Inicial para un Segundo Tiempo de la Transición Energética. https://energia.gob.cl/sites/default/files/documentos/agenda_inicial_para_un_segundo_tiempo_de_la_transicion_energetica.pdf

Ministry of Energy in April 2023. Noteworthy in this are the tender for storage, the submission of an Energy Transition Bill,[29] the tender and construction of transmission expansion works, the reform of the Tariff Revenues system and the adjustments to the emissions tax offsetting system, among others.

Photograph: High voltage towers / Source: Chile Sustentable.

29 Ministry of Energy, 2023. Anuncio Proyecto de ley de Transición Energética. https://energia.gob.cl/mini-sitio/proyecto-de-ley-transicion-energetica

5. Regulatory changes to remove obstacles to the insertion of NCREs and eliminate subsidies for fossil fuel generation

An efficient increase in the insertion of NCREs in the Electricity System requires identifying, assessing and understanding the regulatory and market barriers that prevent the use of renewable generation, and promoting reforms that provide a greater penetration of these. An example of the necessary State leadership in this regard, and the importance of pro-NCRE regulatory reforms, was Law 20,257 (2008),[30] which established mandatory NCRE quotas. Thanks to this law and the subsequent scaling of mandatory quotas and modifications to regulated customer tenders, among other reforms, Chile has been able to reach over 30% non-conventional renewable energy generation annually in just over a decade.

However, today the increased penetration of NCREs faces regulatory and market barriers that hinder their efficient and equitable insertion in what has been called an "open market"; however, it maintains distortions in favor of fossil fuel generation. The main modifications that would enable an efficient and sustainable NCRE insertion in the electricity market include the following:[31]

1. **Eliminate the Strategic Reserve Status (ERE)**, a regulation through which the electricity system provides 5-year subsidies to coal-fired thermoelectric plants that announce their phase-out, even though they have far exceeded the years of operation of their useful life.

2. **Reduce the technical operating minimums for coal-fired thermoelectric plants,** in order to improve the flexibility of the system operation and create space for greater penetration of clean NCRE generation.

3. **Increase the amount of green tax to a value that is at least equivalent to the social cost of CO2 abatement**, which is set at a baseline environmental cost of US$32 per ton of CO2. Likewise, it is necessary to eliminate the current distortion in the way the green tax is applied, **including the cost of the levy on the variable cost of energy,** to ensure transparency in the merit of the economic dispatch of the energy injected into the electricity system.

4. **Eliminate the current technical standard for scheduling and coordinating the operation of units using regasified LNG** and avoid distorted marginal cost signals generated by the gas inflexibility standard.

5. There is a need to implement the current regulations that **mandate the Coordinator to make the operation of the National Electricity System more flexible to** ensure that the coordination of the operation is compatible with the mainstreaming of variable NCRE generation and to accelerate the phase-out of fossil fuel generation.

30 Library of the National Congress. Ley 20.257; Introduce modificaciones a la Ley General de Servicios Eléctricos respecto de la generación de energía eléctrica con fuentes de energías renovables no convencionales. https://www.bcn.cl/leychile/navegar?idNorma=270212

31 Chile Sustentable, 2021. Propuestas regulatorias para el ingreso masivo de las ERNC a la matriz eléctrica de Chile.

6. **Incentivize Distributed Generation,** reforming Law 20,571 to adapt technical, economic and tariff standards that regulate this market to promote its development and establish NCRE goals for the public sector and for the distribution segment.

6. Review, monitoring and oversight of coal-fired power plant closure plans

Article 72-18 of the General Electricity Services Law (DFL 4/20,018, 2006) regulates the removal, modification or disconnection of electric generation and storage facilities. Additionally, Supreme Decree No. 40 (2013) establishes that Environmental Impact Studies must describe the activities, works and actions to be carried out during the closure stage of a facility. This should specify how infrastructure will be dismantled and how the environmental components affected by the implementation of the project or activity will be restored.

Under current regulations, the Environmental Qualification Resolution (RCA) that approves each thermoelectric power plant should specify the closure measures for the generation facility, its coal storage yard, ash deposits, and cooling water suction and return systems, among others. Unfortunately, there are several existing coal-fired power plants and ash deposits that do not have an Environmental Qualification Resolution (RCA), or have RCAs with no closure plans, which poses an additional challenge for the environmental authority in terms of requiring commitments to dismantle the generation infrastructure, dispose of waste and restore the affected environment.

A review conducted by Chile Sustentable, which analyzed the RCAs of the 28 coal-fired power plants in operation in Chile in 2019, showed that 7 units had no RCAs associated with the original project, and therefore they do not have a closure plan. Specifically, these are Tocopilla U-12, U-13, U-14, U-15 (Engie) in Mejillones; Ventanas 1 and 2 (AES) in Quintero/Puchuncaví; and Bocamina 1 (Enel) in Coronel.[32]

Two other plants, Norgener 1 and 2 (AES), have an RCA associated with the original project, but it does not include a Post-Closure Plan.

Finally, there are 6 plants whose RCA does not include a Post-Closure Plan: Guacolda 3 (AES, now Capital Advisors), Hornitos and Andina (ENGIE); Nueva Ventanas and Campiche (AES) and Santa María (Colbún). However, the RCA includes the requirement to present a Closure Plan between 6 months and 1 year before closure begins.

32 Chile Sustentable, 2019. Regulación de cierre para centrales de generación eléctrica. https://www.chilesustentable.net/wp-content/uploads/2019/04/Condiciones-de-Cierre-de-Termoeléctricas-a-Carbon_VF_24042018.pdf

The RCAs for the remaining 13 coal-fired plants indicate that the units will most likely be converted to other generation technologies and state that, should they be required to abandon the site, they must dismantle and remove aboveground and offshore structures and equipment.[33]

In light of this regulatory disparity, an important aspect of the decarbonization schedule underway is that the energy and environmental authorities must require an **update to the closure and/or post-closure plans for thermal power plants**. It is the duty of each project owner to take responsibility for the infrastructure that ceases to operate and also to undertake remediation and restoration measures for the damage caused to ecosystems, in addition to taking responsibility for the environmental liabilities caused by the operation of the generation units as well as the contamination of the shoreline and coal ash deposits.

7. Training, skills validation and job reconversion

The process of closing coal-fired thermoelectric plants is causing legitimate concern among workers and the local population in terms of what will happen to the jobs that this industry generates in the territories. For many families, these plants are their main source of income. Local workers have specialized in a specific technical process related to thermoelectric generation, which means that the closure of the plants would leave part of the local population with no source of employment.

Photograph: Guacolda Thermoelectric Complex, Huasco / Source: Chile Sustentable.

33 Ibid, note 21

A study commissioned by the government to the Inter-American Development Bank in 2019, in the context of the Decarbonization Working Group, indicates that the removal of coal-fired thermoelectric power plants from Chile's electricity matrix would imply the loss of about 14,000 direct and indirect jobs. However, the same study shows that alongside the loss of jobs, about 32,000 to 40,000 new direct and indirect jobs could be generated with the development of new energy alternatives and technologies as a result of the energy transition.[34]

The energy transition clearly needs to go hand in hand with a labor transition process that includes private and public incentives (such as SENCE and Chilevalora), training of local workers, population and organizations for the new technological processes; and the development of new jobs that involve the remediation, restoration and eventual environmental protection tasks to be carried out; generating opportunities to improve health and quality of life and to grow the local economy through an increase in tourism, the recovery of fishing, agriculture and local commerce, for example.

The State must work with the generator companies' trade association to engage and incorporate workers in a just energy transition process, in order to **carry out strategies and planning for labor reconversion** in the 5 municipalities where coal-fired power plants are installed. This reconversion planning must contain **public-private commitments and responsibilities,** including technical training for new technological processes, incentives for new investments in the municipalities, and strengthening of trade, agricultural production, handicrafts and local tourism.

34 IDB, 2019. Impacto económico y laboral del retiro y/o reconversión de unidades a carbón en Chile. https://publications.iadb.org/en/impacto-economico-y-laboral-del-retiro-yo-reconversion-de-unidades-carbon-en-chile

CONCLUSIONS

In June 2024 it will be 5 years since the announcement and kick-off of Chile's Decarbonization Schedule.[35] Therefore, according to the established commitment, the schedule should be reviewed and updated. This update requires the authorization of the National Energy Commission (CNE) and the National Electricity Coordinator (CEN for its acronym in Spanish) for the closure of the Ventanas 3 and 4 (Nueva Ventanas and Campiche) and Angamos 1 and 2 plants (combined capacity of 1,097 MW) that AES made available to the CNE for closure on January 1, 2025, as reported to the Financial Market Commission (CMF) in July 2021.[36]

The update of the Decarbonization Schedule must also include authorization of the definitive disconnection of the Norgener 1 and 2 plants (276 MW) by December 31, 2025, as recently requested by AES to the CNE on May 25, 2023, which was reported to the Financial Market Commission,[37] as established under current regulations.

Also, in June 2024, Colbún, AES and Capital Advisors, companies that own the 8 coal-fired power plants that have not yet committed to their phase-out, must give the authority a date for the closure or reconversion of these units before 2030. This is necessary so that the government -as committed in the NDC- can plan to definitively end the peak of CO2 emissions by 2025 and comply with the 2030 emissions budget to achieve carbon neutrality by 2050, as committed in the Framework Law on Climate Change in force.

It is fundamental to establish a definitive decarbonization schedule for planning national electricity development, compliance with climate commitments and the reduction of local pollution, such as that seen in the health emergencies that have occurred repeatedly in Quintero/Puchuncaví.

In Chile, it is feasible to establish the closure or reconversion of all coal-fired power plants by 2030 at the latest, to put an end to the impact of these industries on human health and to put an end to the sacrifice zones, especially considering that the coal plants' phase-out schedule depends on only 5 companies, which have very high levels of technical and financial capacity for technological reconversion. However, to achieve this, it is urgent to encourage new investments in storage technologies, expand transmission lines, modernize operating systems and make regulatory changes that are currently hindering the mainstreaming of NCREs into the electricity market, as we have presented synthetically in this document.

35 Ministry of Energy, 2020. Plan de retiro y/o reconversión de unidades a carbón. /https://energia.gob.cl/sites/default/files/plan_de_retiro_y_o_reconversion_centrales_carbon.pdf

36 AES Andes Material Events Report to the CMF, July 2021. https://www.cmfchile.cl/sitio/aplic/serdoc/ver_sgd.php?s567=3976f41ebe05dfd7a9aea1048f5ba4eaVFdwQmVVMVVRVE5OUkVreVQxUk5lRTFSUFQwPQ==&secuencia=-1&t=1686691657

37 Informe Hecho Esencial de AES Andes a la CMF, mayo 2023. https://www.cmfchile.cl/sitio/aplic/serdoc/ver_sgd.php?s567=52cc0c5330951537457e888780bc25e8VFdwQmVVMTZRVEZOUkVsNVRtcGpNazVSUFQwPQ==&secuencia=-1&t=1686691476

Likewise, it is also important that energy and environmental authorities review and oversee effective closure and post-closure plans for coal-fired power plants and their waste in the respective RCAs, to ensure a responsible transition process and the restoration and remediation of environmental liabilities and components affected by their years of operation.

Finally, it is the co-responsibility of the State and the private sector to lead a labor transition process to provide workers with new job opportunities. This process must be carried out with the participation of and in dialogue with workers, to generate new job opportunities that will benefit the healthy and sustainable development of the most contaminated communities in the country where these industries have operated for decades.

By working simultaneously on these technological, social, environmental and regulatory challenges required by decarbonization, only then will it be possible to move towards a **just energy transition** that is robust enough for energy development and security, while also meeting climate commitments, enabling legitimacy and support from local communities based on transparency, participation and an equitable distribution of the burdens and benefits of electricity development.

Photograph: Renewable energy / Source: Chile Sustentable.

COAL PHASE-OUT BY 2030

PROGRESS AND PENDING TASKS IN THE DECARBONIZATION SCHEDULE FOR CHILE

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