



HAL
open science

Challenges for a just energy transition in Andean economies

Simón Ladino Cano

► **To cite this version:**

Simón Ladino Cano. Challenges for a just energy transition in Andean economies: A comparative case study of La Guajira (Colombia) and Antofagasta (Chile). Humanities and Social Sciences. 2021. dumas-04136491

HAL Id: dumas-04136491

<https://dumas.ccsd.cnrs.fr/dumas-04136491>

Submitted on 21 Jun 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - ShareAlike 4.0 International License



Challenges for a just energy transition in Andean economies

A comparative case study of La Guajira (Colombia) and Antofagasta (Chile)

Présenté par **Simón Ladino Cano**

Sous la direction de **Sébastien Velut**

Mémoire de **Master 2** mention **Sciences Sociales, Coopération et Développement en Amérique Latine/Latinamerican Studies**.

Parcours-type **Master Erasmus Mundus Latin America and Europe in a Global World (LAGLOBE)**, avec les universités de **Salamanque et Stockholm**.

Mémoire présenté le **20 septembre 2021** à l'université **Sorbonne Nouvelle**



Acknowledgements

First and foremost, I would like to thank my supervisor Sébastien Velut for patiently orienting me throughout this research. His guidance and great interest were invaluable to me in this process of academic and personal discovery. I would also like to acknowledge the European Union for the funding that allowed me to devote myself entirely to my studies over the past two years. To the participants of this research, whose openness, kindness, and experience inspired me to enter a fascinating field of studies. To my family, my parents and my sister, in whose affection I find the best refuge. Today and always, you are my compass in life. And last but not least, to Karen Curiel whose relentless support has been indispensable to making the most of this never-ending journey.

Table of Contents

List of Acronyms.....	6
1. Introductory Chapter.....	8
1.1. Researching energy transitions: insights for entering a burgeoning field of study	8
1.1.1. A complex yet ambiguous global challenge.....	8
1.1.2. The centrality of renewable energies.....	11
1.1.3. Energy transitions in Latin America: between challenges and opportunities.....	14
1.2. Problem statement.....	18
1.2.1. Research question and objectives.....	19
1.2.2. Hypotheses	19
1.3. Literature review.....	20
1.3.1. From the transitions literature to the just transition approach	21
1.3.2. Studying energy transitions in and from Latin America	22
1.3.3. Social studies of energy in Colombia and Chile.....	24
1.4. Theoretical framework.....	25
1.4.1. New energy spaces.....	25
1.4.2. Just transition framework	29
1.5. Methodology.....	34
1.5.1. A Comparative Case Study (CCS) approach.....	35
1.5.2. Presentation of the case studies	37
1.5.3. Research phases	44
2. Unraveling Leadership: Chile and Colombia’s pathways to renewables.....	49
2.1. Energy profiles and trajectories	50
2.2. Beyond climate action: triggering factors of energy transitions	54
2.3. Building an investment ecosystem: enabling conditions for NCRE development.....	61
3. New Energy Spaces in Andean Economies: the cases of La Guajira and Antofagasta	69
3.1. Environmental justice challenges: unwrapping the socio-ecological footprint of renewables.....	70

3.1.1.	Towards a large-scale and rapid transformation of the energy landscape	71
3.1.2.	Territorial impacts of renewable energies	76
3.1.3.	Renewable energy landscapes: revisiting the resource curse?	83
3.2.	Climate justice challenges: unexpected connections through coal value chain	86
3.2.1.	The indelible stain of coal in the ‘sacrifice zones’	86
3.2.2.	Phasing out coal: contradictions across multiple scales	91
3.2.3.	The challenge of path dependence: addressing energy incumbency	101
3.3.	Energy justice challenges: lights and shadows of energy policies	104
3.3.1.	The various faces of energy poverty	104
3.3.2.	On winners and losers: uneven benefits of sustainable energy	109
3.3.3.	Renewable energy dilemmas.....	121
4.	Conclusions	125
	ANNEX 1. Table of informants	132
	ANNEX 2. Semi-structured interview protocol	134
	REFERENCES.....	136
	Tables & Figures Index	153

List of Acronyms

AFOLU	Agriculture, Forestry and Other Land Uses
BCCh	<i>Banco Central de Chile</i>
BP	British Petroleum Company
CAC	<i>Comité Asesor de Comercialización</i>
CASEN	<i>Encuesta de Caracterización Socioeconómica Nacional</i>
CCS	<i>Comparative Case Study</i>
CEN	<i>Coordinador Eléctrico Nacional</i>
CENSAT	<i>Asociación Centro Nacional Salud, Ambiente y Trabajo</i>
CLP	Chilean pesos
CNE	<i>Comisión Nacional de Energía</i>
CO2	Carbon dioxide
CODELCO	<i>Compañía Nacional del Cobre</i>
CON	<i>Consejo Nacional de Operación</i>
COP	UNFCCC Conference of the Parties
COP	Colombian pesos
CORFO	<i>Corporación de Fomento de la Producción</i>
CREG	<i>Comisión de Regulación de Energía y Gas</i>
CSP	Concentrated Solar Power
DANE	<i>Departamento Administrativo Nacional de Estadística</i>
ECLAC	Economic Commission for Latin America and the Caribbean
EDF	Electricité de France
EPM	<i>Encuestas Públicas de Medellín</i>
ERE	<i>Estado de Reserva Estratégica</i>
EU	European Union
ETI	Energy Transition Index
FEO	Firm Energy Obligations
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIZ	Gesellschaft für Internationale Zusammenarbeit
GPE	Geographical Political Economy
GW	Gigawatt
GWh	Gigawatt hour
HDI	Human Development Index
HVDC	High Voltage Direct Current
ICEE	<i>Índice de Cobertura de Energía Eléctrica</i>
IDB	Interamerican Development Bank
IDEAM	<i>Instituto de Hidrología, Meteorología y Estudios Ambientales</i>
IEA	International Energy Agency
ILO	International Labour Organization
INDEPAZ	<i>Instituto de Estudios para el Desarrollo y la Paz</i>
INE	<i>Instituto Nacional de Estadística</i>

IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
IRENA	International Renewable Energy Agency
JTRC	Just Transition Research Collaborative
LCOE	Levelized Cost of Energy
MTE	<i>Misión de Transformación Energética</i>
MW	Megawatt
NCRE	Non Conventional Renewable Energies
NDC	Nationally Determined Contribution
NEC	Net Effective Capacity
OECD	Organisation for Economic Cooperation and Development
OLADE	<i>Organización Latinoamericana de Energía</i>
OPEX	Operational expenditures
PELP	<i>Planificación Energética a Largo Plazo</i>
PIEC	<i>Plan Indicativo de Expansión de Cobertura de Energía Eléctrica</i>
PPA	Power Purchase Agreement
PV	Photovoltaic
QCA	Qualitative Comparative Analysis
RCA	<i>Resolución de Calificación Ambiental</i>
REDPE	<i>Red de Pobreza Energética</i>
RELAC	Renewable Energy for Latin America
SDG	Sustainable Development Goals
SDL	<i>Sistema de Distribución Local</i>
SEC	<i>Sistema Interconectado Central</i>
SEIA	<i>Sistema de Evaluación de Impacto Ambiental</i>
SEN	<i>Sistema Eléctrico Nacional</i>
SIEL	<i>Sistema de Información Eléctrico Colombiano</i>
SIN	<i>Sistema Interconectado Nacional</i>
SING	<i>Sistema Interconectado Norte Grande</i>
SNiChile	<i>Sistema Nacional de Inventario de Gases de Efecto Invernadero de Chile</i>
SSP	<i>Superintendencia de Servicios Públicos</i>
STN	<i>Sistema de Transmisión Nacional</i>
STR	<i>Sistema de Transmisión Regional</i>
TEBSA	<i>Termoeléctrica de Barranquilla S.A</i>
TJ	Terajoule
UBN	Unsatisfied Basic Needs
UNFCCC	United Nations Framework Convention on Climate Change
UPME	<i>Unidad de Planeación Minero-Energética</i>
USD	United State dollars
WEF	World Economic Forum
WRI	World Resources Institute

1. Introductory Chapter

This investigation aims to provide a comparative input to the still incipient field of social studies on energy transitions in Latin America. Beyond the realm of techno-managerial visions exclusively focused on the technical aspects of energy technologies and policies, the core reflection is linked to the tremendous challenges that the region must face to be part of the global energy transition under a perspective of justice, equity, and sustainability.

Through the implementation of a comparative case study and from the approach of geographic political economy, the objective of this research is to describe and understand the socio-spatial transformations operated by the transitions towards renewable energies in Colombia and Chile. Therefore, I seek to identify the justice-related challenges posed by the accelerated development of renewables in both countries by examining the trajectory of two strategic energy-producing regions: La Guajira in Colombia and Antofagasta in Chile.

1.1. Researching energy transitions: insights for entering a burgeoning field of study

1.1.1. A complex yet ambiguous global challenge

A global energy transition is underway. A transition unlike any previous one. One that seeks to address the destabilizing effects caused by the exorbitant consumption of fossil fuels on the Earth systems, which has even given rise to a new geological era: the Anthropocene (Le Gall et al., 2017; Steffen et al., 2011; Zalasiewicz et al., 2011). Mainly due to the rapidly growing unsustainability of our way of life, to that ‘Great Acceleration’ of certain socioeconomic trends linked to human activity, the planet is already hitting its tipping points. And the anthropogenic climate change, one of its manifestations, is intrinsically related to energy and its different uses. More than 70% of annual greenhouse gas (GHG) emissions come from the energy sector and, notably, from electricity and heating (accounting for almost one third of all GHG emissions) (Figure 1.1). In prospective, ensuring the sustainability of energy systems is indeed a crucial issue to guarantee a safe operating space for humanity within planetary boundaries (Rockström et al., 2009; Steffen et al., 2015).

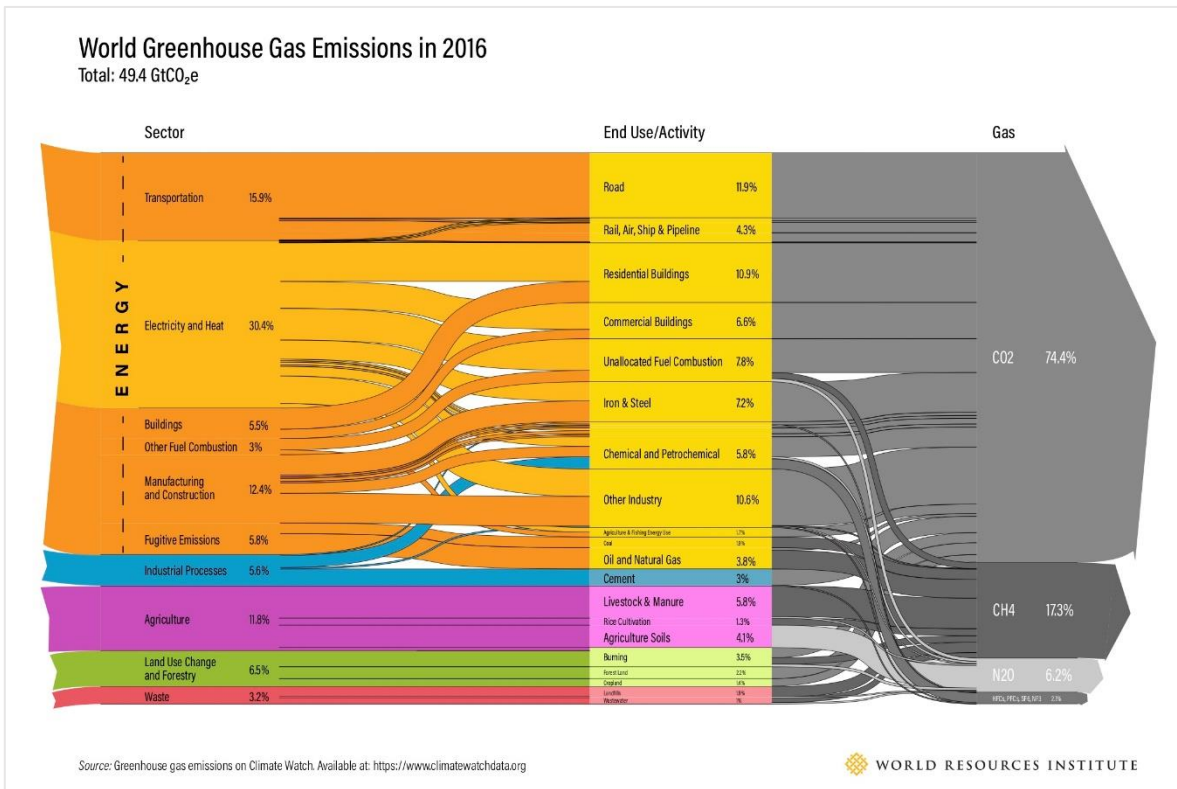


Figure 1.1. World GHG emissions by sector, end use/activity and type of gas in 2016. Source: WRI (2021).

Moving towards a low-carbon future has thus become a matter of urgency for a wide range of political and economic actors on a global scale. In this regard, the Paris Agreement¹ Signed in 2015 at the 21st UN Climate Change Conference (COP21), the agreement was adopted by 193 signatory countries. Since then, it has had a multiplier effect on the implementation of national policies around the transformation of energy production and consumption to move towards the realization of climate change mitigation goals. In terms of energy policies, there is a *before* and an *after* COP21 (Yergin, 2020).

Such renewed interest in the long-term sustainability of energy systems has a correlate in academia. Energy transitions studies are an emerging field in academic research (Araújo, 2014). The number of indexed publications covering this topic doubled during the 2010s².

¹ On December 12, 2015, the parties to the UNFCCC signed the Paris Agreement. It requires all parties to do their utmost through Nationally Determined Contributions (NDCs) to keep the global temperature increase this century far below 2°C above pre-industrial levels, as well as to pursue efforts to further limit this increase to 1.5°C.

² A search in the Scopus database reveals how the number of publications per year regarding energy transitions skyrocketed throughout the 2010s. This figure jumped from an average of about 10,000 publications per year at the beginning of the decade (10,402 in 2010) to surpassing the threshold of 20,000 publications in a single year (20,715 in 2020).

Indeed, the frequency of occurrence of the n-gram “*Energy Transition*” (Figure 1.2) in Google’s text corpora, which gathers millions of written documents of all kinds, skyrocketed after 2015—presumably due to the Paris agreement. Yet, despite being a relevant and topical issue, there is no universally accepted definition of ‘energy transition’. This term carries instead a plurality of contradictory meanings given by a wide range of actors outside and inside academia.

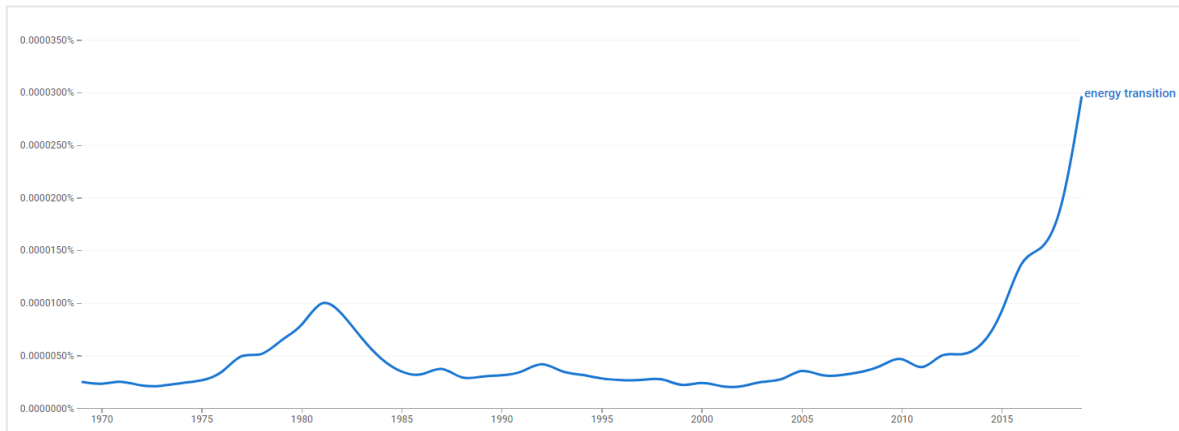


Figure 1.2. N-gram “*Energy Transition*” frequency of occurrence in written sources (1969-2019).
Source: Google Books Ngram Viewer (2021).

Although the topic of energy transitions is already compelling for a great diversity of institutions, governments, movements, companies, and so on, it is not entirely clear whether everyone confers the same meaning to this process. As Theys (2017) points out, at least two downsides are noticeable with respect to this mounting but ambiguous attention to this process: First, it poses a problem of operationalization, as there is a risk that the notion will not really have a grip on anything concrete inasmuch as it tries to encompass everything or a wide range of challenging socioecological issues at least; second, behind a facade of unanimity, it masks the coexistence of very different logics that do not interact and even refuse to recognize each other. As stressed by him: « *Plusieurs « mondes » de la transition coexistent qui s’ignorent en large partie et ont tendance à se séparer de plus en plus* » (Theys, 2017). Therefore, to adequately immerse oneself in its study without losing depth, it is necessary to limit the scope of the research to a limited set of transition components.

1.1.2. The centrality of renewable energies

Notwithstanding this ambiguity of transition narratives, two constituent aspects of this global energy transition stand out. The first refers to the pace at which the transformation of energy systems is sought to be advanced on a global scale. In a nutshell, the term energy transition is generically used to refer to “*the change in the composition (structure) of primary energy supply, the gradual shift from a specific pattern of energy provision to a new state of an energy system*” (Smil, 2010). To that extent, a significant difference in this contemporary transition is the sense of urgency and haste posed by the challenges to cope with accelerated climate change. The critical threat that current energy consumption patterns imply for the stability of life on Earth means that the gradual change towards a ‘new state’ of energy systems must be accelerated through bold policies and innovative technologies (Araujo, 2017)—which are meant to progressively structure a sustainable *socio-technical regime* (Geels, 2010; Rohracher, 2008).

The core question of the current low-carbon transition about the speed of substitution of the most polluting energy sources from the energy mix generates important discussions. In particular, the issue of *fossil fuel phase-out* brings a manifest urgency, but the terms and timing of this shift are still subject to a powerful uncertainty that fuels academic debates (Grubler et al., 2016; Smil, 2016; Benjamin K. Sovacool, 2016)³. Contrary to expectations with the decarbonization trajectories set in international commitments such as the Paris Agreement, the decarbonization of the electricity sector and, even more so, the *deep decarbonization* (Geels et al., 2017) of the economy has no fixed time horizon—least of all, single contents, modalities and/or direction. It is, in short, a race against the clock in which urgency goes hand in hand with uncertainty.

The second key feature of the global energy transition is thereby the widespread deployment of renewable energy sources to move away from fossil fuels. Unlike socio-technical transitions through which coal and oil spread, the current energy transition as a sustainability

³ In this regard, while there are pessimistic views such as that of Smil (who, based on the experience of historical transitions, mentions that no promise of accelerated transition on a large scale can be fulfilled), there are also visions of such as that of Sovacool (who claims that the experiences of rapid transitions on a national scale can set the path to accelerate the transformation at a global scale). Both positions reveal a cross-cutting concern about the required pace of the current transition and, therefore, about the instruments needed to accelerate it.

transition is not driven primarily by the convenience, practicality, or affordability of an energy source, but by the urgency of curbing the perils brought about by fossil fuels' massive use. While transition pathways diverge between countries and regions of the world and depending on the strategic priorities of different stakeholders, a cross-cutting feature is the massive penetration of renewable energies.

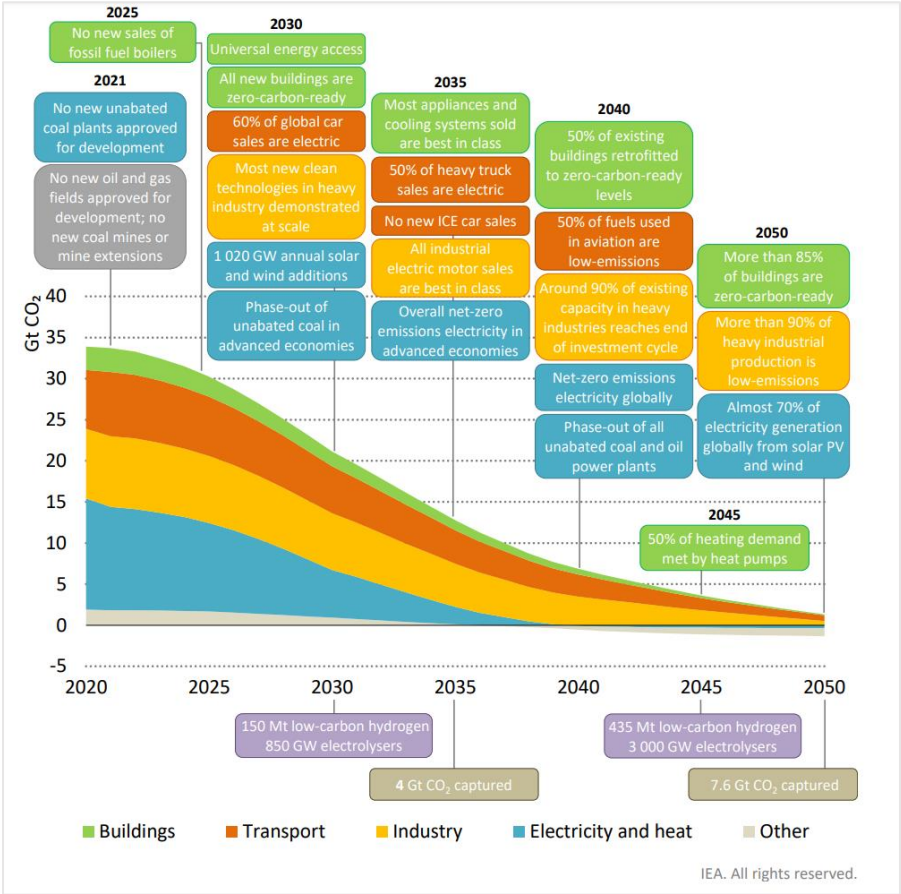


Figure 1.3. Selected global milestones for policies, infrastructure, and technology deployment in the Net Zero Emissions scenario. Source: IEA (2021b).

The centrality of renewables and, especially, of non-conventional renewable energies (hereinafter, NCRE)⁴ is embedded in the agenda of governments, energy companies, international organizations, among others. An example of the latter is the place assigned to

⁴ Whereas in certain contexts renewable energies and non-conventional energies are often used as synonyms, the term NCRE seeks to designate variable renewable energies (particularly wind and solar) as well as other renewable sources that are not massively deployed (such as geothermal, tidal, and so on). Without going into details, in the Latin American context it is relevant to differentiate hydropower and, even more so, large-scale dam hydroelectricity from other renewable energy sources. In any case, the normative distinction between conventional and non-conventional energy sources varies from one country to another.

the expansion of renewables by specialized agencies that are benchmarks in energy issues, such as the International Energy Agency (IEA) or the International Renewable Energy Agency (IRENA). In its roadmap to achieve net-zero emissions in the energy sector by 2050, the IEA (2021b) proposes a drastic reduction in the use of fossil fuels (90% reduction in total coal use, 75% reduction in oil demand and 55% reduction in gas demand) accompanied by a complete transformation of energy systems through the massive deployment of renewables (Figure 1.3). This includes some key milestones such as:

- Deploying 1,020 GW annual solar and wind additions by 2030
- Reaching worldwide net-zero emissions electricity by 2040
- Jumping to near 70% of power generation globally from solar PV and wind sources by 2050

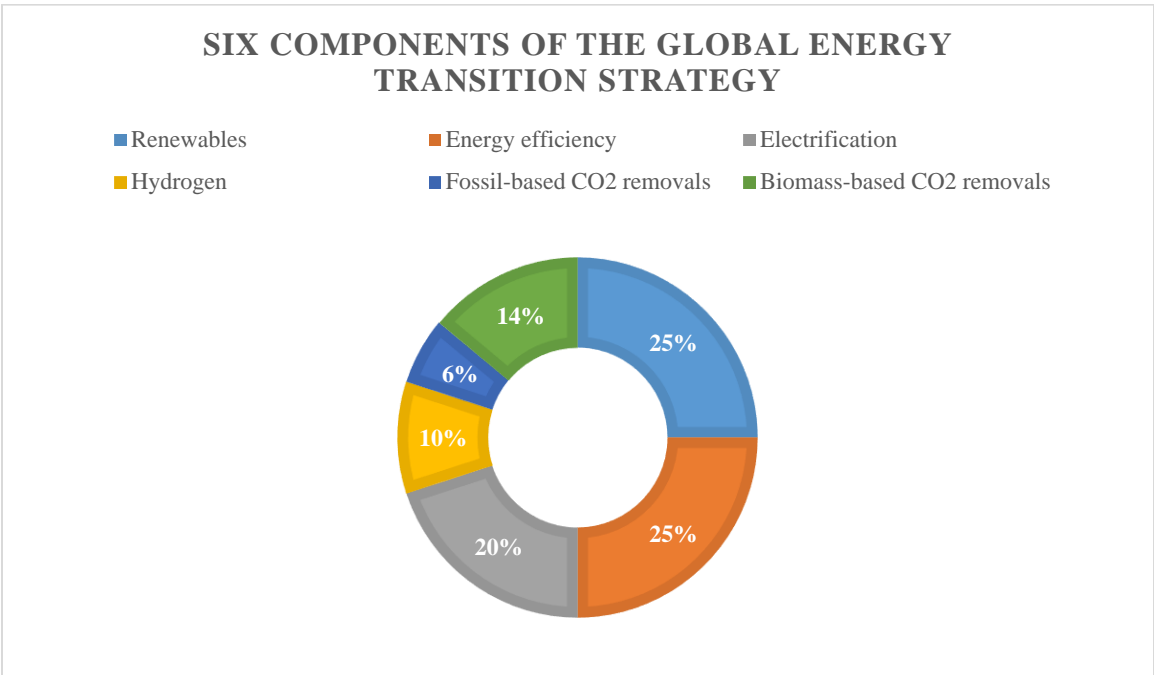


Figure 1.4. Six components of IRENA’s Energy Transition Strategy to achieve total mitigation of energy-related emissions by 2050 in a <1.5°C pathway. Source: Author’s elaboration based on IRENA (2021).

For its part, IRENA (2021b) highlights that more than 90% of the solutions required to reduce emissions related to the energy sector by 2050, under a 1.5°C maximum temperature rise pathway, involve renewables in several ways. In fact, among the six components of IRENA's global energy transition strategy (Figure 1.4), renewables are at the top of the list (accounting for 25% of emission reductions through direct energy supply). However, they are also

connected to other key components such as electrification, energy efficiency, green hydrogen production, etc. Investment in the energy transition should hit thereby a colossal USD\$131 trillion by 2050 and a cumulative payback of at least USD\$61 trillion by 2050. As stated by IRENA, such a level of deployment is necessary to achieve a transformation speed compatible with a 1.5°C scenario. This will require then specific policies and measures aligned with this objective. Nevertheless, such urgency clashes with the diverging interests of the different stakeholders of the energy system, which leads to various types of obstacles for the development of policies and technologies (Laird, 2013). And this is especially true in highly conflictive contexts such as Latin America.

1.1.3. Energy transitions in Latin America: between challenges and opportunities

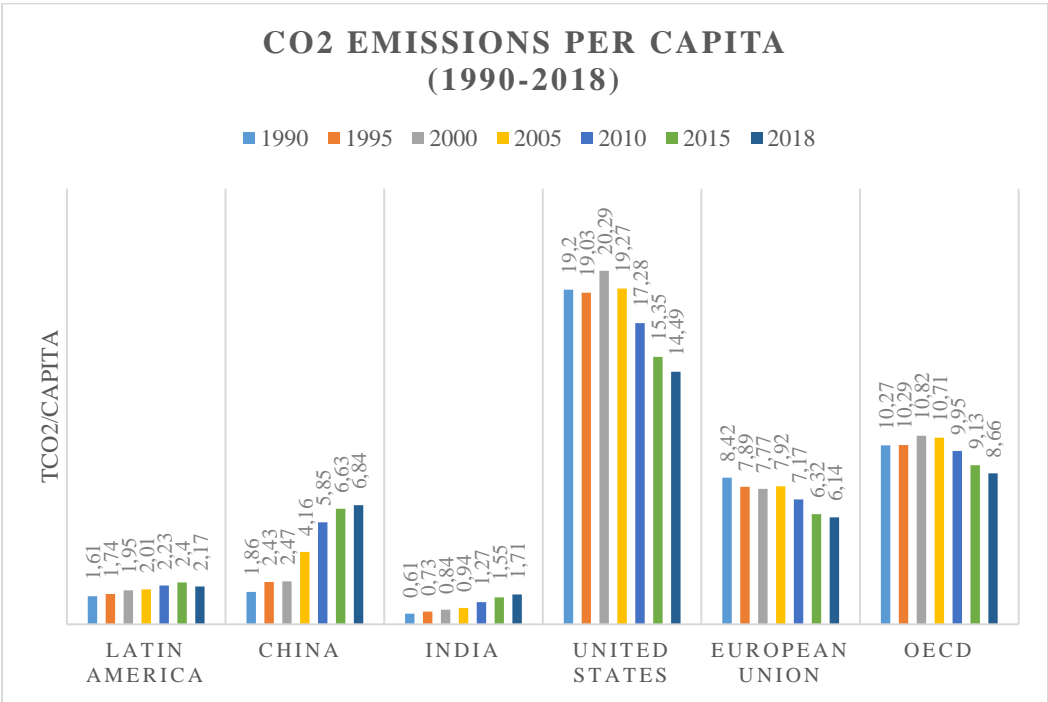


Figure 1.5. CO₂ Emissions per capita in selected countries/regions of the world. Source: Author's elaboration with data from IEA (2021).

Studying energy transitions in Latin America through the transformation of the electricity sector towards renewables must first of all confront a salient reality. Unlike advanced economies in Europe or North America, Latin America as a whole is a relatively low-carbon emissions region (Figure 1.5). Moreover, unlike the emerging economies of Asia, the level of emissions per capita has remained stable over time and has even tended to decline.

This is reflected in its share of total annual emissions, which reached just 3.6% in 2020 - the lowest in the world, even below Africa (3.9%) (BP, 2021).

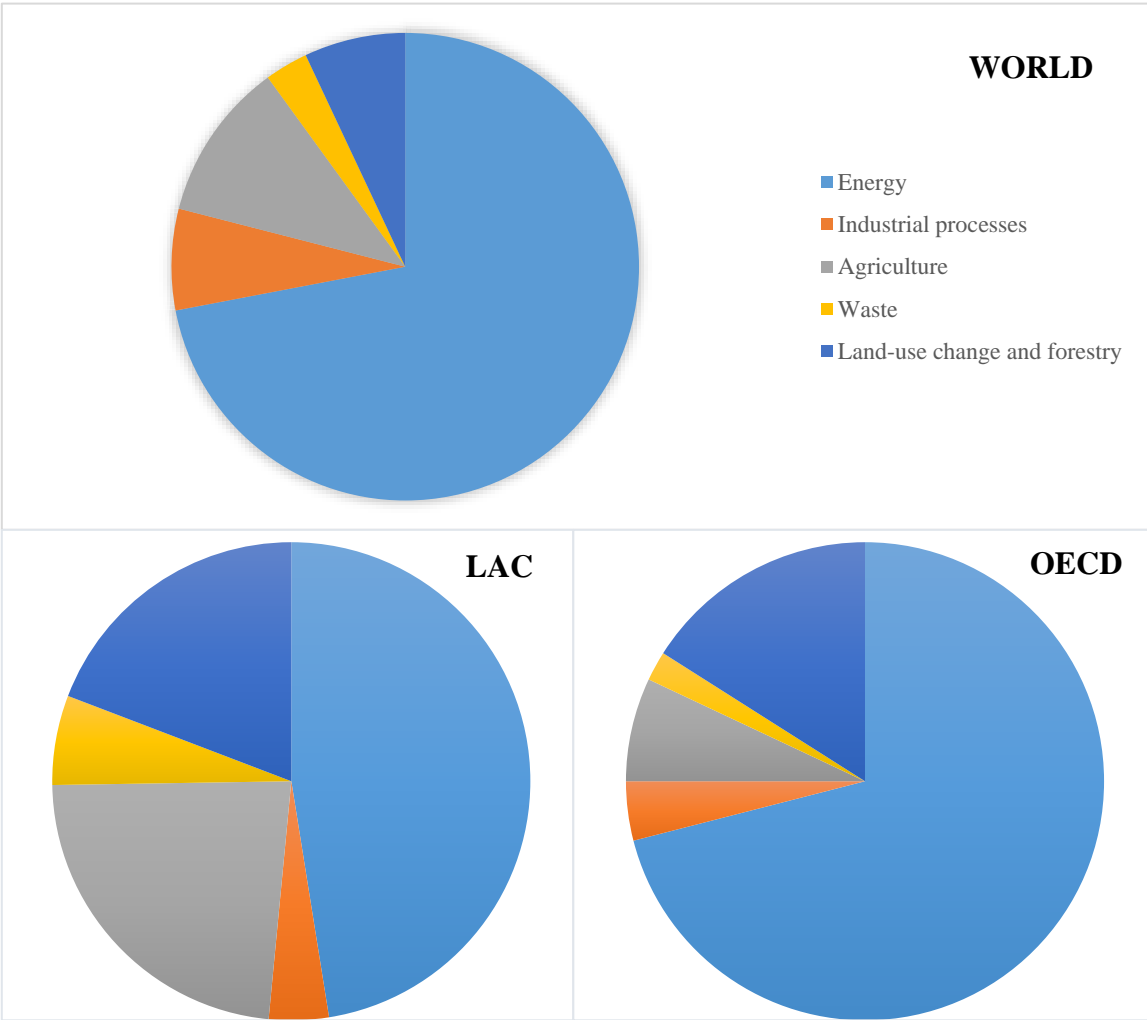


Figure 1.6. GHG emissions by region and sector in 2018.
 Source: Author's adaptation from OECD et al. (2019) based on WRI (2017) and World Bank (2018).

This situation is due, in the first place, to the higher share of agriculture and land-use change and forestry in total GHG emissions. Unlike the pattern of emissions in advanced economies and the world total, in which the energy sector accounts for more than 70% of total emissions, in Latin America this figure was barely 47% in 2019 (Figure 1.6). Nonetheless, this finding does not suggest that the prevailing economic model in the region is environmentally sustainable. On the contrary, the region is caught in an *environmental trap* (OECD et al., 2019) associated with low productivity, high environmental degradation and a tendency to

depletion of natural resources. Widespread high-carbon development paths based on hydrocarbon and mineral extraction are increasingly unsustainable. This is compounded by, on the one hand, the large-scale transformation of land use driven by deforestation through cattle ranching, mining, and agribusiness (which puts immense pressure on fragile ecosystems such as the Amazon) and, on the other hand, the high vulnerability to extreme climate events. This accidental combination of low emissions, low productivity, high extractivism and high environmental degradation is what ECLAC has called “*la tragedia ambiental de América Latina*” (Gligo et al., 2020).

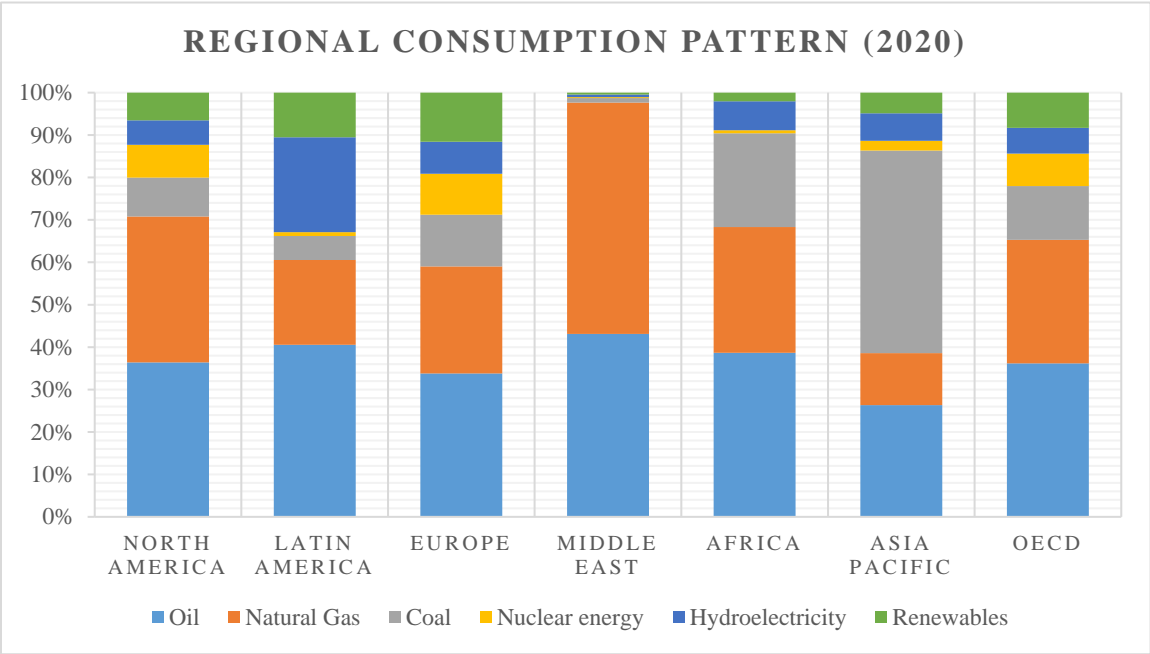


Figure 1.7. Energy consumption pattern by region of the world in 2020. Source: Author's elaboration with data from BP Statistical Review (2021).

The second factor contributing to this low emissions profile is the relatively high percentage of renewable resources in the energy supply (Figure 1.7). In Latin America, the share of fossil fuels in the primary energy matrix is predominant (with a singularly high share of oil, comparable to that of the Middle East). However, unlike other regions of the world, there is a large percentage of the regional energy consumption that comes from renewable sources such as hydroelectricity and biofuels (OLADE, 2020a). This factual reality has given rise to the notion that the region has a clean and even sustainable energy matrix, which is inscribed in the discourse of international organizations, development banks and governments in the region. Despite the above, the high renewability of the electricity matrix contrasts with the

high dependence of the external sector of the countries of the region on mining-energy exports, which has generated fossil fuel-dependent *patterns of productive specialization* (Ocampo, 2017; Phillips, 2015). This structural situation sets the big picture of the energy transition in Latin America, despite being a heterogeneous reality at the intra-regional level.

Ostensible differences in development strategies and transition paths among the countries of the region do not hinder the fact that the global energy transition is making headway in Latin America through the development of NCRE—which, by the way, are identified as the prime transitional pathway (Pérez Urdialez et al., 2021; Pistonesi et al., 2019; UERN CEPAL México, 2017). As noted by the IDB Energy Division (2021), the region has at least three comparative advantages for the development of renewable energy sources: 1) Natural resource endowment and energy potential with biomass, wind and solar; 2) Experience using auctions as a market mechanism for the allocation of new energy capacity; 3) Investor confidence among renewable energy international developers and lenders. The report also highlights the following: “*La abundancia de recursos naturales y los bajos precios de la generación de energía renovable en América Latina y el Caribe significan que la región está bien posicionada para promover políticas que al mismo tiempo generen empleos y construyan una infraestructura energética baja en carbono.*” (Pérez Urdialez et al., 2021).

From this perspective of renewable energy development as a business opportunity, some countries have consolidated their leadership by promoting strategies such as the RELAC initiative⁵— which aims for at least 70% of installed electricity generation capacity to come from renewable sources by 2030 (compared to a 55% baseline in 2019) The increasingly ambitious goals of incorporating utility-scale renewables (mainly variable NCREs such as solar PV and wind) make it pertinent to take a detailed look at the impacts of this transition on these countries, which have become ‘role models’ for the sector investors. Based on a geographic political economy approach, this research aims to interrogate the effects of the transition to NCRE in Latin America by studying the territorial trajectory of energy-producing regions in some of the countries that are pushing this transformation forward.

⁵ Launched by Colombia and co-led by Chile and Costa Rica, the RELAC initiative was presented at COP25 with the support of specialized agencies, international organizations, and recognized NGOs such as WWF. It was also welcomed at the OLADE Ministerial Meeting of November 14, 2020 in Lima (OLADE, 2020b) attended by the 27 member states.

1.2. Problem statement

The façade of unanimity about NCRE’s importance for climate change mitigation strategies does not equate to agreement about the policies and measures needed to achieve their deployment at the required scale and speed. On this point, Vaclav Smil stresses the following: *“Public acceptance and environmental considerations have become critical components in the conquest of new markets. New energy sources and techniques now face unprecedented public scrutiny and must comply with many environmental laws and restrictive regulations”* (WEF & IHS CERA, 2013). In contrast to the transition narratives diffused by international organizations, large-scale development of renewables is not universally accepted. Policies and technological solutions rather face multiple resistances across places and scales, from different stakeholders of the energy system. Here, the relevance of studying energy transitions through the development of renewables in power generation meets the analysis of the inevitably political nature—in terms of conflict and negotiation—of socio-technical transitions (Geels, 2014a; Marquardt & Delina, 2021; Meadowcroft, 2009, 2011).

Hence, given that a wide range of socio-environmental conflicts characterizes Latin America’s development model, this axis of analysis constitutes an indispensable focus for analyzing the justice-related issues derived from the transformation of national energy systems within the region. For this purpose, I decided to adopt a comparative perspective to analyze two cases of regional leadership in the transition to renewables—which, in turn, share certain macroeconomic and political commonalities. These are: Colombia and Chile, the main Andean economies. In this sense, from a geographical political economy approach, it is pertinent to interrogate the discourses of success and leadership that in recent years have made both countries stand out on the international scene. Such narratives risk projecting a post-political image (Flores-Fernández, 2020; Kenis et al., 2016) of absence of contradictions, divergence of interests and/or localized resistances that does not correspond to the materiality of the energy transformation processes.

Accordingly, in an effort to better understand the challenges facing the implementation of energy transition policies using social science tools, I aim to answer the following question and meet the following research objectives:

1.2.1. Research question and objectives

Research question:

Under the just transition framework, how are the energy transition processes in Colombia and Chile similar and different at the territorial scale?

Overall objective:

With special regard to the justice-related challenges, compare the energy transition processes in Chile and Colombia through the territorial trajectory of La Guajira and Antofagasta, their main NCRE producing regions.

Specific objective 1: *To describe the enabling conditions and triggering factors for the development of NCREs in Colombia and Chile.*

Specific objective 2: *To identify the socio-spatial transformations being produced by utility-scale renewable energy deployment in two strategic energy producing regions (La Guajira in Colombia and Antofagasta in Chile).*

Specific objective 3: *To interpret the main environmental, climate and energy justice challenges of energy transitions in Colombia and Chile at the territorial scale.*

1.2.2. Hypotheses

Since the research problem is eminently qualitative, the following working hypotheses do not constitute propositions to be confirmed. In fact, they were used to guide the inquiry through the different research phases in order to inductively uncover the findings presented in later sections. These are as follows:

1. The rhetoric of environmental sustainability and climate action that frames energy transition policies veils prevailing economic interests that, ultimately, are the determinants of the speed and scale at which NCRE technologies are being developed in Colombia and Chile.
2. Spatial reconfigurations operated by the massive deployment of utility-scale NCRE generating capacity can create patterns of injustice and inequality disproportionately affecting host communities in the energy-producing regions.

3. Power sector transition to NCREs does not imply overcoming pre-existing environmental conflicts associated with the exploitation of conventional energy sources and with fossil fuels production—instead, it may engender cross-scale tensions between different stakeholders of the energy system.
4. From a just transition perspective, energy policies in Chile and Colombia face formidable challenges to connect the creation of favorable market conditions for renewables with considerations of fairness and equity about the distribution of the social, economic, and environmental benefits of NCREs.

It should be clarified that, although some observations are of a technical nature, my purpose is to address issues linked to the specifically *social dimensions* (Miller et al., 2013) of energy transitions, using the methodological and theoretical tools of social sciences.

1.3. Literature review

This section is devoted to the literature review, which was conducted in two stages: first, a review of theoretical literature; second, a review of empirical literature. Three subsections are presented below: the first refers to the framing of the inquiry within the field of social sciences; the second contains the theoretical literature exploration; the third presents the empirical references that provided a better understanding of the relevance of this research.

Above all, a preliminary twofold clarification is needed. On the one hand, regarding the time frame. Although some backward-looking perspectives focus on the so-called *historical energy transitions* (Fouquet, 2016b; Grubler, 2012)⁶, only the literature on the contemporary problem of the transition to a low-carbon energy system is of interest here. On the other hand, regarding the epistemological framing. Although energy studies are often considered *multidisciplinary* (Araújo, 2014) or even *transdisciplinary* (Max-Neef, 2005; Spreng, 2014), only the specific contributions of the social sciences are relevant to this research (Benjamin K. Sovacool, 2014a, 2014b, 2014c; Benjamin K. Sovacool et al., 2015). This becomes meaningful inasmuch as these disciplines can support the understanding of energy transitions

⁶ The term historical energy transitions is used to refer to past processes of transformation of energy systems after the Industrial Revolution. Most notably, it is used to refer to the replacement of traditional biomass by coal at the end of the 19th century and its subsequent replacement by oil around the mid-20th century.

in a reflexive, analytical and projective manner (Rohracher, 2008)—i.e., beyond the realm of applied techno-scientific knowledge linked to the natural sciences.

1.3.1. From the transitions literature to the just transition approach

The literature on *socio-technical transitions* (also called sustainability transitions studies, transition management approach, etc.) constitutes an unavoidable first entry point. In short, this approach provides a comprehensive framework to understand the challenges of transitions from a ‘multi-level perspective’⁷. From this point of view, multiple actors (whose societal values and beliefs may or may not be encompassed) are involved in the deployment of innovative practices and technologies that break new ground towards sustainable socio-technical systems (Geels, 2011; Geels et al., 2016; Köhler et al., 2019; Markard et al., 2012). By developing a complex set of insights on the directionality, pace, speed, and scales of structural changes, this approach allows to interpret the required reconfigurations towards a horizon of sustainability—transformations not only in terms of technology, infrastructure and scientific knowledge, but also in terms of socio-cultural practices and political settings (Geels, 2014b; Roberts et al., 2018; B. K. Sovacool & Geels, 2016).

However, a persistent criticism of this perspective is the lack of solid framing of two key features of energy transitions: vested interests and conflicts (i.e., politics rather than policies) as well as context and place dependence across different scales (Kern & Markard, 2016; Newell, 2020a). Therefore, as my interests deal with the social dimensions of energy transitions (Miller et al., 2013) more than with the role of technologies, I incorporated another major input to the theoretical literature review: the *political economy* approach. I’m not going to drill into the specifics of that here, but political economy allows to explore power relations *between* and *within* countries, their changes and dynamics across social groups, political actors, and geographical scales (Arndt et al., 2017; Moe, 2016; Newell & Paterson, 2010).

⁷ In a nutshell, the *Multi-Level Perspective* (MLP) is a theoretical model for understanding socio-technical transition processes in sequential phases and at multiple levels based on the interaction of many actors and innovations. As Duruisseau (2014).summarizes : « *Cet outil d’analyse, utilisé dans le cadre de l’Histoire des Techniques et des Sciences de l’innovation, propose « une organisation des univers sociotechniques en trois niveaux » (Jaglin et Verdeil, 2013). Le niveau micro –« Technological niches » – est formé de niches technologiques qui sont de véritables lieux d’innovation placés à l’abri de la pression des marchés. Le niveau meso – « Socio-technical regime » – est constitué par le régime socio-technique défini plus haut. Le niveau macro – « Landscape » – correspond à l’environnement le plus large affectant les évolutions du régime socio-technique (mondialisation, problèmes environnementaux, changements de mentalités). »*

Moreover, to the extent that insights from the *international political economy* (IPE) (Kuzemko, 2019; Kuzemko et al., 2019) and the *global political economy* (Newell, 2019, 2021) are useful for exploring international relations and their interplay with domestic politics, my review rather focused on combining them with the so-called *geographical political economy* (Bridge et al., 2013; Bridge & Gailing, 2020) perspective. Through this approach, the foundations of energy policies and technologies as well as the (sometimes diverging) interaction of political and economic actors can be understood in deep connection with the production of energy spaces. I thus sought to connect this disciplinary focus with a thematic frame to address the comparison of energy transitions in Chile and Colombia.

Hence, I decided to delve into the aspects of equity and justice, since these are the most specifically social and naturally conflictive aspects of transitions. Accordingly, the heterogeneous idea⁸ of a *just transition* (García-García et al., 2020) emerged as a plausible alternative to bridge the aforementioned approaches and provide the research with a more solid thematic structure. This framework encompasses a growing literature that seeks to account for the extremely challenging political tradeoffs that characterize attempts to enact and realize a transition that integrates justice in substantive terms rather than as a rhetorical device (Jasanoff, 2018; Newell & Mulvaney, 2013). Ultimately, by bringing together environmental, climate and energy justice scholarships (McCauley & Heffron, 2018), just transition provides the lens to read the underlying tensions that a truly transformative transition ought to tackle (Heffron, 2020; Heffron & McCauley, 2018; K. Jenkins et al., 2018).

1.3.2. Studying energy transitions in and from Latin America

The empirical literature review was a two-stage process. First, I conducted an overview of the literature on approaches for studying energy transition policies and dynamics

⁸ The Just Transition Research Collaborative (JTRC) (2018) identifies four major groups of just transition approaches: 1) *Status Quo* approaches, consisting of voluntary greening of the private sector and job creation for workers in the affected sectors, without altering the economic model; 2) *Managerial Reform* approaches, involving modification and/or creation of rules, including investment processes linked to employment but without changing neither the economic nor the political model; 3) *Structural Reform* approaches, which imply structural change of the system and its institutions both at the level of governance and social ownership of assets; 4) *Transformative* approaches, involving a substantial systemic change which modifies the structures that reproduce and aggravate environmental issues and social injustices.

in Latin America, paying special attention to references to just transition issues. As a result, I was able to observe a fragmentation of the field into two main visions—broadly speaking:

First, there is a mostly *normative approach* oriented to the implementation of renewable energy policies and technologies, as well as towards the assessment of their effectiveness (Bersalli et al., 2020). Within this view, in which economists tend to prevail, an emphasis on the idea of the energy transition as a market-driven solution to the region’s environmental and energy concerns can be identified (Ebeling, 2020; Jakob et al., 2019; Nasirov et al., 2018; Viana, 2020). Most of these studies roughly coincide with the interests of energy players and tend to assume the neutrality and desirability of renewable energy technologies in the path of climate change mitigation, while focusing on regulatory or technical issues of energy system transformation (Aghahosseini et al., 2019; Noura Guimarães, 2020; Santos & Sabbatella, 2020). In addition, further concern is expressed regarding the alignment of national energy transition policies with the agenda promoted by international organizations and development banks at the international level (Pistonesi et al., 2019; Rivera Albarracín, 2019). In this field, comparisons at the macro level predominate—with regard to national policies; however, few works are framed in terms of just transition.

Second, there is a set of *critical perspectives*—oscillating between strong and super-strong sustainability—that place energy transition related issues within a horizon of overcoming extractivism and even capitalism (Bertinat, 2016; Fornillo, 2017; Gudynas, 2011). Insofar as it relies on the activity of environmental NGOs and grassroots movements, most of this literature pursues a militant appropriation of the just transition discourse as part of a rhetorical apparatus that advocates a long-term transition to a new energy and societal model. Whether adjacent to or directly connected with *political ecology*, these critical perspectives warn about the limits of renewable energies, their long-term unsustainability, and their socio-environmental impacts at a territorial scale (Avila-Calero, 2017; Dunlap, 2018; Honty, 2014). Similarly, they contest the idea of universal acceptance of renewable energies and, more broadly, the dominant narratives of the transition (Gudynas, 2019). In this field, regional case studies predominate—with a politically engaged understanding of just transition; however, there is a gap of comparative work at the local level.

Still, this typology does not mean these two frameworks are poles apart. Quite the opposite, in fact. The contraposition fulfills only the schematic purpose of indicating that, at their intersection, innovative points of view could emerge so that novel avenues of research can thrive. In this respect, some studies that tackle energy justice issues (Tornel, 2020; Velasco-Herrejon & Bauwens, 2020) are similar to the heterodox approach I want to explore here: a perspective that address the actually existing transformation processes in order to enhance the understanding of their possibilities—neither by fully assimilating a normative thought pattern nor by plunging into the depths of the critical stream of thought.

1.3.3. Social studies of energy in Colombia and Chile

Finally, in a second stage, I fragmented the search for relevant empirical literature around four analytical units that constitute the case studies: on the one hand, at the macro level, Chile and Colombia as national entities; on the other hand, at the meso level, Antofagasta and La Guajira as strategic regions/territories of the energy transition.

On the one hand, the available literature on Chile's trajectory and outlook is more abundant and diverse than the one on Colombia, which indicates greater public awareness about this subject. Research on Chile ranges from studies that exalt the country as a role model for its successful development of the NCRE sector (P. E. V. López et al., 2020; Simsek et al., 2019, 2020) to those that apply the socio-technical transitions framework to analyze the energy transformations in the country (Blanco-Wells, 2019; Karjalainen et al., 2020) and those that highlight the grey aspects of the Chilean process, primarily regarding the tensions underlying the neoliberal model for promoting renewable energies (Flores-Fernández, 2020; Furnaro, 2020). In turn, research on Colombia points either to the prospective analysis of the country's macroeconomic and institutional readiness for transition (Corredor, 2018; Delgado et al., 2020; Martínez Ortiz, 2021) or to the controversial aspects of energy sector planning—such as dependence on fossil fuels or the targets for expanding the electric power industry (Martínez & Castillo, 2019; Torres, 2019).

On the other hand, when replicating this exercise with Antofagasta and La Guajira, the outcome is different. Concerning Antofagasta, few studies have this region as their unit of analysis. Yet, some have inquired about the formation of sacrifice zones for coal-based thermal power generation (P. E. V. López et al., 2020) while others focus rather on the

territorial impacts of mining and its role in shaping the regional energy system (Bustos-Gallardo & Prieto, 2019; Carrizo et al., 2011). Regarding La Guajira, there is a vast literature on the multiple impacts of thermal coal extraction, its value chain and the economic implications of its phase-out (Cardoso, 2016; Cardoso & Turhan, 2018; Martínez Ortiz, 2019; Navas et al., 2018). In both cases, however, work on the impacts of NCRE projects is still scarce (González Posso & Barney, 2019; Pradenas Canales, 2018)—above and beyond prospective studies regarding their natural resource potential for power generation.

What becomes clear from the above is that there is a wide-open space for the study of the transition to renewable energies in both regions and countries within the scope of social sciences. Therefore, my objective of implementing a geographical political economy approach to analyze two case studies in Latin America with a comparative and multi-scalar perspective may constitute an innovative contribution to an expanding field of study.

1.4. Theoretical framework

This research falls within the approach of the *geographical political economy* (GPE) (Sheppard, 2011, 2018) applied to the study of energy transitions. Therefore, the conceptual tools proposed by Bridge & Gailing (2020) to analyze the so-called *new energy spaces* constitute the basis of the theoretical framework implemented. Likewise, the ‘*just transition*’ framework (Heffron & McCauley, 2018) is used to set a thematic frame to control the comparison between the units of analysis—which were selected according to geographic criteria that will be further specified in the methodological section.

1.4.1. New energy spaces

While studying energy from a social science perspective is not something new, public debate on energy issues is largely dominated by engineering or economics-related approaches. Yet, a growing interest in the socio-spatial context of energy systems has led to a repositioning of other disciplines (among which geography stands out). In this regard, since early 2010s, a spatial turn has been underway, drawing special attention to the crucial role of energy in the social production of space—particularly at a regional scale (Bridge, 2018; Coenen et al., 2021; Huber, 2015). Considering that energy systems are produced above all by a constellation of social, cultural and political relations that define the specific

appropriation of energy resources in a given spatiality, the geographies of energy are useful to support the planning and implementation of technologies but also, primarily, to understand the energy-society relationship in its complexity (Calvert, 2016). Given this scenario, the application of a GPE approach to the study of emerging energy transition processes in Latin America becomes relevant.

To that extent, Bridge & Gailing (2020) point out three key contributions of the GPE perspective on energy transition:

1. Explaining how new energy spaces are part of uneven and combined geographical development, which emphasizes the continuous production and reproduction of new energy landscapes as a contingent combination of new and old energy systems.
2. Placing the changing spatiality of energy production and consumption within a broader account of the contemporary dynamics of accumulation.
3. Analyzing how the places, scales and spatialities of energy systems are key current sites of struggle through which broader issues of political and economic governance come into play.

This perspective aims to overcome a shortcoming of research on energy transitions, which is to fail to account for the importance of different spatial contexts and to treat places as merely sites where transitions occur. The relationships between spaces and energy transitions, as well as the multiple ways in which space and energy infrastructures shape each other, indicate the importance of conceiving of energy transitions as a geographic issue and not solely as a techno-managerial matter of technologies and policies. Thus, I highlight three key concepts correlated with the three main contributions of the GPE. These are presented below, aiming to provide a conceptual basis for analyzing the unfolding of the energy transitions in Chile and Colombia through the lens of the new energy spaces theory:

- *Landscape*

The term *landscape* is the first useful conceptual tool for transcending a techno-centric approach to energy systems. It describes “*the assemblage of natural and cultural features across a broad space and the history of their production and interaction*” (Bridge et al., 2013). It has not only the descriptive function of alluding to the biophysical characteristics

of a place. The concept of *energy landscape* refers, instead, to the material expressions of the social, political and institutional relations bound to the extraction, conversion, distribution and consumption of energy (Kirshner et al., 2019). It is the visual record of the political economy of an energy system, the product of multiple contingent practices linked to the historicity of its spatial differentiation processes. Still, energy spaces do not evolve in a linear way but, in turn, they reflect the dialectical interaction between differentiation and equalization tendencies: they are the outcome of the *uneven and combined geographic development* of capitalism. (Bridge & Gailing, 2020; Sheppard, 2018).

Such linkage with the socio-materiality of energy consumption and production in concrete places provides an understanding on how the articulation and recombination of energy infrastructures from different eras of production gives rise to conflicts and negotiations around the processes of energy infrastructuring and resource-making (Bridge & Gailing, 2020). In other words, the energy landscape does not evolve following a unique and linear pattern. On the contrary, its configuration process results from diverse articulations between old and new elements that of themselves produce meaning, identity and imaginaries around energy (Kuchler & Bridge, 2018). These articulations attest then that –although energy planning is produced in accordance to an instrumental rationality– the development of energy infrastructure is also connected to emotional phenomena of *place-attachment* (Devine-Wright, 2011) that contribute to slow down or accelerate the pace of low-carbon transitions.

The usefulness of this concept thereby lies in revealing how material landscapes contain the traces of successive evolutions of energy systems, depicting them as part of complex and non-linear social processes that contain different forms of *carbon lock in* (Seto et al., 2016). Addressing the energy-society relationship through a comparative approach (that is, by exploring the constitution of energy spaces and landscapes by comparing regional case studies) can then open up a field of study that broadens the understanding of the different types of outcomes being currently produced by regional energy transitions and decarbonization processes (Coenen et al., 2021). This is of particular interest in Latin America due to the limited availability of energy research with a comparative geographic perspective.

- ***Territory***

Now, space and its transformations are not only linked to the deployment innovative technologies and bold policies, but also to how power is organized and exercised over space, This is called *territory*; in short, it refers to “*the organization of social and political power over space in and through energy systems*” (Bridge & Gailing, 2020). This concept provides a way of thinking about the configuration of energy systems as a problem of *spatial differentiation*, which implies their connectivity and integration across space as well as their boundedness and separation. The foregoing makes it possible to acknowledge that territorial form is not a given but an area of strategy in which several alternative territorial formations are in play at any one time (Bridge, 2018). Energy infrastructures are hence not relevant only as constituted spaces but as a manifestation of a vision of territoriality embedded in a larger political and/or economic project. The allied concept of *territoriality* is useful as well, as it refers to the strategic processes ‘behind territory’ and applies to the geographical partition and integration strategies employed by the state and/or other powerful stakeholders in the exercise of their authority or position of power (Bridge et al., 2013).

To that extent, such concepts contribute to thinking about the changing ways in which energy systems are (re)territorialized over time and their intimate relationship with power strategies that interact at a variety of scales (local, national, international). This approach is extremely useful for grasping *regional dynamics of accumulation* not in a localized manner but as profoundly multi-scalar phenomena. In this sense, the long-standing questions about *path dependency* (Fouquet, 2016a; Stein, 2017) and *path creation* (MacKinnon et al., 2019) as well as the problem of *incumbent energy regimes* (Turnheim & Geels, 2012) make sense for a relational understanding of the intricate links between low-carbon economies and prior regional forms of industrial organization (Bridge & Gailing, 2020; Gailing et al., 2020). This type of analysis also puts into perspective the scales and actors in which the necessary shifts to achieve an energy transition that dismantles the entrenched high-carbon sectors and transforms the *carbonscapes* (Haarstad & Wanvik, 2017) must operate. Therefore, it is highly relevant to analyze the territorial trajectory of Antofagasta and La Guajira using this framework, as they are regions in which energy transitions generate some tensions between the incumbent coal energy regimes and renewable energy landscapes.

- ***Governance***

Finally, these forms of (re)organization of space are not only related to a certain set of regulations and legal frames that rule energy systems (i.e., policies) but to a broader spectrum of relationships between actors and institutions that determine the modes of social organization of energy (i.e., politics). Politics indeed occupies a central place in socio-technical transition processes (Meadowcroft, 2009, 2011). However, what derives from the political fact is how human beings make decisions and create institutions that craft rules shaping individual behavior: that is, *governance* (Benjamin K. Sovacool, 2011). In short, governance is a multilevel process that shapes the relationship of human beings to the management of the commons and, specifically, of energy resources (Ostrom, 2007). It concerns then who can do what, who will monitor it, and how rules are modified and changed over time.

Regardless of the discussions about its background in the process of liberalization and financial globalization at the end of the 20th century (Van de Graaf & Colgan, 2016), the concept of governance applied to research on energy systems underscores the existence of a plurality of relevant actors with often divergent political and economic interests at different scales. From the study of *global energy governance* (Florini & Sovacool, 2009) through its interaction with country-specific domestic politics (Kuzemko et al., 2016) to its centrality in the configuration of *energy regions* (Späth & Rohracher, 2010), inquiries into energy governance illustrate the relevance of a non-statist-centric approach to politics in energy transitions. Hence, the GPE approach is useful to consider the multi-scalar and multilevel nature of politics in energy transitions, as well as to capture the contentious dimension of new energy spaces—which constitute key contemporary sites of struggle where issues directly linked to energy governance are at stake (Bridge & Gailing, 2020). This raises awareness about issues related to the dimensions of equity and justice in the transformation of energy systems, as we shall see.

1.4.2. Just transition framework

The concept of *just transition* refers, first and foremost, to a term that arose within U.S. labor environmentalism in the 1970s and 1980s. It was originally based on the recognition of the

environmental impact generated by the fossil fuel industry (particularly coal mining) and called for a transition whose costs should not be borne by the working class. Having this trade union origin, it thus became a mobilizing term to promote green jobs as a necessary component of the transition away from fossil fuels (Abraham, 2017). Notably since the 2000s, it has become a mainstream discourse of labor organizations in North America and Europe, forming communicating vessels with environmental, social and political movements in the Global North (Henry et al., 2020).

Likewise, the concept took on a global dimension from the turn of the 21st century. On the one hand, it has reached the agenda of global governance organizations and has become a recurring topic in meetings such as the Conference of the Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC)—to such an extent that it has been included in final agreements since COP16 in Cancun in 2010 and even in the Paris Agreement’s preamble (Glynn et al., 2020). Just transition frameworks have also been integrated into the political discourse of the European Union (EU) and international organizations such as the International Labor Organization (ILO) at least since the early 2000s (Henry et al., 2020). On the other hand, it has also been appropriated by social and political movements in the Global South to demand redistributive policies within their claim for climate and environmental justice in the context of the global energy transition. In Latin America, the idea of a just transition is often advocated as a strategic bet for implementing an economic and societal alternative to the widespread development model based on extractivism⁹ (Bertinat, 2016; Fuentes et al., 2020; Rivera Albarracín, 2020).

Such massification of its use has caused the concept to lose its original specificity. The different meanings attributed to it by different groups according to their backgrounds and interests therefore make its content and scope vary—which generates potential contradictions between the dimensions of justice it seeks to integrate (Newell & Mulvaney, 2013). Still, this possibility of transcending its original strategic purpose is what makes the concept of just transition attractive, as Healy & Barry (2017) point out when proposing fossil fuel divestment

⁹ For a first-hand approach to the just transition narratives in Latin America, from the standpoint of social and environmental activism, see: Soler Villamizar, J. P. (Ed.). (2019). *Transición energética en América Latina. Propuestas de transición energética: agua y energía para nuestra soberanía*. CENSAT Agua Viva - Movimiento Ríos Vivos. <https://areaslivresdepetroleo.org/wp-content/uploads/2020/07/transicio-n-energetica-en-america-latina-digital.pdf>

as a way to enhance and repoliticize energy justice. Through the political economy approach, the notion has been elaborated that a just transition –beyond protecting workers in fossil industries– needs to address critical issues such as energy access and poverty as well as must adopt climate justice goals to ensure an equitable energy transition (Jasanoff, 2018). Just transition frameworks are useful, in short, for grasping the value of implementing policies and developing technologies without losing sight of social equity issues in the sustainable design of a low-carbon future.

To that extent, I opted to implement the *just transition framework* proposed by Heffron & McCauley (2018a 2018b, 2019) to operationalize a concept with a strong normative content. This approach is used as a thematic frame for the comparison of case studies and not as an aspirational category that designates the ought-to-be of energy transitions, in the manner of narratives linked to activism. By including several justice scholarships in a comprehensive and interdisciplinary framework, this reframing of just transition can be used to direct the research towards identifying issues of equity and justice in the Chilean and Colombian energy transitions at the local scale. In this sense, its relevance consists in establishing common dimensions of analysis to address the regional formation of Antofagasta and La Guajira as new energy spaces. All of this is based on the assumption that the concept of just transition “enables researchers to more explicitly reflect upon the intersectionality of environment, climate and energy, assess justice issues from a truly interdisciplinary perspective and ultimately contribute to meaningful long-term solutions” (McCauley & Heffron, 2018).

The three dimensions associated with this just transition framework and the emerging issues they allow to analyze are:

- ***Environmental justice***

Environmental justice has developed over the past four decades to both identify and account for the disproportionate effects of environmental burdens on marginalized communities. Since its emergence as a field in the late 1980s, the environmental justice movement and accompanying academic studies have held a joint commitment to demonstrate and call for solutions to the fact that burdens are “*inequitably distributed both spatially and socially*” (Bickerstaff & Agyeman, 2009). This focus on the emergence of patterns of distributional injustice has meant that, when applied to the study of the transition to a low-carbon energy

system, environmental justice refers in a primarily critical way to the following questions: how is the transition taking place, by whom and for whom, within the setting of what political economy, how spatiality, dynamics of accumulation and land grab are interlinked, and so on (Levenda et al., 2021; McCarthy, 2015; Newell & Mulvaney, 2013).

Appealing to the responsibility of powerful stakeholders in view of the possible emergence of new social and environmental inequalities (and/or reinforcement of old ones) in the transition to low-carbon economies, this critical lens warns against the risk of pure technological fixes to solve the climate-energy crisis (Avila, 2018; Mulvaney, 2013). This is the case, for instance, of the impacts of large-scale windfarms in the Isthmus of Tehuantepec in Mexico (Avila-Calero, 2017; Dunlap, 2017, 2018; Mejía-Montero et al., 2020). This dimension of just transition contributes to detract from the notion of neutrality of energy technologies and to think about the risks of massive transformation of landscapes and ecosystems by the accelerated development of renewable energies in energy-producing regions. Furthermore, its emphasis on the distribution of costs and benefits of economic activities across space also contributes to identify emerging and potential socio-environmental conflicts that may affect the overall pace of transformation of national energy systems.

- *Climate justice*

Climate justice has the same starting point as environmental justice: the acknowledgement that climate change this time can have disproportionate social, economic, public health, and other adverse impacts on disadvantaged groups. Nonetheless, it provides a less localized approach with a greater temporal and spatial scope, through which it seeks to emphasize the equitable sharing of the unavoidable burdens of accelerated climate change (Caney, 2014). While also having strong activist roots, climate justice holds a call for the recognition of uneven risks and asymmetric responsibilities with regard to the generation of public policies for climate change mitigation and adaptation between countries in the Global North and Global South (McCauley & Heffron, 2018). By addressing justice issues in a multi-scalar way, it takes into consideration the inequalities and inequities arising along the value chain of fossil fuels and energy commodities, more broadly speaking— which is useful, for example, to better understand the political, economic, and cultural challenges for the phase-

out of coal and fossil industries in general (Billon & Kristoffersen, 2019; Brown & Spiegel, 2019).

In the same direction, this dimension of just transition focuses the analysis on the causes of climate change and the systemic transformations required to confront it, raising the need to establish criteria of equity and justice in the process of decarbonization of economies. It thus allows addressing the uncertainties for energy exporting countries such as Colombia in the face of global decarbonization (Armstrong, 2020) as well as the impacts of the low-carbon energy transition in the regions where extraction and/or transformation of energy commodities take place (Bainton et al., 2021; Fisher, 2015; Fuentes et al., 2020). Ultimately, climate justice offers an interesting angle to observe the permanencies of incumbent energy regimes and their relevant actors, and so understand the challenging landscape that must be faced by climate policies in connection with energy policies in order to avoid creating unfair outcomes or further exacerbating, maintaining or ignoring inequalities (Williams & Doyon, 2019).

- ***Energy justice***

Energy justice has a different origin and trajectory than the two previous dimensions of the just transition framework. Unlike climate and environmental justice, energy justice does not have an activist origin and emerges from a more scholarly environment as an alternative to try to influence energy policy-making at different levels and, therefore, to have incidence in the transformation of energy systems (K. Jenkins et al., 2016, 2017). It envisages at least a '*triumvirate of tenets*' which are *distributional*, *procedural* and *recognition justice* through which justice-based concerns within energy systems, from production to consumption, can be addressed (McCauley et al., 2013). Similarly, it enables thoughtful reflection on the challenges and paradoxes that arise from the transformation of energy systems when justice and sustainability issues are taken into consideration altogether (Monyei et al., 2019; Benjamin K. Sovacool et al., 2017). From such rationale, one can infer, among other things, that the pursuit of sustainability through the transformation of energy systems can create or recreate various patterns of injustice.

Finally, energy justice aims to address disputes and threats to policy implementation by identifying procedural and recognition shortcomings in the aforementioned policies. Just as

it advocates for the inclusion of the issues of energy efficiency, modern energy access and consumption, ensuring reliable energy supply, and, in a broader sense, overcoming energy poverty (Heffron & McCauley, 2019; McCauley & Heffron, 2018; Newell & Mulvaney, 2013), it also points to the question of equitable inclusion of the most disadvantaged stakeholders (such as residential users, local communities, ethnic groups, among others) in policy design. Procedural and recognition issues can thereby be expressed in their deeply political nature that involves not only formal but substantial recognition of these actors in policy instruments, which implies, to some extent, thinking energy-related uses and visions outside the horizons of Western reason (Healy & Barry, 2017; K. Jenkins et al., 2018; Benjamin K. Sovacool et al., 2017). This approach has been little explored in Latin America and moreover there is very scarce literature with a geographical comparative case study perspective (K. E. H. Jenkins et al., 2021). Given the governance problems that energy policies have faced and may face in the studied countries, energy justice is a relevant dimension of the just transition framework that provides useful conceptual tools to consider.

1.5. Methodology

This investigation is framed by the principles of qualitative research (Becker, 2009) and, more specifically, implements an emergent design, one of its hallmarks. According to Becker (2009), “*not fully pre-specifying (research) ideas and procedures, as well as being ready to change them when their findings require it, are not flaws, but rather two of the great strengths of qualitative research.*” Unlike traditional data-oriented approaches, which are more commonly employed in energy studies, applying a process-oriented methodology allows for systematic theory building from inductive analysis processes (Bendassolli, 2013). By doing so, non-obvious connections between differing contexts can be brought to the fore empirically, allowing to think out of the box and make innovative observations.

Nevertheless, the aforementioned does not mean that the use of numbers is disdainful; on the contrary, due to the nature of the object of research, quantitative data have special relevance. Here, descriptive statistics play a major illustrative role, as they allow to obtain “*a richer picture or enhanced representation, in which to examine the phenomenon of interest*” (Schreiber, 2008). This tool is, however, under permanent critical inspection. Numbers are meaningful insofar as they capture the way in which the actors who collect and use them give

them meaning (Peneff, 1995), not as hard or neutral indicators that transparently reflect the “reality” of a given phenomenon.

Therefore, I seek to set up a qualitative approach to the comparison of two case studies on the implementation of energy transition policies and their territorial impacts in Latin America. In this section, I proceed to summarize the implemented methodological strategy, justify the case selection and describe the various phases of the research:

1.5.1. A Comparative Case Study (CCS) approach

One of the main approaches to qualitative research is the *case study* (Stake, 1995). This method is useful for in-depth research as it allows empirical conclusions to be drawn on the analysis of a given phenomenon in its natural context, which is especially important when the boundary between a case and its context cannot be unequivocally defined. Moreover, for in-depth research, the use of the case study method makes sense in the search for answers to questions of an exploratory nature (Yin, 1998, 2009). Unlike other approaches, the case study is not purely qualitative in nature. Because of its in-depth study of contexts, actors, and places, it can also rely on quantitative data and techniques to gather detailed information on a particular case. Besides, one of its advantages is that it has a comparative strand.

Now then, traditional case study methodology has a problem related to the ‘bounding’ of cases. Bartlett & Vavrus (2017a, 2017b) point out that cases tend to be obsessively bounded with fixed notions of culture and context when using this method—limiting their potential to capture reality as a complex process. In contrast, Bartlett & Vavrus propose to extend the value of the case study approach by iteratively building and comparing models. Designed to rethink the case study as an effective qualitative tool for researching the impact of policy and practice in various fields of social research, this approach is referred to as *Comparative Case Studies* (CCS). Therefore, CCS is oriented to explore with a comparative perspective the processes that have produced a common sense of place, purpose, directionality, or identity.

An advantage of the CCS is that it allows for an in-depth description of the cases on a limited number of variables which, during the analytical phase, offers the opportunity to identify patterns in the data that add to or extend the application of theory, or enrich and refine the theoretical framework. It thus constitutes a method that needs to be methodologically skillful

in using and combining a range of qualitative and quantitative data collection techniques¹⁰. This mixed methods reliance provides a methodological flexibility that is useful, especially when the exploration of cases is not previously based on fixed criteria of similarity or difference. To that extent, the researcher seeks to understand and explain patterns and establish plausible explanations as to why they have occurred. The aim of comparison is to question and explore configurations between cases through CCS, and not merely to compare them in a static way (Goodrick, 2019). Consequently, the challenge is to return to the comparative level to draw the final conclusions and ensure that the comparative framework is theoretically sound (Mills et al., 2010).

The intellectual dexterity and methodological flexibility required by CCS are coupled with the contingencies of an emergent design. It demands periodic review of the data collected so far and an analysis of emerging findings throughout the course of the research. As we shall see, the phases of the research are not followed sequentially, but tend to provide feedback to each other. So, “*one phase can inform methodological decisions for the next phase*” (Bartlett & Vavrus, 2017a). Triangulation constitutes the cornerstone of CCS, as it relates to strategies for surmounting potential weaknesses that may arise from using a single method, a single data source, a single observer, or a single theoretical basis. In this sense, triangulation is not only about seeking convergence but also about addressing underlying reasons for divergent conclusions. It is the tool to give robustness to both the methodological procedure and the research findings. The researcher is thus not limited to focusing on the technical aspects of the method, although these are important “*but makes thoughtful inquiries into converging and diverging patterns*” (Goodrick, 2019).

In this way, the CCS relies on three axes of comparison (Bartlett & Vavrus, 2017b):

- a *horizontal axis*, which compares how similar policies or phenomena develop in different places that are socially produced and complexly connected
- a *vertical axis*, which insists on paying simultaneous attention to and across scales

¹⁰ CCS has the peculiarity of being an appropriate method both for research and for impact evaluation of public policies. It results as well from a combination of data collection techniques such as Qualitative Comparative Analysis (QCA), Process Tracing and Pattern Matching.

- a *transversal / longitudinal axis*, which situates the analyzed processes historically

These three axes of comparison illustrate that the processual approach of CCS is well suited to the theoretical framework provided by GPE, as it allows us to compare processes across a variety of spatial and temporal scales and levels of analysis. This rethinking of the case study research process has important implications for comparison, as it urges us to pay close attention to changing social relations and networks of relations that provide the empirical setting to the research and to how these relations and networks have been shaped over space and time. The above represents the possibility of establishing a plausible comparative framework between two regional case studies whose structural differences would otherwise constrain the application of the classical logic of comparative analysis (Lijphart, 1971)—given the importance accorded to the *a priori* bounding of the study and, consequently, to the pre-established criteria and variables required to control the comparison.

1.5.2. Presentation of the case studies

In accordance with CCS logic, cases were not strictly bounded *a priori*, but rather chosen on the basis of a theory-led selection. This procedure is, therefore, iterative. “*This means that case selection and conditions for case comparison cannot often be fully specified at the beginning of a study*” (Goodrick, 2019). Colombia and Chile constitute the starting point as entities where market-driven energy transition policies have been implemented and which share a macroeconomic profile and a strategy of international insertion that has allowed them, for example, to promote a common free market-based regional integration scheme such as the Pacific Alliance (Pastrana Buelvas & Castro Alegría, 2020) as well as to be part of organizations such as the OECD. Based on this statement of country-level similarities and considering their structural differences, I proceeded to case selection at the regional scale with a mostly geographic perspective.

First and foremost, I must point out that the multi-scalar and multi-level nature of the methodological and theoretical approach implemented makes it necessary to constantly jump between spatial scales and levels of analysis. Here, the structural differences of the Colombian and Chilean energy systems allow to anticipate temporally divergent transition trajectories and, consequently, differentiated patterns of spatial transformation—albeit their

political economic similarities lead to infer the possible emergence of common issues in light of the just transition framework. To that extent, in the GPE understanding that policy and regulatory changes in energy systems are always spatially constituted, the analysis of energy transition policies makes more sense by focusing on the conjunction of regional and local scales. This geographical reasoning drove me to choose regional case studies following a logic of selection by *exemplarity* (Goodrick, 2019): the places where the largest flows of investment in renewable energy and large-scale energy infrastructure projects are concentrated may best capture the arising challenges and dilemmas of energy transition processes.

Table 1. Case selection criteria. Source: Author's elaboration

Units of analysis	Colombia	Chile	La Guajira	Antofagasta
Scale (Level of analysis)	International-National (<i>Macro-Meso</i>)		Regional-Local (<i>Meso-Micro</i>)	
Similarity criteria	<ul style="list-style-type: none"> • Macroeconomic profile • Market-driven energy transition • International insertion and regional leadership 		<ul style="list-style-type: none"> • Energy-producing regions • Mining-based regional economies • Natural resource endowment 	
Differentiation criteria	<ul style="list-style-type: none"> • Energy profile (energy exporter vs. energy importer) • Level of human development (High vs. Very High) 		<ul style="list-style-type: none"> • Regional energy systems (energy extraction vs. power generation) • Uneven economic development (Regional 'failure' vs. Regional 'success') 	

Case studies were selected according to qualitative criteria of both *similarity* and *difference* (Table 1). The regional case studies to be compared are, on the one side, the department of La Guajira in Colombia and, on the other side, the region of Antofagasta in Chile. In summary, the reasons to select them among other regional entities were as follows: in terms of similarities, it should be noted that they are energy-producing regions, their regional economies are based on mining and they have an enormous potential of renewable natural resources in desert areas; in terms of differences, mention should be made of their regional energy systems (one based on electricity generation and the other on energy extraction - coal mining) and their uneven development (as the one has a comparatively high level of income

and human development within Chile, while the other has a comparatively low level of income and human development within Colombia).

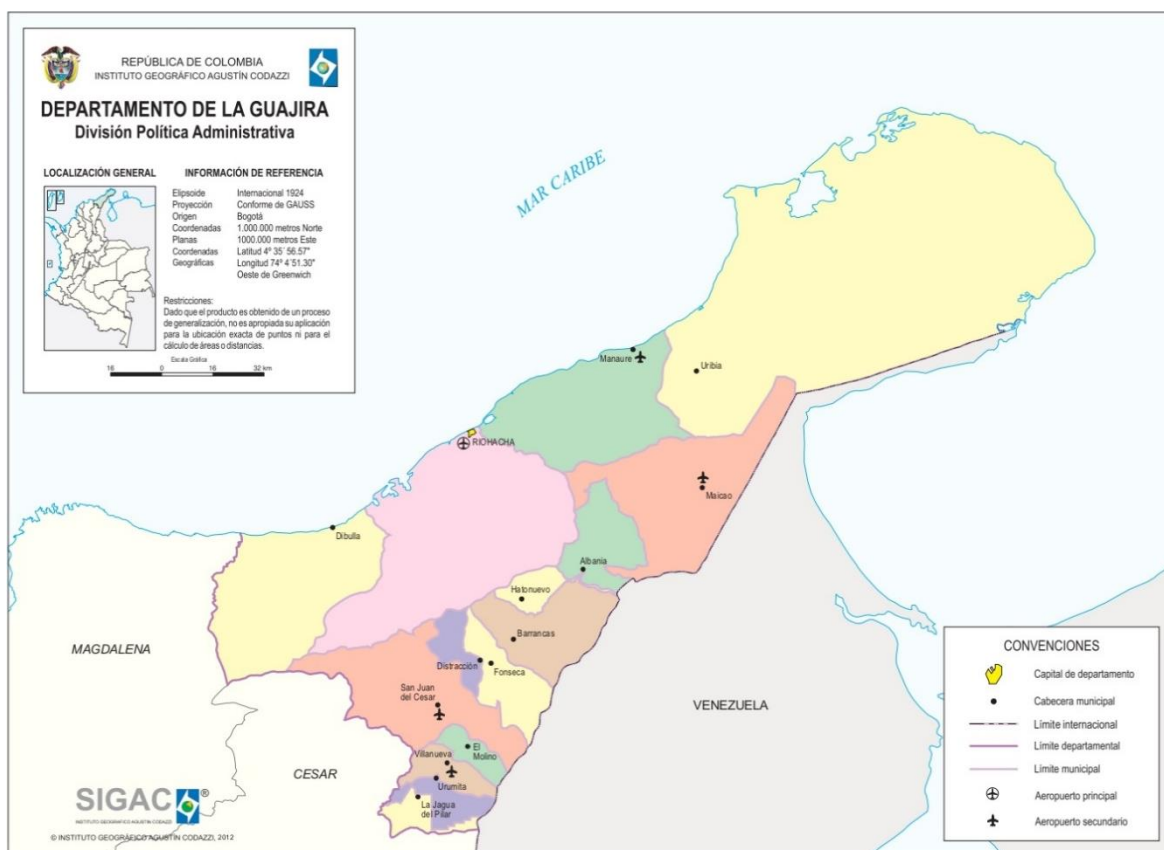


Figure 1.8. Political and administrative map of La Guajira. Source: Instituto Geográfico Agustín Codazzi - IGAC (2012)

In that sense, La Guajira is a territorial entity located in the extreme north of Colombia's and South America's continental surface, in the northern part of the border with Venezuela and facing the Caribbean Sea. Its landscape, comprising primarily the homonymous peninsula, is predominantly flat and desert-like. Inwards, it is divided into three sub-regions that encompass fourteen municipalities and a special district, Riohacha, the capital (Figure 1.8): the *Alta Guajira*, constituted by the desert in the northern area of the municipality of Uribia; then, the *Media Guajira*, where there are sandy and silty soils created from the strong winds during the dry season; finally, there is the *Baja Guajira*, bordering the departments of Cesar and Magdalena, along the foothills of the *Sierra Nevada de Santa Marta* and the *Serranía del Perijá* in the south, where altitudes of up to 4,000 meters above sea level are reached (Meisel Roca & Perez, 2006).

Nevertheless, beyond its physical characteristics or its political and administrative division, what is striking about La Guajira is its condition as a *backward periphery*. La Guajira is one of the departments with the most precarious socio-demographic and socio-economic indicators in the country. In terms of poverty, it has the second highest incidence of monetary poverty and the fourth greatest rate of multidimensional poverty among the 32 Colombian departments; in both measurements, more than half of the population falls into this category (DANE, 2020). Likewise, according to DANE's 2018 National Population and Housing Census, a distinctive demographic feature is the majority proportion of indigenous communities—reaching 394,683 people in 2018 (i.e., almost half of the entire departmental population). Within this group, 94.1% corresponded to the *Wayúu* indigenous people (which, moreover, are mostly located in rural desert-like areas, in the municipalities of Uribia, Manaure and Maicao, where they exceed 50% of the municipal population).

In line with the above, precariousness is manifested in two other significant aspects. On the one hand, there is a low coverage of public services and a high presence of household deprivation, especially in the Alta Guajira (where the percentage of households with Unsatisfied Basic Needs - UBN or in misery exceeds 50%). On the other hand, it is worth noting the low complexity of the regional economy, which is reflected in a strong dependence on export-based extractive mining of coal and, to a lesser extent, natural gas. In fact, the economic activity with the largest share in the departmental GDP has traditionally been mining, in a much higher proportion than sectors that make considerable contributions to the GDP, such as social, communal, and personal services (mostly tourism) or traditional activities like agriculture, cattle ranching and fishing. Without going into detail, this mining exploitation has been purely *extractivist* (Gudynas, 2011), namely, driven by a logic of extraction without regard for territorial development.

However, a progressive reduction in mining's contribution to La Guajira's regional GDP can be observed since the early 2000's. This trend provides a first axis of comparison with the second regional case study: Chile's Second Region, Antofagasta. As shown in Figure 1.9, Antofagasta's mining sector has a weight in regional GDP similar to that of La Guajira. As a matter of fact, the Chilean region's economic reliance on the mining industry also tended to decrease throughout the 2010s, but at a slower pace than in its Colombian counterpart.

Activities related to mineral extraction (copper and its derivatives) continued to account for more than 50% of value-added region wide. Yet, this similarity contrasts with their divergent socio-economic trajectories and socio-demographic profiles.

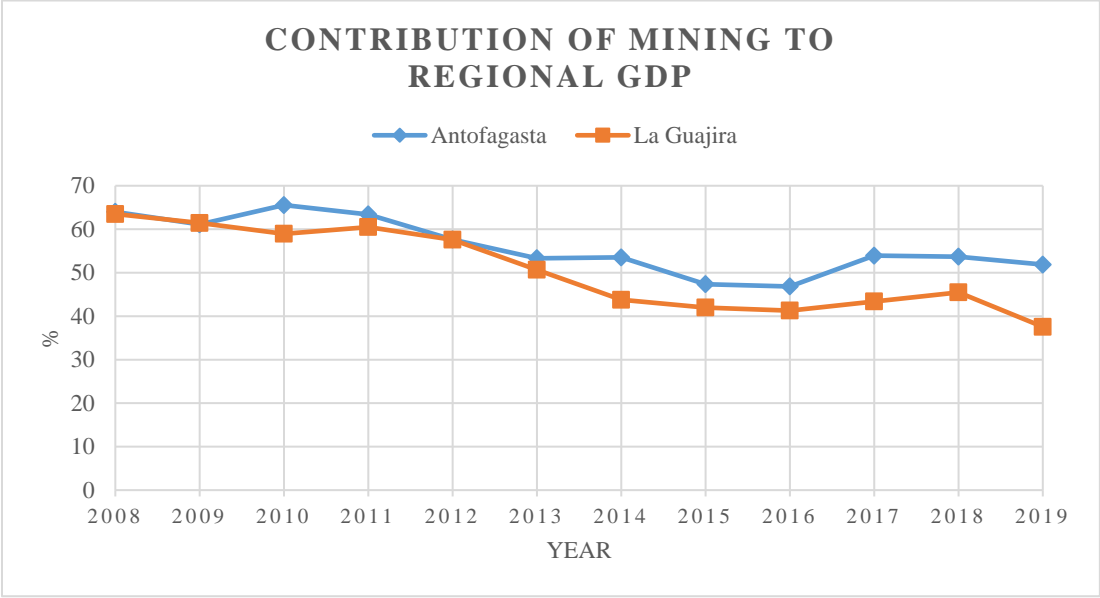


Figure 1.9. Contribution of mining to regional GDP in Antofagasta and La Guajira (2008-2019).
 Source: Author's elaboration with data from DANE (2021) and BCCh (2021).

On the one hand, the scale of the mining industry in Antofagasta is much larger than that of La Guajira, which is evidence of deep structural asymmetries between the two regions. The annual volume of exports (essentially from mining) of the Chilean region is equivalent to almost fourteen times the total amount of annual exports from the Colombian department. The so-called Second Region has therefore the highest economic growth as well as the highest GDP per capita in Chile (Lardé et al., 2008), a fact that is correlated with other economic and social indicators. As can be appreciated in the BCCh database (2021), the dynamism of the regional economy of Antofagasta is also reflected in the relevance of other areas of economic activity (among which construction, financial services and, with singular importance, the electricity sector stand out). In this case, productive specialization does not conflict with economic diversification.

On the other hand, social conditions of the regional population excel among Chile's regions. According to the National Socioeconomic Characterization Survey (CASEN) made by INE in 2017 and based on data from the National Population and Housing Census of that same

year, only 5.1% of the population was characterized as income poor while this figure stood at 16.4% in relation to multidimensional poverty. This makes it one of the three regions with the lowest incidence of poverty at the national level. Similarly, the profile of Antofagasta's population is markedly urban (94.1% of all households, above the Chilean national average) and accounts for a significant percentage self-identified as belonging to an indigenous community¹¹. The main deficiencies identified among the region's households are: first, lack of schooling (in 20 out of every 100 households); second, lack of social security (in 23 out of every 100 households); and third, lack of habitability (which refers to a qualitative deficit in the housing conditions and affects 17 out of every 100 households in the region) (Ministerio de Desarrollo Social y Familia de Chile, 2017).

In addition to the previously mentioned socio-demographic and economic features, there is a second axis of comparison: regional geography. Antofagasta is located in the north of Chile, in a vast area that extends from the Andean highlands border with Bolivia and Argentina in the east to an extensive strip of coastline facing the Pacific Ocean in the west. Despite the similarity of its relief with the rest of the country, Antofagasta has the particularity of an extreme aridity, scarcity of water and little vegetation. This is because the desert extends along the intermediate zone of the region, where the maritime influence loses importance and where the steep slopes of the *Cordillera de Los Andes* do not yet rise. Combining aridity, sparse rainfall and great temperature range, such a situation defines, broadly speaking, a natural landscape known as the *Desierto de Atacama* (BCN, 2021). In turn, the region is subdivided into three provinces comprising nine communes (Figure 1.10). These are: Antofagasta (made up of the communes of Antofagasta, Mejillones, Sierra Gorda and Taltal); Tocopilla (which groups the communes of Tocopilla and Maria Elena); and El Loa (including Calama, Ollagüe and San Pedro de Atacama). Although it is a peripheral region distant from Chile's main consumption centers, Antofagasta represents the case an *integrated periphery*

¹¹ According to the 2017 National Census, the population self-recognized as belonging to one of the indigenous peoples recognized by Chilean law reached 13.57%, slightly above the national average (12.44%).

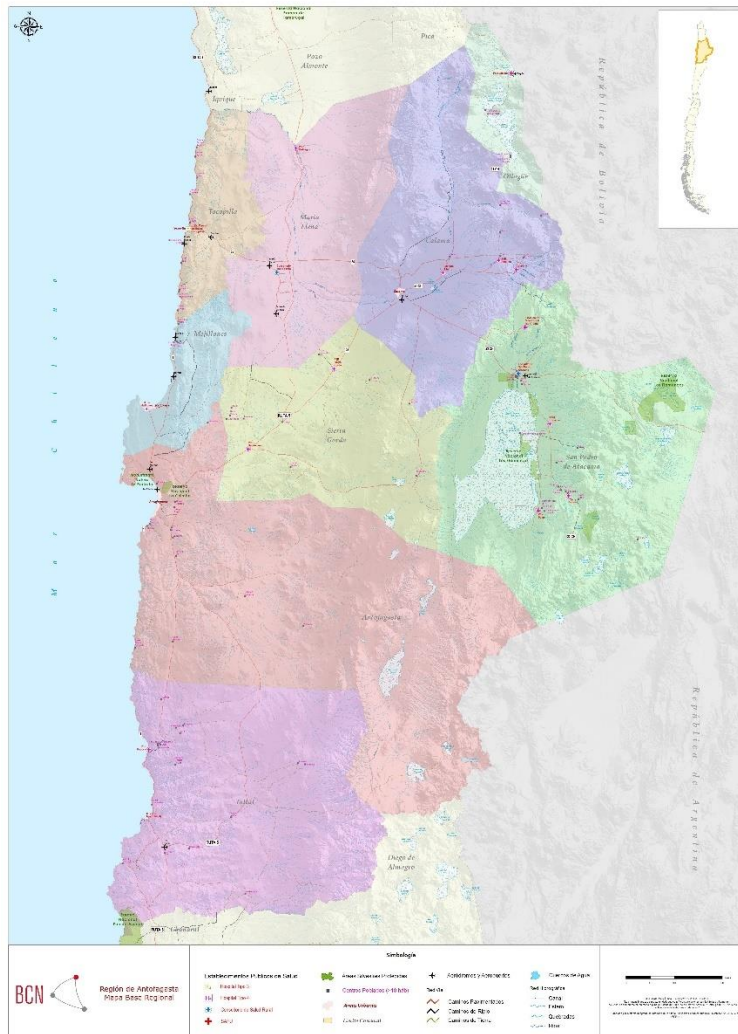


Figure 1.10. Political and administrative map of Antofagasta. Source: BCN (2008)

Even though they are two different types of peripheries (one “failing” and one “successful”), La Guajira and Antofagasta share the geographic similarity of having a desert landscape connected both to the coast and to the mountain. As will be discussed, this particularity makes both regions resemble each other in something even more significant: their availability of renewable natural resources. This situation gives them a central place in the transformation processes of the Chilean and Colombian energy systems and, therefore, within the clean energy transition on a global scale. Given their trajectories as extractive territories, the comparative perspective can contribute to form an overview of the present and future challenges of energy transitions in Andean economies. The conceptual apparatus of the new energy spaces will thereby allow me to explore the issues that must be addressed in light of

developing renewable energies according to some minimum criteria of justice, equity and sustainability.

Table 2. Key characteristics of the regional case studies.
Source: Author's elaboration with data from DANE (2021) & INE (2021)

	La Guajira	Antofagasta
Country	Colombia	Chile
Population	880,560 (2018)	607,534 (2017)
Area	20,848 km ²	126,049,1 km ²
Density	42.24/km ²	4.82/km ²
Monetary Poverty	53.7% (2018) (31/32)	5.1% (2017) (3/16)
HDI	0.695 – Medium (2019) (30/32)	0.875 – Very High (2019) (3/16)
Indigenous Population (%)	44.82% (2018)	13.57% (2017)
Main Economic Activity	Mining (coal)	Mining (copper)
Total Exports (USD\$MM)	\$1.526,86 (2019)	\$22.365,0 (2019)
Prevailing NCRE Source	Wind	Solar PV

1.5.3. Research phases

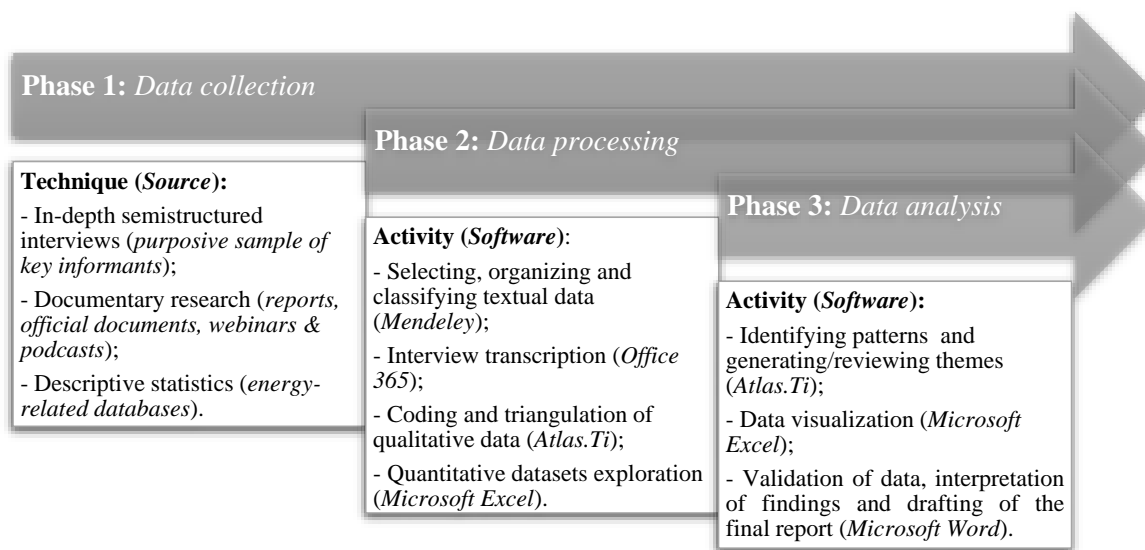


Figure 1.11¹². Diagram of the research phases. Source: Author's elaboration.

¹² The planning and development of the research phases were constrained by the health emergency caused by the Covid 19 pandemic. In this regard, due to persistent mobility restrictions, fieldwork was carried out

The stages of the investigation were not developed sequentially, given the emergent design of the investigation. The research process was, instead, planned with flexible boundaries between phases as well as allowing the presence of circularity among them. As a result, the phases tended to coincide over time, providing constant feedback and redefinition of the research problem towards the elaboration of the final report (Figure 1.11). In this section, a presentation of how these phases were conducted is given:

Phase 1: *Data collection*

The first phase consisted of the collection of information through the implementation of an empirical strategy based on the use of three research techniques:

Chronologically, the first was *documentary research* (Scott, 1990), which I carried out in two stages. On the one hand, I employed it as a means to overview the research's main topics and issues, primarily through the assessment of a broad set of policy documents, reports from international organizations (such as IRENA, IEA, World Economic Forum, OLADE, etc.) and, given their growing relevance, webinars and podcasts involving different stakeholders of the energy transition processes in Chile and Colombia. Identifying key actors at each level of analysis as well as discovering the phenomena to be traced and compared at each scale was then rendered possible. On the other hand, after conducting the interviews, I utilized this technique to gather specific information. This was done to further enhance the coverage of the main dimensions of analysis and, above all, to fill some gaps in the emerging themes discussed with the interviewees.

The second, and most important, was the *in-depth semi-structured interview*¹³ (Longhurst, 2009). For this purpose, I carried out a *purposive sampling* (Creswell & Plano Clark, 2018),

remotely. It should be noted that both access to some potential informants and the feasibility of conducting on-site observation were affected by this circumstance. Hence, the empirical strategy had to be flexible enough to adapt the methods, while ensuring the soundness of the research design.

¹³ The use of the semi-structured in-depth interview had the purpose of making the researcher positionality explicit and stimulating reflexivity in the development of the interviews. These were conceived both as a way of gathering information and as a means of learning about the topic. Thus, they unfolded in a conversational manner offering informants the chance to explore issues that they considered important, in addition to those initially proposed at the time of contacting them. This allowed me to overcome communicative barriers linked to distance and virtuality, as well as to attenuate the asymmetries in the relationship between informant and researcher due to the informant's greater knowledge, experience or symbolic power.

in order to identify and select individuals who were proficient and well-informed about the phenomenon of interest. At first, I clustered the key stakeholders of the energy system (WEF, 2018) in three broad categories (*'public sector'*, *'private sector'* and *'civil society'*). I then contacted participants who could fulfill the profile of *key informants* (Parsons, 2008), i.e., experts non-randomly selected who could act as a proxy for their group's or organization's perspective. Afterwards, guided by an interview protocol (Annex 2) containing the issues to cover, I conducted the interviews either via Zoom or Google Meet. A constraint of this methodological choice was the limited accessibility to a certain profile of informants¹⁴. One of the advantages, in turn, was to use a tool that allowed me to involve participants in different locations around the world while establishing a more horizontal and less intimidating communication than face-to-face dialogue.

The third was *descriptive statistics* (Frey, 2018). I opted to employ this technique to give more robustness to the arguments concerning technical aspects of energy systems - and to track their evolution over time. Exploring energy-related databases (such as those of IRENA, IEA, BP, and OLADE) was done for two reasons: on the one hand, to harmonize the sources of quantitative data used in the comparison; on the other hand, to improve the soundness of qualitative analyses by using reliable quantitative inputs to illustrate them.

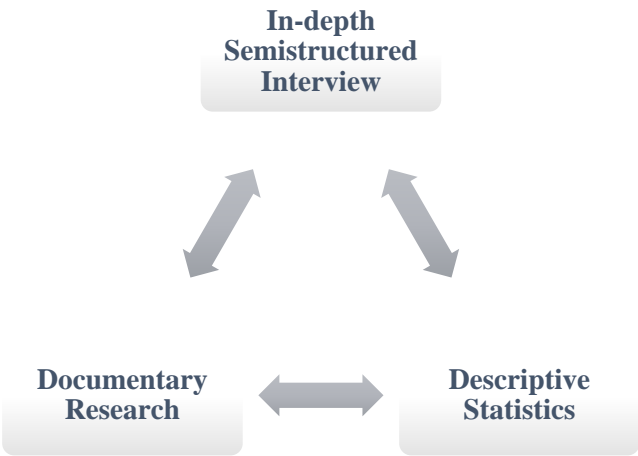


Figure 1.12. Triangulation between methods. Source: Author's elaboration.

¹⁴ Key informants were selected following a criterion of cultural rather than statistical representativeness. That is to say that the informants accessed represented organizations, institutions, or stakeholder groups relevant to the energy transformation in Chile and Colombia, from the local/territorial to the international scale.

Phase 2: Data processing

The second phase concerned the processing of different kinds of data. *Triangulation* was the common thread that linked the activities carried out. Following McFee (1992), this may refer to two types of procedure, in the explication of research methods: *triangulation between methods* (Figure 1.12), which involves mutual validation, and *triangulation within a method* (Figure 1.13), in which the interplay between inputs from different perspectives is sought. Throughout this phase, I applied this logic when organizing the gathered information; that is, to contrast informants' discourses, locate the gaps in each level of analysis and recalibrate data collection. However, it should be clarified that triangulation operates here as a metaphor in the search for methodological robustness and, therefore, does not imply an alignment of interests and narratives. Contrariwise, it acts as a revelatory mechanism for exposing the tensions *between* and *within* the three stakeholder clusters.

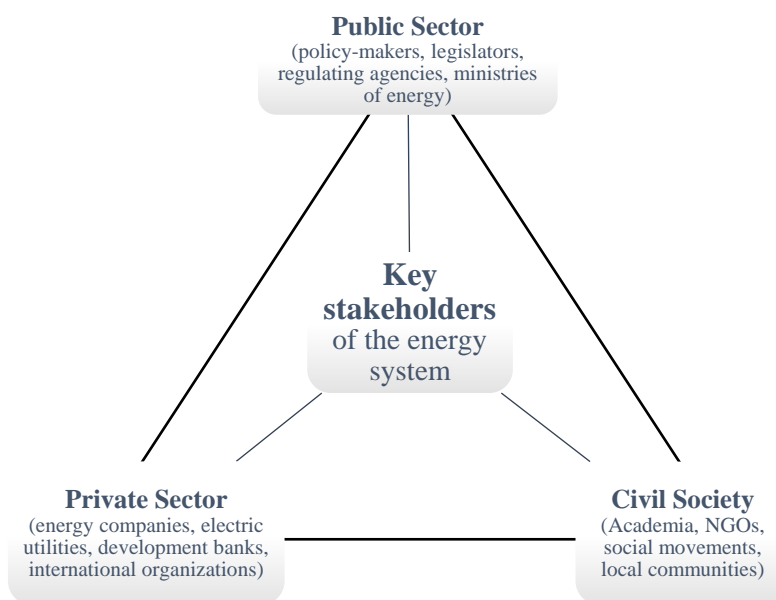


Figure 1.13. *Triangulation within a method*. Source: Author's elaboration based on WEF (2018).

Clusters of relevant stakeholders fulfill, then, the schematic purpose of organizing the analysis according to the affinities perceived during the data collection, especially in the interviews. In no way is homogeneity within the clusters presupposed, nor is a unidirectionality of relationships between presumably close or presumably distant stakeholders taken for granted. The overflowing complexity of reality imply that clusters are

porous and coincidences between stakeholders are not fixed. Likewise, stakeholders' visions tend to adapt to the uniqueness of the context. Accordingly, it should not be assumed neither that the relative alignment of interests and discourses in Colombia is the same as in Chile. The metaphor of triangulation only functions as a methodological mechanism to overcome prejudices of the researcher and to disdain the temptations of unilateralism.

Phase 3: Data analysis

Table 3. Thematic Content Analysis Matrix. Source: Author's elaboration.

	Theoretical Concepts	Main Themes	Objectives
New Energy Spaces	Landscape	Places and scales NCRE sites of production Socio-materiality of energy production and consumption Land-use changes	Identify material expressions of the social, political and institutional relations bound to the extraction, conversion, distribution and consumption of energy.
	Territory	Territorial transformations Energy infrastructure Energy planning	Describe the enabling conditions and triggers for the development of renewable energies in Colombia and Chile.
	Governance	Energy Transition Policy Actors and Institutions: Role of electricity companies Local communities	
Just Transition	Climate Justice	Actors and Institutions (Regional and Global) Value Chain-Fossil fuels Decarbonization of Economies Incumbent energy regimes	- Identify the territorial impacts of the penetration of renewable energies in two strategic energy producing regions.
	Energy Justice	Energy Poverty Employment / Creative destruction Governance and participation in energy planning	- Analyze the challenges for energy transition policies from a just transition perspective.
	Environmental Justice	NCRE Project's Environmental Impact Social acceptance of NCRE projects Local Communities and Social Inequalities	- Interpret the dilemmas of the transitions to renewable energies in Colombia and Chile.

The third phase comprised the analysis of the data previously collected and processed. It is critical to understand that *qualitative data analysis* (Mihás, 2019) is a continuous, dynamic, and cyclical process that starts as early as the data collection phase begins and continues throughout the data processing stage. In this sense, the analysis took place in two stages, due to the empirical strategy followed: one *deductive*, in which quantitative and qualitative data were addressed with preconceived themes stemming from the theoretical framework; and one *inductive*, in which themes were generated and reviewed based on identifying patterns in the textual data mainly produced by the interviews. The analytical cycle led to an interpretation of the results, which in turn concluded in a selection of the comparable themes that were included in the final report (Table 3).

2. Unraveling Leadership: Chile and Colombia's pathways to renewables

In recent years, Chile and Colombia have been building regional leadership towards the global energy transition. Along with the adoption of ambitious climate commitments in the international arena¹⁵, both countries have established robust policy and regulatory frameworks that provide the market conditions to enable a thriving renewable energy industry—which is one of the main components of national strategies towards bringing carbon emissions closer to net-zero by 2050. Thus, despite being at different stages of transformation of their national energy systems, these countries have been spotlighted internationally for their progress and prospects for non-conventional renewable energy (NCRE) development.

Several recent events are indicative of the emergence of such regional leadership. In 2021, Colombia announced its entry into the International Energy Agency (IEA) and Chile served as host of the 12th Clean Energy Ministerial (CEM12), two high-level fora to promote policies and programs that advance clean energy sources. Furthermore, both were selected to take part as 'global champions' in the 2021 UN High-level Dialogue on Energy. Likewise, according to the World Economic Forum's *Energy Transition Index* (ETI) (2021) and BloombergNEF's *Climatescope* (2020), Colombia and Chile appear at the top of the regional rankings, along with Uruguay, Costa Rica and Brazil. Indeed, in the latter ranking, Chile appears classified as the number one country for investment in renewables worldwide.

Therefore, this short chapter aims to provide an overview of the energy profiles and recent trajectories of Colombia and Chile to frame the background for the rest of the research. It also presents a brief description of the triggering factors and enabling conditions for the massive integration of NCRE into the electricity matrices of both countries as a central component of their energy transition strategies.

¹⁵ While it is debatable to what extent Chile's and Colombia's NDCs are in line with a global decarbonization trajectory compatible with the 2°C or 1.5°C scenario, both countries were recognized in 2020 for submitting updates with increased targets that exhibit, on the surface at least, increasing climate ambition. For a detailed analysis of these plans and their targets, the *Climate Action Tracker* project (<https://climateactiontracker.org/>) provides relevant insights.

2.1. Energy profiles and trajectories

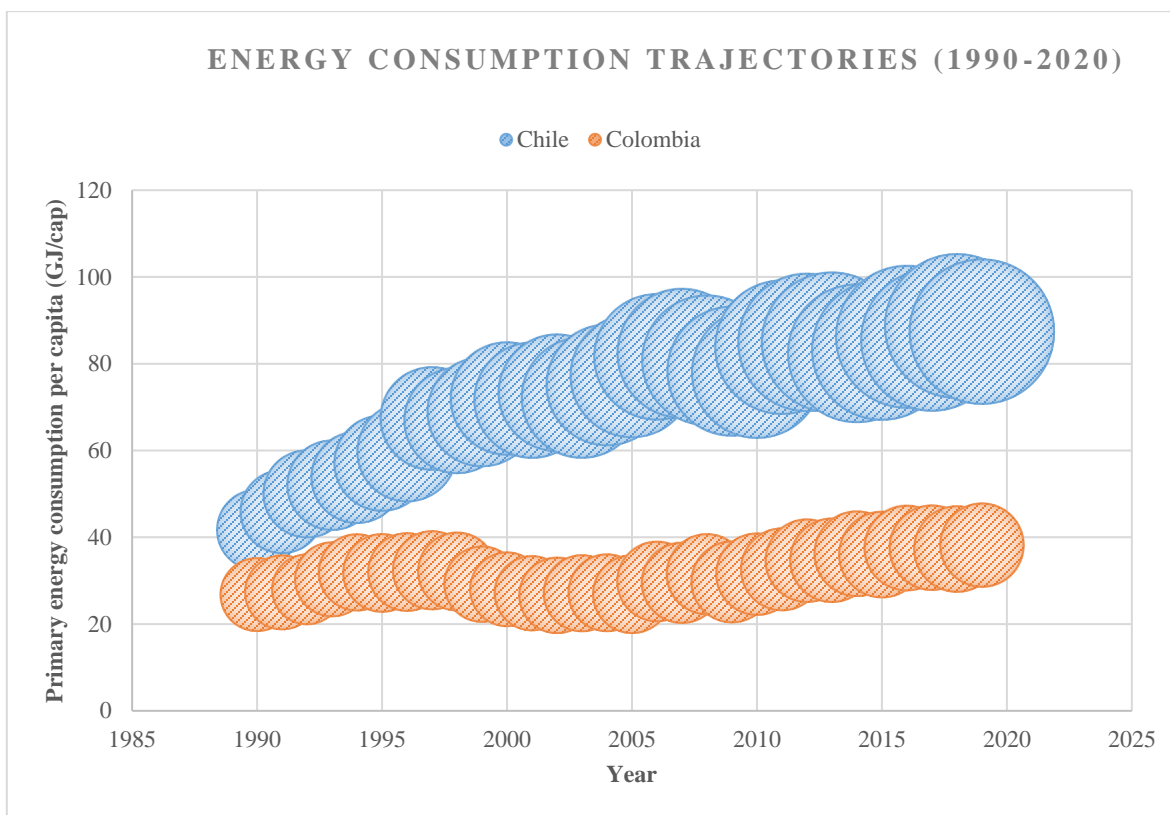


Figure 2.1. Energy intensity trajectories in Chile and Colombia (1990-2020).

Source: Author's elaboration with data from BP Statistical Review (2021).

Note: The size of the bubbles corresponds to the annual power generation per capita (kWh/cap).

The energy profiles and trajectories of Colombia and Chile diverge fundamentally. Although both countries resemble each other in the reliance of their *pattern of productive specialization* (Ocampo, 2017) on energy-mining production¹⁶, Colombia is a net exporter of energy commodities (particularly oil and coal) while Chile is a net importer. Proof of this is that while the share of fossil fuels in Colombia's total exports reached 54.7% in 2019, it barely reached 0.9% in the case of Chile (World Bank, 2021). This implies different dilemmas in the face of the geopolitical and economic challenges of the global energy transition (Bradshaw, 2010). Gradual substitution of fossil fuels puts pressure on Colombia's current account balance in the long term, due to the expected decline in oil and coal revenues (Martínez Ortiz, 2021). Meanwhile, as dependence on fossil fuel imports are expected to

¹⁶ As of 2017, fossil fuels and mining accounted for 5.8% of Colombia's GDP and 11% of Chile's GDP. (ECLAC, 2021). But while Colombia specializes in the extraction of oil and coal, Chile produces copper and its derivatives, as well as increasingly lithium and other minerals critical to the global energy transition.

decrease, favorable impacts on Chile’s balance of payments and greater macroeconomic sustainability are foreseen (Ebeling, 2020).

In addition to this key difference in the share of the energy sector in the two economies, it must be added that the two countries follow different energy consumption patterns (Figure 2.1). While per capita primary energy consumption has remained relatively stable in Colombia over the last 30 years, in Chile there is a clear increase in energy consumption driven, to a large extent, by the sustained growth of electricity generation. This suggests the existence of an *energivorous development model* (Carbonnier & Grinevald, 2011) in Chile, whereby the pattern of economic growth is coupled to the growth of energy consumption. Hence, the growing consumption of energy and, above all, of electricity in its various applications is a central aspect of the Chilean energy transition.

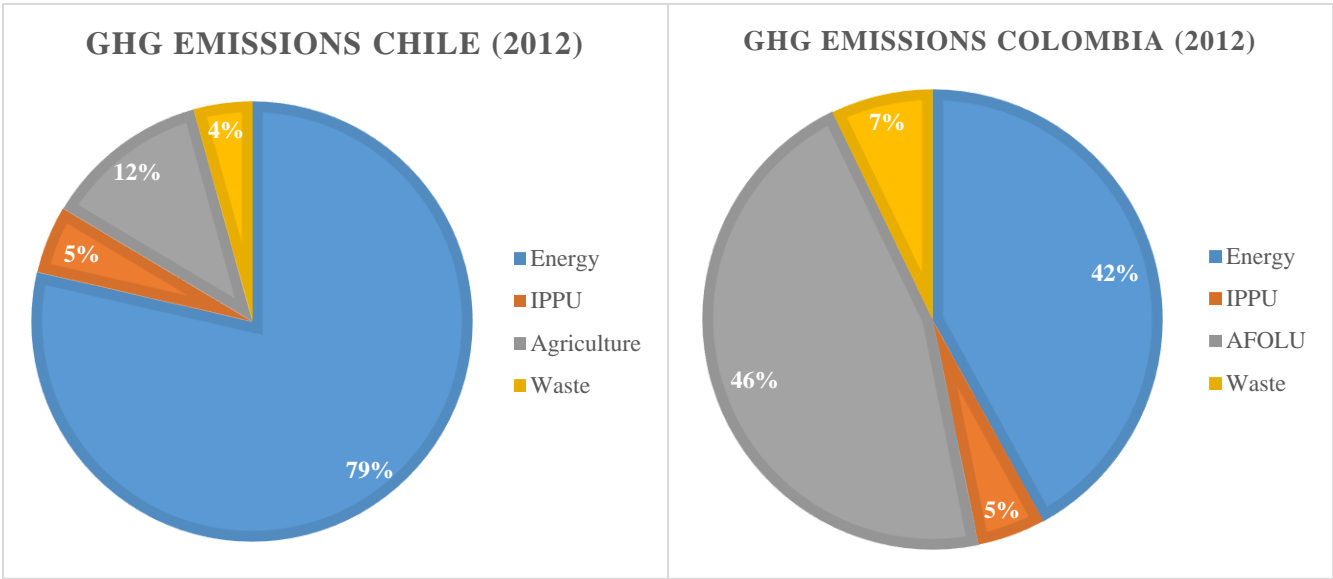


Figure 2.2. Net GHG emissions by IPCC sector in Chile and Colombia in 2012. Source: SNiChile (2020) & IDEAM et al. (2016). Note: Land use and forestry were excluded from the Chilean AFOLU sector because their carbon removals exceed their emissions.

In that direction, Chile's economic growth pattern is relatively coupled to its energy intensity and, likewise, to its carbon intensity. Colombia, by contrast, is accidentally a low emitter of CO₂ and is the only large economy in Latin America in which GDP growth is strongly decoupled from GHG emissions and energy consumption (OECD et al., 2019). Thus, the national GHG inventory of both countries accounts for this phenomenon (Figure 2.2): in line with the world average, 79% of Chile's annual emissions come from the energy sector while in Colombia most emissions come from the AFOLU sector. The high emissions factor of this

sector stems from the fact that the different activities linked to deforestation and forest degradation are the main cause of emissions in Colombia, due among other things to the destruction of natural carbon sinks (IDEAM et al., 2016).

This difference is reflected in the electricity sector as well. While in 2012 the activity with the highest level of net emissions in Chile was electricity generation (equivalent to 32.04 Mt CO₂), energy industries in Colombia were barely ranked as the seventh IPCC group in terms of net emissions (equivalent to 17.3 Mt CO₂) (IDEAM et al., 2016; SNChile, 2020). Hence,

the Colombian power sector produced annually about half of the total emissions of its counterpart in Chile, a country with a population three times smaller than that of Colombia.

In the case of Chile, this climate challenge also highlights the transformations that have occurred in its energy matrix over the last three decades (Figure 2.3).

After having a mostly renewable matrix in the 1990s, Chile switched to a predominance of fossil fuels after the turn of the millennium. The growth in electricity demand, one of the foundations of its economic growth, was supported first by natural gas and later by coal. Sudden jumps from one energy source to another are part of the vicissitudes of an energy-importing country. One of the promises of the transition to NCREs is to address that lack of *energy security* (Jakstas, 2020) understood as security of supply (i.e., adequate supply to meet domestic demand in order to support the growing economy needs).

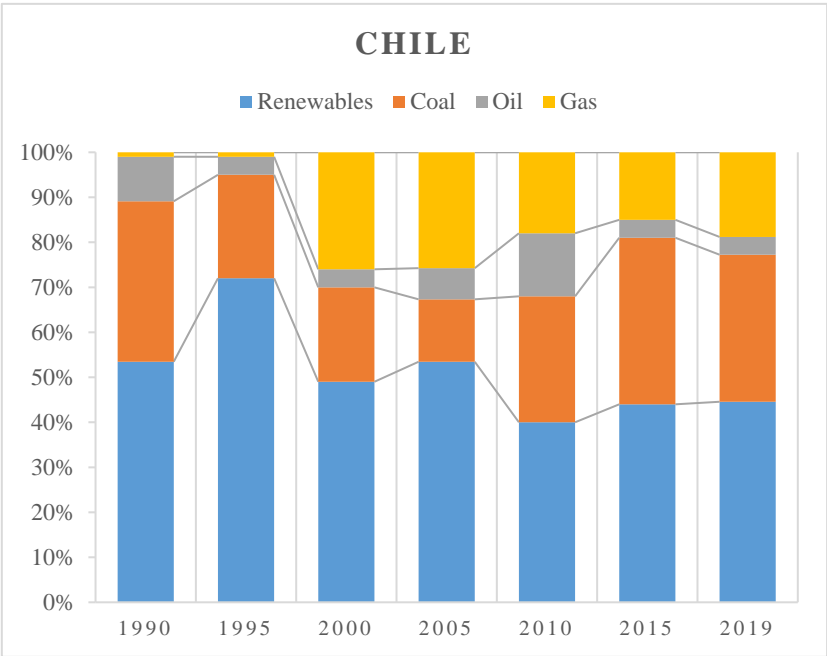


Figure 2.3. Share of fossil fuels and renewables in Chile's power supply (1990-2019). Source: Author's elaboration with data from IEA (2021a).

In the case of Colombia, the situation is the opposite. In line with the country’s emissions pattern and energy consumption trajectory, the power mix has remained stable from the 1990s onwards (Figure 2.4). The Colombian electricity system has maintained a 75-25 ratio

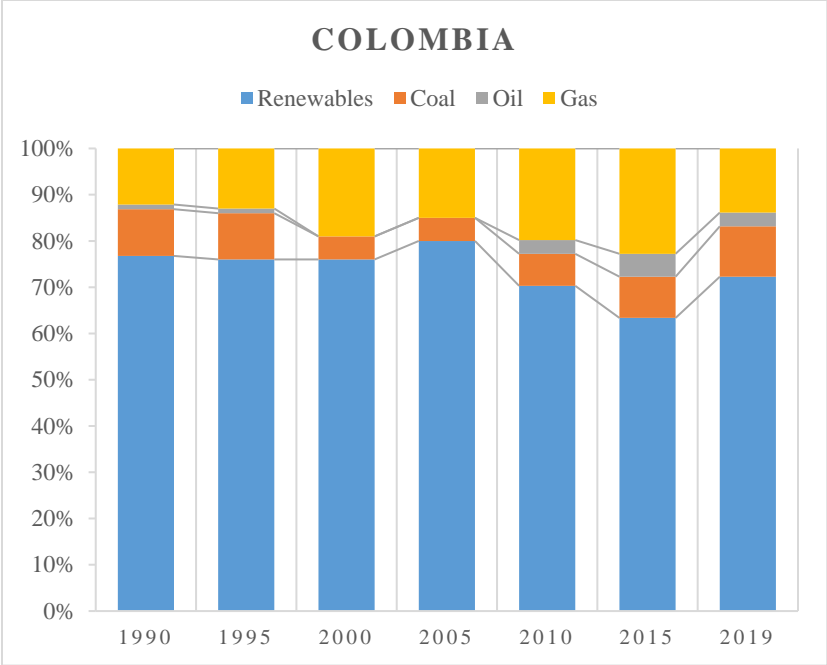


Figure 2.4. Share of fossil fuels and renewables in Colombia’s power supply (1990-2019). Source: Author’s elaboration with data from IEA (2021a).

between renewable and non-renewable sources over time. Consequently, the crucial role of hydro in electricity supply has remained with a thermal backup combining gas, coal, and biofuels.

Although the situation is unlike that of Chile, here the promise of greater energy security is also appealing as a driver of the transition to NCREs. But its meaning changes. Being a low-emitting country with high

renewability of electricity supply, energy security in that context means that the diversification of energy sources through renewables provides greater security of demand, robustness to the system and protection against extreme climate events.

Based on this overview of the energy profiles and trajectories of both countries, it is clear that the narrative of renewables as the spearhead of climate change mitigation falls short in capturing the complexity of the transition underway. Behind this rhetorical frame lie motives and interests that are not necessarily linked to environmental sustainability and climate action. Therefore, without losing sight of the differentiated challenges arising from the above-mentioned differences between the two countries, we will now take a look at the main factors that have triggered the relative leadership that Chile and Colombia have been acquiring in the field of renewable energies.

2.2. Beyond climate action: triggering factors of energy transitions

As made clear in the previous section, energy profiles and trajectories of the energy systems in Chile and Colombia are fundamentally different. Considering these dissimilarities, under the assumption that they shape the choices of the relevant stakeholders and most importantly those of the decision makers, in this section I will try to present the main triggering factors for the incorporation of NCRE into the electricity matrices of both countries. To this end, I will primarily present the contributions made by the informants on this topic, as they reveal the weight that different stakeholders give to the milestones, policies, technologies, institutions, and events that have marked the development of renewables in both countries.

Chile's energy transformation process began first, much earlier than in Colombia. In fact, together with Uruguay, this country is one of the pioneers in the development of NCRE sources in Latin America (KPMG, 2016). The main trigger for the search for the integration of NCRE into the electricity matrix was the energy insecurity of the system's supply. In this regard, Javier Obach Martiniello (Informant A3) – head of the Environmental Unit at the Environmental and Climate Change Division of Chile's Ministry of Energy, highlighted:

“En Chile, la matriz históricamente ha sido renovable. En los años 1990, el 60% de la electricidad generada provenía de fuentes renovables. Sin embargo, empezamos a tener problemas hídricos desde los 90. Así fue como la matriz que era bastante hidro-térmica, como en otros países sudamericanos, empezó a disminuir la participación de hidro por cuenta del cambio climático.

(...)

En la medida en que empieza a haber una baja del hidro, se busca diversificar matriz para suplir la demanda creciente de energía. Aquí juega un rol central el tema del gas y el abastecimiento en relación con Argentina, pues debido a la crisis económica de ese país a inicios de los 2000, decidieron cortar la llave de paso del gas.

(...)

La solución que se encuentra es el uso de otro combustible de base que era el carbón. Se ponen en marcha así 28 unidades de generación a carbón para tener una estructura base con combustible más barato. El criterio con el que se justificó esta decisión fue la búsqueda de mayor eficiencia y seguridad del suministro para evitar intermitencias y black-outs.

(...)

Muy resumidamente, esto explica cómo el carbón modelaba el sistema por necesidad. Sin embargo, esto empezó a cambiar desde inicios de los 2010, con la caída internacional de los precios de las renovables.” (Informant A3, June 17, 2021).

Chile’s path was thereby clearly determined by its condition as an energy-importing country. As the provisioning of natural gas was jeopardized by supply shocks from Argentina since 2004, these external disruptions that threatened the robustness of the electricity system forced an urgent quest for alternatives to diversify the country’s energy mix (Ministerio de Energía de Chile, 2015). Therefore, two seemingly antagonistic solutions crystallized at the same time. On the one hand, the quick and cost-efficient solution of massively deploying coal to generate electricity was implemented—leading to a fourfold increase in the share of coal in the total electricity generated annually in Chile between 2005 and 2015 (making it the main power source) (Figure 2.5).

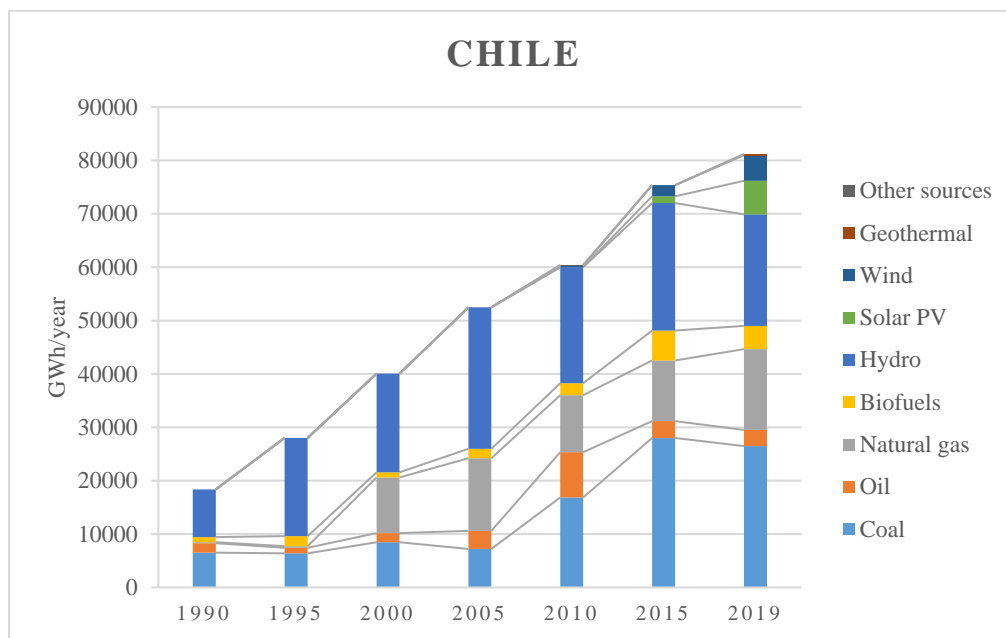


Figure 2.5. Evolution of power supply in Chile by source (1990-2019).
Source: Author's elaboration with data from IEA (2021a).

On the other hand, what has been known in recent years as Chile’s “*revolución energética*” (Pacheco, 2018) began to take shape. Although it was not an automatic process, this energy revolution understood as the deployment of utility-scale electricity generating projects from NCRE sources started to be developed since the mid-2000s and managed to take off with a

first policy milestone in 2008: the NCRE Law N° 20.257¹⁷. Parallel to the aforementioned increase in coal use, there was an explosion of renewable projects that led to the incorporation of new sources to the mix (some of them even pioneers in Latin America, such as geothermal energy and Concentrated Solar Power - CSP). Although their share is still a minority compared to conventional sources, they are in the midst of an accelerated expansion process, as will be seen in a later section. On this matter, Claudia Fuentes (Informant C2), researcher at the environmental NGO *Chile Sustentable*, stated:

“El pánico generado por el desabastecimiento e inseguridad energética a causa de la crisis del gas en Argentina llevó a que se formaran dos enfoques de solución: uno eran las centrales a carbón; (...) el otro era un enfoque más incipiente, proveniente del movimiento ecologista, que proponía que la crisis podía aprovecharse como un momento para incorporar renovables. En ese sentido, es muy importante la Ley de ERNC de 2008, aunque no tuvo efectos inmediatos. Su importancia radica en que, cuando se habla de esto, empieza a existir.” Informant C2 (June 17, 2021).

In addition to the pursuit of energy security through a bold and robust legislation, there are two other relevant contingent factors that triggered Chile’s ‘boom in renewables’. First, the unfeasibility of large-scale dam hydroelectricity due to the failure of the *HidroAysén*¹⁸ megaproject (Agostini et al., 2017) as a result of massive public opposition. So much so that, in June 2014, the Committee of Ministers unanimously resolved to revoke the *Resolución de Calificación Ambiental* (RCA) that had previously been granted in May 2011 (Raineri, 2018). The bid for diversification with a conventional renewable source came into collision with a strong rejection from a contingent coalition of citizen pressure groups, environmental movements and political parties. However, Chile's exceptional potential for renewable natural resources had already been diagnosed and the country was on the radar of international energy investors (Ministerio de Energía de Chile & GIZ, 2014).

¹⁷ Enacted on March 20, 2008, this law “*introduce modificaciones a la Ley General de Servicios Eléctricos respecto de la generación de energía eléctrica con fuentes de Energías Renovables No Convencionales*”. It obliges conventional generators with an installed capacity of more than 200 MW to commercialize 10% of their energy from non-conventional renewable sources or from hydroelectric power plants with a capacity of less than 40 MW, as from January 1, 2010.

¹⁸ *HidroAysén* was a project that envisaged the construction and operation of five hydropower plants, two on the Baker River and three on the Pascua River, located in the region of Aysén, South of Chile. The complex would have had a nominal installed capacity of 2,750 MW.

Second, the other contingent triggering factor that enabled the massification of NCRE in Chile is the drop in international renewable energy prices during the 2010s. Due to a steep drop in prices for solar PV and onshore wind projects since 2010, by 2014 the levelized cost of energy (LCOE) for these NCRE sources were already *“in the range of fossil fuel generation costs and are competitive not just in local terms but internationally as well”* (IRENA, 2016). As noted by Paz Araya (Informant C3), researcher at the *Red de Pobreza Energética* (RedPE) and participant in several energy policy construction scenarios:

“La transición energética ha sido impulsada más por dinámicas de mercado que por iniciativas de política. Lo que fundamenta todo este proceso viene en parte desde la privatización de los servicios públicos desde los ochenta, durante la dictadura. (...) Después de diversas crisis del sector energético por falta de planificación en Chile durante los noventa y 2000, llega la crisis del gas de Argentina en 2004 y ahí la preocupación por la planificación empieza a crecer hasta 2008.

(...)

Esto se vuelve un tema de interés por la intención de entrar la OCDE y demás, pero para ese entonces los precios de las renovables seguían altísimos. Al entrar a la OCDE, se sigue la recomendación de crear el Ministerio de Energía de manera independiente al de Minería y también unos organismos de planificación del sistema eléctrico.

(...)

Pero, por otro lado, llegan las protestas 2011 y empieza la judicialización de proyectos termo e hidroeléctricos hacia 2013. Había un ambiente de mucha polarización por protestas estudiantiles y oposición contra Hydroaysén. (...) Y aunque la hegemonía hasta 2013 estaba en contra de las renovables por temas de intermitencia y demás, el mercado entró porque iba a entrar. Y se da el boom de la energía solar en 2014. Desde entonces, las cuotas de energía solar fueron desbordadas y han crecido a saltos. Más que un impulso de política fue por condiciones de mercado”. Informant C3 (June 22, 2021).

At this point, Chile and Colombia have similarities. Although Chile started much earlier because of its own characteristics and needs, in Colombia it is a consensus among different stakeholders that the country entered the NCRE trend late. And certainly the first milestone

in that sense was Law 1715 of 2014¹⁹. This was developed at a time when the renewables market was already thriving and Colombia was evaluating how to enter this market taking advantage of its energy potential (UPME et al., 2015). In a scenario with apparently no significant risks on the security of supply side²⁰, the competitive LCOE of solar PV and wind energy were a key factor in driving the transformation of the regulatory framework. Abel Mauricio Gallego (Informant B2), engineer at *Empresa de Energía de Pereira* (a network operating company), noted the following:

“Aquí todo inició con la Ley 1715 de 2014. Eso fue lo que le dio un push a la inclusión de las renovables. (...) Con la promulgación de la 1715, se permitió que mucha gente, sobre todo grandes industrias, se interesara en esos temas (sobre todo, proyectos solares y eólicos). Aunque ya habíamos tenido un primer proyecto en 2004, el parque Jepirachi en La Guajira, que se favoreció de incentivos tributarios, pero por ciencia. Como por temas de innovación y no de expansión del mercado eléctrico.

(...)

Y luego llegó el Acuerdo de París. Pero según el trilema de la energía del Foro Económico Mundial, Colombia está en el top 10 de las matrices más limpias. Entonces acá hay todo un tema de inserción internacional y apuesta por ser más competitivos, por no quedarse rezagados en avances tecnológicos. Casi que se puede decir que es también por un tema de moda.

(...)

No es un tema de necesidad para evitar el apagón como en los noventa. (...) Pero SÍ es un tema de seguridad por la búsqueda de diversificación de fuentes de generación. La solar y la eólica tienen una correlación inversa (se compensan). Eso le da complementariedad y seguridad a la red. (...) Todos los panoramas que se buscan para la descarbonización de la energía contemplan la electrificación, allí es donde está la centralidad de la generación con renovables para soportar esa electrificación.” Informant B2 (June 18, 2021).

¹⁹ Approved on May 13, 2014, Law 1715 is the legislation “*por medio de la cual se regula la integración de las energías renovables no convencionales al Sistema Energético Nacional.*”. It represents the cornerstone of the regulatory framework to integrate NCRE into the country's electricity matrix, through the legal definition of the technologies and sources recognized as such and the establishment of tax incentives to favor the development of this market.

²⁰ This statement should be qualified because, as Zapata et al. (2018) show, increasing climate variability poses the risk of extreme drought scenarios in the foreseeable future jeopardizing reservoir levels and, as a result, the availability of the water resource for power generation (such as in the 1990s).

All of the above is reflected in the evolution of the Colombian electricity generation matrix (Figure 2.6). Unlike the increasingly diversified mix in Chile, in Colombia the preponderance of hydro has remained stable over time with a minority participation of thermal sources. Largely due to the late entry into the trend of renewables, the share of NCRE sources is still marginal but is expected to expand significantly. The current energy transition policy contemplates the ambitious goal of going from less than 1% of installed generation capacity in 2018 (around 30 MW) to more than 12% in 2022 (equivalent to more than 2,400 MW) (Ministerio de Minas y Energía de Colombia & BID, 2021).

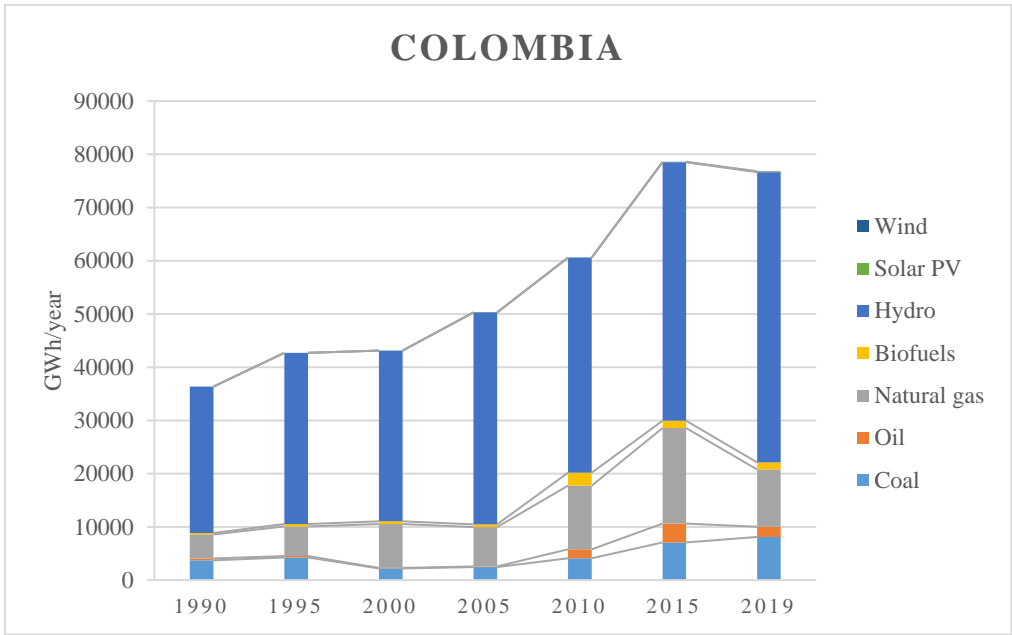


Figure 2.6. Evolution of power supply in Colombia by source (1990-2019).
 Source: Author's elaboration with data from IEA (2021a).

As in the case of Chile, another triggering factor for the adjustment of Colombia's energy policy to ambitious goals for the massive expansion of NCRE is the country's international insertion strategy. Although the energy transformation is just arriving in trickles, Colombia's active participation in global climate governance scenarios²¹ (Rodríguez Becerra, 2019) as well as its integration into international organizations such as OECD are consistent with its growing leadership in renewable energies. International commitments of the country play a

²¹ Colombia's active international policy manifested, for instance, in its involvement in the roadmap that led to the design and promulgation of the 2030 Agenda and the Sustainable Development Goals (SDGs).

crucial role in driving the energy transformation policy, even if they are not well aligned with domestic policies (as is the case in most Latin American countries) (Rivera Albarracín, 2019)

Anyway, about this convergence between international insertion and favorable conditions of international markets, Monica Gasca (Informant A2) –advisor to the Colombian Minister of Energy– said:

“Nosotros llegamos tarde al tema de las renovables. Y yo diría que llegamos sobre todo por moda. Fuimos a la COP25 y volvimos con unos compromisos ambientales muy ambiciosos que, además, coincidieron con el bajón de los precios internacionales. (...) En esa época empezó entonces a plantearse la subasta como mecanismo para impulsar estas inversiones en Colombia. Además, ya se venía viendo cierta dificultad con los proyectos hidro desde El Quimbo. El Quimbo casi no entra por temas de licenciamiento ambiental, oposición tenaz al embalse y, además, ya hay un copamiento geográfico de grandes proyectos hidro. Por eso yo diría que hay una combinación de cierta “moda” de la sostenibilidad después del Acuerdo de París con circunstancias nacionales e internacionales. El boom de las energías renovables coincide con el boom de empresas que buscan hacer inversiones más sostenibles y tener acceso a fuentes de energía limpia.”
Informant A2 (June 10, 2021).

Another unexpected coincidence in both processes comes up: in the medium term, the reliance of the power system and its projections of supply expansion in large hydro is environmentally, economically and socially unsustainable (Duarte-Abadía et al., 2015; Martínez & Castillo, 2016; Weng et al., 2020).

The above is useful to shed light on the following: although they differ in their trajectories, profiles and projections of demand and system growth, the energy transition processes in Chile and Colombia have at least four common triggering factors. The first is the decisive impact of the fall in the LCOE of NCRE in the international market and, more generally, of the favorable conditions for attracting investment flows. The second is the pursuit of energy security by strengthening their systems through the diversification of sources and technologies in the mix. The third is the exhaustion of the model based on large hydro. And finally, the last one is the deployment of international insertion strategies that allow both

countries to have a greater impact in international fora while projecting the image of democratic societies with free markets that promote sustainability.

2.3. Building an investment ecosystem: enabling conditions for NCRE development

Energy system trajectories in Chile and Colombia reveal important differences and similarities that provide insight into some relevant challenges for energy transitions in Latin America. While the different speeds of progress towards NCREs are conditioned by structural differences in resource endowment and energy potential, there are also a number of *enabling conditions*²² (Sareen & Haarstad, 2018) for the development of this business model that must be taken into account in the analysis. Such conditions consist of structures or institutions that enable or obstruct the progress of the transition. In relation to this topic, Alfonso Blanco Bonilla (Informant B4) - executive secretary of the *Organización Latinoamericana de Energía* (OLADE) - noted:

“El hecho de que la transición no se da a mismas velocidades está relacionado a la dotación de recursos y aspectos estructurales de cada país. Está vinculado a una lógica de la transición energética entendida fundamentalmente a partir de la incorporación de ERNC de gran porte. Las grandes economías que han logrado que estos negocios se consoliden es porque también han logrado la consolidación de sus mercados financieros. Estos proyectos requieren de instrumentos sofisticados de deuda de largo plazo. Para que sean viables, los inversionistas tienen que tener las garantías necesarias para que sean validados por los mercados financieros.

(...)

Cada país debe tener, entonces, condiciones para que esto se dé: riesgo país, acceso a la tierra, condiciones regulatorias, estabilidad institucional, robustez de la infraestructura energética... En fin, todo un ecosistema para el desarrollo de este tipo de negocios.

Los mercados que han avanzado más son: uno, mercados fuertemente condicionados por la importación de energía a partir de fósiles (...) como en el caso de Uruguay o de Chile; y dos, mercados en los que la alta penetración de renovables se da a partir de la participación del

²² As Sareen & Harstaad (2018) remark, these enabling conditions are conceptualized as facilitators of social, economic, and technical activity in the literature on sociotechnical transitions, while in the energy justice literature they tend to describe institutions that derive from stabilizing structural constraints on justice or that tend to reflect unfair social relations. In this case, the concept is used to describe the structures and actors that organize and institutionalize the transition in both countries. Its use does not, therefore, have an evaluative function, nor does it seek to interpret the effects that ongoing transitions entail.

sector privado. Esto último requiere: un marco regulatorio establecido; reglas de largo plazo fijadas; garantías de esos contratos; marco jurídico institucional estable.” Informant B4 (July 28, 2021).

A first enabling condition has been the existence of a competitive electricity market with a consolidated presence of private agents that can assume long-term debts to leverage risky investments in new technologies. As such, the power generation market in Chile is essentially dominated by four big players that together account for more than 60% of the installed generating capacity. These are: three subsidiaries of multinational electricity companies (ENEL, AES Andes and Engie) and one of Chilean origin (COLBÚN) (Figure 2.7). In the last decade, hand in hand with the expansion of the NCREs, some players have increased their market share and many new ones have arrived—reducing the market share of the four main conglomerates (-1.5% compared to 2019) (CEN, 2021). This is the case for the fifth generation company (*genco*) by market share, which is the Chilean subsidiary of EDF. The main conglomerates also have a diversified investment portfolio in different technologies.

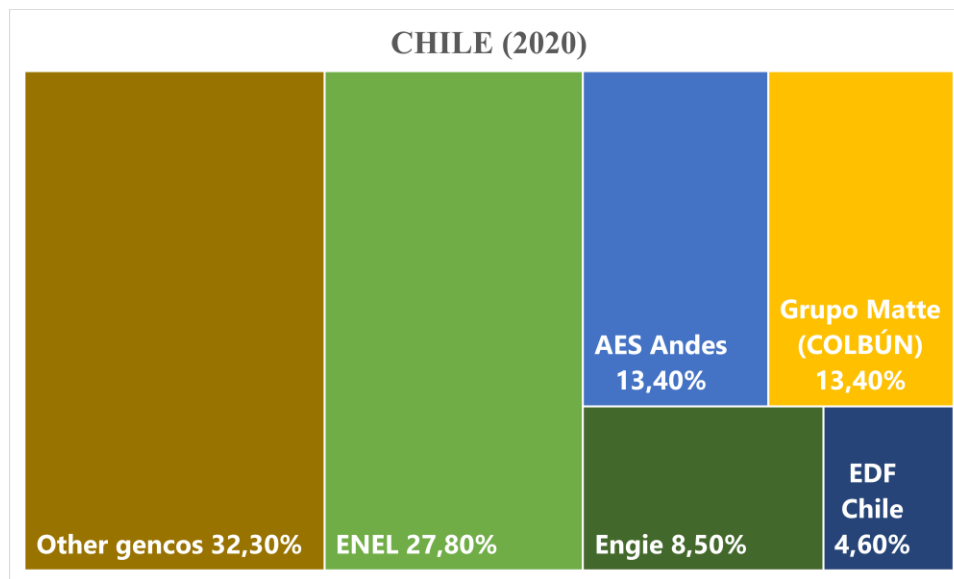


Figure 2.7. Chile's power generation market share by company in 2020.
Source: Author's elaboration with data from CEN (2021).

The generation market in Colombia is meanwhile dominated by three big players that account for more than 60% of the electricity generated annually. These are: EPM (a Colombian company with predominantly public capital), Emgesa (whose shareholding is split between ENEL and Grupo Energía de Bogotá) and ISAGEN (which went from being majority state-

owned to being controlled by a Canadian investment fund in 2016). These constitute a *de facto* hydropower oligopoly and share the market with 80 other gencos that, to a large extent, generate power from thermal sources or, as is the case of Celsia, are making strong inroads into the NCRE market (Morganstein et al., 2021; XM, 2021). As stated by the informant from the Ministry of Energy: “*en las subastas de renovables y la subasta del cargo por confiabilidad de 2019, participaron los mismos actores pero buscando diversificación de portafolios. Sólo dos empresas que no estaban en el mercado entraron, pero de resto son los mismos actores*”. (Informant A2, June 10, 2021).

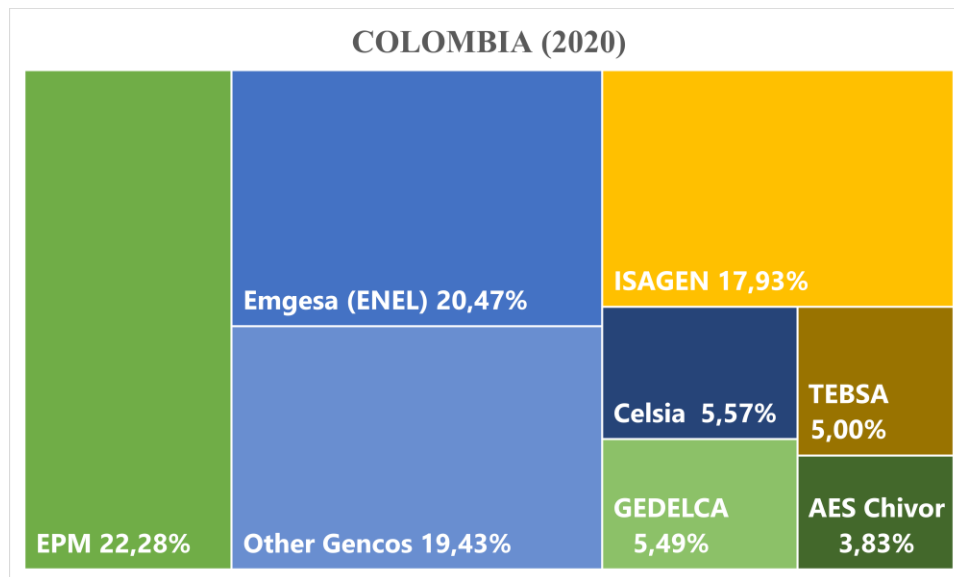


Figure 2.8. Colombia’s power generation market share by company in 2020.
Source: Author’s elaboration with data from XM (2021).

In both cases, there is a separation of the generation, transmission and distribution segments of the electricity system, which is regulated by law to avoid vertical market concentration and distortion of competition rules. Similarly, a peculiarity highlighted by several informants was that the mechanisms for the incorporation of NCRE have been *market-driven* (Nasirov et al., 2018; Viana, 2020) and have not involved the use of preferential tariff mechanisms such as Feed-in Tariffs (FITs)²³ (Simsek et al., 2019; Villada Duque et al., 2017). Instead, both countries have implemented energy auctions to promote the financing and development of NCRE projects as it has proven to be a mechanism of undoubted effectiveness—since 80%

²³ Although efficient in promoting low carbon energy sources in some European countries, in Latin America this mechanism has been questioned for introducing serious distortions in the market without significant impact on the achievement of energy policy goals (Jacobs et al., 2013)

of the capacity allocated in renewable PPAs in Latin America has been promoted through auctions and public tenders (OLADE & GWEC, 2020; Pérez Urdialez et al., 2021; Viscidi & Yépez-García, 2019).

At this point, it is worth highlighting the technical and financial support provided by development banks and cooperation agencies to strengthen public capacities and leverage renewable energy projects. While in Chile a strategic alliance has been established with Germany through the GIZ to promote Chile's energy transformation agenda, in Colombia the fundamental support has been provided by the Inter-American Development Bank (IDB). On this issue, Alvaro Mejia (Informant B5) –from the IDB Energy Division– said:

“El BID busca proveer financiación a soluciones distribuidas y energías renovable, jalando recursos a tasas muy bajas, que a veces los bancos comerciales no se atreven siempre a dar. (...) El BID no trabaja en la política como tal, sino en ejecutar cooperaciones técnicas en proyectos que apunten a las metas que tiene la política pública. Excepto cuando se trata de PBL, que es un tipo de préstamo que apoya directamente la financiación de la política pública, en cuyo caso el gobierno debe cumplir ciertas condiciones para asegurar los desembolsos por parte del banco

(...)

La cooperación técnica se trabaja en dos aspectos para salvaguardar la calidad de los proyectos: 1) los términos de referencia del banco, aunque se trabajan con el gobierno, se hace revisión juiciosa con expertos y consultores del BID, se hacen observaciones y estudios necesarios para que los proyectos salgan de la mejor manera (para la revisión técnica, traemos experiencias de otras zonas para ajustar actividades y objetivos); 2) cuando empezamos a pensar en una operación, el banco nos exige que hagamos ciertos estudios que justifiquen esa operación (relación costo-beneficio, etc.), también se hacen estudios para verificar capacidad institucional para implementar un programa, etc. (...) Siempre estamos acompañando al gobierno y prestándole apoyo técnico para que las operaciones se pueden ejecutar.” Informant B5 (September 1, 2021).

This means that, in addition to a competitive market, effective project financing channels and legal stability are needed. The former is ensured by the active participation of development banks, which, as in the case of the IDB, also aims to encourage commercial banks. The latter depends on the establishment of a solid and robust governance structure that can enforce

energy policy. This is the second enabling condition: a strong set of energy institutions with defined functions and responsibilities (Table 4).

Table 4. Key energy governance institutions in Chile and Colombia. Source: Author's elaboration with data from Ministerio de Minas y Energía de Colombia (2015) and Ministerio de Energía de Chile (2021a).

	Chile	Colombia
Grid	<i>Sistema Eléctrico Nacional (SEN)</i> ²⁴	<i>Sistema Interconectado Nacional (SIN)</i>
Responsibility	<i>Institution</i>	
Direction	Ministry of Energy	Ministry of Mines and Energy
Planning	<i>Comisión Nacional de Energía (CNE)</i>	<i>Unidad de Planeación Minero-Energética (UPME)</i>
Regulation		<i>Comisión de Regulación de Energía y Gas (CREG)</i>
Control	<i>Superintendencia de Electricidad y Combustibles (SEC)</i>	<i>Superintendencia de Servicios Públicos (SSP)</i>
Operation	<i>Coordinador Eléctrico Nacional (CEN)</i>	<i>Compañía de Expertos en Mercados S.A. E.S.P. (XM)</i>
Guidance	<i>Panel de Expertos</i>	<i>Consejo Nacional de Operación (CON) Comité Asesor de Comercialización (CAC)</i>
Legal	Legislative Decree N° 4/20.018 (<i>Ley General de Servicios Eléctricos</i>)	Law 143 of 1994 (<i>Ley Eléctrica</i>)

For the case of Chile, the most relevant institutional changes mentioned by the informants were the following:

1. Creation of the Ministry of Energy in 2010, after separating from the Ministry of Mining.
2. Creation of the *Coordinador Eléctrico Nacional* (CEN) with the 2016 Transmission Law, setting up an independent technical body to operate the system and preserve supply.
3. Creation of the *Sistema Eléctrico Nacional* (SEN) from the merger of the *Sistema Interconectado Central* (SEC) and the *Sistema Interconectado del Norte Grande*

²⁴ Although there are two other interconnected systems in Chile, the SEN has more than 99% of the total installed capacity.

(SING) in 2017, which created the technical conditions for a more efficient exploitation of the intermittency of NCRE sources.

On this issue, Claudia Fuentes commented:

“El factor institucional es súper importante. Esto es algo que viene de al menos hace 20 años. No es tanto un “boom renovable”. Ha habido todo un proceso y una preparación para facilitar las inversiones en coherencia con la planificación nacional. Debe haber incentivos de remuneración y legislación adecuada para facilitar los flujos de inversión. Ésa ha sido la clave del éxito de Chile. Además de la creación de una institucionalidad independiente, también se han dado avances normativos a la par.” Informant C2 (June 17, 2021).

As for Colombia, institutional changes have not occurred at the same speed. In fact, the existing institutional rails precede the boom in renewable energies and were first set up by Law 143 of 1994. The *Ley Eléctrica* already contemplated this separation of functions since its enactment. Still, differentiated roles of the UPME and the CREG are noteworthy. As indicated by Wilman Silgado (Informant A1) - UPME consultant -: *“La UPME se crea para que no vuelva a ocurrir desabastecimiento y crisis del sistema energético en Colombia. Es la entidad encargada de la previsión de la demanda de energía para anticipar todas las posibles contingencias. Es un organismo técnico y no político”* (Informant A1, May 5, 2021).

Lastly, a final enabling condition identified is the existence of a flexible and constantly evolving policy and regulatory framework. In addition to an autonomous institutional structure governed with ‘technical criteria’, there is a changing energy policy to adapt to the rapid pace at which electricity generation technologies are developing and, ultimately, to create suitable conditions for attracting investment flows. To this extent, policy instruments are conceived as accelerators of investment in renewables (Hutchinson et al., 2021).

With regard to the latter, the informants outlined the following policy and regulatory milestones (Figure 2.9):

- In the case of Colombia, Law 1715 of 2014 was emphasized as well as Decrees 2143 and 849 that regulate the tax incentives contemplated in the law. Furthermore, private sector interviewees made special mention of CREG Resolution 030 as well as those regulating the auctions in which long-term PPAs are allocated. Finally, the so-called

Energy Transition Law of 2021 was outlined as the relevant update of Law 1715, inasmuch as it establishes the prospective vision for developing sources such as geothermal, biomass and hydrogen together with other regulatory adjustments to the governance of the system.

- In the case of Chile, as expected, the policy milestones mentioned were more abundant. First, Law No. 20.257 was identified as the starting point and later Law 20/25 as its enhancement, as it raises the NCRE generation target from 10% to 20% by 2025. Then, the National Energy Strategy was referred to as a bet for concerted planning solutions among the different stakeholders. And finally, the 2015 Energy Tenders Law was remarked, as it allowed tendering by hourly blocks to generate better competitive conditions for NCRE, and the 2016 Transmission Law, which sought to take a step forward towards the strengthening of the grid to ease the entry of new actors.
- In both cases, the long-term energy planning (LTEP) instrument with a 2050 vision was considered as a synthesis of the macro vision for the electricity sector in the two countries. In Chile, the '*Política Energética de Chile – Energía 2050*' instrument is regulated by law and is periodically and participatively updated (Ministerio de Energía de Chile, 2021a). In Colombia, the '*Plan Energético Nacional (PEN) 2050*' is kept up to date with technical criteria by the UPME and with a sense of 'transformative planning' that involves the opening of channels for citizen participation in the planning of the electricity sector (UPME, 2021a).

However, the existence of this investment ecosystem does not ensure that the development of projects takes place in a context of universal social acceptance. On the contrary, some of these conditions collide with the interests of other relevant stakeholders in the energy system and may even generate clashes at a territorial scale, especially with the host communities of large-scale energy infrastructure. As we have seen, the energy transitions in Colombia and Chile are not solely driven by a perspective of climate action and long-term sustainability. This rhetorical frame tends to hide the interests at stake on the part of the different actors in the energy system. It is therefore necessary to scale down to take a closer look at the implementation of energy transition policies and at the often-unintended impacts they are producing at the local-regional level.

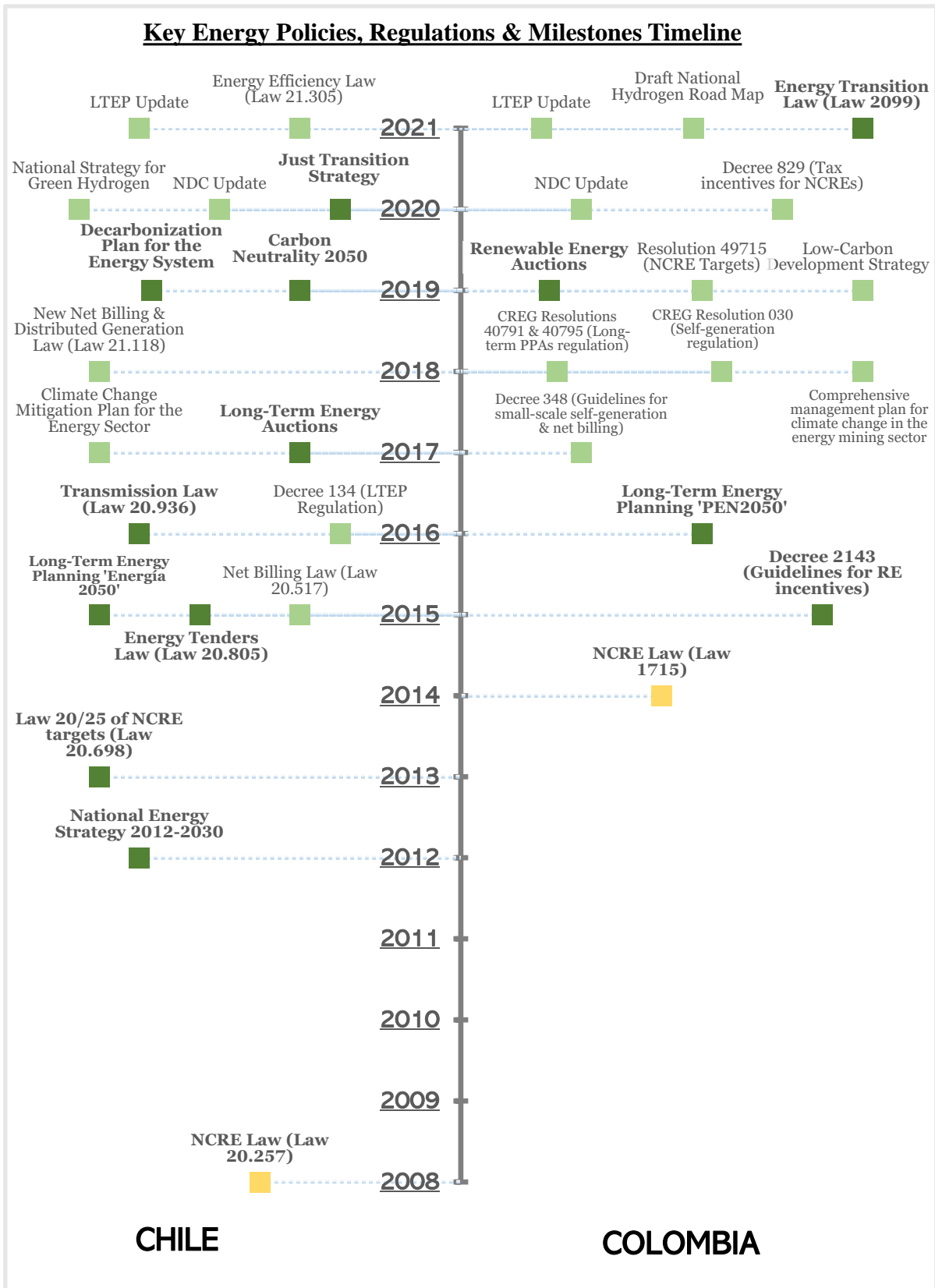


Figure 2.9. Timeline of key policies, regulations, and milestones for NCRE integration in Chile and Colombia. Source: Author's elaboration with data from IEA & IRENA (2021), Grantham Research Institute (2021), Allotrope, NREL & WRI (2021), Ministerio de Minas y Energía de Colombia (2021a) & Ministerio de Energía de Chile (2015).

3. New Energy Spaces in Andean Economies: the cases of La Guajira and Antofagasta

Energy transition processes do not occur in a spatial vacuum. On the contrary, transition-related policies and technologies always have a concrete spatial configuration. In this chapter, I will therefore focus on exploring how the transitions in the electricity sector in Chile and Colombia towards a predominantly renewable energy matrix (reliant on NCRE sources) have been producing massive transformations at the territorial scale. To this end, I adopt Bridge & Gailing's (2020) theoretical perspective on what they call *new energy spaces*. This approach emphasizes an understanding of energy transitions as both spatially-constituted and space-making processes. The “new” is not a temporal marker referring to certain energy technologies (e.g. renewable energies); instead, the “new” addresses “*the production of novel combinations of energy systems and social relations across space*” (Bridge & Gailing, 2020). This conceptual lens is useful to analyze the process of uneven development of renewable energy landscapes as well as to interpret the transformation/emergence of conflicts around energy and identify the challenges to overcome the path dependency of high-carbon energy systems (Fouquet, 2016a).

In this regard, I focus on the two strategic regions for the transition to renewable energy systems: La Guajira in Colombia and Antofagasta in Chile. The perspective of a *geographical political economy of energy transition* is particularly striking here for three reasons, following Bridge et al. (2013). First, it offers insights into how spatial interactions in regions that are critically uneven (and that have a history of socio-environmental conflicts around energy) can either enable or frustrate transition policy objectives. Second, by delving into space and its configurations, it breaks down the belief that there is only one possible transition pathway. Instead, it provides tools to interpret the multiple coexisting energy pathways (not mechanically related to an idea of sustainability) and so to understand the relationship between energy transition trajectories and their underlying geographical conditions. Third, it highlights how the deployment of a low-carbon economy, as a simultaneously creative and destructive process, is significantly changing the way in which different places relate to each other, at a range of different scales—generating potentially contentious reconfigurations of social, economic, and cultural relations.

After completing the empirical data collection, I conducted a specific thematic analysis of justice considerations from the different textual data inputs of the research and then complemented this with the analysis of relevant quantitative data from different datasets. In order to establish a controlled and plausible comparison, the findings were systematized in three dimensions that constitute the *just transition framework* (Heffron & McCauley, 2018, 2019; McCauley & Heffron, 2018). These dimensions (*environmental justice*, *climate justice* and *energy justice*) are in turn related to well-established scholarships that address research on energy from different angles. Hence, the enquiry into justice-related issues, from this comprehensive viewpoint, interconnects the themes of energy transitions at the territorial scale and provides an understanding of how they produce a complex assemblage of interactions (not always virtuous and cooperative) between actors, policies, and scales.

3.1. Environmental justice challenges: unwrapping the socio-ecological footprint of renewables

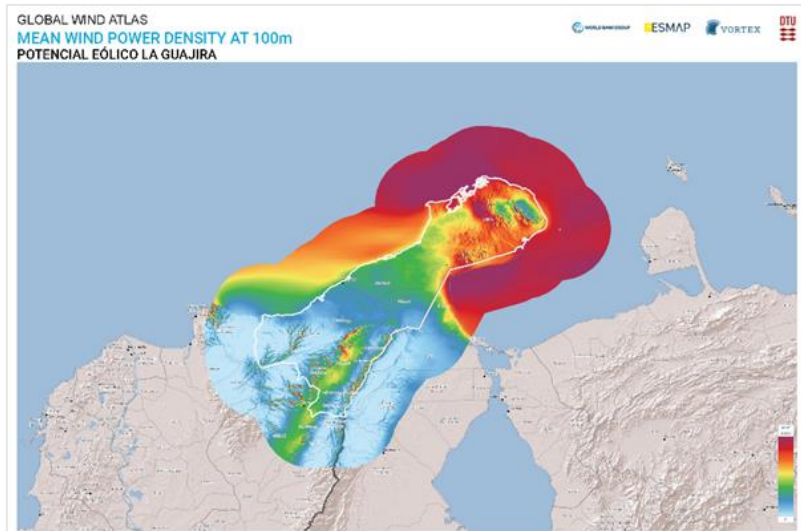
The massive development of renewable energies involves a major socio-ecological footprint with many implications considering the first relevant dimension for a just transition: *environmental justice*. In that regard, Antofagasta and La Guajira have become two of the preferred destinations for investments in the electricity sector in Latin America, in line with both the consolidation of a financial ecosystem for energy companies in Chile and Colombia and their enormous potential of renewable energy sources. This scenario has triggered an outburst of large-scale NCRE projects, which have been rapidly proliferating over time. Despite contributing to climate change mitigation by reducing GHG emissions in power generation, renewables have multiple environmental impacts that must be taken into account—specially, when it comes to the burgeoning of large-scale projects (Klugmann-Radziemska, 2014; Sayed et al., 2021). Hereinafter, I will discuss this issue as follows: 1) observing the massive and accelerated transformation of the energy landscape; 2) noting the territorial impacts of NCRE expansion; and 3) analyzing the paradox of the extraction-renewable energy nexus as a possible contemporary re-edition of the *natural resource curse* (Sachs & Warner, 2001).

3.1.1. Towards a large-scale and rapid transformation of the energy landscape

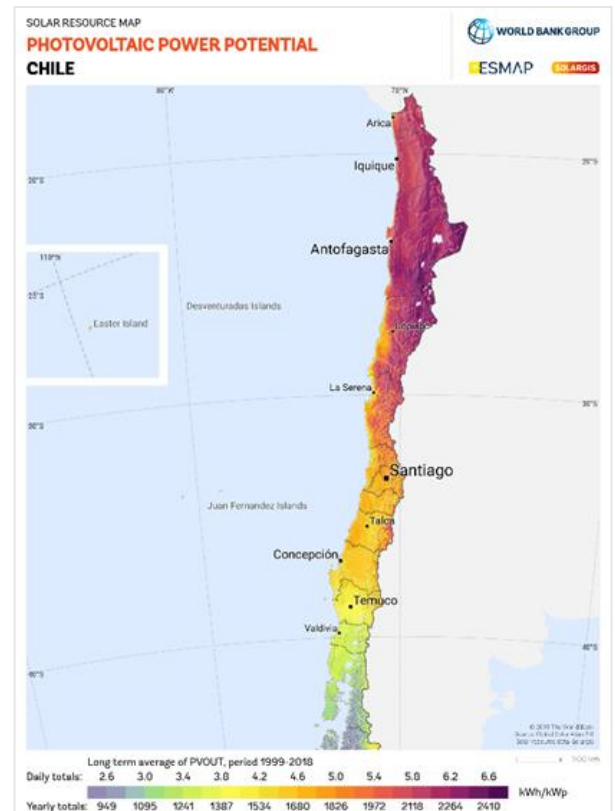
To begin with, La Guajira and Antofagasta are regions with an extraordinary renewable energy potential, although in the former the availability of wind resources prevails while in the latter solar resources hold sway. In the specific case of La Guajira, its winds are considered among the best in South America since there the trade winds blow throughout the year with greater intensity than in the rest of Colombia (Figure 3.1a²⁵). The average speeds of these winds are close to or higher than 9 m/s (at 80m height), from which a potential installable capacity of near 18 GW is estimated. This department plays therefore a major role in NCRE integration plans in Colombia, as is evidenced by a 2015 study by UPME, Colombia's Ministry of Mines and Energy, and IDB (UPME et al., 2015).

On the Antofagasta side, the *Desierto de Atacama* has been catalogued as the region with the highest solar radiation in the world (Zurita et al., 2018). As a result, the specific PV power output of Chile's *Norte Grande* and particularly of the Antofagasta region lies in a remarkable range of 4.82 - 6.58 kWh/kWp (Figure 3.1b). In fact, a study conducted in 2014 by the Ministry of Energy of Chile and the German cooperation agency (GIZ) calculated the available renewable energy potential of the Chilean regions regarding four types of power generation technologies (wind, solar PV, CSP and hydro). According to this estimate, Antofagasta was highlighted as having the highest available potential, with a total of 1,276,988 MW distributed in 390,476 MW of CSP potential, 883,651 MW of solar PV, and 2,622 MW of wind power (Ministerio de Energía de Chile & GIZ, 2014). Such an exorbitant figure was, in turn, equal to 68.48% of the total estimated potential for the entire Chilean territory.

²⁵ The assumed capacity density for offshore wind farms along the peninsula of La Guajira is even stronger, as depicted in the map. Yet the relatively high LCOE of this type of technology has so far hindered the exploitation of this energy carrier.



(a)



(b)

Figure 3.1. Renewable energy potential maps: (a) Mean wind energy density at 100m in the department of La Guajira; (b) PV power potential in Chile. Source: Global Wind Atlas (2021) & Global Solar Atlas (2021).

However, utility-scale development of NCRE in La Guajira and Antofagasta began at different times. While in Antofagasta the first projects date back to 2008²⁶, as the first wind farms were registered, in La Guajira this process started belatedly in 2015²⁷. This fact is closely related to the consolidation of their respective countries' policy and regulatory frameworks—which were established in different moments, due to a combination of internal and external factors discussed in Chapter 1. But either way, in recent years, investment flows to both regions have been steadily increasing, driving a far-reaching reconfiguration of the

²⁶ Driven by Law 20.257 of 2008 on NCRE, that year was registered the Minera Gaby Wind Farm project—built by the engineering firm Seawind S.A. on a site belonging to the *Corporación Nacional del Cobre* (CODELCO) in the commune of Sierra Gorda. So, the arrival of renewables in the region was done hand in hand with the mining industry, which they came to energize.

²⁷ Nonetheless, La Guajira is home to Jepirachi, the country's only wind farm in operation. With a total installed capacity of 19.5 MW nominal power, the project was built by the German firm Nordex Energy GmbH and put into operation in 2004 by *Empresas Públicas de Medellín E.S.P.* (EPM). It is located on a coastal strip between the villages of Cabo de la Vela and Puerto Bolívar in the municipality of Uribia (in the Alta Guajira).

energy landscape. This trend can be noticed when looking at the growing number of NCRE projects registered between 2008 and 2021 (Figure 3.2).

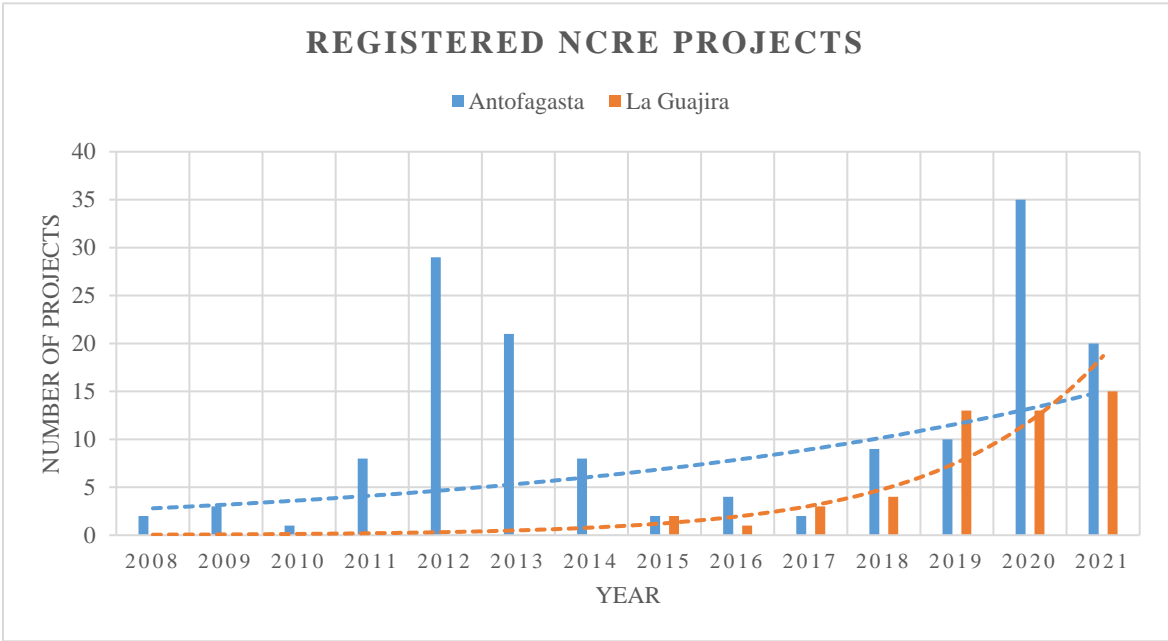


Figure 3.2. NCRE projects registered in Antofagasta and La Guajira (2008-2021). Source: Author's elaboration with data from UPME (2021a) and CNE (2021). Note: In the Chilean case, only projects with RCA approved or in qualification are considered. In the Colombian case, all projects in Phase 1, 2 and 3 were included²⁸.

On the one hand, the surge in the number of NCRE projects in Antofagasta began in 2011, when the boom of photovoltaic plants in the region broke out. In parallel to Chile’s strategic commitment to diversify its electricity matrix, the Second Region has accumulated a total of 154 NCRE generation projects registered between 2008 and 2021 (of which 29 are undergoing the Environmental Assessment Process). According to the region’s outstanding solar radiation potential, around 80% (122) are solar PV projects, while the remaining 20% correspond mostly to wind projects and, to a lesser extent, to geothermal and CSP projects (Energía Abierta & CNE, 2021b)²⁹. Most of these projects (72 out of 154) are concentrated as well in the northern communes of María Elena and Calama. This wide range of NCREs corresponded, as of July 2021, to 22.4% of the installed capacity of the regional energy

²⁸ Regardless of whether they were or will ever be built, projects that advanced to this point must have undergone a prior structuring process that is indicative of real investment interest.

²⁹ Antofagasta is a pioneering region in South America in terms of implementing NCRE technologies. Two projects are milestones in this regard: First, there is *Cerro Pabellón*, a geothermal plant composed of two units with a gross installed capacity of 24 each. It was put into operation by the companies Enel and ENAP in September 2017; Second, there is *Cerro Dominador*, a 210 MW power plant combining CSP and Solar PV. It became operational in June 2021 and belongs to the company EIG Global Energy Partners.

system (1524.66 MW of nominal power distributed in 22 operating plants with more than 10 MW of capacity—17 Solar PV, 3 wind, 1 CSP and 1 geothermal) and injected into the interconnected system, as of June 2021, 19.2% (349.02 GWh) of the electricity generated in the region each month (Energía Abierta & CNE, 2021a).

On the other hand, registered NCRE projects in La Guajira only started to appear since 2015, in compliance with the tax incentives of Law 1715 of 2014. There, the boom time comes after the Second Renewable Energy Auction in 2019, when long-term contracts were signed in line with Colombian government plans to expand the share of NCREs in this country's electricity matrix—jumping from less than 1% in 2018 to around 12% in 2022 (Ministerio de Minas y Energía de Colombia & BID, 2021). Among the 51 projects registered with UPME from 2015 to the thirty-first week of 2021, 24 are in force (7 solar PV and 17 wind). These plants have a total rated power of 4,117.45 MW, range from 10 MW to 500 MW of installed capacity and are expected to start operating from December 31, 2021 to July 1, 2026 (UPME, 2021b). While none of the projects have been fully constructed or went into operation, the unprecedented scale at which their deployment is planned makes it possible to anticipate substantial transformations in the energy landscape of the Alta and Media Guajira due to the installation of thousands of wind turbines.

Additionally, this massive integration of NCRE requires more robust electricity transmission and distribution networks to inject the power generated into each country's national interconnected system. In this regard, both Chile and Colombia are implementing ambitious plans to expand their transmission networks. Incorporating a prospective long-term vision, these technical documents are updated on an annual basis and repeatedly highlight the imperative need to improve the energy transmission infrastructure in Antofagasta and La Guajira³⁰. So critical is it that this infrastructure is seen as a technical prerequisite to ensure the proper connection of new NCRE projects to the grid as well as a powerful source of socio-

³⁰ The generation and transmission expansion plans (GTEPs) can be found in the *Sistema de Información Eléctrico Colombiano* - SIEL (siel.gov.co/Inicio/Generación/PlanesdeExpansiónGeneraciónTransmisión/tabid/111/Default.aspx) and in the web page of the *Coordinador Eléctrico Nacional de Chile* (<https://www.coordinador.cl/desarrollo/documentos/desarrollo-de-la-transmision/propuesta-de-expansion-de-transmision-del-sen-2020/propuesta-2020/informe-2020/>). They are updated annually according to prospective models on the evolution of demand and involve long-term planning horizons of the electricity systems.

environmental conflicts that, as we shall see, could delay decarbonization plans. This idea was common to public sector, private sector, and civil society informants.

Hence, the put into operation of mega transmission lines involving the pioneering use of High Voltage Direct Current (HVDC) power transmission systems is projected towards 2030. This is the case of the Kimal-Lo Aguirre line in Chile, with an extension of 1,500 km from Antofagasta to Santiago, and the second line planned from the Colectora substation in La Guajira to the inland of Colombia (Figure 3.3). It is estimated that these 500 kV high voltage lines will have between 2,000 and 3,000 MW of power, which is required to smoothly evacuate the electricity generated from renewable sources to the main consumption centers within their countries and to export the energy to neighboring countries (namely, Argentina in the case of Chile and Panama in the case of Colombia³¹). The massive and utility-scale development of these new electrical infrastructures is thereby tailored to the forecasts of a growing demand from populations living far away from the territories that are directly impacted by electricity generation.



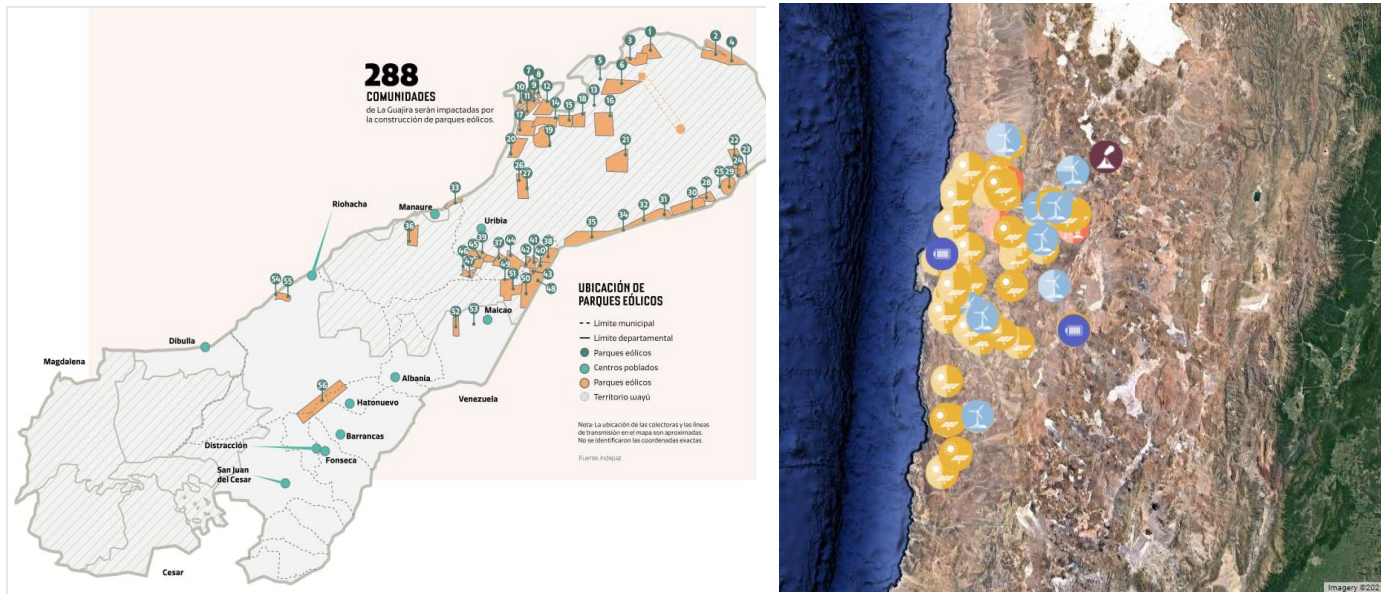
Figure 3.3. Prospective expansion map of Colombia's National Transmission System (STN) and Regional Transmission Systems (STRs) with a 2033 horizon. Source: UPME (2019a). Note: The projected transmission lines in La Guajira include the 500kV high voltage lines between the Colectora 1 substation –to be constructed– and Cuestecitas –located in the vicinity of El Cerrejón mine– as well as the HVDC line projected to carry the energy generated in Alta Guajira to the Cerro Matoso substation, from where it could be transported to Panama.

³¹ Supported by IDB, the Ministry of Mines and Energy of Colombia and the National Energy Secretariat of Panama agreed on July 21, 2021, to define the principles and general guidelines on which the Regulatory Harmonization Scheme for the electrical interconnection between the two countries will be based.

3.1.2. Territorial impacts of renewable energies

The complex assemblage of new electricity generation technologies at a massive scale and transmission networks spreading over space in a high-density configuration is rapidly reshaping the energy landscape in Antofagasta and La Guajira. This transformation is not politically neutral. On the contrary, it exposes the deployment of different projects and contested visions of *territoriality* (Bridge et al., 2013). The way in which changes in energy systems are territorialized brings to the surface a highly contentious dimension of energy transitions. This aspect, referring more to *politics* than to *policies* in energy transitions (Meadowcroft, 2009), underscores the existence of (often hidden) individual interests that make problematic the rhetoric of a consensual, win-win transition for everyone.

Such a sprawling tangle of transmission lines and large-scale generation infrastructure brings into play divergent conceptions of territory. In La Guajira, this situation is becoming increasingly dangerous. As shown in Figure 3.4a, there is a conflictive overlap between indigenous lands and energy projects. The territories of more than 200 indigenous communities are impacted in multiple ways by the development of the energy sector's infrastructure (which includes both power generation and transmission) (González Posso & Barney, 2019). This scenario implies that both large-scale wind farms and critical transmission projects, such as the Colectora substation, are put on hold, either due to slow environmental licensing processes or to frustrated prior consultations with the department's indigenous communities. Wind energy expansion plans in La Guajira are facing multiple obstacles in line with the existing evidence of high conflict around wind farms in Latin America and, specifically, in the isthmus of Tehuantepec in Mexico (Avila-Calero, 2017; Dunlap, 2018; Mejía-Montero et al., 2020).



(a) (b)

Figure 3.4. Maps of NCREs in the studied regions: (a) Spatial distribution of projected wind farms in La Guajira, and coincidence with the territories of Wayúu indigenous communities. Source: Energía Estratégica (2021); (b) Geo-referencing of NCREs at an advanced stage of development in Antofagasta. Source: ACERA (2021).

As mentioned by INDEPAZ’s researcher Joanna Barney (Informant C5), in an interview of August 6, 2021:

“Las empresas le están ‘haciendo conejo’ (cheating) a las consultas previas. Por ejemplo, los hatos ganaderos de caprinos y bovinos, muy importantes para la economía tradicional Wayúu, se encuentran afectados por la construcción de los parques. Es lo que está pasando desde ya, desde antes de entrar en operación, con el parque de Isagén.

(...)

No hay consulta previa para los predios que están fuera de un radio de 80 pasos de cada aerogenerador. Esto está agravando las diferencias entre clanes, entre los Wayúu que siempre han sido bien temperamentales.

(...)

Como no está clara la propiedad de la tierra, se hicieron “negocios” con la gente que estaba en el territorio, pero no siempre eran los dueños de esos terrenos. Es así que se han producido nuevas peleas entre clanes, a veces a bala, porque están avalando consultas previas sin las autoridades legítimas. Se están matando entre ellos y, para ellos (gobierno y empresas), es mejor” (Informant C5, August 6, 2021).

As they have been denouncing since 2019, the processes of prior consultation with the communities are being regarded as a mere formality. These procedural injustices give rise to the emergence of unexpected opposition to wind projects, on the one hand, and to the emergence of violent intra-ethnic conflicts between Wayúu clans, on the other hand. Such rising opposition is driven by environmental concerns³² but, above all, by social, political,



Figure 3.5. Wayúu women near Jeirachí wind turbines.
Source El Espectador (2021)

and cultural issues related to the disruption of indigenous territoriality. In addition, the emerging struggles within Wayúu communities reflect a dangerous disregard for their worldviews and cultural practices from the energy companies and national government side, which is exacerbated by the disruption of the fragile semi-desert

ecosystems that tourism depends on. The latter, needless to say, is one of the few economic alternatives to coal mining in La Guajira. “¿Quién va a querer viajar en un futuro hasta La Guajira para ver una hilera interminable de aerogeneradores?,” she wondered during the interview.

In this regard, Jessenia Villamil (Informant C4) – researcher for the environmental NGO *Asociación Centro Nacional Salud, Ambiente y Trabajo* (CENSAT-Agua Viva) – stated:

“En La Guajira ya se conocen los impactos de la energía eólica por la experiencia de Jeparachi. Los wayúu ya saben cómo llegan las empresas y se apropian del terreno. Eso ya lo conocen. Y como ellos están organizados por clanes y familias, el tema de propiedad de la tierra se imbrica con la llegada de estos proyectos. (...) El desconocimiento de esto por parte de las empresas de los parques eólicos está generando rupturas familiares, de clanes, etc., que se pueden resolver incluso violentamente. (...) La energía que se piensa generar va

³² These environmental impacts on the landscape, bird biological corridors, among others, have been extensively described in the scientific literature (Dunlap, 2020; Levenda et al., 2021; Sayed et al., 2021).

al interior del país e incluso se va a exportar, ahora con todo esto de la interconexión con Panamá. Hay de por medio una lógica perversa de extracción de la energía. Las comunidades a los cuales les arrebatan los territorios no van a gozar de la energía eléctrica generada.” (Informant C4, July 17, 2021).

In the same vein, Informant B3 recognized that this lack of knowledge of Wayúu territoriality will inevitably delay the construction and entry into operation of wind projects. He mentioned that, on behalf of the electricity sector, more emphatic and sincere efforts are needed in order to improve the results of the consultation processes with the communities and avoid a snowball effect whereby the resolution of problems becomes increasingly challenging.

A cross-cutting idea in the testimonies of interviewees from the different clusters of stakeholders is the absence of multi-stakeholder dialogue channels as a major governance problem. Lack of dialogue jeopardizes the investments in renewables and, in turn, tends to fuel new socio-environmental conflicts in the department. Failures in the governance of the energy sector also threaten the country’s credit rating in the financial markets and, consequently, endanger future investment flows in renewables. Such a doomsday scenario is even considered by the private sector. As pointed out by Informant B3:

“Esto puede hacer que se echen todas las esperanzas en saco roto: si se deja todo el peso de la descarbonización y el cambio del modelo de desarrollo en la expansión de las renovables pero no se arreglan estos problemas, no va a haber ningún toque de Midas ni posibilidad de reemplazo de las rentas y fuentes de trabajo de los fósiles. Aquí todos podemos salir afectados, si no se arreglan las cosas a tiempo.” (Informant B3, July 13, 2021).

La Guajira was already an inhospitable and ungovernable place, where illegal flows and legal actors converged in a tense territorial dynamic. The picture with the wind projects does not seem to be shifting. Instead, the accelerated pace at which these infrastructures are intended to be developed is clashing with a reality that is invisible in the most optimistic prospective studies: La Guajira is an inhabited desert and its inhabitants have so far suffered the marginalization of a development and social model that does not include them. The risk of continuing with projects at such a fast rate is that renewable energy, instead of being a vector of sustainable development, could turn into a new pattern of environmental injustice at the regional level.

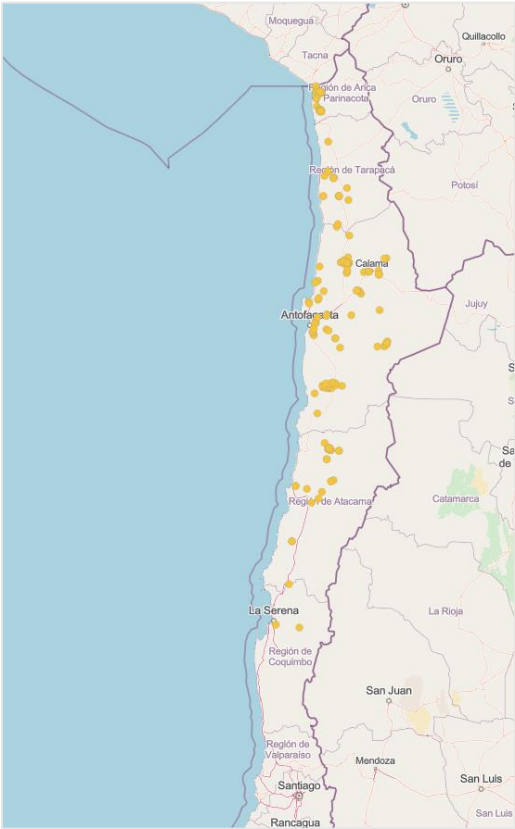
In Antofagasta the experience has been drastically different. In comparison, the development of NCREs in the region has rarely been conflictive. Despite the high number of projects of different sizes and implementing different technologies, there are no major socio-environmental conflicts linked to renewable energies. This is due to the prevalence of solar energy, which, although it leaves a significant ecological footprint due to the materials used in its construction, tends to have greater social acceptance and less environmental impact than other technologies (Levenda et al., 2021; Tawalbeh et al., 2021). Nonetheless, there is a prevailing vision of territoriality that conceives the region as a place primarily specialized in the production of renewable energy.

Such a conception is reflected in the high density of generation projects, which spreads across the regional map (Figure 3.4b). This phenomenon raises questions, in turn, about the environmental sustainability of this industry in the long run. Although the Second Region has a much lower population density and greater availability of land than La Guajira, some estimates put the number of total area required on 7,582,536 ha to exploit the full solar PV and CSP potential (Ministerio de Energía de Chile & GIZ, 2014). Even if solar energy development is unlikely to reach this magnitude, the use of this data as a benchmark for framing energy policy has contributed to create and disseminate a perception that the Atacama Desert landscape can be endlessly exploited. Over the long run, the extensive transformation of the desert landscape for the development of solar energy may generate the risk of creating serious socio-environmental problems. Yet, this concern still seems very distant for relevant stakeholders (even the environmental advocacy groups) and the more immediate concern refers, first, to the layout of transmission lines and, second, to the implementation of the decarbonization plan of the electricity matrix, as we shall later discuss.

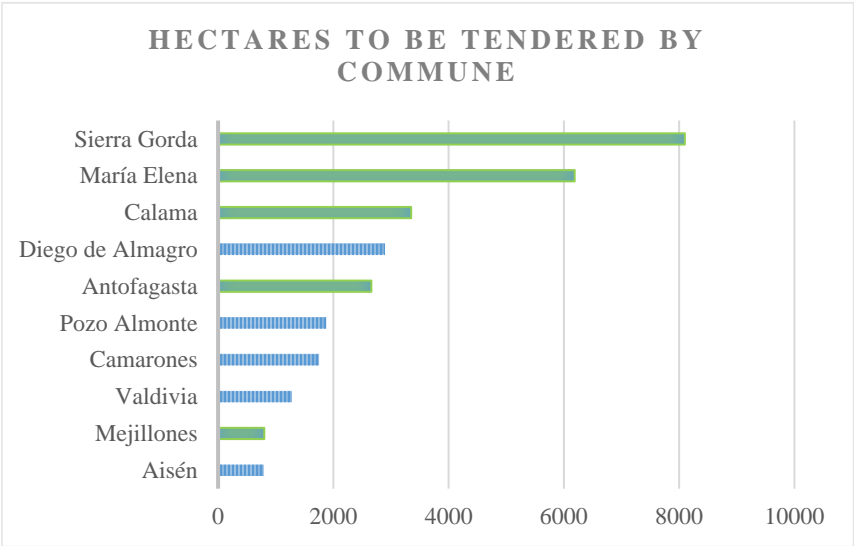
Anyway, there is indeed a tendency to transform the regional landscape in a unique direction. In the Ministry of National Assets' *Plan de Licitaciones 2018-2022*³³, Most of the fiscal properties earmarked by the Chilean State for the development of energy projects with a strategic interest were in the Second Region (93 out of 174) (Figure 3.6a). Likewise, 4 of the

³³ The *Plan de Licitaciones* defines the utilization of a certain number of state-owned properties to leverage the strategic development of different productive sectors, according to the purpose of each property: tourism, conservation and heritage, industrial, agricultural, real estate, housing-commercial, and for the development of renewable energies.

5 communes with the largest area of land available for bidding (Figure 3.6b) were located in Antofagasta (Sierra Gorda, María Elena and Calama being the first three, respectively) (Ministerio de Bienes Nacionales de Chile, 2021). In the same direction, the Chilean government announced in July 2021 the provision of 27 properties³⁴, equivalent to 20,369 hectares, in which is projected an investment of US\$ 1,775 million to build 2,037 MW of installed capacity for electricity generation. The latter would expand the regional NCRE capacity by about 30% (Ministerio de Energía de Chile, 2021c).



(a)



(b)

Figure 3.6. Plan de Licitaciones (2018-2022); (a) Map of properties earmarked for energy projects; (b) Top 10 communes with the largest surface area to be tendered. Source: Author’s adaptation from Ministerio de Bienes Nacionales de Chile (2021).

³⁴ The lands are located in the communes of María Elena (8 properties and 6,205 hectares); Antofagasta (7 and 1,892 ha); Calama (5 and 3,320 ha); Sierra Gorda (3 and 8,146 ha); Mejillones (3 and 775 ha); and Tocopilla (1 and 30.56 ha).

Although this vision of land use is not the subject of major socio-environmental conflicts³⁵, this should not be interpreted to mean that there are no objections to the decision-making mechanisms being employed in the territorial planning of renewable projects. Conversely, as stated by Paz Araya:

“El Sistema de Evaluación de Impacto Ambiental (SEIA) no es vinculante y además es muy asimétrico. Es lo que ocurre con la entrada e implementación de los proyectos renovables. Todo se plantea en un lenguaje técnico y engorroso que limita participación de la ciudadanía. Así, cuando hay inconformidad, a lo sumo se logra detener un proyecto. Como no hay planificación a escala local, nadie incorpora estas voces y críticas.” (Informant C3, June 22, 2021).

Besides this weakness of the participatory mechanisms in power sector planning, there is also the absence of a *place attachment* (Devine-Wright, 2011) with the new places for the generation of electricity from renewable sources. As Carla Lanyon (Informant C1), researcher for the *Centro de Energía* at Universidad de Chile, told—alluding to the region and the symbolic place it occupies in the imaginary of citizens in the country’s large cities:

“A diferencia de lo ocurrido con Hidroaysén o de lo que pasa con las zonas de sacrificio cercanas a Santiago, nadie defiende Antofagasta. La gente, y por ‘la gente’ me refiero a los actores influyentes en Santiago, ya la cedió. La dio por perdida.” (Informant C1, June 16, 2021).

Such a lack of place attachment is enabling the monoproduction of renewable energy to expand increasingly in the Atacama Desert (Figure 3.7) without significant backlash. In this manner, concerns about environmental impacts such as landscape degradation and habitat loss (Klugmann-Radziemska, 2014) are quickly dismissed in the face of the global economic benefits derived from the blooming of this industry. Behind this conception of the desertscape, its ecosystems and inhabitants, lies a certain *environmental racism*. As pointed out by the informant of CENSAT-Agua Viva: *“Hay cierta idea de que esos indios no*

³⁵ Despite the lack of major conflicts around NCREs, there have been tensions related to the planning of some projects and their RCA process. This is the case of the claims filed by the indigenous communities of Taira and Pueblo de San Pedro against the Cerro Pabellón geothermal plant expansion project, which were admitted by the First Environmental Court of Chile.

importan, el desierto no importa, no es un ecosistema y territorio digno de cuidar.” This is happening in both La Guajira and Antofagasta, albeit in different ways.



Figure 3.7. Cerro Dominador solar power complex (PV+CSP plant). Source: Meteored (2021).

The global energy transition is bringing about then a massive transformation of the landscape in Antofagasta. It is simultaneously transforming large desert ecosystems to produce electricity and increasing anthropic pressure on the Andean highlands - due to the rapid growth in demand for minerals and

rare earths to supply the global value chains of clean energy. Such freneticism raises serious doubts about the long-term sustainability of this trend.

3.1.3. Renewable energy landscapes: revisiting the resource curse?

The suggestive idea that renewable energies might be following the path of fossil fuels (Raman, 2013)) is an alarm bell about the limited transformative scope that ongoing transformations of energy systems may have. More precisely, one of the risks involved in the inadequate governance of these processes is the repetition of the resource curse. In other words, a new version of the development trap in which countries with a greater abundance of non-renewable natural resources (i.e., essentially hydrocarbons such as oil or minerals such as gold) were unable to make the structural leap towards societies with high standards of social welfare. In this sense, the trajectories of the new energy spaces reveal that the gears of development do not align automatically.

Considering environmental justice issues, renewable energies can accentuate patterns of socio-spatial inequality and leave a notorious socio-ecological footprint in the areas destined

for the installation of electricity generating capacity. Emerging socio-environmental conflicts at the local scale are not inevitable. It is possible to avoid these conflicts if the transition to renewables is part of a inclusive sustainable development strategy and does not threaten the well-being of local stakeholders and especially the most vulnerable and historically marginalized communities (Månsson, 2015). There is no relationship of consubstantiality between renewable energies and environmental injustices, as there is with fossil industries, but neither is there a necessary link between these energy sources and a social and environmental sustainability perspective. Because of these changes, which involve a wide range of actors, scales and locations, it may be useful to study the impacts of renewable energy plans and projects from a bottom-up perspective, focused on local actors and their territorialities, rather than from a techno-managerial perspective centered on the state and only-technological solutions. As Spreng (2014) stresses, *“although the tools for harvesting and using energy are technical devices, most problems we have with society’s physical energy metabolism are non-technological problems.”*

Looking closely at the regional case studies, it is noteworthy that environmental justice issues are not only related to the contentious aspects of transitions but to broader socioecological concerns. Dilemmas that challenge the environmental sustainability of a burgeoning industry also arise—questioning the high requirements for land, rare earths and minerals that threaten to introduce anthropogenic disturbances in vast ecosystems as well as abrupt land-use changes. The high surface requirement of renewables and its potential interactions with agricultural systems for food production (Månsson, 2015) is a critical issue requiring more attention from policymakers and project-developers. La Guajira is particularly critical, because of the precarious institutional presence in areas that are gaining centrality for wind energy development and the spatial overlap of illegal flows, traditional uses, and fragile ecosystems. Preventing these conflicts thus requires the development of local institutional capacities by linking the decisive participation of non-state actors in the definition of land use planning. However, this multi-stakeholder dialogue should not consist solely of integrating economic interests of the power sector major players into public policy instruments. Instead, it is important to enhance the needs and voices of local communities to co-construct energy networks with criteria of sustainability, equity, and justice.

The energy transition is therefore generating extraordinary gains for some countries, such as Chile, and increasingly for others, such as Colombia. Considering their development strategies, this poses a challenge: to avoid turning strategic regions for renewables into extractive enclaves of electric power. The absence of planning and agreement on a new territorial fit for these areas, outside the logic and narratives of *extractivism* (Gudynas, 2019), may lead to the repetition of the fossil fuels' development traps and, in this case, of the so-called resource curse. Nonetheless, the repetition of such a phenomenon at a large scale is yet evitable (Overland, 2019). What can certainly happen (and to some extent is happening) is that governance gaps in the transition processes towards clean energy become a source of new socio-environmental conflicts and, contrary to the expectations created, cannot properly address pre-existing conflicts around energy. As we will see, this is the case for the coal value chain and its transformations, both in a place of extraction (La Guajira) and in a place of transformation (Antofagasta).

3.2. Climate justice challenges: unexpected connections through coal value chain

A peculiarity of the new energy spaces is the uneven and geographically differentiated development of pathways and institutions associated with a low-carbon future. The weight of the incumbent energy regimes (with their actors and technologies) and path dependence become thus central issues in the investigation of the *regional dynamics of accumulation* (Bridge & Gailing, 2020) that shape renewable energy spaces. In this sense, the prevalence of coal in the energy landscape of La Guajira and Antofagasta is a pressing issue in light of the second relevant dimension for a just transition: *climate justice*. Despite being the energy source most threatened by the energy transition due to its very high level of carbon emissions, there is no absolute certainty as to its phase-out. Rather, this matter raises several questions. Coal thereby introduces instability in the energy landscape of both regions (as *carbonscapes* (Haarstad & Wanvik, 2017)) which produces great uncertainty with respect to the assemblage of low-carbon spatialities. Next, I will examine this issue as follows: 1) realizing the impacts of coal in the constitution of La Guajira and Antofagasta as “sacrifice zones” for energy production/extraction; 2) analyzing the challenges for a coal phase-out in the context of the ongoing renewable energy transitions in Colombia and Chile; and 3) discussing the weight and effects of *path dependence* (Fouquet, 2016a; Stein, 2017) in both regional energy transition processes.

3.2.1. The indelible stain of coal in the ‘sacrifice zones’

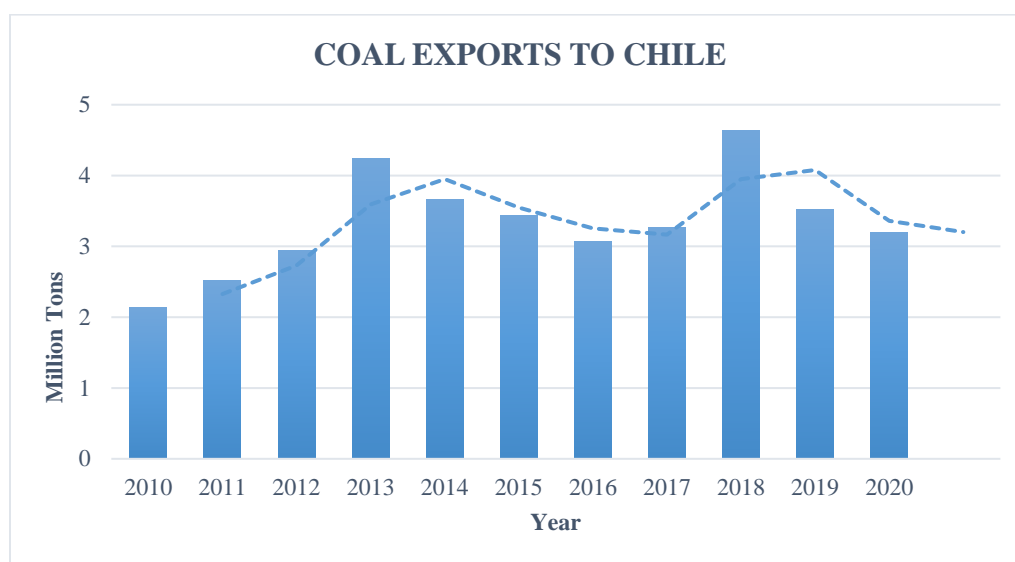


Figure 3.8. Hard Coal exports to Chile from La Guajira.
Source: Author's elaboration with data from UPME (2021b).

A contingent connection between Antofagasta and La Guajira is their insertion in two different links of the thermal coal value chain. While millions of tons of coal are extracted each year in La Guajira, after being shipped, the same coal is transformed in large quantities for electricity generation in Antofagasta. Together with the mines in the north of the neighboring department of Cesar, the coal mined in La Guajira has Chile as the fourth commercial destination since 2010³⁶. In fact, due to the drop in global demand due to the Covid-19 pandemic, in 2020 Chile became the second destination for La Guajira's coal (or third if the European Union is taken as a single trading partner). Totalling 154,750,699 USD FOB of commercial exchange, this relationship was only surpassed by the one with Turkey—whose coal purchases reached a value of almost 282 million dollars FOB (UPME, 2021c). Coal exports from La Guajira to Chile has remained in the range of 3 to 4 million tons per year since 2012 (Figure 3.8).

Most of this coal was destined for the thermoelectric power plants in the Mejillones and Tocopilla communes in Antofagasta. The majority of Chile's coal consumption is concentrated there. According to 2017 National Energy Balance (Energía Abierta & CNE, 2021c), 43.35% of the national total was transformed in Antofagasta for electricity generation. As we shall see, in both places, at both ends of the value chain, the stains left by coal are indelible—to the point of making the extraction/transformation sites authentic *sacrifice zones* (P. E. V. López et al., 2020; Reinert, 2018). Following Reinert's (2018) operational definition, the concept of sacrifice zone “*describes forms of environmental violence degradation and destruction that operate spatially, at the level of landscapes and regions. The term captures a relationship between destructive violence and disposability or “sacrificability”.*”

To begin with, the municipalities of Albania, Hatonuevo and Barrancas in La Guajira are home to El Cerrejón, one of the largest open-pit coal mines in the world. Divided into three sections (North Zone, Central Zone and South Zone), this mine has been in operation since 1981. Until June 2021, *Carbones del Cerrejón S.A.* was owned in equal parts by the

³⁶ 7% of the coal extracted in these two departments throughout the 2010s was consumed in Chile—which was only surpassed by the Netherlands (18%), Turkey (13.9%) and the United States (7.52%) (UPME, 2021c). Recently, Turkey has become the main buyer of Colombian coal while the Netherlands and the United States have decreased their volume of imports (presumably due to European decarbonization commitments and increased domestic production on the U.S. side).

multinational mining companies BHP Billiton, Anglo American and Xstrata plc. The latter was acquired in 2013 by Glencore, which, in turn, bought the remaining 66% of El Cerrejón shares in 2021, in a USD \$588 million transaction. The mine produces 35 million tons (almost all of it for export purposes) and has mining titles in force until 2034. The company also has 69,000 hectares under concession, of which approximately 10,000 hectares are directly involved in coal mining projects (Figure 3.9a). Finally, it has a railroad of more than 150 km, one of the few operational in Colombia, which in turn connects the mine directly to a harbor in Bahía Portete (in the north of the department). The aforementioned is complemented by administrative and military facilities (Fundación Terram et al., 2020). To sum up, it is an extractive complex of colossal dimensions.

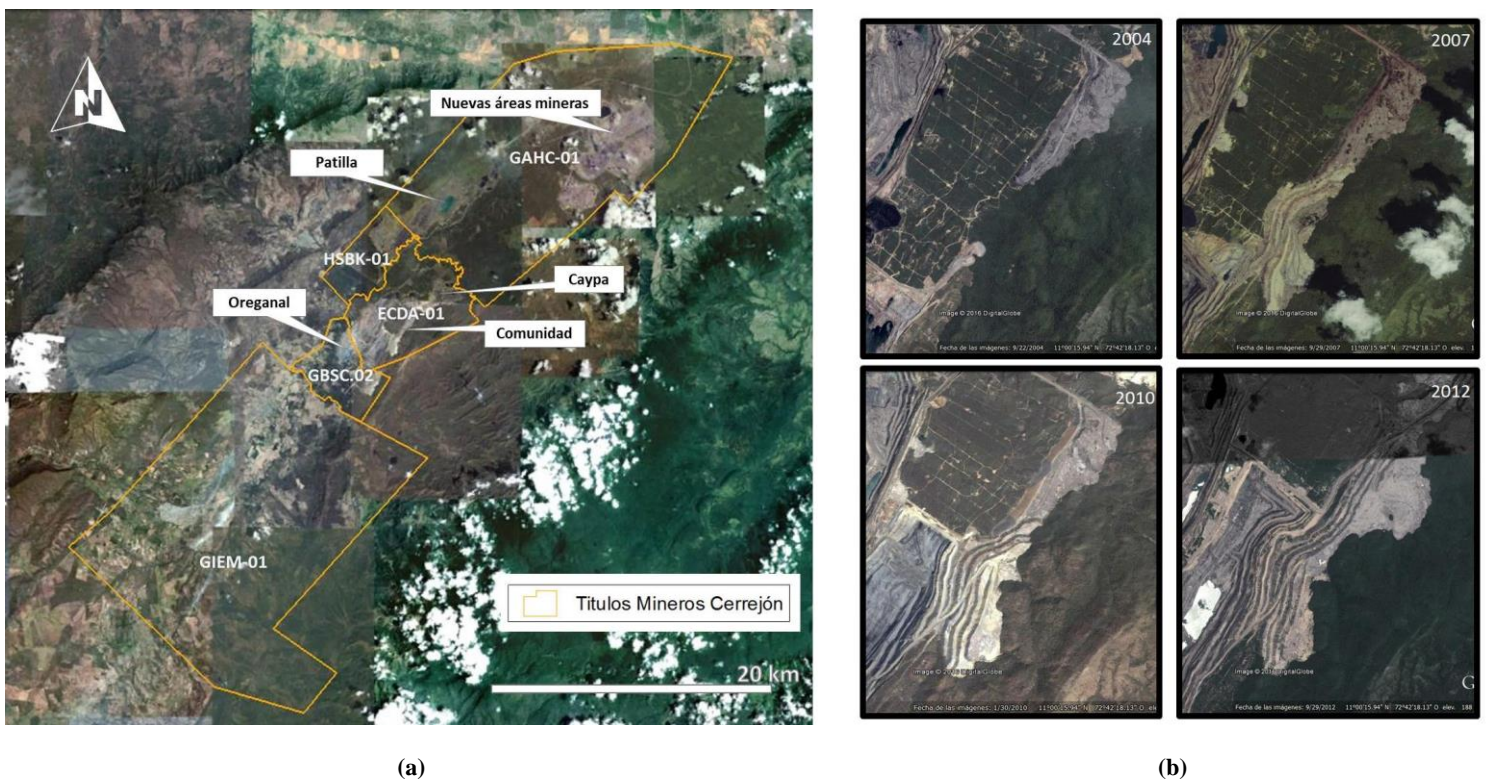


Figure 3.9. Satellite maps of El Cerrejón: a) Mining titles; b) Historical evolution of pits and dumps.
Source: Fierro Morales & Llorente Valbuena (2016).

More than a mine, Cerrejón represents an extractivist idea that has radically transformed La Guajira. On the one hand, its environmental and geological impacts have been sufficiently documented. A detailed report by geologists Fierro Morales & Llorente Valbuena (2016) extensively documented the impacts of Cerrejón. These range from unintended and diffuse geological impacts to large water and material footprints. In sum: direct affectations on water

bodies (diversion and drying of streams) and air quality (high environmental concentration of particulate matter-PM10 and heavy metals) have direct effects on fauna, flora and landscape, as well as on land uses and traditional visions of the territory in areas surrounding the mine. Thus, in addition to the physical and geological instability introduced into the ecosystems, there are direct consequences on local communities.

On the other hand, coal mining in southern La Guajira has been a source of socio-environmental conflicts since the late 1970s, when Cerrejón was still in the exploratory phase. In a report published by the environmental NGO CENSAT Agua Viva, made an exhaustive account of the socio-environmental conflicts associated with Cerrejón from 1977 to 2010. Such conflicts have pitted mining companies and state institutions (including paramilitary organizations, as in the case of the Bahía Portete massacre in 2004³⁷) against local communities (mostly Wayúu indigenous people). The repercussions of these conflicts include forced displacement of populations; legal pressures for the sale of land; damage to property and cultural heritage; contamination and disintegration of the physical-social environment; persecution of social leaders; and restrictions on civil liberties. Coal has then turned La Guajira into an authentic sacrifice zone.

At the other end of the value chain is Antofagasta, where coal is transformed to convert it into electricity. Indeed, on July 2021, coal-based thermoelectric plants continued to represent 39.9% of the regional net installed capacity of electricity generation, equivalent to 2,463.9 MW of nominal power. Despite the massive incorporation of non-conventional renewable source projects, 64.4% of monthly electricity generation (1177.11 GWh) still comes from the burning of thermal coal (Energía Región, 2021). The centrality of coal in the regional energy system is such that the four largest coal-fired power plants in Chile³⁸ are in two communes within the region: Mejillones and Tocopilla (Figure 3.10a & Figure 3.11b). Due to the

³⁷ This massacre involved the slaughtering and disappearance of 32 people as well as the subsequent murder of the witness and indigenous social leader, Liliana Epinayú, and the forced displacement of 500 people from the indigenous community. The mining company allegedly financed paramilitary groups in complicity with the mechanized infantry Battalion No. 6 of the Colombian Army (Idárraga et al., 2010).

³⁸ In July 2021, these plants were, ordered by their nominal power and the name of the company to which they belong: 1) Mejillones (Engie Chile) - 580 MW; 2) Angamos (AES Andes) - 558.2 MW; 3) Cochrane (AES Andes) - 549.72 MW; 4) IEM (Engie Chile) - 376.96 MW. To these are added in Antofagasta the Norgener (AES Andes) - 276.39 MW and Hornitos-Andina (Engie Chile) - 354-54 MW (Energía Abierta & CNE, 2021a).

environmental and public health impacts, these industrial enclaves have been referred to as sacrifice zones by a wide range of actors.



(a)

(b)

Figure 3.10. Information documents for Antofagasta's sacrifice zones. Source: Fundación Terram (2019).

Totalling five in Chile (Tocopilla, Mejillones, Coronel, Huasco and Quintero-Puchuncaví), sacrifice zones produce 88% of the carbon emissions of the national electricity system (P. E. V. López et al., 2020). In addition, there are other industrial activities that are responsible, in turn, for aggravating the environmental pollution produced by coal-based thermoelectric plants. These power plants are located in huge industrial parks and operate alongside copper and iron smelters, cement plants, chemical plants, gas and oil terminals, copper concentrate shipments and landings, explosives and cellulose plants, among others. In addition to the high levels of air, soil, and water pollution resulting from the concentration of these industries, the surrounding communities are marginalized and suffer from the absence of state institutions that guarantee their rights. At a short distance from residential areas, these plants emit high concentrations of fine dust that pollute air, soil and water, and periodically generate coal strandings on the coast, hydrocarbon spills, among other negative impacts on the environment and the health of the population (Fundación Terram et al., 2020; Sandra Cortes et al., 2019). The above configures a highly unstable and destructive *carbonscape* (Haarstad & Wanvik, 2017) that ignites contentious responses from the population.

In this sense, Mejillones and Tocopilla have also become focal points of socio-environmental conflicts. As recorded in July 2021 by the map of environmental conflicts of the National

Institute of Human Rights of Chile (INDH), 88% of the conflicts in Antofagasta were related to the energy sector and, more specifically, in the areas of Mejillones and Tocopilla (INDH, 2021). Dating back nearly three decades ago and most since the mid-2000s, these mostly involve demands by civil society organizations for the Chilean state to adopt adequate measures to protect the social and environmental rights of the inhabitants of these areas. In particular, the demand for the right to live in a pollution-free environment and the right to biodiversity, as well as the human rights to life and health, is reiterative. Such disputes usually oppose, on the one hand, civil society organizations (environmental NGOs, neighborhood councils, fishermen's unions, among others) and, on the other hand, the multinational companies operating the power plants (AES Andes, ENEL and ENGIE), which are usually protected by the regulations in force.

Finally, in both Colombia and Chile, the coal industry is not dead, and its indelible mark can be seen in the physiognomy of the sacrifice zones in both countries. Although it is the energy source most directly tackled by the global energy transition, the perspective of its substitution and exit in Colombia and Chile is still diffuse. As we shall see, its place in decarbonization plans as well as its interplay with renewable energy sources in the process of expansion, raises questions in the light of climate justice.

3.2.2. Phasing out coal: contradictions across multiple scales

Antofagasta and La Guajira illustrate well the economic, social, and ethical challenges that decarbonization in Latin America must face to take place within a framework of justice and equity. Despite their differences, both regions face some similar sustainability challenges. From the perspective of climate justice, they bring to the fore the complex set of scales in which interactions and exchanges between relevant actors take place (Jasanoff, 2018). They are thereby at crossroads resulting from the uneven and combined geographic development of the new energy spaces (Bridge & Gailing, 2020).

On the one hand, in Antofagasta the coal phase out corresponds directly with a plan to decarbonize Chile's electricity matrix. After declining to sign up to the *Powering Past Coal Alliance* at COP23 in 2017, which was intended to accelerate the phase-out of coal-fired power plants worldwide, Chile organized a concerted roundtable with coal-power companies to structure a decarbonization plan under the scheme of public-private partnership. The result

was that the electricity generating companies³⁹ proposed a schedule of closure dates and the state accepted it with a target horizon of 2040 to complete the retirement and/or reconversion of all coal-fired power plants. This plan to decarbonize the electricity matrix was presented in 2019 under the premise of contributing to reduce emissions from the energy sector and to gradually replace coal-based generation with clean and renewable energy source (Ministerio de Energía de Chile, 2020a).

Likewise, the consultation process to draw this plan involved the participation of all relevant stakeholders in the national energy system. Such plurality of voices resulted from the convening of 21 institutions from 10 different categories (companies, public sector, unions, clients/consumers, NGOs, civil society, international organizations, academia, independent institutions, and municipalities). Yet, as expressed by Claudia Fuentes (Informant C2) of the NGO *Chile Sustentable*, one of the participating organizations, the plan is not exempt from criticism:

“Las críticas desde las organizaciones de la sociedad civil se resumen en dos. Primero, está la voluntariedad de las fechas de retiro. Eso implica dejar todo en manos de las empresas y sus prioridades. Segundo, está la credibilidad misma del plan y sus objetivos. Las metas de disminución de emisiones deben incorporarse en la ley para que sean creíbles. Es cierto que este plan está al mismo nivel de importancia de la Política Energética 2050 y otros documentos de política pública y planificación estratégica, pero debe convertirse en ley para garantizar su cumplimiento por parte de las autoridades”. (Informant C2, June 17, 2021).

Besides this, another controversial element of the decarbonization policy is the *Estado de Reserva Estratégica* (ERE)⁴⁰. In the agreements reached in June 2019, the Ministry of Energy and the *Comisión Nacional de Energía* (CNE) committed to incorporating a new form of back up to the system: the ERE, through which inactive coal-fired plants could receive up to 60% of the usual payments for power generated for an extendable 5-year period, in order to keep them on standby (in a kind of hibernation) in the event of a supply deficit. This measure was fiercely criticized for introducing distortions in the generation market by indirectly

³⁹ Four companies concentrate the coal-fired generation park: three are multinationals (AES Andes, Engie and ENEL) and one company is Chilean (Colbún) (Figure 3.11).

⁴⁰ After a modification introduced on December 26, 2020, this mechanism is regulated by Decree 62 of 2006 of the Chilean Ministry of Economy, which “*aprueba reglamento de transferencias de potencia entre empresas generadoras establecidas en la Ley General de Servicios Eléctricos*”.

subsidizing thermal plants, generating disincentives for investments in clean energy (Chile Sustentable, 2020).

Despite having a public policy framework, coal phase out process in Chile is still subject to market volatility and can have setbacks⁴¹. An example is that the voluntary nature of the agreements leads to a determination of the retirement deadlines according to the discretion of power companies and their investment plans. In fact, despite the progress of the first phase of the phase-out schedule, the big picture for coal-fired generation had not changed substantially by 2021, two years after the plan’s approval (Figure 3.11). The market remains concentrated in four large companies as to 2017 and only one (Engie) had effectively reduced its market share. In fact, of the 1,731 MW of installed capacity to be retired in Phase 1 of the decarbonization plan (2019-2024), only 322 MW are part of AES Andes portfolio (Ministerio de Energía de Chile, 2020a). Furthermore, it is as well the only company that have expressed so far the intention of including all its units in the ERE (Chile Sustentable, 2020), and, together with Colbún, does not have a definitive date for closing the remaining plants during Phase 2 (2024-2040).

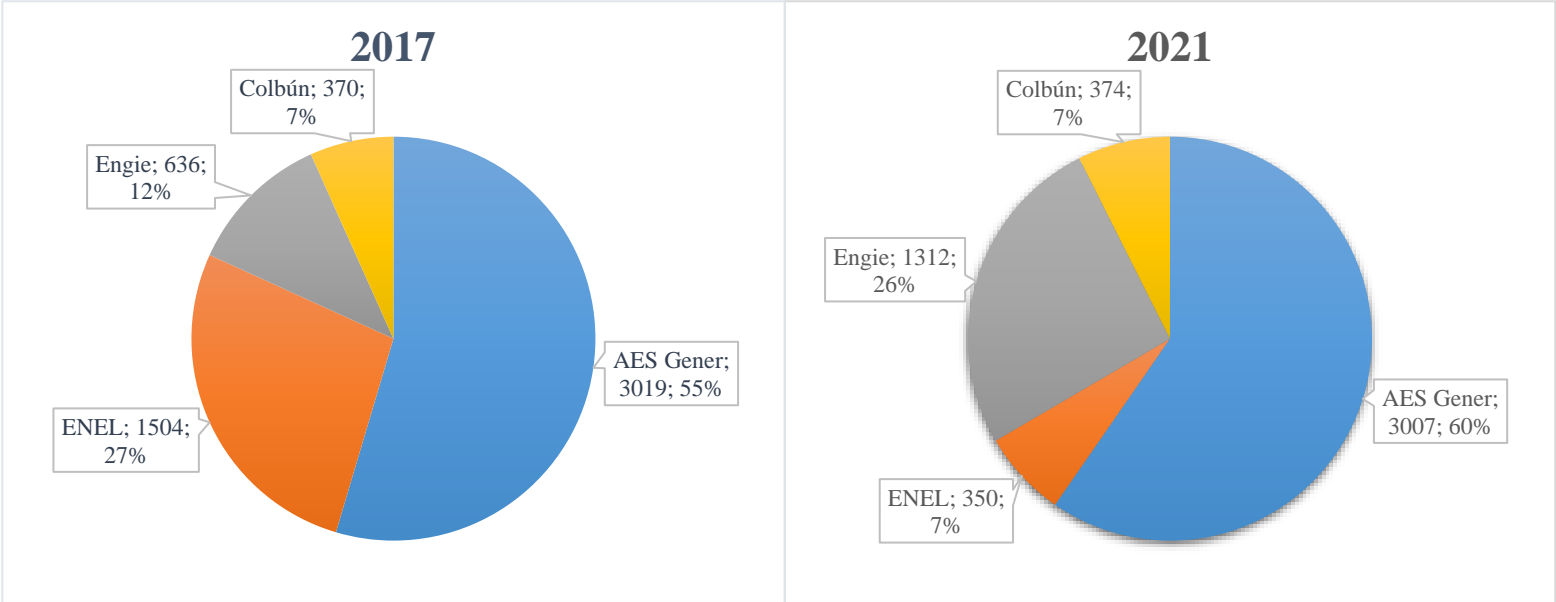


Figure 3.11. Coal-fired plants installed capacity by company (2017 vs. 2021). Source: Author’s elaboration with data from Energía Abierta & CNE (2021).

⁴¹ In early August 2021, CEN proposed the reopening of the Ventanas 1 unit - which stopped operating in December 2020 - due to the drought that negatively affected hydroelectric generation in Chile and left the responsibility of supplying 70% of the total required electricity in the hands of thermal power plants.

This lack of haste is due, to a large extent, to a lack of political pressure in its country of origin. While the headquarters of Engie and ENEL, French and Italian respectively, are subject to the political and economic situation of the EU, AES Corporation –from the U.S.– enjoys less domestic pressure to retire its coal-fired plants worldwide. This would be one of the reasons why in the Mejillones and Tocopilla sacrifice zones until mid-2021 only the two oldest units of the Engie plant had been retired and until 2024, during the first phase, only four more units of this company expect to be retired in Antofagasta (Figure 3.12). AES Andes units in the region would not be retired or reconverted during this phase.

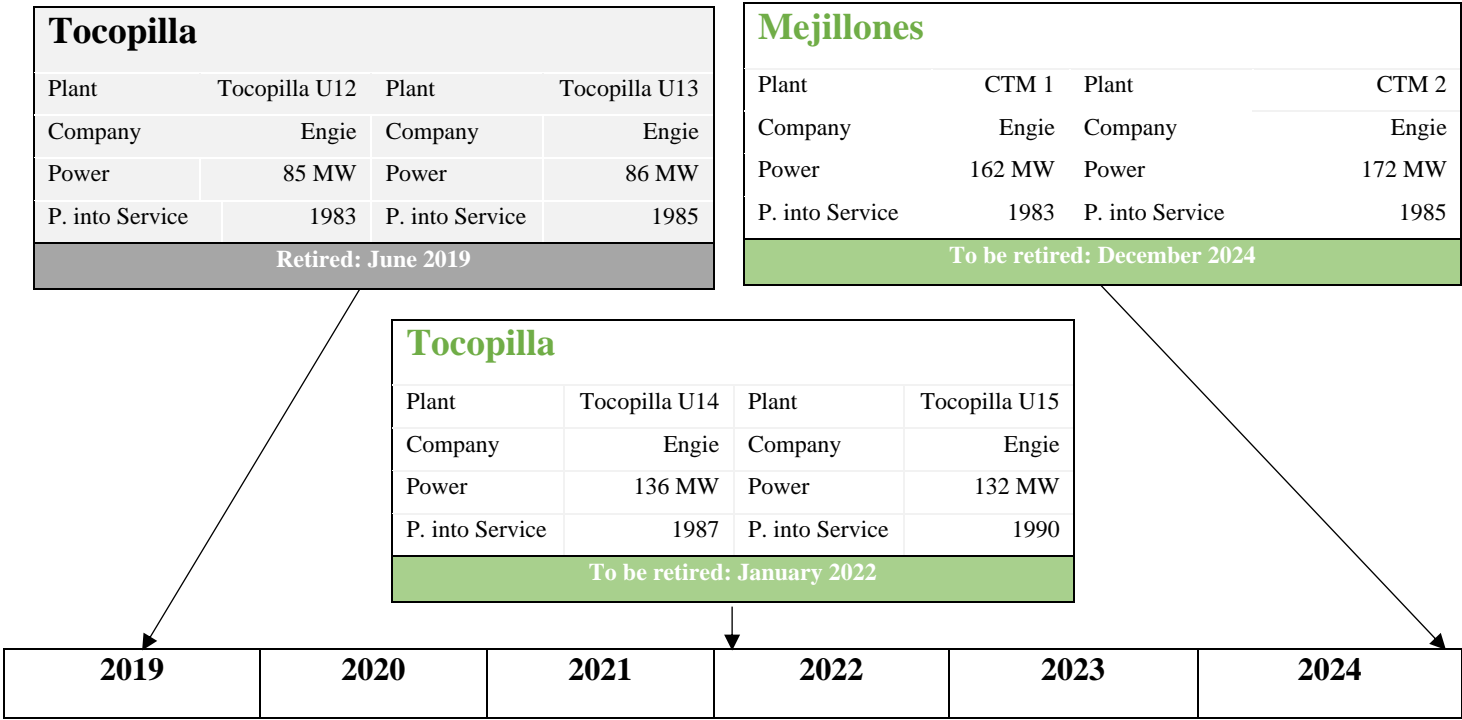


Figure 3.12. First phase retirement schedule for the coal-fired power plants in Tocopilla and Mejillones. Source: Author's adaptation from Ministerio de Energía de Chile (2020).

Some decisions concerning the decarbonization of the Chilean electricity matrix are taken thousands of kilometers away from the country, without much consideration of its social or environmental situation. They are not primarily related to the technical aspects of the operation of the national electricity system and its requirements to supply domestic demand, much less to the territorial realities of the sacrifice zones. Several informants mentioned this as an unfair aspect of the Chilean energy transition. In this regard, Carla Lanyon stated:

“En las zonas de sacrificio, la gente paga los costos ambientales de los proyectos industriales, pero no ve los beneficios, no ve que se invierta en ellos las regalías de los proyectos. Tienen la sensación de que las ganancias no se quedan en el lugar. Entonces, el problema no es la industria en sí. La industria siempre puede generar riqueza y empleo. El problema son los impactos ambientales.

(...)

Entonces pareciera que el extractivismo de las renovables está reemplazando el extractivismo de los combustibles fósiles y de las industrias basadas en combustibles fósiles. No es sustentable una transición energética sin diversificación económica, sin alternativas productivas para los habitantes de esas zonas.” (Informant C1, June 16, 2021).

In contrast, the vision of policymakers emphasizes the opportunities arising from this coal phase out. While the timing of the exit of power plants depends on the diversification of the investment portfolios of electric utilities, they are also deeply involved with a great share of NCRE projects and even with the implementation of new technologies. In this regard, Javier Obach Martiniello (Informant A3) of the Chilean Ministry of Energy, highlighted:

“Son muchos los actores que tienen que hacer que esto funcione, entre ellos la empresa privada. (...) AES Gener, Engie, ENEL, Colbún, tienen carteras de inversión en renovables muy fuertes. Están entendiendo la importancia de hacer el tránsito hacia las renovables. No son empresas térmicas: son empresas de energía eléctrica que invierten donde ven una oportunidad de negocio. Por eso, en términos de transición justa de la fuerza laboral, no habría grandes inconvenientes: la misma empresa relocaliza los trabajadores en proyectos cercanos u ofreciendo traslado de regiones. En esto también debe estar el Ministerio, generando oportunidades para la reconversión de los trabajadores, creando esas oportunidades.” (Informant A3, June 17, 2021).

On this regard, another tension emerges. On the one hand, there is a community of public-private efforts to take advantage of the investment ecosystem created during more than a decade for the development of NCREs. This aspect facilitates cooperation to explore new technologies, propose alternatives for technological reconversion of the existing infrastructure, etc. The *Cluster de Energía de Antofagasta*⁴² is conceived in this direction: to

⁴² This is a program by the Antofagasta CORFO Committee that seeks to implement a territorial management model to enhance the development of the regional energy industry value chain and promote the articulation and coordination of a variety of actors in the territory.

generate new productive backward and forward linkages, through public-private cooperation, to integrate renewables in a new development strategy at a territorial scale in which, in addition, other economic sectors are jointly promoted⁴³.

On the other hand, no compensation for the environmental liabilities left by the thermal plants is envisaged, nor recognition of historical responsibilities or reparation of the sacrifice zones. Beyond the issues associated with the management of the human capital of coal-fired power plants, in Antofagasta the idea of a just transition is related to the guarantee of human rights understood in a broad sense: that is, as economic, social, cultural, and environmental rights. From this crossroads between robust institutions that encourages private investment and a historical debt unpaid at the territorial scale, doubts arise about the sustainability of the energy transition underway and the transformative scope that decarbonization is having.

Coal stains are still perceptible in the landscape and the social life of the sacrifice zones. They continue to exist, even when this fuel is phased out. As Claudia Fuentes stressed:

“A escala local, las zonas donde están las termoeléctricas siguen igual que antes. Las zonas de sacrificio siguen existiendo y siguen igual, como si nada pasara. De hecho, ahora se suma la preocupación por el cierre de las termoeléctricas. Pareciera que no hay un compromiso de salida más conversada y con cierta gobernanza, con participación de la comunidad, de las centrales. Es clave que se dé esta discusión para evitar que estas zonas sigan igual después de salida de las termoeléctricas.

(...)

Es importante que las comunidades no queden peor que como estaban. La idea es que queden mejor. Por eso hay una fuerte necesidad de proyectos de reconversión laboral, de alternativas para comunidades y familias.” (Informant C2, June 17, 2021).

Furthermore, in La Guajira the coal phase-out acquires other dimensions, due to the magnitude of its contribution to the department’s economy (Martínez Ortiz, 2019). First, it is not directly linked to the transformation of the electricity system. Before the start of operations of the wind farms, the installed generating capacity in the department consists of

⁴³ According to the *Seremi de Energía de Antofagasta* (Informant A4), these types of institutional strategies have led to attracting investments in new technologies, such as CSP, and the exploration of others, such as green hydrogen. In addition, the transformation of industrial parks such as Tocopilla is being promoted with the development of desalination plants, for instance.

two thermal plants, including *Termoguajira*⁴⁴. Yet, the impacts of their operation are not comparable in scale or dimension with the Antofagasta plants, nor their place in the region's energy landscape is like that of Cerrejón. The challenge of phasing out coal in La Guajira relates more to the most basic link in the energy supply chain: extraction, mining (Wehnert et al., 2019).

Second, current policies do not contemplate a time window for ending coal mining. At the national level, both mining-energy sector policies and the National Development Plan (2018-2022) include considerations for a path towards energy transition focused primarily on two axes: 1) Increasing the participation of NCRE sources in the electricity matrix (taking advantage of the wind and solar potential of departments such as Cesar and La Guajira); and 2) diversifying the mining basket to improve the insertion of the country's exports in the global supply chains of critical minerals for the global energy transition (Ministerio de Minas y Energía de Colombia & BID, 2021).

As the informant of the Colombian Ministry of Energy made clear, the Government does not envisage a substitution of coal in the foreseeable future:

“La transición energética no se trata de sacar tecnologías del mix. De hecho, se debe buscar varias alternativas para hacerle frente a la pérdida de socios comerciales. La transición no puede ser sacar de un momento a otro las tecnologías o las fuentes. Eso pondría en peligro la seguridad energética del país.

(...)

Es por eso que estamos mirando la proyección del hidrógeno para reemplazar el carbón, incluso podría considerarse el uso del carbón para producir hidrógeno. Es algo que aún se está evaluando de cara a la definición de la Hoja de Ruta del Hidrógeno en Colombia. (...) Todavía hace falta introducir un poco más de educación en las comunidades. La gente sataniza mucho la minería.” Informant A2 (June 10, 2021).

The outlook for coal is uncertain and risks becoming an *stranded asset* (Caldecott et al., 2016; Ploeg & Rezai, 2020) as a consequence of the global energy transition. This concept is useful to emphasize risky implications of not adjusting investments according to the

⁴⁴ *Termoguajira* is a coal-fired power plant with a net installed capacity of 286 MW, divided into two units of 143 MW each. It is in the municipality of Dibulla,

decarbonization trajectories needed to limit global warming. It is generally accepted that stranded assets are those that, before the end of their lifecycle, are no longer capable of earning an economic return (i.e., meeting the firm's internal rate of return) because of changes associated with the transition to a low-carbon economy (lower-than-expected demand/prices) (Bos & Gupta, 2018). In other words, such assets are deemed to turn out to be worth less than expected by investors because of the energy transition.

Although a wide range of factors can explain this decline, in the case of La Guajira it is essentially due to: First, an economic one, associated with the loss of trading partners due to the climate commitments acquired, for example, in the framework of the Paris Agreement; Second, a geographical one, related to the department's distance from major coal consumption hubs in the world, what puts Colombian exports in a disadvantaged position with other producers, as Australia, to compete for the South and Southeast Asian market. In the face of this risk, there is no clear bet for the future of Colombian coal in the medium and long term (S. López & Patzy, 2021). At a territorial scale, there are no solid initiatives to develop new economic activities to overcome coal dependence.

This creates a potential scenario for climate injustice: given the risk of stranding, there could be an intention to compensate the decline of coal in international markets by promoting domestic consumption for purposes. Informant B3 stated:

“Vea, las térmicas siguen siendo necesarias. Un mal necesario, si se quiere. La nueva ley de transición energética, sí, está muy bien: pero acá se sigue necesitando la generación con gas y carbón. Ya hay 12 térmicas listas para respaldar el sistema⁴⁵. Con el ingreso de las eólicas, se vienen más centrales térmicas que ya están adjudicadas. Van porque van. Eso se sabe. ¿Por qué? Porque es más fácil el respaldo de térmicas que de hidros. Ituango se tiró en todo. Todo el mundo le tiene miedo ahora a las hidros.

(...)

Pero lo que pasa con esas termos es que tienen como obstáculo la falta de reservas de gas. Entonces tendrían que meterse con el carbón o avanzar en exploración con fractura hidráulica (fracking) en la franja del Orinoco. Y eso usted sabe que es complicado.

⁴⁵ Portafolio. “Hay 12 térmicas listas para respaldar el sistema”. Retrieved from: <https://www.portafolio.co/economia/hay-12-termicas-listas-para-respaldar-el-sistema-electrico-550623>

(...)

Las térmicas tienen aún mucha capacidad de lobby. Si desaparecen va a ser más por un movimiento natural del mercado que por temas regulatorios.” (Informant B3, July 13, 2021).

Moreover, this observation stems from the results of the 2019 auction of the *Cargo por Confiabilidad*⁴⁶, corresponding to the Firm Energy Obligations (FEO)⁴⁷ allocated to cover the projected demand for the period 2022-2023 (Table 5). Although NEC on grid expansion for 2022 foresaw a distribution of 4,010 MW in almost equal parts between NCRE (Wind and Solar), Hydro and Thermal, FEO allocations were almost entirely shared between This is due, on the one hand, to the expected entry into operation of the Hidroituango dam and, on the other hand, to the start-up of the new thermal plants with a mixed base (part coal and part gas). Given the delays of the Ituango project, a major responsibility falls on the shoulders of the thermal generators. Given the availability of coal mined in Colombia, one of the likely end uses of this mineral is, therefore, the generation of electricity to ensure the reliability of supply to the *Sistema Interconectado Nacional*.

Table 5. 2022 -2023 Firm Energy Obligations auction overall results by source. Source: Author’s adaptation from XM (2019). Note: FEO means Firm Energy Obligations; NEC means Net Effective Capacity.

ALLOCATIONS	WIND		HYDRO		SOLAR		THERMAL		Total
	FEO [GWh/day]	NEC [MW]	FEO [GWh/day]	NEC [MW]	FEO [GWh/day]	NEC [MW]	FEO [GWh/day]	NEC [MW]	FEO [GWh/day]
EXISTING			85.09	10,669			41.93	3,191	127.02
NEW	2.51	1,160	3.50	1,372	0.76	238	30.75	1,240	37.52
Total	2.51	1,160	88.59	12,041	0.76	238	72.68	4,431	164.54

A paradox catches the eye: as it is progressively phased out from the energy systems of some countries (especially in the Global North) due to their climate change mitigation commitments, coal from La Guajira could be recycled for electricity generation in Colombia.

⁴⁶ Remuneration scheme that seeks to incentivize the development of surplus power generating capacity in order to ensure the future supply of demand. To this end, this mechanism seeks to guarantee investors an efficient payment for the coverage guarantee they offer. It is, then, the modality under which the system is shielded and a reliable supply of energy is provided without the need for direct state intervention in the market.

⁴⁷ “Obligación de Energía Firme: Vínculo resultante de la Subasta o del mecanismo que haga sus veces, que imponga un generador el deber de generar, de acuerdo con el Despacho Ideal, una cantidad diaria de energía durante el Período de Vigencia de la Obligación, cuando el Precio de Bolsa supere el Precio de Escasez. Esta cantidad de energía corresponde a la programación de generación horaria resultante del Despacho Ideal hasta una cantidad” (Resolución CREG 071 de 2006).

In a country whose electricity matrix has traditionally been based on a low-carbon renewable source as hydropower, the global energy transition may unfold simultaneously through the entry of non-conventional renewable energy sources and the emergence of carbon-intensive fossil fuel-based generation technologies. Since 95% of La Guajira's coal is exported annually (S. López & Patzy, 2021), will it start to be consumed domestically to avoid stranding risks?

As for La Guajira, its development plan (2020-2023) does not contain concrete strategies to substitute the sources of income and jobs generated by the coal industry. But, as the Natural Resources Governance Institute (2021) mentions, progress has been made in designing strategies to improve the department's participation in the development of NCREs in its territory. One of the actions included in the aforementioned planning instrument is: *“Definir el esquema de participación de La Guajira en los proyectos de energía eólica desarrollados en nuestro territorio (creación de una empresa de economía mixta de energías para La Guajira).”*

The inclusion of a vision of energy transition in the regulatory frameworks, in which renewable energies and thermal coal coexist, is a source of constant tensions. In this regard, Jessenia Villamil stated the following

“Estas fuentes de energía, eólica y solar, nunca han sido planteadas como alternativa a la extracción de carbón. Nunca se ha planteado así. A pesar de la pérdida de mercados del carbón, la frontera extractiva sigue ampliándose de forma cada vez más acelerada en La Guajira. Un ejemplo de eso es el conflicto alrededor del arroyo Bruno. Allí se pretende desviar el arroyo, pero no han podido por la presión de las comunidades a Cerrejón.

(...)

Por la manera como se está dando la incursión de la energía eólica, creo que las energías renovables no podrían darse en horizonte posextractivo porque se están produciendo en lógica extractivista. Además, los parques eólicos funcionan sin personal o con muy pocos operarios muy especializados. No se puede desde punto de vista del empleo. Por eso debe mejor hablarse de reconversión económica integral del departamento, más que una reconversión de la fuerza laboral hacia las energías renovables.

(...)

Debemos superar la lógica de enclave. Nada hacemos cambiando el enclave del carbón por el enclave de la energía eólica.” (Informant C4, July 17, 2021).

In La Guajira, NCREs would then not be part of a path of decarbonization of the economy but rather of energization of extractivism. This paradox of Colombia’s energy transition⁴⁸ policy is connected to the decarbonization process in Chile. More than a withdrawal of coal, from the perspective of global climate action, what is happening in both places is more resemblant to a geographical *displacement* (Bouzarovski & Simcock, 2017) of its environmental costs.

An unfair coal phase-out is likely to happen in both cases. In La Guajira, due to the lack of planning regarding the possible local economic recession with subsequent job losses derived from a possible disarticulation of the existing productive chains. In Antofagasta, due to the absence of clear strategies to insert the sacrifice zones in a sustainable development path, after the retirement of the thermoelectric plants. The transition to renewable energies is occurring at a sped-up pace in the two places, but there are major governance issues regarding the decline of the incumbent coal industry. Such a decline is expressive of a complicated interplay of interdependencies at multiple scales that makes it difficult to conceive transformative alternatives from a bottom-up perspective.

3.2.3. The challenge of path dependence: addressing energy incumbency

Regional energy transition trajectories do not follow linear paths to a sustainable, low-carbon future. Far from it, the incumbent actors, structures, and high-carbon technologies have a determining weight on the definition of transition pathways. The case of coal in Antofagasta and La Guajira offers a glimpse into the challenges of breaking *carbon lock-ins* (Seto et al., 2016) in two structurally different situations. However, in both places the global energy transition is producing trends to the destabilization of the *coal energy landscapes* (Pasqualetti & Stremke, 2018). One of them is the penetration of NCREs. Nonetheless, this fossil fuel has dug already the path along which the transit towards these

⁴⁸ Although it seems to be a matter of political will alone, overcoming coal dependence is part of the complexities of the global energy transition (Svobodova et al., 2020). Even though the share of coal in Colombia’s GDP is scarcely around 1%, in La Guajira (near 40%) the economic reliance resembles that of countries dependent on this energy source. Ultimately, the effective pace of its phase-out is conditioned by more than just the intention to mitigate climate change.

new technologies is heading. On the Colombian side, such conditioning is rooted in the dependence of La Guajira's economy on extractive rents. On the Chilean side, it derives from the important share of coal-fired plants in Antofagasta's electricity generating capacity.

The geographically uneven and combined development of the energy landscape (Bridge & Gailing, 2020) produces an unstable coexistence between high-carbon and low-carbon energy sources. Such coexistence appears to extend indefinitely over time, although its instability. From a climate justice perspective, this hybridization poses a major challenge in terms of energy policy. Fossil fuels *path dependency* (Fouquet, 2016a) may lead to the replication of bad practices associated with the industry in the past. Identifying the regional and local socio-materiality of energy infrastructures becomes fundamental to insert new electricity generation technologies within a strategy to tackle the *incumbent energy regimes* (Bridge, 2018). Incorporating this concept into policy frameworks is required to provide a transformative horizon to the destabilization and reconfiguration of the energy landscape through the development of utility-scale NCRE projects.

Contrary to what has happened in other places, in Antofagasta and La Guajira NCREs are not rivaling the incumbent industries. Quite the opposite, they enter either to energize them (in La Guajira) or to complement them (in Antofagasta). Regional energy transitions are situated here in a non-linear and unbalanced perspective in the evolution of energy landscapes, producing a recombination of the old and the new that reinforces patterns of spatial injustice linked to energy production. Particularly in the Colombian case, it is alarming how the massive penetration of renewables means the projection of a new vector of territorial instability that reproduces pre-existing power relations with their consequent forms of socio-spatial segregation, marginalization, and exclusion of local communities. Moreover, their incorporation follows the logic of the extractive enclave under which the spatiality of the department has been configured.

The articulation and recombination of energy infrastructures and materialities across space will inevitably produce winners and losers. A just transition approach incorporated into the public policy can prevent thus a concentration of benefits, on the side of energy investors, and localization of losses, on the side of local communities (Carley & Konisky, 2020). Such a vision can contribute to boldly inserting these places on a sustainable development path.

On the side of La Guajira, this implies a bet for structural transformation of the regional economy in the long term, through a productive diversification strategy in which the electricity sector can take part by accelerating the speed of incorporation of new technologies in dialogue with host communities. On the side of Antofagasta, this means social and environmental revitalization of the communities affected by thermoelectric generation by creating new economic opportunities, enhancing local populations' capacities, and repairing any socio-environmental damage caused by coal plants in the past. This horizon seems possible but requires the engagement of stakeholders with increasingly divergent interests. And particularly in La Guajira, the window of opportunity for such concertation is increasingly narrower.

Finally, aside from the dilemmas of decarbonization and diversification of the electricity matrix, the expansion of national energy systems through renewables does not automatically result in a spillover of benefits to the territories producing this sustainable energy. The growing penetration of NCRE in regional energy systems certainly generates opportunities for structural change but also complicated energy policy challenges. Next, we shall see then how the enclave characteristics of the renewable energy investment model in Antofagasta and La Guajira can limit the capacity to address phenomena such as energy poverty. And, moreover, how it can contribute to reproduce situations that are essentially unfair and/or inequitable — jeopardizing the legitimacy and, therefore, the reliability of investments in the electricity sector.

3.3. Energy justice challenges: lights and shadows of energy policies

Utility-scale integration of NCREs in existing electricity grids tends to be justified either with climate change mitigation rhetoric or with technical claims regarding the improvement of electricity service. Notwithstanding, the latter benefits are not automatically conveyed to end users (in terms of affordability, household energy security, and so on). Indeed, a *decarbonization paradox* (Monyei et al., 2019) may be unfolding, whereby the potentially beneficial effects of increased renewables on electricity supply capacity could be constrained by structurally unjust or inequitable situations. At the regional level, the staging of this paradox and its multiple manifestations is a central topic of analysis in relation to the third relevant dimension for a just transition: *energy justice*. Insofar as the patterns of injustice and inequity that shape energy systems are spatialized, sustainable solutions must also be spatialized (Bouzarovski & Simcock, 2017) to achieve a just transition—whether in terms of policies or technologies. I will address this question in the following way: 1) describing the diverse manifestations of energy poverty in La Guajira and Antofagasta; 2) critically discussing the benefits of sustainable energy in renewable energy producing regions, in light of the distributional, procedural and recognition aspects of energy justice (Williams & Doyon, 2019); 3) examining the dilemmas of renewable energy at the territorial scale and, likewise, overviewing the sustainability challenges of ongoing transformations in regional energy systems.

3.3.1. The various faces of energy poverty

One alleged objective of the global energy transition is ensuring access to modern, cheap and reliable energy. Accordingly, SDG7 calls for “*affordable, reliable, sustainable and modern energy for all*”, constituting the material basis of the UN 2030 Agenda through its synergies and trade-offs with other SDGs and their targets (Fuso Nerini et al., 2017). The purpose of bringing electric power to millions of human beings who still lack of it becomes part of the framework of just transition discourses (Newell & Mulvaney, 2013). Hence, addressing energy poverty is a presupposition (often implicit) of the transformation of national energy systems.

Nevertheless, the concept of energy poverty does not have a univocal definition. It derives from the classic notion of *fuel poverty* (Boardman, 1991). Its meaning varies according to the variables used on its measurement, which acquire greater or lesser relevance depending on the differentiated geographical conditions of the territory where it is observed (Scarpellini et al., 2015). Despite of its relativity, indicators and dimensions associated with the concept are relevant to identify patterns of injustice in energy systems. And certainly, Latin America proves to be a fertile ground for exploring operational definitions of this concept. La Guajira and Antofagasta, in turn, can be used as places for capturing the diversity of manifestations and situations of deprivation that may correspond to energy poverty.

Energy poverty manifests itself, above all, through unequal access to electricity. While total coverage rates in both countries are high and approaching universal coverage⁴⁹, a significant access gap persists and constitutes a powerful challenge for ongoing energy transitions. What has been referred to in Latin America as the ‘last mile’ of electricity coverage (Informant B4, July 28, 2021) by policymakers still needs to be covered.

This access gap is dramatic in the case of La Guajira. According to the *Índice de Cobertura de Energía Eléctrica – ICEE 2018* (UPME, 2019b), this department was the third in Colombia with the lowest coverage rate— only behind Vichada and Vaupés, two isolated Amazonian departments, disconnected by land from the rest of the country. Electricity service reached only 58.81% of total households and just 25.06% of rural households in 2018 (Figure 3.13). It was also by far the territorial unit with the highest absolute number of households without electricity (81,960). This means that almost half of the department’s population lived disconnected from the power grid.

⁴⁹ The electricity coverage rate reaches 96.45% nationwide in Colombia (UPME, 2019b) and 99.6% in Chile (Ministerio de Energía de Chile, 2019).

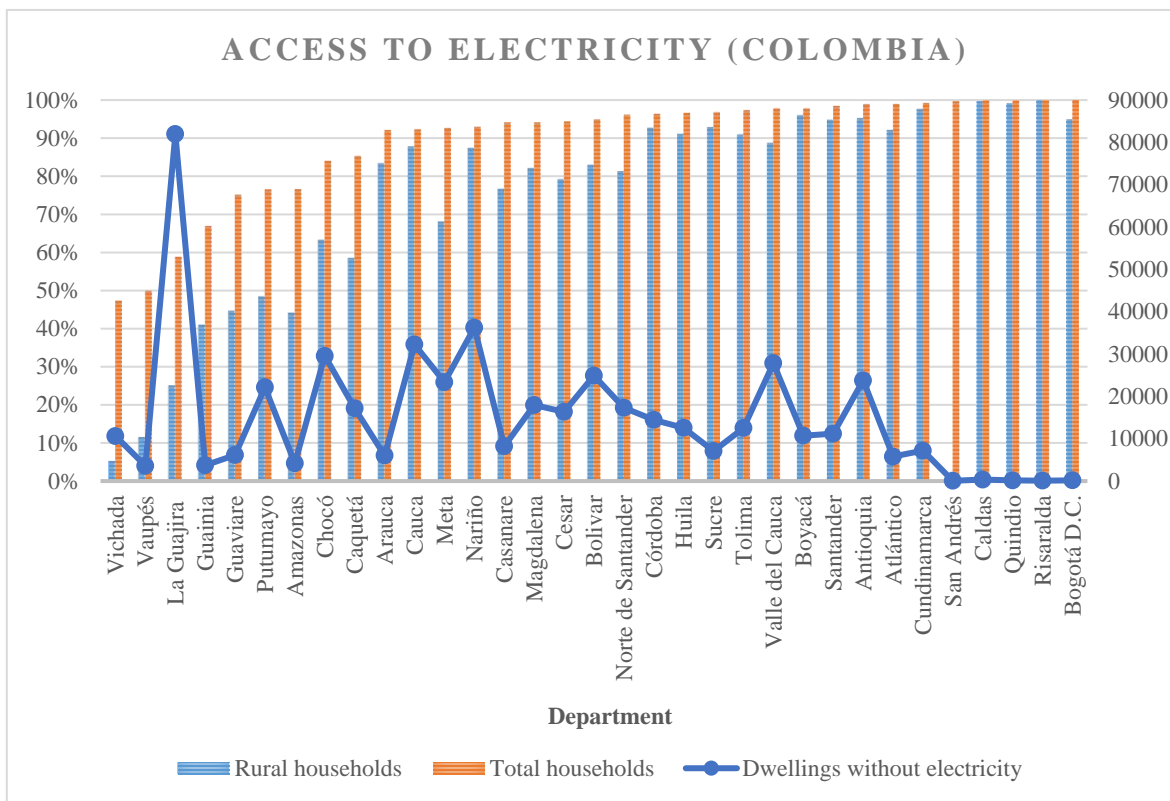


Figure 3.13. Access to electricity in Colombia by department (2018).
 Source: Author's elaboration with data from UPME (2019).

Moreover, this gap is unevenly distributed across the department (Table 6). While in Riohacha and the municipalities of Baja Guajira the coverage rate was above 80%, in a range closer to the national average, in Media Guajira and especially in Alta Guajira the situation was critical. In the municipalities of Uribia, Manaure and Maicao, the rural coverage rate was less than 20%. In fact, in Uribia the lack of access was so severe that only 5.63% of households had electricity service and the total number of homes without electricity amounted to 35,476, almost the same number as in the second department with the second-highest number of disconnected dwellings (Nariño). It is precisely in these desert municipalities in the north of the department where almost all the projected wind farms are projected to be built.

Table 6. Access to electricity in the municipalities of La Guajira.
Source: Author's elaboration with data from UPME (2019).

Municipality	Dwellings without electricity			Access to electricity (%)		
	Urban	Rural	Total	Urban	Rural	Total
Uribia	339	35,137	35,476	81.43%	1.76%	5.63%
Manaure	293	13,952	14,245	85.77%	16.76%	24.31%
Dibulla	93	2,739	2,832	91.76%	57.59%	62.67%
Albania	825	1,469	2,294	77.83%	41.17%	63.11%
Maicao	936	12,328	13,264	95.90%	17.49%	64.90%
San Juan del Cesar	707	1,519	2,226	90.42%	61.44%	80.33%
Riohacha	798	7,802	8,600	97.41%	44.02%	80.79%
Hatonuevo	182	638	820	93.36%	62.91%	81.61%
El Molino	107	153	260	92.97%	31.70%	85.10%
Barrancas	99	731	830	97.49%	75.02%	87.93%
Distracción	18	158	176	98.73%	90.27%	94.21%
Villanueva	177	167	344	96.88%	48.14%	94.26%
La Jagua del Pilar	-	30	30	100.00%	81.37%	94.64%
Fonseca	197	307	504	97.71%	80.98%	95.06%
Urumita	35	24	59	98.22%	57.14%	97.08%

In the case of Antofagasta, the access gap is quite smaller—almost nonexistent. First, the coverage deficit in Chile is less relevant than in Colombia. Additionally, most of the dwellings without electricity are concentrated in the regions of Los Lagos, La Araucanía, Coquimbo and BíoBío (Figure 3.14). In terms of access, it is worth noting that Antofagasta

has a significant rural coverage gap (21.8% of rural dwellings without electricity service in 2017), which made it the second department with the highest share of homes without energy in rural areas. In absolute values, nevertheless, this figure reached only 1,016 dwellings, distributed mainly in the communes of Calama (312), Taltal (254) and Tocopilla (217) (Ministerio de Energía de Chile, 2019). Similarly, these communes stand out for their importance in the regional energy system: while in Calama most of the NCRE projects registered between 2008 and 2021 are concentrated, in Taltal there are large wind farms operating and in Tocopilla large coal-fired power plants are spatially embedded.

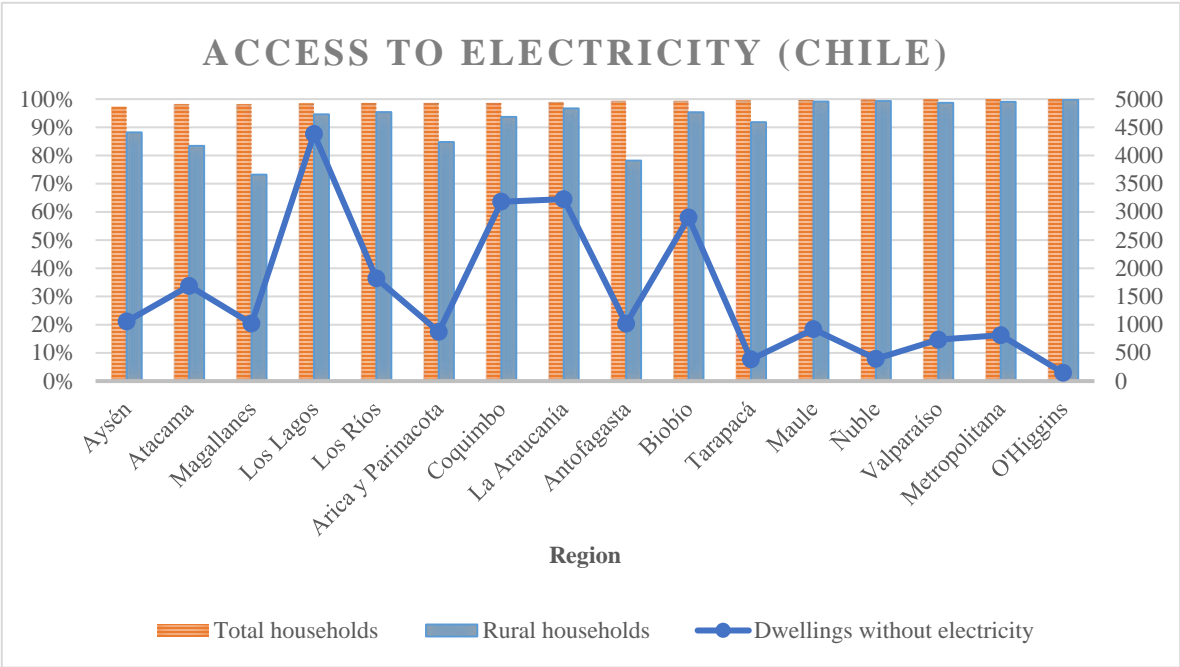


Figure 3.14. Access to electricity in Chile by region (2017).
 Source: Author's elaboration with data from Ministerio de Energía de Chile (2019).

The above figures show that, although energy poverty is notoriously evident in La Guajira in terms of access to electricity, in Antofagasta the problem acquires different features. And so do the challenges posed to overcome it. In this region, as in Chile in general, electricity tariffs are perceived as very high. According to the *Encuesta Barómetro Regional de Antofagasta 2020* (IPPUCN, 2021), high living costs are considered the main regional problem by most respondents (41%). Although the region has a lower average bill per regulated (residential) end-user than the Chilean average, tariffs are still perceived as high—which may produce other manifestations of energy poverty.

In that vein, Paz Araya mentioned that in Antofagasta *hidden energy poverty* phenomena (Karpinska & Śmiech, 2020; Urquiza et al., 2019) may occur, i.e., energy underconsumption due to the high proportion of expenditure it represents for the household. Concerning this, she stated:

“En Chile, la pobreza energética, más que un tema de acceso físico a la energía es un tema de equidad en relación con los ingresos. Hay un amplio alcance de la llamada pobreza energética oculta (es decir, que los hogares priorizan otros consumos sobre energía, se gasta menos en energía debido a la privación que significa tener poco presupuesto mensual). En esta situación se encuentra alrededor del 20% de la población del país.

(...)

En el Norte, el acceso es un problema para la población más aislada, pero se presentan fundamentalmente fenómenos de pobreza energética oculta, con una dimensión de calidad de los consumos energéticos. Por ejemplo, esto se relaciona con el confort térmico en la vivienda, debido al calor. En esta zona del país, es más difícil de visibilizar la pobreza energética, pero en efecto es un problema que afecta a la población.” (Informant C3, June 22, 2021).

Ultimately, energy poverty adopts a very different shape in Antofagasta and La Guajira. Yet, their energy transformation processes are similar in one key aspect: the search for social acceptance for the implementation of renewable energy technologies has pushed policymakers and players in the energy sector to create expectations around the achievement of greater robustness of the electricity system and, consequently, of overcoming persistent phenomena of energy poverty. As we shall see, the rapid expansion of renewables may contribute to the former without addressing the latter, and even to its detriment.

3.3.2. On winners and losers: uneven benefits of sustainable energy

Producing sustainable energy not only faces, as we have seen, enormous challenges and paradoxes from the point of view of environmental impacts and climate action. It also does so from the point of view of so-called energy justice. Energy justice is defined as “*as a global energy system that fairly distributes both the benefits and burdens of energy services, and one that contributes to more representative and inclusive energy decision making*” (Benjamin K. Sovacool et al., 2017). It thus constitutes a research agenda that makes it

possible to refocus social studies on energy on people rather than on purely technical aspects (Benjamin K. Sovacool, 2014c; Benjamin K. Sovacool et al., 2015). In the following, some critical considerations of the energy transitions in Antofagasta and La Guajira will be examined in light of the three tenets of energy justice: *distributional, procedural and recognition justice*. (K. Jenkins et al., 2016; Mccauley et al., 2013)

To begin with, both in Antofagasta and in La Guajira, the rapid integration of NCRE carriers to the energy mix may be leading to patterns of inequitable distribution of the benefits and burdens associated with the energy transformation. Hence, it is relevant to understand the meaning of the transition and its consequences from the aspects of distributional justice; that is, from the analysis of the temporal and spatial distribution patterns of the risks and benefits produced by the governance associated with this transition (K. Jenkins et al., 2016; Mccauley et al., 2013). This approach makes it possible to explore the inequalities that transition policies recreate and that are inscribed in the spatialities of low-carbon energy systems.

On the Chilean side, one of the delayed promises of the market-driven energy transition has been the reduction of electricity prices. This vision is incorporated in the *Política Energética de Chile – Energía 2050*, the long-term energy planning document, and is based on the premise that the country's advantage in terms of natural resource endowment for power generation with renewable sources can reduce the volatility of the spot price of electricity. This would mainly result from the substitution of fossil fuels in electricity generation. As Chile is a net energy importer, the use of fossil fuels in the electricity system is stated as the main cause of high electricity prices in the country. Theoretically the massive deployment of variable renewable energies -together with other energy generation and storage technologies- is expected to reduce tariff burdens, especially for regulated end users (residential).

Nevertheless, when correlating the penetration of NCRE in the electricity matrix with the fluctuation of the average electricity price from 2008 to 2021 (Figure 3.15), the trend differs from expectations. Similar to Germany, Australia or California (Monyei et al., 2019), no significant reduction in electricity prices is found in Chile as part of the benefits of an accelerated expansion of the renewables industry. While such a finding is one of the critical elements of the balance of the renewables boom in Chile, as acknowledged by the *Seremi de Energía de Antofagasta* (Informant A4): “*Estos beneficios de las energías renovables en*

términos de seguridad, calidad y confiabilidad del suministro eléctrico, aún no se reflejan en la cuenta de la luz para las personas.” This is a cross-cutting concern for the different stakeholders of the energy system, as electricity prices in the country are consistently in the range of the highest in South America (OLADE, 2020a).

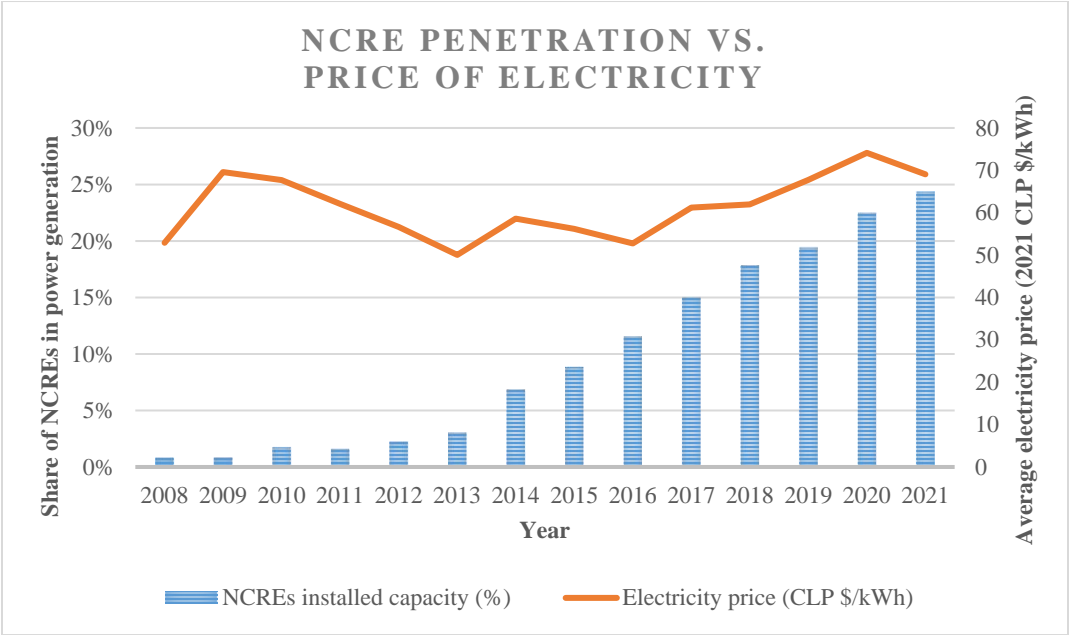


Figure 3.15. Penetration of NCRE sources and average electricity prices in Chile (2008–2021).
 Source: Author's elaboration with data from CNE (2021).

Although market-oriented transition policies have failed to reduce electricity tariff prices, this limitation does not prevent the low-carbon energy transition from producing other kind of benefits for some economic agents. As stressed by Furnaro the NCRE boom is partly explained by the urgency of the mining industry (with an enormous weight within the country’s economy) to find a long-term structural solution, at the energy system level, to the price volatility and insecurity in the fossil fuel supply chain. Under this critical perspective, renewables would provide a *socio-ecological fix* (McCarthy, 2015) for the process of capital accumulation in Chile, by allowing the oxygenation of the Chilean economy with new investment flows, reducing the concentration of the electricity market and relegitimizing state policies in the environmental arena.

All the above can be seen in the Second Region. As the epicenter of Chile’s mining economy, Antofagasta reflects the industry’s main trends. A functional and spatial coincidence between the mining deposits and the spatial distribution of the new energy infrastructures can also be

observed, in line with the idea of the *spatial fix* (Furnaro, 2020) that non-conventional renewables provide to a regional economy based on minerals extraction. So, as no automatic spill-over effect of NCRE benefits to end-users of energy occurs, the benefits tend to be concentrated in the short term among the main regional economic agents, especially within the mining industry. An example of this is the case of Antofagasta Minerals, the main Chilean private mining group.⁵⁰

In Colombia, the price effect of renewables cannot be assessed because, on the one hand, their share in the country's electricity generation remained insignificant in 2021 (less than 1%) (XM, 2021) and, on the other hand, the predominance of hydro with thermal backup based mainly on gas extracted mainly domestically avoids the contingencies of energy-importing countries such as Chile. In La Guajira, distributional considerations are mainly related to issues of access to electricity. According to UPME (2019) calculations in the *Plan Indicativo de Expansión de Cobertura de Energía Eléctrica 2019-2023* (PIEC)⁵¹, the required investment to fill the existing access gaps in the department exceeded 1.5 trillion Colombian pesos (tripling the amount of the next department with the highest investment requirement). Once again, 80.02% of this amount was concentrated in three municipalities of *Media* and *Alta Guajira*: Maicao, Manaure and, fundamentally, Uribia (where 99.33% of the unserved dwellings should be covered with individual solutions and isolated microgrids, which makes electrification more expensive).

Regarding this issue, in a column published on August 21, 2021, Colombia's Deputy Minister of Energy, Miguel Lotero, referred to La Guajira as the "*joya energética de Colombia*"⁵². He further indicated that, between 2018 and 2021, electric power service was provided to 2,360 homes and 6,600 more homes were expected to be connected in the short term. Put in

⁵⁰ On the one hand, this company has promoted large-scale NCRE generation projects such as the *Conejo Solar* photovoltaic plant in the municipality of Taltal. This project was conceived as one of the solutions to lower the OPEX of *Los Pelambres*, the largest mining operation of this company. On the other hand, it has been a pioneer in the industry's transition to renewables. With a PPA signed with Colbún, it made *Minera Saldívar* -located in Antofagasta- the first Chilean mine to use only renewable energies to produce copper from 2020 onwards (Antofagasta Minerals, 2020).

⁵¹ The PIEC is a document prepared by the UPME with two purposes: 1) To identify the energy service needs, 2) To quantify the investments to be made to achieve the universalization of the electric energy service.

⁵² El Heraldo. (2021). *La Guajira, la joya energética de Colombia*. Diario El Heraldo de Barranquilla. <https://www.elheraldo.co/columnas-de-opinion/miguel-lotero-robledo/la-guajira-la-joya-energetica-de-colombia-columna-de>

perspective of the results yielded by the ICEE 2018 (which form the basis of the PIEC 2019-2023), this meant that in three years just 2.88% of the dwellings without service in the department were effectively covered (with the possibility of jumping to more than 10% before the end of the government's term in 2022). This glacial pace of progress towards universal access to electricity contrasts with the frenetic pace for the development and entry into operation of wind farms.

Regarding this, Informant A2 of the Ministry of Mines and Energy mentioned:

“El cierre de brechas de acceso en zonas no interconectadas (ZNI) avanza de forma más lenta. Por recomendaciones de la Misión de Transformación Energética (MTE) se está avanzando en un marco más estructurado para las ZNI. En particular, se está mirando la posibilidad de asignar a un operador las ZNI. El marco regulatorio se está modernizando, aunque la tecnología va más rápido que la regulación. Por eso uno de los objetivos prioritarios del Ministerio y de la MTE es responder a la pregunta: ¿por qué no se están cerrando las brechas de cobertura en lugares como La Guajira?” Informant A2 (June 10, 2021).

In the private sector, there are several explanations for the persistence of these access gaps. A first consideration was given by Informant B2, who is engineer of *Empresa de Energía de Pereira* (one of the partner companies of the consortium in charge of the network operation in La Guajira). He stated:

“Sí está en la mente de los players del sector llegar a estas zonas. El problema no es de generación con energías renovables sino de transmisión. Hay un gran reto de lograr una mayor transmisión para darle mayor robustez al sistema. (...) Y los problemas de transmisión en La Guajira afectan todos los eslabones de la cadena, incluida la distribución del servicio. Ejemplo de ello es lo que pasa con la Colectora. Por eso es tan importante mejorar esto para resolver problemas de pobreza energética.

Otro problema grande es la lejanía y dispersión de las viviendas sin servicio. Se necesita demasiada inversión en infraestructura que deben hacer los privados para suministrar energía eléctrica a los usuarios. Hay una regulación de la CREG en ese sentido. O sea que sí hay incentivos, pero son nuevos.” Informant B2 (June 18, 2021).

From the perspective of an Asian multinational company with major investments in the sector, Informant B3 added the following:

“Cubrir esta brecha es complicado porque requiere otra infraestructura, diferente a la de los parques de generación. Requiere líneas de distribución, subestaciones y transformadores de distribución, en fin... Yo diría que ése es un vacío de la política de transición energética, que no conecta la ampliación de la generación con renovables con el cierre de la brecha de cobertura de energía eléctrica. Por eso sigue habiendo tantas dificultades para implementar los planes de electrificación rural. Nadie se quiere meter en eso. ¿Quién va a pagar eso? ¿Por qué no hay convocatorias de la UPME para conexión de proyectos de zonas no interconectadas? ¿Por qué no hay conexión de los sistemas de transmisión regionales para zonas no interconectadas?” Informant B3 (July 13, 2021).

Market regulations are thus reconfigured toward the development of utility-scale generation infrastructure, but not for connecting households without electricity. The rush of investors and government institutions to produce positive results in meeting the goals of inclusion of NCRE carriers in the electricity matrix seems to leave behind the enabling conditions to close the dramatic access gaps in La Guajira. A potential distributional injustice is, then, that tax incentives included in the regulatory framework to encourage the use of clean energy favor the big energy players and, more specifically, the big Incumbents, the ones who can retain these benefits. But this is not reflected in better energy supply conditions for the communities impacted by large-scale generation and transmission projects. In these areas, public and private investments for the development of regional transmission system infrastructure (STR) and local distribution systems (SDL), as well as small-scale distributed generation solutions, arrive in dribs and drabs.

On this issue, Yordan Stiven Cruz (Informant B1) of the company O3 Smart Cities, a small-scale PV solutions supplier, said:

“Los incentivos tributarios del gobierno van a darle más herramientas a los grandes. Está bien que les apuesten a los grandes para cumplir metas, pero si hablamos de transición energética y no sólo de diversificación, la apuesta no puede ser sólo instalar fuentes renovables, también es cambio cultural y consumo consciente. Más que apoyar a los grandes, es también concientizar a la gente del común.”

La gente no se está beneficiando de los grandes proyectos. Lo que pasa en lugares como La Guajira es que la gente sólo se beneficia al momento de la construcción de los parques solares o eólicos, pero los trabajos son estacionarios debido a que estos parques son desatendidos en cuanto a su operatividad. Los grandes proyectos no generan mucho empleo. Generan más empleo las pequeñas empresas que se dedican a este tema.” Informant B1 (May 20, 2021).

Indeed, the benefits of transitions to NCRE are concentrated in the big energy players and investors in Chile and Colombia, a trend perceived in different ways by informants in the three clusters of stakeholders. Such dynamics reveal *energy path dependency* (Stein, 2017) phenomena that reveal the decisive influence of incumbent actors, technologies and regulations in the transformation of energy systems. The *institutional stickiness* produced by this influence of incumbents slows down the pace of the overall transformation of the system and narrows the transformative scope of the implemented policies. In a just transition horizon, this poses a governance challenge to move in the direction of democratizing the energy system (Healy & Barry, 2017) and to limit any tendency towards further concentration of the electricity market.

A final cross-cutting consideration that was mentioned by several informants (especially from civil society) as a potential vector of distributional injustice is the question of the impacts of NCRE expansion on the regional labor market. Although more aligned with the classical notion of just transition and thus to the risks of massive job losses on account of decarbonization (Kern & Rogge, 2016; Newell & Mulvaney, 2013), this concern is not expressed in terms of *creative destruction* (Aghion et al., 2020) vis-à-vis incumbent energy regimes—as we saw in the section on climate justice⁵³. On the contrary, in La Guajira as in Antofagasta, the concern regarding labor market dynamics is mainly expressed in relation to the quality and type of jobs created.

In both regions, the accelerated expansion of renewables has come hand in hand with promises of massive job creation. In the Caribbean region of Colombia, the energy transition

⁵³ Since these are not competing activities, at least in La Guajira, the innovation of energy carriers does not generate a scenario of creative destruction of the jobs created by the coal industry.

policy of the government of Iván Duque projects the creation of 11,700 jobs⁵⁴. Meanwhile, in Chile, the economic reactivation policy of the government of Sebastián Piñera was supposed to create 3,200 jobs in the construction of 24 renewable energy projects in Antofagasta⁵⁵. However, as expressed by informants from the three clusters of stakeholders, the fact that NCRE projects operate as unattended plants, besides the highly qualified profile (often of foreign origin) of the personnel required to put them into service, means that the jobs created are temporary and do not correspond to the labor needs and competencies of the local population.

Furthermore, this concentration of the benefits of regional energy transitions is related to considerations of possible procedural injustices. Procedural justice “*refers to the means through which different stakeholders are involved in decision-making*” (Sareen & Haarstad, 2018). From this perspective, the fairness of energy processes and equitable opportunities for participation of all stakeholders and, in particular, of the most disadvantaged are as important (Mccauley et al., 2013). Concern for procedures is as relevant as concern for outcomes, as both aspects are interrelated. As seen in cases such as wind energy development in Mexico (Avila-Calero, 2017; Juárez-Hernández & León, 2014; Mejía-Montero et al., 2020), procedural injustices can indeed undermine the social acceptance of renewable generation infrastructures and, therefore, the materialization of the objectives of incorporating NCRE carriers into the energy matrix.

In the case of Antofagasta, the longer trajectory in the implementation of various NCRE technologies - as well as the history of socio-environmental conflicts linked to electricity generation - has resulted in experience-based learning. In this regard, Javier Obach and Aldo Erazo of Chile’s Ministry of Energy commented

“La estrategia de transición justa del Ministerio de Energía fue construida con muchos actores: sindicatos, académicos, ONG, etc. Lo más importante de este proceso ha sido saber

⁵⁴ El Herald. (2021). *La Guajira, la joya energética de Colombia*. Diario El Herald de Barranquilla. <https://www.elheraldo.co/columnas-de-opinion/miguel-lotero-robledo/la-guajira-la-joya-energetica-de-colombia-columna-de>

⁵⁵ Reporte Sostenible. (2020). *Industria de las energías renovables en Antofagasta será “el motor” de la reactivación económica sostenible del país*. Reporte Sostenible. <http://reportesostenible.cl/blog/industria-de-las-energias-renovables-en-antofagasta-sera-el-motor-de-la-reactivacion-economica-sostenible-del-pais/>

escuchar para desarrollar una mejor política pública. Es imprescindible equilibrar y escuchar a distintos actores de forma coordinada y ordenada. Es por eso que se tienen divisiones especializadas para llegar a estos actores. Uno de los grandes aprendizajes en este proceso ha sido la importancia de la validación social del proyecto.

(...)

Nuestra regla número 1 es ir al territorio, escuchar las demandas. Trabajamos con una lógica de learning by doing. No siempre sale bien, pero las mesas de trabajo público-privado nos han demostrado la importancia de que todos los actores pongan sus opiniones sobre la mesa. No siempre esa participación y esas opiniones son vinculantes, pero se trata de que todo se haga con procesos participativos, transparentes y abiertos.

(...)

En el Ministerio de Energía, se somete a juicio toda la política pública. La participación siempre es insumo relevante para que los tomadores de decisiones puedan tomar decisiones de la manera más informada posible.” Informant A3 & Informant A4 (June 17, 2021).

This participation process therefore starts with the recognition of relevant stakeholders and sets deadlines and modalities for receiving input to the policy (Figure 3.16). Yet, this conception of participation reduced to a merely consultative function and the idea of just transition incorporated in the energy policy generates dissatisfaction among some civil society actors. The former generates doubts about the fairness of the process because the consultative and non-binding nature of the contributions during the participatory phase places the burden of decision-making, in first and last resort, on the centralized policymakers themselves.

In this respect, Paz Araya noted:

“Yo mencionaría dos elementos críticos: uno, que la estrategia de transición justa se reduce a una visión clásica, de compensación económica y laboral para los trabajadores del sector, pero, en el fondo, se está compensando a las empresas grandes. El tema de la pérdida de empleos por la descarbonización es de tal magnitud, pues las centrales a carbón operan con poco personal. Es miope reducir los temas de justicia energética sólo a un tema económico. Ése es un primer error.

Y dos, que invisibiliza otros problemas. Las zonas de sacrificio existen por problemas de planificación. Este enfoque invisibiliza la causa porque aparenta que el problema de los impactos sobre la población y el medioambiente es de la tecnología y no de la mala

planificación. (...) Se debe avanzar hacia un sistema más distribuido en todos los sentidos (...) No basta sólo con cambio tecnológico.” Informant C3 (June 22, 2021).

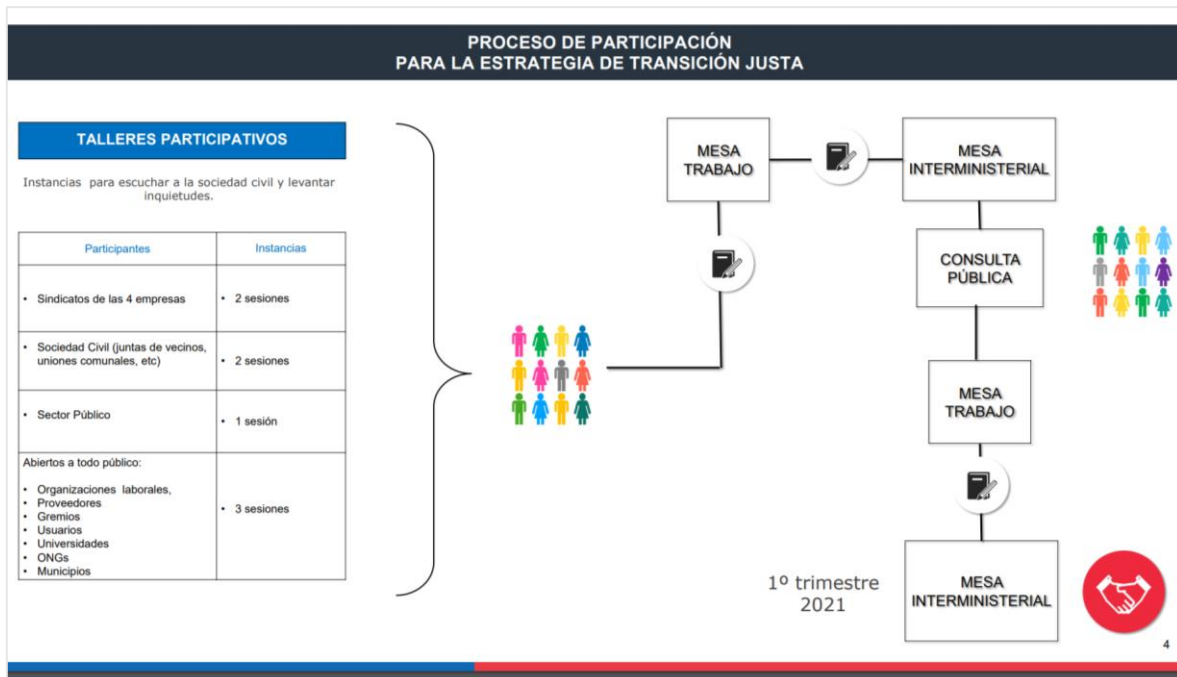


Figure 3.16. Participation process for the design of the Just Transition strategy in Chile.
Source: Ministerio de Energía de Chile (2020b).

The latter is connected to what was mentioned by Claudia Fuentes:

“Es de gran importancia vincular la transición energética y la transición justa a temas de derechos humanos. Debe discutirse el tema de que contaminación asociada a la generación de energía vulnera los derechos humanos. Hay que localizar la discusión. Responder a problemas globales, pero también, sobre todo, a problemas locales. (...) Esto requiere pensar la transición energética de otra manera. Podrían crearse mesas entre empresas y comunidad con el Estado como mediador, para garantizar el respeto entre las partes.” Informant C2 (June 17, 2021).

This consideration implies that, even in scenarios where formal inclusion operates through procedural or distributional means, there may be a lack of recognition that generates perceptions of injustice. This is happening in Antofagasta: the communities of the sacrifice zones are included in the consultative processes, but the lack of recognition operates through the refusal to repair the social and environmental damages caused by the coal-fired power plants. In other words, this misrecognition shows that the rights of these populations are not

adequately restored in order to lay the foundations to prevent the repetition of similar patterns of injustice due to the future implementation of energy policy (Heffron & McCauley, 2017).

In the case of La Guajira, this conjunction between procedural injustices and recognition injustices is even more evident and threatens the stability of the entire NCRE investment model in Colombia. On the one hand, a first aspect of procedural/recognition injustice is the functioning of the prior consultation mechanism. As mentioned in a previous section and as evidenced by González Posso & Barney (2019), the distortion of the consultations with the Wayúu communities is triggering conflicts between the clans and the companies as well as between some clans and others. In a highly unstable social context where illegal flows and armed actors circulate, the lack of recognition is a time bomb that threatens the legal security of investments in renewables.

An obstacle to tackle this challenge is the vision of territory of the private sector and energy companies as opposed to that of the ethnic communities. From very different personal experiences, informants B1, B2 and B3 alluded at different moments of the interviews to what, in their opinion, was stopping the advancement of the projects. Words such as “*complicados*”, “*jodidos*”, “*dificiles*”, among others, were often repeated throughout the interviews to refer their perceptions of Wayúu attitudes towards energy projects. But, as Informant B3 acknowledged, this perceived difficulty in establishing effective communication is due to a lack of knowledge of the Wayúu’s deep-rooted identity relationship with the landscape.

Where project developers see a barren desert, indigenous people see places that, in turn, are marks of collective identity and differentiation between family clans. These places, which can be *Prohibidos*, *Encantados* or *Comunales* (Ministerio de Cultura de Colombia, 2021) and be delimited by cemeteries or grazing sites, are mostly found in the installation sites of large wind farms. Without going into details, this socio-cultural difference in the perception of the landscape of La Guajira produces an important asymmetry of expectations with respect to energy projects. This lack of knowledge leads to the impossibility of establishing *multistakeholder dialogue* (Hemmati, 2002; Todorow, 2016) as the cornerstone of regional energy governance. At the moment of interaction between companies and indigenous peoples, and therefore of negotiations between these companies and local communities, the

procedures tend to become entangled and even suffer a succession of setbacks after having almost been completed. If the absence of clear procedures to involve local communities in the territorial delimitation of energy infrastructure persists, and as long as due process continues to be disregarded during prior consultations, backlashes against the installation of wind turbines and transmission lines will likely intensify.

This expectation gap around energy projects puts their acceptance at risk and, hence, threatens to result in the closure of financing channels and may even lead to stop ongoing projects. According to Álvaro Mejía of the IDB, the view of development banks is as follows:

“El banco tiene unas salvaguardias ambientales y sociales en cada proyecto en el que se vea involucrado. Cada vez más los desarrolladores y el país voltean a mirar estas salvaguardas, así el BID no esté metido de lleno en los proyectos. Muchas veces los proyectos se piensan desde las capitales, pero hay que tener en cuenta lo que quiere la comunidad (si la comunidad quiere energía o no). (...) El tema de las salvaguardias es que sea la comunidad la que identifique las necesidades y pueda efectivamente requerir el proyecto. Que salga desde la comunidad y no desde un escritorio en las ciudades principales.

(...)

En la visión del BID, hay siempre un aspecto social bien marcado de incluir participación de la comunidad. Siempre. Cuando el banco ve impacto negativo muy fuerte del proyecto, prefiere poner en pausa el proyecto. El problema es que la comunidad compre el proyecto desde su concepción. El banco blindo los proyectos con estas salvaguardas. El banco cuida mucho sus proyectos, sus iniciativas, con estas salvaguardas sociales y ambientales, en su sostenibilidad.” (Informant B5, September 1, 2021).

The role played by the public sector is another component of this pattern of recognition/procedural injustice. It is worth mentioning that a retribution scheme is being implemented in La Guajira in which 1% of energy sales will be allocated to projects defined in a participatory manner by the communities. As Mónica Gasca said: *“Queremos obras que le queden a la comunidad, que la plata de las regalías de los proyectos de energía no se siga perdiendo.”* (Informant A2, June 10, 2021). Given the history of corruption in the handling of public finances in the department, this scheme represents an apparent distributional opportunity to redistribute the benefits of the energy sector more equitably. At the same time,

it is presented as an alternative to ‘imposing’ the provision of electricity as a solution to the host communities of power projects.

Yet, as Jessenia Villamil of the NGO CENSAT-Agua Viva emphasized, this appearance of inclusiveness demonstrates a lack of awareness from the policymakers of the high percentage of households with UBN in the department and the absence of ambitious policies for providing public services to the communities:

“La primera preocupación no es la energía eléctrica porque la primera preocupación es el agua. Puede que no sea percibido como una necesidad básica principal porque tienen otras necesidades básicas insatisfechas irresueltas mucho más graves y urgentes. De hecho, la energía eléctrica podría facilitar acceso al agua, entonces no es aislamiento por voluntad ni falta de voluntad. Las comunidades están aisladas por la pobreza. Si a ellos les preguntaran si quieren tener energía eléctrica para diferentes usos, ellos dirían que sí.

(...)

Aquí radica la importancia del vínculo agua-energía. Lo más artificial es la bomba eléctrica, pero el vínculo es mucho más profundo. El agua se necesita para obtener la primera fuente de energía: el alimento. La gente que vive o que vivirá al lado de los aerogeneradores no tiene acceso a la electricidad ni siquiera para consumo más básico.” (Informant C4, July 17, 2021).

The experience of Antofagasta and La Guajira in the transformation of their energy systems shows that the production of sustainable energy can (re)create (often spatialized) patterns of unfair and/or inequitable distribution of benefits. However, while the distributional issue raises concerns, there are also procedural and recognition considerations that demonstrate the limited transformative scope of energy transition policies.

3.3.3. Renewable energy dilemmas

The urgency expressed in the policy frameworks to make leaps in the incorporation of NCRE into the electricity matrix of Chile and Colombia collides with the requirements of a just transition that, indeed, attempts to avoid accentuating pre-existing inequalities or fueling new social conflicts. This irreducible dilemma between urgency and justice frames the energy transitions in the Global South (Kumar et al., 2021). This tension is a synthesis of the multiple contradictions between energy transition policies and their socio-materiality,

between the macro view of the transition and its emerging territorial realities. At the regional scale, in that sense, this main dilemma is broken down into a plurality of dilemmas that highlight the complexity of the socio-technical, political, and cultural challenges involved in building a low-carbon future in Latin America under a perspective of equity and justice.

Unlike environmental justice and climate justice, energy justice provides a critical point of view, albeit on the fringe of activism. Coming from an academic tradition more focused on a holistic understanding of the energy system than on contesting the economic system and the power relations that condition energy use, energy justice has the virtue of offering a conceptual framework and analytical tools to reveal complexity and develop reflexive governance mechanisms (K. Jenkins et al., 2017; Wood & Roelich, 2020). As such, the dilemmas posed are not irresolvable in nature, nor do they express direct antagonisms. I decided to select three to illustrate the above.

The first dilemma refers to the scale of the transition. A tension between large-scale centralized projects and small distributed solutions is evident in the territorial trajectory of La Guajira and Antofagasta. The emphasis of the regulatory frameworks is on generating the enabling conditions to accelerate the incorporation of NCRE carriers to the electricity mix, leaving aside the encouragement of distributed generation solutions at local scale. The business model based on the massification of utility-scale generating capacities thus favors industrial-scale energy production to feed energy-intensive industries, some of which are hundreds of kilometers away from the energy production sites. From this derives the limited scope of large-scale NCRE in mitigating energy poverty-related justice issues in rural and remote communities (Banerjee et al., 2017). The absence of an adequate (and concerted) balance between both scales generates frictions between stakeholders that, at least in the case of La Guajira, may lead to the rise of socio-environmental conflicts in the short-term.

The second dilemma refers to the pace of transition. In relation to the above, a spatialized look at the problem of the temporal dynamics of transitions brings other connotations to the table. Whereas at the global scale resistance to a rapid transition comes from incumbents with powerful economic interests (e.g., the coal or oil industry) (Kern & Rogge, 2016), at the territorial scale, opposition to speed up a transition based on large-scale NCREs tends to come from host communities and other disadvantaged stakeholders. Accelerating the

transformation of the electricity system without taking into account the governance-related issues that may arise risks overcoming “carbon lock in” at the price of “energy injustice lock in” (Healy & Barry, 2017). A poorly governed rapid transition may end up creating an energy future of environmental sustainability but socio-spatial injustice that, instead of restoring the rights of the communities affected by fossil fuels, ends up aggravating the burden of their marginalization. Such may be the case with the population of the Antofagasta sacrifice zones or the ethnic communities of La Guajira.

The third dilemma refers to transition planning. Combining insights on procedural and recognition considerations, this last axis of analysis puts into perspective the tension between energy planning executed with techno-managerial criteria, as a post-political vision that assumes the neutrality of technologies, and a participatory approach, which puts at the center an articulation between the needs of the system, the priorities of the actors and the technical diagnoses that emerge bottom-up. Ongoing processes have shown that participation tends to be deprived of decision-making capacity and, in the end, depoliticized technical criteria prevail. As long as centralized decision-making is maintained, the concentration of benefits in a handful of market players will presumably remain. This dilemma thus opens the possibility of rethinking governance not merely as an articulation of institutions but as a possibility for the formation of organizations and communities (Gailing, 2018) around the decentralized reconfiguration of energy systems. After all, *“el paradigma de la descentralización implica una desconcentración a nivel tecnológico, institucional y de toma de decisiones, lo que requiere, a su vez, de una articulación que dé cuenta de las prioridades y diagnósticos que emerjan desde los mismos territorios.”* (Araya J. & Zamora Z., 2021).

In sum, addressing these dilemmas in practice poses a looming challenge in order to avoid not only making invisible and reinforcing the injustices and inequalities that operate through energy systems (Bouzarovski & Simcock, 2017) but also to jeopardize the long-term stability of the projects and of the investment model that Chile and Colombia have managed to build. A rapid transition can not only be a profitable and desirable business from the point of view of climate action (Newell, 2020b), it can also become a transformative force towards territorial reordering of energy spaces under a logic of breaking the patterns of socio-spatial injustice. Although this permanent tension and imbalance is inherent to the very idea of a just

transition (Newell & Mulvaney, 2013), incorporating this perspective into the study of ongoing transformations in the regional energy systems of Antofagasta and La Guajira serves the purpose of producing evidence grounded in experience. Ultimately, such a perspective can illuminate the development of policies to address the (re)production of distributional, procedural and recognition injustices through a deep understanding of spatial formations and without leaving it all to the mercy of market forces.

4. Conclusions

By way of conclusion, this section provides a closing reflection to the research. On the one hand, the main findings will be summarized with the purpose of solidifying the comparative approach. Since the formulation of the hypotheses was not done in a confirmatory manner, but rather as a definition of theoretical starting points for the empirical research, they will not be discussed separately here. Instead, the main similarities and differences of the case studies will be systematically summarized according to each of the research objectives. On the other hand, some final reflections will be formulated in prescriptive terms on the relevance of incorporating this type of methodological and theoretical approaches in the construction of energy policy, as well as some general notes to steer the ongoing energy transitions in Andean economies along a path of sustainability, equity and justice will be presented.

First, it is worth mentioning that the energy transitions of Chile and Colombia follow fundamentally divergent paths. Despite being open market economies with similar macroeconomic fundamentals and reliance of their external sector on the production of the mining-energy sector, their energy profiles and trajectories differ significantly. While Chile is a net energy importer whose economic growth pattern is relatively coupled to the growth of energy consumption and particularly that of electricity, Colombia is an energy exporter in the form of energy commodities (coal and oil, to be precise). As such, the energy-intensive nature of the development model of the former is reflected in the inherent growth of its carbon intensity, in contrast to the unintended low emissions of the latter—in which the energy sector does not represent the main source of GHG emissions.

Faced with the different challenges and opportunities presented by the global energy transition and considering structural constraints of their economies, both countries have embarked on their own transitional paths towards renewable energies. Chile started first. Faced with the growing energy insecurity caused by the cut-off of natural gas supplies from Argentina in 2004, this country began an accelerated search to diversify its energy sources. At the same time, two opposing visions crystallized: one that advocated the massive use of coal, an efficient but carbon-intensive energy source; the other that defended a pioneering bet on NCRE sources, even before the LCOE of these technologies reached a competitive

range with respect to fossil fuels. Since 2008, with Law No. 20.257, which established NCRE generation goals, Chile set out on a path that led it to become the protagonist of an ‘energy revolution’ considered by various actors on the international scene as a role model to follow on the road to clean energy.

For its part, Colombia was a latecomer to this trend. In 2014, it introduced Law 1715 seeking to attract investment flows and take advantage of the business opportunities presented by an increasingly competitive market. The favorable economic circumstances due to the sharp drop in the LCOE of variable NCRE (wind and solar), added to the impetus given by the commitments made by Colombia in scenarios such as COP21 and subsequently in the context of the Paris Agreement governance, triggered the start of the transformation of its electricity system. In this case, diversification of sources did not appear as a solution to strengthen the energy supply or to reduce the carbon footprint of electricity supply, but rather as a medium-term climate adaptation strategy in the face of the vulnerability posed by the system’s dependence on hydro and, above all, as a strategy for the country’s international insertion.

Both countries have, therefore, very different degrees of progress in the incorporation of NCRE sources into the electricity matrix. However, they are similar in that they have built a solid energy governance with consistent legislation, flexible regulatory frameworks and legal stability that has made it possible to attract the attention of investors, development banks and international organizations. Thus, both countries have been highlighted in international rankings such as the ETI and Climatescope, as well as in international forums such as the UN High-level Dialogue on Energy or the 12th Clean Energy Ministerial. The two countries have managed to build what Alfonso Blanco Bonilla, executive secretary of OLADE, called an “*ecosystem of investment in renewables*” that combines the following three elements: a competitive and fundamentally private electricity market, a flexible and adaptive policy and regulatory framework, and favorable financial and macroeconomic conditions for investment. The above-described elements occur in an environment of depoliticization of the public discussion on energy policy, in which technical criteria seem to prevail at the time of making strategic decisions concerning system planning.

Nevertheless, this post-political image tends to obscure the emerging tensions in the processes of energy system transformation at the territorial scale. This is the case of La

Guajira and Antofagasta, the renewable energy producing regions par excellence in Colombia and Chile respectively. In these two geographically peripheral places with desert landscapes and an exceptional renewable natural resource endowment for electricity generation, most of the investment in large-scale projects is being concentrated. Although once again the regional case studies show a non-synchronous evolution of both systems in transition, the emphasis of energy transition policies on meeting ambitious goals of incorporating NCRE into the electricity matrix is generating accelerated socio-spatial transformations with comparable impacts. The new energy spaces are thereby a lens through which to observe the challenges of justice and equity of the transitions underway in the main Andean economies.

In this sense, connecting the conceptual tools of geographic political economy with a thematic framework of just transition was extremely useful to understand the challenges of regional energy transitions from a multi-scalar, multi-level and multi-stakeholder perspective. This approach allowed me to use various social science tools applied to energy research without the need to inscribe my point of view in a single discipline. Together with the combination of research techniques and sources of information, this allowed me to overcome the methodological constraint of not being able to access the field in person. The void left by the absence of direct observation of the space was filled by the attention paid to triangulation between methods and within each method.

I will now proceed to present the findings regarding the regional case studies comparison in an orderly fashion, grouping the emerging themes in the empirical research under the three scholarships integrated in the just transition framework: environmental justice, climate justice, and energy justice. First, in terms of environmental justice, the accelerated transformation of the energy landscape in both regions is producing consequences that raise doubts about the environmental sustainability of large-scale expansion of NCRE carriers in the long haul.

In Antofagasta, this consideration can be found in the frantic search to modify land use to pave the way for generating renewable energies by taking advantage of the extraordinary potential (especially solar radiation) provided by the Atacama Desert. The allocation of thousands of hectares for electricity generation raises concerns, even among policy makers,

about the risk of encouraging the creation of "green sacrifice zones" in the foreseeable future. Based on the notion that the desert ecosystem is susceptible to limitless exploitation, the enthusiasm for exploring innovative energy technologies poses a major planning challenge to avoid the spatial diffusion of patterns of environmental degradation. Although there are no major socio-environmental conflicts related to NCREs yet, claims such as those filed against the expansion of Cerro Pabellón demonstrate the importance of respecting due process in energy planning and environmental assessment to avoid contentious responses to new energy infrastructure.

On the La Guajira side, in contrast, the situation is much more problematic. Although utility-scale wind energy projects have not yet started to operate, the delays in the construction process demonstrate the collision between very different visions of territory. Unlike the Atacama Desert, the Alta Guajira (where most of the 16 wind farms under construction are located) is a peninsula with a relatively high population density and where multiple flows and actors both legal and illegal converge. Notably, it constitutes the living space in which the identity and culture of the Wayúu indigenous communities is grounded. Their collective identity closely linked to the space and their community organization based on family clans makes that the rush to speed up the processes of prior consultation and environmental licensing is generating clashes between project developers and host communities. In both cases, these considerations from the point of view of environmental justice lead to the realization that the transition to renewables may not be creating a path of sustainability in which old socio-environmental conflicts related to energy are overcome but rather may be adding new patterns of environmental injustice against local communities.

Second, this irruption of new energy infrastructures does not follow a linear course in which there is a gradual replacement of high-carbon technologies associated with incumbent energy regimes. The uneven and combined geographical development of the new energy spaces is producing a recombination of infrastructures that, on a territorial scale, generates a coexistence between fossil and renewable energy sources. The dilemmas and challenges for the coal phase out from a climate justice perspective are then a point of connection between Antofagasta and La Guajira.

In Antofagasta, the phase out of coal is directly linked to the decarbonization of the electricity system. The retirement of coal-fired plants reveals, though, the complicated game of scales and interests in which the energy transition is being debated. Global companies with diversified investment portfolios and broad participation in the NCRE market are in charge of defining the timing and modalities for the voluntary retirement of the plants, while local communities in the so-called ‘sacrifice zones’ are only taken into account in a consultative manner in the design of the decarbonization policy. In La Guajira, again, the challenge of coal phase-out is more complex. In this case, coal mining represents the main source of wealth and employment in the department. Cerrejón, the coal mine, has built an enclave spatiality that shapes mindsets, practices and institutions around extractivism. Its replacement requires a perspective of structural transformation of the regional economy in which the NCRE can be embedded in a sustainable development strategy to create new forward and backward productive linkages.

To this extent, overcoming coal dependence will require a dual approach of justice and equity to avoid burdening the communities most affected by fossil fuels disproportionately during the transition. On the one hand, it requires the productive reconversion of the enclaves used as sacrifice zones and the reskilling of coal industry workers. This aspect of equity refers to ensuring the labor rights of workers within the industry and the economic rights of workers and local communities dependent on the industry. On the other hand, it should focus on guaranteeing the human rights (understood in a broad sense) of the communities in the areas impacted by coal. From a climate justice perspective, such an approach has implications across different scales and involves different national and international actors. First, it involves the commitment of transnational companies (mining or electricity) and governmental institutions to responsible decarbonization. Second, it refers to the recognition and remediation of the environmental liabilities left by coal extraction and transformation to produce electricity. Third, it points to a question of recognition in terms of not jeopardizing the lives and lifestyles of local communities and other disadvantaged energy stakeholders.

Third and last, this observation that NCREs come to coexist with technologies and activities associated with a high-carbon economy illustrates the contradictions that energy transition policy must face. The predominant view of transitions as massive deployment of renewables

may be leaving blind spots in the transformation of energy systems that, in turn, may become spatialized patterns of energy injustice. In particular, the disconnection of the NCRE incorporation targets with respect to plausible objectives to overcome energy poverty is a sign of the limited transformative scope of the energy transitions underway and the unequitable sharing of the benefits of renewable energies.

In the case of La Guajira, this distributional injustice is reflected in the absence of short or medium-term plans to overcome the gaps in access to electricity. Even with the connection of the new utility-scale power generating capacity to the grid, the interconnection solutions or off-grid supply of electricity to serviceless dwellings arrive only in dribs and drabs. In addition, the promise of massive job creation with the construction of wind farm infrastructure generates an illusion of fairness that hides recognition and procedural injustices. The latter are related particularly to the misrecognition of the local communities' territorial visions and their identity relationship with the landscape, as well as a misrepresentation of their customs that leads to rendering their needs invisible. As a consequence of this, there are delays in the development of generation and transmission infrastructure that jeopardize the investment model that Colombia has sought to build through the transition to NCRE.

In the case of Antofagasta, conversely, the almost universal access to electricity means that the challenges to be faced lie in other aspects of the energy system. High electricity prices are a concern for the regional population but large-scale NCRE deployment does not significantly affect this issue. Instead, it provides a socioenvironmental fix for the main local industry (mining). The benefits of NCRE end up being concentrated, in the short term, on energizing the extractive industries. Notwithstanding, the main concerns regarding energy transition policies are linked to procedural and recognition injustices associated with the disregard of the environmental burdens of coal-based electricity generation and its impacts on the public health of communities in the sacrifice zones. The absence of strategies with a comprehensive approach to restoring the human rights of local communities in the sacrifice zones is a critical element of the transition.

Finally, this articulated view of the three tenets of energy justice provides a general conclusion about the challenges for a just transition in Andean economies: the scalability of

the Chilean and Colombian renewable energy investment model and, therefore, its suitability for a transformative path of transition depends to a large extent on connecting such technological and financial efforts with considerations not only of mitigation and sustainability but also of justice and equity. While changes of the scale of the energy transition inevitably create winners and losers, an equitable distribution of gains and losses among the different stakeholders in energy systems is necessary to avoid backlashes against a low-carbon future. The academic community has an important role to play in ensuring that policy efforts are based on empirical evidence about the actual experience of those experiencing these changes across space. This is an enormous challenge that requires more extensive research and represents an opportunity to move academic inquiry forward in a yet underexplored terrain such as Latin America.

ANNEX 1. Table of informants

Type	Code	Name	Profile	Date	Length
Public Sector (A)	A1	Wilman Daniel Silgado	Lawyer. Legal Counsel at the <i>Unidad de Planeación Minero Energética</i> (UPME) of Colombia.	May 5, 2021	00:59:35
	A2	Mónica Gasca Rojas	Economist. Advisor to <i>Colombia's Mines and Energy Minister</i> . Responsible for key energy transition initiatives such as the <i>Misión de Transformación Energética</i> and the geothermal & hydrogen strategy.	June 10, 2021	01:45:23
	A3	Javier Obach Martiniello	Renewable natural resources engineer. Head of the Environmental Unit at the Environmental and Climate Change Division of <i>Chile's Ministry of Energy</i> .	June 17, 2021	01:43:48
	A4	Aldo Erazo Aracena	Industrial civil engineer. <i>Seremi</i> (Regional Ministerial Secretary) of Energy at Antofagasta Region (Chile).	June 17, 2021	01:43:48
Private Sector (B)	B1	Yordan Stiven Cruz	Mechanical engineer. Project Coordinator at <i>O3 Smart Cities S.A.S.</i> , a small solar PV and e-mobility solutions company.	May 20, 2021	00:33:32
	B2	Abel Mauricio Gallego	Electrical engineer. Energy Efficiency Manager at the electric utility <i>Energía de Pereira S.A. E.S.P.</i>	June 18, 2021	01:16:23
	B3	Informant B3 ⁵⁶	Engineer. Technical Business Development Manager in the South American subsidiary of an Asian multinational construction and engineering company (Fortune 500).	July 13, 2021	01:37:25
	B4	Alfonso Blanco Bonilla	Mechanical and industrial engineer. MSc in Energy Economics. Executive Secretary of the <i>Organización Latinoamericana de Energía</i> (OLADE).	July 28, 2021	01:21:58
	B5	Álvaro Mejía Villegas	Civil engineer. Advisor at the Energy Division of the <i>Inter-American Development Bank</i> (IDB).	September 1, 2021	01:08:15
	C1	Carla Lanyon Garrido	MSc in Social-Ecological Resilience for Sustainable Development. Researcher for	June 16, 2021	01:15:57

⁵⁶ Anonymized at the informant's request.

Civil Society (C)			the <i>Centro de Energía</i> at Universidad de Chile.		
	C2	Claudia Fuentes Pereira	Renewable natural resources engineer. MSc in Governance of Risk and Resources. Researcher for the environmental NGO <i>Chile Sustentable</i> .	June 17, 2021	01:34:17
	C3	Paz Araya Jofré	MSc in Energy Economics. Researcher for the <i>Red de Pobreza Energética</i> (RedPE) - Chile. Doctoral Researcher IRI THESys at Humboldt University.	June 22, 2021	01:41:52
	C4	Jessenia Villamil Ruiz	Ecologist and social worker. Researcher for the environmental NGO <i>Asociación Centro Nacional Salud, Ambiente y Trabajo</i> (CENSAT-Agua Viva).	July 17, 2021	01:25:55
	C5	Joanna Barney	MSc in Peace and Conflict Resolution. Financial manager and researcher at the <i>Instituto de Estudios para el Desarrollo y la Paz</i> (INDEPAZ).	August 6, 2021	01:23:28

ANNEX 2. Semi-structured interview protocol⁵⁷

PROTOCOLO DE ENTREVISTA SEMI-ESTRUCTURADA

Informante: -----

Investigador: Simón Ladino Cano – Estudiante del máster Erasmus Mundus LAGLOBE

Descripción.

La presente entrevista hace parte de una investigación académica como requisito para acceder al título del máster Erasmus Mundus Latin America and Europe in a Global World (LAGLOBE), el cual es financiado por la Comisión Europea y ofertado conjuntamente por tres universidades en Francia, Suecia y España. Por lo tanto, la misma está motivada por el interés de contribuir a la producción de conocimiento y la divulgación científica.

Objetivo.

Recabar información empírica acerca de la transición energética en América Latina y, particularmente, sobre los procesos de Colombia y Chile como casos de estudio. Asimismo, se pretende indagar las transformaciones territoriales en curso, en el departamento de La Guajira y en la región de Antofagasta, bajo la perspectiva de las transiciones justas y sostenibles.

Temas de discusión.

En tanto se trata de una entrevista semi-estructurada a profundidad, se proponen los siguientes temas de discusión en lugar de un formulario predefinido de preguntas. Éstos se encuentran agrupados por bloques temáticos. Asimismo, se enumeran de forma indicativa,

⁵⁷ This semi-structured interview protocol was sent in Spanish and adapted to the requirements and specificities of each informant. The topics presented are only indicative and varied from one interviewee to another.

con el propósito de ordenar la conversación en cada bloque. No son, por ende, una guía de estricto cumplimiento durante el desarrollo de la entrevista:

ACTORES Y POLÍTICAS DE TRANSICIÓN ENERGÉTICA

1. Hitos de política de la transición energética
2. Factores explicativos de la expansión de las fuentes no convencionales de energía renovable.
3. La especificidad de Colombia/Chile frente a la transición energética global.
4. El papel de los organismos internacionales frente a los desafíos de la transformación energética de la región.
5. El rol de la banca de desarrollo en el impulso a las políticas y a los proyectos de energía renovable.

DESCARBONIZACIÓN DE LA ECONOMÍA

6. Las energías renovables: ¿competencia o complemento de los combustibles fósiles?
7. Futuro del carbón térmico y de las centrales termoeléctricas en Colombia y Chile.

SOSTENIBILIDAD SOCIAL Y ECONÓMICA

8. Proyectos de ERNC y creación de empleo
9. Pequeñas y grandes empresas generadoras de energía frente a la expansión de las ERNC.
10. Aceptación social de los proyectos de ERNC.

HACIA UNA TRANSICIÓN JUSTA

11. Retos de las energías renovables frente a la pobreza energética y la reducción de las brechas de acceso.
12. Impactos sociales y ambientales de los proyectos de generación eléctrica de fuentes no convencionales.
13. Gobernanza y participación en el diseño de las políticas energéticas.

REFERENCES

- Abraham, J. (2017). Just Transitions for the Miners: Labor Environmentalism in the Ruhr and Appalachian Coalfields. *Http://Dx.Doi.Org/10.1080/07393148.2017.1301313*, 39(2), 218–240. <https://doi.org/10.1080/07393148.2017.1301313>
- Aghahosseini, A., Bogdanov, D., Barbosa, L. S. N. S., & Breyer, C. (2019). Analysing the feasibility of powering the Americas with renewable energy and inter-regional grid interconnections by 2030. *Renewable and Sustainable Energy Reviews*, 105, 187–205. <https://doi.org/10.1016/J.RSER.2019.01.046>
- Aghion, P., Antonin, C., & Simon, B. (2020). Le Pouvoir de la destruction créatrice. In O. Jacob (Ed.), *PSE-Ecole d'économie de Paris (Postprint)*. PSE-École d'économie de Paris.
- Agostini, C. A., Silva, C., & Nasirov, S. (2017). Failure of energy mega-projects in Chile: A critical review from sustainability perspectives. *Sustainability (Switzerland)*, 9(6). <https://doi.org/10.3390/SU9061073>
- Antofagasta Minerals. (2020, September 8). *En la ruta de las energías renovables*. Antofagasta Minerals. <https://www.aminerals.cl/media/6471/renewable-energy-in-spanish-prg.pdf>
- Araújo, K. (2014). The emerging field of energy transitions: Progress, challenges, and opportunities. *Energy Research and Social Science*, 1, 112–121. <https://doi.org/10.1016/j.erss.2014.03.002>
- Araujo, K. M. (2017). *Low Carbon Energy Transitions: Turning Points in National Policy and Innovation*. Oxford University Press. https://books.google.pt/books?id=bcQ9DwAAQBAJ&pg=PA1&hl=es&source=gbs_toc_r&cad=3#v=onepage&q&f=false
- Araya J., P., & Zamora Z., M. (2021). Una transición de los saberes y competencias, el desafío para construir el futuro energético. *Revista Planeo*, 47. <http://revistaplano.cl/2021/04/08/una-transicion-de-los-saberes-y-competencias-el-desafio-para-construir-el-futuro-energetico/?fbclid=IwAR2DufrZl8hzHZMyTUzSvQjlld1fcQ2QVddjRPwQtllr6Wt0vDFoWWdD7s>
- Armstrong, C. (2020). Decarbonisation and World Poverty: A Just Transition for Fossil Fuel Exporting Countries? *Political Studies*, 68(3), 671–688. <https://doi.org/10.1177/0032321719868214>
- Arndt, C., Miller, M., Tarp, F., Zinaman, O., & Arent, D. (Eds.). (2017). *The Political Economy of Clean Energy Transitions*. Oxford University Press.
- Avila-Calero, S. (2017). Contesting energy transitions: Wind power and conflicts in the Isthmus of Tehuantepec. *Journal of Political Ecology*, 24(1), 992–1012. <https://doi.org/10.2458/v24i1.20979>
- Avila, S. (2018). Environmental justice and the expanding geography of wind power conflicts. *Sustainability Science*, 13(3), 599–616. <https://doi.org/10.1007/S11625-018-0547-4>
- Bainton, N., Kemp, D., Lèbre, E., Owen, J. R., & Marston, G. (2021). The energy-extractives nexus and the just transition. *Sustainable Development*, 29(4), 624–634. <https://doi.org/10.1002/SD.2163>
- Banerjee, A., Prehoda, E., Sidortsov, R., & Schelly, C. (2017). Renewable, ethical? Assessing the energy justice potential of renewable electricity. *AIMS Energy*, 5(5), 768–797. <https://doi.org/10.3934/energy.2017.5.768>
- Bartlett, L., & Vavrus, F. (2017a). *Rethinking Case Study Research: A Comparative Approach*. Routledge.
- Bartlett, L., & Vavrus, F. (2017b). Comparative Case Studies. *Educação & Realidade*, 42(3), 899–920. <https://doi.org/10.1590/2175-623668636>
- BCN. (2021). *Clima y Vegetación Región de Antofagasta* —. Biblioteca Del Congreso Nacional de Chile. <https://www.bcn.cl/siit/nuestropais/region2/clima.htm>

- Becker, H. (2009). How to find out how to do qualitative research. *International Journal of Communication*, 3(March), 545–553. <https://doi.org/10.4135/9781849209663.n9>
- Bendassolli, P. F. (2013). Theory Building in Qualitative Research: Reconsidering the Problem of Induction. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 14(1). <https://doi.org/10.17169/FQS-14.1.1851>
- Bersalli, G., Menanteau, P., & El-Methni, J. (2020). Renewable energy policy effectiveness: A panel data analysis across Europe and Latin America. *Renewable and Sustainable Energy Reviews*, 133, 110351. <https://doi.org/10.1016/j.rser.2020.110351>
- Bertinat, P. (2016). Transición energética justa: pensando la democratización energética. *FES Sindical Análisis*, 1, 1–18.
- Bickerstaff, K., & Agyeman, J. (2009). Assembling Justice Spaces: The Scalar Politics of Environmental Justice in North-east England. *Antipode*, 41(4), 781–806. <https://doi.org/10.1111/J.1467-8330.2009.00697.X>
- Billon, P. Le, & Kristoffersen, B. (2019). Just cuts for fossil fuels? Supply-side carbon constraints and energy transition: *EPA: Economy and Space*, 52(6), 1072–1092. <https://doi.org/10.1177/0308518X18816702>
- Blanco-Wells, G. (2019). La vida social de la energía: apuntes para el estudio territorializado de las transiciones energéticas. *Sociologías*, 21(51), 160–185. <https://doi.org/10.1590/15174522-0215106>
- Bloomberg NEF. (2020, December 9). *ClimateScope - Emerging Markets Outlook 2020*. Bloomberg Finance LP.
- Boardman, B. (1991). *Fuel poverty : from cold homes to affordable warmth*. Belhaven Press.
- Bos, K., & Gupta, J. (2018). Climate change: the risks of stranded fossil fuel assets and resources to the developing world. *Third World Quarterly*, 39(3), 436–453. <https://doi.org/10.1080/01436597.2017.1387477>
- Bouzarovski, S., & Simcock, N. (2017). Spatializing energy justice. *Energy Policy*, 107, 640–648. <https://doi.org/10.1016/J.ENPOL.2017.03.064>
- BP. (2021, July). *Statistical Review of World Energy 2021*. British Petroleum. <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>
- Bradshaw, M. J. (2010). Global energy dilemmas: a geographical perspective. *Geographical Journal*, 176(4), 275–290. <https://doi.org/10.1111/J.1475-4959.2010.00375.X>
- Bridge, G. (2018). The map is not the territory: A sympathetic critique of energy research's spatial turn. *Energy Research & Social Science*, 36, 11–20. <https://doi.org/10.1016/J.ERSS.2017.09.033>
- Bridge, G., Bouzarovski, S., Bradshaw, M., & Eyre, N. (2013). Geographies of energy transition: Space, place and the low-carbon economy. *Energy Policy*, 53, 331–340. <https://doi.org/10.1016/j.enpol.2012.10.066>
- Bridge, G., & Gailing, L. (2020). New energy spaces: Towards a geographical political economy of energy transition. *EPA: Economy and Space*, 52(6), 1037–1050. <https://doi.org/10.1177/0308518X20939570>
- Brown, B., & Spiegel, S. J. (2019). Coal, climate justice, and the cultural politics of energy transition. *Global Environmental Politics*, 19(2), 149–168. https://doi.org/10.1162/GLEP_A_00501
- Bustos-Gallardo, B., & Prieto, M. (2019). Nuevas aproximaciones teóricas a las regiones-commodity desde la ecología política. *Eure*, 45(135), 153–176. <https://doi.org/10.4067/S0250-71612019000200153>
- Caldecott, B., Harnett, E., Cojoianu, T., Kok, I., Pfeiffer, A., & Rios, A. R. (2016). *Stranded Assets: A Climate Risk Challenge* (A. Rios (Ed.)). Inter-American Development Bank. <http://myidb.iadb.org/publications/resources/img/by-nc-nd.png>
- Calvert, K. (2016). From 'energy geography' to 'energy geographies.' *Progress in Human Geography*, 40(1), 105–125. <https://doi.org/10.1177/0309132514566343>

- Caney, S. (2014). Two Kinds of Climate Justice: Avoiding Harm and Sharing Burdens. *Journal of Political Philosophy*, 22(2), 125–149. <https://doi.org/10.1111/JOPP.12030>
- Carbonnier, G., & Grinevald, J. (2011). Energie et développement. *International Development Policy*, 2(2), 9–28. <https://doi.org/10.4000/POLDEV.687>
- Cardoso, A. (2016). Pasivos ambientales de la minería de carbón en Colombia: Una aproximación desde la ecología política. *Ecología Política*, 51, 94–98.
- Cardoso, A., & Turhan, E. (2018). Examining new geographies of coal: Dissenting energyscapes in Colombia and Turkey. *Applied Energy*, 224, 398–408. <https://doi.org/10.1016/J.APENERGY.2018.04.096>
- Carley, S., & Konisky, D. M. (2020). The justice and equity implications of the clean energy transition. *Nature Energy*, 5(8), 569–577. <https://doi.org/10.1038/s41560-020-0641-6>
- Carrizo, S. C., Velut, S., & Hevia, J. (2011). Le Nord du Chili : un isolat énergétique dans un désert minier. *Cybergeo : European Journal of Geography*, 2011(567). <https://doi.org/10.4000/CYBERGEO.24792>
- CEN. (2021, March 31). *Informe - Monitoreo de la competencia en el mercado eléctrico de Chile 2020*. Coordinador Eléctrico Nacional. <https://www.coordinador.cl/wp-content/uploads/2021/03/Informe-Monitoreo-CEN-2020.pdf>
- Chile Sustentable. (2020, August 12). *Critica a la compensación a centrales a carbón mediante pago por Estado de Reserva Estratégica*. Programa Chile Sustentable. http://www.minenergia.cl/archivos_bajar/2019/12/Reglamento_Potencia.pdf
- Coenen, L., Hansen, T., Glasmeier, A., & Hassink, R. (2021). Regional foundations of energy transitions. *Cambridge Journal of Regions, Economy and Society*, 14(2), 219–233. <https://academic.oup.com/cjres/article/14/2/219/6309334>
- Corredor, G. (2018). Colombia y la transición energética. *Ciencia Política*, 13(25), 107–125. <https://doi.org/10.15446/cp.v12n25.70257>
- Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). SAGE Publications.
- DANE. (2020). *La información del DANE en la toma de decisiones de los departamentos. La Guajira*. <https://www.dane.gov.co/files/investigaciones/planes-desarrollo-territorial/050220-Info-Gobernacion-La-Guajira.pdf>
- Delgado, R., Wild, T. B., Arguello, R., Clarke, L., & Romero, G. (2020). Options for Colombia's mid-century deep decarbonization strategy. *Energy Strategy Reviews*, 32, 100525. <https://doi.org/10.1016/j.esr.2020.100525>
- Devine-Wright, P. (2011). Place attachment and public acceptance of renewable energy: A tidal energy case study. *Journal of Environmental Psychology*, 31(4), 336–343. <https://doi.org/10.1016/J.JENVP.2011.07.001>
- Duarte-Abadía, B., Boelens, R., & Roa-Avenidaño, T. (2015). Hydropower, encroachment and the re-patterning of hydrosocial territory: The case of hidrosogamoso in Colombia. *Human Organization*, 74(3), 243–254. <https://doi.org/10.17730/0018-7259-74.3.243>
- Dunlap, A. (2017). 'The Town is Surrounded:' From Climate Concerns to life under Wind Turbines in La Ventosa, Mexico. *Human Geography(United Kingdom)*, 10(2), 16–36. <https://doi.org/10.1177/194277861701000202>
- Dunlap, A. (2018). The 'solution' is now the 'problem:' wind energy, colonisation and the 'genocide-ecocide nexus' in the Isthmus of Tehuantepec, Oaxaca. *International Journal of Human Rights*, 22(4), 550–573. <https://doi.org/10.1080/13642987.2017.1397633>
- Dunlap, A. (2020). The Politics of Ecocide, Genocide and Megaprojects: Interrogating Natural Resource

- Extraction, Identity and the Normalization of Erasure. *Journal of Genocide Research*, 1–24.
- Duruiseau, K. (2014). L'émergence du concept de transition énergétique. Quels apports de la géographie? *Bulletin de La Société Géographique de Liège*, 63, 21–34. <https://halshs.archives-ouvertes.fr/halshs-01412895>
- Ebeling, F. (2020). Assessing the macroeconomic effects of sustainable energy transitions in Costa Rica and Chile: a multisectoral balance-of-payments-constrained growth approach. In *The Regulation and Policy of Latin American Energy Transitions* (pp. 39–58). Elsevier. <https://doi.org/10.1016/B978-0-12-819521-5.00003-6>
- ECLAC. (2021). *CEPALSTAT - Estadísticas e Indicadores*. Economic Commission for Latin America and the Caribbean. https://estadisticas.cepal.org/cepalstat/web_cepalstat/estadisticasindicadores.asp
- Energía Abierta, & CNE. (2021a, August 11). *Capacidad Instalada de Generación Total en Chile*. Comisión Nacional de Energía. <http://datos.energiaabierta.cl/dataviews/240266/capacidad-instalada-de-generacion-total-en-chile/>
- Energía Abierta, & CNE. (2021b, August 11). *Proyectos de Generación Eléctrica en Etapa de Construcción*. Comisión Nacional de Energía. <http://datos.energiaabierta.cl/dataviews/236039/ultimos-proyectos-de-generacion-electrica-en-etapa-de-construccion/>
- Energía Abierta, & CNE. (2021c, August 15). *BNE - Consumos Regionales de Energía*. Comisión Nacional de Energía. <http://datos.energiaabierta.cl/dataviews/236065/bne-consumos-regionales-de-energia/>
- Energía Región. (2021, August 11). *Región de Antofagasta*. Portal de Datos Oficiales de Energía de Las Regiones de Chile. <https://energiaregion.cl/region/ANTOF>
- Fierro Morales, J., & Llorente Valbuena, A. M. (2016). *Consideraciones ambientales acerca del proyecto carbonífero de El Cerrejón, operado por las empresas BHP Billiton, Angloamerican y Xstrata en La Guajira*. <http://extractivismoencolombia.org/consideraciones-ambientales-del-proyecto-carbonifero-cerrejon-operado-las-empresas-bhp-billiton-angloamerican-xstrata-la-guajira/>
- Fisher, S. (2015). The emerging geographies of climate justice. *Geographical Journal*, 181(1), 73–82. <https://doi.org/10.1111/GEOJ.12078>
- Flores-Fernández, C. (2020). The Chilean energy “transition”: between successful policy and the assimilation of a post-political energy condition. <https://doi.org/10.1080/13511610.2020.1749836>, 33(2), 173–193. <https://doi.org/10.1080/13511610.2020.1749836>
- Florini, A., & Sovacool, B. K. (2009). Who governs energy? The challenges facing global energy governance. *Energy Policy*, 37(12), 5239–5248. <https://doi.org/10.1016/J.ENPOL.2009.07.039>
- Fornillo, B. M. (2017). Hacia una definición de transición energética para Sudamérica: Antropoceno, geopolítica y podesarrollo. *Páginas de Oficio*, 2(20), 46–53.
- Fouquet, R. (2016a). Path dependence in energy systems and economic development. *Nature Energy*, 1. <https://doi.org/10.1038/NENERGY.2016.98>
- Fouquet, R. (2016b). Historical energy transitions: Speed, prices and system transformation. *Energy Research and Social Science*, 22, 7–12. <https://doi.org/10.1016/j.erss.2016.08.014>
- Frey, B. B. (2018). *The SAGE Encyclopedia of Educational Research, Measurement, and Evaluation*. <https://doi.org/10.4135/9781506326139 NV - 4>
- Fuentes, C., Larraín, S., & Poo, P. (2020, November). *Transición Justa. Desafíos para el proceso de descarbonización, la justicia energética y climática en Chile*. Programa Chile Sustentable. <http://www.chilesustentable.net/wp-content/uploads/2020/12/Transicion-Justa-baja.pdf>
- Fundación Terram. (2019, June). *Las cinco Zonas de Sacrificio de Chile – Carbón – Fundación Terram*. No + Carbón. <https://www.terram.cl/carbon/2019/06/las-cinco-zonas-de-sacrificio-de-chile/>

- Fundación Terram, Heinrich Böll Stiftung, & Friends of the Earth International. (2020). *Atlas del Carbón 2020. Hechos y cifras de un combustible fósil*. www.bund.net/coalatlas
- Furnaro, A. (2020). Neoliberal energy transitions: The renewable energy boom in the Chilean mining economy. *Environment and Planning E: Nature and Space*, 3(4), 951–975. <https://doi.org/10.1177/2514848619874685>
- Fuso Nerini, F., Tomei, J., To, L. S., Bisaga, I., Parikh, P., Black, M., Borrion, A., Spataru, C., Castán Broto, V., Anandarajah, G., Milligan, B., & Mulugetta, Y. (2017). Mapping synergies and trade-offs between energy and the Sustainable Development Goals. *Nature Energy* 2017 3:1, 3(1), 10–15. <https://doi.org/10.1038/s41560-017-0036-5>
- Gailing, L. (2018). Die räumliche Governance der Energiewende: Eine Systematisierung der relevanten Governance-Formen. In O. Kühne & F. Weber (Eds.), *Bausteine der Energiewende* (pp. 75–90). Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-19509-0_4
- Gailing, L., Bues, A., Kern, K., & Röhring, A. (2020). Socio-spatial dimensions in energy transitions: Applying the TPSN framework to case studies in Germany. *Environment and Planning A*, 52(6), 1112–1130. <https://doi.org/10.1177/0308518X19845142>
- García-García, P., Carpintero, Ó., & Buendía, L. (2020). Just energy transitions to low carbon economies: A review of the concept and its effects on labour and income. *Energy Research & Social Science*, 70, 101664. <https://doi.org/10.1016/J.ERSS.2020.101664>
- Geels, F. W. (2010). Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective. *Research Policy*, 39(4), 495–510.
- Geels, F. W. (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms. In *Environmental Innovation and Societal Transitions* (Vol. 1, Issue 1, pp. 24–40). Elsevier B.V. <https://doi.org/10.1016/j.eist.2011.02.002>
- Geels, F. W. (2014a). Regime Resistance against Low-Carbon Transitions: Introducing Politics and Power into the Multi-Level Perspective. *Theory, Culture & Society*, 31(5), 21–40. <https://doi.org/10.1177/0263276414531627>
- Geels, F. W. (2014b). Regime Resistance against Low-Carbon Transitions: Introducing Politics and Power into the Multi-Level Perspective. *Theory, Culture & Society*, 31(5), 21–40. <https://doi.org/10.1177/0263276414531627>
- Geels, F. W., Berkhout, F., & Van Vuuren, D. P. (2016). Bridging analytical approaches for low-carbon transitions. *Nature Climate Change*, 6(6), 576–583. <https://doi.org/10.1038/NCLIMATE2980>
- Geels, F. W., Sovacool, B. K., Schwanen, T., & Sorrell, S. (2017). Sociotechnical transitions for deep decarbonization. *Science*, 357(6357), 1242 LP – 1244. <https://doi.org/10.1126/science.aao3760>
- Gligo, N., Alonso, G., Barkin, D., Brailovsky, A., Brzovic, F., Carrizosa, J., Durán, H., Fernández, P., Gallopín, G., Leal, J., Marino De Botero, M., Morales, C., Monasterio, F. O., Panario, D., Pengue, W., Becerra, M. R., Rofman, A., Saa, R., Sejenovich, H., ... Villamil, J. (2020). *La tragedia ambiental de América Latina y el Caribe*. CEPAL.
- Glynn, P. J., Błachowicz, A., & Nicholls, M. (2020). *Incorporating just transition strategies in developing country Nationally Determined Contributions*. https://climatestrategies.org/wp-content/uploads/2020/06/CS_Just-Transition-NDCs-report_web.pdf
- González Posso, C., & Barney, J. (2019). *El viento del este llega con revoluciones. Multinacionales y transición con energía eólica en territorio Wayúu*.
- Goodrick, D. (2019). Comparative Case Studies. In P. Atkinson, S. Delamont, A. Cernat, J. W. Sakshaug, & R. A. Williams (Eds.), *SAGE Research Methods Foundations*. SAGE Publications. <https://doi.org/10.4135/9781526421036849021>

- Grubler, A. (2012). Energy transitions research: Insights and cautionary tales. *Energy Policy*, 50, 8–16. <https://doi.org/10.1016/j.enpol.2012.02.070>
- Grubler, A., Wilson, C., & Nemet, G. (2016). Apples, oranges, and consistent comparisons of the temporal dynamics of energy transitions. *Energy Research & Social Science*, 22, 18–25. <https://doi.org/https://doi.org/10.1016/j.erss.2016.08.015>
- Gudynas, E. (2011). Transitions to post-extractivism: Directions, options, areas of action. *Beyond Development*, 165–189.
- Gudynas, E. (2019). Las narrativas que construyen un sentido común extractivista. In E. Castro (Ed.), *Pensamiento crítico latino-americano. Reflexões sobre políticas e fronteiras*. Annablume.
- Haarstad, H., & Wanvik, T. I. (2017). Carbonscapes and beyond: Conceptualizing the instability of oil landscapes. *Progress in Human Geography*, 41(4), 432–450. <https://doi.org/10.1177/0309132516648007>
- Healy, N., & Barry, J. (2017). Politicizing energy justice and energy system transitions: Fossil fuel divestment and a “just transition.” *Energy Policy*, 108, 451–459. <https://doi.org/10.1016/J.ENPOL.2017.06.014>
- Heffron, R. J. (2020). Thinking Globally: An Accelerated Just Transition to a Low-Carbon Economy. *Global Energy Law and Sustainability*, 1(1), ix–xiii. <https://doi.org/10.3366/gels.2020.0003>
- Heffron, R. J., & McCauley, D. (2017). The concept of energy justice across the disciplines. *Energy Policy*, 105, 658–667. <https://doi.org/10.1016/J.ENPOL.2017.03.018>
- Heffron, R. J., & McCauley, D. (2018). What is the ‘Just Transition’? *Geoforum*, 88, 74–77. <https://doi.org/10.1016/J.GEOFORUM.2017.11.016>
- Heffron, R. J., & McCauley, D. (2019). Beyond energy justice: Towards a just transition. *Research Handbook on Global Climate Constitutionalism*, 302–313. <https://doi.org/10.4337/9781788115810.00022>
- Hemmati, M. (2002). Multi-stakeholder Processes for Governance and Sustainability : Beyond Deadlock and Conflict. In *Multi-stakeholder Processes for Governance and Sustainability: Beyond Deadlock and Conflict*. Routledge. <https://doi.org/10.4324/9781849772037>
- Henry, M. S., Bazilian, M. D., & Markuson, C. (2020). Just transitions: Histories and futures in a post-COVID world. *Energy Research & Social Science*, 68, 101668. <https://doi.org/10.1016/J.ERSS.2020.101668>
- Honty, G. (2014). Límites de las energías renovables. *Ecuador Debate*, 92, 103–116. <http://repositorio.flacsoandes.edu.ec/handle/10469/9486>
- Huber, M. (2015). Theorizing Energy Geographies. *Geography Compass*, 9(6), 327–338. <https://doi.org/10.1111/GEC3.12214>
- Hutchinson, N., Dennis, M., Damgaard Grann, E., Clevenger, T., Manion, M., Bøggild, J., & Layke, J. (2021). Unlocking a Renewable Energy Future: How Government Action Can Drive Private Investment. *World Resources Institute*. <https://doi.org/10.46830/WRIWP.20.00077>
- IDEAM, PNUD, MADS, DNP, & Cancillería. (2016). *Inventario Nacional y Departamental de Gases de Efecto Invernadero - Colombia*. Instituto de Hidrología, Meteorología y Estudios Ambientales - IDEAM. <http://documentacion.ideam.gov.co/openbiblio/bvirtual/023634/INGEI.pdf>
- IEA. (2021a). *Data and statistics*. International Energy Agency. <https://www.iea.org/data-and-statistics>
- IEA. (2021b, May 18). *Net Zero by 2050 - A Roadmap for the Global Energy Sector*. International Energy Agency. <https://www.iea.org/reports/net-zero-by-2050>
- IEA, & IRENA. (2021). *Policy database*. International Energy Agency & International Renewable Energy Agency. <https://www.iea.org/policies>
- INDH. (2021, July). *Mapa de Conflictos Medioambientales de Chile*. Instituto Nacional de Derechos Humanos. <https://mapaconFLICTOS.indh.cl/#/>

- IPPUCN. (2021, March). *Informe de Resultados Encuesta Barómetro Regional de Antofagasta*. Instituto de Políticas Públicas - Universidad Católica Del Norte. <https://www.politicaspUBLICASdelnorte.cl/web/wp-content/uploads/2021/03/Barometro-Antofagasta-Marzo-2021.pdf>
- IRENA. (2016). *Renewable Energy Market Analysis: Latin America*. International Renewable Energy Agency. www.irena.org
- IRENA. (2021, June). *World Energy Transitions Outlook. 1.5°C Pathway*. International Renewable Energy Agency. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2021/Jun/IRENA_World_Energy_Transitions_Outlook_2021.pdf
- World Energy Transitions Outlook 1.5° C Pathway, International Renewable Energy Agency (2021). https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2021/Jun/IRENA_World_Energy_Transitions_Outlook_2021.pdf
- Jacobs, D., Marzolf, N., Paredes, J. R., Rickerson, W., Flynn, H., Becker-Birck, C., & Solano-Peralta, M. (2013). Analysis of renewable energy incentives in the Latin America and Caribbean region: The feed-in tariff case. *Energy Policy*, 60, 601–610. <https://doi.org/10.1016/J.ENPOL.2012.09.024>
- Jakob, M., Soria, R., Trinidad, C., Edenhofer, O., Bak, C., Bouille, D., Buirra, D., Carlino, H., Gutman, V., Hübner, C., Knopf, B., Lucena, A., Santos, L., Scott, A., Steckel, J. C., Tanaka, K., Vogt-Schilb, A., & Yamada, K. (2019). Green fiscal reform for a just energy transition in Latin America. *Economics*, 13(1), 2019–2036. <https://doi.org/10.5018/ECONOMICS-EJOURNAL.JA.2019-17>
- Jakstas, T. (2020). What does energy security mean? In M. Tvaronavičienė & B. B. T.-E. T. T. S. Ślusarczyk (Eds.), *Energy Transformation Towards Sustainability* (pp. 99–112). Elsevier. <https://doi.org/https://doi.org/10.1016/B978-0-12-817688-7.00005-7>
- Jasanoff, S. (2018). Just transitions: A humble approach to global energy futures. *Energy Research and Social Science*, 35, 11–14. <https://doi.org/10.1016/J.ERSS.2017.11.025>
- Jenkins, K. E. H., Sovacool, B. K., Mouter, N., Hacking, N., Burns, M. K., & McCauley, D. (2021). The methodologies, geographies, and technologies of energy justice: A systematic and comprehensive review. *Environmental Research Letters*, 16(4). <https://doi.org/10.1088/1748-9326/abd78c>
- Jenkins, K., McCauley, D., & Forman, A. (2017). Energy justice: A policy approach. *Energy Policy*, 105, 631–634.
- Jenkins, K., McCauley, D., Heffron, R., Stephan, H., & Rehner, R. (2016). Energy justice: A conceptual review. *Energy Research and Social Science*, 11, 174–182.
- Jenkins, K., Sovacool, B. K., & McCauley, D. (2018). Humanizing sociotechnical transitions through energy justice: An ethical framework for global transformative change. *Energy Policy*, 117, 66–74. <https://doi.org/10.1016/J.ENPOL.2018.02.036>
- Juárez-Hernández, S., & León, G. (2014). Energía eólica en el istmo de tehuantepec: Desarrollo, actores y oposición social. *Problemas Del Desarrollo*, 45(178), 139–162. [https://doi.org/10.1016/S0301-7036\(14\)70879-X](https://doi.org/10.1016/S0301-7036(14)70879-X)
- Just Transition Research Collaborative. (2018). *Mapping just transition(s) to a low-carbon world*. United Nations Research Institute for Social Development (UNRISD). [https://www.unrisd.org/80256B3C005BCCF9/\(httpPublications\)/9B3F4F10301092C7C12583530035C2A5?OpenDocument](https://www.unrisd.org/80256B3C005BCCF9/(httpPublications)/9B3F4F10301092C7C12583530035C2A5?OpenDocument)
- Karjalainen, J., Vähäkari, N., & Heinonen, S. (2020). Foresight for Chile’s energy transition—unleashing societal transformations. In *The Regulation and Policy of Latin American Energy Transitions* (pp. 263–282). Elsevier. <https://doi.org/10.1016/B978-0-12-819521-5.00015-2>
- Karpinska, L., & Śmiech, S. (2020). Invisible energy poverty? Analysing housing costs in Central and Eastern

- Europe. *Energy Research & Social Science*, 70, 101670. <https://doi.org/10.1016/J.ERSS.2020.101670>
- Kenis, A., Bono, F., & Mathijs, E. (2016). Unravelling the (post-)political in transition management: Interrogating pathways towards sustainable change. *Journal of Environmental Policy and Planning*, 18(5), 568–584. <https://doi.org/10.1080/1523908X.2016.1141672>
- Kern, F., & Markard, J. (2016). Analysing Energy Transitions: Combining Insights from Transition Studies and International Political Economy. In *The Palgrave Handbook of the International Political Economy of Energy* (pp. 291–318). Palgrave Macmillan UK. https://doi.org/10.1057/978-1-137-55631-8_12
- Kern, F., & Rogge, K. S. (2016). The pace of governed energy transitions: Agency, international dynamics and the global Paris agreement accelerating decarbonisation processes? *Energy Research and Social Science*, 22, 13–17. <https://doi.org/10.1016/J.ERSS.2016.08.016>
- Kirshner, J., Broto, V. C., & Baptista, I. (2019). Energy landscapes in Mozambique: The role of the extractive industries in a post-conflict environment: <https://doi.org/10.1177/0308518X19866212>, 52(6), 1051–1071. <https://doi.org/10.1177/0308518X19866212>
- Klugmann-Radziemska, E. (2014). Environmental Impacts of Renewable Energy Technologies. *IPCBEE*, 69, 104–109. <https://doi.org/10.7763/IPCBEE>
- Köhler, J., Geels, F. W., Kern, F., Markard, J., Onsongo, E., Wiecek, A., Alkemade, F., Avelino, F., Bergek, A., Boons, F., Fünfschilling, L., Hess, D., Holtz, G., Hyysalo, S., Jenkins, K., Kivimaa, P., Martiskainen, M., McMeekin, A., Mühlemeier, M. S., ... Wells, P. (2019). An agenda for sustainability transitions research: State of the art and future directions. *Environmental Innovation and Societal Transitions*, 31, 1–32. <https://doi.org/10.1016/j.eist.2019.01.004>
- KPMG. (2016, December). *Desarrollo de energías renovables. Contexto latinoamericano y el caso argentino*. KPMG International. <https://assets.kpmg/content/dam/kpmg/ar/pdf/kpmg-energias-renovables-en-latam-y-argentina.pdf>
- Kuchler, M., & Bridge, G. (2018). Down the black hole: Sustaining national socio-technical imaginaries of coal in Poland. *Energy Research & Social Science*, 41, 136–147. <https://doi.org/10.1016/J.ERSS.2018.04.014>
- Kumar, A., Höffken, J., & Pols, A. (2021). Dilemmas of Energy Transitions in the Global South. In A. Kumar, J. Höffken, & A. Pols (Eds.), *Dilemmas of Energy Transitions in the Global South* (1st ed.). Routledge. <https://doi.org/10.4324/9780367486457/DILEMMAS-ENERGY-TRANSITIONS-GLOBAL-SOUTH-ANKIT-KUMAR-JOHANNA-H>
- Kuzemko, C. (2019). Re-scaling IPE: local government, sustainable energy and change. *Review of International Political Economy*, 26(1), 80–103. <https://doi.org/10.1080/09692290.2018.1527239>
- Kuzemko, C., Lawrence, A., & Watson, M. (2019). New directions in the international political economy of energy. *Review of International Political Economy*, 26(1), 1–24. <https://doi.org/10.1080/09692290.2018.1553796>
- Kuzemko, C., Lockwood, M., Mitchell, C., & Hoggett, R. (2016). Governing for sustainable energy system change: Politics, contexts and contingency. *Energy Research and Social Science*, 12, 96–105. <https://doi.org/10.1016/j.erss.2015.12.022>
- Laird, F. N. (2013). Against Transitions? Uncovering Conflicts in Changing Energy Systems. *Science as Culture*, 22(2), 149–156. <https://doi.org/10.1080/09505431.2013.786992>
- Lardé, J., Chaparro, E., & Parra, C. (2008, March). *El aporte del sector minero al desarrollo humano en Chile: el caso de la región de Antofagasta*. División de Recursos Naturales e Infraestructura - CEPAL. https://repositorio.cepal.org/bitstream/handle/11362/6329/1/S0701042_es.pdf
- Le Gall, J., Hamant, O., & Bouron, J.-B. (2017). Notion en débat : Anthropocène. *Géoconfluences*. <http://geoconfluences.ens-lyon.fr/informations-scientifiques/a-la-une/notion-a-la-une/anthropocene>
- Levenda, A. M., Behrsin, I., & Disano, F. (2021). Renewable energy for whom? A global systematic review of

- the environmental justice implications of renewable energy technologies. *Energy Research & Social Science*, 71, 101837. <https://doi.org/10.1016/J.ERSS.2020.101837>
- Lijphart, A. (1971). Comparative Politics and the Comparative Method. *American Political Science Review*, 65(3), 682–693. <https://doi.org/10.2307/1955513>
- Longhurst, R. (2009). Interviews: In-Depth, Semi-Structured. In *International Encyclopedia of Human Geography* (pp. 580–584). <https://doi.org/10.1016/B978-008044910-4.00458-2>
- López, P. E. V., Paris, A. P. D., Sepúlveda, J. G. E., Leiva, G. M. M., & Sanchez, A. M. (2020). Zonas de Sacrificio y Justicia Ambiental en Chile. Una Mirada Crítica desde los Objetivos de Desarrollo Sostenible 2030. *Historia Ambiental Latinoamericana y Caribeña (HALAC) Revista de La Solcha*, 10(3), 342–365. <https://doi.org/10.32991/2237-2717.2020V10I3.P342-365>
- López, S., & Patzy, F. (2021). *Carbón térmico en Colombia: implicaciones para la economía de La Guajira y Cesar*. Natural Resource Governance Institute (NRGI).
- LSE, & Grantham Research Institute. (2021). *Climate Change Laws of the World*. London School of Economics - Grantham Research Institute on Climate Change and the Environment. <https://climate-laws.org/>
- MacKinnon, D., Dawley, S., Pike, A., & Cumbers, A. (2019). Rethinking Path Creation: A Geographical Political Economy Approach. *Https://Doi.Org/10.1080/00130095.2018.1498294*, 95(2), 113–135. <https://doi.org/10.1080/00130095.2018.1498294>
- Månsson, A. (2015). A resource curse for renewables? Conflict and cooperation in the renewable energy sector. *Energy Research & Social Science*, 10, 1–9. <https://doi.org/10.1016/J.ERSS.2015.06.008>
- Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research Policy*, 41(6), 955–967. <https://doi.org/10.1016/j.respol.2012.02.013>
- Marquardt, J., & Delina, L. L. (2021). Making time, making politics: Problematizing temporality in energy and climate studies. *Energy Research and Social Science*, 76.
- Martínez Ortiz, A. (2019). *Contribución del carbón a la economía guajira*. https://www.repository.fedesarrollo.org.co/handle/11445/3899#.YQCDvcA_gtc.mendeley
- Martínez Ortiz, A. (2021). La transición energética y los retos del sector energético en Colombia (2020-2030). In Fedesarrollo (Ed.), *Descifrar el Futuro. La economía colombiana en los próximos diez años*. (pp. 463–538). Debate.
- Martínez, V., & Castillo, O. L. (2016). The political ecology of hydropower: Social justice and conflict in Colombian hydroelectricity development. *Energy Research & Social Science*, 22, 69–78. <https://doi.org/10.1016/J.ERSS.2016.08.023>
- Martínez, V., & Castillo, O. L. (2019). Colombian energy planning - Neither for energy, nor for Colombia. *Energy Policy*, 129, 1132–1142. <https://doi.org/10.1016/J.ENPOL.2019.03.025>
- Max-Neef, M. A. (2005). Foundations of transdisciplinarity. *Ecological Economics*, 53(1), 5–16.
- McCarthy, J. (2015). A socioecological fix to capitalist crisis and climate change? The possibilities and limits of renewable energy. *Environment and Planning A*, 47(12), 2485–2502. <https://doi.org/10.1177/0308518X15602491>
- McCauley, D., & Heffron, R. (2018). Just transition: Integrating climate, energy and environmental justice. *Energy Policy*, 119, 1–7. <https://doi.org/10.1016/J.ENPOL.2018.04.014>
- Mccauley, D., Heffron, R. J., & Jenkins, S. K. (2013). Advancing energy justice: the triumvirate of tenets. *International Energy Law Review*, 32(3), 107–116.
- McFee, G. (1992). Triangulation in research: two confusions. *Educational Research*, 34(3), 215–219. <https://doi.org/10.1080/0013188920340305>

- Meadowcroft, J. (2009). *What about the politics? Sustainable development, transition management, and long term energy transitions*. 42(4), 323–340. <https://link.springer.com/article/10.1007/s11077-009-9097-z>
- Meadowcroft, J. (2011). Engaging with the politics of sustainability transitions. *Environmental Innovation and Societal Transitions*, 1(1), 70–75.
- Meisel Roca, A., & Perez, G. J. (2006). *Geografía Física y poblamiento en la Costa Caribe colombiana*. Banco de La República de Colombia. <https://www.banrep.gov.co/sites/default/files/publicaciones/archivos/DTSER-73.pdf>
- Mejía-Montero, A., Alonso-Serna, L., & Altamirano-Allende, C. (2020). The role of social resistance in shaping energy transition policy in Mexico: the case of wind power in Oaxaca. *The Regulation and Policy of Latin American Energy Transitions*, 303–318. <https://doi.org/10.1016/B978-0-12-819521-5.00017-6>
- Mihas, P. (2019). Qualitative Data Analysis. *Oxford Research Encyclopedia of Education*. <https://doi.org/10.1093/ACREFORE/9780190264093.013.1195>
- Miller, C. A., Iles, A., & Jones, C. F. (2013). The Social Dimensions of Energy Transitions. *Science as Culture*, 22(2), 135–148. <https://doi.org/10.1080/09505431.2013.786989>
- Mills, A., Durepos, G., & Wiebe, E. (Eds.). (2010). *Encyclopedia of Case Study Research*. SAGE Publications. <https://doi.org/10.4135/9781412957397.NV-0>
- Ministerio de Bienes Nacionales de Chile. (2021). *Plan de Licitaciones 2018-2022*. Ministerio de Bienes Nacionales de Chile. <https://licitaciones.visorterritorial.cl/>
- Ministerio de Cultura de Colombia. (2021). *Caracterizaciones de los pueblos indígenas de Colombia. WAYÚU - Gente de arena, sol y viento*. Dirección de Poblaciones - Mincultura. <https://www.mincultura.gov.co/prensa/noticias/Documents/Poblaciones/PUEBLO WAYÚU.pdf>
- Ministerio de Desarrollo Social y Familia de Chile. (2017). Región de Antofagasta . In *Año* (Vol. 8). http://observatorio.ministeriodesarrollosocial.gob.cl/storage/docs/fichas-regionales/2017/region_antofagasta.pdf
- Ministerio de Energía de Chile. (2015). *Energía 2050. Política Energética de Chile*. Ministerio de Energía. https://www.energia.gob.cl/sites/default/files/energia_2050_-_politica_energetica_de_chile.pdf
- Ministerio de Energía de Chile. (2019). *Mapa de Vulnerabilidad Energética: Síntesis metodológica y resultados División de Acceso y Desarrollo Social*.
- Ministerio de Energía de Chile. (2020a). *Plan de retiro y/o reconversión de unidades a carbon*. https://energia.gob.cl/sites/default/files/plan_de_retiro_y_o_reconversion_centrales_carbon.pdf
- Ministerio de Energía de Chile. (2020b, November 3). *Talleres Participativos Sesión n°1 Para la elaboración de la Estrategia de Transición Justa en Energía*. Ministerio de Energía de Chile. https://energia.gob.cl/sites/default/files/documentos/201103_sesion_1_taller_etj.pdf
- Ministerio de Energía de Chile. (2021a). *Planificación Energética de Largo Plazo 2023-2027*. Ministerio de Energía de Chile. <https://energia.gob.cl/panel/planificacion-energetica-de-largo-plazo-0>
- Ministerio de Energía de Chile. (2021b). *Reglamentos*. Ministerio de Energía. <https://energia.gob.cl/minisito/reglamentos>
- Ministerio de Energía de Chile. (2021c, July 23). *Energía y Bienes Nacionales anuncian más de 20 mil hectáreas fiscales para el desarrollo de energías renovables en Antofagasta*. Ministerio de Energía de Chile. <https://energia.gob.cl/noticias/nacional/energia-y-bienes-nacionales-anuncian-mas-de-20-mil-hectareas-fiscales-para-el-desarrollo-de-energias-renovables-en-antofagasta>
- Ministerio de Energía de Chile, & GIZ. (2014). *Energías Renovables en Chile. El Potencial Eólico, Solar e Hidroeléctrico de Arica a Chiloé*. http://www.minenergia.gob.cl/archivos_bajar/Estudios/Potencial_ER_en_Chile_AC.pdf

- Ministerio de Minas y Energía de Colombia. (2015, May 26). *Decreto Reglamentario Único del Sector Administrativo de Minas y Energía 1073 de 2015*. Minenergía. <https://www.minenergia.gov.co/en/decreto-unico-reglamentario>
- Ministerio de Minas y Energía de Colombia. (2021). *Energías Renovables No Convencionales*. Minenergía. <https://www.minenergia.gov.co/en/energias-renovables-no-convencionales>
- Ministerio de Minas y Energía de Colombia, & BID. (2021). *Transición energética: un legado para el presente y el futuro de Colombia*. Gobierno de Colombia & BID.
- Moe, E. (2016). The Political Economy of Sustainable Energy Transitions. *Global Environmental Politics*, 16(2), 130–135. https://doi.org/10.1162/glep_r_00344
- Monyei, C. G., Sovacool, B. K., Brown, M. A., Jenkins, K. E. H., Viriri, S., & Li, Y. (2019). Justice, poverty, and electricity decarbonization. *The Electricity Journal*, 32(1), 47–51. <https://doi.org/10.1016/J.TEJ.2019.01.005>
- Morganstein, J., Hutchinson, N., Murphy Rogers, M., Posner Ross, R., Venetoulis, J., Speer, B., & Roa, H. (2021). Renewable Energy Procurement Guidebook for Colombia. *World Resources Institute*. <https://doi.org/10.46830/WRIGB.19.00129>
- Mulvaney, D. (2013). Opening the Black Box of Solar Energy Technologies: Exploring Tensions Between Innovation and Environmental Justice. *Http://Dx.Doi.Org/10.1080/09505431.2013.786995*, 22(2), 230–237. <https://doi.org/10.1080/09505431.2013.786995>
- Nasirov, S., Agostini, C., Silva, C., & Caceres, G. (2018). Renewable energy transition: a market-driven solution for the energy and environmental concerns in Chile. *Clean Technologies and Environmental Policy*, 20(1), 3–12. <https://doi.org/10.1007/S10098-017-1434-X>
- Navas, L. M., Catalina, C., & CENSAT Agua viva. (2018). ¿Cómo salir de la dependencia del carbón? Elementos para debatir una transición socioeconómica en La Guajira. In *Hacia una Colombia post minería de carbón: aportes para una transición social y ambientalmente justa* (Hacia Una Colombia Post Minería de Carbón: Aportes Para Una Transición Social y Ambientalmente Justa, Issue 3).
- Newell, P. (2019). Transformismo or transformation? The global political economy of energy transitions. *Review of International Political Economy*, 26(1), 25–48. <https://doi.org/10.1080/09692290.2018.1511448>
- Newell, P. (2020a). Towards a global political economy of transitions: a comment on the transitions research agenda. *Environmental Innovation and Societal Transitions*, 34, 344–345. <https://doi.org/10.1016/j.eist.2019.10.007>
- Newell, P. (2020b). The business of rapid transition. *WIREs Climate Change*, 11(6). <https://doi.org/10.1002/wcc.670>
- Newell, P. (2021). *Power Shift: The Global Political Economy of Energy Transitions*. Cambridge University Press. <https://doi.org/10.1017/9781108966184>
- Newell, P., & Mulvaney, D. (2013). The political economy of the “just transition.” *Geographical Journal*, 179(2), 132–140. <https://doi.org/10.1111/geoj.12008>
- Newell, P., & Paterson, M. (2010). Climate capitalism: Global warming and the transformation of the global economy. In *Climate Capitalism: Global Warming and the Transformation of the Global Economy*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511761850>
- Noura Guimarães, L. (2020). Is there a Latin American electricity transition? A snapshot of intraregional differences. In L. Noura Guimarães (Ed.), *The Regulation and Policy of Latin American Energy Transitions* (pp. 3–20). Elsevier. <https://doi.org/10.1016/b978-0-12-819521-5.00001-2>
- Ocampo, J. A. (2017). Commodity-Led Development in Latin America. In *Alternative Pathways to Sustainable Development: Lessons from Latin America* (Issue 9, pp. 51–76). Graduate Institute Publications, Brill-Nijhoff.

- OECD, CAF Development Bank, ECLAC, & European Commission. (2019, September 27). *Latin American Economic Outlook 2019. Development in Transition*. OECD Publishing; OECD. <https://doi.org/10.1787/G2G9FF18-EN>
- OLADE. (2020a). *Panorama Energético de América Latina y el Caribe*.
- OLADE. (2020b, November 20). *Ministerial Decision Proposal L/D/XXX Relac Initiative*. Organización Latinoamericana de Energía. http://extranet.olade.org/wp-content/uploads/2020/11/Decision-Proposal-RELAC-2020_20201117_vfinal.pdf
- OLADE, & GWEC. (2020). *Procesos competitivos para el financiamiento de proyectos de energías renovables: Situación en América Latina y el Caribe*. Organización Latinoamericana de Energía & Global Wind Energy Council. <http://biblioteca.olade.org/opac-tmpl/Documentos/old0441.pdf>
- Ostrom, E. (2007). The Governance Challenge: Matching Institutions to the Structure of Social-Ecological Systems. In S. Levin (Ed.), *Princeton Guide to Ecology*. Princeton University Press.
- Overland, I. (2019). The geopolitics of renewable energy: Debunking four emerging myths. *Energy Research & Social Science*, 49, 36–40. <https://doi.org/10.1016/J.ERSS.2018.10.018>
- Pacheco, M. (Ed.). (2018). *Revolución energética en Chile*. Ediciones UDP.
- Parsons, J. A. (2008). Key Informant. In P. J. Lavrakas (Ed.), *Encyclopedia of Survey Research Methods* (pp. 406–408). Sage Publications, Inc. <https://doi.org/10.4135/9781412963947>
- Pasqualetti, M., & Stremke, S. (2018). Energy landscapes in a crowded world: A first typology of origins and expressions. *Energy Research & Social Science*, 36, 94–105. <https://doi.org/10.1016/J.ERSS.2017.09.030>
- Pastrana Buelvas, R., & Castro Alegría, E. (2020). Auge y estancamiento de la Alianza del Pacífico. *Análisis Carolina*, 7, 1–20.
- Peneff, J. (1995). Mesure et contrôle des observations dans le travail de terrain. L'exemple des professions de service. *Sociétés Contemporaines*, 21(1), 119–138. <https://doi.org/10.3406/SOCCO.1995.1423>
- Pérez Urdialez, M., Yépez, A., Tolmasquim, M., Alatorre, C., Rasteletti, A., Stampini, M., & Hallack, M. (2021). El papel de la transición energética en la recuperación sostenible de América Latina y el Caribe. *Nota Técnica Del BID*, 2142, 1–50. <https://doi.org/10.18235/0003214>
- Phillips, N. (2015). The Dynamics of Asymmetrical Development: Latin America in the Global Economy. In J. I. Domínguez & A. Covarrubias (Eds.), *Routledge Handbook of Latin America in the World* (pp. 85–96). Routledge.
- Pistonesi, H., Bravo, G., & Contreras Lisperguer, R. (2019). *Mapeo situacional de la planificación energética regional y desafíos en la integración de energías renovables Hacia una planificación sostenible para la integración energética regional*. CEPAL. www.cepal.org/apps
- Ploeg, F. van der, & Rezai, A. (2020). Stranded Assets in the Transition to a Carbon-Free Economy. *Annual Review of Resource Economics*, 12, 281–298. <https://doi.org/10.1146/ANNUREV-RESOURCE-110519-040938>
- Pradenas Canales, K. (2018). *La Huella Territorial de la generación de Energía Eléctrica en Chile : el caso de las regiones de Antofagasta, Metropolitana y del Biobío* [Universitat Autònoma de Barcelona]. <https://ddd.uab.cat/record/208042>
- Raineri, R. (2018). *Transición Energética en Chile : Una Verdad Incómoda*. 86. <http://www.clapesuc.cl/assets/uploads/2018/01/05-01-18-doc-trab-39-r-raineri-transicin-energetica-en-chile-una-verdad-incmoda-dec-9-2017.pdf>
- Raman, S. (2013). Fossilizing Renewable Energies. *Science as Culture*, 22(2), 172–180. <https://doi.org/10.1080/09505431.2013.786998>

- Reinert, H. (2018). Notes from a Projected Sacrifice Zone. *ACME: An International Journal for Critical Geographies*, 17(2 SE-Research).
- Rivera Albarracín, L. (2019). El cambio climático y el desarrollo energético sostenible en América Latina y el Caribe al amparo del Acuerdo de París y de la Agenda 2030. In *Documentos de trabajo (Fundación Carolina): Segunda época, ISSN-e 1885-9119, N.º. 15, 2019* (Issue 15). Fundación Carolina.
- Rivera Albarracín, L. (2020). Potencialidades del concepto de “transición justa” en el escenario de crisis económica y social de América Latina. *Caravelle*, 115, 105–120. <https://doi.org/10.4000/CARAVELLE.8951>
- Roberts, C., Geels, F. W., Lockwood, M., Newell, P., Schmitz, H., Turnheim, B., & Jordan, A. (2018). The politics of accelerating low-carbon transitions: Towards a new research agenda. In *Energy Research and Social Science* (Vol. 44, pp. 304–311). Elsevier Ltd. <https://doi.org/10.1016/j.erss.2018.06.001>
- Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., Lambin, E. F., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H. J., Nykvist, B., De Wit, C. A., Hughes, T., Van Der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P. K., Costanza, R., Svedin, U., ... Foley, J. A. (2009). A safe operating space for humanity. *Nature*, 461(7263), 472–475. <https://doi.org/10.1038/461472A>
- Rodríguez Becerra, M. (2019). *Nuestro planeta, nuestro futuro*. Debate.
- Rohracher, H. (2008). Energy systems in transition: Contributions from social sciences. *International Journal of Environmental Technology and Management*, 9(2–3), 144–161. <https://doi.org/10.1504/IJETM.2008.019026>
- Sachs, J. D., & Warner, A. M. (2001). The curse of natural resources. *European Economic Review*, 45(4–6), 827–838. [https://doi.org/10.1016/S0014-2921\(01\)00125-8](https://doi.org/10.1016/S0014-2921(01)00125-8)
- Sandra Cortes, A., Karla Yohannessen, V., Lidya Tellerias, C., & Ericka Ahumada, P. (2019). Exposure to contaminants from coal-fired thermoelectric plants and children’s health: What is the international and national evidence? *Revista Chilena de Pediatría*, 90(1), 102–114. <https://doi.org/10.32641/RCHPED.V90I1.748>
- Santos, T., & Sabbatella, I. (2020). Energy (and climate) challenges in South America: what planning for what transition? In *The Regulation and Policy of Latin American Energy Transitions* (pp. 59–74). Elsevier. <https://doi.org/10.1016/b978-0-12-819521-5.00004-8>
- Sareen, S., & Haarstad, H. (2018). Bridging socio-technical and justice aspects of sustainable energy transitions. *Applied Energy*, 228, 624–632.
- Sayed, E. T., Wilberforce, T., Elsaid, K., Rabaia, M. K. H., Abdelkareem, M. A., Chae, K. J., & Olabi, A. G. (2021). A critical review on environmental impacts of renewable energy systems and mitigation strategies: Wind, hydro, biomass and geothermal. *Science of The Total Environment*, 766, 144505. <https://doi.org/10.1016/J.SCITOTENV.2020.144505>
- Scarpellini, S., Rivera-Torres, P., Suárez-Perales, I., & Aranda-Usón, A. (2015). Analysis of energy poverty intensity from the perspective of the regional administration: Empirical evidence from households in southern Europe. *Energy Policy*, 86, 729–738. <https://doi.org/10.1016/J.ENPOL.2015.08.009>
- Schreiber, J. B. (2008). Descriptive Statistics. In L. M. Given (Ed.), *The SAGE Encyclopedia of Qualitative Research Methods* (Vols. 1–0, pp. 209–212). SAGE Publications, Inc. <https://doi.org/10.4135/9781412963909.N108>
- Scott, J. (1990). *A matter of record: documentary sources in social research*. Polity Press.
- Seto, K. C., Davis, S. J., Mitchell, R. B., Stokes, E. C., Unruh, G., & Ürge-Vorsatz, D. (2016). Carbon Lock-In: Types, Causes, and Policy Implications. *Annual Review of Environment and Resources*, 41, 425–452. <https://doi.org/10.1146/ANNUREV-ENVIRON-110615-085934>
- Sheppard, E. (2011). Geographical political economy. *Journal of Economic Geography*, 11(2), 319–331.

<https://doi.org/10.1093/JEG/LBQ049>

- Sheppard, E. (2018). Heterodoxy as Orthodoxy: Prolegomenon for a Geographical Political Economy. *The New Oxford Handbook of Economic Geography*, 159–178. <https://doi.org/10.1093/OXFORDHB/9780198755609.013.9>
- Simsek, Y., Lorca, Á., Urmee, T., Bahri, P. A., & Escobar, R. (2019). Review and assessment of energy policy developments in Chile. *Energy Policy*, 127, 87–101. <https://doi.org/10.1016/J.ENPOL.2018.11.058>
- Simsek, Y., Sahin, H., Lorca, Á., Santika, W. G., Urmee, T., & Escobar, R. (2020). Comparison of energy scenario alternatives for Chile: Towards low-carbon energy transition by 2030. *Energy*, 206, 118021. <https://doi.org/10.1016/j.energy.2020.118021>
- Smil, V. (2010). *Energy Transitions: History, Requirements, Prospects - Vaclav Smil*. ABC-CLIO.
- Smil, V. (2016). Examining energy transitions: A dozen insights based on performance. *Energy Research and Social Science*, 22, 194–197. <https://doi.org/10.1016/j.erss.2016.08.017>
- SNICHile. (2020). *Base de Datos del Inventario Nacional de Gases de Efecto Invernadero (1990-2018)*. Sistema Nacional de Inventario de Gases de Efecto Invernadero de Chile. <https://snichile.mma.gob.cl/documentos/>
- Sovacool, B. K., & Geels, F. W. (2016). *Further reflections on the temporality of energy transitions: A response to critics*. 22, 232–237. <https://doi.org/10.1016/J.ERSS.2016.08.013>
- Sovacool, Benjamin K. (2011). An international comparison of four polycentric approaches to climate and energy governance. *Energy Policy*, 39(6), 3832–3844. <https://doi.org/10.1016/j.enpol.2011.04.014>
- Sovacool, Benjamin K. (2014a). Diversity: energy studies need social science. *Nature*, 511(7511), 529–530. <https://doi.org/10.1038/511529a>
- Sovacool, Benjamin K. (2014b). Energy studies need social science: A broader pool of expertise is needed to understand how human behaviour affects energy demand and the uptake of technologies, says. *Nature*, 511(7511), 529–530. <https://doi.org/10.1038/511529A>
- Sovacool, Benjamin K. (2014c). *What are we doing here? Analyzing fifteen years of energy scholarship and proposing a social science research agenda*. 1, 1–29. <https://doi.org/10.1016/J.ERSS.2014.02.003>
- Sovacool, Benjamin K. (2016). How long will it take? Conceptualizing the temporal dynamics of energy transitions. *Energy Research and Social Science*, 13, 202–215.
- Sovacool, Benjamin K., Burke, M., Baker, L., Kotikalapudi, C. K., & Wlokas, H. (2017). New frontiers and conceptual frameworks for energy justice. *Energy Policy*, 105, 677–691. <https://doi.org/10.1016/J.ENPOL.2017.03.005>
- Sovacool, Benjamin K., Ryan, S. E., Stern, P. C., Janda, K., Rochlin, G., Spreng, D., Pasqualetti, M. J., Wilhite, H., & Lutzenhiser, L. (2015). Integrating social science in energy research. *Energy Research and Social Science*, 6, 95–99. <https://doi.org/10.1016/J.ERSS.2014.12.005>
- Späth, P., & Rohrer, H. (2010). “Energy regions”: The transformative power of regional discourses on socio-technical futures. *Research Policy*, 39(4), 449–458. <https://doi.org/10.1016/j.respol.2010.01.017>
- Spreng, D. (2014). Transdisciplinary energy research – Reflecting the context. *Energy Research & Social Science*, 1, 65–73. <https://doi.org/10.1016/J.ERSS.2014.02.005>
- Stake, R. E. (1995). *The Art of Case Study Research*. SAGE Publications.
- Steffen, W., Grinevald, J., Crutzen, P., & McNeill, J. (2011). The Anthropocene: conceptual and historical perspectives. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 369(1938), 842–867. <https://doi.org/10.1098/RSTA.2010.0327>
- Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., Biggs, R., Carpenter, S.

- R., de Vries, W., de Wit, C. A., Folke, C., Gerten, D., Heinke, J., Mace, G. M., Persson, L. M., Ramanathan, V., Reyers, B., & Sörlin, S. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*, 347(6223), 1259855. <https://doi.org/10.1126/science.1259855>
- Stein, A. L. (2017). Breaking Energy Path Dependencies. *Brooklyn Law Review*, 82(2), 559–604.
- Svobodova, K., Owen, J. R., Harris, J., & Worden, S. (2020). Complexities and contradictions in the global energy transition: A re-evaluation of country-level factors and dependencies. *Applied Energy*, 265, 114778.
- Tawalbeh, M., Al-Othman, A., Kafiah, F., Abdelsalam, E., Almomani, F., & Alkasrawi, M. (2021). Environmental impacts of solar photovoltaic systems: A critical review of recent progress and future outlook. *Science of The Total Environment*, 759, 143528. <https://doi.org/10.1016/J.SCITOTENV.2020.143528>
- Theys, J. (2017). Des Transitions a La Transition Ecologique. Débats Et Controverses Autour De La Notion De Transition . *Colloque «Eduquer et Former Au Monde de Demain»*, 1–21.
- Todorow, L. (2016). Understanding multi-stakeholder dialogues: the emerging concept of community of practice. *Business, Peace and Sustainable Development Journal*, Vol. 7, 8.
- Tornel, C. (2020). Integrating social and justice dimensions to energy transitions: the case of Mexico. In *The Regulation and Policy of Latin American Energy Transitions* (pp. 283–301). Elsevier. <https://doi.org/10.1016/B978-0-12-819521-5.00016-4>
- Torres, A. (2019). A Just Energy Transition: The Social, Political, and Economic Shifts Necessary to Divest from Coal in Colombia. *SSRN Electronic Journal*. <https://doi.org/10.2139/SSRN.3385161>
- Turnheim, B., & Geels, F. W. (2012). Regime destabilisation as the flipside of energy transitions: Lessons from the history of the British coal industry (1913-1997). *Energy Policy*, 50, 35–49. <https://doi.org/10.1016/j.enpol.2012.04.060>
- UERN CEPAL México. (2017). *Energía, cambio climático y desarrollo sostenible: los desafíos para América Latina*. Unidad de Energía y Recursos Naturales CEPAL México.
- UPME. (2019a). *Sistema Interconectado Nacional STN - STR con expansión* . Unidad de Planeación Minero Energética de Colombia. http://sig.simec.gov.co/GeoPortal/images/pdf/UPME_EN_STN_STR_ACTUAL_2019.pdf
- UPME. (2019b, December 5). *Metodología y resultados de la estimación del Índice de Cobertura de Energía Eléctrica ICEE - 2018*. Unidad de Planeación Minero Energética. http://www.upme.gov.co/Siel/Siel/Portals/0/Piec/Anexo3_Metodologia_ICEE_2018_paraComentariosDic5.pdf
- UPME. (2021a). *PEN 2020 – 2050: Transformación energética para el desarrollo sostenible*. Unidad de Planeación Minero Energética. <https://www1.upme.gov.co/DemandayEficiencia/Paginas/PEN.aspx>
- UPME. (2021b, August 11). *Informe de Registro de Proyectos de Generación de Electricidad. Inscripción según requisitos de las Resoluciones UPME No. 0520, No. 0638 de 2007 y No. 0143 de 2016*. Unidad de Planeación Minero Energética - UPME. <https://app.powerbi.com/view?r=eyJrIjojODRjNWMyNmEtZDI5MC00OGJhLWFrMTItYmU3NTNiMDE4MTM2IiwidCI6IjUxYzFhOGQwLTMyYmQtNDZiYi05YmRILTkxZTZINGU3MDRmZCJ9>
- UPME. (2021c, August 15). *SIMCO - Estadísticas del carbón en Colombia*. Sistema de Información Minero Colombiano. <https://www1.upme.gov.co/simco/Cifras-Sectoriales/Paginas/carbon.aspx>
- UPME, BID, & Ministerio de Minas y Energía de Colombia. (2015). *Integración de las energías renovables no convencionales en Colombia*. http://www1.upme.gov.co/DemandayEficiencia/Doc_Hemeroteca/Estudio_integracion_energias/Resumen_ejecutivo_integracion.pdf

- UPME, & Ministerio de Minas y Energía de Colombia. (2019, December 30). *Plan Indicativo de Expansión de Cobertura de Energía Eléctrica - PIEC 2019-2023*. Unidad de Planeación Minero Energética - Ministerio de Minas y Energía de Colombia. http://www.upme.gov.co/Siel/Siel/Portals/0/Piec/Informacion_Base_PIEC_Dic302019.pdf
- Urquiza, A., Amigo, C., Billi, M., Calvo, R., Labraña, J., Oyarzún, T., & Valencia, F. (2019). Quality as a hidden dimension of energy poverty in middle-development countries. Literature review and case study from Chile. *Energy and Buildings*, 204, 109463. <https://doi.org/10.1016/j.enbuild.2019.109463>
- Van de Graaf, T., & Colgan, J. (2016). Global energy governance: a review and research agenda. *Palgrave Communications*, 2(1), 1–12. <https://doi.org/10.1057/palcomms.2015.47>
- Velasco-Herrejon, P., & Bauwens, T. (2020). Energy justice from the bottom up: A capability approach to community acceptance of wind energy in Mexico. *Energy Research and Social Science*, 70.
- Viana, A. (2020). Using market mechanisms for a reliable energy transition in Latin America. In L. Noura Guimarães (Ed.), *The Regulation and Policy of Latin American Energy Transitions* (pp. 21–37). Elsevier. <https://doi.org/10.1016/B978-0-12-819521-5.00002-4>
- Villada Duque, F., López Lezama, J. M., & Muñoz Galeano, N. (2017). Efectos de los incentivos para energías renovables en Colombia. *Ingeniería y Universidad*, 21(2), 257–272. <https://doi.org/10.11144/JAVERIANA.IYU21-2.EIRE>
- Viscidi, L., & Yépez-García, A. (2019, December). *Clean Energy Auctions in Latin America*. IDB Energy Division; Inter-American Development Bank. <https://doi.org/10.18235/0002133>
- WEF. (2018). Fostering Effective Energy Transition. A Fact-Based Framework to Support Decision-Making. In *McKinsey & Company* (Issue March).
- WEF. (2021, April 20). *Fostering Effective Energy Transition 2021 edition*. World Economic Forum. <https://www.weforum.org/reports/1edb4488-deb4-4151-9d4f-ff355eec499a/in-full>
- WEF, & IHS CERA. (2013). *Energy Vision 2013. Energy transitions: Past and Future Industry Vision Prepared in Partnership with IHS CERA*. World Economic Forum.
- Wehnert, T., Andreeva, T., Fekete, H., Lütkehermöller, K., Luna, L., & Vieweg, M. (2019). *Challenges of Coal Transitions - A comparative study on the status quo and future prospects of coal mining and coal use in Indonesia, Colombia and Viet Nam*.
- Weng, W., Becker, S. L., Lüdeke, M. K. B., & Lakes, T. (2020). Landscape matters: Insights from the impact of mega-droughts on Colombia's energy transition. *Environmental Innovation and Societal Transitions*, 36, 1–16. <https://doi.org/10.1016/j.eist.2020.04.003>
- Williams, S., & Doyon, A. (2019). Justice in energy transitions. *Environmental Innovation and Societal Transitions*, 31, 144–153. <https://doi.org/10.1016/J.EIST.2018.12.001>
- Wood, N., & Roelich, K. (2020). Substantiating Energy Justice: Creating a Space to Understand Energy Dilemmas. *Sustainability 2020, Vol. 12, Page 1917, 12(5)*, 1917. <https://doi.org/10.3390/SU12051917>
- World Bank. (2021). *World Development Indicators*. The World Bank Data Bank. <https://databank.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG/1ff4a498/Popular-Indicators>
- XM. (2019, March 1). *Resultados generales subasta OEF 2022-2023*. Compañía Expertos En Mercados S.A. E.S.P.
- XM. (2021). *Reporte integral de sostenibilidad, operación y mercado 2020*. Compañía Expertos En Mercados S.A. E.S.P.
- Yergin, D. (2020). *The New Map: Energy, Climate, and the Clash of Nations*. Penguin Press.
- Yin, R. K. (1998). The Abridged Version of Case Study Research- Design and Method. In L. Bickman & D. J. Rog (Eds.), *Handbook of Applied Social Research Methods* (pp. 229–260). SAGE Publications.

- Yin, R. K. (2009). *Case Study Research: Design and Methods* (4th ed.). SAGE Publications.
- Zalasiewicz, J., Williams, M., Haywood, A., & Ellis, M. (2011). The anthropocene: A new epoch of geological time? *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 369(1938), 835–841. <https://doi.org/10.1098/RSTA.2010.0339>
- Zapata, S., Castaneda, M., Garces, E., Franco, C. J., & Dyner, I. (2018). Assessing security of supply in a largely hydroelectricity-based system: The Colombian case. *Energy*, 156, 444–457.
- Zurita, A., Castillejo-Cuberos, A., García, M., Mata-Torres, C., Simsek, Y., García, R., Antonanzas-Torres, F., & Escobar, R. A. (2018). State of the art and future prospects for solar PV development in Chile. *Renewable and Sustainable Energy Reviews*, 92, 701–727. <https://doi.org/10.1016/J.RSER.2018.04.096>

Tables & Figures Index

Table 1. Case selection criteria.....	38
Table 2. Key characteristics of the regional case studies.....	44
Table 3. Thematic Content Analysis Matrix.....	48
Table 4. Key energy governance institutions in Chile and Colombia.	65
Table 5. 2022 -2023 Firm Energy Obligations auction overall results by source.....	99
Table 6. Access to electricity in the municipalities of La Guajira.....	107
Figure 1.1. World GHG emissions by sector, end use/activity and type of gas in 2016.....	9
Figure 1.2. N-gram “Energy Transition” frequency of occurrence in written sources (1969-2019)	10
Figure 1.3. Selected global milestones for policies, infrastructure, and technology deployment in the Net Zero Emissions scenario	12
Figure 1.4. Six components of IRENA’s Energy Transition Strategy to achieve total mitigation of energy-related emissions by 2050 in a <1.5°C pathway.....	13
Figure 1.5. CO ₂ Emissions per capita in selected countries/regions of the world	14
Figure 1.6. GHG emissions by region and sector in 2018.....	15
Figure 1.7. Energy consumption pattern by region of the world in 2020.....	16
Figure 1.8. Political and administrative map of La Guajira.....	39
Figure 1.9. Contribution of mining to regional GDP in Antofagasta and La Guajira (2008-2019).....	41
Figure 1.10. Political and administrative map of Antofagasta.....	43
Figure 1.11. Diagram of the research phases.....	44
Figure 1.12. Triangulation between methods	46
Figure 1.13. Triangulation within a method	47
Figure 2.1. Energy intensity trajectories in Chile and Colombia (1990-2020).....	50
Figure 2.2. Net GHG emissions by IPCC sector in Chile and Colombia in 2012	51
Figure 2.3. Share of fossil fuels and renewables in Chile’s power supply (1990-2019)	52
Figure 2.4. Share of fossil fuels and renewables in Colombia’s power supply (1990-2019)	53
Figure 2.5. Evolution of power supply in Chile by source (1990-2019)	55
Figure 2.6. Evolution of power supply in Colombia by source (1990-2019)	59
Figure 2.7. Chile’s power generation market share by company in 2020	62
Figure 2.8. Colombia’s power generation market share by company in 2020	63
Figure 2.9. Timeline of key policies, regulations and milestones for NCRE integration in Chile and Colombia	68
Figure 3.1. Renewable energy potential maps: (a) Mean wind energy density at 100m in the department of La Guajira; (b) PV power potential in Chile.....	72

Figure 3.2. NCRE projects registered in Antofagasta and La Guajira (2008-2021).....	73
Figure 3.3. Prospective expansion map of Colombia's National Transmission System (STN) and Regional Transmission Systems (STRs) with a 2033 horizon.....	75
Figure 3.4. Maps of NCREs in the studied regions: (a) Spatial distribution of projected wind farms in La Guajira, and coincidence with the territories of Wayúu indigenous communities; (b) Geo-referencing of NCREs at an advanced stage of development in Antofagasta.....	77
Figure 3.5. Wayúu women near Jeirachí wind turbines	78
Figure 3.6. Plan de Licitaciones (2018-2022); (a) Map of properties earmarked for energy projects; (b) Top 10 communes with the largest surface area to be tendered.....	81
Figure 3.7. Cerro Dominador solar power complex (PV+CSP plant)	83
Figure 3.8. Hard Coal exports to Chile from La Guajira.....	86
Figure 3.9. Satellite maps of El Cerrejón: a) Mining titles; b) Historical evolution of pits and dumps.....	88
Figure 3.10. Information documents for Antofagasta's sacrifice zones	90
Figure 3.11. Coal-fired plants installed capacity by company (2017 vs. 2021).....	93
Figure 3.12. First phase retirement schedule for the coal-fired power plants in Tocopilla and Mejillones.....	94
Figure 3.13. Access to electricity in Colombia by department (2018)	106
Figure 3.14. Access to electricity in Chile by region (2017).....	108
Figure 3.15. Penetration of NCRE sources and average electricity prices in Chile (2008–2021)	111
Figure 3.16. Participation process for the design of the Just Transition strategy in Chile.....	118

Résumé

Le mix énergétique de l'Amérique latine est souvent considéré comme le plus propre au monde, en vertu de la forte contribution de l'hydroélectricité et des biocarburants à la consommation d'énergie dans plusieurs pays sud-américains. Pourtant, la région s'est inscrite dans la tendance mondiale de transition vers une économie bas carbone, notamment depuis la proclamation de l'Accord de Paris. Dans ce contexte, certains pays ont été mis en lumière au niveau international pour leurs engagements en matière de réduction des émissions et leurs plans de décarbonisation. C'est précisément le cas de la Colombie et du Chili, les principales économies andines. Grâce principalement à la création d'écosystèmes d'investissement visant à intégrer les énergies renouvelables non conventionnelles (ERNc) dans leurs réseaux électriques nationaux, ces pays sont devenus des leaders régionaux dans le domaine de la transition énergétique. Cependant, en examinant la trajectoire territoriale de leurs principales régions productrices d'énergie, les tensions sous-jacentes à la transformation des systèmes énergétiques deviennent évidentes.

En partant d'une perspective d'économie politique géographique (EPG), ce mémoire est axé sur la comparaison de deux études de cas régionales : d'une part, le département de La Guajira en Colombie, où 16 parcs éoliens étaient en cours de réalisation en 2021 ; d'autre part, la région d'Antofagasta au Chili, où plus de 20 projets à grande échelle et concernant un vaste éventail de technologies énergétiques étaient en phase de construction afin de renforcer la transition du secteur électrique chilien vers les énergies renouvelables. Par conséquent, cette comparaison des nouveaux espaces énergétiques vise à dévoiler les impacts des politiques de transition énergétique au-delà de la rhétorique de l'action climatique. En mettant en rapport l'approche de l'EPG avec un cadre théorique de transition juste pour analyser la reconfiguration du paysage énergétique dans ces deux régions, cette étude cherche finalement à faire ressortir quelques considérations essentielles en matière de justice et d'équité qui sont absentes des cadres de politique énergétique existants en Amérique latine.

Mots clés : transitions énergétiques, Colombie, Chili, La Guajira, Antofagasta, énergies renouvelables non conventionnelles, nouveaux espaces énergétiques, transition juste.

Abstract

It is often repeated that Latin America has the cleanest energy matrix in the world due to the significant share of hydropower and biofuels in several South American countries. Yet, especially since the Paris Agreement proclamation, the region has followed the global trend of transitioning towards a low-carbon economy. In this context, some countries have been spotlighted at the international level for their mitigation commitments and decarbonization plans. This is the case with Colombia and Chile, the main Andean economies. Mainly through the creation of investment ecosystems to integrate non-conventional renewable energies (NCRE) into the grid, these countries have been building regional leadership regarding the energy transition. However, when looking at the territorial trajectory of their energy-producing regions, the tensions emerging from the transformation of national energy systems become evident.

From a geographical political economy (GPE) perspective, this dissertation focuses on comparing two regional case studies: on the one hand, the department of La Guajira in Colombia, where 16 wind farms were underway by 2021; on the other hand, the Antofagasta region in Chile, where more than 20 utility-scale projects from a wide spectrum of NCRE carriers were under construction to continue energizing the shift of the Chilean electricity matrix towards renewables. Therefore, this comparison of

new energy spaces aims to unravel the impacts of energy transition policies beyond the rhetoric of climate action. By bridging this GPE approach with the just transition framework to interpret the reconfiguration of the energy landscape in these places, it seeks to bring to light some key considerations of justice and equity that are absent in existing energy policy frameworks.

Keywords: energy transitions, Colombia, Chile, La Guajira, Antofagasta, non-conventional renewable energy, new energy spaces, just transition.