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**Financial geopolitics and energy transition
the current financial territorialization of renewable energy in Mexico**

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Financial geopolitics and energy transition: the current financial
territorialization of renewable energy in Mexico

Presented by:

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Abstract

This thesis draws from a critical perspective on the connections between geography, energy and finance. It explores the recent development of a hypothetical energy transition in Mexico, analysing the financial processes and mechanisms that are underpinning the expansion of renewable energy technologies and infrastructure. Since the 2013-2014 Energy Reform, Mexico's energy system transitioned from a State-owned industry to a private-driven market based on financial structures. This explains how the current deployment of renewable energy projects and electricity markets in Mexico has become financialised, showing how financial actors and institutions are expanding into the energy transition frontier. Additionally, this finance-Energy Transition nexus has had increasing impacts in the Mexican territory. To assess this process, I included the case study of the northern Mexican state of Baja California, a region with solar and wind energy potential but isolated from the rest of the electricity system in the Mexican heartland. Thus, Baja California became a reference to analysis of how finance produces a specific geographical knowledge in the deployment of energy transition projects, organising the space according to financial needs and interests. By exploring the geographical implications of large-scale renewable energy projects in Baja California, I assess the limits of the mainstream approaches to the Energy Transition and the possibilities for alternative finance-energy relations for local socioecological transitions.

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Finally, I must state that, despite the people and institutions mentioned above, the errors and omissions that prevail throughout this work are solely my responsibility as the author.

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Acronyms

AMLO – Andrés Manuel López Obrador (Mexico's president, 2018-2024).

BC – Baja California.

CC – Climate Change.

CEC – Clean Energy Certificate

CENACE – Centro Nacional de Control de Energía (System Operator)

CF – Climate Finance.

CFE – Comisión Nacional de Electricidad.

ER – Energy Reform enacted in 2013-2014.

ET – Energy Transition (mainstream).

FF – Fossil Fuels.

FTR – Financial Transmission Right.

GCF – Green Climate Fund.

GIS – Geographical Information System.

IADB – Inter-American Development Bank.

IDB – International Development Banks

LMP – Local Marginal Price.

LTA – Long-Term (electricity) Auction.

M&A – Mergers and Acquisitions.

MDB – Mexican Development Bank.

MXN – Mexican peso.

NAFIN – Nacional Financiera (a MDB)

Pemex – Petróleos Mexicanos.

PPA – Power-Purchase Agreement.

PPP – Public-Private Partnership.

RE – Renewable Energy.

SENER – Secretaría de Energía (Mexico's Ministry of Ennergy).

WEM – Wholesale Electricity Market.

INTRODUCTION

Times of crisis are also times of great freedom. Our world is out of joint; societies are disintegrating, our lifelong hopes and values are crumbling. The future ceases to be a continuation of past trends. The meaning of present development is confused; the meaning of history suspended.

— ANDRÉ GORZ, *Paths to Paradise*, 1983

Electricity systems and financial markets are two of the largest and more complex sectors of contemporary capitalism. Their entanglement acquired relevance during the last 20 years in the face of climate change impacts and the narrative of low-carbon energy transitions. It is believed that the world is moving towards electrification, and the global task of scaling renewable energy technologies and infrastructure would be achievable through a massive expansion of financial mechanisms and markets. Yet large-scale investments in renewable energy is already having different impacts and implications in various latitudes due to variegated socioecological and geographical conditions. In order to shed some light on these processes, this thesis will explore the connections between geography, energy and finance, offering a broader perspective on the mechanisms and concrete manifestations of the move of finance towards the energy transitions frontier. The objective is to grasp, understand and explain the current progress of this energy-finance symbiosis, problematising the role of financial actors and institutions and achieving a deeper understanding of the combined operation of electricity systems and financial markets.

To approach this phenomenon, I have proposed Mexico as my main empirical reference. Mexico is a mature country with more than a century of oil activity. This historical oil dependency is one of the foundations of the Mexican State, resulting in a series of fossilised geographies, landscapes, cultural representations, economic structures, and power-class relations. The Mexican energy nationalism (inaugurated with the expropriation and nationalisation of oil in 1938 and electricity in 1960), is now in the midst of the climate debate, facing a terminal depletion of oil reserves since 2003 and the increasing pressures to open its territory for renewable energy investments since the 2014 Energy Reform and the 2015 Paris Agreement.

I believe that the importance of this dissertation lies in how a country like Mexico is adapting to the current financial expansion of energy transitions. Studying finance means analysing a combination of power structures, techno-economic hermetic languages and geographical processes. To achieve this, this dissertation wants to set a critical precedent on how the Climate Finance narratives and policies are shaping these early stages of financial expansion into renewable energy and electricity markets, pointing to the specific campaigns and material interests that introduced the finance-based Energy Transition like the one experienced in Mexico since 2014. The dissertation highlights not only the discourses but also the institutional linkage between financial institutions, energy companies, technology developers, NGOs, environmental think tanks and international agencies on their task to

reinforce these expansion processes by endorsing finance as the one-and-only vector to achieve energy transitions. This contribution aims to fill a space in the literature on how the many institutions that intervened in reforming the Mexican energy sector to push the Energy Transition political and economic project represent a major trend subjected to comparative analyses with other countries or regions.

Project background and justification

This thesis is the result of three parallel processes.

The first is an academic interest in continuing a previous master's research project. During 2012-2016, I was curious about the finance-oil relation and how financial interests have a long-standing geopolitical presence in the Mexican energy history. I proposed the concept of *financial geopolitics* to give a geostrategic interpretation of the US-Latin America energy relations, analysing several factors such as the financialisation of oil and the expansion of financial interests into the non-conventional fossil fuels reserves in Mexico and Argentina. The resulting research work was later published and has contributed to a debate on the future of oil in the region (see Álvarez-Herrero, 2019). This gave me an impetus to continue studying finance-energy relations. At the time, the Paris Agreement introduced a national debate of how a highly oil-dependent nation like Mexico could achieve an energy transition to renewable energy. The Climate Finance reports that resulted from the COP21 ranked Mexico as one of the attractive countries to invest in renewable energy due to its privileged geography. This sparked some inquiries that evolved as the initial research questions for this thesis:

- *Is finance a central force behind the renewable energy deployment in Mexico?*
- *Is an Energy Transition taking place in Mexico because of financial processes?*
- *Why does finance matter for the materiality of renewable energy?*

Although the presence of renewable energy is relatively recent compared to the Mexican oil tradition, I decided to begin with the first stage of the expansion of renewables (2014-2018), exploring the possibilities of processes of continuity and rupture between the financialisation of oil and renewables. This idea evolved as the main proposal to the PhD.

The second motivation for this project is the possibility to contribute to the finance-energy consultancy field through applied research. Since my undergraduate, I had the opportunity to assess environmental impact projects from a financial standpoint, supporting investment decisions that benefited the access to clean water or the impact mitigation of infrastructure development. Although brief, these jobs exposed me to the dynamics of environmental consultancy projects, achieving a preliminary integration of financial and ecological concerns. This vocational side was soon combined with the critical approach to finance that I developed in the master's research project. Over time, I developed a critical finance research agenda while looking for ways of applied research in alternative financial consultancy to support local energy and climate change initiatives. Achieving this would require a deeper understanding of the finance-energy transitions relations, taking further the study of electricity systems and markets, Climate Finance investment mechanisms, transmission infrastructure deployments, and the

geographical implications of renewable energy projects. This became one of my main arguments during my PhD application.

The third incentive was a visit to the northern Mexican state of Baja California in April 2017. Before the first year of the PhD, I had a visit invitation from Prof. Rubén Lara-Lara, an oceanographer researcher at the Ensenada Centre for Scientific Research and Higher Education (CICESE), in Baja California. At the time, we discussed the financial implications of the Mexican Carbon Program and the potential role of investment schemes for the new renewable energy research centres developed by the State agency CONACYT. Prof. Lara-Lara was interested in how to incorporate a financial element for the acceleration and development of regional projects related to environmental and energy issues. These projects were related to the current challenges that the region face: reducing dependence on fossil fuels by using local renewable energy, mitigating water stress through irrigation systems and desalination plants, and improving sustainable agricultural systems. This energy-water-agriculture nexus became the first energy transition reference I experienced in the territory. On the other hand, I met actors on the financial side with investment interests in large-scale solar and wind projects to sell energy to the Mexican State-owned utility CFE (Federal Electricity Commission) or supply the US market (California). Since then, I was curious about using Baja California as a case study since it is an energy island not integrated into the electricity system of the Mexican heartland. During the first year of the PhD, I included Baja California as my empirical reference aiming to understand both the progress of a mainstream Energy Transition and the potential for local autonomous renewable energy projects. The research questions that guided this experience were:

- *What are the geographical implications of investing in a large-scale energy transition in Mexico?*
- *How does finance organise space for energy transition projects in a region like Baja California?*

It is important to add that this dissertation evolved through different stages, adapting to the recent events in the Mexican political arena and the international context. From 2017 through 2018, the research project was immersed in the first stage of the mainstream Energy Transition in Mexico, a process that started since the enactment of the 2013-2014 Energy Reform and its deregulation and liberalisation policies. The Energy Reform has been the main vector that dismantled the Mexican State-owned energy sector to introduce a private-driven wholesale electricity market based on a financial structure. This shift represented a major structural change that has sought the privatisation of strategic sectors of the Latin American economy since the 1980s.

Yet, in 2019, a new left-wing administration under the presidency of Andres Manuel López Obrador (AMLO) stopped these opening and privatisation processes, taking back the oil and electricity industries to the State energy companies (Pemex and CFE, respectively). This led to a hiatus in the development of the mainstream Energy Transition where private players have had difficulties and uncertainties developing new renewable energy projects and participating in the wholesale electricity market. This allowed me to mark a watershed to understand how and by which mechanisms the first stage of the ET had evolved. However, the Covid-19 crisis in 2020 brought further delays and cancellations of renewable energy projects.

During the pandemic, the new CFE administration disclosed information on the financial process that the Energy Reform introduced. This helped me to complete the financialisation analysis with concrete data and official information. Thus, the adaptation process of this thesis managed to conserve the main ingredients of its former version, adding new perspectives through fieldwork.

This dissertation wants to set a critical precedent on how the Climate Finance narratives and policies are shaping these early stages of financial expansion into renewable energy and electricity markets, pointing to the specific campaigns and material interests that introduced the finance-based Energy Transition like the one experienced in Mexico since 2014. The dissertation highlights not only the discourses but also the institutional linkage between financial institutions, energy companies, technology developers, NGOs, environmental think tanks and international agencies on their task to reinforce these expansion processes by endorsing finance as the one and only vector to achieve energy transitions. This contribution aims to fill a space in the literature on how the many institutions that intervened in reforming the Mexican energy sector to push ET political and economic project represent a major trend subjected to comparative analyses with other countries or regions.

Content summary

The dissertation is arranged thematically in 7 chapters, plus introduction and conclusions.

Chapter 1 contains an introductory literature review of the mainstream narrative that emerged from the Paris Agreement. This is the contextualisation of the current trends on Climate Finance and the investment roadmaps for a large-scale global Energy Transition. It is the first step into the mental and operative universe of the financial sector. These reports were crucial in understanding the origins, characteristics, mechanisms and lexicon of the environmental shift that finance has undertaken in recent decades. The objective is to penetrate these discourses, ideas and arguments to comprehend and critique the development of Climate Finance.

In chapter 2, I will review the contemporary climate debate from an interdisciplinary perspective. I have gathered different critical approaches on the historical-theoretical foundations of human geography, the political ecology of financialisation, the political sociology of climate change, and the future studies of finance-energy relations. This literature inspired me to establish the key subject of the research project: the contradictory relationship between financial expansion and the deployment of a hypothetical mainstream Energy Transition. The structure of the chapter helped me to support my analysis of the Mexican case study and discuss research outcomes.

In chapter 3 there is an exposition of the methodological procedures I followed to answer research questions and achieve dissertation objectives. I detail both the interpretative and research methods that guided my inquires, as well as the qualitative procedures of obtaining, managing and exposing information collected from fieldwork.

Chapter 4 contains an introductory context to the Mexican case study. I analyse the three main historical processes that shaped the idea of a hypothetical Energy Transition in Mexico: *a)* the 2013-2014 Energy Reform, *b)* Mexico's alignment to the Climate Finance international agreements, and *c)* Mexico's role in the North American Energy Integration (NAEI) geopolitical scheme. These processes were documented in several reports that underpinned the enactment of

the Energy Reform. The objective is to denote the interaction of the endogenous and exogenous variables and the State and class relations that shaped the Energy Transition model in Mexico.

Chapter 5 is an in-depth analysis of the financial structure and the deregulation/liberalisation policies that underpin the new wholesale electricity market model. Here I am tracing financialisation symptoms in the electricity market chain (generation, transmission, distribution, and retail), exploring the different roles that financiers have in the market (funders, project developers, traders and brokers), and deciphering the different mechanisms that financial actors and institutions established to profit from the new renewable energy business models (mechanisms of separation, integration, negation and rent-extraction). Overall, my intention is to identify both the continuity patterns and new mechanisms that finance introduced in the renewable energy industry in Mexico.

Chapter 6 consists of the Baja California case study, identifying recent trends of how the region is understood and shaped like an energy investment space. I expose the financial territorial perspective of the Energy Transition, deciphering how financial interests organise and produce space according to the strategic vision of renewable energy locations, the spatial deployment of generation plants, the expansion of transmission infrastructure, and the geography of prices, markets and energy-intensive industries. I also explore the financial-spatial limits of a large-scale deployment of Energy Transition projects and its implications for the Baja California isolated energy system.

The general conclusions offer a panoramic of the key contributions of the research. These topics are the financialisation debate, the precedents laid by this project, and the role of the State in energy transitions. The discussion aims to fill a gap in the literature by contributing to the finance-energy-geography literature.

CHAPTER I

Mainstream approaches to the Climate Finance and Energy Transition narratives

[...] there was inevitably some communication between living capital and more or less inert capital, with the part of the latter always turning into the former. And this phenomenon is all the more significant, today as in the past, since [...] the richest people are not necessarily the most active capitalists. This store of hoarded money constituted a mass of reserves, securities and guarantees for the whole economy. It was like a sponge saturated with water.

— FERNAND BRAUDEL, *The Identity of France*, 1986

During the last decade, one of the main debates around climate change (CC) has been the need to finance large-scale energy transitions that could mitigate carbon emissions and prevent the global atmospheric temperature from rising above the irreversible 2°C threshold. Because of its contemporary predominance, the financial sector has taken the lead on mainstream climate actions by establishing the shape, scale, scope, and speed of the deployment of renewable energy (RE) technologies, infrastructure, and markets to achieve hypothetical low-carbon futures. After accumulated UN climate summits, the label "Climate Finance" (CF) emerged as a way of marring financial innovations and environmental concerns in the search for "solutions" to mitigate CC. Such an initiative deals with the possibilities, opportunities, and risks of a mainstream financial-led Energy Transition (ET) in decades to come.

In this chapter, I will briefly review the literature on some of the current trends of a hypothetical mainstream ET, as well as the financial narrative and mechanisms that would achieve its goals on both global and regional scales. The objective is to give a brief introduction of the basic elements of the CF discourse and the financial interests pushing towards the environmental frontier and massive RE deployments. This would help me to expose the main variables that are currently influencing the progress of an ET in Mexico, defining the context where my later case study and fieldwork experience take place.

1.1. Filling the gap: a brief look into the mainstream narrative elements

Throughout several of the UN climate agreements, the financial sector has become a dominant force to address environmental adversities in areas like technology, infrastructure, emissions markets, and the sustainable management of natural spaces and resources (UNFCCC, 2007, 2009; Smallridge *et al.*, 2013). The central argument is that the average global temperature is currently $\pm 1.1^{\circ}\text{C}$ above pre-industrial levels due to anthropogenic carbon emissions, predicting that the world could cross the adverse 1.5°C line towards 2030 and the irreversible 2°C threshold by 2050. Therefore, "limiting global warming to 1.5°C is still narrowly possible and will be determined by the investment decisions we make over the next decade" (GCF, 2021: 1). Based on this premise, CF has been defined as "the local, national or transnational financing (drawn from public, private, and alternative sources) that seeks to support mitigation and

adaptation actions that will address climate change"; its mechanisms focus on "assessing the financial needs of developing countries, as well as to understand how these financial resources can be mobilised" (UNFCCC, 2020).¹ As a result of the 2015 COP21 in Paris, CF initiatives aligned with the recent "climate emergency" declaration and the acknowledgment of irreversible ecological adversities due to rising global temperatures. This moment captures a late stage of a broader process in force during the last 30 years, just when "the corporate environmentalism made its transition into the mainstream", and also when CC "moved from a niche academic debate to a looming catastrophe" (Adams, 2009: xvi, 86-139).

As Wolf (2011) stated, CF evolved as a discourse based on financial frameworks and terminologies that translate into mitigation and adaptation policies, North-South financial cooperation, and investment flows towards low-carbon sectors of the "green economy". According to the financial firm FTSE Russell, since 2008 the evolution of environmental markets has been a constant and permanent "sizing of the green economy", in terms of identifying opportunities and value market capitalisation of all the interconnected, multifaceted, and diversified areas and sub-areas subject to climate investment (Dai & Campos, 2020). Deepen this "green space" for capital (especially in the "developing world") means that financial institutions and actors are shifting investment strategies to "create new markets, address long-term opportunities and risks arising from climate change, promote wider socio-economic benefits, and minimise social and environmental harm" (WRI, 2020).

Unlocking this investment potential relies on an institutional infrastructure —based mainly on the World Bank's Global Environmental Facility (GEF) and Green Climate Fund (GCF)—designed to facilitate North-South financial flows into the developing countries (UNFCCC, 2016; GCF, 2021).² These investments require structured coordination between institutional investors, private banks, financial firms, stock markets, consultancy agencies, and corporations, in coalition with local ministers of finance, governmental bureaucracies and research sectors (UNFCCC, 2020). The proper economic environment would be provided by the International Monetary Fund blueprint for Central Banks and financial systems to "greening" macroeconomic frameworks, promote sustainable finance, drive carbon trading markets, and support reforms to fossil fuels (FF) subsidies (IMF, 2020).

Broadly speaking, CF opened four interrelated environmental markets:

- 1) *Low-carbon technologies and infrastructure*. These projects are designed for the management and circulation of the so-called "natural capital": natural resources, spaces, reserves, and ecosystem services (see Natural Capital Coalition, 2018; The Nature

¹ "Climate Finance" relates to similar conceptual variations like "Mitigation Finance" and "Adaptation Finance" (Watson & Schalatek, 2021, 2021a). Other terms are: "Environmental Finance", referring to "the project management and market mechanisms focused on producing the greatest environmental benefit for the largest number of people at the lowest possible cost" (Curley, 2014: 2); "Net-Zero Finance", to address future scenarios where the market, policy and institutional requirements are unlocked to finance emission reduction schemes and costs savings (Robins, 2020); "Sustainable Finance", defined as the financial mechanisms "that assimilate environmental and social factors to promote sustainable economic growth and the long-term stability of the financial system" (Smith & Simpson-Marran, 2021: 6); this differs from "Transitional Finance", whose objective is to invest in emissions mitigation in the large polluting industries harder to decarbonise (Smith & Simpson-Marran, 2021: 7).

² A brief but comprehensive guide to the "Global Climate Finance Architecture" can be found in Watson & Schalatek, 2021b.

Conservancy, 2019). These technologies and infrastructure are funded through project finance schemes using financial instruments like climate bonds and syndicated loans promoted by the banking sector and international development funds (Coalition for Green Capital, 2020; GCF, 2021).

- 2) *The securitisation of natural resources and environmental processes.* CF represents the transformation of fixed climate assets into commodified and securitised financial assets. For Sandor *et al.* (2014), it is the creation of a new asset class like the rights to emit pollutants renewable energy credits, water quality and quantity rights; weather risk management, and indices of sustainable corporate equities. These assets must offer the benefits of "a) scale (the capacity to absorb sizable capital inflows/outflows), and b) liquidity (frequent trading that allows securities to be bought or sold immediately)" (Donovan, 2020: 9). Instead of participating in real assets —solar or wind farms that "does not offer the necessary scale or liquidity that many investors need to adequately manage an investment portfolio" (p. 9)— investments tend to materialise in asset-backed securities (ABS) like shares of a publicly-traded RE company (equity), loans for energy projects (debt), ownerships in fixed facilities (real estate), and speculative runs on the price of electricity, oil, or carbon emission allowances (commodities) (p. 9).
- 3) *Environmental FinTech.* CF relies on the current development of digital technologies, microfinance, and high-frequency information exchange. For financial intermediation and expansion, this represents "new opportunities for raising capital, enhancing transparency, and making market mechanisms more inclusive. New online financing platforms can aggregate global data on isolated investment opportunities, cutting the number of intermediaries between investors and project holders" (OECD-World Bank, 2018: 9). Thus, digital initiatives like crowdfunding and financial match-making online platforms have also helped to integrate broader public participation in environmental projects and raise awareness of the impacts of CC (UN Environment, 2019; TFDf, 2020).
- 4) *Climate adaptation programs.* A recurrent argument within the climate debate is the idea of investing in adaptation mechanisms rather than mitigation actions. From a financial standpoint, this would be more cost-effective rather than reducing emissions. As the Goldman Sachs (2019) research group stated, reducing carbon emissions is an important part of CF but insufficient to prepare the global economy for climate adversities. For the investment bank, there is already too much carbon accumulated in the atmosphere and the oceans that will continue this warming process that just cannot be turned off quickly.³ Thus, adaptation investment encompasses innovative financial instruments (government funds, PPP, institutional investors) to finance a broader infrastructure agenda (urban planning, coastal protections, climate-resilient construction, upgraded water and waste-management systems, renewable energy, resistant communication networks and stronger transportation systems (Goldman Sachs, 2019: 3). The main interest lays in the so-called "developing economies" where international financial institutions can provide investment mechanisms to adapt regions to climate risks and potential conflicts related to displacements, resettlements,

³ The report can be found in Goldman Sachs, 2019. An interview with the authors is in Goldman Sachs, 2019a.

and lack of access to vital resources (see De Sherbinin *et al.*, 2011: 457; World Bank, 2019; Goldman Sachs, 2019: 3).

Energy is a centrepiece that integrates these four major CF trends. The international energy matrix is around 80% FF and accounts for nearly 90% of CO₂ emissions globally, "being the dominant contributor to climate change" (IEA, 2019a).⁴ The heavy dependence on FF-based energy systems represents a double interrelated challenge: *a*) FF are a relatively abundant but eventually finite source of energy that is vital for several contemporary industrial and human needs (Ritchie & Roser, 2017; Ritchie, 2017); and *b*) this dependence translates into an international asymmetric conflict: while some countries live in energy poverty others are the mayor carbon emitters (Roser, 2020). These arguments are part of the mainstream literature that introduced the need for an ET based on business opportunities to decarbonise the economies. That is, the deployment of RE⁵ and energy efficiency programs that "must supply 70 to 85% of electricity by 2050 for the global economy to meet the goals of the Paris Agreement", delivering "over 90% of the energy-related CO₂ emission reductions required to limit global temperature rise" (GCF, n.d.: 2).

In general terms, an ET supposes a wide process of economic, social, and geopolitical changes; a shift from a system dominated by FF towards a diversified and sustainable system where RE sources gradually account for larger participation in the energy matrix. Such a shift requires the decarbonisation (namely, electrification) of primary energy consumption, supported by smart transmission and distribution grids, energy efficiency programs for urban areas, liquid electricity markets, clean air policies, and energy storage systems. This implies a conversion to "decarbonise" jobs so the economy can absorb the labour that eventually would be transferred from polluting industries to clean sectors (over 11 million additional global energy jobs by 2050). For their part, non-energy companies should drive the clean demand to rise the overall RE supply. Such technologies would achieve scalable development due to falling costs that compete with the mature shrinking oil and gas business. This scale expansion represents a renewed geography for the deployment of RE technologies and infrastructure in potential solar and wind regions. The ET initiatives would impact international relations as core countries will compete to allocate CF investments in the "Global South", integrating regional energy hubs. This also translates into geopolitical tensions to access critical materials (rare earths) to develop RE technologies. Lastly, this process demands new financial actors, institutions, and business models consistent with the SDG and investment agendas that prioritise environmental, social, and governance (ESG) factors, like the relief of energy poverty and the conservation of natural capital.⁶

According to McKinsey (Heiligttag *et al.*, 2019), falling RE costs are the main driver of the current progression of the ET. Three trends would follow the expansion of RE: *a*) the

⁴ This is one of the main historical arguments throughout the climate debate, analysed in Le Treut & Somerville, 2007; Adams, 2009.

⁵ Throughout this chapter, I will refer to "renewable energy" (RE) or "renewables" as the industrial technologies (mostly solar and wind energy supported by lithium-ion batteries) used to generate electricity. This is different from non-industrial renewables that represent plural energy practices with less developed technological means.

⁶ Because of overlaps and parallels, I took the essential ingredients of the definition in this paragraph from: WEF, 2018; IRENA, 2016, 2019, 2020, 2020a; S&P, 2020; GCF, n.d.; IEA, 2020. This would roughly constitute the definition of a mainstream ET.

growing final demand for electricity, *b*) the role of natural gas as a "transition fuel" for power generation that is expected to peak in a post-2035 scenario, and *c*) the slow down and eventual decline of oil and coal in the global energy matrix from 2030 onwards (McKinsey, 2019). In addition to population and economic growth, the firm calculates that global energy demand will plateau in 2030 as RE take over up to 25% of the primary energy demand. This would lead to the decarbonisation of China and India (reducing 22% of global carbon emissions) supported by innovative sectors like e-mobility and smart grids (McKinsey, 2019; IRENA-CPI, 2020).

The key enablers of a massive scale ET can be found in the financial sector, having a decisive role in *a*) unifying energy hubs between power companies, technology developers and infrastructure planers; *b*) boosting investments beyond the electricity generation sector to develop transmission, distribution, and storage infrastructure industries; and *c*) blending financial planning with every link of the energy business chain by providing capital at a lower cost to develop assets, create liquid markets, drive M&A, and restructure investment portfolios (Heiligttag *et al.*, 2019). For the GCF (2021a: 1), financial policies target several obstacles in the development and scale-up of RE projects, thus enabling business frameworks and prioritising developing countries to rapidly increase the share of RE in the electricity generation mix.

Financing RE differs from FF energy systems. While the latter depends heavily on the costs of the fuel (coal, gas, refined oil), renewable sources (sun, wind, geothermal heat) do not qualify as fuel costs. Also, RE do not represent "stocks" or "packages" (like oil barrels or coal), but more of a flow "that must be generated and transmitted as it is consumed" (Laloux & Rivier, 2013: 2). Therefore, projects development relies on the expenses of building a RE plant based on the falling costs of technologies, accessing cheap capital sources, and finding a potential market to sell the electricity and generate cash flows (Citi, 2016). The IEA (2018: 120) classifies finance for new energy assets into two main primary sources:

- 1) *Balance sheet financing*. Understood as the internal self-finance mechanisms coming from retained earnings available for reinvestment. It also includes corporate debt, equity issuance in capital markets (stocks), and other liabilities.
- 2) *Project Financing*. A scheme where the project is financed with the cash flows that the RE plant will generate from its operation. To meet the financial liabilities that financed the plant, project financing requires liquid guarantees or Power Purchase Agreements (PPAs) to sell energy in exchange for contracted cash flows. The funding sources can be syndicated loans, grants, equity participation, convertible loans, institutional investors funds, and other structured financial instruments.

In the mainstream literature, private firms are the central actors of the ET (see IRENA, 2016; IEA, 2019: 136). For the CF discourse, public investment is an "inefficient and inconsistent way for speed and scale energy transitions", and whose role should limit to a catalyst for private capital (Heller & Seiger, 2018). Under this premise, government spending and public finance are mere "facilitators" by providing grants and funds to the energy sector and mitigating risks by guaranteeing key infrastructure tenders, regulations, business-friendly environments, and liberalised economic policies (IRENA-CPI, 2020). Thus, public spending must go beyond subsidies and taxes to allow PPP and other leverage mechanisms for private investments (Heller & Seiger, 2018).

RE projects development also represents diversified and complementary markets. These interdependent sectors are land acquisition/management and land-use changes, the development of sustainable housing and smart buildings, electrified transport of goods and people, and the general connection of energy as the key enabler to gain access to other natural resources (agriculture, water, mining) (IFC, 2016; IEA 2018; OECD-World Bank, 2018). Lastly, along with these sectors, the financial markets introduced broader risk management strategies to protect portfolios from CC adversities, "future-proofing" investments in the whole chain of environmental and non-environmental markets (IRENA, 2016; TCFD, 2020).

Having explored the CF and ET narratives, it is possible to conclude that both initiatives share a common identifiable and interrelated phraseology.

- 1) *An increasing idling mass of liquid capital remains in hands of the corporate and financial community, eager to channel investments into environmental and energy sectors searching for further business opportunities.*

"The world is awash in capital, in greater quantities than ever before", stated Sean Kidney, CEO of the Climate Bonds Initiative, when asked if a lack or shortage of capital was the main issue to achieve a timely ET (Climate Bonds Initiative, 2017; Foresight Climate and Energy, 2018). "Too much capital chasing too few opportunities", is the diagnosis of Bain & Co. (2020) regarding an increasing capital amassed in the financial sector that surpasses the "real" economy in terms of profitable places to vent investments. For the IMF (Dao & Maggi, 2018: 30), there is a structural trend of the non-financial corporate sector in major advanced economies to retain savings and cash holding; such gains "have not spurred higher investment in new fixed capital, leaving firms instead with growing stocks of liquid assets on their balance sheets". This supposes a shift from early stages of scarce finance in the 1980s to a contemporary era of "abundant capital" due to a mix of falling interest rates, slow growth, increasing needs of liquidity, and expansive macroeconomic policies decisions (see Mankins *et al.*, 2017; Smith, 2019). Falling rates have had an impact on green bonds and climate markets, allowing easier borrowing to raise capital for long-term investment in green infrastructure and other environmental projects that can absorb this cheap and abundant capital in a new long-term-investment cycle (Penrith, 2014; Marsters *et al.*, 2021).

- 2) *Climate change has moved from a universal threat to a corporate strategy of risk management and investment opportunities in the global environmental business, making the private sector a catalyst to mobilise this cheap, abundant, and idling capital to bridge the climate financing gap.*

CF initiatives established a prospective narrative based on the challenges and opportunities embedded in the SDG. Within the Paris Agreement framework, the OECD argued that

there is a unique opportunity to develop infrastructure systems that deliver better services while protecting the environment. Harnessing the benefits of rapidly emerging technologies, new business models and financial innovations will be key in opening new pathways to low emission, resilient futures. [...] Opportunities for climate innovations are economy-wide, and include technologies for renewable energy, electric vehicles, drought-resistant crops, vaccines to inhibit methane production by ruminants, permeable materials for pavements and roads, or technologies for carbon capture, storage and use (OECD-World Bank, 2018: 1, 7).

Several financial reports and environmental business-related disclosures share these aims. The GCF (2021b) stated that "climate change offers businesses an unprecedented chance to capitalise on new growth and investment opportunities that can also protect the planet. GCF employs part of its funds to help mobilise financial flows from the private sector to compelling and profitable climate-smart investment opportunities" (p. 1). For its part, the IFC identified business opportunities for further growth in the green markets and the "climate space", based on rebranding a green corporate identity as fashionable market strategy, complying with international standards required by law or voluntary agreements, and managing risks as investment portfolios are threatened by CC processes (Dasek, 2014).

Yet the mainstream narrative introduced the idea of "filling gaps" to financially harness these opportunities. The WRI (2018) pointed opportunities for creating new green markets and long-term sustainable business by shifting \$5 trillion USD in business-as-usual investments into "green growth", as well as mobilising "an additional \$700 billion to ensure this shift actually happens". The firm FT Russell estimates that the environmental sector offers valuable opportunities for sustained growth that went from \$2 trillion USD in 2009 to \$4 trillion in 2018, an annualised growth rate of 8% (Dai & Campos, 2020).

Such a "green investment space" is more relevant when referring to the "developing world". There, financial needs for adaptation are prominent, making "a unique opportunity [...] for public and private actors to work together to increase CC-related private capital flows to developing countries" (WRI, 2020). The Global Green Growth Institute (2016: 4) calculated the "gap and opportunity" to invest in non-OECD countries, reaching "4.0-4.9 trillion USD from 2016 to 2030". The institute concludes that bridging this gap "would require an additional USD 166-322 billion USD per year" (p. 4). Soon, CF initiatives and the World Bank Group (WBG) development programs were aligned into renewed North-South aid and cooperation agendas.

[It is estimated that] \$6.3 trillion dollars of infrastructure investment is needed each year to 2030 to meet development goals, increasing to \$6.9 trillion a year to make this investment compatible with the goals of the Paris Agreement. [...] The urgent need to address this gap presents a unique opportunity in the coming years to move the climate and development agendas forward and develop infrastructure systems that deliver better services while also achieving climate and development goals (OECD-World Bank, 2018: 2).

Other institutions followed this line. The IFC (2016: 2) stated that "the historic Agreement on climate change adopted in Paris helped open up nearly \$23 trillion USD in opportunities for climate-smart investments in emerging markets between now and 2030". The WB calculated a \$6.4 trillion USD investment space across 15 clean technology sectors in 145 developing countries, with a \$1.6 trillion accessible to small and medium enterprises (World Bank Group, 2014). The "sustainable infrastructure imperative" by the Global Commission on the Economy and Climate says that only the "Global South" would absorb two-thirds of a \$90 trillion USD investment margin enabled by the Paris Agreement (New Climate Economy, 2016). According to the IEA (2019: 119), these gaps "are largest in the least financially developed markets", where a supporting enabling environment for investments requires "deep availability of capital from private institutions, liquid capital markets, and access to domestic and foreign sources, complemented by limited public finance [...]". This would require the liberalisation of international relations so that financial institutions like the IADB and WBG can establish CF investment platforms in Latin America, Africa and Asia, channelling capital into energy and environmental sectors.

In terms of the ET, business opportunities still "depend on the ability to develop RE markets to attract massive levels of investment"; using instruments like green bonds, structured finance, and capital market tools "can help scale up renewable energy investment and open opportunities for institutional and other major investors to enter in the market" (IRENA, 2016: 73).⁷ Here again, we can identify the term "opportunities" is often associated with an expected low-carbon "investment gap" that needs to be filled to achieve a global ET. For McDonald & Bailey (2020), this "green horizon" represents an opportunity to uncover "trillions of dollars in low-carbon sectors" based on costs management, capitalising on market behavioural changes, and profiting from new revenue from sustainable goods and services across all sectors. For its part, the IEA (2015: 1) estimated a \$13.5 trillion USD investment gap in energy efficiency and low-carbon technologies that needs to take place between 2015 to 2030. The Carbon Tracker Initiative (Sussams, 2018) pointed out a "carbon budget" as a warning sign for investors and companies to divest from key pollutant energy sectors and divert resources into RE to meet the Paris Agreement goals. A \$1.6 trillion USD transition risk gap for FF companies has also been an incentive to mobilise capital to decarbonisation scenarios (Carbon Tracker Initiative, 2018).

Following Wolf (2011: 55-59), the private sector must take the lead on the new CF environmental markets, while governments must limit their action to leverage private investments by facilitating grants, absorbing risks, tendering key infrastructure, and complying with international climate policies to attract investments (see also IFC, 2016). In this context, "governments must remove these barriers and create an environment in which the private sector can thrive and in which investments in RE make financial sense for private capital" (Tsitsiragos, 2016). For McKinsey (2018), removing these barriers would expand high profitability ET: electric vehicles, efficiency gains of low-emissions fuels for aviation and marine transport, electrification of residential heat and cooking, reduction and recycling of plastics, recycling and low-emission feedstock of iron and steel, and RE storage. From there banks like Citi (2021: 3) reported a "massive climate investment gap" of "as much as \$3 to 5 trillion USD per year to decarbonise the highest carbon-emitting sectors", resulting in diversified mitigation portfolios and a whole range of new financial instruments.

Lastly, this lexicon also applies to the opportunities spotted in carbon emissions trading and pricing. Projections suggest that "the financial size of the virtual carbon market is about \$167 billion USD a year in 2030, increasing to \$347 billion a year in 2050 and reaching \$1.2 trillion a year in 2100" (IETA, 2019: 7). For the World Bank (2020: 18), the untapped potential for carbon trading, credits, bonds and pricing in cap-and-trade markets represented "\$45 billion USD in carbon pricing revenues raised in 2019", with more than half "going into environmental or developmental projects".

Speaking of bonds, these instruments bridge the gap between providers of capital and green assets development. Climate bonds represent a "transition gap" as the world "needs to invest at least \$500 billion USD annually for 10 years to close the climate financing gap. [This figure rises to around] \$2 trillion to \$3 trillion USD annually in developing countries alone"

⁷ IRENA (2020: 42) calculates that "86% of this projected demand, or about 21,300 TWh, would need to come from renewables to be in line with global climate objectives. Existing company targets, commitments and ambitions would lead to only 3,800 TWh generated from renewables in 2050, leaving some 17,500 TWh of untapped opportunity in the sector".

(Ausick, 2020). However, "the cumulative issuances of green bonds are below \$1 trillion USD, while the global bond market is valued at around \$100 trillion, accounting for less than 1% of cumulative global bond issuances" (IRENA, 2020). Others estimate that the international green bonds market could fill the \$18 trillion USD global climate infrastructure investment gap needed to meet climate agreements (Jackson, 2018).

3) *Climate Finance represents a transformation in the habitus of investors and other financial actors.*

CC is also an opportunity for financial actors to renew their role as key participants of the environmental sector. Theoretically, the need for ethical finance and carbon-responsible investors would leave behind speculative greenwashing and short-term practices harmful to the long-term care of the environment (Guez & Zaouati, 2017; Lowitzsch, 2019). This climate sensibility translates into concrete actions like ethical divesting from FF, capital relocation into greener assets, and redesigning a whole range of decarbonised industries (Caldecott *et al.*, 2016; Carbon Tracker Initiative, 2017; IRENA, 2017; Nelder, 2020). Several public and private investors "are increasingly prioritising environmental and social performance in their practices" (IRENA 2020c: 8). This would require clearer CF information disclosures to allow investors, assets managers, companies, and consultants to expose scenarios, processes, and metrics related to the financial impact of CC in business chains and strategies (TCFD, 2020). Activist investors are implementing this "transitional thinking" arguing that finance needs a "big reset" in terms of measuring the positive impact of long-term resilient financial systems and technologies, as well as having metrics of the direct repercussions of CC in the people and the planet rather than just in the financial materiality (Responsible Investor, 2020). Such an initiative seeks to avoid financial greenwashing and acknowledge CC as a complex, nonlinear systemic risk beyond the solely "market failure" and "externality" labels (Responsible Investor, 2020).

Along with the "Responsible Investor" narrative, the financial sector turned towards the "impact investing" agendas, a renewed way of aligning financial, social, and environmental goals (GIIN, 2020). Impact investing implies several approaches, methodologies, and metrics to give SDG markets and climate projects development a broader framework for financial action (Impact Management Project, 2021). These initiatives establish roadmaps and toolkits to measure the impact of finance in the environment and stakeholder's materiality through the quantification of intangible values such as social development, environmental management, and the social return of investments (SROI), among others (Godeke & Briaud, 2020; Social Value UK, 2021). To meet such objectives, organisations like the OECD (2018) use the term "blended finance" to strategically design a wide range of public, private, and social sources of capital to mobilise investments towards SDG, especially in developing countries. Thus, scholars have defined this behavioural turn as a "capital switching" into green infrastructures, understood as the ability of finance to remake its practices and relations through healthy credit and liquid capital that can be "fixed" into sustainable socioecological futures (Castree & Christophers, 2015).

4) *The Energy Transition has a major potential in regional planning and community schemes to introduce sustainable renewable energy projects.*

Several reports have emphasised the potential of the regional/local development of RE projects to cover a broader and diverse spectrum of social problems in specific territories. Financing

such initiatives is still a main concern for this kind of planning. In IRENA's roadmap, the expansion of public grants, debt instruments, and equity sources can adapt the financial system to regional planning opportunities, since "renewable energy, with its inherent adaptability and decentralised nature, is well positioned to help build more equitable, inclusive and resilient economies, while fostering increased citizen participation in the energy transition" (IRENA, 2020b: 7). Therefore, financing mini-grid and off-grid systems is one of the main opportunities for regional planning, supported by digital crowdfunding and microfinance schemes to allow "project proponents to raise funds directly, bypassing traditional intermediaries such as commercial banks. Based on the funders' primary motivation for investing (financial or non-financial) and type of expected return, crowdfunding models can be classified into four main types: donation, reward, debt, and equity" (IRENA-CPI, 2020: 64).

Regional energy planning will be feasible if regulatory frameworks facilitate the design of financial mechanisms depending on the characteristics of local economies: "Financial instruments should be tailored to the specificities of community energy projects, as well as to national and local contexts, so as to make renewable energy economically viable for even the most vulnerable communities" (IRENA, 2020b: 25). From there that the mitigation of energy poverty is a central policy, focusing on "locally owned solutions for agriculture, water, waste management, climate resilience and clean energy" (Practical Action, 2019: vii). Such planning considers an interrelated scale-up policy based on geography (localised priorities, livelihood economies, and basic human needs), finance (the development of local financial architectures, capital for small-scale energy entrepreneurship, and affordable tariffs), and gender (empowerment and consumer inclusion) (Practical Action, 2019: 56). Regional energy planning and off-grid local infrastructure also entail initiatives on "financing consumer co-ownership" and community participation (Lowitzsch, 2019). According to IRENA (2020b: 7), "community energy" projects have played a central role during the Covid-19 crisis recovery, "promoting local social and economic prosperity while helping to meet climate and sustainability objectives" (IRENA, 2020b: 7).

5) Climate action and the global ET will gain momentum because of the Covid-19 pandemic crisis, resulting in a renaissance of renewable energy deployment.

In general terms, the Covid-19 pandemic paralysed the global economy and international relations, disrupting the mobility of populations and the circulation processes of capital. According to the IEA (2021: 6), the pandemic "made the global energy demand in 2020 [fall] by 4%, the largest decline since World War II and the largest ever absolute decline". The Covid-19 phenomenon brought to light the magnitude of the global economy dependence on FF. For Attiga & Benali (2020: 53), energy consumption disruptions and supply chains restrictions derived in sharp cuts in capital expenditures for RE projects leading to a global slowdown in project finance and M&A due to liquidity constraints, higher borrowing costs, and growing risks of defaults that provoked project delays and cancellations. These problems aligned with the meltdown of the international oil market at the beginning of 2020. In the prelude to the pandemic, the US shale revolution and the Saudi-Russia price war drove oil prices to fluctuate around \$50 USD per barrel until the Covid-19 crisis pushed the price to its lowest levels in over two decades and even achieving negative prices in April of the same year, just to recover in June after the "OPEC+" agreement to cut international oil extraction (Lahn & Bradley, 2020). Thus, the Covid-19 experience served as an incentive for the financial sector to reformulate ET investment roadmaps to achieve global decarbonisation.

Even though oil prices have recovered, it is believed the pandemic changed the FF market profoundly: "Aided by technological advances and the rapidly decreasing cost of renewable energy, a growing commitment towards decarbonisation, and waning investor appetite, the fossil fuel industry is faced with the prospect of structural decline" (OECD, 2020). For the Carbon Tracker Initiative (Bond, 2020, 2020a), the Covid-19 crisis would speed up the ET: despite FF lobbyists, the oil and gas industry will struggle to return to a business-as-usual scenario, facing a "structural peak demand" in 2020 as idling capital and rescue funds can be allocated in low-cost green technologies, RE systems, and electricity storage. For the IEA (2021), the pandemic drove down FF consumption (oil demand falling 8.6% and coal 4% in 2020), whereas RE and electricity sectors (the pillars of the ET systems) "were largely immune" to the crisis. Combined, the pandemic and the ET inflicted major disruptions in the FF systems due to "cheaper renewable technologies and more aggressive government policies", while FF peak demand would lead to "lower prices, less profit, and stranded assets" (Carbon Tracker Initiative, 2020).

Preliminarily, the Covid-19 crisis has inspired several authors to theorise prospective scenarios for a more sustainable global economy in the near future, taking into account health issues along with environmental concerns and emissions mitigation (Oxford Energy Forum, 2020). Nonetheless, the IEA (2021a) suggests that emissions have steadily rebounded to business-as-usual levels up to December 2020, driven by the recovery of economies like China, the US, India, and Brazil. In general, the pandemic is still creating economic and geopolitical disruptions that need to be evaluated in terms of environmental impact. This means revisiting the UN climate agreements, accelerating international cooperation, enforcing governments' actions, and expanding private capital opportunities (IRENA, 2020a). Nonetheless, the Covid-19 crisis has absorbed most of the funds that could be catalysed into climate action, especially in developing countries struggling with the economic effects of the pandemic (GCF, 2021).⁸

1.1. Preliminary conclusions

In the preceding lines, I briefly resumed the mainstream CF and ET narratives, weaving their essential ingredients, drawing parallels, and defining common goals shared by the current climate policy literature. It is a panoramic of the key institutions that have a decisive weight in the international climate debate and direct influence in the decision-making process to foster a large-scale deployment of RE. This lexicon establishes the roadmap for private investment expansion into a renewed environmental frontier and the unprecedented business opportunities opened in the ET industry. The urge to place finance in the front of the climate action policies has proven the dynamics and contradictions of capital on how investments put pressure on the geographical scale to reach new latitudes and embark on new accumulation cycles. Nonetheless, this is not an unprecedented trend in the history of capitalist globalisation. Critical perspectives on finance have theorised and historicised the contradictions that led to the contemporary liquidity accumulation and expansion patterns of the financial phenomenon and its current manifestations in the environmental and energy sectors. I will now turn to the analysis of this literature.

⁸ The GCF (2021: 3) considered a climate-resilient recovery fund through the Energy Access Relief Facility (EARF), a "\$60 million USD multi-country concessional debt fund" (p. 3). For their part, the OECD countries and partner economies have so far allocated \$336 billion USD to environmentally positive measures within their Covid-19 recovery packages (OECD, 2021).

CHAPTER II

Critical perspectives and historical-conceptual foundations in the development of energy transitions, finance, and geography

The time of human societies is organised in three interrelated ways: (1) as a sequence (course), processes that started many decades ago, perhaps centuries, others beginning more recently; (2) time as a radius of operations (space), processes that sometimes take place on small geographies, others in wide spaces or far from each other; and (3) time as the speed of change (intensity), where peoples have lived processes of slow development for centuries, or others more vertiginous in just a couple of days.

— SERGIO BAGÚ, *Tiempo, realidad social y conocimiento*, 1970

The mainstream CF literature and the global institutions behind the ET narrative have established large-scale investment roadmaps to achieve hypothetical low-carbon futures. However, these imaginaries currently face both the *material* and *structural* limits of the capitalist world-economy. The former being the environmental crisis caused by anthropogenic global warming, the eventual terminal depletion of non-renewable natural resources, and the historical-geographical dependence on finite fossil fuels (FF); while the latter is related to the limits imposed by the dominance of finance and the so-called *financialisation* process upon international and local economies.

As seen before, finance took the lead in the global ET through a series of mechanisms, actors, institutions and international agreements. On the one hand, it has been a matter of assessing investment requirements and mechanisms, estimating the size of environmental markets, and calculating the profit value of new climate businesses while ensuring mitigation and sustainability goals. Nonetheless, on the other hand, CF also represents the contradictions on how an ET of such a scale can currently take place in austere, privatised, deindustrialised, and financialised economies with macroeconomic frameworks benefiting finance rather than long-term productive investments. Moreover, we face concerns on whether finance would detonate RE technologies and infrastructure to solely focus on rent-extraction mechanisms, speculative investment manoeuvres, M&A strategies, and monopoly benefits derived from PPP. And, if finance ultimately achieves an ET, it is legitimate to wonder if this could mitigate carbon emissions and break the dependence on FF while avoiding territorial dispossession and extractive practices widely known in contemporary mining and energy industries.

In this chapter, I will expose some critical historical-theoretical foundations of energy and finance geographies to present a broader panoramic of the international context where the ET is embedded. I will also review critical perspectives that point to the lines of continuity from FF to RE in the context of contradictions and crises of capital. Finally, I will address preliminary reflections to rethink alternative geographies and landscapes for energy transitions planning and finance beyond the mainstream discourses. My objective is to oppose these arguments to the

preceding mainstream literature, establishing the interpretative focus that will guide my inquiries on the entanglement of geography, energy, and finance throughout the dissertation.

2.1. Conceptual debates and contradictions of financing a mainstream Energy Transition

CC represents a "battlefield" of ideas that claim different paths to address the contradictions between environmental crises and economic development (Adams, 2009). Opposed to the mainstream narrative, a body of scholars have pointed out a series of urgent systemic changes that shows the complexity of future climate adversities and the limits of capital to achieve sustainable processes of civilisational adaptation. From there the argument that CC is more of a political process signed by conflict, power relations, and contradictions rather than just a series of financial, technical, and infrastructure solutions.⁹

As the aftermaths of the 2008 financial crises unfolded, the world has experienced a deeper and more complex global collapse beyond economic and financial variables: an "epochal crisis" that has exposed "the interconnections between the deepening impasse of the capitalist economy and the rapidly accelerating ecological threat —itself a by-product of capitalist development" (Foster, 2013). Facing this interconnected series of crises requires grasping the sometimes abstract and "supraliminal" climate processes and their impact on the social dynamics (Saxe-Fernández, 2018: 68-69). These manifestations have been explained as the "planetary boundaries": a combination of earth-system processes that represent key risk indicators that would provide a "safe operating space for humanity" in decades to come (Rockström *et al.*, 2009; Steffen *et al.*, 2015).¹⁰ As Heinberg (2016) stated, studying these phenomena requires a holistic approach of an interrelated system rather than reductionist descriptions of isolated climate issues. Yet tracking the global manifestations of CC has become a difficult task due to the relatively recent available data to assess preparation, mitigation, adaptation, and compensation policies (Responsible Investor, 2020). Also, the task for climate models has been "to simulate with absolute precision the behaviour and relationship of the atmosphere, the biosphere, the oceans or the bodies of ice and snow. All these components of the earth-system interact with each other at different spatial and temporal scales, making the problem even more complex" (Conde, 2010: 12).

In addition to its manifestations and impacts, the study of CC motivated reinterpretations of two main scholarly debates: *a*) the historical meaning of our relationship with nature, and *b*) a renewed historiographical debate around environmental history (see Foster, 2000; Smith, 2008; Malm, 2019). Both intellectual currents are long-standing debates that sparked a renewed interest since the growing environmental concerns towards the end of the 20th century (Fontana, 1992). As Arnold (1996:1-6) stated, since CC became a common problem for humanity, the study of the environment surpassed the local and regional boundaries to fully represent the

⁹ This is a brief definition of the political ecology of CC. Current contributions to this field can be found in Perreault *et al.*, 2015. Other proposals based on this argument are Martínez-Alier, 2002; Gudynas, 2003; Saxe-Fernández & Fal, 2012.

¹⁰ Roughly, the planetary boundaries are climate change, biodiversity loss, alterations to the nitrogen and phosphorus cycles, stratospheric ozone depletion, ocean acidification, global overconsumption of freshwater, atmospheric aerosol loading and chemical pollution (Rockström *et al.*, 2009).

international dimension of global warming. These interpretations denote "universal" or "global" histories of the environment that encompass diverse ecological experiences, from past human civilisations to contemporary society (Hughes, 2009, 2016; Diamond, 2013; Crosby, 2015; Ladurie, 2017). On the other hand, critical scholars interpret the current environmental crisis within the uneven evolution of capitalism and its variegated historical geographies. That is, the development of a global ecology: its energy flows, material exchanges, cultural transfers, and the overall metabolism of a historical world-system economically and politically hierarchised (Hornborg & Crumley, 2006; Hornborg *et al.*, 2007; Moore, 2015).

These scholarly positions served as the basis for the contemporary debate around the Anthropocene and Capitalocene concepts. The former encompasses the new geological epoch where human activity has shaped the earth's crust and the living world metabolism since the large-scale development of the industrial civilisation (Dalby, 2007; Steffen *et al.*, 2011). In contrast, the Capitalocene concept argues that human influence is not an abstract force emanating naturally from the civilisational growth and evolution but more of a process of concentration, centralisation, circulation, and accumulation of capital that have had profound impacts on the living world and its territories (Moore, 2016a). Both concepts translate into the "anthropogenic" or "capitalogenic" nature of CC, the former being a depoliticised collective responsibility of humanity as a whole (the abstract *Anthropos*), while the latter points to the relations of power, State, and class in the decision-making apparatus that closely correlates wealth accumulation with CO₂ emissions and its consequences (Moore, 2016; Malm, 2018).¹¹ Nonetheless, as Thornett (2019: 163-172) argues, this debate ultimately shows that both are meaningful concepts to understand the historical environmental impact of humanity since "Capitalocene" problematises the last 200 years of industrial activity, while the "Anthropocene" encompasses the non-capitalist societies of the past that had different impacts through diverse social organisations.¹²

Other critical concepts coming from the ecological Marxism tradition have contributed to this intellectual landscape. The intensive and extensive processes of capital over natural resources and spaces have been theorised as the "capital shifts" (Clark & York, 2008) and "ecological fixes" (Bakker, 2009; Castree & Christophers, 2015; Ekers & Prudham, 2017) derived from capital flows towards new environmental sectors, green business models, and territorial exploitation. For its part, the "metabolic rift" (Schneider & McMichael, 2010; Brett & Foster, 2013; Foster & Burkett, 2016; Napoletano *et al.*, 2019), and the renewed theory of value (Salleh, 2010; Foster & Burkett, 2018) give an insight into the contradictions and alienated mediation between the reproduction of society and nature. Such approaches critique the market-based interpretation of CC, rising a warning sign of greenwashing practices and corporate facades that deepen the extractive and exploitative process of capital. Thus, this literature can be summed up in the contradictions of mainstream sustainable development (Redclift, 2005;

¹¹ Recent studies on the political sociology of CO₂ emissions can be found in Kenner, 2019; Kartha *et al.*, 2020. Richard Heed's (2014) contribution on the historical responsibility of the top 90 oil-gas-cement companies for the 63% of cumulative emissions between 1751-2010 also shows the sociological and power asymmetries of CC. King (2020) also offers a model on the links between energy consumption rates, wage inequality and indebtedness.

¹² The scholarly debate on this topic can also be found in critiques like Chakrabarty, 2018; and in the Eurocentric condition of the Anthropocene concept analysed by Morrison, 2018.

Adams, 2009), the continuity of ecological modernisation trends (Barca, 2019), and the open critiques of ecosocialism to contemporary capitalism (Löwy, 2015; Thornett, 2019).

In general terms, critical interpretations of CC encompass diverse left-wing intellectual traditions in a decisive critique of the structural and material limits of contemporary capitalism. Currents like ecological Marxism, ecosocialism, and political ecology have had an important progression throughout the 20th century up to this date (Foster, 2016). But "the left" (in extended ontological terms) has struggled to fully integrate ecology into its worldview in order to challenge the Western civilisation model (see Kallis, 2015). Critical ecology serves as a renewed front for left-wing movements to reformulate revolutionary movements linked to past experiences and pointing to future utopias (Traverso, 2014: 45; 2017, 2019a; Löwy, 2015). This movement has branched out into various fronts such as race studies (Pulido, 2016; Vergès, 2017; Padovan & Alietti, 2019; Saldanha, 2020), gender issues (Rehaag, 2015; Bee *et al.*, 2015; Salleh, 2017), urban movements (Heynen, 2013; Bahadur & Tanner, 2014; Shi *et al.*, 2016), indigenous and peasant movements (Borras Jr., 2009; Lam *et al.*, 2020; Waldmüller, 2020), and decolonial and postcolonial critiques (Sousa Santos & Meneses, 2014; Pulido & De Lara, 2018).

In other words, CC is a concept subjected to two main sociological fields: *a*) the political sociology of capital, in terms of the class interests involved in the historical decision-making apparatus driving CC phenomena; and *b*) the sociology of knowledge, that encompasses a wide range of interpretations of the environmental crisis, from corporate market-based views to critical studies and social movements. According to Saxe-Fernández (2019), the combination of both subdisciplines is crucial, not only to fully appreciate the historical richness of the climate debate but it is also indispensable to decipher the supposed ideological and political neutrality of CC and the material interests that lay behind the mainstream climate discourses: a critical exercise to counteract speculative interests on the atmosphere, the manipulation of climate science, the climate denialism, and other interventions into the public interest present since Project Camelot.¹³

Critical scholars refer to two major paths of how capitalism is shaping the climate debate. The first is the trend analysed in the previous chapter, where capitalism acknowledges CC as a problem but also as an investment space opportunity (Lohmann, 2009, 2015). The second is somehow the opposite: the denialism of CC, reflected in a series of fragmented discourses that tries to preserve the "cultural ecology" (Heinberg, 2017) of the 20th century linked to the liberal rights of high material and energy consumptions (Dunlap & McCright, 2011; Huber, 2013). According to Traverso (2019: 57), here we find the combination of distinctive features in the rise of current right-wing and far-right movements, as well as renewed anti-communist rematches: "nationalism, anti-feminism, homophobia, xenophobia, and [...] a clear hostility towards ecology, modern art, and intellectualism". Some of these manifestations have historically flourished through the lens of Malthusian, sociobiology, and biopolitics theories: the so-called "naturalisation" of human behaviour under capitalism that justifies violence patterns and uneven exploitation relations between genders, races, nations, social classes, and

¹³ At the time, Saxe-Fernandez (1978: 95-144) documented the security programs promoted during the 1960s and 1970s by the US State and Defense Departments to create or intervene in Western academia and research centres with the objective of shaping social science education under conservatism and counterinsurgency principles. Out of this came projects such as Camelot, Themis and Agile, made to counter the advance of critical social movements nurtured by universities. The author concludes with the need to overcome a supposedly value-free science amid an intellectual environment constantly intervened by lobbies and other dictates from power.

nature itself (Lewontin *et al.*, 1984; Veuille, 1990; Muñoz, 2006; Lemke, 2011). More recently, a body of researchers addressed these trends as the emerging "political ecologies of the far-right" (Malm & Zetkin Collective, 2021).

After this brief contextualisation of contemporary climate debates, I will introduce the literature review around the geographical, historical, and political economy perspectives of energy transitions. I will aim for an interdisciplinary approach to the triad geography-energy-finance, elaborating on the temporal and spatial foundations of energy transitions.

2.2. Geographies of energy and finance

The relationship between finance and energy represents two overlapped geographies: the spatial localisation of energy sources and the mapping of investment opportunities for their profitable development. Supported by the literature, I argue that both geographies are interdependent and share perspectives on how the current energy transitions are planned, whether in the mainstream or alternative fields.

2.2.1. Energy geographies

Energy geographies evolved from early interpretations within the "renovation of geography"¹⁴ through several works like George, 1950, 1980; Chapman, 1961; Manners, 1964; Linton, 1965; Hoare, 1979; Calzonetti & Salomon, 1985. Product of its time, this literature developed in parallel with the post-war material growth based on FF and the cultural-political significance that oil achieved throughout the 20th century (Huber, 2013; Lohmann, 2020; Furlan, 2014). Energy became an essential ingredient to understand the spatial configuration of industrial society, both in the "American Way of Life" high-consumption societal model analysed in works by Lynd & Lynd (1957) and Illich (1974), as well as the energy modernisation roadmaps included in the development agendas of several countries in the capitalist periphery (see Neu & Bain, 1983). The 1973 oil crisis also contributed to the study of geography-energy relations, focusing on the geopolitical and geostrategic influence of oil through foreign policy and national security narratives, energy statecraft, diplomatic-military intervention programs, and the multinational oil companies' expansion strategies (Barnet & Müller, 1974; Barnet, 1980; Saxe-Fernández, 1980). This historical process produced two clashing geographies: a political division between States (politically antagonistic and economically interdependent) and a heterogeneous geological distribution of energy resources that has little or no relationship with the drawing of national borders (Saxe-Fernández, 1980: 10; 2009).

Yet spatial interpretations of energy towards the 21st century established renewed interpretations derived from the multiple and interrelated "globalisation" scales, studying the environmental, landscape, and spatial impacts of natural resources extractivism, and the socio-economic and technological relations on the production, distribution, and consumption of energy (see Nadaï & van der Horst, 2010; Zimmerer, 2011; Pasqualetti, 2011; Huber, 2015; Calvert,

¹⁴ A brief analysis on the "renovation" of critical and human geography can be found in Moraes & Messias da Costa, 1984: 25-31; Harvey, 2001; Moraes, 2003; León, 2016. An important complementary work on the critique to the energy "spatial turn" is Bridge, 2018.

2015; Herrero & Baraja, 2017; Castán Broto & Baker, 2018; Labussière & Nadaï, 2018; Bridge & Gailing, 2020). For Calvert (2015), energy geographers enjoy the advantages of being at the "borderland" between different theoretical and methodological traditions. This multidisciplinary and transdisciplinary research approach benefits from a broader conception of energy:

Energy is simultaneously (a) a physical entity that is derived from natural processes and transformed through physical systems, and therefore partly the domain of the "physical geographer"; (b) a social relation to the extent that physical entities are socially constructed as energy resources through political-economic and cultural processes but also a primary agent in the spatialisation of social activities, and therefore partly the domain of the "human geographer"; (c) the primary mediator of our relationship with the environment and therefore partly the domain of the "nature-society" or "human-environment" geographer; and (d) non-uniform over space and made accessible or not by site-level conditions and therefore partly the domain of the "GIScientist" and "cartographer". Working at the borderland is therefore necessary to fully engage with the essential energy policy problems and key scholarly questions surrounding energy (Calvert, 2015: 108-109).

Scholars refer to the potential of energy geographies as a disciplinary dialogue to address a rich thematic diversity not just within social science but also in the permanent integration of human-space relations with technology-engineering systems, biophysical frameworks, and society-environment interactions (Solomon & Calvert, 2017; Bouzarovski *et al.*, 2017). Energy geographies have also focused on the social practices, relations and settings that make energy a space-production factor (Huber, 2015; Hui & Walker, 2018). That is, energy as a co-product of historical socioecological processes but also producing space as a series of flows going through and between regions, scales, landscapes, territories, and latitudes (Huber, 2013; Calvert, 2015; Bridge *et al.*, 2018). Such spatial and material relations take place in a context of cultural imaginaries, political practices, and everyday livelihoods structured under the capitalist mode of civilisation (Huber, 2013; Petrocultures Research Group, 2016; Walks, 2014). These relations go beyond the energy textbook definition (the apolitical and abstract "ability to do work" materialised in a series of physical and quantitative measures), to address thermodynamic energy as a series of historical and political processes of power, class struggle, dominance, and resistances in the *longue durée* of capitalist expansion (Lohmann & Hildyard, 2014; Lohmann, 2020). In recent decades, a geography of crisis followed the depletion of conventional FF reserves, pushing the extractive frontier and its spatial impact towards the integration of new terrestrial and maritime territories for non-conventional hydrocarbons exploitation. Some of these approaches have been debated as the geographies of peak oil (North, 2010; Bridge, 2010; Bailey *et al.*, 2010), the geopolitics of fracking (Bacchetta, 2013), and the limits of Petro-states territorialisation (Kennedy, 2014).

As the 21st century unfolds, energy geographies introduced transition narratives, gaining momentum by the current climate debate (Bridge *et al.*, 2013). According to Bridge & Gailing (2020: 1037), energy transitions are transformation processes that take place "in the context of a geographically differentiated political economy". That is, the combined and uneven development of decarbonisation pathways conditioned by existing investment patterns, infrastructures, technologies, and carbon-intensive industries (p. 1038-1309). This opens the debate on "how energy transitions are a space-making process, but one also shaped by spatial contexts [and marked by] ecological politics of energy infrastructures, the governance of novel geo- and bio-energy resource spaces, or the rescaling and re-territorialisation of key energy actors" (p. 1038). The authors conclude three central contributions:

(1) Explaining how "new energy spaces" are part of uneven and combined geographical development, a perspective that illuminates how novel energy landscapes – combining both new energy systems and remnants of the old – are continuously produced and reproduced. (2) Situating the evolving spatiality of energy production and consumption within a broader account of dynamics of accumulation including, for example, logics of capitalisation and disinvestment associated with energy resources and infrastructures. (3) Analysing how sites, scales and spatialities of energy systems are key contemporary sites of struggle, through which broader questions of political economic governance (and the social relations of capitalism) are being worked out (p. 1040).

Energy transition geographies make an analytical difference between the spatial, environmental, technological, and infrastructural circulation of RE flows (solar, wind, geothermal, etc.) compared to the FF materiality.

Indeed, in contrast with the resources consumed for centuries (oil, gas, coal), these energy materialities have to be "concentrated"—that is, their flow harnessed and their turbulences tamed to allow a regular and predictable production of energy. As the "concentration" of these diffuse and sometimes fluctuating materialities is not bounded in space, it can give rise to invasive technological developments in fragile environments (e.g., large-scale wind or solar farms) and a competition for space between different users and visions (Labussière *et al.* 2018: 243).

Unlike the energy density and efficiency of FF, renewables are characterised by spatial-temporal contradictions that challenge the stability and safety of power grid management: intermittency, distance, dispersion, distribution, storage, congestions, and power variations (Tarroja *et al.*, 2011; Merzic *et al.*, 2014; see also Labanca, 2017: 23-78). Additionally, energy transition planning and grid integration unfold in differentiated geographies of costs-prices and generation-consumption patterns, where transmission lines need to mediate between large low-cost centres of supply (e.g., wind and solar farms) and profitable demand centres (cities, urban spaces, and energy-intensive industrial clusters), likely across many heterogenous territories and settings (Arent *et al.*, 2018).¹⁵

Geographically —write Moraes & Messias da Costa (1984: 115)— the "strategic valorisation" of space is not always related to direct economic exploitation of space but its control, potential value, or privileged location. As energy transition planning makes progress, we are witnessing a race for occupying strategic regions based on the mapping of solar, wind, and other RE resources. Geographic analyses of energy will become crucial to understand the heterogenous socio-territorial impacts of these technologies and their infrastructure, a challenge that is already showing the spatial limits of the current mainstream ET deployment.¹⁶ A recent diagnosis pointed two central geographical problems of the ET planning: a) RE supply chains are linked to intensive and extensive mining for critical materials, reviving

¹⁵ Complementary analyses of the techno-economical aspects of energy transition markets can be found in Petit, 2017, 2019; Bush, 2019.

¹⁶ In this regard, Germany is a prime example of a country that heavily invested in the learning curve of wind energy during the past decades of the *Energiewende* program. From a geographical perspective, the deployment of wind turbines is facing an increasing problem of land availability for further expansion. This includes landscape invasion and the onshore territorial exhaustion that is forcing them to move towards offshore farms. To this, we must add the environmental concerns of land saturation, social resistance, and NIMBY conflicts. Overall, the increasing energy demand is making Germany go back to coal plants as wind generation only accounts for 4.1% of the national primary energy consumption (see Nkomo, 2018; Lauf *et al.*, 2018; Franziska, 2018; Wehrmann, 2019; Solomon, 2020; Appunn *et al.*, 2020; Bosch & Schmidt, 2020).

environmental and territorial conflicts; and *b*) the eventual shortages of available land due to territorial and political conflicts over land-use rights (Hickel, 2019; The Economist, 2021).

Spatial conflict is also connected to the "transition geographies" literature centred on a more predominant environmental activism in the face of CC and future FF scarcity (Barr & Pollard, 2017; Wood & Baker, 2020). Others suggest reimagining energy transitions through the lens of energy commons and Integrated Community Energy Systems (Acosta *et al.*, 2018). To this, we can add the evolving field of urban energy transitions literature as a way of rethinking high-energy consumption spaces towards low-carbon urban processes and configurations (see Droege, 2008; Bulkeley *et al.*, 2010; Rutherford & Coutard, 2014; Castán Broto, 2019). I will revisit this literature at the end of the chapter.

One last area to explore within the energy geographies literature is the geopolitical interpretation of energy transitions. Roughly, CC has had four major impacts on the current energy international conflict:

- a*) The power and influence of the Petro-States and their evolution under the current global energy transitions framework due to shifts in trade patterns, the renovation of national security schemes, the decarbonisation-industrialisation challenges, and the geographical decentralisation of energy sources (ACORE, 2018; IRENA, 2019; Goldthau & Westphal, 2019; Hafner & Tagliapietra, 2020; Bordoff, 2020; Carbon Tracker Initiative, 2021).
- b*) The uneven geography of carbon emissions and energy supply chains, producing asymmetries between the different spaces where energy is generated, transferred, distributed, and consumed; this translates to an international conflict over the responsibility of emissions between top polluters (i.e., developed and emerging economies) and less developed and environmental vulnerable nations (Neumayer, 2004; Bergmann, 2013; Rocha *et al.*, 2015; Tänzler *et al.*, 2020; Basu, 2021).
- c*) A renewed competition to access critical minerals required for the development and maintenance of RE technologies and infrastructure (De Ridder, 2013; Månberger & Johansson, 2019; IRENA, 2019; Church & Crawford, 2020; Hund *et al.*, 2020; IEA, 2021b).
- d*) A competition for regions to allocate investment and deploy ET projects, especially in the developing countries and emerging economies where territorial conflicts, militarisation, and displacements related to extractivism have been experienced (Saxe-Fernández & Fal, 2012; Howe, 2015; Goldthau *et al.*, 2020; Furtado & Paim, 2021).

For Saxe-Fernández (2002, 2018) continuity patterns of the energy geopolitics and geoeconomics of capital lies in the articulation of the foreign policy of nations, combining the influence of the State-corporation symbiosis and its geographical knowledge to access natural resources and spaces. Following Saxe-Fernández (2019), if geography deals with the unique specificity of spaces and places, but also with the comparative generalisation of the historical phenomena that occur there, it is important to focus on the study of how mainstream climate discourses and financial interests are trying to integrate heterogeneous and variegated geographies under the ET hegemonic roadmap, generating a series of contradictions and conflicts that are the main observation concern for the social scientist.

2.2.2. Geographies of finance and financialisation¹⁷

The efforts to combine geography and finance is an evolving academic field that constantly gathers new interpretations and experiences nourished by the contemporary recurrence of deeper and complex financial crises. While the "end of geography" discourses and imaginaries erode as the 21st century unfolds, contributions from critical economic geography offer a renewed interpretation of the spatial dynamics of finance (see Corbridge & Martin, 1994; Garretsen *et al.*, 2009; Martin, 2011; Seo, 2011).

During the 1970s and 1980s, "there were some studies of regional banking structures, urban mortgage markets, regional credit availability, and regional interest rate differentials; but the studies that appeared hardly added up to a substantial or coherent body of theoretical or empirical research. During the 1990s, however, the relationship between money and space began to attract increasing attention, with a succession of books and papers by economists and geographers" (Garretsen *et al.*, 2009: 143). Moreover, the advent of bigger financial crises and the predominance of the financialisation concept to explain their manifestations resulted in a renewed literature on the entanglement of the deep geographical dimension of the financialisation phenomenon (Pike & Pollard, 2010; French *et al.*, 2011). To achieve a comprehensive rundown of the spanning heterodox literature on financial-geographical relations, I will group theoretical contributions in four interrelated scales:

a) Financialisation as a regime of historicity.

The influence of finance on space occurs through a "presentist" regime of historicity (see Hartog, 2015). As Harvey (2000: 59) and Traverso (2016) analysed, it is the temporality of Wall Street: a constant acceleration of time marked by recurrent crises and the lack of stability for socioecological reproduction and adaptation. Contemporary scholars have linked the temporality of finance to several topics in economic and social studies, including the temporal logics of financial risk, crises, and instability (Kloeckner & Mueller, 2018), the financialised temporalities of urban development (Grafe & Hilbrandt, 2019), and the financial influence in the temporalities of social security (Hardin, 2014), to name a few.

b) Financial international relations in the world-economy.

The international relations are deeply related with the geographical expansion of finance. That is, the investment relations established across and between uneven States and regions, based on the classification, mapping, and exploitation of differentiated profit opportunities on natural resources, wages, currencies, stock markets, and fiscal policies (see Lacoste, 1976; Moraes & Messias da Costa, 1984: 15, Harvey, 2001:108-120). These dynamics refer to the

¹⁷ The financialisation debate is a broader body of literature that encompasses the complex process that spans from the post-war structural crisis of capitalism to the contemporary financial expansion witnessed since the 1980s and 1990s. To not divert from the subject and take up space with more literature, I will leave aside this debate which I have already reconstructed in Álvarez-Herrero, 2019. Some exponents on this topic are Arrighi, 1994, 2007; Epstein, 2005; Brenner, 2006; Duménil & Lévy, 2007; Toporowski, 2008; Foster & Magdoff 2009; Krippner, 2011; Lapavistas, 2013; Christophers, 2013; Hudson, 2015; Roberts, 2016. In this section, I will limit to the financialisation literature that relates to geography and energy phenomena.

geographical "spatial fix" analysis (Harvey, 1982, 1989) or the studies on the geopolitics of *Haute Finance* and its hegemonic transitions that have structured the world-economy during the last 500 years (Arrighi, 1994, 2007).

Recent contributions to this field are in the volume compiled by Martin & Pollard (2017) regarding a wide variety of geography-finance connections (speculative bubbles, financial crises, stock markets, currencies, sovereign funds, regulations, high-frequency trading technologies and spatially centralised financial centres (see Christophers, 2014; Christophers *et al.*, 2017: 1-116; Borch & Wosnitzer, 2021: 135-257). Scholars have also contributed to this field through the geographies of monetary blocs (Sánchez-Pereyra, 2004), international banking systems (Alessandrini *et al.*, 2009), spatial banking anatomies (Christophers, 2013: 187-228), and the spatialisation of global financial-monetary systems within International Financial Centres relations (Hall, 2021). Others argue that most of the geographical interpretations of finance are centred in the Anglo-American type of financial configuration, proposing further explorations of geo-finance and geo-banking in the capitalist periphery (Grandi *et al.*, 2019; see especially Sellar *et al.*, 2019).

c) The financialisation of everyday life and the financial plurality of spaces.

"Money and finance constitute a core foundation of the particular (capitalist) experience of geography that most of us take as 'normal': they underwrite the spatial infrastructure that we start from in our daily lives" (Barnes & Christophers, 2018: 213). As part of the different "turns" in political economy (spatial, cultural, anthropological), the literature on the "everydayness" of finance and financialisation consider the subjectivities and differentiated impacts of financial institutions, actors, mechanisms, markets, and languages in the social reproduction of the household. As Leyshon (1995, 1997, 1998) discussed, spatial analyses of money and finance helped connect systemic global crises with local financial experiences, producing diverse spatial and temporal contexts, multiple understandings of money, and different scales of social inequalities. Cultural studies and anthropological interpretations of finance also diversified into the construction of daily financial subjects (Hall, 2011, 2012). This leads to a wide thematic variety related to socio-spatial segregations, individual behaviours and citizenship constructions that are constantly shaped by the consumption of financial services (see Langley, 2008; Lai, 2018; Pellandini-Simányi, 2021; Hartman & Kear, 2021: 328-331; other contributions on this domain are French & Kneale, 2009; Karaagac, 2020). Since 2008, the impact of the financial crisis sparked interest in the uneven repercussions of financial processes and their variegated effects across different spaces at national and sub-national levels, as well as in-between states, cities, suburbs, and even neighbourhoods (Dymski 2009; Aalbers, 2009; Pike & Pollard, 2010: 34).

d) The financialisation of urban spaces and infrastructures.

Finance is related to intensive and extensive processes of urban development, being a manifestation of the capitalist expansion crisis and infrastructures shaped by the cities' political and class struggles (Harvey, 2008, 2012). For Aalbers (2020) and Pike *et al.* (2019), financial geographies of the city gained momentum in the literature by analysing increasing trends on the speculation, gentrification and geographical zoning processes of urban development and

governance. While the debate is constantly contributing with case studies on cities in both the North and the South regions (with the debate still focused on the former, according to Grafe & Mieg, 2019: 498), scholars have contributed with comparative trends like financial redevelopment policies (Weber, 2010; Rutland, 2010; Savini & Aalbers, 2016), urban governance and financial crisis (Godechot, 2013; Quintana, 2020; Goldman, 2021), and housing-mortgage markets (Fernández & Aalbers, 2016).

Financialisation also begs the question of how finance "becomes anchored in the city", making the transition from "built environment to infrastructure" (Grafe & Mieg, 2019: 499). Scholars have recently addressed infrastructure deployments as part of a broader "energy materiality" in terms of its spatial and scalar relations (Balmaceda *et al.*, 2019). For O'Neill (2019: 1309-1310), this process establishes the links "between the creation of investable infrastructure products and the operation of major urban infrastructure assets", creating "the presence of private capital in urban infrastructure investment [as] the translation of an asset's operational characteristics into financial terms and contracts". As Moraes & Messias da Costa (1984: 114) reminds us, finance introduces the "future" valorisation: the appropriation of potential values and the speculation of space, making it circulate in an abstract way through property instruments. Infrastructure as an asset, suggest Purcell *et al.* (2020), is where the circulation and accumulation of value can occur: it is financialised through a series of rent-extraction and commodification mechanisms (as the transition from "real" to "financial" assets detailed in Donovan, 2020). Lastly, scholars have not only addressed these spatial dynamics of infrastructures but also the financial temporalities of infrastructure along with their social organisation and interactions (Besedovsky *et al.*, 2019; Grafe & Hilbrandt, 2019).

e) The political ecology of financialisation and the environment as investment frontier.

The precedent literature opens the way to the financial integration of natural resources, flows, and spaces. To begin with, there is a growing concern with the "financialisation of nature", understood as the flexible conceptualisation of the living world divided into "different 'ecosystem services' that can be quantified, measured, and above all, broken up into individual units, so profit can be made from selling rights to these individual units of nature" (Kill, 2015: 1). For this, financialisation plays a central role in the reproduction of nature:

On the one hand, financiers have become further entrenched in their relations with more conventionally defined aspects of the natural world through dense linkages and new financing arrangements in mining, oil and gas extraction, farmland, and agricultural production. On the other, financiers have developed new instruments that involve substantial financial engineering for novel engagements with more-than-human natures, such as weather derivatives, catastrophe bonds and commodity index funds. This entanglement continues to expand both geographically and sectorally, as the industry has helped produce financial assets in diverse fields such as carbon markets, ecosystem services compensation and mitigation schemes, water rights, agricultural microinsurance, and agri-food chains (Ouma *et al.*, 2018).

But how and by which mechanisms does finance make nature investable? For Sullivan (2012, 2017) nature first acquired its status as "natural capital" by environmental conservation policies and the corporate lexicon; then it is materialised in natural resources as a bank of financial assets that institutions can value, monetise and exchange as financial instruments and ecosystem services. Financialisation —writes Hudson (2015: 78-79)— plunges economies into

a chronic state of "debt pollution", where the creditors' conditionality drains resources by investing in lucrative assets to extract land rent and other rent-yielding opportunities in natural resources and infrastructure. Therefore, a vast array of critical materials and natural spaces were integrated into this financial rent-extraction logic, securitising "assets" like tradable carbon, biodiversity, conservation areas, oil, water, land, agricultural products and many other "commodities" subjected to price volatility (Bracking, 2015, 2019; Brand & Wissen, 2018). That said, there are several studies regarding the pricing, commodifying, and securitising of nature. This literature deals with the financialisation of carbon markets (Lohmann, 2009, 2012), farmlands (Fairbairn, 2014), water infrastructure (Bayliss, 2014; Loftus *et al.*, 2013), oil markets (Labban, 2010; Dicker, 2011), agricultural products (Bruno *et al.*, 2017), weather risks (Pike & Pollard, 2010; Tang & Jang, 2011), commodities financial derivatives (Cheng & Xiong, 2014) and green asset-backed securities and green indices (Sibanda, 2013), just to name a few.

Additionally, researchers refer to the "green grabbing" strategies by the dispossession and privatisation of land to profit from ecosystem services payments (Fairhead *et al.*, 2013). In that vein, authors also suggest that it is financial appropriation rather than accumulation that guides capital to create property rights and "grab surplus value" or extract rent from nature (Felli, 2014; Andreucci *et al.*, 2017). Thus, finance has colonised the environmental lexicon, absorbing malleable concepts like adaptation, resilience, mitigation, and transition to put forward financial agendas and hedging strategies (Watts, 2015; Liverman, 2015; Dietz *et al.*, 2016; Walker & Cooper, 2018).

After this brief rundown on the geographies of energy and finance, it is possible to conclude that both fields have deepened studies on the evolving processes of socioecological relations, production of space and the financial development of CC. Before exploring the direct connections between energy transitions and finance, I will mention some of the literature on the historiographical debate of energy transitions to expand the context of the research.

2.2.3. Energy transitions: historical and historiographical reflections

The experimentation of the present —writes Koselleck (2004)— represents the symbiotic unity between a *space of experience* and a *horizon of expectation*. Current energy transition narratives share this unity: in the search for data, "it is vital to look at historical experiences for lessons about how [energy transitions] might unfold in the future" (Fouquet, 2016: 1). Any contemporary study of energy transitions is oriented by prospective concerns on "the long-term effects of global climate change, and worries about rapidly approaching depletion of low-price, high-quality fossil fuels" (Smil, 2010: 107). This future-oriented perspective of energy history is constantly assessing hypotheses of how energy systems ought to be technologically and financially managed in the coming decades. However, the "energy transition" concept itself represents historical-theoretical controversies subjected to *a*) the current revisionist trends on energy and environmental history and *b*) the historical-comparative studies of energy transitions.

Reviews, revisits, and revisionisms

CC contributes to the current revisionist trends in environmental and energy historicizations. Historiographic "revisionisms" —explains Traverso (2011: 105)— are possible not only due to

the discovery of new information sources but to a new interpretive paradigm that changes the historical perspectives: "history is always written in present time and the inquiries that guide our research of the past is constantly modified according to the times, generations, the transformation processes of society and the paths of collective memory" (p. 106). Indeed, as Malm (2016: 4) stated, "global warming is a sun mercilessly projecting a new light onto history", forcing historical inquiry to decipher 200 years on the evolution of the fossil economy that was clearly unearthed until the current climate crisis. Or, as Chakrabarty (2009) discussed, CC brings a renewed historical reflection for re-examining the deep relations between natural and human history, between geological and anthropological times, and ultimately between globalisation and environmental limits. For Saxe-Fernández (2018), this subject ought to account for the *origins* rather than the deterministic *causes* of CC.

The "universal history" approaches tend to reconstruct the civilisational process of humanity from early human muscles and animal traction to contemporary FF and RE sources. This is the case of Smil's contributions (1999, 2017, 2017a) on the study of energy sources, conversion technologies, and consumption patterns of past energy transitions have focused on the key sociotechnical variables to understand how energy is constantly shaping history and future energy system transformations. For Crosby (2006), this "unappeasable appetite for energy" represents the historical evidence of how the civilisational leap was possible due to the "energy binge" that eventually led to our fossil fuel society. Recently, Penna (2020), analysed the overlapping biological, mineral, and renewable stages of the energy evolution of humanity, concluding some insights into the technical requirements to reduce times for future energy transitions. Others like Wrigley (2010, 2016) and Allen (2009) have updated interpretations of energy as a common thread for the British Industrial Revolution transformation processes as references for future climate adversities. Lastly, works like Rhodes (2018) have also addressed energy transitions as a narrative element to revisit historical events and processes.

Nonetheless, as Lohmann (2020: 1) criticised, this kind of literature deterministically concludes that "every society in history has possessed fundamentally the same hunger for greater and greater supplies of an item they call 'energy'", obviating the fact that "the practice and theory of energy, energy stocks and energy sources that we take for granted today did not exist before 1800". Lohmann (2015) also adds that the concept of "energy transition" is somehow Western-centric or North-centric since several populations and regions in the capitalist periphery have been historically struggling for decades and even centuries with climate adversities and energy access. Also, according to Daggett (2019: 27), what subsequently became "energy" was for a long time a complex metabolic exchange between humans, domesticated animals, food, climate, and terrain, a set of relations vital "to understand the rise of hierarchical human societies". Thus, the word "energy" acquired its status as a material and intellectual product of thermodynamic capitalism and the fossil economy inherited from the 19th century: an obfuscating and abstract definition that contaminated our understanding of the past and distorts our contemporary thinking of future energy transitions (see Lohmann, 2015; Malm, 2016: 1-19). Based on the literature, I would argue that this critical perspective has five main historiographical implications:

- a) *The problem of positivism in energy history.* Critical historians have denounced the uncritical position of some scholars that tend to explain the evolution of the natural world

"without social relations" (see Chesneaux, 1977: 140; Fontana, 1992: 65-78). As Hornborg (2016) stated, positivist environmental history has developed sophisticated biogeographical studies on energy but leaving behind the macro-sociological processes and relations of the capitalist world-economy. For Malm (2016: 6), the studies on energy physics, global warming, and climate science centred on the "meteorological causes of past events" sometimes lacks the human experience of labour under fossil capital and the socio-ecological structure through which economic activity and energy "are welded together" (p. 12). The author concludes that energy history must be a critical exercise, being a matter of searching not for "climate in history, but for history in climate" (p. 6).

- b) *Energy as anachronism.* Lohmann's (2020: 1) critique of the idea that humanity has always had the same appetite to consume "energy" is a call to avoid an anachronistic view that prevents us from understanding plural environmental and energy metabolisms of the past (see also Lohmann & Hildyard, 2014). This would avoid the projection of the current thermodynamical *homo economicus* and market-competitive individual of contemporary capitalist societies into the past as if it were the eternal anthropological model of all time and places. Conceiving this anachronistic view is failing to access other cultural, economic, social, and political models that are a fundamental part of our historiographical inquiries.
- c) *A limited idea of progress linked to FF.* Energy revisionisms have also contested the idea of progress linked to FF, reinterpreting it as a process full of contradictions. For authors like Hornborg (2016) and Malm (2016), this has put into perspective the role of technology and its exploitative relations established between human labour and the environment. Others like Huber (2011, 2013) argue that the 20th century fed the imaginaries of progress, linked to FF consumption patterns and socio-spatial configurations but showing their environmental limits and violent contradictions. For the Corner House scholars (Lohmann & Hildyard, 2014), social movements and grassroots initiatives have "brushed against the grain" by questioning the hegemonic "progress" of fossil capital and its ruling classes. The idea of FF-based progress has also been challenged by left-wing movements, especially the critiques of the "socialist way of exploiting nature" witnessed during the 20th century (Gorz, 1979: 27; Löwy, 2015).
- d) *From little-e energies to Energy.* Following Lohmann & Hildyard (2014), the history of energy transitions can be reinterpreted as a long process of power, conflict, and struggle on the confrontation between "Big-E Energy and little-e energies". Big-E Energy is the centralisation of power and class violence materialised in extractive relations with the environment and exploited labour: "it is the energy of thermodynamics, of electromagnetism, of the fusion of heat, motion and electricity in steam engines, turbines, dynamos, electric motors and electric grids. It stands simultaneously for photosynthesis, nuclear, solar and muscle power, and the force generated by the internal combustion engine" (p. 6). On the other hand, little-e energies are plural social experiences of energy, from premodern societies to current grassroots movements that have been subordinated, absorbed, displaced and/or vanished by the hegemony of Big-e Energy (p. 6). This contribution reinterprets historical energy transitions, not as mere shifts from one energy source to another but a continuous and permanent process of violence that current RE inherits from FF. It also shows the importance of the commons own understanding of

accessing, storing and distributing energy among its members, a long tradition before the rise of centralised thermodynamics (see also Hornborg 2016: 19; Dagget, 2019: 27). It is important to add that Big-E vs. little-e does not necessary represent big projects against small, or that little-e represents alternatives against Big-E (Lohmann & Hildyard (2014).

- e) *Energy as regime of historicity*. According to Hartog (2015: 9), our interpretation of the represents "the modalities of self-consciousness that each and every society adopts in its constructions of time and its perceptions". FF have drawn scholarly attention to the "acceleration" process of the historical experience.¹⁸ The fossil economy accelerated timeframes through the development of industrial machinery (Malm, 2016), agricultural systems (Weis, 2010), and capital's time-space compression of production and circulation processes (Huber, 2013: 9-12). Scholars have also discussed the implications of CC, identifying "metabolic rifts" in the biosphere and biogeochemical cycles that minimise the temporal frames for nature's reproduction and adaptation (Clark & York, 2005; Saxe-Fernandez & Fal, 2012; Moore, 2015). Lastly, literature has also discussed how the fossil economy shapes a particular anthropological model: the cultural reproduction of society through an influx of commodities, needs, imaginaries, desires and spaces based on competition, profitability, individualism, scarcity, and privatisation (Rogers, 2015; Petrocultures Research Group, 2016; Wilson *et al.*, 2017).

Energy transitions through comparative history

Even though energy transitions are unique temporal and spatial phenomena, historical inquiry "is not really interested in the unique, but in what is general in the unique" (Carr, 1961: 80). Energy studies highlight the importance of key indicators as "triggers" or "accelerators" that allowed the energy diffusion from one source to another (Smil, 1999). The author adds that "comparing the spans of individual energy transitions cannot be done without defining their onsets and progressive milestones", resulting in a careful parallel analysis of the temporal and technological factors for each energy source to become dominant (Smil, 2017a: 63). Energy transitions have been characterised by three recurrent variables: the new emerging industries, the price-efficiency of new energy sources, and the development of conversion technologies (Fouquet & Pearson, 2012; Fouquet, 2016). For his part, Sovacool (2016), points to the combination of coexisting energy sources, the interdependence of energy systems, and the complex interactions of different speeds and time scales, resulting in discrete conversions and small-scale changes that collectively can be conceptualised as bigger transitioning events in history. As Fernández & González (2018: 338-349) conclude, rather than defined events or progressive stages, past energy transitions represent the coexistence of energy sources and practices in variegated rural, urban, and industrial regimes. Thus, these changes required decades and sometimes centuries to come to fruition, and their comparisons parameters are certainly subjected to temporal (speed) and spatial (scale) conditioning factors, deeply related to the development of new technologies, companies, infrastructures, mobility means, social needs, legal frameworks, and financial mechanisms.

¹⁸ On the concept of "social acceleration" see Harvey, 1989; Rosa, 2013; the term "great acceleration" is explored in McNeill & Engelke, 2014; Steffen *et al.*, 2015a.

This comparative narrative is also present in the mainstream lexicon. The IMF assessment team claims:

a demand-driven abandonment of oil would not be unprecedented —after all, wood and coal use in the 19th and 20th centuries did not diminish due to resource scarcity. [...] Major energy source in general could have a much shorter life span than many assume. Like wood and coal in the past, a demand-driven switch away from oil could happen in not too distant a future. In our projection, this switch could happen in the next 10 to 25 years as electric cars replace motor vehicles like motor vehicles displaced horses a century ago. Oil would lose its role as the main fuel for transportation. Coupled with the ascent of renewables for power generation [...] (Cherif *et al.*, 2017).

The technological and financial "enablers" would allow an 82% drop in RE costs over the last 10 years, predicting that solar and wind could account for half of the power generation by 2035 and even for two-thirds of the total primary energy supply by 2050 (IRENA, 2018: 9; IRENA, 2020c: 11; McKinsey, 2021: 3). However, even though there are important decarbonisation efforts, "there is not a single indicator that can fully capture the complexity of the global clean energy transition" (IEA, 2019a: 1). In this field, scholars are considering social, political, regulatory, economic, and technological criteria to measure the decision-making "readiness" for the ET (Singh *et al.*, 2019; Neofytou *et al.*, 2020).

Following Sovacool (2017: 17), measuring progress and impact indicators must consider that energy transitions: *a*) may vary in time and space according to the data obtained; *b*) can be a "bundle of more discrete minor conversions and substitutions" rather than a "sweeping" process; *c*) are complex processes and do not depend on a single factor or cause; and *d*) would not be a linear process, but "dependent rather than revolutionary, cumulative rather than fully substitutive". Thus, energy transitions comparative knowledge is still a work in progress that faces challenges due to the global magnitude of the ET envisioned towards 2050. As Fattouh *et al.* (2019: 52) conclude:

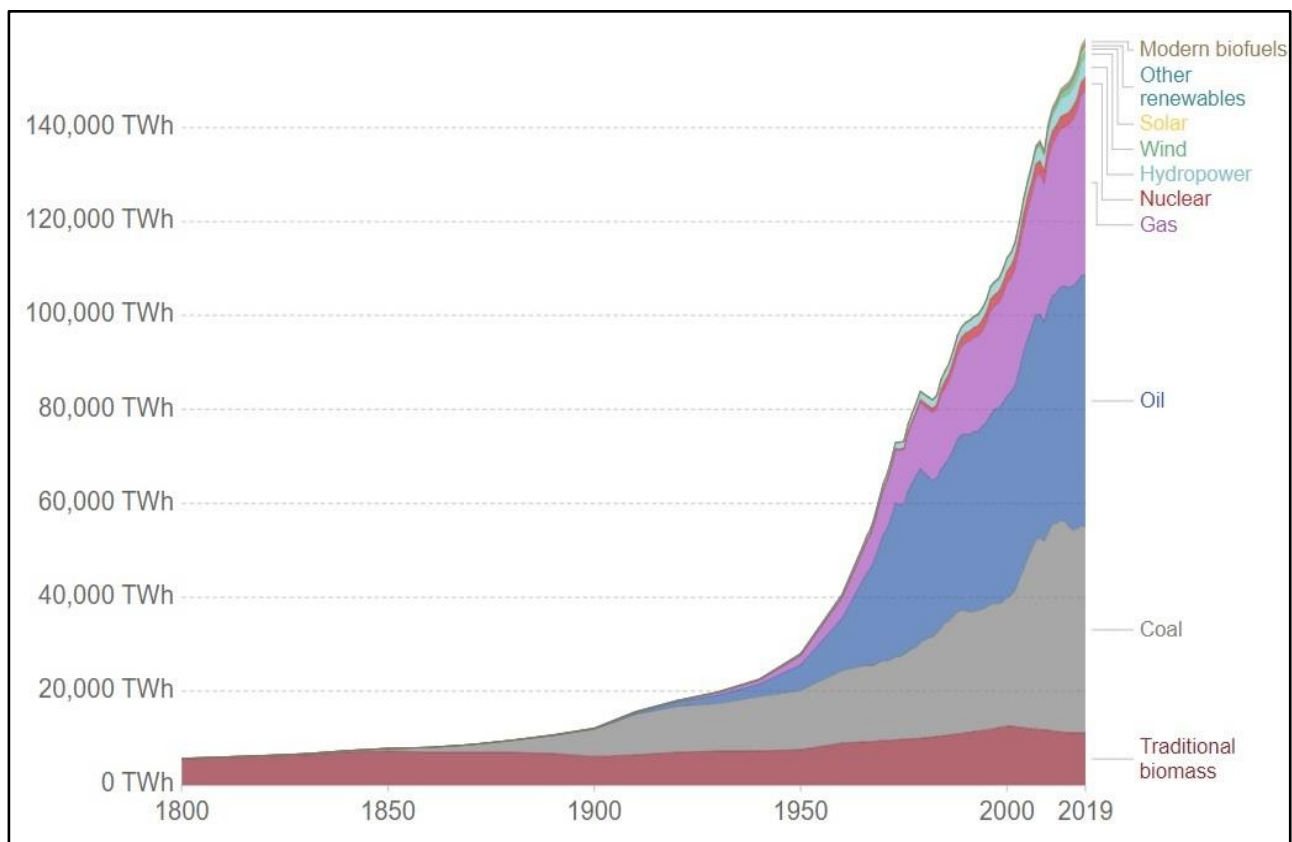
[1] historical evidence regarding the speed of transition is inconclusive, with both cases of slow and fast transitions populating the history. [2] historical data about slow transition are instructive, but not necessarily predictive about future transition. [3] the speed of transition differs across sectors and regions and has multiple layers that make it difficult to draw a concrete conclusion at the global scale. [4] policy plays a key role in the current transition at least in the short to medium term before the market fully takes over. [5] the challenge of gaining market share today is amplified because the energy market is larger than ever before: 12 times 1900 levels and 35 times 1800 levels.

In this context, the concept "energy transition" (also related to terms like "transformation" or "revolution") is in itself problematic. Some suggest that it is quite premature to declare an ongoing transition, especially if comparison takes FF as a transitional stage rather than the hegemonic material and intellectual foundation of energy (Lohmann, 2015; Lohmann & Hildyard, 2016). Therefore, the current ET is not a transitional-substitutive process, but an accumulation pattern still based on the principles of the fossil economy.

These historical changes in the energy system [...] have been a matter of addition, not transition. Although the percentage shares of biomass, coal and oil in our energy supply have fallen with the rise of alternatives, their total use continues to grow. The world has never experienced an energy transition, but the challenge of climate change means that, for the first time, one will need to begin. Since 1800 biomass consumption has increased by about 275%, and coal use by more than 60% just since 2000. Rapidly falling costs and growing investments have helped boost wind and solar power, but these energy sources —like nuclear, oil, and gas before them— are building on top of old ones, rather than replacing them (Newell & Raimi, 2018).

For Tertzakian (2018), the world has spent approximately \$3.0 trillion USD on RE, "pricy considering that such investment has only stolen a percentage point of share away from coal". Finance would need to ensure that the following investments can replace FF rather than a parallel growth. The author concludes: "For now, we are in an era of 'energy diversification', where alternative sources to fossil fuels, notably renewables, are growing alongside (not at the expense of) the incumbents" (p. 1). This idea brings us back to the fossil fuels-renewables connection, where the latter is serving as a complementary business line of the former (Lohmann, 2015). Or as Fernández & González (2018a: 212) concluded, past energy transitions required "support fuels" to underpin new emerging incumbent sources, leading to cumulative and complementary processes of energy.

Figure 2.1. Historical global direct primary energy consumption



Source: Our World in Data (<https://ourworldindata.org/>).

A range of literature now highlights the dominant role of FF and how their influence will shape future trends of energy transitions. These ideas can be divided into four main debates:

a) *The peak oil revival.*

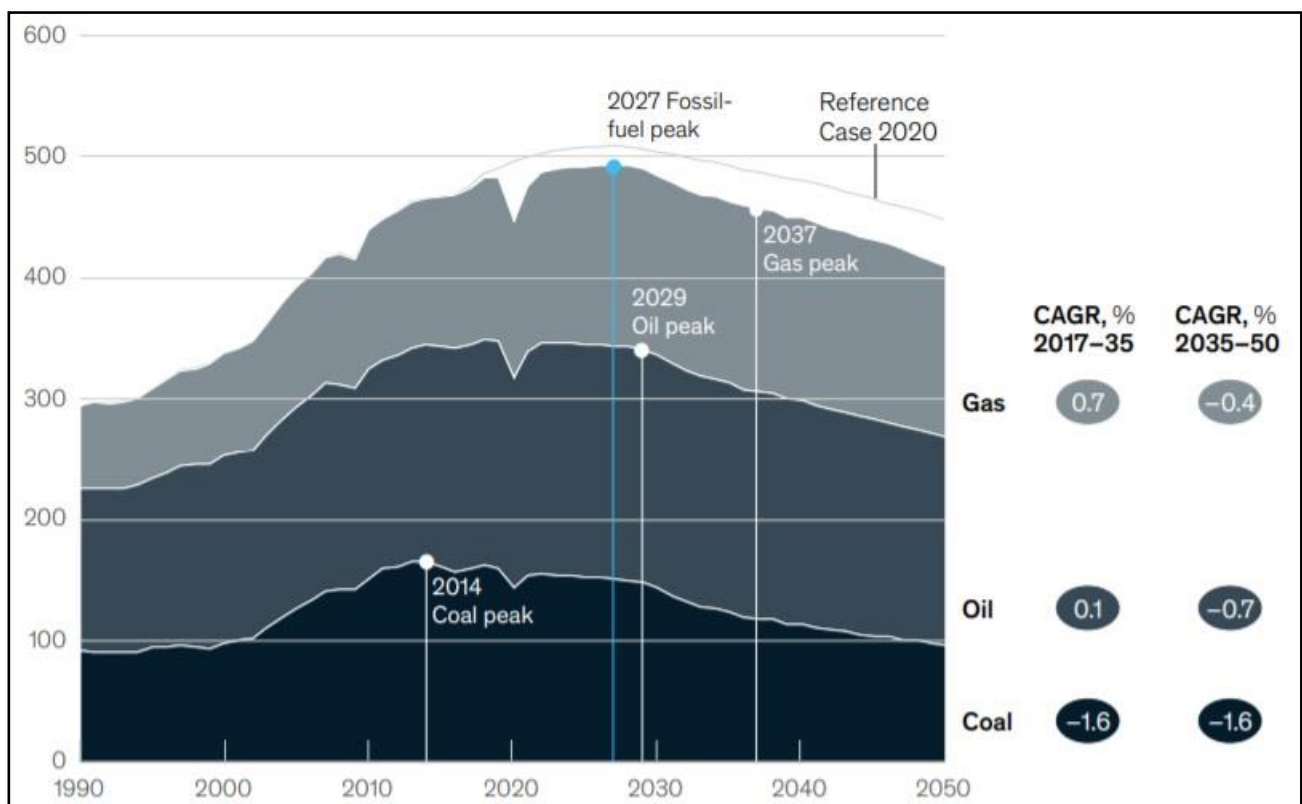
An important part of the energy transitions narrative is the eventual terminal depletion of FF in coming decades.¹⁹ Peak oil literature gained momentum during the first decade of this century

¹⁹ A comprehensive work on the debates surrounding the peak oil phenomenon and its conceptual development can be found in Bentley, 2016.

(see Deffeyes, 2006, 2010). As Heinberg (2020) explains, the "shale revolution" changed the idea of terminal oil scarcity, shifting the debate from a "peak supply" to the need for a "peak demand" that eventually would "lead to falling oil prices and the eventual failure of the oil industry". Heinberg (2020) concludes that the conventional peak oil has certainly occurred, and the industry is relying in non-conventional fuels that will become geologically and financially harder to extract over time (see also Hughes, 2014). The hypothetical demand-driven abandonment of FF is one of the key mainstream arguments in the CF literature (see Cherif *et al.*, 2017; Bain & Co., 2021). However, FF are still irreplaceable growth factors for both developed and developing countries (IEA, 2021c). Their role is still crucial in heavily oil-dependent industries like transport, iron, steel and petrochemicals (IEA, 2018a; Alvik & Irvine, 2020). Also, there is still a persistence to FF activities like coal mining (Carbon Brief, 2020; IEA, 2021), and the increasing role of natural gas as "transition fuel" to support RE intermittency and decarbonisation processes (see IEA, 2019b; Dicker, 2020: 189-213; Gürsan & de Gooyert, 2021).

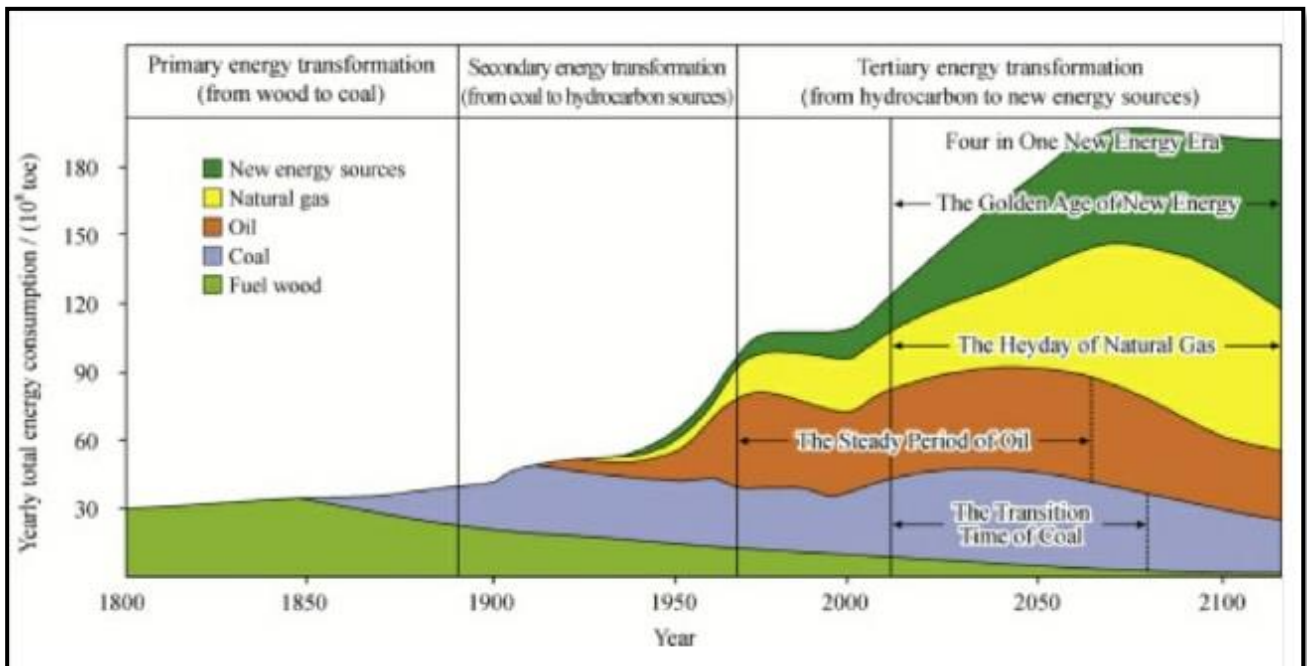
For Dicker (2020: 44), financial markets and oil companies are still sceptical of peak oil (whether terminal depletion or demand), anticipating a "natural progression" of "supplement" energy sources that build on their predecessors rather than a fully "supplanting" scenario. Projections differ on when a peak FF demand may occur due to different economic, technological, financial, and even geopolitical factors.

Figure 2.2. Prospective FF demand peaks (Primary energy demand per FF, million terajoules)



Source: McKinsey, 2021: 7.

Figure 2.3. Hypothetical Energy Transition cumulative process



Source: PetroChina Research Division, in Dicker, 2020: 44.

b) *The Covid-19 rebound.*

Mainstream literature argues that the global pandemic accelerated the terminal decline of FF consumption, forcing shifts and adaptations for new business opportunities in the ET (Carbon Tracker Initiative, 2020; Barbosa *et al.*, 2020). However, in the run-up to the pandemic, the world was about to burn 100 million barrels of oil per day, only to drop to 91 million and then steadily recover its upward trend (Sönnichsen, 2021). This drop represents 8% in global energy use, "not enough in itself to progress towards the Paris climate ambitions" (Alvik & Irvine, 2020). The international recovery will require carbon-intensive recovery to overcome a 3.8% contraction of the global GDP, a substantial figure compared to the 0.1% provoked by the 2009 financial crisis (S&P, 2020a).

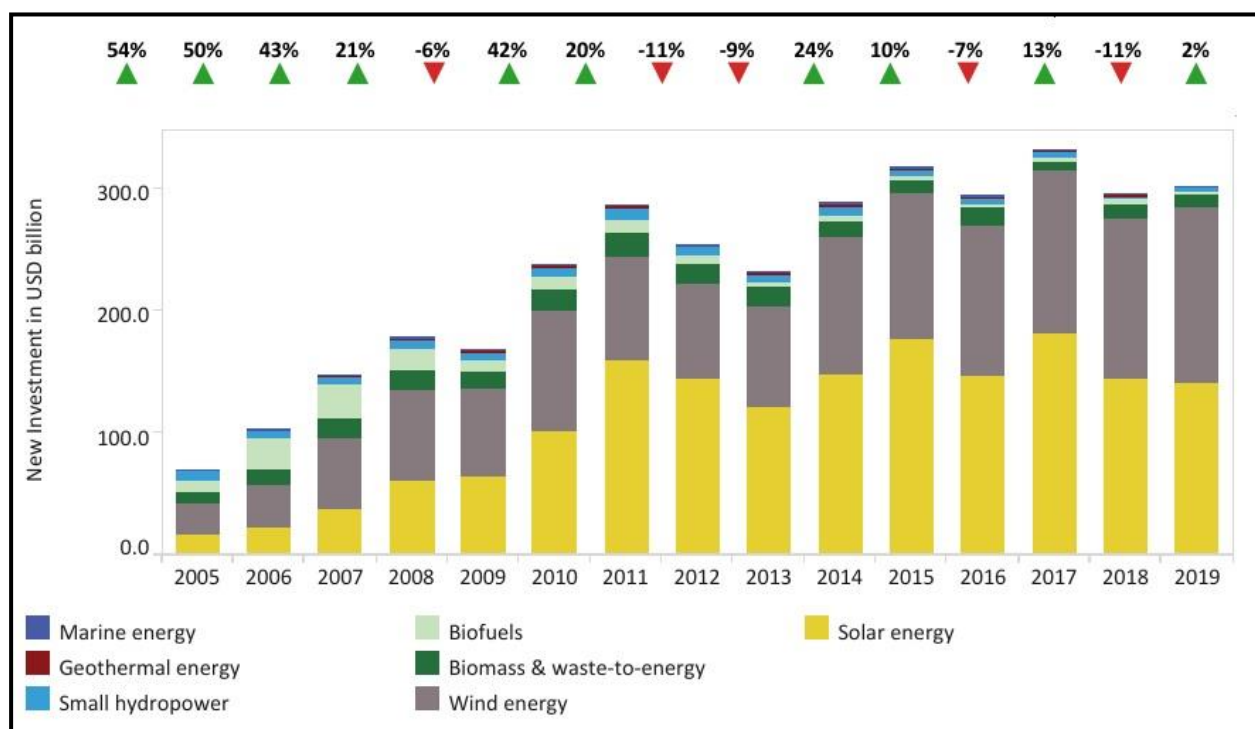
The IEA (2021, 2021a) states that, despite the pandemic, FF remain the primary energy source based on two main indicators. On the one hand, "global energy demand is set to increase by 4.6% in 2021, surpassing pre-Covid-19 levels"; on the other hand, "global energy-related carbon dioxide emissions are on course to surge by 1.5 billion tonnes in 2021", reversing the CO₂ decline caused by the pandemic and reaching a second-largest increase in history. An updated report argues that, with only 2% of governments' recovery spending, "emissions are set to climb to record levels in 2023 and continue rising in the following years, far from the net-zero roadmap towards 2050" (IEA, 2021d).

c) *The renewable energy limits.*

Critical perspectives have contested the idea of a 100% renewable or "net-zero" energy future under mainstream and business-as-usual patterns, pointing to the technical, physical,

ecological, and land-use limits of a hypothetical global and massive-scale ET (see Zehner, 2012; Moriarty & Honnery, 2016; Hansen *et al.*, 2017; Hickel, 2019; Basit *et al.*, 2020). As the "100% clean energy" study by Jacobson *et al.* (2017) discusses, the "renewable future" is still limited largely to solar and wind energy, being the most demanding technologies in mining activities and spatial occupation. For energy analyst Edgar Ocampo (2019), "a combined cycle power plant is basically the same in any part of the world, you just need to add fossil fuels to obtain the same density for electricity generation. On the other hand, solar and wind would occupy nearly 30 times the territorial size of the plant to generate roughly the same quantity of energy, but this energy is not the same in any part of the world nor any time of the year, it will be fluctuating and intermittent due to significant variations on solar intensity and wind speed". These RE boundaries are explored by Mills (2019) who argues that these technologies "will continue to become better, within limits. Those limits matter a great deal [...] because of the overwhelming demand for power in the modern world and the realities of energy sources on offer from Mother Nature" (p. 7). There is also a critique of lithium-ion batteries as storage and intermittency solvers, considering their temporal discrepancies between dispatch and charge times, and their problematic power-weight relation (pp. 11-13).

Figure 2.4. Global trends in Renewable Energy Investment



Source: Frankfurt School-UNEP Centre/BNEF (<https://www.fs-unep-centre.org/>).

d) The "creative destruction" dilemma.

Energy transitions represent an interrelated constellation of core industries, technical innovations, crucial materials, new infrastructures, productive processes, and novel goods. According to Pérez (2003), energy is a key variable that has defined the relation between

technological revolutions and investment cycles during the last 300 years of capitalist expansion. Mainstream literature sees energy transitions as a Schumpeterian "creative destruction" process that would change the techno-economic paradigm, resulting in stranded assets in the FF industry to give way to massive RE deployments (Criekemans, 2018). Yet a radical creative destruction is still hindered by the current dependence on shale reserves and natural gas (Aghion *et al.*, 2021: 188-193). According to Peerbocus (2020: 32),

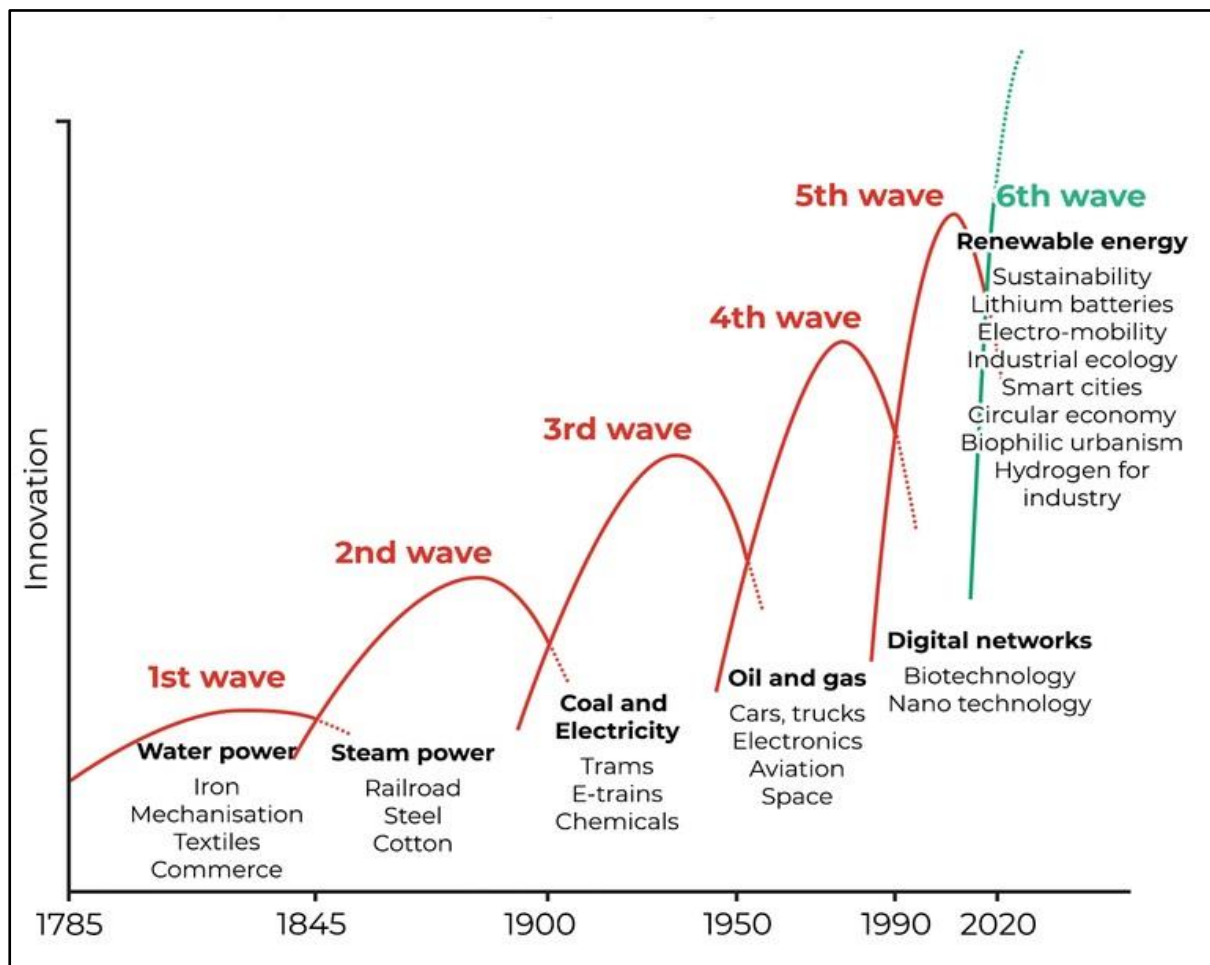
the energy transitions we are witnessing today are sub-processes of a larger creative destruction process that will inevitably result in winners and losers. Energy transitions can take several years to several decades depending on the definition used. [...] Wind turbine was invented in the 1880s and solar photovoltaics in 1954. Clearly it will take much longer for these technologies to meet 80% of energy demand. Meanwhile fossil fuels (oil, gas, and coal) will need to fill in the gap and meet 60 per cent of the energy demand by 2040. [...] Given a choice, most countries would prefer a gradual orderly transition which minimises the impact of stranded asset risks.

Under these circumstances, finance "generates a powerful magnet to attract investment into the new areas, hence accelerating the hold of the paradigm on what becomes the 'new economy'. Financial capital then acts as the agent of massive creative destruction" (Pérez, 2003: 75). Nonetheless, such a process under the current global economy is still hypothetical, since the current post-pandemic recovery will require a combination of new and old technologies to underpin growth trends (Attiga & Benali, 2020: 53).

2.2.4. Energy transitions under Climate Finance and financialisation

In the previous chapter, I addressed the liquidity surpluses currently pursuing investment opportunities in the environmental and energy sectors. From a historical-theoretical perspective, this phenomenon is a manifestation of the longer and complex capitalist overaccumulation crisis that results in an increasing mass of liquidity constantly looking for reinvestment opportunities, surpassing the productive sphere to allocate and valorise capital through financial mechanisms (see Arrighi, 1994, 2007; Foster & Magdoff 2009; Hudson, 2015). Following Pérez (2003), parallel processes of technological and financial innovations set the early stages of a new techno-economic paradigm: "idle money rapidly engages in the enthusiastic backing of the new industries and their entrepreneurs; the financial and banking worlds jump to the quick adoption of modernising innovations for their own operations" (p. 91). Theoretically, the conditions for a transition to a new cycle are given, "as the firms wedded to the previous paradigm increasingly confront exhaustion, in the form of depleted innovative trajectories, diminishing profits and stagnation of productivity and markets [FF supposedly], while the new ones display extraordinary profits, growing productivity and rapid market penetration [renewables]" (p. 39). As seen above, any "financialisation" of the energy transition requires the deployment of real assets (technologies, infrastructure, and markets) where energy flows and services can circulate as commodities and investment assets. Under Pérez's model (2003), this would be the early stage where finance "engages in the backing of the new industries and their entrepreneurs", an essential step to integrate the industrial and financial activities of the ET.

Figure 2.5. Waves and lifespans of technological change, 1785-2020



Source: Newman, 2020.

Different areas within finance have different ways of intervening in the market.²⁰ First, we have the corporate and project finance areas in charge of the material deployment of the ET. According to the IEA (2020a) and IRENA-CPI (2020), investment mechanisms used to fund RE projects during 2015-2020 are:

- a) *Balance sheet financing of developers.* Includes energy companies' internal sources of funding such as retained earnings, equity and other liabilities.
- b) *Debt.* These are loans and convertible loans (debt to equity), provided by commercial and investment banks, national, and international Development Financial Institutions (DFIs).
- c) *Green Bonds.* Investment fixed-income securities used for new energy developments or refinance existing assets.
- d) *Other sources.* Including project-level equity, DFIs project debt, and grants.

Other financial activities based on the material deployment of new RE plants are the securitisation or commodification of real assets. As mentioned above, RE differs from FF since

²⁰ I will further explore this topic in my methodology and fieldwork chapters.

electricity is a flow rather than a physical "stock" or "package" like oil, coal, or gas. This created different financial options to invest and manage risks in the RE industry. These mechanisms are:

- a) *Physical and financial Power Purchase Agreements (PPA)*. These bilateral contracts represent fixed-price electricity exchanges between generators and suppliers. It is a guarantee for project finance because they represent future income streams (cash flows) for the repayment of debt and equity (see Mohamadi, 2021). They can be physical (where an amount of electricity is delivered) or financial (where a counterpart agrees to a fixed purchase price but does not take physical delivery) (see IEA, 2019: 138).
- b) *Proxy revenue swap*. These risk-transfer contracts are used as weather variations and price volatility hedging instruments. Here, solar or wind volatile cash flows are swapped for a fixed income stream. It is an alternative to long-term PPAs used by insurance companies for RE risk management. As Karsten Berlage from Allianz explained: "[imagine that] a wind farm has an annual revenue projection of \$10m [USD], which the project is supposed to generate on average wind and on average forward price. If the wind farm only generates \$8m because the wind isn't blowing or the market price is lower than expected, then Allianz would pay the remaining \$2m to the wind farm. If the wind farm generates more than \$10m, the wind farm pays to Allianz the excess" (Valtimora, 2019). Here, abstract intermittency becomes an investment opportunity.
- c) *Forward contracts*. Financial derivatives whose underlying asset is the electricity traded in wholesale markets. Since these markets work on a real-time and day-ahead basis, the forward contract allows the generator to bilaterally agree a fixed price for a future delivery date according to supply needs, thus hedging the volatility of spot markets (see Aïd, 2015: 15-20).
- d) *Clean energy instruments*. Energy systems have introduced market-based innovations like Renewable Energy Certificates (RECs) or Renewables Obligation Certificates (ROCs) to incentivise and gradually increase the participation of RE supply. These certificates create a market between electricity generators and suppliers to meet compulsory decarbonisation targets. They work as financial instruments that provide liquidity to RE exchanges and have the possibility of being traded in secondary markets (see IRENA *et al.*, 2018).
- e) *Financial Transmission Rights (FTR)*. A financial instrument that allows the holder to hedge against potential losses derived from congestion costs in the transmission grid. The spread is determined by the congestion components of two nodes: the injection node and the withdrawal node. Like the Certificates mentioned above, FTR are also a potential instrument for secondary market trading (see Rosellón & Kristiansen, 2013; Petropoulos & Willems, 2020).
- f) *Mergers and acquisitions (M&A)*. A financial strategy where medium and large power companies absorb others and integrate RE assets into diversified business portfolios. M&A are part of financial modelling forecasts that predict an increase in the value of the RE supply chain (IEA, 2020; Deloitte, 2013; KPMG, 2018; EY, 2019).

Even though financial innovations are expanding because of CF initiatives, the IEA (2020a) recognises that despite the competitive costs of solar and wind technologies over the past decade, renewables "are not expanding at the rate needed to align with sustainability goals" (p. 135). So

far, finance has not been a massive capital reallocation vector since FF are still more attractive to investors due to financial metrics: market capitalisation, dividend pay-out ratio, firm capital structure, and liquidity (p. 136).²¹ The financialisation debate also deals with this phenomenon: finance represents more obstacles to the ET due to the financial short-termism dynamics and the overall proliferation of financial non-productive activities. Some of these arguments are:

- a) *Financialised macroeconomic frameworks.* Spanning over 30 years, macroeconomic policies have marked a division between a financial explosion and structural stagnation of production and real wages, imposing significant restrictions in decarbonisation and climate resilience initiatives (Heller & Seiger, 2018). Moreover, such policies have plunged individuals, families, businesses, companies, and States of the global economy into chronic indebtedness, diverting income from consumption and production into the financial sphere (Hudson, 2015). This context characterises by stagnant, uneven and shrinking economies where finance establishes rent-extraction mechanisms through interests, dividends, and amortisations rather than fostering long-term productive investments (pp. 78-79). Thus, financial short-termism opposes the long-term energy planning needed for complex environmental adaptation in different regions of the planet (Saxe-Fernández & Fal, 2012).
- b) *Austerity and privatisation.* In reference to the dismantling of the State that prevents energy transition planning and regulations based on public interest and collective future adaptation. The problem lies in the continuous and permanent transfer of monetary and natural resources from public to private through privatisation of State-owned energy companies, reduction of public spending, and the lack of planning in long-term energy and environmental policies (on this topic see Magdoff & Foster, 2011; Saxe-Fernández & Fal, 2012; Lohmann & Hildyard, 2014, Fernández & González, 2018a: 212).
- c) *The deindustrialisation phenomenon.* This process is related to the increasing accumulation and centralisation of the climate policy and technological cores in monopoly capital (Saxe-Fernández, 2018). Hypothetical low-carbon industrialisation faces the challenges of financialised economies, where finance divert resources into M&A strategies and hoarding idling surpluses away from productive lines to focus on debt, rent extraction, and stock buybacks (this analysis on the discrepancies between financial and industrial capitalisms can be found in Hudson, 2021).

These processes provide preliminary elements of the financialisation of energy transitions in years to come and their manifestations certainly remain to be seen. They also open a debate over one of the most controversial arguments when reviewing the critical literature: the conceptual and material development of energy transitions as an extension of the fossil economy.

The fossil continuity

As their reports and advertisements frankly reveal, most oil companies, banks and industrial corporations see energy transition not as a process that will replace fossil fuels, but as a process that will supplement them. They're not against transition, but they don't see it in climate terms. Instead, they see it as a way of

²¹ A recent article on the financial constraints and bankruptcies in the US residential solar business can be found in Eavis & Penn, 2021.

delivering better returns on investments that, at bottom, will go on being organised around oil, coal, and gas. For them, an energy transition is a way of diversifying and intensifying the same type of labour exploitation that fossil capitalism made universal (Lohmann, 2015: 6).

The financialisation critique is also a theoretical tool to analyse the economic and political complementarity between FF and RE. Roughly, this continuity encompasses three main study areas: *a)* the political ecology of renewables, analysing the impact of technologies and infrastructure in territories, populations, and environments (Lohmann & Hildyard, 2014); *b)* the political economy of energy markets, their uneven dynamics and accumulation axes (Fernández & González, 2018a); and *c)* the political sociology of capital, in terms of State and class relations that subordinates the energy industry to the FF hegemony (Saxe-Fernández, 2018).

It is true that "capitalism had never devoted so much attention to an environmental problem", but the ET narrative made visible the investment opportunities in the green sector, making CC legible and manageable as a market-based technologic problem (Fernández & González, 2018a: 64-70). Recovering Lohmann (2015), this approach interprets the ET not as a distancing from FF but a by-product of the expansion of the fossil economy.

Some reports address this relation. For Barbosa *et al.* (2020), the FF industry can benefit from new businesses related to the ET: "The returns for some of these opportunities remain unclear, and the oil and gas industry will have to prove whether it can be a natural and leading participant in these businesses. Hydrogen, ammonia, methanol, new plastics, and carbon capture, utilisation, and storage (CCUS) could all be interesting areas for the oil and gas industry". The bank Goldman Sachs (2019b: 5) stated that "Big Oil must transit to Big Energy", displaying "a deeper presence in the global gas and power chains, including retail, electric vehicles charging and RE; biofuels; petrochemicals; improved upstream and industrial operations; nature-based solutions and carbon capture and reforestation". This step must be supported by the financial sector, as "capital markets and shareholders are taking a leading role by pushing companies into the energy transition sectors and divesting from pollutant industries and new hydrocarbon assets" (p. 1). For the IEA (2020: 45) several oil and gas companies are shifting business strategies, "supplying liquids and gases for energy transitions", getting into "carbon capture, utilisation, and storage", and making the transition "from fuel to energy companies". Rather than a radical "creative destruction", the fossil industry is expanding "through processes of creative accumulation, [that is] incumbents may be able to absorb new technologies and integrate them within their existing capabilities and thereby prevent the destruction of existing industries as a consequence of discontinuous technological change" (Bergek *et al.*, 2013).

Yet this environmental interest remains marginal and ambiguous compared to the monopoly FF-finance symbiosis. According to Influence Map (2019: 2-3), "the five largest publicly traded oil and gas majors (ExxonMobil, Royal Dutch Shell, Chevron, BP and Total) have invested over \$1 billion USD of shareholder funds in the three years following the Paris Agreement on misleading climate-related branding and lobbying". Such a strategy sought to "control, delay, or block binding climate-motivated policies", convincing stakeholders that the companies are complying with ambitious climate actions while channelling only around 3% of spending to low-carbon investments (p. 3). For their part, the financial sector —and more specifically the world's 60 largest fossil commercial and investment banks— "poured a total of \$3.8 trillion into fossil fuels from 2016-2020", targeting profitable areas in the Canadian tar sands, Arctic oil and gas, offshore hydrocarbon reserves, fracking wells, liquefied natural gas

(LGN), coal mining and coal power generation (Rainforest Action Network *et al.*, 2021). The report confirms that "fossil fuel financing dropped 9% last year, parallel to the global drop in fossil fuel demand and production due to the Covid-19 pandemic. And yet 2020 levels remained higher than in 2016, the year immediately following the adoption of the Paris Agreement" (p. 4). These trends add to the debate around CC scepticism, a long-stand conflict on how companies like ExxonMobil and Chevron have consciously denied and concealed the origins, responsibilities, and effects of CC.²²

Wall Street and the ET

One last area to explore is the financial predominance in the oil markets as a major obstacle for the ET. Making the ET an attractive investment requires RE to be a competitive profit space compared to the current FF-fed systems. That is to say, *a*) divest from mature and low-yield fossil assets at risk of remaining "stranded", and *b*) pushing the RE generation costs and tariff prices down enough to generate liquidity in the energy markets that can compete and displace *fly-to-quality* investments in highly subsidised and cheap FF (Carbon Tracker Initiative, 2018, 2020). Nonetheless, according to NYMEX veteran Dan Dicker (2020), the ET narrative is failing to address the other side of the coin: it is not a matter of making renewables cheaper but oil more expensive. From a financial perspective, "energy companies are going to spend their time getting and selling the most profitable energy they can find. For them, if sunshine and wind power make them a better profit than mining tar sands oil and carving coal out of the ground, they'd be as enthusiastic about renewables as any environmentalist" (p. 18). On the other hand, "prices drive choices", so consumers would lean to the cheapest energy source they can afford to fulfil their everyday activities. As Tertzakian & Hollihan (2009: 128) concluded, "we may lose forests or biodiversity, have trouble breathing, or witness a rise in cancer rates. But curiously, none of those impacts hit us with the same immediacy and urgency as a sudden steep jump in the price of gasoline or heating oil".

Table 2.1. Competitive profit margins from a financial perspective

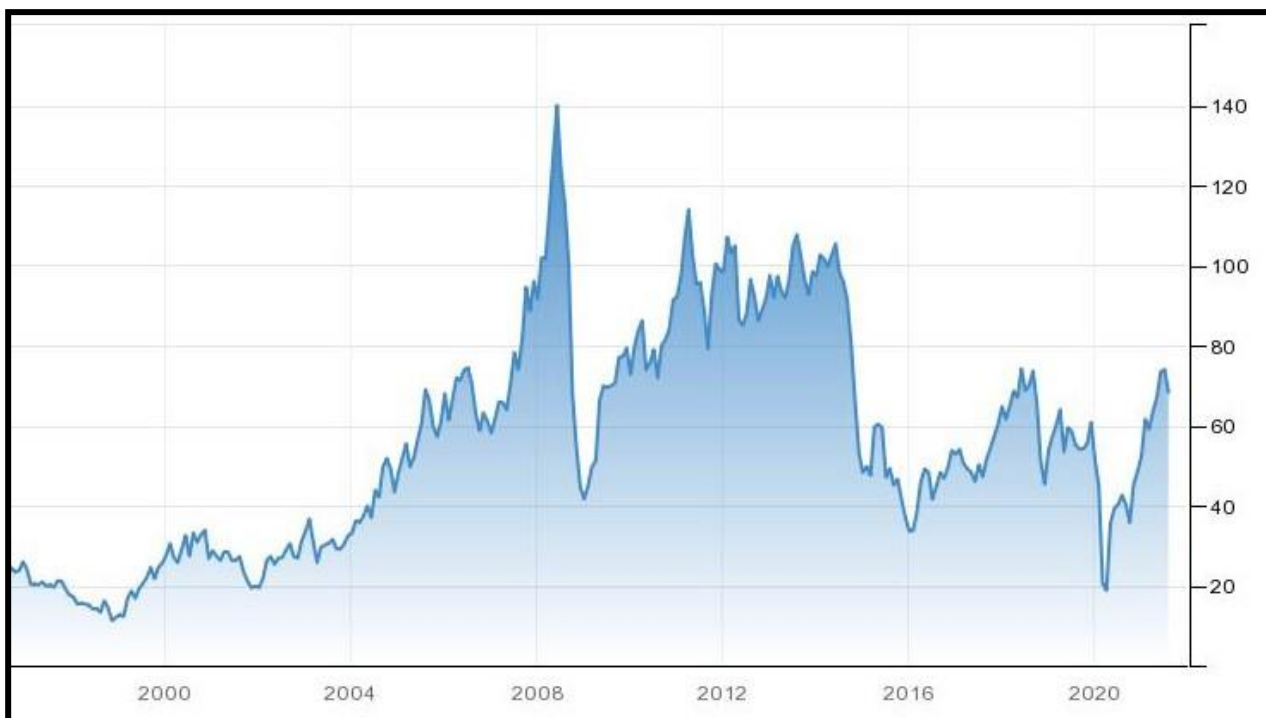
Source	Cost	Price	Profit
Oil	\$80 per barrel	\$120	50%
Natural Gas	\$2 per MMBtu	\$4	100%
Solar	\$0.03 per kWh	\$0.09	200%

Source: data collected from Dicker, 2020: 33.

²² The prime example in this regard was the conflict between the Rockefeller family and its institutional heir ExxonMobil. The company was denounced for corruption and manipulation of climate science by introducing systematic lobbying to delay and hinder environmental policies and divestment strategies on FF (Kaiser & Wasserman, 2016). On this topic see also Oreskes & Conway, 2011; Coll, 2012.

Following Dicker (2020), energy transitions face a double problem. First, wind and solar are approaching their ultimate "cheapness" limits, and therefore their profitable returns (p. 25). Secondly, "oil prices have stayed shockingly low compared to just about every other financial asset and particularly since the oil bust of 2014" (p. 18). Therefore, RE can't compete with cheap oil: "low oil prices are destroying the competitiveness of wind and solar and scuttling environmentally sustainable technologies and their advancement" (p. 27). So, instead of focusing on cheapening RE, it is mandatory to "make oil prices stable and then consistently rising, like nearly every other asset class in the world" (p. 18). Dicker parts from the idea of a "natural progression" of energy: oil extraction begins from the geologically accessible places (conventional) to the most difficult and costly reserves (non-conventional), until terminal depletion of reserves and peak oil occur (pp. 32-48). Theoretically, this would give the barrel of oil a geological value, where each extracted barrel is more expensive than the previous one. But several factors over the last two decades have driven lower oil prices: The Commodity Futures Modernization Act de 2000, the speculative deleveraging collapse of oil prices in 2008-2014, the erratic US-OPEC oil policies, the shale revolution oversupply (funded by Wall Street), and more recently, the Covid-19 crisis and the uncertainties of the post-pandemic recovery (see Dicker 2011, 2020: 17-31, 50-72, 138-167).

Figure 2.6. Historical oil prices, 1995-2021



Source: Trading Economics (<https://tradingeconomics.com/>).

This also relates to the long-standing "financialisation of oil markets" that is preventing prices from stabilising and following a sustained increase (Dicker, 2011). Such a process represents a shift: in the 1980s the users of oil futures were oil producers and end-users hedging their operations from price volatility (p. 106). But by the mid-1990s, investment banks took

over most of the seats in the NYMEX exchange, changing the rules of the oil trading floors by introducing financial innovations for short-term profits (p. 104). By not being end-users of oil but mere gamblers on prices (98% of the open contacts in the market are purely financial), Wall Street banks transformed the physical oil barrel into a financial asset (the so-called "paper barrel"). This created the short-term speculative "rollercoaster" variations of oil prices that hinder the long-term planning and expansion of RE (Dicker, 2020: 106-111). Any energy transition initiative must target keeping long-term oil prices high and fixing the bankrupt energy markets controlled by FF subsidies and Wall Street interests, introducing substantial changes in the oil pricing mechanism which plays a central role as an international benchmark for global energy markets (see Labban, 2010; Dicker, 2020: 238).

2.2.5. Alternative energy-finance relations

Critical geography-energy-finance literature is also emphasising the need for alternative social constructions through energy transitions. While alternatives in this regard are a work in progress, the role of finance in energy futures is still a debate within the socioecological transitions' literature. Following Lohmann (2015: 6), "one way out of this trap might be to try to work not so much toward an 'energy transition' as toward a political transition that better recognises plural forms of energy. Like all fundamental political transitions, this one would be less about finance than about movement-building" Or as Reyes (2020: 150) concludes, "changing the financial system in ways that benefit the planet requires reducing the size and influence of the financial sector, as well as 'de-financialising' other parts of the economy". In this last section, I will briefly review alternative perspectives on the relation energy-finance, citing preliminary theoretical contributions and empirical approaches under the "transition" narrative.

Degrowth and future studies

Degrowth movements point to the importance of reducing materials, energy and waste throughput as a long-term solution to energy poverty, terminal FF depletion, environmental damage and carbon emissions. "The only truly clean energy is less energy", says Hickel (2019). Heinberg (2011: 221) concludes that, due to geological constraints, "the future global society will have to live with less energy for economic purposes, not more", shifting to efficiency and RE programs to do "more with less". According to Fernández & González (2018a: 117), the road to renewables must be paved with strong planning and social awareness based on decreasing energy consumption and the introduction of conservation policies that would leave untapped FF reserves underground. For Liegey & Nelson (2020: 117), energy degrowth constitutes a strategy against the current overproduction and overconsumption patterns, achieving less social inequality and mitigating environmental damage. Renewables —argue Stuart *et al.* (2021: 34)— are only viable by "promoting reductions in fossil fuels and reductions in total energy consumption", reaching a "sufficiency" level while improving the consumption of basic human needs in developing regions. Therefore, it is true that many populations in the capitalist periphery cannot "consume less" since they do not have access to energy or have historically lived in energy poverty (Roser, 2020), so degrowth strategies could allow people to politically and autonomously organise around energy to improve local economies and collective

livelihoods (D'Alisa *et al.*, 2015; Kallis, 2018; López *et al.*, 2019; Savini, 2021). Thus, it is not a matter of adjusting RE to our modern fossilised-based view of energy but of adapting our needs to the capabilities and limits of renewable sources (Fernández y González, 2018a: 117).

Degrowth parts from the idea of a reduction of materials and energy consumption, always related to the redistribution of income, changes in the GDP accounting, and the overcoming of the market-based visions of the economy (see Kallis *et al.*, 2012; Hickel, 2019a; Hickel & Kallis, 2019). Its focus encompasses material and energy conservation for essential social reproduction needs rather than non-productive expenditures (see Romano, 2015). In other words, degrowth pursues an "energy democracy" by allowing growth in generalised human needs within broader degrowth in total energy use (Kunze & Becker, 2015). This is also an opportunity for the decommodification of labour, natural resources and land, as well as the "deaccumulation" of the economic process (Kallis, 2018). Degrowth phraseology is deeply linked to the "just transition" and "climate justice" narratives to open the debate to plural political visions of the world (Velicu & Barca, 2020). Thus, degrowth narratives and activism challenge the underlying system that is causing environmental depletion, going beyond mainstream green discourses.²³

From a geographical perspective, energy degrowth is a spatial planning phenomenon (Wächter, 2013). Plural energy transitions must abandon the centralised focus (big energy projects supplying massive anonymous markets to feed endless-growing consumption) to reach localised and regionalised energy projects based on *in situ* social, political and economic experiences. Scholars refer to the decentralisation and municipalisation of the energy supply, based on local RE sources "crafted for territorial energy sovereignty" (Liegey & Nelson, 2020: 142). Alternative practices can fill the gap in energy access and metering problems by implementing locally produced energy through small-scale projects (Baker, 2021). This implies spatial management of decentralised off-grid and mini-grid systems based in Integrated Community Energy Systems (Acosta *et al.*, 2018). Decentralisation has sparked political movements and grassroots initiatives of energy cooperatives and commons reappropriation of spaces, technologies, productive activities, housing and even the use of alternative credit systems and local currencies for trade (see Gibson-Graham *et al.*, 2013; D'Alisa *et al.*, 2015; Stuart *et al.*, 2021; Savini, 2021). Despite its local and regional approach, energy degrowth also claims a global scope of different scales of social movements connecting through plural experiences, actors, institutions and policies (Stuart *et al.*, 2021: 36).

In terms of energy transitions, Liegey & Nelson (2020: xvi) suggest that "more growth means more energy demand, and more energy demand makes it all the more difficult to roll out enough renewable capacity to meet it". Indeed,

growth drives energy demand up and makes it significantly more difficult –and likely infeasible– for nations to transition to clean energy quickly enough to prevent potentially catastrophic levels of global warming. In recent years, IPCC scientists have argued that the only feasible way to meet the Paris Agreement targets is

²³ Degrowth scholars refer to the flawed lexicon of "green", "smart", "sustainable" and "inclusive" growth, among other terms that pose the contradictory mirage of "capitalist growth without environmental destruction" (see Liegey & Nelson, 2020: 30). For their part, Stuart *et al.*, (2021: 11) argue the "false solutions" offered by the mainstream narrative, such as "individual behavioural changes (without changing the social systems in which individual behaviours are structured), market-based solutions through carbon pricing, improving energy and carbon efficiency (without pursuing total reductions in energy consumption), expanding renewable energy (but not simultaneously reducing fossil fuels use and total energy consumption), and lastly geoengineering (which is too risky)".

to actively scale down the material throughput of the global economy. Reducing material throughput reduces energy demand, which makes it easier to accomplish the transition to clean energy (Hickel 2019a: 54).

Also, it is believed that plural energy transitions require the integration of other transitions such as energy democracy and decolonisation, co-housing, eco-villages, permaculture, agroecology, vegetarianism and veganism, water access, urban farming, cycling, ecofeminism, consumer cooperatives, solidarity-based economies, time-banks, ethical banks and credit cooperatives, community currencies, among others (see Demaria *et al.*, 2013; Burke & Stephens 2018; Khmara & Kornenberg, 2020).

Towards an alternative financial architecture

Scholars also propose radical changes in the contemporary banking and financial systems to support just and plural energy transitions. This implies "resetting" finance in order to integrate a broader spectrum of socioecological needs based on co-ownership, cooperative, adaptative and resilient energy systems. Such proposals have been named positive finance (Guez & Zaouati, 2016), alternative finance (Davis & Brauholtz-Speight, 2016), just transition finance (Zadek, 2019), transitional finance (Louche *et al.*, 2019; Lowitzsch, 2019), finance commons/commoning (Bollier & Conaty, 2015), and community finance (Graham-Gibson *et al.*, 2013). Alternative financial performance represents a redefinition and reappropriation of stakeholder's theory to overcome pitfalls related to energy and environmental local projects development (Shrivastava *et al.*, 2019). Other scholars address financial advantages in FF divestment strategies (Hunt & Weber, 2019) and the elimination of barriers to allow low-income participation in renewable energy projects (Baker, 2021: 170-176).

Alternative finance is also linked to radical changes in monetary theory and macroeconomic policies. Scholars have theorised about new forms of property, zero or negative interest rates, non-debt money, debt deflation, and regional currencies for energy and material exchanges (see Kallis *et al.*, 2012; Tokic, 2012; Douthwaite, 2012; Demaria *et al.*, 2013). There have also been studies on the ideological constraints of money fetishism and the need to separate local communities and metabolisms from global-scale economic flows (Hornborg, 2019).

Overall, the critical theory proposes an alternative social prognosis, since the mainstream literature implicitly states that "there will be a kind of post-FF narrative but hardly a post-capitalist argument" (Fernández & González, 2018a: 207). From there the need for "post-" scenarios (the overcoming of capitalism, developmentalism, fossil fuels and growth) that would establish renewed political practices for alternative spatial, energy and money relations (see Gibson-Graham, 2006; Petrocultures Research Group, 2016; Chatterton, 2016; Buxton & Shipman, 2018; Hajer & Versteeg, 2018; Feola, 2020; Schmid & Smith, 2020). In terms of finance, this literature also inspired scholars to theorised post-capitalist entrepreneurship start-ups (Cohen, 2017) and the scalable democratic regulation and reappropriation of the local and international financial systems, like the ones proposed by Reyes (2020) and Pettifor (2020) in the context of the Green New Deal.

2.3. Preliminary conclusions

Throughout this chapter, I proposed a common thread to review the relevant critical literature on the relations between geography, energy and finance. By weaving these theoretical approaches, I am establishing an analytical framework to support and guide the analysis in the following chapters. To conclude, I would resume this literature examination in three main discussion points, using the thesis-antithesis-synthesis method.

- 1) CF mainstream narrative represents an international architecture based on a series of identifiable discourses, agreements, initiatives, policies, regulations, institutions, assets, markets, innovations, investments mechanisms, technologies, infrastructure projects, actors, and spaces. This narrative blends the need to allocate idling capital surpluses in new business lines pursuing investment opportunities in comprehensive environmental sectors. Such an approach includes the commodification, management and commercialisation of natural resources, spaces and ecosystem services. It also emphasises the need for North-South financial and technical cooperation, implementing green agendas for developing nations and vulnerable populations. Due to the centrality of energy for the climate debate, CF also introduced the need for an ET and energy efficiency programs. These initiatives would allow achieving low-carbon futures based on large-scale and long-term investments in RE technologies, infrastructure, and markets.
- 2) Critical theories have developed different perspectives on the study and explanation of the global environmental crisis, proposing a more complex and plural understanding of the energy and finance phenomena through the lens of critical geography and political ecology. These critiques range from historical reinterpretations to policy analysis, and from reformist proposals to radical approaches. The debate highlights the dangers of a business-as-usual ET based on the continuity and complementary patterns of capital expansion into the environmental frontier, as well as the deepening of extractivist practices for RE deployment. It also problematises the ET concept by challenging the idea of growth, the FF capitalist dependency and the short-term practices and speculative mechanisms financialisation over natural resources and spaces.
- 3) The above leads to the future studies and prospective analyses on both energy and finance relations. This emerging literature has opened a debate around the imperative for degrowth and the local-regional approach for energy transitions. Such a perspectives implies a change or "reset" in the financial system, overcoming the barriers to acquire energy technologies and the possibilities of reducing, adapting, and democratising the financial system.

Reviewing the literature in this chapter also allowed me to assess the connections between finance, energy and geography. One of the challenges I found while reviewing the literature was to find the authors that had already covered the intersections between finance and energy transitions. While I have already quoted the most relevant contributions on the critical side, I felt there are still brief gaps to explore the finance-energy-geography nexus that belong to the specific knowledge of financial actors and institutions. This research is an effort to bring some of that knowledge to dialogue with critical theory. Therefore, I would like to conclude with a summary of this information to wrap up the literature review and gaps to fill in further research agendas.

Figure 2.7. Theoretical overview of the finance-energy-geography nexus

Domain	Finance-energy relations	Key areas to further explore
Critical Geography	• Geographical and cartographic knowledge of finance in search of space and natural resources (Lacoste, 1976). • Overaccumulation crisis and the spatial fix towards natural spaces and resources (Harvey, 2001).	• Uneven geographies on the valorisation of renewable energy sources. • Financial-based energy spatial planification.
Energy Geography	• Capital switch to energy transitions (Castree & Christophers, 2015). • Financial configuration of the Wholesale Electricity Market (see section 2.2.4.). • Deregulation and liberalisation of electricity prices (see section 2.2.4.). • Investment portfolios of ET assets (Heiligttag <i>et al.</i>, 2019).	• Commodification of renewable energy-related instruments. • Secondary markets around Wholesale Electricity Markets. • Financial derivatives on nodes and electricity flows. • Rent-extraction mechanisms to generation technologies and transmission-distribution infrastructure. • Financial spatial planification for generation plants and transmission lines.
Political Ecology	• The territorial conflict generated by investment interests over energy sources (Lohmann & Hildyard, 2014). • Land valorisation through renewable energy technologies and infrastructure (see section 2.2.2.). • Financial management of Natural Capital (Sullivan, 2012, 2017; Bracking, 2019).	• Integration of environmental assets portfolios.

Source: own elaboration.

CHAPTER III

Methodology

Geography, in any of its branches, must be a genetic science, that is, account for origins and processes.

— CARL O. SAUER, *Foreword to Historical Geography*, 1941

This chapter contains the methodological procedures I followed to answer research questions and achieve dissertation objectives. I briefly refer to the background to the research, followed by the interpretative method (the subjective elements in the interaction between philosophy and science) and the research methods (the qualitative and quantitative techniques, tools and skills used for data collection and interpretation). I will also explain the motivations that led me to choose empirical references and the fieldwork location, focusing on their relevance for the scholarly debate. My objective is to give the reader a deeper understanding on the motivations and underlying ideas that supported the planning, developing and culmination of this research project.

3.1. Research background, purposes, and justification

This dissertation emerged as a concern with understanding the contemporary financial expansion processes in the renewable energy (RE) industry. It is a follow-up to previous comparative work on the development of the financialisation phenomenon in the Mexican and Argentine oil industries during the 1982-2015 period (Álvarez-Herrero, 2019). In that book, the conclusions left open the hypothesis of similar financialisation patterns in a mainstream Energy Transition (ET) that is taking place in Mexico since the 2013-2014 Energy Reform (ER). This reflection provoked three parallel lines on analysis that I will develop in the following chapters:

- 1) Since the ER, the deregulation and liberalisation of the Mexican energy industry introduced a wholesale electricity market and allowed private investments to develop massive solar and wind projects in the Mexican territory. This process marked a change from a State-owned centralised industry to a private electricity market model based on a broader participation of financial mechanisms, instruments, actors and institutions. While exploring the literature exposed in the previous chapters and identifying some parallels, I had the interest of study the recent trends of a hypothetical ET in Mexico, tracing financialisation symptoms and exploring energy geographies relations.
- 2) The idea of an ET brought another crucial reflection: the role of Mexico as a mature petrostate in the face of the climate debate and the need for socioecological transitions. Since the ER, a national debate around the energy future of the country aroused, suggesting that Mexico ought to leave behind the 20th-century oil nationalism to embrace a private-driven ET. As Meyer has suggested (1990, 2009), the Mexican energy history is deeply linked to the history of the State, the construction of the national economy, and the cultural development of landscapes and regions. But, as seen in the previous chapter, climate change (CC) is a renewed light that transformed these interpretations by pointing to the

material limits of FF and the contradictions of the massive expansion of renewables. This sparked my interest in the alternatives to the Mexican fossil capital model and the role that finance could play in alternative scenarios to cooperate and support energy futures.

- 3) In April 2017, I visited the Mexican northern state of Baja California (BC), a region with increasing water and energy challenges due to climatic and geographical conditions. There I met Prof. Rubén Lara-Lara, a researcher from the oceanography, marine biology and carbon cycles divisions at the CICESE (the Centre for Scientific Research and Higher Education of Ensenada, BC). Lara-Lara exposed me to the challenges that BC faces in terms of energy transitions and the diverse nexus between energy, water, agriculture and social-owned land. Since the ER, the region sparked interest from investors to exploit its solar and wind energy potential. However, BC is an energy island with an isolated grid without connection to the rest of the country. This geographical condition offers the potential of exporting electricity to the US (California), supplying the local industrial hubs next to the border, and developing off-grid and mini-grid projects. During that visit, I also had the opportunity to visit the agriculture ejido community of Sánchez Taboada (Maneadero, BC) to assess the possibility of local energy projects in need of financial support. This led me to choose BC as an empirical reference to analyse some of the mainstream trends of the ET as well as local proposals for energy relations.

During 2017-2018, these experiences evolved as the main drivers for my PhD research project, using the Mexican case study to fill a gap in the current debates on the financialisation of energy transitions and the geographical implications of renewables. From there that my research questions focused on the relevance of finance-energy-geography relations:

- *Is finance a central force behind the renewable energy deployment in Mexico?*
- *Is an Energy Transition taking place in Mexico because of financial processes?*
- *Why does finance matter for the materiality of renewable energy?*
- *What are the geographical implications of investing in a large-scale energy transition in Mexico?*
- *How does finance organise space for energy transition projects in a region like Baja California?*

Fieldwork expanded these questions into a more elaborated questionnaire regarding the financial mechanisms behind the ET and the spatial interpretation of financial actors and institutions that are currently shaping the Mexican territory according to their investment roadmaps. As I explore in the following chapters, this RE-finance relationship is neither linear nor deterministic but a process of contradictions between the discourse and practice of the ET.

Nonetheless, the changes in the Mexican political landscape that emerged with the new presidency in 2019 and the Covid-19 crisis in 2020 partially halted the financial processes that the ER detonated. The financialisation process entered a hiatus due to the new administration's shift of the Mexican energy policy and the effects of the pandemic that forced capital outlays cuts for new RE projects. Such a hiatus served as a watershed to assess how the financial phenomenon has developed during the first stage of the ER (2015-2018). Also, the new administration took a

more nationalistic approach, disclosing key information to understand how the ER was structured under State and class relations to extract rent from the public State utility CFE.

These two events also had an impact on my fieldwork experience. In 2019, I visited BC again to undertake the first fieldwork period for data collection. However, the pandemic prevented a second visit to continue with in-person interviews and *in situ* explorations for the case study. The shift in the energy policy also affected the investment plans in the BC region, with several companies interested in the solar and wind potential but with limitations due to the lack of new State transmission projects to expand the electricity market. During that time, my interviews drifted from the mainstream processes of the ET to more recent inquiries on the possibilities of alternative finance for plural future energy transitions. This was due to a gap (pointed by my interviewees) on the need for alternative financial planning and management for local energy transition projects in Mexico. Interviewees asked me if finance could respond to community energy initiatives in places like BC and the Mexican southeast regions, being territories with several problems and interrogations regarding RE sources, spatial configurations, environmental challenges, and socioeconomic necessities.

However, these recent reflections represented new challenges for the research agenda, introducing substantial changes in the structure of the dissertation and its methodological procedures. To avoid premature and inconsistent analyses that would require my attention to more fieldwork dedicated to dialogue with grassroots movements and deepen in a whole different body of literature, I decided to point to these early findings as the foundation for a post-doctoral project, having a gateway for a future research agenda. I will address these interests in the concluding chapter, giving an insight of further steps that emerged from this PhD project.

3.2. Interpretative method

According to Moraes & Messias da Costa (1984), studies in critical geography must clearly establish the interpretative method that defines it as a social science. Such a method would be "the researcher's conception of the world, the logical and rational representations of reality and science. It includes the philosophical positions, explaining the reasons behind the choice of certain categories and hypotheses, as well as (why not to say) the ideology and political position of the social scientist" (p. 33). For Saxe-Fernández (2002: 75-81), this is a crucial step on the social scientist's real "objectivity" by making a conscious exposure of the value judgments that guide everyday inquiries and the predilection for certain theoretical systems and explanatory hypotheses. This contributes to the constant and permanent process of *self-gnosis* and *self-critique* to unravel all those *sub-theoretical* factors (cultural patterns, existential conceptions, biases, personal background) that daily intervene in our perception of the phenomena we are trying to grasp and explain (p. 79).²⁴

The critical finance-geography-energy nexus

As a scholar financier, I planned this dissertation as a critique, finding in human geography the proper discipline to grasp, interpret and explain the finance-energy relation in a heuristic and territorialised way. Rather than an abstract and impersonal "global financial system", studying

²⁴ For a critique of the value-free sociology, see Gouldner, 1973: 3-26.

finance parts from the spatial and geopolitical dynamics of financial actors, mechanisms, and institutions, as well as its implications for States, territories, power relations, and the structure of social classes (see Álvarez-Herrero, 2019). This leads to a rich disciplinary interaction between critical social science (mainly geography and the political traditions of economy, ecology, and sociology) and some technical elements of financial and electricity markets.

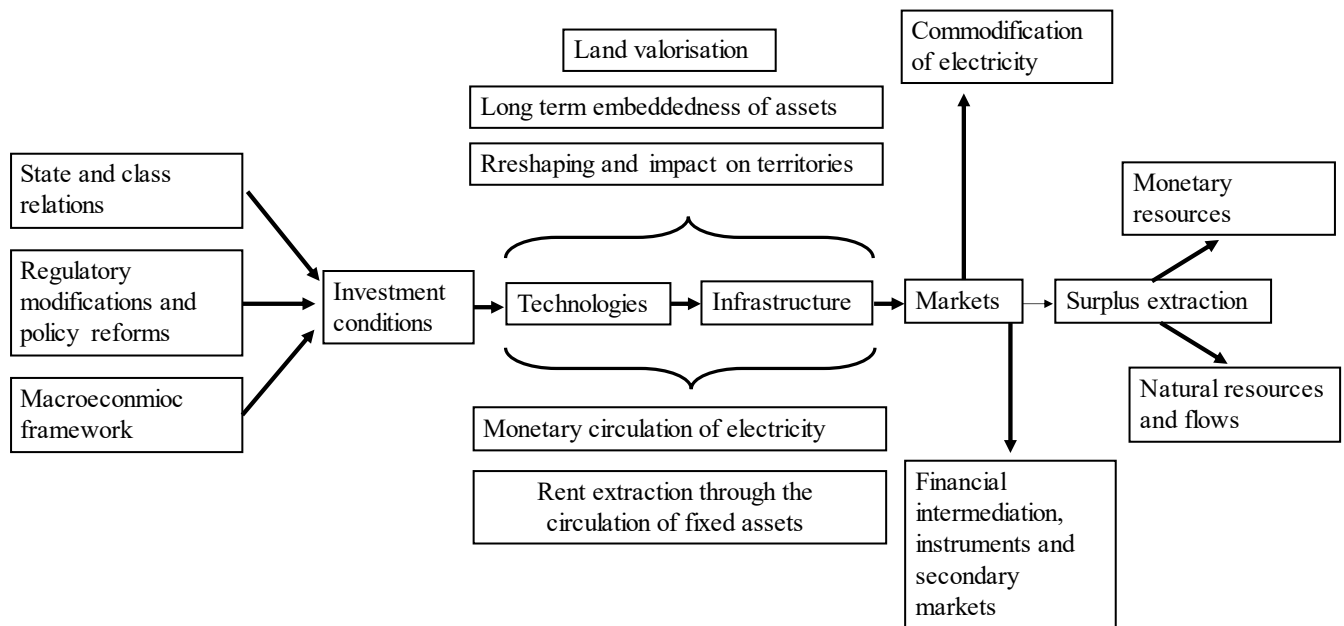
Nonetheless, the idea of marrying finance, energy, and geography is part of a broader and long-standing problem of achieving the unity of science. As León (2016: 20) argued, since the overcoming of traditional positivist geography in the 1970s, the discipline flourished but proved to be a "great mirage" in terms of its role as a "bridge" between social and natural sciences. According to the author (p. 28), this is because of the absence of a "geographic method" that would allow the great feat of encompassing all the connections of the rich thematic division that shares the physical and the human domains. Such "methodological vacuum" is a distance that both fields have filled with their own methods and ways of understanding the world, "sharing more institutional roots than theoretical and methodological coincidences".²⁵ Connecting finance, energy and geography requires a broader disciplinary umbrella or common ground to discuss defined topics through the academic "borderlands" established by energy geographies (Solomon & Calvert, 2017: 3). Therefore, based on the literature explored in chapter 2, the finance-geography-energy nexus I develop here is not defined by a specific method or intellectual tradition; it is still a group of disciplinary dialogues and connections on the political ecology of financialisation, the critical geography of energy transitions and the political sociology of climate change.

The territorialisation of finance

This is a concept I started building in my previous work (Álvarez-Herrero, 2019). At that time, I was concerned in giving the financial interests in the Mexican oil privatisation a concrete name, gathering several variables into one main concept. I transferred this term to the energy transition study that later became this research project. By financial territorialisation I mean a specific process where finance creates the conditions (physical and abstract spaces) so investments can be embedded in the territory as technologies, infrastructure, markets and enclaves of natural and monetary resource extraction. This process can be represented as follows:

Figure 3.1. Process diagram of financial territorialisation

²⁵ On this topic see also Cresswell, 2013: 241-246; Bridge, 2018.



Source: own elaboration.

Defining finance and financiers as a study subject

Following Ceceña (2006), studying power manifestations requires making the hegemonic subject intelligible and identifiable. I have drawn from this reflection to study the abstract manifestations of finance, explaining more clearly the activities of specific actors and institutions involved in the current financial development of the ET in Mexico. Authors like Duménil & Lévy (2007: 32-33), and veteran scholars of finance like Hudson (2015) and Roberts (2016) have already debated the characteristics and activities that define contemporary financial actors under financialisation. For my part, I identified four specific groups of energy financiers involved in the Mexican case study that are subjects of my fieldwork agenda: bankers, developers, traders, and brokers. This classification is based on the specific motivations, material interests and objective needs related to the profit mechanisms in the ET technologies and markets. Individually or collectively, and sometimes complementary, I classify these financiers as follows:

- a) *Commercial, investment and development banking.* This group encompasses the institutions that serve as intermediaries between savings and borrow/investment needs. In a strict sense, commercial and investment banks blend corporate and trading activities, becoming financial *supermarkets* of products and services. On the one hand, they operate through corporate management schemes; on the other, banks have become predominantly stock market institutions since the 1990s. These banks allocate resources for RE project finance taking liquid guarantees. They operate individually or through

syndicated loans. Also, banks became CF institutions by issuing green bonds and climate-related investments. In this section, we can include International Development Banks that allocate bonds, loans and grants for the energy and climate sectors.

- b) *Corporate finance*. Corporate financiers are focused on the company's performance, being strategists who have the task of studying and mobilising balance sheet resources or funds obtained from banks and investors. They design the structure and relation between capital, assets and liabilities, maximising shareholder's value and implementing strategies for cash and investments allocation. In terms of the case study, these are the actors involved in the design, planning, and long-term financial sustainability of RE projects, usually working for energy companies, or hired as project managers.
- c) *Trading finance*. Energy traders specialise in the negotiation and settlement of bilateral contract transactions, taking short or long market positions. Depending on the needs of their clients, traders are intermediaries that provide liquidity and hedging strategies for the wholesale electricity market participants. They are experts using mechanisms like bilateral electricity contracts, Clean Energy Certificates, financial derivatives, and other hedge instruments like Financial Transmission Rights. As we will see, these activities are subjected to speculative manoeuvres due to price volatility.
- d) *Brokerage finance*. Brokers are like traders but focused on financial transactions. They have a wider scope for action dealing with securities, cash, currencies, commodities, contracts and short-term trading of energy assets. They operate in platforms like the ICE exchange or through bilateral contracts. Brokers also design energy investment portfolios, trade RE assets, allocate funds resources in energy projects and trade securities for institutional investors.

This division helped me to identify the activities of my interviewees, making it easier to conceptualise financial participation in the Mexican energy industry and markets. The objective is to establish hermeneutics of finance: decipher the mental universe of financiers to geographically understand and interpret the relation between financial discourses and practices on the current investment strategies and interests of the ET.

Finance as critique

In terms of a critical position towards finance, this study considers the necessity of a critique on the current conditions and possible practical bifurcations of financial activities. From a sociology of knowledge perspective, I am referring to a critique in a hermeneutic sense:

The aim of a critique is not simply to show a theory to be in error, formally or empirically, for the problem is not only the reliability of the theory's assertions. The "truth" of a theory does not boil down to its reliability but also involves the nature of its selective perspective of the world. A critique is concerned with the meaning of this selective understanding, examining it in terms of the social forces that led to the *focalisation* of certain perspectives and to the repression or rejection of others. As the structuralists might say, a critique is as much concerned with the "*silences*" of a theory as with what it dramatically accentuates. A critique, then, is hermeneutic. It seeks an interpretation of the meaning of a theory or belief-system by linking it to the society or culture in which it lives –to show that the theory was not born of mind alone– and thus to undermine its false consciousness. It seeks to establish the manner in which the theory relates to and serves the larger

society, especially its leading elites, and to show how this relation has shaped the theory itself (Gouldner, 1973: 427-428, emphasis in the original).

In the context of the Mexican case study, this critique points to the connection between the narrative elements and material practices of the ET. As I explore in the following chapters, the recent expansion of RE technologies and markets in Mexico shares parallels with the mainstream literature previously reviewed. However, this "universal" discourse is anchored to specific and concrete material class interests. Beyond abstract environmental and social benefits, it is a continuity of a specific and identifiable "ideology" of capitalist territorial expansion and extractivism. By ideology, I am referring to how finance selectively intervenes in key climate change and energy transitions debates. Therefore, throughout this dissertation I use the concept "ideology" in a sociological sense; that is, to acknowledge "the existence of false generalisations, by which certain concepts about reality and specific values that govern a given social formation are universally valid. Such validity corresponds to the domination interest of a social class" (Villoro, 2007: 58). Moreover, Villoro (1997: 194) adds:

[...] the dominant group must manage two discourses: the one that postulates a project in accordance with the general interest and the one that responds to the needs of power. Ideological thinking seeks to reconcile these two languages. It responds to the need to hide the contradiction between the practice of power and the ethical principles that could legitimise it. It involves a linguistic feat: to erase with words the logical contradiction between a discourse that, on principle, denies the situation of domination and another whose objective is to expose the procedures necessary to maintain it. It thus must carry out a work of masking: it hides the stark language of power under the language of value

My fieldwork experience assessed this contradiction. On the one hand, the ET phraseology resulted in the supposed universal benefit of scalable RE. On the other, its implementation has had significant impacts on territories and populations while allowing intensive and extensive capital accumulation patterns. Thus, I identified a contradiction between a universal discourse and the deepened financialisation processes and its material class interests. As Gouldner (1976: 276) concludes, "that is why ideology is rooted in a conflict between the part and the whole, the individual and society, private and public interests".

The above relates to the role of being an "insider" of the financial sector that can decipher financial lexicon and bring cryptic financial information to the public debate. In this research I have referred to financial insiders like Hudson (2015) and Dicker (2011, 2020) that are continuously contributing with the recent development and crisis of the financial markets and practices to have a broader understanding of financial phenomena. This research is trying to follow a similar research line to promote a broader debate between finance and social sciences.

Overall, I believe a critical perspective on finance is necessary for the formulation and exposure of better value judgments amid an intellectual and academic environment increasingly intervened by the interests of capital. As Hudson (2015, 2018) explained, it is important to denounce how Wall Street lobbies have subsidised "junk economics" on the media and academia to deny the financial speculative and predatory rent-extraction interests that have plunged economies into chronic crises. Or, as Saxe-Fernández (1978, 2002, 2018) documented since Project Camelot,²⁶ critical thought has been the main tool to counteract fossil lobbies influence

²⁶ See chapter 1, footnote 13.

on the denial of climate change, the manipulation of climate science and the obstruction or delay of binding climate policies to mitigate global warming impacts on populations and territories.

A Latin American studies perspective

In addition to human geography, this research is rooted in the critical perspective of Latin American studies.²⁷ The region has a long-standing intellectual and social movement-building tradition on the political ecology of energy, exploring issues like oil nationalism, environmental degradation, territorial displacements, natural resources self-determination, colonial extractivism, and the persistent imperialism phenomenon (some references are Saxe-Fernández *et al.*, 2001; Saxe-Fernández & Fal, 2012; Gudynas, 2015; Svampa, 2019). As seen in chapter 1, Latin America became one of the priority regions of the "Global South" for RE investments. On the other hand, several reports have a more critical diagnosis of recent energy transitions processes, pointing to complex historical and social experiences related to energy sovereignty and economic development within a wide political and environmental thematic diversity (see Lia Guerrero *et al.*, 2020; Furtado & Paim, 2021).

Although this dissertation is focused on Mexico, the ET phenomenon can be understood from four Latin American studies methodological foundations: *a)* the place and role that Latin America occupies in the capitalist world-system, *b)* the interaction between its internal structure and external variables, *c)* the geographical scale analyses that allow understanding phenomena from global to local and vice versa, and *d)* the possibility of comparative studies to find similarities and differences of phenomena, and continuities and ruptures of processes.²⁸ These perspectives contribute to the dialogue between the global climate issue and the regional-cultural territorialisation of energy transitions. Recovering Ortega y Medina (1989), Latin American studies have sometimes tended to an excessive regionalism exclusively concerned with national issues, preventing us from approaching other regions and processes related to the Latin American sub-continent common past. In brief, studying the external to deepen one's own history. Other scholars (Castillo & Gandásegui, 2012) have proposed a research agenda based on the need of understating global research issues grounded in Latin America instead of relying on texts that are alien to the Latin American political, social, and environmental experiences.

3.3. Research method

My research method encompasses qualitative and quantitative tools to collect and interpret information. The overall structure of the methodology is as follows.

3.3.1. Fieldwork scope and empirical references

²⁷ In reference to the human and geographic space that, including the Caribbean, extends from the northern border of Mexico to Cape Horn. For a brief introduction to the Latin American studies intellectual tradition see Crespo, 2011.

²⁸ Literature on these topics can be found in the compilation made by Lang & Mokrani, 2011; see also Fal & Oliveros, 2012.

Defining energy and electricity as objects of study

Throughout the case study, I use specific concepts to understand and define energy and its relation to the energy transition processes:

- *Energy*. For the Mexican case study, I refer to "energy" as the whole industrial system involving generation, circulation and consumption. It is the system where different sources and types of energy, whether thermal, mechanical or electrical, converge and coexist. Also, this energy supplies all kinds of domestic and industrial activities, and it is the abstract form of energy that establishes social relations, produces spaces and traces paths.
- *Renewable energy*. The dissertation is centred on the recent development of a mainstream ET in Mexico that implies a hypothetical decarbonisation process, replacing FF with low-carbon technologies. We can collectively define these sources as "renewable" because of their origin in the constant reproduction of flows linked to natural, geographic and/or climatic phenomena. Renewables normally span sources like biomass, solar radiation, wind currents, water movements and geothermal energy. These sources have a "constant natural replenishment, but limited flow"; that is, renewables "are virtually inexhaustible but limited in the amount of energy available per unit of time" (EIA, 2021). In the Mexican context (SENER, 2020), renewables are mostly solar and wind technologies (defined as "intermittent" renewables), and hydroelectric and geothermal (known as "firm" renewable sources). Throughout the thesis, I avoid the use of problematic and even contradictory concepts like "clean" or "green" energy. Overall, these are the expanding technologies that the ET is promoting, and the Mexican territory is dealing to absorb as settlements.
- *Electricity*. In the discourse, decarbonisation means electrification. The ET is about the migration of the direct use of fossil fuels (oil, fuel, natural gas, coal) towards electricity generating and consumption technologies. Thus, my main object of study in terms of renewable energy and markets is electricity. Electricity establishes a series of spatial relations and paths through generation plants and transmission-distribution infrastructure that transport its flows to final consumers. Even though the Mexican energy system is a mixture of "electricities" generated with both fossil fuels and renewables (and difficult to separate because of the complexity of the system itself), my intention is to exemplify electricity as a commodity for financial interests. In the case study, I mention specific investment mechanisms in renewable energy (electricity), but my point is to understand how bigger shares of electricity that would increase with the ET are being integrated into the financialisation processes through commodification.

Accessing the financial sphere

In general, financial information is surrounded by confidentiality and non-disclosure clauses. Also, due to the quality and specialisation of the information, finance is sometimes understood as a cryptic profession based on hermetic mechanisms and esoteric languages. Therefore, two considerations were made during fieldwork planning: a) information must be accessible and

for public use, and b) the case study is based on a proper geographical reference to validate explanatory hypotheses. Studying financial phenomena requires the means to access truthful information that represents the phenomenon in question so it can be integrated into the scrutiny of social science. Therefore, some procedures were considered when accessing information:

- By introducing myself as a scholar financier, I received greater openness from interviewees. This was important to accessing first-hand information.
- This dissertation uses public-available information only. Interviewees granted their authorisation to make their testimonies public, following the standards agreed with KCL ethical approval process.
- During interviews, I avoided asking for information related to business model strategies or other data that represents private disclosures or would require the payment of fees for professional services.
- Due to the nature of their work, some interviewees chose to remain anonymous but agreed to have their testimonies in the dissertation.
- Following the ethics protocol, some interviews were not recorded by request of interviewees, but some of their reflections ended up in the analysis of the case study.
- All information will be used under the specificities requested by interviewees and for purely academic contexts and purposes.

Fieldwork locations

My fieldwork experience focused in two specific locations:

- *Mexico City*. Being the financial heart of the country, Mexico City was the first approach to financial institutions and actors for data collection and interviews. Most of the financial firms and energy companies are located there even though they have a presence in several states of the country. Also, CFE directors and energy planners were contacted there. The academic sector was also crucial, mostly located in said capital. The information collected is intended to establish the general framework where the research is taking place by introducing how the wholesale electricity market operates, what financial processes the ER started and under which context the ET is currently developing.
- *Baja California (Ensenada)*. This is my main empirical regional-local reference to develop research questions and verify hypotheses. As mentioned above, I established a link with the region by visiting the state in early 2017. There I found actors in the RE project investment side, the academia, the ejido community and the CFE regional division that granted me information and interviews on how BC is currently facing energy transition challenges. Half of these interactions were carried out online since the Covid-19 pandemic.

In both locations, the figure of gatekeepers was crucial to access actors and institutions for interviews. Being a relatively small professional niche, most of the interviewees who accepted my request referred me to another person involved in the sector.

Table 3.1. Fieldwork timetable

Date	Activity
sep-17	Structure and literature review Definition of the research perspective, objectives, hypotheses, questions, methods and empirical references.
oct-17	
nov-17	
dec-17	
jan-18	
feb-18	
mar-18	
apr-18	
may-18	
jun-18	
jul-18	
aug-18	
sep-18	
oct-18	
nov-18	PhD upgrade
dec-18	Fieldwork 1 Time for interviews and data collection was distributed between Mexico City and Baja California.
jan-19	
feb-19	
mar-19	
apr-19	
may-19	
jun-19	
jul-19	
aug-19	Fieldwork 1 data interpretation and processing Information analysis in the UK to assess hypotheses and research questions.
sep-19	
oct-19	
nov-19	
dec-19	
jan-20	Fieldwork 2 Carried out in Mexico City, with cancelled plans to go to Baja California due to the Covid-19 outbreak.
feb-20	
mar-20	

apr-20	Fieldwork 2 (online) Online interviews and data collection in Mexico City because of Covid-19 restriction.
may-20	
jun-20	
jul-20	
aug-20	
sep-20	
oct-20	GTA activities at KCL Online teaching at the <i>Climate Change and Sustainability in Emerging Economies</i> module.
nov-20	
dec-20	Writing up request
jan-21	Writing up process Final stage of data interpretation, structuring and drafting. Done in Mexico City.
feb-21	
mar-21	
apr-21	
may-21	
jun-21	
jul-21	
aug-21	
sep-21	
oct-21	
nov-21	
dec-21	

3.3.2. Qualitative analysis

Because of the nature and specialised quality of financial and energy information, the research relies mainly on documented and oral sources. These are divided as follows.

3.3.2.1. Secondary sources

I have grouped these sources considering their relevance for the purposes of the research. All this information is publicly available and fulfils ethical implications on its access and use.

Mexican State reports and energy cartography

The information related to the ER can be found in several reports made by the Mexican Congress and the State's energy agencies that regulate the wholesale electricity market: SENER (Secretary of Energy), CRE (Energy Regulatory Commission) and CENACE (National Energy Control

Centre). I am also using several reports from CFE, the main public organism that owns the national grid and where much of the information regarding the introduction of renewables is contained. I also relied on the Geographical Information Systems (GIS) developed during the first stage of the ER. These "investment platforms" are the main tools where the RE potential and exclusion areas can be consulted when looking for spatial references for project developments.

Financial and energy sectors reports

Here I include all the international reports on CF and ET roadmaps. This encompasses banks, financial institutions, consultancy firms, energy companies, energy agencies, International Development Banks, as well as environmental and energy *think tanks*.

Civil society reports

Important information has been disclosed by independent institutions and grassroots movements that are currently documenting the progress of the ET and its impacts on territories, environment, and communities.

Bibliography, newspapers, journals and academic literature

This is mostly the literature reviewed to support the central debates. The sources relate to the theoretical explorations of financialisation and energy transitions, as well as the links between geography, energy and finance. Other resources focus on the historical background of Mexico's electricity industry and some methodological quotations for the interpretative method. Newspapers are also important to gather the recent trends in the Mexican energy sector that has not been documented elsewhere.

Internet sources

This section contains all the online reports and webpage information used to obtain detailed information or databases. Internet data became crucial since the outbreak of Covid-19, allowing access to virtual lectures, talks and interviews.

3.3.2.2. Interviews

Interviews became the main tool to access information. The objective was to grasp and interpret the experience of financiers and energy planners by accessing first-hand information from the people that have a hands-on role in the current operation of electricity markets. My interviews followed the open-ended question format suggested by Kitchin & Tate (1999: 215). I realised that this type of interview has the advantage of creating an informal conversation environment, where interviewees can elaborate more on the question and reveal parts of the process that I was not aware of. This is important due to the complex nature of the topic. I tried to narrow my questions to specific issues, but interviewees tend to cover more of the topic to give context to their words.

3.3.2.2.1. Interview formats and structure

Interviews were conducted in three modalities:

- *In-person*. During the first fieldwork leg, interviews were conducted in physical spaces like offices and coffee shops, depending on requests by interviewees.
- *Informal*. Some testimonies were collected during the summits *Mirec Week 2019 Energy Congress & Expo* (WTC Mexico, May 20-22, 2019), and *Energy Mexico 2020 Expo & Congress* (Citi-Banamex Centre, January 28-30, 2020). Information was extracted *in situ* from panellists and informal interviews that were carried out after the panel.
- *Virtual*. Since the Covid-19 outbreak, interviews were conducted by phone and through online platforms such as Zoom and Google Meets.

Table 3.2. Proposed interview structure

Interviewee Subject	Public sector	Finance			Academia/civil society
		Project development	Traders/brokers	Banking	
Institution/actor	• CFE. • Energy regulatory agencies.	• Project managers. • Corporate financiers. • Consultants.	• Energy traders and brokerage services.	• International Development Banks. • Commercial and investment banks.	• Energy researchers and experts.
Topics	• Energy Reform and regulations. • Wholesale Electricity Market and National Electricity System. • Public-private partnerships. • Renewable energy projects. • Energy transitions.	• Energy projects financial planning. • Project finance. • Wholesale Electricity Market dynamics. • Spatial and temporal dimensions of energy investments. • Public-private partnerships. • Business models. • Risks.	• Investment interests. • Financial instruments on electricity. • Geography of nodes and prices. • Investment funds and RE portfolios.	• Project finance. • Guarantees.	• Historical background. • Critical perspectives on energy transitions. • Climate finance alternatives.
Location	• Mexico City. • Baja California.	• Mexico City. • Baja California.	• Mexico City.	• Mexico City.	• Mexico City. • Baja California.
Interviews conducted	5	6	5	2	4

3.3.2.2.2. Interview questionnaire elaboration

Interview questions had two stages, each based on a different approach to the topic:

- During the first year of the PhD, research questions were based on a phenomenological inquiry to understand how phenomena are accessed and interpreted prior to any biases. These questions are:

Is finance a central force behind the renewable energy deployment in Mexico?

Is an Energy Transition taking place in Mexico because of financial processes?

Why does finance matter for the materiality of renewable energy?

- During fieldwork, research questions evolved to more specific topics, leading to the problematisation of events and processes:

What are the geographical implications of investing in a large-scale energy transition in Mexico?

How does finance organise space for energy transition projects in a region like Baja California?

3.3.2.2.3. Data interpretation and analysis

The information gathered from interviews is presented in the format of *thematic analysis* suggested by Kitchin & Tate (1999). Interviews and data collection helped me to define the thematic structure of the chapters, combining the theoretical perspective from the literature review with the inductive process of incorporating fieldwork experience and empirical references to the analysis.

The way interviews are cited responds to a textual quotation format where I display the interviewee's answers as a complete text fragment. This is because the open-end questions provoked long answers that work as long pieces of information encompassing several elements that the interviewee covered to expand the topic. In the transcript and translation of interviews, I polished the information into core arguments and ideas to grasp the key elements of the answers that are relevant to the debate. This allowed me to blend the interviews with the argument line of the chapter, mixing documents and oral sources into one analysis.

3.3.2.2.4. Observations on the process of conducting and assessing interviews

- Interviews are essential for research objectives since much of the information collected has not been published in digital or printed media.
- Interviews were recorded using a mobile phone, transcribed and translated into text according to the thematic division proposed in table 3.2.
- Financiers are highly pragmatic on information; interviewees tend to present information in a "neutral" way without further problematisation. Because of this, some

parts of my recorded interviews are redundant pieces of information or statements similar to the content of financial reports. Thus, I am avoiding quoting big abstract and generic statements like "finance is important for the environment", "investments will solve future energy problems" or "renewables are good for the country". I removed that excess of information leaving only essential statements.

- This last point also applies to bureaucrats in the Mexican energy sector. In some cases, it seemed that the interviewee was reading an information manual that I later found available in the Mexican Government's official documents and websites. I used only relevant statements in the quotation.
- There is information that was not recorded due to ethical procedures. This was requested by the interviewee prior to the interview. However, the notes from these meetings were integrated into the dissertation to support some statements or as questions for other interviews.

3.3.2.2.5. Interviews risk assessment

To achieve all interviews objectives, KCL Minimal Ethical Risk Registration forms were properly discussed and filled with supervisor's assessment. There were no in-person interviews or visits during the Covid-19 pandemic since March 2020, all fieldwork activities were transferred online.

3.4. Preliminary conclusions

Throughout this brief chapter, I have discussed the main methodological procedures of the dissertation and some details on information use. The methodology proposed is the path to answer the research questions on the current relationship between finance and energy transitions. These questions deal with how specific actors and institutions are currently shaping the development of a hypothetical mainstream ET in Mexico. To grasp these processes, I have proposed a methodology that allows me to integrate finance with a critical human geography perspective. This framework encompasses the objective elements of finance (the manifestations of financial mechanisms, actors and institutions) as well as the subjective principles (the mental universe of concrete actors working in the financial sector).

The methodological system is structured on both the interpretative and research methods that need to be clearly differentiated. In the former, I wanted to expose the background and the subjective elements behind this text. These are the concrete motivations for the preparation and development of this PhD project, as well as the future praxis potential expected from its outcome. In terms of the research methods, my main tool in addition to documental research were direct interviews with the actors that have the knowledge and active participation in the development of the current ET model implemented in Mexico since 2014. In the following chapters, I will display the results of this methodological system applied to the Mexican case study.

CHAPTER IV

The foundations of the Energy Transition in Mexico

Our lives are controlled by a ruling class with vested interests not merely in change but in crisis and chaos. "Uninterrupted disturbance, everlasting uncertainty and agitation," instead of subverting this society, actually serve to strengthen it. Catastrophes are transformed into lucrative opportunities for redevelopment and renewal; disintegration works as a mobilising and hence an integrating force. The one spectre that really haunts the modern ruling class, and that really endangers the world it has created in its image, is the one thing that traditional elites (and, for that matter, traditional masses) have always yearned for: prolonged solid stability. In this world, stability can only mean entropy, slow death, while our sense of progress and growth is our only way of knowing for sure that we are alive. To say that our society is falling apart is only to say that it is alive and well.

— MARSHALL BERMAN, *All That is Solid Melts into Air*, 1982

After reviewing the literature and establishing the methodological basis, I am now narrowing the research to the specific case study and fieldwork experience in Mexico. This chapter aims to give the reader a broader context where the main international and local variables interacted to shape the energy policy-making processes and the official discourse regarding the development of a mainstream Energy Transition in Mexico. I analyse three major trends: the 2014 Energy Reform, the adoption of Climate Finance initiatives, and the North American Energy Integration regional program. This represents the first stage of my fieldwork and the introductory chapter to establish the main events that derived into the financial opening and expansion of energy projects and the development of the Wholesale Electricity Market.

4.1. Energy Transition as structural change

As seen in the literature review, financing a mainstream Energy Transition (ET) is a process of multiple variables. For Mexico, an ET represents a simultaneous two-way movement: on the one hand, we have the impact of accumulated structural change programs that have dismantled the Mexican energy industry grounded on the 20th century State economy; on the other, it is an integration to the international capital flows and financial expansion patterns. This constant and permanent interplay of endogenous-exogenous State, class and spatial relations is the result of three recent processes that conditioned and shaped the ET narrative and its material deployment: The Energy Reform (ER), the Climate Finance (CF) initiatives ratified by Mexico, and the long-standing North American Energy Integration (NAEI) geopolitical design. I will briefly analyse these processes to contextualise the case study and fieldwork references of the dissertation.

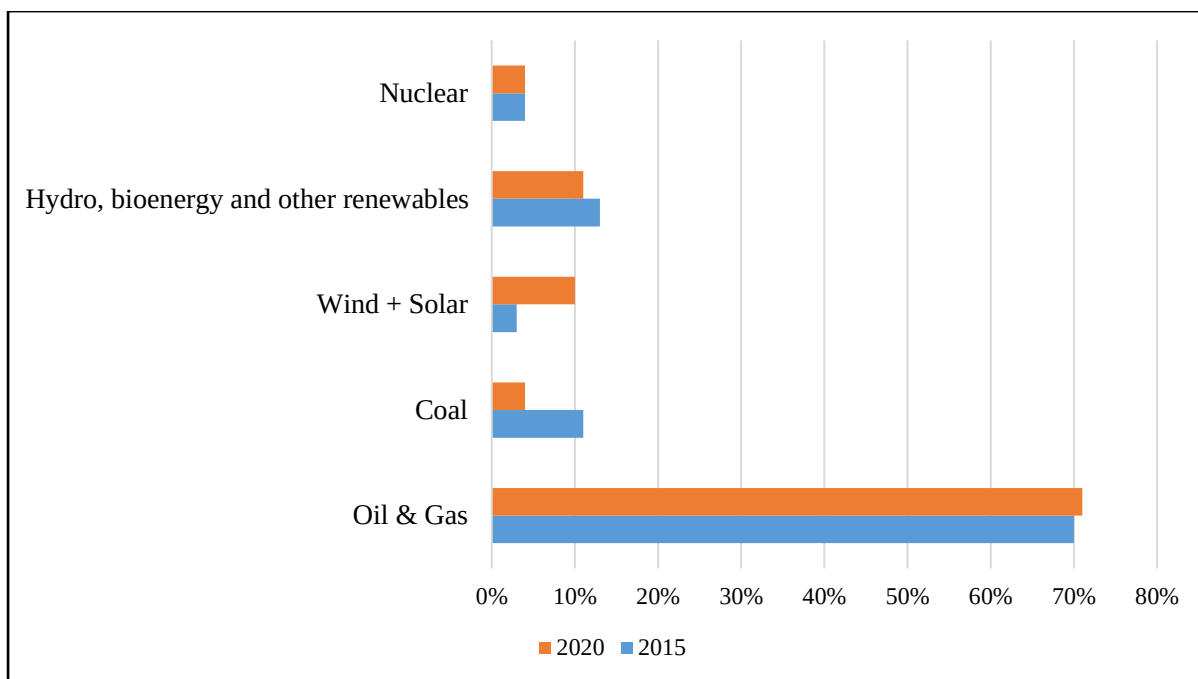
4.1.1. The Energy Reform and the mainstream Energy Transition narrative

The ER is a continuation of the so-called "structural adjustment programs" provided to the Mexican economy as part of the IMF-World Bank political project of the 1980s-1990s to privatise strategic industries in Latin America (see Álvarez-Herrero, 2019: 85-116). Previous reforms to the electricity sector paved the way for the current opening and deregulation of the industry. The first reforms in this direction date back to 1992 during the Carlos Salinas administration (1988-1994), when private capital entered the generation segment through the figure of independent power producers (IPPs) (Braceda, 2000). The first major presidential initiative to restructure the Mexican electricity sector under the wholesale market model came in 1999 with the Ernesto Zedillo administration (1994-2000), proposing the fragmentation of CFE and the privatisation of the power system (Braceda, 2000; Campos, 2003). This initiative did not materialise though. Another important reform took place in 2009 by Felipe Calderón (2006-2012) (CEFP, 2009). This initiative eliminated the regional market controlled by the State-owned company *Luz y Fuerza del Centro* (LyF) to integrate the whole national electricity system into one single grid and introduced mechanisms for RE finance.²⁹

With this momentum, the 2013 constitutional initiative and its 2014 secondary legislation carried out a major and comprehensive ER of the Mexican sector under the Enrique Peña Nieto administration (2012-2018). At the time, Wolf (2011) analysed the mainstream lexicon that emerged from the Cancún COP16 in 2010, endorsing Mexico's integration into the international climate agreements. The official ER narrative urged a shift in the oil-dependent Mexican energy matrix through private-driven opportunities, free-market mechanisms, and modernisation-efficiency narratives schemes. Mexico's energy mix is based 80% in FF, with minor changes since 2010, like the increasing dependency on imported US natural gas (a "transition" fuel) and the replacement of coal by wind and solar power (Climate Transparency, 2020; Fulghum, 2021).

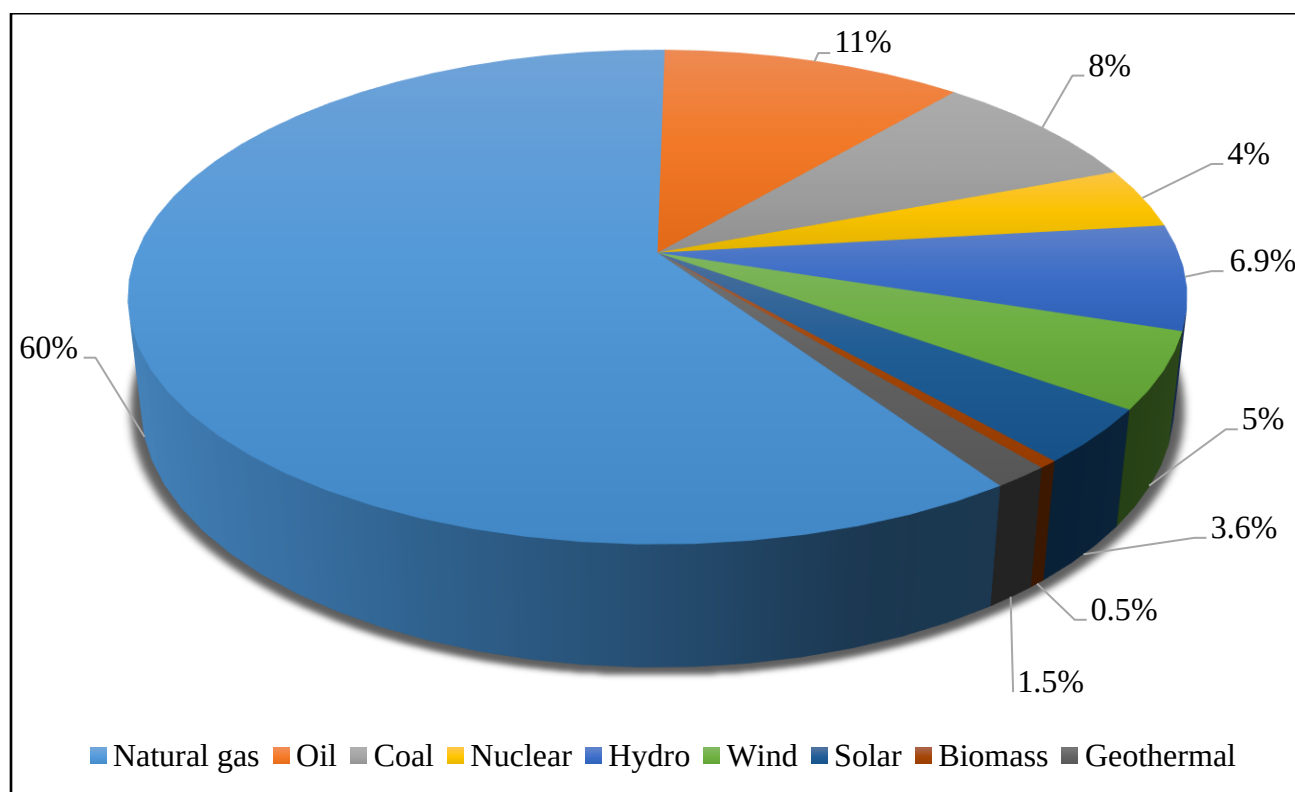
Figure 4.1. Mexico's energy matrix, 2015-2020

²⁹ During this time, the 2008 "Law for the Use of Renewable Energy and the Financing of the Energy Transition" (*Ley para el aprovechamiento de energías renovables y el financiamiento de la transición energética*) and the 2012 "General Climate Change Law" (*Ley General de Cambio Climático*) were enacted, setting the need of renewable generation targets and financing mechanism for its development. The legislative texts of these initiatives can be found in the memoirs of the Mexican Chamber of Deputies (<http://www.diputados.gob.mx/>) and their enactment in the Official Journal of the Federation (<https://www.dof.gob.mx/>).



Source: Fulghum, 2021: 2.

Figure 4.2. Mexico's electricity generation by source, 2019³⁰



Source: Climate Transparency, 2020: 8.

³⁰ See appendix 1 for a Sankey diagram of Mexico's energy balance.

According to Melgar *et al.* (2016), the need for an ER in Mexico combined several factors:

- Declining oil and gas production (the so-called Mexican peak oil since 2003).
- Increasing electricity generation costs.
- Stagnant investments in RE.
- Ageing infrastructure.
- Slow technological development.
- A widening human resources gap.
- Increasing dependency on natural gas and oil products imports.

Focusing on electricity, the ER raised four debates. Hernández-Ochoa (2018) specifies:

- It is important to reduce electricity costs to have competitive tariffs and economic growth. Prior to the ER, tariffs in Mexico were 73% higher than in the US (25% considering subsidies).
- RE generation was stalled in 17% of the national generation due to a lack of regulations and financial mechanisms. The ER introduced the Clean Energy Certificates (CELs) to meet progressive carbon mitigation goals and expand RE projects.
- Despite having 98.5% coverage of the population, almost two million Mexicans live without access to electricity. Therefore, the ER set the objective of universal energy access.
- CFE works under obsolete operational and financial frameworks. It needs a modernisation program under corporate schemes and economic competition standards, making a transition from an electricity utility to a comprehensive energy company.

The ER addressed the country's energy problem through a free market-based lens that interprets the need to overcome a supposed obsolete State-centralised model to make way to competitive electricity markets and innovative energy technologies (see Wood, 2018). The key initiative for this was the decentralisation of the State-owned electricity sector:

The changes in the energy markets represent a paradigm shift. The power sector is transitioning from a vertically integrated industry with a dominant State-owned utility to a decentralised market open to both public and private companies. The reform is comprehensive and imposes significant changes throughout the electricity supply chain: power generation is set to become a fully competitive activity; an independent system operator will run a wholesale electricity market; and open access to the power grid will be guaranteed to all market participants. The power sector reform also means a more proactive role for government agencies and regulators. The Mexican Government will oversee the industry's transformation, promote competition, and enforce transparency measures. Furthermore, Comisión Federal de Electricidad (CFE) – the incumbent utility – will unbundle and compete on equal terms with incoming private companies. To help CFE compete, the reform has granted the utility greater operating flexibility, and CFE will be able to partner with the private sector through joint ventures and bilateral agreements in order to optimise its investment strategies (Chanona, 2016).³¹

The first rearrangement introduced by the ER were in the legal and jurisdictional domains. The initiative implied a major controversial surgery to the sovereignty articles of the Mexican

³¹ See annex 1 for a summary of the ER and the WEM structures.

Constitution (numbers 25, 27 and 28), which reserves the exploitation and management of energy solely to the Mexican State. These modifications follow the same principle detected by Krieger (1994) during the privatisations of the 1990s: remove the State as operator and owner of the energy resources on the Mexican soil and subsoil, to become a mere "administrator" and mediator of contracts for private parties. Besides the Constitution, the real effect of the ER lies in the "transitional articles" and the modification of secondary laws (García-Sánchez, 2018).³² The legal effect of the ER over State-owned energy companies like Pemex and CFE was to strengthen a double rule of law: "On one hand, the state energy companies must be forced to follow the same rules as private enterprises [...]. Second, the market rules must be implemented and overseen by competent regulatory agencies, so that competition may flourish" (Ríos & Wood, 2018: 226).

The second rearrangement of the ER is the operational structure of the electricity market itself. As I detail ahead, the ER created a Wholesale Electricity Market (WEM) resembling those in Western countries, with short-term spot markets and long-term auctions. Also, several other commodities in addition to electricity and power capacity were added: ancillary services, Clean Energy Certificates and Financial Transmission Rights.

Figure 4.3. Wholesale Electricity Market structure³³



Source: own elaboration.

³² In annex 1 there is also a brief table with the legal modifications of the ER.

³³ See appendix 1 for more information of the WEM structure.

The mainstream narrative in Mexico shares common arguments and goals with the literature analysed in chapter 1 (see SENER, n/d; Hernández-Ochoa, 2016, 2018; Chanona, 2016; Wood, 2018; Bancomext, 2018). I extracted from these sources the discussion points of the ET:

- Private investment is the only path to achieve a modern, efficient and clean electricity sector with increasing energy production under market rationality, while FF represent the anachronic State-centralised energy systems of the past.
- Financial innovations, wholesale markets, and RE technologies and infrastructure will take Mexico to the path of OECD energy standards implemented by Western and emerging economies.
- Both State-owned energy companies (Pemex and CFE) represent technological, operational and financial inefficiencies. They must turn into "State Productive Enterprises" based on market efficiency and economic value creation but remaining 100% public and Mexican.
- Competition in the sector would lead to new technologies, human capital, quality jobs, new companies and lower costs and prices.

As Álvarez-Béjar (2018) argues, the ER represented a structural change of the Mexican economy aligned with the "neoliberal" policies in force since the 1980s. For Saxe-Fernández (2016), the ER is the deepening of the IMF-World Bank political project in the region, part of the structural crisis of capital that is trying to absorb the geostrategic sectors that historically remain under State management and public interest.

Table 4.1. Structural changes in Mexico since the ER

Economic	Political/legal	Geographical	Cultural
A renewed macroeconomic framework that benefits the operation of foreign capital and financial gains. Shifts in economic planning, from a State-owned industry into a deregulated and foreign-controlled market.	New State and class relations for the transfer from public to private. Constitutional, legal and regulatory changes to the jurisdiction of the State regarding energy planning, sovereignty, security and self-determination.	Shifting spatial relations, leading to a fragmentation of territories for infrastructure deployment and RE harnessing. Changes in social-owned land to replace primary activities with RE technologies and infrastructure.	Disruption of the cultural and historical meanings of energy and how the population interprets its collective past through the experience of the present.

Source: own elaboration.

The critical approaches that have followed the "structural adjustment programs" since the 1980s analysed the privatisation processes in the Mexican energy sector as a double movement: a universal narrative stating the supposed general benefits of the reforms while adopting State and class practices to transfer resources from public to private spheres (see Ortiz-Wadgymar, 1998; Guillén, 2007; Saxe-Fernández, 2016). Since the Legislative discussions of the ER in 2013, the Mexican Government denied the privatisation of the industry arguing that Pemex and CFE assets remain 100% public and Mexican while leaving enough ambiguity about the mechanisms that maintain State participation and rights but transferring its activities to private hands (Mariscal-Corona, 2018).

Here we find the contradiction between narrative and material interest: the ideological foundation of the ER that, on the one hand, offers the modernisation discourse while on the other, deploys structural changes based on class interests.³⁴ Vargas (2015: 134) argued that the ER "was stated in a general and discursive way, but not in an instrumental one", leading to an undermined role of the State related to a gradual decline of national income, the uncertainty of national authority over foreign institutions, and the eventual extinction of the public agencies, both now transformed into "State productive enterprises" and whose objective is to maximise economic value (and therefore, implement extractivist and expansive activities). Opposed to the mainstream narrative, the critical study of the ER lies in the sociology of capital where the local political and business elites can put forward their interests over the highly profitable State sectors in the face of overaccumulation crises (Saxe-Fernández, 2016). Overall, as Osorio (2014) theorised, the Latin American capitalist state and its economic policy are not structured over discourses but on the material interests of a ruling class.

At the time, it was known that former Mexican Government officials used the reforms they promoted, their experience in the public sector, the information they handled, and the network of contacts attached to power to insert themselves into the private initiative and benefit from the recently privatised energy sector (Rodríguez-Nieto, 2015; Cervantes, 2016). Moreover, for Salas-Porras (2014), many of these practices operated under direct corruption, legislative lobbying and revolving doors dynamics, with several former officials becoming part of the board of directors of foreign energy companies or members of international energy think tanks after the ER was enacted (see Rodríguez-Nieto, 2017; Cota & Williams, 2021). During his 2020 hearing at the Mexican Congress, the General Director of CFE Manuel Bartlett proclaimed:

The Reform created and strengthened regulatory agencies that took away essential functions of the Mexican State –such as energy generation permits, gas commercialisation and electricity tariffs– and given to individuals selected solely for their adherence to the dominant ideology and their commitment to corporate interests. [...] This elite is made up of former public officials, think tanks, groups of judges and lawyers working to impose corporate law, businessmen, and representatives of transitional corporations, academics and organic intellectuals associated with interest groups.³⁵

Nonetheless, these local actors limit their role to mere name lenders, minority shareholders and secondary associates in relation to foreign capital expansion in the Mexican energy sector. For Petras & Veltmeyer (2016, 2018), this is the power context under climate crisis and

³⁴ See chapter 3 for the definition of ideology used in this context.

³⁵ Congressional hearing at the Mexican Senate, streamed live on October 27, 2020, available online in: <https://www.youtube.com/watch?v=UL83-r4Oceg>.

extractivism that allows the imperialism analysis of State and class relations between domestic classes and the representatives of the imperial State. Therefore, these relations result in more complex dynamics that cannot be described as simple relations of "domination", "subordination" or "dependence" (Petras & Veltmeyer, 2011: 125). From there that the political sociology of the ER points at the asymmetries and fragmentation between local oligarchies and central States, something that Jeff Faux (2006) documented as an uneven "class solidarity" that characterised lobbying activities in Mexico since NAFTA.

Back to the discursive issue, another important aspect of the ER was its ability to shape and maintain a moulded meaning of the ET. Energy researcher Karla Cedano expressed:

"What the Reform did is to put the energy transition debate on the table. For better or worse, it made visible the challenges and needs of a transition. But at the same time, it was based on a market model that does not incorporate the amplitude and complexity of what an energy transition means for a country like Mexico. While there were innovative ideas such as the Clean Energy Certificates, the reform is written with a certain ambiguity that allows presenting it as something advantageous for the country, but once endorsed it could put the locks on the main private interests. In general, I think it is a transition of discourse but not course. For instance, despite the sustainability discourse, 80% of the Mexican oil revenues are channelled to fossil fuels and only 20% to energy sustainability. This means that the Reform continues to work on a traditional model but with a slight inclusion of renewables".³⁶

This connects to Lohmann's (2015) critique of the role of RE as a complement sector of the fossil economy, something that shows the limits of the ET roadmaps in a heavily oil-dependent country like Mexico. As Álvarez-Béjar (2018: 166-172) concluded, rather than a transition from FF to RE, the ER represents a transition from public to private. During fieldwork, I inquired about the impact of the ER in the Mexican State and its meaning for the ET. CFE engineer Emmanuel Gómez argued:

"There is a cost-State in the transition. Moreover, the transition is not only a matter of moving to renewables: it is also the incorporation of new private actors into the market dynamics. However, many countries that experienced the opening of their electricity systems have returned to having a State presence to ensure the stability of the system. It is not about free markets. Therefore, we lack a real integration of renewables, there is no long-term system and territorial planning of the State. Instead of smart grids or storage systems, fossil fuels are still the solvers of renewables' intermittency".³⁷

But what is the role of RE so far?

In Mexico, the transition has two problems. On the one hand, CFE has not been interested in the subject; it is married to natural gas. The few renewable projects that CFE has were due to business deals that a previous CFE director had with private companies. On the other hand, Mexico, like many other countries, jumped on the renewable energy bandwagon because of technological development, not the environment. This is what the US has done in terms of the impact on their productive chains and markets. Mexico should enter renewables for economic development and energy security reasons. There is already an irreversible climate impact, so we ought to go towards adaptation rather than mitigation".

If we go over to the financial side, opinions on the ER have a more favourable diagnosis of the meaning and impact for the ET. I asked energy projects financier Pablo Partearroyo where the appetite for the ER came from:

³⁶ Interview conducted online on February 20, 2021.

³⁷ Interview conducted in Mexico City on June 11, 2019.

"In a brief period, the Reform created new markets and business lines for private players. With this, the reform sent a positive signal to investors, offering a stable and profitable investment framework. More importantly, it forces a diversification of sources. Energy should no longer come from one or two centralised sources, but rather a portfolio of energies in which renewables gradually have greater participation. The State is incapable of creating this portfolio, which is why the Reform opens the market and establishes the rules of the game for all participants. This is an international trend that makes renewables compulsory. Financing energy projects in Mexico requires you to comply with renewables and energy efficiency technologies to access funding. It is a MUST, not a PLUS for energy finance. I have negotiated project financing where I have had to include a component of solar panels and energy efficiency for public buildings, otherwise, they would not give us the loan".³⁸

I also interviewed energy trader Alejandro Keijser on this topic. He remarked:

"There is definitely an energy transition in Mexico. I would say that solely the idea dates back from the Climate Change General Law of 2012. But that law is only a letter of good wishes, there is no clear State implementation or financing mechanisms. There is the Energy Transition Act of 2015, which is also quite useless. Now, the Electricity Industry Act of 2014 is really the law that introduces real mechanisms to meet Mexico's commitment to international climate agreements, like the Clean Energy Certificates. In my view, this is what makes the first steps for marrying an energy transition locally and the compromise with climate agreements internationally".³⁹

The ER not only forced structural changes internally but also a simultaneous process of integration to the international circuits of capital. Here is where the Climate Finance (CF) initiatives mentioned in chapter 1 connect with the current pressures to open the Mexican territory to the ET investment roadmaps. This brings us to the second area of analysis.

4.1.2. The Climate Finance initiatives

Since the Paris Agreement, the Mexican Government addressed climate change as a market-based problem manageable through clean technologies and emissions reduction targets in relation to pre-industrial levels (Bancomext, 2018). Under this premise, Mexico's climate commitment relied on the gradual penetration of RE in the energy matrix: 35% by 2024, 37.7% by 2030, and 50% by 2050 (DOF, 2018). In 2030, these technologies should reduce 22% and 51% of GHG and black carbon emissions, respectively, accounting for 36.7 GW of installed capacity (Bancomext, 2018: 10).

These policies sparked corporate optimism and investment interests. By 2018, "Mexico is one of the countries with the highest investment in the renewable energy sector, showing an increase of 810% compared to 2016, reaching \$6 billion USD" (Bancomext, 2018: 12). Also, by 2018, the ER "created important opportunities", positioning Mexico as one of the most attractive markets for foreign investment among other emerging markets and ranking #1 in Bloomberg energy analytics (BMW-SENER, 2018: 4). According to BlackRock's CEO in Mexico, "the development of renewable energy is not a whim, nor is the energy transition the product of arbitrary policy or a unilateral decision, but rather a rational choice to join a three-factor global trend: decarbonisation, decentralisation and [FF demand] deceleration" (Bancomext, 2018: 51).

³⁸ Interview conducted online on August 19, 2020.

³⁹ Interview conducted in Mexico City on March 1, 2020.

The alignment of the ER with the CF initiatives can be found in the energy investment publications, roadmaps or "outlooks" that describe Mexico's regulatory, economic and geographic characteristics as investments opportunities.⁴⁰ On the Mexican side, the Peña Nieto administration used the "Promexico" program (defunct since 2019) to promote investments in Mexico and attract foreign capital into highly profitable sectors. These business brochures included regulatory and geographical information for RE opportunities under the new deregulated model (see Promexico, 2013, 2016). In December 2014, Promexico held the "Green Solutions" summit, focused on the promotion of Mexico as an investment "green space". According to the Mexican Embassy (2014: 10), the event had the objective of:

- Spreading Mexico's potential and commitment to green investment.
- Transferring public environmental policies to the business sphere.
- Promoting business meetings.
- Offering solutions in terms of financing, liaison, knowledge of regulations, and investment opportunities related to the recent approval of reforms.
- Communicating the investment opportunities derived from the recent structural reforms.

This narrative follows the analysis of chapter 1 regarding "investment gap opportunities" rhetoric and the connection between RE investment requirements and the need for private participation in the industry. The combination of these factors would lead to the deregulation, growth and modernisation of the Mexican electricity sector. The firm Fitch Ratings (2019: 95, 102) claimed that Mexico "needs to build 70,313 MW of installed capacity in 2019–2033, of which 42% will correspond to combined-cycle plants (29,294 MW) and 53% to renewable technologies (36,928 MW)". This potential growth put Mexico in the top 10 largest renewable energy markets globally and the top 3 Latin American countries with Brazil and Chile (IRENA, 2016a). Also, financial firms like JP Morgan (Morón, 2013), Sánchez-Devanny (2014), and KPMG (2018), envisaged an accelerated M&A business in the Mexican energy sector and the RE industry particularly, sparking interest in energy assets that sell energy to the Mexican Government (CFE) and M&A financial consultancy (see also Griskonis *et al.*, 2020). In 2016, the Mexican energy sector (driven by RE projects and the oil industry) reached a value of 6 billion dollars in M&A transactions (Hernández, 2017).

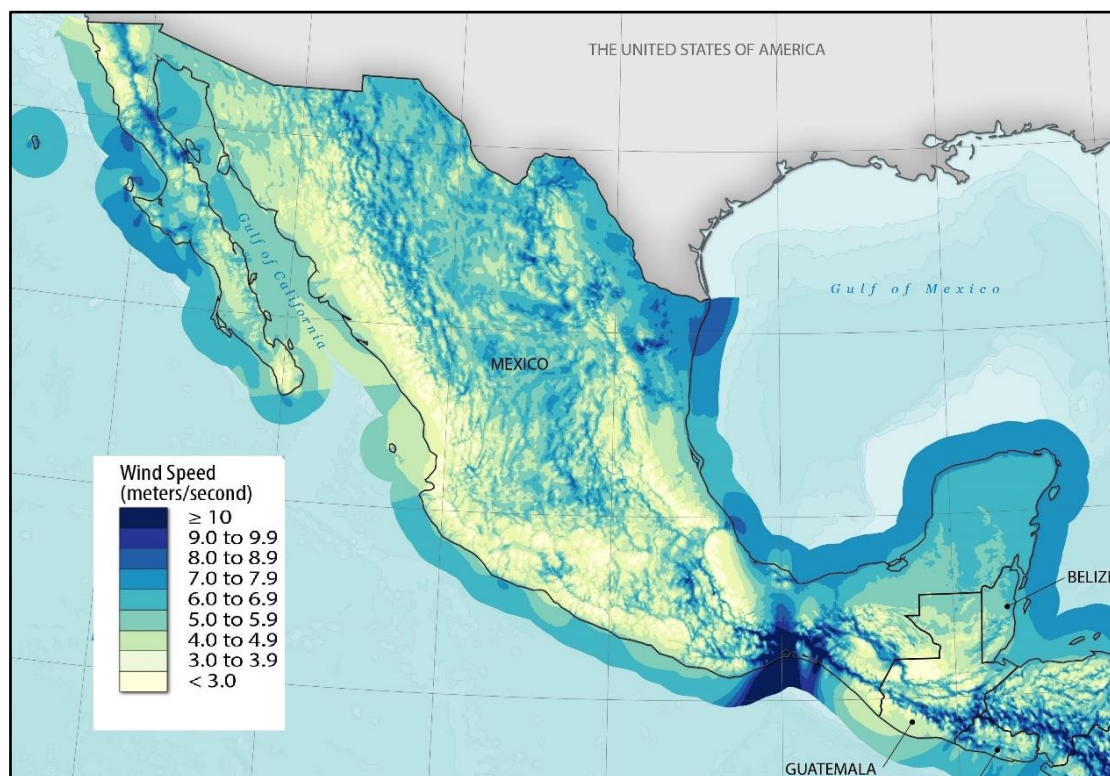
The ER became the catalyst for foreign capital in Mexico. This led institutions like the IFC (2020) to allocate the first certified Green Loan to finance a portfolio of solar projects by IEnova in 2019-2020 (5 projects with a 526 MW installed capacity). For its part, the GCF has an environmental program in Mexico based on mitigation funds (i.e., equity and technical assistance resources) for developing nations (GCF, 2020). These programs benefited from the Geographic Information Systems (GIS) provided to investors to map the solar and wind potential of the Mexican territory (Bancomext, 2018: 27-28). The spatial references allowed financiers to make investment decisions based on the geography of prices, markets and project development. According to Yaneva *et al.* (2018),

⁴⁰ Examples on this regard are Ren21, 2014; IRENA, 2015; OECD-IEA, 2016; other references are McKinsey (Bolio *et al.*, 2014) and the WRI publication archive (www.wri.org).

While solar radiation around the globe is unevenly distributed, studies have defined the most favourable belt for solar energy production to be between 15°N and 35°N. Semi-arid regions in this belt have the greatest amount of solar radiation, more than 90% of which comes as direct radiation because of the limited cloud coverage and rainfall. Mexico's total territory lies between the latitudes 14°N and 33°N and the longitudes 86°W and 119°W, meaning that it is one of the few countries that lie 100% within the most favourable sun belt on the planet. [...] On average, Mexico enjoys 2,190 hours of sunshine per year, mainly in the state of Baja California, Coahuila, Chihuahua and Sonora (p. 16).

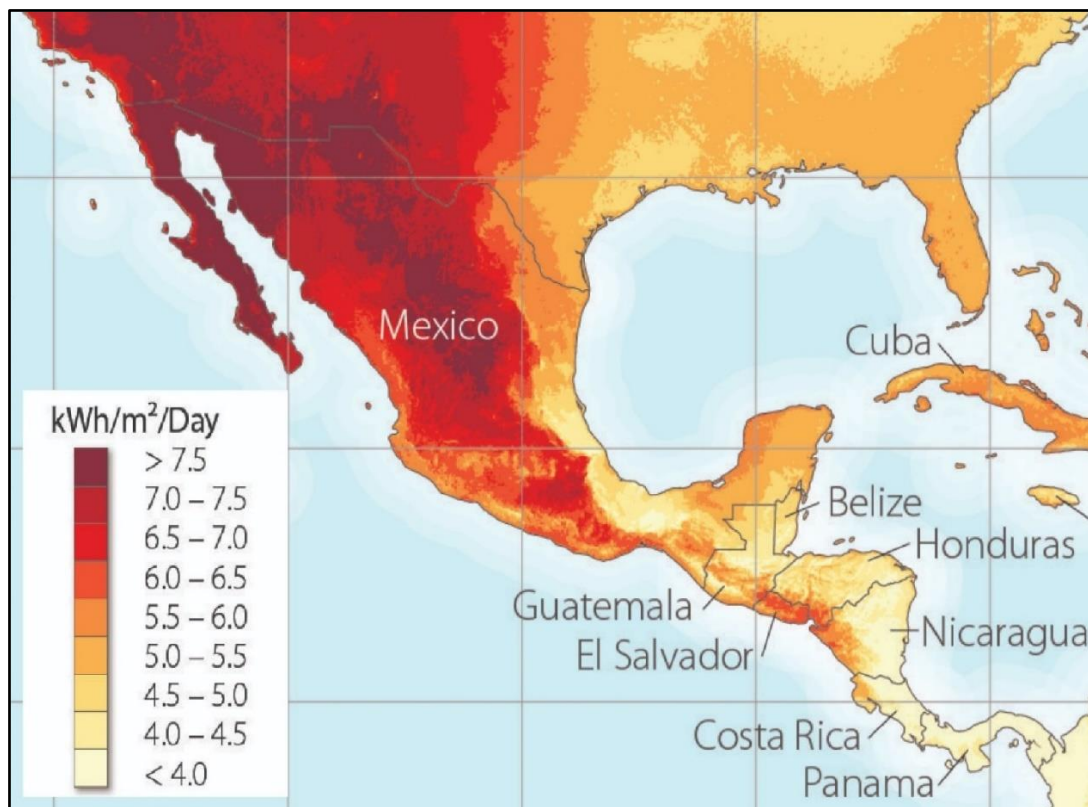
The second opportunity area for RE development is wind energy and the geostrategic place that Mexico has in terms of wind currents in the Gulf region and both peninsulas (Baja California and Yucatan). The report states: "Wind turbines nowadays can operate at wind speeds as low as 3 m/s and up to 14 m/s. In parts of Mexico [like] Oaxaca, Baja California, Sonora and Tamaulipas, wind speeds can reach 12 m/s in the first quarter of the year and in November-December. The country's overall wind power potential is estimated at 50 GW" (p. 22). As I detail in the following chapters, this solar and wind potential is embedded in core-periphery areas, conditioned geographically by technology deployments, infrastructure expansions and market profitability.

Map 4.1. Mexico's wind potential



Source: NREL database (<https://www.nrel.gov/gis/>).

Map 4.2. Mexico's solar potential



Source: NREL database (<https://www.nrel.gov/gis/>).

The alignment of the ER with the CF initiatives and institutions brings a key element of the internationalisation of capital in Latin America: the fact that investment roadmaps are designed abroad and imported as local policy initiatives tailored to the necessities of foreign investments under the overaccumulation crisis (see Saxe-Fernández, 2016). I asked Edgar Del Villar, former official of the Mexican Energy Secretariat (SENER), about the tensions between foreign and local capital in the context of the ER. He told:

"The Reform aroused more enthusiasm than action. The local private sector thought that the money was going to flow like a river from international funds, helping Mexico to reach mitigation targets. The country signed all the existing climate agreements and has been an avid promoter of the Green Climate Fund. But the problem is the lack of liquidity in the Mexican market. National companies were not inclined to use their resources to start up renewable energy projects; they thought everything would come from abroad and that the Mexican Government would provide the missing resources for free. Also, the scarcity of big emblematic projects led to the arrival of foreign capital, monopolising the renewable generation market. Therefore, local companies ended up being associates of foreign capitals".⁴¹

The Mexican Government promoted the ER as a combination of several elements taken from foreign electricity markets (see annex 1). Mexico is one of the last countries to open the energy sector, having the advantage of adopting "best international market practices" (Bancomext, 2018:38). Yet Mexico lacks the experience in RE that only foreign capital can introduce: "Most of the developers who have come to the country are foreign investors,

⁴¹ Interview conducted online on March 8, 2021.

particularly European and American, who already have experience in other parts of the world. It is worth noting that 80% of the participation in the renewable sector is made up of European developers who already have significant maturity" (pp: 38-39). Thus, the ER represented a familiar roadmap for these companies, providing a model designed abroad and adjusted as a proper environment for foreign capital to operate the ET in Mexico. According to energy economist Manuel P.,

"It is true that several international consulting firms advised the Mexican Government on the Energy Reform. There is not a particular pattern, there are selective elements of other markets like the ERCOT of Texas, the Spanish Wholesale Market model, coupled with other unique characteristics of the Mexican system. Even [William] Hogan, who is like the modern father of electricity markets came to give opinions to the CRE and SENER on the design and operation of the new model".⁴²

US assistance on the implementation of the ER became a key element during the 2013 legislative debates. On the same subject, Emmanuel Gómez added:

"Firms like McKenzie were close advisors of the Government and were heavily involved in creating the new wholesale market. The US administration at the time had an active role too. The appetite for the Energy Reform was like a magnet to attract best practices from abroad along with national talent. But in the end, is no surprise that the Mexican energy policy is designed and mentored by the US".⁴³

The USAID (2020) is a concrete example of this influence to open the industry to US companies. The report stated that "total investment in the three [renewable electricity] auctions was roughly \$9 billion USD, with investors from 12 countries, and more than \$1 billion USD in energy projects awarded to US firms" (p. 2). The USAID also advised the design of the Mexican grid for solar and wind energy penetration (Parsons *et al.*, 2015). A more comprehensive document by the US GAO (2018) details the role and implications of US Agencies to advise the Mexican Government in several key policy areas of the ER.⁴⁴ Lastly, Vargas (2015a) concluded:

In the run-up to the energy reforms of 2008 and 2013, the demands of transnational and national corporations were expressed in a series of think tanks, electronic media, forums, and business organisations, promoted by journalists, specialists, academics and lobbyists from the local political spectrum. [...] The differences between the 2008 and 2013 reforms have been of form, but the lobbying strategy is similar. While in 2008 the lobbying leadership was from the Council of Foreign Relations (based in Washington), through its national support in the Mexican Council on International Affairs and the Mexican Energy Network at the Autonomous Institute of Mexico (ITAM), in 2013 the Woodrow Wilson Center Mexico Institute took the lead, also with affiliates at the ITAM.

Such an institutional integration leads to a broader geopolitical design to integrate markets and energy sources under a single regional regulation. This brings one last historical process on the endogenous-exogenous analysis of the ET in Mexico.

⁴² Interview conducted in Mexico City on May 23, 2019.

⁴³ Interview conducted in Mexico City on June 11, 2019.

⁴⁴ See annexe 2.

4.1.3. The North American Energy Integration

The regional energy integration of the North American sub-continent is a long-standing process.⁴⁵ This initiative is built on the trilateral relations materialised in NAFTA (rebranded as USMCA since 2018) and the old US interests of creating a geopolitical and geostrategic energy bloc in the western hemisphere (see Saxe-Fernández, 1980, 2016; Vargas, 2015a). Based on the Trilateral Energy Outlook (NEB *et al.*, 2015), the US-Mexico-Canada energy markets

are becoming increasingly interdependent as physical infrastructure continues to be built across North America. With free trade treatment of many energy commodities, the three neighbouring countries include each other's largest import and export markets for many of these commodities. Geographic proximity has also led to some degree of market integration—for example, regional electricity markets extend across the US/Canada border, broadening the market in both countries. Conversely, North American geographic isolation creates trade barriers to the rest of the world for energy commodities like natural gas and electricity, while other commodities such as crude oil and petroleum products travel more readily over water. As a result, Mexico, Canada, and the United States can be understood as a single (semi-integrated) regional energy market with internal commodity flows and external links to the rest of the world (p. 3).

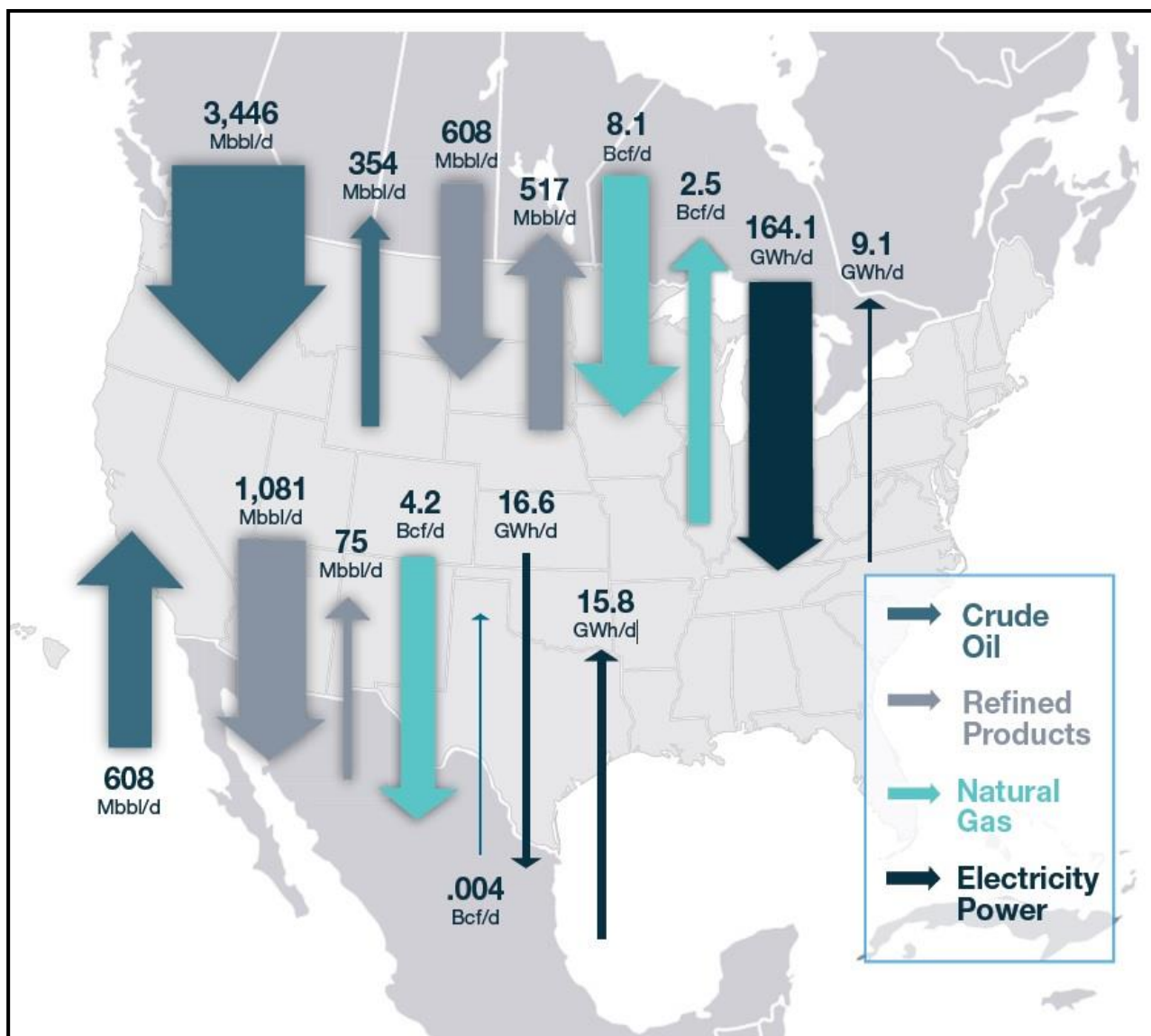
This diagnosis is based on the idea that the US shale revolution and RE technologies have created an energy self-sufficiency regional hub by reversing peak oil and stimulating economic activity with new RE technologies. For Wood (2014):

As North America begins to appreciate the significance of a new era of energy abundance, the time is right for increased collaboration. The former paradigms of energy nationalism, energy security and high prices are, for the time being at least, being replaced by market-based approaches, new supplies and low prices. The common challenge of improving infrastructure to allow energy to get to the market, both within the region and globally, should drive the three governments to closer collaboration with each other. The creation of a unified energy marketplace in North America, will not only help to improve energy supply but also drive economic competitiveness (p. 18).

This implies the "unitisation" of the North American subcontinent as an interconnected energy reserve based on oil, gas and electricity exchange flows. At the time, banks like Citi (2012) talked about a "New Middle East" in North America due to diversification and abundance of energy sources in the region, from non-conventional FF to RE. This narrative soon found its way into the official Pemex discourse and as a justification for the ER modernisation project (Rathbone & Thomson, 2013). By joining this scheme, Mexico would engage in *a*) a multi-commodity energy trade, exporting crude oil to import fuels, natural gas and petrochemicals; and *b*) allowing US and Canadian companies direct investment in the Mexican energy industry.

Map 4.3. North American energy flows by commodity, 2017

⁴⁵ Saxe-Fernández (1980, 2016) has traced the NAEI design since the early 1980s and more predominantly after the enactment of NAFTA in 1994. The Office of International Affairs of the US Department of Energy (2020) dates the trilateral energy cooperation since 2001. For the US GAO (2018), the tri-national energy relations dates from the leadership summits of 2005, and more recently since the prelude to the Mexican ER in 2013.



Source: API, 2019.

The current interest in incorporating Mexico into a regional energy hub is part of a renovated geopolitical and geostrategic process. Elsewhere (Álvarez-Herrero, 2019), I analysed how the US foreign policy established State and class relations to integrate the Mexican oil reserves into the North American hemispheric energy assets, spanning from the oil discoveries in the late 1970s to the current non-conventional reserves (deep-water fields in the Gulf of Mexico and shale reserves on the border between Texas and northeast Mexico). For Mexico, this FF integration lies in replicating the US shale revolution and developing a cross-border pipeline infrastructure project to import cheap natural gas into Mexico (see NEB, *et al.*, 2015).

In terms of RE and electricity, the NAEI draws a two-way integration: *a)* the cross-border RE technology and infrastructure program, and *b)* the introduction of a WEM model that covers the entire Mexican industry and territory. The first step in this direction is the cross-border technology and infrastructure corridors for the integration of electricity grids and markets. Based on documents by Wood (2014), Parsons *et al.* (2015), Parfomak *et al.* (2017), and the US GAO (2018), the trilateral energy initiative comprise the following points:

- Shared geographical information systems and models will point to the potential RE areas and geospatial references for electricity projects development on both sides of the border.
- Energy projects need a comprehensive mapping of optimal transmission infrastructure locations and distances for cross-border grid interconnection.
- Cross-border energy projects require the synchronous operation of systems to ensure a dynamic coverage of supply and demand on both sides of the border.
- Binational energy cooperation encompasses financial and legal mechanisms to create a proper investment environment.
- Energy infrastructure must be subjected to security programs and territorial jurisdiction to achieve system integrity and preserve the stability of RE assets.
- Energy regional integration will require broader institutional coordination of policies, regulations, workforce, financial innovations, energy efficiency practices and sustainable technologies.
- A binational regional market would lead to higher volumes of electricity that will push prices down for final consumers.

From a financial perspective, the North American Development Bank (NADB) has promoted CF initiatives in the border region, providing loans, grants and green bonds to fund RE projects (wind, utility-scale solar and distributed solar) and energy efficiency programs (Municipal and commercial building upgrades, retrofitting, efficiency upgrades) (NADB, 2020: p. 3). As a binational bank, it was "established and capitalised by the Governments of the United States and Mexico with the mandate to finance environmental infrastructure projects that preserve, protect or enhance the environment in the US-Mexico border region" (p. 2). Since 2011, the NADB has supported 18 solar projects (13 in the US, 5 in Mexico) and 14 wind projects (4 in the US, 10 in Mexico).⁴⁶ The first cross-border wind farm dates to 2015 with Project Sierra Juarez, Baja California, a model that seeks to be replicated in other key cross-border points (NADB, 2013).

On the Mexican side, the ER materialised these initiatives during the first stages of implementation. It is believed that the NAEI "could not have been contemplated until Mexico's electricity market was opened to foreign companies in 2014" (Matalon, 2017). Nonetheless, even though regional progress has been achieved, the Mexico-US grid integration is still a low-tension exchange and is used sporadically or only during peak times and emergencies. According to SENER (2018), these limitations lie in the lack of binational market integration and the need for capital-intensive investment programs to expand the transmission and distribution infrastructure (SENER, 2018). In 2016, about 70% of the Mexican electricity exports went to the US (30% to Guatemala and Belize); while Mexico absorbed 98% of the US imports (BMW-SENER, 2018: 44).

⁴⁶ For a full list and information briefings of the financial mechanisms for agriculture, water and RE projects, see the NADB database available online in: <https://www.nadb.org/our-projects/infrastructure-projects>.

Map 4.4. Mexico-US cross-border electricity grid connections



Source: BMWi-SENER, 2018: 43.

The evolution of the cross-border regional program would lead to broader integration that encompasses the whole Mexican electricity industry and territory. That is, the adoption of a wholesale market based on the liberalisation and deregulation model where US energy companies operate like being at their homeland, gradually replacing the 20th-century Mexican State-owned electricity sector. In Wood's (2017) words, the ER provided this environment:

For decades, Mexican sensitivities regarding the connection between energy and national sovereignty prevented the development of a modern and multi-faceted dialogue over energy cooperation between the two countries. The 2013 reform, however, has opened the way for comprehensive interaction on energy policy. In February 2014, only two months after the approval of the reform, the three North American heads of government met in Toluca, in the State of Mexico, to discuss the future of regional integration. Energy featured high on the agenda, and it was agreed that the energy ministers of the three countries would begin a regular dialogue (pp. 8-9).

As Vargas (1999) documented, a discursive strategy of oligarchic governments in Mexico since the 1990s is to empty the sovereignty concept, giving it a free market sense: "energy sovereignty means that Mexico makes sovereign decisions to ensure that we have electricity" (p. 2). This is a common place in the US-Mexico bilateral relations since the formalisation of NAFTA in 1992 (Faux, 2006). Therefore, one of the final acts of the Peña Nieto administration in 2018 was the renegotiation of the energy clauses of NAFTA, now rebranded as the US-Mexico-Canada Agreement (USMCA). At the time, this presented

a unique opportunity to create a new era of trade, and this era must include specific obligations concerning trade in electricity. Negotiators should consider the different degrees of integration regarding the US-Canadian electric sector and the US-Mexican electric system. Legal, political, sociological, and geographic factors have caused gaps between the integration of the electric markets in the NAFTA region. The absence of infrastructure, like transmission lines, stands today as the major obstacle for the integration and growth of electric trade in the region. Further, transmission lines and generators need to come close to the border to exploit this potential (Cabrera-Colorado, 2018: 106-107).

The USMCA renegotiation is materialised in a series of consultancy and technical assistance programs that the US foreign policy agencies provided to the Mexican Government in terms of electricity regulations, market design and energy policy. These institutional relations were documented extensively by the US GAO, pointing to close State relations that used the ER as a catalyst for private and financial interests in the ET developing in Mexico.⁴⁷

4.2. Preliminary conclusions

Throughout this chapter, I have established the general context of the ET in Mexico by studying the connections between these three foundational events. I have addressed the ongoing ET as a process of structural change based on the interaction of endogenous and exogenous variables encompassing political, economic, cultural, socioecological and geographical phenomena. The ET is a constant and permanent tension between narrative and material deployment, the former being the supposed neutral and universal conception of change, while the latter reflects the material class interests that shape energy-related processes. As Saxe-Fernandez (2016, 2018) and Álvarez-Béjar (2013, 2018) suggest, energy transitions and integrations are part of the historical evolution of how Latin America is embedded in technological and financial internationalisation processes. Therefore, to grasp the magnitude of the ET in Mexico it is important to draw on the analysis of the phenomenon of imperialism: State-class relations between cores and peripheries, personified by actors and institutions situated in the decision-making apparatus with the means to "make history" (see Mills, 1958). I consider this a proper introduction to the current ET in Mexico, going beyond the energy and environmental "free market" perspectives to go deeper into the geopolitics and geoeconomics of the energy-finance nexus.

⁴⁷ This information is available in appendix III, table of the US GAO (2018: 42-52).

CHAPTER V

A financialised Energy Transition? Preliminary findings on the financial configuration and development of renewable energy in Mexico

In time, men were more at home with abstractions than they were with the goods they represented. The typical operations of finance were the acquisition or the exchange of magnitudes. [...] Men became powerful to the extent that they neglected the real world of wheat and wool, food and clothes, and centred their attention on the purely quantitative representation of it in tokens and symbols: to think in terms of mere weight and number, to make quantity not alone an indication of value but the criterion of value that was the contribution of capitalism to the mechanical world-picture.

— LEWIS MUMFORD, *Technics and Civilization*, 1934

This chapter contains the second stage of my fieldwork. I use the interpretation lens of the financialisation debate to analyse the recent development of Energy Transition projects and the development of the Wholesale Electricity Market. It has the objective of questioning and assessing the recent financial expansion trends by giving some clues on how the financial sector has shaped and driven the operation of the electricity system in Mexico since the processes analysed in the previous chapter. It is a dialogue with the literature explored in chapter 2 to contribute to contemporary analyses of financial expansion toward energy transitions. I will address the different areas of the sector subjected to financial interests and the concrete mechanisms used for financial intermediation to fulfil this task.

5.1. The financialisation interpretative lens

This dissertation was inspired by the financialisation debates tracking the dynamic processes of financial expansion into other latitudes, spaces and industries. While conducting fieldwork, I spotted that some phenomena that unfolded since the 2014 Energy Reform (ER) had a close relation to the financialisation trends reviewed in the literature. To verify this, fieldwork required an understanding of the combined complexity of electricity systems and financial markets, finding specific manifestations of a financial expansion process within structural change. Here I am coming back to the financialisation debate with the main empirical finding of the Mexican case study.

As I briefly explored in chapter 2, the financialisation literature deals with the contradiction between industry and finance, or the tensions between income and rent. From this scholarly debate, I recover four relations that encompass the financialisation process in contemporary economies:⁴⁸

⁴⁸ A preliminary exploration of this interpretation can be found in the financialisation literature reviewed in Álvarez-Herrero, 2019.

- The *separation* of productive and financial activities into two identifiable domains (Arrighi, 1994, 2007; Foster & Magdoff, 2009; Simon & Kwak, 2011; Lapavistas, 2013).
- A simultaneous *integration* of industry and finance through mechanisms like brokerage, commodification and securitisation (Beinstein, 1999; Caputo, 2012; Krippner, 2011; Lohmann & Hildyard, 2014).
- The *negation* process, where one of these domains operates in detriment of the other (Franco, 2006; Guillén, 2007; Huerta, 2009; Hudson, 2015).
- And a *parasitic* nexus, where finance extracts rent from the productive sphere (Hudson, 2015; Purcell *et al.*, 2020).

While structuring the case study, I identified some of these relations in the conformation of the new Wholesale Electricity Market model (WEM) and the introduction of renewable energy (RE) technologies. In this section, I am drawing from fieldwork to contribute to the financialisation and energy transitions debate. These findings span the initial financial configuration and first operation years of the new model derived from the ER (January 2016-December 2018). I am focusing on the RE roadmap, so I am leaving aside immature environmental markets in Mexico like carbon trading or weather financial derivatives (see López-Toache *et al.*, 2015). Also, my interest is not a *description* of the model that emerged from the ER (which can be found in the comprehensive documents like BMWi-SENER, 2018; Yaneva *et al.*, 2018; Bancomext-GIZ, 2018), but the *problematization* of its main trends.

5.1. The financial separation-integration dynamics of the WEM

After 54 years of a centralised State-owned electricity industry, the ER introduced a private-driven WEM model: a deregulation scheme implemented in Western countries since the 1980s to dismantle nationalised electricity industries (Ramos & Veiga, 2014: xi). A WEM is the result of the gradual integration of energy and financial markets: the establishment of a "competitive market" where "agents offer and buy electricity", opened to "new participants such as generators, retailers, or financial intermediaries or end-users" (Dias & Ramos, 2014: 216). This electricity-finance connection represents a deregulation-integration process that creates new markets, commodities, services and structured investment mechanisms. Following Ramos & Veiga, 2014,

The necessary conditions were in place: a sector with overwhelming growth (that is likely to continue) and many investment opportunities, and investors eager to find new asset classes and who have acknowledged the energy sector's growth potential. The trigger came with the wave of deregulation in the energy markets, which attracted a large number of new investors and strengthened the link between financial and energy markets. This increased link [took] several forms: The development of energy markets with a growing number of participants, and energy-based products are now being traded like financial assets. New spot and derivative energy markets have emerged, and financial exchanges have extended business lines to energy products (p. xii).

Along with market deregulation, the introduction of RE is renewing the technical and financial feasibility of sustainable energy systems within the Paris Agreement policy framework (see Shah *et al.*, 2016; OECD, 2016; IRENA, 2017a). The combination of a deregulated WEM

and the expansion of RE assets derived in a broader investment space paved the way for the creation of financial business niches in the electricity industry. As I mentioned before, different financiers have different interests in different segments of the WEM, creating identifiable investment areas designed and operated by financial principles. By transitioning from a State-owned model to a private-deregulated WEM, the Mexican industry is exemplary in the conformation of this structure.⁴⁹

Table 5.1. Financial structure of the Wholesale Electricity Market in Mexico

Green Finance	Wholesale Electricity Market			Energy brokerage
	Energy generation, transmission, and distribution	Energy commercialisation and retailing		
Structured finance	Project and infrastructure development	Energy trading	Retailing	Investment portfolios
Funding mechanisms to build renewable energy generation plants and/or infrastructure.	Financial management of RE generation projects to supply the WEM. Creation of PPP to modernise or expand transmission and distribution lines.	Risk management and bilateral intermediation of physical and financial electricity contracts. Financial derivatives, CECs and FTRs trading.	Business models and microfinance for energy sale. Financing schemes for distributed generation.	Intermediation of energy-related securities and portfolio investment in electricity generation assets.
Circulation	Production	Circulation		

Source: own elaboration.

This *separation* of financial niches leads to a complementary movement under financialisation: the *integration* of activities through the commodification of electricity and the liberalisation of its price. As seen in the literature review, one of the main trends during the 2000s was the expansion of finance into commodity indexes and markets, following the model of the US Commodity Futures Modernization Act of 2000 (Johnson & Kwak, 2011; Ramos & Veiga, 2014). This created a "convergence" of a multi-commodity market based on electricity generation and supply (Fusaro, 2002). Electricity was thus included in the commodity basket for profit-making, speculation and hedging.

The primary advantage of including commodities is that commodity returns are expected to be relatively uncorrelated with the returns of traditional asset classes [stocks, bonds]. The absence of correlation is attributable in part to inflation. In fact, holding commodity futures is often considered to be an inflation hedge. Indeed, during periods of rising inflation, traditional asset categories like stocks and bonds perform poorly. Commodities, on the other hand, generally perform well during these periods. Indeed, increased

⁴⁹ See appendix 1 for additional information on the foundations of the electricity industry in Mexico.

demand for goods and services, typical in periods of rising inflation, usually implies increased demand for the commodities used in the production of those goods and services (Carmona, 2015: 10).

Following Carmona (2015), investors have expanded their activities in commodities through three main mechanisms:

- 1) *Financial intermediation*. Financial actors "are not ready or equipped to deal with issues of transportation, delivery, storage and perishability of energy" (p. 10), so their work is to hedge to mitigate financial risks associated with uncertainties of producing and delivering a specific commodity.
- 2) *Equity and funds*. Investments can acquire bonds or shares of companies that have a commodity-intensive activity or participate in commodity-based indexes. This is a more stock market approach to have exposure to commodity prices.
- 3) *Financial derivatives*. Due to price volatility, investors can use financial futures, options and swaps to hedge or speculate on price trends.

Nonetheless, from a financial standpoint, electricity is a unique commodity that differs from other energy sources and natural resources, adding some specificities to its commodity condition. Based on works by Fusaro, 2002; Edwards, 2010; Laloux & Rivier, 2013; Ramos & Veiga, 2014; Aïd *et al.*, 2015; and Božić *et al.*, 2020; the financial commodification-securitisation of electricity lies in the following trends:

- The industry must create a supply-demand balance in two uncorrelated markets: the spot market (daily activity) and the forward market (expected future demand). This division is necessary since electricity cannot be stored in a practical way for market dynamics (i.e., storage would allow electricity to be bought cheaply during low demand periods and resold when demand is higher), so it must be generated and transmitted as it is consumed in accordance with specific consumption needs at a specific time and space. Therefore, the objective of trading mechanisms is to continuously provide market clearing.
- The supply contracts must be done in advance. Because of this, it is difficult to trade electricity on short notice. Energy trading primarily consists of buying and selling agreements to deliver electricity at some point in the future. The exact season, time, and location where the electricity needs to be delivered is a central clause in these agreements.
- Unlike oil, physical electricity must be purchased and used immediately. By itself, energy is not intrinsically valuable, it is only valuable in the right place and time to be consumed.
- Electricity is not delivered as "packages" from origin to destination, it is transmitted as a flow through grids where the pathway cannot be chosen at will and is determined by physical constraints of the grid. This creates a risk environment that must consider the stability of the system in any of its points. Therefore, electricity hedging is crucial against dynamic and interdependent systems where a failure of a single component between generation and demand can cause disturbances in the rest of the grid.
- There is a separation between physical and financial electricity, the former being the actual trading of energy while the latter is based on financially settled contracts.
- In a wholesale spot market, electricity is supplied to an anonymous pool where there is no clear connection between generators and final consumers.

- Price volatility is a key risk variable since private companies attempt to maximise their earnings while public institutions aim to minimise the cost of the service for final users.
- There is a historical cost correlation between FF and the electricity generated with them. However, RE changes this component since the "fuel" is a natural flow that has virtually no cost but cannot be controlled at will or easily forecasted.

These characteristics have a direct implication on electricity prices. The deregulation-liberalisation process makes electricity behave like a financial underlying asset, fluctuating in the zero-sum game of profits and losses. Thus, financial models based on electricity demand offers intermediation opportunities in price volatility, jumps and spikes (Dias & Ramos, 2014: 217). For Ramos & Veiga (2014), liberalised prices are determined by "the interaction between supply and demand", but electricity demand "is quite inelastic and supply tends to be rigid", so "price volatility is likely to increase, or prices will at least show spikes" (p. xii). Božić *et al.* (2020) add:

Due to the non-storable feature of electricity, power prices tend to be more volatile than prices of other commodity markets. Prior to liberalisation, price fluctuations were minimal and controlled. After the liberalisation of energy sector, it became important to model and forecast price development. Understanding the dynamics of prices is important because they are usually used as a reference price for financial contracts. [...] Volatility processes are key elements in risk management, as they present price fluctuations over a period, and when evaluated properly they can be used in portfolio optimisation and asset allocation. Uncertainty measure of the future prices is determined by the spread of these fluctuations (p. 3).

Multi-commodification trends expand to other underlying electricity products such as power capacity, ancillary services, Clean Energy Certificates (CECs), Financial Transmission Rights (FTRs) and financial derivatives. As I analyse ahead, this is the theoretical multi-commodity market introduced in Mexico since the ER.

The Mexican case study reveals the implementation patterns that were replicated from this theoretical model, showing parallels trends on how the Mexican authorities were advised to open and deregulate the national electricity sector. According to the MER (2017: 38-39) energy business brochure, the ER made the Mexican industry transition from a State-controlled sector into a deregulated model akin to those in the US and Spain where several and more typical financial elements were added instead of plain electricity commercialisation.

As seen in chapter 2, any "financialisation" or financial expansion of the ET requires the previous large-scale deployment and long-term operation of RE projects. That is, the existence of real fixed assets to generate renewable-based electricity that massively supplies wholesale markets. This would be the material basis of the ET where the financial separation-integration dynamics are built on. But, in the case of Mexico, how is RE finance introducing generation projects and investment incentives? For energy project developer Carlos A. Villanueva,

"Any renewables investment decision considers the potential growth of the market. For this, what the government and experienced energy companies did during and after the Reform was to explain to the financial sector the business models available in the market. I would say the novelty and lack of experience in Mexico for this kind of industry is the major barrier. But there are useful tools to break into the market. Financial projections, cost-benefit analyses, due diligence, syndicated loans, project management methodologies, etc. Big companies can finance their projects with their own resources. But the main

challenge for other small or medium developers is to combine funds under project finance schemes. Thus, my main concern for finance energy planning is who to sell the energy to, at what price and for how long".⁵⁰

On the supply side, one of the main arguments is the recent price reductions of solar and wind technologies that makes generation plants investment costs more accessible. While Mexico has had access to these technological improvements, their development is still determined by demand and prices. According to the investment guide for RE participation in Mexico (Bancomext-GIZ, 2019), financiers see the sector "as a relatively new system with market risks [where] electricity generation projects with spot market sales still face barriers to accessing adequate financing" (p. 6). Based on this market rationality, financiers identify entry opportunities and barriers for renewable energy projects development.

Table 5.2. Market incentives and barriers for RE expansion in Mexico⁵¹

Incentives	Barriers
• Attractive Local Marginal Prices with hedging mechanisms. • CENACE's economic merit dispatch scheme means that renewable projects with near-zero variable costs are dispatched first, meaning a secure operation in the market. • Clearing house held by a decentralised public body of the federal government (CENACE), so payments are guaranteed. • Cost reduction of solar and wind technologies. • Extra income from CECs, FTRs, power capacity and ancillary services. • Market growth and benefits from climate policies. The increased deployment of RE would close the gap to achieve Mexico's clean generation targets, from 21% in 2018 to 35% in 2024. There are still 68 MWh of additional renewable energy to be generated, which is equivalent to about 25 GW to be installed.	• Local Marginal Prices volatility and fluctuant cashflows. • A shortage of market off-takers with high-credit ratings to sign long-term PPAs. Most of these players have already signed contracts. • PPAs liquidity risk. • Short-term PPAs that would not cover long-term financial and operating costs. • Long ROI periods. • Little experience of successfully financed projects. • Limited participation of funding institutions like commercial banks. • Geographical and climate adversities for RE project development.

Source: Bancomext-GIZ, 2019:4-6; HR Ratings, 2018.

From a financial perspective, asset and commodity prices are the only variables that generate income. Therefore, prices are the centrepiece of ET projects to *a)* obtain financing to build new plants, and *b)* pursue long-term profitability in the RE business. Following the renewable investment guide (Bancomext-GIZ, 2019), most opinions in the Mexican financial sector mentioned the potential of

⁵⁰ Interview conducted in Baja California, Mexico, on May 5, 2019.

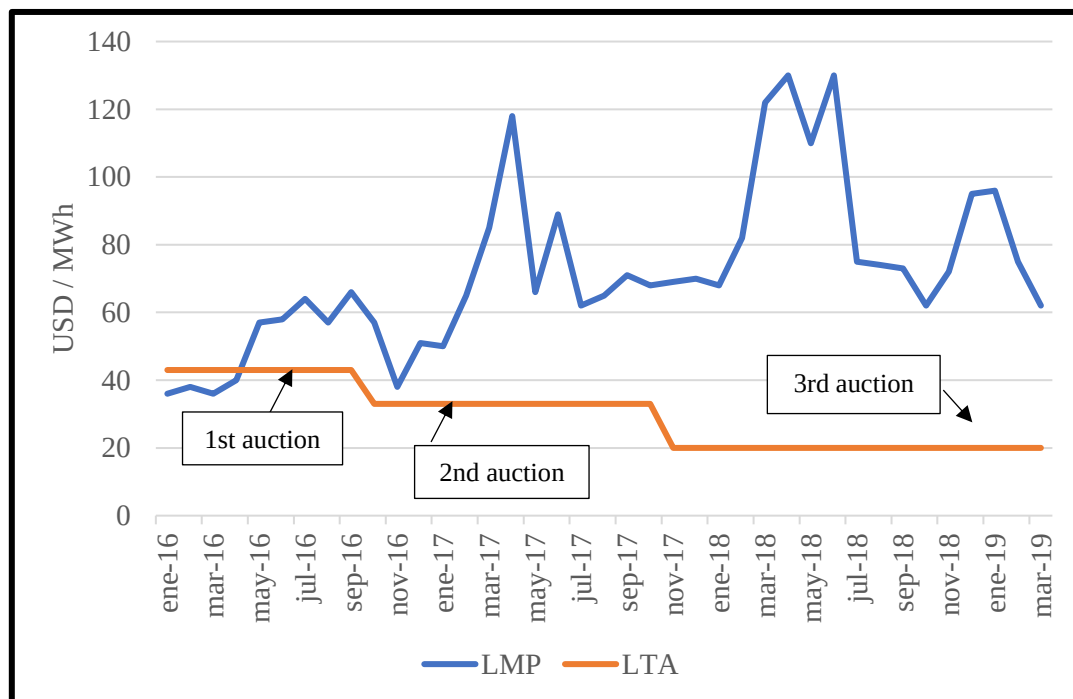
⁵¹ See appendix 1 for a brief resume of the Mexican electricity industry.

electricity prices as the main variable for investment decisions in RE projects. This approach to the WEM model offers three business models based on commodified electricity prices:⁵²

- *Short-term spot market.* Economic dispatch allows RE supply to be dispatched first due to low variable costs. Here, the Local Marginal Price (LMP) fluctuates according to the demand and the geographical conditions of the node. Like any commodity, profit or loss is related to price fluctuation, which represents both market risk and higher profits.
- *Long-Term Auctions.* Auctions are intended for a gradual penetration of RE in the market. These are celebrated yearly, and the purchaser of the electricity is the public utility CFE. It offers a stable income for up to 15 years due to fixed prices agreed by the contract. The participation of projects still in planning or construction is allowed, which generates certainty in the return on investments, costs coverage, and access to project finance schemes.
- *Bilateral PPAs.* Like long-term auctions, generators sign a contract with a qualified user (final consumer) to sell energy at a fixed price. It is a common mechanism to obtain cash flows and fund RE projects. Even though PPA prices are lower than spot prices, PPAs are a hedge for financial institutions if the off takers have good credit ratings.

Financiers see different investment strategies based on electricity prices. On the one hand, LMP volatility is attractive due to the spreads on prices that result in higher revenues. On the other hand, LTAs and PPAs offer a long-term guaranteed income by fixed electricity prices and CECs revenue, but the cash flow value is less compared to the LMP volatility profits.

Figure 5.1. Price differential Local Marginal Prices (LMP) vs. fixed Long-Term Auction prices (LTA)



Source: Bancomext-GIZ, 2019: 13.

⁵² See appendix 1.

During decades of Mexican energy nationalism, electricity prices were a common good "supplied by CFE [...] as a public body created for social interest, public service, energy security and to meet national needs, even in the most distant geographical areas" (Vargas, 2015: 139). The ER, under financial principles, changed this perception, making electricity a financial commodity with a fundamental formation of prices.⁵³ Price transparency is one of the main concerns for financial planning, especially their correlation with costs and tariffs. Trader J. Chauvet argues:

"Financial markets are driven by prices, and prices determine decisions on investments. If we were to imagine a strictly financial market for renewable energy, something similar to what has happened in the oil markets would occur. I think it is still premature but if in the future it is thought that most of the energy will be generated with renewables and we are moving towards an electrified economy, the price of electricity will be as financially relevant as a barrel of oil. In the case of renewables, there is no barrel of fuel, so the fundamental analysis of electricity prices must focus on other variables such as energy source, technology and location. On those variables, there must be hedges for risk management and above all understand where prices can go, especially if there will be a higher volume of financial transactions in years to come".⁵⁴

For the financialisation debate, financial integration processes since the ER mean that non-energy companies can now enter the energy business or have corporate divisions for self-consumption. Guillermo Canales, energy strategist at PwC, mentioned:

"Since the Reform, energy became a more strategic business line rather than a mere expense. The objective is not only to have savings, now it is possible to generate more electricity and sell it in the market for profit. Companies with different activities can now have energy self-supply divisions to consume and sell energy".⁵⁵

In the electricity markets, Local Marginal Prices are made up of three components: energy, congestion and losses.⁵⁶ Volatility results in the combination and movement of these three factors and their variations have financial hedging mechanisms for risk mitigation.

Table 5.3. Components of electricity prices and financial hedging mechanisms

	Component	Financial hedging mechanism
Local Marginal Prices (LMP)	Energy	Bilateral financial transactions (TBFin) of financial derivatives over prices.
	Congestion	Financial Transmission Rights (DFTs).

⁵³ A report by the Centre for Public Finance Studies of the Mexican Chamber of Deputies (CEFP, 2017) concluded that the pre-Reform price scheme was opaque or artificially set due to State subsidies that distort CFE's income and overshadows the cost-reflecting process of obtaining the electricity. After the ER, the new business model uses a transparent scheme so that the tariffs and costs reflect an efficient operation of each of the stages of the process of electricity production. In financial terms, this is the market information needed to build financial models, close bilateral contracts, operate economic dispatch and use financial hedging mechanisms.

⁵⁴ Interview conducted online on June 10, 2021.

⁵⁵ Information retrieved at the *Mirec Week 2019 Energy Congress & Expo*, Mexico City, on May 22, 2019.

⁵⁶ An explanation of LMP components can be found in appendix 1.

	Losses	Investment in transmission and distribution grid expansion (through bids and/or PPP contracts with the Mexican State).
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Source: own elaboration.

The integration of financial and electricity markets lies in projects financing schemes, where prices create a link between funding institutions, RE projects and energy trading/brokerage. The firm HR Ratings (2018) summarises:

The main source of income of the private parties and, consequently, the source of payment of any financing they may contract would be the income derived from the sale of electricity in the wholesale market based on the price of the corresponding node. Likewise, the revenues derived from the sale of related services (power capacity, Financial Transmission Rights and CECs) could also serve as a source of payment to cover debt obligations. Considering the above, the collection rights from the sale of electric energy and any associated products, to which the Generator is entitled, could be assigned to an Administration and Payment Trust (p. 1).

The viability of RE depends on other key variables conditioning project financing, like solid regulatory and legal frameworks, the geographic and climatic characteristics where projects are embedded, and a broader catalogue of operational and financial risks (see Edwards, 2010; HR Ratings, 2018). In Mexico, CF initiatives support the bankability of merchant projects based on the potential cash flows to meet the obligations undertaken during the initial capital outlay, leaving a margin to yield optimal revenues. This creates an equilibrium between feasibility, viability, liquidity, risk management, financial security, and value creation (Bancomext, 2018). The main incentive to achieve this relates to the idling liquidity looking for opportunities and the privatisation trends in the energy industry previously analysed. Thus, it is not only the new WEM model and the new investment spaces available for RE, but also the replacement of the State sector in hands of CFE with a private one. Energy trader Alejandro Moreno commented:

"The incentive on the generation side is the renewable energy goals. But companies in Mexico do not have the resources or do not know how to finance energy projects. Many companies see a good margin to enter the Mexican market by selling electricity to CFE, but a key driving factor is that the generation park in Mexico is very old and obsolete, based on fossil-fuelled combined cycle plants. Therefore, a new and more efficient generation is required, both to replace installed capacity and to add new. What renewables are changing is the way to access short- and long-term project financing. Since the State is not capable to fund renewables, these mechanisms will add liquidity and certainty to the Mexican market in years to come".⁵⁷

According to IFC (2014), CF initiatives in Mexico rely on blended finance and structured investment vehicles to support wind and solar projects. The first stage of the ER (2016-2018) saw the advancement of structured financial schemes, blending equity, debt and grants to promote RE projects in a volatile and uncertain investment environment (Bancomext-GIZ, 2019). During this period, commercial banks have stayed away from financing long-term projects (15-20 years), and equity-based investments still perceive risks and uncertainties in project development (Bancomext, 2018). Therefore, structured finance has taken the form of tailored loans adjusted to the specific project size, location, technology, and business model characteristics (García, 2017). As of 2020,

⁵⁷ Interview conducted in Mexico City on March 25, 2019.

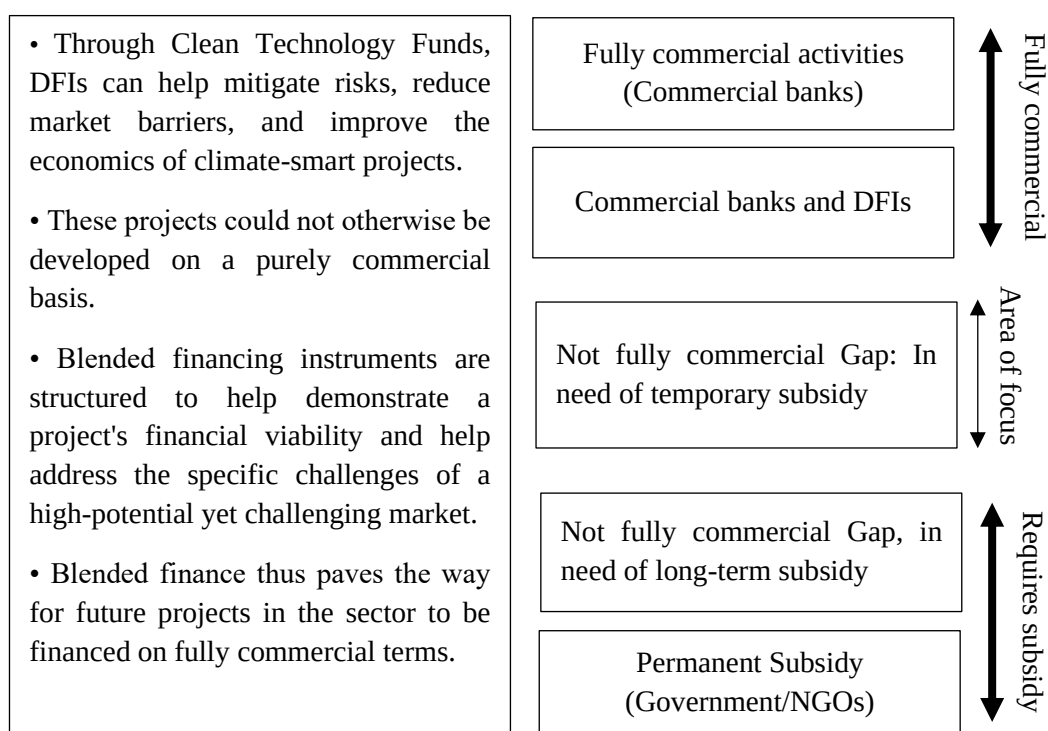
financing RE depends on a diversified matrix of blended financial mechanisms to encompass all the risks and interests surrounding solar and wind projects deployment.

Table 5.4. Current financial mechanisms supporting renewables in Mexico

Financial instrument	Description	Institutions
Long-term syndicated loans	Loans are sourced from a group of banks, investors, or other financial institutions. Financing has an average term of 20 years. The group of funders considers risk diversification, financial leverage, available cash flows, hedging mechanisms, and reserve accounts.	Syndicated banks or/and other financial institutions
Credit lines	Low-interest and long-term debt programs under project finance. Loans can take up to 15-20 years while RE projects mature.	Mexican and International Development Banks
Guarantee of Timely Payment	A financial figure used by Mexican Development Banks. It is a trust fund that serves as a guaranteed backup for lending financial institutions. It includes <i>a)</i> the source of payment for a loan, and <i>b)</i> serves as a payment vehicle for the Financing or Guaranteed Obligation.	Mexican Development Banks (Banobras)
Insurance contracts	Consists of insurance clauses in the event of default by the borrower. Insurance becomes expensive or even rejected for high-risk energy projects because of a lack of experience in the industry.	Insurance companies, commercial banking.
Green Bonds	Green bonds are used to finance or refinance renewable energy projects, transmission infrastructure, energy efficiency plans or other related projects that meet international objectives of social and environmental benefits. However, Mexico is still a low issuance market due to the lack of knowledge of the benefits of green finance, low liquidity, little interest in sustainability, and lower interest rates compared to other corporate bonds. The issuance of green bonds is supported by investment banks.	Mexican Development Banks (Banobras, NAFIN)
Equity certificates (Fibra-E)	These instruments are authorised by the Mexican Stock Exchange to raise capital through trusts for transmission infrastructure finance. They pay cash flows based on the performance of the project and the ownership of the asset. As I detail ahead, this kind of instrument has been operated by CFE to collect equity and invest in energy infrastructure through stock certificates and monetised assets.	CFE
International financial cooperation schemes	Infrastructure financing mechanisms like export-import loans, direct credit lines, Independent Power Producer structures, foreign investment loans, political risk guarantees, and build-own transfer schemes.	International Financial Institutions

Source: own elaboration based on BMWi-SENER, 2018; Banobras-GIZ, 2019: 34-37; Rodríguez, 2020.

Table 5.5. Development Financial Institutions (DFIs) Blended Finance scheme



Source: IFC, 2014: 2.

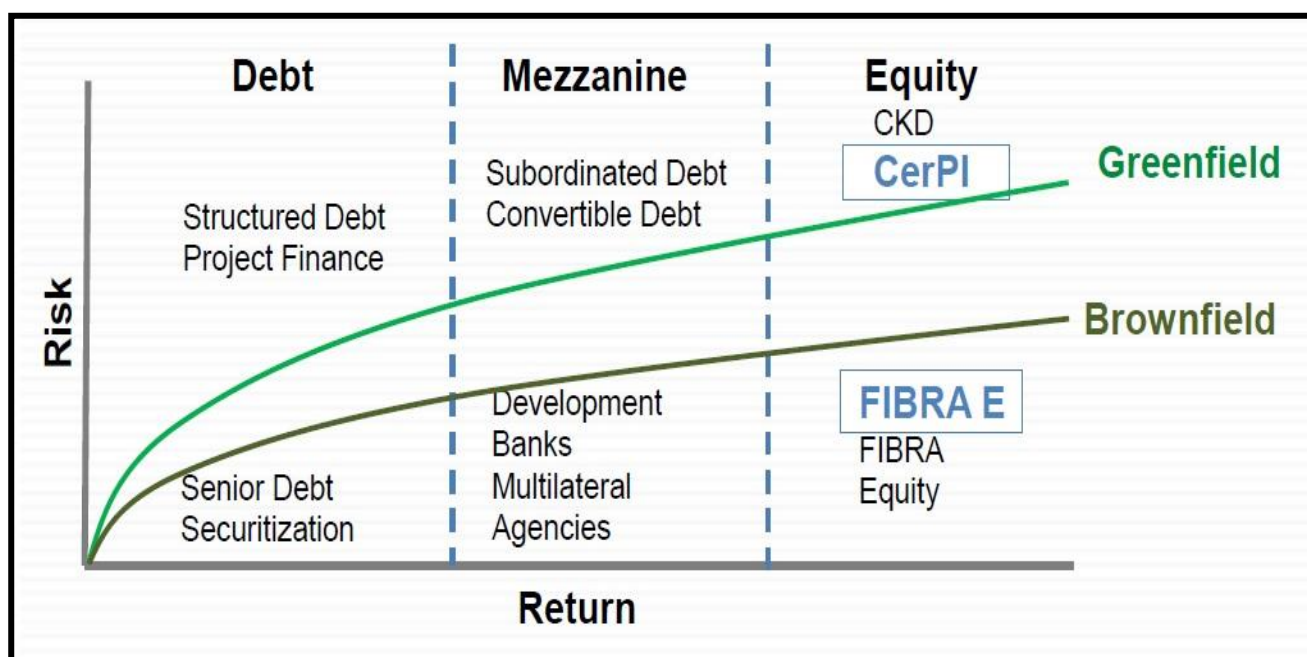
Along with the commodification-deregulation trend, the new model also expects the creation of new brokerage services focused on energy-based assets and investment vehicles. Such vehicles operate through the securitisation of specific infrastructure segments of the energy industry, called Investment Project Certificates (CerPIs) and Development capital certificates (CKDs) (see Deloitte, 2016). Both are private equity listed vehicles that aim to:⁵⁸

- Attract top global asset managers and alternative investment managers.
- Invest in a wide range of industries, with different risk exposures, combining resources of domestic and foreign investors.
- Attract a broader base of local and international Institutional Investors (i.e., pension funds, insurance companies).
- Allow partnerships with experienced global investment funds, managers, and institutional investors.

Structured finance aims to provide a complete scheme for RE project development: “the trust fund, the construction contract, the land, the whole package and with that the bank goes to the international markets and sells its position” (Bancomext, 2018: 44). As I analyse ahead, these instruments are the main mechanisms for land value grabbing and the financialisation of transmission infrastructure in hands of the public utility CFE.

⁵⁸ See Melgar *et al.*, 2016.

Figure 5.2. Planned investment vehicles for ET projects in Mexico



Source: Melgar *et al.*, 2016: 34.

Nonetheless, even though the CF narrative spreads the idea that the financial sector is the main vector for the ET, the Mexican case shows that most of the financing during the first stage of the new model has come from the Mexican Development Banks (MDB). As I mention ahead, the ER was accompanied by a financial reform that deregulated the role of MDB to allocate credits for RE projects (see Bancomext, 2018). MDB implemented two main mechanisms for financing RE:

- *Direct loans.* In 2017, the three major MDB (Bancomext, Banobras and Nafin) granted loans totalling 810 million USD for solar and wind projects, incentivised by the safe long-term auction contracts to sell energy to CFE (García, 2017; Bancomext, 2018).
- *Green bonds.* Nafin and Banobras were the first national entities to issue green bonds to fund RE projects. According to both banks' press releases (NAFIN, 2017; Banobras, 2018) bonds served as the main supporters of solar and wind energy projects, grouped into regional investment portfolios. Bonds attracted investors from Asia, Europe, the United States and Latin America; mainly funds specialised in green investments and energy projects, as well as institutional clients such as pension funds and insurance companies.⁵⁹

⁵⁹ NAFIN (2017) stated that several international institutions were involved in the green bond process: the transaction was made by Bank of America, Merrill Lynch, Credit Agricole and Daiwa. The technical support was provided by the firm Sustainalytics. It had the internationally recognised Climate Bond Certification issued by the Climate Bond Standard Board. Also, the Climate Bonds Initiative endorsed the collocation. Finally, Moody's y Fitch rated the bond A3 and BBB+, respectively.

Table 5.6. Thematic bond issues by Mexican Development Banks (2015-2021)

Bank	Emissions made	Projects	Percentage
Banobras	11 sustainable bond bonds for 37,060 million MXN.	Disaster recovery	18
		Renewable energy: wind, solar, hydro.	44
		Public utility infrastructure	21
		Other	17
		Total	100
Nafin	2 green bond issues for 10,353 million MXN.	Renewable energy: wind, hydroelectric.	100

Source: Banxico, 2021: 2.

The new administration that took office in late 2018 has denounced the use of MDB to finance and leverage private energy investment (CFE, 2021). In chapter 2, the financialisation literature reminds us of that finance rarely finances productive activities, focusing on speculative manoeuvres and extracting interests, dividends and amortisations. CFE's diagnosis is that, during the early stages of the ET, private finance has not taken any lead in the RE industry; it has been the MDB (based on public money and pension funds) the ones that subsidised and prepared the field for private investments. One argument is that commercial and investment banks do not have any experience financing energy generation projects, and they are not willing to provide resources for the length of the contracts, therefore, "the presence of developing banking is needed to pave the way for private banking to start offering financing options" (MER, 2018: 215). On another occasion, Bancomext (2018), stated:

Development banks and multilateral organisations play a central role in the early stages of the development of a new business model or sector when the ground is prepared for investment and the technical feasibility of projects that are relatively new in Mexico is demonstrated. [...] Mexico's economic policy has always favoured strategic sectors, where energy is a key promoter to attract investments (pp. 35-36).

For its part, Banobras opened an energy division to support RE projects, moving from previous infrastructure sectors into the energy business models. According to the MDB,

There are two types of companies: large companies with a corporate plan that do not need financing because they have resources of their own and smaller companies that are looking for project finance. Large companies are not focused on a specific project but rather are focused on the power segment to compete with CFE in the next 10 or 15 years. Small companies do focus on a specific project such as wind or solar energy. Banobras focuses on small companies that need project financing because we can take on riskier projects as a complement to commercial banks (Mexico Business News, 2017).

According to BMWi-SENER (2018), the ER took place in tandem with other key structural reforms, including a strategic Financial Reform that "expanded the role of National

Development Banks to be more focused on productive activities and, in the case of financial institutions, to extend credit lines and securities, primarily for the energy sector" (p. 9). Energy trader Alejandro Keijser added:

"Development banks are more expensive than commercial banks, they participated mainly in the long-term auction projects and lent at very high rates. These banks were able to place resources with zero country risk because their sources are public, and the energy projects developed sell energy to the State. The truth is that development banks win by financing these projects. The current CFE administration is approaching the problem in the wrong way".⁶⁰

This situation confronted the new CFE administration (2018-2024) with the foreign-controlled energy sector currently operating in Mexico. Mario Morales Vielmas (general director of legacy contract intermediation at CFE) argued in a press conference:

"[Foreign energy companies] did not come to invest, which is what was expected with the Energy Reform. National Development Banks have been supporting foreign energy companies and investments funds. Strictly, we cannot call them investors since most of the financing came from our Development Banks. There are many countries that have a private electricity sector, but national-private, not foreign-private. In the case of Mexico, when we talk about the private sector, we must refer to the foreign-private sector. These groups sell assets to each other rather than invest in new ones and have benefited from the resources of the Mexican State. There is undoubtedly local participation, but those who have control of all the key variables and strategic elements of the energy sector are international investment funds. If electric energy is to become the engine of development in the coming years, it will be in foreign hands. It is a matter of a State intervening in another State" (Canal 11, 2021; see also CFE, 2021a).

I searched for public information on these investment funds. On an interview, CFE's deputy director of grid business stated:

"We are aware of investment funds that are operating energy projects, both renewable and conventional. We asked the Ministry of Finance [SHCP] for a list of international energy investments operating in Mexico but the information was denied because of confidential policies. We believe this is related to political tension derived from the counter-reform supported and promoted by CFE".⁶¹

According to Keijser, international investment funds are constantly borrowing money from banks, pension funds and millionaires to develop or buy RE energy assets. These diversified portfolios have 5 to 7 years of maturity, also having the option of selling the asset to another portfolio or company. Blackrock, Blackstone and KKR (sometimes their local subsidiaries) are examples of this type of funds currently operating RE projects in Mexico.⁶²

The current CFE administration insists that both reforms (energy and financial) created a flawed mechanism for using local public resources and the Mexican working-class pension funds to fund RE projects instead of attracting new foreign investment (CFE, 2021). This is a relevant issue since the ER stated that the opening and deregulation of the industry would attract large volumes of foreign direct investment, supposedly having unprecedented multiplier impacts on the Mexican economy (see Hernández-Ochoa, 2016).

⁶⁰ Interview conducted online on October 28, 2021.

⁶¹ Information retrieved on July 30, 2021.

⁶² Interview conducted online on October 28, 2021.

Table 5.7. Top 8 renewable energy investment funds with interests in Mexico

Fund	Volume of assets (USD million)	Annual return	Dividend return	Major investing countries
BlackRock Global Funds – New Energy Fund	1.112	5.4%	–	EU, US
Pictet Clean Energy	767	5.38%	–	EU, US, China
RobecoSAM Smart Energy Fund	636	16.27%	–	EU, Singapore
Guggenheim Solar ETF	373	25%	1.92%	EU, China, Germany, Spain
Vontobel Fund New Power B	298	New	–	EU
PowerShares Cleantech Portfolio	166	12.2%	–	US, Switzerland, Germany, UK
iShares Global Clean Energy ETF	153	3%	2.27%	US
PowerShares WilderHill Clean Energy	118	20.17%	2.79%	US

Source: Gutiérrez, 2018: 46.

This predominance of the State during the early material development of the ET evokes Parenti's (2016) reflection on the current role of governments as key environmental actors and a reproductive agent of capital, being the guarantor of the large-scale investments needed in the climate sector. To summarise this section, I would like to quote an excerpt from my first interview with energy trader Alejandro Keijser:

"Financiers were not the ones who led this trend towards green energy. I'd say they mounted over the structure. In the beginning, loans are expensive, and banks only give you 30% in project finance. Banks never lose, if they see that an industry is profitable, they will definitely invest in it. Today the green finance trend is because there is a global market valued at 6 billion per year in solar alone. Now there are financial directors of clean energy dedicated to it, but I bet you that 10 years ago they were doing business with coal plants themselves because that was profitable at the time. In the end, I think that finance is more opportunistic than spearheads".⁶³

5.1.1. Energy trading and brokerage

The financial separation-integration process is also materialised in the role of market intermediaries that operate physical or financial positions through bilateral contracts. This figure is known in the ER as "non-supplier intermediary" and follows one of the financialisation principles: "a growing presence of financial investors without a commercial position on the commodity" (Ramos & Veiga, 2014: xviii). Nonetheless, the early Mexican

⁶³ Interview conducted in Mexico City on March 1, 2019.

experience under the WEM model has been a predominantly physical market with only a few trends towards financial processes. Alejandro Keijser said:

*"A trader is someone who takes a short or long position on electricity. In the Mexican market, these positions have actual MW as the underlying commodity. These are physical transactions made by private parties and CFE. Yet the financial side of the market is still embryonic. For instance, financial derivatives have not matured well because there are only a few market participants and lack of liquidity".*⁶⁴

For his part, energy trader Alejandro Moreno complemented:

*"That is why there is the figure of a non-supplier trader, usually brokers. In theory, these participants are risk-takers, create a very large energy portfolio, break it up, restructure it and resell it to suppliers, taking the risk and acquiring the profit or differential for taking that risk. In Mexico, there are still few of these participants, but the market is turning towards these transactions".*⁶⁵

So far, bilateral electricity trading and brokerage transactions in Mexico take place through three main financial instruments:

- *Clean Energy Certificates (CECs)*. A financial mechanism for RE expansion. These certificates create two types of revenues: *a)* each CEC equals 1 MWh and represents extra income for generators to finance RE projects; and *b)* due to their variable price, they can be traded as securities based on supply and demand on secondary markets (Bancomext, 2018: 16; BMWi-SENER, 2018).
- *Financial Transmission Rights (FTRs)*. Acquired yearly through auctions, granting their holder the right and obligation to charge or pay the difference resulting from the value of the congestion component of the LMP in two nodes: origin and destination. Under this principle, transmission becomes a scarce commodity (see CENACE, 2018).
- *Financial derivatives*. With a long-standing tradition in energy markets, financial derivatives are one of the main mechanisms for price exposure. There are futures, options, and swaps. Derivatives are considered a financialisation process, a way of integrating commodities into investment portfolios, and the rise of new financial actors in the trading segment (Lautier *et al.*, 2015). Considering that less than 1% of future contracts in energy markets end in physical delivery (Edwards, 2010: 48), most of the financial expansion in the industry complements short-term hedging and speculation strategies. Electricity financial derivatives require cross hedging strategies because, as a non-storable commodity, electricity is delivered as power over time periods, having longer periods of increased risk (see Nguyen & Oudjane, 2015: 149).

During fieldwork, I found that these markets had an incipient and limited development in the first stage of the WEM implementation (2016-2018). The CEC trading platform is probably the most relevant tool for Mexico to achieve progressive stages of RE expansion, making it compulsory for generators and suppliers to trade higher shares of renewable energy. For energy economist Manuel P., CECs are the complement to carbon trading so that Mexico could achieve decarbonisation targets. In both cases, these mechanisms can be traded in secondary markets with volatile prices since the compulsory climate laws and commitments would create

⁶⁴ Interview conducted online on October 28, 2021.

⁶⁵ Interview conducted in Mexico City on March 25, 2019.

speculative dynamics where traders can buy these securities cheap and sell to suppliers at higher prices prior to default deadlines.⁶⁶ For financier Guillermo Canales, this secondary market is not yet structured in a proper platform: "As long as it is not settled (until someone goes and declares the CEC) it has a market value. It is an artificial market that arises to meet mitigation goals, but there is a lack of liquidity".⁶⁷ Since the ER, CECs and Long-Term Auctions were the main mechanisms to achieve a broader RE penetration in the Mexican industry. According to Keijser:

Both mechanisms anchored more than 7,000 MW of clean energy, which is equivalent to 7 billion dollars of investment. Officially, CECs started in 2018 but the truth is that secondary markets have already operated before. In the company where I was, we did private auctions for more than one million CECs. This is because there are no structured markets, both regulated and OTC. What we have is a lot of bilateral transactions, by phone, one to one. Ideally, the market needs an ICE Exchange-type of a platform to expand CECs".⁶⁸

Along with CECs, financial derivatives are the other instrument that has had limited participation during the first stage of the WEM. These hedging mechanisms have become attractive since the price volatility introduced by the deregulation and liberalisation of the market and the slow implementation of FTRs. In terms of financial integration, markets participants must hedge their physical and financial operations in the multi-nodal energy system. Hedging becomes more relevant for RE markets, having a clearer financialisation integration. Alejandro Moreno said:

"From a financial perspective, it is important to know where the energy comes from, especially if it is renewable. I don't think there can be a disconnection between the contract and the underlying commodity. For example, in terms of non-storable renewable energy, it is crucial to match generation and demand according to season, time and location; financially it is important to model at what time and place those MW are going to be needed. The Mexican Derivatives Stock Exchange [MexDer] is planning an electricity future. But if the LMP is difficult to model, predict and stabilise, those derivatives will not help much because the risk exposure would be very high and the risk unmanageable".⁶⁹

The combination of complex electricity market regulations and complex financial derivatives rules would lead to higher volatility that would make profit or loss margins unmanageable. Under the theoretical model of the ER, the further growth of the WEM would lead to more liquidity, less volatility, and the maturity of financial hedging services over LMP. In the meantime, trading and brokerage services have found their way to establish financial practices to incentivise the financialisation of renewable-based electricity. These practices have relied in bilateral contracts and secondary OTC markets. As Keijser concluded:

"I have traded bilateral swaps with several generators. I tell them: I buy this price for this week but for differences, it was not a physical product. It is about nodal differences between regions. This operation is on the average LMP in a week. I have also participated in hedging trades without having any clients, it is just an operation to go against the market. In the short term, the financial instruments that will be most attractive are call options on the LMP: you pay a premium and you have an option on the LMP. In the long term, the objective is for new participants to enter, not only traders but also brokers who are looking to intermediate so that there is greater liquidity".⁷⁰

⁶⁶ Interview conducted in Mexico City on May 23, 2019.

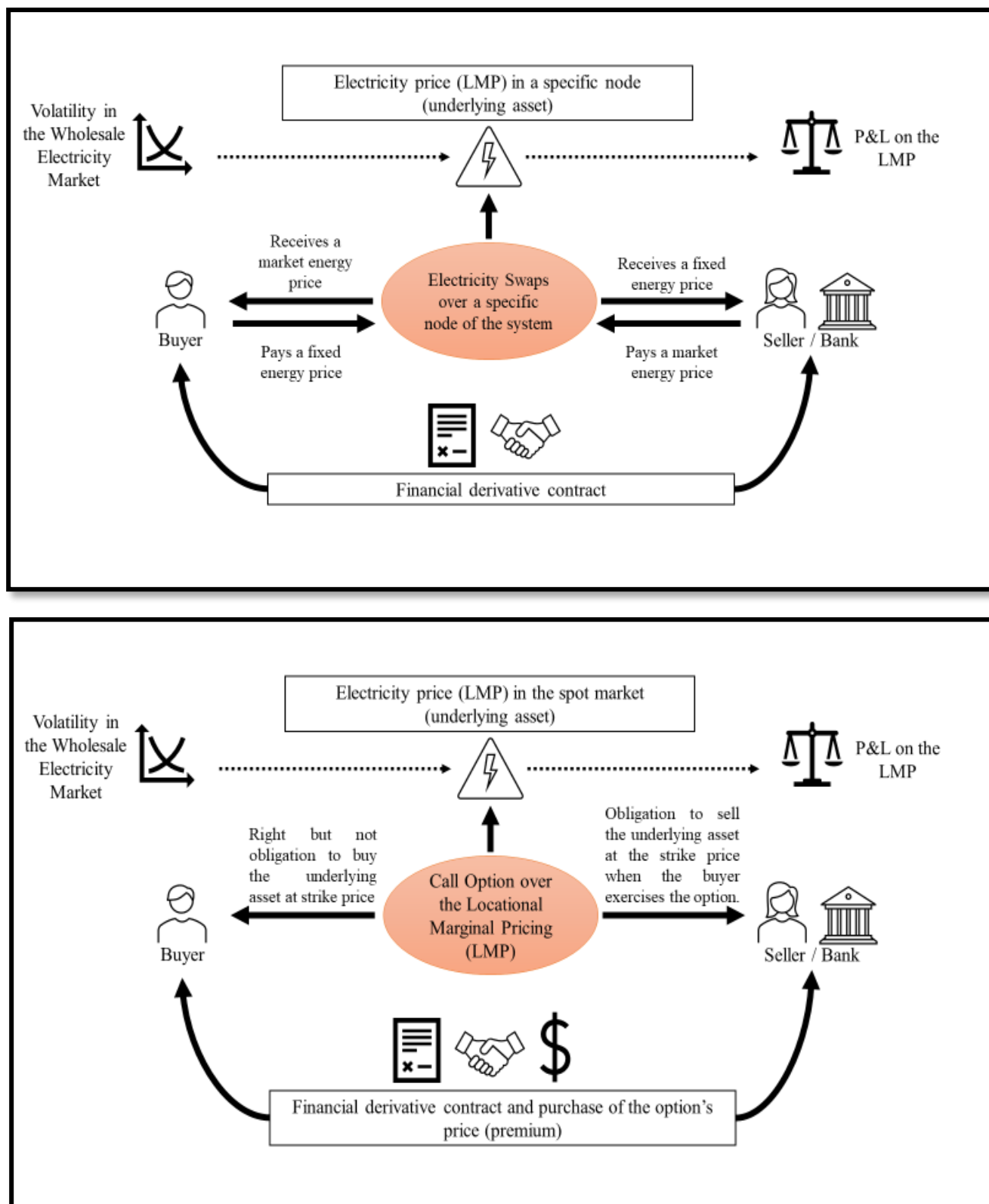
⁶⁷ Information retrieved at the *Mirec Week 2019 Energy Congress & Expo*, Mexico City, on May 22, 2019.

⁶⁸ Interview conducted in Mexico City on March 1, 2019.

⁶⁹ Interview conducted in Mexico City on March 25, 2019.

⁷⁰ Interview conducted in Mexico City on March 1, 2019.

Figure 5.3. Bilateral financial derivative contracts modelled for the wholesale electricity market in Mexico



Source: own elaboration, based on Bancomext-GIZ, 2019.

An additional element of energy brokerage is the current international energy assets funds and M&A transactions. As seen before, the financialisation critique lies in the fact that finance does not create new installed capacity but acquires the one already in place. Initially, the ER aligned Mexico to the recent wave of M&A in the renewables industry. For the financial sector, "the optimism generated by the structural reforms could lead to further company movements, especially in the energy and infrastructure sectors" (Cadena, 2014). More recently, González *et al.* (2018) stated:

Given the high amount of capital needed to implement these projects, many sponsors will seek to raise capital, which could result in a spark in the M&A and financing sectors in Mexico and all other cross-border jurisdictions with allocable capital. [...] This spurred the creation of publicly traded vehicles that are managed by a general partner and that serve as platforms to carry out investments in various sectors (CKDs), including private equity, infrastructure, renewable energy and real estate sector. The existence of the CKD market in Mexico has caused M&A transactions in various fields and sectors to take off, as pension funds put their cash to work, through fund managers, in acquisitions and similar investments (p. 329).

This brings a strategic element of financial planning since the interest is to acquire or absorb companies already in place that have a secure income from long-term contracts already signed with CFE (Sánchez-Devanny, 2014). Also, institutional investors and M&A transactions bring other elements of the unproductive nature of financialisation, like the fact of being intermediary investing pension funds to acquire assets already in place.

Overall, trading and brokerage actors denote the increasing financial separation-integration process in the electricity industry. While these markets have been disrupted in Mexico since the beginning of the current administration in 2019, the general trend of the ER model was to establish financial markets that support both physical and paper transactions linked to electricity flows and intermediation. In the case of Mexico, I consider this trend as exemplary since the ET represented a transition from a State-centralised model with little or marginal financial participation into a broader financialisation scheme.

5.2. Financialised macroeconomics and the negation of energy transitions

During the last 30 years, critical economists in Mexico have studied (and denounced) the dominance of a financial macroeconomic framework that favours financial interests while limiting and even undermining production and employment growth (see Franco, 2006; Huerta, 2009; Lichtensztejn, 2010; Levy, 2013; Levy & López, 2013). Although the literature has not always referred to this as "financialisation", the critique of orthodox monetarist policies and financial markets efficiency theories have pointed to the uneven relation between financial expansion and the endogenous limits to achieve large-scale technological development and national industrialisation projects (Guillén, 1990; 2006). Mexico is certainly at a disadvantage in initiating an ET because of the current macroeconomic conditions of privatisation, deindustrialisation, foreign ownership and financialisation. Following Álvarez-Béjar (2018), the double energy transition that México requires faces the burden of accumulated structural reforms in the energy and financial sector. Briefly, some of the financial phenomena hindering an ET in Mexico are:

- *Restrictive monetary policy.* Financialised macroeconomics has the objective of controlling inflation and maintaining exchange rate stability (Levy, 2013). But by controlling wage/prices inflation the financial sector promotes debt and financial asset inflation. This

prevents long-term productive investment since there is no viable access to cheap credit and debt deflation, leading to unemployment, idle capacity and income inequality. In the end, there is a lack of internal savings and increasing indebtedness (Mantey & Levy, 2007).

- *The dismantling of the State's activity and fiscal austerity policies.* Financialisation is a process based on the reduction of government deficit spending, privatising State companies and increasing taxes (Huerta, 2019). Austerity and privatisation leave space for venting idling liquidity in high profitability state-owned sectors. The State is forced to cut spending and issue debt to attract resources from the financial markets and sterilise the money supply. Overall, the financial pressures on the government lead to neglecting the investment required in the energy sector to achieve a comprehensive national energy policy (Álvarez-Béjar, 2018).
- *Liberalisation/deregulation of macroeconomic variables.* Foreign companies need a financialised macroeconomic environment that allows the free mobility of capital and the leveraging of interest rates, currencies, capital gains and capital flight (Guillén, 2006). The Mexican economy becomes a speculative enclave for short-term capital inflows and outflows. This also creates a dependence on external investment variables to replace the lack of endogenous capital (Huerta, 2009).
- *An underdeveloped financial system.* The main financial institutions in Mexico have a limited long-term impact on the industrial apparatus. Foreign banks in Mexico account for 80% of the sector, being predominantly stock market institutions focused on rentier practices (Ortiz-Palacios, 2009). For its part, the Mexican stock exchange has low marketability, with only around 35 active companies. Most of the financial activity in Mexico relies on bonds and other short-term securities. Together, these processes create a subordinated financialisation (Powell, 2013), or other concepts like underdeveloped or peripheral financialisation (see Álvarez-Herrero, 2019: 85-116, 180-279).
- *The "endogenous core" weakness.* Lastly, financialisation and deindustrialisation are linked to the absence of a local entrepreneurship class willing to articulate large-scale national industrialisation processes, subordinating themselves to the interests and agendas of foreign capital. (Fajnzylber, 1990; Fal & Oliveros, 2012). This refers to the lack of strategic national planning, including climate adaptation and energy transitions.

Addressing this question during fieldwork, former SENER official Edgar Villar commented,

"[There is] a lack of liquidity in the Mexican sector. Even national companies were not inclined to use their resources to start up renewable energy projects; they thought that everything would come from abroad and that the Mexican Government would provide the missing resources. Domestic weakness and the scarcity of projects led to the arrival of foreign capital, and it was they who began to monopolise the renewable generation market. The Reform had created conditions that were well received by foreign capital, but local companies faced financial and human resources limitations. Thus, the latter ended up being associates of the former".⁷¹

For CFE engineer Emmanuel Gómez, local energy companies are missing financial strategies to capitalise on innovative investment instruments and dynamic green markets:

"Foreign companies have a greater risk appetite and their target return is below 7%. Local companies generally have low-risk exposure and return expectations above 30%. They need to enter more sophisticated

⁷¹ Interview conducted online on March 8, 2021.

financial markets and obtain better financing instruments such as convertible debt or structured products. Domestic companies, including CFE, only use debt, and assume all the associated risks".⁷²

As Álvarez-Béjar (2018) argues, socioecological transitions in Mexico must change the economic model implemented over the last 40 years, searching to democratise economic policies and finance in the face of predatory financial burdens and the impact of climate change processes. This is a pertinent reflection to explain why and how the current transition is a product of financialisation and is shaped by the financial environment that only allows the development of a mainstream model of energy change. Such a proposal is a key issue in works like Reyes (2020), suggesting a radical reset of finance to become a broader and inclusive force that allows the adaptation and mitigation of all political, economic and socioecological expressions. In the case of Mexico, the re-appropriation of finance (a topic briefly explored in chapter 2 and discussed in the conclusions) is a way of reimagining energy geography futures and the productive economy.

5.3. The role of CFE: the rent-extraction debate

In this final part of the chapter, I will address the rent-extraction mechanisms of financialisation. The gradual opening process of the Mexican electricity sector and its impact on the State-owned utility CFE is a long-standing debate within the literature since the nationalisation of the company in 1960. Some recent works on the history of the public utility are CFE, 2012; González-Quñones, 2015; Global Energy, 2018. Another brief history of the electricity sector in Mexico during the 20th century was recapped by Breceda, 2000. A more critical and comprehensive compilation of the privatisation and liberalisation processes of the Mexican petro-electricity sector can be found in Saxe-Fernández, 2009; Martí & Uharte, 2018. A brief rundown on the implication of previous electricity reforms for CFE is explained by Wood & Martin, 2018.

As I analysed in chapter 2, the "rent-extraction" concept is one of the key discussion points in the financialisation debate and the overall political economy of finance. The literature previously reviewed states that the expansion of finance into the renewable energy and environmental frontiers has an appropriation and rent-extractive logic in order to incorporate natural resources and spaces through the mechanisms of interests, dividends, amortisations, and subsidies.

If we were to apply this concept to the first stage of the deregulated Mexican electricity sector, it would have to be to the role of CFE in the ET investment roadmap. Previously (Álvarez-Herrero, 2019), I referred to financialisation as an unintelligible concept in the Latin American context if it is separated from the processes of privatisation, liberalisation, deindustrialisation, reprimarisation, foreignisation and maximum extraction of natural and monetary resources. CFE is a relevant case study to analyse the current CF initiatives that denote how the current ET in Mexico is not a transition from fossil fuels to renewables but from public to private. As Lohmann & Hilyard (2014) argued, the overaccumulation crisis in the industrial economy made energy finance the vector to open the "infrastructure space" to divert public money into private hands. "Private-public partnerships are on the rise everywhere, together with new financial products, tax breaks, 'pension grabs', government gifts of land, and

⁷² Interview conducted in Mexico City on June 11, 2019.

other mechanisms aimed at guaranteeing private investors' 'right to profit' at the same time that austerity measures eat into the livelihood security of the less well-off" (p. 22).

In this section, I will expose some of the rent-extraction mechanisms on CFE, materialised with the EF and denounced since the arrival of the AMLO administration in 2018. To nuance this debate, I will include the financial perspective that challenges the nationalist discourse.

5.3.1. CFE through the Energy Reform

The ER stated that CFE had transitioned from a "natural State monopoly" into a "State-owned Productive Company with a business model structure; its purpose is to create economic value and increase the nation's income, with a sense of social and environmental responsibility" (SENER, n/d: 17). To adapt to this new situation, CFE had to move from a vertically integrated State-owned company to multiple unconnected business models, with budgetary autonomy and a board of directors. According to Vargas (2015), the objective was to neutralise CFE as a "natural monopoly" and transform its operation into a private business model under the label "State-owned productive company". This "unbundling" came in the "Terms for Strict Legal Separation of CFE" (SENER, 2016), based on the vertical separation between generation, transmission, distribution, and commercialisation; and the horizontal dismantling of several electricity generation units in competition with each other. Additionally, a policy of "Chinese walls" was enforced to procure the geographical and administrative dispersion of CFE assets and avoid information exchange, institutional coordination, intra-firm contracts, marketing strategies and financial integration between subsidiaries (Hernández-Ochoa, 2016). Finally, the Mexican Electricity System was "disincorporated" from CFE (while still retaining ownership) and handed over to a new autonomous and neutral operating agency: CENACE.⁷³

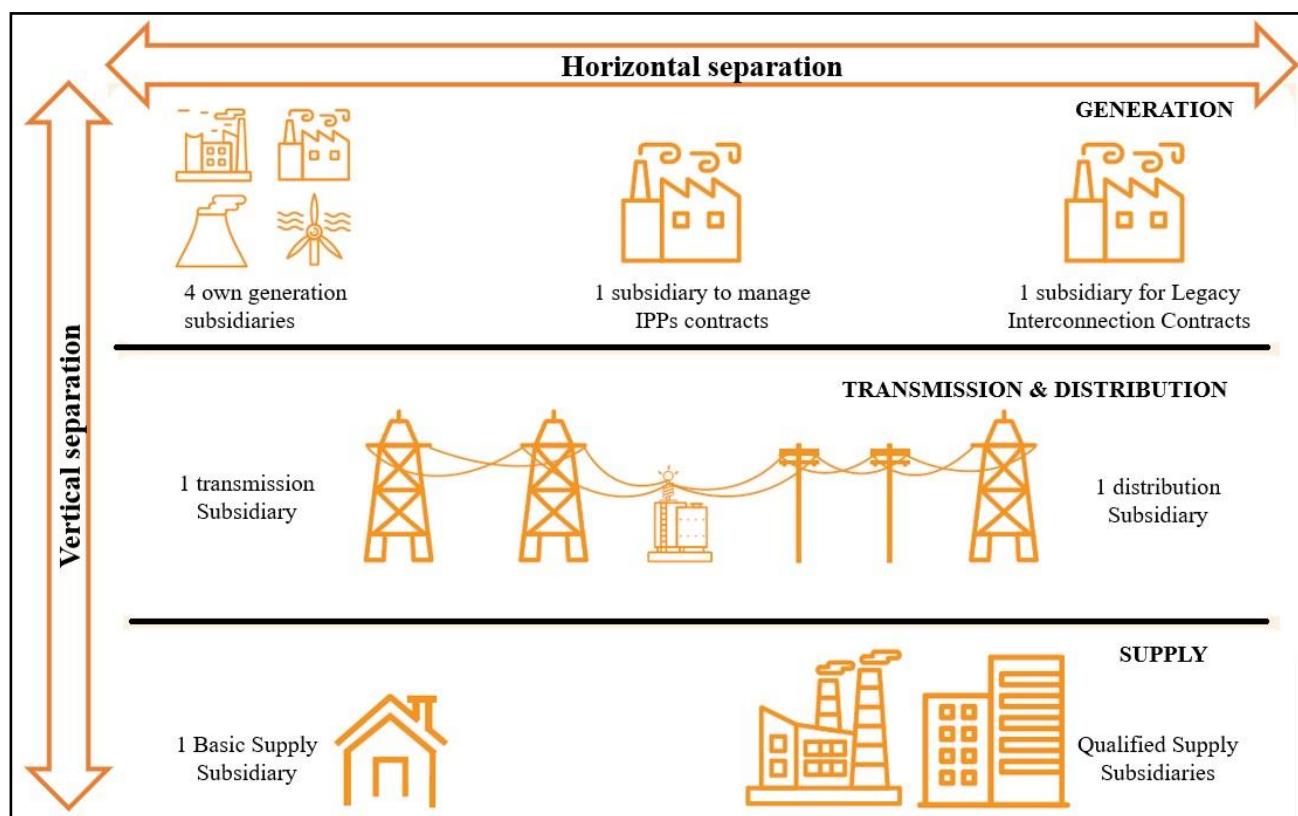
From a strategic-financial standpoint, two trends completed this process: "First, to separate the potentially competitive functions of generation and retail from the natural monopoly functions of transmission and distribution. Second, to establish a wholesale electricity market and a retail electricity market. Ideally, a wholesale market should have a sound free-market base such as competitive supply offers, demand bids and prices set by market-clearance" (Dias & Ramos, 2014: 218). In the end, CFE was neutralised to transition from a vertically integrated parastatal "into a corporate group of several companies able to act nimbly and independently in the various segments of the industry but limited in its ability to negatively affect the competition processes in the new electricity market" (Hernández-Ochoa, 2018: 29-30).

According to Dyer (2018: 224), the new CFE model aimed to:

- Force State energy companies to follow private firms' transparency and efficiency principles by eliminating all political leverage over them.
- Create regulatory agencies to assure that market rules are correctly implemented.
- Allow State energy companies to go public, listing them on the Mexican stock exchange.
- Transform CFE from an electricity company to a comprehensive energy holding with several subsidiaries.

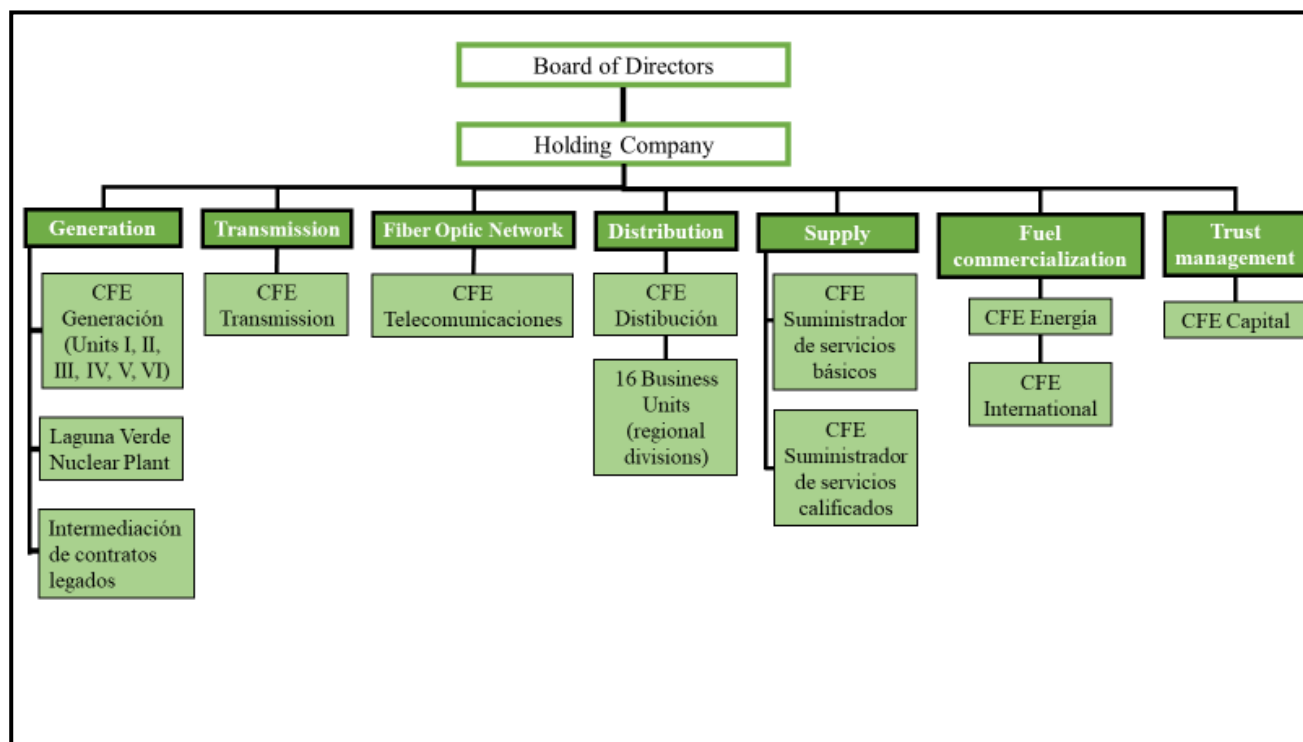
⁷³ See appendix 1.

Figure 5.4. Horizontal and vertical CFE legal separations



Source: SENER, 2016a: 22.

Figure 5.5. CFE Corporate Structure after the Energy Reform



Source: own elaboration based on CFE, 2020: 79.

Nonetheless, the new rules encountered a series of contradictions by creating a selective public-privatised scheme: *a)* CFE is another neutral competitor in the market albeit one that retains the ownership of the national grid (used by the rest of the market players); *b)* CFE is just another market player interested in business and profits, leaving aside the guiding elements of public interest and strategic planning of the system; *c)* CFE must compete unbundled in the market with local companies and vertically-integrated foreign conglomerates, but is relegated to the less profitable segments of the market and use old generation technologies because of operational and financial constraints; and *d)* the independent system operator (CENACE) must supervise to avoid market manipulation but foreign monopoly conglomerates can technologically and financially dominate the market. Energy researcher Luca Ferrari (2021) stated:

[The ER] drove the massive installation of natural gas combined cycle power plants, and solar and wind farms by private local and foreign companies. The gas plants are more efficient, and renewables have a lower cost because the "fuel" is free. Therefore, these plants have priority in dispatch and are financially profitable, in addition to being better received because they are considered "clean". In this system, CFE is left in a disadvantaged position because it must compete with private parties, using less efficient and dirtier plants –thermoelectric plants based on fuel oil and coal–, and also because its renewable plants –hydroelectric and geothermal– cannot be considered within the Clean Energy Certificates market. In addition to competing at a disadvantage, CFE must bear costs that private companies do not have, such as ensuring the stability, continuity, and quality of the electric service; that is, supplying the power and frequency variability of solar and wind power plants, the maintenance and expansion of the national transmission grid, as well as providing natural gas at a preferential price to the combined cycle plants built by private companies. Additionally, the reform perpetuated CFE to progressively keep the less profitable part of the market, the small commercial and residential users –about 80% but representing only 30% of the revenues–, while the large users and more profitable consumers –approximately 1% who, nevertheless, bill 65%– were left free to exchange electricity among themselves.

Part of the problem lies in the integration of two different schemes that are placed one on top of the other, a wholesale market over a State-owned industrial system. Applying a WEM model designed and advised from abroad to a State-owned industry leads to a hybrid scheme where the public-private frontier certainly becomes blurred. On another occasion, I discussed with Prof. Ferrari more details of this situation. His diagnosis was:

"In addition to the purchase of energy, the State is charged with some external costs. We must recognise that the prices of the long-term auctions were very low, especially solar and wind. But the hidden costs in intermittency are significant. CFE must support the system with thermoelectric and combined cycle plants of high cost and wear. The construction of transmission lines extended where the new private projects are is a cost that CFE absorbs. Let's say it is an attractive model because you can make a high investment at the beginning, but then you sit back and charge CFE for 25 years, without worrying about the stability and planning of the system. On the other hand, the Wholesale Electricity Market is designed to earn as much as possible. This system of 2,500 nodes where the local marginal price is calculated every moment, even presents itself for speculation. This is roughly why the market in Mexico is a paradise for investors. We must also add the corruption of the Peña Nieto administration, reflected in the series of contracts that were extended to large energy companies".⁷⁴

As seen in chapter 4, the political sociology of the ER allowed local politicians and the business class to prepare the ground to later enter with their own companies to play the game under the rules they had carefully prepared in advance.

⁷⁴ Interview conducted online on September 9, 2020.

I will part from this critique for the rent-extraction analysis, based on the information disclosed since 2019 by the AMLO administration and the new CFE nationalist directors. These rent-extracting mechanisms are as follows.

5.3.2. Short-term market and long-term auctions

In the 2020-2021 legislative proposal to reverse some of the main elements of the ER, CFE denounced that the WEM model created a "simulated market that aims to favour private economic groups in detriment of CFE" (CFE, 2021: 5). In this uneven competition, private parties can carry out all types of transactions: intra-firm trading, bilateral hedging contracts, simulated transactions, and access subsidised energy prices. Private companies can even trade and securitise CECs like any other instrument in the stock exchange. However, "CFE cannot freely perform intra-firm transactions, its energy is not accepted as clean to obtain CECs, and it is forced to buy energy from private players in the spot market and auctions" (p. 17). This issue became a central controversy addressed by CFE's general director at a presidential press conference:

CFE has a contract with one of its subsidiaries, *CFE Suministro Básico*, to supply the market of 45 million Mexican households. Although CFE has its own generation plants, it cannot compete in bidding variable costs in the economic dispatch of the Wholesale Market, because private companies have the advantage of reducing costs. In order to meet the supply with *Suministro Básico*, *CFE Generación* must purchase energy from private companies at a high price. Therefore, since it is not dispatched, CFE does not obtain income, is forced to buy energy from the private sector and must also provide maintenance to its plants. The energy that is not dispatched equals 45% of *CFE Generación*. This represents a loss of 215 billion MXN, plus the 222 billion lost due to electricity purchases from private companies. The other modality is the long-term auctions, where renewables have been more prominent. This is another way for the CFE to buy energy from the private sector in contracts last up to 25 years. Private generators date back to NAFTA and were a concession to allow foreign companies to install and sell energy to CFE in Mexican territory, the so-called Independent Power Producers. These private generators were introduced against the Mexican Constitution. The 25-year contract with CFE allows private players to recover the investment made to build the plants in Mexico. Very low-risk investments since the government is the safe buyer for 25 years. Basically, the CFE is paying for these plants, which later become competitors of CFE. In the entire model, there is not a single contract that is not detrimental to CFE. Under this scheme, 34 IPPs have been built, which produce 40% of the energy produced by the CFE, replacing the state-owned company. CFE is obliged by contract to pay 100% of the energy even if these generators only deliver 70% due to intermittency or other factors (AMLO, 2021).

Both options are profitable for RE projects since the economic dispatch takes solar and wind as first supplies for the short-term market, and the ER also forced the State to buy these sources in long-term auctions to promote their development. Moving away from the free market discourses, investing in RE in Mexico became financially attractive since the Mexican State acts as a low risk "buyer of first resort". From a financial perspective, this is an advantageous scheme to access financing to build solar and wind projects, being able to repay financial costs and have profits. Energy project manager Carlos A. Villanueva commented:

"Having a company like CFE changes the way of financing projects. Since energy projects require high capital outlays, cutting-edge technology hubs and long maturity times, the opportunity to sell the energy to CFE through long-term PPAs or auctions is priceless. Selling electricity to the government for 15 or 20 years means easier and less risky financial schemes. You can have access to more sophisticated financial vehicles like SPVs, convertible loans, or syndicated loans. I participated in the due diligence for a syndicated loan where the final clean energy user was Mexico City's government. For the banks it was a huge guarantee

that the main stakeholder is the State, you know the State never fails to get electricity for the population. In a country like Mexico, private bilateral PPAs are riskier and take longer periods to maintain the plants and repay any financing used to build them. However, I would add that many local companies do not even manage to materialise projects. Statal and municipal governments have little idea how to implement renewables. They usually pay for feasibility and viability studies to integrate renewables into public infrastructure, but many of these projects turn out to be unprofitable in the end. There are local energy and environmental consulting firms that earn a lot from these government contracts, they do the studies but, in the end, there is no project development".⁷⁵

According to Rodríguez (2019), there are currently "31 power plants, with a generation capacity of 14,104 MW, which has guaranteed the sale of electricity to the CFE for 25 years". In turn, CFE stopped building power plants. And moreover, in the event of any fortuitous event or force majeure that prevents one of these IPP plants from generating electricity, it can be excused and still have income. For their part, the Business Coordinating Council (CCE) proposed to the Mexican Chamber of Deputies that CFE should remain only in the areas where it is profitable: transmission, distribution and basic supply, while private companies can be in charge of electricity generation, concluding that CFE should only dedicate to buy electricity from private parties (Méndez, 2021a). On the financial side, A. Keijser stated that these arguments have a false starting point:

"The current CFE administration statements are mostly false. You have CFE generation and then the generation contracted to private parties, the so-called IPPs, which is 12,000 MW and in accounting terms this generation belongs to CFE, it is the cheapest generation and CFE earns a lot from it. The problem is that the new administration does not want to understand the potential of the market model. The economic dispatch is based on variable costs. CFE has been carrying out economic dispatches since the 70s. You dispatch energy with the lowest variable cost because it is cheaper, that is the main goal. Whether you have a marginalist system or an average price system, the cost of fuels is lower when you dispatch the cheapest first. Then, CFE argues about the total costs and depreciation of its plants, but CFE is destroying value in the system by prioritising its plants with higher fixed and variable costs. By destroying value and breaking contracts with private parties, the rule of law is being overturned. This is not the way it works. The AFORES pension funds are involved in this, they financed a large part of the projects for long-term auctions, and now the Government will let this go by default? It's ridiculous".⁷⁶

This debate opened other controversies over whether such a public-to-private transfer exists. Here we can include the creation of parallel electricity and financial markets mounted on the national grid under the self-supply scheme.

5.3.2.1. Self-supply corporate societies

In Mexico, the figure of electricity self-supply was created in 1992 so that large companies could generate and supply energy to their subsidiaries or other geographically decentralised productive processes. It emerged as an alternative for industries using the IPP figure to have an electricity supply other than CFE but still using the low-cost CFE transmission grid to move electricity around the national territory. This modality became more prominent since the ER, being a predilect way of generating and supplying energy for large corporations. Self-supply

⁷⁵ Interview conducted in Baja California, Mexico, on May 5, 2019.

⁷⁶ Interview conducted online on October 28, 2021.

societies raised controversies on the use and profit from CFE's transmission lines, considered a subsidy for companies that do not pay proper fees for using the national grid. This is a case of the crucial role of infrastructure for the ET roadmaps.

During 2019-2020, the nationalist CFE administration denounced the parasitic scheme used by large corporations based on the legal and commercial advantages of self-supply societies. Morales Vielmas said at a press conference:

The figure of self-supply was born for companies to generate and supply electricity to their activities. But to send this energy to their subsidiaries in other parts of the country, they need to use CFE's transmission grid. This scheme benefits from the fact that private companies can generate energy at a lower cost and thus avoid buying more expensive energy generated by CFE. However, they still require using the transmission network and porting service. The original figure of self-supply began to be distorted into simulated partnerships. These societies are integrated by shares that are worth one peso or one dollar, with that you become a partner and automatically comply with the supposed conditions of self-supply. Then, companies become 1-dollar shareholders that should not have energy transactions between them if they are partners, but in the end, they are carrying on electricity exchange transactions which should not happen if you are self-supplying. Previously, these partnerships consisted of 5, 10 or 15 partners. Nowadays there are companies with 10,500 partners, which is irregular from a commercial standpoint. CFE is harmed since this artificial and inequitable market is created parallel to the Wholesale Market, but it still uses the transmission network at no cost. It is an electricity black market. What CFE seeks is not to eliminate the figure, since it is legally complicated, but it does seek that CFE is paid the transmission loss, which amounts to 7,800 million MXN in 2018 and almost 7 billion in 2019 (CFE, 2020a).

This rent-extraction scheme through subsidies was again addressed by CFE's General Director Manuel Bartlett in the presidential press conference:

A generator such as Iberdrola or ENEL generates energy and pretends to have multiple partners, false partners of course, because having preserved the privilege of the previous electricity law of 1992, now repealed, they do not pay the use of the transmission grid. Currently, there are 223 self-supply power plants, with 75,656 partners-customers taken away from the CFE. The largest companies in Mexico with high rates of energy consumption are embedded in this mechanism and it is convenient for them not to pay transmission rights. This is a fraud against the Mexican law (AMLO, 2021).

For Villegas (2021), self-supply societies have a financial component that is used as a shadow market, not only competing with CFE for the best customers on the physical electricity side (both industrial and residential) but also in the financial one. This market

emerged linked to debt issues through private trusts to obtain additional resources and yields from electricity generation projects. Thus, the recovery of the investment in energy generation projects for private players who obtain more attractive electricity tariffs is not only achieved with savings from the self-supply scheme, but financial benefits are also obtained for their investors through the stock market by selling electricity to third parties under the scheme of "partners", as in the case of the Oxxo chain stores of Grupo Femsa or Walmart. The so-called electricity self-supply companies also compete with CFE for the resources of the debt market, where the State company also participates with its own bonds.

The ER argued that CFE was an anachronic and bureaucratic monopoly that needed a modernisation program of its financial structure. From there that one of the financialisation symptoms in the Mexican energy industry is to deliberately provoke an operative-financial crisis in the State companies, turning to the debt markets to issue bonds and restore revenues (see Álvarez-Herrero, 2019: 85-116). Due to the lack of internal resources, this chronic corporate indebtedness of CFE is based on short- and long-term liabilities issued in the

domestic and international debt markets to fund its activities.⁷⁷ However, the resources raised from the last bond issues in 2020 and 2021 have only been used to refinance debt and cover financial liabilities (Forbes, 2021). For Linares (2021), CFE's financial constraints stem from the rent-extracting interest of foreign private companies operating in the Mexican industry:

The currently reported loss of 27 billion MXN is not due to the new administration. This problem comes from the deformations caused by both the 2014 Reform and the abuses of self-supply by many companies. CFE's deficit is related to private evasion in transmission payments, which has reached 22 billion MXN in the last three years, absorbing losses of almost 7 billion MXN per year on average.

From a financialisation perspective, CFE could benefit from monopoly rent linked to the transmission and distribution infrastructure embedded in the Mexican territory. Nonetheless, the ER precisely procured the neutralisation of this State mandate, reducing CFE as mere owner and intermediary that needs to guarantee the reproduction of private interests. So, in a strict sense, private companies simulated monopoly rent benefits linked to this parallel market that uses CFE infrastructure to trade electricity at no cost, but delegating system operation, maintenance and stability to the State. This monopoly rent is one of the main objectives of privatisation, granting rent-yielding based on a former State activity (see Huerta, 2009; Hudson, 2015).

To have a full picture of the self-supply societies, I questioned Keijser, who stated:

*"The answer is no. There is no rent extraction to CFE in the self-supply, which has been going on since 1992 and accelerated since the 2000s. The Government says they are simulated but the Court already ruled that they are legal. The CFE charges a transmission fee called willing. This is done by a methodology of distances between generators and interconnection points, but the truth is that the transmission tariff is in the CFE's favour. However, in 2010-2011, the law to promote clean energy sought to expand solar and wind generation. At that time, the levelized cost of generating these technologies exceeded 150 dollars, today it is 30 dollars. Incentives were required, which is why the so-called postage stamp pricing was established, which costs 3 cents for high voltage and 8 cents for medium voltage. And yes, this postage stamp pricing is cheaper than the regular tariff of 18 cents in high voltage and about 40 in medium. But these are assets that were installed before 2010 and represent 2% of the national consumption. I tell you this because I was the one who led the structuring of transmission and distribution tariffs that are applied today in the market, I know the cost structure. CFE does not lose money, it stops earning, but it does not lose. So, bottom line, no rent is extracted from CFE. Transmission and distribution tariffs alone are a surplus, they have rates in dollars above 10% on a regulated business, who gives you that?"*⁷⁸

According to Keijser, this debate is founded in a State ideology vs. technical arguments, where the new administration is following a nationalistic line but ignoring key financial and technical market elements. Such a confrontation is present in other key issues of the rent-extraction debate I will now analyse.

5.3.2.2. Intermittency backup and Clean Energy Certificates

The State also subsidises its private competitors in the WEM through the intermittency backup that CFE supplies as a line base for solar and wind generation (CFE, 2021). The State company

⁷⁷ A complete CFE's stock market listing during the past 10 years can be found in its investor relations portal, available online in: <https://www.cfe.mx/finanzas/financiamiento/pages/emision-de-la-deuda.aspx>.

⁷⁸ Interview conducted online on October 28, 2021.

has an installed capacity of three main clean sources: hydropower, geothermal and nuclear.⁷⁹ But the new Electricity Law does not consider these sources "clean" because they were installed before the ER and are not subjected to CECs (p. 16). This situation opened a controversy in the Mexican Senate on October 27, 2020, during the Energy Commission hearing. That day, the General Director of CFE, Manuel Bartlett, addressed this conflict between private solar/wind vs. State-owned renewables:

When there is no sun or wind, there is no electricity, so the CFE must, by mandate of the Reform, use its plants immediately so that there is no interruption in the electricity supply. This backup has a high cost for CFE plants, and the private sector does not pay for this support. So, it is false that renewable energy is cheap. The Reform established that the economic dispatch should supply clean and cheap electricity first since wind and solar do not have the variable cost of fuel. By bidding their variable costs, renewables have the advantage and benefit of relying on free fuel and being dispatched first: the sun and the wind. However, the State's renewable energy par excellence, hydropower, does not represent a renewable source for the ER. Then, the State's clean energy is not dispatched since hydroelectric power only serves to ensure the backup of solar and wind intermittency. This backup is a subsidy since the CFE is not paid for the installed backup capacity. In the end, is not a policy of good renewables against bad fossil fuels, is private against the public interest. [...] Despite this, we are not against private investment in renewables, what we are against is that the CFE should carry the private sector on its shoulders. We want a private initiative that contributes, not one that comes to plunder through uneven contracts (CFE, 2021b).

The solar and wind generation that private companies trade in the WEM comes with CECs that suppliers must acquire at variable market prices. Thus, CFE's supply division (*Suministro Básico*) must certify that the energy bought to private players comes from renewable sources by buying these CECs. CFE's Director referred again to this policy as an uneven extractive mechanism, stating that *CFE Suministro Básico* must subsidise its competitors through CECs even though the State company produces 55% of the country's renewable energy. In the end, "it is a double subsidy for CFE competitors which do not pay for transmission and backup: the purchase of energy through auctions and the payment of CECs" (AMLO, 2021). Former SENER official Edgar Villar complemented this debate:

"The cost of supporting private intermittency is very high, both for CFE and the public budget. The missing piece would be an official requirement forcing private parties that generate with sun and wind to guarantee 24 hours of energy injection into the grid. How they do it is their problem. If the private company does not have the energy at the time and place required due to intermittency, it must buy it or install storage systems to offer it when is needed. That would be a levelized market floor. But this is one side of the picture. You must also recognise that CFE is outdated in more sophisticated technologies and was intentionally left to compete without tools. Therefore, it is impossible to leave the sector to the free market, no country does this, and planning is a key strategic point".

Yet the financial side of the debate criticised these statements, confronting the current CFE nationalist perspective that is trying to reverse part of the ER with the technical arguments from private players in the WEM. In this regard, Keijser commented:

"I would say that this is a false debate. It is a fabricated problem. If CFE plants were to obtain CECs there would be a Certificates inflation. Mexico has the commitment to reduce emissions 22% by 2030 according to its baseline, establishing progressive obligations for renewable generation through new installed capacity. New CFE plants were given CECs. But why not give to all its old clean plants? The objective is to have a public policy instrument that would allow project developers to be able to pay their debt or equity ratio. So, if you

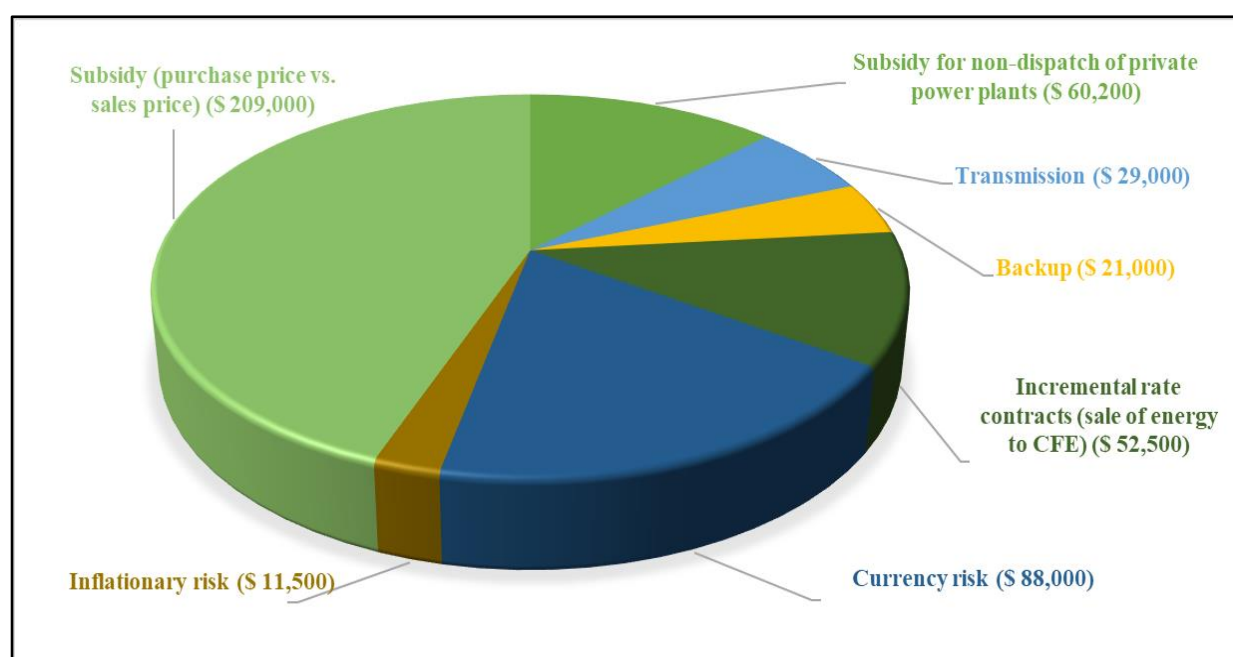
⁷⁹ See appendix 1 for more data.

give those 60 million CECs to CFE, you will just increase the requirement for CECs to the users. There cannot be a market in which there are more CECs than MWh in the system. One CEC is equivalent to 1 MWh. What can happen is that there are more CECs than what is needed as a mandatory requirement. For example, in 2024, instead of 35% there will be a 38% compliance. In that case, there may be regions that want more clean energy and cancel the certificates, or there will be those who bank them and postpone investments, i.e., you keep them and use them later because you can prove that you produced that clean energy a year earlier".

During the discussions on the 2020-2021 electricity counter-reform, CFE made a broader catalogue of the State subsidies that benefited private companies during the first stage of the ER. These subsidies encompass the transfers made from the State to the private sector, making a critique of the competitive market narrative and the supposed "death of the State monopoly" discourse. As CFE's Finance Director concluded, "there is no free competition in the electricity sector, but rather a monopoly of a very small group of companies", referring to the power granted to private companies through public subsidies (Méndez, 2021). One of the exemplary cases for the new administration is the Spanish company Iberdrola, which has received subsidies of 56.175 billion MXN; this amount is equivalent to 37% of the 150 billion MXN that the company has officially invested in Mexico as foreign direct investment (Alegría, 2021). From there that the new CFE administration denounces a plan to introduce and leverage the private sector through State support so that eventually there will be a private-structured market and CFE's participation will be reduced until its disappearance (see Canal 11, 2021).

Overall, the subsidies denounced by the new CFE administration can be understood within the broader financialisation process related to the constant transfer from public to private. For Lohmann & Hildyard (2014), subsidies are a renewed mechanism in terms of PPPs, pensions grabbing, public budgets absorption, and the private investments' "right to profit" in energy infrastructure programs.

Figure 5.6. Total CFE subsidies to private companies under the Energy Reform (\$471.2 billion MXN), 2020



Source: AMLO, 2021.

Table 5.8. CFE vs. private parties, market participation in electricity generation

Year	2017	2018	2019	2020	2024*	2029*
CFE	54%	52%	45%	39%	29.5%	16%
Private**	46%	48%	55%	61%	70.6%	84%

* Data projected.

** IPP schemes, self-supply companies, long-term auctions, and post-ER plants.

Source: Canal 11 (2021).

5.4. Financialised infrastructure

One last point I consider important is the role of finance in the expansion of electricity transmission infrastructure. As seen before, scholars like Grafe & Mieg (2019), Balmaceda *et al.* (2019), and O'Neill (2019) have analysed the centrality of infrastructure for spatial relations through the investment territorial embeddedness of energy assets. Following Lohmann & Hildyard (2014), "Big-E Energy-organised economic activity survives only because sufficient surplus can be directed to building, maintaining, refurbishing and expanding the infrastructure", transforming it into a "new asset class" (p. 69). In this section, I will recover some of these ideas to study the financialisation of the Mexican electricity infrastructure within the ET framework.

In 2018, the "Program for the Expansion and Modernisation of the National Transmission Grid" (CENACE, 2018a) details a regional strategy to invest in new electricity transmission lines.⁸⁰ The document states the needs and opportunities for the adaptation of the transmission grid to the ET, coupling its expansion with the regional integration of RE generation to address the problem of intermittency, congestion and the overall stability and reliability of the system. This strategy "will rely on the energy policy and the Energy Transition Law to encourage clean energy sources and meet climate targets, modernising of the national transmission grid, introducing smart grid technologies and improving operational flexibility" (p. 7).

As seen in appendix 1, transmission and distribution grids are segments of the industry that remain under CFE's ownership. Nonetheless, it is possible to argue that, under the deregulation scheme, transmission infrastructure is subjected to a simultaneous managed privatisation and financialisation process under a hybrid private-public model. Since the entry of private players in 1992, the transmission-distribution opened to investments through the so-called "Productive Infrastructure Investment Projects with Deferred Registration in Public Expenditure" (*Proyectos de Inversión de Infraestructura Productiva con Registro Diferido en el Gasto Público* or PIDIREGAS). Montes (2007) defines PIDIREGAS as "triangulations of public debt through the contracting of external credit for payment to the (also external) developers of energy infrastructure". In the electricity sector, these schemes "derived from the build-lease-transfer scheme, where the private contractor builds infrastructure, then rent it to the CFE, and at the end of its useful life, transfers it to the State". Montes argues that PIDIREGAS lead to an infrastructure securitisation based on the issuing of debt on the Mexican

⁸⁰ 2018 was the last year of the business-as-usual operation of the WEM.

stock exchange through commercial banks. With this, CFE has a "financial operator that obtains the credits in foreign currency, grants the loans to the State-owned company to pay private contractors and manages its revenues in national currency to pay bank and stock market obligations" (p. 62). PIDIREGAS survives to this day, being an off-balance mechanism that enables the State to contract private parties to develop energy infrastructure, transfer the ownership and operation of the asset to CFE and use its revenues to pay the private developer (CFE, 2020). PIDIREGAS are also mechanisms that have exposed CFE to financial derivative markets to hedge exchange rate and interest rate risks (pp. 54-55).

For the ET, transmission grid expansion is crucial to solve system constraints of electricity flows related to supply, intermittency and congestion. As energy project financier Pablo Partearroyo stated, transmission infrastructure remained under CFE's control because it is the most expensive and less profitable sector: "This win-win situation offers a good incentive for PPP schemes, private parties build, and the State operates and pays".⁸¹

The ER took further steps in the deregulation/liberalisation of electricity infrastructure. Article 30 of the new Electricity Industry Law states that the State "may associate with private parties so they can, on behalf of the Nation, carry out the financing, installation, maintenance, management, operation and expansion of the infrastructure necessary to provide the public service of transmission and distribution of electricity" (CENACE, 2018a). This allows private companies to expand, upgrade, finance or operate transmission projects and modernise distribution networks, whether for CFE or private independent self-supply. As Viscidi (2018) explained: "The Reform also allows private generators to independently build and operate transmission lines connected to the national grid instead of relying entirely on CFE for interconnection. This agreement lowers the barriers to the construction of new generation projects, particularly for renewable energy sources in remote locations, by attracting new technologies, financing, and expertise to expand and enhance the grid" (p. 164).

This is common practice in the privatisation programs introduced in Mexico by the World Bank since the 1990s. As Saxe-Fernández & Delgado (2005) documented, the conditioned loans and technical assistance induced the operational and financial bankruptcy of energy parastatals that limits public infrastructure development to then fill the gap with private contractors. The result is nominally State-owned companies but working as empty shells that only intermediate private contracts. From here we can identify the privatisation-financialisation nexus that transfers electricity infrastructure to the stock market, integrating physical and financial business lines under a single investment scheme.

5.4.1. The *Fibra-E* mechanism

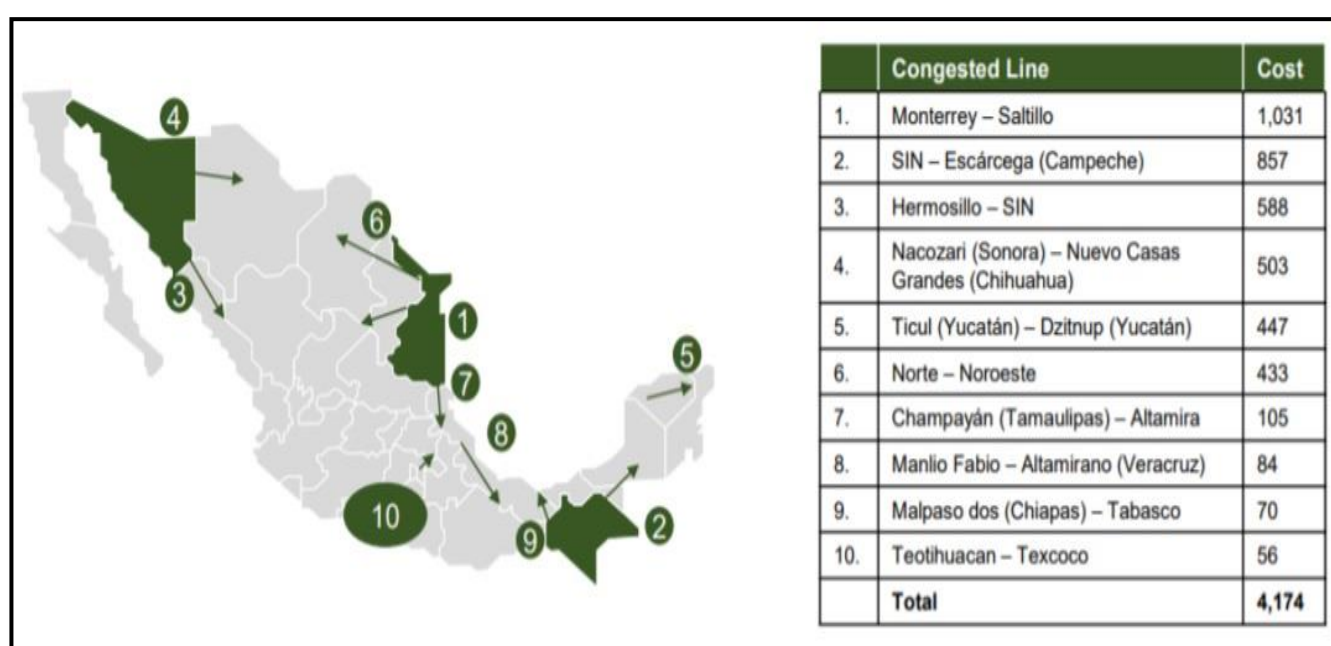
In terms of the financialisation of infrastructure, the ER put forward a financial mechanism for the securitisation of the high voltage transmission lines owned by CFE. Through one of its new subsidiaries (*CFE Capital*), the State company created an Energy and Infrastructure Investment Trust (*Fibra-E*) to issue stock certificates and access resources from a broader investor public to fund electricity transmission infrastructure. This follows a similar trend to the CFE debt issuance programs mentioned above: induce the long-standing draining of internal savings

⁸¹ Interview conducted online on August 19, 2020.

through privatisations, private subsidies, debt repayment, corruption and mismanagement, and then resorting to the financial markets for external funding.

The first public details of the *Fibra-E* mechanism were published in 2015 as an investment strategy against the decline of local oil production and the depreciation of the Mexican peso due to low international oil prices. This forced budget cuts in Pemex and CFE, reducing the Federal Government spending on infrastructure (Meza, 2015). Financially, this tool is derived from the traditional FIBRAS and Master Limited Partnerships (MLP). They are an alternative to government debt and serve to attract private financing for energy projects (Meza, 2015). For the Mexican State, *Fibra-E* became a strategy for modernising and expanding transmission lines and supporting the expansion of RE (solving intermittency, congestion and demand issues).

Map 5.1. Transmission congestion zones, 2019 (millions of MXN per MW/h)



Source: Solano-Pérez, 2019.

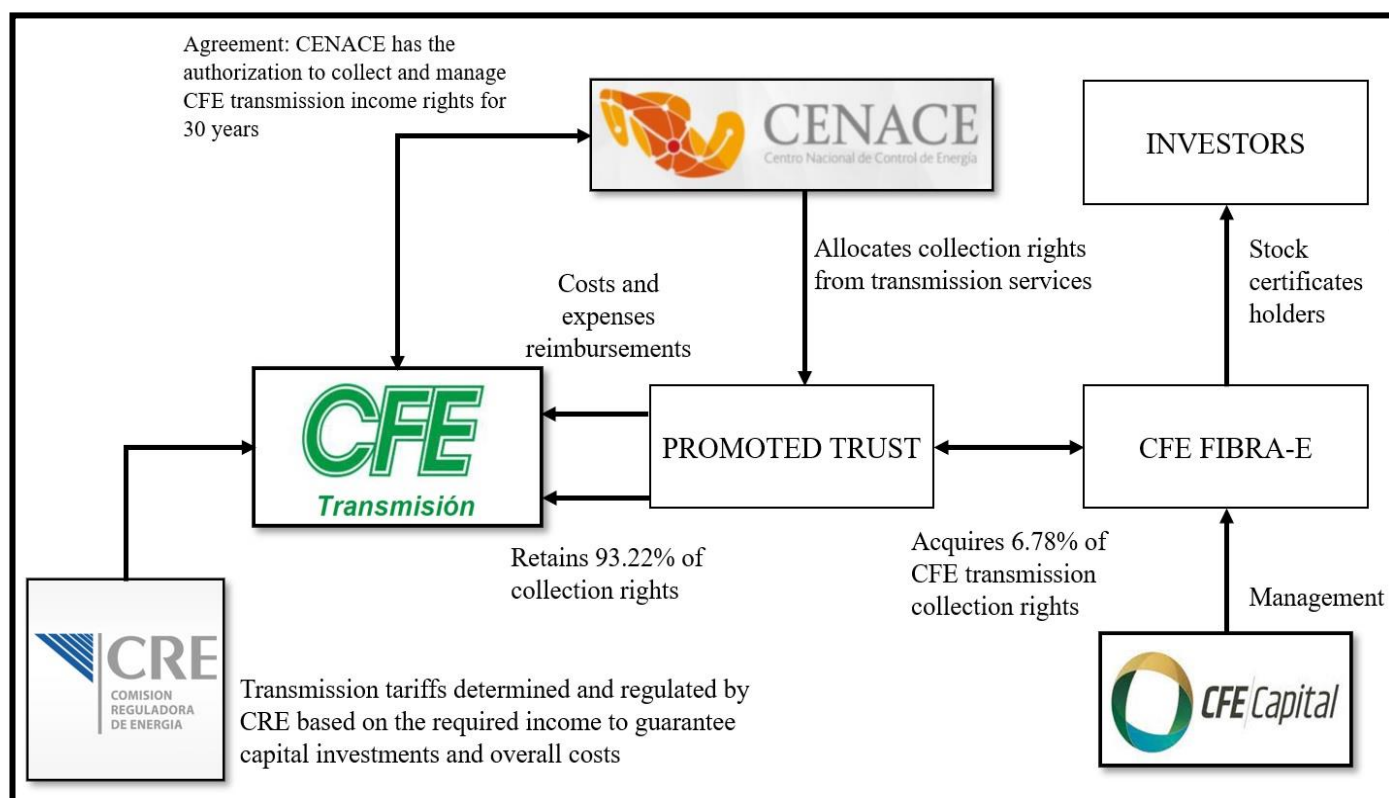
After CFE's "unbundling" policy, two subsidiaries oversee transmission infrastructure development: *CFE Transmisión* (created in 2016 to manage the national transmission grid) and *CFE Capital* (born in 2017 to create and manage trusts funds and financial vehicles to expand and modernise the national electricity system). Subsequently, in February 2018, CFE issued the "Fibra-E Energy and Infrastructure Investment Trust" with the objective of issuing stock certificates for energy infrastructure investment through the Mexican Stock Exchange and reaching a diverse universe of investors and energy portfolios.⁸²

Roughly, the *Fibra-E* mechanism consists of *CFE Transmisión* assigning the revenue collection rights to CENACE, which channels them to the Promoted Trust (owned by CFE). Transmission fees are regulated and determined by the CRE, based on an inflation-indexed

⁸² Several documents regarding *Fibra-E* can be found in the "investor relations" portal of *CFE Capital*, available online in: <http://cfecapital.com.mx/en/investor-relations/>.

calculation that becomes the transmission rights cash flow. Then, the Trust divides the beneficiary rights into two: 93.22% goes to *CFE Transmisión* for operation,⁸³ while the 6.78% of the rights is collected by *Fibra-E* and channelled to public investors and CFE shareholders. Under this scheme, CFE retains full control and ownership over the public electric transmission service and 100% market share of electricity transmission assets in Mexico.⁸⁴

Figure 5.7. *Fibra-E* institutional and operational structure



Source: own elaboration.

This complex scheme is a general trend in the financialisation of energy infrastructure. It is similar to the oil-backed securitisation structure applied to Pemex in order to put the Mexican oil revenues and infrastructure in the international financial circuits (see Álvarez-Herrero, 2019: 257-261). This follows the abstract circulation of fixed assets as finance is constantly incorporating sectors and new assets into international capital flows. While interviewing, energy financier Mr. P.B. summarised this idea:

"The importance of this type of instrument lies in the underlying asset. What Fibra-E does is to make liquid or provide liquidity to assets that are not originally liquid, in this case, because of government ownership. Also, transmission infrastructure represents long-term fixed assets, so it is attractive that they are already in place and generating revenues, thus you are monetising mature assets that have predictable and stable

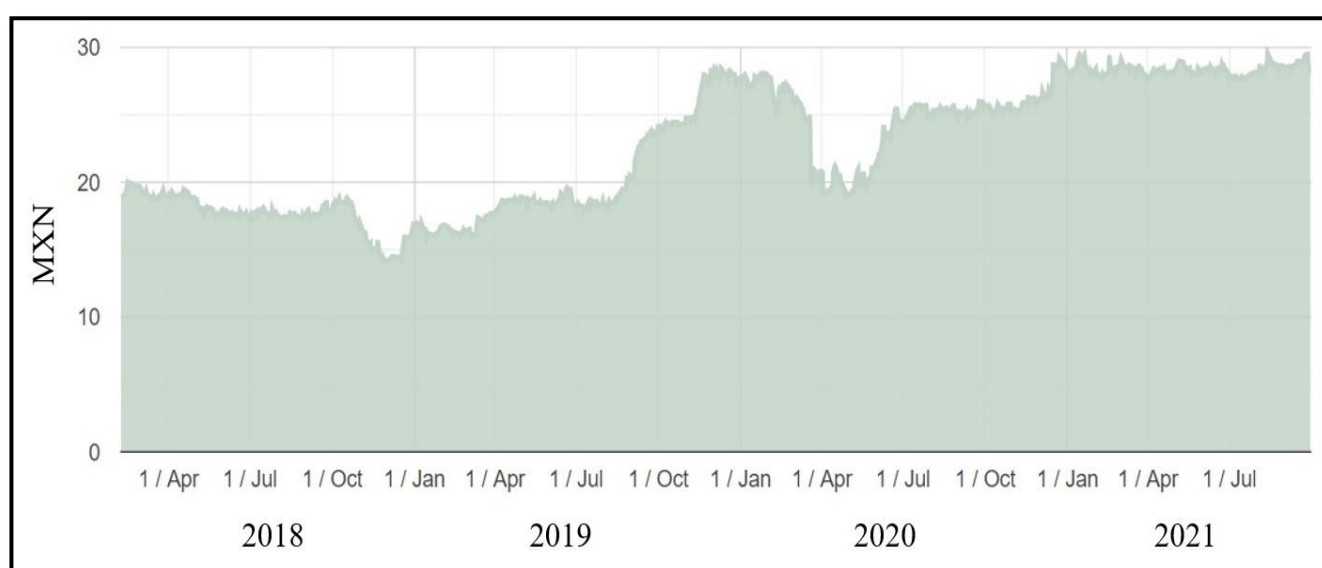
⁸³ CFE Transmisión's costs and expenses are mainly salaries, employee benefits, maintenance, materials, general services, duties, taxes, indemnities, and financing.

⁸⁴ More detailed information can be found in CFE Capital website and the investor relation reports of *Fibra-E*, available online in: <http://cfecapital.com.mx/>.

cash flows. CFE has the long-standing experience and market share to operate, maintain and expand transmission lines. This monopoly position can be capitalised and works under this scheme since the Promoted Trust will be the primary beneficiary of any increase in electricity transmission volumes or tariffs. Another advantage is that the government does not have any direct participation in controlling or regulating the Trust, maybe only on taxes issues. Therefore, we have high-quality long-term assets with attractive operating margins. A transmission asset has a long-term useful life, and its maintenance costs represent on average 1% of its value. On the other hand, we have cash flows. Then, as I see this instrument, the Trust receives stable and predictable high-quality cash flows derived from regulated tariffs, growth factors attractive tax regime, and governmental ownership".

Reports by commercial banks address the market growth opportunity in transmission infrastructure, especially from a regional perspective to manage RE intermittency and congestion risks. According to the bank Banorte (2020: 7), one incentive to invest in *Fibra-E* is the potential asset portfolio that would increase transmission infrastructure and revenues associated with it. For CENACE (2018a), this regional approach established a balanced geography between RE generation areas and consumption centres mediated by infrastructure expansion projects. Thus, this strategy has been one of the key elements of the ER, "anticipating the new infrastructure required to take advantage of clean energy resources" (Hernández-Ochoa, 2016: 48).

Figure 5.8. *Fibra-E* historic price



Source: CFE Capital, available online in: <http://cfecapital.com.mx/relacion-con-inversionistas/>.

In its annual report, CFE Capital (2020) lists the strategic and priority transmission projects under the *Fibra-E* modernisation and expansion objectives. These infrastructure plans are scheduled in the 2020-2034 National Electric System Program of the Mexican Federal Government. However, the Federal Superior Audit (ASF, 2020) found inconsistencies in the 2018 and 2019 financial statements, where the stipulated transmission projects have not been financed and the surpluses have been channelled mainly to the purchase of short-term liabilities of the Mexican Federal Government. Once again, I asked Keijser about this:

"Fibra-E is nothing more than expensive debt. With the volume and the sovereign guarantee that CFE has, there was no need to create this mechanism. The resources obtained were supposed to be used for transmission projects and were going to be funded with the recognised flows from the tariff. Nonetheless, Fibra-E was issued but the assets were never built; CFE is just paying for that fund. It is labelled money that paid a premium because it took the risk-tariff. But if you didn't use the resources to build the assets then it ends up being a useless mechanism. CFE can even go to other international debt markets, which is much cheaper than issuing Fibra-E. In short, it ends up being an untapped financial mechanism because they did not develop the transmission assets. Without the transmission asset base expansion, CFE's revenues are not growing so the cash flows cannot fulfil the mechanism".⁸⁵

Both securities used by CFE (bonds and *Fibra-E*) demonstrate a degree of financialised integration of the Mexican electricity infrastructure, both in the private participation on the transmission-distribution segment as well as the commodification-securitisation of electricity flows and transmission lines. This connects to one last argument on the current magnitude of the financial integration and interdependence achieved under the WEM deregulated model. Regarding the 2020-2021 electricity reform that is tiring to reverse privatisation trends of the ER, Keijser rounded off in his final comment:

"If the current electricity counter-reform gets through Congress, the first thing that would happen is a collapse of the financial sector, because a lot of the contracts are leveraged, so major clauses, covenants, etc., all of that is at risk. A lot of people are going to be angry: sovereign wealth funds in Canada, Europe, the US, etc. It is certainly a financial catastrophe, to the point of losing investment grade; you become a bottom-of-the-list country in terms of loss of investment confidence. Then you would create an operational mess. Tariffs will necessarily have to go up, because it is more expensive to produce with CFE plants. If they don't go up via bills, the State will absorb it from other public services. The taxpayer always pays. Finally, this initiative would cancel the energy transition because the government and CFE do not have the technical capacity to develop 5,000 MW of clean energy per year, it would take years. Any company that wants to set up a production process in Mexico and sees that there is no clean generation will end up leaving for another country precisely because of international climate treaties".

After this interview, I found information on how Mexico eroded its attractiveness for renewable energy investments since the new nationalistic CFE administration came into office in December 2018. As the Renewable Energy Country Attractiveness Index (RECAI) of EY stated, Mexico dropped from 13th to 19th position in the 2018-2019 period, then to the 25th in 2020, just to drop again to the 33rd in 2021 (EY, 2019a, 2021). Additionally, the Climate Transparency Report (2020) ranked Mexico as a "not-on-track" country in achieving the 1.5°C path for global emissions reductions, suggesting that Mexico should enhance Climate Finance mechanisms, reopen RE auctions cancelled since 2019, and redefine its Nationally Determined Contributions (NDB) to mitigate emissions.

From a financialisation critical perspective, *Fibra-E* is an example of how finance turns infrastructure into an asset that can be investable, tradable, and subject to rent extraction. As seen before, scholars like Purcell *et al.* (2020) addressed the importance of infrastructure as a circulation factor for natural resources, values, and capital, understanding how monopoly ownership of infrastructure enables financial actors and institutions to appropriate value in the form of rents. Hudson (2015) also analysed the role of finance inducing rent-yielding opportunities in natural resources and infrastructure monopolies through privatisation schemes. Moraes & Messias da Costa (1984: 114) argued that finance takes over the space or the fixed

⁸⁵ Interview conducted online on October 28, 2021.

assets embedded in it and makes them circulate in an abstract way, reaching a broad spectrum of capital flows. Lastly, Lohmann & Hildyard (2014: 89) argued that this mechanism of making infrastructure a new asset class goes beyond plain privatisation, it is a complex set of relations and rent-extraction mechanisms from PPP to innovative financial products to incorporate infrastructure, having "a progressive financialisation of companies throughout the entire supply chain, from the companies that build infrastructure to those that service them" (p. 93).

5.5. Preliminary conclusions

Throughout this chapter, I have gathered my main fieldwork findings regarding the recent financial development of the Mexican electricity market and the introduction of large-scale RE projects. I have planned this chapter as a bridge that has parallels and connections with the literature explorations of previous chapters while serving as a prelude to the Baja California case study. Some of the financialisation characteristics became notorious because Mexico transitioned from a State centralised electricity industry with little or marginal financial participation into a post-nationalist energy model based on the deregulation-liberalisation trends and the overall financialisation of the Mexican electricity industry.

Several financial elements were involved in the structural change introduced by the ER and the international CF context. Financial interests and energy investment roadmaps provided the technical and fundamental arguments for the dismantling of the Mexican State-owned industry, the "unbundling" of CFE, the introduction of a financially based WEM, the deployment of large-scale RE as generation and investment assets, and the integration of Mexico's industry and geography into global capital flows. Therefore, the Mexican territory opened the appetite to allocate the idling liquidity amassed by financial actors and institutions looking for RE geographies and the reproduction of financialised accumulation mechanisms.

Mexico has experienced a financialised ET for several reasons. It is possible to identify some financialisation symptoms based on the four relations of the debate (separation, integration, negation and rent-extraction). In the model derived from the ER, we can point to:

- New market figures representing financial actors and institutions that intervene as an independent financial sector with funding, trading and brokerage interests in the renewable electricity sector.
- The deregulation-securitisation process of the electricity industry that achieves the integration of physical and financial activities.
- There are structural limits to trigger large-scale national industrial deployments of RE due to financialised macroeconomic frameworks.
- The introduction of a managed privatisation model that allows the extraction of resources from the public to the private sector.

Yet if we address these phenomena as "financialisation" we need to put them in the right dimension of the Latin American context: financialisation in its underdeveloped and peripheral condition, characterised by a lack of financial sophistication, the immaturity of the markets, the structural weaknesses of the economic model, and the overall proliferation of endemic corruption and illegal activities. As I discuss in the conclusions, this is a way of reinterpreting

the financialisation concept through the combination of historical foundations and new empirical elements offered from the Latin American experience.

Lastly, this analysis reveals the initial role of finance in the materiality of RE. Preliminary, mainstream finance introduced the debate on the need and potential to achieve a nationwide ET in Mexico. Finance (and private investment particularly) is presented as the only viable way to reach renewable energy targets, emissions mitigation, and economies of scale based on the electrification of the industry. Finance also represents the opportunities for large-scale centralised RE projects that would expand through the variegated regions of the Mexican territory. Therefore, it is possible to conclude that finance has constructed a hegemonic model and shaped a mainstream discourse of what an ET should be. This is a model that interprets the climate problem and energy transitions as a quantitative market issue of weights, quantities and measures based on investment opportunities, renewable generation targets and emissions mitigation goals. It is also a model that sees the territory as an investment space where the only way of achieving an ET is through massive RE deployments and growth patterns. Thus, finance represents a market-based model that currently excludes other interpretations of energy transitions, portraying the financial sector as the one-and-only way to hypothetically mitigate the climate crisis and achieve the decarbonisation of economies.

CHAPTER VI

Financial territorialisation of the Energy Transition: general trends and the Baja California case as investment space

To the geography of the military who decide from the maps their tactics and strategies, to the geography of the State apparatus leaders that structure their space in provinces, departments, districts; to the geography of the explorers (often military) who have prepared the colonial conquest and the "valorisation"; to the geography of States, corporations and banks that decide the location of their investments in regional, national and international levels. These different geographical analyses, closely linked to military, political and financial practices, constitute what can be called the "geography of the General Staffs", from those of the armies to those of the great capitalist apparatuses.

— YVES LACOSTE, *La géographie, ça sert, d'abord, à faire la guerre*, 1976

The third fieldwork stage explores the financial spatial strategies of the mainstream Energy Transition (ET). My objective is to give a broader interpretation of the finance-energy-geography nexus by using the Baja California case as the empirical matter for this research project. In this chapter, I aim to materialise the several levels of analysis gathered from the previous ones to strengthen the contributions of this dissertation. I combine the Climate Finance initiatives, the 2014 Energy Reform, the financialisation interpretation, the spatial dynamics of corporate finance, and the political ecology of ET investments. The Baja California case study will allow me to have a deeper understating of this processes and explain to the reader a concrete case of how the abstract manifestations of finance lead to concrete examples of the finance-energy-geography relations.

This empirical experience is divided into two main sections. First, I analyse the geographical implications of the Energy Reform and the territorial perspectives that guide renewable energy (RE) investments. Here I explore key official documents from the Mexican Government, energy companies and financial firms, using this literature to contextualise how investment roadmaps are opening and shaping the Mexican territory and energy industry. I also include transcripts of the interviews conducted in Mexico City to explain how finance is geographically planning and impacting territories and how RE profitability is related to spatial locations. The second segment is based on the Baja California (BC) fieldwork and serves as a concrete empirical reference to assess some of the information collected in the first part. I will also use available literature and interviews transcripts to guide the analysis and debate.

6.1. Financial geopolitics and ET: the early Mexican experience

Mexico's geography has attracted both RE investment interest and scholarly studies on the impact that these technology deployments have had on the territory.⁸⁶ As seen before, energy finance reports and outlooks have portrayed Mexico electricity market and energy geography as an investment space for ET projects (see IRENA, 2015). That is, finance has a particular geographical knowledge on how regions are defined, maps are read, distances are calculated, resources are harnessed, and land is valued. During fieldwork, I tried to decipher this spatial understanding through documents and interviews to illustrate how the first stage of the ET in Mexico was implemented. The results of this experience are divided thematically as follows.

6.1.1. A financial race over the territory

One of the main incentives of the Energy Reform was the provision of energy cartographies and spatial references to encourage RE investments in the Mexican territory. During the Peña Nieto administration (2014-2018), the Mexican Government promoted the national geography as a deregulated-liberalised investment space for RE projects and business opportunities in the new Wholesale Electricity Market (WEM). This was the objective of the Promexico (2016) business brochures that not only gave detailed requirements and regulations for foreign companies to invest in strategic sectors in Mexico and obtain local funding and subsidies but also provided preliminary maps of optimal areas for wind, solar, geothermal and biomass energy.

This territorial opening evolved into geographical "investment platforms", making strategic spatial information and georeferenced data available for decision-making processes and investments (Bancomext, 2018: 18). Such platforms were institutional consortiums led by SENER with the objective of developing online Geographical Information Systems (GIS) for RE localisation and harnessing. These are:⁸⁷

- The National Inventory of Clean Energy (*Inventario Nacional de Energías Limpias*, INEL).⁸⁸ This online platform shows the current use of RE sources for electricity generation and the untapped potential on solar, wind, geothermal, marine and biomass energy, as well as waste heat for cogeneration.
- National Atlas of Areas with High Clean Energy Potential (*Atlas Nacional de Zonas con Alto Potencial de Energías Limpias*, AZEL).⁸⁹ According to Bancomext (2018: 18), this platform complements the INEL by showing RE areas for technological development. It supports investors in the planning of generation projects and serves as an input for the expansion and modernisation plans of the National Transmission and

⁸⁶ Throughout the dissertation, I use the term "territory" to denote the dialectics between space and place, resulting in a combination of physical and human sites that are characterised by power relations, socio-cultural identities, and political appropriation that generate disputes over land ownership and usufruct (see León, 2016).

⁸⁷ Although there have been no major updates since the past administration, the interactive platforms are still online.

⁸⁸ Available online as *Inventario Nacional de Energías Limpias* (<https://dgel.energia.gob.mx/inel/>).

⁸⁹ Available online as *Atlas Nacional de Zonas con Alto Potencial De Energías Limpias* (<https://dgel.energia.gob.mx/azel/index.html>).

Distribution Grids. It also displays key geographical information like regional demand, natural reserves exclusion zones, areas with an indigenous presence, and spaces far from the transmission lines, among other data.

- The Financing and Risk Transfer Program for Geothermal Energy in Mexico (*Programa de Financiamiento y Transferencia de Riesgos para Geotermia en México*).⁹⁰ A platform designed to mitigate the financial risk in geothermal projects by providing a comprehensive GIS to assess the investment value chain: a) exploration and drilling of heat wells in exploitable sites, b) the design and construction of electricity generations plants, and c) the interconnection to transmission and distributions grids. Through this financial mechanism, "successful exploratory wells are expected to be paid for by the developer within a grace period of six years; and, in case they are not successful, a government non-repayable grant is activated" (Bancomext, 2018: 17). The digital platform is supported locally by SENER, INEEL and NAFIN, and by foreign institutions like the CTF and IADB. After solar and wind, geothermal is the third most important non-intermittent renewable energy. The Mexican State owns 90% of this energy source and serves as a baseline for system support. Thus, the ER included a Geothermal Energy Law to exploit heat wells for electricity generation. "The Law establishes a framework for private companies to develop these resources and facilitates the issuance of permits for the study of sites, as well as concessions for the exploration and development of geothermal resources" (Viscidi, 2018: 164).

Along with these platforms, CFE also developed a comprehensive GIS for mapping and regionalisation of electricity transmission and distribution infrastructure. This is part of CFE's modernisation program to integrate renewables into the National Electric System. According to the energy firm ESTA International (2014), the Energy Reform opened an opportunity to adopt the Competitive Renewable Energy Zone (CREZ) model used in the US to install smart grids and exploit RE sources. The official document prepared for the CRE stated:

Mexico has a vast and diverse geography with multiple climatic zones and is surrounded by two oceans. It offers sun and wind both inland and offshore. Mexico's vast geography also offers plenty of opportunities for interconnecting renewable energy resources to the grid. [...] This requires CFE to open its transmission and distribution planning process, studies and conclusions with clear indication of geographical areas to facilitate low-cost interconnection. Transmission planning has often been a closed process in many countries, including Mexico. Successful development of renewable resources requires full knowledge of CFE's transmission plans and how those plans can create opportunities for investment for renewable resources. Opening the transmission and distribution planning process opens the door to the developers to study investment opportunities. In addition, such information will reduce renewable resource developers' exposure to unknown costs. Furthermore, CFE should be required to provide a geographical map where Competitive Renewable Energy Zones (CREZ) are identified. This information facilitates creation of projects that are not only cost effective but also reduce the investment requirement in the transmission and distribution system. [...] A host utility such as CFE has the ultimate knowledge on its transmission system. Developers generally do not possess such knowledge and can potentially initiate projects that are not physically and/or economically viable. CFE can define CREZ where transmission capacity is available, network upgrade requirements are minimal, transmission grid expansion is not costly, technical losses can be reduced and local systems can absorb the resulting intermittency. CREZ encourage the developers to

⁹⁰ Available online as *Programa de Financiamiento y Transferencia de Riesgos para Geotermia en México* (<https://www2.ineel.mx/geotermia/index.php>).

locate their power plants in the designated areas, hence encouraging development of electrically and economically viable projects. (pp. 38, 51).

As seen before, the material deployment of the ET requires the large-scale installation of RE generation plants, supplying a growing share of renewable energy to the WEM. This first step for RE expansion combines two overlapped and contradictory geographies: *a)* energy cartographies based on the hierarchisation of solar radiation, wind currents and terrestrial heat areas;⁹¹ and *b)* a territorialisation of finance based on the mapping of profitable locations for power plant locations, interconnection distances, prices, markets and proximity to other strategic industries. These combined realities offer a geographical approach to the current ET phenomena. From a theoretical perspective, the uniqueness of the Mexican territory can be analysed through three key concepts from human geographical research: location, region and social land regime.

- *Location.* When developing RE projects, location is the first geographical condition to ensure the availability, stability and intensity of renewable sources (solar, wind, heat) according to the potential market demand. For Scholten (2018: 13, 26), RE generation relates to site location, technologies used, centralised-decentralised dynamics, material requirements, and the limitations of available space. Location also conditions geographical, weather and geological non-controllable variables that affect the temporalities of RE (intermittency, variability, seasonality). These variables are "dependent and highly unlikely to change over the course of centuries (assuming that climate change will not alter this). Distribution networks, in contrast, are actually more flexible despite their fixed appearance: electricity wires, transformer stations, storage facilities, interconnectors, and managerial control may relocate based on political decisions, costly as it may be" (p. 13). From a project finance perspective, location "determines the quality and quantity of renewable resources to generate energy; the distance from the electricity infrastructure will depend on additional investments; land tenure affects the management for securing real estate rights, and the demand of the node influences energy prices and congestions" (Bancomext, 2018: 43). In a multi-nodal system such as the Mexican one, there may be locations with a high degree of renewable resource potential, but these are areas far from the interconnection grid, leading to a transmission and distribution "infrastructure void" (ESTA International, 2014: 63. See also map 6.13 below). The location is also a condition where renewable sources are subjected to environmental, social and bureaucratic studies and permits that limit the use of specific spaces (see BMWi-SENER, 2018). The financial sector also measures the adaptation and climate risks of locations, concern mainly in phenomena that could affect RE projects like changes in wind patterns (Banxico, 2020: 37). In other words, as Labussière *et al.* (2018) argued, optimal location and available land are scarce commodities where RE developers compete for profitable spaces.

⁹¹ Here I am following Mbembe (2011: 43): "The inscription of new spatial relations ("territorialisation") ultimately consists of producing lines of demarcation and hierarchies, zones and enclaves; the questioning of property; the classification of people according to different categories; the extraction of resources and, finally, the production of a vast reservoir of cultural imaginaries".

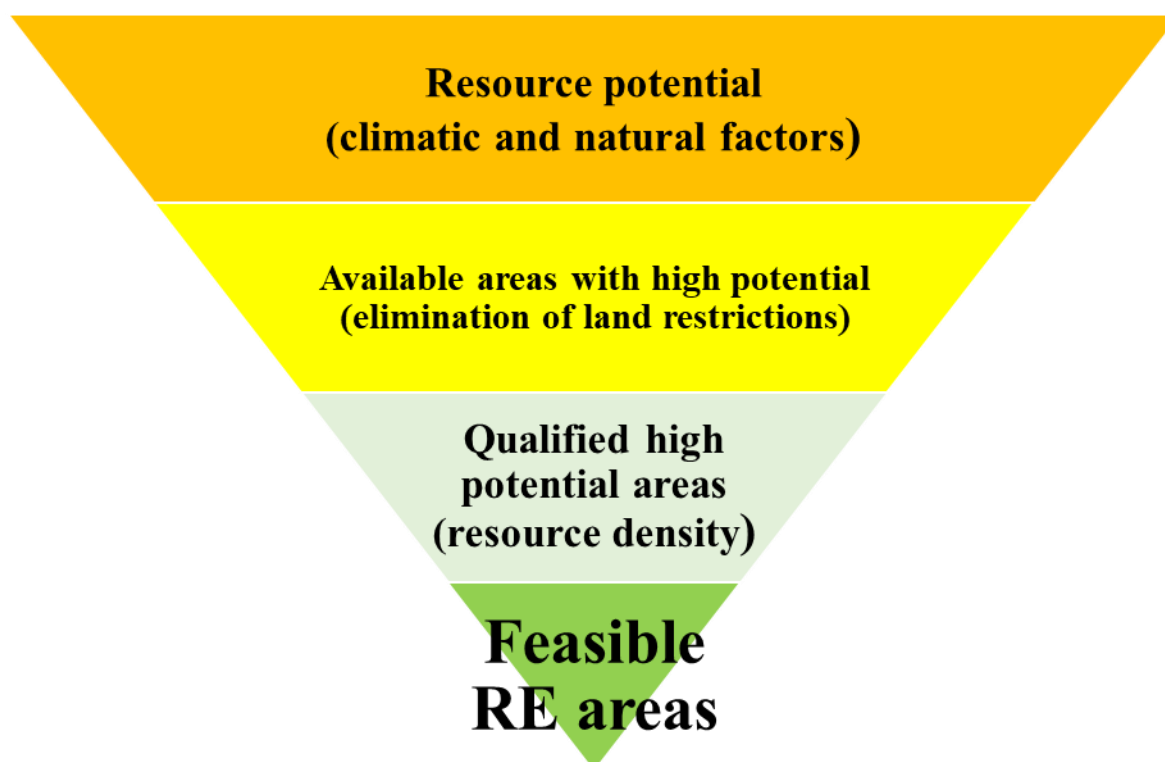
Table 6.1. Classification of potential areas for the development of renewable energy projects in the Mexican territory

Scenario	Distance from transmission lines	Estimated installable capacity (MW)	Estimated generation potential (GWh/a)
1	Not considered	2,593,889	5,695,580
2	≤ 20 km	1,381,945	3,024,235
3	≤ 10 km	397,020	912,913
4	> 20 Km	1,093,979	2,424,762

Source: Bancomext, 2018: 24-25.

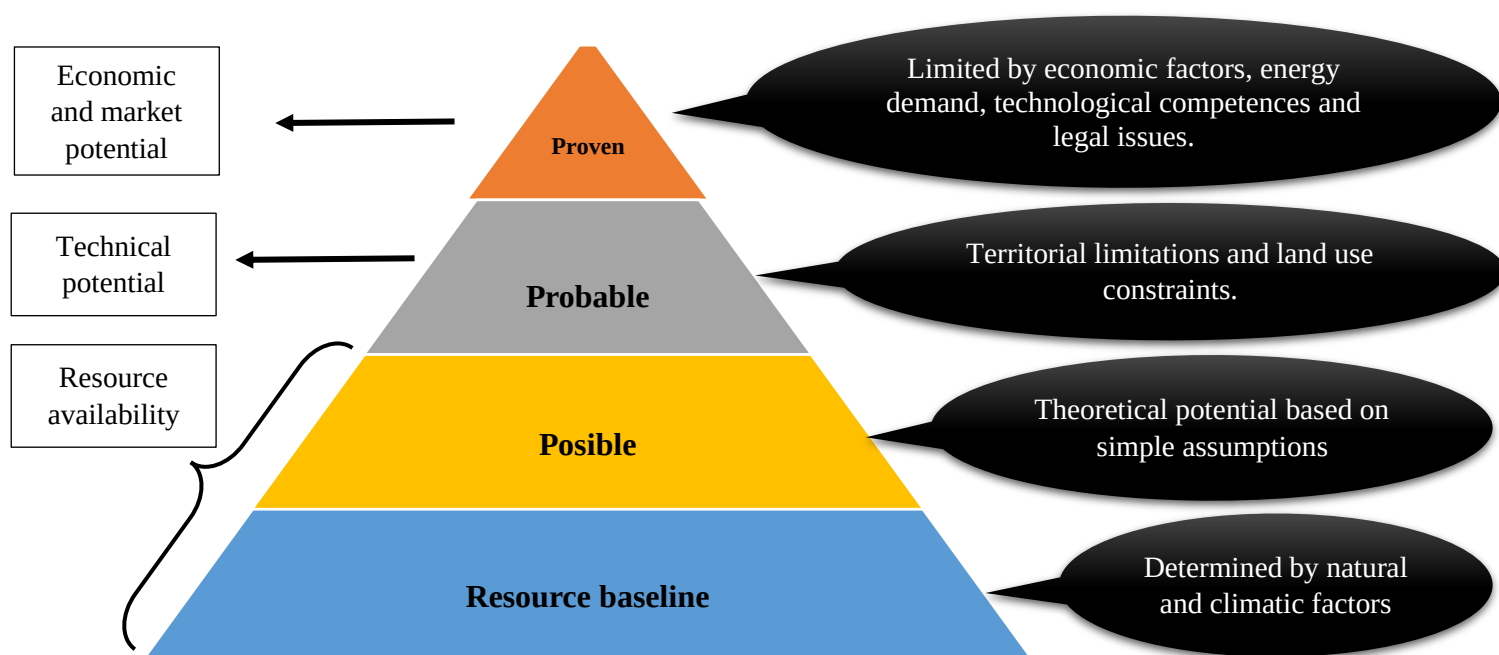
- *Regionalisation.* For Cardoso & Brignoli (1979: 81), "region" is a concept that results from the interaction of two realities in human geography: *a)* the *formal* region that considers homogeneous phenomena (the natural environment) that give unity to a certain space; and *b)* the *functional* region, when there are spatial constructions from an economic or social point of view, independently of the strictly physical or natural environment. Along with location, RE also depends on the surrounding environment where physical and human geographies interact. Following Scholten *et al.* (2018), we are witnessing a regionalisation of energy relations, shaped by the electrification of energy systems, transmission/distribution grids proximities and the embedded infrastructure that supplies nearby markets to avoid energy losses. This regionalisation is crucial to maintain the profitability of a project and the renewable resource density and efficiency to supply a regional grid (p. 4). In Mexico, energy regionalisation must consider the political-administrative units (municipalities and inter-state shared spaces), strategic economic activities, energy infrastructure, biophysical landscapes, watersheds, urban and peri-urban settlements, socio-ecosystems, coastal zones and natural protected areas (see SEMARNAT-INECC, 2016; BMWi-SENER, 2018). Thus, the regional perspective of RE investment creates a hierarchy of zones subjected to a classification for RE harnessing.

Figure 6.1. Methodology for the identification of available zones with high renewable energy potential in Mexico



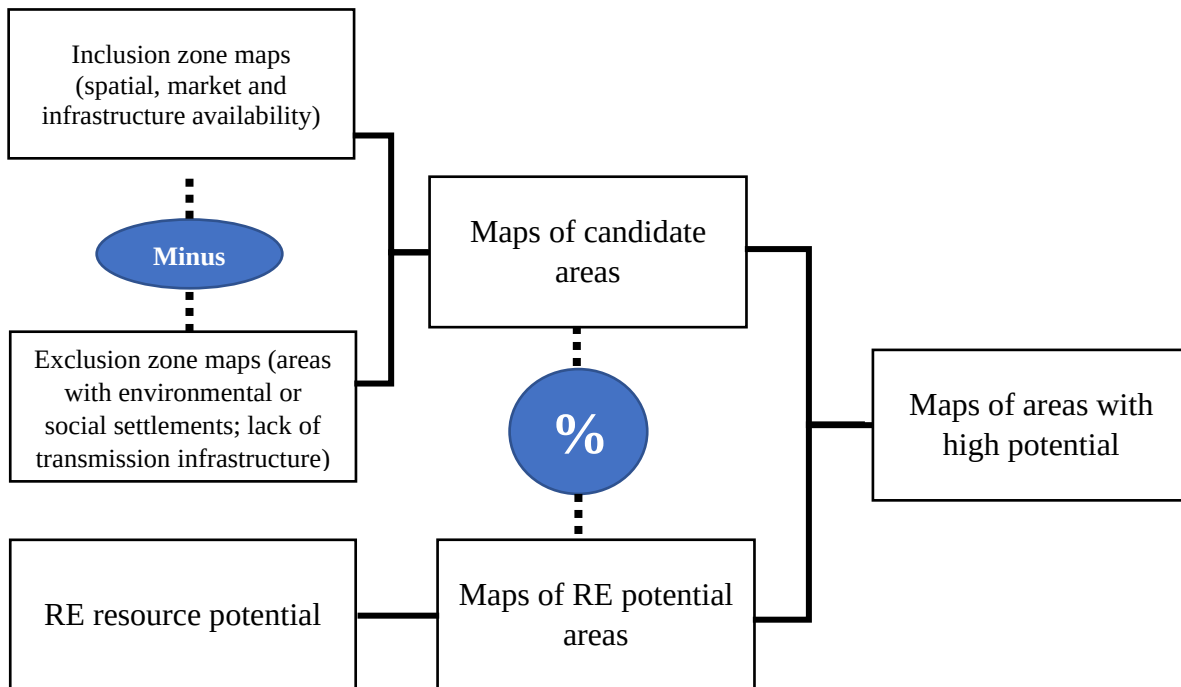
Source: SENER, n/da; based on the NREL methodology.

Figure 6.2. Classification of the renewable energy potential in Mexico and its main constraints factors



Source: SENER, n/da; based on the NREL methodology.

Figure 6.3. Methodology for the selection of areas with renewable energy potential



Source: SENER, n/da; based on the NREL methodology.

- *Social land regime.* In Mexico, energy and infrastructure projects are subjected to land tenure which has historically remained under the social regime of ejido and communal land.⁹² This is an example of how energy projects not only create conflicts over the use of land but also represent social and spatial relations that currently characterise the territorialisation of the ET (see ahead).

From a project development standpoint, financiers agree that these three conditions guide RE financial planning. As Pablo Partearroyo mentioned:

"The question of where to build a power plant, whether wind, solar, geothermal or thermovalorisation, is the first step in any investment decision. The location determines the availability of energy sources, interconnection infrastructure and target markets. The further away from the grid, the more additional investments will be needed such as transmission lines extension, storage systems to relieve the problem between daytime generation and night-time consumption, and potential induced works like roads and highways. This has an impact on securing land rights, or whether it is a greenfield or brownfield construction site moulded by already existing public infrastructure. Lastly, the proximity to attractive node pricing will determine future revenues,

⁹² The ejido and communal legal figures emerged as a land redistribution mechanism after the Mexican Revolution (1910-1917) and the 1915 Agrarian Reform. The objective was to re-establish the modalities of land tenure and communal organisation based on the political footprint of the original peoples of Mexico. The redistributive mechanism also helped to maintain primary productive activities under communal principles and organisation. Social land ownership is equivalent to 54% of the Mexican territory and is divided into ejido (44.3%) and communal (9.5%). Private ownership is 35.7%, while public ownership 11.3% (see López-Bárcenas, 2017: 22).

being a mandatory variable for the due diligence to secure project financing. Renewables certainly work fine in autonomous 'inside the fence' environments, but large projects need interconnection".⁹³

In the Mexican real state and energy industries, most of the territorial, environmental and social issues related to the occupation of space are treated as legal conflicts that can be assessed through impact and risk studies. Carlos Villanueva added:

"It is a combination of operating costs and dimensional requirements for a generation plant. Solar requires more homogeneous extensions without obstacles to radiation. In the case of wind energy, it can take up to a year of wind current studies to know the potential area for the number and position of the turbines. Then comes the construction site evaluation, measurements and distances, and the sub-spaces required for the operation and maintenance of the plant. Also consider the access roads, highways, the proximity to the interconnection loads, and how close you can be to energy-intensive industrial hubs in the region. These conditions must follow legal procedures and licenses on soil mechanics, environmental impact assessments [MIA], social impact assessment [EVIS], and the interconnection studies with CENACE. Finally, there is a clause related to the end of the plant's useful life. That is, if at any time it must be dismantled or modified due to contractual conditions, having a divestiture impact on the site".⁹⁴

Energy project development also has a geographical component in the advantages of forming strategic clusters and hubs. Financiers distribute investments according to a client mapping attractive for financial institutions. Therefore, the more the energy projects and industries are grouped together, the higher the allocation of capital and liquid guarantees for investors and financial institutions (MER, 2015: 111). Grouping several projects in a determined space reduce investment amounts, times and risks, optimising strategic areas for high-energy consumption industries. Alejandro Keijser argued:

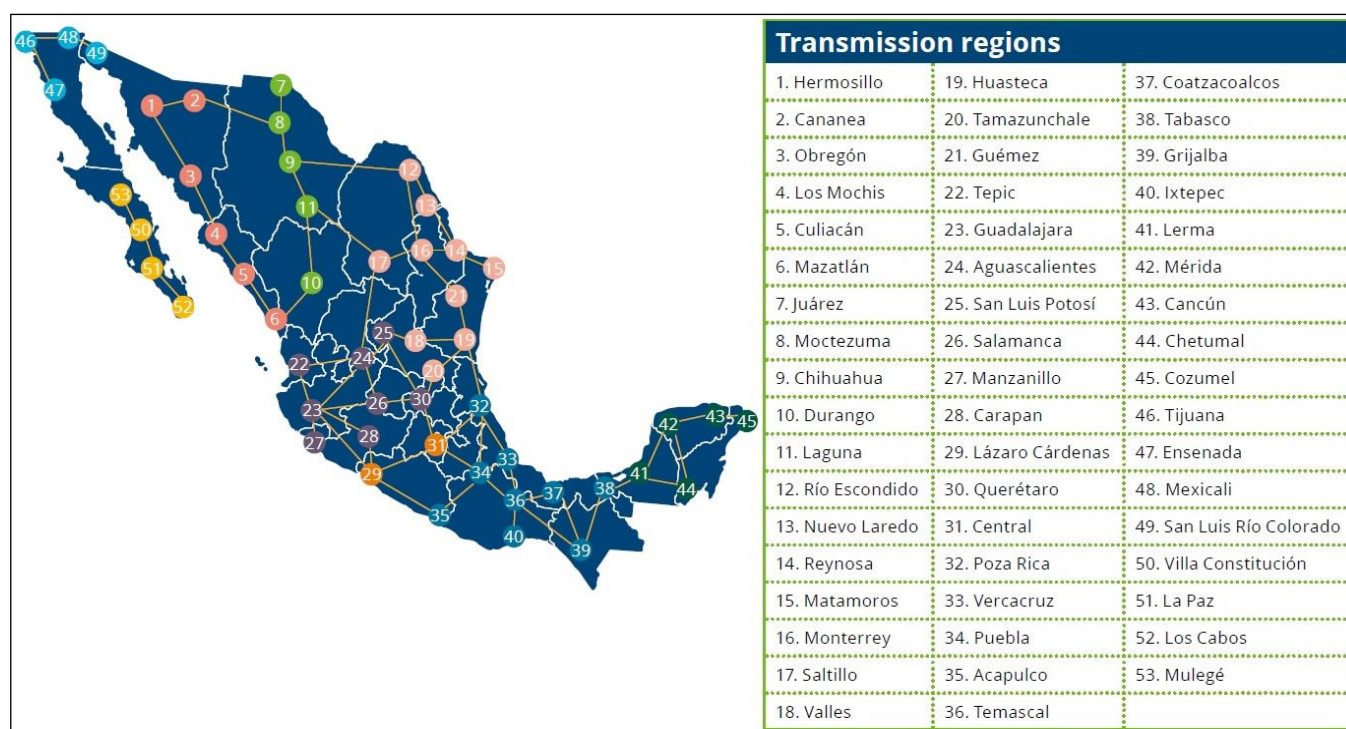
"What a developer wants is to build renewable energy assets, especially in a place with a lot of sun or wind to reduce costs. The generator may not care about the node, the crucial issue is transmission lines because otherwise, it would be very expensive to evacuate the energy. This allows making profits by reducing prices and being attractive to clients. The problem would be the proximity of transmission lines, rights of way associated with the land, and social conflict. Regardless of how well the sun and wind are arranged, it is the interconnection infrastructure and the land conditions that dictate costs and the profitability of the project in the long run".⁹⁵

Map 6.1. Transmission regions of the National System, 2016

⁹³ Interview conducted online on August 19, 2020.

⁹⁴ Interview conducted in Baja California, Mexico, on May 5, 2019.

⁹⁵ Interview conducted online on October 28, 2021.



Source: BMWi-SENER, 2018: 39.

Yet critical perspectives on this opening process have pointed to the limits and contradictions of an expansive large-scale regionalisation of RE deployments. This geographical management of the ET would result in a reductionist approach to the environmental and energy challenges. My interlocutor Luca Ferrari stated:

"In addition to the favourable conditions offered by the Energy Reform, Mexico's solar and wind potential became a major appetite for investors. Hydroelectric and geothermal belong to the State and cannot grow anymore. I anticipate something similar for solar and wind, a territorial saturation of these technologies as occurred in Spain or Germany. This is why companies are interested in the Mexican geography. Peña Nieto's government had precisely that vision of providing foreign investors with all the territorial information possible, under an extractivist and logic and through corrupt businesses. However, the best solar and wind spots are the first to be occupied. This would lead to a territorial dispersion like that of fossil fuels. In the oil industry, you discover and exploit the largest, cheap, abundant and high-quality oil reserves first, and then you gradually move towards smaller non-conventional fields like shale or deep waters. Something similar would happen with renewables. First, you occupy the best insolation and wind regions, the ones closer to interconnection spots. Then you have regions with less renewable resources and distant from interconnection lines. In short, the best sites are occupied first and then the profitability goes down with geographical dispersion, from a technical and economic point of view".⁹⁶

One of the recurring topics during fieldwork was the speculative race that companies and investment funds launched over the Mexican geography. This implies the use of sophisticated financial mechanisms but a lack of comprehensive planning on social, territorial, environmental, and power system stability issues. CFE's "unbundling" process also affected its planning programs to manage and expand the National Electricity System. Thus, the companies

⁹⁶ Interview conducted online on September 9, 2020.

that entered with the Energy Reform interpreted the Mexican territory from a "free market", aiming to maximum profitability rates in RE projects. Emmanuel Gómez commented:

"Speculation and corruption issues came with the Reform. The expansion of renewables took place in a logic of project development, not in an electricity market or energy needs perspective. These are different dynamics. A project developer is placed where renewable sources are located to generate as much as possible, regardless of whether that energy is necessary for the electricity system or the nearer population. This led to a territorial takeover on the part of the local governors and authorities, who held meetings with private companies to exploit profitable land reserves. Also, the real estate business jumped into the renewable's bandwagon, making consortiums with the energy developers to occupy lands. In a brief period, deserts and other desolate spaces acquire value since the sun and wind became valuable. In the long run, CFE must bear this lack of planning that is generating vulnerability for territories and the national system".⁹⁷

Grid planning issues were also a concern during my interview with Edgar Villar:

"In my perspective, the electricity market entered a stage of disorder since the Energy Reform. Under the new law, if you have the capital and land rights, you can put the power generation plant almost wherever you want. And I say almost because there are environmental and social restrictions. This energy would be generated regardless of whether is necessary or not, what matters is to supply this anonymous market with cheap clean energy that is dispatched and paid first. You cannot leave the system to the free market; you need regional planning to connect the oversupply areas with the energy poverty populations".⁹⁸

Since 2019, the new nationalist CFE administration denounced that the ER had created this massive entry of solar and wind private generators into the Mexican electricity market. This led to a lack of regulation that caused the detrimental effects to CFE analysed in the previous chapter. CFE argued that the dismantling of the State's energy planning eroded territorial sovereignty by ceding investment opportunities to energy companies through land acquisitions, construction sites procedures, grid interconnection permits, access to fuels, technical feasibility studies and other licenses (SENER, 2019: 9). In October 2021, the AMLO administration pushed through a piece of legislation to reverse part of the ER and recover the State planning of the electricity industry:

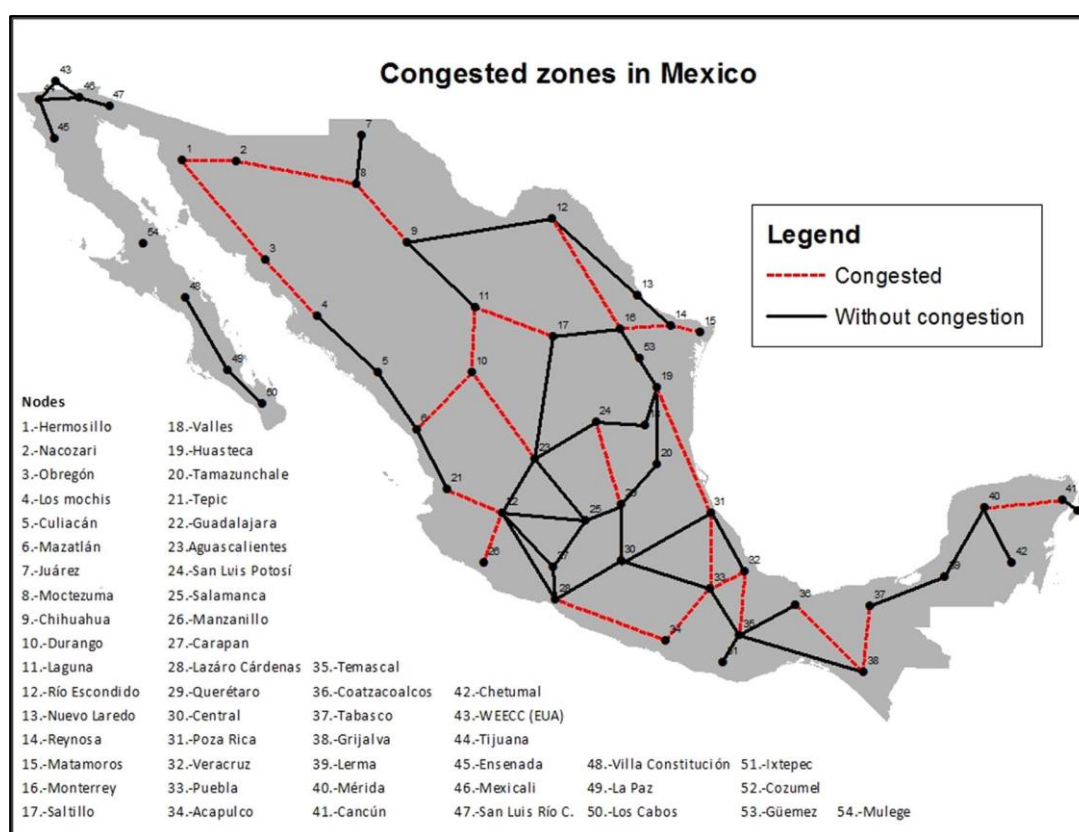
The Energy Reform, through the CRE, granted unlimited generation permits without considering planning and future demand; most of them are intermittent renewables, creating an oversupply to meet the electricity demand forecast for 2024. Generation permits were authorised for 104,372 MW when the estimated demand by 2024 is 52,419 MW. The generation permits double the demand of the electricity sector capacity. In 2021, 86,039 MW are already installed with a peak demand of 46,628 MW in 2020. Generation requests for 30,074 MW are pending approval, bringing the installed generation capacity to 134,409 MW, which would triple the required generation considering that a reserve capacity of 15-20% is sufficient to operate the National Electricity System safely (Gobierno de México, 2021: 8).

The deregulation-liberalisation of the Mexican territory would gradually create a RE expansion and concentration in the most profitable regions, generating an oversupply in some areas of the country that cannot be diverted to centralised consumption centres. This is the case of wind farms that have already caused chronic congestion in regions like Oaxaca, Tamaulipas, and Yucatan (García, 2017).

⁹⁷ Interview conducted online on August 25, 2020.

⁹⁸ Interview conducted online on March 8, 2021.

Map 6.2. Congested zones in Mexico, 2015



Source: Zenón & Rosellón, 2017: 357.

But rather than a spatial limitation of technologies is not this a matter of infrastructure expansion? On the financial side, Pablo Partearroyo⁹⁹ and Alejandro Keijser¹⁰⁰ referred in parallel to the following points:

- As in any business line, the first competitors to enter are the ones that take over the market. In this case, it was the generators that occupied the best solar spots in the Mexican northwest desert and wind sites in the Tehuantepec Isthmus.
- Yet Mexico's geography is larger than that of Germany or Spain, and its electricity demand is lower compared to these countries. Therefore, the national margin for RE expansion represents an untapped territorial capacity subject to investment opportunities.
- The Energy Reform has a maturity horizon of 20-25 years, so competition has a “territorial room for manoeuvre” to expand and innovate the market in areas where the State is absent, like generation, self-consumption, and the intermediary financial market.
- Thus, the problem is not a territorial saturation but the lack of transmission infrastructure to interconnect renewables across all regions of Mexico.

According to Keijser, the lack of new investments in transmission lines is currently slowing down the ET in Mexico. This duty is still in hands of the State (SENER and CFE) and the

⁹⁹ Interview conducted online on August 19, 2020.

¹⁰⁰ Interview conducted online on October 28, 2021.

financial mechanisms to fulfil these projects (the *Fibra-E* mechanisms referred to in the previous chapter) have not been fully implemented:

"The Mexican Government has not invested in transmission lines in the last five years, which is absurd as there is a legal obligation to do so. In this case, space limitation for renewables is not the problem. Remember that there will be substitutions for more intensive technologies. There are already 15MW turbines, i.e., in the same space you can produce 10 times more than 10 years ago. At the same time, fast innovations in smart grids will help to reduce intermittency periods in regions with chronic grid congestions. Temporality is another key question. It will be crucial in the future to build a renewable plant faster than a combined cycle plant. This would allow meeting project finance commitments earlier".¹⁰¹

As I explained before, different financiers have different approaches to the electricity industry, depending on the side of the market they are playing on. While energy project development has a particular concern with the location and region for RE generation, the trading and brokering side has a more dynamic interpretation of the territory and the circulation of energy. Now I will address some of these arguments.

6.1.2. A geography of prices and land valorisation

The main spatial characteristic of the Mexican electricity system is the geographical dispersion of 2,500 nodes, all different and impacted by several variables. Nodes represent zones, regions, energy islands and small areas that serve as geographical points to link generators, load capacities and transmission lines (Zenón & Roesellón, 2010). Historically, the Mexican energy system required an expansive energy policy to cover the national territory and provide public services to the population, creating a multi-nodal system to satisfy the energy needs of distant and different regions, municipalities and localities (see Capel & Casals, 2013). Thus, the private interests that are playing over the footprint of a system designed and built by the State economy create a unique situation for the ET. Trader Alejandro Moreno sums it up as follows:

"The biggest challenge for the Mexican market is introducing renewables to a multi-nodal system, making the grid more complicated to manage in terms of supply and price stability. Instead of adding renewables to a reference hub node, multiple nodes must deal with a seasonal and intermittent electricity supply that is injected into the grid in several magnitudes, from big solar and wind projects to distributed generation systems. Mexico still lacks this level of grid management and therefore renewable energy market penetration".¹⁰²

¹⁰¹ Interview conducted online on October 28, 2021.

¹⁰² Interview conducted in Mexico City on March 25, 2019.

Map 6.3. Representative nodes of the National Electricity System marked by region



Source: CENACE, 2018

While inquiring into the geographical foundation of the WEM, energy financier and consultant Mr. P.B. argued:

"Don't think too much about it; geographically what you need is the proximity to the node with the best price. In an energy system like Mexico's, nodes are the main driver in terms of the future projection of revenues. The node is the starting point to a series of price trends studies and analyses, land jurisdiction and real estate rights, as well as the proximities of other generators, transmission infrastructure, congestion bottlenecks, consumption centres and strategic industries. Instruments like Financial Transmission Rights help energy traders to understand and manage this risk between injection and extraction nodes".¹⁰³

This relates to the comments in chapter 5 regarding the centrality of prices for RE investments and the financial settlements in the WEM. Therefore, there is a location-price combination that maintains a balance in the market between developers, generators, traders and consumers. Prices link several spatial variables, from the construction site costs of a plant, the quantity and quality of available sun or wind, the proximity to interconnection infrastructure, and the components of the Local Marginal Price (energy, congestion and losses).

Mexico's geography and the deregulation-liberalisation of prices in the WEM made the key combination for the ET investments roadmaps. For Climate Finance to access the Mexican territory, the major legal modification of the Energy Reform allowed the territorialisation of capital and the Big-E Energy patterns theorised by Lohman & Hildyard (2014). The original text of the 2014 Electricity Industry Act (*Ley de la Industria Eléctrica*, LIE) specifies:¹⁰⁴

Article 42. The Public Service of Transmission and Distribution of Electricity is of social interest and public order, so it has preference over any other activity that implies the use of the surface and subsoil of the land affected by such activities. For all legal purposes, the Public Service of Transmission and Distribution of Electric Energy is of public utility. The lands necessary for the installation of the National Transmission Network and the General Distribution Networks are subject to legal easement.

[...]

Article 71. The occupation or impacts on the surface, or the constitution of easements necessary to provide the Public Service of Transmission and Distribution of Electric Power, and for the construction of electric power generation plants in those cases in which, due to the characteristics of the project, a specific location is required, in accordance with the applicable provisions, will be applicable. [sic] [...] The Federation, the governments of the States and of the Federal District [Mexico City], of the municipalities and of the delegations, will contribute to the development of projects for the generation, transmission and distribution of electricity, by means of procedures and bases that will expedite and guarantee the granting of permits and authorisations within the scope of their competence.

[...]

Article 73. The consideration, terms and conditions for the use, enjoyment, or assignment of the land, property, or rights necessary to carry out the activities referred to in Article 71 of this Law, will be negotiated and agreed upon between the owners or holders of such land, property, or real rights, including ejido or communal rights, and those interested in carrying out such activities. In the case of private property, the acquisition may also be agreed upon.

These modifications brought a series of territorial conflicts that could be framed in the Big-E energy vs little-e energies relation (see Lohman & Hildyard, 2014). The conflict has been analysed by organisations like GeoComunes (2016, 2021), which have pointed out the territorial conflict that ER introduced: the affectation of indigenous communities that have suffered from

¹⁰³ Interview conducted in Mexico City on June 2, 2019.

¹⁰⁴ See Cámara de Diputados, 2014.

territorial dispossession, alteration of agricultural activities, disruptions in access to water, invasion of extractive mining and forced subordination as consumer-clients of the new electricity market projects. Communities and local populations took a more active role in denouncing and organising to stop the advance of the ER projects, demanding the right to energy self-determination. According to GeoComunes (2021: 55), communities have proposed the reappropriation of hegemonic technologies through decentralisation and democratization of local energy for the support of productive activities. Nonetheless, the Mexican State has prioritised energy activities according to the market value that the territory can acquire.

For energy finance, any territorial settlement and technology/infrastructure embedding is a double valorisation movement: first, companies approach the territory as a cheap commodity, speculating and paying as little as possible for it; subsequently, as land is occupied by energy assets, there is a valorisation process where companies profit "buy low and sell high" (see GeoComunes, 2021). From a financial perspective, "the renewable energy market in Mexico is maturing and laws can always evolve, for example, that non-productive land can be used for infrastructure developments, mainly renewable energy. Mexico is in a key geographic location and has a lot of potentials. Modifying the Agrarian Law, i.e., making it more flexible, would give more certainty to partners who want to invest in these projects" (Bancomext, 2018: 70). Energy projects may even involve negotiating the "disincorporation" (i.e., privatisation) of ejido land. Under the Energy Reform framework, the land and real estate subjected to RE investment acquire the status of guarantees for financial commitments. Following the Bancomext roadmap, investors and banks entering the RE industry in Mexico must comply with the new model, taking risks and advantages on how land and real estate can serve as financial collateral for project finance or as a contribution to a guarantee financial trust (p. 70). For Cabrera-Colorado (2018: 96), this occupation and use of the surface is an alignment with the US eminent domain doctrine: "for transmission and distribution, and for electric power plant construction, investors may occupy and affect the surface or obtain easements. Electricity transmission and distribution are affected with social interest and public policy; thus, they will prevail over any other activity implicating the land's use".

For their part, energy brokerage and investment funds have a more abstract approach to the geographical dynamics of RE and electricity. According to Bancomext (2018: 38), "most of the developers who entered the first wave in Mexico are foreign: pension funds or investment funds, which are managed with a mentality of regional independence, i.e., they do not distinguish in carrying out projects in Mexico than in Chile, as long as projects comply with the premises of profits and investment security". Such a mapping follows the financialisation debate by analysing the management of assets already in place but that can be put into circulation abstractly as financial assets. Broker Julio Chauvet added:

"One of the strategies for investing in energy assets is portfolio diversification. A profitable mix of assets is made based on diversification of generation technologies, the strategic location of projects, market prices, contractual terms, and convenient alliances with complementary industries such as steel and agriculture. It is possible to own the generation assets, manage the asset for a third party or simply intermediate the sale and purchase of power generation. These assets can be sold in the financial market and portfolios restructured depending on return opportunities and the direction of the industry, locally or internationally".

Beyond abstract and impersonal markets, financial interests over the territory are also related to security schemes for securing land, resources and markets. In order to access

locations, regions and land rights, RE investment has also deployed instruments of occupation that have gradually become part of the ET landscape.

6.1.3. Energy, finance, violence, territory

Financial interests play an important role in the subordination of land and other productive activities to the dynamics of mainstream energy projects. Renewables are no different in this respect, creating conflicts over human and ecological settlements. For financial planning and risk management, social and environmental issues became a frontier that must be adapted, absorber or displaced to give way to the material deployment of the ET. The ER, "opened the hydrocarbon and electricity value chains to private participation and unleashed a wave of investment projects, many of which have faced substantial local opposition" (Cruz *et al.*, 2019: 1). Thus, "during the life cycle of these projects, conflict and opposition frequently arise, thereby creating significant challenges, including delays, legal trials, and direct costs to investment" (p. 1). As García-Hernández (2016: 4) and López-Bárceñas (2017) documented, the effects of wind farms in the Mexican territory (especially in the Isthmus region) have had several repercussions. These include:

- Low social and economic benefits derived from land rent.
- Low social acceptance in places where conflicts over land use change have occurred.
- Concerns regarding the impacts on the environment and culture.
- Poor application of consultation mechanisms and legal instruments that guarantee the conservation of the environment and its components.
- Little or no information on the benefits and negative impacts of wind energy.
- A lack of citizen mechanisms for project auditing.
- Unequal legal mechanisms for peoples' access to justice.

In the past, Pemex and CFE could negotiate with the population as State-owned companies searching for public interests, but the legal changes of the Energy Reform allowed the private companies to penetrate territories with infrastructure projects, "fading State companies' local governance" (Cruz *et al.*, 2019: 1). This represents a shift that institutions like the WB or IADB are currently fostering, where private companies are "focusing strongly on how to bring communities on board as stakeholders" (MER, 2014: 231).¹⁰⁵ For the financial sector, this new model encourages dialogues with investors and developers, "negotiating with indigenous communities to cede the land as an equity contribution" (p. 231). These negotiations purport to give local communities benefits like the long-term option of participating as shareholders or other management activities related to RE projects instead of just being tenants receiving royalties for the land. Nonetheless, this process has not been as romantic as it sounds. At the time, De la Fuente (2014) warned:

This implies that private companies will be given priority access to the land, no matter who and what activities are being developed there. Companies will negotiate directly with the landowners the amounts that they will pay them for the rent or purchase of their land. In case they do not reach an agreement, companies

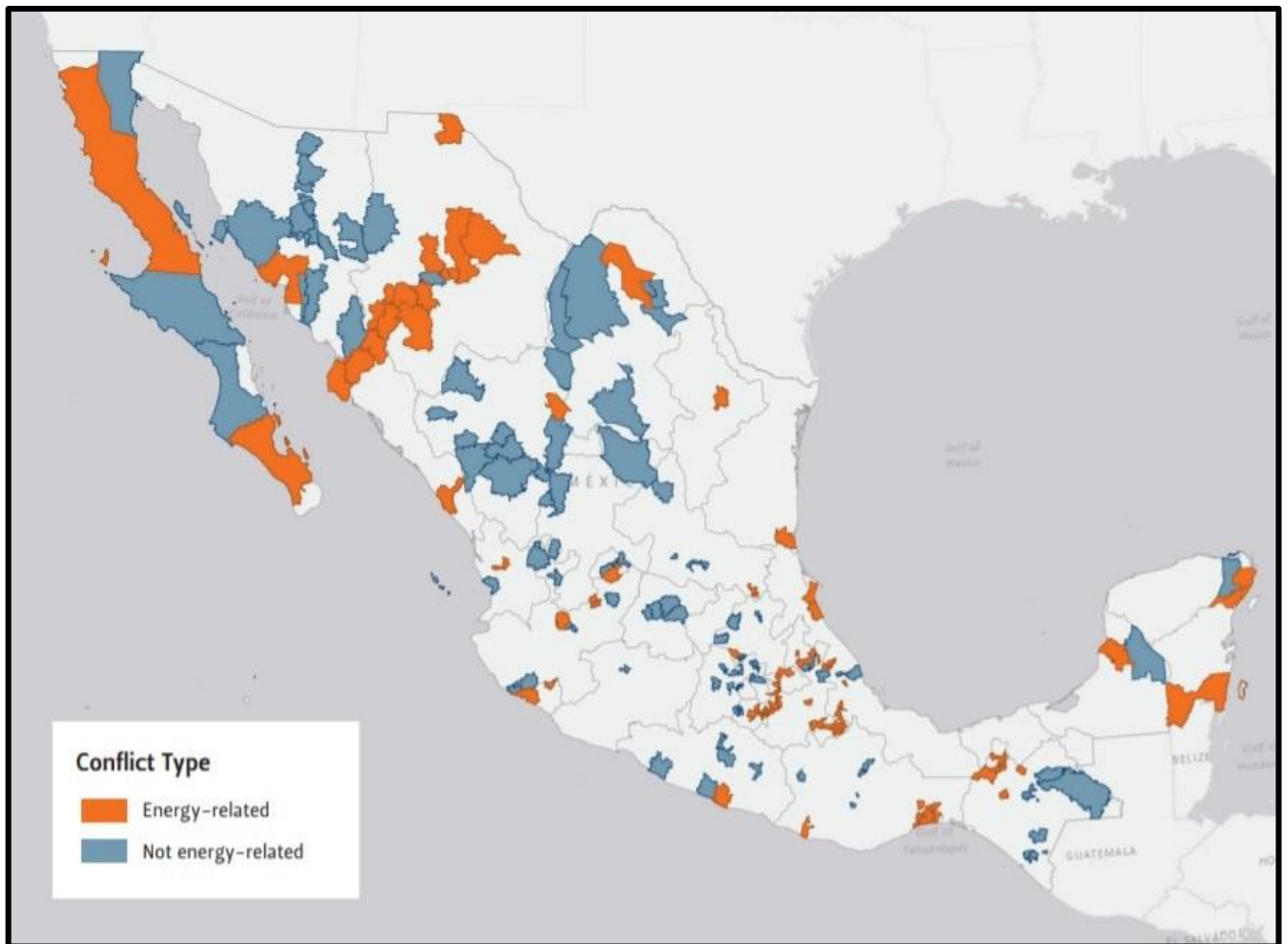
¹⁰⁵ Some of the key elements of this narrative can be found in IRENA, 2020b.

may resort to the Judiciary or the Executive to decree the legal easement of the land, which means forcing the owners to rent it.

Energy-territory conflicts have been a recurrent element in Mexico with the increasing penetration of wind farms. The Tehuantepec Isthmus region (and specifically the Oaxaca state) has become an international reference for the academia to study comparatively how wind energy is having negative economic, socio-territorial and environmental impacts, especially in terms of displacements, forced negotiations, land occupation, intimidation, unfair contracts, lack of payments, breach of clauses and direct violence (see Nahmad 2011; Pasqualetti, 2011a; Juárez-Hernández & León, 2014; Pérez-Huesca, *et al.*, 2016; Alonso-Serna, 2017; Cabrera, 2017; Boyer, 2019; Dunlap, 2019). While writing this chapter, the regional conflict continues to evolve due to the lack of land lease payments from wind energy companies such as Siemens, Electricité de France, and Japan's "Eólica del Sur", all installed in this region (see Matías, 2021, 2021, 2021a).

Territorial conflicts arising from RE expansion is part of a long-standing process of security programs, militarisation, mercenarisation, counterinsurgency and war-on-drugs violence contexts to maintain control over territories, populations and natural resources in Latin America (see Fazio, 1996, 2016; Calvo-Ospina, 2007; Salazar, 2012; Luzzani, 2012; Svampa, 2019; Petras & Veltmeyer, 2018, 2019). For Mexico, this brings some reflections on how RE is following the fossil capital patterns, expanding through territorial violence processes. In the period following the adoption of the Energy Reform, it was possible to identify renewed mechanisms of territorial occupation for the oil sector (especially the shale industry), using State instruments for internal control, drug trafficking violence and the militarisation of the police to protect energy investment, sending "positive messages to investors" interested in exploiting the Mexican northeast region (see Álvarez-Herrero, 2019: 273-279). These practices were also implemented in the RE industry, revealing the territorial impact of wind farms (mentioned above), natural gas pipelines, hydroelectric dams, and the mining-electricity nexus (GeoComunes, 2016; De La Fuente *et al.*, 2017; Oxfam, 2018). Overall, this is a warning sign to break the current false dichotomy in the Mexican public debate between "bad fossils and good renewables". And as Lohmann & Hildyard (2014) concluded, renewable energy (in all its forms and sources) operates under fossil capital processes by representing the lines of continuity of the Energy-energies conflict.

Map 6.4. Geography of social conflicts in Mexico, 2000-2017



Source: Cruz *et al.*, 2019: 2.

6.2. Baja California: a renewable energy investment space

In chapter 3, I briefly explained the reasons why I chose Baja California (BC) as a case study for this dissertation. During the visit to CICESE (Ensenada, BC, April 2017), Prof. Rubén Lara-Lara introduced me to the challenges that the region faces in relation to climate change impacts, energy dependence, water stress, industrial growth, and agriculture development. This event took place just after the WEM came into force in the BC region on January 26, 2017. Lara-Lara, who in addition to being an academic has undertaken several business ventures in BC, pointed out the geographical and financial problems of developing energy sustainability projects and how the idea of an energy transition reshaped the BC state territory. While talking to investors and the ejido community of Sanchez Taboada (Maneadero, Ensenada BC), I realised that the main problem of a regional energy transition is the access to finance to fund RE projects.

The solar, wind and geothermal potential of the region attracted the imagination of investors, interested in funding medium and large-scale projects (above 30MWh) to sell energy to CFE. Others had more ambitious initiatives, like selling cross-border energy to California or installing desalinating water plants for the wine cluster in Valle de Guadalupe. On the other hand, I also found a more localised approach in the ejido communities, looking for autonomous energy and water systems to support agriculture activities and adapt to increasing periods of

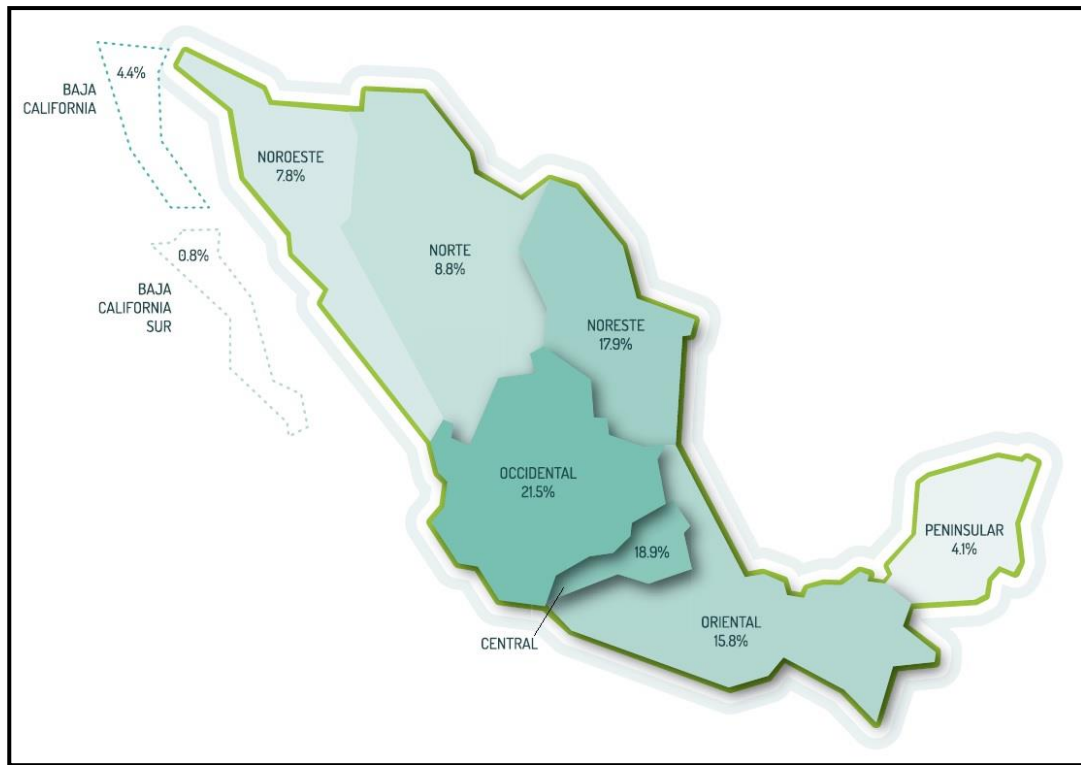
droughts. Yet in different degrees and scales, these projects face a combination of geographical, technical and financial constraints in terms of spatial deployment and access to funding.

Since then, the results of this experience contributed to my interest in the region, making it part of the PhD research project. In this section, I will analyse the mainstream trends of finance and the ET. I will use the BC case to contribute to the energy geographies and financialisation debates by taking the region as an example of a space where contradictions between geography, energy and finance mediate. Also, the case study targets the northern region of BC (the Ensenada-Tijuana-Mexicali polygon), where the regional WEM takes place, and the ET interests are located. As I mentioned in chapter 3, fieldwork accumulated three different stages: *a*) the initial approach and the PhD upgrade documentation (2017-2018), *b*) the Energy Reform hiatus with the arrival of the AMLO administration (2019), and *c*) the Covid-19 paralysis (2020-2021). Fieldwork was then divided into the first *in situ* approximation and second leg achieved through remote information collection.

6.2.1. Baja California as an energy island

The geohistorical characteristics of the Baja California peninsula have made the region an energy island in relation to the Mexican heartland. Several factors have prevented the interconnection of the peninsula with the rest of the country: geographical phenomena (distances mediated by the sea and mountain ranges), environmental spaces (protected natural reserves and wetlands), territorial use (land under social ownership), geostrategic conditions (proximity to the US border), and economic constraints (low State investment on expensive medium and high-voltage transmission grids). Both states in the peninsula –Baja California and Baja California Sur– are energy islands with independent electricity grids isolated from the rest of the Republic and from each other. Thus, the Mexican electricity system is divided into the National Integrated System (known as SIN, which consists of 7 interconnected regions accounting for 94.8% of the system) the Baja California system (BCA, 4.4%), and the Baja California Sur system (further divided in two: the BCS and Mulegé systems, representing 0.8%).

Map 6.5. The National Electric System, based on the Integrated system and both Baja California peninsula systems



Source: Bancomext-GIZ, 2018: 14.

The official SENER (2019) document states:

The 7 regions of the continental massif are interconnected and constitute the National Interconnected System (SIN). They share resources and capacity reserves to meet the diversity of demands and operational situations; this makes it possible to exchange energy and achieve a more economical and reliable operation of the system as a whole. The Baja California system operates interconnected to the US Western Electricity Coordinating Council (WECC) electricity grid through two 230 kV alternating current transmission lines. The Baja California Sur and Mulegé electricity systems are isolated from each other and from the rest of the national grid (p. 21).

BC represents a semi-closed system that benefits from US natural gas imports and the cross-border exchange of electricity through two key geographical points: the Tijuana-Miguel border and the La Rosita-Imperial Valley border, both consist of synchronous transmission line with a limit of 408 MW for import flows and 800 MW for export (ESTA International, 2020: 74).¹⁰⁶ BC has no reserves or deposits of oil or refining infrastructure. Gasoline, fuel oil and diesel supplies are provided by Pemex by boat, while natural gas is imported from the US through private pipelines and consumed in combined cycle plants or processed as LNG in Costa Azul, Ensenada (Muñoz-Meléndez, 2012; Muñoz-Andrade *et al.*, 2020).

BC also benefits endogenously from the Cerro Prieto geothermal plant, active since the 1970s and with 5-unit expansions from the 1980s through the 2010s (Gupta & Roy, 2007: 165-193; DiPippo, 2012: 289-304). Cerro Prieto has a registered installed capacity of 720 MW and supplies the BC grid with non-intermittent baseline electricity (see SENER, 2019). Even though renewables in BC account for 22% of total power generation in 2018, Cerro Prieto represents 99% of the RE generated in the state (Muñoz-Andrade *et al.*, 2020: 3). BC became a reference

¹⁰⁶ See chapter 4, map 4.4.

internationally as one of the regions promoting geothermal energy as a clean and non-intermittent source. Cerro Prieto, along with Los Azufres in Michoacán and Los Hornos in Puebla, Cerro Prieto represent 90% of Mexico's geothermal output, with only low-enthalpy fields.

BC is an energy-intensive region due to its industrial hubs and manufacturing (*maquilas*) activities arranged in clusters based in Tijuana, Ensenada, Tecate and Mexicali. Industrial clusters span a variety of strategic activities for the border region: automotive, aerospace, electronic gadgets, household appliances, medical products, biotechnology, information and communication technologies, medical services and transportation (SE, 2016; Cervantes, 2013; Chávez & García, 2015). Its geostrategic position made BC the third exporting state in Mexico, with the US being the main recipient of manufactured products (80%).¹⁰⁷ BC has eight maritime ports: five for commercial activities, two for fisheries and one for oil products (SE, 2016). Lastly, because of its arid and dry-tropic climate and increasing temperatures (reaching 50°C in Mexicali during 2021), BC is subjected to the summer "peak electricity demand" due to the growing consumption of electricity for refrigeration and air-conditioned for dwellings and buildings (see ESTA International, 2014; PRODESEN, 2019; Oropeza-Pérez & Petzold-Rodríguez, 2021).

¹⁰⁷ Data can be retrieved from the INEGI online databases, available at: www.inegi.org.mx.

Table 6.2. Baja California basic electricity indicators

Electricity service coverage, 2017	
Urban	99.11%
Rural	96.32%
Total population	3.7 million*
Electricity coverage of total population	99.3%

Source: Muñoz-Andrade *et al.*, 2020: 6.

*Data from INEGI database
(<https://www.inegi.org.mx/>).

Energy demand, 2019	
Annual	14,621 GW/h
Peak demand	2,887 MW/h

Source: SENER, 2020: 35, 38.

Electricity supply by sector, 2017		
Sector	Market share	Power consumption
Residential and commercial	90%	34%
Industrial	1.3%	56%

Source: Muñoz-Andrade *et al.*, 2020: 6

Installed capacity 2020 (MW)	
Total	4,049
Export to California	1,102
Effective installed capacity for BC	2,947

Source: Muñoz-Andrade *et al.*, 2020: 2.

Table 6.3. Baja California energy matrix, 2019

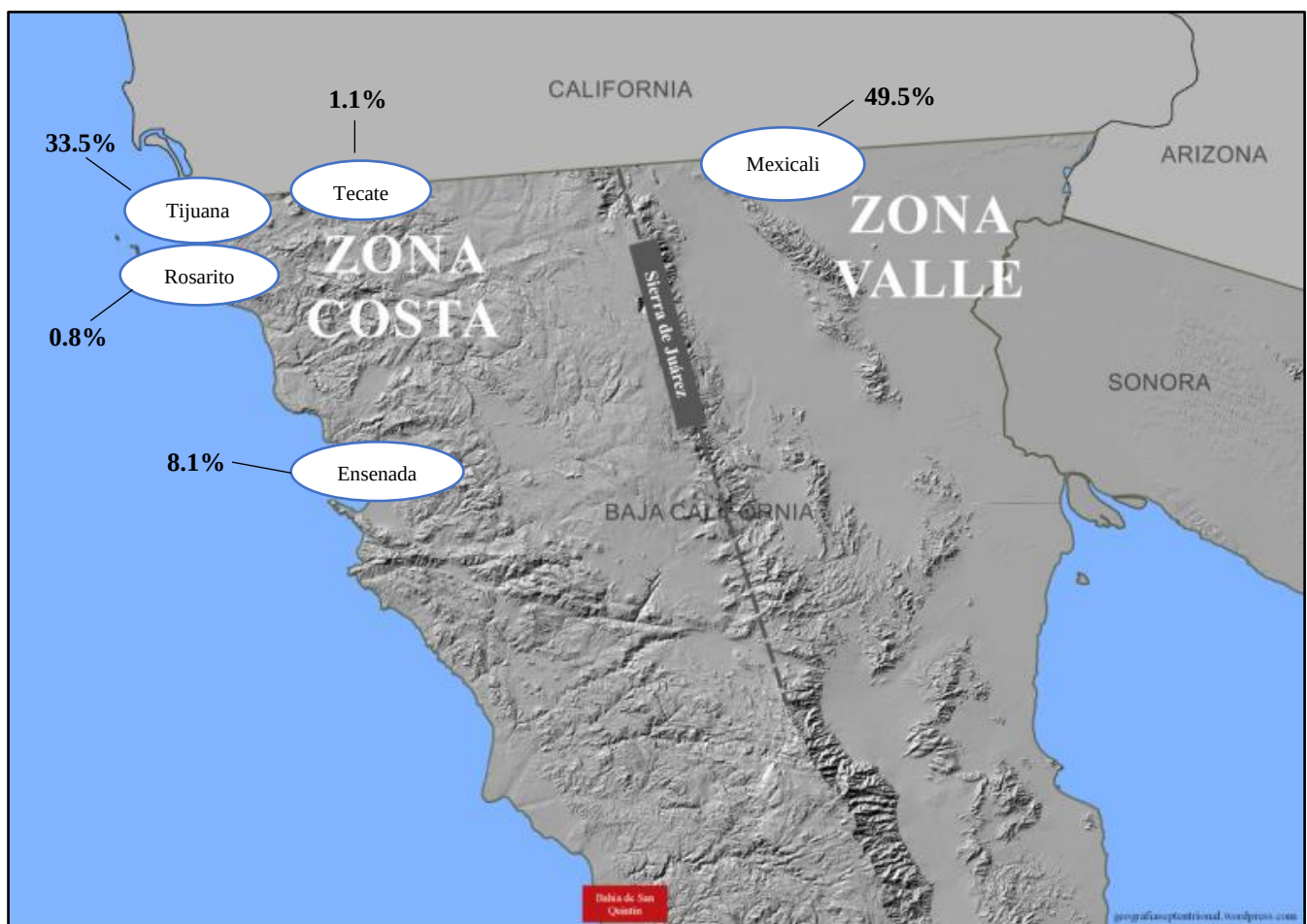
Technology	Ratio	Consumption sector	Ratio
Combined cycle (natural gas)	75.93%	Industrial	56.3%
Turbogas	12.03%		
Geothermal	9.40%	Residential	34.3%
Solar	1.27%	Commercial	5.1%
Internal combustion (natural gas)	1.06%	Agriculture	2.9%
Wind	0.28%	Public services	1.3% ⁵
Internal combustion	0.03%		
TOTAL	100%	TOTAL	100%

Source: Muñoz-Andrade *et al.*, 2020: 7, 12.

Electricity consumption in BC is concentrated in two different climatic and geographical regions where the state's main cities are located. Between both areas lies the main orographic system of BC: The Sierra Juarez and the Sierra San Pedro Martir mountain ranges. BC shares the course and delta of the Rio Colorado (96 km), the main river that has water all year round and supplies fresh water to the region. The other hydrographic systems are smaller and flow into the Pacific slope, remaining dry most of the year (INAFED, 2010). BC is connected to the Gulf of California (also known as Sea of Cortés) and the broader Pacific Ocean coastline, having maritime and geopolitical communication with Asia/Oceania and the rest of the American continent. It shares its terrestrial border with the US states of California (226.52 km), Arizona (26.35 km) and the Mexican state of Sonora, the only in-land communication with the rest of the country. Following Muñoz-Andrade *et al.*,

Mexicali, located in the Zona Valle, has hot summers that lead to higher air conditioning usage than is common in the more moderate Zona Costa. In addition, owing to a combination of robust industrial activity and electricity demands for the Colorado River water supply to Tecate, Tijuana, Rosarito, and Ensenada, the per capita electricity consumption is several times higher in Zona Valle than in Zona Costa. Both regions, however, are relatively higher electricity consumers than the national average, owing to their high industrialisation, higher per capita income, and the lack of enforcement in building energy efficiency (2020: 7).

Map 6.6. Baja California geographical zones, main cities, and share of electricity consumption, 2017



Source: Martínez-Zazueta, 2018.

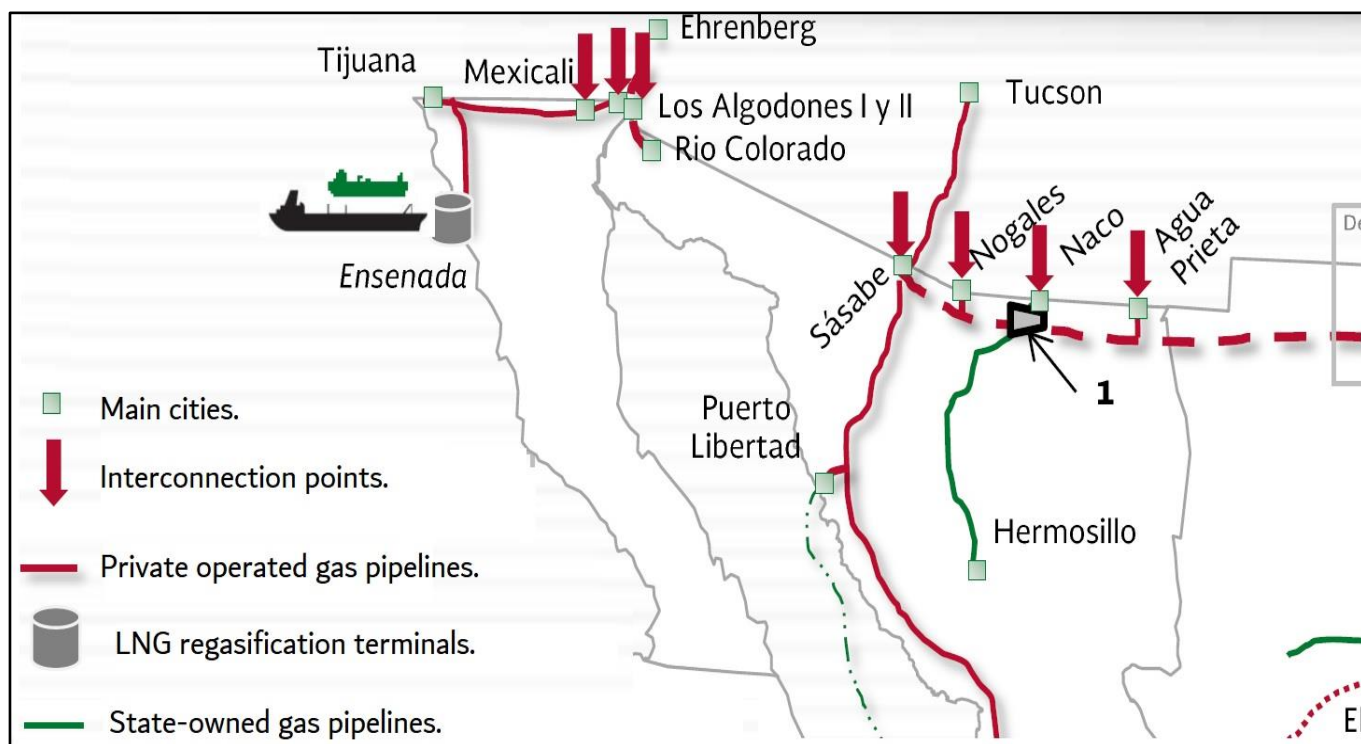
In the face of climate adversities, BC has had several energy challenges that emerged during the last 20 years. The combination of factors includes rising temperatures and increasing energy demand, the US shale gas imports boom, and the exhaustion of Cerro Prieto's geothermal output. According to Muñoz-Meléndez *et al.* (2017: 192), before 2020, "up to 70% of electricity generation was from geothermal sources followed by about 25% from fuel oil and to a minor degree from diesel". However, since 2001, natural gas was introduced in the region, "becoming the most important source to produce power, due to the establishment of two privately-owned power plants in Mexicali" (p. 192). This situation led to the substitution of the historical geothermal output by imported natural gas (branded as a "transition fuel" for decarbonisation). One of the diagnoses of the Energy Commission of BC was

Currently 14 utility-scale power plants are operational in Baja California with a combined installed capacity of 4,049 MW. However, not all of the units are under the same regulatory framework. With 1,102 MW destined for export to California, that leaves Baja California with an effective installed capacity of 2,947 MW. Considering that not all facilities are fully operational at the same time actual capacity is insufficient to meet current peak load and the projected increases in demand. The most salient case of underutilisation is that of Cerro Prieto. Once the second-largest geothermal power plant in the world, it had an effective capacity of only 340 MW compared to its installed capacity of 570 MW. Cerro Prieto suffered major capacity retirement in 2011, when four of thirteen turbines were shut down permanently (decommissioned) because of the lack of steam, reducing the original installed capacity from 720 MW to 570 MW. In other words, Cerro Prieto is now operating at a little less than 60% its installed capacity and less than 50% its original capacity (Muñoz-Andrade *et al.*, 2020: 11).

Thus, the BC isolated electricity system has followed three interrelated processes: *a)* the deterioration of Cerro Prieto geothermal output, *b)* the growing dependence on imported US natural gas, and *c)* the relatively recent interest in solar and wind energy deployments based on the region's potential. The current energy matrix and installed power capacity have been financed through public budgets (CFE and the state Government of BC) and private investment under the IPP scheme (Muñoz-Meléndez, 2012: 34). The main private player in the region is the multinational company Sempra, through its Mexican subsidiary IEnova, investing in natural gas pipelines and plants, as well as solar/wind projects for electricity generation (IEnova, 2012). One case has been the Sierra Juárez cross-border wind project, financed by the NADB as part of the NAEI. In this case, Sempra in California sells energy to itself through IEnova with the territorialised wind resource in the Jacume ejido land, Tecate.¹⁰⁸

¹⁰⁸ The project profile and the "Certification and Financing" proposal can be found in the Sierra Juárez project overview, available online in: <https://www.nadb.org/our-projects/infrastructure-projects/energia-sierra-juarez-wind-energy-project-first-phase-tecate-municipality-baja-california> [retrieved: July 30, 2021].

Map 6.7. Baja California natural gas isolated system, based on maritime supply and US gas pipelines imports, 2016

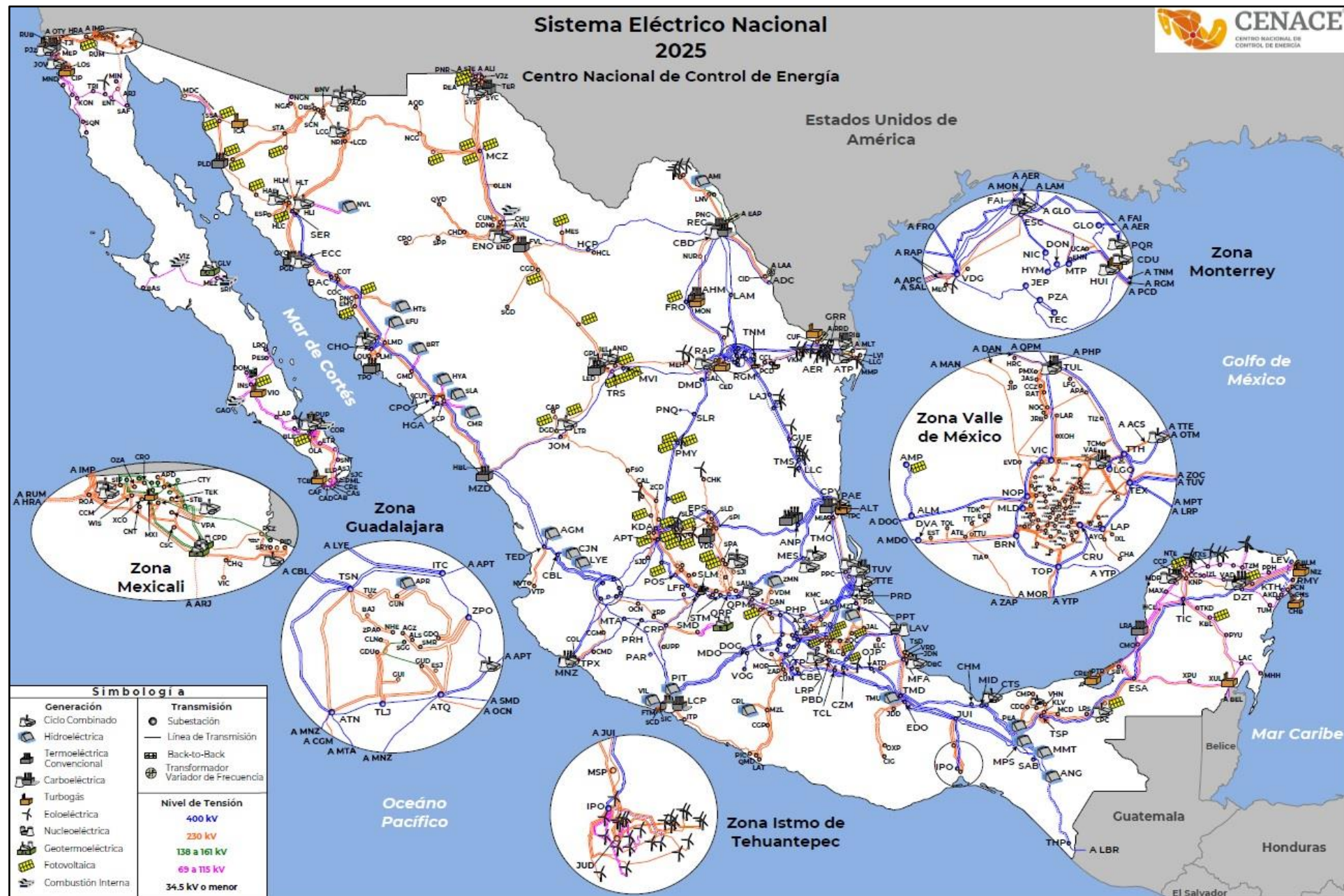


Source: SENER, 2016b.

Table 6.4. Main power plants in Baja California

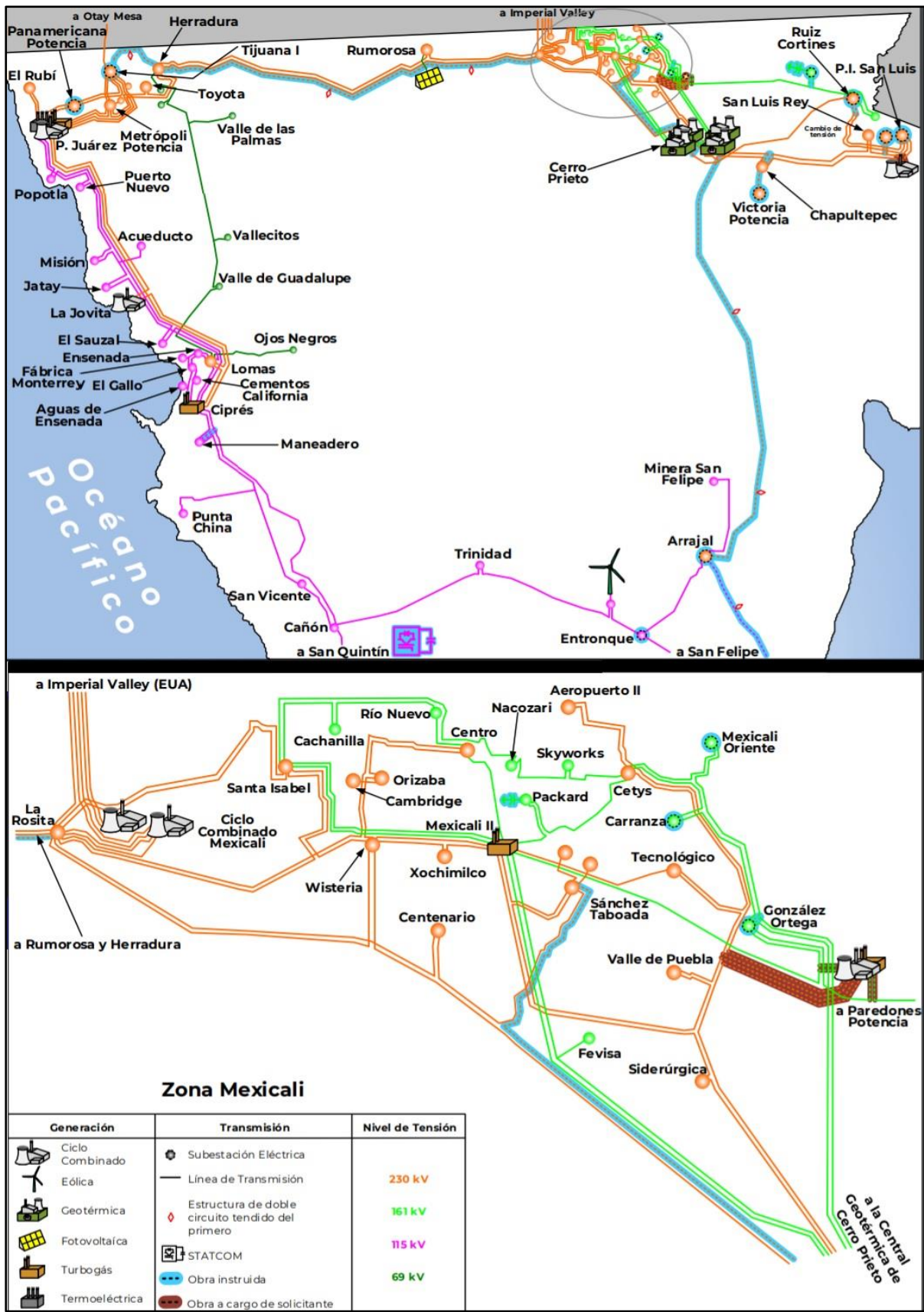
Project	Technology	Owner	Capacity (MW)	Location	Regulatory framework	Off-Taker
CI Cedros	Internal combustion	CFE	1	Ensenada	Generator	CFE-Basic Service Supplier
Cerro Prieto Solar	Solar photovoltaic	CFE	5	Mexicali	Generator	CFE-Basic Service Supplier
Parque Eólico La Rumorosa	Wind	State Government of BC	10	Tecate	Self-supply	City of Mexicali
Turbo-gas Ciprés	Turbogas	CFE	28	Ensenada	Peaker	WEM
Energía Costa Azul	Internal combustion (natural gas)	IEnova	38.5	Ensenada	Self-supply	Energía Costa Azul
Rumorosa Solar	Solar photovoltaic	IEnova	41	Mexicali	Generator	CFE-Basic Service Supplier
Turbo-gas Mexicali	Turbogas	CFE	62	Mexicali	Peaker	WEM
EAX – AA	Combined cycle (natural gas)	SAAVI	80	Mexicali	Self-supply	Industrial use
Energía Sierra Juárez	Wind	IEnova	157	Tecate	Export	San Diego Gas & Electric
EAX – Gen	Combined cycle (natural gas)	SAAVI	165	Mexicali	Generator	Industry, WEM
Baja California III	Combined cycle (natural gas)	Iberdrola	324	Ensenada	Generator	CFE-Basic Service Supplier, WEM
Cerro Prieto	Geothermal	CFE	340	Mexicali	Generator	WEM
Turbo-gas Tijuana	Turbogas	CFE	345	Tijuana	Generator	WEM
La Rosita	Combined cycle (natural gas)	SAAVI	320	Mexicali	Export	WEM
La Rosita	Combined cycle (natural gas)	SAAVI	489	Mexicali	Generator	CFE-Basic Service Supplier
Termoeléctrica de Mexicali	Combined cycle (natural gas)	IEnova	625	Mexicali	Export	WEM
Presidente Juárez	Combined cycle (natural gas)	CFE	1063	Rosarito	Generator	CFE-Basic Service Supplier, WEM

Source: Muñoz-Andrade *et al.*, 2020: 7, 12.



Source: CENACE, 2021.

Map 6.8. Main nodes of the Baja California energy system and Mexicali industrial cluster, 2020



Source: CENACE, 2021.

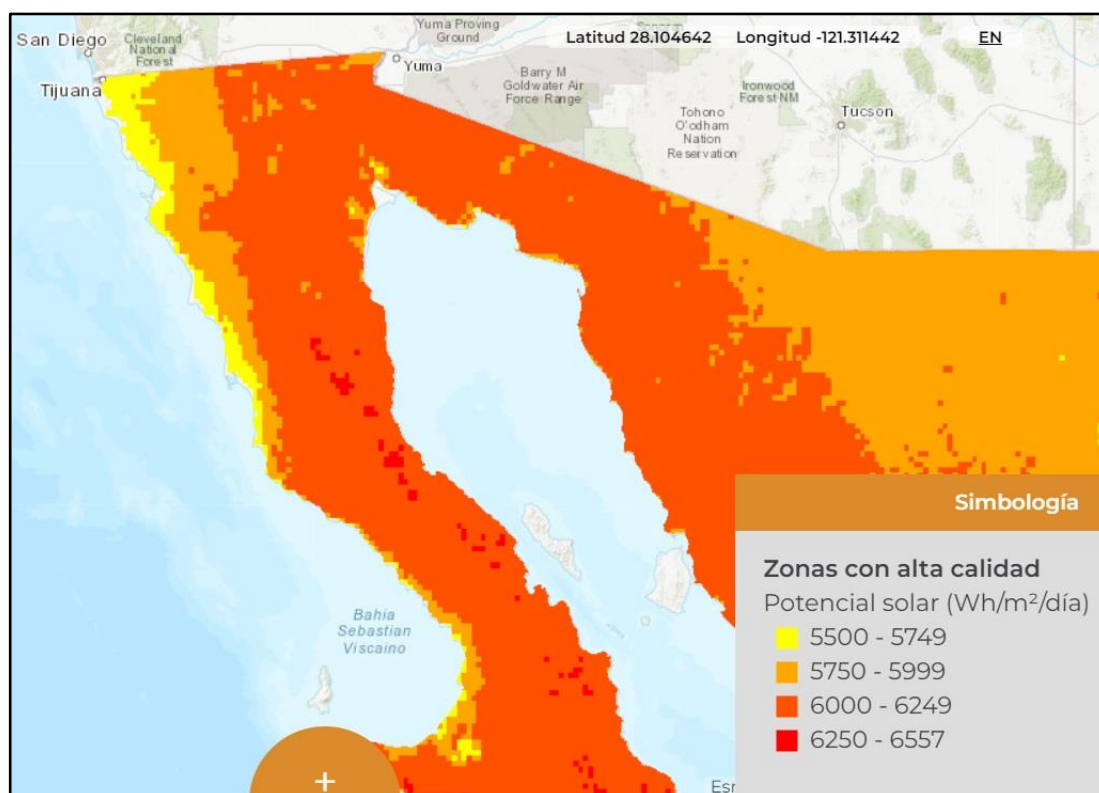
6.2.2. A financial approach to the BC isolated energy system

From a financial standpoint, the "energy island" concept brings challenges and opportunities for RE investments. The BC State Energy Commission concluded two complementary scenarios to address the projected power capacity shortfall through 2025 and the opportunity to boost the local ET. First, is the optimisation scenario:

[It] consists of optimising [the] current electricity generation assets to avoid large investments in new resources and infrastructure. The scenario focuses on upgrading the Cerro Prieto Geothermal Field to improve efficiency, reducing non-technical losses through wider penetration of Advanced Metering Infrastructure [AIM], interconnecting existing generation assets that currently export power, and promoting participation of the Baja California Norte grid in the California Independent System Operator Energy Imbalance Market (CAISO EIM). It also looks at upgrading simple cycle gas turbines to combined cycle at the Presidente Juárez Power Plant in Rosarito (Muñoz-Andrade *et al.*, 2020: 17).

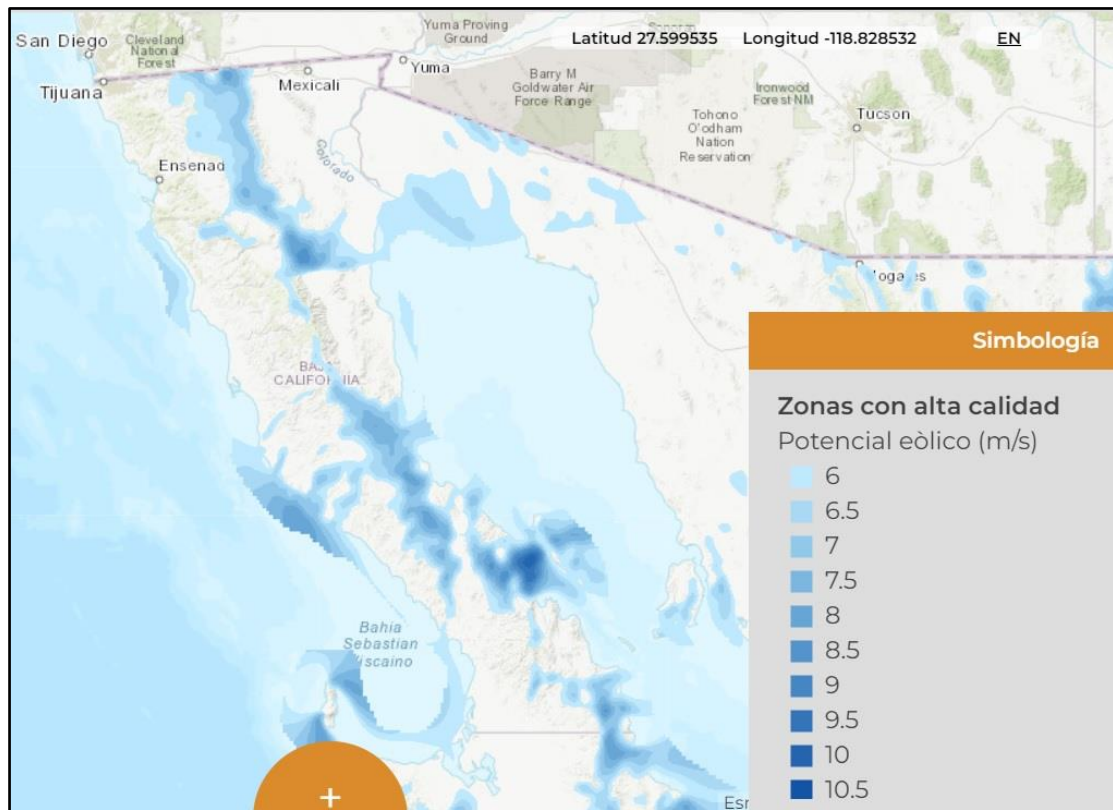
The second path is the renewables maximisation scenario. As I have mentioned before, the financialisation of the ET requires an initial wave of RE assets to establish the contradictory relation between industry and finance. After the Energy Reform, the ET narrative reshaped the BC territory to exploit the geostrategic and geoeconomic potential of the solar, wind and geothermal sources, while adding others such as small-hydro and biogas (Muñoz-Andrade *et al.*, 2020: 26). The primary argument used within the financial discourse is the "unprecedented potential" for harnessing these energies, considering that renewables are the only endogenous sources that BC has to meet the growing energy demand within an isolated system.

Map 6.9. Baja California solar energy potential



Source: retrieved from the AZEL GIS (<https://dgel.energia.gob.mx/azel/>).

Map 6.10. Baja California wind energy potential



Source: retrieved from the AZEL GIS (<https://dgel.energia.gob.mx/azel/>).

Map 6.11. Baja California geothermal energy potential



Source: retrieved from the AZEL GIS (<https://dgel.energia.gob.mx/azel/>).

This potential became a crucial argument for the diversification and decarbonisation of the regional energy matrix. The idea of transforming BC into a relatively autonomous energy island, based mainly on solar and wind sources, became an ET example to mitigate Cerro Prieto's geothermal output decline, the increasing natural gas foreign dependence, growing electricity demand for industrial activities, and the need for system stability during summer peak demands. Nonetheless, by being an isolated system, BC represents both untapped potential and a constrained investment space. These combined factors are:

6.2.3. Project size and grid congestion

While inquiring about the financial potential for RE projects in BC, Guillermo Chávez of PwC briefly mentioned:

"Investment interests are in projects over 30 MW, this is the milestone for attractive projects from a market standpoint. These are the ones financial firms are looking for in terms of growth and profit potential".¹⁰⁹

This is a recurrent argument on financial roadmaps for RE finance, pointing to the importance of introducing "merchant" and "bankable" energy projects in the Mexican industry (see Bancomext-GIZ, 2018, 2018a; Bancomext, 2018; Yaneva *et al.*, 2018). As I discuss in the next chapter, this is one of the most reductionistic approaches of finance in terms of the ET. Anything below 30MW represents a gap that large-scale energy planning and mainstream finance will not cover because of a lack of profitability. Even though Climate Finance reports mentions blended mechanisms and other dynamic investment vehicles to attend small projects and community energy, it is true that the Mexican financial system and the structural conditions of the economy still envisage an ET based on building massive and centralised energy projects to feed anonymous electricity markets (see Álvarez-Béjar, 2018). Carlos Villanueva commented:

"When presenting projects for syndicated loans or institutional investors, the main clauses refer to the need for solid guarantees and attractive returns in project finance schemes. In Baja California, the only attractive projects in that sense are those waiting to sign PPAs with private players or CFE, and of course selling energy to the US and cash in dollars. Due to the amounts required to finance renewable technologies and the problem of interconnection, projects are turning to solar installations for self-supply, taking advantage of the desert radiation. It is also true that there are plans to micro-finance solar panels for distributed generation, but this is different from productive projects that solve other local problems such as agriculture and access to drinking water. This requires the design of off-grid or micro-grid projects, also storage systems, but these are still expensive technologies. I have seen projects well sustained on the social and environmental side, but in the end, profit margins and liabilities payback are what dictates funding".¹¹⁰

Nonetheless, building bigger projects also has its limitations within the BC isolated system due to congestion bottlenecks. Wind projects like Sierra Juarez prefer the more dynamic and liquid US market because the local BC grid would not support such a supply under current conditions (Jiménez, 2019). Edgar Del Villar pointed:

"After the Reform, the energy sector thought that financing would come from abroad to fund renewable energy projects. Internally, there was a lack of financial resources to achieve these initiatives. The problem is that local companies only presented small projects because of high risks and the lack of experience and

¹⁰⁹ Information retrieved at the *Mirec Week 2019 Energy Congress & Expo*, Mexico City, on May 22, 2019.

¹¹⁰ Interview conducted in Baja California, Mexico, on May 5, 2019.

guarantees. We need the regional approach. It doesn't matter if you want to install a high-end technology, or if you have a good financing deal tied up. The problem is that the grid would not support the interconnection. That is the problem of Baja California; if you want to install a 100 MW generation plant, be it solar or wind, the system operator will tell you that you can only inject 10 MW due to grid constraints. Who is going to invest under those conditions? Especially with long return-on-investment periods in renewables projects".¹¹¹

As seen before, grid expansion is a Federal Government activity in hands of SENER planning and *CFE Transmisión*. The lack of transmission infrastructure and interconnection to the National System depends on Federal budgets and PPP agreements, despite it being a regional and local state issue. Without this infrastructure, the isolation condition of BC represents financial constraints for RE expansion and market growth. According to ESTA International (2014),

interconnecting Baja California with the SIN would be technically viable and economically justifiable. This interconnection would allow reserve sharing and enable serving peak demand in the Baja California system with generation resources from the SIN. Conversely, during low demand in Baja California, surplus electricity from baseload (i.e., geothermal and combined cycles) may be exported to the SIN. As a result of this interconnection, Mexico would benefit from reduced investment in generating resources and transmission infrastructure as well as a reduction in operating costs of Mexico's power grid. [...] Due to the absence of this connectivity, its ability to absorb a large number of renewable resources will be limited. Mexico's plans to connect Baja California to the rest of Mexico's power grid should not only reduce operating costs, but also provide further opportunities for placement and integration of utility-scale renewable resources (pp. 16, 49).

Solar and wind generators will choose places or proximity places that have the best renewable resource and are close to a substation. Yet we have the recurring problem of a lack of interconnection infrastructure available. On the financial side, Keijser argued:

"The main challenge in Baja California is a commercial one: prices drop due to a massive solar and wind availability, provoking the subsequent congestion of the grid. This contributes to new investment in generation being stalled until the State invests in transmission lines or interconnection infrastructure, which it has not done in the last 5 years. The generator may not even care about the node but needs transmission to evacuate the energy. An additional problem for the entire Baja California peninsula as an island territory is that demand is relatively low, at around 200 MW. It is a demand that would not absorb renewables massively, being necessary sending it to other regions. One solution would be solar with batteries, which helps to manage intermittency and gives you a leveled cost of 90 dollars, is cheaper than diesel and does not pollute".¹¹²

The project to interconnect BC with the rest of the National System is a long-standing debate subjected to techno-economic, financial and spatial issues. In 2018, SENER published the public bidding LT/SENER-01-2018 to attract international capital into the construction of the transmission line that would link BC with the neighbour inland state of Sonora. The project is scheduled for completion in 2023.¹¹³ This opening process for infrastructure investment guaranteed by the Mexican State attracted several global firms. The cost of the project "will be approximately 1.1 billion USD for the transmission of 1,500 megawatts over 700 km. SENER reports on the tender microsite that so far there are 22 participants, although 109 companies have

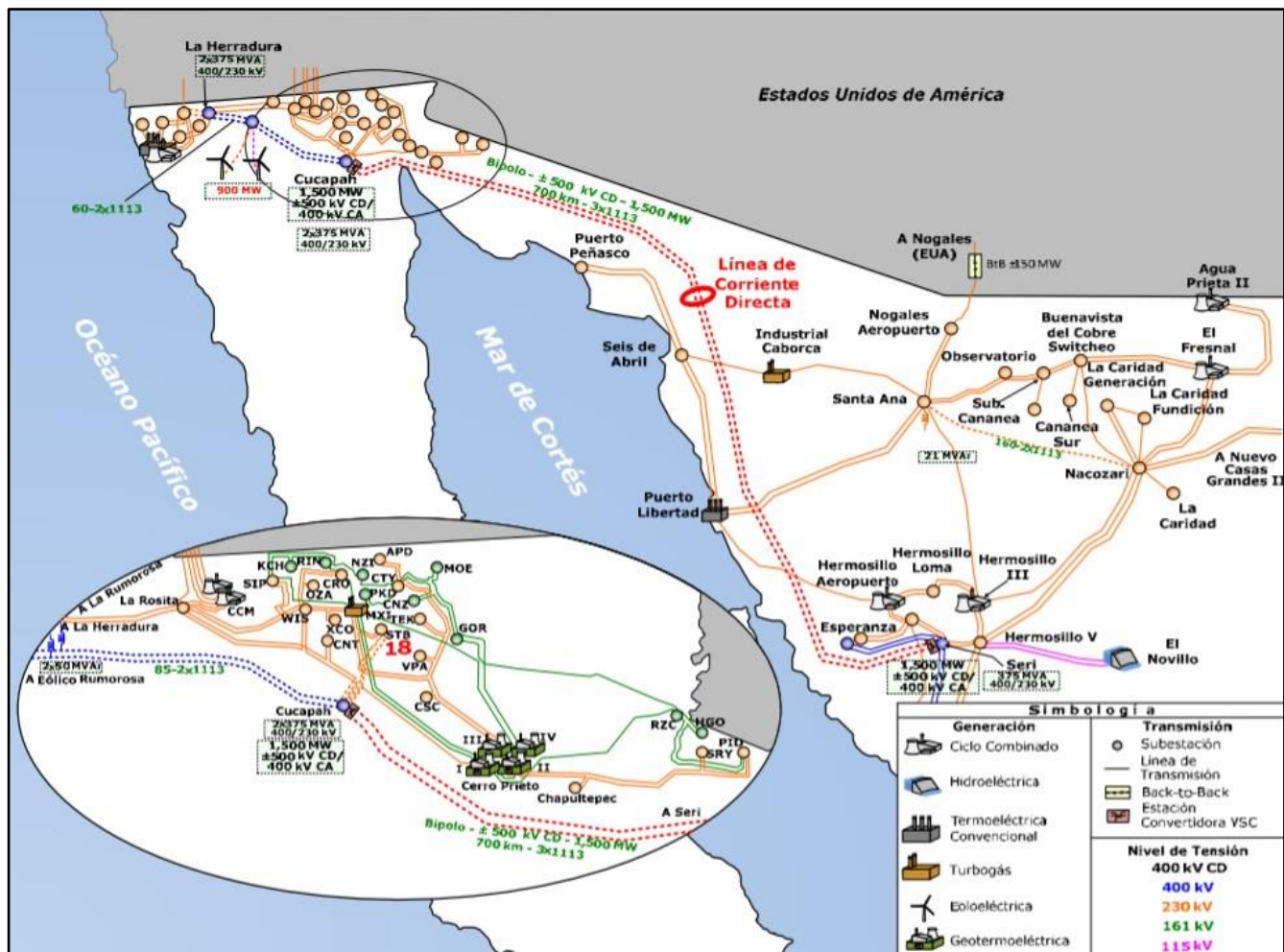
¹¹¹ Interview conducted online on March 8, 2021.

¹¹² Interview conducted online on October 28, 2021.

¹¹³ See SENER, 2018a. The original initiative is available online in the Mexican Government portal: https://www.proyectosmexico.gob.mx/proyecto_inversion/716-interconexion-del-sistema-electrico-de-baja-california-con-el-sistema-interconectado-nacional/ [retrieved: May 12, 2021].

shown interest" (García, 2018). At the time, it was thought that the project "will allow taking advantage of the installation of renewable electricity in the entity, which has wind and solar potential installation of more than 1,000 MW (1.5% of the current national capacity)" (García, 2018). The project was expected to be a PPP, "in which the winning company of the tender will invest 1,100 million USD, while SENER will grant a concession for 30 years" (Martínez, 2019).

Map 6.12. Baja California - National System interconnection project, 2018¹¹⁴



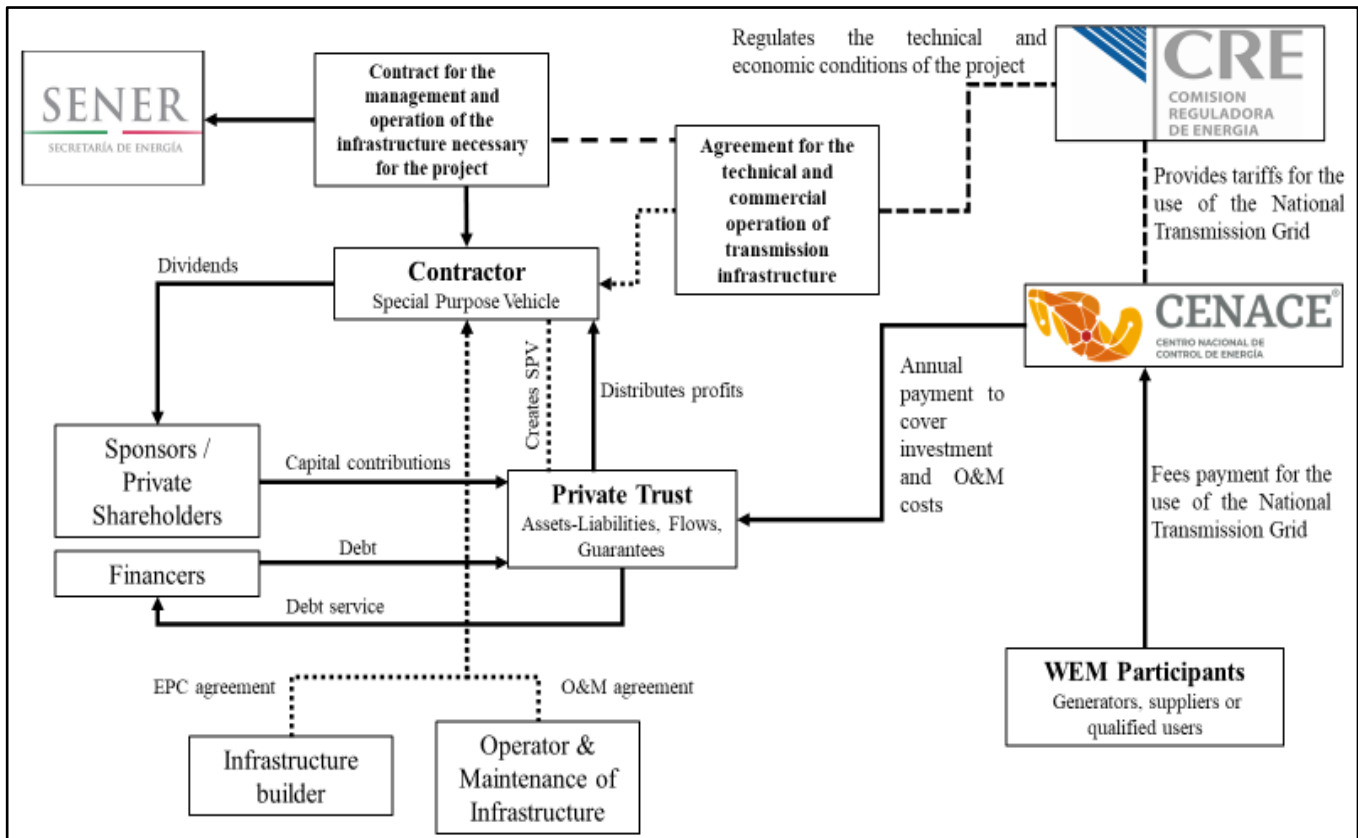
Source: SENER, 2018a.

In line with the financialisation of energy infrastructure, the BC interconnection project also sparked interest in financial innovations to avoid State control over the transmission grid and a traditional public-private association. According to SENER (2018a: 100), the ER allowed the Mexican State to "create associations or sign contracts with private parties to carry out, on behalf of the Nation, the financing, installation, maintenance, management, operation and

¹¹⁴ The official document states: "The power transmission line will run from Seri, Hermosillo in the state of Sonora, to Cucapah, Mexicali in the state of Baja California. The project involves a point-to-point direct current interconnection with a design capacity of 1,500 MW, at a voltage level of ± 500 kV and an initial operation at 1,000 MW. The estimated length of the line is 700 km" (SENER, 2018a: 100).

expansion of the infrastructure necessary to provide the Public Electricity Transmission Service". Thus, this scheme must be supported by a financial scheme where energy infrastructure is subjected to rent extraction through interests, dividends and amortisations.

Figure 6.4. Proposed financial scheme for the transmission infrastructure expansion project in Baja California



Source: own elaboration, based on Ramos *et al.*, 2017.

Yet in 2019, the AMLO administration cancelled the bidding process, in line with the more nationalistic approach of giving CFE all the main attributes to plan and develop the interconnection infrastructure. During the writing-up process of this thesis, I questioned CFE personnel about the BC interconnection project. I got an answer from CFE's Sub-directorate of Networks Businesses:

"The interconnection project was resumed this year [2021] and will be done in stages to ensure the stability of the system. The current plan foresees the construction of a photovoltaic plant near Puerto Peñasco, Sonora, of 2 million panels over 2,000 hectares, representing an installed capacity of 1000 MW. This would support the interconnection plan between Baja California and Sonora. The plant will supply the Baja California system, but it will also provide electricity to the rest of the national grid. The bidding process for private companies to participate in the project along with CFE will be resumed, but this time there will be no concessions, only payment to private parties for the construction of the infrastructure. However, we still have to technically assess the space between Puerto Peñasco and Mexicali, as the Pinacate natural reserve is there. It is a narrow space between the Gulf of California and the US border, about 80 km long. It is not possible to install infrastructure there. We are thinking of a more surgical intervention in the territory, like

sticking to the right of way next to the small highway through the reserve or taking the transmission line next to the border wall. There is also the possibility of a submarine cable, but this is even more expensive in terms of investment and environmental impacts that must be considered".¹¹⁵

6.2.4. Supply-demand dislocations and price volatility

Other characteristics of the BC isolated grid are related to the economic limitations of a closed system. Recent literature pointed to the advantages of introducing RE into off-grids or independent systems based on small-scale wind and solar for distributed generation, supported with storage or emergency fuel plants (see Roy & Bandyopadhyay, 2019; Zobaa & Abdel-Aleem, 2021). These initiatives see the transition to a more localised supply for tailored demands based on system flexibility and avoiding capital costs of expanding centralised transmission lines. But the current centralised projects based on the WEM perspective still understand the territory as a potential space for large project deployments. Like any capitalist macroeconomic system, closed economies face the pressure of growth and processes of oversupplied markets and underinvestment in capital accumulation axes (see Valenzuela-Feijóo, 2014). As long as the BC system is isolated, the growth perspective fostered by financial interests would work on the lack-of-infrastructure / lack-of-new-generation vicious circle. Energy consultant Valeria Ojeda, one of my field gatekeepers, stated:

"Baja Norte has three main problems in terms of renewables. The first is the physical limitations of the current grid. The second is a cost issue: wind and solar have become cheaper technologies but it is difficult to compete with imported cheap natural gas that gives you clean and efficient electricity 24 hours. Lastly, it has been difficult to scale renewables due to a lack of market off-takers that can purchase the energy through PPAs. We have spotted places with good resources and accessible negotiations with landowners, but the big consumers have already signed PPAs with other generators, including CFE. New industries arriving in Baja California could help renewables to grow, especially in climate sectors like desalination plants, water pumping and irrigation systems. The problem is the ambiguity of the new administration that undermines investor confidence. Building a plant takes risks from 3 to 5 years, including regulations, interconnection permits and other impact assessments such as social and environmental studies".¹¹⁶

So, what areas of the industry are still attractive for financial development of RE at BC?

"One thing that encouraged private investment in Baja Norte was CFE's inability to meet peak demand during the summer. CFE's capacity has been overwhelmed by rising temperatures and the increasing use of electricity for air conditioning, especially in the valley zone. That is why the Reform introduced the correction protocol mechanism for the reliability, stability and security of the energy system in Baja California. A public bidding process takes place every end of the year where private parties and CFE. The objective is to present economic dispatch proposals to sell capacity and electricity in advance to cover the summer peak of next year. The plants can be of any technology, but the main interests are solar and wind due to lower variable costs and being the first in the line to be dispatched. However, the private sector understands these as strategic projects in conjunction with the operation of the system because you cannot have a generation park that is three times your need and then have it shut down for three-quarters of the year. From there the challenge of finding attractive market off-takers that require electricity all the time and not just during summer peaks. Another interest comes from the gap left by CFE and the possibility to replace old generation parks. Electricity infrastructure in Baja California is insufficient and sometimes even

¹¹⁵ Interview conducted online on May 13, 2021. See the environmental exclusion zones ahead to support this quote.

¹¹⁶ Interview conducted in Baja California, Mexico, on May 7, 2019.

obsolete. Therefore, one of the challenges for renewables is to help Baja California to move towards the electrification boom. This growing demand would require renewables to be able to follow the industrial growth pace that the local Energy Commission promotes. We have been in dialogue with industries that are looking to settle in Baja California precisely because of the renewable potential and the proximity to the US. These companies are committed to decarbonising their industrial activities".

If more participants enter the market, will there be an oversupply to cover the summer peak and increasing limitations to vent the surplus energy?

"Energy companies have tended to look for other business models with renewables and avoid the market. First is self-supply. Companies use their own funds or external financing to install generation plants on their property, using their own land or leasing adjacent lands. The second is distributed generation, where companies are looking for door-to-door businesses to sell rooftop solar panels, an attractive business considering the kWh/m² of solar exposure that Baja has. The third trend is selling energy to the US. The electricity market is more liquid on that side. Since California took the lead as a green state. There has been an interest in offering clean energy generated in Mexico to supply the neighbour market, whether during peaks or 24 hours. This is a good opportunity that needs to be accelerated, energy trading and brokerage with the US is attracting companies to energy consultancy areas. Investors are waiting to see how bilateral agreements to homologate and coordinate infrastructure regulations and systems stability on both sides of the border evolve".

Geographical energy system isolation brings additional characteristics to the centrality and geography of prices that I referred to previously. A multi-node system such as the Mexican one, coupled with the deregulation of the Energy Reform, led to a mapping of the more strategic nodes for energy trading. As Alejandro Moreno remarked, *"Each node responds to different climate, demand, price and regional system conditions. In medium and long-term auctions, it is expected to supply the electricity based on hubs or zones where there is an agglomeration of nodes that theoretically behave similarly. Liquidity tends to be concentrated in a few nodes where the market is centred"*.¹¹⁷ The BC node hub is subjected to attractive prices but seasonal volatility cycles that are part of financial planning modelling. While checking the *MEM México* app on his phone, energy consultant Mr. P.B. commented:

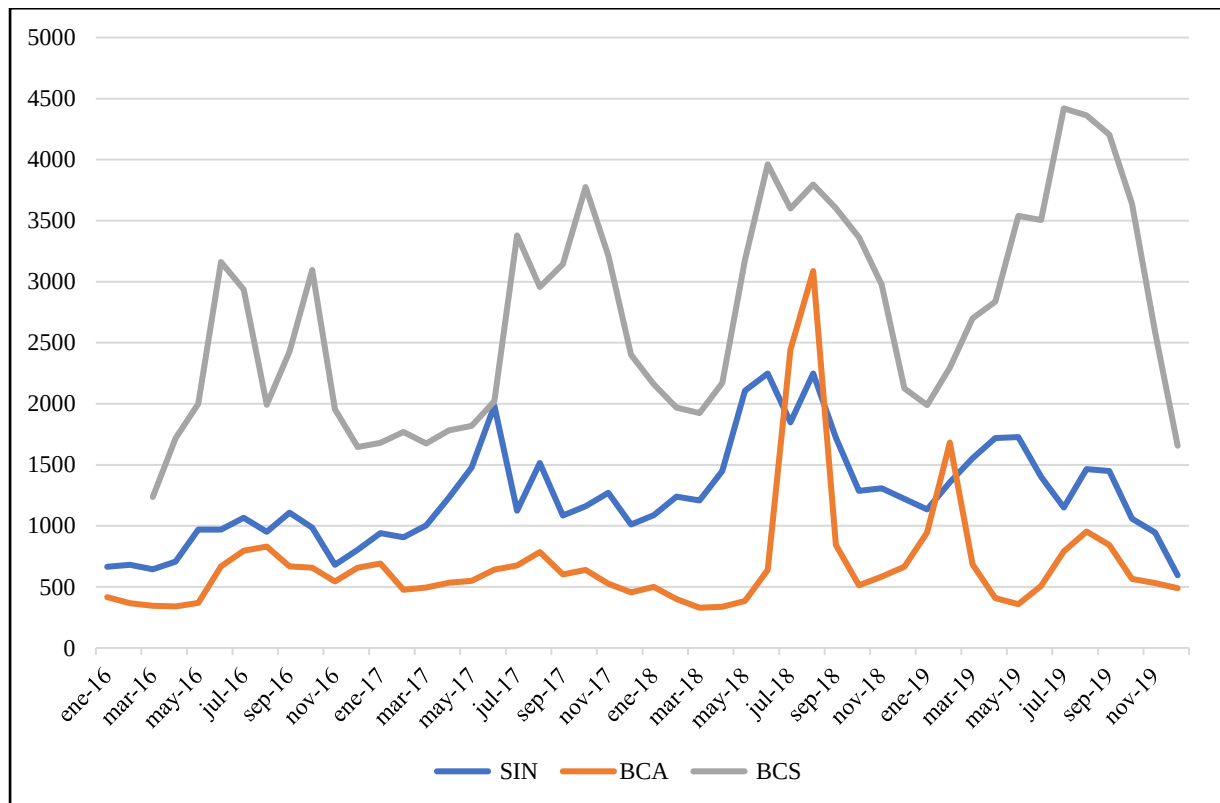
"To install a plant in BC, the generator must model the historical LMP in both the day-ahead and real-time markets. Attractive pricing is what leads to the process of leasing risk-free land close to interconnection nodes. The Baja California nodes are very dynamic in terms of prices, influenced by seasonality, maquila-based demand, the energy exchange with the US, the regional generation mix and the congestion component of the LMP. On the other hand, much also depends on solar and wind PPAs. The more solar and wind generators, the more price diversification for PPAs. In the market, you are going to find someone offering solar at \$35 USD or someone offering it at \$16. The \$16 will be more attractive even if you add \$20 for congestion risk".¹¹⁸

CENACE database shows that LMPs on the BC system have fluctuated since the entry of the WEM and the Energy Reform protocols in January 2017. Yet prices in the BC system (BCA in the chart below) have remained below the average of the National Interconnected System, but with more abrupt seasonal variations. The combination of volatility and low averaging wholesale prices still represents a challenge for solar and wind investment in the region due to the lack of certainty in electricity supply and stability of cash flows (see Muñoz-Andrade *et al.*, 2020: 23).

¹¹⁷ Interview conducted in Mexico City on March 25, 2019.

¹¹⁸ Interview conducted in Mexico City on June 2, 2019.

Figure 6.5. Local Marginal Prices (Day-ahead Market). Monthly averages (MXN/MWh), 2016-2019



Source: own elaboration with CENACE database (<https://www.cenace.gob.mx/>).

As discussed in previous chapters, the project finance side of the equation sees price volatility as a risk for the stability of cash flows. On the trading and brokerage side, there is a more opportunistic approach related to the volatility of commodity prices. Energy economist Pablo Marcelino explained:

"Electricity prices behave like any commodity in the market. It is about the relative scarcity of that commodity in a specific region. In a place like Baja California, a surplus of sun or wind can cause prices to fall, resulting in an oversupply of renewable generation. For instance, strong waves of heat strokes or wind surges would inject cheap electricity into the grid, considering their low variable costs and fluctuating demand. This could lead to negative LMPs, sometimes affecting generator's profits. This causes the system to continuously balance between oversupply and undersupply according to annual seasonality. Looking at CENACE's weekly reports, prices in Baja California are very attractive for business opportunities. The problem is the infrastructure deficit. Injecting cheap and abundant renewable electricity into the grid would lead to grid congestions and subsequent losses. This is where planning models help to assess the impact and viability of a solar or wind plant. Investments will not succeed if you are not being able to offer the full installed capacity due to limits in the transmission network".

Negative prices are another characteristic of deregulated WEM based on renewable energy and isolated grids. By having regions with high resource exposure, "some renewable energy producers prefer to pay to generate energy" (Roldán, 2017: 56). This situation arises because "for some renewable energy Power Plant Units it is more economical to continue producing energy during off-peak hours than to go out of service, therefore, by submitting bids with a negative value it is a given that they will be designated to go into operation (as they are paying

to produce energy)" (p. 56). In 2019, I interviewed Rodrigo, who works for one of the multinational energy companies currently operating in Mexico. At the time, he told me about the characteristics of the BC node pricing:

"The import-export interaction with CAISO is what makes the Baja California node prices unique. You have two markets, with different demands, supplies, and prices. This has an impact on the prices in Baja California, where seasonal supply-demand relation can make overcapacity situations in the winter, but you can operate under emergency during the summer. In 2018 there were cases of prices spiking to 14,000 USD/MWh and then negative prices of around 2,000 USD/MWh. This kind of volatility between maximum and minimum is what makes financial hedging attractive to mitigate price risks".¹¹⁹

The ESTA International (2020: 89) report argues that the CAISO electricity import-export dynamic has become more relevant for the definition of LMPs in BC. On the one hand, energy surpluses occur when demand is low in relation to the baseline energy supply, inducing negative prices. On the other, during hours when capacity shortages occur, BC must rely on imports to meet demand and avoid higher marginal costs due to power outages (see ESTA International, 2020: 89-90, 230). To this, we must add the lack of flexibility in the system. Plants that were built to sell power to California (such as the *La Rumorosa* wind farm in Tecate) would not be able to supply Baja California itself due to a deficit in transmission infrastructure mentioned earlier (Jiménez, 2019; Sánchez-Berrospe, 2020).

Figure 6.6. Example of negative prices in the Baja California system, March 2018



Source: CENACE, 2018b.

¹¹⁹ Interview conducted in Mexico City on April 4, 2019.

6.2.5. Geographical exclusion zones

In this section, I will briefly analyse some of the spatial deployment limitations that RE has in BC. The viability of harnessing solar and wind sources confronts two visions of the territory: a geohistorical space shaped by socio-environmental relations, and the financial profitability geopolitics of energy technologies and infrastructure. Fieldwork helped to assess the coexistence of these two overlapped geographies, pointing to the limits of the ET model that originates from the asynchronous race between growing demand and renewables spatial expansion. Financially, investment platforms consider as "exclusion zones" several variables that reduce available hectares for potential installed capacity. Thus, the financial geostrategic approach hierarchically divides the territory into centres and peripheries as not all of BC's solar and wind potential is economically, socially, environmentally and geographically viable. Let us review some of these arguments.

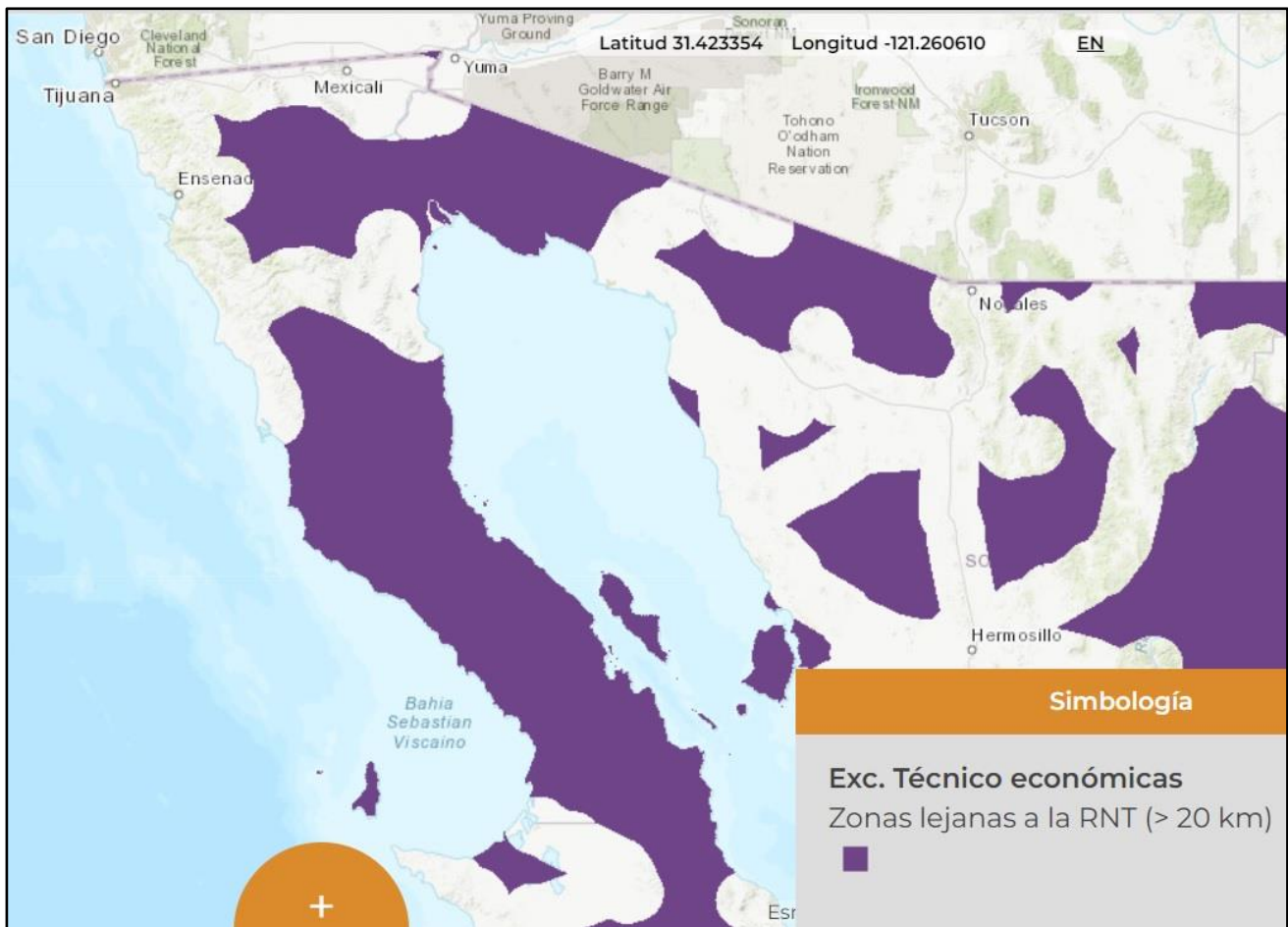
The transmission infrastructure void

As we saw, one of the recurrent arguments on the financial side is the lack of interconnection infrastructure and transmission lines to vent energy through the rest of the national system. This discourages investment due to the lack of liquidity and the limitations in supplying electricity and installed capacity. In chapter 2, I reviewed the literature that explains one of the main characteristics of the geography of energy: its ability to trace pathways based on flows and the potential to produce space and socio-environmental relations (see Calvert, 2015; Bridge, 2018; Bridge *et al.*, 2018). It is precisely the infrastructure that enables this phenomenon: electricity involves flows, paths, congestion, losses and supply-demand relationships thanks to the extent and capacity of the transmission and distribution grids embedded in the ground. The BC region is currently in an impasse where there are no new RE generation plants because there is no expansion of this infrastructure in the hands of the Mexican State. By looking at the GIS investment platform, it is possible to identify an "infrastructure void" in most of the BC territory. These areas have solar and wind energy with market potential but are limited by a combination of variables: low population density, protected natural reserve areas, social land tenure and distances greater than 20 km from the nearest interconnection substation. Interviewee Valeria Ojeda said:

"Historically, Baja California still suffers from being the most remote region in Mexico. We still see a division between core cities and regions with more territorial and population dispersions. Most of the people in Baja Norte have access to energy because they are within 5 km or less of the last grid line. However, the challenge is to connect regions rich in sun and wind resources with large consumption centres that will demand more electricity in the future, especially renewable energy due to climate treaties. This is the reason for installing autonomous, self-consumption or distributed generation systems. They are cheaper and less dependent than waiting for a regional expansion of the transmission grid".¹²⁰

¹²⁰ Interview conducted in Baja California, Mexico, on May 7, 2019.

Map 6.13. The infrastructure void: Areas remote from the national transmission grid (> 20 km)



Source: retrieved from AZEL GIS (<https://dgel.energia.gob.mx/azel/>).

Yet these areas share other environmental and social restrictions that limit the available land for RE installations. I will build on this infrastructure void idea using other RE exclusion zones considered by the GIS investment platforms.

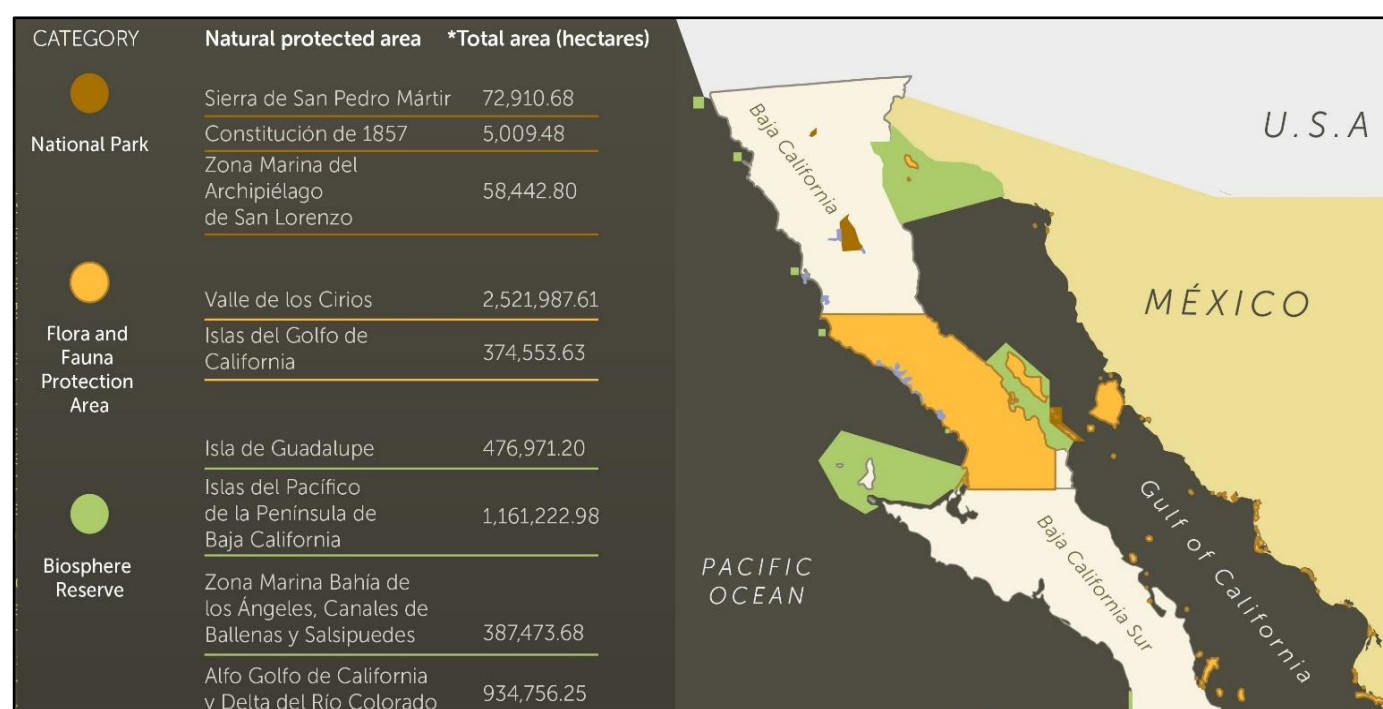
Protected natural areas and wetlands

The BC peninsula represents a terrestrial and maritime biological system that contains 19 natural protected areas: 3 national parks, 2 flora and fauna protection areas, 4 biosphere reserves and 10 areas voluntarily designed for conservation (see Meza & Valenzuela, 2021). These spaces are protected by Federal law under legal and ecological instruments to preserve natural systems, conserve their biological biodiversity and maintain environmental services.¹²¹ The northern part of BC subjected to RE development houses diverse ecosystems containing flora and fauna species considered endemic. These are the Upper Gulf of California and Colorado River Delta Biosphere Reserve, the San Pedro Martir National Park, the Constitution of 1857

¹²¹ The environmental manuals on the protection and conservation of "natural capital" in Mexico can be found in the National Commission of Natural Protected Areas (CONANP, <https://www.gob.mx/conanp>) and the National Commission for the Knowledge and Use of Biodiversity (CONABIO, <https://www.gob.mx/conabio>).

National Park and the Gulf of California Islands. Together, these areas represent 1,363,125 hectares (19.03 % of the state's territory) (SEFAO, n/d). Natural protected areas are "fragile ecosystems with a high degree of endemism, containing terrestrial, coastal and marine environments that serve as natural laboratories to know the processes of life from origin to extinction and the sustainable use of natural resources" (p. 1). The Gulf of California is also integrated into the *El Pinacate* natural reserve and the upper Gulf region where the endangered Vaquita porpoise inhabits. Overall, it is the territorial and maritime strip in the Sonora state that mediates the BC interconnection project mentioned above.

Map 6.14. Natural protected areas in Baja California

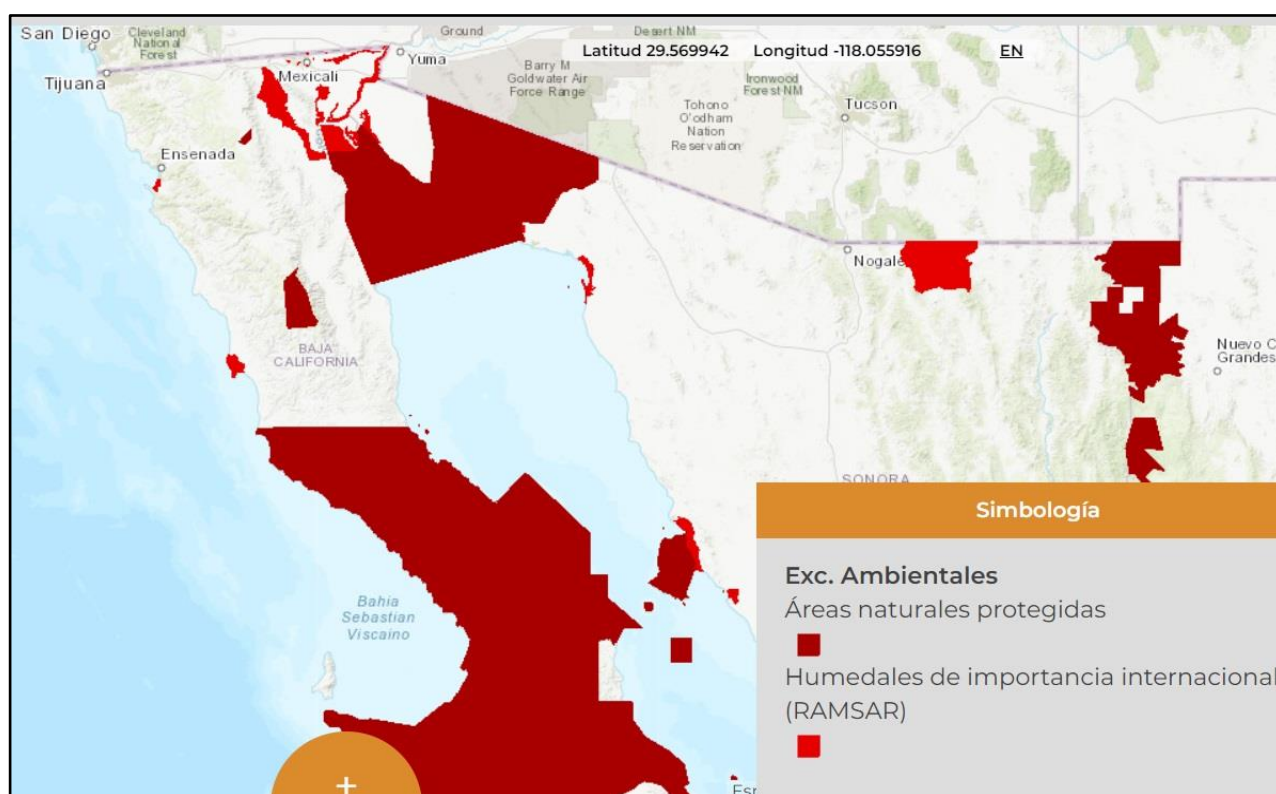


Source: Meza & Valenzuela, 2021.

According to the investment platforms based on GIS, natural protected areas and their surroundings are exclusion zones for electricity generation plants, interconnection lines, substations, medium and high voltage transmission grids, distribution lines extension, and other induced infrastructure. Any installation of new infrastructure requires environmental management programs to create a balance between productive activities and natural reserves. The Electricity Networks Business Sub-directorate at CFE commented:

"We know that transmission is essential to improve grid capacity and encourage new generation projects. But the financial and environmental costs of pulling lines to the northern region of Baja California increase dramatically. We are aware of the concerns in the changes to the landscape and impacts on local wildlife. This has raised concerns from environmental groups on both sides of the border. Also, the wetlands of the Colorado River and the inner part of the Gulf of California are very delicate areas in terms of ecosystem stability. We are still evaluating how to materialise this project".

Map 6.15. Environmental exclusion zones: natural protected areas and wetlands



Source: retrieved from AZEL GIS (<https://dgel.energia.gob.mx/azel/>).

Yet there are spatial planning instruments to integrate RE projects and ecological regions. These initiatives are used by companies to comply with environmental impact studies and permits. Ecological Spatial Planning is an assessment of the natural, social and economic variables that may influence the change in the pattern of land use and occupation. For the Mexican Government, the objective is to "analyse the processes of deterioration of the environmental attributes that define sectoral suitability. Build scenarios that analyse the demand for infrastructure and the pressure on natural resources associated with the expansion of productive activities and human settlements; the surrounding conditions (market, political and global); as well as the desirable future for the territory" (SEMARNAT, 2021).

One particular case is the *Sol Insurgentes* project in Baja California Sur, where Ecological Management Programs helped to integrate a 23 MW photovoltaic plant based on 100,800 panels into an ecological region (Sol de Insurgentes, 2014). The program represents an intervention within a protected natural area to introduce "structural changes that may affect economic and social behaviour and the maintenance of goods and services obtained from natural capital" (p. 36). For energy companies, territorial planning for RE expansion implies an ecological regionalisation that identifies areas of priority attention and areas of sectoral suitability, as well as the ecological guidelines and strategies applicable to them. This regionalisation is based on synthetic territorial units constituted from the integration of the main factors of the biophysical environment, climate, vegetation and soil (SEMARNAT, 2021). But then, what determines the possibility of introducing energy technologies and infrastructure into protected natural areas? Valeria Ojeda remarked:

"There is a program called Natural Protected Areas Management. It contains the zoning or sub-zoning that indicates the core area where no activity other than conservation is allowed. On the other hand, we have buffer areas and other peripheral spaces where productive activities are allowed, including energy infrastructure. Remember that, according to Mexican law, even mining can be carried out in protected natural areas. A second instrument is land use planning, which helps to settle conflicts over land ownership and management".¹²²

As seen in previous chapters, the new Electricity Industry Law hierarchised the deployment of energy infrastructure over any other productive activities. Thus, the environmental and social impact assessments that companies must comply with as a requirement for the construction and operation of solar and wind power plants have gained relevance for the ET narrative and policies. As part of these studies, companies and financial institutions have paid more attention to "social" issues as investment risks factors related to land-use conflicts and energy projects. This brings us to the third exclusion zone.

Social land tenure and rights of way

Under the legal framework of the ER, energy project developers have the right of gaining access to the land through direct negotiations and contract settlements with landowners (SEGOB, 2015). As I mentioned earlier, energy financial planning envisages the possibility of incorporating ejido landowners and communities as stakeholders of RE projects (MER, 2014: 231). In BC, solar and wind developers have followed the leasing model to contract ejido land to install RE plants. The community signs a long-term contract (20-30 years) to transfer the land in exchange for an annual rent. Land occupation spans the useful life of the project, divided into *a)* site preparation and construction, *b)* operation and maintenance areas, and *c)* the dismantling of long-lived assets and the return of land to its owners (see CAM, 2009; IEnova, 2018). Land occupation in BC is managed through climate and social offsetting mechanisms, such as "programs for the protection and conservation of local flora and fauna, which include, among other activities, the protection and production of plants for reforestation and maintenance in nurseries installed on construction sites" (IEnova, 2018: 89). Overall, this would encompass the CF for RE territorial penetration.

Table 6.5. Renewable energy projects in Baja California under the ejido land lease scheme

Project	Company	Financing	Capacity	Land occupation mechanism	Land contract years	Construction -operation period
Sierra Juarez Wind	IEnova	50 million USD loan by NADB	155 MW (47 windmills in 5,300 hectares)	Jacume ejido land lease contract	30	2014-2019
La Rumorosa Solar	IEnova	Debt (IFC, NADB).	41 MW (165,510 panels in 35 hectares)	La Rumorosa ejido and Benito Juárez García ejido land lease contract	20	2017-2019

Source: NADB, 2013; IEnova, 2018; 2018a.

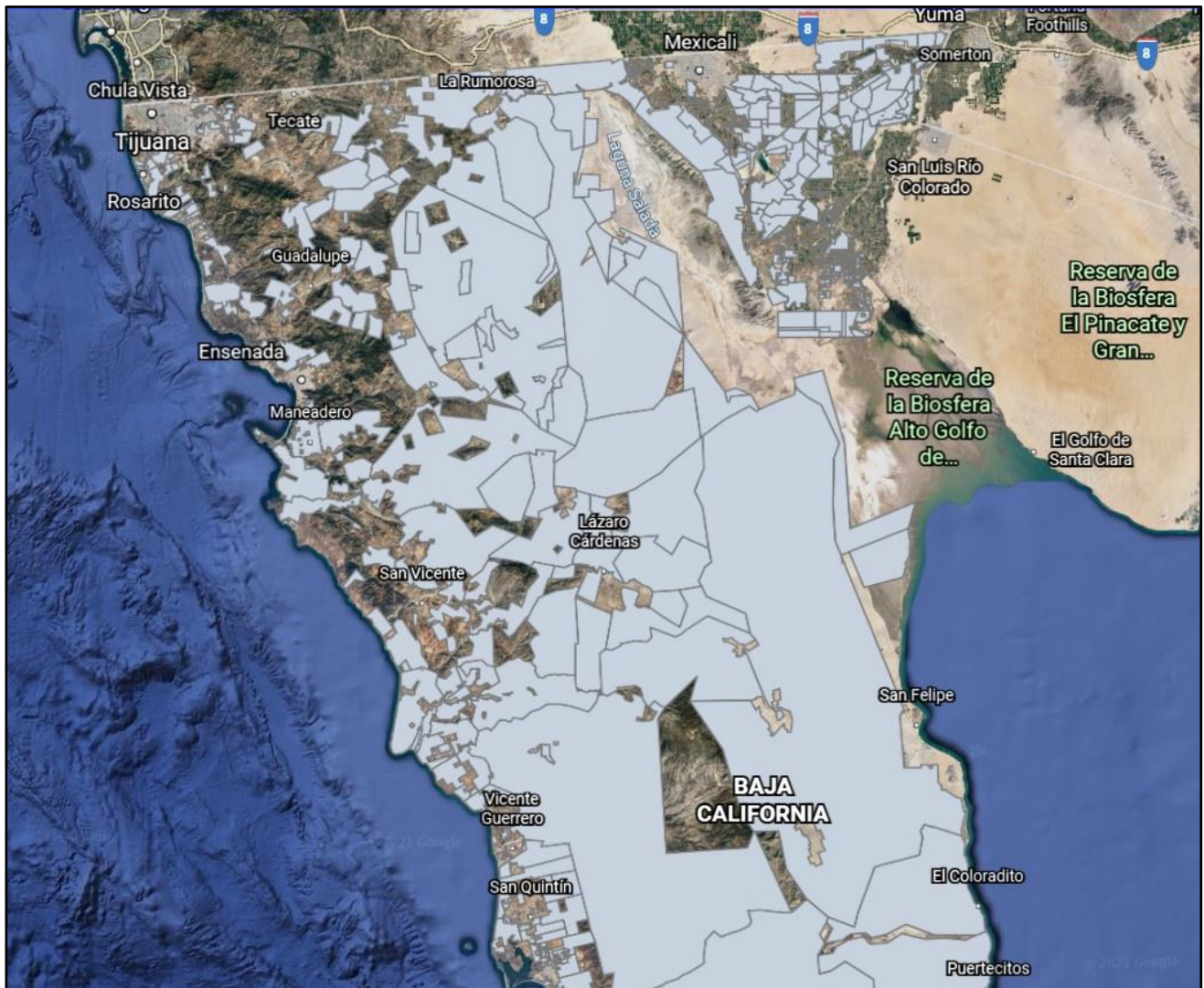
¹²² Interview conducted in Baja California, Mexico, on May 7, 2019.

Financially, social responsibility in land management and RE projects implies a new model of community integration based on asset management participation, social-based investment promotion schemes, social responsibility financial planning and environmental care programs. Following MER (2014), renewables can reverse the "worthless" condition of the land in Baja California, adding value to the land according to the value of the RE project installed in it (i.e., the financial performance of the plant compared to the size of the site) (p. 231). This is also a strategy to monetise Social Return of Investment indicators (SROI) by showing to investors that the project is allowing the communities access to services, take care of the environment, and even developing entrepreneurial values (p. 231)

The Energy Reform stated that Mexico must align to the international policies of valuing land, so its lease and use can be harnessed by both owners and developers. However, in the case of Mexico, "these conditions do not exist since there is no regulation and the value of land fluctuates drastically, always tending to go towards the least fair values when it comes to adjusting the final annual value per hectare" (SEGOB, 2015: 14). Under financial principles, generators require long-term contracts to cover investment risks and guarantees to occupy the land for 20-30 years during the lifespan of projects. Energy installations should allow and not compete with other productive activities that can take place simultaneously in the territory, such as ejido agriculture. The value offered by RE generators to the landowner "must be higher than the landowner's opportunity cost of using the land for agricultural or similar purposes. These payments may accrue to landowners who own areas with strong wind speeds, close to transmission areas and roads. In such a case the landowner could appropriate a share of the profits produced by the turbines" (p. 21). This supposes a shift in financial planning, because "land rent should not be considered as a cost in socio-economic terms, but as a transfer of income, i.e., as a redistribution of profits, since, for logical reasons, rent can only be earned if the profits on that particular piece of land exceed the normal profits required by an investor to carry out the project. Thus, when calculating the cost of wind-generated electricity, it is not correct to include the land rent in the socio-economic costs, but it should be considered part of the project's profits" (p. 21). Nonetheless, the same document (p. 16) acknowledges that, while in the US and other countries in Europe the land lease (land cost) ranges from 1 to 5% of the gross revenue from the energy sales of a wind farm, in Mexico these figures only range from 0.025% to 1.53%. This shows the contradictions between the narrative of Climate Finance investments and the material actions to promote ET projects.

In BC, 70% of the territory is under social property and comprises 238 agrarian nuclei, representing 99% of regularised and registered areas in the National Agrarian Registry (RAN, 2016). The territorial conflict between energy developers and communities has been part of the risk catalogue of companies and financial institutions, being a variable that can increase costs due to interruption, delay, change of route, or even cancelation of RE projects (see IEnova, 2019: 39). As Alejandro Moreno briefly added: "In a place like Baja California, the procedures and permits to build a renewable energy project are multidimensional. These are technical, environmental and social analyses required by Mexican law. In Mexico, many projects are stopped because of social issues, even when you have all the paperwork in order. It is a risk that investors must foresee and manage".

Map 6.16. Socially owned land (agricultural nuclei) in Baja California



Source: KML file retrieved from the RAN database (<https://www.gob.mx/ran>).

It is true that potential territorial conflict in BC is lower than in south-eastern Mexico (see García-Hernández, 2016). However, according to Cruz-Aguirre (2015), BC has been subjected to land-grabbing and the displacement of indigenous communities: “In the dispute to participate in a potential 100-billion-dollar market, at least five US and Mexican companies that generate wind energy have taken over thousands of hectares in four indigenous communities in Baja California [Yumanos Pai, Kiliwa, Kumiai and Cucapá], paying an average of 1.25 USD per hectare for the use of land”. Cruz-Aguirre explains that businessmen acquire land rights and pose as ejido landowners to use territories for private purposes. Unlike communal land, ejido property facilitates territorial privatization. This is a common mechanism to transfer in disguise ejido land to private activities, especially extractivist and mega-projects based on infrastructure (see López-Bárceñas, 2017).

Overall, BC exemplifies the processes of territorial conflicts that begin to characterize the centralized expansion of ET projects. The massive deployment of RE revives the struggles of indigenous communities and social-owned lands that have resisted mega-projects and capital's

territorial incursions in search of natural resources. As these initiatives move forward, the critique of finance must incorporate analyses on how financial mechanisms incorporate land to the financialization dynamics and their impacts on variegated human and environmental spaces.

6.3. Preliminary conclusions

Throughout this chapter, I intended to display the main research findings collected during my fieldwork. These preliminary conclusions are divided into two complementary analyses, following the general structure of the chapter: the ET territorial perspective of finance in Mexico, and the contradictions of BC as a specific RE investment space. I will briefly elaborate on these ideas, prior to a comprehensive discussion in the next chapter.

During the first implementation stage of the Energy Reform, finance opened a territorialisation process to invest in renewables in Mexico, one of the largest and most attractive countries to exploit solar and wind energy. This territorialisation relies on a series of mechanisms grounded in financial interpretations of key geographical variables such as resource availability, electricity grid dispersion, market regionalisation, demographics, natural conservation areas and land tenure. Therefore, the Mexican case provides the opportunity for some preliminary reflections:

- Finance produces a particular knowledge and understanding of the territory, reflected in the constant and permanent mapping of RE sources with market growth potential.
- There is a valorisation and hierarchical classification of “worthless” or “idling” lands to which value must be added through RE projects, reconfiguring the value of territories to benefit capital circulation and rent extraction dynamics.
- By investing in RE assets, financial interests reshape geographies, territorial activities, landscapes, and spatial cultural references. Yet finance absorbs these imaginaries and practices limited to the corporate management of socio-environmental relations.
- In the absence of oil barrels, electricity circulates as a physical and financial commodity through energy-monetary flow exchanges, creating an energy trading space conditioned by the uneven geography of nodes, prices, energy-intensive urban areas, and dynamic industrial clusters.
- The infrastructure where electricity flows became a financialisation investment space through securitization schemes in order to make embedded fixed assets liquid and open to investment by circulating abstractly in financial markets.
- It is possible to identify a regionalisation of electricity prices, RE technologies, industrial clusters, transmission-distribution infrastructure, competitors, and markets. This represents a strategic and speculative approach in order to profit from the spatial and temporal differentiation of the electricity industry.
- Financial interests over the territory do not occur in a power vacuum. We are witnessing State and class relations (materialised with the Energy Reform) opening up the uneven and variegated Mexican geography to ET investments.
- The metabolism that mediates society, territory and environment is interpreted and managed as mere financial risks within project management planning and the Climate Finance quantitative interpretation of the climate crisis.

Nonetheless, the first stage of the ET is a process full of contradictions and immature financialization manifestations. Here we can point to the difficulties of making finance the main driver of the ET. Such contradictions relate to the structural foundations of the Mexican economy (as analysed in previous chapters) but also from spatial relations through which finance and geography meet. For this purpose, I wanted to bring the case study of BC, which due to its geographic characteristics is a place with high solar and wind availability but with limitations in the financing of large-scale ET projects. Therefore, it is important to ask: is finance an obstacle or an enabler of the ET in BC? The main discussion factors are:

- *Growth limits in isolated systems.* The development of RE is conditioned by mainstream financial interests in medium to big merchant and bankable projects (> 30 MW). Even though BC has an important solar and wind potential, its isolated condition represents a limitation to fund and invest in new RE capacity until transmission lines are expanded. Therefore, the financial interpretation of the ET is based on growth factors: bigger RE projects to add new installed capacity to complement or replace FF plants, as well as expansive markets to absorb the supply. This centralized infrastructure and wholesale intermediation have the objective to break the isolation condition to expand energy markets. Financial interests subordinate renewable energy to the profitability of project development, risk management decisions and the potential value of energy trading transactions, both physical and financial. This brings some of the processes analysed in chapters 1 and 2. On the one hand, Climate Finance shapes the BC geography as an investment space that can be incorporated into the mainstream process of the ET. On the other, critical perspectives point to the limits of this model and the deep spatial and socioecological implications that this capitalist expansion process imposes.
- *Spatial constraints.* Finance overlaps two different geographies. On the one hand, mainstream finance would invest in the ET if the geographical conditions were suitable for RE harnessing and commercialization. These variables are RE potential locations, regional configuration of the market (infrastructure, prices, strategic industries, and electricity exports to the US), proximity to interconnection nodes and the use of available transmission lines in hands of the State. On the other hand, the large and centralised projects aiming for market growth clash with the spatial, environmental and social “exclusion zones” conditioned by Mexican geohistorical conditions. This limits the investable areas for RE development, showing the financial strategies and mechanisms that attempt to open these spaces for ET investments.
- *Temporal gaps.* Mainstream finance defines a particular time frame for RE expansion. Financial flows establish the timing and risk parameters of project development and the cash flows necessities to comply with return-on-investment ratios. Only the big, centralised projects that finance is interested in can fulfil these profit requirements. This is because financial short-termism now faces the challenge of funding RE plants that need securing bankable long-term PPAs under project finance schemes or locating next to attractive regional nodes with high LMPs. Also, climate change phenomena have a different temporality compared to the current accelerated financialised timeframe where socioecological relations reproduce. This brings a contradiction between short-term

financial planning based on quarterly earnings and the need for broader socioecological adaptation processes amid climate change.

- *Structural conditions.* Lastly, the local industry has not been able to adapt to the new Climate Finance models and RE investment roadmaps due to a weak endogenous core derived from the structural conditions of the Latin American economies. As I discuss in the next chapter, Latin American financialisation suffers from a chronic and peripheral condition of underdevelopment where the financial processes of the major capitalist centres cannot be fully emulated.
- *The generalisation of the phenomenon.* The limits of mainstream finance and the ET become relevant as long as their trends allow for comparative studies. By choosing the BC case study, my intention is not just to focus on the geographical specificities of the region but to offer the generalisation of the unique that could help to understand the similarities and differences of the ET limits in other latitudes.

Lastly, in terms of the ET, it is important to ask if RE could help a region like BC to achieve long-term decarbonisation goals. The BC geographical condition studied suggests that it would be possible to find alternative paths to the ET. This would imply a bifurcation towards local energy transition projects and grassroots movements focused on solving local problems around the commons and answering concrete questions grounded on their territories. Such initiatives would require financing to acquire and socially organize RE technologies, both industrial and non-industrial. The local approach is a way of covering the gap that mainstream finance is not interested in and avoid the centralised approach of the ET. With the RE potential and its energy island condition, BC can be a laboratory for local energy transitions, escaping the logic of exponential growth, wholesale market dynamics and massive-centralized technology and infrastructure deployments. I will return to this discussion point in the next chapter.

GENERAL CONCLUSIONS

There is always a gap between what is theoretically desirable and what is politically possible.

— ARTHUR M. SCHLESINGER JR., 2001

I will now discuss the key subjects from previous chapters with the objective of returning to the universe of literature that inspired this research and contributing to its main scholarly debates. My general conclusions aim to highlight the overall contributions of this research project, occupying a place in the recent debates and literature regarding finance and energy transitions.

7.1. Key debates, outcomes and contributions

7.1.1. The financialisation debate

As I explained in chapter 2, this dissertation is based on the broader literature of the financialisation historical-theoretical studies. During the development of the research, I addressed the relevance of this concept to grasp, understand and explain the expansion of finance into the renewable energy industry and the overall processes surrounding a mainstream Energy Transition (ET). As Lapavistas (2011) stated, the main issue of financialisation is not to invoke it as an abstract force but to clearly identify and decipher how and by which mechanisms the diverse actors and institutions (individually and collectively) have been "financialised" in and across the international and local economies. These phenomena encompass the four finance-production relations I explored in chapter 5 (separation, integration, negation and rent-extraction) and served as a common thread to understand the early financial formation and evolution of the Mexican electricity industry.

Over the past 10 years, scholars have suggested that the use of the financialisation concept requires a more cautious approach. Caputo (2012) criticised the use of financialisation as a theory to understand the events of 2008, arguing that the critical social scientists were carried away by financial interpretations of the crisis, leaving aside crucial phenomena such as the role of international production, the exploitation of labour, and the increasing climate change impacts. For Toporowski (2015) financialisation represents a neologism that supposes an analytical innovation but lacks a consistent theory, being more of an eclectic combination of old and new elements with "dubious analytical value" due to its generic use in different contexts and meanings. Christophers (2015) raised a warning sign on the "limits" of a "fragmented, excessively vague and stretched" concept, calling for a reflection on the use and abuse of a theory that basically consists of "reinventing the wheel". Christophers' reflection is relevant as the financialisation concept could be at risk of falling into abstraction and losing explanatory capacity like other contemporary concepts such as "globalisation" and "neoliberalism".

I would argue that the financialisation concept is meaningful to understand the general Latin American context and the geography-finance-energy relation particularly. For the Mexican case study, I propose four main arguments.

1) *Financialisation makes visible the underdeveloped nature of economic processes and energy relations in Latin America.*

This dissertation analysed how a country like Mexico has been integrated into the international capital flows in the context of climate change and energy transitions. Such integration is based on a financial expansion both on the corporate side that develops renewable energy assets and the brokerage activities of commodifying electricity and securitising infrastructure (these trends are theorised by Donovan, 2020). However, the evolution of financial phenomena in Latin America is still part of a broader process of structural change that takes place within the limits of an "imitative capitalism" embedded in the core-periphery international relations (Presbisch, 1981: 14). That is, the idea that Mexico is attempting to pursue an ET similar to the one portrayed by the Climate Finance roadmaps while having a chronically stagnant financial system rooted in the historical structures of underdevelopment that fail to reproduce the financialisation dynamics theorised in the capitalist cores.¹²³ Therefore, financialisation helps to understand the structural and material limits of an ET in Mexico by deciphering the underdeveloped and peripheral condition of finance, exemplified by the absence of dynamic stock markets, the lack of a financialised domestic industry, a rentier foreign banking system, monopoly industrial structures, and the finance-oil dependency nexus (see Guillén, 2007; Álvarez-Herrero, 2019). Thus, financialisation becomes a combined analysis of *a*) the role that Latin America has in the capitalist world-system as an ET investment space, and *b*) the local specificities and contradictions of finance that hinder the large-scale ET deployment in the region. Overall, the financialisation concept requires a constant and permanent reassessment of its analytical scope and empirical references to trace the evolution of financial processes in areas like climate change and energy transitions (see Lagoarde-Segot, 2015).

Also, the financialisation analysis gives continuity to the extractive patterns that finance established in the region since the 1980s-1990s (Schatan, 1998; Saxe-Fernández *et al.*, 2001). Thus, the extraction of natural and monetary resources that financial actors and institutions have inflicted in the region share more roots with financialisation rather than the abstract and heuristically limited concept of "neoliberalism". For Saxe-Fernandez (2019), there is nothing *new* or *liberal* about the autocracies and oligarchies that have allowed the advance of extractive finance in Latin America, something that the original liberalism fought against. Or, as Hudson (2015) proposes, financialisation relates more to a neo-feudalism that revives the rent-extraction practices that the original liberalism also opposed, giving a broader historical interpretation of the role of finance in contemporary economies. Thus, the Latin American financialisation is reproduced through a regional economic enclave that allows the operation

¹²³ Following Prebisch (1981: 31), the Latin American experience of structural change and financial expansion is alien to the western literature of financialisation, mainly because the region did not transition to the liberal model of perfect free markets, neither to the "mature capitalism" stages theorised by Marxist and Keynesian currents. Thus, Latin America draws from these texts to understand the international variables that influence the region but also makes a difference to explain the internal underdeveloped and peripheral structures under which finance locally operates.

of foreign financial institutions and corporations, macroeconomically limiting the growth of national productive activities and favouring the extraction of natural and monetary resources.

2) *Financialisation is a common thread to understand the multidimensional structural change in Latin America.*

Nonetheless, financialisation in itself is not a stand-alone central issue but more of a conceptual glue that allows understanding the combination of other processes related to the expansion of finance. Broadly speaking, these are:¹²⁴

- *Privatisation.* In the Mexican case, instead of transferring Pemex or CFE entirely to private hands, the privatisation mechanism maintains the façade of the State energy companies that own energy assets (plants, oil fields, transmission lines). However, there is a deliberate operational and financial sabotage based on the intermediation of contracts with private players to fill the gap the parastatal is not covering anymore (Saxe-Fernández & Delgado, 2005). This allows *a)* assuming strategic duties that constitutionally belong to the State; and *b)* induce securitisation and rent-extraction mechanisms in the infrastructure in hands of the energy State-owned companies.
- *Deindustrialisation.* Privatisation leads to the dismantling of the State-owned energy industry, allowing the introduction of foreign monopoly capital. Also, restrictive macroeconomic frameworks hinder the expansion of local industries, favouring the operation of foreign energy conglomerates and international financial transactions (see Huerta, 2009).
- *Liberalisation.* For the electricity industry, the means that prices will now behave like any other commodity in the stock market. Price liberalisation leads to fluctuations that serve as the basis for financial intermediation.
- *Deregulation.* The process of privatisation and liberalisation eliminate any State control on the electricity sector. This means that electricity prices are no longer a basic good regulated under public interest but a commodity that must incentivise investments.
- *Foreignsation.* Mexico's local industry is not technologically and financially equipped to fund large-scale ET projects. The gap is filled by foreign companies interested in the Mexican geography for RE projects development (Guillén, 2007). These companies have broader and solid financial structures, and their presence attracts international funds and financial institutions to deepen the electricity-financial markets.
- *Reprimitisation.* It means a colonial policy where Mexico should not transform energy resources or use strategic spaces, limiting its activity to an extractivist primary sector (Petras & Veltmeyer, 2014). This means that Mexico transfers the opportunity of harnessing renewable energy sources and territories to private foreign companies, limiting the State as a mere administrator of its sovereignty.
- *Maximum extraction.* Related to the previous point, the Mexican energy policy must follow the principles of maximum growth and energy extraction to satisfy the local and international markets. This acceleration is related to the financial expectations of profitability and debt repayment (see Petras & Veltmeyer, 2014).

¹²⁴ For a broader literature review and analysis of this topic, see Álvarez-Herrero, 2019.

I have used these concepts in chapter 5 to exemplify the major trends on the opening of the Mexican electricity industry since the Energy Reform. The study of an ET in Mexico would be unintelligible if we only refer to financialisation as a mere presence of financial interests in the Mexican electricity industry without addressing the combination of these events. Here I draw from the analyses elaborated by Arrighi (1994, 2007) where financialisation represents a *process* that allows tracing several political and economic variables within structural change. In a Latin American context, this is crucial to encompass a broader framework where the territorialisation of over-accumulated liquidity takes place, producing an uneven geopolitical in relation to the capitalist cores (especially the US). This asymmetric integration process is what allows the phenomena represented in the battery of concepts mentioned above. Using comparative knowledge, the financial integration processes present today in the Mexican electricity industry are similar to past events that have also dismantled other key industries in the region. Therefore, financialisation works as a common thread giving a solid and critical explanation of the entanglement of finance with ET processes and its impact on the national economies, the State, and social class dynamics.

3) *Financialisation defines and makes visible a specific context of class and power.*

Here I insist on the role of financialisation as a process embedded in the imperialism analyses of State and class relations in Latin America (Petras & Veltmeyer, 2011; Saxe-Fernández, 2018). The ET in Mexico is built on a series of endogenous-exogenous relations based on the design of investment roadmaps that provide a solution to the overaccumulation crisis. Therefore, the ET is a manifestation of the international liquidity pressuring over the Mexican territory and the local interests waiting to take advantage of new Climate Finance business lines. Financialisation makes visible how financial actors and institutions intervene or co-govern the decision-making apparatus to trigger the processes that complement financial expansion (privatisation, deregulation, etc). These institutional dynamics are not the product of abstract markets, but State and class relations based on the material interests that lie behind the ET discourses. Thus, financialisation adds to the political sociology of the ET and how specific interests are shaping the material deployment of RE.

This State and class conflict is reflected in the preliminary analysis of Big-E energy vs. little-e energies theorised by Lohmann & Hildyard (2014). During the case study, I mentioned how the Energy Reform and the ET roadmaps fostered the expansion of centralised projects and technologies that support the new wholesale market model. As GeoComunes (2016, 2021) have criticised, communities in the northern region of Mexico have suffered from territorial dispossession, alteration of agricultural activities, disruptions in access to water, invasion of extractive mining and forced subordination as consumer-clients of the new electricity market projects. To this, we can add the financial exploitation and extraction model that the ET industry model is starting to inflict on natural and human spaces in regions like Baja California. Nonetheless, it is true that communities that would represent little-e energies are not the bearers of the alternative energy models, nor is it a conflict of large versus small projects (see Lohmann & Hildyard, 2014). As GeoComunes (2016, 2021) stated, these communities are trying to adopt renewable energy technologies for their own productive and territorial projects, a trend that somehow continues the expansion of large-scale production of these technologies. In the end, the Big-E vs little-e conflict is more complex than a deterministic conflict, but the objectives of this thesis have focused on

analysing the dynamics of power and how the Big-E energy trend is expanding through the ET. I have mentioned this conflict as a result of this capitalist expansion in the Mexican territory, but I would leave the centrality of this confrontation to other research agendas.

4) *Financialisation represents a constant intersubjective dialogue in the finance-energy-geography nexus.*

At the time of planning this research project, I made a comprehensive search of the literature that integrates finance, energy and geography in a single analysis. I spent time in the literature gathering trying to weave the connections shown in chapter 2. Nonetheless, I felt there were gaps in the interpretation of this relation, gaps that wanted to quote to support the research project, but I discover that *a)* there was a mention of some financial trends in the energy transition sector but without clear explained examples, and *b)* the authors perspective and interpretation does not fully grasp the experience of a country like Mexico. The financialisation concept has been a glue to analyse the finance-energy-geography nexus, not only because of the literature used to support the thesis but also to decipher and contribute to new trends in the area. I have exposed some of these topics in figure 2.7., but the combined chapters 4 and 5 intend to fill the gap in some of the connections that hold these three domains together and were an important part of my inquires. Thus, financialisation helped me to:

- Preliminary understanding of the differences and uneven processes of financial expansion between northern regions (like the UK and US) and peripheral countries (Mexico). Through the Climate Finance literature and empirical work, it is possible to identify a differentiated geography on how Mexico became a target of idling liquidity looking for renewable energy sources, markets and regulations favourable for the financialisation processes of the ET. This geography is marked by political and territorial conflict, resistance to structural changes in the economy, and the dispute over the nationalised energy companies.
- Decipher part of the mental universe of financiers and have a deeper understanding of what are their geographical interpretations of the ET. This is the task of making a dialogue between financial actors and critical thinking. The financialisation concept allowed me to incorporate the pragmatic view of financiers into a more elaborated theoretical building to shed some light on the geographical planning of the ET. The opinions and views of these actors changed my initial perception of how investments were flowing into renewable energy in Mexico, contributing to electricity commodification trends, land valorisation, financial derivatives, secondary markets for financial assets, transmission lines transformation into financial assets, and brokering activities through energy and environmental investment portfolios.
- To a more project management scale, financialisation also helped me to analyse the financial spatial planning of renewable energy plants, technologies and infrastructure. For the Mexican case study, the centrality of the ET is the development of renewable energy projects, where corporate energy finance has had an important expansion since the 2014 Energy Reform. Part of financialisation is not only the deregulation and opening of the Mexican territory for projects but also the financial hierarchisation of the territory

according to energy sources, available infrastructure, location of markets and proximity to other major consumers (like the US in the northwest region of Mexico).

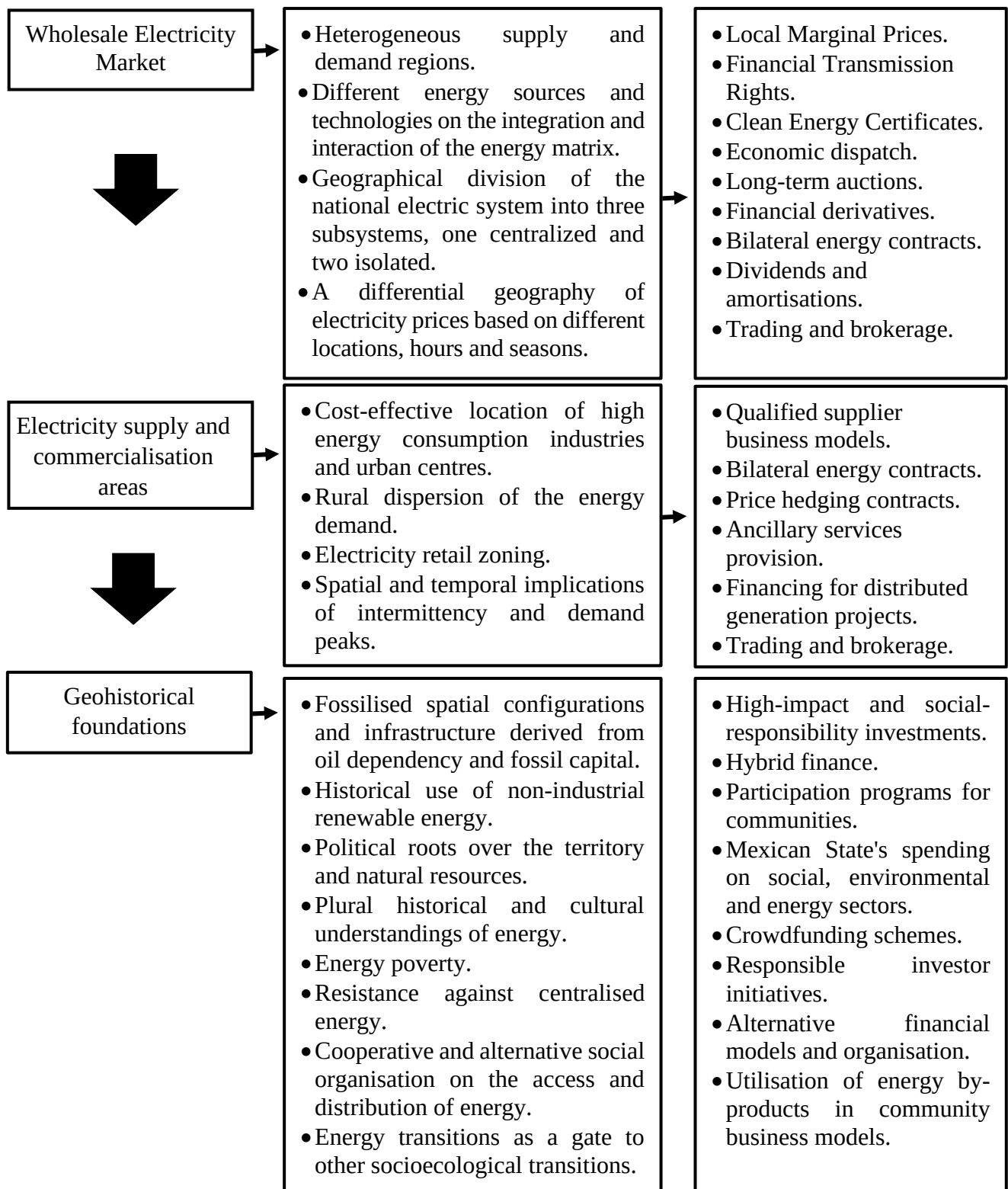
5) *Financialisation gives conceptual tools to renew left-wing perspectives of environmental and geographical processes.*

Beyond the academic field that either praise and criticise the use of financialisation, I would argue that its conceptual baggage (overaccumulation, rent-extraction, commodification, debt pollution, etc.) represents a renewed but limited narrative that gives extra tools to political and social movements on the contemporary critique of economic and environmental phenomena. While the political ecology and ecosocialism narratives found in the environmental problem are the definitive bastion for the critique of the material crises of capitalism, the financialisation analysis complements specific contradictions of the structural problems of contemporary economies: unemployment, deindustrialisation, indebtedness, monopoly holdings companies and investment expansion to new high profitability sectors. I would say that, for left-wing activism, financialisation helps to connect the complex relations of how capital expands on different scales, like the relationship between the stock market crash and a graduate student's indebtedness, or between carbon trading and the commodification of electricity.

Nonetheless, from a Latin American studies perspective, this is still a challenge since the communication of financial activism with the rest of the social sciences is not always clear due to the hermetic languages and mechanisms of finance. Even though financialisation could make this dialogue more fluid by revealing the "secrets" of the financial realm, there are still voids in the interdisciplinary dialogue that are a work in progress (like the complexity of financial and electricity systems, or the incorporation of new natural resources and climate process to the financial dynamics). To this, I must add the complex Latin American reality, where there is not only a "disciplinary" or "academic" dialogue but a broader cultural, political and social-movement spectrum of how finance impacts the life and process of populations and communities. Here I can introduce the problem of alternative finance, that is, the critique and understanding of finance not just to challenge its dynamics but also to find its productive elements for common goals. I will address this topic below in the future research agenda of this dissertation.

Table 7.1. Summary of the geographical analysis of energy transitions in Mexico

<i>Geographic scale</i>	<i>Spatial relation</i>	<i>Financial variables</i>
Financial Geopolitics	• Latin America's place in the capitalist world-economy. • Historical State and class relations (imperialism). • Geopolitical access to natural resources and spaces.	• Idling liquidity (overaccumulation crisis). • Core-periphery investment flows. • International Climate Finance funds.
Macroeconomic space	• Favourable energy market conditions and regulations. • Privatisation and State direct-indirect subsidies (rent-extraction). • Macroeconomic stability for financial profits.	• Monetary and fiscal variables. • PPP schemes. • Financial deregulation-liberalisation.
Energy cartography	• Location and quality of renewable energy sources. • Environmental, geological, and social metabolism conditions. • Geostrategic energy planning.	• Cost-benefit analyses. • Monetary-energy-materials flows. • Land valorisation and speculation.
Energy project development	• Plant site dimensions and interconnection distances to nodes and the national grid. • Integration of renewable energy technologies into the environment. • Spatial integration of industrial hubs, clusters, highways, real estate and export enclaves.	• Financial and business models. • Land acquisition and use. • Rights of way. • Project Finance. • Risk management. • Interests and dividends.
Node mapping	• Node georeferencing and energy flows roadmaps. • Node energy injection and extraction dynamics. • Internodal congestions.	• Interconnection costs. • Prices and cash flows projections.
Transmission and distribution lines	• Transmission and distribution lines embedding. • Line congestion and intermittency cycles. • Environmental impact and social conflicts related to grid expansion planning (rights of way).	• Subsidies for the use of the national grid and for energy intermittency fluctuations. • PPP investment in infrastructure. • <i>Fibra-E</i> stock certificates.



Source: own elaboration.

7.1.2. A precedent on energy transition-finance studies

This dissertation has evolved as a contribution to the recent trends in energy transitions and financial phenomena. My intention is to set a precedent and fill a gap in the debate on how the financial sector is moving towards the energy transitions frontier in Mexico, a country that combines several key factors for this process: its peripheral condition in the world-economy, its proximity to the United States, its place as an investment platform for Western economies, its dependence on oil, the size of its economy and its wealth of renewable energy sources. After the analysis developed during the past chapters, I conclude that this thesis:

- a) Helps to identify and decipher the discourses embedded in the energy agencies' roadmaps, environmental policies and Climate Finance reports. These narratives contain the main ingredients to understand the continuities and "business as usual" interests that are moving from both the green corporate policies and fossil-fuel industries into the renewable energy sector and markets. This is important because the transition being portrayed does not introduce radical changes to the fossil capital energy system, making the transition more of a business management problem than a civilisational collective challenge. Also, it is a discourse that still identifies Latin America (and the South in general) as a region that requires international financial aid and direct investment to achieve development agendas and climate objectives. In Quijano's (2014) words, this is a reminder of the coloniality of power that maintains the region as investment and surplus extraction of natural and monetary resources. With this, I want to provoke an understanding of the "business as usual" narrative, making not just a critique but also the possibilities of counter-narratives to propose and build alternatives. I will come back to this last point in the next chapter.
- b) Understands and explains how the institutional relations between financial institutions, energy companies, technology developers, think tanks, NGOs and international agencies on energy and the environment have collectively introduced the need for finance as the one-and-only solution for the climate crisis. This is important since, in Mexico, international environmental agencies have traced climate action programs linked to business lines. One example is McKinsey (2021a), the OECD (see OECD-IEA, 2016), the World Resource Institute (2020), and the several NGOs that helped to pave the way for the World Bank environmental programs since the 1990s and 2000s (see Saxe-Fernández & Delgado, 2005). Understanding the role and interests of these institutions is part of the obfuscating belief that the financial sector is the only mean to achieve energy transitions. In the long run, this situation inhibits other political perspectives that have pointed to finance as the problem of capitalist contemporary development, especially on the deepening of the environmental crises. Scholars have mentioned this predominance of finance as an obstacle to other socioecological, political, and territorial movements. This is the comprehensive analysis of Lohmann (2015) and Reyes (2020), who claim that energy futures will rely more on social-adaptative models and productive activities and less on finance, which will be an important but not dominant force as we know it today.

- c) Establishes a dialogue with the recent literature to contribute to a body of work on the early manifestations of finance in energy transition processes. One of the main objectives of this thesis was to fill a gap in the literature on the relation between energy transition and finance, using Mexico as a prime example of the current expansion of capital into the renewable energy sector. Throughout the literature review and empirical research, my intention has been to dialogue with other disciplines by grasping the complexity of the energy-finance-geography nexus. I also wish to debate not only with critical perspectives who find affinities with this analysis but also with my subject of study: financiers and energy consultants that I had the opportunity to interview and that hold the discourses I have criticised in this work.
- d) Serves as a reference for comparative studies in other countries or regions. Mexico, as well as other places in Asia, Africa and the rest of Latin America, are experimenting with similar opening processes related to environmental and energy investment. For the Climate Finance reports, the Global South shares parallel characteristics: a lack of domestic financial resources to embark on an ET, needing international investments to achieve energy efficiency programs, electric cars use, renewable energy sources harnessing, electricity markets development, etc. Overall, my intention is to offer generalisations that would allow a comparative knowledge with other case studies related to energy transitions and finance.

7.1.3. The role of the State in energy transitions

The State continues to be a central actor in the processes of capitalist mundialisation (Osorio, 2014). As I have analysed through this research project, the centrality of the State in the current ET explains the connections between foreign policy, macroeconomics, electricity systems, financial sector, class relations and geographical remodelling. During the research, the State went through two stages: the mainstream ET and the nationalist energy takeover. On the one hand, the mainstream ET has proven to be a continuation of the imperialist phenomenon: State-and-class relations that paved the way for the financial expansion of western economies into the Mexican energy sector and territory. On the other, the nationalist policy of the AMLO administration that still shows premature signs of what a sovereign energy transition would be. Overall, we can address some preliminary conclusions.

Mexico is a mature oil-producing country with a long-standing energy nationalism and an energy-based construction of the State (Meyer, 2009). The climate debates and energy transition initiatives have introduced historical and political reinterpretations of Mexico's energy past, rooted in the 20th century State economy (see Vergara, 2021). As Álvarez-Béjar (2018) suggests, this context forced a renewed vision of the State-energy relations, assessing how its social, ecological, and geographical impacts would evolve to overcome fossil fuels dependency. However, these ideas are still proposals that have not found their way as concrete projects, or they have not found a response from State policies. The author insists that the State requires a double energy transition to break the reductionistic "private vs. nationalist" approach and the historical dependence on the fossil economy (see Álvarez-Béjar, 2018: 166-172):

- The first is a transition from the current energy matrix dominated by fossil fuels to a more diversified basket of renewable energy. This is crucial since Mexico reached its peak oil in 2003, adapting to declining oil levels and breaking the dependence on imported US natural gas for electricity generation. Yet renewables must follow a two-way process: *a)* the degrowth of energy intensity and a geographical long-term planning strategy to avoid the territorial predation of centralised projects, and *b)* applying energy sustainability and efficiency programs in energy-intensive spaces like urban centres and agriculture.
- The second energy transition is an institutional one. This implies that Pemex and CFE must achieve a long-term adaptation to climate change, remaining State-owned and operating under public interest to favour socioecological transitions. This means finding a third way, leaving behind the centralised State energy model from the 20th century and avoiding the privatisation scheme promoted by the Energy Reform. Thus, the State can become a spatial organiser that responds to a broader public interest.

According to CFE (2021c), in 2020-2021, Mexico's share of renewable energy increased from 22.6% to 25.4%. Does Mexico has achieved an ET during the first stage of the new model? Following the arguments of Perez (2003), Bergek *et al.* (2013), Attiga & Benali (2020) and Tertzakian (2018), Mexico is currently in an energy diversification stage. That is, there is not a "creative destruction" of fossil assets but a conversion of plants for imported natural gas and steady participation of solar and wind projects for WEM participation (SENER, 2020). For GeoComunes (2021), Mexico has not moved towards an energy transition but more of a "market transition" where the current expansion of solar and wind projects is measured in terms of its economic success rather than wider socioecological goals. Thus, the Energy Transition in Mexico creates more problems for communities, territories, and environmental spaces due to its speculative, extractivist and expansive logic (pp. 57-60).¹²⁵

Since 2019, the energy policy of the new AMLO administration (2018-2024) introduced a renewed debate of Mexico's future as a petrostate and the reconstruction of the economy based on socially and environmentally sustainable transitions (Torres-Flores, 2021). Herein lies the question of whether an oil-producing nation would shift to an "energy transition nationalism" and how such a State would be constructed jurisdictionally (borders, territory, sovereignty) and sociologically (social relations) under this materiality (GeoComunes, 2021). Energy transitions are complex processes in time and space based on the structural possibilities of each State and subjected to "geographically differentiated political economies" (Bridge & Gailing, 2020: 1037). The gap the State must fill, argues Ockwell *et al.* (2021), is based on "which technologies and energy systems receive support, whose energy needs get prioritised and which actors are charged with the responsibility for meeting energy needs are a function of very different decision-making processes, political systems and political economies". This is important in Latin America, a region whose States have been subjected to the constant changes of regime, the imperialist interests of local oligarchies, and the permanent transferring of resources from public to private, emptying the capacities of long-term investment and planning (see Saxe-Fernández *et al.*, 2001).

¹²⁵ According to GeoComunes (2021: 59), "the wind and solar power plants currently being planned in Mexico will require approximately 1.5 million tonnes of minerals for their construction".

The State is at the centre of the energy transitions debates. In a country like Mexico, the analysis of the State is crucial to understand both the ET progress and the current nationalist takeover of the AMLO administration. In the former, the State represents the institutional and class relations that allowed the deregulation and privatisation of the Mexican energy industry, opening geographical spaces for private capital to develop energy projects and expand wholesale markets. The latter sees the State as a renewed project to restore energy nationalism and sovereignty, making the State the main actor in territorial remodelling for the deployment of energy technologies and infrastructure. Also, in both cases, the State establishes relatively different capitalist relations with finance due to *a)* the deregulation-privatization process that allows financial expansion in the Mexican economy and geography, and *b)* the long-standing processes of financial weakening of the Mexican State, indebtedness, and the draining of domestic savings through rent extraction that makes the State resort to external financing.

There is also the spatial dimension. Since the early beginnings of oil exploitation in 1900, the Mexican geographies and landscapes have been fossilised (see Negrín, 2017; Vergara, 2021). That is, the way distances are thought out, locations settled, and spaces produced are mediated by the fossil economy. An energy transition in Mexico would require the defossilisation of a century of oil embeddedness (the "strata of time" according to Koselleck, 2001), introducing geographical reorganisations of the territory.

Lastly, this connects with the role of the State as a mean of political change. In the tradition of Latin American Studies, the State represents a space of dispute for political projects that claim different paths to development (Osorio, 2014). In recent decades, countries like Ecuador and Bolivia have incorporated pluri-national representations of political movements beyond the "neoliberal multiculturalism" discourse, claiming part of the State to vindicate historical demands (see Cruz, 2012). In the 1982-2018 period, Mexico lived the neoliberal period by excluding political movements that represents counter-hegemonic forces against the capitalist project (Nuñez *et al.* 2021). The State has been closed while strengthening the mechanisms of violence in order to deepen the privatisation and territorial dispossession related to energy and the environment (Fazio, 2016). After 2018, the nationalist and energy sovereignty policies implemented in the AMLO administration have portrayed a discourse based on the inclusion and "for the welfare of the people" (the *pueblo* in the abstract). However, it is still premature to assess if the so-called "post-neoliberal" AMLO administration will open the State to pluri-national initiatives regarding energy and environment (Nuñez *et al.* 2021). This is crucial since the nationalist and sovereignty discourse is focused on "taking back control" of the oil and electricity industries, portraying a stronger petro-state that resembles 20th century Mexican nationalism. For Saxe-Fernández (2019), it is important to open the State to a more diversified Alternative Social Construction to incorporate post-fossil and post-capitalist perspectives into the decision-making apparatus. Yet this process remains to be seen but constitutes the current debate on the future of energy socioecological systems and the dispute between antagonistic interpretations of finance, territories, and energy (Lohmann & Hildyard, 2014).

7.2. Assessing research questions

The dissertation is built in four main research questions. Here I will explain how these questions were approached and answered.

1) *Is finance a central force behind the renewable energy deployment in Mexico?*

The expansion of RE since the 2014 Energy Reform has been backed and fostered by corporate finance looking for generation projects, trading actors profiting from bilateral electricity transaction in the WEM, and brokers interested in the commodification of electricity and RE assets. The Mexican State played a role in the deregulation and privatization of the energy sector (oil and electricity), establishing a WEM and leaving the industry to an increasing participation of foreign energy companies. These companies' financial actors and institutions that found in the recently created WEM with three main incentives: *a)* the climate discourses that urged Mexico to embark on an ET in line with the Climate Finance guidelines; *b)* a geographical potential for RE projects that was soon exploited by foreign energy companies, and *c)* the appetite for a WEM that not only for electricity trading but also in place for different financial intermediation instruments and mechanisms. As seen in chapter 4 and 5, the CF initiatives and the international State-class relations captured by the 2014 ER paved the way for the corporate, trading and brokering finance to shape the energy policy and WEM in Mexico.

2) *Is an Energy Transition taking place in Mexico because of financial processes?*

In the early stages of the PhD, my main concern was to know if finance has a predominant role in the current renewable energy expansion, and if so, by which mechanisms financial actors and institutions are using to participate in this process. In chapters 4 and 5, I argued that finance is a central force behind the mainstream ET implemented in Mexico. This is because *a)* the Energy Reform introduced a private-driven financial structure to replace the long-standing Mexican State-owned industry, *b)* this Reform is modelled on the Climate Finance roadmaps that are currently opening the "Global South" to renewable energy investments, and *c)* the creation of a Wholesale Electricity Market is based on the opportunities for different financial activities: banks and funds allocating investments for project financing, corporate financiers developing renewable energy assets, bilateral transactions trading physical and financial electricity, and financial-energy brokerage activities. This shift is notorious since Mexico is one of the last countries to open its energy sector, showing clear trends on the transition from a close State model to an open financial market.

The information to answer this question is available in the extensive Energy Reform literature reviewed in chapter 4. It consists of international energy outlooks, Climate Finance reports, energy business brochures and the official Mexican Government documents of the Peña Nieto administration (2012-2018). Thus, it is possible to conclude that *a)* the financial configuration of the ET is a particular objective of the Energy Reform, and *b)* the ET is not a mere process of replacing fossil fuels with renewables but replacing the State with a private-driven model based on the expansion of financial markets.

This question also led to the financialisation analysis. In chapter 5, I relied on the financialisation literature explored in chapter 2 to prove that the first stage of the ET (2016-2018) shows financialisation symptoms based on four main relations: *a)* the separation of physical and

financial business lines, b) the integration of electricity and financial markets, c) the negation of national large-scale renewable energy deployments due to restrictive macroeconomic frameworks, and d) a rent-extraction logic over the remnants of the State industry (especially CFE). Based on these relations, I managed to explain the complex areas that integrate electricity and financial markets. Yet, the financialisation analysis suggests further complexity since it is not a single process. Financial events in Latin America take place in underdeveloped structures. Therefore, we cannot address a single financial vector but a series of processes that supports financial expansion. As I discussed in the conclusions, these processes are privatisation, deregulation, liberalisation, foreignisation, deindustrialisation and extractivism. The combination of these processes makes financialisation visible as a Latin American experience, giving renewed insights into the geographical specificity of financial phenomena.

To access this information, I relied on interviews with financial actors that have a hands-on role in the markets, trying to decipher the mental universe and the arguments for this shift in the Mexican electricity industry. My interest is to make more accessible the financial understanding of the ET and how it is designed to have several financial structures that intervene in different market segments and through different profit mechanisms. This first-hand information from actors involved in financial processes was crucial to answering the question due to the hermetic mechanisms and esoteric languages of the financial sector.

3) *Why does finance matter for the materiality of renewable energy?*

One of my main interests during fieldwork was to decipher the connections between renewable energy and finance. These connections encompass the profits channels and accumulation patterns established by financial actors and institutions in the renewables business. In chapter 5, I argued that different financiers intervene in the new Wholesale Electricity Market depending on their role. Therefore, there is not a single financier but several actors that have a combination of activities that sometimes blur the line between roles. I explained that there are at least four financiers intervening in the ET: funders, projects developers, traders and brokers. These actors share a common interest in the financialisation of renewable energy: the commodification of electricity, the liberalisation of its price, the securitisation of renewable energy assets, and the securitisation of transmission infrastructure. The whole value chain of the industry (generation, transmission, distribution and retail) becomes interdependent investment spaces determined by prices and a series of electricity and cash flows. This finance-ET symbiosis is what makes profitable the allocation of idling liquidity and the business lines related to environmental and energy sectors.

To answer this, I questioned interviewees about the appetite and business opportunities, whether in the physical side of developing a solar or wind project and selling electricity, or the financial sector where actors are not users of the electricity but mere traders or price gamblers. My questionnaire did not attempt to reveal the professional activities of my interviewees, the objective was to understand the underlying interests of a relatively new sector as an investment space.

4) *What are the geographical implications of investing in a large-scale energy transition in Mexico?*

To introduce the geographic element, I was concerned with the mainstream financial interpretation of energy geographies. I was convinced that financiers, regardless of their activity, have a particular way of understanding, reproducing, and organising spaces. I

dedicated the first part of chapter 6 to exploring the main arguments on how investment decisions are leading the occupation and exploitation of territories through the development of solar and wind projects. This production of space is based on the hierarchisation of regions and the profitability chain of the ET business line: the localisation of renewable energy sources, the valorisation-speculation of land, the location of energy projects, the differential regional prices, the securitisation of agglomerated energy assets, and the strategic proximity to transmission infrastructure, markets and energy-intensive industries.

One of the main spatial implications I discovered is the increasing competition and speculation for territories. This financial race aims to invest in the areas with high availability of sun or wind coupled with the proximity to the interconnection infrastructure. As in any market, the first to enter are those who occupy the best areas, leaving marginal places for other competitors. This denotes a spatial constraint that evolves parallel to the growth of the renewables industry.

The other geographical implication is the conflict derived from the expansive dynamics of solar and wind technologies, as well as the need to expand the transmission infrastructure, producing new energy spaces through energy flows and social relations. Thus, the occupation of land is subjected to social and environmental issues that finance incorporates as investments risks. Here we find the mechanisms to incorporate communities as stakeholders of renewable energy projects as compensation for occupying their land. In the end, renewable energy sits above other productive activities, subordinating space to the logic of the electricity market.

My strategy for this question was to review the investment manuals (made by financiers for financiers) looking for this geographical knowledge. The information that CFE disclosed in terms of transmission lines helped me to understand the geographical complementarities between private projects and public infrastructure. I also questioned my interviewees about geographical imaginaries, asking for ways to read maps and define a decision-making process based on renewable energy localisation.

5) *How does finance organise space for energy transition projects in a region like Baja California?*

As I explained in chapters 3 and 6, I chose the northern Mexican state of Baja California to exemplify the current stage of energy transitions. At the time, I thought this space was a regional laboratory for solar, wind and geothermal projects, having the potential to become an energy island due to the resources available and the lack of interconnection with the Mexican heartland. During fieldwork, I realised that Baja California is a constrained space due to the lack of transmission infrastructure that prevents a massive expansion of renewables. This made me reflect on the financial appetite of market growth, implying that an ET can only take place if there is an expansive deployment of renewable energy technologies and transmission infrastructure. This expansion would rely on a parallel financial structure that capitalises on the growing electricity demand.

Yet I later realised that Baja California constitutes a geohistorical space where socially-owned land, environmentally protected areas and worthless deserted areas coexist. These represent the exclusion zones that limit the space for constant growth of renewables. Because of this geographical situation, the development of solar and wind projects has been limited, focused on exporting to the US or selective bilateral contracts for seasonal supply. Thus, the region is subjected to the growth vs. degrowth debate, where the mainstream and expansive ET roadmap opposes other alternatives like smaller regional projects operating within a productive energy island.

In the second half of chapter 6, I developed the answer for this question, using documents, Geographical Information Systems, and in-person and online interviewees to give a concrete panoramic of Baja California as an Energy Transition investment space.

7.3. Next steps in the research agenda and future praxis

This dissertation had two main moments in my development as an academic financier. The first was my sparked interest while building this PhD project, seeking to become a critical financier able to bring some of the financial knowledge to the scholarly debate, making a critique but also gaining tools to understand energy and financial systems in order to apply research agendas to concrete energy projects. The second came in a later stage of my fieldwork, especially during my interviews in Baja California and Oaxaca where my interviewees talked about the need for alternative finance for their local energy project planning. Both events built a curiosity that reached the end of this dissertation as a concern and the foundation to elaborate a further research agenda. In this last section, I would like to reflect on this "alternative finance" debate and what it implies with the rest of this dissertation as a future activity as applied research.

In the early stages of the PhD, I was inspired by Castree & Christophers (2015) and Hudson (2015), whose proposals suggest the need for ethical financial practices and healthy credit programs to move economies to a more socially and environmentally sustainable future. Also, proposals by Cohen (2017) were valuable reflections to assess the possibility of a post-capitalist entrepreneurship activity that could support energy and environmental initiatives, as well as Reye's (2020) book on the need for progressive financial activism. Most of this contribution had an impact on my predilection of the literature reviewed for this thesis. I admit I address these debates from a purely academic and abstract perspective since there was no concrete application of these ideas as part of the fieldwork experience. But I can say that this critical perspective derives in proposals that guided the construction of the research project. After all, I needed to learn first more about financial and energy systems before getting into any practical task.

During fieldwork, my interviews regarding the processes of financialisation in the Mexican ET came to a dead-end, partly because of the interruption of the 2014 Energy Reform when the AMLO administration arrived in 2018 and the COVID crisis in 2020. My first set of interviews in Baja California in 2019 included some preliminary conversations about the need for financial schemes for small energy projects, an area that the mainstream financial programs were not interested in because of the lack of profitability in the short term. This derived from a first invitation for assessing the possibility of small-scale financial initiatives to raise funds from several sources to acquire technologies, especially solar panels and a relatively small desalination plant. In brief, I left these proposals aside to focus more on the literature review, documental research and actual critique that is the foundation of this thesis. Nonetheless, during the pandemic in 2020-2021, my interviewees in Baja California and the people that contacted me regarding energy finance projects in Oaxaca were interested in the effects that the crisis had on the development of new projects and how financial resources could be raised to fund local energy projects. At that time, my interviews drifted from the mainstream CF critique to a more

alternative approach to how finance could "become its opposite" and support these projects. These interviews led to an interesting but fragmented body of information that created an imbalance in the research project. On the one hand, I had the original subject matter of the critique of the financialisation process of the ET in Mexico (and Baja California particularly), on the other, I had a bunch of premature information and research questions that could not materialise easily in a complementary way with the rest of the dissertation.

After assessing the potential of the alternative's perspective, I decided to leave aside this information to avoid imbalances and inconsistencies in the original thesis. However, I would like to use some of those results to close this dissertation, using it as a closing debate on how this thesis can have a continuation derived from the premature experience. This would help me to close this project as a diagnosis of the current trends of financialisation and the ET in Mexico, making a link to a future research agenda based on alternatives and concrete energy projects development.

Initially, by "alternative" I was referring to a counter-hegemonic movement that could create collective futures beyond the fossil economy and the capitalist dynamics. This is important since the mainstream financial discourse considers alternative any investment that is moving from fossil fuels to renewable energy. However, this initial idea was a bit radical when I approached the empirical experience. During fieldwork, my interviewees pointed out a gap in the need for "alternative" finance to satisfy the local energy initiatives created by cooperatives and communities. But what does alternative mean in this context? If we follow the "become its opposite" theory, this means alternative financial actors, institutions, instruments, and mechanisms that emerge from political and social movements to support the plural and diversified needs of communities and populations. During one of my interviews with Rosendo Morales, an accountant of energy cooperatives in Oaxaca, I realised that the "alternative" path so far was to use traditional finance schemes adapted to the community energy planning. That is, promote a more politically organised planning of energy transition projects using a mix of private and public sources to acquire renewable energy technologies while searching for alternative financial schemes that could adapt more to the low-scale necessities of the communities. Rosendo Morales mentioned that there are no clear alternative financial schemes other than the political lobby to obtain more public budgets from the government. Nonetheless, he mentioned some clues that made my initial reflections on alternative finance:

- *Internal sources of finance.* Local energy projects require funds to obtain low-scale renewable energy technologies and infrastructure. Traditional planning relies on grants, debt or equity to acquire them, but most of these sources are subjected to project finance schemes that demand short-term paybacks and guarantees that cannot be granted due to the communal tenure of the land. If low-scale projects are well planned and administered, they can support productive activities that generate revenues to repay financial liabilities. But the idea, in the long run, is to generate a significant surplus to have an internal fund of savings. This fund would be redistributive rather than accumulative, allowing the reinvestment and even the funding of other projects. This is a practice that the savings and credit cooperatives of Oaxaca have been planning. From

there it is possible to design other mechanisms, like community shareholders or crowdfunding schemes.

- *Localised technologies.* According to Morales, the recent conflict experiences regarding large-scale wind turbines in Oaxaca¹²⁶ shifted the interest of communities to more localised technologies, like low-enthalpy geothermal or OTEC plants. These technologies allow communities to create business plans and build productive economies around the energy generated, creating a series of sub-products for local consumption and exchange. This generates a series of cash flows that supports the project and creates savings for the objectives mentioned above.
- *Spatial planning process.* Productive local projects and financial autonomy can contribute to reshape idle or unproductive lands, creating a renewed spatial planning for energy transition and climate adaptation projects. Here we can add a series of indicators and funds dedicated to specific necessities of ejidos or communities. One of these funds is the restitution fund: any social or environmental impact generated by a project can be restored with a reinvestment plan. This was exemplary in the Baja California ejido of Maneadero, where a desalination plant was planned to compensate for a water source used to irrigate local agriculture.

Nonetheless, on the other hand, I have anticipated some of the barriers and problems that the "alternatives" path could bring. Some of these reflections were also present in my interviews:

- *The rigidity of the financial system in Mexico.* The financial system in Mexico is quite monolithic. It is integrated by a rentier foreign banking sector, and the rest of the local financial institutions have barely moved towards environmental financing. This means a lack of democratisation and diversified institutions that cannot provide resources to energy projects, let alone small ones. Without substantial initial changes and reforms in the Mexican financial system, energy financing would continue to be a matter of foreign companies and international banking looking for large-scale developments, or the World Bank programs to introduce companies under the "social" and "community" investment labels.
- *The weak impact of alternative financial mechanisms in the face of major monopolistic financial actors and institutions.* There is a risk that any alternative project can be absorbed by mainstream finance, especially under the new "social perspective" branding of the CF roadmaps. This would represent a limited impact of small projects and the ability of finance to use its own mechanisms to subordinate any initiative under the CF umbrella, meaning that the market model will exclude other alternative models that speak of a broader energy transition.
- *The financial long-term stability of projects.* While it is still a theoretical approach, the long-term planning of alternative projects has yet to overcome a turbulent environment marked by financial crises and economic fluctuations. Even though there are preliminary

¹²⁶ These are the projects that have the "bringing them on board as stakeholders on their own territories" policies used by international energy companies as "social investment" initiatives.

ideas of the autonomy and self-determination of small energy projects, they are still embedded in the circuits of the capitalist economy.

- *The lack of replicability in other regions.* There is a risk that any alternative project has initial success but represents isolated laboratories that have difficulties being replicated in other regions. This is a challenge to the generalisation of experiences that remains to be seen as projects develop.

These ideas allowed me to have a dialogue with my interviewees, resulting in preliminary invitations to visit communities that are developing similar ideas. My perception of "alternative finance" has certainly shifted since then, and I decided that this deserves a post-doctoral research agenda where I can reflect and apply these ideas more extensively. This would fulfil my objective of applied research in the field of marrying finance, energy and geography, using the PhD research project as the basis for future activities.

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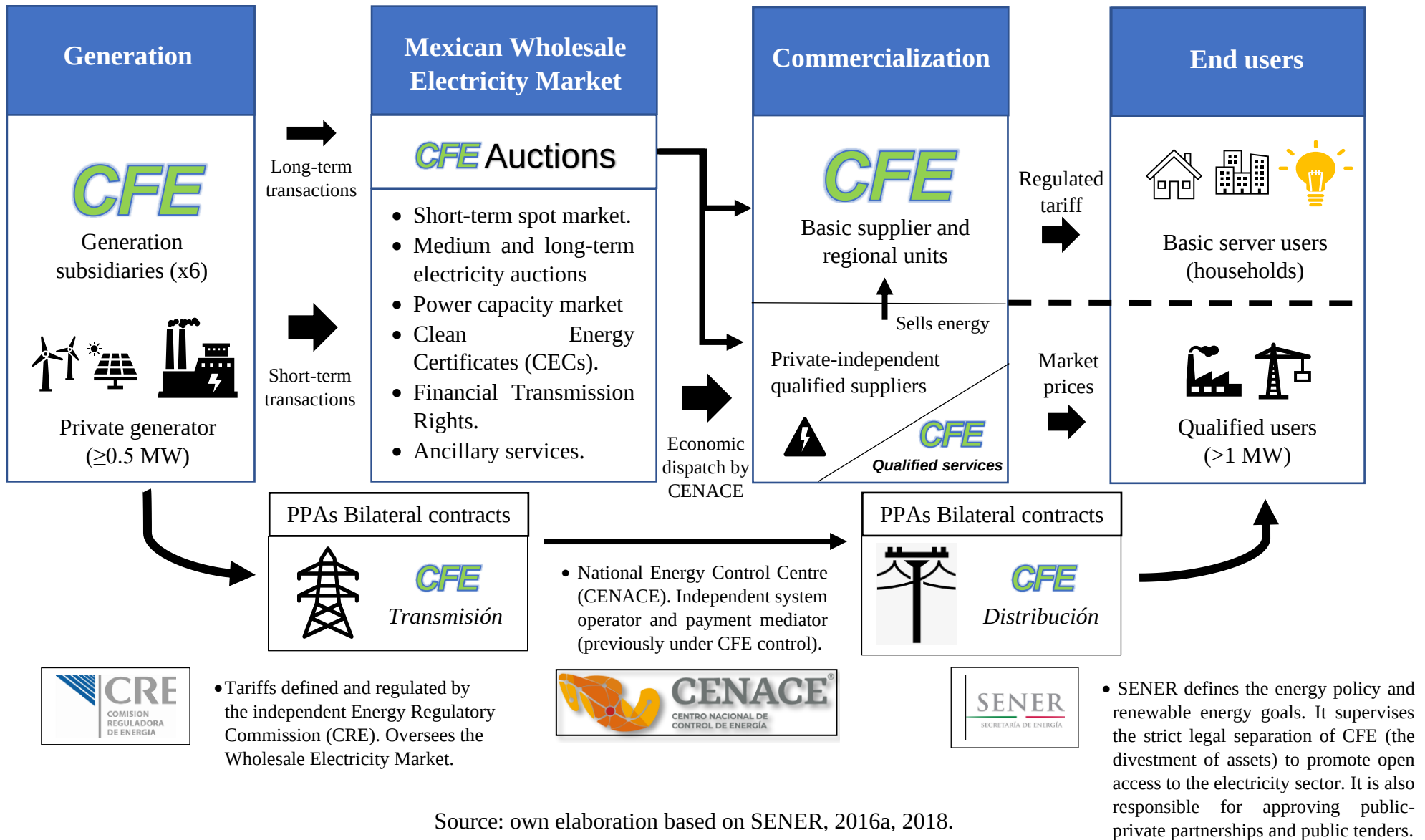
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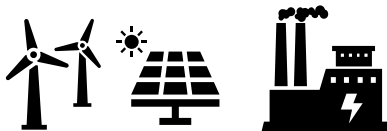
Appendix 1. Technical elements of the Mexican electricity industry and market

Basic structure of the Mexican Wholesale Electricity Market (Energy Reform scheme)



Source: own elaboration based on SENER, 2016a, 2018.

Market changes since the Energy Reform

Sector	Pre-Energy Reform	2013-2014 Energy Reform
 Generation	• CFE oversees the generation of electricity to all end users. • Private generators could participate through the self-consumption scheme, cogeneration, and the IPP figure.	• Competition between CFE and private generators. No barriers to entry. • Participation through three main schemes: 1) Sale of energy and associated products in the Wholesale Electricity Market. 2) Bilateral contracts with Qualified Users or Suppliers. 3) Medium- and long-term auctions organized by CENACE.
 Transmission and distribution	• CFE is solely responsible for providing transmission and distribution services, including operation, maintenance and expansion of the National Transmission and Distribution grids.	• Open and non-discriminatory access to National Transmission and Distribution Grids. • The private sector may participate through bids and/or PPP contracts with the Mexican State to carry out financing, installation, maintenance, management, operation and expansion of transmission and distribution infrastructure.
 Commercialization and retail	• The Basic Supply Service was exclusive on CFE's hands. • The end-user tariff aggregated all components along the value chain and was determined by the SHCP.	• Two types of consumers in the electricity market: 1) Basic User: Basic supply public service. End-user tariffs are regulated by the CRE and designed to recover the costs of generation, transmission, distribution and market operation costs. 2) Qualified User: Large industrial or commercial customer (>1MW) that can purchase energy and related products at competitive prices in the spot market or negotiate bilateral contracts with Qualified Suppliers or Generators. • Although CFE retains Basic Supply, private participants may register to provide the public supply service. • Qualified Suppliers (including CFE) compete on equal terms to market electricity, capacity, CECs, and other associated products.

Source: own elaboration based on SENER, 2020.

Market participants under the new Wholesale Electricity Market model

Actor	Function
Generators	Installed capacity plants (fossil fuels-based or renewable energy) that generate electricity.
Basic service supplier	Represents load centres corresponding to basic service users.
Qualified supplier	Represents load centres related to qualified users that do not participate directly in the Wholesale Electricity Market.
Basic supply user	End-user that acquires electricity from a basic service supplier (households mainly).
Qualified user	End-user who purchases electricity through a qualified supplier. The minimum demand is 1 MW (industries and energy-intensive activities)
Qualified user market participant	Represents load centres for self-consumption or for consumption within its facilities. Electricity and associated products are obtained directly from the market, without the need to be represented by a supplier. Their demand is above 1 MW.
Last resort supplier	Represents qualified users for a determined period, generally in case of emergencies involving the grid (peak demands, congestion, disasters or grid failures)
Non-supplier trader	Trade energy in the wholesale market without representing physical assets. Can participate in the purchase and sale of electricity, ancillary services, installed power, Clean Energy Certificates (CECs) and Financial Transmission Rights (FTRs). Usually related to the physical and financial trading of electricity.

Source: own elaboration.

International practices adopted from other markets

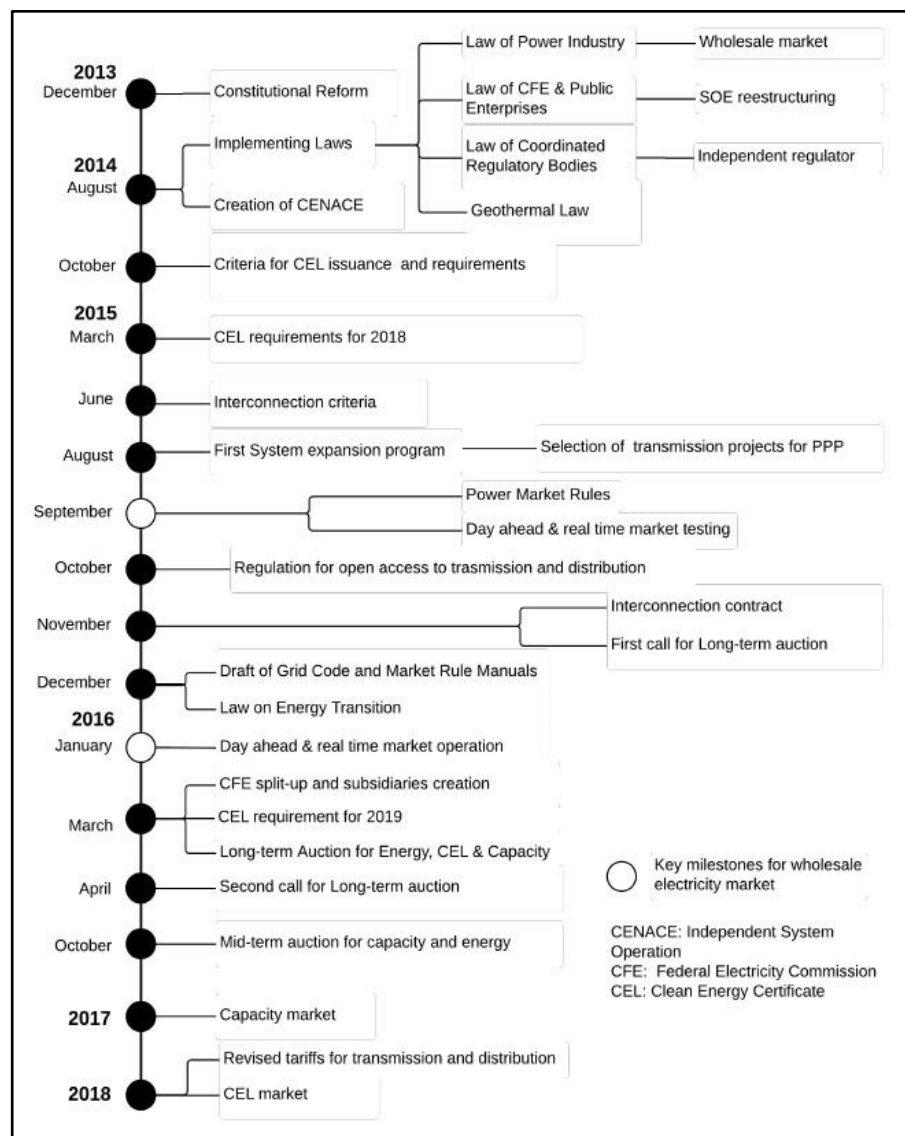
Market element	Taken from
Nodal prices for the spot market.	Argentina, Chile, Ireland, Russia, Singapore, New Zealand, PJM, ERCOT, CAISO, MISO.
Cost-based market for new generation with reserves demand curve.	United Kingdom, Ireland, Russia, Colombia, PJM, NYISO, MISO.
Clean Energy Certificates with clean portfolio requirements.	Nordpool, Italy, CAISO, United Kingdom, Australia, Chile, India.
Financial Transmission Rights through periodic auctions.	New Zealand, PJM, ERCOT, CAISO, MISO.

Source: Hernández-Ochoa, 2016.

Major players	Products and services (sub-markets)	Transaction
1) CRE (independent regulation). 2) CENACE (independent operator). 3) Market participants. a) Power generation. b) Qualified user (demand $\geq$ 2MW). c) Supplier. • Basic. • Qualified. • Last resort. d) Non-supplier trader.	1) Electricity. 2) Ancillary services. 3) Power capacity. 4) Clean Energy Certificates (CECs). 5) Financial Transmission Rights.	1) Short-term transactions. a) Day-ahead electricity and ancillary services. b) Real-time electricity and ancillary services. c) Capacity Market (annual). d) CELs market. 2) Medium and long-term contracts. a) Medium-term electricity and capacity auctions (3-year contracts). b) Long-term capacity and clean energy auctions (15-year contracts); and CECs (20-year contracts). c) Financial Transmission Rights auctions.

Source: Chanona, 2016: 15.

Timeline of the Energy Reform implementation



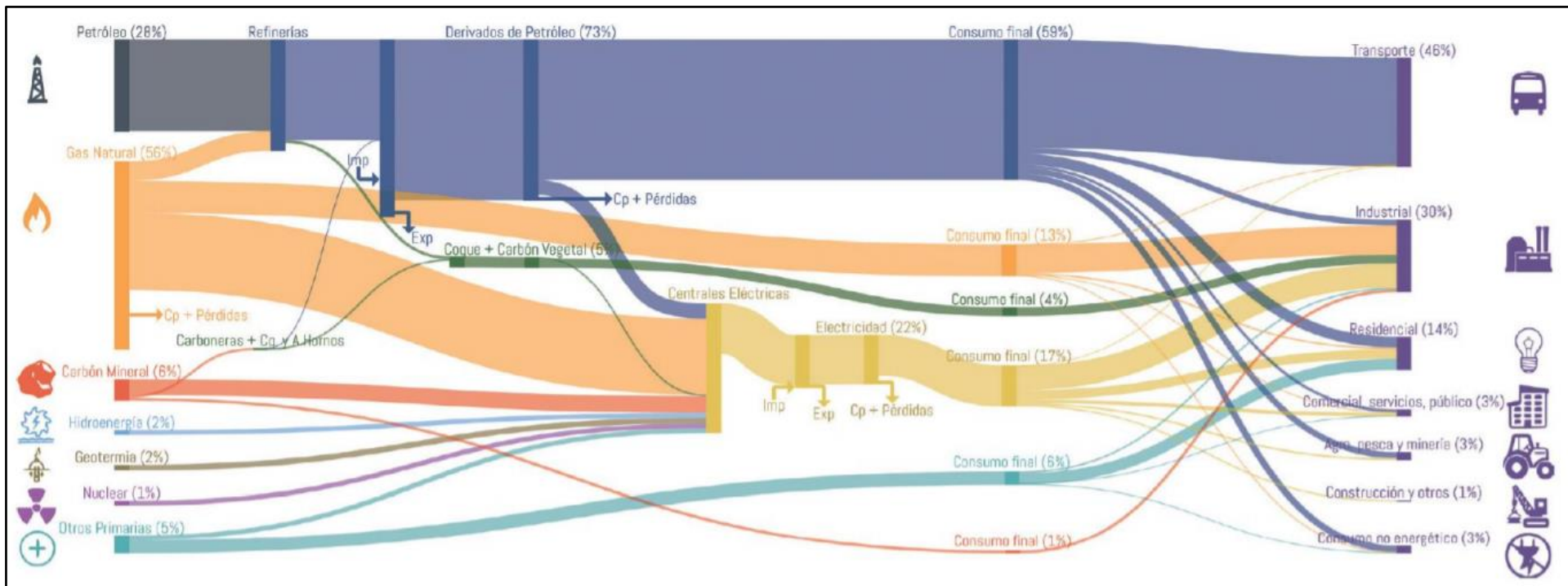
Source: BMWi-SENER, 2018

Financial risk analysis for market players

Risk	Variables	Implications	Mitigation
LMP volatility	Components of the price of electricity	Income variations due to fluctuations of prices and cash flows related to demand-supply, grid congestion, season, and geographic location.	Bilateral contracts with fixed price agreements to reduce market volatility. Deep analyses of the nodes involved in the business model.
Currency volatility	Mexican Peso-dollar parity	Exposure to exchange rate variations in the acquisition of technologies, fuels, debt, and other specific contractual commitments in foreign currency.	Foreign Exchange financial derivatives.
Dispatch	High variable costs or low demand	Not being dispatched in the market because of high generation costs (even though this is low risk for a renewable energy generator) or a lack of demand to cover.	Risk analyses and assessment of the interconnection nodes.
Generation and supply commitments	Supply-demand dislocation	Failure to meet the demand of a client due to the differences in generation technologies, economic activities, and time-space dynamics.	Proper economic valuation of the grid and the client's energy profile.
Bilateral nodal asymmetries	Differences between input and output nodes	Variations in energy price components like spreads of supply, demand, losses, and congestion. This volatility has an impact on cash flows and forecasted income.	Bilateral Fixed price agreements, analyses on nodes prices and demand, and Financial Transmission Rights.
Contractual conditions	Conditions of energy generators and bilateral contracts	Contractual loopholes that result in conflicts regarding forms of settlement, take-or-pay clauses, pass-through agreements and guarantees.	Proper legal and technical assessment prior to market participation.

Source: Bancomext-GIZ, 2018.

Mexico's Energy Balance (218,456 thousand tonnes of oil equivalent), 2016



Source: Blanco, 2018: 31.