Mexico's road towards energy sustainability:

The case of the recent electricity reform

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Abstract

In 2013, Mexico started the liberalisation of its electricity sector through a major reform that ended the state monopoly and created an electricity market. The 2015 Energy Transition Law (ETL) established clean energy obligations for big energy consumers as a way to introduce sustainability to the sector. Although the ETL seems to set an important precedent for Mexico's transition to more sustainable energy, the law should be analysed in the wider context of an energy reform that has sought to make the fossil fuels sector more efficient.

This thesis focuses on the ETL and analyses the emergence of the Mexican electricity reform and its relationship with sustainable energy transitions (SETs). The thesis applies a framework that draws on elements from Socio technical-transitions (STT) studies and Historical Institutionalism (HI) to examine the Mexican electricity system, to determine how the political dynamics within the sector have affected its transformation over the last two decades. It tests analytical elements from STT and HI (three-level analysis, path dependence, power distribution and critical junctures) that have been used to explain SETs in other contexts. The thesis also adds other analytical elements that have not been included in the STT-HI framework, namely a detailed analysis of the policymaking process of reform and the role of policy entrepreneurs. The overall aim is to determine whether and to what extent the STT-HI combined framework could explain the dynamics of the Mexican case, which remains understudied in the literature.

The thesis highlights the need to examine a broader range of relationships and political processes affecting energy policies and sustainable transitions. The research contributes to SETs theories and is situated within an emerging subfield that seeks to conceptualise transitions as political phenomena. The analysis also provides empirical insights into the transitions literature beyond widely-studied European cases.

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Declaration

I declare that this thesis is a presentation of original work and I am the sole author. This work has not previously been presented for an award at this, or any other, University. All sources are acknowledged as References.

Chapter 1: Context and conceptualisation of Sustainable Energy Transitions

1.1. Introduction

In 2013, Mexico started the liberalisation of its electricity sector through a major regulatory reform, which created an electricity market, opened the sector to private investment and ended a state monopoly, which had lasted for nearly sixty years. The Energy Transition Law (ETL), approved in 2015, sought to regulate the sustainable use of energy in the electricity industry through the application of clean energy obligations.

The approval of this law opens up a discussion about the course of Mexico's sustainable energy transition, broadly defined as the transition to more sustainable patterns of energy consumption and production – i.e. generating less GHG emissions as compared to current patterns. Although the ETL seems to set an important precedent for Mexico, the law needs to be analysed in the wider context of an energy reform seeking to make the fossil fuels sector more efficient and of the development-related challenges that the country faces.

This research sheds light on the different ways in which sustainable energy transitions (SETs) unfold by analysing the case of the Mexican electricity sector. The economic, social, political and institutional context of Mexico results in specific energy challenges, that differ from those faced by European countries, which have been widely studied in the literature on energy transitions and socio-technical transitions (STT) studies. As a developing country, Mexico faces particular tensions between effectively managing resource extraction to meet the rapid growth in energy demand, based mostly on fossil fuels, and the need to transition to more sustainable energy sources.

These tensions are aggravated in the context of poor management and governance of oil revenues, which has led to waste and inefficient use of the resources; a heavily subsidised energy sector, that creates distortions in consumption patterns, making low carbon technologies unable to compete with fossil-fuel-based technologies; and a weak regulatory framework that discourages investment in innovation technologies. At the same time, Mexico faces vulnerability to climate change events, which has led the

country to adopt ambitious climate change goals, the achievement of which require fundamental changes to the energy system.

The findings of the thesis show that institutions have limited the scope for a sustainable transition in the Mexican electricity sector. Mexico's attachment to oil originated from a historical abundance of oil resources and became deeply embedded in the political structure and system. Consequently, oil has enjoyed a privileged position as the main source of energy, limiting the scope for technological innovation. In the 1990s and the 2010s, pressures for change emerged at different levels of the electricity sector, producing enabling conditions that opened opportunities for change. Further, mainly political facilitating circumstances reinforced the pressure for change during the energy reform of 2013. Key factors were partisan alignment, and the presence of policy entrepreneurs seeking to extend the use of renewable energy, in order to advance a sustainability agenda. However, both in the 1990s and 2013, institutional structures and their patterns of reproduction constrained the scope for change.

The thesis is organised like a case study that explains the emergence of stability and identifies the conditions for major policy changes. The analysis is divided into two periods: one prior to the energy reform (1990-2012) and a second focused on the energy reform process (2013-2015). The analysis of the first period (presented in Chapter 4) reveals trends of stability and instability in the electricity sector and a set of drivers and obstacles to a sustainable transition. The analysis of the second period (Chapters 5 and 6) reveals how those patterns were embedded in the policymaking process of the electricity reform and the Energy Transition Law (ETL).

This chapter is organised into five sections. Section 2 presents the purpose of the research, the research questions and briefly introduces the analytical framework and contributions. Section 3 discusses current global energy challenges and makes a case for adopting more sustainable patterns of energy. This section also establishes a concept of sustainable energy and the governance challenges associated with it. Section 4 explains some of the main features of energy transitions and the conceptualisation of SETs. Section 5 links the global discussion on sustainable energy, and SETs, to the Mexican case. To that end, the last section introduces some of the main features of the Mexican energy sector and a brief context in which the 2013 energy reform emerged. The chapter concludes with an overview of the thesis.

1.2. Research purpose, research questions and contributions

A quick overview of the Mexican case shows that the country is undergoing major changes in its energy sector due to the 2013 energy reform. Whether those changes will actually lead to more sustainable energy patterns – i.e. less environmental impacts – is still unclear since the changes have only recently been introduced. However, it is useful to understand the context in which the Mexican reform emerged and evolved. The purpose of this research is to analyse the ongoing process of changes in the Mexican electricity sector to determine how the political and institutional dynamics have affected its sustainable transition from 1990 to 2015.[1] To achieve this aim, this thesis addresses three main research questions:

1. What are the drivers and obstacles to a sustainable transition in the Mexican electricity sector?
2. How have institutions shaped the sustainable transition in the Mexican electricity sector?
3. What was the role of sustainability in the electricity reform of 2013?

To address the first question, this thesis analyses the period from the 1990s, which covers a wave of regulatory reforms to electricity laws, until 2013, when the energy reform started. The analysis centres on the structure of the electricity sector prior to the reform in order to uncover historical, technological and institutional drivers, and their respective impacts upon actors and interests in the sector. The analysis investigates how the forces for and against RE affect the way in which energy decisions are taken by using the policymaking process of the 2013 reform as an example.

The second question requires an understanding of how institutions and institutional arrangements[2] shape the transition by creating or blocking opportunities for change.

[1] In general, a "transition" refers to a set of large-scale disruptive changes in a societal system, like the energy sector, e.g. an energy transition. A "sustainable transition" is when such a process leads to less environmental impacts. These definitions are expanded throughout this chapter.

[2] The term "institution" is used in this thesis to refer to the formal entities and structures ruling the energy sector in Mexico. Although some of the institutions analysed in the next chapters govern economic or technological aspects, they will be considered political institutions insofar as: 1) they are part of the Mexican political structure; 2) they govern different aspects of energy and electricity; and 3) they reinforce their own stability and contribute to path dependence, as explained in Chapter 2. The term "institutional arrangements" is used to refer to the set of laws,

Consequently, the research analyses the origins and the evolution of the institutional arrangements in the electricity sector to comprehend their persistence over time.

To address the third research question, the research analyses the sustainability approach of the 2013 energy reform by exploring its meaning, origins, and how it was translated into new laws. Sustainability is taken to refer to the environmental approach to energy, which for the purposes of this thesis, centres on the development of RE electricity (see discussion in the next section). The analysis of sustainability focuses on three significant reform avenues: constitutional; electricity (i.e. the Electricity Industry Law); and the Energy Transition Law (ETL). The aim is to determine whether and to what extent the 2013 reform represents a step towards sustainability in the Mexican electricity sector and how the new regulation limits or enables a sustainable transition.

The research reflects on these questions from a political perspective and by applying an analytical framework that combines elements from the literature on Socio-Technical Transitions (STT), Multi-Level Perspective (MLP), and Historical Institutionalism (HI). The thesis uses this analytical framework to explain the dynamics of the Mexican electricity transition, a case that has been overlooked in the literature to date (see Chapter 2).

Thus far, there are a limited number of studies that combine these frameworks in cases of transitions (see Kern and Rogge, 2018; Kuzemko et al., 2016; Lockwood et al., 2016; Roberts and Geels, 2019, which are discussed in Chapter 2). These studies are part of an emerging literature that seeks to capture better the political processes associated with transitions. This literature responds to a need identified in energy transition studies about a lack of attention to the political aspects in most of the analysis.

Studies that combine STT-HI elements have produced a more nuanced analysis of the politics and political processes embedded in transitions, but they still face three main limitations. First, given the limited number of studies, there is an overall lack of systematisation of the research approach, methodology and findings. Also, they are not exclusive to sustainable energy transitions (for example, Roberts and Geels' (2019)

regulations, policies, policy instruments that, together with the institutions, constitute the organisational structure of the Mexican electricity sector.

study historical transitions in the agriculture and transport sectors). Second, the scope of the studies is limited to a small number of West European cases (UK and Germany). Their applicability to other contexts, i.e. countries with notably different levels of development and different institutional systems, remains largely unexplored. Third, studies overlook the relationship between liberalisation and sustainability, which is relevant in developing countries.

This thesis makes four main research contributions. First, it contributes to the systematisation of the emerging literature that conceptualises sustainable energy transitions (SETs) as political phenomena in which the political processes and policies play a fundamental role in fostering or blocking sustainability. Second, it mitigates the "European bias" that currently exists in the classic STT literature (Markard et al., 2012) and in the emerging field that combines STT and HI, by providing empirical case-specific insights from Mexico and testing some of the analytical elements from STT and HI that have been used previously to explain transitions in European contexts. Third, it develops a combined theoretical framework by adding analytical elements from HI to produce a more complete framework that may be useful for other cases of transitions similar to Mexico, i.e. countries that face similar development and energy challenges, and/or that are going through a simultaneous process of liberalisation and sustainability. Four, the Mexican case reveals that the economic structure – i.e. the degree and model of economic liberalisation – is an important element to be taken into account when studying SETs in developing countries.

1.3. Energy challenges: the need for a Sustainable Energy Transition

The cumulative scientific evidence and increasing recognition of the adverse environmental impacts associated with the massive use of fossil fuels have made clear that current energy production and consumption patterns are not sustainable. The relevance of this issue is evident in the number of academic and policy publications that seek to analyse, both from theoretical and practical perspectives, the best ways in which to overcome current energy challenges from sustainability, security and geopolitical and economic points of view (see *inter alia*). In recent years, the term "energy transition" has been frequently used in the context of sustainability and transition to a low-carbon economy (see Foxon, 2011; Skea et al., 2011; Urban, 2014) and the term "sustainable energy transitions" (SETs) has become common. Importantly, these public and academic debates seek to explore the ways in which SETs can be incentivised and accelerated (Loorbach et al., 2017; Roberts et al., 2018; Roberts and Geels, 2019).

1.3.1 Current pressures in the global energy system

Concerns over the marked dependence on depleting fossil fuel reserves and current trends in energy use demand, population growth, urbanisation and global greenhouse gas (GHG) emissions have directed attention towards the need to modify current energy systems. Global energy use has grown by more than 50% since 1990, and it is estimated that global energy demand will expand between 20-35% by 2030 (Global Commission on the Economy and Climate, 2014). This growth is mostly driven by population and economic growth, with developing countries playing a key role as they will account for 90% of energy demand growth to 2035 (OECD, 2012).

The addition of 2 billion people to the world population by mid-century will significantly increase the pressures on demand for energy (Araújo, 2014) and will place additional pressures on energy infrastructures. Electricity generation has had a dramatic growth of more than 250% during the last forty years (IRENA, 2014). This rapid increase in electricity was in line with the expansion of urbanisation as today more than half of the world's population live in urban areas (UN, 2018). Despite this growth in the provision

of electricity, it is estimated that 1.2 billion people worldwide (17% of the global population) still lack access to reliable electricity (IEA, 2015).

About 81% of world primary energy supply originates from fossil fuels (IEA, 2018), which represents a risk. Additionally, the intensive use of fossil fuels is the main driver of carbon emissions: energy production and use already account for two-thirds of global GHG emissions (IEA, 2015). Also, highly driven by GHG emissions, climate change represents increasing challenges for energy production and transmission as a result of temperature increases, extreme weather events, and changing precipitation patterns. Furthermore, emissions from energy use contribute to multiple impacts on social and environmental systems (Global Energy Assessment, 2012).

Addressing these challenges requires a transformation of current energy systems (i.e. how we produce, distribute and consume energy). That transformation offers an opportunity to meet the future growing energy demand in more sustainable ways. As will be discussed in the next section, while there is consent on the need for an energy transition and for it to be sustainable, there is no agreement on what this transformation means in practice.

1.3.2 Sustainable Energy

The crucial role played by energy, particularly electrification, in achieving sustainable development has been recognised in several energy policy documents. A consensus seems to exist that without sustainable energy patterns, sustainable development will not be achieved (World Bank, 2008; UN, 2012; UNDP, 2005). Nevertheless, there is a variety of interpretations of the term “sustainable energy” and its implications. The different aspects involved in this discussion have been extensively studied elsewhere (e.g. see Elliot, 2007; Dincer, 2000; Tester et al., 2012), so they will be briefly introduced here to illustrate the lack of consensus and the complexity of this topic.

In 1987 the Brundtland Commission's Report, “Our Common Future”, provided four key elements for energy in the context of sustainable development: 1) sufficient growth of energy supplies to meet human needs; 2) energy efficiency and conservation measures, such that waste of primary resources is minimised; 3) public health, recognising the problems of risks to the safety inherent in energy sources; and 4)

protection of the biosphere and prevention of more localised forms of pollution (Brundtland et al., 1987). According to these features, sustainable energy should be reliable, efficient, safe and clean (i.e. with low environmental impacts). An affordability concern was later associated with this definition (Goldemberg et al., 2004), which was reinforced in 2015 with the adoption of the Sustainable Development Goals (SDG) framework as part of the 2030 Agenda for Sustainable Development (UN, 2015). Specifically, the SDG 7 focuses on ensuring universal access to affordable, reliable, sustainable and modern energy.

A more straightforward definition implies that "sustainable energy is that which can be provided without adverse effects on the earth's biosphere" (Tester et al., 2012: 5). This rigid definition, however, suggests that there are very few options (if any) of sustainable energy as it implies that energy resources should be available for an indefinite future and have zero (or very low) impacts. By contrast, a flexible vision of sustainable energy resources could be "those that have reasonably long lifetimes and relatively low impacts", so sustainable energy is one that is "more sustainable than the conventional" energy resources (Elliot, 2007: xviii).

In a review of literature on sustainable energy, Peura (2013) found 19 "typical" definitions and identified energy efficiency and renewable energy as the most common features in all definitions. Sustainable energy strategies normally involve energy savings on the demand side and efficiency improvements in energy production, and the use of renewable energy to replace fossil fuels (Lund, 2007).

Renewable energy (RE), generally understood as the energy that comes from sources that are naturally and relatively rapidly replenished,[3] fits into the idea of sustainable energy because these resources have fewer environmental impacts (Dincer, 2000; Pagnoni and Roche, 2015). For instance, life-cycle assessments for electricity generation indicate that GHG emissions from RE technologies are, in general, significantly lower than those associated with fossil options (IPCC, 2012). This is why deploying renewable technologies has been widely associated with climate change (Grubb et al., 2008; IPCC, 2012; IRENA, 2015c). One of the general ideas of promoting

[3] It includes generation from solar, wind, biomass, the renewable fraction of municipal waste, geothermal sources, hydropower, ocean, tidal and wave resources, and biofuels (IEA, 2007).

RE resources, in the context of sustainable energy, is that RE technologies contribute to lower carbon intensity (IRENA, 2015a). Importantly, given the crucial role that electricity plays as one of the largest sources of emissions, advances in sustainable energy are increasingly associated with increases in the share of electricity from RE sources and in investments in RE technologies. For instance, Germany and Denmark have been regarded as a successful case of sustainable energy because of their substantial expansion in the use of RE (IRENA, 2015a; Jacobsson and Lauber, 2006).

Sustainable energy is also usually associated with the term “low-carbon energy” (and similar terms: “low-carbon fuels”, “low-carbon power”, “low-carbon technologies”). As with “sustainable energy”, there is no specific definition for these terms other than technologies that generate “fewer GHG emissions” as compared to conventional sources or fossil fuels (IEA, 2016a; Urban, 2014). This group of energy sources usually includes RE, nuclear power and carbon or gas with carbon capture and storage (CCS) technologies (IEA, 2016a). Other associated terms are “clean energy” and “green energy”, which have been frequently used in policy publications (OECD, 2012). The use of all these terms is contentious because while they may imply sustainability in terms of long-term availability and less environmental impact, they also attach a discussion about affordability, health and economic risks. For example, some countries, such as the United Kingdom, and Mexico, consider nuclear power as part of their clean energy policies, but there is disagreement in the literature whether this type of energy is sustainable given the environmental and health risks, high costs and social impacts associated (Forsberg, 2009; Mez, 2012; Mitchell, 2008;). Likewise, CCS technologies have been criticised because they reinforce the use of fossil fuels instead of their substitution; also. they imply costs and risks that are open to debate.

One last point in this discussion concerns the social implications associated with “sustainable energy”, specifically, the link between energy and development, i.e. poverty. As energy patterns are deeply embedded in our society, changes in energy systems usually involve changes in societal functions (Laird, 2013). For instance, historically, the use of steam, petroleum, and electricity contributed significantly to shape countries’ development by affecting transportation, housing, working, communication (Nye, 1999). Access to energy, especially to electricity, has been regarded as crucial for eradicating poverty (Goldemberg et al., 2004; Sovacool and

Drupady, 2012). This is because limited access to energy services tends to prevent the improvement of living conditions; therefore energy is considered decisive to advancing health, food security, education, and gender equality goals (Goldemberg et al., 2004). RE technologies have been regarded as a means to expand electricity access due to their "modular, scalable and decentralised nature", which facilitates their local adaptation, for example via off-grid systems, with potential benefits like local jobs creation and household incomes increases (IRENA, 2014; IRENA, 2015c). Yet again, these benefits are not automatic and will depend on local conditions and enabling policies.

In brief, we can argue that sustainable energy is related to energy's long-term availability and the use of alternative energy sources that have a less environmental impact and offer improvements in societal aspects. As such, a sustainable energy system is "one based on new low carbon technologies across the energy spectrum-electricity, transport, heat, and demand reduction" (Mitchell, 2008: 200). However, as has been discussed, the implications of these aspects are part of an on-going debate. Much of the diversity of views and arguments come from the fact that the various challenges affect countries in very different ways, depending on their specific conditions (i.e. human and natural capital and economic systems) such as the energy mix, climate vulnerability, institutions and access to alternative sources. Even within countries, changes in the energy system have heterogeneous impacts across society and regions. Above all, the complexity and lack of consensus show why it is necessary to develop analytical frameworks to understand and explain SETs.

1.3.3 Governance of sustainable energy

A transition to sustainable energy systems will require significant shifts on different fronts: technology, pricing regimes, energy markets, banking and financial rules, business models, investments, behaviours and consumption (Mitchell, 2008; OECD, 2012). Specifically, it will "involve changes to practices of energy use; innovation and deployment of a range of low carbon technologies; and a broader change in the mix of industries within national and global economies" (Foxon, 2011: 2258). It has become evident that such a transformation requires "deliberate efforts" because, given the characteristics of the current energy system, and particularly of current energy markets,

it is unlikely that a sustainable energy transition will be prompted by itself, thus, government intervention (e.g. via legislation or tax policy) is necessary (Fouquet, 2010; Mitchell, 2008).

In general, we could say that sustainable energy governance is the first step of a sustainable energy system (Mitchell, 2008). Government intervention is needed because this transition is costly, and "the long-term public external cost of energy use", as opposed to the short-term revenues that current energy system privilege, should be addressed (Andrews-Speed, 2016: 223). Additionally, restructuring the energy sector involves distributional effects within and between countries that will need to be addressed by governments; for example, job losses, variations on prices and changes in the patterns of trade-related to fossil fuel change (OECD, 2012).

Governing SETs is a contested area (Shove and Walker, 2007) for different reasons. First, energy policy objectives depend on national interests and the priorities prevailing within each country. In general, energy security and reliability have been dominant objectives in energy policy. Also, keeping prices affordable for consumers and businesses have been significant concerns for countries, particularly in the UK and Mexico (Scrase and Ockwell, 2009). Increasingly environmental and climate concerns have gained attention (Kuzemko, 2013; Mitchell, 2008); sometimes they have been added as considerations in energy policy, but not as drivers (Verbong and Geels, 2007) because they compete with the traditional goals and other "immediate" goals such as enabling jobs creation or fiscal policy. The hierarchies between these different objectives will determine the priorities in energy policy. For example, if an energy transition is seen as an opportunity to mitigate emissions via sustainable energy innovations, then it could be possible that climate change is considered a driver. Moreover, "the more that climate change is perceived as a crisis the more likely it is that major transformations in the energy system can be brought about" (Lockwood et al., 2013: 25).

Second, due to the connections of the energy sector with nearly every other economic and social sector, energy governance is interrelated to several policy areas: fiscal, industrial, environmental, technology and R&D, economic development, to name only a few. However, the overlap between energy and other policy areas does not

automatically generate coherent policies, which is a major challenge in governing SETs. For example, since the energy system is both the primary cause of climate change and the primary means of mitigation, policies that seek to address climate change are energy policies but not every energy policy addresses climate concerns (Scrase et al., 2009).

Third, energy governance is a contingent process in which multiple interests are involved. Energy transitions can become politically contested (Hess, 2014) because they imply disturbing established interests (Meadowcroft, 2011) and the unequal distribution of benefits (Eames and Hunt, 2013). Energy governance, thus, is expected to mediate between different forces: those in favour of transformation (the ones that will win with SETs) and those that seek to maintain the status quo (the ones that will lose). Additionally, to overcome "carbon lock-in" that is the inertia in which economies "have become locked into fossil fuel-based technological systems" (Unruh, 2000: 817), policymakers have to design policies specifically directed towards change-resisting factors (Marechal and Lazaric, 2010). For example, targeted policy mechanisms to attract private finance to the RE sector are required due to the large investments this sector requires (OECD, 2012). Also, RE technologies face obstacles such as cost-effectiveness, fiscal and regulatory barriers, intellectual property barriers and other cultural and social obstacles that could be mitigated via policy interventions (Mitchell, 2008; Painuly, 2001).

1.4. The conceptualisation of Sustainable Energy Transitions

Despite the growing literature on the subject of sustainable energy transitions (SETs), there is no universally accepted definition. SETs descriptions depend on the scope of the study, and the frameworks used to analyse energy transitions.[4] This section discusses four key features of energy transitions that are useful for establishing the conceptualisation of SETs for the Mexican case: 1) the type of changes involved, 2) the elements of an energy system, 3) the magnitude and speed of changes, and 4) the sustainability aspects of a sustainable energy transition.

1.4.1 Nature of changes

One of the most common approaches in the literature has been to understand energy transitions in terms of the "shifts in the *fuel source* for energy production and the *technologies* used to exploit that fuel" (Miller et al., 2015: 31; emphasis added). For example, the transition from wood to fossil fuels, from steam engines to internal combustion engines or from gasoline cars to electric vehicles.[5] Also, energy transitions are "associated with changes in the way an energy service is provided (Fouquet, 2010: 4) and the changes "to the patterns of energy use in a society" (O'Connor, 2010: 2).[6]

Araújo (2014) provides a thorough definition of the energy transition that takes into consideration all these approaches:

> a shift in the nature or pattern of how energy is utilised within a system. This definition recognises the change associated with fuel type, access, sourcing, delivery, reliability, or end use as well as with the overall orientation of the system. Change can occur at any level – from local

[4] For example, in a study on the evolution of the field of energy transitions studies, Araújo (2014) found that the term "energy transition" has been in use since the early 1900s, associated with different meanings and topics that range from molecular dissociation to technological adaptation and, more recently, to low-carbon economies.

[5] However, for some, focusing only on fuels and their associated technologies has led to a narrow conventional approach that "serves to mask the social and political dimensions of energy systems behind a false veneer of limited technological choices" (Hirsh and Jones, 2014: 110; also Laird, 2013).

[6] Other approaches conceptualise energy transitions in terms of the predominant energy in the markets. For Smil (2010), "an energy transition encompasses the time that elapses between the introduction of a primary energy source (coal, oil, nuclear electricity, wind captured by large turbines) and its rise to claiming a substantial share of the overall market" (Smil, 2010: 136).

> systems to the global one – and is relevant for societal practices and preferences, infrastructure, as well as an oversight (Araújo, 2014: 212).

Other approaches emphasise the national character of energy transitions. Cherp et al. (2018) argue that energy transitions involve changes in at least three national dimensions: energy markets, technological and political. The first domain refers to changes in the energy flows associated with energy production and consumption, for example, fossil fuel deposits, streams of water, sunlight and wind, but it also involves shifts in the conversion of energy into electricity and in the transmission of electricity. The second involves changes in the technologies used for extracting, transforming and utilising energy. Examples of this category are changes in developers, manufacturers and installers of solar PV panels and wind turbines. The third category refers to "political actions affecting formulation and implementation of energy policies", for example, "'inputs' such as demands and support for certain policies from voters, parties, lobbies and bureaucracies and 'outputs' such as energy-related laws, regulations, and international agreements as well as feedback between the two" (Cherp et al., 2018: 176-178). Cherp et al.'s (2018) perspective is congruent with this research, which seeks to understand energy transitions as processes of policy and technological change.

1.4.2 Energy system

There is no specific definition of an energy system within the literature, but there seems to be a consensus that an energy system "describes a particular production, distribution and consumption of energy" (Fouquet, 2010: 4). Furthermore, it has been common to conceptualise the energy sector (supply and/or demand side) as an energy system and mainly at the scale of the national economy.

Araújo (2014) refers to the energy system as the "constellation of energy inputs and outputs, involving suppliers, distributors, and end users along with institutions of regulation, conversion and trade" (Araújo, 2014: 212). In line with Araújo's definition, Lockwood et al. (2016) characterise energy transitions in terms of the changes in *practices* by actors in the energy system and the resulting *outcomes*, which in turn are largely shaped by the rules and incentives that the governing institutions of the energy system generate.

These definitions denote an important consensus found in the study of transitions: transitions involve comprehensive changes in different dimensions from technological, material, organisational and economical to institutional, political, and socio-cultural (Markard et al., 2012). This is because energy systems are made up of multiple, interconnected areas, as well as complex relations between the technologies, institutions and behaviours of firms and consumers (Van den Bergh and Bruinsma, 2008). In particular, as energy systems are more than collections of fuels and technologies, "energy consumption profoundly affects everything from how individuals work, play, socialise, and eat to how industries cluster, how cities and economies grow, and how nations conduct their foreign affairs" (Nye, 1998 cited in Laird, 2013: 150-151).

Understanding the interrelated nature of the energy system is a first step to understanding the complexity of energy transitions. It is also useful to comprehend that the drivers and enablers of change are as diverse as the obstacles and barriers. This approach also opens up the possibility of understanding that energy changes occur in a context influenced by pre-established conditions, which frame the transformation processes of the energy system. Such a perspective is also consistent with a key objective of this study, namely, to identify how the interactions between the energy system actors are conditioned by the institutions that govern the energy system.

1.4.3 Magnitude, pace and speed of change

A third crucial element for understanding energy transitions is the magnitude and speed at which changes occur. For Loorbach et al. (2017), transitions refer "to *large-scale disruptive* changes in societal systems that emerge over a *long period of decades"*. (Loorbach et al., 2017: 600; emphasis added). There seems to be a consensus in the literature that energy transitions involve large-scale, complex and diverse processes of change in the energy system. However, the obvious question then is how significant must those changes be to be considered as transitions? Again, there are diverse opinions and mixed empirical evidence. Most authors in the energy transition field have tended to associate this term to "transformation" or "revolution", alluding to *disruptive* or *radical* changes that have major implications for technology and social practices (Sovacool, 2016). As Cherp et al. (2018) point out, there is no consensus on how large a change would constitute a transition; however, there is "a general understanding of

the relationship between the speed, the scale, and the depth/complexity of change" (Cherp et al., 2018: 176; see, for example, Grubler et al., 2016; Sovacool, 2016).

Concerning the pace of the changes, some authors study the processes of energy transitions in stages. For instance, Roberts and Geels (2019) divide the evolution of energy transitions into two phases: a *formative phase*, when a new system exists in market niches but does not expand rapidly; and an *acceleration phase*, a period where the transition is deliberately sped up (Roberts and Geels, 2019).

In terms of the speed of the changes, energy transitions have historically proved to be long, protracted and gradual processes, taking decades to fully unfold (Meadowcroft, 2009; Smil, 2010, 2012). In the "classical" energy transitions literature, a transition away from hydrocarbon-based energy technologies is referred as a *slow process* associated with radical technological changes (Kemp, 1994: 1023; emphasis added).

Historical records of past energy transitions and the literature on the lock-in of the energy system seem to support the argument of the prolonged nature of energy transitions. However, recent evidence suggests that under certain conditions, energy transitions can occur rather speedily. For instance, Sovacool (2016) present several national cases in which transitions in supply occurred in short periods, "between a few years and a decade or so, or within a single generation" (Sovacool, 2016: 203). Those cases include national transitions to oil in Kuwait, to natural gas in the Netherlands, and nuclear power in France.[7] Mexico itself underwent a recent rapid energy transition – of only fifteen years – in which natural gas became the dominant fuel in electricity generation substituting oil (see Chapter 4).

To be sure, defining the magnitude, pace and speed of change is more a matter of interpretation than a scientific fact. As Sovacool (2016) concludes, even when "fast transitions have occurred and are capable of occurring", "they only become apparent when one carefully adheres to a particular notion of significance, society, energy resources, and energy services, and then appreciates contextual specificity" (Sovacool, 2016: 211-212). Outlining the extent and timing of energy transitions is subjective

[7] "Critical substitution shifts within [Brazil, France, Denmark, and Iceland] were accomplished often in less than 15 years. Moreover, these transitions were effectuated even amidst circumstances at times involving highly complex energy technologies" Araújo (2014: 12).

because transitions are context-dependent.[8] This is why examples of energy transitions could range from the introduction of electricity in a community to the renewal of the lighting system in a city or a complete substitution of fossil fuels with renewable energy in a particular country.

A transition would depend on what the actors involved "conceptualise" as energy transition, which in turn depends on their priorities. The definition depends on what we understand as "significant" and for "whom" (Sovacool, 2016: 211). More specifically, the transition will depend on how "engaged" or "active" those actors become in the transition process and their "ideas about where they want (or do not want) the process to go" (Meadowcroft, 2009: 327). Therefore, understanding energy transitions as processes of decision-making helps to explain why transitions may differ considerably in form, pace and magnitude.

1.4.4 Sustainability approach

No consensus has been achieved in the literature over a standard definition of SETs. One of the most frequently cited definition of sustainable transitions describes them as "long-term, multi-dimensional and fundamental transformational processes through which established socio-technical systems shift to more sustainable modes of production and consumption" (Markard et al., 2012: 956). Thus, a sustainable energy transition can be thought of as a transformation that leads to more sustainable patterns of energy consumption, distribution and production.

Mitchell (2008) characterises a sustainable energy system as one that "results not only in carbon emissions that are as low as possible but also other sustainable outcomes such as reductions of other greenhouse gases or radioactive wasted from nuclear power" (Mitchell, 2008: 63). Such a system is based on a combination of different renewable sources, a demand reduction, and the efficient electricity use and integration of heat and power loads by "smart" information technology. As discussed above, one of the general ideas in promoting RE resources, in the context of sustainable energy, is that they are considered a step towards a less-carbon energy system, either as a

[8] "Sometimes the "speed" at which an energy transition occurs has less to do with what actually happened and more to do with what or when one counts" (Sovacool, 2016: 211).

substitute or as a supplement to conventional fossil fuels technologies. Importantly, given the crucial role that electricity plays as one of the largest sources of emissions, this sector provides one of the most direct and substantial ways of introducing sustainability to the energy sector, via reducing greenhouse gas emissions (Keay, 2009 in Sen, 2014). This is why the conceptualistaion of SETs throughout this thesis is focused on the environmental sustainability of the electricity sector via the use of RE in electricity generation.

Additionally, a feature of sustainability is that whereas most past transformations in the energy systems have been "emergent" processes (Geels, 2005; Kemp et al., 2007), some recent literature has signalled the purposive and guided nature of sustainable transitions (Smith et al., 2005).[9] Understanding this more directed character of sustainability transitions is useful for explaining why "political actors, as well as regulatory and institutional support, can be expected to play a major role in sustainable transitions" (Markard et al., 2012: 957).

1.4.5 Conceptualisation summary

Based on the different literature approaches, this section summarises the main definitions used in the thesis and outlines the conceptualisation of sustainable energy transition applied for the Mexican case. In line with Loorbach et al.'s (2017), the term "transition" is used to refer to a set of large-scale *disruptive* changes in societal systems that emerge in a specific period, which is not necessarily long, i.e. it could happen within a decade (Sovacool, 2016). These changes are disruptive in the sense that they are fundamental transformational processes with major and long-term implications for technology and social practices (Kemp, 1994; Sovacool, 2016). For example, the increasing use of natural gas in the 1900s led to a *transition* to natural gas in the Mexican electricity sector as it became the main fuel by 2013, with 50% of total gross generation as compared with 9% in 2000 (SENER, 2006; see Chapter 4).

[9] This is not to say that other transitions or past energy transitions have not been managed but the nature of the changes that sustainability entails requires changes to be triggered or incentivised in specific ways. In particular, given that sustainability is a collective good, private actors have limited incentives to achieve. It is unlikely that environmental innovations replace existing systems without changes in the economic conditions (e.g. via policies such as taxes, subsidies, regulatory frameworks) (Geels, 2011: 25).

The term “energy transition” is used to refer to a *multi-dimensional* shift in the patterns of energy production (sources and technology), energy consumption (end-use, societal practices and preferences) and energy distribution (access, delivery and reliability) (Araújo, 2014). Such process is multi-dimensional because it involves changes in three domains: energy and market flows (via changes in economic development and structures); technological (via changes in technological innovation and infrastructure); and political (via changes in policy and political institutions) (Cherp et al., 2018).

Transitions can be sustainable when they lead to less environmental impacts.[10] While there is not a universally accepted definition, the term “sustainable energy transitions” (SETs) is used in this thesis to refer to energy transitions that result in more *sustainable* patterns of consumption, distribution and production (Markard et al., 2012). As previously discussed, *sustainable* implies reducing environmental impacts across the energy spectrum (electricity, transport and heat) as compared with current patterns (see the discussion in the first part of this chapter). For example, less carbon and GHG emissions due to the use of more sustainable resources (i.e. renewable energy) and low-carbon technologies but also as a result of a demand reduction due to the efficient use of energy (Mitchell, 2008).

This research seeks to explain the emergence of the sustainable energy transition in Mexico and the role that institutional and political structures have played in that transition. In line with the definitions established, a sustainable energy transition in the case of Mexico will be understood as the processes of change that occurred in the Mexican electricity sector from 1990 to 2015, which are aimed at increasing the amount of electricity generated from renewable energy sources.

This conceptualisation takes into account the four elements discussed in the previous sections. First, it recognises that energy transitions involve changes both in production and consumption of energy, thus the Mexican transition is studied through the changes

[10] Other terms used in the literature include “sustainability transition”, “low-carbon transition”, “transition to (or towards) sustainability”. Literature has studied this type of transitions in areas like transport, housing, urban planning, water management, materials supply, manufacturing and industry processes (see Markard et al., 2012).

in the three main dimensions: energy markets, energy technologies and energy policies (see Chapter 2).

Second, in line with the Araújo's (2014) and Lockwood et al.'s (2016) characterisation of energy systems, this study considers the set of energy inputs and outputs in the electricity sector, but also the actors and the institutions involved. Importantly, this study adopts the commonly used systematic approach of transitions, by which it is assumed that energy transitions imply changes at different levels. Thus, while the analysis focuses on the electricity sector, a national perspective is undertaken as the research is framed in the 2013 energy reform and looks at how actors' interactions within energy systems have impacted the transition in the electricity sector. Also, external elements (drivers and impacts) will also be considered given the centrality of the electricity sector to energy, whereby changes in this sector may greatly affect Mexico's national electricity transition and vice versa.

Third, while recognising that SETs can happen rapidly, the transition in the Mexican electricity sector is studied as an on-going process. The period studied in this thesis (1990-2015) is a snapshot of a long process of change in the Mexican energy sector. The period examined appears likely to be a *formative phase*, while the electricity reform could end up being an *acceleration phase* (Roberts and Geels, 2019). This means that it is too early to fully evaluate the impacts of the changes introduced and to determine whether the outcome of the electricity reform and the ETL approval heralds a new trajectory for Mexico's energy system (see Chapter 7).

Fourth, while recognising that renewable electricity is one of the many aspects involved in a sustainable energy transition, this conceptualisation focuses on the changes and policies related to the use of renewable sources in electricity generation. The rationality for focusing on the electricity sector comes from the central role that this sector plays in the Mexican economy and in reducing GHG emissions. The sustainable energy transition in the Mexican case is then studied in terms of how the use of RE has disrupted the country's energy matrix and the historical dependence on oil.

1.5. Mexico's energy challenges

Mexico is a country of big contrasts. On the one hand, Mexico is the eleventh-largest economy in the world by purchasing power parity and the second-largest economy in Latin America (World Bank Group, 2019). In recent decades, the country has achieved moderate economic growth supported by a solid macroeconomic framework that has allowed the country to keep low inflation rates (OECD, 2019). The country was the first Latin American to join the OECD and is a member of the G20. On the other hand, Mexico is a developing country (UN, 2018).[11] Mexico's economic growth has not been enough to improve its living standards, and inequality levels remain high (World Bank Group, 2019). The country is characterised by low productivity growth, poor educational outcomes, weak rule of law, low competition in key sectors, widespread informality, and large infrastructure gaps (OECD, 2019). Also, violent crime and corruption continue to grow (World Bank Group, 2019).

As with most oil-rich countries, Mexico faces tensions between effectively managing its energy resources to meet the growth in energy demand, and the need to transition to more sustainable energy patterns. However, these tensions are aggravated by problems such as the poor management and governance of oil revenues; a heavily subsidised energy sector; and a weak regulatory framework that discourages investment in innovation technologies. At the same time, Mexico has adopted ambitious climate change goals whose accomplishment require fundamental changes in the energy system. How all these tensions and challenges interact will determine Mexico's energy path in the near future.

This section discusses three of the main energy challenges facing Mexico: high dependence on oil and natural gas and low development of renewable sources; a range of development problems such as inequality and the negative effects of high energy subsidies; and Mexico's vulnerability to climate change and its ambitious climate change goals.

[11] The OECD usually refers to Mexico as an "emerging market economy", a term frequently used to refer to developing economies that "are attractive from the point of view of foreign investment, both portfolio and direct investment" (Blázquez and Santiso, 2004: 297).

1.5.1 Fossil fuels dependency vs renewable sources potential

Fossil fuels still account for 90% of primary energy supply, reflecting Mexico's status as a major oil producer, and the share of renewables has risen only modestly in recent years. Mexico is one of the largest producers of petroleum and other liquids in the world: eleventh the world. Although the role of the oil sector has decreased significantly in recent years, Mexico is still an oil-dependent economy. In 2017, 62% of total primary energy production came from oil, while 38% of gross domestic energy supply was provided by oil (SENER, 2018a). Natural gas has become the second main energy source in Mexico, providing 46.8% of gross domestic energy supply and 21.6% of energy primary production in 2017 (SENER, 2018a).

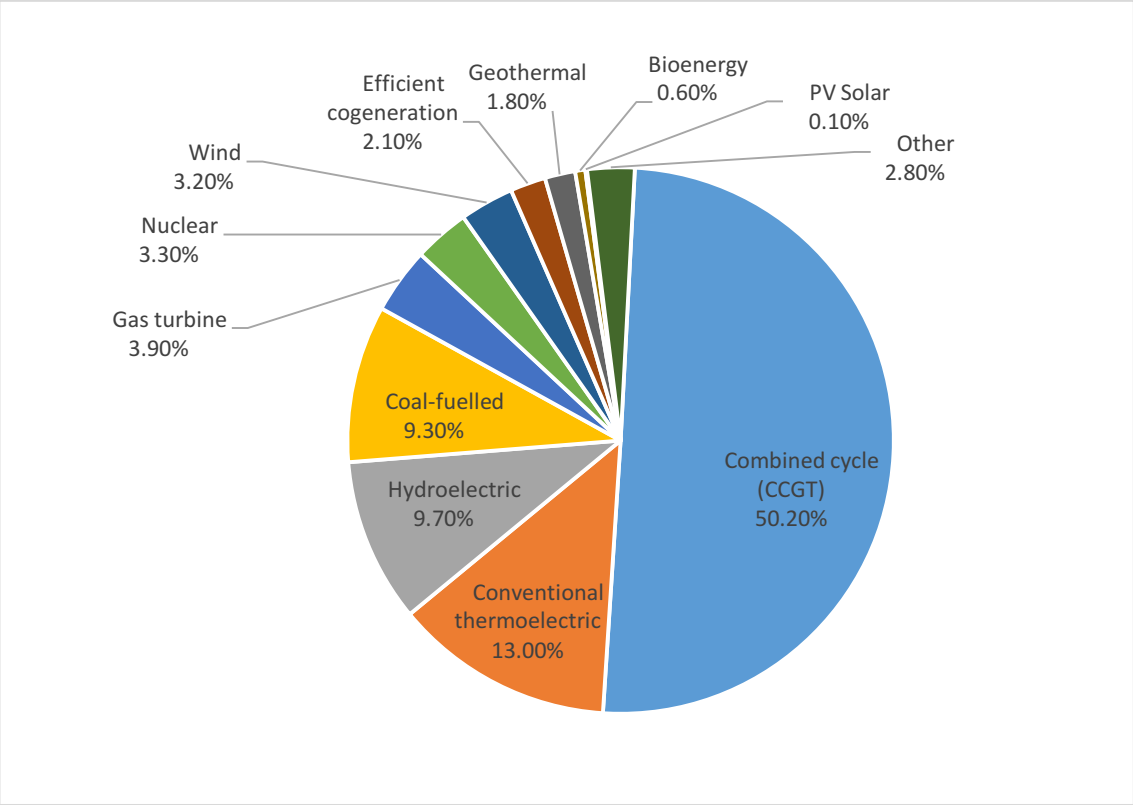
Domestic oil production has considerably decreased since 2005 as a result of declines in national oil fields. Some sources estimate that Mexico's total oil production has decreased 32% since 2004 (IEA, 2017),[12] which has translated into a reduction from 9% to 4% of Mexico's GDP over the last decade (OECD, 2019).

The steady decline in oil production has exacerbated Mexico's challenges in at least two ways. First, the decrease in oil production occurs in a context of efficiency and corruption problems of Petróleos Mexicanos (PEMEX), the state-owned oil company, which has led to insufficient investment in the sector. As a result, the country has struggled to cope with energy demand. Although Mexico continues to be a significant crude oil exporter, the country is now a net importer of refined petroleum products. Second, Mexicos's export earnings from oil have substantially dropped from about 30% in 2009 to 6% in 2015 (EIA, 2017). Significantly, since earnings from the oil industry (including taxes and direct payments from PEMEX) account for a large part of government's spending (up to one third in 2013), declines in oil production have a direct impact on the country's economic output and the government's fiscal health (Studer, 2014). Other problems, such as the high level of security problems, also affect Mexico's energy sector.[13]

[12] For example, Mexico's total oil production peaked in 2004 at an average of 3.383 million barrels per day, declining to 1.833 million barrels a day in 2018 (OECD, 2019: 27).
[13] For example, in 2018, 58.2 million barrels of oil were lost to fuel theft along the oil supply chain on average per day costing about 0.3% of GDP (OECD, 2019: 60).

Mexico's fossil fuels dependency is very visible in the electricity sector. Fossil fuel dominates electricity generation with 81.3% of gross electricity generation in 2017, while renewable sources 15.4% and nuclear accounted for 3.3% as shown in Figure 1.1 (SENER, 2018b: 48). Natural gas-fired combined cycle gas turbine (CCGT) is the dominant technology, producing 50.20% of electricity, also shown in Figure 1.1. Natural gas has increasingly replaced oil in electricity generation within the past decade. Despite having important natural gas resources, Mexico became a net importer of natural gas in 2014 when demand surpassed production capacity (EIA, 2015).

Figure 1.1. Gross electricity generation by technology, 2017



Source: SENER (2018b)

Mexico has considerable alternative sources of energy (including shale gas reserves and renewable sources), but their participation in the energy mix remains low. As shown in Figure 1.1, in 2017 Mexico generated 9.7% of its electricity with big hydro, the main renewable source, while non-hydro renewables such as wind, geothermal, and solar PV, represented 5.7% (SENER, 2018b). This low participation contrasts with Mexico's potential and its large and diverse renewable energy resources base: the country has

some of the highest wind and insolation levels in the world[14] and ranks fifth in the list of the world's countries with largest geothermal reserves.

1.5.2 Development challenges

Poverty and inequality rates in Mexico remain high. For example, 52.4 million people or 42% of Mexico's population is in poverty, a figure that has slightly changed in the last decade (in 2008 the percentage was 44.4%) (CONEVAL, 2019). Large gaps of inequality prevail between regions and poverty disproportionally affects the indigenous population.[15] Also, informality remains high; for example, more than 56% of total employment was in the informal economy in 2017 (World Bank Group, 2019: 24). Mexico's tax revenue is lower than the average rate in OECD and Latin American countries, which limits social spending and infrastructure investment (OECD, 2019).

The numerous social programmes and poverty-alleviating policies do not necessarily reach their targets and most of the social assistance programmes are inefficient due to duplications and leakages (OECD, 2019).[16] The heavy subsidy of energy consumption is a good example of these policy failures. The subsidies to electricity, gasoline, diesel and liquefied petroleum gas amounted USD 24 billion in 2011, about 1.5% of GDP, which doubled what was spent on poverty eradication programs (OECD, 2013). Although these subsidies are aimed to benefit lower-income populations, they favour those who consume more energy, usually the richest (Scott, 2011). In 2010, about 20% of the poorest population in Mexico received about 11% of the electricity subsidies (OECD, 2013: 59) while at least 2 million Mexicans (2% of the total population) still lack access to electricity or any form of modern energy (SENER, 2013). Moreover, regressive subsidies encourage the use of energy and create distortions in consumption patterns, which make low carbon technologies unable to compete with

[14] Average daily solar irradiation during the year is 5.5 kWh/m^2 and can reach values of 8.5 kWh/m^2; and solar energy has 16,351 GWh of generation potential. Likewise, wind potential is estimated at about 19,805 GWh, with capacity factors between 20% and 25% (SENER, 2012).
[15] Poverty in rural areas remains higher than in urban areas: 55.3% versus 37.6% in 2018 (CONEVAL, 2019). The southeast of the country is the poorest region, with states the highest rates of poverty: Chiapas (76.4%), Guerrero (66.5%), Oaxaca (66.4%) and Veracruz (61.8%) (CONEVAL, 2019). The percentage of the indigenous language-speaking population in poverty is 74.9% (CONEVAL, 2019).
[16] Social spending is fragmented into more than 5,000 programmes at the different government levels, which greatly reduces the efficiency of spending and thereby poverty alleviation (CONEVAL, 2016 in OECD, 2019: 50).

fossil fuel-based technologies. After the 2013 energy reform, Mexico started to reduce energy subsidies and introduced more taxes on transport fuels.[17] However, subsidies of fossil fuel and electricity use have not yet been phased out.

Mexico has had to address its development challenges with a government budget heavily dependent on oil revenues. For over 30 years, PEMEX provided more than a third of the total income of the federal public sector (PEMEX, 2013). This means that the changes in oil revenues have a direct effect on government social spending, especially in its efforts to fight poverty.[18] In the last decade, oil revenues have significantly reduced its participation in public money from 43.4% in 2008 to 16.1% in 2017 (BANXICO, 2019), due to reductions in oil production and a fall in oil prices.

1.5.3 Climate change vulnerability and green gas house emissions

Due to its geographical position and social characteristics, Mexico is one of the most vulnerable countries to climate change (INECC, 2015). The limited resilience of lower-income segments of the population, combined with increased exposure to climate risks, means that 319 municipalities (13% of the country) are considered "highly vulnerable" to climate change (IEA, 2017). Between 2000 and 2005, natural disasters, exacerbated by climate change, were more frequent and severe, increasing poverty between 1.5 and 3.7% (depending on the poverty measure used) (World Bank Group: 2019: 29).

The negative impacts of climate change also translate into risks to the energy sector and energy security. For example, the National Climate Change Strategy recognises that 46% of PEMEX's infrastructure and over 30% of electricity transmission lines are vulnerable to the impacts of climate change (IEA, 2017: 50). Other risks include increasing water stress due to changes in hydrological patterns with impacts in hydropower generation and thermal power generation, two of the main forms of electricity generation (see Figure 1.1). Around 70% of the country's GHG emissions come from the energy sector. The largest emitting sector in Mexico is transport, with

[17] While coal is taxed at a reduced rate, natural gas is exempt. The overall taxation of emissions remains low (at about one euro per tonne of emissions, which is much lower than the estimate of around 30 euros per tonne) (Arlinghaus and van Dender, 2017 in OECD, 2019: 69).

[18] About 62.5% of the federal budget is spent on social development, while 27% is spent on economic development. These percentages are taken from the programmable expense, that is, the public expenditure aimed to provide public goods and services to the population, which accounted about USD 195,181 million in 2018 (SHCP, 2018).

35.1% of the total, followed by electricity generation with 32.0% and industry (manufacturing and construction) with 13.4%, while other energy industries (including refining) emit 12.1% of the total (IEA, 2017: 42).

Given the climate vulnerabilities and the important role of the energy sector in reducing GHG emissions, Mexico has passed important climate change regulation such as the General Law on Climate Change (LGCC in Spanish), created in 2012. With this law, Mexico became the first Non-Annex I country legally committed to reducing GHG emissions by 30% by 2020 and by 50% by 2050, in relation to the baseline in 2000 (LGCC, 2012). Mexico was also the first developing country to submit its Intended Nationally Determined Contribution (INDC), by which the country is committed to reducing 50% of emissions by the year 2050 (SEMARNAT, 2015b). Mexico's INDC also covers adaptation actions, such as measures to enhance the resilience of its strategic infrastructure in the energy sector.

In order to fulfil its international GHG reduction pledges, Mexico has set a clean energy generation target for 2050. The 2014 Electricity Industry Law establishes that "clean energy" includes renewables, cogeneration, nuclear energy, fossil fuels with CCS, and "other low-carbon technologies" (LIE, 2014). With these targets, Mexico is aiming to triple the total amount of clean energy generation, which is a huge logistical and operational challenge. However, with current policies, Mexico is unlikely to meet its CO^2 emission reduction targets (OECD, 2019).

1.5.4 The recent Energy Reform

The 2013 energy reform (also referred to as the Reform) emerged in this context of energy, development and climate challenges. The Reform consisted of modifications to the Mexican Constitution, the creation of six new laws and the amended 15 existing laws. For the purposes of this thesis, the energy reform is divided into three main parts:

1) The Constitutional reform, by which articles 25, 27 and 28 were modified in December 2013, with the approval of the Mexican Congress (Senate and Chamber of Deputies) and local Congresses.
2) A set of secondary laws, proposed by the Federal Government and approved by the Mexican Congress in August 2014, including a new electricity law.

3) The Energy Transition Law (ETL), which was proposed by the National Action Party (Partido Acción Nacional - PAN) (opposition party) in June 2014 and approved in December 2015, after a long process of negotiation.

The 2013 reform introduced major changes in the oil, natural gas and electricity industries such as the establishment of new regimes, rules and institutions, allowing more participation of the private sector, but maintaining the State's ownership and control of hydrocarbon and electricity assets.

Prior to the Reform, the electricity sector was characterised by a vertically integrated public monopoly, in which the state-owned utility, the Federal Electricity Commission (Comisión Federal de Electricidad - CFE), dominated electricity generation and was the only entity undertaking the transmission, distribution and commercialisation. In 2014, the electricity reform opened the sector to private investment as a means to modernise the national electricity system. The reform created a centralised wholesale electricity market and the CFE was restructured but not privatised. It also introduced incentives for the use of alternative technologies, mainly through clean energy certificates. The Electricity Industry Law, approved in 2014, defined "clean energies" as renewables, cogeneration, nuclear energy, fossil fuels with CCS, and "other technologies" determined by the Energy Ministry (Secretraría de Energía - SENER) (LIE, 2014). This is why the term "clean energy" is used in this thesis to refer to RE but also other technologies.

The Energy Transition Law (ETL) was created in 2015 to "regulate the sustainable use of energy in Mexico, the obligations of clean energy, and the reduction of pollutant emissions from the electricity industry" (LTE, 2015). The ETL specified the policies and mechanisms required for the clean energy certificates and confirmed the goal of 35% of clean energy by 2035, stated by the 2012 LGCC. The new law also repealed previous legislation on RE, i.e. the Law for the Use of Renewable Energy and the Financing of the Energy Transition (LAERFTE in Spanish) and the Law for the Sustainable Use of Energy (LASE in Spanish), both approved in 2008.

It is important to note that the 2013 reform represents the formal start[19] of a liberalisation process in the Mexican electricity sector, which is a key characteristic of the Mexican case. As will be discussed throughout the thesis, the sustainable energy transition process in Mexico occurred alongside the liberalisation process, which constitutes an important difference from other cases studied in the literature and could have implications regarding what a sustainable transition means for the Mexican case. Importantly, this parallelism between the liberalisation and the energy transition implies a link between sustainability and liberalisation that does not necessarily exist – or at least not in such an explicit form – in other cases of SETs in the literature. This intrinsic link affects how the transition process takes place in Mexico and might have implications in our understanding of SETs in other developing countries.

[19] Formal start in the sense that, although there was some private participation in the sector since 1992, it did not imply the liberalisation of the sector as the state monopoly continued, no independent regulator was not established, nor was a formal electricity market created (see Chapter 4).

1.6. Overview of chapters

Having established the purpose of the research and a definition of sustainable energy transitions (SETs) within the context of some of the major energy challenges at the global level and in Mexico, the thesis now moves to discuss the relevant literature in the field, the analytical framework developed and its application to the Mexican case. The rest of the thesis is organised in seven chapters.

Chapter 2 presents a literature review on SETs and establishes the analytical framework, built from a combination of socio-technical transitions (STT) studies, in particular, the Multi-Level Perspective (MLP), and historical institutionalism (HI). The chapter has three goals. First, it makes a case for the need to use analytical tools from political science to compensate for STT's main limitations, namely: its underestimation of the complex political nature of energy transitions; the lack of a developing countries approach that mitigates the prevailing Eurocentrism; and the overlook of relationship between liberalisation and sustainability. Second, it explains how HI complements the STT-MLP approaches by discussing the main features of both frameworks, their similarities and disparities, and how they are addressed to produce a complementary analysis. Third, the chapter details the combined framework, which includes the following elements: sources of stability, both technological and institutional, and three main drivers of change: technological innovation, institutional change and political actors. The framework takes into consideration three main dimensions of change (economical-market, technological-material and institutional-political) and three levels of analysis (landscape, regime and niche). The HI elements that are included in the framework are path dependence patterns through institutions, the critical juncture approach and the uneven distribution of power.

Chapter 3 centres on the methodology of the research. The chapter first justifies the adoption of an interdisciplinary approach, the use of a qualitative approach and the criteria for case study selection. It also defines the three units of analysis: 1) the electricity sector prior to the 2013 reform, 2) the Constitutional and electricity reform, and 3) the ETL. Chapter 3 also explains the process of data collection and the sources of information, i.e. 85 different types of documents, 27 semi-structured interviews with key stakeholders involved in the design and negotiation of the electricity reform and the

ETL, and 17 videos, which compensate for some lack of information. The chapter also explains the use of the thematic analysis and the challenges and limitations in the analysis.

Chapter 4 presents an analysis of the first unit of analysis: the Mexican electricity sector prior to the 2013 reform. First, the chapter identifies the trends in energy demand, production and consumption within the three levels of analysis (regime, landscape and niche) and the prevailing technologies and infrastructure. The second part focuses on the patterns of stability from the political and institutional dimension by explaining the origins of the state monopoly and the main actors in the electricity regime. The third part discusses the main processes of the change prior to the 2013 reform. It focuses on the period of the 1990s when relevant legal changes took place having major implications for the electricity regime like the transition to natural gas as the main source of electricity. As such, the analysis presented in Chapter 4 identifies four features. First, the general characteristics of the electricity regime prior to the 2013 reform. Second, the patterns of stability emerging from an oil-based electricity regime and how they have not only maintained the stability of the regime but also have prevented the adoption of RE. Third, the role of different political actors, their interests, relationships and distribution of power. Four, the opening up of opportunities for systematic change, which allowed a rapid transition to natural gas but prevented a change to RE, and the emerging of further drivers of change.

Chapter 5 examines the second unit of analysis, the 2013 energy reform process, which is composed of the constitutional reform and the electricity reform. The chapter has three aims. First, it investigates the political circumstances in 2012-2014 that allowed a wider opening of the energy sector to private participation, a change that had been attempted several times previously. The analysis signals the importance of the political agreement but also how actors' strategies determined the depth and the scope of such reform. Second, the chapter presents the main features introduced both by the Constitutional reform and by the new Electricity Industry Law (LIE, 2014). Third, the chapter shows how the patterns of stability identified by a HI approach in Chapter 4 – i.e. oil prevalence and deep power relationships – framed the reform process, for example, by excluding sustainability from the secondary laws.

Chapter 6 centres on the third unit of analysis, the ETL, both its content and the process of its approval, starting in December 2014, when it was originally proposed, to December 2015, when it was approved. The analysis divides the negotiation process into three main periods: the origins of the law, the negotiation impasse and the process of approval. The analysis of the policymaking process identifies the main actors involved in the negotiation, both promoting the law and opposing it as well as the coalition formation process. The analysis shows the relevance of two main elements. First, the role of policy entrepreneurs in crafting the opportunities opened by the reform, within the regime and outside (i.e. the negotiations of the COP 21), to include sustainability in the reform agenda; also in forming coalitions for the ETL's approval. Second, the analysis also shows that the consensus on sustainable energy is less clear in Mexico and contradictions over environmental sustainability still prevailed in the Mexican electricity policy.

Chapter 7 discusses the findings of the thesis in the backdrop of SETs studies. It summarises how the Mexican case study shows that path-dependent developments are enacted not only through the physical-material form of technologies and infrastructures but also through the political processes and institutions related to those technologies. The chapter argues that the combined framework explains how political processes have affected the transition process, limiting the development of renewable energy and how the patterns of stability framed the reform process. It also emphasises that the opportunities for change mainly depend on the political processes of the sector and in the ways in which actors interact and influence policy developments. However, the chapter also discusses three features of the Mexican case that cannot be explained by the combined STT-HI framework. First, the fact that the Mexican case is not innovation-driven. Second, the disconnect between the environmental/climate policy and electricity policy in Mexico. Third, the absence of a full market in Mexico which in turn begs the questions as to whether market liberalisation is a precondition for a sustainable energy transition.

Chapter 8 identifies the conclusions of the thesis building on the contributions of the research and its wider relevance. It also discusses the limitations of the investigation and identifies avenues for future research.

Chapter 2: Literature review and analytical framework

2.1 Introduction

The previous chapter showed that achieving sustainable energy patterns involves fundamental changes in the ways that energy is produced, distributed and consumed, which in turn entail fundamental economic, technological and political changes. It showed too that this kind of transformation requires government intervention and that sustainable energy transitions (SETs) are politically contested between those in favour of transformation and those that seek to maintain the status quo. Understanding those processes is crucial for explaining the emergence, development and possible acceleration of this type of transitions.

The purpose of this chapter is to argue that SETs need to be understood as political processes and that political science concepts are needed to understand the complex processes – such as policy change – that SETs entail. In line with the recent literature on energy transition studies, this chapter shows that the prevailing approach, socio-technical transitions studies (STT), fails to fully account for the processes in which energy policies are negotiated, adopted and implemented. The chapter, therefore, develops a combined framework that synthesises elements from STT and Historical Institutionalism (HI) to analyse long-term patterns of stability but also to explain the circumstances in which policy change can emerge.

The first part of this chapter explores the dominant perspective in the transitions literature, the STT approach, which explains systematic change via the emergence and diffusion of new technologies. It also makes a case for the need to use analytical tools from political science to compensate for STT's main limitations. Such drawbacks refer, to an underestimation of the complex political nature of energy transitions and a lack of thoughtful deliberation on the influence that institutions, institutional arrangements[20] and political actors' interactions have in processes of transitions. Other limitations are the lack of analyses of developing countries to mitigate the Eurocentrism and the

[20] As explained throughout this chapter, the term "institution" is used to refer to the formal political entities and structures governing the energy sector in Mexico. The term "institutional arrangements" is used to refer to the set of laws, regulations, policies, policy instruments that, together with institutions, constitute the organisational structure of the Mexican electricity sector.

overlook of the relationship between liberalisation and sustainability, which is relevant in developing countries.

The second part explains why Historical Institutionalism (HI) can contribute to the study of the complex political dynamics shaping energy decisions, which in turn affect the emergence and development of SETs. In particular, because HI explains the role of institutions in creating or constraining opportunities for changes, it provides a useful framework for analysing opportunities for policy change. The section thus discusses the relevance of the context, the dynamics of path dependence within institutions, the concept of critical juncture as moments of policy change, and uneven distribution of power. Overall, these factors affect the type of policies adopted in the energy sector and, in turn, the course of SETs.

The last part of the chapter further explains the commonalities shared by STT and HI and their strengths. It also explains the divergences and how they are addressed in the combined framework. It explains the elements of the analytical framework used in this thesis, including different levels of analysis and dimensions of change, along with stability patterns – technological and institutional – and the drivers of change. This section also discusses examples of the literature in European countries and in developing contexts, making the case as to why it is so important to consider other institutional contexts. The final part explains why and how the approaches are both useful and necessary for the analysis of the Mexican case.

2.2 Socio-technical transitions studies

In the past two decades, a significant set of literature has emerged that seeks to explain and understand the complexity of sustainable transitions (Markard et al., 2012; Shove and Walker, 2007). This emerging literature has been driven by a growing interest in large-scale transformations both in the policy arena and in social science research (Markard, 2012). One important goal of this research field is to explore the possibilities of advancing and accelerating such transitions (Loorbach et al., 2017; Roberts et al., 2018; Roberts and Geels, 2019).

The most developed theoretical framework for transitions in general and SETs, in particular, is the innovation-technological approach.[21] Socio-technical transitions studies (STT) are the leading body of theory under this approach (Markard et al., 2012; Shove and Walker 2007; Smith et al., 2010), and centres on how the introduction of new technologies leads to long-term transitions.[22] The main unit of analysis in the STT perspective is the socio-technical system, which encompasses the production, distribution and use of technology to fulfil a societal function (e.g. transport, communication, materials supply, housing) (Geels, 2004). Energy systems can be characterised as socio-technical systems and a sustainable energy transition can be acknowledged as a particular type of socio-technical transition. The application of a systemic perspective implies highly dependent changes in different areas and helps to explain the "non-linear dynamics" of sustainable transitions (Markard, 2017: 10).

The multi-level perspective (MLP) is the most developed (and influential) conceptual framework within the STT studies.[23] It provides a view of the multi-dimensional complexity of changes in a concrete socio-technical system, i.e. the energy system. The MLP framework examines the patterns of transitions into three analytical "levels": niche (micro), regimes (meso) and landscape (macro). Each level refers to a

[21] Smits (2016) and Sovacool (2016) situate the energy transitions field within a wider spectrum of academic disciplines, identifying four key theoretical approaches towards sustainable energy transitions: socio-technical transitions, ecological modernisation theory, sociological perspective and political ecology.

[22] Although the STT approach focuses on the major role of technology for explaining socio-technical transitions, it recognises technology as a social phenomenon, i.e. the knowledge and practices embedded in infrastructure and other technical artefacts, shared by actors, and circulating in social networks, collectively known as technological (Cherp et al., 2018: 180).

[23] Markard et al. (2012) identify three additional approaches within socio-technical systems: transition management, strategic niche management and technological innovation system.

“heterogeneous configuration of elements” that interact across the same level but also among the others (Geels, 2011: 26).

The *regime* level of the MLP approach can be thought of as “the semi-coherent set of rules that orient and coordinate the activities of the social groups that reproduce the various elements of socio-technical systems” (Geels, 2011: 27). The second level, the niche-innovations, incubates new technology – typically radical innovations – that builds up internal momentum and eventually breaks through into the regime level (Kemp et al., 1998). Therein lies the importance of this level: niches “provide seeds for systematic change” as novelties are expected to succeed and eventually be used in the regime, altering it and leading to long-lasting changes (Geels, 2011). The third level, the landscape, can be understood as the “technical and material backdrop that sustains society, but also includes demographical trends, political ideologies, societal values, and macro-economic patterns” (Geels, 2011: 28). The conceptualisation of the landscape’s factors has been underdeveloped in the transitions literature compared with the attention that regime and niche levels have received (Kern and Mitchell, 2010).

In brief, within the MLP framework, a transition is defined as a *regime change*, which is a “non-linear”, interactive process of change that results from the interplay of developments between the three levels (Geels, 2011). Transitions can be accelerated when niches are created, protected, nurtured and managed (Elzen and Wieczorek, 2005; Kemp et al., 1998). This can be done by adopting policies that encourage niche developments. For example, evidence from European countries shows how the creation of “protective spaces” for solar PV projects through public research programmes in the 1980s and the adoption of specific policies in the 1990s helped to open the market-niche and integrate these technologies into the grid (Smith and Raven, 2012). Therefore, in the MLP, “sustainability can become mainstream through the “management” of niches of sustainable innovation” (Smits, 2016: 21).

The overall question underlying the MLP perspective and SETs is how fossil fuel-based energy systems, a “powerful, well-articulated and stable socio-technical regime” can be modified or replaced by more sustainable alternatives (i.e. renewable energy) over the long term (Berkhout et al., 2009). Evidence in the MLP literature shows that past transitions generally occurred when developments at all three levels link together and

reinforce each other (Geels, 2005). Thus in general terms, a sustainable energy transition takes place when: a) niche-innovations (sustainable energy technologies) build up internal momentum; b) changes at the landscape level create pressure on the regime and c) destabilisation dynamics in the regime create windows of opportunity for niche-innovations (Geels, 2011: 29).

One advantage of the STT and MLP literature is that it is grounded in an extensive academic base of energy transitions in general, and the electricity and RE sectors in particular. Examples of MLP literature in the electricity sector include: studies of the Dutch case by Hofman et al. (2004) and Verbong and Geels (2007); analyses of the UK electricity sector by Shackley and Green (2007) and Foxon et al. (2010); a comparative analysis of the German and UK sustainable electricity transitions by Geels et al. (2016); and, an analysis of the dynamics within the German electricity sector by Konrad et al. (2008). Also, a recent study applied the MLP framework to the historical development of the Mexican electricity sector, focusing on the role of the incumbent natural gas industry (Jano-Ito and Crawford-Brown, 2016). These studies are discussed throughout this chapter.

2.3 STT limitations

This thesis argues that current STT-MLP frameworks are not adequate to analyse the transition process in Mexico due to three main drawbacks. First, STT-MLP studies usually neglect the political nature of SETs, which means that the impact that politics could have on the type of policies adopted is overlooked, and the role of political actors is overly simplified. Second, the overconcentration on European cases leads to "idealistic" sets of ideas (Andrews-Speed, 2012) that cannot be applied to other national realities, like Mexico. Third, STT literature overlooks the relationship between liberalisation and sustainability, which is relevant in developing countries.

2.3.1 The neglect of the political nature of SETs

The neglect of the political nature of SETs has been one of the main criticisms of the STT literature (Meadowcroft, 2009). As discussed in Chapter 1, "almost per definition, policies are an essential element in sustainability transitions" (Markard, 2017: 13) as SETs entail significant shifts that require deliberate efforts (Kemp, 1994; Kuzemko et al., 2016; Markard et al., 2012; Meadowcroft, 2007; Shove and Walker, 2007; Smith et al., 2005). Government intervention, via policies and regulation, is needed because SETs are costly and have distributional effects that need to be addressed; e.g. job losses, variations in the price and the patterns of trade-related to fossil fuel (OECD, 2012). Restructuring the energy sector also implies policy support as RE technologies face multiple obstacles (for example, fiscal and regulatory barriers and intellectual property barriers) that could be mitigated via policies (Mitchell, 2008; Painuly, 2001).

Examining the type of policies adopted implies analysing the politics behind them, i.e. the process of negotiating and interacting between a variety of state and non-state actors in policymaking (Knill and Tosun, 2012). In other words, politics comprises the contested processes through which policy goals and instruments are formulated and modified. In the SETs context, politics is expressed in actors' struggles to legitimise (or delegitimise) one type of energy and prevent policy change (Hess, 2014). Understanding the politics is important because the type of policies adopted depends on them: as Meadowcroft (2011) puts it, "behind policy there is always politics, and getting the politics right appears to be a prerequisite to getting the policies right"

(Meadowcroft, 2011: 73). Thus, politics is a constant element in socio-technical transitions, "serving alternatively (and often simultaneously) as context, arena, obstacle, enabler, arbiter, and manager of repercussions" (Meadowcroft, 2011: 71).[24]

Recognising the political nature of SETs also requires a deep understanding of the broad-rage of actors participating in the energy system, their interests and interactions, and specifically their power relations, in order to comprehend how they influence the policy process (Avelino and Wittmayer, 2016). Within STT, actors, agency and power – the basic elements of politics – have mostly been studied based on the relationship between incumbent industries (frequently big firms) and policymakers (mostly regulators), leaving a broader range of actors and their relationships within the political processes out of the analysis. This has led to a simplification of actors' roles, in which it is assumed that the most influential actors in SETs are the big firms with vested interests in the dominant technologies. However, the dynamics of the decision-making processes are more complex and the governance of SETs have proven to be a "messy, complex and ongoing" process (Kuzemko et al., 2016: 100).

2.3.2 The need for a non-European political perspective

Although a growing body of literature has come to recognise that policies and politics are an integral part of long-term transitions and need to be better addressed in the STT literature,[25] studies centre in European experiences, which constitute the second major drawback in STT-MLP studies. Geographic concentration leads to what Markard et al. (2012) describe as a "European bias" in the field. This bias could have major implications in the development of theoretical frameworks and lead to "idealistic" sets of ideas (Andrews-Speed, 2012) that cannot be applied to other national realities. For instance, "as institutional and human capabilities in developing countries are characteristically weak relative to developed countries" (Arent et al., 2017: 10), the conceptual approach of STT-MLP, originated from European experiences, might not be applicable in other contexts.

[24] In particular, in the context of the SETs, governments suffer from a "chicken and egg" problem, in which "a circle exists wherein politics drives policy, policy drives technology, and the state of technology circles back to influence politics" (Arent et al., 2017: 5).
[25] See Geels, 2011 and 2014; Hess, 2014; Meadowcroft, 2007, 2009 and 2011; Rotmans and Kemp, 2008; Scrase and Smith, 2009; Shove and Walker, 2007; Smith and Raven, 2012.

Recent literature on sustainable transitions has started to draw attention to the "structural differences" between developing[26] and developed countries and how these differences "may influence the manner in which transitions toward sustainability unfold" (Hansen et al., 2018: 198). One main difference is that regimes in developing countries are more dynamic and heterogeneous than in European contexts (Hansen et al., 2018; Wieczorek, 2018). For example, given the dysfunctional provision of basic services, in some cases, "society relies on a variety of alternatives and develops new practices, which become very stable over time" (Wieczorek, 2018: 208; also see Furlong, 2014). Ramos-Mejía et al. (2018) refer to these practices as "survival strategies", deployed by actors in developing countries "to secure provision, avoid risk and manage uncertainty" (Ramos-Mejía et al., 2018: 219). The mix of these non-uniform conditions entails diverse contexts in which old systems coexist with new ones (Berkhout et al., 2009; Furlong, 2014) while different institutional arrangements, both formal and informal, emerge. It also means that different types of actors get involved in energy decisions, which may shape not only the type of policies adopted at the regime level but also "the way niche structuration processes create and unfold" (Ramos-Mejía et al., 2018: 220).

Different realities in developing countries lead not only to less uniform regimes but also to different policies, priorities and ways in which decisions are taken. For example, while energy security and reliability are dominant energy objectives in most countries (Scrase and Ockwell, 2009), the low cost of energy and affordable prices for consumers are major concerns in contexts of enduring poverty and social inequalities. These differences in policy priorities become clearer when it comes to sustainability. As Wieczorek 2015 and 2018 explain, "immediate concerns about social inequalities and the lack of access to modern services (...) dominate the distant environmental challenges" (Wieczorek, 2018: 209). Therefore, decisions to move to "cleaner" forms of energy that generally rival traditional national goals of enabling job creation or fiscal policy (Verbong and Geels, 2007) become more complex in developing countries.

[26] Some authors in the field of sustainable transitions use the term "Global South" to refer to developing countries. In general, Global South refers to a broad group of countries, including "emerging" economies and least-developed countries. For example, the term has been used to refer to countries like Kenya (Newell and Phillips, 2016), Colombia (Furlong, 2014), China, Brazil, Ecuador, Cuba (Akizu et al., 2017). However, there is no universal definition for Global South in the SETs literature. In this thesis, the term "developing countries" is preferred as it makes explicit reference to the different levels of development among countries; whereas "Global South" has geopolitical connotations outside the scope of this study (see Dirlik, 2007).

As such, the directionality or the "normative orientation" of SETs – commonly assumed in STT-MLP approaches – should not be taken for granted in developing countries. Hess (2014) stresses that in Europe and other advances countries "there is a broad policy consensus in favour of a sustainable transition for energy" and therefore "the focus of research tends to involve issues of management and policy implementation", giving less theoretical importance to the political conflict over sustainable transition (Hess, 2014: 279). However, in developing countries, the political conflict over sustainable transitions is important because the consensus on sustainable energy is less clear and contradictions over environmental sustainability are "amplified".[27]

Additionally, new works in the field of SETs have emphasised that power relationships are "extremely" relevant in developing countries (Wieczorek, 2018: 208), where informal interactions are frequent as well as clientelism and patronage relationships. In these scenarios, the influence of large firms and transitional corporations could be stronger than in European countries. For example, in countries where infrastructure is unevenly planned, as in many developing countries, the dynamics of power are affected as the influence of certain actors increases. A change in infrastructure, for instance, to modernise it by adopting more efficient or environmental-friendly methods, "is usually not a matter of the adequacy of the infrastructure itself, but about the interests and power of the actors involved" (Ramos-Mejía et al., 2018: 219).

This new literature has pointed out the need to develop analytical frameworks that consider the dynamic and heterogeneous nature of regimes in developing countries (Hansen et al., 2018; Wieczorek, 2018) to understand further how those differences affect the transitions. As differences affect the policymaking process, they also affect the policies adopted. The framework of analysis used in this thesis builds on understanding the origins and persistence of institutions and institutional arrangements and how they translate into the policymaking process; therefore it is a useful approach that can develop our understanding of SETs in developing countries. In the following sections, some examples in the emerging literature in developing countries will be introduced along with arguments on how these cases relate to Mexico.

[27] This is not to say that approaches to sustainability are not contested in European countries (see discussion on sustainability in Chapter 1).

2.3.3 Liberalisation in developing countries

An important difference between developed and developing countries refers to the level and/or model of liberalisation in their energy sectors, which might have implications for how SETs emerge and evolve. This difference is especially relevant for the Mexican case because Mexico began the liberalisation of its electricity sector recently. The STT literature overlooks the discussion between sustainable transition and liberalisation because it is based on Western European cases, i.e. countries already liberalised.

The electricity liberalisation in developing countries have differed from developed countries in various aspects. For instance, developing countries have undertaken slower liberalisation processes,[28] usually in the form of stages rather than the full implementation of the standard model[29] (Hall and Nguyen, 2017). Also, the literature indicates that the drivers pushing electricity reform differ among developing and developed countries. While "higher efficiency, lower prices, consumer choice, and national competitiveness" were common motives in developed countries, the main objectives in developing countries referred to solving the declining state of utilities' finances and the proliferation of private investment (Williams and Ghanadan, 2006).[30] Liberalisation reform in developing countries was presented as a solution aimed at addressing the "technical and financial inefficiencies and at infusing transparency into the operations of state-owned enterprises" (Sen, 2014: 4; also Hall and Nguyen, 2017).

Importantly, as liberalisation in developing countries followed different motives, phases and variations of the standard model, it created different institutional structures. Such differences should be considered in current debates about SETs in non-European countries. Liberalisation is especially relevant for Mexico since the sustainable transition process occurred alongside the liberalisation of the electricity sector.

[28] For example, Latin American countries started their electricity liberalisation until the mid-1990s (except Chile that started in 1982) and they followed similar paths for deconcentrating, decentralising, and privatising the activities and property of the electricity (Rudnick, 1998).
[29] The standard model (also referred as the textbook model) includes: the opening up of the electricity sector to Independent Power Producers (IPPs), the corporatisation of vertically integrated state-owned, the establishment of an independent electricity regulator, the unbundling of vertically integrated utilities into competitive (generation and retail supply), and the privatisation of the competitive segments of the electricity sector (Sen, 2014: 1).
[30] Other driving forces identified in the literature include: the expansion of the electricity service for the population; the need to remove subsidies to the sector; and the desire to raise immediate revenue for the government through the sale of assets (Bacon and Besant-Jones, 2001).

2.4 Why Historical Institutionalism?

The use of analytical tools from political science can compensate for STT's major limitations on providing a detailed analysis of the political processes and the lack of perspective of different institutional realities. Some scholars have proposed incorporating elements from Historical Institutionalism (HI) to the STT-MLP framework to allow a systematic consideration of the interactions between political actors and institutions. Studies combining such frameworks have been applied to recent cases of SETs in the UK and Germany (Kuzemko et al., 2016; Lockwood et al., 2013 and 2016), and to historical transitions in the transport and agricultural sector in the UK (Roberts and Geels, 2019) (see below for further discussion).

HI is an approach to political research[31] that emerged in the early 1990s, aiming to analyse the differences and change in economic and political institutions. Historical institutionalists conceptualise institutions "as formal or informal procedures, routines, norms, and conventions in the organisational structure of the polity or the political economy" (Amenta and Ramsey, 2010: 16). Thus, HI is best understood as "a research tradition that examines how *temporal* processes and events influence the *origin and transformation* of institutions that govern political and economic relations" (Fioretos et al., 2016: 3; emphasis added).

The core argument of HI is that institutions – both formal and informal – shape the decisions by framing actors' behaviour and goals, distributing political power and structuring political preferences and coalitions. Applied to the analysis of energy transitions, HI elements allow dissection of the complex political dynamics in which energy policy is embedded, e.g. by revealing the far-reaching consequences that the institutions in the energy sector can have. In the context of SETs, HI can help uncover the role of political institutions in creating or constraining opportunities for changes. Also, a historical institutionalist analysis of the Mexican electricity sector provides explanations of the stability or instability over time and thereby allowing identification of the drivers and obstacles to a sustainability transition.

[31] For Steinmo (2008), HI is neither a particular theory nor a specific method (Steinmo, 2008: 118). Other authors argue that historical institutionalists do not form a theoretical school as its practitioners do not always identify themselves such (Amenta and Ramsey, 2010: 22).

2.4.1 Context matters

HI rejects the assumption that "the same operative forces will generate the same results everywhere" and instead, claims that "the effect of such forces will be mediated by the contextual features", which are essentially institutional and inherited from the past (Hall and Taylor, 1996: 941). This is why HI analyses centre their attention on contextual conditions to explain "whether, when, and how the same causal mechanisms yield different outcomes across time and space", using narratives to identify the mechanisms that shaped contestation over time (Fioretos et al., 2016: 9).

HI explanatory arguments about variations of political outcomes are useful for analysing why SETs emerge and develop along various paths in different countries. Recent literature has started to recognise that contextual dimensions such as "technological capabilities; natural resource endowments, industrial specialisation, and cultural repertoires" affect sustainable transitions, especially the scope for their deliberate acceleration (Roberts et al., 2018: 307). Some examples of those contextual conditions are Swedish collectivism, Dutch consensus-based society, and the emphasis on individual freedoms predominating in the UK and the US (Roberts et al., 2018: 307).

Lockwood et al. (2013 and 2016) use the Varieties of Capitalism framework to explain how the differences in institutional contexts have affected SETs processes in the UK and Germany. Lockwood et al.'s (2013) analysis claims that coordinated market economy (CME), like Germany, are expected to produce more sustainable economies than a liberal market economy (LME) like the UK.[32] This is because Germany has an institutional context that tends to "produce more conducive conditions" for sustainable transitions. For instance, a proportional representation electoral system that allows centre-left governments, frequently active in environmental issues, and alternative political parties (i.e. green parties) with greater chances to gain representation. Also, the CME model is thought to encourage political parties to seek support from a broad spectrum of voters, which generally results in close collaboration with stakeholders and the attendance of civil society demands, e.g. sustainability concerns (Lockwood et al., 2013). This, combined with a strong environmentalist tradition, helps to explain the

[32] The literature on whether CMEs are more suitable at accelerating sustainable transitions is rather mixed. See, for example, Lachapelle and Paterson (2013); Neumayer (2003); and Poloni-Staudinger (2008).

active ruling of the green German party on RE policies. By contrast, the majoritarian electoral systems present in LMEs, like the UK, tend to work against small parties and create incentives for politicians to focus narrowly on the concerns of a relatively small group of swing voters in marginal constituencies (Lockwood et al., 2013 and 2016).

Building on this perspective, Kuzemko et al. (2016) reflect that "different configurations of political institutions and energy resources will tend to influence *types* of governance choices made and, therefore also, the nature of changes that take place in energy system" (Kuzemko et al., 2016: 97). The Varieties of Capitalism framework is therefore useful for understating that contextual factors – including economic structures, national technological infrastructures and political institutions – are crucial determinants of countries' transition paths. However, the classification of LME and CME is not relevant for Mexico, as it follows a different socio-economic model, known as "hierarchical market economies" (HME) (Schneider, 2009). In HMEs, Latin American economies, those with more economic power (large firms and transnational corporations) dominate the business structure and exert a significant influence in the policymaking, particularly by influencing political parties and the legislative assemblies (Martínez et al., 2009).

2.4.2 Path dependence and institution's stability

HI explanations are grounded in the relationship between institutions and actors' behaviour, particularly the ways in which institutions shape political behaviour and outcomes (Hall and Taylor, 1996). Historical research emphasises how institutional configurations "structure politics in the present and in ways that commonly run counter to the interests or preferences of individuals" (Fioretos et al., 2016: 8-9).

The conceptualisation of path dependence through institutions is well recognised in political science[33] and refers to "the dynamics of self-reinforcing or positive feedback processes in political system" (Pierson and Skocpol, 2002: 699). In other words, institutions enter a process in which "each step along a particular path produces consequences that increase the relative attractiveness of that path for the next round; they accumulate and then they generate a powerful cycle of self-reinforcing activity"

[33] See David, 1994; Greener, 2005; Pierson, 2000; Thelen, 1999.

(Pierson, 2004: 14). Thus, once a particular course of action is introduced, it becomes difficult to reverse because moves in another direction generate high costs.

Applied to the energy sector, path dependence helps to explain the stability of the energy systems and the persistence of institutions over time. Path-dependent patterns in the energy sector are evident in what Unruh (2000) calls "carbon lock-in". Regulations, infrastructure, user practices and maintenance networks are intensely aligned with current technologies. As Unruh (2000) puts it, national economies "have become locked into fossil fuel-based technological systems through a path-dependent process driven by technological and institutional increasing returns to scale" (Unruh, 2000: 817). Another example stressed by Pierson (2004) refers to the developments in "petro-states" that become increasingly embedded over time. Using Karl's (1997) work, Pierson (2004) explains that following the discovery of large deposits of oil, developing countries "are placed on a particular self-reinforcing trajectory", in which "oil resources shape the structure of organized interests" (Pierson, 2004: 65). As a result, "the state-building process leads to a particular type of political regime distinguished by deeply entrenched patterns of rent seeking" (Pierson, 2004: 65). This institutionalisation pattern is consistent in Venezuela, Iran, Nigeria, Algeria and Indonesia, where "executive power became linked to the fate of the oil industry, and states centralized while expanding their jurisdiction in an oi-propelled dynamic" (Karl, 1997: 197).

The adoption of specific institutional arrangements – like laws, regulations and policies – has effects not only on the political processes and policy outcomes but also on the "prospects of further institutional revision" (Pierson, 2004: 148). The concept of *asset specificity* explains how institutions create incentives for actors to protect their investments in assets (site, physical, human and dedicated assets) (Pierson, 2004: 148). Institutional arrangements usually urge investments in specific types of assets, while actors usually protect their investments by opposing change. Furthermore, by encouraging investments in a specific type of assets, institutions end up altering the actor's calculations of the costs and benefits of institutional change. Translated to the energy sector, asset specificity contributes to explain why a change to alternative sources of electricity is so difficult. The accumulation of investments in particular assets (i.e. technology and institutions related to fossil fuels) can make the adoption of other alternatives – which were previously plausible – very costly and unfeasible.

2.4.3 Institutions, actors and coalitions

Institutions are important because they limit some forms of action and facilitate others, by structuring interactions and by shaping "who participates in a given decision" (Steinmo, 2008: 124). In the context of energy, this means that energy decisions are influenced by the institutional arrangements in place. For instance, energy companies' decisions (i.e. investment decisions) are heavily shaped by the type of incentives and regulations in place, which also would determine companies' willingness to innovate (e.g. change their existing practices and investments) (Lockwood et al., 2013: 22). Such processes are significant as they can determine how readily new entrants (e.g. new renewable energy companies) can gain access to energy markets.

Within the political realm, actors and social groups with common interests or ideas usually align in coalitions to achieve political influence (Pierson, 2004: 31). However, as institutions shape actors' goals and often alter their preferences, institutions structure coalitions in ways that could have transformative effects on policy (Fioretos et al., 2016: 7). This political process is relevant to this research because SETs greatly depend on coalitions, in that they involve mobilisation of actors in support or opposition to change (Geels et al., 2016; Roberts et al., 2018). Recent conceptualisations of different transition pathways within the STT literature recognise that changes rely on shifts on the composition and strength of actor coalitions (Geels et al., 2016). Incumbent coalitions usually seek to contest the policies that affect them by bargaining and lobbying against them (Roberts et al., 2018). Policies promoting new technologies, such as renewable energy, would be positively received by energy incumbent coalitions, only if the policies fit their interests (Stenzel and Frenzel, 2008).

However, institutional arrangements can also be affected by the relationships between political actors, thereby shaping energy policy changes. Policymakers base their decisions on the potential costs of policies, which affect "their approach to shaping institutions" (Lockwood et al., 2013). Policymakers are influenced by their relationships with energy users, such as households and large companies (either as energy producers or as energy-intensive users) because they are voters. Due to the logic of electoral politics, political actors, especially politicians, respond to voters' concerns and interests, who usually oppose any policy threatening to increase energy costs. The

business sector, as an energy user, is politically important, both because it employs voters and because it could threaten to exit the market if the conditions change (Lockwood et al., 2013).

2.4.4 Asymmetries of power and institutions' perpetuation

Actors' ability to influence policies depends on the distribution of power, which ultimately depends on political institutions. HI studies place emphasis on the ways in which institutions distribute power across social groups via asymmetric access to the decision-making process (Hall and Taylor, 1996).

HI studies how power dynamics can become sources of path dependence and therefore are central to explaining institutional stability. Through the institutionalisation of power, actors can impose rules and can use power for self-consolidation. The exercise of authority, then, could become a way of generating power, in which actors use the rules in their favour to enhance their power (Pierson, 2004), by increasing their capacities for future political action while lowering those of their rivals. This is why inequalities of power may increase over time and become deeply embedded in institutions (Pierson and Skocpol, 2002: 700).

As political decisions are made by influential actors, analysing power dynamics and its distribution is crucial to understanding the policymaking process of energy policy. Such analysis implies identifying the influential actors and the institutional arrangements in which they have invested, as well as understanding how those investments are suited over time (Pierson, 2004: 49). In other words, the uneven distribution of power and its institutionalisation are important features for the study of SETs because they affect the incentives or "willingness" to change.

2.4.5 Temporality, critical junctures and institutional change

HI scholars aim at "historically grounded investigations, by which they mean not just looking at the past, but looking at *processes over time*" (Pierson and Skocpol, 2002: 698). In particular, HI scholars study specific patterns of timing and sequence and their impact on the emergence and change of institutions and policies (Pierson, 2004). Time order has a significant impact on policy outcomes and institutional development

(Pierson, 2004: 54), and is relevant to the study of institutional stability for two main reasons. First, as the events or processes that occur in an early stage trigger positive feedback or self-reinforcement, the processes or events occurring later may have less impact. This means that previous events set the stage for a particular reaction in some direction and thus, later initiatives will be "constrained to operate within the contours established" (Pierson, 2004: 67). Second, as actors compete for a limited political space, their success depends on the resources available *at a specific time* and in relation to their competitors. "Getting there first" could magnify the competitive advantages of political actors as consolidated groups can gain access and allocate important resources to increase their advantages over time (Pierson, 2004: 73).

For instance, considering Karl's (1997) work on petro-states, Pierson (2004) highlights how a different order of events can result in different outcomes, i.e. variation in state capacities. In countries where state-building occurred first, like Norway, political leaders successfully managed the petro boom, avoiding the "destructive self-reinforcing dynamic" experienced by other countries, such as Venezuela, where oil was discovered first and thus the state-building became oil-driven (Pierson, 2004: 65-66, footnote 11).

While self-reinforcing dynamics can make political outcomes persistent, i.e. locked-in, self-reinforcement is not perpetual and institutions should not be taken as completely "frozen" (Pierson, 2004: 77). HI does not deny the possibility of institutional change. However, major or radical institutional change rarely occurs, most of the times, changes are incremental, particularly when institutions have been in place for a long time (Pierson, 2004: 153).

Institutional stability may be occasionally altered during brief moments known as critical junctures. Pierson (2004) describes these phases as "brief moments in which opportunities for major institutional reforms appear followed by long stretches of institutional stability. Junctures are 'critical' because they place institutional arrangements on paths or trajectories, which are often very difficult to alter" (Pierson, 2004: 135). A more recent approach characterises these phases as "a situation in which the structural (that is, economic, cultural, ideological, organisational) influences on political action are significantly relaxed for a relatively short period" thus major institutional change becomes possible (Capoccia and Kelemen, 2007: 343).

The core idea of critical junctures is that during these phases, path dependence can be overcome because change becomes less constrained, opening opportunities for major alterations. In other words, at critical junctures, political actors can "create new institutions, or modify existing ones" (Fioretos et al., 2016: 10). In the energy sector, examples of such patterns include the policy changes that led to the expansion of district heating, energy efficiency and wind power in Denmark after the 1970s oil shocks; the process of privatisation of energy undertaken since 1986 in the UK; and the reversal of the electricity market liberalisation in California after the electricity sector crisis of 2001 (Lockwood et al., 2016: 323). Another example is the change in German policy during the late 1990s, which led the country to adopt a renewable energy path despite the strong obstacles in the German political system and the power of anti-RE groups (Stefes, 2010).

Recent research on critical junctures has placed special attention on the agency (Capoccia and Kelemen, 2007; Capoccia, 2016), centring the analysis on the political processes occurring *during* these phases, i.e. the role that actors have in shaping changes. According to this framework, agency increases during critical junctures because actors face a broader range of feasible options as they have more room for manoeuvre and their choices are likely to have a significant impact on subsequent outcomes (Capoccia and Kelemen, 2007: 348). As agents' choices become more likely to affect the subsequent outcome, the possibilities for influencing institutional formation also increase.

However, although critical junctures can enable relatively free agency, the range of options available is finite and limited by antecedent historical conditions (Mahoney, 2001). "Institutional outcomes of critical junctures are not structurally pre-determined but they are not random" because they are firmly embedded in their historical context (Cappocia, 2016: 96). In other words, while the range of feasible options is determined by antecedent conditions, as actors operate with a significant margin of manoeuvre, the institutional outcome is determined by the politics of institutional formation (i.e. the strategies and choices of political leaders, decision-making processes, coalition-building, acts of political contestation, waves of public debate) (Capoccia, 2016: 98).

Applied to the analysis of SETs, a critical juncture analysis is useful for examining more profoundly the moments in which the opportunities of institutional change emerge. These moments are important because it is from them that processes of policy reorientation can arise, which in turn can lead to major alterations of the energy system. In particular, focusing on agency during these periods helps to direct attention to the political interactions of key actors during SETs and is useful for identifying the strategies used to embed and legitimise change. For example, Stefes (2010) explains Germany's departure from a fossil fuels path using a critical juncture framework, which identifies the key political developments in the late 1980s, including the strategies used by key actors in specific moments. The combination of economic and political events in the late 1980s (the end of coal subsidies; the strengthening of the environmental movement; increasing climate change concerns permeating the Parliament; and the Chernobyl disaster in 1986) opened a critical juncture in Germany. However, these events by themselves did not lead to a policy reorientation; specific actors' strategies allowed the introduction of regulation for renewable energy in a highly inert political system – a system of multiple veto points and highly asymmetrical distribution of power between the pro and anti-RE groups (Stefes, 2010: 149).

The critical juncture framework is compatible with the idea of change within the STT-MLP approach in at least two ways. First, the STT literature assumes that systematic change occurs when momentum is created within different levels . In essence, an external shock at the landscape level (e.g, the Chernobyl disaster in the case of Germany) reinforces the pressures for change and the weakening of the regime, while technologies in innovation-niche also advance. Second, STT also recognises that an important aspect of the transition process is institutional change, although it does not study institutional change processes in depth. For example, Roberts and Geels (2019) recently presented an analytical framework that considers the compatibility between critical junctures and STT-MLP. One of their proposed ideal-type patterns of "politically accelerated transitions" is one in which the stability of the socio-technical regime is disrupted by an external shock, at the landscape level, creating "a major "push" factor for political reorientation towards niche-alternatives" and the introduction of new policies (Roberts and Geels, 2019: 229-232). In their example, World War II plays a critical role in explaining the transition from traditional mixed agriculture to specialised wheat agriculture in the UK from 1920 to 1970.

2.5 Combining approaches: the analytical framework

This thesis applies an analytical framework that synthesises the Multilevel Level Perspective (MLP) and Historical Institutionalism (HI) to explain the emergence and development of the transition in the Mexican electricity sector. This section discusses the divergences across the two approaches and how they are addressed in the combined framework. The section also emphasises why and how the STT and HI complement each other by explaining how patterns of change and stability are addressed within the frameworks.

STT-MPL and HI come from different epistemological underpinnings, use different methods and have been applied to different aspects of change. However, as is acknowledged in recent literature, these two frameworks are compatible because they share interests in "meso-level phenomena, organised collective actors, rules and institutions, longitudinal processes, co-evolution, path dependence, stability and change" (Roberts and Geels, 2019: 225). Also, both frameworks have a longitudinal orientation and use developing historical narratives to explain decades-long processes; thus, temporality is often a central topic for both.

At first glance, it could seem contradictory to seek to analyse a phenomenon of profound changes, such as SETs, using theoretical elements from HI, a perspective that mostly focuses on explaining stability and resistance to change. However, explaining the circumstances under which opportunities for change emerge (that eventually can lead to a sustainable energy transition) entails an understanding of the processes and pressures that act against and for those changes. HI is useful to explain both processes of stability and change, as after all, they "are sides of the same coin" (Pierson, 2004: 141).

The conception of the speed of change in the STT-MLP and the HI could also seem contradictory. On the one hand, for STT-MLP, as innovation change occurs incrementally, systematic change is generally slow. On the other hand, the concept of critical juncture implies the conception of change in relatively short phases[34] in which

[34] The length of a critical juncture has to be understood in relation to the duration of the path-dependent process that is being investigated (Capoccia and Kelemen, 2007: 348).

the institutional structures are somehow relaxed and the opportunities for change become viable.

Historical records of past energy transitions and the argument of path-dependent patterns support the argument of the prolonged nature of energy transitions. Nevertheless, as discussed in Chapter 1, the transitions literature has begun to adopt the idea that energy transitions, and in particular, sustainable transitions, can unfold in relatively short periods. Recent evidence suggests that under certain conditions, energy transitions can occur speedily, i.e. in short periods, "between a few years and a decade or so, or within a single generation" (Sovacool, 2016: 203).

The conceptualisation of critical junctures is not completely at odds with the idea of incremental change. Most HI studies operate on the assumption of a dual model in which the flow of historical events is generally divided into long periods of continuity and brief moments of change. This assumption, however, does not refuse the possibility of adaptations or incremental changes during the periods of continuity. In fact, HI recognises that most of the times, institutional changes are incremental, particularly when institutions have been in place for a long time (Pierson, 2004: 153). Institutional stability is occasionally punctuated and critical junctures are phases in which *radical* (major) changes increase their possibilities of realisation. The general sense in the HI literature is that incremental change is the "normal" condition of policy development because institutions change gradually.

2.5.1 SST-HI framework: Explaining stability and change at different levels

Both MLP and HI seek to explain the process of change and continuity by understanding patterns of persistence (i.e. path dependency) at different levels: while MLP seeks to explain systematic changes, HI explains change at the institutional level. In STT-MLP perspective, prevailing institutional arrangements – like laws, regulations, and policies – are usually studied as part of the regime level and to a less degree at the landscape level. Both formal and informal institutions are considered relevant in energy transitions, but they are usually taken as given and even static, without fully considering their own processes of changes (or lack of them) over time.

Literature in the field has started to signal the importance of institutional change not only as part of the transition process but also as a possible driver of systematic change, i.e. to accelerate SETs. Recent work using HI sees this approach as an "instrument" that contributes to STT analysis. In the words of Roberts and Geels (2019), STT provides the "big picture" of the transition process, while HI is an "auxiliary theory" that allows a "more fine-grained understanding of the political dimension in socio-technical transitions" (Roberts and Geels, 2019: 225). In their approach, institutional arrangements and their political processes are considered one part of the regime, i.e. institutional change is confined to the regime level.

However, this thesis argues that the process of change (or lack of it) studied under HI goes beyond the analysis of institutions at the regime level. Thus, rather than seeing institutional change as a regime process, my analysis sees institutions as another dimension within the process of systematic change. In this framework, the STT literature provides an overall view of the SETs through the lens of levels (i.e. the processes at different levels that work together to generate a systematic change), while HI adds an extra layer of analysis using the lens of institutional change (see Figure 2.1).

The main elements of this hybrid STT-HI framework are presented in Figure 2.1. The *levels of analysis* are based on STT-MLP conceptualisation of socio-technical systems (explained before) and the historical evidence that transitions only come about when developments at all three levels link up and reinforce each other (Geels, 2005; Van Driel and Schot, 2005). Based on Cherp et al. (2018), the dimensions of change are economic (material), technological (material) and institutional (political).

The institutional-political dimension of the STT-HI framework entails the analysis of institutions, institutional arrangements and politics within the Mexican energy system. Although HI conceptualisation of institutions is broad and includes both formal and informal institutions, this thesis centres on the analysis of formal institutions. Therefore, the term "institutions" is used to refer to those structures and entities that rule the Mexican energy sector in policy terms but also in economic terms (by dictating the economic structure of the sector, e.g. the state monopoly structure). These institutions are political because: 1) they are part of the Mexican political structure; 2) they govern different aspects of energy and electricity; 3) they reinforce their own stability and

contribute to path dependence, for instance, by institutionalising power, reproducing oil-based policies, shaping actors' interests and decisions, structuring coalitions, and limiting the range of policy options. Through these different functions, the institutions analysed in this dimension affect political action and interactions in the energy sector and therefore, might affect the process of SETs.

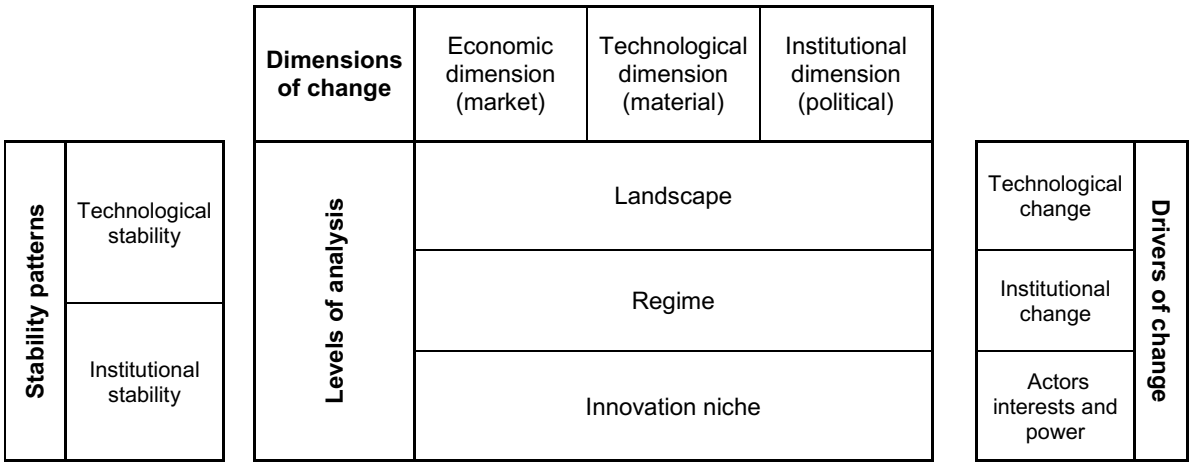
The analysis of the institutional dimension also includes the study of the institutional arrangements – laws, regulation, policies and policy instruments – and the political processes among political actors. In line with Cherp et al.'s (2018) categorisation of the systems of political actions, this dimension centres on politics within the electricity regime, i.e. the interactions between different actors in the policymaking of energy-related policies. Such processes entail the identification of policy goals; demands, interests and support from the different actors involved in policymaking process (parties, lobbies and governmental entities); the characteristics of power relationships and coalition formation.

The institutional analysis in this thesis refers to the influence of political institutions on SETs as they reinforce the stability of the electricity regime by enhancing their own stability, i.e. through path dependence. For instance, by institutionalising power, reproducing oil-based policies, shaping actors' interests and decisions, structuring coalitions, and limiting the range of policy options, political institutions in the energy sector affect political action and interactions in the energy sector. However, in this analysis, the technical path dependencies of the energy system are also analysed. Technological and material path dependencies originate in sunk investments in machines, physical artefacts and infrastructures, but are reinforced by political institutions, which intensify the carbon lock-in condition with specific policies that override market forces and redirect resources toward specific goals (Unruh, 2000). Regime stability, therefore, emerges from technological and institutional stability, which is further explained in the next section.

In the framework, the forces against change are presented as *stability patterns*, i.e. those processes that provide inertia (stabilisation) to the system by impeding major changes. Two main types of stability patterns are studied based on their sources: technological and institutional, which are explained in the section. The forces for

change, are studied as *drivers for change,* which include technological change, institutional changes, i.e. those moments in which institutions are relaxed and policy changes become feasible; and actors and their interests and power.

Figure 2.1. Combined analytical framework



2.5.2 Explaining stability: obstacles to change

Historical path dependencies generate inertia in the energy sector. HI's path dependence approach is compatible with STT's conceptualisation of regime stability. However, while STT-MLP assumes that technology-innovation has its own dynamics and socio-material obduracy, in HI studies technological change is "either neglected or conceptualized as external force"; therefore, the material dimension is often missing in policy studies (Roberts and Geels, 2019: 225). In the combined framework, the inertia of energy systems is assumed to emerge from (though not exclusively) two main sources: technology and the institutions that govern that technology, e.g. energy policy.

2.5.2.1 Technological stability

The inertia of energy systems against changes originates in the historical investments in particular technologies and infrastructure that create path dependence. According to the STT literature, this inertia manifests in the regime by lock-in patterns such as economies of scale, sunk investments in technology and infrastructures, consumer preferences and behavioural patterns[35] and favourable subsidies and regulations

[35] While it is recognised that consumption and behavioural practices are important sources of stability in energy systems, this research will not focus on them.

(Geels 2010: 495). The long investment cycles of energy infrastructures or production plants mean that new technologies have a high price and low-performance ratio (Lund, 2007: 3318). Thus, a prominent source of system stabilisation emerges from the machines, structures, and physical artefacts where capital had been invested in a technology (Verbong and Geels, 2007).

An MLP approach also recognises that a technological regime consists of the routines of engineers and firms, the "rule-sets" of complex engineering practices, skills and product characteristics embedded in the institutions and infrastructures related to that technology. Hence, stabilisation also comes from the persons whose professional skills were attached, trained, and associated with a particular technology but also from the business interests and political concerns connected (Sovacool, 2016: 205).

In the STT approach, regimes provide a "selection environment" for new technologies and other innovations, i.e. they hinder the diffusion of innovations in the different regime dimensions (Rip and Kemp, 1998; Smith et al, 2010). As the regime imposes a direction along established pathways of development (Markard et al., 2012: 957), innovation occurs incrementally, with small adjustments accumulating into stable trajectories (Geels, 2011). Clean technology does not diffuse rapidly given the "overarching structures of markets, patterns of final consumer demand, institutional and regulatory systems and inadequate infrastructures for change" (Smith et al., 2005: 1491). Dominant technologies and infrastructures refuse innovations through technical standards and infrastructural arrangements. For example, innovations are rejected through established network relations, industry platforms, strong user-producer interactions, shared routines and existing capabilities, because they usually do not fit with existing industry structures (Smith and Raven, 2012). In terms of market, path-breaking innovations face challenges because the external environmental costs are not represented in end-user prices (Smith and Raven, 2012: 1026-1027).

2.5.2.2 Institutional stability

Technological patterns are profoundly associated with institutions and institutional arrangements. As the energy system is integrated not only by technology and infrastructure (material), but also by the "constellation of energy inputs and outputs,

involving suppliers, distributors, and end users along with institutions of regulation, conversion and trade" (Araújo, 2014: 212), the inertia that comes from such institutions should be considered when explaining dependency paths in SETs.

The relationship between institutions and technology has been addressed within different perspectives in the energy literature. For example, Unruh (2000) uses the term "institutional lock-in" to explain the relationship between technology and institutions at two levels, private institutions (corporations and firms) and governmental institutions. He concludes that the involvement of government intensifies the lock-in condition created by individuals, firms and interdependent technological systems. Hence, the stability of energy systems is profoundly associated with the government's intervention because public policies override market forces and redirect incentives towards specific goals (Unruh, 2000).

In HI, political institutions, including those in the energy sector, create and reproduce path dependency because they push historical developments along one particular path through mechanisms that reinforce their own stability. The sets of rules, policies and practices of the actors involved in the system tend to stabilise existing trajectories (Kuzemko et al., 2016). For instance, a regime, such as the electricity sector, is stable because it has institutional reproduction patterns and stabilising mechanisms that oppose changes. For example, in an electricity system that relies on natural gas as the main source of electricity generation, government objectives will be directed towards natural gas production and the improvement of the existing gas facilities. Policies are synchronised in both the electricity and gas sector, to increase natural gas production on the one side and investment in natural gas burning technologies on the other. Another example of stabilising mechanisms in the energy sector is evident in the processes of lobbying. Energy companies exert pressure on political actors and policymakers to protect their interests through strong formal and informal relationships (i.e. asset specificity).

These assumptions of technological and institutional stability, however, may not always be true in developing countries, where regimes tend to be more dysfunctional and heterogeneous. In developing countries, the insufficient distribution of infrastructure and uneven access to basic services results in a variety of alternatives and practices

that become stable over time (Wieczorek, 2018; also Furlong, 2014). As a result, regimes "are not always tied to one specific technological configuration but embed a great diversity of modes that can fulfil the same need" (Wieczorek, 2018: 208). In these scenarios, there is a coexistence of old systems alongside new ones (Berkhout et al., 2009; Furlong, 2014) and informal institutional arrangements that become as important as the formal ones. These considerations call into question the straightforward explanations of the STT-MLP framework.

2.5.3 Explaining change: drivers of change

If the energy system is carbon-locked in and stable and has mechanisms that not only hinder change but prevent it, then when and under what circumstances does change occur? Furthermore, when do SETs, which imply transcendental changes in a system, occur? Based on past energy transitions, STT and MLP provide explanations centred on the technological change emphasising disruptive patterns, while HI provides explanations for institutional changes. The following sections discuss both types of changes, along with the important role that actors play as drivers of change.

2.5.3.1 Technological change

A switch away from hydrocarbon-based energy involves fundamental changes in energy technologies. In the STT approach, technological innovation is crucial to systemic change and it emerges from niches. Niches are "incubation rooms" where technologies are protected until they are ready to compete in the mainstream market, for example, where the RE technologies are developed.[36] In practical terms, niches represent segments of markets with particular demand features or "proto-markets intentionally created by policy regulations or incentives to encourage the development of alternatives" (Foxon et al., 2009: 5).

Niches can be actively constructed via interventions, i.e. technology policies, including supply-side measures for counter-acting cost differentials or performance

[36] Shackley and Green (2007) provide a classification of technologies, which may contribute, to SETs, including different types of technologies (fossil fuel-based, nuclear, renewables, demand-side technologies and energy carriers and storage technologies) and different technology stages (mature, early commercialisation, development and demonstration stage and research stage).

characteristics (e.g. regulations, tariffs, and taxes), but also demand-side measures aimed at altering preferences (e.g. quotas, public purchasing, information campaigns or market segmentation)" (Smith and Raven, 2012: 1027). According to STT-MLP, the need for niche protection drops progressively as the innovation enters broader markets and becomes mature (competitive). In this process, internal niche dynamics such as building social networks, learning processes and articulation of expectations to guide learning processes, are necessary. Those processes are complemented with functions of the innovation system such as entrepreneurial activities, knowledge development and diffusion, market formation and resource mobilisation (i.e. investment in both financial capital and human capital involving the accumulation of relevant skills and capacities).

However, the STT framework seems not to completely fit in developing countries as the promising new sustainable technologies "hardly ever originate from developing countries, due to a lack of capacity, adequate policy frameworks or resources" (Wieczorek, 2018: 209). In contexts of less advanced industries and fragmented innovation sectors, technological innovations are usually transferred from abroad. This different origin of innovation makes it necessary to focus on "the conditions whereby a foreign technology transfer can spur a more radical change in a sustainable direction" (Wieczorek, 2018: 207). Therefore, there is a need in the field to address the knowledge dimension of technologies to understand how innovations are transferred and embedded in developing countries, for example, by studying their innovative capabilities (Berkhout et al., 2009: 225).

The different contexts in developing countries also affect the type of policies adopted for niches. For example, Wieczorek (2018) argues that there are two opposing views in the developing countries' literature on the form of protection of niches. In countries like China and India, governments play a central role in "devising policies that could foster regime shift, allocating resources to promote low-carbon energy transitions" and in mobilising financial resources to finance low-carbon energy systems (Wieczorek, 2018: 206). However, in other cases, centralised state programmes "are target-oriented and subsidy-driven", which provide few incentives for fostering innovation financing or energy efficiency (Wieczorek, 2018: 206). These observations might be relevant for the

case of Mexico, where electricity policies respond to the logic of a strongly centralised energy system and electricity subsidies play a relevant role (see Chapter 4).

On the STT-MLP perspective, once niches become mature, they can become influential in contributing to regime transitions, for instance, towards sustainability. However, historical studies have shown that transitions only come about when developments at all three levels link up and reinforce each other (Geels, 2005). In other words, the development and availability of technology are not enough for a transition to happen. For example, Geels et al. (2016) argue that key developments at the regime level, such as the start of a liberalisation process in 1998 and the new Red-Green government taking office the same year, were key driving forces for the expansion of the RE niche in Germany. Similarly, in the UK, regime developments such as the strong emphasis on climate change in the government's agenda and the adoption of the 2008 Climate Change Act and the 2009 UK Low Carbon Transition Plan, had a strong influence at the niche level. However, further developments at the regime level, both in Germany and the UK, also altered the course of niche developments in the opposite direction. For instance, the German RE coalition weakened in the sight of the Chinese competition and the rise of electricity price, which led to the government's attempts to slow down the RE expansion by modifying recent laws. In the UK, concerns about the financial-economic crisis and the election of a new Conservative-Liberal Democrat government in 2010 led to less political support for the RE (Geels et al., 2016).

Developments in the landscape (or macro-economic and institutional context) are also key in exerting pressure on the established regime, opening up opportunities for alternative niches to breakthrough. Landscape developments in the energy sector have been exemplified in the literature as political elections, major nuclear accidents, macro-economic trends, commodity price developments (Geel at al., 2016: 901), but also scientific knowledge about climate change (Kuzemko et al., 2016: 38). For example, the nuclear accidents of Chernobyl in 1986 and Fukushima in 2011 hardened negative public attitudes towards nuclear policy in Germany, placing pressures to halt the expansion of the nuclear power plants and programs, and opening opportunities for other technologies, i.e. RE. Another element that has been explored in this literature is the effect of European regulation – as part of the landscape level – in national energy policies that affect the electricity sectors in the UK and Germany. For example, how the

2005 European Emissions Trading Scheme "stimulated utilities to embark on (government co-sponsored) R&D programs into carbon capture and storage" or influenced legislation and commitments on climate change by the UK government in 2008-2009 (Geels et al., 2016: 903).[37]

2.5.3.2 Policy change

While it is generally accepted that changes in policies can have major consequences for socio-technical transitions, policy change within the STT-MLP approach is usually disregarded as a main driver of systematic change, and therefore, it has been understudied. Importantly, the political processes that lead to policy changes are often completely disconnected from systematic changes. For example, policy changes are seen as a reaction to "external" changes – occurring at the landscape level, and to a lesser degree to changes at the regime level. For example, in Geels et al.'s (2016) analysis of the German and UK electricity sectors, the adoption of pro-renewable energy policies is explained as the result of the formation of a Red-Green government in 1998 in Germany and the change to a Labour government in 1997 in the UK, both of which are considered as landscape-level events. Likewise, an analysis of the Mexican electricity sector claims that the transition towards natural gas in electricity generation is a result of a policy change in the late 1980s (Jano-Ito and Crawford-Brown, 2016).

However, these analyses do not fully explain how the processes of policy change took place. For example, in the German and UK cases, Geels et al.'s (2016) analysis does not explain the factors contributing to a change of government in the first place or why the new administrations considered renewable laws a viable option for the country. In Mexico, the low price of natural gas and the emergence of new burning technologies are considered to be factors contributing to a shift in the negative perception of the government towards natural gas. However, Jano-Ito and Crawford-Brown's (2016) miss an explanation for the process behind the change of perceptions: on who pushed for the change at the political level and how exactly it changed. Understanding these

[37] Other examples of landscape influence in earlier energy transitions include: military conflict (e.g. the World Wars spawning the French nuclear program) or some global crisis (e.g. the oil shocks of the 1970s, the collapse of communism in the early 1990s, climate change nowadays) (Sovacool, 2016). Verbong and Geels (2007) claim that changes in the landscape – including the oil crisis of 1973, the economic recession of the 1980s, liberalisation process and Europeanisation – were key events in explaining the transition in the Dutch electricity sector (Verbong and Geels, 2007).

political processes is important because they led to major transformations in the electricity sectors of those countries.

As previously discussed, one way to analyse these political processes within the HI framework is through a critical juncture analysis. The core idea of critical junctures is that during these phases, path dependence can be overcome because change becomes less constrained, opening opportunities for significant alterations, i.e. policy changes that could lead to SETs. During these phases, the role that actors becomes particularly important because agency increases and actors have more scope to influence decisions (Capoccia and Kelemen, 2007: 348).

2.5.3.3 Actors as drivers of change

As different groups of actors seek to frame problems and solutions in a manner that suits their interests, political struggles in SETs seem inevitable. This involves relationships of power in which actors try to persuade others about the best course of action or to keep off the agenda issues that are not their priorities (Smith et al., 2005). Actors and their relationships then play important roles in creating or constraining opportunities for change.

STT and HI share a common interest in collective actors and institutions: “in both approaches agency is relevant as both recognise the fundamental role that actors have in initiating and implementing change” (Roberts and Geels, 2019: 225). However, within that STT-MLP, power is primarily understood in terms of the struggles between incumbent regimes and upcoming niches (Köhler et al., 2019). Therefore, it is usually assumed that the most influential actors in energy transitions are big firms with vested interests in the dominant technologies, conceptualised in terms of “regime resistance”. For example, Geels (2014) theorised “regime stability as the outcome of active resistance by incumbent actors” (Geels, 2014: 23) to explain the resistance and resilience of coal, gas and nuclear production regimes to renewables deployment in the UK electricity system. Therefore, this attempt to introduce the analysis of power reproduces the tendency in STT literature “to equate the regime with ‘government and large corporations’, while associating niches with ‘small entrepreneurs and/or civil society’” (Avelino and Wittmayer, 2016: 639).

Yet, the political nature of SETs implies the need to consider a broader range of actors along with their power relationships for two reasons. First, Kuzemko et al. (2016) stress that "forces for continuity", i.e. those coalitions that support the status quo, include a variety of influential groups, not only big firms. For example, "banks, pension funds and other associated supply chain actors with sizable investments in energy regimes", also "climate sceptics, politicians and energy consumers" (Kuzemko et al., 2016: 102). Second, the response of incumbent actors "may depend on their core competencies and how these affect the capability to respond dynamically to policy changes" (Lockwood et al., 2016: 320). While considerations of asset specificity include physical assets (e.g. ownership of fossil fuel electricity plants), they also include the human assets of companies and the networks they have with other companies. For example, Stenzel and Frenzel (2008) argue that the response of incumbents in different countries to policies supporting wind power depended on these factors, with those in Spain particularly well placed to seize opportunities rather than resist change.

It is also necessary to consider political actors who might take advantage of the moments of change to introduce specific issues in the political agenda. For example, Stefes (2010) studies the role of policy entrepreneurs in facilitating a policy change during a critical juncture in Germany. Policy entrepreneurs are "well situated" actors that play crucial roles in framing reform proposals as they craft solutions and persuade the different parties to work together (Pierson, 2004: 136). The analysis of policy entrepreneurs is compatible with the critical junctures approach because in these phases agency increases and actors face more room for manoeuvre, and a broader range of options become feasible (Capoccia and Kelemen, 2007). In such circumstances, actors who usually do not have "enough" influence to impact political decisions, could become relevant by taking advantage of the political events. Policy entrepreneurs are "willing to invest their resources – time, energy, reputation, money – to promote a position in return for anticipated future gain in the form of material, purposive, or solidary benefits" (Kingdon, 2011: 179). In the German case, policy entrepreneurs in the Parliament and the Ministry for the Environment were vital to secure the passage of the Feed-In-Tariff Law in 1990 and to build a strong pro-RE coalition that would prevent policy setbacks. They translated "the increasing *economic* returns in the RE sector into political capital and brought together a strong alliance of

pro-RE groups" (Stefes, 2010: 151) that protected the feed-in tariff against its powerful opponents.

The role of policy entrepreneurs in joining problems, policies and politics, however, is framed in existing institutions. Actors' ability to influence decisions ultimately depends on the distribution of power, which, in turn, depends on institutional arrangements. Some recent STT-MLP studies have partially recognised these interactions between institutions and power and how they potentially affect energy decisions. For example, Geels et al. (2016) recognise that the differences in the SETs of Germany and the UK can be partly explained by "static landscape characteristics that shaped action possibilities" (Geels et al., 2016: 910). Hence, "societal deep-structures" in Germany created positive avenues for the deployment of RE by new entrants, while in the UK those structures favoured the deployment of RE by incumbents (Geels et al., 2016). In the case of the UK, those structures refer to a "liberal market economy", which favours market-based and non-technology specific policy instruments; and a political system, which favours closed networks with incumbent industry actors and a weak civil society engagement in the energy domain (Geels et al., 2016: 910). In the case of Germany, the structures favouring the development of RE are: a strong and active civil society; a "coordinated market economy" that collaborates with stakeholders and accommodates civil society demands; a strong environmentalist tradition that explains the cultural resonance of the RE discourse and the ruling of Green Party; and manufacturing sectors, which meant that German firms could benefit economically from the sustainable transition in electricity by building wind turbines, solar-PV modules and other RE (Geels et al., 2016: 910). As mentioned, these explanations resonate with Lockwood et al.'s (2013 and 2016) use the Varieties of Capitalism.

However, while the institutional elements are mentioned in Geels et al. (2016), their analysis is limited as they are seen as "external" elements, part of the landscape, and not as processes directly integrated to the transition process in the regime level. Additionally, the authors assume these structures condition actors' actions but do not elaborate on how exactly they influence the policymaking process or how they affect the agency and distribution of power among actors.

As such, STT-MLP literature tends to assume that regime actors' roles are univocal and mostly studied outside the regime. Regimes in developing countries, however, are highly heterogeneous; thus, the role of regime actors in developing countries could be rather ambiguous (Ramos-Mejía et al., 2018). In developing countries, it could be less clear "which dimensions create resistance and what exactly needs to be destabilised (if at all)" (Wieczorek, 2018: 208). Therefore, STT-MLP assumption that resistance of incumbent industries and policymakers is the main obstacle in the process of transition could be not completely true in developing contexts.

Also, scholars analysing cases in developing countries have emphasised how power relationships could be "extremely" relevant in some countries (Wieczorek, 2018: 208) because the attempts to weaken and delegitimise transition processes can be magnified in contexts of ill-functioning institutions (Ramos-Mejía et al., 2018). The use of informal interaction mechanisms by powerful actors becomes more frequent in developing contexts, both in terms of influencing the decision-making in their favour and in excluding other stakeholders from the process (Hansen et al., 2018). For example, Nygaard and Bolwig (2018) argue that direct connections to powerful government representatives in Ghana were central for some actors in order to mobilise access to land and sources of financing for the development of Jatropha-based biofuel plants. Also, Hansen and Nygaard (2014) show that a persistent lack of social actor network and cooperation were a crucial limiting factor for the development of a biomass waste-to-energy niche in Malaysia. Technologies can also be used in favour of specific political interest. For example, Power et al. (2016) found that in Mozambique, utility companies have manipulated the development of electricity infrastructure, serving the political purposes of the dominant political party. This has benefited companies with links to political and economic elites.

2.6 Fostering a developing country perspective for Sustainable Energy Transitions

Different views about how to achieve sustainable energy come from the fact that the challenges related to energy affect countries in different ways depending on their specific contextual conditions, i.e. energy mix composition, degree of fossil fuel dependence, climate vulnerability, and access to alternative sources of energy. The previous sections have introduced some empirical examples from the emerging STT literature in developing countries that highlight the differences in the institutional and technological dimensions. At the institutional level, those characteristics include inefficiency in bureaucracy; less transparency in legal proceedings; weak enforcement of legal frameworks; high levels of economic and social inequality; and clientelism and patronage relationships that affect the policymaking processes (Ramos-Mejía et al., 2018; Wieczorek, 2018). In terms of the technological dimension, developing countries face a higher reliance on foreign sources of technology, knowledge and financial resources; less advanced industrial processes and dominance of low-tech (primary) sectors (Hansen et al., 2018; Ramos-Mejía et al., 2018; Wieczorek, 2018). Importantly, the empirical evidence points to how the differences might affect the trajectories of niche developments from those patterns observed in European contexts. Given the differences, "the ways in which transitions toward sustainability take place in the context of low-income developing countries are likely to differ from those in their western high-income, industrialized counterparts" (Hansen et al., 2018: 199).

This raises two main questions relevant to the aims of this research: one related to the suitability of the STT-MLP conceptual frameworks to developing contexts (Hansen et al., 2018), and other on how the institutions in developing countries limit countries' possibilities for SETs. These questions are starting to be addressed in SETs literature, but so far, there are no clear answers in current theoretical frameworks.

In particular, it is important to understand how "the fractured character of regimes" in developing countries might influence the opportunities for their sustainability transformation (Köhler et al., 2019: 15). This is not to say that issues like corruption, lack of transparency, weak law enforcement, political instability, lack of democratic decision-making processes, do not occur in developed contexts. But the STT-MLP

approach tends to emphasise the "harmonic, consensual and inclusive" processes underlying niche development while developing countries are more prone "to elite capture, non-transparent political decision making processes, relations based on clientelism and patronage, and no independent judiciary" (Hansen et al., 2018: 201). HI could provide a context-based analysis of the political processes in such contexts while allowing a closer look at power relations and actors' strategies in moments of change.

As discussed in Chapter 1, despite being an upper middle-income economy, Mexico shares characteristics of developing contexts. For example, corruption, high electricity subsidies that compensate for the high cost of electricity, and extensive non-technical losses of electricity due to large levels of electricity thief, which is seldom penalised.[38] Also, as a country dependent on mainly oil-based fossil fuel resources, the lobbying dynamics around energy decisions become particularly relevant. One of the implications of such a process is that lobbying in the energy sector does not come only from the energy companies but from the sectors that depend on them, such as manufacturing. The coexistence of old and new systems in the provision of electricity is also a common feature in Mexico. For instance, the provision of distributed-generated electricity from RE – i.e. solar PV – in poor rural areas that are not connected to the grid; or when big wind turbines providing electricity to large urban centres, are installed in rural areas in which nearby communities have intermittent and irregular access to electricity services. These features contribute to a heterogeneous electricity regime and different political process that shape Mexico's process of SET.

Advocates of liberalisation argue that energy liberalisation would improve environmental quality by driving out old technologies (Lovins et al., 2002; Joskow 1998; Flavin and Lessen 1994) and/or by facilitating "green" consumerism (Wiser, 1998). Theoretically, it was expected that competition and incentives for efficient use of inputs would contribute to a reallocation of resources from manufacturing to other areas, e.g. disruptive innovation (Pollitt, 2012). However, existing literature on this subject is scarce both in developing or developed countries.

[38] About 21% of the electricity generated in Mexico is not charged, owing to technical and non-technical losses, for instance, because bills are not paid (IEA, 2017: 138)

Despite the lack conclusive evidence on the sustainability benefits of electricity liberalisation, the literature recognises that liberalisation has helped improve the quality of policy instruments for environmental emissions control (for instance, with the establishment of trading mechanisms) (Pollitt, 2012). Yet, the existing literature on SETs neglects the linkages between sustainable transition and liberalisation because it is based on contexts already liberalised.

Some of the works discussed in this chapter recognise the relevance of market-based structures and institutional contexts in explaining different SETs paths. For example, Lockwood et al.'s (2013 and 2016) use of the Varieties of Capitalism framework describes the differences between Germany and the UK based on their market economy type. A coordinated market economy (CME), like Germany, is expected to produce more sustainable economies than a liberal market economy (LME) like the UK. Also, Geels et al. (2016) acknowledge that differences in the liberalisation process resulted in different structures in Germany and the UK, which led to different deployments of RE energies. While Germany's liberalisation process led utilities to focus on economic expansion and new roles (i.e. diversification), the electricity liberalisation in the UK resulted in the consolidation of the "Big Six" electricity companies. These differences created positive avenues for the deployment of RE by new entrants in Germany, while in the UK, the implementation of RE was made by incumbents (Geels et al., 2016).

Although these authors reflect on the relevance of market structures and the effects of electricity liberalisation, their analyses exclude a specific discussion on the liberalisation-sustainability relationship. Furthermore, the examples are based on developed countries, which may not be applicable to developing countries. As such, the current SETs literature lacks an analysis of the role that liberalism – or its absence – has in the processes of the energy transition in general, and in developing countries in particular.

As the sustainable energy transition process in Mexico occurred alongside the liberalisation process, the Mexican case can provide insights about the link between sustainability and liberalisation and how that link can affect the transition process in developing countries.

2.7 Summary

This research is situated within an emerging subfield of energy transition studies that seeks to conceptualise SETs as political phenomena and processes of policy change. In line with the recent literature, this chapter argues that the prevailing approach, the STT and MLP perspective, fails to account for how energy policies are conceived, negotiated, adopted and implemented, processes that are crucial in determining the developments of SETs. It, therefore, proposes an analytical framework that combines STT-MLP with concepts of HI to analyse the transition in the Mexican electricity sector.

A more profound consideration of the political realities in which energy policies are embedded can better explain the different paths that countries follow. The differences seem to reside in the historical dynamics within each country's economy, technological development and policies. However, the European bias that prevails in the field limits the scope of STT assumptions about sustainable transitions in the electricity sector, as they draw from countries that share characteristics such as modern developed societies, democratic stability and similar sustainability challenges. Countries with different contexts, and above all, with different development challenges and institutional and technological contexts face different energy challenges and follow different policymaking processes.

Cases in developing countries have only started to be explored. The existing empirical evidence is limited but indicates a difference in the trajectories of niche developments and SETs in developing countries from the patterns observed in European contexts. This raises two main questions relevant to the aims of this research: one related to the suitability of the STT-MLP conceptual frameworks for developing contexts (Hansen et al., 2018), and the other on how the institutional arrangements in developing countries limit the potential for SETs.

The second gap identified in the literature is that the prevailing approaches overlook the politics involved in the energy policies, i.e. the negotiating and interacting dynamics between different actors in order to influence the policymaking and/or to legitimise one type of energy over others. Although this has been one of the major criticisms of STT approaches, there have been few attempts to develop an analytical framework

specifically focused on these particular aspects of a SET. The STT literature provides straightforward explanations for SETs in which it is assumed that the systematic change originates in new technology – which is typically radical – offered by niches. Hence, transitions in general, and SETs, in particular, can be accelerated when niches are nurtured and protected. Although these explanations seem logical, their applications have been partial because the drivers and processes within SETs have proven to be more complex in practice. HI focuses on how institutions influence policy and political action by "constraining, superimposing conditions of possibility for mobilisation, access, and influence" (Amenta and Ramsey, 2010: 17). This understanding of the political process is compatible with STT's conception of regime establishing the selection environments for new technologies and other innovations, discussed above.

Third, the study of past energy transitions suggests that historical developments matter but as the Mexican case has been under-studied, the ways in which historical dynamics are affecting current changes in the electricity system remain uncertain. An STT analysis can help to explain why, despite Mexico having rich RE resources, the prevailing sources for electricity continue to be natural gas and oil. Recent research has pointed out that institutional arrangements shape the capacity of countries, particularly developing countries, to achieve the technological change required to SETs. An HI analysis of the Mexican case, taking into account the nature of electricity institutions and its politics can provide leverage to complement STT limitations. The use of HI allows an actor-based approach and analysis of the power relationships among actors and institutions. By giving attention to the agency as a condition for the reproduction or creation of paths, HI can help to address the existing critics of a lack of adequate consideration of how institutions shape actors' interests and a room of manoeuvre in the policymaking of energy policies. Finally, as HI examines power asymmetries, it is useful to identify who has the power to change, who sets the terms of transition, and for whom. As such, this framework, is compatible with the aims of this investigation, which seeks to understand the origins of Mexico's transition in the electricity sector and its main drivers, while identifying how the institutional context influences the transition process in the electricity sector.

Chapter 3: Methodology and methods

3.1 Introduction

Previous chapters have made clear how the transition paths followed by countries depend on their different economic, social, political and institutional contexts. Importantly, different realities in developing countries lead not only to less uniform regimes but also to different policies, priorities and ways in which decisions are taken. As case studies produce concrete, context-dependent knowledge (Flyvbjerg, 2006), the Mexican case can provide new empirical evidence about how sustainable energy transitions (SETs) emerge and evolve in the context of developing economies.

The research design of this thesis is based upon a single embedded case of the Mexican case to enrich the existing combined STT-HI frameworks, while mitigating the long-standing European bias in the field.

The chapter comprises five sections. The first section covers the research design and the use of an interdisciplinary approach. The second section introduces the case study approach (CSA) and highlights its suitability for addressing the research questions. This section also justifies the criteria for case study selection and explains the units and subunits of analysis.

The third section focuses on the data collection process and the different data sources, i.e. documents, semi-structured interviews and videos. It addresses why and how these sources were used to inform the research questions. It also reflects on some of the challenges and limitations in collecting the data.

The fourth section examines the methods of analysis, including the process tracing and thematic analysis. The former enabled the tracing of a historical narrative of the evolution of the electricity sector from 1990 to 2015 and the policymaking process of the reform, including the ETL, while identifying key events, actors and impacts. The thematic analysis allowed the identification of the drivers and obstacles for change. Importantly, an analytical framework that combines theoretical concepts from STT and HI was used to guide the process. The last section reflects on some of the challenges and limitations of the methodology and the analysis process.

3.2 Research design and strategy

This thesis is based upon a single embedded case study of a sustainable energy transition in the Mexican electricity sector. The research addresses the following research questions:

1. What are the drivers and obstacles to a sustainable transition in the Mexican electricity sector?
2. How have institutions shaped the sustainable transition in the Mexican electricity sector?
3. What was the role of sustainability in the electricity reform of 2013?

Answering these research questions requires an in-depth analysis of the electricity system and associated technologies and institutions, which entails an interdisciplinary approach and a combination of qualitative and quantitative data.

As discussed in Chapters 1 and 2, the complexity of energy systems, due to the different interests and actors involved, along with increasing environmental and economic pressures, constitute an analytical challenge. Recently, there seems to be consent among energy transition scholars that the array of elements involved in energy systems and their multiple interconnections with other sectors demand interdisciplinary research and the use of different theories (Geels et al., 2016; Spreng, 2014: Sovacool, 2014). However, no consensus has been reached on which theories or disciplines should be integrated or on how to develop consistent analytical frameworks for analysing SETs.[39]

An interdisciplinary study of SETs implies a combination of approaches that allow an understanding, on the one hand, of the different changes that such a transition entails – economically, technologically and politically – and on the other hand, of the complex political dynamics impacting energy decisions, and the transition process in turn. To achieve such an approach, this thesis proposes the application of an analytical framework that combines three dimensions: socio-technical, market-economic and

[39] Cherp et al. (2018) recognise that the disciplinary diversity in scholarly approaches represents one of the main difficulties in explaining energy transitions and attribute this lack of consensus to the variations of scope and method in energy studies (Cherp et al., 2018).

institutional-political, while the detailed political analysis is provided by applying elements of Historical Institutionalism (see Chapter 2).

The analysis of quantitative data on electricity consumption and production was useful to uncover the characteristics of the regime and its *patterns of stability and change* over time. For instance, the historical data was useful to identify the main energy sources and main technologies from 1990 to 2015 and to understand the role that electricity from RE sources has historically played. They were also useful to identify the moments of change in the electricity regime as shown, for example, in the quick increase in the use of natural gas by the late 2000s, in line with the increase in imports and production of gas. The data on energy demand were used to identify the main consumers, their type and scale of consumption, as well to understand the role of specific actors, as manufacturing industries. Quantitative data were also useful to establish relationships, for example, between the entrance of new private investment and the increase in electricity generated by natural gas plants. Other data such as the costs of electricity proved useful for explaining certain political decisions – i.e. the preference of natural gas over other sources of energy given the low price in the years previous to the 2013 reform or the relevance that a reduction in the costs of solar and wind electricity had during the ETL negotiation process.

Qualitative analysis was useful for understanding the different aspects involved in the political conditions in which electricity policies are taken. For example, qualitative methods were used to: identify the main actors and their positions in relation to changes; to define the current institutional framework and the ways in which it enables or constrains changes; to single out the characteristics of the regime and to identify whether they have changed in recent years; and to define the type of changes in terms of SETs and institutional change.

3.3 Case study approach (CSA)

3.3.1 The rationale for choosing a case study approach

The case study approach (CSA) allows the researcher to develop theory "regarding the causes of similarities or differences among instances (cases) of that class of event" (George and Bennettt, 2005: 18). In this study, SETs can be understood as the class of event while the Mexican transition is an instance of this phenomenon, i.e. a case study. The CSA allows the empirical inquiry of contemporary social complex phenomena within its real-life context, especially when the boundaries between the phenomenon and context are not clear (Yin, 2014). This idea resonates with the complex dynamics and multi-dimensional processes involved in energy transitions (see Chapter 1).

There are thee main benefits of using a CSA in the study of SETs. First, the CSA allows the researcher to examine the hypothesised role of causal mechanisms closely in the context of individual cases (George and Bennett, 2005: 21). A robust causal analysis through within-case analysis can facilitate the assessments of complex causal relationships at a broader level (Mahoney 2000 in Tansey, 2007: 765). The CSA allows researchers to consider a wide range of intervening variables (Yin, 2003), observe unexpected aspects of the operation of a particular causal mechanism and explore under which conditions it can be activated (George and Bennett, 2005: 21). As discussed in previous chapters, the political decisions related to energy are taken in contested contexts that involve different interests and pressures. Different tensions emerge due to the interplay of interests, the profound nature of the changes required, and the interconnections of the energy sector with many other sectors. This close examination allows for the analysis of complex interactions such as path dependency mechanisms (George and Bennett, 2005: 22). The latter has proved to be an important constraint in SETs, as discussed in Chapter 2.

A second benefit is that case studies provide scope to trace events *over time* (Yin, 2014: 53; emphasis added), which is essential for this research for at least two reasons. First, SETs are long-term processes that involve changes over time – sometimes decades – at different levels (see Chapters 1 and 2). In particular, the transition in the

Mexican electricity sector is an ongoing process. Second, the use of HI analytical elements such as the critical juncture approach, make the study of events over time, particularly relevant. As discussed in Chapter 1, the study of path dependence, or self-reinforcing processes over time, is based on temporality arguments. Specifically, CSA contributes to the research aim of constructing a historical narrative of the transition in the Mexican electricity sector. Also, the establishment of a chronological sequence of the policy process helps to identify presumed casual events and cover different types of variables (Yin, 2014: 154).

A third benefit of the CSA methodology is that it allows the researcher to identify alternative explanations that might be relevant (George and Bennett, 2005: 12). This characteristic is helpful when examining the Mexican case as this country has not been previously studied under a combined STT-HI analytical framework. Thus, the case is likely to provide new insights that could reveal the importance of other variables and a wider range of explanations than those provided by the current literature. As such, the CSA allows linking empirical data to theoretical propositions (Yin, 2003), which is a key aim of this research – i.e. gathering data to assess the applicability of existing theoretical explanations.

3.3.2 Process tracing

The narrative analysis in this thesis was made through process tracing, which is a methodology appropriate for investigating temporal phenomena (Langley et al., 2013). Process tracing is not only useful to process substantial amounts of evidence like SETs but also to test theory because it generates numerous observations within a case, that need to be linked in particular ways to constitute an explanation of the case (George and Bennett, 2005: 207).

In practical terms, process tracing was used to achieve two main goals. First, for providing an explanatory narrative from the mechanisms and factors shaping the Mexican electricity sector, i.e. it provided a systematic framework for developing a rigorous analytical account of the evolution of Mexican electricity sector from 1990-2013.

Second, process tracing helped to build a detailed analysis of the policymaking process of the 2013 energy reform and the ETL negotiation 2013-2015. Process tracing is consistent with the critical junctures approach, in which the policymaking process is systematically reconstructed by looking at each step of the process in order to identify "which decisions were most influential and what options were available and viable to the actors who took them, and clarify both their impact and their connection to other important decisions" (Capoccia and Kelemen, 2007: 354). Therefore, it was possible to establish a link between the different possible causes (i.e. the interests of actors involved) and observed outcomes (i.e. the law approved) (Yin, 2003).

3.3.3 Criteria for choosing Mexico as a case study

This thesis adopted an information-oriented strategy for the selection of the case, in which "cases are selected on the basis of expectations about their information content" (Flyvbjerg, 2006: 230). As such, the choice of Mexico is based on both theoretical and practical considerations.

On the theoretical side, the Mexican case can be considered a *critical case* as it was selected "to achieve information that permits logical deductions of the type" (Flyvbjerg, 2006: 230), i.e. "if it is valid for this case, it is valid for all (or many) cases". As identified in Chapter 2, the literature on sustainable transitions has been described as having a "European bias" (Markard et al., 2012) due to the concentration of cases from this region. A recent review of the literature found that in the last years, there has been a growing number of publications studying sustainable transitions in developing countries (Wieczorek, 2018). However, the Latin American region remains underexplored, and Mexico's sustainable transition has not been studied under the STT-MLP.[40]

Despite the important analytical insights that the combination of the STT framework and the HI approaches provides, these understandings have also arisen from a limited number of European countries. Whether the scope of these insights is useful to explain SETs in non-Western European countries, and more precisely, in developing economies, remains undetermined due to the few studies that apply this combination

[40] Up to date, only Jano-Ito and Crawford-Brown (2016) have applied the MLP framework to the Mexican electricity sector, but their work focuses on the role of the incumbent natural gas industry rather than in the renewable sector.

of frameworks to countries in other regions.[41] Examining the transition in the Mexican electricity sector can also generate analytical insights about how different institutional and technological contexts shape the developmental trajectory of SETs.

As noted in Chapter 1 and 2, countries face particular energy realities that seem to condition their energy policy decisions and therefore, their SETs process. These differences should be taken into account. Institutional scenarios in developing countries differ from those in Europe (Ramos-Mejía et al., 2018). As case studies produce concrete, context-dependent knowledge (Flyvbjerg, 2006), the Mexican case can provide new empirical evidence about SETs emerge and evolve in the context of developing economies, which face different challenges from advanced, higher-income economies.

The Mexican case is different in itself because the liberalisation of its electricity sector is happening at the same time as sustainability efforts. As explained in Chapter 2, the few cases of SETs in developing countries that exist so far, focus on the experiences of countries that started their processes of economic liberalisation of the electricity sector prior to their processes towards sustainable energy. One would expect that these differences have implications in the transition path that Mexico has followed and therefore it remains to be defined whether the theoretical generalisations of the STT-MLP approach and the combined STT-HI apply to the Mexican case.

Besides these theoretical considerations, the Mexican case is of particular interest in its own terms. For example, the major changes in its energy system – such as the 2013 energy reform – create scope for an analytical discussion. Whether current changes in Mexico will actually lead to a sustainable energy system in the near future is still to be determined since most of the changes are very recent. However, it is useful to understand the context in which this transition emerged and is evolving to make further comparisons.

[41] For example, as explained in Chapter 2, studies from the economic policy perspective and HI have used specific "classification" of institutional systems, such as Varieties of Capitalism to explain the differences in the pathways of change among developed countries. However, such classification does not fit to countries like Mexico.

3.3.4 Units and subunits of analysis

This research follows the model of an embedded case study in which a case is studied through multiple units and subunits of analysis as a means to an extensive analysis (Yin, 2014: 55-56). This research has three units of analysis: the electricity sector prior to the reform, the Energy reform process and the process of approval of the Energy Transition Law (ETL). Table 3.1 presents a summary of the different units and subunits of analysis of this research, along with their elements.

3.3.4.1 Electricity system (pre-reform)

The Mexican electricity system represents the first unit of analysis of this research because identifying its conditions and main characteristics help to understand how it evolved and the context in which the energy reform emerged. This unit of analysis is divided into three subunits – the economic-market structure, the technological-material structure and the institutional-political structure. The subunits are compatible with the dimensions of change established in the analytical framework: economic dimension (market), technological dimension (material) and institutional dimension (political) (Chapter 2). The elements analysed in this unit include market structure and main energy flows and trends, material and technical structures such as prevailing technologies; and institutional arrangements, along with main actors. This analysis is presented in Chapter 4.

3.3.4.2 The Energy reform

The second unit of analysis is the 2013 energy reform, which is divided into the constitutional reform and the electricity reform. These subunits are compatible with the levels of analysis established in the analytical framework and involved both the policymaking process of the reform (i.e. how the reform was negotiated within the Federal Government and the political parties) and its content (i.e. the major legal changes introduced in general and in the electricity sector in particular). Among the elements included in this unit is the political context of the reform, the objectives and content, and the sustainability approach. Chapter 5 presents the analysis of this unit.

3.3.4.3 The Energy Transition Law

The third unit of analysis is the ETL, both in terms of the policymaking process and its content. Although the ETL is part of the 2013 reform, it is studied separately to allow a more detailed analysis. This unit was divided into three subunits that correspond to the main negotiation process of the law: the origins of the law, the negotiation impasse and the process of approval (see Chapter 6). Among the elements studied in this unit are the political context, coalitions in favour and against, and the mechanisms used to influence the policymaking process and the legal changes introduced by the ETL.

Table 3.1. Summary of the units of analysis, subunits and elements

Unit	Subunits	Elements	Dimensions/indicators
Electricity system prior to the reform (Chapter 4)	Economic-market structure	Market structure and energy flows	- Energy resources (types of reserves) - Trends in imports and exports - Production and demand trends in energy use and electricity - Energy use/consumption - Tariffs-subsidies system - Investments
	Technological-material structure	Material and technical elements	- Infrastructure: generation plants - Distribution and transmission lines - Main technologies - Innovation system and technology diffusion
	Institutional-political structure	Institutions	- Institutional arrangements - Policies, regulations and policy instruments - Policy goals
		Actors and their interactions	- Governmental actors - Private sector actors - Other relevant actors - Power distribution - Political interests of different actors

Energy Reform (Chapter 5)	Constitutional reform	Political context	- Institutional drivers - Political dynamics and key events in the negotiation - Proposals for Constitutional amendments - Role of actors in the negotiation (fluidity and agency)
		Objectives and content	- Reform objectives - Legal changes introduced
		Sustainability approach	- Objectives - Legal changes introduced
	Electricity reform	Political context	- Institutional drivers - Political dynamics and key events - Role of actors in the negotiation (fluidity and agency)
		Objectives and content	- Reform objectives - Legal changes introduced
		Sustainability approach	- Objectives - Legal changes introduced
Energy Transition Law (ETL) (Chapter 6)	Origins of the law	Political context	- Draft of the law - Political dynamics and key events - Role of actors in the negotiation (fluidity and agency)
		Sustainability approach	- Objectives - Legal changes introduced by the ETL
	Negotiation impasse	Actors/coalitions against approval	- Incumbents actors - Arguments and mechanisms used to influence the process
		Actors/coalitions in favour of approval	- Policy entrepreneurs - Private sector and non-governmental actors - Arguments and mechanisms used to influence the process
	Approval of the law	Unlock of negotiations	- Negotiation within the Congress - Negotiation outside the Congress
		Legal changes introduced by the ETL	- Clean energy goals - Clean energy certificate scheme - Other changes

3.4 Data collection and methods

Data collection was executed in two main phases, as shown in Table 3.2. More detailed information about these stages and the methods used is given throughout the following sections. This research uses documentary sources and semi-structured elite interviews. An additional source of data were videos. The following section also provides details about how the methods were used to answer the research questions to inform the research questions.

Table 3.2. Stages of data collection

Stage and time	Task
Stage 1a: Documentary sources August - November 2016	Policy review Documents review
Stage 2a: Fieldwork visit December 2016 - February 2017	Interviews with key stakeholders
Stage 1b: Documentary sources August 2017	Policy review Documents review Videos review
Stage 2b: Fieldwork visit September - October 2017 December 2017	Interviews with key stakeholders

3.4.1 Documentary sources

Documents are key sources of information because they are stable, exact and with a broad coverage (Yin, 2003). However, they can be biased as they are often written for a specific purpose; thus, they need to be corroborated with other sources. Multiple sources of documents were used in this research for two main reasons: they were used as data collection instruments, and they were used to develop core themes and subsequent questions for interviewees in the first phase of the fieldwork.

3.4.1.1 Sampling

A two-stage snowball sampling process was followed for the identification of key documents. First, a list of documents was prepared after reviewing key academic literature related to the recent energy and electricity reform. However, given that the energy reform process in Mexico is very recent, there is no extensive literature on the subject; thus, more general publications were also used, for example, documents from national and international consultancies, research centres and non-governmental organisations (NGOs). Together academic and non-academic documents helped to build up the first sample as they would often cite specific policy documents (stage 1a; see Table 3).

Second, after the first interviews took place, another set of documents were added to the sample list, based on interviewees' suggestion, i.e. documents that they issued or they suggested, but also based on the information they provided. For example, during the first round of interviews, it became clear that in order to understand the process of the 2013 reform it was necessary to understand the the 1990s reforms. Therefore, the second search for more historical documents was undertaken (stage 1b).

3.4.1.2 Types of documents

The documents were classified into four main categories and their description are shown in Table 3.3. A detail list of the documents analysed is included in Appendix I.

Table 3.3. Classification of documents

Category	Description
1) Policy documents	- Plans, programs and policies documents from Federal Government - Work reports, including diagnosis of the electricity sector and the renewable sector - General information/statements regarding the Reform, the Electricity Law and the ETL

2) Legislative documents	- Law proposals, minute of the draft law, decree initiative, decree minute, the decree of law - Meeting minutes and opinions of Congress Committees on the decree of law - Studies or special reports for the Congress regarding the proposals of laws - Transcriptions of legislator appearances in Congress
3) Contemporary documents (media)	- Press releases by the Federal Government, Senate and Chamber of Deputies - Public statements made by key senators, deputies and officials from the Energy Ministry (SENER), and private sector representatives - Advertisements in newspapers by the actors supporting and opposing the laws.
4) Other documents	- Technical, economic or opinion publications by research centres, non-governmental organisations, think tanks; international organisations and private sector associations

The first category, *policy documents,* covers documents issued by the Federal Government, including the Presidential Office, Energy Ministry (SENER), Environment Ministry (SEMARNAT), and the Federal Electricity Commission (CFE). These documents included national programs, plans, policies and progress reports of the electricity sector mainly dating from 2010 to 2015, but also some historical records from the 1990s were used. Policy documents were central to identify policy goals and details about the implementation of policy and subsequent institutional changes. These documents were also useful to uncover the justifications for the energy and electricity reform. In some cases, these documents also compensated the lack of historical statistics on the electricity sector as the SENER's website only provides electricity data from 2002 in some areas (see next section of challenges).

The second category covered *legislative documents*, which included laws and documents issued by the political parties and the different Senate and Deputies commissions related to the Constitutional Reform, the Electricity Law and the ETL.

Documents from different stages of the legislative process were included. For example, the original proposals of the reforms or laws, the revised versions approved at the different chambers and after voting and debates took place, as well as the final versions of the laws, i.e. those approved and published in the Official National Diario (Diario Oficial de la Federación). This category also included the special report and studies issued regarding the proposals of the laws, where experts in the areas state their evaluation of the proposal and suggestions for amendments.

The third category of documents was named c*ontemporary public sources* and includes media articles of the legislative process of electricity reform and the ETL approval. These sources "often offer an important part of contextual developments to which policymakers are sensitive, to which they are responding, or which they are attempting to influence" (George and Bennett, 2005: 97). Media sources were particularly useful to document the consultation process of the Reform and to identify controversial issues and the arguments posed by key actors for and against the law. Press releases by the Federal Government, the Senate and the Chamber of Deputies were also included in this category, as well as public statements made by key public and private sector representatives. These documents were also very useful for establishing the exact dates of the events and discussions as many of the interviewees provided ambiguous dates about the process, due to problems of recall.

One important source of data was collected through the paid advertisements in national newspapers sponsored by the actors supporting and opposing the ETL at the end of 2015. As recounted in Chapter 6, these adverts became key elements in influencing public opinion at a crucial moment in the negotiations and are considered critical for the approval of the ETL (see Appendix II). These documents were particularly useful to collect information about the arguments of the coalition opposing the ETL.

The fourth category of documents, *other documents*, includes technical, economic or opinion publications on the Mexican energy sector in general, and in particular of electricity and renewable energy produced by research centres, non-governmental organisations (NGOs), think tanks; international organisations (i.e. the International Energy Agency (IEA) and the International Renewable Energy Agency (IRENA)); and private sector. This category was useful to compensate for the paucity of academic

literature on SETs in Mexico. Although these publications do not provide theoretical insights, they offered key information on the obstacles in the implementation of renewable electricity policies thus they were useful for making a first diagnosis of the electricity sector and for identifying key actors. Also, they were used for developing the initial core themes and subsequent questions for interviewees. In some cases, these documents also compensated the lack of historical statistics on the electricity sector.

Most of the policy documents were available electronically on governmental websites, via the SENER, the Senate and the Chamber of Deputies. Some were available only upon request directly through the institutions/organisations involved or via the National Institute of Transparency and Access to Information. Documents from other sources were also publicly available; otherwise, they were requested by following the established procedures of each organisation or by asking some of the interviewees themselves.

3.4.2 Semi-structured elite interviews

Interviews are commonly recognised as a central tool in social research literature because they focus directly on the case study and can provide perceived causal inferences and explanations, as well as account for behavioural events (Yin, 2003; George and Bennett, 2005). Elite interviews are defined as "a tool to assemble both a series of time-frame pictures of structure and process (in the subject or phenomena to be studied) and a sequential sense of how that structure and process evolved" (Davies, 2001: 76). In this case study, they were used to confirm the information collected from policy documents and other sources, i.e. to triangulate the data, by corroborating previous findings and overall robustness (George and Bennett, 2005). They were also used as a second layer of analysis (Tansey, 2007), as they provided additional information and insight into the formal and informal debates and negotiations involved in decision-making.

Elite interviews allow researchers to "reconstruct political episodes on the basis of respondents' testimonies" (Tansey, 2007: 767). This application was particularly relevant for the overall aim of this research as it seeks to reveal the decision-making process that led to the approval of the Reform and the Energy Transition Law (ETL).

As elite interviews can provide “the kind of data that can be critical in uncovering the causal processes and mechanisms that are central to comprehensive causal explanations” (Tansey, 2007: 767), they were useful to single out the different interests of actors and coalitions in favour or against the electricity reform and the ETL.

Elite interviews also helped to compensate for the limitations of documentary evidence (Davies, 2001), which is common in political processes as official documentation may “conceal the informal processes and considerations that proceeded decision-making” (George and Bennett, 2005: 103). In this sense, the information gathered through the interviews was crucial to map the relationships among actors, the distribution of power and the mechanisms used to influence political decisions. Interviews were also very useful to track the emergence of the sustainability approach during the reform and to uncover how the topic was inserted in the reform. All this data was useful to address the third research question.

The interviews followed a semi-structured technique that allows focused questions but also flexible conversations. These type of interviews allows the researcher to ask theoretically guided questions about specific issues, to ensure that all themes and research objectives are covered (Tansey, 2007). In semi-structured interviews, the interviewee also has the flexibility to provide additional information if they considered it relevant.

The topics covered during the semi-structured elite interviews were: the characteristics of the current electricity system; the drivers of the 2013 energy reform in general, and in particular of the ETL; the major changes introduced by the ETL; insights on of the policymaking process of the electricity reform and/or the ETL; an opinion on current energy policy in terms of sustainability, and a general assessment of the Mexican renewable energy sector (see Appendix VI for a sample of the interview protocol).

3.4.2.1 Sampling

Identifying key political actors is not an easy task because influential actors are not always visible or publicly known (Tansey, 2007). The first list of potential interviewees was drawn based on their close proximity to Mexico’s electricity policymaking and politics circa 2013-2015. As suggested by Tansey (2007), both positional and

reputational criteria were used to maximise the probability that the most influential actors in the energy policy sphere were included in the sample. In the positional criteria, the occupations of key elites are considered, based on the knowledge of the researcher of the area of interest. In the reputational criteria, individuals are selected based on the influence they have in the related political arena (Tansey, 2007: 769). While the positional criteria involve some sort of purposive sampling (at least in the early stages of the research), the reputational method is more consistent with snowball sampling (Tansey, 2007: 769-770). The combination of approaches was helpful to identify unknown or unexpected influential actors.

Individuals from different types of organisations regularly involved in the electricity sector and in the renewable energies field were recruited to ensure a representative range of perspectives. Specifically, interviewees were selected for their status as either policy actors (involved in designing and elaborating policies) or more general political actors (involved in deliberating and legitimising policies). The research sought to recruit a range of respondents in order to avoid the danger that participants suggest others with similar characteristics or views.

3.4.2.2 Interviews conducted

In all, 27 semi-structured elite interviews, lasting on average between one and two hours, were conducted during three visits to Mexico City (stage 2a and 2b; see Appendix II for the list of the interviews). During the first tranche of fieldwork, 26 potential interviewees were contacted, but only 15 interviews were conducted. For the second visit, I conducted eight interviews in total, four from the initial list of potential interviewees and four from a new group. The last interviews were conducted during the third visit to Mexico, which was not originally planned but was made due to the unforeseen circumstances faced during the second visit (explained in the next section). Table 3.4 provides an overview of the interviewees conducted and a complete list is included in Appendix III.

Table 3.4. Number of interviews conducted classified by type

Number	Type	Description
5	Researchers and policy experts	- Experts on the Mexican energy policy and/or academics involved in the negotiation process
6	Non-governmental representatives	- Senior analysts and knowledge brokers from civil society organisations
8	Private sector representatives	- The private sector, businessmen, leaders of business chambers and associations
7	Public sector representatives	- Policy officials in relevant federal ministries Legislators, advisers and committee members in the Congress
1	Other	- Senior advisers and consultants from international organisations or media

Participants were recruited either through direct contact or by referral. All interviews were conducted in Spanish and most of them were face-to-face, taking place in Mexico City (mostly in the workplace of the interviewees). In three cases, the interviews were conducted remotely: two were made via skype and one via telephone. Anonymity was offered to the participants at the time that the interview was requested and at beginning the interview. Each interviewee's voluntary participation was ensured through a statement in the project's information sheet and a consent form that stressed the participant's ability to withdraw their contribution at any time. All interviews were recorded, with the interviewee's permission. Notes were taken during the interviews and the interviews were transcribed and translated into English afterwards.

3.4.3 Videos

Videos were also used as sources of data of the policymaking process of the reform and the ETL. Although videos could be considered a type of document – i.e. a visual document – in this thesis, they are separated from written documents because they were used to compensate for lack of data. The advantages of video data include the ability to capture the interaction of the participant with the environment, capturing of nonverbal cues, and establishing a permanent record (Tomáš and Seidel, 2013: 2933).

Videos were used to corroborate the information gathered through elite-interviews and the documentary analysis of the policymaking process. They were particularly useful for compensating for the lack of interviews by the private sector and legislators, as is explained in the next section on challenges. Most of the videos sourced were produced by the Senate and the Chamber of Deputies and were publicly available through official webpages. A detailed list of the videos analysed is included in Appendix IV.[42]

Two types of videos were used. First, videos of the positions within the legislative precincts by the legislators who negotiated the electricity reform and the ETL. In these videos, legislators of different political parties give their political pronouncements during the voting sessions of the laws. Second, videos of the public discussions of the proposers of the law, organised by different Committees within the Senate and the Chamber of Deputies. In these videos, legislators appear along with other actors who were involved in the decision-making process such as representatives of the Federal Government, the private sector, technical specialists and people from NGOs.

3.4.4 Data collection challenges

Several challenges were faced in the data collection. One challenge was finding reliable and consistent statistical data on the energy and electricity sectors. Gaps in energy data, both in collection and publication, is a common problem in the Mexican energy sector (IEA, 2017: 27-28; 37). There were two main problems with regard to quantitative data on energy: one, official statistics differ from one source to another or report data inconsistently; two, it is difficult to find historical energy statistics. For example, the National System of Energy Information (SENER, 2019) only provides information from 2002, so other sources were used for the data from the 1990s, i.e. historical CFE reports or the documents of prospects in the electricity and renewable energy sectors. However, the way in which the information in these documents is reported is inconsistent, i.e. sometimes the data are presented per year, sometimes per decades, and in other cases, only the data of the current year are presented. In addition, the documents prior to 2012 are not available on SENER's website. Some of them were

[42] The video of the presentation of the 2013 energy reform was also included. The speech by President Enrique Peña Nieto during this presentation contains relevant information about the origin and objectives of the reform; however, the written version of the speech was deleted from the official site of the Mexican government, when the new administration of President Andrés Manuel Lopez started in September 2018. The video substitutes the written document.

found through other platforms, such as Senate resources, but even this institution does not have an information bank specific to the electricity sector. It was, therefore, necessary to use international sources that have aggregated data, provided by the country, for instance, the IEA, the OECD and IRENA.

Regarding the interviews, it was difficult to access some of the actors involved in the process like the legislators and the businesspeople who opposed the law. This limited the universe of people available for interviews and slowed down the data collection. I was particularly interested in interviewing the public officials and the legislators involved in the early negotiations of ETL, but access to legislators was restricted as terms for elected representatives in Mexico last only three years. The legislators that proposed the ETL were part of the LXII Legislature (September of 2012 - August of 2015) and by the time I contacted them to ask for an interview they were no longer at the Congress. Most of them were in other public positions outside Mexico City, making it difficult for them to agree to an interview. To overcome this difficulty, I reviewed the public positions made by the different legislators, which are part of the public records of the Senate and the Chamber of Deputies. I also reviewed the videos of the sessions in which the ETL was voted. Although the public positions are very general and full of political positions, through a meticulous, review it was possible to identify the main arguments in the discussion and corroborate some of the information obtained through the interviews.

It is important to mention that it was relatively easy to gain access to the supporters of the ETL given my previous working experience. Before starting the PhD, I worked at a small research centre that promoted different sustainable-related topics, including renewable energy in Mexico's public policy agenda. One of the main projects of the centre was an initiative that brought together representatives from business associations, civil society, research centres, financial institutions, and public entities, through a series of closed-door meetings in which they discussed and exchanged ideas on how to encourage the use of these sources in Mexico. As such, this position allowed me to have previous knowledge of the main actors in the Mexican renewable energy sector and to establish a network of contacts in the field prior to the PhD research.

When I developed the first list of potential interviewees, I included around 18 of these previously-known contacts while added eight others based on my documental research

of the policymaking process of the ETL. As described in section 3.4.2 of this chapter, although not all of the people included in the initial list were interviewed, most of the contacts who previously participated in the centre's meeting were willing to give me an interview. These people referred me to more actors in the field, so the universe of potential interviewees was expanded for the following visits to Mexico.

It was particularly difficult to gain access to the representatives from the mining and steel industry. I had no previous connections with this industry, which hindered my access for interviews with this sector in comparison to supporters of the ETL. Only one interview could be done from a representative of this industry. The lack of access to these actors was a major obstacle as it raised the risk that my data would be biased. This deficiency was mitigated through the use of documents and press releases published by the opposition coalition during the approval process of the ETL. Information was also collected through the videos of the public debates that took place in the Senate, and in which representatives of the industry participated, stating their strong opposition to the law.

Another major challenge was that my visits to Mexico City to undertake interviews were affected by circumstances beyond my control. The first visit (January to February 2017) was hampered by a controversial political context given the high rise in gasoline prices in late 2016, which meant people were unwilling to talk about energy issues. Although my research does not directly involve the topic of gasoline, people in the sector tended to associate my research subject with gasoline prices, which resulted in difficulties in securing interviews with several actors.

The second visit (September-October 2017) was affected by the earthquake of September 19, 2017, which had major implications for my data collection, as most of the interviews planned during this visit were cancelled. For example, given that the earthquake caused major damage in the southern part of the country, where the most important wind electricity plants are located, the interviews with this sector were indefinitely postponed. I had to wait several weeks (and in some cases, months) before I could reschedule some of the planned interviews. As a result, I had to plan a third visit to Mexico at the end of 2017 to complete the interviews, while some had to be held via skype in the months following the earthquake.

3.5 Data analysis

This thesis looked for analytic explanations of the processes involved in the Mexican electricity transition, to convert the "historical narrative into an analytical causal explanation couched in explicitly theoretical forms" (George and Bennettt, 2005: 211). For that aim, two main narratives were built based on the information collected through the different stages of the data collection (see Table 3.2), followed by thematic analysis.

The first narrative corresponded to the first unit of analysis, the electricity sector prior to the reform, in which a timeline of the main phases of the electricity sector, along with the institutional developments was developed. The second narrative corresponded to the second and third units of analysis, the policymaking process of the reform and the ETL, respectively. In this narrative, the negotiation process was reconstructed step by step along with the identification of the main actors and their interests, the policy options available and connections to the decisions taken. Both narratives were useful to address the three research questions.

3.5.1 Thematic analysis

Once the two narratives were built, qualitative analysis was conducted using thematic analysis of the data coded from the documents, videos and transcribed interviews. Thematic analysis is particularly useful for synthesising and analysing data collected through diverse qualitative methods (interviews, observations and documents) (Seal, 2016: 444). The process involves not only organising data but also making data become meaningful by developing themes, i.e. theoretical constructs that explain similarities and variations across codes (Seal, 2016: 452).

Thematic framework analysis involves a systematic and methodologically rigorous approach of data management and analysis. The process followed consisted of three main steps. The first step was the creation of initial codes, which were based on the conceptual and theoretical literature and the research questions. This initial coding helped not only to organise the data into manageable categories but also to contextualise the data and identify themes and patterns within and across the data (Seal, 2016: 446). The initial coding framework was applied to a number of documents and transcripts and then codes were refined if necessary. This allowed an interactive

process in which codes became responsive to emergent and analytical themes but also to research questions (Mason, 2017: 203-204).

Second, after referencing the data to appropriate themes, I was able to compare and contrasts accounts, perceptions and reasoning about the drivers and obstacles to the electricity reform and the adoption of a sustainability approach within the reform. The themes then reflected the significance of patterns within the data and in relation to the research questions (Seal, 2016: 451). It was also possible to identify the main features of the policymaking process, the key events and the formation of the coalitions for and against, as well as perceptions about the content and impacts of the reforms.

Third, once the data were organised thematically, conceptual and theoretical literatures were used to “build a picture”. At this point, it was possible to standardise the application of the themes to identify the patterns of stability and mechanisms of path dependence existing before the reform process as well as the moments where opportunities to change were open. It was also possible to identify the mechanisms used by the key actors to influence the process and to establish a relationship between their interests and the patterns identified before the reform.

3.6 Methodological and analytical limitations

Case studies are criticised for being partial and indicative rather than systematic and definitive. In particular, single-case studies are usually criticised for not providing evidence relevant to other researches and for not addressing all the relevant aspects of a historical event, i.e. a lack of potential generalisability (Yin, 2003). This is because the researcher should treat a historical episode in a selectively focused way in accordance with the type of theory that the researcher is attempting to develop (George and Bennettt, 2005: 70). However, it is incorrect to conclude that one cannot generalise from a single-case because "it depends on the case one is speaking of and how it is chosen" (Flyvbjerg, 2006: 225).

It is possible to make logical inferences using case studies that help develop and inform policy and theory, and by recognising emerging themes, trends and issues from such instances (Hartley, 2004; Mitchell, 1983;). The generalisability in this research was addressed by choosing a critical case selected "to achieve information that permits logical deductions of the type" (Flyvbjerg, 2006: 230), i.e. "if it is valid for this case, it is valid for all (or many) cases". For instance, this research aims to reveal potential theoretical venues for further investigation and reveal emerging trends concerning the "why's" and "how's" about the process of change in SETs, particularly in developing countries. As prior knowledge of SETs in these countries is limited, the Mexican case could be considered "a test of the proposition, which may turn out to be confirmed or infirmed by it" (Lijphart, 1971: 692)

Another potential criticism is the internal validity of the study. This concern refers to the causal mechanisms, i.e. are the mechanisms analysed really responsible for the change or could there be other possible explanations? (Yin, 2003). The construction of the validity of this thesis was accomplished by using multiple sources of evidence and establishing chains of evidence (Yin, 2003). To overcome "subjective judgements" when collecting data for which case studies are usually criticised, this thesis established two procedures. First, definitions were established based on the literature, which included the dimensions of change, levels of analysis, patterns of stability and drivers of change (see Chapter 2). Second, the operational elements that match the concept were also established. The internal validity or the causal relationship, whereby certain

conditions are believed to lead to other conditions, was achieved via explanation building and addressing rival explanations (Yin, 2003).

One methodological challenge is that studying the Mexican transition involves both historical analysis and the study of a process in-the-making (Köhler et al., 2019: 20). Thus, one limitation of the approach is that studying policy processes does not allow policy outcomes to be directly judged because the outcomes are difficult to trace over time and the effects of policies cannot often be isolated from other influences (Sharp and Richardson, 2001). This limitation has been signalled in recent literature in the STT field. For example, Köhler et al. (2019) suggest that frameworks that focus on the politics of policy processes and how they shape policy outputs, do not pay enough attention to the policy outcomes and too often are applied to the study of single policy instruments rather than wider policy mixes. Analysing the policy outcome of the 2013 energy reform and, in particular, of the changes in the sustainability of the sector is a major limitation in the Mexican case. It is currently too early to determine its long-term impacts.

Although the analytical framework is the key asset and innovation of this research, applying it to the Mexican case has been a complex process. The systematic approach of SETs entails analysing the changes in a multilevel perspective. Thus, although the focus of the research is the sustainable transition in the electricity sector, the analysis entails looking at the energy level and at the economic, technological and institutional dimensions of change.

Having discussed the methodology of this thesis, the following three chapters will present the empirical results divided into the three units of analysis: the electricity sector prior to the reform (Chapter 4), the energy reform (Chapter 5) and the ETL (Chapter 6). The seventh chapter discusses the findings in a broader theoretical context.

Chapter 4: The electricity regime: understanding the roots of stability and change

4.1 Introduction

This chapter focuses on the state of the Mexican electricity sector prior to the 2013 reform, which composes the first unit of analysis. By explaining the evolution of the sector from 1990 to 2013, the chapter identifies the patterns of stability and self-reforming mechanisms. It explores the drivers and pressures for change before 2013 and the elements that have constrained transition in the electricity sector as a whole, and in terms of sustainable energy transition (SETs).

The analysis in this chapter applies the framework of levels and dimensions of change established in Chapter 2. As such, the Mexican energy sector is conceptualised as a socio-technical system, in which the electricity sector is the regime level, the renewable electricity is the niche, and the landscape level is composed of the developments in the oil and natural gas sectors. The analysis looks at the different dimensions of change: economic-market, technological-material and political-institutional. The elements analysed in this unit include the market structure and main energy flows and trends, material and technical structures such as prevailing technologies; and institutional structures and policies, along with main actors.

This chapter consists of four main sections. The first section centres on the economic and technological dimensions by identifying the main trends in energy demand, production and consumption within the three levels of analysis, the prevailing technologies and infrastructure, as well as the operation of the tariff system and the subsidies structure. The second section focuses on the patterns of stability from the political and institutional dimension by explaining the origins of the state monopoly, the historical relationship between oil and electricity, along with their link to the political system, and the political power of Federal Electricity Commission (CFE).[43]

[43] There were two state-own electricity companies until 2009: CFE and Luz y Fuerza del Centro (LFC). LFC was a small company producing electricity for a limited number of users in the central region; it was dissolved in 2009 by a presidential decree, and its assets were transferred to CFE (see Elizondo Mayer-Serra, 2011).

The third section discusses the main processes of change before the 2013 reform. It explains the legal changes introduced in the 1990s and their implications for the electricity regime, such as the transition to natural gas as the main source of electricity. The analysis of the partial liberalisation during this period is useful for understanding why, despite the problems and shortcomings in the system, the monopoly model persisted. It is also useful for understanding the emergence of private generators, who would become key actors in the years leading up to the 2013 reform.

The fourth section explains the attempts to secure electricity reform during the 2000s and the circumstances (mainly political) that prevented the approval of reforms. The section also discusses some of the deep-seated problems in the sector, which were exacerbated by the effects of a decline in oil production and pressures to maintain electricity subsidies. Altogether these developments created pressures for change at different levels (regime, landscape and niche) and within the different dimensions (economic, political and technological), producing enabling conditions for a reform in 2013.

4.2 The economic and technological dimensions

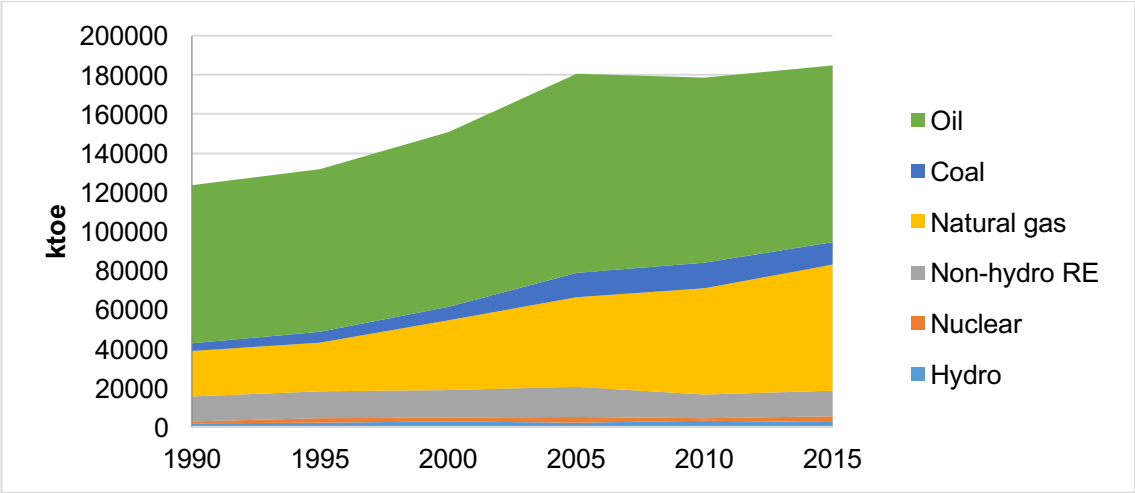
Prior to the 2013 reform, the electricity regime was vertically integrated monopoly characterised by a high dependence on oil in primary energy supply, dependence on natural gas in the electricity sector and limited participation of alternative sources, i.e. non-hydro renewable energies. As such, the main technologies and infrastructure were attached to the main sources of energy – oil first, later natural gas. This section explains the energy trends at three levels of analysis and the state of the transmission and distribution network during 1990-2103. The last part analyses the operation of the tariff system and the relationship between electricity costs and subsidies.

Understanding the technological and economic dimension of the electricity regime is relevant to the study of SETs for three reasons. First, the *technological stability* of the electricity regime emerges from the lock-in patterns such as economies of scale, sunk investments in technology and infrastructures (see Chapter 1). Second, it is useful to understand the "selection environments" by which new low-carbon technology-innovations (like RE) are rejected, for example, through the established network relations, industry platforms and existing capabilities. Third, understanding the economic structures such as the electricity subsidies and the tariff system is relevant because they seem to have implications in the sustainability of the regime, i.e. they incentivise the use of energy, and they limit the possibilities of adopting incentives such as feed-in tariffs.

4.2.1 Main energy trends at the landscape level

For decades, Mexico's abundant reserves provided stability in the sector. Historically, the country has been a top world producer of oil and petrol liquids and oil has dominated both the supply and the demand side. As shown in Figure 4.1, fossil fuels (oil, coal and natural gas) accounted for an average of 88% of total primary energy supply from 1990 to 2015. However, although oil continues to be the main source, its share has declined due to an increase in the use of natural gas. For example, oil accounted for 65% of the total primary supply in 1990, while it was only 51% in 2013, the year of the Reform (IEA, 2019; see Figure 4.1). Conversely, natural gas increased its share during the same period from 19% in 1990 up to 32% in 2013 (IEA, 2019; see Figure 4.1).

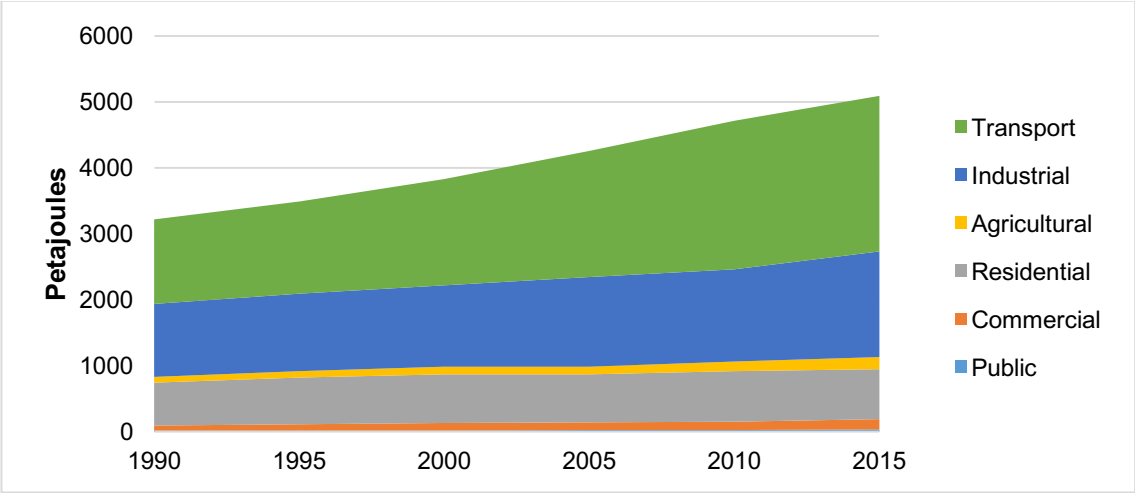
Figure 4.1. Total primary energy supply by fuel (1990-2015)



Source: Data from IEA (2019)

On the demand side, transport is the largest consuming sector, with an average share of 43% of the total final consumption from 1990 to 2015 (SENER 2019; see Figure 4.2). The industry is the second-largest consuming sector with an average share of 32% of demand in the same period, followed by the residential sector that accounted for 18% of energy demand on average (SENER, 2019; see Figure 4.2).

Figure 4.2. Total final energy consumption by sector (1900-2015)

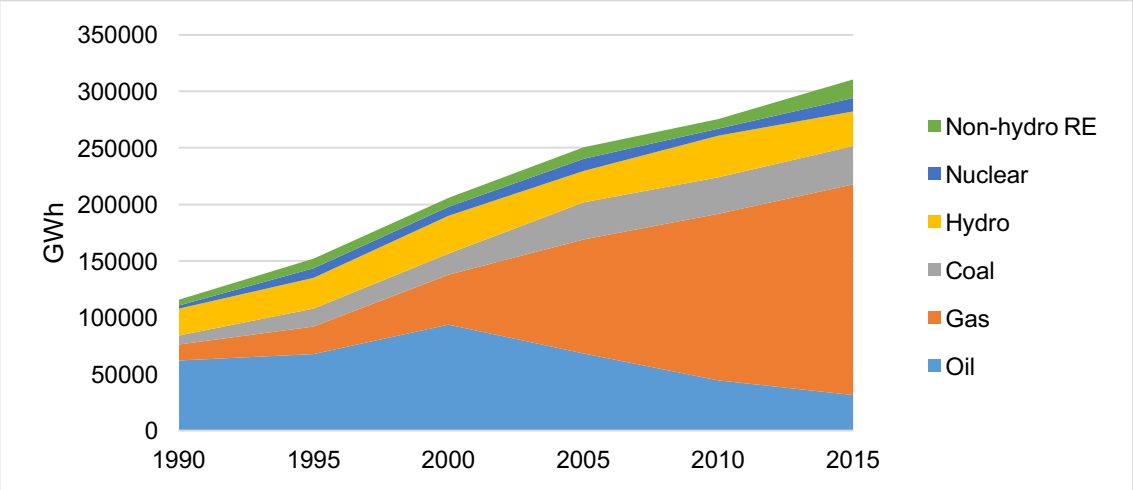


Source: Data from SENER (2019)

4.2.2 Regime level: electricity production and consumption

Mexico's dependence on fossil fuels has been reflected in the electricity regime, where the main fuels for generation have been oil and natural gas (since 2005), and to a less extent large hydro and coal. As shown in Figure 4.3, until 2000, Mexico relied heavily on domestic oil for electricity generation. Due to its low price and availability during the 2000s, natural gas became a reliable supply of low-cost fuel for Mexico, which explains the rapid adoption of gas as a substitute for oil (see section 4.4. in this chapter). Oil accounted for 54% of electricity generation in 1990 but declined to 27% in 2005 and down to 16% at the time of Reform (IEA, 2019). Conversely, around 13% of Mexico's electricity came from natural gas in 1990, compared to 40% in 2005 and 56% in 2013 (IEA, 2019; see Figure 4.3).

Figure 4.3. Electricity generation by fuel (1990-2015)



Source: Data from IEA (2019)

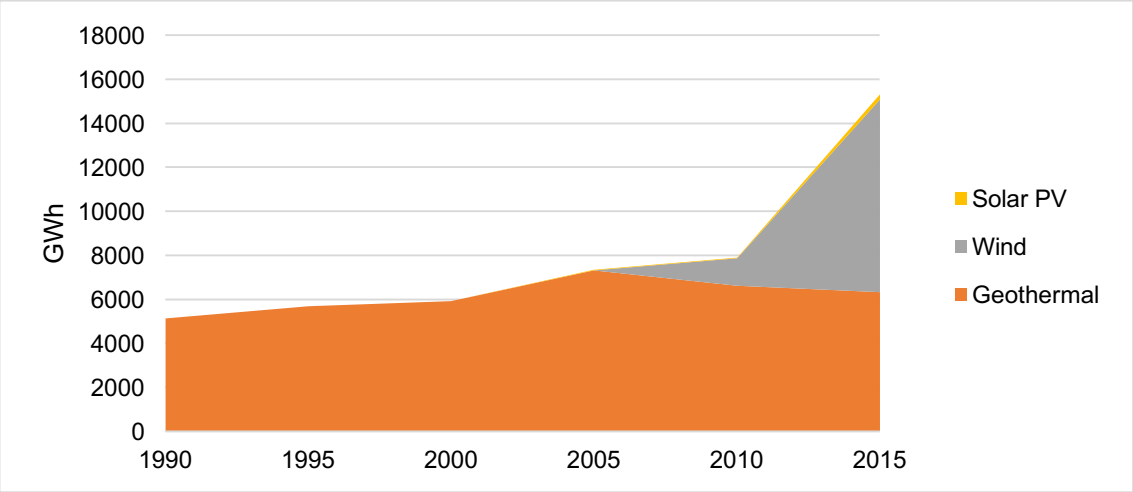
Historically large hydroelectric plants have been an important source of electricity generation. On average, hydropower represented 15% of Mexico's electricity during 1990-2015 (IEA, 2019). However, its contribution varies depending on annual water availability. Hydroelectric plants were the second-largest source during the 1990s but were displaced to third and fourth place as gas increased its share (see Figure 4.3). As hydroelectric is a mature technology in Mexico, it is therefore considered a regime technology and not part of the RE niche.

On the demand side, electricity demand in Mexico more than doubled from 1990 to 2015 (IEA, 2019). Electricity accounted for 10.2% of total final energy consumption in 1990 and 17% in 2013 (IEA, 2019). Among the end-use sectors, industry accounts for over half (55.4%) of final electricity consumption, much higher than the average elsewhere in the OECD (IEA, 2017: 134). Mexico's industrial electricity consumption has increased significantly in recent years, rising by almost 70% since 2000 (IEA, 2016b: 19).

4.2.3 Niche: renewable electricity participation

Non-hydro renewable electricity accounted for 3.06% of total gross generation in 2013: geothermal 2.35% and wind 0.7% (SENER, 2019). As Figure 4.4 shows, geothermal was the largest non-hydro renewable source in 1990-2015, which represented about 3% of total electricity generation in this period. Wind electricity developed significantly during the years prior to the 2013 reform, tripling its production in 2007 and exponentially growing since 2011 (IEA, 2019; see Figure 4.4).

Figure 4.4. Electricity generation from non-hydro renewables sources (1990-2015)

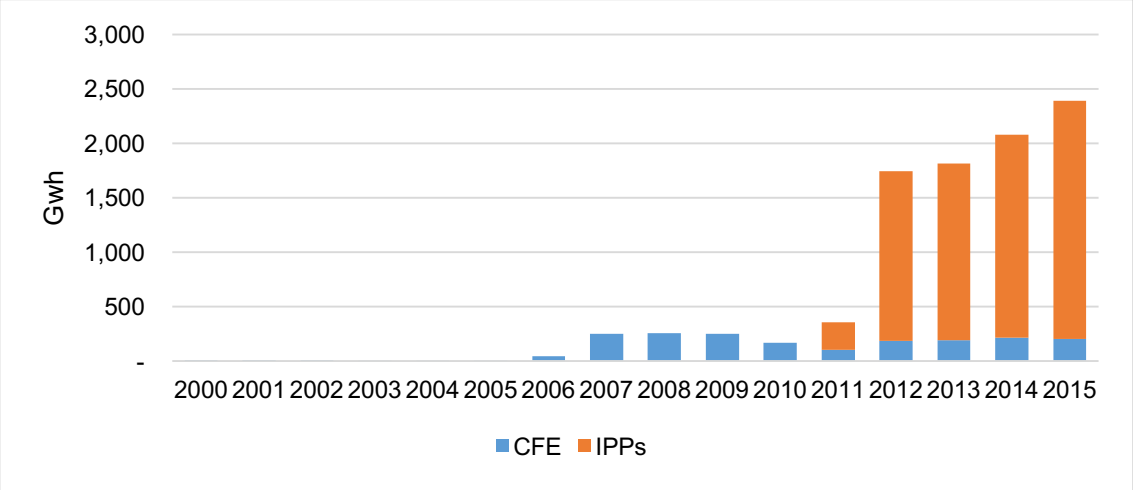


Source: Data from IEA (2019).

The exponential growth in wind electricity, shown in Figure 4.5, can be explained by the entrance of private investment in the generation sector – in the form of Independent power producers (IPPs) – as a result of the legal changes in the mid-1990s, discussed in the next section. During the 1990s, no electricity from solar sources was produced

in Mexico. However, as in the case of wind, solar PV technology grew in the years prior to the reform: from 0 GWh in 2011 to 2.08 GWh in 2012 and 13.09 GWh in 2013 (SENER, 2016a). As in the case of wind, this growth was not visible in the national electricity production aggregate (see Figure 4.3 in the last section).

Figure 4.5. Wind gross electricity generation by generation-scheme (2000-2015)



Source: Data from SENER (2016a).

The limited electricity generated from non-hydro renewable sources contrasts with Mexico's potential and large base of solar, wind and geothermal resources. Average daily solar irradiation during the year is 5.5 kWh/m^2 and can reach values of 8.5 kWh/m^2; and solar energy has 16,351 GWh of generation potential (SENER, 2012). The entire country lies between 15° and 35°, commonly considered the most favourable band for solar resources, with the lowest average levels in the country comparing favourably with the highest averages in Germany and Japan, the world's second- and third-largest solar producers (SENER, 2012).

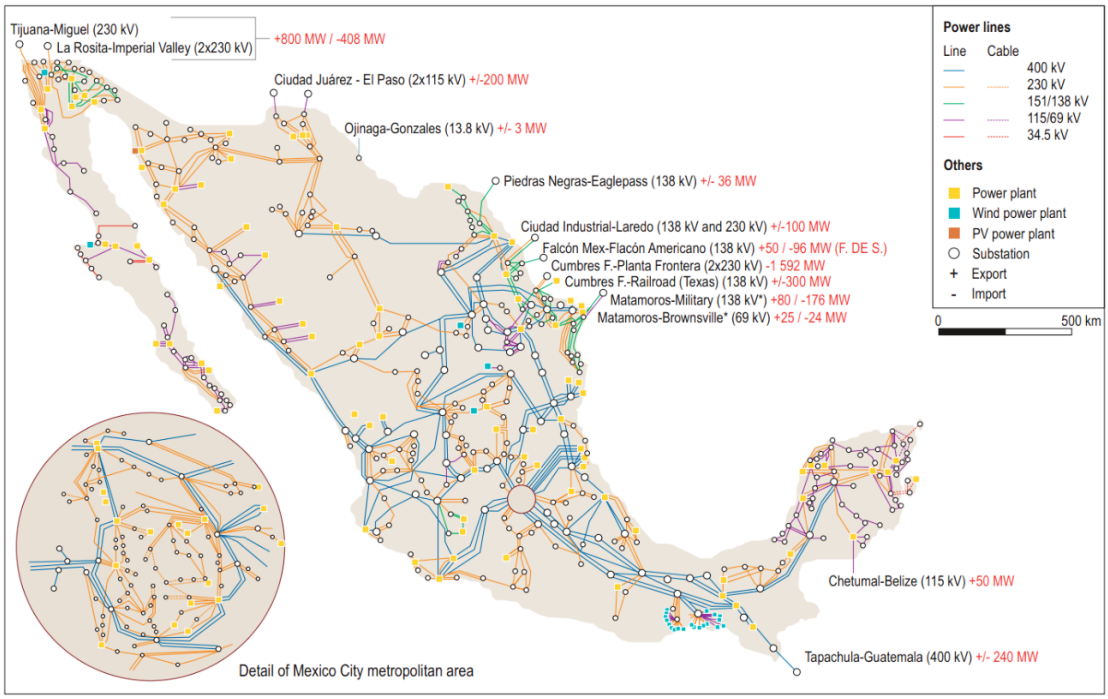
4.2.4 Transmission and distribution network

In 2013, Mexico's national electricity system included 860,000 km of transmission and distribution lines (SENER, 2014b), compared to 538,223 km in 1995 (CFE, 2000).[44] CFE owns the entire transmission and distribution network, and the country was (and still is) divided into nine electricity management regions with eight control centres and

[44] Electricity is transmitted over long distances through high-voltage lines of 230-400 kilovolts, covering 51,184 km (5.8% of total), equalling the total of 69 kV and 161 kV lines. Mexico City forms a central node in the high-voltage network (IEA, 2017: 143)

16 divisions in charge of distribution. Three electricity systems cover the national territory (1,964,375 km^2): the interconnected national system, which covers the main transmission network; and two small systems, which cover the north and south of the California Peninsula (Baja California and Baja California Sur) but are not physically connected to the rest of the country (IEA, 2017; see Figure 4.6). Mexico is interconnected to the United States via 11 lines, to Belize with one line and Guatemala with one. Excluding interconnections used mainly for mutual emergency support between Mexico and the United States (5 of the 11 lines), overall import capacity is 3,175 MW and export capacity 1,887 MW (IEA, 2017: 144).

Figure 4.6. Map of Mexico's electricity network (2016)



Source: IEA (2017)

4.2.5 Tariff system, cost of electricity and subsidies

Since the establishment of the electricity monopoly in 1960, the Ministry of Finance was the sole entity in charge of determining electricity rates, based on user types and levels of consumption. CFE has different tariffs for five groups of customers: domestic, agricultural, industrial, commercial, and public service. In 2013, industrial customers represented more than half of CFE's sales (58.5%) but only amounted to 0.76% of

consumers, while the domestic customers accounted 25.4% of CFE's sales but were about 90% of the buyers (CFE, 2014).[45]

Domestic rates are classified by the level of consumption in eight different ranges, seven of which are related to the average temperature of regions. Electricity prices for domestic users vary among the country due to the subsidies applied to users in the warmest regions of the country. In addition, there is a variation of prices depending on the seasons (summer or winter).[46] Commercial rates (applied to a low voltage; usually 220-120 volts) and industrial tariffs (medium and high voltage) are divided into subcategories.[47] The agricultural tariff applies for individuals that use electricity for the operation of pumping equipment and/or re-pumping of water for agricultural irrigation.[48]

In several interviews, it was stressed that one of the major characteristics of the electricity sector, before and after the Reform, was the high cost of electricity.[49] In 2013, the average CFE tariffs were 25% higher than the average tariffs in the United States, and without subsidies, they would have been 73% higher (IEA, 2016b: 138). In particular, industrial prices were 84% higher in Mexico than in the United States, raising concerns about the competitiveness of the industry in the country.[50]

Some of the factors that contribute to explaining the high costs of electricity in Mexico, identified in the literature and during the interviews, are the fluctuations in the cost of fuels, a poor state of the electricity infrastructure that generates technical losses and

[45] Commercial and the public services summed 10.5% of users and 11.1% of sales, while agricultural users were 0.34% of CFE's users and 5% of sales in 2013 (CFE, 2014).
[46] The eighth classification is the DAC tariff, applied to high domestic consumption, i.e. when the established limit for the average monthly consumption for a region is exceeded. In addition to the average temperature, the tariff considers the consumption of kWh to establish the consumption scale.
[47] Rate 2 for low voltage (usually 220-120 volts) with the demand of up to 25 kilowatts; rate 3 also for low voltage but with demand greater than 25 kilowatts; and the average voltage rate. Commercial rates are calculated differently; for example, rate 2 has both a fixed charge and a consumption charge.
[48] The energy quota is determined by the Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA).
[49] There is a debate about how the costs of electricity are calculated in Mexico. Some consider that the cost is high because the calculation includes other CFE's costs such as the tax benefits paid by the company, labour liabilities and depreciation. However, although CFE pays taxes, it also received tax advantages and privileged treatment for decades, i.e. CFE is not obliged to pay the property tax or other local public services to municipalities due to the exemption granted by the Constitution for the provision of public services. Also, the company pays a small amount of income taxes as its income is low and does not cover expenses (Hernández Ochoa, 2007).
[50] Only the large industry was allowed to self-supply its electricity, which is explained in the next sections.

the lack of incentives to generate cheaper electricity given the monopoly structure. In CFE's costs structure, fuels payments occupy one of the largest element and it is an item that increases in line with the international rise in energy prices (Hernández-Ochoa, 2007). The financial difficulties of CFE prevented significant investments in the decades prior to the Reform, which contributed to low productivity of the company as it was providing electricity service using obsolete equipment and old facilities, i.e. there were deficiencies in maintenance, which generated inefficiencies and high costs (Interviews 3, 6, 13, 20; also Hernández-Ochoa, 2007).

Another important factor related to the high costs of electricity is a non-real price scheme due to electricity subsidies, which was a very frequent topic in the interviews. Subsidies in the electricity sector are directly linked to the price regulation that prevailed in the energy sector until mid-2014 (Elgouacem et al., 2017). Mexico has "a strong, expensive and distorting tradition of electricity subsidies and very low taxes on energy use" (IEA, 2017: 37). However, finding accurate data on the size and distribution of subsidies from 1990 to 2013 was difficult. Some estimates suggest that public resources used to subsidise the consumption of energy from 2006 to 2012 represented an accumulated amount equivalent to 14% of Mexico's GDP, of which 5.9% were subsidies to electricity and 6.1% to gasoline and 0.9% to LP gas (Scott, 2013). Other estimations indicate that from 2010 to 2015, net electricity subsidies to end-users amounted to USD 37.6 billion, of which 54.4% were covered with taxes, while the remaining 45.6%, or USD 17.1 billion, was covered by CFE (Elgouacem et al., 2017). According to the OCDE, subsidies on electricity cover up to between 60% and 70% of the total cost in certain residential tariff categories (IEA, 2017: 71), while agricultural and domestic customers received most of the subsidies. In 2008, the domestic sector received the 64% of the total amount (approximately USD 12 billion), while the agricultural sector received 8% (Carreón-Rodríguez, 2010; Ramírez-Camperos et al., 2013: 1101).

The topic of electricity subsidies is complex and beyond the scope of this research. However, electricity subsidies are relevant for this study in at least three senses. First, electricity subsidies seem to compensate for the high cost of electricity in Mexico. The lack of transparency in the way subsidies are assigned indicates a "lack of transparent information about costs and deficits" of electricity within the CFE (IEA, 2017: 138).

Additionally, the current system of electricity subsidies promote an inequitable distribution of public resources (CIDAC, 2013: 16), and as fiscal resources are directed towards consumption, State's capacity to invest in other areas becomes limited (Scott, 2013).

Second, the link between electricity subsidies and their social impacts is relevant to understand the electricity policy and the politicisation that this topic generates. Electricity subsidies are usually justified due to the high proportion of the population in poverty. However, by design, electricity subsidies in Mexico are regressive in absolute terms (Scott, 2013). They end up supporting higher-income households and farmers, i.e. middle-class residential users, residents in relatively more prosperous - albeit hot - regions, and irrigating farmers. Since a decade ago, the three lowest deciles only received around 16% of electricity subsidies, while the highest deciles benefited with 40% of the subsidies (Elgouacem et al., 2017).

The mechanisms used by the Ministry of Finance (SHCP) for the application of the tariff system and subsidies have created “important gaps between prices and marginal long-term costs, which has involved real cross-subsidies that benefited some users and penalised others“ (Rodríguez-Padilla, 2016: 42). As such, electricity subsidies represent an instrument of politically functional patronage (Hernández-Ochoa, 2007). The vast political resistance to the alteration of the electricity subsidy is particularly notable in Mexico because it comes from groups whose economic situation is relatively good and not from the most disadvantaged classes in the country (Hernández-Ochoa, 2007).

Third, the fact that the domestic tariff is highly subsidised means that the tariffs do not reflect the real costs of its production (Carreón-Rodríguez, 2010), which encourages overconsumption of energy and waste in consumption (IEA, 2017; Scott, 2013). Subsidised electricity prices also increase the negative externalities associated with the consumption of fossil fuels as they discourage investments in more efficient equipment and contribute to the adoption of energy-intensive technologies (CIDAC, 2013: 16; IEA, 2017). Electricity subsidies, therefore, create a vicious cycle that incentivises the consumption of fossil fuel-based energy. As such, the historical use of fossil-fuels subsidies conflicts with the establishment of economic incentives for RE technologies, such as feed-in tariffs.

4.3 Political-Institutional dimension: the origin and implications of the monopoly structure

Prior to the 2013 reform, the electricity regime was characterised by a vertically integrated public monopoly, in which the state-owned utility, the CFE, dominated electricity generation and was the only entity legally permitted to undertake the transmission, distribution, and commercialisation of electricity in the country.[51] This section explains the origins of the monopolistic structure, founded on the exclusivity of the state for the provision of the public electricity service. It also analyses the ways in which the monopolistic structure has shaped the centralisation of policies in the sector. The second part considers two elements that have historically marked the Mexican energy policy, and therefore electricity policy: the close relationship between the oil and electricity sectors and their intimate link with the political system. The last part analyses the political power of the CFE.

Understanding the foundations of the state-owned electricity market monopoly structure and its effects is relevant to the study of SETs for two reasons. First, it helps to explain the institutional stability of the electricity regime. The embedding of oil-dependency in the Mexican political system and in the electricity institutional arrangements are self-reinforcing processes that have framed the development of electricity policies. The high dependence on oil (technological patterns) coupled with the enduring state monopolistic structure (institutions) created political pressures for the maintenance of oil dependency, as well as deep-rooted power relations between the institutions governing the sector and industrial actors. Second, the origin and effects of the state monopoly structure are useful to understand the limited opportunities for non-fossil-based electricity, i.e. renewable electricity. The endurance of the monopoly structure not only provided stability to the electricity regime but also generated structural constraints that for decades blocked any fundamental changes.

[51] Originally, there were two state-own electricity companies: CFE and Luz y Fuerza del Centro (LFC). LFC was a small company producing electricity for a limited number of users in the central region, but it was dissolved in 2009 by a presidential decree and its assets were transferred to CFE (see Elizondo Mayer-Serra, 2011).

4.3.1 Origins of the state monopoly structure

Petróleos Mexicanos (PEMEX) and the CFE had exclusive control over the hydrocarbons and electricity sectors until 2013 and were the most significant actors in deciding and implementing energy policy in Mexico. The political power of these two state-owned companies originates from the fact that the country relied exclusively on them for the provision of hydrocarbons and electricity for almost sixty years.

Unlike PEMEX, which was a monopoly since its creation in 1938,[52] CFE was created in 1934 as an electricity agency to regulate private monopolies and to provide electricity in areas where private service was neglected.[53] A gradual process of electricity nationalisation took place during the 1940s and 1950s. By 1960, most of the national electricity system was under CFE's control, except for the area surrounding Mexico City, which was serviced by the local state-owned firm Luz y Fuerza del Centro (LFC).[54]

The monopolistic nature of the system was grounded in the article 27 of the Mexican Constitution, which established "the exclusive power of the nation (State) to generate, conduct, transform, distribute, and supply electricity as a public service" (Mexican Constitution 1917, 2019). It also ordered that "no concessions will be granted to individuals" and that the nation had the exclusive right to exploit natural resources (Mexican Constitution 1917, 2019). The nationalisation of the electricity sector was completed in 1975 with the Law of the Public Service of Electric Energy (LSPEE of 1975, 2012). As a result, Mexico structured the supply of electricity as a vertically integrated public service from generation to distribution.

Soon after the electricity nationalisation, the use of hydrocarbons rapidly expanded, particularly combustion, which contributed to the consolidation of oil and coal as the main fuels for electricity generation (Carreón-Rodríguez and Grunstein, 2014). The electricity monopoly was implemented through the two state companies, CFE and LFC,

[52] The origin and functioning of the monopoly model of the oil sector in Mexico have been widely studied in the literature. See De la Vega (1999), Morales et al. (1988) and Sánchez (1999).
[53] In the early days of the Mexican electricity sector (the 1920s), the system consisted of small regional networks built and operated by private firms via government concessions. Private foreign electricity companies provided electricity to industrialised and urban areas, where the provision was profitable, leaving rural areas behind (Carreón-Rodríguez and Grunstein, 2014: 10). In 1926, the provision of electricity was declared a public service, obliging the State for universal coverage, and the Mexican Congress was given the responsibility to rule the sector.
[54] A presidential decree transferred the assets of LFC to CFE in 2009 and the public monopoly was consolidated into a single company (see Elizondo Mayer-Serra, 2011).

while the production of electricity depended largely on the hydrocarbons supplied by PEMEX at subsidised prices.

As in the case of other countries, the vertical state monopoly model (i.e. encompassing the whole electricity industry) ensured the rapid growth in electricity demand by providing sufficient and reliable electricity. The monopoly also facilitated the development of economies of scale and the building of large electricity systems, which allowed low tariffs for end users, with particularly favourable rates for farmers and low-income households (Kelly, 1994: 9 in Rodríguez-Padilla, 2016: 38). This structure also allowed the extension of subsidies to people with low incomes and led to significant advances in the electrification of rural and low-income areas of the country. For instance, access to electricity doubled from 1970 to 1990, reaching 95% of coverage in 1997 (Carreón-Rodríguez and Grunstein, 2014: 14).

4.3.2 The oil prevalence and its effects on the electricity regime

The strong relationship between the energy sector and the political scene started in the 1930s. The link became more solid in the subsequent decades, reinforced by the important role that oil played in Mexico's industrialisation. Oil rent became the most important source of fiscal resources (Puyana and Romero, 2008). Oil expropriation in 1918 was strongly associated with "nationalism" and "sovereignty" (Rousseau, 2008) and symbolised the beginning of the political-institutional consolidation of the Mexican state (Sánchez, 1999).[55] Created during the expropriation, PEMEX became an important symbol of Mexico's independence and national sovereignty, and oil came to be perceived as a "national treasure" (Wood, 2010).

Mexico's historical dependency on oil has been widely studied in the literature from an economic, fiscal and financial perspective.[56] The dependency also forged strong institutions in the energy sector, whose dynamics have permeated different features of the Mexican political system in a two-way oil-politics relationship (De la Verga Navarro,

[55] According to Benítez-Manaut (1990), "the history of oil from 1917 to 1938 is closely linked to a great struggle between Mexico and foreign powers for the control of Mexico's resources" (Benítez-Manaut, 1990: 48). This led to an association between oil and nationalism-sovereignty since the origins of the Mexican state. Political leaders have used oil as part of the discourse for national unification. This indoctrination process persisted over the years and helped to explain why the energy sector is politically sensitive (see Carreón-Rodríguez et al., 2005).

[56] See, for example, Colmenares (2008), Puyana (2008), Puyana and Romero (2008) and Sánchez (1999).

1999; Elizondo Mayer-Serra, 2011; Grunstein and Carreón Rodríguez, 2012). This relationship forged corporate relationships within political institutions and became deeply embedded in the political structure underpinned by the idea of an oil abundance (Cupolo, 1997; Morales et al., 1988; Sánchez, 1999).

The administration and management of oil – i.e. of PEMEX's income and the distribution of rents via taxation – became a permanent political bargain among all stakeholders and the equivalent of a *"raison d'Etat*" of the Mexican state (Morales, 2013: 15). Certainly, PEMEX proved to be a reliable source of government revenue for many decades (Colmenares, 2008; Puyana and Romero, 2008). For instance, revenues from the oil industry (including taxes and direct payments from PEMEX) accounted for between one-third and 40% of total government spending over the ten years to 2014 (PEMEX, 2013; Banco de Mexico, 2015 as cited in EIA, 2016b:26).

Additionally, a monopoly over hydrocarbon resources became a strategic tool in Mexico's development as oil rent was used to finance the country's industrialisation (Puyana, 2008; Sánchez, 1999). By strategically managing the oil rent, Mexico's political elite was able to shape industrialisation and economic policies (Morales, 2011). One example is that during the years of Mexico's *stabilising development* (1952 to 1970),[57] PEMEX granted direct subsidies to certain economic sectors such as railways, public transport and electricity. As such, by providing cheap energy to these sectors, the oil sector contributed to a vital boom in economic growth (Rabasa Kovacs, 2013).

Historically, Mexico's electricity policy and electricity generation have followed the logic of a prosperous country with oil resources (Grunstein, 2014; Sánchez, 1999). The abundance of oil resources, or "oil bonanza" as it is usually referred to in Mexico, "induced the generation of electricity to have a primary base in oil" (Carreón-Rodríguez, 2010: 12). Oil-fired plants were, "relatively easy to construct and supply with fuel from an oil-rich nation" than coal and gas plants, which typically required greater purchases of equipment overseas (Carreón-Rodríguez et al., 2005: 94). For a long time, the CFE was captive of the oil sector and PEMEX, which provided oil at subsidised prices.[58]

[57] Mexican stabilising development, also known as "the Mexican miracle", was a development strategy that led to sustained economic growth from the late 1940s to the late 1970s.
[58] During the 1970s and 1980s, PEMEX sold fuel oil to the electricity sector at around 30% of its opportunity cost, which allowed the expansion of the electricity sector during those years (Carreón-Rodríguez et al., 2005). However, in the long term, this strategy became very costly:

The emergence of PEMEX and CFE has to be understood in the context of a broader process at the landscape level, one of a national political reorganisation. In the 1930s, the precursor party of the Institutional Revolutionary Party (Partido Revolucionario Institucional - PRI) consolidated its power by unifying the widespread Mexican states into an integrated federal country and by controlling strategic economic sectors such as the energy sector (Carreón-Rodríguez et al., 2005; De la Vega, 1999). In subsequent years, tight integration of PEMEX and CFE with the political elite became evident. It was through these monopolies that the state ensured "its own political, economic, and ideological construction and expansion, as well as its own survival" (Morales, 2011:11). By "keeping domestic energy prices below international levels, PEMEX and CFE have become icons of nationalism and state-led policies promoting growth and welfare during the second part of the 20th century" (Morales, 2011:10).

The association between oil, the political system and the electricity regime helps to explain the political sensitivity of energy affairs and the lack of major policy changes. As revealed in some of the interviews, oil expropriation continues to play a central role in the collective imagination of Mexican society and played a relevant role in the negotiation process of the 2013 energy reform (Interviews 5, 8 and 27).

4.3.3 CFE political power

Both the CFE and PEMEX appeared to be political entities dictating Mexico's industrial model, instead of being entities following national state plans. Grunstein (2014) explains this endowment in terms of the double concentration of power that CFE and PEMEX have been given: one related to their control over the industrial activities of oil and electricity; and the other to decide on the direction of these strategic areas in the absence of a strong organisational and regulatory framework that regulates them. In the broader context, this factor has implication in other economic, safety, health and environmental areas (Grunstein, 2014). This integration also contributes to explaining why these institutions have survived over the years (Carreón-Rodríguez et al., 2005).

"the under-pricing of fuel oil amounted to a massive implicit subsidy" (Carreón-Rodríguez et al., 2005: 95). When world oil prices increased, the subsidy increased; but "when oil prices plummeted in the late 1980s, the price charged to CFE and LFC for fuel oil was only 70% of its true opportunity cost" (Carreón-Rodríguez et al., 2005: 95).

According to some interviewees, the political power of the CFE originates from two main sources. First, its dominant position in electricity generation and its control of the generation projects and the expansion of the transmission grid (Interview 17). CFE decided the fuel for generation, investments in infrastructure and the contractual models and policies related to efficiency programs in the sector (Grunstein, 2014). Before the entry of private investment in the 1990s, CFE was practically the only electricity generator in the country. LFC produced electricity for a small number of users, but as its financial situation deteriorated, it stopped producing and started buying electricity from CFE. After LFC's dissolution in 2009, CFE became the only supplier in a national market of 37 million customers and employing around 90,000 people (CFE, 2014). In 2013, CFE was the sixth-largest electricity company in the world (Alpizar–Castro and Rodríguez–Monroy, 2016: 726). The CFE's monopoly included the specific task of developing a minimum-cost centralised planning "to exploit economies of scale, scope, and sequence" (Pistonesi, 2001 in Rodríguez-Padilla, 2016: 38). Thus, even though the Energy Ministry (SENER) was in charge of national energy policy, by law CFE was in charge of the planning of the national electricity sector.

Second, the legal monopoly gave rise to CEF's political power, which was evident with respect to the SENER (Interviews 3, 11 and 17). In words of one interviewee: "CFE had become a political entity with such political force that it considered it had no stakeholder to answer to, not even to SENER (…) they thought they knew better than the (Energy) Minister" (Interview 17). For these interviewees, this political power translated not only into the inefficiencies in the system but also into opacity and lack of transparency. For example, several of them cited the example of electricity tariffs and subsidies as a problem in the sector as it is was not a transparent process.

CFE's decision-making was based on the logic of providing coverage to all users in Mexico at the lowest possible cost. Due to Mexico's development level, electricity has been considered a trigger for development, which adds a political connotation that helps to explain why CFE has been "ostensibly sensitive and receptive" to the will of the interest groups (Grunstein, 2014: 11). Additionally, the process of fixing fees by the Ministry of Finance was highly politicised and unclear (Hernández-Ochoa, 2010: 131). Thus, the tariff regime is more responsive to political considerations than economic realities (Mayer Brown, 2014 in Alpizar–Castro and Rodríguez–Monroy, 2016).

4.4 The 1990s: the partial opening of the regime and the transition to a hybrid model

This section explains the origins and impacts of the regulatory changes of the 1990s, under which new schemes for private generation were created, and the system transited into a hybrid model.[59] Explaining these changes serves two main purposes. First, it shows how a policy change in the mid-1990s led to a relatively rapid technological and economical alteration of the electricity regime, i.e. the adoption of natural gas as the main fuel for electricity generation. The analysis of these developments also explains the emergence of the private sector as a new important actor in the electricity regime. Second, the analysis of the partial liberalisation helps to understand why the state monopoly structure persisted and was not replaced by a market model. However, the partial liberalisation came at the cost of avoiding a restructuring of the system, which years later led to further problems, reflected on the attempts at constitutional reform in the 2000s, as discussed in the last part of this section. Importantly, these developments in the regime level help to explain the emergence of incremental drivers for sustainable energy change prior to 2013.

4.4.1 Legal changes: the creation of special schemes for private electricity generation

Legal changes started in 1992 when the 1975 Law of the Public Service of Electric Energy (LPSEE)[60] was modified to create six specific schemes of electricity provision separated from public service, i.e. private generation (Mexican Congress, 1992). The new schemes, described in Table 4.1, were alternative legal forms to allow private participation, given the constitutional prohibition of private participation. The architects of the 1992 reform used a "legal formula" "to negatively define the public service" namely, to classify specific generation activities as no longer considered public service (Interview 13; Hernández-Ochoa, 2010: 112).

[59] A new hybrid model is where IPPs play an important role alongside the state-owned electricity utilities (Gratwick and Eberhard, 2008)

[60] Based on article 27 of the Mexican Constitution, this law stated the exclusivity of the Nation (Mexican State) for the provision of the public service of electricity, which includes: the planning of the national electricity system; the generation, conduction, transformation, distribution and sale of electricity; and the realisation of all installations and works required by the planning, execution, operation and maintenance of the national electrical system.

Table 4.1. New schemes for private generation introduced in article 3 of the Law of the Public Service of Electric Energy in 1992

Scheme	Description
Self-supply	Generation of electricity to meet an industrial facility's own energy needs. Refers to electricity plants owned and operated by private companies
Cogeneration	It refers to electricity generated simultaneously with steam or other types of secondary thermal energy to be used in an industrial process, or the generation of electricity from the surplus of thermal energy of an industrial process
Independent power producers (IPPs)	It refers to electricity plants with an installed capacity larger than 30 MW, built and operated by private companies. Their production is exclusively for CFE, under a power purchase agreement.
Exports	Exports refer to electricity produced under cogeneration, IPP or small-scale generation categories.
Imports	Imports refer to by natural or legal persons of electricity exclusively used for self-supply purposes.
Small-scale generation	Refers to electricity plants with an installed capacity less than 30 MW, built and operated by private companies. This electricity is to be sold solely to CFE.

Source: Adapted from Carreón-Rodríguez et al. (2005)

Interviewees frequently cited this process of the opening as the beginning of a transition process in the Mexican electricity sector (Interviews 1, 2, 5, 13 and 17). In short, the creation of the new schemes opened up the possibility for the private sector to build, operate and own electricity generation plants and for the private ownership of transmission networks for the purpose of self-consumption and exchanges abroad (Rodríguez-Padilla, 2016). Additional reforms in 1995, separated utilities and non-utilities and allowed the transport, storage and distribution systems for natural gas, activities previously reserved exclusively for state operators (both PEMEX and CFE) (Díaz-Bautista, 2005).[61] For some interviewees, here lies a transcendental point since this new regulation gave rise to a change in the energy policy to promote the

[61] The liberalisation of the natural gas sector meant that the State's exclusive rights were limited to exploration, production and commercialisation up to first-hand sales. Every owner of transport and distribution gas systems, including PEMEX, had to provide open access to other parties (Bauer and Quintanilla, 2000).

development of the gas industry at the national level, a process that permeated the electricity regime and that was reflected in the 2013 reform (Interviews 1 and 2).

In the long term, the legal framework that followed the 1992 reform resulted in technological and economic alterations of the electricity regime: the adoption of natural gas as the main source for electricity generation as a relief for CFE's lack of investment capacity and the creation of an electricity market, working in parallel with the public service in non-fully market conditions.

The legal changes of 1992 and 1995 should be understood in terms of a broader adverse economic context at the landscape level. The 1990s marked a major change in Mexico's regulation from a strongly State-interventionist economy to a more open economy (Larios, 1999 in Ramírez-Camperos et al., 2013: 1092). The country was undergoing a process of economic restructuring as a result of an economic crisis during the 1980s, arguably caused by the collapse of the model of import substitution, industrialisation and the excesses of public spending in an effort to sustain it (Díaz-Bautista, 2005: 9).

During the administration of Carlos Salinas de Gortari (1988–1994), the Mexican electricity sector faced financial difficulties due to the fall in international oil prices, which had severe impacts on export revenues (Ramírez-Camperos et al., 2013: 1096). Furthermore, there were budget constraints due to inflation control policies and commitments to international financial organisations. President Salinas de Gortari started a process of privatisation, deregulation, and liberalisation of some sectors of the economy and "adopted a policy aimed at reducing public expenditure and the investment capacity of the State in infrastructure for development" (Díaz, 2005; Viqueira, 2007 in Ramírez-Camperos et al., 2013: 1096).

In this context of structural adjustment policies, symptoms of the exhaustion in the electricity regime became more evident. For example, the high costs of maintaining a policy based on a tariff structure oriented to granting subsidies, which was not adjusted to inflation, and CFE's lack of management autonomy and unsustainable foreign debt (Ramírez-Camperos et al., 2013: 1096). Thus, one of the main arguments for the 1992 and 1995 reforms was to attract private investment and to reduce the financial load of

the government in infrastructure, while ensuring the long-term sustainability of the sector (Ramírez-Camperos et al., 2013).

As such, Mexico's partial opening during the 1990s followed the case of other developing countries where "the progress of liberalisation has been strongly driven by the increasing need to finance investment in expanding systems, as well as by external pressure from the conditionalities of the international financial institutions and donor countries" (Hall and Nguyen, 2017: 101).

4.4.2 Impacts on the technology and economic dimensions

The entrance of the new electricity production schemes was a slow process that thrived until the 2000s.[62] Once in operation, private investment had three main consequences. First, there was a boost in electricity production due to the rapid development of generation infrastructure by the Independent Power Producer (IPPs), the self-supply private generators and cogeneration permit holders, that liberated CFE from investment and production pressures. Second, the transition towards natural gas as the main source of electricity as many of the permit holders opted to invest in combined cycle gas turbine (CCGT) generation plants, urged by the adoption of policies favouring gas as a new source of energy, in substitution to oil. Third, the emergence of an incipient electricity market operating in parallel to the public service provision of electricity, in which new private actors could exchange electricity at a lower price.

4.4.2.1 The boost in electricity generation and infrastructure by the private sector

Between 2005 and 2013, around 30% of the gross generation for the national electricity sector was produced under the scheme of IPPs (SENER, 2016b). By the end of 2015,

[62] One of the main issues slowing the process was the negotiation between PEMEX and CFE and the private companies. Reforms in 1995 aimed to fix the shortcomings by creating new modalities in the financing of the sector. The first was a scheme designed to the Independent Power Producer (IPPs), where the private builder carried out all the investments required and sold the electricity produced to the CFE. Through this mechanism, private consortia had to negotiate long-term purchase-sale contracts with PEMEX and CFE, with fixed purchase prices both to buy gas from PEMEX and to sell the electricity production to CFE under "unfavourable economic conditions" (Díaz-Bautista, 2005: 10). The second method was the Financed Public Works by which a private builder carried out all the investments though long-term financing, and at the end of the building process, the CFE was obliged to pay 100% of the contracted price and the operation and maintenance of the generation plant.

the infrastructure to generate electricity in Mexico included 188 generating plants, of which 159 belonged to CFE and 29 were managed by IPPs (SENER, 2016b).

The investments through IPPs scheme meant less immediate pressure on public finances by channelling significant amounts of resources into the electricity generation. The private investment allowed the installation and operation in Mexico of several new generating plants with more modern and efficient technologies, i.e. there was a modernising process in the generation plants (Hernández-Ochoa, 2007). In this sense, it could be said that the IPPs represented a response to two fundamental problems of CFE: the lack of resources to invest and the high costs of building and operating the plants on their own (Hernández-Ochoa, 2007).

The entrance of private investment in the electricity sector also had an implication at the niche level. After the partial liberalisation of electricity, the adoption of subsequent mechanisms incentivised investments in RE electricity, particularly in wind plants. For instance, RE grid access was improved in 2001 by the establishment of the Interconnection Contract for Renewable Energy Sources and Efficient Cogeneration. In 2006, this contract was replaced by the concept of “Self-Supplied Power” or “a capacity credit for renewables providing firm capacity during the hour of maximum demand of the system” (IRENA, 2015b: 4). Also, a virtual energy bank was introduced, through which surplus electricity could be stored in a virtual account to be delivered at a later time (SEMARNAT, 2015a).

In 2003 a new “stamp system” (*estampilla postal* in Spanish) was created, by which private companies were allowed to use the national grid for transporting electricity with a transmission fee per kWh. The 2004 Wheeling Agreement established further regulations on the use of the grid to transport electricity from off-site plants to load centres, which contributed to the proliferation of wind self-suppliers whose consumption was physically separated from generation (IRENA, 2015b). Additionally, some tax benefits for RE were introduced in 2004. For example, the income tax law included the option for companies to deduct 100% of their total investment in RE machinery and equipment, provided it is in operation for a minimum period of five years (SEMARNAT, 2015a).

As a result, self-supply grew to be the main modality for development of renewable electricity. However, the effects of the entrance in private investments were reflected a decade after. CFE's production of wind electricity grew from 7.6 GWh in 2005 to 45 GWh in 2006 and then to 166 GWh in 2010 (SENER, 2016a). By the year of the reform, CFE was producing 190 GWh while IPPs were producing 1,624 GWh of wind electricity for public service[63] (SENER, 2016a). In the decade 2005-2015, the most important growth in electricity plants was in wind electricity, which grew by 78.1%, followed by internal combustion plants with 7.0% (See Figure 4.5).

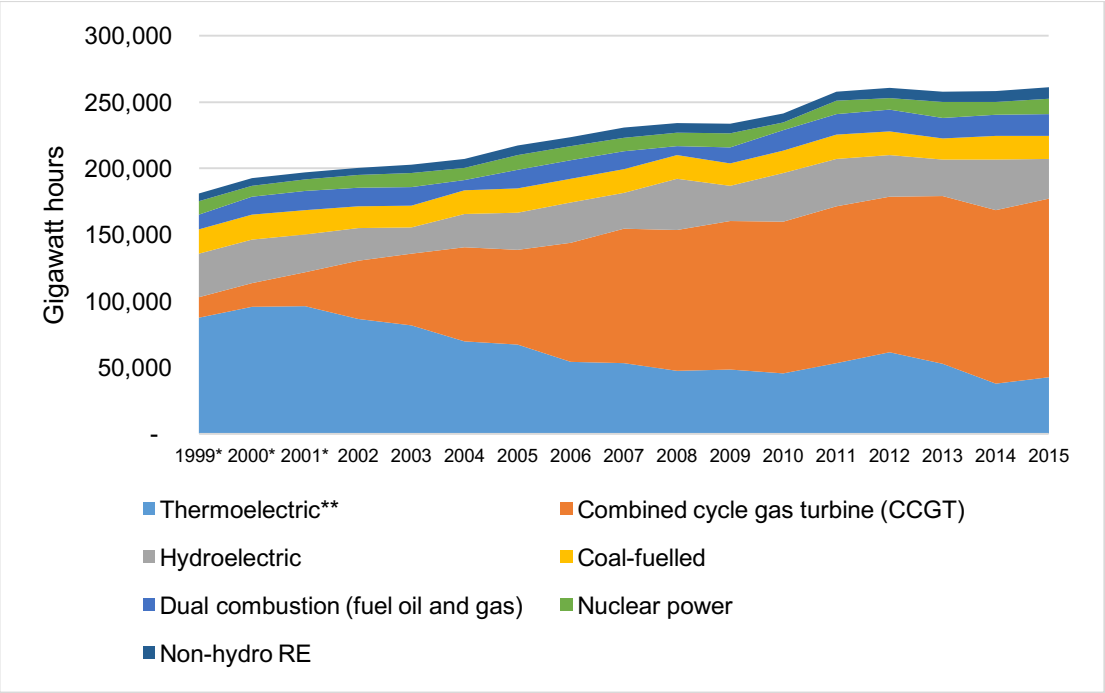
4.4.2.2 Transition to natural gas

The most important impact of the partial opening of transmission and distribution was the use of natural gas as the prevalent fuel for electricity generation, through large cogeneration projects. Since the 1990s reform, electricity generation by natural gas-fired combined cycle gas turbine (CCGT) plants replaced the use of thermoelectricity, hydroelectricity and coal-fuelled. For instance, in the early 2000s, half of Mexico's electricity came from thermoelectric plants, while hydroelectricity on average accounted for 15% and coal-fuelled electricity was about the 10% (SENER, 2016a). As shown in Figure 4.7, in 2013, electricity generated by CCGT already represented 50% of total gross generation, compared with 9% in 2000 and 31% in 2005. Conversely, thermoelectricity had decreased to 20% of gross generation while coal-fuelled electricity was only 6% (SENER, 2016a; see Figure 4.7).

CFE began to expand the generation infrastructure, giving preference to natural gas plants belonging to independent producers. The changes were also reflected in CFE's capacity and infrastructure. For example, in 2000, CFE only had 8 CCGT electricity plants, which represented 8% of its total effective capacity (CFE, 2000). In 2013, 38% of CFE's effective capacity was from CCGT plants, provided by the 13 CFE's plants and 23 IPPs plants (SENER, 2014b).

[63] Public service only includes the net energy delivered to CFE by IPPs; i.e. it excludes wind electricity from cogeneration or self-supply.

Figure 4.7. Gross electricity generation by type of technology (1999-2015)



Source: Data from SENER (2016a). **Thermoelectric includes steam, gas turbine and internal combustion.

Some of the reasons for the growth of natural-gas consumption are related to the technological progress that transformed the gas and electricity sectors, and its high efficiency (Ramírez-Camperos et al. 2013: 1097). However, the growth was also related to the advantages brought by the opening to the private sector. For example, since 1995 a total of 25 permits have been issued for IPP projects for gas-fired electricity plants and more than 40 private companies are active in gas and electricity projects (IEA, 2016b: 20-21).

4.4.2.3 The emergence of a partial market

As a result of the 1990s opening, an incipient electricity market started to operate in parallel to the public service. Companies managed to overcome the constitutional prohibition on electricity sale by including the electricity generator and the consumer as partners in the same project, through bilateral contracts. As such, large private generators (cogeneration permit holders) and electricity consumers emerged, benefited by new mechanisms which allowed them to use the network to transport electricity at low tariffs (IRENA, 2015b). Through the bilateral contracts, private generators and large consumers exchanged significant electricity volumes at lower

electricity prices, i.e. between 5 and 10% below the rates established by the Ministry of Finance (Rodríguez-Padilla, 2016: 39-40). As such, private participation managed to generate electricity at costs significantly lower than those of the public sector, even cheaper than CFE's production with combined cycle plants similar to those used by the IPPs (Hernández-Ochoa, 2007).

This parallel electricity market in which private generators were operating in non-market conditions is crucial to understand the growing pressures for change during the 2000s in the economic dimension of the electricity regime.

4.4.3 Impacts on the institutional dimension: the monopoly survival and the emergence of new private actors

Despite the economic and technological alterations in the electricity regime, no fundamental changes occurred in the institutional dimension. The partial opening of the sector to private participation involved some adjustments in governmental structures and institutions. In 1995, the Energy Regulatory Commission (Comisión Reguladora de Energía - CRE), which had been created three years before as an administrative body of SENER, expanded its scope and powers to become a decentralised technical-consultative body (Salerno, 2016). CRE's role before 1995 was limited to the administration of the entrance of private permits (Hernández-Ochoa, 2007).

The changes in 1995 aimed at providing the CRE with more faculties to become a relevant actor in developing an electricity market but in practice, CRE's role was submissive to CFE. As the regulator of the sector, the CRE had a limited influence in aspects such as the fixing of rates despite having the authority to approve the methodologies for setting charges for transmission and distribution (Carreón-Rodríguez, 2010: 8). By keeping control of the national transmission network, CFE maintained a significant power that allowed it to limit the progress of new private participants (Hernández-Ochoa, 2007). As private companies were not operating under full market conditions, participants in private schemes faced weak regulatory protections. The CRE managed the granting of permits but the negotiation of the contracts and agreements were CFE's responsibility. The agreements for the interconnection to the CFE network were particularly challenging as CFE usually

rejected the requests of the projects in which it perceived the potential risk of losing important clients (Interview 24).

In practical terms during the 2000s, Mexico transited to a single buyer model but CFE's decision-making power remained. Private investments in the public service were carried out according to the centralised planning, which was founded on the national premise of generating electricity at the minimum cost (Rodríguez-Padilla, 2016: 40). In short, the independent energy producers were practically "private contractors" of CFE because their production was sold exclusively to CFE, a company that then resell the electricity to its own customers (Hernández-Ochoa, 2007).

Although the monopoly of the CFE was preserved in the public electricity service (Ramírez-Camperos et al., 2013: 1097), the opening of generation did have one major institutional impact with the emergence of a new group of actors, whose role would become critical in the process of the 2013 reform. Among the permit holders of self-supply and cogeneration, there were two main types of companies. One group of companies that, due to the nature of their business, have privileged access to fuels (for example, sugar mills with access to cane bagasse, or PEMEX with privileged access to hydrocarbons). Another group for which electricity input represented a very important part of their costs and which sought alternatives to reduce them (for example, mining, cement and telephone). Among this second group are the largest Mexican corporate groups such as Bimbo, Peñoles, Cemex and Telmex (Hernández-Ochoa, 2007). As mentioned before, both business groups created partnerships via bilateral contracts that allowed them to exchange electricity, overcoming the constitutional bidding on electricity selling (IRENA, 2015b; also Interview 13).

Additionally, these companies would later become larger producers that generated electricity for themselves without needing to use the public network (Rodríguez-Padilla, 2016: 39-40). As explained above, a large majority of these firms invested in cogeneration projects (principally in CCGT plants), while some invested in RE technologies (mainly wind farms). The distinction in the type of investment projects is important because, in the negotiations surrounding the electricity reform in 2013, the groups that had opted for cogeneration would support that cogeneration was considered within the scheme of clean energy certificates. Also, the choice of

technology would have implications in the negation of the ETL process as it would determine the support and the opposition coalitions, as is explained in Chapter 6.

To sum up, the partial opening of the sector liberalised pressures on the electricity system and allowed the “adapted” survival of the monopolistic system when channelling private resources to electricity generation while updating the electricity infrastructure. The reforms also marked the appearance of a new actor in the Mexican electricity sector: a group of private companies dedicated to generating the electricity they consume, or to generate and market electricity for large users. The relevant role of this group of companies would be clear in the decade of the 2000s and the years prior to the 2013 reform.

4.5 The 2000s: Pressures for change and failed attempts for a reform

The opening in the mid-1990s also highlighted major structural problems and challenges that would become more evident in the late 2000s, which contributed to weakening the regime, reinforced by pressures for changes from the landscape level. On one side, there were challenges within the regime itself, given the pressures generated by the state monopoly structure and the centralised system. In the economic dimension, although private generation was emerging as an important element to satisfy the energy demand, private generators were operating in non-market conditions and were subordinated to CFE's planning.

Further pressures were created as the tax burden was excessive and reflected in electricity rates, the Federal Government granted large subsidies to some type of consumers (World Bank, 2009 in Rodríguez-Padilla, 2016: 40), which despite not generating cash flow were registered and affected the accounting of the CFE (Rodríguez-Padilla, 2016: 40; author's translation). On the other side, pressures at landscape level such as the decline in oil production and the subsequent decline in oil rent further pressed for a change in both the oil sector and the electricity regime.

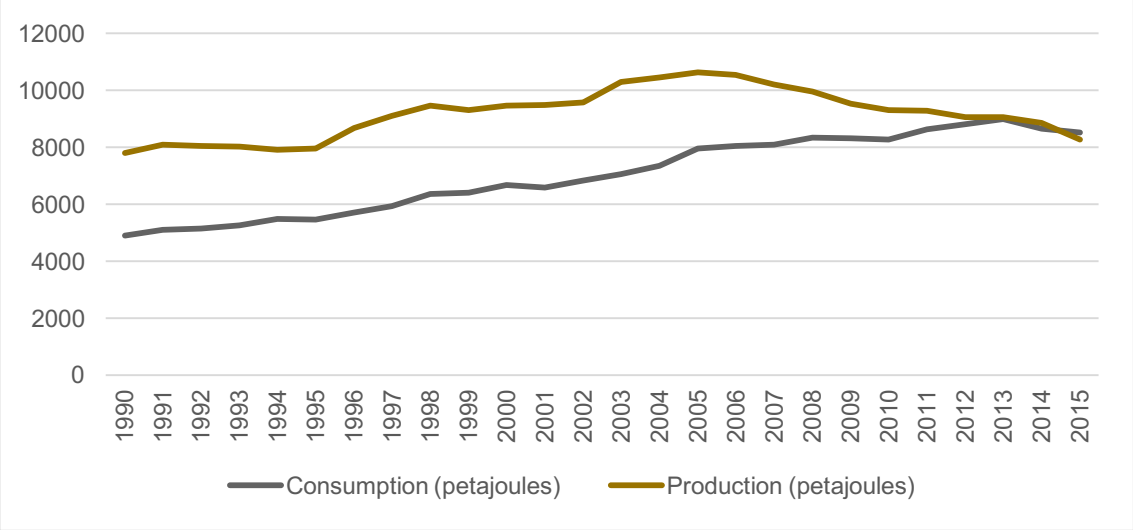
4.5.1 Changes at the landscape level: Oil production decline and natural gas imports rise

Pressures for change at the landscape level came from a decreasing trend in Mexico's crude oil production and total reserves, combined with a decline in crude oil exports. Declining trends in oil production and increases in gas imports raised concerns about Mexico's energy security. As explained in the next chapter, those concerns were also used as arguments to justify the reform at the beginning of Enrique Pena Nieto administration in 2012.

Crude oil exports declined by 36.4% from 2006 to 2016, owing to a decline in production and increased domestic consumption (IEA, 2017: 21). The decreased in production was related to a drastic decline in national oil fields, including the Cantarell field, Mexico's largest oil field and one of the largest in the world. Mexico's total oil production declined by one-third from the peak of 3.8 million barrels per day (mb/d) in 2004 to 2.5 mb/d in 2016, while total oil consumption remained relatively steady over the past

decade, averaging about 1.7 million b/d in 2015 (EIA, 2017: 11).[64] As shown in Figure 4.8, in the year of the Reform, oil consumption surpassed production.

Figure 4.8. Evolution of oil production and consumption 1990-2015

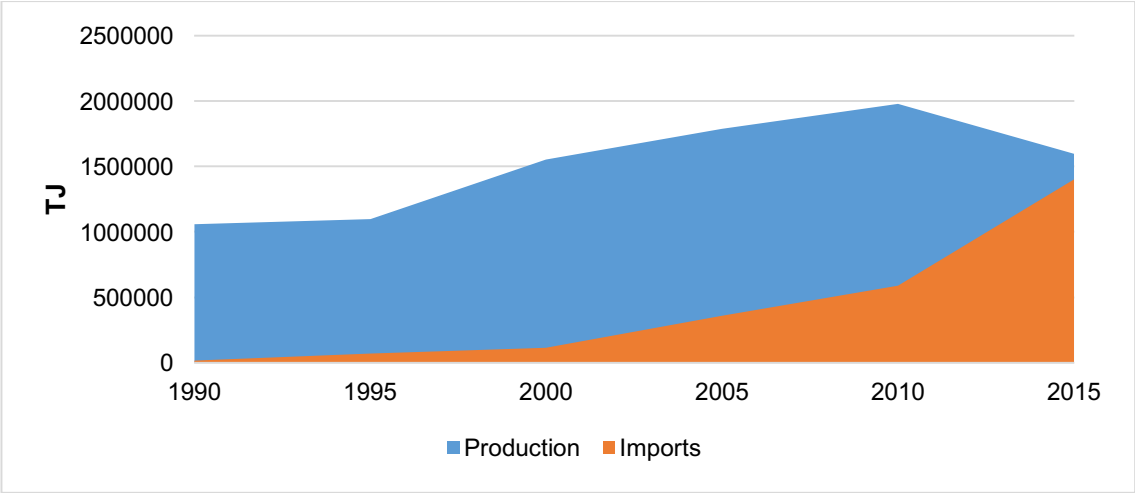


Source: EIA (2017)

Due to the shift to natural gas in electricity generation, the demand for natural gas significantly intensified, i.e. it tripled since 2000 (IEA, 2016b: 21). As a consequence of demand rising faster than production, Mexico's gas imports also tripled during 2000 to 2005, and by 2013, gas imports already accounted nine times the imports of the early 2000s (IEA, 2019; see Figure 4.9). In 2014, Mexico became a net importer of natural gas, with most of the imports coming from the United States via cross-border pipelines. Between 2008 and 2013, US pipelines to Mexico doubled their capacity, reaching 4.9 bcf/d and about 81% of Mexico's natural gas imports in 2015 were from the United States (EIA, 2017). These trends show the country dependency not only to one source of energy but also to trade with the United States.

[64] Although the use of oil in generation has more than halved since 2000, the oil used for generation remains higher than in many other OECD countries (IEA, 2017: 131).

Figure 4.9. Production and imports of natural gas (1990-2015)



Source: Data from IEA (2019)

The changes in the technological and economic dimension at the landscape level – decline in oil production and increase of natural gas imports - put pressures in the institutional dimension, particularly through the public finances. Reductions in oil production and exports since 2005 affected the financial situation of PEMEX (IEA, 2016b; Sánchez, 1999) and exacerbated the deficit that the company suffered (Morales, 2013). As the symbiosis between PEMEX and the state obliged the company to be the guarantor of the country's public finances (Puyana and Romero, 2008), a vicious cycle was created. The use of PEMEX revenues for taxation and operating expenses left little room for new investment exploration, infrastructure, and technological innovation (Puyana and Romero, 2008; Sánchez, 1999).

In the material dimension of the electricity regime, limited public investments generated an out-of-date and insufficiently integrated national transmission network, which in turn acted as a barrier to the interconnection of potential new generation projects, especially renewable energy projects. Technical and institutional mechanisms contributed to halting the development of renewable sources. Therefore, although technologies to develop renewable sources existed in the 1990s and private companies were willing to invest in them, their production and distribution were more expensive than fossil fuels, (Studer, 2014). Other failures included a high level of distribution losses – both technical and non-technical (electricity theft), which were twice the average of OECD countries.

4.5.2 Attempts to reform the electricity regime

In this context of pressures at the landscape and regime level, the need for reform became imminent. The three Mexican presidents preceding Enrique Pena Nieto (2012-2018)[65] attempted to make structural reforms – i.e. Constitutional reforms – to the energy sector. While the reform proposals of Ernesto Zedillo in 1999 and Vicente Fox in 2002 were mostly based on a full liberalisation of electricity, Felipe Calderón proposal was centred on a major reform to the oil sector. All three attempts failed to pass the approval of the Senate. The political circumstances seemed to be the main explanation for these failed attempts. For instance, in 1999, Zedillo's (from PRI) efforts to pass a constitutional reform were blocked at the Congress by the opposition parties, the National Action Party (PAN) and the Democratic Revolution Party (PRD). In 2002, Vicente Fox, the first PAN president in Mexico's history, submitted a new proposal, including several points of Zedillo's, which was rejected by the Congress, now dominated by PRI legislators. A similar situation occurred some years later, in 2009 when president Calderón (from PAN) attempted to reform the energy sector but his proposal was blocked in the Congress again by PRI legislators.

Although different, the reform proposals of Zedillo and Fox sought the creation of an electricity market and were intended to increase the responsibilities of the regulator, CRE, in setting electricity prices, while including a redesign of electricity subsidies (Jano-Ito and Crawford-Brown, 2016: 578). Most of all, the proposals showed the urgency of reforming the sector to allow further private investment, and the need for restructuring energy public companies and their relationship with the new private actors (Hernández-Ochoa, 2007). Zedillo's 1999 proposal was an attempt to deepen the changes introduced by the reforms in 1992 and 1995, aiming at a complete restructuring of the electricity sector. The initiative included reforms to the Mexican Constitution (articles 27 and 28), which faced strong rejection from public opinion and legislators, even from the same party (Carreón-Rodríguez, 2010; Ramírez-Camperos et al. 2013).

In 2002, president Vicente Fox (PAN) proposed the opening of the sector excluding privatisation (i.e. without removing CFE). Some opposition legislators, mainly PRI

[65] Ernesto Zedillo (1994-2000), Vicente Fox (2000-2006) and Felipe Calderón (2006-2012)

supported the proposal, but a coalition of PRI-PRD legislators prevented the approval (Carreón-Rodríguez, 2010; Ramírez-Camperos et al., 2013). Also, proposals to unbundle and liberalise the system were rejected as unconstitutional by the Supreme Court, ruling that it contravened the requirement for state ownership of the system in the constitutional articles 27 and 28. Fox also attempted to revise the electricity subsidies but the political reactions and public rejection led to the establishment of additional subsidies for specific groups. As a result, the Law for Agricultural Energy was approved in 2002, which established prices and beneficial rates for energy used in agricultural activities, with significant effects in terms of the amount of the electricity subsidy (Hernández-Ochoa, 2007).

The last attempt at energy reform was under Felipe Calderón's mandate. Since winning the presidential election in 2006, Calderón encouraged a national debate about the Mexican energy sector (Interview 5). Unlike the previous presidents, Calderón sought a comprehensive energy reform, not confined to the electricity sector. Again, the proposal presented in 2008 faced massive public opposition, organised by PRD. Although all major political actors seemed to recognise the need for reform, no consensus emerged during his administration (Wood, 2010: 870). Consequently, Calderón did not succeed in passing a comprehensive energy reform but he managed to restructure PEMEX.

4.5.3 Boost for sustainable energy: legislation on renewable energy and climate change

Although no electricity reform was approved during Calderón's administration, laws related to sustainable energy and climate change were approved in 2008 and 2012. Understanding the emergence of this regulation is relevant to the study of the electricity transition because they are incremental drivers for sustainable energy change before the 2013 reform.

In 2008, two laws related to sustainable energy were created: the Law for the Sustainable Use of Energy (LASE in Spanish) and the Law for the Use of Renewable Energy and the Financing of the Energy Transition (LAERFTE in Spanish). The objective of the LASE was to rule the sustainable use of energy through its optimal use, i.e. energy efficiency (LASE, 2008). The law established the National Commission for

the Efficient Use of Energy (Comisión Nacional para el Uso Eficiente de la Energía - CONUEE) as the technical body in charge of promoting energy efficiency in all economic activities, along with different dispositions to incentivise the establishment of a national policy on energy efficiency.

The LAERFTE aimed to regulate the use of RE for electricity production for the first time in Mexico. It established the first legal definition of renewable energy, i.e. wind, solar, mini-hydro, biomass, geothermal, wave electricity, large hydroelectric plants and, more controversially, nuclear energy. The law also specified mechanisms to promote and finance these alternative sources such as a Special Programme, a National Energy Transition Strategy and an Energy Transition Fund. Also, this law made mandatory for the SENER to develop a National Renewable Energy Inventory to provide reliable information on renewable energy resources in Mexico (LAERFTE, 2008). In 2011, the LARFTE was modified to introduce aspirational targets for maximum fossil generation in the total electricity mix: 65% of fossil generation by 2024; 60% by 2035 and 50% by 2050 (LAERFTE, 2011).

Both the LAERFTE and the LASE were in line with Calderon's strategy to establish a national policy and regulation on climate change. The 2007–2012 National Development Plan recognised for the first time the importance of addressing climate change in all economic sectors, while the Special Program on Climate Change (PECC in Spanish) of 2009 introduced long and medium-term goals for adaptation and mitigation. With the PECC, Mexico committed for the first time towards climate action at a time that the country was leading climate change negotiations in different international forums (e.g. Mexico hosted the COP16 in 2010).

The introduction of these policy instruments culminated with the approval of the General Law on Climate Change (LGCC in Spanish) in July 2012. The law regulates Mexico's actions on mitigation and adaptation and seeks to strengthen public policies, administrative structures and social participation on this matter. Importantly, the LGCC

establishes “indicative goals” or “aspirational targets” for GHG emissions reduction[66] and clean energy electricity generation.

As such, together with the legal changes of the mid-1990s, the 2008 and 2012 legislation can be considered incremental drivers of a sustainable energy transition in Mexico for three main reasons. First, the LAERFTE was the first and main instrument governing the Mexican renewable sector, until 2015 when the ETL replaced it. According to some interviews, the LAERFTE was Mexico’s first step towards a sustainable transition in the energy sector (Interview 2, 7, 20, 21). This law contributed to the development of the REs, which began with the partial liberalisation of the mid-1990s. For instance, after the LAERFTE, the “open season” mechanism was created, which allowed private developers to bid to reserve transmission capacity for wind electricity for self-supply. Through the open season, Mexico developed extensive transmission lines for renewable energy in the states of Oaxaca, Tamaulipas, Baja California and Puebla (IRENA, 2015b).[67] Also, in 2010, the “stamp” transmission system was revised, and the wheeling charges for renewable energy became fixed and reduced (SEMARNAT, 2015a).[68] Thanks to these mechanisms, transmission lines and interconnection capacity widely developed in the south of Mexico, specifically in the Isthmus of Tehuantepec. For example, the electricity grid was expanded to 2,600 MW for wind energy production alone. About 2,000 MW off this electricity was for private off-takers, while the 600 remainings were distributed to residential consumers from the CFE’s owned wind plants (Friede, 2016).

Although limited, the mechanisms created in the mid-1990s, reinforced by the LAERFTE, were used by private companies to boost the expansion of wind electricity plants (see Figure 4.5). As a result, in the years previous to the Reform (2009 and 2013), 20 new wind plants entered into operation in different modalities, mainly in self-supply (generation for private use) and independent energy producer (generation for

[66] With the LGCC, Mexico became the first Non-Annex I country legally committed to reducing GHG emissions by 30% by 2020 and by 50% by 2050 (with the baseline in 2000) and producing at least 35% of its electricity with clean technologies by 2024 (LGCC, 2012).
[67] The open season allowed coordination between the CRE, the CFE and renewable energy developers. The demand for RE transmission was estimated through a “call of interest” and “after a vetting process and the deposit of guarantees by developers, CFE had a “firm” demand for transmission that was then used to build the infrastructure (IRENA, 2015b: 4).
[68] Renewable energy generators receive a preferential rate for electricity transmission of $0.14 pesos/kWh against $0.30–$0.40 pesos for electricity generated by conventional fuels.

public service), while 33 were under construction (SENER, 2014a). However, the overall progress of non-hydro renewable electricity in terms of the participation of the generation matrix remained low: it represented only 3.06% of total gross generation in 2013, of which wind accounted only 0.7% while geothermal 2.35% (SENER, 2019: see Figure 4.3 and 4.4).

Second, there is a direct connection between the LAERFTE, the LGCC and the ETL in terms of sustainable energy goals. As explained above, Mexico's clean energy targets were first legally established by a modification to the LAERFTE in 2011 (a cap of 65% of fossil generation by 2024, 60% by 2035 and 50% by 2050). These targets were reinforced with the LGCC, which set at least 35% of electricity with clean technologies by 2024. As explained in the next chapters, the creators of the ETL sought to incorporate previous legal dispositions into the ETL, such as these targets (Chapter 6). Additionally, the links between these laws are important to understand the disconnection between the electricity sector and the climate change policy, which presented in Chapter 7. A large number of interviewees pointed out that the previous legislation on sustainable energy – i.e. LARFTE and LASE – was not sufficient for a sustainable transition in the energy sector as their objective was the promotion of ER and energy efficiency rather than establishing obligations (Interviews 7, 8, 9 and 20). Most of all, these laws, along with the LGCC, were considered environmental laws, outside the energy and electricity sector (see Chapter 7).

Third, interviewees highlighted a connection between the LGCC and the ETL in terms of the actors involved in their processes of approval (Interviews 7, 8, 9, 10, 11 and 25). Key actors that supported or opposed the LGCC in 2010-2012 were key supporters and detractors of the ETL in 2013-2015, which is discussed in Chapter 6. For instance, the first draft of the climate change law was presented in 2010 by the PAN, the ruling party at that time, which was in line with the President's strategy on climate change. Some other parties presented their proposals later on, but it was the PAN who led the legislative negotiations and worked closely with the environmental NGOs during the consultations (Interview 25). As explained in Chapter 5, unlike the other 20 new laws and laws modifications involved in the 2013 reform, the proposal for the creation of the ETL was also presented by the PAN, now as an opposition party.

Also, the approval of the LGCC involved extensive consultations with different sectors in which environmental NGOs actively participated. The NGOs took advantage of the boost of the COP16 in Cancun to promote an ambitious agenda on climate change at the national level, including their support for a new climate change law. For example, NGOs sought that the LGCC included quantitative objectives on mitigation and adaptation per sector and financing (i.e. setting a minimum percentage of GDP spending on climate change); however, the approved version of the law only included general aspirational goals and excluded a long-term financing strategy. Averchenkova and Guzman (2018) signalled that the exclusion of these issues was due to the opposition from the private sector, in particular, the energy and steel sectors (also signalled in Interviews 11, 26). As such, the draft of the LGCC was modified and "several flexibilities were introduced in the end" as concessions for the private sector (Averchenkova and Guzman, 2018: 10). A similar process occurred in 2015 when NGOs – experienced with the climate legislation process – attempted to include ambitious provisions in the ETL but faced fierce opposition from the private sector. This process is explained in the following chapters.

4.6 Summary

The analysis presented in this chapter identifies three main features in the electricity regime that had shaped the scope and pace of its sustainable transition. First, the chapter identifies general trends in the technology and economic dimension before the 2013 reform. Second, it reveals the patterns of stability emerging from an oil-based electricity regime and how those patterns have not only maintained the stability of the regime but also have limited the opportunities for alternative technologies. Three, the chapter identified the opening up of opportunities for systematic change, which allowed a rapid transition to natural gas but prevented a transition to RE, and the emerging of further drivers that led to the energy reform of 2013.

By explaining the prevailing technologies in electricity generation and the recent evolution of renewable energies in electricity generation, this chapter identified infrastructure path dependence patterns in the sector. Fossil fuel prevalence in the Mexican energy mix, arising from the historical abundance of oil resources, resulted in a stable electricity regime in which electricity objectives, infrastructure, planning and policy were oriented to oil. In this context, the path-dependent patterns developed in the oil sector translated into an electricity system captive of the dynamics of the oil industry.

In the political-institutional dimension, the electricity regime was stabilised by a vertically integrated public monopoly, in which was the only entity legally permitted to undertake the transmission, distribution, and commercialisation of electricity in the country. The wealth generated by PEMEX reinforced the merging the energy sector and the political system. The close connection between the oil sector and the Mexican political system permeated the electricity regime, both technologically and institutionally. Since the nationalisation of the electricity sector in 1960, the legal framework prevented any type of private participation in the sector until 1992, when it was modified to allow private investment in certain electricity projects.

The analysis of the institutional structure of the electricity sector and regulation prior to the Reform shows how the high dependence on oil and the centralisation of energy policies constrained a sustainable transition as they have prevented fundamental changes in the system, consequently, limiting the scope for technological innovation.

Nonetheless, this chapter also revealed some key moments and elements that brought the alteration of the regime. In the 1990s and the 2010s, pressures emerged at different levels, producing conditions that opened opportunities for change. The accumulation

of regulatory changes in the electricity sector since the 1990s gradually opened up the system to private sector participation without fundamental restructuring. These changes allowed a transition towards natural gas as the new dominant fuel in electricity generation. Analysing these circumstances of change is useful for understanding why, despite the problems and shortcomings in the system, the monopoly model persisted for five decades. CFE kept control of national electricity and owned generation parks but it also started to buy large quantities of electricity from private producers.

Pressures for changes during the 2000s were intensified in the economic dimension by the growing challenges of private generators operating in non-market conditions and the emergence of a parallel electricity market. However, pressures for change also came from a decreasing trend in Mexico's crude oil production and total reserves, combined with a decline in crude oil exports. The decline in the levels of oil production, the depletion of oil deposits that for years provided abundant resources to the country, coupled with increasing energy consumption, and a crisis in the sector due to inadequate management of the main oil institution, put pressure on the idea of further changes in the oil sector.

The next two chapters focus on the political process occurring during the years of the 2013 reform in order to see how the dynamics identified in the years prior to reform shaped the policymaking process of the reform.

Chapter 5: The 2013 Energy Reform and the electricity reform

5.1 Introduction

Chapter 4 presented a detailed examination of the Mexican electricity sector and its main characteristics prior to the reform. It identified stability patterns in the three main dimensions included in this research – economic, technological and institutional – but also key moments and elements that allowed partial changes to the electricity regime. Above all, the previous chapter showed how the patterns of stability have also served as obstacles to the incorporation of alternative sources of energy, and to the development of renewable energies. As such, these elements have been shaping the scope and pace of Mexico's sustainable energy transition in recent years.

Chapter 5 is the first of two chapters that focus on the political process occurring during the 2013 reform. Concretely, Chapter 5 examines the second unit of analysis, the 2013 energy reform process, composed of two main legislative reforms: the constitutional reform and the electricity reform. The chapter has two aims. First, it centres the analysis on the political circumstances in which the reform occurred and at the same time, it shows how the patterns of stability identified by a HI approach in Chapter 4 – i.e. oil prevalence and deep power relationships – framed the reform process, for example, by excluding sustainability discussion from the secondary laws. Therefore, this chapter shows how the patterns that have constrained changes in the electricity regime were translated into the policymaking process, shaping the scope of the decisions and following the established power dynamics.

Second, this chapter sets the context to understand the process of approval of the ETL. As the ETL is one of the 21 new or modified laws of 2013 reform, it would not be possible to fully analyse and understand its process of approval without taking into consideration the big picture of the reform. The systematic approach adopted in this study allows us to see the constitutional reform as part of the landscape level, while the electricity reform and the ETL are part of the regime and niche levels, respectively.

The chapter consists of three main sections. The first section briefly examines the political circumstances in 2012-2014 that allowed the approval of the opening of the energy sector to private participation, a change that had been attempted several times

unsuccessfully before (see Chapter 4). This section also discusses the main justifications and aims of the Reform (i.e. a reform that will lower the cost of electricity and protect the environment).

The second part presents the main features introduced by both the constitutional reform and the secondary laws. It reflects on the objectives of the constitutional reform – the modernisation of the sector by allowing private investments avoiding the privatisation of the sector – and the main legal changes introduced to articles 25, 27 and 28 of the Constitution. It also discusses how the sustainability approach of the reform emerged and the limited ways in which it was included in the negotiations.

The third part of the chapter focuses on electricity reform. It explores how the electricity reform agenda was included in what was meant to be a purely oil-based reform. This section also identifies the major legislative changes contained in the Electricity Industry Law, two of which are relevant for the study of the SETs. First, the creation of a wholesale electricity market because it entailed fundamental changes in the institutional structure (i.e. the end of the state monopoly model in generation and commercialisation). Second, the creation of a clean energy certificates (CECs) scheme, which was included in the electricity reform and became the main instrument to promote the sustainability of the electricity regime.

5.2 Political context 2012-2013 and the *Pacto por Mexico*

In July 2012, Enrique Peña Nieto, the candidate of the Institutional Revolutionary Party (PRI), won the presidential elections in Mexico. PRI had been in power for over 70 years, until the National Action Party (PAN), a right-wing opposition party, won in 2000 and then in 2006. Peña Nieto's victory thus represented the reinstating of PRI to the presidency.

The day after Peña Nieto's inauguration, on December 2, 2012, the *Pacto por México* (Pact for Mexico) was announced as a political agreement signed by the three main political parties (PRI, PAN, and PRD, the Democratic Revolution Party) to work together with the new government.[69] The issues included in the Pact involved 95 initiatives in five different topics, namely: democratic governance; transparency, accountability, and anti-corruption; rights and liberties; security and justice; and, economic growth, employment, and competitiveness. The core idea behind the Pact was to create a common agenda to allow a long-term consensus between the government and the main political forces to approve structural reforms that had been fiercely opposed before.[70]

The axis of sustainable development of the Pact considered the need "to move towards a low carbon economy" by reducing Mexico's dependence on fossil fuels and promoting investment in research and development of projects from solar and wind electricity. Additionally, the Pact included the realisation of an energy reform to "turn the sector into one of the most powerful engines of economic growth through the attraction of investment, technological development and the formation of value chains" (Document 13). The Pact also stated the intention to renovate the hydrocarbons sector and transform Petróleos Mexicanos (PEMEX), into a state-productive company. This

[69] See Elizondo Mayer-Serra (2017) on the different reasons behind the creation of the Pact and its process of negotiation.

[70] The loss of the simple majority of the presidential party (PRI) in the Chamber of Deputies for the first time in 1997 brought fundamental changes in the power relations between the Executive and the Legislative branches. For instance, the approval of Constitutional reforms implies an agreement between the different political forces to achieve a qualified majority. Particularly, initiatives proposed by the President had been rejected at different times by a more empowered Legislature (Zepeda, 2017).

objective was very general since it was one of the points in which no consensus had been achieved (Elizondo Mayer-Sierra, 2017).

It should be noted that electricity reform was not included as part of the initiatives in the Pacto, which suggests that there were no plans to reform the electricity sector at the beginning of Peña Nieto's administration. However, during the presidential campaign, Peña Nieto did promise to "reduce electricity tariffs".[71] As established in Chapter 1, given that 42% of Mexico's population is in poverty (CONEVAL, 2019), the cost of electricity has always been an important topic in social policy and a sensitive political issue, as electricity tariffs remain heavily subsidised for low-income consumers (OECD, 2013). The topic of the energy reform was frequently included in Peña's speeches as a presidential candidate and it was normally associated with tariff reduction:

> I have committed myself to lower the electricity rate for the benefit of all Mexicans. And how am I going to do it? We are going to promote the energy reform, a reform that really allows greater production of electricity, with better technology, and that will allow lowering the electricity tariff for the benefit of Mexicans (Video 1).

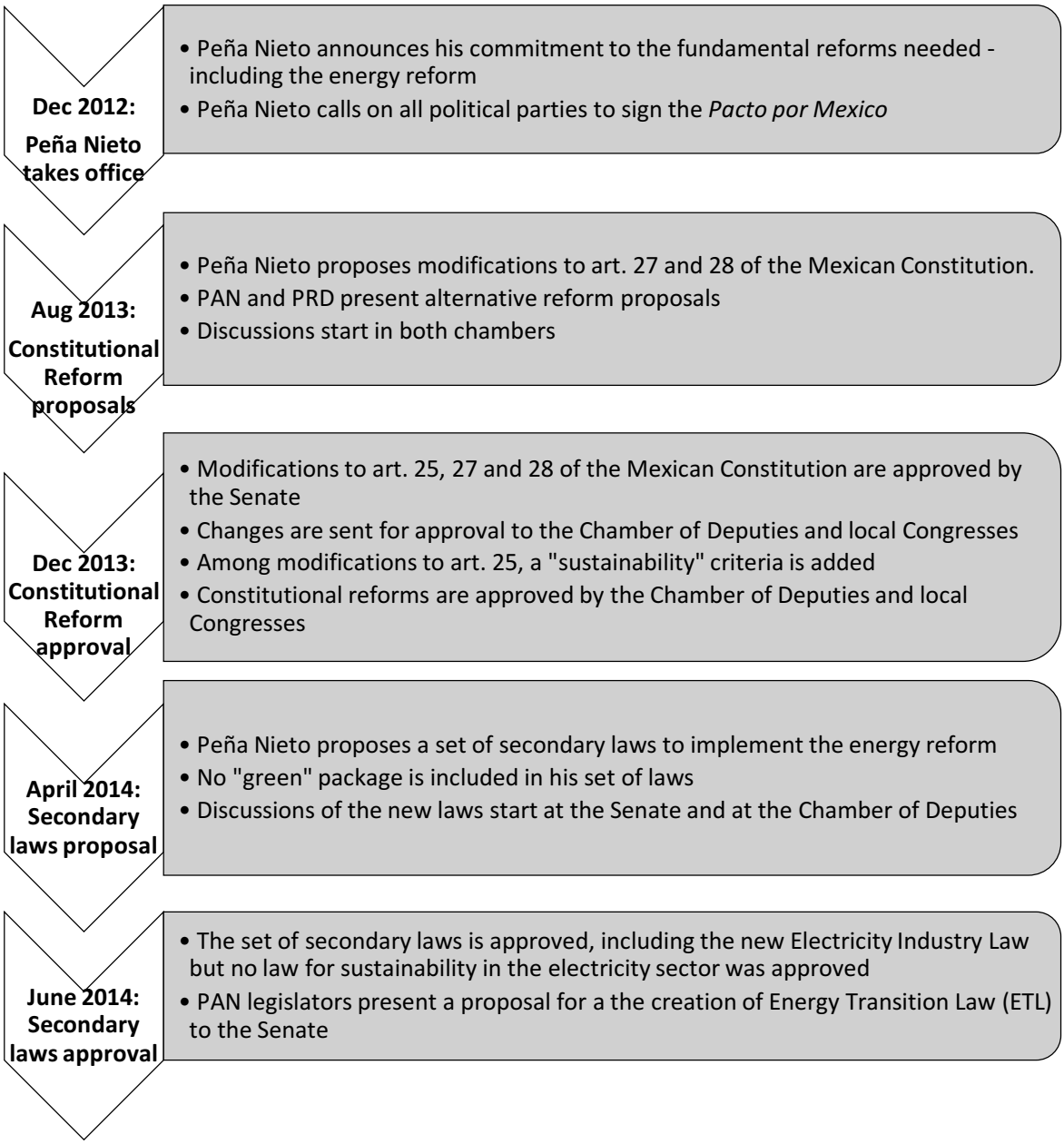
In the months following Peña Nieto's taking of office, the *Pacto por Mexico* enhanced the process of establishing a common agenda to work on during the first years of the new presidential administration. The energy reform was regarded as the most controversial reform (Elizondo Mayer-Sierra, 2017) and among the most radical (the others concerned electoral reform and telecommunications), insofar they involved more profound changes, while the rest were gradual reforms (Madero in Zepeda, 2017). However, the Pact seemed to have set foundations for Congress to approve constitutional reforms (Zepeda, 2017).

The energy reform of 2013 consisted of two main parts: a Constitutional reform, approved by the Mexican Congress (Senate and Chamber of Deputies) and local Congresses in December 2013; and, a set of secondary laws, approved by the Mexican

[71] As a candidate for the presidency, Peña Nieto used the strategy of signing political commitments on specific issues, as if they were legal obligations. He used the same political strategy during his administration as Governor of the State of Mexico (2005-2011) to guarantee the fulfilment of his political promises and gain public support.

Congress in August 2014. Figure 5.1 presents a timeline of the main events of the energy reform process.

Figure 5.1. Key moments in the process of reform: constitutional reform and the secondary laws



5.3 Energy Reform: an overview of the process and content

This section provides a brief account of the key moments in the process of negotiating the legal framework of the 2013 energy reform. It emphasises the launch of the reform initiative and the general steps in the legislative process of the Constitutional Reform and the approval of the secondary laws. A detailed analysis of the content of the electricity reform is presented in the following section.

5.3.1 Constitutional Reform

5.3.1.1 Reform objectives

The Federal Government's proposal for an Energy Reform was presented on August 12, 2013, by the President Enrique Peña Nieto. It was one of the three reform proposals presented to the Mexican Senate; the PAN and the PRD presented the other two.[72] The Federal initiative included amendments of two constitutional articles, 27 and 28, to transform the hydrocarbons and electricity sector. Unlike the Pact for Mexico of December 2012 where no explicit reference to an electricity reform was made, the reform initiative of August 2013 already included changes to both oil and electricity sectors.[73]

The initiative was based in six strategic axes: strengthening the role of the state in the oil industry; economic growth; inclusive development; energy security; transparency and access to information; and, sustainability and environment protection. On the latter, the proposal explicitly justified that "it is possible to mitigate the negative effects that the production and consumption of fossil energy can have on health and the environment, through the greater availability of more clean energy sources" (Document 19). Regarding the hydrocarbon sector, the initiative proposed two new schemes: State contracts for oil exploration and extraction; and the participation of third parties in the entire hydrocarbons value chain through the express authorisation of the Federal government. In order to implement those schemes, the initiative proposed two main

[72] On July 31, a PAN legislative group presented the initiative of "Project of Decree that reforms, adds and repeals diverse dispositions to the articles 25, 27 and 28 of the Political Constitution". On August 20, members of the Parliamentary Group of the PRD presented the "Initiative that creates, ads, modifies and repeals various Legal Provisions in the National Energy Sector".

reforms. First, modify article 27 of the Mexican Constitution to eliminate the prohibition by which the State cannot hold contracts for the exploitation of hydrocarbon. Second, modify article 28 of the Mexican Constitution to eliminate basic petrochemistry from the State strategic areas and give constitutional certainty that all the activities of the hydrocarbon industry can be carried out by State agencies, social and private sectors, through permits granted by the Federal Executive (Document 19).

From this early stage of the Reform, two main objectives are worth emphasising as they contribute to the analysis of the sustainable transition process in Mexico. First, the objective of the reform was to modernise the sector by allowing private investments in the oil industry. Thus, the original aim of the Reform was a financial restructuring of the hydrocarbon sector by opening it to private investment. Importantly, the opening of the electricity sector was associated with a positive effect of lowering the cost of energy. As established in the Federal Government's initiative, the ultimate goal was the opening of the sector "to reduce costs and increase the productivity and efficiency of the electricity system, in such a way that electricity tariffs are reduced for the benefit of the population and the industry" (Document 19). With these elements, the reform "will make it possible to modernise the electricity sector, ensure the adequate supply of electricity, and most importantly, that the electricity bill paid by households and small businesses in the country will be cheaper" (Video1).

The association of the reform with a low cost of electricity was a constant justification, from the origin of the reform to the approval of the secondary legislation. An interviewee who participated in the early discussions of the reform commented:

> The vision (among the group) was that we were going to substitute oil with natural gas so that prices of electricity could go down. Which was true: at that time, the fuel oil was four times more expensive than natural gas, and had more emissions; diesel was six times more expensive than natural gas. Then it was a good proposal to replace them with natural gas. Then you have a transition to gas, less polluting, a transition fuel, and all that but (...) they were not seeing that the volatility of fuels was also real. Today it is very cheap but anything can happen (Interview 24).

The second objective was that the opening of the sector did not mean its privatisation; in other words, that the ownership of the oil and hydrocarbons was to remain with the state. Thus, the reform would "allow the country to take advantage of its abundant energy resources *under the strict rectory of the Mexican state*" (Video 1; emphasis added). This is why the Federal Government made sure to frame its reform initiative within the Cardenist rationale. As explained in Chapter 4, oil expropriation in 1938 was a historic landmark in Mexico's political history. Soon after President's Lázaro Cárdenas declared that oil was the property of the State and oil became a symbol of nationalism and sovereignty. Since then, the liberalisation and privatisation of the energy sector have always been politically sensitive issues, generating fierce public and political opposition (Interviews 13 and 23). At the time of the 2013 reform, as a means to avoid opposition, it seemed important to emphasise that the opening of the sector was in line with Cárdenas' original ideas of allowing private contracts as long as the State retained the control and ownership of hydrocarbons.[74] That the Reform was framed within the Cardenist framework was a political decision intended to avoid opposition. However, for a couple of interviewees, the fact that it was linked to the Cardenist rationality restricted the scope and extent of the initiative, i.e. it could not be too "liberal-ambitious" (Interview 23).

On the one hand, these two aspects of the constitutional energy reform – that the reform was investment-seeking and did not introduce privatisation – envisage how the stabilisation patterns prevailing in the energy sector (landscape level) tended to influence the electricity regime even at "times of change" and show how institutional structures framed the debate. On the other hand, the modification of the Mexican Constitution in 2013 has a historical significance that should not be underestimated. Past attempts to liberalise the energy sector, at least three times during the previous 15 years, have faced fierce political opposition (due to partisan politics) and public resistance (see Chapter 4).

Certainly, the alignment of political forces at the Mexican Congress – via el *Pacto por México* – seemed to have facilitated the negotiation of the constitutional energy reform (Interview 26), which was speedily discussed and approved in four months. The

[74] Although Cárdenas' Reform banned private concessions, it allowed private contracts. A modification to article 27 of the Mexican Constitution in 1960 prohibited private contracts, and reserved all the activities of the sector for PEMEX.

Executive's initiative was submitted to the Senate Energy and Legislative Studies Committees along with two alternative proposals presented by the opposition parties, PAN and PRD.

On December 10, a qualified majority in the Senate approved the reform initiative, and a day later, the Chamber of Deputies approved it. It was then passed to the 32 Local Congresses for approval. In about ten days, 24 Local Congresses gave their approval and the Executive Power promulgated the reform on December, 20. The same day, Peña Nieto announced that his government would present a set of initiatives for secondary laws to give effect to the constitutional reform within the following months.

5.3.1.2 Constitutional changes

The constitutional changes included modification and additions to three Constitutional articles (25, 26 and 27) to rule in the control, administration, and operation of the oil, gas and electricity sectors. Changes to article 25 allowed the transformation of PEMEX and the Federal Electricity Commission (CFE) into "State productive enterprises", which means they are now value-creating state companies. Modifications to article 27 allowed for the establishment of contracts with private entities in all areas of the energy sector, which effectively reverses nationalisation. As a result of changes to article 28, oil and basic petrochemicals are no longer considered strategic areas, but exploration and extraction of oil and other hydrocarbons are added as strategic areas. Also, with changes to article 28, the monopoly of electricity generation disappears, but the planning and control of the national electricity system and the public service of transmission and distribution of electricity are recognised as strategic areas.

In addition, the reform included 21 complementary provisions, known as transitory articles,[75] in which legal specifications and deadlines for compliance were established. Table 5.1 provides details on the main additions and modifications to constitutional

[75] According to Mexican legislation, a "transitory article" refers to "a provision that is added after the legislated matter has been treated in its own articles and its legal effect is limited in time. That is, it is a provision intended to govern temporary situations that are existing prior to the effective date of a law or regulation, or that are created by it" (Berlín, 1997: 51).

articles 25, 27 and 28 in terms of the electricity sector, while Table 5.2 summarises the main content related to electricity in the transitory articles.

Transitory articles 11 and 17 are particularly relevant to this analysis as they established the deadlines for the implementation of the electricity reform and the sustainability legislation. While the former stated that electricity legislation should be approved in a period of no longer than six months; the latter established a deadline of one year to adapt the legal framework for the "environment protection in all processes related to the matters of the Reform" (Document 21).

Table 5.1. Modifications and additions to Constitutional articles related to the electricity sector

Article	Summary of changes
Article 25	- The term "productive State enterprises" was introduced to refer to the new status of CFE and PEMEX, and includes them among the organisations through which the Federal Government meets its responsibilities in these strategic areas. - The term "sustainability" was added on two occasions: as a criterion for supporting social and private companies, and criteria for industrial development.
Article 27	- Private investment in electricity generation and commercialisation activities is allowed. Electricity supply is no longer part of the concept of "public service". - The planning and control of the national electricity system, as well as the public service of electricity transmission and distribution, are exclusive matters of the nation. - Express prohibition of granting concessions in these activities is maintained, however, contracts with individuals in activities related to the public service of transmission and distribution of electricity are now allowed.
Article 28	- The monopoly of electricity generation disappears. - The planning and control of the national electricity system, as well as the public service of electricity transmission and distribution, are recognised as strategic areas, in which the State exercises functions exclusively. - The Executive power will have coordinated regulatory bodies for matters of energy known.

Table 5.2. Transitory Articles in the Constitutional Reform that relate to the electricity sector

Article	Summary of content
Transitory 3	Establishes a period of 2 years for CFE (and PEMEX) to become a productive State enterprise.
Transitory 10	Establishes the attributions of the different public dependencies: for example, in the case of electricity, the Energy Ministry (SENER) is in charge of the legal separation for open access and the efficient operation of the electricity sector; while the the Energy Regulatory Commission (CRE) is the entity in charge of granting the generation permits and determining the postage rates for transmission and distribution.
Transitory 11	Establishes a deadline of six months for adapting the legal framework so that individuals can carry out, on behalf of the State, the financing, maintenance, management, operation and expansion of the infrastructure necessary to provide the public service of transmission and distribution of electricity.
Transitory 16	Determines that the State must create the National Centre for Energy Control (Centro Nacional de Control de Energía - CENACE) as a decentralised public body in charge of operational control of the national electricity system; to operate the wholesale electricity market; of open and non-discriminatory access to the national transmission network and the distribution networks.
Transitory 17	Establishes a 12-months deadline to adopt the legal framework on which the State will seek the environment protection in all processes related to the matters of the Reform. It also states that the law will establish obligations of clean energies and reduction of polluting emissions to the participants of the electricity industry.
Transitory 18	Establishes that the Federal Executive must issue the National Program for the Sustainable Use of Energy, a transition strategy to promote the use of cleaner technologies and fuels.
Transitory 20	Establishes the rules related to the organisation, administration, corporate structure and operation of the State productive enterprises such as budget autonomy, the new integration of their Councils, and their special regimes in matters of remuneration, acquisitions, leases, services, public works, budget, public debt and responsibilities administrative.

In short, the Constitutional reform established the framework for introducing fundamental changes to the electricity system. Cossío Díaz and Cossío Barragán (2017) summarise those changes as follows:

1. the planning and control of the national electricity system, as well as the public service of electricity transmission and distribution, are an exclusive matter of the nation;
2. no concessions would be granted for either of those activities;
3. the State is entitled to enter into contracts with individuals with respect to these activities;
4. individuals may participate in the other activities of the sector in accordance with the provisions in legislation; and
5. the State maintains control over the companies and bodies in the electricity sector with respect to the regulatory activities and opportunities noted above (Cossío and Cossío, 2017: 16-17).

That the transmission and distribution remained under the State control seemed to be a political decision intended to avoid confrontation with the electricity union, as many CFE jobs are in the "distribution lines".[76] Therefore, "Article 27 of the Constitution states that the transmission and distribution of the electricity service, as well as the operation of the national electricity system and its planning, remain as strategic areas of the State (...) But in the (another article) transitory, where it is specified the types of contract that CFE can make, the issue remains open (…) That was done thinking that eventually, we can follow some of these schemes of South America" (Interview 24).

5.3.1.3 Sustainability

In this early stage of the reform, the sustainability dimension, i.e. the environmental approach, of the reform seems limited. Certainly, the environmental benefits were

[76] As one of the stakeholders reported: "In the case of distribution, the issue was purely political. Yes, we discussed the idea of removing transmission (from the state), and we studied the cases of the Brazil and Colombia, in one case, it (distribution) is privatised and in the other not (…) But the problem was that most of the workers of the CFE are concentrated in the distribution area and it's the area that the union controls the most. That would result in a confrontation with the (electricity) union, and here it was very important to achieve this reform without getting into any confrontation with the union" (Interview 24).

among the most cited benefits of the reform. The link between the Reform and the "protection of the environment" became a frequent topic in the speeches of the President and the Energy Minister and the public statements of PRI legislators. For instance, Peña Nieto initially presented the Reform as "a green reform that will favour greater investment in technological development and the adoption of less polluting and low-cost energy sources, such as solar, wind and gas" (Document 14). Thus, the environmental aspects of the reform became commonly referred as its "green dimension", which was a key part of the information issued by governmental institutions and in the governmental media campaign in favour of the reform.[77]

Peña Nieto's reform initiative also included a brief diagnosis of the electricity sector with an explicit reference to the "energy transition" as one of the objectives of the electricity reform. The diagnosis emphasised the relationship between clean energy and emission reduction goals, and the link to the 2012 General Law of Climate Change. This diagnosis identified some obstacles for the development of alternative sources, such as renewable energies. For instance, it was recognised that CFE's mandate to generate energy at the lowest cost had meant that fossil fuels were historically privileged. It was also acknowledged that the institutional model did not provide the required flexibility to integrate the use of renewable energies efficiently. The proposal exposed how the problems in the transmission network had hampered the development of large-scale renewable projects (Document 19).

Yet, within the green dimension of the Reform, natural gas was given a privileged place. For instance, Federal government emphasised how the reform would help to "accelerate the substitution of generation of combustion and diesel by clean generation and natural gas generation, which will reduce costs", as combustion and diesel were "usually four or six times more expensive than natural gas, so the shift to natural gas will represent savings" (Document 19).

Additionally, although the discussion of the environmental benefits was frequently part of the political and media discourses about the reform, it was not really reflected in the content of the reform. While the addition of "sustainability" to article 25 of the

[77] As one interviewee recalls "the most popular TV spot about the Reform was one in which a boy was running in a wind farm (…) it clearly was the spot with the highest level of population's acceptance; they showed us the numbers at a meeting at the presidential office" (Interview 23).

Constitution seems to be in line with Federal Government's commitment to transit to more sustainable patterns of energy production and consumption, it was not originally proposed in Peña Nieto's initiative. Some of the interviewees signalled that the inclusion of "sustainability" in the constitutional reform had to be negotiated between the parties. Most of the interviewees indicated that the PAN legislators insisted on inserting the explicit reference to sustainability in article 25. One respondent claimed: "We saw it coming. They were not really interested in adopting a sustainability approach, so we lobbied to make them include the topic (...) we could not make them include all our proposals but at least this one (the addition of sustainability to article 25) was included" (Interview 7).

This information contrasts with an alternative view reported by another interviewee who affirmed that it was "people" in the Energy Ministery and the Ministery of Finance, who "put the sustainability topic in article 25" (Interview 24). However, the interviewee acknowledged that there was a confusion between "environmental sustainability" and "financial sustainability", which negotiators took advantage of, and "sustainability" was added to the article without specifying its meaning (Interview 24).

As there is no evidence of changes to article 25 in the document presented by Peña Nieto as there is in PAN's proposal, it is deduced that the addition of sustainability at the constitutional level – also referred as "the sustainability clause" – was originally presented by PAN legislators and therefore had to be negotiated.

Some interviewees stated that since the early discussions of the constitutional reform, there was opposition from specific industrial groups to the inclusion of sustainability. However, the confrontation was not open at this stage. One respondent recalled that:

> as the constitutional norms are very general or vague, this (the confrontation) was basically very little because what was done in the constitutional reform was to modify article 25 to incorporate the word sustainability in a couple of parts... saying that the industrial policy would be sustainable or that support to certain sectors of the economy will be made with criteria of sustainability. But (…) the word (sustainability) was there only twice and only in terms of "supports" (Interview 23).

Although general, the change to article 25 marks a key moment in Mexico as for the first time the Mexican Constitution states that energy policy has to be sustainable, from which it could be inferred that the energy reform was to be environmentally sustainable. Transitory article 17 set a one-year deadline for Congress to make the necessary adjustments to the legal framework to establish:

> the bases on which the State will seek the protection and care of the environment in all processes related to the subject matter of this Decree in which state-productive enterprises, individuals, or both intervene, by incorporating criteria and best practices in the issues of efficiency in the use of energy, reduction in the generation of gases and greenhouse compounds, efficiency in the use of natural resources, low generation of waste and emissions, as well as the lowest carbon footprint in all their processes (Document 21).

In addition, the same article established that "in the electricity matter, the law will establish to the participants of the electricity industry obligations of clean energies and reduction of polluting emissions" (Document 21). The following article, transitory 18, establishes that the Federal Government, through the SENER, should establish an energy transition strategy to promote the use of cleaner technologies and fuels within a year of the approval of the Reform. Thus, as a result of the modification to article 25 and the inclusion of transitory 17 and 18, the sustainable energy transition became a Constitutional mandate, which would later become the *raison d'etre* for the Energy Transition Law (ETL). Particularly, the inclusion of sustainability at the Constitutional level introduced an explicit link between environment and energy.

Two important points related to sustainability and economic liberalisation stand out at this point of the reform. First, it is clear that the reform process was in itself an enabling condition for an electricity reform and subsequently for the introduction of a sustainability approach in the electricity sector, i.e. conditions opened for a policy change. However, in this analysis, it is also clear that stability patterns were present. For example, the processes of change were framed within the Cardenist myth to avoid opposition to the reform. Also, the State retained control over the distribution and transmission of energy and CFE was reformed but not privatised, elements that are deepened in the next section.

Second, it is important to note that although sustainability was associated with the energy reform from its inception, (i.e. the reform was presented as a green reform), the narrative of sustainability in the constitutional reform does not necessarily assume its relationship with the economic liberalisation of the sector. The constitutional reform establishes a broad idea of sustainability: the general obligation of the State to seek to protect the environment in energy processes; and the obligation of public and private participants of the electricity industry to incorporate clean energy, energy efficiency, emission reduction and waste reduction practices in their processes. It can be argued, therefore, that the sustainability-liberalism relationship at this stage of the reform is not explicit. Although articles transitory 17 and 18 call for the establishment of obligations to reduce emissions and pollutants in the electricity sector, it is not mandated that such obligations should be established through market mechanisms.

5.3.2 Secondary Laws

On April 30, 2014, the Federal Government presented to the Senate an initiative to create or modify 21 laws, as a means to adjust the Mexican legal framework to implement the constitutional energy reform. The proposal, which became known as "the secondary laws", included the creation of nine new laws and the modification of 12 others in different areas. Table 5.3 shows all the laws included. Discussions between the different political groups and industrial-business actors effectively started in June 2014, organised by the different Committees of the Senate. After this discussion, four different dictums evaluating the set of secondary laws were issued in August and voted on by the different chambers.[78]

[78] The dictum 1 included the Initiative to create the Hydrocarbons Law and reform the laws of Foreign Investment, Mining and Private Public Associations. The dictum 2 included the Initiative to issue the Electricity Industry Law and the Geothermal Energy Law and reform the National Water Law. The dictum 3 included the Initiative to create the Law of Petróleos Mexicanos and the Law of the Federal Electricity Commission and a reform to the Federal Law of Parastatal Entities, the Law of Acquisitions, Leases and Services of the Public Sector and Services related to them. The dictum 4 included the Initiative to issue the Law of the Coordinated Regulatory Bodies in Energy Matters, which reforms the Organic Law of the Federal Public Administration, and issues the Law of the National Agency for Industrial Safety and Environmental Protection of the Hydrocarbons Sector.

Table 5.3. Secondary laws of the Energy Reform proposed by the Executive branch in April and approved in August 2014

Laws created by the Energy Reform (9)	Laws modified by the Energy Reform (12)
- Law on Hydrocarbons - Electricity Industry Law - Law of Geothermal Energy - Law of the National Agency of Industrial Safety and Protection of the Environment - Law of Petróleos Mexicanos (PEMEX) - Law of the Federal Electricity Commission (CFE) - Law of Coordinated Regulatory Bodies - Law on Hydrocarbons Income - Law of the Mexican Petroleum Fund	- Foreign Investment Law - Mining Law - Law of Public-Private Associations - Federal Law of Rights - Fiscal Coordination Law - National Water Law - Federal Budget and Fiscal Responsibility Law - General Law of Public Debt - Organic Law of the Federal Public Administration - Federal Law of Parastatal Entities - Law of Public Sector Leases y Services - Law of Public Works and Related Services

The secondary legislation ruled on five main themes. The first set of laws focused on the hydrocarbon sector and included regulation on the new model of contracts for exploration and extraction, and assignments of fields and projects to PEMEX; the new bidding and investment schemes; the liberalisation of gasoline and diesel, and opening in the natural gas sector. A second group focused on the electricity sector, including topics such as the new market model, the institutional adjustments and the scheme of clean energy certificates, including a new Geothermal Energy Law (LEG, 2014) by which this sector is opened to the private sector. This set of laws, mainly the Electricity Industry Law (LIE, 2014), is further discussed in the next section.

The third group of secondary laws focused on the institutional design of the new energy system. These laws ruled on the new attributions of governing bodies such as the regulatory bodies (the National Hydrocarbons Commission and the Energy Regulatory

Commission - CRE) and the new independent system operators (the National Centre for Natural Gas Control and the National Centre for Energy Control - CENACE)[79]. They also ruled on the new role of PEMEX and CFE as market participants. Within this group, legislation was issued to regulate the energy companies in their new state of "State productive companies". Also, new legislation modified State income, i.e. new fiscal decrees related to hydrocarbons and federal participation, the creation of the PEMEX Fund and a new revenue law on hydrocarbons.

The fifth group of secondary legislation grouped two laws related to sustainability and security. The first, the Law of the National Agency of Industrial Safety and Protection of the Environment in the Hydrocarbons Sector, established technical standards for industrial safety and environmental protection within the hydrocarbon sector but had no implications for the electricity sector. The second, the Geothermal Energy Law, regulated the exploration and exploitation of geothermal resources to generate electricity. The Law proposed that CFE indicates the geothermal areas of its interest for the granting of a permit or concession. CFE may establish public-private partnerships or develop these projects on its own.

The lack of more references to sustainability within the secondary laws seems to contradict the original reform's objectives of making the energy system more sustainable. It also undermines the great emphasis that was placed to sustainability when the Reform started.

[79] As the new ISO in the electricity sector, the CENACE is in charge of the operational control of the national electricity system and the wholesale electricity market and provides access to the National Transmission Network and the General Distribution Networks.

5.4 The Electricity Reform

The core purposes of the electricity reform were the modernisation of the system by allowing private investment in generation plants and transmission and distribution networks, and a full restructuring of the CFE to allow the creation and operation of an electricity market. The electricity reform was mainly based on the Electricity Industry Law, approved as part of the package of secondary laws in August 2014. This law introduced two main topics concerned with sustainability: clean energy certificates (CECs) and an auctions scheme in which all types of energy can participate. The following section expands on these aspects but also in the origins of the electricity reform.

5.4.1 Origins and aims of the electricity reform

Prior to the 2013 reform, the electricity sector was going through deep challenges that contributed to the weakening the regime (see Chapter 4). On one side, there were challenges within the regime itself, given the pressures generated by the state monopoly structure and the centralised system. On the other side, the weakening of the regime was being exacerbated by pressures coming from the landscape level, such as the decline in oil production and the subsequent decline in oil rent.

At the time of the Reform, all these challenges seemed to be widely acknowledged both by the government and the private sector. Nevertheless, as noted above, when the Peña Nieto administration started, a reform to the electricity sector was not part of his political agenda. For instance, while the *Pacto por Mexico* did consider energy sector reform, it did not mention the creation of an electricity market or any further modification to the monopolistic structure.

A common view among the interviewees was that the energy reform was conceived as a reform to the hydrocarbon sector to allow investment in oil and to liberalise the gas sector further. The consensus among the interviewees was that the main objective of the reform was to make the oil sector more cost-efficient. As one interviewee put it:

> The primary interest of the Federal Government in the energy reform of 2013 was totally oriented to business as usual. The logic was: I don't have oil because I no longer have reserves in the easiest places to get

> oil, so I'm going to make a reform that injects money to the sector so that I can get more oil... It wasn't a reform to diversify the matrix (Interview 27).

By the time that the constitutional reform initiative was presented (August 2014), the electricity sector was already considered a fundamental part of the reform. Notably, Peña Nieto's proposal recognised the big problems of the electricity sector and the relevance of diversifying the energy matrix by incorporating alternative sources. For instance, the diagnosis of the electricity sector included in the constitutional initiative refered to challenges in three main areas; institutional arrangements, clean energies, and transmission and distributional networks. Regarding institutional problems, CFE was criticised for having the capacity to make all electricity decisions, privileging the electricity generated by itself even when it was more expensive than that of private generators. Also, CFE's financial deficit and its non-competitive tariffs were identified as two main drawbacks.[80] The initiative concluded that given CFE's financial situation, and the "impossibility of raising tariffs", "it is indispensable to reduce the production costs" of electricity, through the use of cheaper inputs such as the use of natural gas (Document 19). A reform to accelerate the replacement of fuel by natural gas was therefore necessary, to produce savings to the CFE that can be translated into lower electricity costs (Document 19). Regarding clean energy, the initiative emphasised the insufficient meshing of the transmission network to interconnect regions with high potential for clean energy production.

Two features stand out in this second stage of the process of reform. First, in line with the justification for the constitutional reform, the reform to the electricity sector was framed as meeting the need to reduce the costs of electricity in order to generate lower electricity rates. As the presidential initiative stated, "With the proposed reform there will be a greater supply of electricity and at a lower cost, for the benefit of all users, including the homes of Mexican families, micro and small and medium enterprises" (Document 19). Some interviewees suggested that the logic behind this argument is that it was perceived that the main problem in the sector was the lack of competition in generation, which had led to higher costs and non-competitive electricity rates (Interview 3 and 24). The creation of a generation market was expected to boost

[80] For instance, in 2012 CFE's financial deficit amounted to 77 billion pesos, of which almost half (33.4 billion) had to be absorbed through the company's equity (Document 19).

competitiveness that could then be translated into lower costs of electricity and lower tariffs.

Second, the interests of key political actors were crucial for allowing the electricity reform. According to some interviews, the idea of an electricity reform arose within the office of the undersecretary of electricity when it became clear that the volatility of the price of gas was not taken into consideration in the early reform discussions (Interview 15, 18, 23 and 24). Others claim that the electricity topic was suggested by actors outside the SENER, within PAN legislators, the private sector and civil society (Interviews 6, 7, 9 and 20). Thus, the electricity reform seemed to have arisen from the combination of interests of specific, who sought to incorporate the subject into a larger oil reform agenda.

Within the SENER, the electricity reform was pushed by specific political actors who took the opportunity to bet on the opening up of the sector, also introducing possibilities for a sustainability approach. One interviewee reported:

> One day, at a meeting with the Minister, we said "look, these problems we have with the renewables (…) and the transmissions lines (will not be solved) if CFE is the one in charge" (…) "Also, if the President wants to reduce electricity rates, this (the natural gas) is a temporary solution. We cannot solve all these problems if we do not get to the bottom. Removing generation from the Constitution doesn't solve the problem; we need to create a market… Then the Secretary asked us to prepare a proposal (Interview 24).

Another interviewee confirmed that while the focus of the negotiations was always the oil reform, the undersecretary electricity office eventually started to insist on the inclusion of an electricity reform:

> I think it was clear that CFE was in serious trouble. There were numbers describing the current situation. It looked terrible. CFE was losing more and more money. CFE's operational indicators (losses, fuel mix) were getting just worse. It was evident that there was not enough investment neither in generation nor in transmission. The figures spoke for themselves. But no, it wasn't easy to convince them. It was difficult

> because they are huge decisions and many people have to agree. But the argument was made and, eventually, the undersecretary managed to make the case (Interview 18).

However, the proposal for an electricity reform seemed to be accepted by the Finance and Energy Ministers, as long as it did not "contaminate" the negotiation of the oil liberalisation, which was the priority of the Federal Government. As reported by a respondent:

> Then, we made the presentation (of the electricity reform) and Videgaray (Finance Minister) said, ok, I like it, we're going to take it to the President (...) But there was a lot of discussion about this because the important reform was the hydrocarbons reform, then our proposal (of an electricity reform) was making noise. Some said, with so much noise for the opening of oil, who will see the electricity reform? (…) Then the (Energy) Minister said, let's add the (electricity) reform but the priority is the other and at the slightest noise or problem, or whatever, that (electricity) reform goes out (Interview 24).

Importantly, the electricity reforms seemed to be also influenced by the political dynamics outside and inside the Congress, in a context in which larger national changes were being negotiated (landscape level) – for instance, eleven structural reforms. For example, a year after the *Pacto por Mexico* was launched, the PRD withdrew from it arguing that they had been excluded from the energy reform negotiations and that the Federal Government was collided with the PAN to grant licenses of gas and oil to private companies (Torres, 2013; Palacios, 2013). PRD is a left-wing party that has historically opposed any kind of privatisation of the oil and electricity sectors (Interview 23). This party organised the massive public demonstrations to oppose Felipe Calderón's Energy Reform in 2006. Given the objections that the PRD had regarding the opening of the sector, the energy reform had remained "conservative" until that moment. For one of the interviewees, PRD's abandonment of the energy reform discussions was a catalyst for inserting a liberal electricity reform. It was then when the reform "really became liberal" and opportunities opened for the electricity reform to include the creation of an electricity market and the creation of a clean energy certificates (Interview 23). Within the Congress, PAN

legislators exercised leadership by including the topic of the electricity reform in the wider energy reform agenda, which they used as a negotiation card for other structural reforms of Peña Nieto (Interviews 6, 7, 9 and 20). The political circumstances seemed to be acting as drivers of institutional change.

5.4.2 Content of the Electricity Industry Law

The Electricity Industry Law is relevant to this study for two main reasons. First, by creating the wholesale electricity market and establishing rules on opening up of the electricity sector, the law introduced a series of institutional changes, including the dissolution of the state monopoly. Second, the EIL introduced some elements related to the sustainability of the sector, although the main objective of the law in itself was not concerned with sustainability.

In general terms, the main changes introduced by the law can be summarised as follows (Rodríguez-Padilla, 2016: 37):

i. It reduced the scope of the public service;

ii. It disintegrated the supply chain vertically and horizontally;

iii. It introduced competition in generation and commercialisation, but the preserved State control over the operation of transmission lines and distribution, electricity dispatch and the wholesale market.

At the same time, the responsibilities of the CRE and the Energy Ministry (SENER) were extended to ensure the operation of the market, the expansion of networks and greater use of renewable sources. Importantly, the electricity reform specified a division between basic service, which is provided by the CFE (sole supplier) to residential users and small commercial or industrial users, and the new figure of “qualified users”, to refer to users that report a demand of more than 2MW until August 2016 and of more than 1 MW from that date. The term also refers to those producing under the modes of self-supply, cogeneration, and import. These users have the option to contract their supply directly in the electricity market.

Figure 5.2. Main changes introduced by the EIL presented by areas

Area	Summary of Reform changes
Generation	- Electricity generation is open to the participation of private individuals.
Transmission and distribution	- CFE builds and operates the networks: Public service of transmission and distribution continues to be provided by CFE, but is now subject to new regulation designed by the CRE to encourage the expansion and efficient operation of the networks. - CENACE is now in charge of the planning of the new transmission networks, with approval from SENER, to guarantee impartiality. - CENACE is now in charge of setting the necessary requirements for interconnection. - The state can hold contracts with individuals for the expansion and improvement of transmission and distribution networks. The possibility of hiring third parties. - Universal Electricity Service Fund.
Commercialisation	- The electricity market is open to private sector participation. - The Electricity Industry Law provides for the classification of qualified and basic supply users. Qualified users will be able to participate directly in a wholesale electricity market, while users of basic supply will be served by the CFE, which must acquire electricity through auctions to guarantee lower electricity costs for users. Qualified users agree on prices freely. - The necessary coordination to meet the demand for energy at the lowest cost and provide the necessary stability to the electrical system will continue to be carried out by the CENACE. The new status of the decentralised public body will endow it with impartiality to control the electricity dispatch. - Finance Ministry sets user fees for basic supply. - CFE provides the basic supply.
Operational control and access to the network	- The state preserves the control and exclusivity of planning and control of the National Electricity System (NES). - CENACE becomes independent. - CENACE controls the NES and proposes the expansion of the transmission.

The reform also transferred part of the subsidy burden from CFE to the Treasury, introducing it as a specific item in the national budget, which is intended to increase oversight and inject impetus into finding ways of reducing the cost of the subsidy scheme in the future (IEA, 2016b: 32). Figure 5.2 offers a more detailed summary of the main elements introduced by the EIL in the different areas of the electricity system.

5.4.3 Institutional changes to CFE: the "end" of monopoly

The Electricity Industry Law redefined the roles of the CFE and the energy regulatory agency, CRE. The transmission grid operator, CENACE, became a new institution (before it was part of the CFE) in charge of the operational control of the National Electricity System and the operation of the wholesale electricity market. The formulation of transmission programs is now under the direction of the SENER. Figure 5.3 summarises the new institutional responsibilities per institution as established by the electricity reform.

Figure 5.3. Summary of the new functions of public entities in the electricity sector

Institution	Mandates
Energy Ministry (SENER)	- Establishes, conducts and coordinates national energy policy. - Establishes requirements to acquire clean energy certificates. - Fosters competition. - Prepares and coordinates the execution of infrastructure projects. - Ensures coverage in rural communities and marginalised areas.
Energy Regulatory Commission (CRE)	- Establishes conditions for transmission, distribution, and supply. - Establishes tariff regulation. - Issues the bases of the wholesale electricity market and monitors its operation. - Issues models of interconnection contracts. - Grants clean energy certificates. - Keeps a record of qualified users
National Centre for Energy	- Operational control of the National Electricity System.

Control (CENACE)	- Security of the energy dispatch and continuity of the electrical system. - Auctions for the celebration of electricity coverage contracts. - Expansion and modernisation of the National Transmission Network. - Establishes guarantees to ensure the fulfilment of obligations.

The electricity sector reform pursued the structural separation of formerly integrated utilities and unbundling of generation, transmission, and distribution services along with the launch of an independent systems operator (ISO) to promote efficiency and sector growth (Ibarra-Yunez, 2015: 19). Notably, unlike many countries where public utilities usually become private utilities, the CFE was not privatised as part of the reform process. The CFE remains a public utility although it is now divided into smaller organisations, and redefined as a "state productive enterprise". With this new status, the CFE is now subject to regular corporate tax and to payments of dividend to the state. Also, the CFE gained management autonomy and corporate governance, similar to a private business entity. However, the CFE keeps being in charge of the natural monopolies of distribution and transmission.

For the CFE, the reform meant a fragmentation and transfer of activities and gradual dilution of its market power in the new industrial structure (Rodríguez-Padilla, 2016: 37). For instance, electricity planning is no longer CFE's functions; it is now part of SENER's responsibilities. CFE's restructuring is important because of its consequences in terms of political power. Some interviewees argued that one of the motors of the electricity reform was precisely to carry out a restructuring to rest CFE's decision power over all the policies of the sector, a power that in many cases contrasted with that of the SENER (Interviews 3, 11 and17). As one interviewee put it: "SENER was sometimes referred to as the tamer of the tigers, being the two tigers PEMEX and CFE, which for their political power accumulated for so many years were not subordinated to the SENER" (Interview 1). Regarding the institutional rivalry in the sector, one interviewee commented: "At that time (when the reform began) SENER threatened the CFE with making it part of the reform process, not that it was considering but to force CFE to provide greater transparency in its information. This possibility

became known by some legislators and against the expectations of SENER itself, this part of the energy reform advanced very effectively" (Interview 17).

5.4.4 Sustainability within the Electricity Industry Law

In compliance with the constitutional mandate, the proposal for the new electricity law created a scheme of obligations for qualified users and electricity supply companies for the acquisition of clean energy certificates (CECs), by which "the costs of the national commitment to the clean generation of electricity, would be distributed to all industry participants" (Document 22).

When asked about the reasons for choosing a CECs scheme, one of the designers of the new electricity law indicated that at the time of the reform it was very clear that the government wanted to promote the use of clean energy as part of the reform, but there was no consensus on which mechanism. This person indicated that three possible options were considered. The first was to introduce a feed-in tariff, an idea supported by RE generators because "they saw it as a less risky mechanism" (Interview 18). However, this idea was not chosen because:

> We did not like it because we knew it'd be difficult for the policymakers to choose the optimal technology mix. We knew that the costs were changing a lot and also that to be an optimal policy you have to take into account not only the energy cost but its value (and) sincerely we did not have faith in the government's ability to choose well (Interview 18).

Another option was introducing a tax on pollution. But this was perceived as unviable because "we realised that it would be impossible to tax electricity pollution from the SENER as this is a SEMARNAT's responsibility (…) we wanted to promote clean energy as energy policy, not as environmental policy" (Interview 18). The third option, which the negotiators chose, was the creation of market certificates for clean energy. In the words of the same interviewee, "the industry did not like the idea because it encourages a lot of competition (...) Along with the auctions, the CECs generate a competition, not only healthy and strong, but a competition 'to death', and that's what we wanted (...) We wanted them (the generators) to compete to the death to provide the cheapest energy" (Interview 18). Once again, the main idea behind the reform was guaranteeing the lowest cost of electricity.

The second main element of the electricity reform was the system of auctions for capacity, electricity and clean energy certificates. This mechanism aimed at allowing "investments from both established and new players into the market on a competitive basis" and was considered "an integral part of the market design created to achieve clean energy goals" (IEA, 2017: 146). The auctions offered long-term contracts (15 years for electricity and capacity, 20 years for CECs), providing stability over future cash flows for generation companies, reducing risks and therefore also the cost of capital.

The long-term auctions allowed contracts for the construction of new generating capacity needed to supply regulated consumers (basic service consumers). In practice, the buyer (CFE in the first stage) determine the requirements for basic service users in terms of energy, capacity or CECs but the choice of technology was left to the market as the auctions were established as technology-neutral.

According to the IEA, "the Mexican clean energy auction system is one of the most sophisticated procurement mechanisms for renewable energy. Distinctively, it seeks to capture the relative value of the system of different generation technologies by location and production profile… the auction system strikes a delicate balance between the need for long-term revenue certainty and the competitive procurement of technologies with the highest system value" (IEA, 2017: 149).

Most of the interviewees agreed that the CECs scheme and the long-term auctions of the basic service were the main elements within the electricity reform to encourage the sustainability of the sector. However, some of the interviewees signalled that two major problems with the Electricity Industry Law were the lack of a clear definition of "clean energy" and the lack of a specific percentage of clean energy that qualified users had to meet to comply (Interviews 7 and 24).

For some interviewees that the initiative of the Federal Government did not include a specific definition of clean energy (Document 22) showed the government's intentions to consider natural gas combined cycle (CCGT) plants as clean energies. The approved version of the law did specify that clean energy technologies were to include renewable energy, nuclear energy, efficient cogeneration and fossil-fired generation with carbon capture and storage (Document 24). However, the definition included a

note about “other technologies determined by SENER and the Environment Ministry (SEMARNAT), based on parameters and standards of energy and water efficiency, emissions into the atmosphere and waste generation, directly, indirectly or in the life cycle” (Document 24). For some, this responded to a political decision, as negotiators of the electricity reform did not want to confront the industry by explicitly banning natural gas so they left a possibility opened under the “other technologies” (Interview 10). Likewise, the negotiators did not want the clean energy percentages would become an impediment for this law to be passed. Thus, the law indicated that it was SENER responsibility to establish the specific criteria for granting the CECs in due term (Document 24).

It is important to note that at this point in the reform process, the narrative of sustainability was intrinsically linked to the process of economic liberalisation of the electricity sector. The designers of the electricity reform chose the CECs and the auctions as the leading market mechanisms to fulfil the constitutional mandate of clean energy obligations for the participants of the electricity industry.

5.5 Summary

The analysis of the 2013 energy reform and its consequent laws in the electricity sector shows the patterns of technological and institutional stability outlined in the historical analysis in Chapter 4. The negotiations illustrate the complex political dynamics in which energy policy is embedded and how institutions influence the adoption of specific energy policies, with concomitant effects on the energy transition process. Thus, the analysis in this chapter was focused on the interaction between political actors and institutions and how political decisions were made.

Given the limited analytical elements of the STT-MLP approach, this analysis was made using elements from HI such as the critical juncture approach, which allows the examination of the agency of the actors during the moments of change. For example, by stressing the moments in which policy options, which were previously not viable, become feasible, i.e. a reform challenging the "sacred" constitutional value of no "privatisation" of the sector; and a reform that includes sustainability at the Constitutional level.

The analysis of the political circumstances in 2012-2014 signals how, despite the political agreement on the need to reform the sector, the depth and the scope of the reform was decided as it unfolded. This is why the actors' preferences and interests became crucial. A new administration and an alignment of political parties, made possible mainly by the Pacto por México, opened an opportunity, which different actors took advantage of for different reasons. The alignment of the political forces at the beginning of the Peña Nieto administration was key to the negotiation of reform, and help explain why the reform took place in 2012, and why previous attempts had failed.

The analysis of the main features introduced both by the Constitutional reform and by the new electricity legislation, concretely the new Electricity Industry Law, allows the identification of the main objectives of the reform. They show that the close relationship with oil shaped the transition agenda within the Reform.

That oil was the main priority of the 2013 reform had mixed effects on the transformation of the electricity sector and the sustainable energy transition. The fact that the priority was the oil sector, and specifically the attraction of private resources for the exploitation

of new oil deposits and the modernisation of the sector, left limited space to include other aspects in the discussion. In a context in which the opening of the sector was a politically explosive issue, everything that “polluted” the negotiation – and approval – of the oil reform legislation, would be left out of the discussion. Paradoxically, the fact that oil was the priority opened some space, albeit limited, for inserting the electricity reform agenda, which in turn, allowed the incorporation of the clean energy certificates and the auction mechanisms.

Finally, this chapter also introduced some examples of how the actors involved in the negotiation process secured the approval of the Constitutional Reform and the electricity reform by avoiding controversial topics of sustainability. For example, they sought to prevent industry opposition hey sought to prevent opposition industry by keeping a broad definition of clean energy and without establishing details of the procedures of the certificates.

The next chapter further explores how the opportunities for sustainability emerged and the coalition formation process for and against sustainability, by focusing on the third unit of analysis: the Energy Transition Law.

Chapter 6: The Energy Transition Law

6.1 Introduction

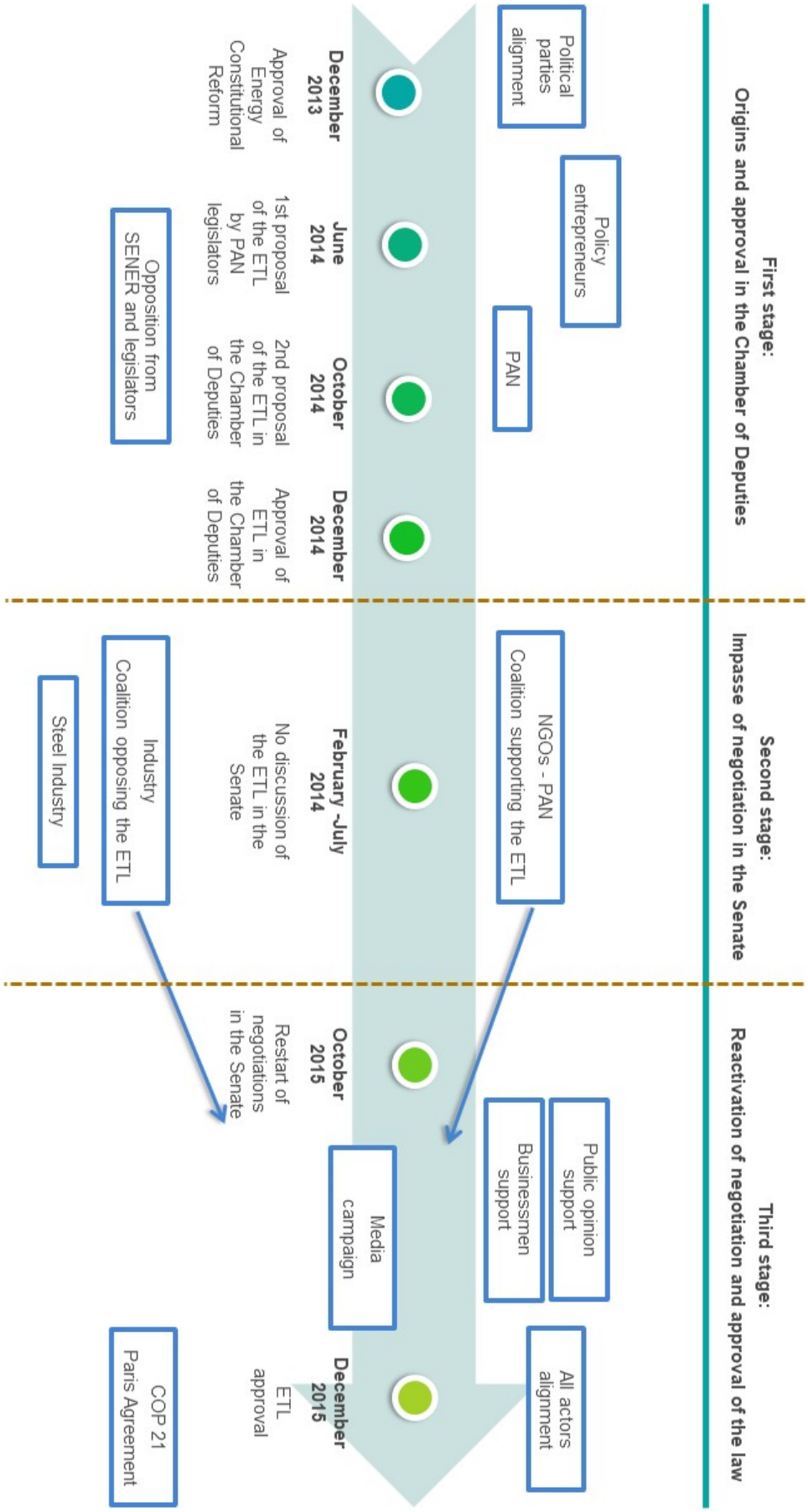
The detailed analysis of the objectives and origins of the constitutional reform and the electricity reform presented in Chapter 5 illustrates how the long-term institutional stability – i.e. oil prevalence and deep power relationships – framed the discussion of the Reform from the beginning. It also shows how these patterns ended up limiting the scope of the sustainability approach within the constitutional reform and the secondary laws, specifically, in the Electricity Industry Law.

This chapter provides a detailed narrative of the third unit of analysis, the Energy Transition Law (ETL), both in terms of the policymaking process and its content. The chapter has two aims. First, it seeks to highlight the interactions between the different actors involved in the negotiation process of the law, their interests and strategies. Particular emphasis is placed on the main coalitions of supporters and opponents of the ETL, but also the role of non-governmental actors, policy entrepreneurs and partisan alignment. Second, the chapter also signals the relevance of the political circumstances that enabled (encouraged) or hindered (discouraged) the approval of the law, at the three levels of analysis (regime, landscape, and niche). Thus, by studying the process of ETL approval in detail, this chapter outlines the complex political dynamics in which energy policy is embedded in order to understand how institutions and institutional arrangements influence the adoption of specific energy policies, shaping the direction and scope of the sustainable energy transition as a result.

The chapter is divided into three main phases. The first phase started in December 2013 when the Constitutional Reform was approved; thus, it comprises the origins of the ETL and the negotiation process within the Chamber of Deputies, until December 2014. The second phase (January – October 2015) began when the proposal was sent to the Senate, the reviewer Chamber, to continue with the legislative process of discussion and approval but it is characterised by an absence of legislative debate. The last phase of analysis is a short but intense period of negotiations at the Senate that started in October 2015 and culminated with the law's approval in December 2015. Figure 6.1 summarises the main moments and key elements for analysis.

The last part of the chapter discusses the main aspects of the content of the ETL. Particular emphasis is placed to those elements identified by the interviewees as the main benefits of the ETL, i.e. the confirmation of the 2030 clean energy goal and the establishment of mid-term goal, along with specifications of the clean energy definition, by which the law eliminates the possibilities of considering natural gas and CCS as clean energy generation sources. Some of the disadvantages are also discussed: the inclusion of a flexibility clause in the compliance of clean energy certification (CEC) obligation and the lack of specific goals on distributed generation and energy efficiency.

Figure 6.1. Stages of the policymaking process of the Energy Transition Law (ETL)



6.2 The origins of the law: December 2013 - December 2014

The set of secondary laws, presented by President Peña Nieto in April 2014 and approved by the Congress in August, excluded the creation of a law on sustainable transition. As in the case of the electricity reform, that was introduced by specific actors, the ETL seems to have emerged thanks to the explicit political interest of a specific group of actors.

Interview data suggest that the idea of proposing new legislation on sustainable energy transition originated among the legislators from the National Action Party (PAN) and civil society soon after the constitutional reform was approved in December 2013. These actors formed a small group that started some discussions about the possibility of creating a new law within the Permanent Committee on Renewable Energy in the Chamber of Deputies. This group had previously negotiated the inclusion of "sustainability" in the constitutional reform and had lobbied to include a specific clause in transitory article 17 to set a deadline on the issuing of regulation of clean energy obligations. An interviewee that participated in those early discussions recalls:

> There were two options: one was to modify the previous legislation, (LASE and LAERFTE), and the other was to make a new law. During the first months of 2014, the group held some meetings to discuss this issue and in the end, it was decided that it was better to generate a new law… So that the previous ones were not too patched up (...) it was decided to make a new law that would take on the previous legislation on renewable energies, and try to strengthen it (Interview 22).

Most of these discussions were private but after identifying that the set of secondary laws (published in April 2014) lacked "green laws", PAN legislators began to publicly demand the inclusion of the topic in the Congress negotiations (Document 33). In June 2014, the group of PAN legislators presented for the first time a proposal to create a new law called the "Energy Transition Law" (Document 23). PAN's proposal was described as the result of "a joint work between civil society experts and PAN legislators" (Interview 22; also interviews 1, 6, 7, 8). Non-governmental organisations (NGOs) groups such as Greenpeace Mexico and the Mexican Center for Environmental Law supported PAN's proposal by issuing press bulletins in which they highlighted the

relevance of the law (Document 68). For this group, the original proposal needed to includ previous legislation on renewable energies and therefore the proposal was in essence "a merger of the LAERFTE and the LASE into a single law (…) we ended with a law of more than 150 articles in the first proposal" (Interview 9). Some additional elements, such as distributed generation and energy efficiency, were incorporated in order to create an "ambitious" law that "could help in the transition process" (Interview 9).

At this point in the process, the absence of specific legislation on sustainability matters attracted the attention from public opinion, exacerbated by PAN legislators. Between May and July, the president of the Senate Energy Committee, Senator David Penchyna of the Institutional Revolutionary Party (PRI), frequently declared in the media that the Federal Government was considering a specific proposal for the "green package" of the reform, but it would be presented once the proposed secondary legislation was approved because "it was part of a different regulatory framework" (Document 28).[81] However, no green package was presented in the following months by the Executive or PRI legislators. Additionally, despite the public presentation of PAN's initiative and remittance to the Permanent Committee at the Senate, their proposal was not included in the discussions of the secondary laws or any other Senate Committee.

The absence of a specific law on sustainable energy within the secondary laws and the lack of Senate interest in PAN's proposal can be explained by a political decision by which sustainability was delivery separated from the rest of the reform laws. According to an interviewee, this decision was taken within the Energy Ministry (SENER) at the early stage of negotiations:

> Since the beginning, it was foreseen that the discussion of the ETL, or sustainability, would become a slaughter between the industrial groups, who were opposing to clean energy because it was more expensive, and the ecologists, who were in favour and wanted a much more pro-environmental version (of the law) with stronger obligations. (...) Just as

[81] "The Green Package is reserved for a different package of laws on fossil fuels, electricity, regulatory bodies, design of state-productive enterprise (…) It's like this because it (the green package) has a strictly technical logic, which is to think in a different regulatory framework, one that truly encourages renewable energies, and requires the help and productivity of the non-renewable energy sector, as is the case with the fossil issue" (Document 28).

> the concern at the beginning was that “adding electricity to the Reform will compromise the hydrocarbons reform” (...), the second political concern was that “adding more environmental issues will contaminate the hydrocarbons and the electricity reforms”. So we decided to leave it aside… (Interview 23).

For some interviewees, the separation of sustainability from the rest of the reform was tdue to a lack of consensus among the political parties and the industrial groups on this topic. For others, the relegation of the ETL initiative revealed the lack of political interest in the subject and the fact that the priority of the reform was oil and gas (Interviews 2, 6, 7, 8 and 9). Also, some interviewees considered that the segregation between the laws ended up being positive for the approval of the law. For example, one interviewee reflected that “(The separation) was premeditated, and in the end, maybe we benefited, those of us interested in pushing climate and environmental agendas because we were able to concentrate on this issue in isolation, separated from other very ‘hot’ elements such as privatisation” (Interview 6).

In October 2014, there was a second attempt by PAN legislators to propose the creation of the ETL, this time at the Chamber of Deputies. A month later, the initiative was turned over to a Joint Committee on Energy and the Environment and Natural Resources due to an express request of PAN legislators, specifically of PAN deputy Isabel Ortiz. That the initiative was turned over to a Joint Committee was a strategic decision of PAN legislators and denoted their interest to promote the discussion of the law proposal and its approval. As expressed in one interview, they were seeking to secure favouring voting of the law: “(Isabel) had a way of controlling the vote in the Environment Committee through its President, Lourdes Lopez, but she could not do the same in the Energy Committee, there she depended on other deputies” (Interview 22).

For those involved in the process, since it was presented for the first time in June, there was no political interest in endorsing the law or even in discussing it. As one of the respondents recalled, the boom of the Energy reform had already passed:

> Senators were not attending the meetings anymore; they had already “carried out” the Energy Reform. They already had the spotlight with their nine new laws and eleven (law) modifications. There was no longer any

> real interest, not even from PAN senators, except Silvia Garza (...) Also, the entire Energy Reform entered through the Senate, and this was the only law (the ETL) entering by the Chamber of Deputies… This became an obstacle (Interview 22).

The second presentation of the ETL initiative seems to have brought together more actors. It was then that the Federal Government, through the SENER became involved in the discussion of the law for the first time:

> Work with SENER started in October (2014). It was then when they started to show openness, even the Minister himself. From October to December, we discussed article by article of the ETL and worked on with them. Perhaps when they realised that they were not going to draw their own law, they "adopted" the one proposed by the PAN and began to review it (…) In fact, it was SENER who called for a meeting for deputies, senators, CONUEE, SEMARNAT, SHCP, SENER to review the law. At that time, the initiative was as it had been presented in June (Interview 22).

It was also at this stage of the negotiation when the voices against the ETL started to become more evident. Interviews reported having received "requests to change the initiative" by "some industrial groups" through the Energy Committee at the Chamber of Deputies. The requests were referred to be claims to include a "national priority content" clause but also to reduce the national clean energy goals.[82] Due to such requests, PAN deputies agreed to add an addendum with a "national content" clause (Interview 22). Left-wing legislators criticised the introduction of these changes and qualified them as "traps" to favour economic viability over clean energy production (Videos 6). For others, these changes were not fundamental but "almost in cosmetic terms", and they were made to "eliminate all the barriers and finally approve the law" (Interview 9).

On December 10, the Joint Committee approved a draft opinion of the law (Document 61), and five days later, the draft was voted in the plenary session and approved. A

[82] It was not possible to identify who made these requests.

group of left-wing deputies, from the Democratic Revolution Party (PRD), voted against the law and complained about the addendum and the last-minute modifications. They considered that the inclusion of the term “economic viability” in the proposal demonstrated the prevalence of the economic criterion in the law over the sustainability approach (Documents 61 and 62). PRD legislators also complained at having been excluded from the ETL negotiation process, which was confirmed by a couple of interviewees: “it was true they were not included, but that was the case from the beginning (…) the left refused to participate in the negotiations because they associated it with the privatisation of the sector” (Interview 22). PRD deputies also complaint for rushing the discussion (Documents 61 and 62; videos 5 and 6).

By approving the draft in mid-December, 2014, the Chamber of Deputies fulfilled the obligation of issuing sustainability legislation within a year as stated in the transitory article 17 of the Constitutional Reform. However, the Law was required to be discussed and approved by the Senate before becoming effective.

6.3 Negotiation impasse: January – October 2015

The second phase of the negotiation process is characterised by a deadlock in the official negotiations. From January to October 2015, no discussion about the ETL initiative took place within the relevant Committees in the Senate. Lobbyists against the ETL became very active in this period (Interview 25), which, to some extent, explains why the ETL was not discussed or approved until the end of 2015. However, debates about the law were held in public forums, incentivised by the coalition in favour of the law: PAN legislators and civil society groups. Notably, the role of non-governmental actors, such as climate NGOs, was essential for the continuation of the process.

6.3.1 Opposition to the law

Once approved by the Chambre of Deputies, the ETL passed to the Senate on December, 15. Due to the seasonal holidays, the law was expected to be discussed until February 2015, when the legislative sessions began; however, the law was not allocated to the relevant Committees. As is discussed below, the opposition that the initiative generated helps explain the lack of discussion during the first half of 2015.

6.3.1.1 Private sector opposition

The main opposition to the ETL arose from specific groups within the private sector: in particular mining, steel and gas companies. The industrial opposition was usually voiced through three of the main national industrial associations: National Chamber of the Transformation Industry (Cámara Nacional de la Industria de Transformación - CANACINTRA), Confederation of Industrial Chambers (Confederación de Cámaras Industriales - CONCAMIN) and Mexican Iron and Steel Industry Chamber (Cámara Nacional de la Industria del Hierro y del Acero - CANACERO). These are the most powerful industrial associations economically and in terms of political influence in the country. The iron and steel industry alone is one of the biggest in the country: it employs 672,000 people (directly and indirectly), which is about 40% of all industry workers, making it among the most important national sources of employment. The steel industry represents 2.1% of Mexico's GDP and contributes 13.1% of the GDP of the

manufacturing industry (CANACERO, 2019).[83] The three organisations - CANACERO, CANACINTRA and CONCAMIN - adopted a common stance to express their opposition to the law publicly.

These groups had expressed their disagreement with the law since the deputies discussed it in October-December 2015 but failed to block its approval in the lower house. According to interviews, these three organisations lobbied with the different political forces in the Senate since early 2015 to try to block the discussion of the law (Interview 6, 7, 8 and 9). As recalled by one interviewee:

> It was expected that the senators would quickly approve the ETL because that was the political agreement... But then, the negotiations with senators took ages… During December and January, the iron and steel industry had lobbied and convinced the senators that renewable energies were harmful to the country. They argued that the country was going to go bankrupt because of the renewables and the goals. Their arguments were based on badly made and biased numbers, but they convinced the senators (Interview 9).

The interest of the steel industry in the electricity reform could be explained by the fact that this industry is the main consumer of natural gas in the country and the third consumer of electricity in the industry sector (CANACERO, 2019). A common view amongst interviewees was that the groups opposing the ETL were big enterprises that, thanks to the legal changes of the mid-1990s, had made significant investments in pipelines and plants to provide their industry with electricity generated by natural gas. For instance:

> The interest groups that did not want the ETL to pass had already invested in the Ramones gas pipeline and thought that they had already reduced their (electricity) costs. They considered that the fulfilment of clean energy obligations would imply additional expenses (Interview 22).

[83] Mexico is the world's 14th steel producer with an annual production of 20.2 million tons of crude steel. The investment of the steel industry in the country is approximately $385 million dollars per year (CANACERO, 2019).

Thus opposition to the ETL emerged mainly from incumbent actors, i.e. big firms with vested interests and investments in current technology (natural gas plants and gas pipelines), which is in line with common claims of the STT-MLP literature (see Chapter 2). In the account of events, one interviewee said:

> This story has names. The opposition to the CECs was originated by a plant in Nuevo León, in Pesquería, a plant of almost one Giga or so… Under the new framework, they were classified as qualified users and therefore had to comply with the new obligation (…) either they had to generate 5% of their energy with clean technologies, buy CECs to cover it or pay a fine. They refused to do so. They managed to include gas as clean energy in the Electricity Law (…). And then they began lobbying with the Monterrey industrial groups: CANACERO, who in turns lobbied with CANACINTRA and the rest of the industry, pressing up to the Ministry of Economy (Interview 7).

The two main arguments used by the economic groups opposing the law were: 1) that the clean energy goals included in the ETL initiative were too ambitious; 2) that the CEC scheme would have negative impacts on the electricity costs of the industry. Interestingly, these two points were not innovative features of ETL. They were already part of the legislative landscape; the ETL would only be copying them from previous legislation. First, as explained in Chapter 4, Mexico's clean energy goals were introduced in 2011 through a modification to the Law for the Use of Renewable Energy and the Financing of the Energy Transition (LAERFTE), establishing maximum targets of fossil generation in the total electricity mix: 65% of fossil generation by 2024; 60% by 2035 and 50% by 2050. These targets were reinforced in the 2012 General Law on Climate Change (LGCC), which set a target of at least 35% of electricity with clean technologies by 2024. During the ETL negotiation period, the opposing industrial groups argued that the goal of 35% clean electricity generation by 2024, considered in the ETL, was very ambitious (Documents 75 and 80; video 10). They would frequently emphasise the fact that other countries with higher GHG emissions (like China or the USA) have less ambitious goals than Mexico.

Second, a specific mandate of clean energy obligations was introduced in the constitutional reform of 2013, and the CECs scheme was one of the innovative features

of the Electricity Industry Law, approved in 2014. It is striking that the opposition of the group of industrialists to this particular scheme was not vociferously expressed during the negotiation of the constitutional reform and the secondary laws. When asked why the opposition to this scheme was more visible during the ETL negotiation than a year before, an interviewee said:

> I think it took time for most of the opposing groups to realise that their real "enemy" was the EIL that had been born a year before (…) My perception is that they didn't really see the dimension of the implications that incorporation of a variant of an RSP (Renewable Standard Portfolio) in the law had, and of the clean energy obligations. They saw them (the implications) when we started to implement the law: until we set the first compulsory clean energy requirement and we launched the first electricity auction for CFE to meet that requirement. That coincided in time with the negotiation of the ETL and the opposing organisations focused their guns on the ETL (Interview 23).

Another interviewee agreed that the industry did not realise the magnitude of the changes in the new design of the electricity sector:

> When we were discussing the law (electricity law), I think the industry didn't appreciate that this time it was different. It was no longer an issue of putting "pretty" goals in a document that was later ignored without any consequences. No. This time, there were fines (and) an individual obligation (…) These two changes (that there is a personal/ individual responsibility, as a legal entity, and that there are fines for not complying) were not appreciated in the electricity law. It was not until a year later (…) that the industry began to appreciate that this time it was for real. And then, they started worrying about the cost (Interview 18).

The opposition of these groups seems to have been successful as the ETL was not discussed at the Senate from January to October 2015. During the interviews, it was claimed that from April 2015, the PAN legislators and members of civil society met privately with senators from different parties to explain the ETL initiative and its relevance for the reform process (Interviews 6, 7 and 20).

6.3.1.2 Opposition within other actors

Interviewees indicated that although most opposition to the law came from specific economic groups, there was also resistance from actors within the Federal Government and legislators from different parties, including PAN. This "inertia", as one interviewee called it, also contributed to delay the discussions and the approval of the law.

For some, SENER's position was ambivalent throughout the negotiation process and they mostly "stayed out" of the debate during the second part of the process (Interview 7). A couple of interviewees involved in the proposal of the law reported holding meetings with the SENER from October to December 2014, after the initiative was presented for the second time (Interview 7, 9 and 22). However, the role of the SENER during the second stage of negotiations, when the law was stuck in the Senate, seems to have been less active and less supportive. For instance, there is no record of public pronouncements in favour of the law by any SENER official. Joaquin Coldwell, the Energy Minister, only started to make public statements in favour of the ETL in the last part of the process (October 2015). One interviewee revealed that the lack of SENER's involvement was not necessarily due to opposition to the law:

> The SENER privately asked us to support the law but they wouldn't do it publicly because they wanted to avoid confrontation. They didn't want Peña's administration and the Energy Minister to be identified as leading the approval of the law (…) SENER took the position of "look, I'm not the one pushing the law" but neither was it blocking it (Interview 6).

Opposition within the government was also expressed through the Ministry of Economy. One interviewee argued that the close relationship of the industrial sector with this ministry enabled it to lobby the Economy Minister, who in turn, "pressed people' from SENER" (Interview 7). According to the same interviewee, this became evident during the negotiation meetings when officials from the Ministry of Economy showed a refusal to approve the law (Interview 7).

Additionally, other interviewees reported resistance among legislators from different parties. For instance, it was reported that PRI legislator David Penchyna, president of the Energy Committee within the Senate, was "close" to the industrial groups opposing

the law; therefore he “didn’t open the space to discuss the law in the Senate” (Interview 25; also Interview 7). A lack of interest from PAN was also reported:

> Even PAN senators blocked the issue. Why? It was supposed to be a PAN’s initiative, why weren’t they supporting it? In one meeting, a senior official from the SENER revealed that the senators did not like having been removed from the spotlight and that interest groups were heavily pressing (…) with the different groups against the law (Interview 22).

When asked why PAN senators were blocking the ETL, another interviewee stated:

> The (PAN) senators never really got involved (in the discussion of the law). Deputies invited them to the meetings and discussions from the beginning but, in my view, deputies failed to link them from the start politically... All parties have their conflicts but there was a strong split within the PAN. They (deputies) focused too much on what they were doing and never included the senators (...). The truth is that the senators did not get involved so when the package (of the ETL initiative) arrived at the Senate, they did not give the interest it should (Interview 25).

Industry opposition plus the lack of interest from senators, both from PAN and PRI, created a political circumstance that contributed to the impasse in the negotiations.

6.3.2 The role of civil society actors

Civil society groups were influential actors at this stage of the negotiation, pressing for the approval of the ETL. A specific group of actors, a small NGO with considerable strategic resources (political, financial and technical), seems to have played a vital role during the negotiations. Their involvement started at an early stage of the constitutional reform in late 2013 and continued during the following two years. This group claimed to be among the first actors who sought to include the sustainable energy transition topic within the energy reform agenda. They negotiated with PAN legislators to adopt the issue when the constitutional reform was being discussed. For instance, a member of this group related their approach to different political parties to promote the inclusion of sustainability in the energy reform:

> Of all the parties, only two showed interest. The PRD asked us to make a proposal to reform the LAERFTE but they didn't want to "privatise" the electricity sector (…) The other was PAN (...) Our proposals made sense to them and they decided to put the electricity issue with force because that was their component of negotiation. Also, PAN had been among the "champions" of the climate issue, they promoted the LGCC years ago, and Calderón's government has been the most climate-friendly or progressive government on climate change. So our message with PAN was "see, keep your leadership and include the component of sustainability in the negotiation of the electricity system (Interview 7).

As explained in Chapter 4, the PAN led the creation of the LGCC in 2010-2012 at the Congress level but also at the Federal Government. The LGCC was part of Calderon's strategy on climate change, which included clean energy targets. In 2013, political entrepreneurs took advantage of the previous link between the PAN and the previous climate legislation to promote their sustainability proposal in the reform process. They started to collaborate on the initiative for constitutional reforms presented by the PAN, proposing reforms to articles 25, 27 and 28 of the Constitution to include the sustainability component (of which modifications to article 25 was the only one approved). In addition to helping with the technical part of the law, i.e. drafting the content of the proposals, the group reported having been involved in all the technical meetings and public discussions in which the ETL was discussed, which was also confirmed by other actors (Interviews 6, 7, 20, 22 and 25).

During the second stage of negotiations, and in the absence of discussions in the Senate, this group was actively lobbying in favour of the law. An interviewee reports that "from January to April 2015, while the steelmakers were lobbying with the senators, they (PAN and civil society) sat down with the senators to convince them and explain the advantages of the ETL" (Interview 22). Additionally, they helped to raise public awareness of the law, in collaboration with PAN legislators. For example, although there was no discussion of the ETL in the Senate from January to October 2015, several meetings and fora took place. At the Senate, at least five different events and discussion fora were organised during these months by the Climate Change Committee (presided by a PAN legislator) to promote the approval of the law. For instance: a

meeting of the Committee on Climate Change with the Konrad Adenaeuer foundation (February 25), a dialogue on the potential of renewable energies in Mexico (March 24), a meeting of the Climate Change Committee with the civil society (April 7, 2015), a meeting of the Climate Change Committee with parliamentarians from the United Kingdom (October 5), the forum on "Energy transition, a key element in climate change" (October 7). Additionally, these groups organised book presentations, talks and conferences in different parts of the country to raise awareness of the ETL.

These actors had been involved in the law since its beginning and acted as critical facilitators during the negotiation process:

> I like to think that we were orchestrators. We did a lot of mapping and planning, situational and political, technical, everything... And then we look for the buttons that we needed to press, what was needed in each moment to make things happen? That is why we played a leading role in this process. Not in the sense of commanding others, but in terms of doing the "heavy lifting". We put a lot of time, effort and money to facilitate... first to raise awareness with a constituency of higher level, insisting with those who were already interested, and then, to expand the actors. We brought to "our party" more actors who otherwise were not going to play, especially NGOs, because they do not have the skills, they do not know the topics, etc. Through trust relationships built over time, we expanded the participants of those pulling on this side of the rope… (Interview 6)

This group also argued that, from an early stage of the negotiations, they understood the importance of involving the private sector in the discussions. In particular, they sought to involve actors in the Mexican private sector who were more open to sustainability, because they had direct investments in renewable energies or because of their business characteristics (large transnational corporations), sustainability was an important part of their business models. Thus, they also met with business people to explain to them the importance of the law, since they recognised the important role those big companies could have in the approval of the law. Nevertheless, they did not manage to have their support until later in the negotiation process, as will be discussed in the next section.

The role of this NGO, however, is unusual in terms of political, technical, and financial resources. As explained in Chapter 4, several NGOs actively participated in the process of approval of the LGCC (2010 to 2012). The participation of this particular NGO in such process allowed it to have extensive experience in legislative negotiations (Interviews 11 and 25). Also, the staff of this NGO is highly trained in technical issues of sustainable energy and climate change, which allowed them to provide technical support on the content of the ETL (Interviews 6, 7, 9, 20 and 22). Lastly, even though this group has important financial resources, it sought additional financing to support the promotion of the ETL (Interview 6).[84]

[84] Given Mexico's visibility in international climate negotiations, most of the "climate" NGOs in Mexico have had access to relevant sources of international funding, mainly from European countries, which is different from other sectors of civil society that usually have limited access to international funds. Access to international funding has contributed to the "independence" and strength of the climate NGO sector in Mexico (Interview 2).

6.4 The process of approval: October 2015 - December 2015

The last stage of the legislative process started in October 2015, when the negotiations of the ETL were resumed at the Senate under a new legislature.[85] Two features are relevant in this phase of the negotiations: an intensification of negotiations and public discussions of the law, inside and outside the Senate; and the effect that external factors seem to have had in the approval of the law (at the landscape level). Within and outside the Senate, promoters and opposing groups intensified their activities, mainly through a media campaign aimed at influencing not only public opinion but also political actors (see Appendix II). At the end of 2015, there seemed to be an alignment of political actors in favour of the law, which contributed to its approval. Among those actors, business actors and public opinion played a relevant role, while civil society actors kept being crucial.

One important feature of this stage is that negotiation of the ETL took place in the light of a tipping point in the international climate negotiations, a landscape development that seems to have influenced the approval of the new law. The link between climate change international negotiations, concretely the COP21, and the ETL was not automatic; it was led by the group promoting the law, by mobilising the media campaign.

6.4.1 Support of corporative groups

Interviewees agreed that during the last stage of negotiations, the support of large international corporations and big national business groups in favour of the law was vital for the approval (Interviews 1, 2, 8, 11, 20 and 24). Two particular businessmen groups became key supporters of the law.

A first group was one of the big national companies, including two of the biggest companies in Mexico CEMEX and Peñoles. These companies supported the law since the beginning but their support became visible in the last stage. These companies were already using alternative sources of electricity when the Reform took place, which explains their support to the law. The mid-1990s reforms in the electricity sector allowed

[85] The LXII Legislature, under which the ETL was proposed and approved in the Chamber of Deputies, ended in August of 2015. The next legislature, LXIII, started in September 2015 and ended in August 2018.

these companies to invest in renewable sources, mainly wind, under the self-supply scheme (see Chapter 4). Thus, when the 2013 energy reform started, they were already generating an important part of their electricity with renewable energy. As one director recalled: “We already had a very clear idea of the benefits that we could achieve… in terms of price and technical conditions, and we said ok, this (the law) only could be good , and that's why we were convinced to support the law” (Interview 16).

The same interviewee also reflected on the division that the ETL brought among the private sector:

> It’s very rare to see such a clear division in the private sector as there was in this case. We were the ones who already had the experience, arguing it (the law) doesn’t have to increase the cost, on the contrary, prices will go down, and they’ll also be much more stable because we won’t be subject to the geopolitical and other fluctuations (…) We were absolutely convinced… But then, there were those who opposed, also convinced. Partly, because of the fear of rising prices, and partly, because they already had invested in natural gas (Interview 16).

Some other interviewees acknowledged the role played by these companies as drivers of the reform as “they were pioneers that started their sustainable transitions way before” (Interview 2). They were “highly emission generating industries that sought to reduce their emissions, not only as part of a Corporate Social Responsibility mandate but also because they truly wanted to become sustainable companies” (Interview 24).

However, this group of businessmen did not show their support to the ETL openly in the early negotiations. Eventually, these companies started expressing their support to the law through the renewable energy associations. For example, individual companies never directly signed the communiqués or declarations. In particular, the support from this group was a counterweight to the industrial group that opposed the law. As one interviewee put it: “Peñoles and CEMEX, two very important companies (…) were the pushing parts within the business sector. If it had not been for them, the law would never have passed because then there would only be the others (the industrialists who opposed)” (Interview 6).

The second group of big companies, which had stayed out of the discussion of the law during the first two stages, started to support the law. The support of those organisations was channelled through the Mexican Business Coordinating Council (Consejo Coordinador Empresarial - CCE) and the Business Council for Sustainable Development (Consejo Empresarial para el Desarrollo Sostenible - CESPEDES). According to the coalition supporting the law, obtaining the support of this sector was difficult, because they were also concerned about the costs that a new law could generate. The promoters of the ETL then had to show them "with numbers" the economic advantages that the law could have (Interview 9). Also, one interviewee said: "It was difficult to get them (CESPEDES) on board. They had important divisions within their own organisation: some were in favour, some were completely opposing. In the end, they decided to support the law, and their support was crucial" (Interview 6).

6.4.2 The media and public opinion campaign

Along with the Senate debate in November 2015, coalitions for and against the law started a media campaign to promote their arguments within the public opinion via advertisements in national newspapers (see Appendix II). The content of the media publications was in line with the negotiations in the Senate and Chamber of Deputies.

Although public pronouncements of the civil organisations were constant during most of 2015[86] and before the new legislature began in October 2015, the tone and frequency of the declarations intensified in November. Especially since the publications in the main newspapers during November and December were paid. As one of the interviewees described, "it became a 'war of communiqués'… We had people at the Congress telling us in real-time what was happening. As soon as we learned that the steelmakers were going to publish an ad, we would call the same newspaper to ask to publish one on the opposite page. It was a very intense process" (Interview 6).

The relevance of this media campaign is that the arguments of the coalitions for and against the law were transferred to the public opinion. For some interviewees, the advertisements were crucial to the reactivation of the negotiations. On the side of the

[86] For instance, the Network for Energy Transition, a collective of business associations, NGOs and other organisations, published statements in favour of the ETL since September 2015, making an appeal to the Senate to approve the law without changes.

supporters of the law, subscribing organisations included a mixture of civil associations, national and international NGOs, along with other environmental groups.[87] The renewable energy association also published a couple of advertisements in favour of the ETL in November 2015, but separately from NGOs.[88] On the other hand, those advertisements against the law were signed by CONCAMIN, CANACERO, and CANACINTRA.

6.4.2.1 The content of the media

Most of the advertisements made direct calls to President Peña Nieto and the Senators to accelerate or stop the process of approving the ETL. The advertisements made explicit references to the relationship between the electricity sector and climate change. This link was one of the main arguments used by the promoters of the law since its inception, but, in the context of COP21 in Paris, the link became more explicit.

One the ETL's supporters side, the press releases signalled how the ETL would help the country to meet its international commitments, i.e. emissions mitigation targets, and how Mexico's image would be damaged if the law was not approved. For example, one of the advertisements said that "failure to approve the ETL (…) will undermine Mexico's word and the recognised international leadership that our country has maintained over the past 20 years" (Document 70). Another advertisement stated that "approving the Energy Transition Law will be fundamental to confirm that Mexico takes seriously its goals and commitments (…) as other emerging economies are doing" (Document 74).

The most aggressive advertisements were signed by Greenpeace Mexico. In these publications, it was suggested that the President should not to attend the COP21 unless the ETL was approved (Document 76; see Annex II). One advertisement reported the "retrograde" Mexican steel industry for "boycotting" the fight against climate change and called on legislators not to be "intimidated by those who seek easy wealth at the

[87] Those organisations included: Tlalocan Alliance A.C., Alianza Mexicana contra el Fracking, Centro de Derecho Ambiental, Comcausa A.C., Red Ambiental Mexicana, Reforestamos México A.C., Fondo para la Comunicación y la Educación Ambiental A.C., ITDP México, Heinrich Boll Stiftung, Hagamos Desarrollo Sustentable, The Climate Reality Project México, Sostenibilidad Mx, Inteligencia Publica, Fundar, Greenpeace México, GFLAC.

[88] The advertisements were signed by renewable energy associations: the Mexican Association of Wind Energy (Asociación Mexicana de Energía Eólica), the Mexican Association of Solar Energy (Asociación Mexicana de Energía Solar), and the Mexican Association of Hydroelectric Energy (Asociación Mexicana de Energía Hidroeléctrica).

expense of our future" (Document 81). The same advertisement declared "a group of industrialists wants to take over the health of the planet and the Mexicans to favour their economic interests" (Document 81).

Another common feature in these advertisements was the dissemination of the benefits of ETL, such as completing the energy model of the energy reform and reducing Mexico's energy dependence (Document 79). Also, some of the advertisements emphasised the economic benefits that the ETL could bring such as "investment opportunities of more than 77 billion dollars and the generation of more than 180 thousand direct jobs" (Document 81).

On the side of the opponents, the coalition against the law also transferred their arguments to the public opinion via advertisements. Their main arguments were: that the national goals were not in line with the level of emissions from Mexico; that the ETL was imposing an unnecessary risk upon the competitiveness of the industry; and that the ETL would have negative impacts on the cost of electricity.

Regarding Mexico's emissions goals, the steelmakers claimed that countries like China were not committing to ambitious goals even when their emissions level was higher than Mexico's. More noticeable, they claimed that Mexico's actions were not useful because: "Global warming is a global problem and requires global solutions. What is done individually will have little effect on the mitigation of climate change but will have a high impact on the generation of jobs and the development of our country" (Document 83). Importantly, they argued that setting ambitious goals, through the ETL, would have further negative impacts such as limiting Mexico's development by subsidising other countries' emissions (Document 83).

Also, the steel industry claimed to be one of the most efficient industries because they had invested in combined cycle gas turbines (CCGT) plants.[89] According to their statements, the clean energy obligations would put them at a competitive disadvantage, which was unfair as they were already producing electricity efficiently. For them, the

[89] According to CONCAMIN, "the Mexican steel industry generates 27% fewer CO2 emissions into the atmosphere per tonne of steel produced than the world average, according to the World Steel Organisation. To achieve the above, in the last ten years we invested more than 5,000 million dollars in improving processes and reducing their emissions" (Document 83)

ETL “only benefits the generators of these energies (renewable energies), giving them investment returns well above of what is required, to encourage these investments, affecting the rest of the industry and consumers” (Document 83). The industrialists also argued that the ETL would generate overrun cost. “The combined effect of privileging ‘clean energies’ and imposing penalties implies a possible increase in the cost of electricity between 20 and 80 per cent in current tariffs” that would be paid by consumers (Document 78).

In one advertisement, the CANACERO, supported by CONCAMIN, proposed to give “natural gas a role as a low-emission fuel to access compliance mechanisms in the ETL” (Document 75). In that way, Mexico would take advantage of the competitive advantage of having access to cheap gas. In response, the organisations in favour of the ETL published an advertisement addressed to the senators, declaring that “natural gas is not clean energy”. Accepting the steelmaker’s proposal “would be inconceivable in the rest of the world” (Document 72).

Interestingly, the steelmakers against the ETL sought to make it clear that they were not against Mexico’s aim of reducing emissions. They wanted the ETL to be modified so as not to affect their competitiveness. In one publication they stated that they were “committed to the protection of the environment, within the terms and conditions of our reality, our business partners, competitors and our commercial position in the world” (Document 83).

Some interviewees argued that the media campaign was successful in that it influenced the presidential support to the ETL and “urged” the Senate to approve the law (Interview 7 and 9). Although it is difficult to establish a direct link between the media campaign and the presidential office support to the law, it is true that the negotiations of the ETL were reactivated at the Senate during this period and that the topic was constantly in national media.

6.5 Unlock of the negotiations

On November 15, PRD senators requested the discussion of the ETL (Document 43; video 12). Senator Armando Ríos Pitter called for “an urgent ruling” on the law as there had been “11 months since the minute (of the ETL) was turned over to the (Senate) Joint Committees, there is still no opinion” (Document 43). This was the first time that the PRD showed public support to the ETL. The party had voted against the ETL in the Chamber of Deputies at the end of 2014 and had not been involved in the negotiations. PRD senators urged for the approval of the ETL to correct “the evils of the energy reform”. They also denounced that the steel industry was behind the lack of negotiations and called the Senate not to be manipulated by these groups (Video 12).

The alignment of the main political forces in favour of the law was completed when PRI Senators started to support the ETL publicly. For example, on the same dates, David Penchyna, the chair of the Energy Committee at the Senate, began to make public declarations in favour of the law, indicating that the complaints of the industrialists were being addressed (Meana, 2015a). Also, Federal Government officials such as the undersecretary of electricity, Cesar Hernández, expressed his support for the ETL stating that the complaints of the industrialists had about seven years of delay because the goal of 35% clean energy goal was approved in 2008 (Meana, 2015). The process was reinforced by the declarations in the Senate strand by the PAN Senators, making frequent calls to the discussion of the law (Video 13).

On November 30, the Committees of Energy and Legislative Studies approved the minutes issued by the ETL (Document 46). The law was discussed and voted with 90 votes in favour, seven against and three abstentions (Document 57). As Senators made some additions to the ETL proposal, the law had to pass to the Chamber of Deputies again for approval. According to PAN legislators, the modifications made by the Senate were issues of drafting (Document 53); however, the modification had one major implication: article 22 included a flexibility mechanism for the CECs obligation (Document 46; Interview 9). This article is further discussed in the next section. Despite CONCAMIN complaints, whose main spokesmen requested more discussions, the ETL was passed by the Chamber of Deputies on December 9, and the Decree of law was published on December 24, 2015 (Document 26).

6.6 Content of the Energy Transition Law

The purposes of the ETL were to regulate the sustainable use of energy and to set out the requirements of clean energy and the reduction of pollutant emissions from the electricity industry (Document 26). For that aim, the law ruled in five main topics: sustainable energy goals, definition on institutions' responsibilities, the creation of policy instruments, financing of some activities related to the goals (including R&D) and elements regarding information and sanctions.

First, the ETL ruled on three types of sustainable energy goals: clean energy (electricity), distributed clean energy and energy efficiency. Transitory article 3 confirmed the goal of 35% of clean energy for 2024, which was established in the previous legislation – the 2008 LAERFTE and the 2012 LGCC (see Chapter 4). The ETL stated the obligation of issuing a regulation to promote clean distributed generation, including facilities and systems, installation methods, certifications, training programs, support mechanisms, fiscal or financial stimuli, and other support mechanisms. However, no specific goals on clean distributed generation were provided in the law. Likewise, in terms of energy efficiency, the law mandated the need to establish goals but it did not establish them. The law stated that an "indicative" energy efficiency goal (as opposed to the mandatory character of the clean energy goals) was to be included in a new National Program for Sustainable Energy (Programa Nacional para el Aprovechamiento Sustentable de la Energía - PRONASE). According to some interviewees, the exclusion of specific goals in distributed energy and energy efficiency was requested by the SENER during the negations at the Chamber of Deputies (Interviews 2 and 8).

Second, the ETL defined the role and responsibilities of the different institutions, although most of the responsibilities were already established in previous laws and regulations. Among SENER's main responsibilities were: promoting the general compliance of clean energy goals and preparing annual progress reports; issuing a National Atlas of Areas with High Potential of Clean Energies; and ensuring the congruence of the policy instruments. The main duties of the Energy Regulatory Commission (CRE) included the identification of areas with high potential for clean energies and infrastructure needs; the clean energies interconnection contract models;

the emission factor of the National Electricity System (NES), and the creation of a Public Registry of Clean Energy Certificates.

According to the law, the main resposibilities of the National Centre for Energy Control (CENACE) included guaranteeing “open and non-unduly discriminatory access” to clean energies into the transmission and distribution networks; adopting the necessary technologies and procedures to guarantee the optimal use of clean energies; determine the transmission expansion needs of the NES in areas with high potential of Clean Energies to meet the Clean Energy goals. Also, the National Commission for the Efficient Use of Energy (CONUEE) is in charge of: proposing the Energy Efficiency Goals and the mechanisms for compliance; establishing the methodologies to quantify emissions (and avoided emissions) per type and end-use; and issuing the Official Mexican Standards regarding Energy Efficiency. The ETL also established the creation of a Consultative Council for the Energy Transition, described as permanent citizen consultation and participation body to provide opinions and advice to the SENER.

Third, the ETL established the creation of four policy-planning instruments: one national strategy on energy transition; two special programs to implement such strategy; and a program focused on smart grids. These instruments are described below:

1) The Energy Transition Strategy is a guiding instrument of national policy in terms of clean energy obligations, sustainable energy use and improvement in the energy productivity of the electricity industry. It contains long-term (30 years) and medium-term (15 years) scenarios to be updated every three years.
2) The Energy Transition Program seeks to implement the actions established in the Strategy by ensuring its economic viability.
3) The National Program for the Sustainable Use of Energy (PRONASE) is the instrument through which the Federal Government will establish the actions, projects and activities established in the national strategy.
4) The Intelligent Electricity Networks Program aims to support the modernisation of the national transmission and distribution networks, to secure that infrastructure meets the electricity demand in “an economically efficient and sustainable manner” while facilitating the incorporation of new technologies.

Fourth, the ETL included some elements about financing and innovation and research. On the former, the ETL established that the resources necessary for the Federal Public Administration to comply with ETL "must come from the Federation Expenditure Budget, from the financial instruments available for public works" and also from private contributions". On the later, the ETL established that the SENER and the National Council of Science and Technology are responsible for promoting applied research and the development of technologies for the fulfilment of the clean energies and energy efficiency goals. It also mandates the creation of the Mexican Centres for Innovation in Clean Energy to promote research and development of clean energy technologies, as well as to build capacities among the scientific community.

Article 84 and 85 of the ETL rule on the development of "Clean Energy Value Chains". The ETL established that the Ministry of Economy and the SENER are in charge of the design and implementation of a roadmap to promote Clean Energy Value Chains, including specific instruments such as direct support to small and medium enterprises.

Finally, the ETL rules the creation of the National Energy Information System to register, update and disseminate information on the sustainable use of energy. On the sanctions, the law established that the CONUEE would fine users with a pattern of high-energy consumption that does not provide the information or provide false or incomplete information, while the CRE will fine the electricity suppliers or distributors of natural gas who refuse the collection service derived from the established agreements.

Interviewees' opinions regarding the content of the ETL and its sustainability approach were diverse. For most of them, the law was necessary for updating the previous legislation and harmonising it with the changes introduced by the electricity reform (Interviews 1, 3, 10 and 21). For example, the 2008 LAERFTE and the LASE were replaced by the ETL (transitory article 2). For few, the ETL was rather unnecessary (Interviews 12, 14 and 15), as it did not contain new legal dispositions, and it ends the benefits that RE generators had under the previous legislation. For example, the clean energy goals already existed in the constitutional reform of 2013 and the LGCC of 2012, while the dispositions for the CECs were already included in the 2014 Electricity Industry Law, as explained in Chapter 5.

Although most of the interviewees acknowledged the value of the ETL in terms of the "sustainability", they recognised that the law alone was not sufficient to foster a sustainable transition in the electricity regime for several reasons. Among the reasons provided were: the transition would depend on the implementation of the ETL (Interview 11 and 25); clean energy goals quite limited (e.g. not technology-specific) (Interview 8); the exclusion of specific energy efficiency goals (Interview 3); the concessions made to the industry with the flexibility clause (Interview 22); the electricity policy keeps prioritising oil and gas (Interviews 2 and 27).

According to most interviewees, there are two specific benefits of the ETL. First, in addition to the 35% goal for 2024, the ETL introduced midway mandatory goals: 25% by 2018 and 30% by 2021, which contributes to the compliance by securing frequent monitoring and that actions are taken in the event of a lag in progress. However, the long-term goals of 40% in 2023 and 50% in 2050, that were included in the LAERFTE and the LGCC, were no longer incorporated in the LTE.

Second, the ETL introduced a limit of 100 kg/MWh of GHG emissions for a source to be considered clean energy. As explained in Chapter 5, the Electricity Industry Law adopted the broad definition used in the previous legislation, i.e. in the 2012 LGCC. However, transitory article 16 of the ETL specifically establishes that "combined cycles cannot be considered as efficient cogeneration"; thus, they are not clean energy. The same article also states that "the minimum efficiency for any other technology to be considered low carbon emissions will be based on an emission rate not exceeding 100 kg/MWh. It is important to signal that the most efficient combined cycle power generation processes have average emissions of 350-400 kg/MWh (Dones et al., 2004). As such, the cap established by the ETL eliminates the possibilities of considering natural gas and CCS as clean energy generation sources.

One of the most important disadvantages of ETL, according to the interviewees, was the last-minute addition made by the Senators, i.e. transitory article 22. This article became known as the "flexibility clause" because it established exceptions on the compliance of CEC's obligations. Specifically, it allows that 50% of the obligation to buy CECs could be deferred for up to two years during the first four years (2018-2021) in two specific cases. One, when the total number of registered certificates did not cover

at least 70% of the total amount of the obligation for each of the first two years. Two, when the price of the certificates in the basic service auctions exceeds 60 UDIs (USD 19.4/MWh).

For some, the inclusion of this flexibility mechanism sought to “generate balance and confidence by encouraging the generating market” as it “sought to safeguard and protect all users of the sector, so that they can have a legal alternative to any case of non-compliance by generators in the offer that will be of these certificates” (Document 46). For others, the flexibility clause in practice was a concession to the steel industry lobby (Interviews 7, 10 and 22). Thus, even though the opposition coalition did not manage to stop the approval of the law, they obtained some of their demands with article 22.

It is important to highlight that the content of the ETL denotes the specific liberalisation-sustainability link that existed during the negotiation of the reform. This link emerged from the design of the electricity reform when the CECs and the auctions were chosen as the main market mechanisms to fulfil the constitutional mandate of clean energy obligations (see Chapter 5). This link was reinforced by the fact that the architects of the ETL used the liberalisation of the electricity sector as a vehicle to insert sustainability into the electricity regime.

By including the prior clean energy target of 35% to 2024 along with new midway goals for 2018 and 2021, the ETL built on the previous narrative of sustainability, the one associated with climate change. With the restriction on the technologies considered as clean energy (i.e. the 100 kh/MWh cap), the creators of the ETL ensured that the measurement in the reduction of emissions from these sources was compatible with international standards. They also sought to expand the limited sustainability approach of Electricity Industry Law, by including in the ETL other elements relevant for a SET, e.g., the goals in distributed energy and energy efficiency, strengthening the role of energy institutions and policy instruments, innovation and technology promotion and the construction of an information system to improve decision-making. The objective was that the legislation on sustainable energy was consistent with the new context of the electricity reform

However, this is only one view of how liberalisation and a more sustainable energy system relate to one another. As discussed in Chapter 1 and 2, different countries have adopted different approaches to sustainability and different process of liberalisation in the electricity regime, which have led to different views about their relationship.

In the Mexican case, the liberalisation-sustainability relation was forged by two particular path dependencies existing in the electricity sector. First, the CECs scheme was the only viable market mechanism given the political impossibility to use alternatives such a feed-in tariffs and fossil fuels taxes due to the economic and political structures.[90] Second, the resources and experience of the coalition that created the ETL played a crucial role in building this particular relationship between liberalism and sustainability. Their technical training on climate-related issues along with their political capabilities such as previous experience in legislative processes contributed to the fact that the sustainability vision of the reform was strongly associated with climate change. As one interviewee related, when the debate about the energy reform and electricity reform started, there were various narratives about sustainability among civil society. However, the one that predominated was the one based on the link with emissions reduction, i.e. climate change (Interview 20).

[90] As accounted in Chapter 5, general electricity consumption is heavily subsidised, which makes difficult to set subsidies in RE generation such as feed-in mechanisms. Also, the architects of the electricity reform avoided the implementation of a tax on fossil fuels because such mechanism would be of environmental jurisdiction, i.e. Environment Ministry (SEMARNAT), instead of being implemented by an energy institution such as SENER.

6.7 Summary

The analysis of the ETL reveals how the institutions influence the adoption of specific energy policies, shaping the direction and scope of SETs. Four main features of the negotiation process are relevant for the analysis of SETs.

First, the detailed analysis of the policymaking process of the ETL identifies the main actors involved in the negotiation, showing the inherent “multi-actor nature” of SETs discussed in Chapter 2. The analysis considers not only the role of incumbent actors but also actors not usually accounted in STT-MLP approach, i.e. policy entrepreneurs. Policy entrepreneurs were key in crafting the opportunities opened by the Reform to include sustainability in the agenda. They were also crucial in forming coalitions for the approval of the ETL. The origin of the ETL was traced to a small group of PAN legislators, who in coalition with some civil society actors became not only the creators of the law but its main promoters throughout the negotiation process.

Second, the analysis of the policymaking process reveals how the structures of power in the electricity regime were evident in the process of negotiating reform. The strongest lobby against the ETL came from a group of industries that have invested in natural gas, i.e. the asset specificity discussed in Chapter 2. In the end, the opposition to the law was “neutralised” by the participation of another influential group: the big companies that already used renewable electricity. The ETL was approved with modifications (i.e. facilities in terms of compliance with the obligations of clean energy), which can be considered as a concession to the opposition industrial groups.

Third, the findings show that external pressures such as the political moment, the dynamics within the Congress, the dynamics (rivalries) between the different ministries (Energy, Economy, and Environment) were relevant pressures to the negotiation process. That an external event like the COP 21 created favourable conditions for the approval of the ETL was because the policy entrepreneurs made the connection between the processes at the landscape level and the policymaking process.

Finally, this chapter emphasises the fact that, from its origin and until its approval, the ETL was separated from the discussion of the other laws, which shows the political conflict over the sustainability of the electricity regime, i.e. the ETL, was not a priority

of the Energy Reform. Rather than resulting from a sustainability approach within the Reform, the ETL resulted from the interactions of a small group of actors who lobbied at various levels for the approval of the law. This explains the limitations of the ETL's content and its contentious negotiation process.

Chapter 7: Discussion Chapter

7.1 Introduction

The thesis has applied a framework that draws on elements from Socio Technical Transitions (STT) studies and Historical Institutionalism (HI) to examine the Mexican electricity system, in order to determine how the political dynamics within the sector affected its sustainability transformation over the last two decades. As such, the study tests some analytical elements from STT and HI (three-level analysis, path dependence, power distribution and critical junctures) that have been used to explain sustainable energy transitions (SETs) in other contexts. The thesis also added other analytical elements that have not been included in the STT-HI framework before – namely the detailed analysis of the policymaking process of the reform and the role of policy entrepreneurs – to produce a more complete framework that may be useful for other cases of transitions similar to Mexico. The overall aim is to determine whether and to what extent they could explain the dynamics of the Mexican case, which has been received little coverage in the literature.

The research addresses three main research questions: 1) what are the drivers and obstacles to a sustainable transition in the Mexican electricity sector; 2) how have institutions shaped Mexico's sustainable transition in the electricity sector, 3) what was the role of sustainability in the electricity reform of 2013. The research has three units of analysis: the electricity sector prior to the reform, the Energy reform process and the process of approval of the Energy Transition Law (ETL). The analysis was divided into two periods: one prior to the energy reform (from 1995 to 2012), and the second one, focused on the electricity reform process, which started in 2013 and ended in 2015, when the ETL was approved.

The findings indicate that institutional arrangements have limited the scope for a sustainable transition in the Mexican electricity sector in the last thirty years. Mexico's attachment to oil originated from a historical abundance of oil resources and became deeply embedded in the political structure and system. Consequently, the governance of the sector privileged the use of oil as a main source of energy, limiting the scope for technological innovation in other energy sources. In the 1990s and the 2010s, pressures to change emerged at different levels of the electricity sector, producing

enabling conditions that opened opportunities for change. More facilitating circumstances, mainly political, reinforced the pressures for change during the energy reform of 2013, in particular, to further the use of renewable energy, including partisan alignment and policy entrepreneurs willing to advance a sustainability agenda in the sector. However, both in the 1990s and 2013, institutional structures and their patterns of reproduction constrained the scope of change.

This chapter discusses the thesis findings in the context of the theoretical frameworks by stressing both how the Mexican case fits under the STT and HI literatures but also how it differs. Crucially this case of the Mexican electricity sector shows that path-dependent developments are enacted through the physical form of technologies and infrastructures but also through the political processes and institutional arrangements related to those technologies. Therefore, a HI analysis of the electricity sector complements the STT analysis by explaining how the political processes have affected the sustainable transition by limiting the development of renewable energy. As such, the combined framework helps to answer the following questions: why the reform occurred in 2013 and not before, despite growing pressure for the change in the electricity regime since the 1990s; why the 2013 reform was not a sustainable energy policy, even when it was promoted as being so; and why, despite Mexico's large renewable resources, the country produces little electricity from these sources.

The answer to these questions lies in the political processes of the sector, in the restrictions and opportunities provided by the institutions and in the ways in which actors interact and influence policy developments. Thus, the Mexican case shows that the (scope and pace of) change depends on the politics of the electricity sector, and not just upon technological change, as traditionally assumed in the STT literature. However, the Mexican case exhibits specific features that cannot be explained by the combined framework, and that seemed to be related to Mexico's particular characteristics as a developing country. Those features are the fact that the Mexican case is not innovation-driven, the disconnect between environmental/climate policy and energy policy in the Mexican electricity sector, and the absence of a liberalised market in Mexico which in turn begs the questions as to whether market liberalisation is a precondition for a sustainable energy transition.

7.2 What the combined framework can explain

Sustainable energy transitions (SETs) are complex processes that cannot be fully explained by one literature. As established in Chapter 1, the energy transition literature stresses the importance of path-dependent patterns in offering or hindering opportunities for change, both in terms of policy and technology. Within the STT literature, policy and political power are acknowledged as elements of the energy regime, but they are little theorised because the focus is on technological developments. By contrast, HI commonly focuses on the complex political dynamics in which policy decisions (energy policy) are embedded, but offers limited consideration of the material dimensions of technological changes (Roberts and Geels, 2019).

This thesis overcomes the limitations of STT and HI by synthesising a new approach from elements of each, in order to understand how the political processes, shaped by the contextual dimensions, i.e. institutional arrangements, affect technological change in the electricity sector, and ultimately shape energy policy and the emergence of sustainable socio-technical change. When combined, STT and HI provide a more thorough analysis of the transition in the Mexican electricity sector.

7.2.1 Forces against change: oil and its institutions

7.2.1.1 Path-dependent patterns: the preservation of oil through institutions

Fossil fuel prevalence in the Mexican energy mix, arising from the historical abundance of oil resources, resulted in a stable energy system. As in other petro-states, where the executive power became linked to the fate of the oil industry (Karl, 1997), Mexico's national interests, infrastructure, planning and policy were oriented to oil. Resource nationalism, combined with a monopolistic structure were the two main elements defining the governance of the Mexican energy industry. In this context, the path-dependent patterns developed in the oil sector translated into an electricity system captive of the dynamics of the oil industry.

For decades, the system provided enough public revenue, sufficient energy to satisfy growing demand and a consolidated oil industry that placed Mexico among the world's top producer and exporters. Institutions created self-reinforce trajectories (Pierson,

2004): production, infrastructure and planning in the electricity sector were oriented to oil needs and priorities, creating technological and policy path dependence patterns that were reproduced in the electricity regime. The State monopoly and its exclusivity in the provision of electricity (a public service) translated into a utility granted complete control over the value chain of the electricity sector with great political power. This structure resulted in the physical and political centralisation of the system, which provided the stability of the electricity regime.

As explained in Chapters 4 and 5, these path-dependent patterns were evident in the 2013 energy reform in at least in three ways. From the beginning, the energy reform was an oil-oriented reform by which the country would open the hydrocarbons sector to allow the necessary private investment injections. In other words, the reform sought to rescue the oil industry from a financial and technological crisis. Also, the patterns of stability reproduction were evident in the process of negotiation, for instance, in the use of the “Cardenista” rationale to justify the reform and minimise opposition. At the time of the negotiation, there were attempts to limit the scope of the reform so that it was not contaminated by other controversial topics (i.e. the electricity reform or the sustainability agenda). The approval of the oil reform was the top political priority. As a consequence, there was explicit segregation between topics, (exemplified in the different terms for the attainment of the secondary laws) which led to the privileging of the hydrocarbon reform over all other initiatives (including sustainability).

Institutions are stable and resistant to change (Pierson, 2004). As discussed in Chapter 4, the centralised system and monopoly structure in the Mexican electricity regime reinforced the prevalence of oil, providing the sector with institutional stability. The centralisation of the system (political structure) was facilitated by an electricity grid built around population centres (physical structure), rather than the location of resources such as RE. Since its creation in 1937, the main goals of the Federal Electricity Commission (Comisión Federal de Electricidad - CFE) were the expansion of electricity infrastructure and the provision of affordable electricity, i.e. at the lowest cost for a population with high levels of poverty.

The relative stability of the system does not mean that the electricity sector has not undergone changes. As recognised in HI, institutions usually undertake incremental changes (Pierson, 2004). The historical account of the sector presented in Chapter 4

shows that incremental changes in the early 1990s led to important technological and infrastructure changes such as the adoption of natural gas as the main source of electricity generation. However, despite these changes, the vertically integrated state structure was not altered, proving the change-resistant character of institutions. CFE retained its decision-making power despite the partial opening and the creation of a regulatory body, the Energy Regulatory Commission (CRE). As discussed in the earlier chapters, the state-owned company continued to have the last word in the planning of the system and the terms of the contracts for generation and distribution projects, therefore private generators were subordinated to CFE's decisions.

The priority was the development of large-scale projects based the predominant technologies, oil and later, natural gas. As the planning of the electricity sector was designed to meet the needs of the oil sector, investing in alternative fuels or sources was not a priority. When Petróleos Mexicanos (PEMEX) changed technologies to invest in natural gas, CFE followed that path and natural gas combined cycle gas turbine (CCGT) plants became the top priority for the electricity sector.

7.2.1.2 Power relationships matter

HI's conceptualisation of the relationship between institutions and actors is useful to explain how institutions unequally distribute political power while shaping political preferences and individual goals, and structuring coalitions (Fioretos et al., 2016; Steinmo, 2008). Uneven power relationships are central to the HI framework as they can explain institutional stability as the in which path-dependent patterns are reinforced.

The empirical chapters of this thesis presented a detailed analysis of the historical power relationships among the main actors in the Mexican electricity sector and how they affected the reform process of 2013. One main consequence of the centralisation of the Mexican energy sector, based on a monopolistic structure of both the oil and electricity sector, was the extended decision-making powers of PEMEX and the CFE. By exercising full authority in the sector, PEMEX and the CFE used the rules in their favour to enhance their power (Pierson, 2004). In contexts of ill-functioning institutions, e.g. weak law enforcement and low accountability, the exercise of political power could be magnified and became "extremely" relevant (Wieczorek, 2018). As such, these state-owned companies dictated the preferences, planning and policies of the energy

sector, vested with a double concentration of power: one from their control over the industrial activities of oil and electricity, and the other from the strategic nature of these economic activities.

CFE's concentration of decision-making power affected the development of renewable energies. For a state-company whose mandate was the mass generation of electricity at the lowest cost, investing in expensive technologies with low rates of return (like renewables) was unattractive in the short term. CFE's limitation on financial and technological resources could in part explain this lack of interest. But CFE's resistance to RE projects prevailed when private companies began to invest in wind generation after the partial opening of the 1990s (Chapter 4). These projects were regarded as unfair and unconstitutional competition to public sector generation; thus CFE kept restraining – and in some cases blocking – their development. The extended decision power of CFE, in practice, acted as a barrier to the expansion of sustainable energy.

Chapter 4 showed that the CFE was not only the dominant market player (main producer and supplier[91] of electricity in the country) and the only regulatory body in the electricity sector until 1992 when the CRE was created as an independent regulatory body. As such, CFE became the strongest governing body in electricity, with greater decision power than the Energy Ministry (SENER). However, CFE's power was subordinated to the oil sector, in other words, to PEMEX.[92] For instance, CFE was forced by law to buy PEMEX's fuel, at the price and conditions that the oil company decided (Interview 24).[93] Also, CFE's power was undermined by the Ministry of Finance, which controlled electricity rates, subsidies and had influence over the approval of electricity projects based on their contributions to the public finances (see Chapter 4).

The uneven distribution of power among the different political actors in the electricity sector affected the process of reform in 2013 in at least two ways. First, the power

[91] CFE became the sole utility in the country in 2009 after the dissolution of Luz y Fuerza del Centro (LFC), state-run energy distribution firm providing electricity to Mexico City users, dissolved because of its unsustainable financial situation.
[92] CFE followed the infrastructure investment plans that favoured the planning of the oil sector.
[93] As recalled by one interviewee "In part, one reason why CFE's generation matrix was so polluting was that CFE was forced to consume PEMEX' fuel oil (...) there were problems with the Tula and Salamanca refineries that PEMEX had not solved and they solved it by sending low-quality fuel to CFE to burn it (..) also at a very expensive price" (Interview 24).

struggle between the SENER and the CFE became evident since the initial discussions of the electricity reform. As CFE resisted any attempt to reform that would affect the power of the institution, it was excluded from the proposal. Instead, the SENER led the electricity reform proposal and initial discussions, backed up by the Presidential Office. Second, the Ministry of Finance played a key role early in the reform process and therefore in the scope of the reform, as it was in charge of approving the proposals before presenting them to the Presidential Office.

The power of influential non-governmental actors was also relevant in determining the scope of reform in the electricity sector. The HI analysis allowed the identification of the influential actors, the institutional arrangements in which they have invested, and how those investments are suited over time (Pierson, 2004). The fact that oil was historically viewed as a strategic asset by the Mexican government led to the formation of strong coalitions of actors who lobbied on behalf of the sectors most dependant on fossil fuels, i.e. energy-intensive industries. As discussed in Chapter 6, the main opposition to the ETL came from the iron and steel industry, one of the strongest industrial sectors in the country based on manufacturing production, use of energy and political power. Its resistance emerged from the significant investments that big enterprises from this sector had made in pipelines and generation plants for natural gas. This was in line with STT argument that regime resistance usually emerges from incumbent actors (Geels, 2014) and with HI claims that institutional arrangements urge investments in specific types of assets, while actors usually protect their investments by opposing change (Pierson, 2004). Lobbying by the steel industrial group was successful in that they managed to halt the negotiation of the ETL for several months and to adjust the law by introducing a flexibility clause (see Chapter 6).

7.2.2 Forces for change: the politics of energy

The accumulation of developments in the 1990s and 2000s generated increasing pressures for change in the electricity regime, contributing to momentum for reform, i.e. pressure for regime destabilisation. However, the conditions enabling change are only part of the explanation in the process of change, as they did not automatically lead to changes in the system. Political actors played crucial roles in this process by seizing the opportunities brought by the oil reform to advance a specific agenda of electricity reform. Although there was a consensus on the need for change since 2012, there was

no agreement on the type or depth of such change. Discussion on these issues emerged as the reform process in the electricity sector was rolled out. Actors' strategies to defend their interests, therefore, became crucial in defining the type of reform and overcoming the forces against changes. Some of these opportunities were in favour of sustainability, but most of the times, electricity liberalisation was the main objective. Thus, in line with Stefes' (2010) assumption, the case suggests that actors' interactions within the institutions were crucial to determining the scope of change, affecting the type of transition.

7.2.2.1 Creating a momentum: Dynamics of change and conditions enabling change

Signs of deficiency in the electricity regime and pressures for change were already clear in the decades prior to the 2013 energy reform. As shown in Chapters 4 and 5, there were two crucial waves of change at the regime level. The first wave marks the opening a critical juncture with the partial opening of the sector in the 1990s to private generation through special legal schemes that contradicted the constitutional bidding. These regulatory changes were driven by the increasing congestion problems in transmission services and out of maintenance distribution infrastructure. The economic crisis of the 1980s worsened the budgetary restrictions, further limiting financial resources for investment in the electricity sector, while subsidised tariffs were maintained. These pressures created deep challenges that eventually led to regulatory changes.

The partial liberalisation of the mid-1990s fostered changes in the technology and economic dimensions such as a boost in electricity generation and infrastructure, the transition towards natural gas and the emergence of a partial electricity market (see Chapter 4). But the liberalisation of the 1990s was also an incremental driver for sustainable energy change before 2013. While a vast majority of the new private actors invested in cogeneration projects, some large companies invested in developing wind plants, benefited by the special RE mechanisms adopted after the reform, i.e. the energy bank, the concept of self-supplied power, the stamp system and tax benefits. The legislation enacted in 2008 and 2012 on sustainable energy and climate change further reinforced the use of RE electricity. As a result, there was a boom in wind electricity in 2012 (see Figure 4.5 in Chapter 4). Importantly, the new actors emerged

as a result of the 1990's reforms and during the process of approval of the LCGG, would play important roles in the 2013 reform, as explained in the next section.

The second wave of changes relates to the opportunities provided by the 2013 energy reform. Pressures for changes were intensified by the growing challenges of private generators operating in non-market conditions and the emergence of a parallel electricity market along with the pressures from declining oil production. In 2013, there seemed to be a consensus on the need for an electricity reform, but most of the forces were pushing towards a transition to the use of natural gas. The costs of the change to gas seemed cheaper than for other sources. Thus, the major justification for reform in the electricity sector was to facilitate the replacement of fuel and oil by natural gas. The political agreement among all political parties willing, through the *Pacto por Mexico*, also urged the conditions for reform. Additional pressure emerged at the landscape level with the international climate change negotiations, specifically from COP21 held at the end of 2015, which had a major impact in the approval of the ETL. The COP incentivised the discussion of Mexico's progress on climate change goals, which was linked with the Senate discussions, favouring the approval of the law (see Chapter 6).

7.2.2.2 Despite stability, actors as the main source of change

While the conditions of the change were already generated, the initiation of change depended on the politics of the electricity sector, i.e. the actors involved in decision-making processes, their strategies and choices, the coalition-building processes, the acts of political contestation and the waves of public debate (Capoccia, 2016). Chapter 5 showed how the interests of key political actors – specifically, actors' interests and their power to influence the policymaking process – were crucial in facilitating electricity reform. At the beginning of Peña Nieto's administration, the energy reform was designed to reform the oil and gas sectors. The electricity reform arose from the combination of interests of specific actors within the SENER and the Congress. Specific actors within the SENER (the office of the Electricity Undersecretary) drafted a proposal for reforming the electricity sector, including the creation of a market and a sustainability approach.

The specific Congress dynamics also influenced the approval of electricity reform at a moment in which larger changes to the national energy system were negotiated. The

decision by of the Democratic Revolution Party (PRD) to withdraw from the energy reform negotiations opened up the opportunity for more liberal reform. National Action Party (PAN), the opposition party, used the electricity reform in exchange for concessions in the approval of another reform. This process of issue linkage allowed the electricity agenda to become one of the pillars of the reform, which in turn contributed to the insertion of sustainable issues such as the clean energy certificates.

As discussed in Chapter 1, the involvement of non-government actors in sustainable transitions is not clear in the STT literature, as it is the role of government in initiating, directing and maintaining transitions. In the Mexican case, a common view amongst interviewees was that the participation of non-governmental actors throughout the negotiation process of the law, both in favour and against, was crucial.

The evidence shows the critical role of policy entrepreneurs in sustainable matters and the emergence of the ETL. Policy entrepreneurs usually persuade the different parties to work together (Pierson, 2004) and are willing to invest their resources to promote their position (Kingdon, 2011: 179). The ETL resulted from a political collaboration between an NGO and PAN legislators. Importantly, the analysis shows that it is not a coincidence that the PAN sought to support the creation of the ELT. As explained in Chapter 4, during Calderon's administration, this party had adopted a climate change agenda that included sustainable energy targets, e.g. the targets included in the LAERFTE and the LGCC, which therefore are considered incremental drivers of change (see Chapter 4).

A specific group of actors took advantage of these previous connections to promote the sustainability agenda in the 2013 reform. The PAN-NGO coalition seized the opportunity created by the reform negotiation to advance specific interests. Early in the negotiations, this coalition proposed the insertion of "sustainability" in the constitutional reform and drafted the first proposal of the ETL. Even when the terms of the legislature changed, the same actors managed to push forward the law approval. In addition to helping with the technical part of the law, the NGO participated in all the political discussions. They were therefore instrumental in leading the lobbying process in favour of the law within and beyond the legislative discussion, for instance by partnering with different stakeholders and by influencing public opinion through outreach activities and media campaigns, especially around the time of the COP21.

The process of approval of the ETL indicates that the link between energy and environment was neither explicit nor automatic; it had to be built by the policy entrepreneurs. This was very clear in late 2015 when public opinion was used to urge President Peña Nieto and the Senate to approve the law before the COP 21. As such, these actors were not only triggers in the creation of the ETL but by collaborating with the PAN, they became facilitators of the negotiation process. As explained in Chapter 6, the role of this NGO, however, is unusual regarding their technical, political and financial resources. This group is composed of experienced staff that has an extensive understanding of sustainable energy as well as experienced in the policymaking process (i.e. they participated in the LGCC legislative process in 2012).

7.2.3 Partial changes: policy change as an outcome of the electricity reform

Historical studies within the STT literature have shown that systemic change, such as SET, only come about when developments at three levels: niche, regime and landscape, emerge and reinforce each other (Geels, 2011). The Mexican case suggests that, despite the stabilisation patterns in the electricity regime, opportunities for systematic change emerge when events at the different levels of the system link and generate pressures for changes. However, the case also shows that although those pressures facilitate the opportunities for change, by creating momentum, they are not determinants of change by themselves. The time and sequence of events and processes (Pierson, 2004), along with the interactions of the actors participating in the political process are significant elements.

The concept of critical juncture was useful to understand the processes that led to the 2013 reform in Mexico. During critical junctures, long-term institutional stability can be altered, and path dependence can be overcome because structural constraints are significantly relaxed (Pierson, 2004) and possibilities to create or modify existing institutions arise (Fioretos et al., 2016). Notably, during these phases, actors increased their opportunities to influence the policy (Capoccia and Kelemen, 2007).

The findings in the Mexican case are partly consistent with this HI approach to change. The analysis showed how the combination of specific events at different levels (regime, landscape and niche) and within the different dimensions (economic, political and technological), began a phase in which the institutional arrangements were relaxed,

and change became possible, i.e. opening critical juncture. In the years before the 2013 reform, a set of conditions in the electricity sector resulting from the semi-opening of the 1990s and the unsustainable financial situation in the oil sector created more pressures to change. The interests of specific political actors in 2013, taking advantage of the opening of a critical juncture, led to a reform in the electricity reform and the introduction of the ETL. Political developments at a particular time explain why the energy reform occurred in 2013 and why previous attempts failed despite the existence of pressures for change.

During critical junctures, agency increases because actors face a broader range of feasible options and, as they have more room for manoeuvre, their choices are likely to have a significant impact on subsequent outcomes (Capoccia and Kelemen, 2007). During the years of the reform, a conjugation of events contributed to creating the necessary fluidity for political actors to increase their influence a policy change. First, the opening a broader range of options such as the possibility to reform the Constitution to “openly” allow private participation in the sector and the possibility to end the state monopoly in the electricity sector for the first time became feasible. On the sustainability domain, the options that became available were the possibility to insert a “sustainability” agenda within the Constitutional reform and the possibility to link sustainability and electricity policies through specific new laws.

Second, the possibilities for actors to influence institutional formation increased when the PRD withdrew the reform negotiations because the withdrawal allowed the Institutional Revolutionary Party (PRI) and PAN to propose a more liberal reform to the electricity sector. On the one hand, as the attention was focused on possibilities of the privatisation of the oil and gas sectors, it became easier for the Electricity ministry to push an ambitious proposal. On the other hand, policy entrepreneurs (NGO), interested in the sustainability of the sector, had greater scope to influence the electricity reform (in favour of the ETL) when they associated with PAN. The latter used the electricity reform and its sustainability aspect as political bargain power with the ruling party, PRI.

Even when the conditions for change are present, the counterweight of opposition and path dependence can limit the magnitude of such changes. Hence, while the 2013 energy reform involved important modifications to the institutions of the electricity sector, i.e. the creation of an electricity market open to the private sector, the state

monopoly survived on certain issues. More importantly, a comprehensive sustainability policy in the electricity sector was not adopted as a result of the reform. Part of the explanation of this lack of policy change seems to lie with HI claims on the constraints imposed by the institutions in place and their path-dependent mechanisms. As shown in Chapter 6, the opening of the electricity sector reflected such constraints and the prevalence of the dominant interests, i.e. rescuing the oil industry.

Another part of the explanation of the lack of a comprehensive sustainability policy relates to characteristics associated with the level of development of Mexico. As discussed in Chapter 1, developing countries' challenges (e.g. weak enforcement of legal frameworks, high levels of economic and social inequality, clientelism and patronage relationships affecting the policymaking processes) make the discussion about sustainability more complex (Ramos-Mejía et al., 2018; Wieczorek, 2018). Factors such as the low cost of electricity, the short-termism of public policies, investments and corporate relations with political actors and history of resource nationalism have been critical in shaping Mexican energy policy. Although these circumstances are present in other cases, Mexico's level of development exacerbates these trends and makes sustainability contentious at the policy level, which is further explored in the next sections.

7.2.3.1 The durability of some structures: State monopoly managed to survive change

The energy sector is resistant to changes because institutions and institutional arrangements are deeply embedded. In Mexico, this was evident in the permanence of the institutional monopoly of the electricity sector for almost seventy years. While many countries underwent a rapid process of liberalisation and privatisation of their electricity sectors, (for instance, in Latin America those processes boomed in the early 1990s; see Chapter 2), Mexico transited to a hybrid model where the state-owned utility retained the dominant role in the sector and CFE was the single buyer.[94] As detailed in Chapter 4, the monopoly structure survived the regulatory changes of the 1990s and its consequences. In other words, a technological change took place in the 1990s in the electricity regime, by which natural gas became the main source for electricity

[94] CFE was the only entity legally entitled to buy and resell electricity for purposes of public service thus it was both a monopoly and a monopsony (see Rodríguez-Padilla, 2016)

generation, but no institutional change occurred as the institutional arrangements only went through adaptations. These incremental institutional changes are consistent with HI, particularly when institutions have been in place for a long time (Pierson, 2004).

In 2013, more fundamental changes were introduced with the creation of an electricity market, the opening and the transformation of CFE into “state-productive enterprise”, i.e. now subject to normal corporate tax and payments of dividend to the state. Those changes showed a partial adaptation of the electricity regime as they challenged the monopoly structure. The modifications represented a reform to the scope of the public service of electricity and supposed the disintegration of the monopoly in the supply chain. The open competition in generation and commercialisation and the structural separation of formerly integrated utilities and unbundling of generation, transmission, and distribution services along with the launch of independent systems operators (ISO) are also major changes. Despite the changes, the state still has the control and operation of the transmission lines and distribution, the electricity dispatch and operation of the wholesale market. In addition, the CFE was not privatised but remained a public entity.

7.2.3.2 Sustainability as a policy change outcome of the reform

The findings of this case indicate that the reform of 2013 is not a sustainability reform in the electricity sector. The policy that governs the Mexican electricity sector continues to favour fossil electricity for three main reasons. First, the prevailing mandate in the sector is still that the generation and supply of electricity have to be the lowest cost. Currently, this goal can only be achieved by using natural gas, due its low cost and availability, but also because of the lock-in sate generated by the investments in infrastructure for generation and transportation of natural gas (Chignell and Gross, 2012). CFE’s policies of the last twenty years have favoured investment in pipelines, plants and infrastructure for natural-gas electricity. As discussed in Chapter 2, sunk costs and technological obduracy are important obstacles for major changes in the energy sector (Geels 2010; Verbong and Geels, 2007), in particular, to the adoption of RE technologies. They are also one of the main sources for incumbent opposition to change (Geels 2014), i.e. it is not surprising that the firms that opposed the ETL were the ones with the biggest investments in natural gas plants (see Chapter 6).

Second, the legal changes introduced at the constitutional level in 2013, via the amendment to article 25, seemed consistent with the objective of the sustainable transformation of both hydrocarbon and electricity sectors. As established in Chapter 5, article 25 of the Constitutional reform was modified to introduce “sustainability” as a criterion in national policy, including energy policy. However, that amendment was proposed and introduced at the request of the PAN legislators, who had presented a constitutional reform initiative that included several sustainability clauses.

The legal modification of article 25 had two contradictory effects in terms of the sustainable transition in the electricity sector. On the positive side, article 25 introduced an explicit link between the environment and energy for the first time, from which it could be inferred that the reform sought to make the electricity sector sustainable. As expressed by some interviewees and discussed in Chapter 6, article 25 would later be used by the promoters of the law as the *raison d'etre* of the ETL. Also, the constitutional reform created an express mandate to the State to establish obligations on clean energy and emissions reductions, applicable to the participants of the electricity sector. In other words, for the first time, clean energy was a legal obligation for individuals and the State was responsible for compliance.

On the negative side, the inclusion of sustainability in the Mexican Constitution was vague enough to leave at the discretion of the negotiators the type and scope of laws and regulations necessary to comply with the new mandate. The establishment of a different deadline for the environmental legislation, conceived as a way to avoid the contamination of the oil reform, contributed to a segregation of sustainability from the rest of the reform. Thus, although the sustainability of the electricity sector was part of the constitutional reform in 2013, the secondary laws left it aside to focus fully on the creation of the electricity market. The ETL ended up being discussed in mid-2015 in complete isolation from the rest of the laws, which were approved a year before.

Third, the reform did not result in the adoption of laws and policies to address the sustainability of the sector systematically. The authors of the ETL intended to create a law to accelerate a sustainable transition in the sector; they named it as such. However, the separation of the sustainability from the rest of the reform (to give priority to oil) plus the power of the influential actors opposing the law, contributed to reducing the scope of the law and its impact in the overall process of change. The approved version of the

ETL focuses on a small part of the electricity sector, i.e. the obligations in the use of sustainable energy by large consumers (industry). The rest of its content is policy-oriented but not mandatory in itself, which makes it a limited law when compared with the rest of the electricity reform (see Chapter 6). Also, the law does not regulate in innovation-technologies of the electricity sector or in other areas in energy issues related to the transport sector, which is further discussed in the next sections.

7.2.4 Limitations of the critical juncture framework

The critical juncture approach used in the combined STT-HI framework was useful in allowing a comprehensive analysis beyond an examination of the antecedent conditions of reform, to include an analysis of the events and processes *during* the reform such as the range of feasible policy options and how actor's choices shaped the outcome of the negotiations (Capoccia, 2016; Capoccia and Kelemen, 2007). A critical juncture analysis, combined with the concept of policy entrepreneurs, was helpful to identify the political interactions of key actors and the strategies used to legitimise change (Stefes, 2010), i.e. supporting the electricity reform and/or the ETL.

However, the application of a critical juncture analysis to the Mexican case was limited for two main reasons: the lack of an external shock and the fact that the 2013 reform is an ongoing process thus it is currently too early to determine its long-term impact.

First, within the HI literature, critical junctures are usually thought to be initiated by external shocks or crises (see Chapter 2). Recent literature that seeks to combine HI with STT also acknowledge the role external shocks, at the landscape level, could have in creating "a major "push' factor for political reorientation (Roberts and Geels, 2019). The analysis of Mexico identified specific events that contributed to boosting the process of reform before 2012 and during the process of negotiation of the reform. For example, the Paris Agreement in late 2015 was a key landscape factor that contributed to the approval of the ETL (Chapter 6). However, most of these events and processes were not triggers or initial shocks in themselves. It could be argued that there seemed to be a sense of crisis within the electricity sector in the years prior to the reform, mainly influenced by the "state of emergency" in which the oil sector was located, at the landscape level. However, it would be difficult to identify this crisis as "the" single shock that led to a reform in electricity. Rather the reform seems to be the result of the

conjugation of events and processes caused by multiple factors (the crisis in the oil sector, the historical trend in low prices of natural gas, the reform to the oil sector in itself and the partisan alignment in 2012 and during 2013, which allowed the Congress approval of the Constitutional reform), which fits with STT view on the interplay of developments between the three levels (Geels, 2011).

Second, as the reform of the electricity sector is an ongoing process, it is not possible to analyse its long-term impacts. The period studied in this thesis (1990-2015) is a snapshot of a long process of change in the Mexican energy sector. The period examined appears likely to be the formative phase of a transition process, i.e. where the new system exists in market niches but does not expand rapidly. And the electricity reform could end up being an acceleration phase, i.e. a period where the transition is deliberately sped up (Roberts and Geels, 2019).

Developments after the approval of the electricity reform seem to indicate a possible acceleration of the projects in renewable electricity. For example, the results of the first three clean energy auctions in 2016-2017 revealed a great interest in investing in renewable energy projects. The first in February 2016 resulted in 74% of the generation awarded to projects and the rest to wind technologies (IEA, 2017: 30). In the second auction of September 2016, solar was again the main technology with 54% of the volume of electricity while wind accounted for 43% and geothermal for 2%. The third auction in February 2017 was open to private buyers, but CFE remained the largest off-taker, buying about 91% of energy and CECs in the auction. Around half of the pledged investment was to solar photovoltaic plants, with the remainder in wind and natural gas. The average prices submitted during these auctions were among the lowest in the world (IEA, 2017: 152). For example, the cost per MWh dropped from USD 47.78 in the first auction to USD 20.15 in the third auction. Together the three auctions represented an installation of more than 7,000 MW with an estimated investment of 8.6 billion dollars in the next years (SENER, 2018c).

While the increase in investments and contracts in RE electricity projects could be considered an indicator of the “success” of the sustainability approach of the electricity reform, it is too early to confirm whether these developments will lead to meeting the clean energy targets. At the time of writing, not all the relevant legislation has been

implemented; thus, the electricity market is not fully operating yet. It is too early to determine whether the outcome of the electricity reform and the ETL approval heralds a new trajectory for Mexico's electricity system, i.e. a critical juncture leading to a more sustainable path.

One way to evaluate the outcome of the recent regulatory changes could be by examining whether a policy paradigm change has occurred as a result of the electricity reform process. For instance, Kern et al.'s (2014) and Kuzemko (2013) use Hall's (1993) policy paradigm concept to assess policy changes in the UK's energy policy. Hall (1993) defined policy paradigm as a "framework of ideas and standards that specifies not only the goals of policy and the kind of instruments that can be used to attain them but also the very nature of the problems they are meant to be addressing" (Hall, 1993: 279). For Hall, a policy paradigm shift occurs when the ideas about a subject and how it should be governed (interpretive framework) change, and the changes are reflected in the objectives and instruments of policy. Kern et al. (2014) included governance institutions as an extra level in their conceptualisation of policy paradigms. The authors found a change in UK energy policy from a pro-market energy policy paradigm in 2000 to a new paradigm embracing new climate change and security goals in 2011. During these years, the interpretive framework accommodated new ideas such as a new understanding of the central role of energy in socio-economic terms (as opposed to its typical role as a commodity) and the recognition of climate change as a market failure that requires a relative change in the role of the state. Those new ideas led to a change of policy goals, where energy security and affordability became primary objectives, while climate change mitigation and renewable energy also became formal objectives of the policy. As a result, new instruments were created – for example, the feed-in-tariff and the introduction and banding of a renewables obligation – along with an electricity market reform. Also, new institutional arrangements were created to accommodate those changes: the Department of Energy and Climate Change, the Committee on Climate Change, the Office for Renewable Energy Deployment, a new energy and climate division within the Foreign and Commonwealth Office and a change in Ofgem's mandate to include sustainability (Kern et al., 2014: 522-523).

7.3 What the combined framework cannot explain

7.3.1 The disconnection between sustainability and domestic-driven innovation

The political context and the interactions between influential political actors – the politics of energy – played a major role in driving the recent reform in the Mexican electricity sector, while technology and innovation played a minor role. This raises questions that the dominant framework, STT-MLP, cannot explain. For example, why has the Mexican transition not been innovation-driven? Is the lack of sustainable energy transition in cases like Mexico related to the fact that the transition was not driven by domestic innovation? In other words, is Mexico's sustainable energy transition limited by the fact that it relies upon importing RE technology from elsewhere? This could be a fundamental factor in how we understand SETs in different countries.

Within the STT framework, technology innovation is the main driver of systematic change and emerges from the niche, which needs to be created, nurtured and protected until technologies are ready to break-through (Elzen and Wieczorek, 2005; Kemp et al., 1998). Under this assumption, sustainability can be achieved in any system, including the energy system, by managing niches, i.e. by protecting sustainable innovation-technologies (Smits, 2016). Thus, the integration of innovation technology in the sustainability policy seems to be a prerequisite for SETs. This has been the case in the successful Western-European cases, widely studied in the SETs literature, i.e. Germany, Denmark, Holland and the UK (Foxon et al., 2010; Geels et al., 2016; Konrad et al., 2008; Shackley and Green, 2007; Verbong and Geels, 2007). During their transition process, these countries developed their RE industries by investing in their own innovation sectors.

However, in the Mexican case innovation and sustainability have not come together. In other words, RE innovation does not emanate from a state-innovation policy, which is a major difference between the Mexican case and the successful cases of SETs explored in the literature. The disjuncture seems to emerge from the historical way in which the country has developed. Developing countries have weak and fragmented innovation systems that lead to a failure in technological catching up (Ramos-Mejía et

al., 2018). The informal security settings in developing countries are characterised by uneven infrastructure, technology imported by firms, coexistence between formal firms and informal businesses, less advanced industrial processes, dominant low-tech (primary) sectors, informal collective property rights and weak regulatory frameworks and law enforcement (Hansen et al., 2018; Ramos-Mejía et al., 2018). These factors, which shape the emergence of technology-innovation such as renewable energy technologies, differ from Western-European settings, where innovation-driven transition emerged in thriving technological environments, with engineering skills capacity and access to raw materials. Such welfare settings include positive conditions for developing innovation such as technology often linked to industrial needs, firms as basic production units, legal property rights in place, legitimate regulatory frameworks, modern lifestyles based on technology and individual freedom, and access to formal labour markets (Ramos-Mejía et al., 2018).

In the Mexican case, RE technologies have not been integrated into the national industrial plan or a technology-innovation policy. Thus far, Mexico lacks a domestic industry of renewable technologies; the small amount of electricity produced from RE comes from imported technology. The fact that RE technologies are not a factor of economic growth for the country was also stressed during the interviews as one of the main obstacles for a sustainable energy transition in Mexico.

The change in electricity policies in the mid-1990s arose from market liberalisation processes instead of innovation-related policies. As a result, a technological change took place in the 2000s, reinforced by specific policies, leading to the adoption of natural gas as the main source for electricity generation and changing the electricity infrastructure accordingly.

HI partially explains the historical lack of innovation in the electricity sector by revealing how the institutional arrangements limited the development of new technologies. The significant investments required by energy technologies and the long-time horizons of technological changes in the electricity sector demand a push-pull approach including government support, but also private participation, from the R&D stage to the commercialisation stage (Tomain, 2017). In most European countries, public and private financing play a crucial role in developing renewable technologies (IRENA and

CPI, 2018). Therefore, energy reforms in different countries have sought to strengthen the regulatory framework in order to incentivise technology investments.

In the Mexican case, the state monopoly structure in the electricity sector implied limitations in financial resources and constrained budgets, worsened by the mismanagement of public finances (see Chapter 4). As the public resources (financial, technical, institutional, human capital) are limited, CFE sought to invest in the most profitable technology, i.e. first the oil, then the natural gas. As a result, the Mexican state left most of the generation of RE electricity to private investors instead of public financing alternative generation plants.

Additionally, a regulatory framework, which allows government support to new technologies and new business practices, for example, through innovation policy and financial support schemes such as subsidies, taxes, R&D funding, seems to be essential for SETs (Tomain, 2017). However, the heavily subsidised nature of the Mexican electricity system constrains the development of such financial support schemes. When electricity consumption is highly subsidised (regardless of the type of technology) like in the Mexican case, RE electricity production cannot be supported via economic incentives such as feed-in tariffs/premiums which continue to be important mechanisms to support renewable technologies (IRENA and CPI, 2018). The Mexican case shows it is difficult to overcome the political pressure for maintaining inefficient and regressive electricity subsidies to companies and consumers.

As a result, while current global discussions on SETs revolve around how to incentivise innovation for developing distributed RE electricity, electricity storage, intelligent grids and microgrids, and the incorporation of advanced information and communication technologies into the electricity system (IRENA, 2019), in Mexico those topics were barely included in the discussion of electricity reform and the ETL. The topic that dominated the reform debate was not innovation, but how to maintain to keep the costs of electricity, which was also the primary concern of those opposing the ETL.

7.3.2 The disconnection between environment-climate policy and electricity policy

One relevant finding in the Mexican case is that the political conflicts over sustainability have been a major obstacle to the development of RE electricity. Although this challenge is not exclusive to developing countries – it is a common trend in all countries (see Chapter 1) – it seems to be deeper and more decisive in countries with lower levels of development. Hess (2014) stresses that in Europe and other advanced countries "there is a broad policy consensus in favour of a sustainable transition for energy" and "the focus of research tends to involve issues of management and policy implementation", giving less theoretical importance to the political conflict over sustainable transition (Hess, 2014: 279).

In developing countries, the consensus on sustainability is less clear, and contradictions are amplified given the "immediate concerns about social inequalities and the lack of access to modern services (Wieczorek, 2018: 209). Issues such as the economic cost of energy, the impact of public policies in the short-term, corporate relationships with political institutions and resource nationalism underpinned by the myth of an oil abundance have played a significant role in shaping in Mexican energy policy. Although these factors are common in other countries, in the Mexican case, they seem to be deep-rooted, creating a continual disconnection between energy issues and environmental and climate issues.

In particular, the political conflict over sustainability is useful to explain the disconnection to sustainability in the Mexican electricity sector. For example, even when previous legislation on sustainable energy and climate change – the 2008 LAERFTE and the 2012 LGCC – were identified as incremental drivers for sustainable energy change because they introduced clean energy targets (see Chapter 4), no legislation was established within the electricity sector to comply with those targets. Importantly, both the LAERFTE and the LGCC were perceived as environmental laws outside the governance of the electricity sector.

It was expected that the 2013 energy reform would bring opportunities to link national climate change targets to energy policy in general and electricity in particular. However,

as discussed in Chapter 5 and 6, such a connection was missed. Moreover, the negotiation of the ETL was a site of contestation between those who sought to incorporate clean energy goals in the electricity reform and those who defended the separation. From its conception, the ETL was considered unrelated to the rest of the reform proposed by the Federal Government via the SENER. The negotiation process reinforced this pattern, having the ETL discussed within the Climate Change Committee of the Chamber of Deputies instead of the Energy committee of the Senate, like the rest of the electricity reform.

The lack of connection between electricity and climate topics in the policy is a pattern evident at the institutional level. Historically, the Environment Ministry (SEMARNAT) had limited authority and involvement in the electricity sector but it has been in charge of the climate policy. While the SENER dictates the national energy policy, it has had little involvement in climate policy. The LGCC of 2012 introduced some institutional bridges between the two ministries but the coordination between both institutions has been quite limited in practice. As such, the SEMARNAT had little involvement in the electricity reform process and in the negotiation of the ETL, which contrasts with its active role on climate change issues.

The analysis of the ETL negotiation process in Chapter 6 reveals that sustainability is contentious in developing contexts. Such contentious is evident if we consider the inconsistent use of the terms “clean energy” and “renewable energy” to refer to more sustainable sources of energy. Initial legislation, the 2008 LAERFTE, focused on the promotion of RE and set specific goals for each RE technology. The climate change legislation, i.e. 2012 LGCC, introduced an unorthodox definition of “clean energies”, which included cogeneration, nuclear energy, fossil fuels with carbon and capture and storage (CCS) and “other low-carbon technologies” considered by the SENER. The LAERFTE was modified accordingly, and the terms started to be used indistinctly, which created confusion. For example, by considering cogeneration, Mexico‘s national targets were suddenly achieved.

As reviewed in Chapter 4, the broad definition of clean technologies included in the original proposal of the electricity reform opened the possibility of considering other

technologies like combined cycle gas turbines (CCGT).[95] As such, during the time of the reform, the terms renewable energy and clean energy continued to be used interchangeably. In the end, the Electricity Industry Law adopted the broad definition used in the LGCC. However, the negotiators of the ETL sought to introduce a cap of 100 kg/MWh GHG emissions for an electricity source to be considered clean by which natural gas and CCS could no longer be considered clean.

One reason that has contributed to the disconnection between sustainability and electricity policies seems to lie in the economic domain. As explained in Chapter 4, there are deep pressures in Mexico to maintain low electricity rates, a discussion that is linked to the high electricity subsidies. The discourse of low electricity rates has been used to defend the status quo in the electricity sector, which in other countries has not been a major issue in SETs. For instance, at the time of the reform, German consumers tended to accept a rise in electricity prices in order to subsidise RE, which is unlikely to happen in the Mexican context.

As explained in Chapter 1, political actors, especially politicians, respond to voters' concerns and interests, who usually oppose any policy threatening to increase energy costs (Lockwood et al., 2013). The low costs of energy – especially electricity – has historically been a political concern in Mexico and the 2013 reform was not an exception (see Chapter 4 and 5). One major justification for high electricity subsidies is keeping the cost of energy low and affordable for the majority of the population, which is a sensitive topic due to the large size of the low-income population in Mexico. However, electricity subsidies have two major implications in terms of the sustainability of the electricity sector. First, the fact that the domestic tariff is highly subsidised means that the tariffs do not reflect the real costs of its production (Carreón-Rodríguez, 2010), which encourages overconsumption of energy and waste in consumption (IEA, 2017; Scott, 2013). Subsidised electricity prices also increase the negative externalities associated with the consumption of fossil fuels as they discourage investments in more efficient equipment and contribute to the adoption of energy-intensive technologies

[95] This position was reinforced, for example, by senior government officials such as Juan José Guerra, the Environment Minister, and Enrique Ochoa, Undersecretary of Hydrocarbons and later CFE General Director, who frequently declared in public that natural gas was clean energy (Interview 9 and 24).

(CIDAC, 2013: 16; IEA, 2017). Electricity subsidies, therefore, create a vicious cycle that incentivises the consumption of fossil fuel-based energy.

Second, the historical use of electricity subsidies conflicts with the establishment of economic incentives for RE technologies, such as feed-in tariffs. As established in Chapter 2, STT's conceptualisation of sustainable transition emerges from the premise that niches need to be nurtured and protected until sustainable innovations are mature enough to break-through and expand in the regime. Thus, specific regulatory instruments and fiscal incentives should be put in place to support niche. Public expenditures for renewable electricity support, including feed-in tariffs, feed-in premiums and green certificates, are recognised as vital mechanisms to support RE technologies (IRENA and CPI, 2018). In Western Europe, for example, annual expenditures for renewable electricity support policies totalled at least USD 66 billion in 2015, while public investment amounted to just over USD 14 billion (CEER, 2017 in IRENA and CPI, 2018: 13).

These two conditions – the imperative of keeping low electricity costs and the high electricity subsidies – may be further exacerbating the disconnection between environment and climate issues and energy policy. The protection of the economy and social policy are major concerns in the country, i.e. the effects that a change in electricity tariffs could have on the industry and the low-income population. These concerns were reflected in the process of reform by the groups opposing the ETL (see Chapter 6). Opposition groups argued that the increased use of RE would damage the competitiveness of Mexican industry; and that such damage would have to be financed through an increase in the cost of electricity that would affect all Mexicans, especially the population with lowest resources.

7.3.3 Electricity liberalisation as a precondition for a sustainable energy transition

The liberalism-sustainability relationship has deeply marked the energy transition in Mexico. The 2013 energy reform was essentially a market reform, which means that the sustainable transition is happening at the same time as the electricity liberalisation. Such parallelism not only represents an analytical challenge and makes the Mexican case more complex, but also makes the relationship between liberalisation and

sustainability more relevant. To understand this relationship, it is necessary to reiterate the ways that narratives about liberalisation and sustainability have been framed in Mexico.

As discussed in Chapter 4, the liberalisation and privatisation of the energy sector have been historically rejected due to the political value that oil has had at the landscape level. Mexico did not adopt the "standard model" of liberalisation of the electricity regime, as other Latin American countries did. In 2013, the liberalisation of the electricity sector was perceived as the solution to its main problems, namely: the increasing need for finance in the expansion and maintenance of the system and the poor performance of the state-run electricity sector (see Chapter 4). These driving forces coincide with electricity liberalisation processes in developing countries (see Chapter 2). In particular, the entry of private investments in the Mexican electricity sector was expected to offset the lack of public investment in generation plants and transmission and distribution networks, triggering its modernisation.[96]

The construction of the sustainability narrative in the Mexican energy landscape and the electricity regime is quite recent. It emerged during Calderón's administration (2006-2012) based on its relationship with climate change. As discussed in Chapter 4, the LAERFTE, LASE and LGCC were the first attempts to incorporate a sustainable energy approach in Mexico, although none of these laws mandates the electricity sector. The constitutional reform of 2013 introduced an explicit link between the environment and energy by declaring the State's obligation to protect the environment in all energy processes, but this sustainability approach was not explicitly linked to the liberalisation of electricity (see Chapter 5).

Sustainability was associated with the energy reform from its origins, i.e. the Reform was presented as a sustainable reform. However, it was the creators of the electricity reform who introduced the explicit link of liberalisation-sustainability by establishing the CECs and the auctions as the main market mechanisms to incentivise the use of clean energies. They assumed the liberalisation-sustainability relationship in terms of CECs

[96] As discussed in Chapter 2, one of the main promises of electricity liberalisation was that competition would bring "improvements in the efficiency of operation of utilities", which could "be passed on to consumers through competitive (potentially lower) prices and better quality of service" (Sen, 2014: 1).

scheme, which was later adopted by the ETL creators. The previous capabilities and experience of the coalition that created the ETL contributed to reinforce the climate change link.

However, this is one view of how liberalisation and a more sustainable energy system relate to one another, one that was forged by the existing path dependencies, i.e. economic and political structures (see Chapter 6), but also by the actors who participated in the process. For instance, if PRD legislators had been part of the coalition that created the Electricity Industry Law and the ETL, another type of relationship would have emerged, perhaps one in which public finance would have had a more prominent role for the development of RE electricity.[97]

One major question that the Mexican case raises is if the market opening is a precondition for a sustainable transition in the electricity sector. As explained in Chapter 2, the liberalisation literature does not offer a clear answer on the positive impacts of electricity reforms in environmental terms, i.e. in the fostering of RE technologies, either in developing or developed countries (see Chapter 2).

Also, SETs literature struggles to answer this question as most of the cited cases of successful sustainable transitions are characterised by well-liberalised electricity sectors. For instance, the UK was a pioneer in the electricity liberalisation, starting in 1986 with its domestic gas supply industry, while Germany, The Netherlands and Denmark began in 1996 as part of a series of reform directives under the European Union (Pollitt, 2012). By the time these countries adopted RE regulation, their electricity sectors had already been reformed.

Although some works in the SETs literature recognise the relevance of market-based structures and institutional contexts to explain the different SETs in the UK and Germany (e.g. Geels et al., 2016; Lockwood et al. 2013 and 2016), their analyses exclude a discussion on the liberalisation- sustainability relationship. Furthermore, their examples are based on developed countries, which may not be applicable to

[97] As analysed in the empirical chapters, the PRD's position has historically been reluctant to liberalisation. Therefore, their withdrawal from the energy reform negotiations opened opportunities for the electricity reform to include the creation of an electricity market and the creation of a clean energy certificates (Interview 23). Specifically, the PRD did not accept the NGO's proposal to create an ETL as it included market mechanisms (Interview 7).

developing countries. As such, the current SETs literature lacks an analysis of the role that liberalism – or its absence – has in the processes of the energy transition in general, and in developing countries in particular.

As Mexico's transition to a market-based structure started recently, its effects and impacts are yet to be assessed. The case cannot offer definite answers on the liberalisation-sustainability relationship, but it does reveal that liberalisation is relevant for our understanding of SETs in developing countries. Therefore, there is a need to recognise the nuances that have typically characterised electricity sector reforms in developing countries in the literature of SETs.

This discussion resonates in the broader debate about the compatibility and trade-offs between market and sustainability, which is not a recent debate. For some, the main problem is that energy markets are primarily designed to match the characteristics of conventional fossil fuel generation and investment (Keay et al., 2013). Then, to encourage the highly capital intensive investments that RE require, "governments have to offer support schemes in the form of subsidies (e.g. feed-in tariffs), "which essentially undermine the role of the liberalized market in setting prices and in motivating investment" (Sen, 2014: 8).

However, for Hall and Nguyen (2017), it is not about the energy market but the policies, for example, planning and financing. In their study, they conclude that the contribution of the private sector to generation in developing countries has depended on governments rather than on the existence of markets, which seems to be the case when it comes to the RE. For Pollitt (2012), liberalisation will have an impact on climate change insofar it is accompanied by policies that aim to "significantly change energy consumption behaviour or energy production technology". In his words, "liberalisation, or the lack of it, will either have a small effect or will be important in *facilitating or hindering* changes which will have a significant impact" (Pollitt, 2012: 135; emphasis added).

7.4 Summary

This chapter argues that the combined framework explains how political processes have affected the transition process in Mexico as historical patterns of stability framed the reform process. It also emphasises that the opportunities for change mainly depend on the political processes of the sector and in the ways in which actors interact and influence policy developments. Thus, the Mexican case shows that the (scope and pace of) change depends on the politics of the electricity sector, and not just upon technological change, as traditionally assumed in the STT literature.

The Mexican case study shows that path-dependent developments are enacted not only through the physical-material form of technologies and infrastructures but also through the political processes and institutional arrangements related to those technologies. In line with HI claims, the Mexican case shows that the electricity sector and its institutions are stable because they have developed mechanisms to ensure their reproduction and permanence. Such mechanisms include path-dependent patterns grounded on the establishment of institutional arrangements and a governing structure that privileged the use of oil (i.e. oil-centred energy policies and a monopoly structure). The centralisation of policies, the establishment of the state ownership of resources at Constitutional level and the denomination of oil and provision of electricity as strategic areas with State exclusivity resulted in politicisation and a highly protected energy system that has survived the waves of privatisation that affected most of the Mexican sectors. Altogether, these patterns determined (limited) the opportunities for market reform in the electricity sector in the first place, and of a sustainable energy transition in the long term. As a result, the set of path-dependent mechanisms hindered the generation and use of alternative sources energy, i.e. they became obstacles to the development of RE.

The negotiation of the electricity reform and the process of approval of the ETL was used to exemplify how the regime path-dependent patterns are reproduced at the policymaking level. This is linked to another important HI assumption met in the Mexican case, namely that institutions shape individual goals and alter their preferences; for example, policymakers influence energy companies' decisions via policy and regulations. This is true in Mexico, for example, in the gasification process,

by which natural gas became the predominant source of energy. The key drivers of this process of change were economic but were reinforced by a deliberative change in policy in the 1990s that sought to take advantage of natural gas low-cost and accessibility. Specific policies were actively pursued and adopted, even if challenging the Constitutional mandate, to facilitate the substitution of oil by natural gas. Independent power producers using combined-cycle plants were favoured with better financing schemes. As a result, this modality was the most dynamic in terms of installed capacity, generation and permits granted in the years following the reform of 1992.

Power relationships are a significant element of the HI framework also useful to explain the stability of the Mexican electricity sector. The uneven distribution of power and its dynamics are the result of institutional constraints; however, they are also sources of path dependence as they contribute to resisting changes. The uneven distribution of power among the actors of the electricity sector affected the incentives or "willingness" of the different actors to change. Influential actors used their power to protect their preference and interests, i.e. protecting the status quo, thereby shaping the course of SETs. The empirical chapters of this thesis presented a detailed analysis of the historical power relationships among the main actors in the Mexican electricity sector and how they affected the reform process of 2013. These findings are linked with one prominent claim of the STT framework that resistance to systematic change often comes from influential actors, usually big energy firms with significant investments in the prevalent technologies.

The chapter also discusses three features of the Mexican case that cannot be explained by the combined STT-HI framework. First, the fact that the Mexican case is not innovation-driven. Second, that sustainability is especially contentious in contexts with high pressures to maintain energy security at a low cost, such as Mexico, which reinforces a disconnect between the environmental/climate policy and electricity policy. Third, the absence of a full market in Mexico which in turn begs the questions as to whether market liberalisation is a precondition for a sustainable energy transition.

Chapter 8: Thesis conclusions

8.1 The problem

The cumulative scientific evidence and increasing recognition of the adverse environmental impacts associated with the massive use of fossil fuels have made clear that current energy production and consumption patterns are not sustainable. In recent years, the term "energy transition" has become commonly used in the context of sustainability and transition to a low-carbon economy (Foxon, 2011; Skea et al., 2011; Urban, 2014). The main challenge is how to shift from a stable fossil fuels system into more sustainable alternatives (i.e. renewable energy). Sustainable energy transitions (SETs) require significant shifts on different fronts: technology, pricing regimes, energy markets, banking and financial rules, business models, investments, behaviours and consumption (Mitchell, 2008; OECD, 2012). Such a transformation entails "deliberate efforts" from government intervention (e.g. via legislation or tax policy) to address the costs of changing given current carbon lock-in state (Fouquet, 2010: Mitchell, 2008).

The leading body of theory, socio-technical transitions (STT) studies and its main analytical framework, the multi-level perspective (MLP), argue that SETs require *radical* technological changes. SETs can be accelerated through the "management" of sustainable innovation niches, i.e. by adopting policies that encourage niche developments because new technologies lead to long-term transitions. However, there are two main limitations to this approach. First, STT-MLP studies usually neglect the political nature of SETs, which leads scholars to overlook the impact that politics have in the type of policies adopted and to a simplification of the role that political actors play. Second, most of their evidence and theoretical assumptions are based on the experience of Western European cases, i.e. countries with modern developed societies, democratic stability and similar sustainability challenges.

This raises two main questions relevant to the aims of this research: one related to the suitability of the STT-MLP conceptual frameworks to developing contexts (Hansen et al., 2018), and other on how the institutions in developing countries limit countries' possibilities for SETs. These questions are starting to be addressed in emerging STT-MLP literature but the limited evidence so far provides no clear answers at the theoretical level.

A second body of emerging literature has used Historical Institutionalism (HI) to compensate for STT's limitations on politics and political process to understand SETs from an institutional perspective. HI emphasises how the institutional processes limit or enhance opportunities of change, including technological change. One fundamental claim in HI is that once a particular course of action is introduced, it can be virtually impossible to reverse (path dependence) because the costs of changing are too high thereby creating a lock-in situation. Combined frameworks of STT-HI are therefore useful to understand that s*tability* in energy systems emerge from material (technological) elements but is reinforced by institutional path dependence. Lock-in patterns such as economies of scale and sunk investments in technology and infrastructures provide technological stability, while the change-resistant character of institutions reproduces this inertia. Institutional stability is occasionally altered in moments of critical junctures when major *changes* increase their possibilities of realisation as actors can create new institutions, or modify existing ones.

As such, HI is helpful to understand why the current fossil-fuels system is so stable and resistant to change and why countries with similar economic structures and energy resources have undergone through different transitions paths. But the answers provided by current combined frameworks of STT-HI are also based on developed countries experiences.

The different realities of developing countries result in different energy challenges and needs, which lead to different priorities and ways to govern energy. For instance, unlike the Western-European settings, where transition emerged in thriving technological environments, with engineering skills capacity and access to raw materials, developing countries have fragmented innovation sectors in which technological innovations are usually transferred from abroad (Ramos-Mejía et al., 2018).

Importantly, developing countries have different institutional scenarios that shape the way in which decisions are taken. For instance, the role and scope of State and informal arrangements may differ from developing contexts than in developed countries, where longstanding democratic traditions prevail, including transparency and accountability processes. Also, the consensus on sustainable energy is less clear in developing countries (Hess, 2014); therefore, the political conflict over sustainable transition is

amplified.[98] Certainly, actors could play diverse roles in contexts of less transparency and non-inclusive policymaking processes, so power distribution may affect the incentives or "willingness" to change differently in developing scenarios. These differences affect not only the policymaking processes but also the type of policies adopted.

The analytical framework used in this thesis builds on understanding the origins and persistence of institutional arrangements and how they translate into the policymaking process. It is, therefore, a useful approach to develop our understanding of SETs in developing countries. HI shows how contextual factors, including economic structures, national technological infrastructures, and political institutions, are crucial determinants of countries' transition paths. As such, while STT allows a systematic approach, HI provides a context-based analysis of the political processes while allowing a closer look at power relations and actors' strategies in moments of change.

8.2 The Mexican case: findings and implications

Public and academic debates seek to explore the ways in which SETs can be incentivised and accelerated (Loorbach et al., 2017; Roberts et al., 2018; Roberts and Geels, 2019); thus most of the debate about SETs is on how to *accelerate* the use of renewable technologies. Low-carbon energy innovations already exist, but "their ability to fully supplant established socio-technical regimes depends on political processes and political conditions" (Meadowcroft, 2016 in Roberts and Geels, 2018: 237).

A quick overview of the Mexican case shows that the country is undergoing major changes in its energy system. In addition, the country subscribed national and international commitments to transit to sustainable patterns of energy, legally binding since 2012 with a General Law on Climate Change. The 2013 energy reform aimed at a profound restructuration of the entire energy sector, while the 2015 Energy Transition Law (ETL) sought to regulate the sustainable use of energy in the electricity sector by introducing legal binding mechanisms as the clean energy certificates. However, the

[98] This is not to say that approaches to sustainability are not contested in European countries (see discussion on sustainability in Chapter 1).

approval of the ETL was a contested process that occurred in isolation of the rest of the reform.

Despite the policies and the vast RE resources, the contribution of renewable electricity in Mexico's energy matrix remains very small. Thus, one of the biggest puzzles in the Mexican case is how to accelerate a SET? This thesis sought to answer three related questions: what are the drivers and obstacles to a sustainable transition in the Mexican electricity sector; how have institutions shaped Mexico's sustainable transition in the electricity sector; and, what was the role of sustainability in the 2013 electricity reform.

The analysis of the Mexican electricity sector through a mixed STT-HI framework reveals that institutions have limited the scope for a sustainable transition in the Mexican electricity sector in the last thirty years. Mexico's attachment to oil originated from a historical abundance of oil resources and became deeply embedded in the political structure and system. Consequently, oil has enjoyed a privileged position as the main source of energy, limiting the scope for technological innovation. In the 1990s and the 2010s, pressures for change emerged at different levels of the electricity sector, producing enabling conditions that opened opportunities for change. Further, mainly political facilitating circumstances reinforced the pressure for change during the energy reform of 2013. Key factors were partisan alignment, and the presence of policy entrepreneurs seeking to extend the use of renewable energy, in order to advance a sustainability agenda. However, both in the 1990s and 2013, institutional structures and their patterns of reproduction constrained the scope for change.

Sustainability is especially a contentious issue in contexts with high pressures to maintain energy security at a low cost, such as Mexico. The fact that the RE innovation does not emanate from a state-innovation policy is a major difference between the Mexican case and the successful cases of SETs explored in the literature. The disjuncture seems to emerge from the historical way in which the country has developed a fragmented innovation system. Also, in a strict sense, the liberalisation process in the Mexican electricity sector started quite recently. In most of the cases studied under the STT approach, liberalisation and sustainability are normally separated processes. In the case of Mexico, the transition to a market-based structure is happening at the same time that the need to transit to sustainable sources of energy

has become more evident. Such parallelism not only represents an analytical challenge but also raises a question as to whether sustainability is only successful in electricity sectors with liberalised markets.

8.3 Thesis contributions

The empirical findings and argument arising from the investigation provide four main research contributions to related fields of existing literature. First, this research contributes to the systematisation of the emerging literature that conceptualises SETs as political phenomena in which the political processes – politics and institutional change – play a fundamental role in fostering or blocking sustainability. Literature in the field has started to signal the importance of institutional change not only as part of the transition process but also as a possible driver of systematic change, i.e. to accelerate SETs. Recent work using HI elements sees this approach as an "instrument" that contributes to STT analysis (Roberts and Geels, 2019), in which institutional arrangements and their political processes are considered as one part of the regime.

This thesis, however, shows that the process of change goes beyond the institutions at the regime level; therefore, an institutional dimension was incorporated in the study of systematic change. In this thesis, the STT literature is used to provide an overall view of the transition through the lens of levels (i.e. the processes at different levels that work together to generate a systematic change), while HI adds an extra layer of analysis using the lens of institutional change. Thus this research is an effort to link policymaking processes with SETs studies using a critical juncture approach but also considering the path dependency processes.

Second, this investigation contributes to mitigating the "European bias" that currently exists in the classic STT literature (Markard et al., 2012) and in the emerging field that combines STT and HI by providing empirical case-specific insights from Mexico. The thesis tests the analytical elements from STT and HI that have been used previously to explain transitions in Europe. In line with HI claims, the Mexican case shows that the electricity sector and its institutions are stable due to mechanisms of path-dependent patterns grounded on oil-centred energy policies and a monopoly structure. Altogether, these patterns determined – and limited – the opportunities for market reform in the

electricity sector in the first place, and of a sustainable transition in the long term. As a result, the set of path-dependent mechanisms hindered the generation and use of alternative sources energy, i.e. they became obstacles to the development of RE.

The electricity reform and the process of approval of the ETL were used in this thesis to exemplify how the regime path-dependent patterns are reproduced at the policymaking level. This is linked to another important HI assumption met in the Mexican case, namely that institutions shape individual goals and alter their preferences; for example, policymakers influence energy companies' decisions via policy and regulations (Lockwood et al., 2013). This is true in Mexico, for example, in the gasification process, by which natural gas became the predominant source of energy after the regulation changes in the 1990s. The uneven distribution of power among the actors of the electricity sector affected the incentives or "willingness" of the different actors to change. Influential actors used their power to protect their preferences and interests, i.e. defending their investments in natural-gas technologies and infrastructure, thereby shaping the course of SET. The empirical chapters presented a detailed analysis of the historical power relationships among the main actors in the Mexican electricity sector and how they affected the reform process of 2013, exemplified in the formation of coalitions in support and against the ETL. These findings are linked with one prominent claim of the STT framework that resistance to systematic change often comes from influential actors, usually big energy firms with investments in the prevalent technologies.

Third, the thesis develops a combined theoretical framework by adding analytical elements from HI in order to produce a more complete framework that may be useful for other cases of energy transitions similar to Mexico, i.e. countries that face similar development and energy challenges, and/or that are going through a simultaneous process of liberalisation and sustainability. The thesis added other analytical elements that have not been included in the STT-HI framework before – namely the detailed analysis of the policymaking process of the reform, the critical juncture approach and the role of policy entrepreneurs – in order to produce a more complete framework that may be useful for other cases similar to Mexico.

The evidence shows the important role of policy entrepreneurs in sustainable matters and the emergence of the ETL. These actors, usually overlooked in the STT studies, had greater scope to influence the electricity reform (in favour of the ETL) when they associated with the National Action Party (PAN). The latter used the electricity reform and its sustainability aspect as political bargain power with the ruling party, the Institutional Revolutionary Party (PRI). As such, combined with the concept of policy entrepreneurs, a critical juncture analysis can be used to identify the political interactions of key actors and the strategies used to legitimise change, i.e. supporting the electricity reform and/or the ETL.

Four, the Mexican case reveals that the economic structure – i.e. the degree and model of economic liberalisation – is an important element to be taken into account when studying SETs in developing countries. The close relationship between liberalisation and sustainability is a major characteristic of the Mexican case. Understanding this relationship is important because it shaped the electricity reform, i.e. type of mechanisms adopted, and therefore the transition process. While the authors of the electricity reform saw the oil reform as a vehicle for an electricity reform, ETL creators saw it as a vehicle for sustainability. This process is a result of particular path dependencies of Mexico: its institutions (i.e. the political and economic structure) and the motivations and capabilities of the actors involved.

As well-liberalised electricity sectors characterise most of the cited cases of successful SETs, this literature lacks an analysis of the role that liberalism, or its absence, has in the processes of the energy transition. In the Mexican case, the pressures for change towards liberalisation concur, and at times are conflate, with pressures towards sustainability. However, liberalisation and sustainability are separated processes, whose drivers and objectives could coincide but also contradict themselves. Also, liberalisation processes in developing countries differ from developed countries and create different institutional, economic and institutional structures that might affect their transition paths. Those differences should be considered in current debates about SETs in non-European countries. Communication between the literature on SETs and studies on economic liberalisation could contribute to recognising these nuances in the study of sustainable transitions in developing countries.

8.4 Limitations of the study

This analysis focuses on one particular aspect of sustainability: renewable electricity. This thesis linked two main dimensions of change – technological and institutional – to provide a more nuanced explanation of SETs in a country with a different level of development than the European cases. Although the thesis applied a systematic approach toward energy, by using the three levels of analysis, it focuses on the regime changes related to renewable electricity, i.e. its evolution prior to the reform and through the policymaking process of the Reform. Therefore, the analysis did not include other relevant sustainability issues. As acknowledged in Chapter 1, the adoption of RE sources of energy is one part of a sustainable energy transition. Energy efficiency – that is, the reduction in energy consumption – is considered a crucial part of sustainability in energy systems (Elliot, 2007: xx), and therefore a fundamental pillar of part of a sustainable transition in the electricity sector (Mitchell, 2008).

Also, the analysis of the social dimension of sustainability was limited in this study. For example, the thesis does not explore the impact that the adoption of RE electricity have in terms of development and reducing poverty levels in Mexico, which is a frequent argument in the sustainability literature. In this research, the social side of sustainability was approached marginally, concerning the electricity subsidies and the high cost of electricity in Mexico. This analysis explains the decision-making in Mexico rather than to explore the impacts of a change towards RE in social terms. Electricity subsidies have always been a policy priority based on two main premises embedded in the Mexican context: 1) the State is obliged to provide electricity services as a basis of the country's development, 2) given the country's oil wealth, electricity must be cheap. Over time these premises became difficult to fulfil but the inertia of the institutions made them prevailed.

Third, although an STT perspective was applied, where the adoption of technologies is assumed to be socially embedded, the thesis did not focus on the demand side of the electricity in Mexico. The demand side was addressed only from the perspective of the largest users of electricity, that is, from the perspective of how the big industries adopted a technological change in the 2000s – mostly natural gas based technologies and to a less extent wind – as a way to keep their electricity costs low. However, the

study did not address how other users reacted to those changes. For example, the change in urban infrastructure that resulted from the transition to natural gas at the household level was not explained in this research.

One last limitation of the study is that the application of the HI approach was appropriate for explaining path dependency process, self-reproduction mechanisms and moments of change, but it was less useful to investigate the impacts of the Reform. As the reform has not been fully implemented yet, assessing its long-term impacts was not an objective of this thesis. The period studied in this thesis (1990-2015) is a snapshot of a long process of change in the Mexican energy sector. Thus the long-term effects of the reform remain to be evaluated in the next decades when all the relevant legislation has been approved and implemented.

8.5 Directions for future research

Building on the contributions of the thesis and limitations of the research, it is possible to identify several avenues for future research. This thesis sought to consolidate the emerging field of research on SETs in developing countries. Nevertheless, this investigation was centred on the policy level. There is a need to engage the policy approach in a more "ground" level discussion, i.e. to explore how the political interactions that contributed to creating patterns of stability in the Mexican electricity policy sector and the policymaking level, permeate the project level, i.e. the implementation of individual RE projects in Mexico. Such analysis could be done, for example, by studying specific projects to investigate whether they have been affected by the dynamics identified in this study. One possible way to look into the project level could be by contrasting the implementation of solar off-grid programs financed by the development bank in the North of Mexico to the big projects, mostly private-investment wind plants in the South of Mexico.

This type of studies may be useful not only to address the interplay between individual projects and the broader framework conditions at a systemic level but also to investigate the how the interactions among other actors are affected by the institutional restrictions found in this thesis, e.g. the local communities and international actors.

While there is an extensive literature on community participation in RE projects in different parts of the world (e.g., Bauwens et al., 2016; Becker et al., 2017; Walker et al., 2007; Wlokas et al., 2012; Yildiz, 2014), research in Mexico is limited. One limitation for that type of research in Mexico is that RE projects with a community or rural development approach are rather scarce. However, increasing research in Mexico has emerged in the recent years with a focus on energy justice, participatory process and the disputes of land and territory in wind projects (Avila-Calero, 2017; Baker, 2016; Hiteva and Sovacool, 2017; Howe and Boyer, 2016; Huesca-Perez et al., 2016; Sellwood and Valdivia, 2018.) Such an endeavour could benefit from establishing a closer link to the political processes involved in the policymaking process of national policy and to SETs studies.

In addition, it has been signalled in recent literature the need to focus "on the knowledge dimensions of technologies and how the transfer of technology relates to learning and capability development for successful local societal embedding" (Hansen et al. 2018). For example, Berkhout et al. (2009) highlight the need in the field to address the knowledge dimension of technologies with a focus on the accumulation of innovative capabilities. Research on capacity building at the community level in Mexico could contribute to understanding how innovations are transferred and embedded in developing countries. Those types of investigation could also help to connect the environmental sustainability agenda with the poverty reduction agenda (Ramos Mejía et al., 2018) in the study of SETs.

Given the transnational nature of SETs in developing countries, additional research in Mexico could benefit from analysing in detail the role of various transnational actors, such as donors, multinational companies, consultancies and foreign investors, in local processes. This is an avenue that has been signalled in the recent literature by Hansen et al. (2018). For example, donors have been key actors in the development of RE technologies – both in positive and negative ways – in countries like India (Wieczorek et al., 2015). Also, Newell and Phillips (2016) have explored how donors have influenced the landscape of Kenya's transition by reinforcing configurations of power between the state and transnational capital. Given Mexico's development level, the role of foreign donors is less visible, but the financing from international corporations and development banks is very important (see for example IADB, 2017; World Bank,

2019).[99] In addition, international linkages seem to play a strategic role in terms of Mexico's national policies. For example, it has been argued that Mexico has had to change its energy policy to "adequate" them to the interests of the United States and international organisations such as the OECD (Vargas Suárez, 2015). The wave of structural reforms of the last years, of which the 2013 energy reform is part, responded to OCED and IMF calls on Mexico's restructuration. The study of the sustainable energy transition in Mexico would benefit from analysing how these dynamics at the landscape level have permeated the type of policies adopted in recent years and therefore affected Mexico's transition path.

One avenue of research is related to the role of private investment in Mexican RE projects as a complementing force of state capacity. Given the severe constraints on public sector finance in developing countries, private investment is considerably needed for the expansion of infrastructure and technology upgrades. This was a topic that emerged in some of the interviews, which seems to be related to the different institutional capacities of developing countries. For example, the Mexican government has repeatedly made use of the private sector to overcome its limitations, e.g. financing resources, energy inputs and technology. The opening of the electricity sector in the mid-1900s is in line with other cases in developing countries, where "the progress of liberalisation has been strongly driven by the increasing need to finance investment in expanding systems, as well as by external pressure from the conditionalities of the international financial institutions and donor countries" (Hall and Nguyen, 2017: 101). In the context of a financial incapacity of the Mexican government due to the economic crisis in the 1990s, the opening to private generation was a way to inject private resources into the electricity sector. The evidence in this thesis shows that the same pattern was followed in 2013 since the main objective was to rescue the oil sector from its financial and technological crisis.

Finally, a study within the next decades will be necessary to explore the impacts of the 2013 energy reform in terms of the changes in the use of RE, i.e. to assess if the electricity reform was actually an *acceleration phase* that deliberately sped up the sustainable energy transition. The very first results of the electricity auctions, in which

[99] World Bank financing in Mexico amounts to 900 million US dollars in 2019. For example, 59 of current or past projects financed by this bank in Mexico are related to energy, including projects for RE and energy efficiency (see World Bank, 2019).

solar and wind electricity dominated seem to indicate that, even when the 2013 reform had a limited approach to sustainability, the electricity reform had positive impacts in the development of the RE in Mexico (see Chapter 7). However, under the new administration of Andres Manuel Lopez Obrador (2018-2023) - the first left-wing president in Mexico - several of the mechanisms introduced by the 2013 reform have been put on hold, e.g. the auctions for the electricity sector (CENACE, 2018). The new administration also recently announced major investments in coal plants (Sígler, 2018; Solís, 2018). Future research should assess how these changes in policy will affect the process of the sustainable energy transition in Mexico.

To conclude, as stated by Wieczorek (2018) “regimes transform on condition of the *availability* of *alternatives* that can fulfil the same societal function” (Wieczorek, 2018: 204; emphasis added). In practice, the Mexican case shows that REs are not available yet to fulfil the electricity function. Although, one of the major obstacles has been the lack of a RE technological sector (via domestic innovation or imported), the findings of this thesis signal that the major obstacles lie in the long-standing institutional arrangements that favour oil as the main source. However, a transition took place in the Mexican electricity sector in the last decades, by which the sector transited to natural gas technologies. The “gasification” of the electricity and energy sector was a rather fast process, which shows that the acceleration of transitions – via policies and right incentives – in relatively short periods is possible. Nonetheless, rather than emanating from protected innovation-niche as STT-MLP dictate, the gasification process in the electricity sector seems to the result of two particular (circumstantial) characteristics of the Mexican case: its geographical proximity to the United States, one the largest gas producers, and the low price of natural gas. These circumstances were reinforced via regulations and policies.

Appendices

I. List of Documents

Policy documents

1. Estrategia Nacional de Energía 2012-2026, SENER, December, 2011
2. Estrategia Nacional de Energía 2013-2027, SENER, December, 2012
3. Estrategia Nacional de Energía 2014-2028, SENER, December, 2013
4. Estrategia Nacional de Energía 2015-2028, SENER, December, 2014
5. Balance Nacional de Energía 2012, SENER, December, 2011
6. Balance Nacional de Energía 2013, SENER, December, 2012
7. Balance Nacional de Energía 2014, SENER, December, 2013
8. Balance Nacional de Energía 2015, SENER, December, 2014
9. Prospectivas de Energías Renovables 2012-2026, SENER, December, 2011
10. Prospectivas de Energías Renovables 2013-2027, SENER, December, 2012
11. Prospectivas de Energías Renovables 2014-2028, SENER, December, 2013
12. Prospectivas de Energías Renovables 2015-2029, SENER, December, 2014
13. Resumen de Reforma Energética del Gobierno Federal, SENER, December, 2012
14. Palabras del Presidente Enrique Peña Nieto, durante la Presentación de la Iniciativa de Reforma Energética, December, 2012

Legislative documents

15. Ley para el Aprovechamiento de Energías Renovables y el Financiamiento de la Transición Energética (LAERFTE), Federal Government, November 28, 2008
16. Ley para el Aprovechamiento Sustentable de la Energía (LASE), Federal Government, November 28, 2008
17. Ley General de Cambio Climático (LGCC), Federal Government, July 13, 2018

18. Proyecto de Decreto que Reforma, Adiciona y Deroga Diversas Disposiciones a los Art. 25, 27 y 28 de la Constitución Política de los Estados Unidos Mexicanos, PAN legislators, July 31, 2013

19. Iniciativa de decreto por el que se reforman los artículos 27 y 28 de la Constitución Política de los Estados Unidos Mexicanos, Initiative by Enrique Peña Nieto, August 14, 2013

20. Dictamen de las Comisiones Unidas de Puntos Constitucionales: de Energía, y Estudios Legislativos, Primera, con Proyecto de Decreto por el que se Reforman y Adicionan los Artículos 25, 26 y 27 de la Constitución Políticade los Estados Unidos Mexicanos en Materia de Energía, Senate Opinion, December 10, 2013

21. Decreto por el que se reforman y adicionan diversas disposiciones de la Constitución Política de los Estados Unidos Mexicanos, en Materia de Energía, Decrete by the Executive power, December 20, 2013

22. Iniciativa con Proyecto de Decreto por el que se expide la Ley de la Industria Eléctrica, Federal Government, April 29, 2014

23. Iniciativa con Proyecto de Decreto que crea la Ley de Transición Energética, PAN legislators, June 11, 2014

24. Decreto por el que expiden la Ley de la Industria Eléctrica, la Ley de Energía Geotérmica y se adicionan y reforman diversas disposiciones de la Ley de Aguas Naturales, Federal Government, September 11, 2014

25. Minuta de Proyecto de Decreto que crea la Ley de Transición Energética, Senate, December 15, 2014

26. Decreto por el que expiden la Ley de Transición Energética, Federal Government, December 24, 2015

27. Palabras de Senadores y Diputados del PAN en conferencia de prensa de la presentación de la Ley de Transición Energética, PAN legislators, June 11, 2014

28. Palabras del Senador David Penchyba Grub durante conferencia de prensa, Senate, June 14, 2014

29. Acta de Reunión de Trabajo de la Comisión Especial de Cambio Climático, March 24, 2015

30. Acta de Reunión de Trabajo de la Comisión Especial de Cambio Climático, April 7, 2015

31. Palabras de la senadora Silvia Garza Galván, durante la inauguración del foro "Transición energética: elemento clave frente al cambio climático", PAN legislators, October 7, 2015

32. Acta de Reunión de Trabajo de la mesa "Transición Energética. Elemento Clave frente al cambio climático", PAN legislators, October 7, 2015

Media documents

33. Ley de Transición Energética reducirá costos en energía: Silvia Garza Galván, Senate newsletter, June 11, 2014

34. Necesario aprobar la Ley de Transición Energética en este periodo de sesiones: senadora Silvia Garza (No. 215), Senate newsletter, February 25, 2015

35. Con la aprobación de la Ley de Transición Energética se prevé instalar 500 mil techos solares, adelantó la senadora Garza Galván, Senate newsletter, February 25, 2015

36. Dar a México una ley comprometida con las energías renovables, plantea la senadora Silvia Garza (No. 410), Senate newsletter, March 24, 2015

37. Senadores y Especialistas plantean aprobar la Ley de Transición Energética antes del 30 de abril (No. 481), Senate newsletter, April 7, 2015

38. México no aprovecha energías renovables, advierte senador Salazar Solorio (No. 693), Senate newsletter, April 29, 2015

39. Ley de Transición Energética detonara inversión en energías renovables: senadora Garza Galván (No. 218), Senate newsletter, October 5, 2015

40. Retoman senadoras Ley de Transición Energética, Senate newsletter, October 6, 2015

41. Senadoras reiteran necesaria aprobación de la Ley de Transición Energética (No. 234), Senate newsletter, October 7, 2015

42. Exige Ríos Piter avanzar en dictiminación de iniciativa sobre Ley de Transición Energética, Senate newsletter, November 15, 2015

43. Urge dictaminar minuta de Ley para la Transición Energética: senador Armando Ríos Piter (No. 555), Senate newsletter, November 15, 2015

44. México debería ir a COP 21 con su nueva Ley de Transición Energética, advierten senadoras y especialistas (No. 646), Senate newsletter, November 25, 2015

45. Senadores del PAN acompañaran Ley de Transición Energética: Fernando Herrera, Senate newsletter, November 29, 2015

46. Avalan comisiones Ley de Transición Energética (No. 675), Senate newsletter, November 30, 2015

47. Senadores debaten y modifican la ley de Transición Energética (No. 696), Senate newsletter, December 1, 2015

48. Senado devuelve a la Cámara de Diputados Ley de Transición Energética (No. 698), Senate newsletter, December 1, 2015

49. Ley de Transición Energética impulsara desarrollo y competitividad, Senate newsletter, December 1, 2015

50. Ley de Transición Energética incrementara costo de la electricidad: Manuel Barlett, Senate newsletter, December 1, 2015

51. La transición energética no puede esperar, pero la propuesta de ley se queda corta para el esfuerzo que se requiere: Dolores Padierna, Senate newsletter, December 1, 2015

52. Necesario diversificar matriz energética: senadores del PRD, Senate newsletter, December 1, 2015

53. Ley de Transición, complementa el modelo energético: Lavalle Maury, Senate newsletter, December 1, 2015

54. Celebra Partido Verde aprobación de Ley de Transición Energética en el Senado, Senate newsletter, December 2, 2015

55. Ley de Transición Energética privilegia el interés publico , Senate newsletter, December 4, 2015

56. Ley de Transición Energética abre las puertas a las energías limpias: Ernesto Gandara , Senate newsletter, December 5, 2015

57. Senado remite al Ejecutivo la Ley de Transición Energética (No. 787), Senate newsletter, December 10, 2015

58. Promueven iniciativa de Ley de Transición Energética, reglamentaria de la reforma constitucional en la materia (Boletín No. 4487), Deputies newsletter, October 26, 2014

59. Impulsar y consolidar uso de energías limpias en México, tema pendiente en el Poder Legislativo (Boletín No. 4662), Deputies newsletter, November 20, 2014

60. Energías renovables, gran ausente en la reforma energética: López Moreno (Boletín No. 4733), Deputies newsletter, December 2, 2014

61. Aprueban en comisiones unidas dictamen de la Ley de Transición Energética (Boletín No. 4793), Deputies newsletter, December 10, 2014

62. Aprueban diputados dictamen que expide Ley de Transición Energética (Boletín No. 4833), Deputies newsletter, December 15, 2014

63. Metas ambientales en riesgo, si no se aprueba la Ley de Transición Energética: Rodríguez Aguirre (Boletín No. 0506), Deputies newsletter, November 20, 2015

64. Reciben diputados minutas sobre transiciones digital y energética (Boletín No. 0614), Deputies newsletter, December 3, 2015

65. Avalan en Comisión dictamen a la minuta sobre la Ley de Transición Energética (Boletín No. 0649), Deputies newsletter, December 8, 2015

66. Diputados avalan, con cambios, Ley de Transición Energética; la devuelven al Senado de la República (Boletín No. 0665), Deputies newsletter, December 9, 2015

67. Certificados de Energías Limpias ayudarán a alcanzar los compromisos nacionales e internacionales en la materia (Boletín No. 0690), Deputies newsletter, December 12, 2015

68. Iniciativa de Ley de Transición Energética con metas claras para renovables: ONG, Greenpeace Mexico, June 17, 2014

69. Declaración en favor de la LTE, Red de la Transición Energetica, September 9, 2015

70. Sin la LTE se incumplen los compromisos internacionales de cambio climático, ONGS, November 11, 2015

71. Comunicado: La LTE pilar de compromisos de Mitigación , Centro Mario Molina, November 14, 2015

72. El gas natural no es Energía limpia, ONGS, November 17, 2015

73. Sr. Presidente de la Republica, Lic. Enrique Pena Nieto, Senadoras y Senadores de la Republica, ONGS, November 23, 2015

74. Farol de la calle, oscuridad de su casa, Greenpeace Mexico, November 24, 2015

75. Comunicado de Prensa CONCAMIN, CONCAMIN, November 25, 2015

76. Enrique Peña, farol de la calle, oscuridad de su casa?, Greenpeace Mexico, November 26, 2015

77. Ley de Transición Energética: base para un México competitivo con menores emisiones, RE Associations, November 30, 2015

78. Comunidado de Prensa CONCAMIN, CONCAMIN, December 2, 2015

79. Diputadas y Diputados, ONGS, December 2, 2015

80. Comunidado de Prensa CANACERO, CANACERO, December 7, 2015

81. La industria mexicana del acero boicotea la lucha contra el cambio climático, Greenpeace Mexico, December 7, 2015

82. A la industria que se opone a la LTE, ONGS, December 7, 2015

83. Comunidado de Prensa CONCAMIN, CONCAMIN, December 10, 2015

84. Al Congreso de la Unión., ONGS, December 14, 2015

Other

85. Estudio sobre las inversiones necesarias para que México cumpla con sus metas de Energía Limpia, CESPEDES and PwC, 2015

II. Samples of advertisements

II.a. Advertisement by the Energy Transition Network

"Declaration in favor of the Energy Transition Law", published by the Energy Transition Network on September 9, 2015

Declaración en favor de la Ley de Transición Energética

La Ley de Transición Energética, cuyo dictamen fue aprobado por la Cámara de Diputados en fecha 15 de diciembre de 2014, busca promover la modernización de la industria eléctrica nacional al regular el aprovechamiento sustentable de la energía, así como las obligaciones en materia de energías limpias y la reducción de emisiones contaminantes en esa industria.

Esta Ley, que forma parte de la Reforma Energética Constitucional al actualizar el marco jurídico en materia de transición energética hacia energías limpias, incorpora las mejores prácticas en la explotación y el uso de la energía y de los recursos naturales, así como en el cuidado del medio ambiente, en un marco promotor del crecimiento económico y del bienestar social. Por esas razones, su promulgación es necesaria para cumplir con los compromisos ya adquiridos ante la comunidad internacional por México en materia de reducción de emisiones de gases de efecto invernadero.

Por lo anterior, las organizaciones y las personas abajo firmantes exhortamos al Senado de la República a aprobar la Ley de Transición Energética, sin cambios frente al dictamen ya aprobado por la Cámara de Diputados, como una parte esencial de la Reforma Energética que ya está en marcha.

Asociaciones de empresas y organizaciones miembros de la Red por la Transición Energética

Alianza por la Eficiencia Energética; Asociación de Empresas para el Ahorro de Energía en la Edificación; Asociación Mexicana de Energía Eólica; Asociación Nacional de Energía Solar; Centro de Especialistas en Gestión Ambiental; Centro Mexicano de Derecho Ambiental; CTO Green Momentum; Energía a Debate; Fundación Heinrich Böll; Instituto de Políticas para el Transporte y el Desarrollo; Instituto Mexicano para la Competitividad; Inteligencia Pública; Latin American Regional Climate Initiative.

Otras organizaciones que apoyan:

Asociación Mexicana de Empresas de Eficiencia Energética, Asociación Mexicana de Energía, Centro de Estudios en Cooperación Internacional y Gestión Pública, Fondo para la Comunicación y la Educación Ambiental, Fundación para el Desarrollo Sustentable, Grupo de Financiamiento Climático para América Latina y el Caribe, PRONATURA México, Red Ambiental Mexicana, Telar Social, Tierra Nueva.

Miembros de la Red por la Transición Energética (a título personal):

Alberto Escofet Artigas, Alejandro Arias Bustamante, Alejandro Lorea, Alejandro Villegas, Carlos Rivera, Daniel Chacón, David Morillón Gálvez, David Shields, Eduardo Zenteno Garza-Galindo, Enrique García Corona, Evangelina Hirata Nagasako, Fernando Sánchez Monter, Francisco Barnés Regueiro, Gabriel Quadri de la Torre, Hilda Martínez, Jenny Tardan Waltz, Jorge Landa, Jorge Villarreal Padilla, José Ramón Ardavin, José Barquet, Leopoldo Rodríguez Olivé, Miguel Ángel Cervantes Sánchez, Roberto Capuano, Sandra Guzmán, Tania Mijares García, Vanessa Pérez Cirera.

Publicado por la Red por la Transición Energética.

RESPONSABLE DE LA PUBLICACIÓN: DAVID SHIELDS CAMPBELL

II.b. Advertisements by Greenpeace

“Street lantern, darkness of your house”, published by Greenpeace Mexico on November 24, 2015

“Enrique Peña Nieto, street lantern, darkness of his house?”, publiched by Greenpeace Mexico on November 24, 2015

“The Mexican steel industry boycotts fight against climate change”, published by Renewable Energy Associations published on December 7, 2015

LA INDUSTRIA MEXICANA DEL ACERO BOICOTEA LUCHA CONTRA EL CAMBIO CLIMÁTICO

LA INDUSTRIA DEL ACERO EN MÉXICO VA CONTRA LA TENDENCIA MUNDIAL DE DETENER EL CALENTAMIENTO GLOBAL.

A MENOS QUE TODOS QUIENES BUSCAN UN ACUERDO CLIMÁTICO EN PARÍS ESTÉN EQUIVOCADOS, LOS ACEREROS SON RETRÓGRADAS:

1. Insisten en generar electricidad sólo quemando combustibles fósiles

2. Insisten en mantener a México en la época medieval de la energía

3. Insisten en detener la aprobación de la Ley de Transición Energética

SEÑORAS Y SEÑORES LEGISLADORES, NO SE DEJEN INTIMIDAR POR LOS QUE BUSCAN RIQUEZA FÁCIL A COSTA DE NUESTRO FUTURO.

BASTA DE QUE UN GRUPO DE INDUSTRIALES SE QUIERA ADUEÑAR DE LA SALUD DEL PLANETA Y DE LOS MEXICANOS PARA FAVORECER SUS INTERESES ECONÓMICOS.

APRUEBEN LA LEY DE TRANSICIÓN ENERGÉTICA.
LOS MEXICANOS Y MEXICANAS SE LOS RECONOCEREMOS.

GREENPEACE

Responsable de la publicación: Gustavo Ampugnani

Inserción pagada.

II.c. Advertisement by the Renewable Energy Associations

"Energy Transition Law: basis for a competitive Mexico with lower emissions", published by Renewable Energy Associations published on November 30, 2015

Fecha 30.11.2015 Sección Nacional

Ley de Transición Energética:
base para un México competitivo con menores emisiones.

El reto del cambio climático puede mostrar lo mejor de nosotros: nuestro compromiso con el ambiente, nuestro país, nuestra gente y las futuras generaciones.

En el mundo, nuestras empresas participan en iniciativas y en negocios basados en energías renovables porque reconocemos la urgencia de trabajar juntos y de manera decisiva ante el problema del cambio climático.

En México, nuestras empresas apoyan la transformación de la economía con inversiones y negocios que impulsan la generación de empleo y la reducción de las emisiones de bióxido de carbono, sustentada en un marco legal que brinda certidumbre a la inversión y respaldada por política pública que apoya la labor empresarial.

El mundo ya se está transformando y nuestro país no se puede quedar atrás. La contribución de México a la COP-21 en París debe respaldarse con acciones concretas, tal como lo anunció recientemente el Presidente Enrique Peña Nieto.

Por ello, apoyamos la Ley de Transición Energética como una pieza clave de la Reforma Energética que permitirá que en México seamos más eficientes en el uso de la energía y aceleremos la incorporación de energías renovables, reduciendo la dependencia de la importación de combustibles fósiles y ofreciendo una planeación inteligente y responsable del futuro energético nacional.

¡Es tiempo de actuar y ver por nuestro futuro!

amdee Asociación Mexicana de Energía Eólica — www.amdee.org

ASOLMEX — www.asolmex.org

www.amexhidro.org

Responsable de la publicación: Israel Hurtado Acosta

Inserción pagada

III. List of Interviews

Researchers and policy experts:

1. Policy expert - January 16, 2017 (former public official)
2. Researcher, Mexican University - January 25, 2017 (former NGO leader)
3. Researcher, Mexican University - February 8, 2017
4. Senior Researcher, Mexican Research Center, September 26, 2017
5. Researcher, US Research Center - December 7, 2017

Non-governmental representatives

6. Director, Mexican NGO - January 19, 2017 (former public official)
7. Program Officer, Mexican NGO - January 19, 2017
8. Director, Mexican NGO - January 23, 2017 (former academic)
9. Program Officer, Mexican NGO - February 10, 2017
10. Coordinator, Mexican (Energy) Network - February 14, 2017
11. Coordinator, Mexican NGO - March 15, 2017

Private sector representatives:

12. Executive Director, (Wind) RE Association - January 18, 2017
13. President, (Solar) RE Association - January 19, 2017
14. Director, RE company - September 27, 2017
15. Partner and Energy consultant, RE company - October 3, 2017
16. RE Manager, Company - October 16, 2017
17. President, RE Company - October 20, 2017
18. Director, RE Company - December 19, 2017
19. Steel Industry representative - January 9, 2018

Public sector representatives:

20. Director, Environment - January 20, 2017

21. Director, Energy - January 20, 2017

22. Former Legislator, (PAN) - February 9, 2017

23. Former (Electricity Undersecretary), Energy - October 10, 2017

24. Former (Electricity Undersecretary), Energy - October 17, 2017

25. Former Coordinator at the Senate - October 18, 2017

26. (ET Undersecretary), Energy - December 15, 2017

Other:

27. Director, UN Agency Mexico - February 15, 2017

IV. List of videos

1. Presentation of Energy Reform, words of Enrique Peña Nieto, Mexican Presidency, August 10, 2013
2. Energy Transition Law, Marisa Ortiz Mantilla, June 13, 2014
3. Deputy Isabel Ortiz (PAN) - Energy Transition Law, Chamber of Deputies, December 15, 2014
4. Deputy Rubén Camarillo (PAN) - Energy Transition Law, Chamber of Deputies, December 15, 2014
5. Deputy Martha Córdova (MC) - Energy Transition Law, Chamber of Deputies, December 15, 2014
6. Senators and specialists propose to pass the Energy Transition Law before April 30, Mexican Senate, April 7, 2015
7. First Part of the Forum “Energy transition: key element in the face of climate change”, Mexican Senate, October 7, 2015
8. Second Part of the Forum “Energy transition: key element in the face of climate change”, Mexican Senate, October 8, 2015
9. Third Part of the Forum “Energy transition: key element in the face of climate change”, Mexican Senate, October 9, 2015
10. Fourth Part of the Forum “Energy transition: key element in the face of climate change”, Mexican Senate, October 10, 2015
11. It is urgent to discuss energy transition law: Piter Rivers, deputy, Armando Ríos Piter, November 18, 2015
12. Senator Garza: let's pass the Energy Transition Law and continue to be an example in climate change, Mexican Senate, November 26, 2015
13. Energy Transition Law takes up the goal of clean energy in electricity generation: Senator Penchyna, Mexican Senate, December 1, 2015
14. Senator Manuel Bartlett points out that Energy Transition Law is only about electrical transition, Mexican Senate, December 1, 2015
15. Senator Ernesto Gándara, with the Energy Transition Law, the regulatory framework will be strengthened, Mexican Senate, December 1, 2015
16. Deputy Rocío Nahle (MORENA) - Energy Transition Law (Reserve), Chamber of Deputies, December 9, 2015
17. Flexibilise the implementation of the new Energy Transition Law: Senator Penchyna, PRI Senators, December 10, 2015

V. Sample of interview protocol

THE UNIVERSITY of York

Interview Protocol

(To be read in Spanish)

Electricity System

- What would you say are the main characteristics of the current electricity system?

Energy Reform and Energy Transition Law

- From your perspective, what are the main drivers of the current energy transition?
- What are the main changes introduced by the Energy Transition Law in terms of sustainable energy?
- What areas (problems) does it seek to tackle?
- How does this law differ from previous legislation and policy on sustainable energy?
- How would you describe your involvement in the process of design, approval and implementation of the ETL? In which activities did you participate?

Process of policymaking in energy policy

- Which do you think are the current goals in energy policy?
- What or who are the most active actors in defining the institutional context of the sector? And why?

Renewable energies

- From your perspective, what are the main achievements in this sector, over the last 10 years?
- What are the main problems in this sector?
- Is this sector relevant for a transition to sustainable energy? Why?

Abbreviations

CANACERO	Cámara Nacional de la Industria del Hierro y del Acero (Mexican Iron and Steel Industry Chamber)
CANACINTRA	Cámara Nacional de la Industria de Transformación (National Chamber of the Transformation Industry)
CCE	Consejo Cordinador Empresarial (Mexican Business Coordinating Council)
CCGT	Combined cycle gas turbine
CCS	Carbon and capture and storage
CEC	Clean Energy Certificate
CENACE	Centro Nacional de Control de Energía (National Centre for Energy Control)
CESPEDES	Consejo Empresarial para el Desarrollo Sostenible (Business Council for Sustainable Development)
CFE	Comisión Federal de Electricidad (Federal Electricity Commission)
CJ	Critical juncture
CME	Coordinated Market Economy
CONCAMIN	Confederación de Cámaras Industriales (Confederation of Industrial Chambers)
CONUEE	Comisión Nacional para el Uso Eficiente de la Energía (National Commission for the Efficient Use of Energy)
CRE	Comisión Reguladora de Energía (Energy Regulatory Commission)
CSA	Case Study Approach
EIL	Energy Industry Law

EPN	Enrique Pena Nieto
ETL	Energy Transition Law
GHG	Green House Gas
HI	Historical Institutionalism
INDC	Intended Nationally Determined Contribution
IPP	Independent Power Producers scheme
ISO	Independent System Operator
LAERFTE	Ley para el Aprovechamiento de Energías Renovables y el Financiamiento de la Transición Energética (Law for the Use of Renewable Energy and the Financing of the Energy Transition)
LASE	Ley para el Aprovechamiento Sustentable de la Energía (Law for the Sustainable Use of Energy)
LFC	Luz y Fuerza del Centro (local state-owned electricity company)
LGCC	Ley General de Cambio Climático (General Law on Climate Change)
LME	Liberal Market Economy
NES	National Electricity System
NES	National Electricity System
NGO	Non-governmental organisation
PAN	Partido Acción Nacional (National Action Party)
PECC	Programa Especial de Cambio Climático (Special Program on Climate Change)
PEMEX	Petróleos Mexicanos (Mexican Petroleos)

PIE	Productor Independiente de Energía (Independent Energy Producer)
PRD	Partido de la Revolucion Democratica (Democratic Revolution Party)
PRI	Partido Revolucionario Institucional (Institutional Revolutionary Party)
PRONASE	Programa Nacional para el Aprovechamiento Sustentable de la Energía (National Program for Sustainable Energy)
R&D	Research and development
RE	Renewable Energy
SAGARPA	Secretaría de Agricultura, Ganadería, Desarrollo Rurual, Pesca y Alimentación (Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food)
SDG	Sustainable Development Goals
SEMARNAT	Secretaría de Medio Ambiente y Recursos Naturales (Mexican Environment Ministry)
SENER	Secretraría de Energía (Mexican Energy Ministry)
SETs	Sustainable Energy Transitions
SHCP	Secretaría de Hacienda y Crédito Público (Mexican Finance Ministry)
STT	Socio-technical Transition

References

Abdmouleh, Z., Alammari, R. A., and Gastli, A. (2015). Review of policies encouraging renewable energy integration & best practices. *Renewable and Sustainable Energy Reviews*, 45, 249-262.

Akizu, O., Urkidi, L., Bueno, G., Lago, R., Barcena, I., Mantxo, M., and Lopez-Guede, J. M. (2017). Tracing the emerging energy transitions in the Global North and the Global South. *International Journal of Hydrogen Energy*, 42(28), 18045-18063.

Alpizar–Castro, I., and Rodríguez–Monroy, C. (2016). Review of Mexico's energy reform in 2013: Background, analysis of the reform and reactions. *Renewable and Sustainable Energy Reviews*, 58, 725-736.

Amenta, E., and Ramsey, K. M. (2010). Institutional theory. *In Handbook of politics: State and society in global perspective*, Leicht, K. T., and Jenkins, J. C. (Eds.). New York, Springer Science & Business Media.

Andrews-Speed, P. (2012). *The governance of energy in China: Transition to a low-carbon economy*. Chippenham, Palgrave Macmillan.

Andrews-Speed, P. (2016). Applying institutional theory to the low-carbon energy transition. *Energy Research & Social Science*, 13, 216-225.

Araújo, K., (2014). The emerging field of energy transitions: progress, challenges, and opportunities. *Energy Research & Social Science*, 1, 12-121.

Arent, D. J., Arndt, C., Miller, M., Tarp, F., and Zinaman, O. (2017). Introduction and Synthesis. In *The political economy of clean energy transitions*, Arent, D. J., and Zinaman, O. (Eds.). Oxford, Oxford University Press.

Avelino, F., and Wittmayer, J. M. (2016). Shifting power relations in sustainability transitions: a multi-actor perspective. *Journal of Environmental Policy & Planning*, 18(5), 628-649.

Averchenkova, A., and Guzman, S. (2018). Mexico's General Law on Climate Change: Key achievements and challenges ahead. Policy report, Grantham Research Institute on Climate Change and the Environment and the ESRC Centre for Climate Change Economics and Policy. London, LSE.

Avila-Calero, S. (2017). Contesting energy transitions: wind power and conflicts in the Isthmus of Tehuantepec. *Journal of Political Ecology*, 24(1), 992-1012.

Bacon, R. W., and Besant-Jones, J. (2001). Global electric power reform, privatization, and liberalization of the electric power industry in developing countries. *Annual Review of Energy and the Environment*, *26*(1), 331-359.

Baker, S. H. (2016). Mexican energy reform, climate change, and energy justice in indigenous communities. *Natural Resources Journal*, 56(2), 369-390.

Banco de México (BANXICO) (2019). Finanzas públicas. Ingresos Presupuestales del Sector Público. *Sistema de Información Económica*. BANXICO website Accessed 09.08.19 https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?&sector=9&accion=consultarDirectorioCuadros&locale=es

Bauer, M., and Quintanilla, J. (2000). Conflicting energy, environment, economy policies in Mexico. Energy Policy, 28(5), 321-326.

Bauwens, T., Gotchev, B., and Holstenkamp, L. (2016). What drives the development of community energy in Europe? The case of wind power cooperatives. *Energy Research & Social Science*, 13, 136-147.

Becker, S., Kunze, C., and Vancea, M. (2017). Community energy and social entrepreneurship: Addressing purpose, organisation and embeddedness of renewable energy projects. *Journal of Cleaner Production*, 147, 25-36.

Benítez Manaut, R. (1990). México 1920-1945. La expropiación petrolera y la reinserción de México al sistema internacional. *Historia Crítica*, (4), 47-56.

Berkhout, F., Angel, D., and Wieczorek, A. J. (2009). Asian development pathways and sustainable socio-technical regimes. *Technological Forecasting and Social Change*, 76(2), 218-228.

Berlín, V. F. (1997). Diccionario universal de términos parlamentarios. *Instituto de Investigaciones legislativas*. Mexico City, Porrúa.

Blázquez, J., and Santiso, J. (2004). Mexico: Is It an Ex-Emerging Market? *Journal of Latin American Studies*, 36(2), 297-318.

Brundtland, G., Khalid, M., Agnelli, S., Al-Athel, S., Chidzero, B., Fadika, L., Hauff, V., Lang, I., Shijun, M., de Botero, M.M. and Singh, M. (1987). *Our common future*. New York, Oxford University Press.

Byrne, J., and Mun, Y. M. (2003). Rethinking reform in the electricity sector: Power liberalisation or energy transformation. *Electricity reform: Social and environmental challenges*, 48-76.

Cámara Nacional de la Industria del Hierro y del Acero (CANACERO) (2019). México. Panorama Siderúrgico 2018. CANACERO website. Accessed 09.08.19 https://www.canacero.org.mx/aceroenmexico/descargas/infografia_canacero_2019.pdf

Capoccia, G. (2016). Critical junctures. In *The Oxford handbook of historical institutionalism*, Fioretos, O., Falleti, T. G., and Sheingate, A. (Eds.). Oxford, Oxford University Press.

Capoccia, G., and Kelemen, R. D. (2007). The study of critical junctures: Theory, narrative, and counterfactuals in historical institutionalism. *World politics*, 59(3), 341-369.

Carreón-Rodríguez, V. C., and Grunstein, M. (2014). Comisión Federal de Electricidad: la no empresa de clase mundial. Hacia la creación de una verdadera empresa productiva del Estado. *Revista legislativa de estudios sociales y de opinión pública*, 7(13), 7-45.

Carreón-Rodríguez, V. G. (2010). La arquitectura de mercado del sector eléctrico mexicano. *Centro de Investigación y Docencia Económicas*, 499.

Carreón-Rodríguez, V. G., Jiménez, A., and Díaz, J. R. (2005). *The Mexican Electricity Sector: Economic, Legal and Political Issues*. Centro de Investigación y Docencia Económicas.

Centro Nacional de Control de Energía (CENACE) (2018). CENACE informa la suspensión de la SLP-1/2018. Accessed 09.08.19 https://www.gob.mx/cenace/prensa/cenace-informa-la-suspension-de-la-slp-1-2018-190196

Cherp, A., Vinichenko, V., Jewell, J., Brutschin, E., and Sovacool, B. (2018). Integrating techno-economic, socio-technical and political perspectives on national energy

transitions: A meta-theoretical framework. *Energy Research & Social Science*, 37, 175-190.

Chignell, S., and Gross, R. (2012). Not locked-in? The overlooked impact of new gas-fired generation investment on long-term decarbonisation-A case study of lock-in to new CCGT in the UK. *ICEPT Working Paper*. Centre for Energy Policy and Technology (ICEPT).

CIDAC. (2013). México inseguro… energéticamente, diagnóstico y propuestas para asegurar el futuro suministro nacional de energía. Centro de Investigación para el Desarrollo.

Colmenares, F. (2008). Petróleo y crecimiento económico en México 1938-2006. *Economía UNAM*, 5(15), 53-65.

Comisión Federal de Electricidad (CFE) (2000). Informe Anual 2000. Accessed 09.08.19 http://aplicaciones.cfe.gob.mx/Aplicaciones/otros/POT/Informe2000.pdf

Comisión Federal de Electricidad (CFE) (2014). Informe Anual 2013. Accessed 09.08.19 http://www.cfe.gob.mx/ConoceCFE/1_AcercadeCFE/Finanzas/SiteAssets/Paginas/Informaci%C3%B3n%20para%20inversionistas/Reporteanual2013.pdf

Consejo Nacional de Evaluación de la Política de Desarrollo Social (CONEVAL) (2019). Medición de la Pobreza 2008 – 2018. *Pobreza 2018*. Accessed 09.08.19 https://www.coneval.org.mx/Medicion/MP/Paginas/Pobreza-2018.aspx

Consejo Nacional de Evaluación de la Política de Desarrollo Social (CONEVAL) (2019). Medición de la Pobreza 2008 – 2018. *Pobreza 2018*. https://www.coneval.org.mx/Medicion/MP/Paginas/Pobreza-2018.aspx. Accessed 09.08.19

Cossío Díaz, J. R, and Cossío Barragán, J. R. (2017). The New Energy System in the Mexican Constitution. *The Rule of Law and Mexico's Energy Reform*. James A. Baker III. Institute for Public Policy of Rice University. Accessed 09.08.19 https://www.bakerinstitute.org/media/files/files/68d55ed8/MEX-pub-RuleofLaw_JR2-042417.pdf

Cupolo, M. (1997). *Petróleo y política en México y Venezuela*. Caracas, Equinoccio.

David, P. A. (1994). Why are institutions the 'carriers of history'?: Path dependence and the evolution of conventions, organizations and institutions. *Structural change and economic dynamics*, 5(2), 205-220.

Davies, P. H. (2001). Spies as informants: triangulation and the interpretation of elite interview data in the study of the intelligence and security services. *Politics*, 21(1), 73-80.

De la Vega, Á. (1999). Capítulo II. El «modelo mexicano de organización petrolera»: una combinación de derechos de propiedad específicos y de un monopolio de estado sobre el conjunto de la industria petrolera. In *La evolución del componente petrolero en el desarrollo y la transición de México*. Mexico City, UNAM.

Díaz-Bautista, A. (2005). El Cambio Estructural y la Regulación del Sector Eléctrico Mexicano. University Library of Munich.

Dincer, I., (2000). Renewable energy and sustainable development: a crucial review. *Renewable and Sustainable Energy Reviews*, 4(2), 157-175.

Dirlik, A. (2007). Global South: predicament and promise. *The Global South*, 1(1), 12-23.

Dones, R., Heck, T., and Hirschberg, S. (2004). *Greenhouse gas emissions from energy systems: comparison and overview* (No. CH--0401). *Paul Scherrer Institut Scientific Report 2003*, 27-40.

Eames, M. and Hunt, M., 2013. Energy justice in sustainability transitions research. In *Energy Justice in a Changing Climate: Social equity and low-carbon energy*, Bickerstaff, K., Walker, G., and Bulkeley, H. (Eds.). London and New York, Sed Books.

Elgouacem, A., Franzen, K., Jensen Díaz, W., Muth, J., and Paciorek, A. (2017) Eliminando Progresivamente Subsidios Ineficientes a los Combustibles Fósiles. México y Alemania en el proceso de revisión por pares de G20. Alianza Energética entre México y Alemania.

Elizondo Mayer-Serra, C. (2011). Stuck in the Mud: The Politics of Constitutional Reform in the Oil Sector in Mexico. James A. Baker III Institute for Public Policy of Rice University: http://bakerinstitute.org/research/stuck-in-the-mud-the-politics-of-constitutional-reform-in-the-oil-sector-in-mexico/.

Elizondo Mayer-Serra, C. (2017). Reforma de la Constitución: la economía política del Pacto por México. *Revista mexicana de ciencias políticas y sociales*, 62(230), 21-49.

Elliott, D. (2007). Introduction: Sustainable Energy: The Options. In *Sustainable energy: opportunities and limitations*, Basingstoke, Palgrave Macmillan.

Elliott, D. (2007). Introduction: Sustainable Energy: The Options. In *Sustainable energy: opportunities and limitations*, Basingstoke, Palgrave Macmillan.

Elzen, B., and Wieczorek, A. J. (2005). Transitions towards sustainability through system innovation. *Technological forecasting and social change*, 6, 651-661.

Fioretos, O., Falleti, T. G., and Sheingate, A. (2016). *The Oxford handbook of historical institutionalism*. Oxford, Oxford University Press.

Flavin, C. and Lenssen, N. (1994). Powering the future: Blueprint for a sustainable electricity industry. Washington, Worldwatch Institute.

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative inquiry*, 12(2), 219-245.

Forsberg, C. W. (2009). Sustainability by combining nuclear, fossil, and renewable energy sources. *Progress in Nuclear energy*, 51(1), 192-200.

Fouquet, R. (2010). The slow search for solutions: Lessons from historical energy transitions by sector and service. *Energy Policy*, 38(11), 6586-6596.

Foxon, T. J., Hammond, G. P., and Pearson, P. J. (2010). Developing transition pathways for a low carbon electricity system in the UK. *Technological Forecasting and Social Change*, 77(8), 1203-1213.

Foxon, T. J., Hammond, G. P., Pearson, P. J., Burgess, J. and Hargreaves, T. (2009). Transition pathways for a UK low carbon energy system: exploring different governance patterns. Paper presented at the 1st European Conference on Sustainability Transitions: 'Dynamics and Governance of Transitions to Sustainability', Amsterdam, The Netherlands, June 5-6. 1–12.

Foxon, T.J. (2011). A coevolutionary framework for analysing a transition to a sustainable low carbon economy. *Ecological Economics*, 70(12), 2258-2267.

Friede, S. (2016). Enticed by the Wind. A Case Study in the Social and Historical Context of Wind Energy Development in Southern Mexico. Wilson Center.

Furlong, K. (2014). STS beyond the “modern infrastructure ideal”: Extending theory by engaging with infrastructure challenges in the South. *Technology in Society*, 38, 139-147.

Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. *Research policy*, 33(6), 897-920.

Geels, F. W. (2005). *Technological transitions and system innovations: a co-evolutionary and socio-technical analysis*. Cheltenham, Edward Elgar Publishing.

Geels, F. W. (2010). Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective. *Research policy*, *39*(4), 495-510.

Geels, F. W. (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental innovation and societal transitions*, 1(1), 24-40.

Geels, F. W. (2014). Regime resistance against low-carbon transitions: introducing politics and power into the multi-level perspective. *Theory, Culture & Society*, 31(5), 21-40.

Geels, F. W., Kern, F., Fuchs, G., Hinderer, N., Kungl, G., Mylan, J., Neukirch, M. and Wassermann, S., (2016). The enactment of socio-technical transition pathways: a reformulated typology and a comparative multi-level analysis of the German and UK low-carbon electricity transitions (1990–2014). *Research Policy*, 45(4), 896-913.

George, A. L., and Bennett, A. (2005). *Case studies and theory development in the social sciences*. Cambridge and London, Mit Press.

Global Energy Assessment (2012). *Global Energy Assessment - Toward a Sustainable Future*. Cambridge and New York, International Institute for Applied Systems Analysis and Cambridge University Press.

Goldemberg, J., Johansson, T.B., and Anderson, D. (2004). World energy assessment: overview: 2004 update. United Nations Development Programme.

González, A. (2015). Acecha al acero 'guerra eléctrica'. *Reforma*, Accessed 09.08.19 https://www.reforma.com/aplicacioneslibre/articulo/default.aspx?id=601143&md5=efd754091ab40ccb8d95f80de56039b6&ta=0dfdbac11765226904c16cb9ad1b2efe&po=4

Gratwick, K. N., and Eberhard, A. (2008). Demise of the standard model for power sector reform and the emergence of hybrid power markets. *Energy Policy*, 36(10), 3948-3960.

Greener, I. (2005). The potential of path dependence in political studies. *Politics*, 25(1), 62-72.

Grubb, M., Jamasb, T., Pollitt, M.G. and Maratou, A. (2008). Technologies for a low-carbon electricity system: An assessment of the UK's technological issues and options. In *Delivering a low carbon electricity system: Technologies, economics and policy*. Cambridge and New York, Cambridge University Press.

Grubler, A., Wilson, C., and Nemet, G. (2016). Apples, oranges, and consistent comparisons of the temporal dynamics of energy transitions. *Energy Research & Social Science*, 22, 18-25.

Grunstein, M. (2014). Monopolios de estado y política del cambio climático en México: ¿Bastiones de cambio o barreras estratégicas? *CEPAL*. Serie Estudios y Perspectivas.

Grunstein, M., and Carreón-Rodríguez, V. G. (2012). Pemex: ¿la no empresa de todos los mexicanos? por qué Pemex no es una verdadera empresa pública y por qué debe serlo. Centro de Investigación y Docencia Económicas.

Hall, D., and Nguyen, T. A. (2017). Electricity liberalisation in developing countries. *Progress in Development Studies*, 17(2), 99-115.

Hall, P. A., and Taylor, R. C. (1996). Political science and the three new institutionalisms. *Political studies*, *44*(5), 936-957.

Hall, P.A. (1993). Policy paradigms, social learning, and the state: the case of economic policymaking in Britain. *Comparative politics*, 275-296.

Hansen, U. E., and Nygaard, I. (2014). Sustainable energy transitions in emerging economies: The formation of a palm oil biomass waste-to-energy niche in Malaysia 1990–2011. *Energy Policy*, *66*, 666-676.

Hansen, U. E., Nygaard, I., Romijn, H., Wieczorek, A., Kamp, L. M., and Klerkx, L. (2018). Sustainability transitions in developing countries: Stocktaking, new contributions and a research agenda. *Environmental Science and Policy*, 84,198–203.

Hartley, J. (2004). 'Case study research', in C. Cassell and G. Syman (eds.) *The essential guide to qualitative methods in organisational research*, London, Sage.

Hernández-Ochoa C. (2007). La Reforma Cautiva: Inversión, trabajo y empresa en el sector eléctrico mexicano. Centro de Investigación para el Desarrollo.

Hernández-Ochoa, C. (2010). Temas de regulación del sector eléctrico mexicano. In *La infraestructura pública en México: (regulación y financiamiento)*, Barquín, A. M., qand Treviño, M. F. J. (coord.). Mexico City, UNAM.

Hess, D. J. (2014). Sustainability transitions: A political coalition perspective. *Research Policy* 43 (2), 278-283.

Hirsh, R. F., and Jones, C. F. (2014). History's contributions to energy research and policy. *Energy Research & Social Science*, 1, 106-111.

Hiteva, R., and Sovacool, B. (2017). Harnessing social innovation for energy justice: A business model perspective. *Energy Policy*, 107, 631-639.

Hofman, P. S., Elzen, B. E., and Geels, F. W. (2004). Sociotechnical scenarios as a new policy tool to explore system innovations: Co-evolution of technology and society in the Netherland's electricity domain. *Innovation*, 6(2), 344-360.

Howe, C., and Boyer, D. (2016). Aeolian extractivism and community wind in Southern Mexico. *Public Culture*, 28(2 (79)), 215-235.

Huesca-Perez, M. E., Sheinbaum-Pardo, C., and Köppel, J. (2016). Social implications of siting wind energy in a disadvantaged region–The case of the Isthmus of Tehuantepec, Mexico. *Renewable and Sustainable Energy Reviews*, 58, 952-965.

Ibarra-Yunez, A. (2015). Energy reform in Mexico: Imperfect unbundling in the electricity sector. *Utilities Policy*, 35, 19-27.

Instituto Nacional de Ecología y Cambio Climático (INECC) (2015). Vulnerabilidad actual. https://www.gob.mx/inecc/acciones-y-programas/vulnerabilidad-actual

Inter-American Development Bank (IADB) (2017). IIC finances Solem solar photovoltaic plant in Mexico. Accessed 09.08.19 https://www.iadb.org/en/news/news-releases/2017-08-09/iic-finances-solem-solar-plant-in-mexico%2C11863.html

Intergovernmental Panel on Climate Change (IPCC) (2012). Renewable energy in the context of Sustainable Development. In *Special Report on Renewable Energy Sources and Climate Change Mitigation*. Cambridge and New York, Cambridge University Press.

International Energy Agency (IEA) (2007). *Contribution of Renewables to Energy Security*, IEA Information Paper. Paris, OECD/IEA Publishing.

International Energy Agency (IEA) (2015). *World Energy Outlook Special Report on Energy and Climate Change*. Paris, OECD/IEA Publishing.

International Energy Agency (IEA) (2016a). *Energy Technology Perspectives 2016*. Paris, OECD/IEA Publishing.

International Energy Agency (IEA) (2016b). *Special Report: Mexico Energy Outlook*. Paris, OECD/IEA Publishing.

International Energy Agency (IEA) (2017). *Energy Policies beyond IEA Countries: Mexico 2017*. Accessed 09.08.19 https://webstore.iea.org/energy-policies-beyond-iea-countries-mexico-2017

International Energy Agency (IEA) (2018). *World Energy Outlook 2018*. Paris, IEA. Accessed 09.08.19 https://www.iea.org/reports/world-energy-outlook-2018

International Energy Agency (IEA) (2019). IEA Electricity Information 2018. Statistics data browser. Accessed 09.08.19 https://www.iea.org/statistics/

International Renewable Energy Agency (IRENA) (2014). *REthinking Energy: Towards a new power system*. Abu Dhabi, IRENA.

International Renewable Energy Agency (IRENA) (2015a). *Renewable Energy Prospects: Germany*, REmap 2030 analysis. Abu Dhabi, IRENA.

International Renewable Energy Agency (IRENA) (2015b). *Renewable Energy Policy Brief*. Abu Dhabi, IRENA.

International Renewable Energy Agency (IRENA) (2015c). *REthinking Energy: Renewable Energy and Climate Change*. Abu Dhabi, IRENA.

International Renewable Energy Agency (IRENA) (2019). *Innovation landscape for a renewable-powered future: Solutions to integrate variable renewables*. Abu Dhabi, IRENA.

IRENA and CPI (2018). *Global Landscape of Renewable Energy Finance*, 2018. Abu Dhabi, IRENA.

Jacobsson, S., and Lauber, V. (2006). The politics and policy of energy system transformation—explaining the German diffusion of renewable energy technology. *Energy policy*, 34(3), 256-276.

Jamasb, T. (2006). Between the state and market: Electricity sector reform in developing countries. *Utilities Policy*, 14(1), 14-30.

Jano-Ito, M. A., and Crawford-Brown, D. (2016). Socio-technical analysis of the electricity sector of Mexico: Its historical evolution and implications for a transition towards low-carbon development. *Renewable and Sustainable Energy Reviews*, 55, 567-590.

Joskow, P. L. (1998). Electricity sectors in transition. *The energy journal*, *19*(2).

Kamp, L. M., and Vanheule, L. F. (2015). Review of the small wind turbine sector in Kenya: Status and bottlenecks for growth. *Renewable and Sustainable Energy Reviews*, 49, 470-480.

Karl, T. L. (1997). *The paradox of plenty: Oil booms and petro-states*. Berkeley and Los Angeles, University of California Press.

Keay, M. (2013). Renewable energy targets: the importance of system and resource costs. Oxford, Oxford Institute for Energy Studies.

Kemp, R. (1994). Technology and the transition to environmental sustainability: the problem of technological regime shifts. *Futures*, 26(10), 1023-1046.

Kemp, R., Loorbach, D., and Rotmans, J. (2007). Transition management as a model for managing processes of co-evolution towards sustainable development. *The International Journal of Sustainable Development & World Ecology*, 14(1), 78-91.

Kemp, R., Schot, J., and Hoogma, R. (1998). Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management. *Technology analysis & strategic management*, 10(2), 175-198.

Kern, F., and Mitchell, C. (2010). Policy Paradigms as part of the landscape: How do policy paradigms influence attempts to govern transitions. *In 14th IRSPM conference, Berne, Switzerland*, 7th-9th April 2010.

Kern, F., and Rogge, K. S. (2018). Harnessing theories of the policy process for analysing the politics of sustainability transitions: A critical survey. *Environmental innovation and societal transitions*, 27, 102-117.

Kern, F., Kuzemko, C. and Mitchell, C. (2014). Measuring and explaining policy paradigm change: the case of UK energy policy. *Policy & Politics*, 42, 513-530.

Kingdon, J. W. (2011). *Agendas, alternatives, and public policies* (updated second edition) Boston, Longman, Pearson.

Knill, C., and Tosun, J. (2012). *Public Policy: A New Introduction*. London, Palgrave Macmillan.

Köhler, J., Geels, F. W., Kern, F., Markard, J., Wieczorek, A., Alkemade, F., and Hess, D. (2019). An agenda for sustainability transitions research: State of the art and future directions. *Environmental Innovation and Societal Transitions*, 31, 1-32.

Konrad, K., Truffer, B., and Voß, J. P. (2008). Multi-regime dynamics in the analysis of sectoral transformation potentials: evidence from German utility sectors. *Journal of Cleaner Production*, 16(11), 1190-1202.

Kuzemko, C. (2013). *The energy security-climate nexus: Institutional change in the UK and beyond*. London, Palgrave Macmillan.

Kuzemko, C., Lockwood, M., Mitchell, C. and Hoggett, R. (2016). Governing for sustainable energy system change: Politics, contexts and contingency. *Energy Research & Social Science*, 12, 96-105.

Lachapelle, E., and Paterson, M. (2013). Drivers of national climate policy. *Climate policy*, 13(5), 547-571.

Laird, F. N. (2013). Against transitions? Uncovering conflicts in changing energy systems. *Science as Culture*, 22(2), 149-156.

Laird, F. N., and Stefes, C. (2010). Creating Path Dependency: The Divergence of German and U.S. Renewable Energy Policy. Paper presented at Annual Meeting of the American Political Science Association, Washington DC, September 2-5. 1–31. Available at SSRN: https://ssrn.com/abstract=1644532

Langley, A. N. N., Smallman, C., Tsoukas, H., and Van de Ven, A. H. (2013). Process studies of change in organization and management: Unveiling temporality, activity, and flow. *Academy of management journal*, 56(1), 1-13.

Ley de Energía Geotérmica (LEG) (2014). Diario Oficial de la Federación. Accessed 09.08.19 http://www.diputados.gob.mx/LeyesBiblio/pdf/LEG_110814.pdf

Ley de la Agencia Nacional de Seguridad Industrial y de Protección al Medio Ambiente del Sector Hidrocarburos (2014). Diario Oficial de la Federación. Accessed 09.08.19 http://www.diputados.gob.mx/LeyesBiblio/pdf/LANSI_110814.pdf

Ley de la Industria Eléctrica (LIE) (2014). Diario Oficial de la Federación. Accessed 09.08.19 http://www.diputados.gob.mx/LeyesBiblio/pdf/LIElec_110814.pdf

Ley de Transición Energética (LTE) (2015). Diario Oficial de la Federación. Accessed 09.08.19 http://www.diputados.gob.mx/LeyesBiblio/pdf/LTE.pdf

Ley del Servicio Público de Energía Eléctrica (LSPEE) (1975). Diario Oficial de la Federación, Accessed 09.08.19 http://www.diputados.gob.mx/LeyesBiblio/abro/lspee/LSPEE_orig_22dic75_ima.pdf

Ley General de Cambio Climático (LGCC) (2012). Diario Oficial de la Federación, Accessed 09.08.19 http://www.diputados.gob.mx/LeyesBiblio/pdf/LGCC_130718.pdf

Ley para el Aprovechamiento de Energías Renovables y el Financiamiento de la Transición Energética (LAERFTE) (2008). Diario Oficial de la Federación. Accessed 09.08.19 http://www.diputados.gob.mx/LeyesBiblio/abro/laerfte/LAERFTE_orig_28nov08.pdf

Ley para el Aprovechamiento Sustentable de la Energía (LASE) (2008). Diario Oficial de la Federación. Accessed 09.08.19 http://www.diputados.gob.mx/LeyesBiblio/abro/lase/LASE_orig_28nov08.pdf

Lijphart, A. (1971). Comparative politics and the comparative method. *American political science review*, 65(3), 682-693.

Lipp, J. (2007). Lessons for effective renewable electricity policy from Denmark, Germany and the United Kingdom. *Energy policy*, 35(11), 5481-5495.

Lockwood, M., Kuzemko, C., Mitchell, C. and Hoggett, R. (2016). Historical institutionalism and the politics of sustainable energy transitions: A research agenda. *Environment and Planning C: Politics and Space*, 35(2), 312-333.

Lockwood, M., Kuzemko, C., Mitchell, C., and Hoggett, R. (2013). Theorising governance and innovation in sustainable energy transitions. University of Exeter.

Looney, R. E. (2014). *Handbook of emerging economies*. Abington, New York, Routledge.

Loorbach, D., Frantzeskaki, N. and Avelino, F. (2017). Sustainability transitions research: transforming science and practice for societal change. *Annual Review of Environment and Resources*, 42, 599-626.

Lovins, A. B., Datta, K., Feiler, T., Rábago, K., Swisher, K., Lehmann, A. and Wicker, K. (2002). Small is profitable: The hidden economic benefits of making electric resources the right size. Snowmass, Rocky Mountain Institute.

Lund, H. (2007). Renewable energy strategies for sustainable development. *Energy*, 32(6), 912-919.

Mahoney, J. (2001). *The legacies of liberalism: Path dependence and political regimes in Central America*. Baltimore and London,The Johns Hopkins University Press.

Marechal, K., and Lazaric, N. (2010). Overcoming inertia: insights from evolutionary economics into improved energy and climate policies. *Climate Policy*, 10(1), 103-119.

Markard J., Raven R., and Truffer B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research Policy*, 41, 955–967.

Markard, J. (2017). Sustainability Transitions: Exploring the emerging research field and its contribution to management studies. 33rd EGOS Colloquium, Copenhagen

Martínez, J., Molyneux, M., and Sánchez-Ancochea, D. (2009). Latin American capitalism: economic and social policy in transition. *Economy and Society*, *38*(1), 1-16.

Mason, J. (2017). Making Sense of Qualitative Data. In *Qualitative Researching*. Third Edition. London, Sage.

Meadowcroft, J. (2007). Who is in charge here? Governance for sustainable development in a complex world. *Journal of Environmental Policy & Planning*, 9(3-4), 299-314.

Meadowcroft, J. (2009). What about the politics? Sustainable development, transition management, and long term energy transitions. *Journal of Policy Science* 42, 23–340.

Meadowcroft, J. (2011). Engaging with the politics of sustainability transitions. *Environmental Innovation and Societal Transitions* 1, 70-75.

Meana, Sergio (2015). Discusión de Transición Energética 'sacará chispas', y te decimos por qué… *El Financiero*. Accessed 09.08.19 https://www.elfinanciero.com.mx/economia/aprobacion-de-ley-de-transicion-energetica-sacara-chispas

Meana, Sergio (2015). Quejas por Ley de Transición llegan con 7 años de retraso. *El Financiero*. Accessed 09.08.19 https://www.elfinanciero.com.mx/economia/quejas-por-ley-de-transicion-llegan-con-anos-de-retraso

Mexican Congress (1992). Decreto que reforma, adiciona y deroga diversas disposiciones de la Ley del Servicio Público de Energía Eléctrica. http://www.diputados.gob.mx/LeyesBiblio/abro/lspee/LSPEE_ref04_23dic92_ima.pdf

Mexican Constitution of 1917 (2019). Título Primero. Capítulo I. De los Derechos Humanos y sus Garantía. Accessed 09.08.19 http://www.diputados.gob.mx/LeyesBiblio/pdf/1_090819.pdf

Mez, L. (2012). Nuclear energy–Any solution for sustainability and climate protection?. *Energy Policy*, 48, 56-63.

Miller, C. A., Richter, J., and O'Leary, J. (2015). Socio-energy systems design: a policy framework for energy transitions. *Energy Research & Social Science*, 6, 29-40.

Mitchell, C. (2008). *The political economy of sustainable energy*. Basingstoke and New York, Palgrave Macmillan.

Mitchell, J. C. (1983). Case and Situation Analysis. *The Sociological Review*, 31(2), 187–211.

Morales, I. (2011). The Energy Factor in Mexico-US Relations. *Belfer Center & Rice University. Centre for Energy Studies*. Accessed 09.08.19 http://hdl.handle.net/1911/91380

Morales, I. (2013). The Twilight of Mexico's State Oil Monopolism: Policy, Economic, and Political Trends in Mexico's Natural Gas Industry. *Belfer Center & Rice University. Centre for Energy Studies*. Accessed 09.08.19 http://hdl.handle.net/1911/91299

Morales, I., Escalante, C., and Vargas, R. (1988). *La formación de la política petrolera en México, 1970-1986*. Mexico City, Colegio de México.

Neumayer, E. (2003). Are left-wing party strength and corporatism good for the environment? Evidence from panel analysis of air pollution in OECD countries. *Ecological economics*, 45(2), 203-220.

Newell, P., and Phillips, J. (2016). Neoliberal energy transitions in the South: Kenyan experiences. *Geoforum*, 74, 39-48.

Nworie, I. (2017). *The Economics of Electricity Market Reforms in Developing Countries: An African Experience and Lessons* (Doctoral dissertation, University of Portsmouth).

Nye, D.E. (1999). *Consuming power: A social history of American energies*. Cambridge, MIT press.

Nygaard, I., and Bolwig, S. (2018). The rise and fall of foreign private investment in the jatropha biofuel value chain in Ghana. *Environmental Science & Policy*, *84*, 224-234.

O'Connor, P. A. (2010). Energy Transitions. The Pardee Papers. The Frederick S. Pardee Center for the Study of the Longer-Range Future. Boston University. Accessed 09.08.19 https://www.bu.edu/pardee/files/2010/11/12-PP-Nov2010.pdf

OECD (2012). *Energy*, OECD Green Growth Studies, Paris, OECD Publishing.

OECD (2013). *Environmental Performance Reviews: Mexico 2013*. Paris, OECD Publishing.

OECD (2019). *OECD Economic Surveys: Mexico 2019*. Paris, OECD Publishing. https://doi.org/10.1787/a536d00e-en

Pagnoni, G. A., and Roche, S. (2015). *The renaissance of renewable energy*. Cambridge, Cambridge University Press.

Painuly, J. P. (2001). Barriers to renewable energy penetration; a framework for analysis. *Renewable energy*, 24(1), 73-89.

Palacios, O. (2013). Abandona PRD mesa sobre reforma política por acuerdo PRI-PAN. Accessed 09.08.19 https://mvsnoticias.com/noticias/nacionales/abandona-prd-mesa-sobre-reforma-politica-por-acuerdo-pri-pan-742/

PEMEX (2013). Principales Elementos del Plan de Negocios de Petróleos Mexicanos y sus Organismos Subsidiarios 2014-2018. Mexico.

Peura, P. (2013). From Malthus to sustainable energy—Theoretical orientations to reforming the energy sector. *Renewable and Sustainable Energy Reviews*, 19, 309-327.

Pierson, P. (2000). Increasing returns, path dependence, and the study of politics. *American Political Science Review*, 94(2), 251-267.

Pierson, P. (2004). *Politics in time: History, institutions, and social analysis*. Princeton and Woodstock, Princeton University Press.

Pierson, P., and Skocpol, T. (2002). Historical institutionalism in contemporary political science. In *Political science: The state of the discipline*, 3(1), 1–32.

Pollitt, M. G. (2012). The role of policy in energy transitions: Lessons from the energy liberalisation era. *Energy policy*, *50*, 128-137.

Poloni-Staudinger, L. M. (2008). Are consensus democracies more environmentally effective?. *Environmental politics*, 17(3), 410-430.

Power, M., Newell, P., Baker, L., Bulkeley, H., Kirshner, J., and Smith, A. (2016). The political economy of energy transitions in Mozambique and South Africa: The role of the Rising Powers. *Energy Research & Social Science*, 17, 10-19.

Puyana, A. (2008). El manejo del petróleo mexicano: ¿política o economía?. *Perfiles latinoamericanos*, 16(32), 67-102.

Puyana, A., and Romero, J. (2008). El petróleo y el crecimiento económico Mexicano. Un recuento de oportunidades perdidas. In *Guerra de Fuego políticas petroleras y crisis energética en América Latina*, Fontaine, G. and Puyana, A. (Eds.) Quito, FLACSO.

Rabasa Kovacs, T. (2013). Auges petroleros en México: sucesos fugaces. *Economía UNAM*, 10(29), 35-55. Accessed 09.08.19 http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S1665-952X2013000200003&lng=es&tlng=en

Ramírez-Camperos, A. M., Rodríguez-Padilla, V., and Guido-Aldana, P. A. (2013). The Mexican electricity sector: Policy analysis and reform (1992–2009). *Energy policy*, 62, 1092-1103.

Ramos-Mejía, M., Franco-Garcia, M. L. and Jauregui-Becker, J. M. (2018). Sustainability transitions in the developing world: Challenges of socio-technical transformations unfolding in contexts of poverty. *Environmental science & policy*, 84, 217-223.

Rip, A., and Kemp, R. (1998). Technological change. *Human choice and climate change*, *2*(2), 327-399.

Roberts, C., and Geels, F. W. (2019). Conditions for politically accelerated transitions: Historical institutionalism, the multi-level perspective, and two historical case studies in transport and agriculture. *Technological Forecasting and Social Change*, 140, 221-240.

Roberts, C., Geels, F. W., Lockwood, M., Newell, P., Schmitz, H., Turnheim, B., and Jordan, A. (2018). The politics of accelerating low-carbon transitions: Towards a new research agenda. *Energy Research & Social Science*, 44, 304-311.

Rodríguez-Padilla, V. (2016). Industria eléctrica en México: tensión entre el Estado y el mercado. *Problemas del desarrollo*, 47(185), 33-55.

Rotmans, J., and Kemp, R. (2008). Detour ahead: a response to Shove and Walker about the perilous road of transition management. *Environment and Planning A*, 40(4), 1006-1012.

Rousseau, I. (2008). La reorganización de Petróleos Mexicanos. Visiones encontradas sobre la gobernanza de una empresa pública (1989-2006). In *La guerra del fuego. Políticas petroleras y crisis energética en América Latina*, Quito, FLACSO.

Rudnick, H. (1998). *The electric market restructuring in South America: successes and failures on market design*. Plenary session. Harvard University, Electricity Policy Group.

Salerno, P. (2016). Naturaleza y funciones de la "Comisión Reguladora de Energía" tras la reforma energética. *Derecho PUCP*, 0(76), 289-304. doi:http://dx.doi.org/10.18800/derechopucp.201601.012

Salerno, P. (2016). Naturaleza y funciones de la «Comisión Reguladora de Energía» tras la reforma energética. *Derecho PUCP*, (76), 289-304.

Sánchez, R. A. (1999). El impacto de la industria petrolera en la economía mexicana. *Estudios Internacionales*, 20-50.

Schneider, B. R. (2009). Hierarchical market economies and varieties of capitalism in Latin America. *Journal of Latin American Studies*, 41(3), 553-575.

Scott, J. (2011). ¿Quién se beneficia de los subsidios energéticos en México? Public Security Expenditure in Mexico. *Centro de Investigación y Docencia Económicas.* Accessed 09.08.19 http://repositorio-digital.cide.edu/handle/11651/141

Scott, J. (2013). Subsidios regresivos. *Nexos*, Special Issue ¿Adiós a Pemex?

Scrase, I., and Ockwell, D. (2009). Energy issues: Framing and policy change. In *Energy for the Future*. London, Palgrave Macmillan.

Scrase, I., and Smith, A. (2009). The (non-) politics of managing low carbon socio-technical transitions. *Environmental Politics*, 18(5), 707-726.

Scrase, I., Wang, T., MacKerron, G., McGowan, F., and Sorrell, S. (2009). Introduction: climate policy is energy policy. In *Energy for the Future*. London, Palgrave Macmillan.

Seal, A. (2016). Thematic Analysis. In *Researching Social Life*, Gilbert, N. and Stoneman, P. (Eds.). London, Sage.

Secretaría de Energía (SENER) (2012). *Prospectiva de Energías Renovables 2012-2026*. Subsecretaría de Planeación y Transición Energética. SENER website. Accessed 09.08.19 https://www.gob.mx/cms/uploads/attachment/file/62954/Prospectiva_de_Energ_as_Renovables_2012-2026.pdf

Secretaría de Energía (SENER) (2013). "Ponderar la energía como impulsora del desarrollo humano: PJC". Comunicado de prensa. Accessed 09.08.19 https://www.gob.mx/sener/prensa/ponderar-la-energia-como-impulsora-del-desarrollo-humano-pjc

Secretaría de Energía (SENER) (2014a). *Prospectiva de Energías Renovables 2014-2028*. Subsecretaría de Planeación y Transición Energética. SENER website. Accessed 09.08.19 https://www.gob.mx/cms/uploads/attachment/file/62945/Energ_as_Renovables_2014-2028.pdf

Secretaría de Energía (SENER) (2014b). *Prospectiva del Sector Eléctrico 2014-2028*. Dirección General de Planeación e Información Energéticas. SENER website. Accessed 09.08.19 https://www.gob.mx/cms/uploads/attachment/file/62947/Sector_El_ctrico_2014-2028.pdf

Secretaría de Energía (SENER) (2016a). Estadísticas del Sector Eléctrico e Indicadores de CFE. Subsecretaria de Electricidad. Accessed 09.08.19 http://egob2.energia.gob.mx/portal/electricidad.html

Secretaría de Energía (SENER) (2016b). *Prospectiva del Sector Eléctrico 2016-2030*. Dirección General de Planeación e Información Energéticas. SENER website. Accessed 09.08.19 https://www.gob.mx/cms/uploads/attachment/file/177626/Prospectiva_del_Sector_El_ctrico_2016-2030.pdf

Secretaría de Energía (SENER) (2018a). *Balance Nacional de Energía 2017*. Subsecretaría de Planeación y Transición Energética. SENER website. Accessed 09.08.19 https://www.gob.mx/cms/uploads/attachment/file/414843/Balance_Nacional_de_Energ_a_2017.pdf

Secretaría de Energía (SENER) (2018b). *Prospectiva del Sector Eléctrico 2018-2032*. Dirección General de Planeación e Información Energéticas. SENER website. Accessed 09.08.19 https://base.energia.gob.mx/Prospectivas18-32/PSE_18_32_F.pdf

Secretaría de Energía (SENER) (2018c). Reporte de Avance de Energías Limpias. Primer Semestre 2018. SENER website. Accessed 09.08.19 https://www.gob.mx/cms/uploads/attachment/file/418391/RAEL_Primer_Semestre_2018.pdf

Secretaría de Energía (SENER) (2019). Sistema de Información Energética (SIE). SIE website. Accessed 09.08.19 http://sie.energia.gob.mx

Secretaría de Hacienda y Crédito Público (SHCP) (2018). Presupuesto de Egresos de la Federación 2018. Guía rápida. SHCP website. Accessed 09.08.19 https://www.transparenciapresupuestaria.gob.mx/work/models/PTP/Home/PEF2018/PEF_2018.pdf

Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) (2015a). Guía de Programas de Fomento a la Generación de Energía con Recursos Renovables. Mexico City, SEMARNAT.

Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) (2015b). Mexico Intended Nationally Determined Contribution. Accessed 09.08.19 https://www.gob.mx/cms/uploads/attachment/file/162973/2015_indc_ing.pdf

Sellwood, S. A., and Valdivia, G. (2018). Interrupting Green Capital on the Frontiers of Wind Power in Southern Mexico. *Latin American Perspectives*, 45(5), 204-221.

Sen, A. (2014). Divergent paths to a common goal? An overview of challenges to electricity sector reform in developing versus developed countries. Oxford, Oxford Institute for Energy Studies.

Shackley, S., and Green, K. (2007). A conceptual framework for exploring transitions to decarbonised energy systems in the United Kingdom. *Energy*, 32(3), 221-236.

Sharp, L., and Richardson, T. (2001). Reflections on Foucauldian discourse analysis in planning and environmental policy research. *Journal of environmental policy and planning*, *3*(3), 193-209.

Shove, E., and Walker, G. (2007). CAUTION! Transitions ahead: politics, practice, and sustainable transition management. *Environment and planning A*, 39(4), 763-770.

Sígler, É. (2018). La CFE destinará 34,310 mdp para resucitar sus plantas más contaminantes. *Expansión México*. Accessed 09.08.19 https://expansion.mx/empresas/2018/12/15/cfe-destinara-34-310-mdp-resucitar-plantas-contaminantes

Skea, J., Ekins, P., and Winskel, M. (2011). *Energy 2050: Making the transition to a secure low carbon energy system*. London and Washington, Routledge.

Smil, V. (2010). *Energy transitions: history, requirements, prospects*. Santa Barbara, ABC-CLIO.

Smil, V. (2012). A skeptic looks at alternative energy. *IEEE Spectrum*, 49(7), 46-52.

Smith, A., and Raven, R. (2012). What is protective space? Reconsidering niches in transitions to sustainability. *Research policy*, 41(6), 1025-1036.

Smith, A., Stirling, A., and Berkhout, F. (2005). The governance of sustainable socio-technical transitions. *Research Policy* 34, 1491–1510.

Smith, A., Voß, J. P., and Grin, J. (2010). Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges. *Research policy*, 39(4), 435-448.

Smits, M. (2016). *Southeast Asian energy transitions: Between modernity and sustainability*. Farnham, Routledge.

Solís, A. (2018). CFE gastará más en plantas de carbón que en centrales renovables. *Forbes México*. Accessed 09.08.19 https://www.forbes.com.mx/en-cfe-gastara-mas-en-plantas-de-carbon-que-en-centrales-renovables/

Sovacool, B. K. (2014). What are we doing here? Analyzing fifteen years of energy scholarship and proposing a social science research agenda. *Energy Research & Social Science*, 1, 1-29.

Sovacool, B. K. (2016). How long will it take? Conceptualizing the temporal dynamics of energy transitions. *Energy Research & Social Science*, 13, 202-215.

Sovacool, B. K., and Drupady, I. M. (2012). *Energy access, poverty, and development: the governance of small-scale renewable energy in developing Asia*. Oxon and New York, Routledge.

Spreng, D. (2014). Transdisciplinary energy research–reflecting the context. *Energy Research & Social Science*, 1, 65-73.

Stefes, C. H. (2010). Bypassing Germany's reformstau: the remarkable rise of renewable energy. *German Politics*, 19(2), 148-163.

Steinmo, S. (2008). Historical institutionalism. In *Approaches and Methodologies in the Social Sciences: A Pluralist Perspective*, D. Della Porta and M. Keating (Eds.). Cambridge, Cambridge University Press.

Stenzel, T., and Frenzel, A. (2008). Regulating technological change—The strategic reactions of utility companies towards subsidy policies in the German, Spanish and UK electricity markets. *Energy policy*, *36*(7), 2645-2657.

Studer, I. (2014). Energías Renovables para la Competitividad en México. Instituto Global para la Sostenibilidad

Tansey, O. (2007). Process tracing and elite interviewing: a case for non-probability sampling. *PS: Political Science & Politics*, 40(4), 765-772.

Tester, J. W., Drake, E. M., Driscoll, M. J., Golay, M. W., and Peters, W. A. (2012). Sustainable energy: choosing among options. Cambridge, MIT press.

Thelen, K., (1999). Historical institutionalism in comparative politics. *Annual Review of Political Science,* 2(1), 369-404.

Tomain, J. P. (2017). *Clean power politics: the democratization of energy*. Cambridge, Cambridge University Press.

Tomáš, J., and Seidel, T. (2013). *The power of video studies in investigating teaching and learning in the classroom*. New York, Waxmann Publishing.

Torres, M. (2013). El PRD deja el Pacto por México por el tema de la reforma energética. *Expansión*. Nacional. Accessed 09.08.19 https://expansion.mx/nacional/2013/11/28/el-senado-entra-en-su-recta-final-con-el-destrabe-de-la-reforma-politica

United Nations (UN) (2012). *Sustainable Energy for All. A Global Action Agenda. Pathways for Concerted Action towards Sustainable Energy for All*. New York, UN.

United Nations (UN) (2015). Resolution adopted by the General Assembly 70/1. Transforming our world: the 2030 Agenda for Sustainable Development. 25 September 2015 https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

United Nations (UN) (2018). World Economic Situation and Prospects 2018.

United Nations Development Programme (UNDP) (2005). *Energizing the millennium development goals. A guide to energy's role in reducing poverty*. New York, UNDP.

Unruh, G. C. (2000). Understanding carbon lock-in. *Energy policy*, 28(12), 817-830.

Urban, F. (2014). *Low carbon transitions for developing countries*. New York, Routledge.

Van den Bergh, J. C., and Bruinsma, F. R. (2008). *Managing the transition to renewable energy: theory and practice from local, regional and macro perspectives*. Cheltenham and Massachusetts, Edward Elgar Publishing.

Van Driel, H., and Schot, J. (2005). Radical innovation as a multilevel process: introducing floating grain elevators in the port of Rotterdam. *Technology and Culture*, *46*(1), 51-76.

Vargas Suárez, R. (2015). Reforma energética: De servicio público a modelo de negocios. *Política y cultura*, (43), 125-145.

Verbong, G., and Geels, F. (2007). The ongoing energy transition: lessons from a socio-technical, multi-level analysis of the Dutch electricity system (1960–2004). *Energy policy*, 35(2), 1025-1037.

Voogt, M., Boots, M. G., Schaeffer, G. J., and Martens, J. W. (2000). Renewable electricity in a liberalised market–The concept of green certificates. *Energy & Environment*, *11*(1), 65-79.

Walker, G., Hunter, S., Devine-Wright, P., Evans, B., and Fay, H. (2007). Harnessing community energies: explaining and evaluating community-based localism in renewable energy policy in the UK. *Global Environmental Politics*, 7(2), 64-82.

Wieczorek, A. J. (2018). Sustainability transitions in developing countries: Major insights and their implications for research and policy. *Environmental Science & Policy*, 84, 204-216.

Wieczorek, A. J., Raven, R., and Berkhout, F. (2015). Transnational linkages in sustainability experiments: A typology and the case of solar photovoltaic energy in India. *Environmental Innovation and Societal Transitions*, 17, 149-165.

Williams, J. H., and Ghanadan, R. (2006). Electricity reform in developing and transition countries: A reappraisal. *Energy*, 31(6-7), 815-844.

Wiser, R. H. (1998). Green power marketing: increasing customer demand for renewable energy. *Utilities Policy*, *7*(2), 107-119.

Wlokas, H. L., Boyd, A., and Andolfi, M. (2012). Challenges for local community development in private sector-led renewable energy projects in South Africa: an evolving approach. *Journal of Energy in Southern Africa*, 23(4), 46-51.

Wood, D. (2010). The Administration of Decline: Mexico's Looming Oil Crisis. *Law & Business Review of the Americas*, 16, 855.

World Bank (2008). *Designing sustainable off-grid rural electrification projects: Principles and practices*. Washington, The World Bank.

World Bank (2019). Projects in Mexico. Accessed 09.08.19 http://projects.worldbank.org/search?lang=en&searchTerm=&countrycode_exact=MX

World Bank Data (2019). World Bank Country and Lending Groups. Accessed 09.08.19 https://datahelpdesk.worldbank.org/knowledgebase/articles/906519

World Bank Group (2019). Mexico - Systematic Country Diagnostic. Accessed 09.08.19 http://documentos.bancomundial.org/curated/es/588351544812277321/pdf/Mexico-Systematic-Country-Diagnostic.pdf

Yildiz, Ö. (2014). Financing renewable energy infrastructures via financial citizen participation–The case of Germany. *Renewable Energy*, 68, 677-685.

Yin, R. K. (2003). *Applications of case study research*. California, Sage Publications.

Yin, R. K. (2014). *Case study research and applications: Design and methods*. Sage publications. California, Sage Publications.

Zepeda, P. J. (2017). El pacto por México; un intento de gobierno de coalición. *Instituto Belisario Domínguez*, 32. Senado de la República.