Liberalisation, the World Bank and investment in the electricity systems of Vietnam

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May 2017

A thesis submitted in partial fulfilment of the requirements of the University of Greenwich for the Degree of Doctor of Philosophy

DECLARATION

"I certify that this work has not been accepted in substance for any degree, and is not concurrently being submitted for any degree other than that of Doctor of Philosophy being studied at the University of Greenwich. I also declare that this work is the result of my own investigations except where otherwise identified by references and that I have not plagiarised the work of others".

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ACKNOWLEDGEMENTS

The research could not have been completed without tremendous support and efforts from my family, my supervisors, colleagues, friends and advisors.

I would like to thank my supervisors, Professor Stephen Thomas and Professor David Hall who have endured and stood by me from the days of my Master degree at University of Greenwich. They have believed and supported me through tough times and encouraged me when I made even the slightest improvements. They are not only my supervisors, my teachers, my inspirations but also my godfathers who have given unconditional support to me. Without them, I could have never thought I could find passion in research.

I would like to thank my father, Professor Dr. Nguyen Van Lich and my mother, Bui Thi Tue for their unconditional love and selfless support. This thesis is dedicated especially to my parents who have waited so long for this day.

I would like to thank my husband, Dr. Tuan Vuong and my daughter, Panda Truc-anh Vuong who have created the most peaceful and exciting home I could be in. My daughter was born at the beginning of this PhD research. She has grown to accept the nature of her parents' jobs and has been the bravest and inspirational girl in my life. My husband has always been the biggest supporter and a dedicated instructor teaching me important visualisation skills. Without them, I could have lost energy and purpose along the way.

I would also like to thank countless people I met and worked with in the past years who gave me their advice, taught me skills and lent me their hands when I needed. Greatest appreciation goes to: Staff, lecturers, colleagues and friends at University of Greenwich, energy economics experts, friends at Young Scholars Initiative, colleagues at Harvard University. Last but not least, I would like to thank inspirational people whose work inspired me and made me believe in what I do.

ABSTRACT

The primary focus of this thesis is on three fundamental research questions: the analytical issue of how investment in power generation happens; the policy issue of how to develop the power sector to meet the economic and social needs of development; and what is the impact of liberalisation policies on both these issues. It addresses these questions through the case study of Vietnam.

The theoretical literature on liberalisation theorised away the role of the state that had grown under post-war Keynesian consensus. Applied to the electricity sector, this called for the unbundling of the vertically-integrated public monopolies, in the expectation of sufficient private investment, lower prices and greater efficiency.

The empirical literature shows that these expectations have not been generally fulfilled. Chapter 3 reviews the evidence from a wide range of countries including 4 developed countries in Europe and 13 developing countries in other continents. Developing countries have made significant progress in achieving extension of networks and increasing generating capacity regardless of the extent of liberalization.

Chapter 4 presents a critique of the lack of data and inadequate data quality from major data sources and shows the need to construct a new database. The Power Sector Database was then constructed with the aim to collect complete data of all power generation projects in Vietnam, their investors and financiers. The spreadsheet containing the database is submitted to the examiners along with the thesis.

Chapters 5, 6 and 7 use the database: to analyse the dynamics and actors in the power sector in Vietnam; the specific policy role of the World Bank in promoting liberalisation, and its cost; and the actual role of public and private, domestic and foreign investors.

The thesis concludes that the benefits gained so far from liberalisation are minimal, whereas the costs to the power sector as well as the society are much larger. Finally, it argues that the results show the weakness of mainstream economic theories of the public sector and public services, and argues for the need to move away from the idea that scarcity must be central.

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'Let us choose to unite the power of markets with the authority of universal ideals. Let us choose to reconcile the creative forces of private entrepreneurship with the needs of the disadvantaged and the requirements of future generations'

-Kofi Annan,1998-

1.1. The Changing Faces of Electricity Sector

The world's economies differ significantly from how they were a few decades ago in the way that the boundaries between economies and markets are almost indefinable. The idea that markets are present and possible in every aspect of life is widely accepted. We tend to link the resourceful life in the Northern countries with the omnipresence of markets. We tend to resolve problems in a low-income country with market-driven policies. Market economy was once a notion, an option out of many, then became an ideal, an absolute. The world's economies have been converging in the way they are structured and governed.

Economic policy convergence would not be an issue if the figures spoke for themselves and if history agrees with the findings. On the one hand, markets have been more deeply embedded in all sectors, including ones that had always been wholly state-controlled as Sandel (1998) commented that, '...markets and market-like practices are extending their reach in almost every sphere of life.' On the other hand, there started to emerge worries about the limits of markets and how markets degrade social values. When a service that is meant to serve all citizens equally well becomes a tool for differentiation, one needs to ask the question of the value of such a movement.

History never repeats itself. But we know it has impacted dependency mindsets of policy makers in developing countries. It rather raises the question of how we can learn from the past - the historic data of what actually happened in comparison to what we assume. No two countries are identical. But we know there are a limited number of economic policies that

have been implemented in the large variety of economic situations. It then questions the validity of such influences and their influencers.

The electricity sector became increasingly state-controlled, often through public ownership, throughout most of the 20th century. It has changed significantly, not only in its grid connections, but also in how it now serves the public. Our increasing dependence on the use of electricity justifies its public-ness. So, its commodification and commercialization for market trading at a global scale were a significant change.

Major reforms have taken place in the last 30 years with the result that the electricity industry today looks significantly different from how it was in the 1980s. At that time, in most European countries, electricity was provided by vertically-integrated companies owned by the State or by a local government. Such companies were shielded and so not subject to competition thanks to the government's guarantee or provision of a legal monopoly right. These companies controlled the entire value chain, from generation to transmission and distribution to end-users. Profit maximization was generally not the top priority. In such a strategic sector, service coverage, promoting local industries, quality improvement, protection of vulnerable consumers, and good employment conditions, were common goals set by the government for the incumbent enterprise.

Today, electricity is considered as a commodity, produced in markets where numerous buyers and sellers trade. Borders between national markets have blurred. In Europe, a single energy market is emerging. In the Association of South-East Asian Nations (ASEAN) and West Africa, cross-country power sales have been expanding. Networks, both transmission and distribution, have been unbundled from generation and supply activities. Independent regulatory authorities have been established to ensure national security objectives while preventing anti-trust activities. Also, governments have started to step back by selling, partially or fully, their generation and retail companies, whilst commonly maintaining the control of transmission and distribution networks. Privatisation of public enterprises in the electricity sector has been justified by the assumption that private companies would be more efficient and provide more innovative solutions, hence reducing costs and benefitting customers. Revenues from these sales are also seen as an additional benefit, especially in countries with budget deficits.

Discussions about the merits of market liberalisation (which includes elements of privatisation, minimal governance and competition) have been rife in academia and in public debate. Contrary to expectations, empirical research so far has produced mixed results while theoretical debate has been far from fruitful.

The following sections elaborate on these changes to the electricity sector and similar changes witnessed in other public services. The chapter provides the rationale for the thesis and my research approach.

1.2. From Public to Private and market: unbundling electricity systems

The period between World War II and the 1970s witnessed a regulatory stability in both OECD and developing countries which favoured public ownership in public infrastructure services, including electricity and gas, in order to ensure social justice and sufficient investment in these strategic sectors for economic development (Van de Walle and Scott, 2009). From the 1980s, there was a strong reaction against the role of government in public infrastructure and public services, as a result of the rebirth of neoliberal policies led by the UK's Margaret Thatcher and the US's Ronald Regan, and then the collapse of the Soviet Union. The key elements in the reform policies were the privatisation and liberalisation of public services, and the liberalisation of gas and electricity sectors.

These policies were applied to electricity started in 1983 in Chile, but the most influential reform was the 'British model', introduced in the UK privatisation of 1990. This involves 'unbundling' vertically-integrated State-Owned Enterprises (SOEs) into separate transmission, distribution, generation and supply companies, creating wholesale and retail markets, introducing an independent regulator, and finally privatisation of state-owned entities. Liberalisation is thus more than just transfer of ownership, it can 'induce greater improvements in performance than privatisation' alone (Newbery, 1997). Inspired by the UK reform, the EU created a series of Directives (1996, 2003, 2009), which required member countries to introduce similar reforms. Although the EU is required to remain neutral on the question of public or private ownership, and so could not insist on privatisation, it does require effective separation of management of distribution and transmission companies from generation and supply. At the same time, the USA introduced a series of measures to 'deregulate' the power sector, opening interstate wholesale markets

for trading power, and encouraging states to replace regulated, or publicly-owned, power utilities with competitive retail markets. Although, unlike the EU, the USA federal government could not make unbundling and the creation of retail markets compulsory, under the separation of powers, electricity is a business regulated at a state level. There was little national public ownership, and privatisation played no part in US reforms.

In developing countries, the same trends have also happened since the 1990s, as a result of external pressures from prescriptive conditionalities, including unbundling and liberalisation of electricity systems, imposed in structural adjustment programmes of the International Monetary Fund (IMF), and development projects managed by the World Bank and other international financial institutions (IFIs). Erdogdu (2011) examined electric power sector liberalization in 63 countries, 31 of which are developing countries, from 1982 to 2009, and showed that despite economic differences, a number of developing countries are progressing towards a complete reform at a relatively similar pace as in developed countries. Among 172 countries that received loans from the World Bank in this period, more than 90 countries accepted liberalisation of the energy market as a conditionality (Erdogdu, 2013).

Broadly speaking, the process of liberalisation is part of the attempt to separate and reduce the involvement of the state via public ownership in investment and operation of a sector. Whilst privatisation can be defined as 'the deliberate sale by a government of state-owned enterprises (SOEs) or assets to private economic agents' (Megginson and Netter, 2001), liberalisation covers a wider set of reforms, including unbundling, marketization, competition, deregulation and corporatization, as well as privatisation. Newbery (1997) argues that liberalisation is more than just transfer of ownership, and can 'induce greater improvements in performance than privatisation'. The spread of liberalization policies in developing countries is associated with the 'Washington Consensus' - a term coined by John Williamson to define a set of policies which cover much more than a single sector (Williamson, 2004). It includes trade liberalization, privatisation, and deregulation among other fiscal and monetary consolidation policies. The consensus, originally intended for Latin America, became the prescription used by the Bretton Woods institutions for all developing countries in need of capital inflows, applied via conditionalities in the 1990s, the 'glorious years' of the Washington Consensus (Birdsall, de la Torre and Caicedo, 2010; Williamson, 2004). As Birdsall et al (2010) point out, 'it is not a coincidence that the

appearance in 1989 of the Washington Consensus coincided with fall of the Berlin Wall, which symbolically marked the burial of centrally planned economies'.

Governments and municipalities usually expect privatisations and liberalisation to attract private investment to benefit their own finances by reducing the expected financial input of governments into the sector in the future. Liberalisation can also be seen as a gradual way of introducing eventual privatisation in a sector that is dominated with an incumbent state-owned giant, and the proceeds of a sale can be used to reduce the existing debts of the government itself.

This impact on public finance and investment was 'the most important' driver for liberalising the sector (Williams and Ghanadan, 2006), despite the inconvenient truth that the proceeds of the sale should be offset by the loss of an asset of a corresponding value, the electricity company itself. Especially in developing countries, the power sector demands high levels of investment in generating capacity (to ensure sufficient supply for increasing industrial and household uses), in maintaining and upgrading transmission lines (to ensure network efficiency) and in expansion of distribution networks (to increase access to electricity). Governments needed to make consistent and increasing investment in this backbone industry but were faced with debts, budget deficits, inflation, and often the constraints of IMF structural adjustment programmes. Governments were therefore attracted by the core promise of liberalisation that a competitive power market could attract continuous commercial investment in generation by the private sector to efficiently supply enough electricity to meet the growing demands of developing economies. They saw liberalisation as a modernising reform which would enable countries to achieve the scale of electrification needed for economic and social development by encouraging foreign direct investment (FDI) in electricity systems, as in other sectors. There has been little adaptation of the standard liberalisation model. The process has been slowed in many countries by strong resistance from stakeholder groups.

This need for investment finance strengthened the role of the World Bank. Large project loans have been tied to the promotion of liberalisation and privatisation, to the use of PPPs, provided guarantees to attract private investment, or used to build international transmission grids to enable power trading, for example in Africa, described as 'infrastructure for private

development' (Hall et al., 2013). The thesis describes how the WB has used large loans simply to finance restructuring of the electricity systems in Vietnam, Thailand, and Lao PDR.

The policy of liberalisation is not restricted to the energy sector, although the forms of unbundling and creation of markets are specific to the electricity and gas sectors. The Bank pursues similar policies in other services, such as water, healthcare, and education. The common driver for reform has been finance (Ménard and Aleksandra, 2011).

1.3. Thesis Structure

The primary focus of this thesis is on three fundamental research questions:

- the analytical issue of how investment in power generation happens,
- the policy issue of how to develop the power sector to meet the economic and social needs of development, and
- what is the impact of liberalisation policies on both these issues.

It addresses these questions through the case study of Vietnam – a transitional economy – for several reasons. First, Vietnam is a large developing country which has experienced strong growth since opening up its economy in 1986. Second, its transition in this period from a closed economy to a market-based economy makes Vietnam a good case study to understand the impact of moving from total public ownership to private ownership. Third, consistent economic growth puts pressure on the energy sector to invest to serve increasing demand, while avoiding raising energy prices makes it important for the government to find an alternative solution to financing investment.

The thesis asks not simply whether the liberalisation policy has brought the expected benefits, but also whether there are costs associated with the application of the policy through World Bank's loan conditionalities. It also addresses the wider question of who are the key actors in expanding power generation, what are the drivers of investment. In seeking answers to these questions, the lack of available datasets and lack of literature on the topic led to the need to create a database and analyse comprehensive data sets at national level on the extent of actual investment in electricity systems, to observe and analyse the patterns of investment, both by private and public sectors. Using the results of this empirical analysis, allows for drawing policy conclusions, reviewing the theory behind liberalisation policies in the light of this experience, and proposing a new framework for analysing public sector

investment. Understanding the past and what is about to happen gives a strong indication of what should have been done and, if present policies continue, what is likely to happen? Overall, it is thus concerned with the general question: what is the political economy of investment in electricity systems?

Most studies of these issues use one or more of the existing international datasets as a basis for analysis. However, these datasets are seriously limited by being incomplete or poorly categorised. A core part of this research was therefore the construction of a new and comprehensive database on the population of all power generation projects (operating, planned, cancelled) and financial and technical actors (investors, lenders, constructors) in electricity generation in Vietnam over the period from 1961 onwards. The spreadsheets containing this database are submitted as part of this thesis.

The thesis also treats the World Bank as a significant economic actor in its own right, and therefore asks what has been the political and economic impact of its policies in terms of loan conditionalities and the structure of loans, including the opportunity costs of providing loans to finance the unbundling and restructuring Vietnam's electricity sector.

The analysis of the patterns of investment identifies it in sufficient detail to separate out different categories which are often confused in other datasets. The data show clearly how actual investments are made, whether equity or debt, the private and public ownership of the company, foreign, national and international actors. These findings provide the basis for reconstructing explanations of how both private and public sectors invest.

The conclusion of the thesis summarises the implications of these results for policy at both national and international levels. It also discusses the implications for the theoretical positions on liberalisation and investment discussed in this section, and especially the need for a new framework for understanding public sector economic behaviour in terms beyond the notion of scarcity.

Figure 1 Overall Thesis Structure

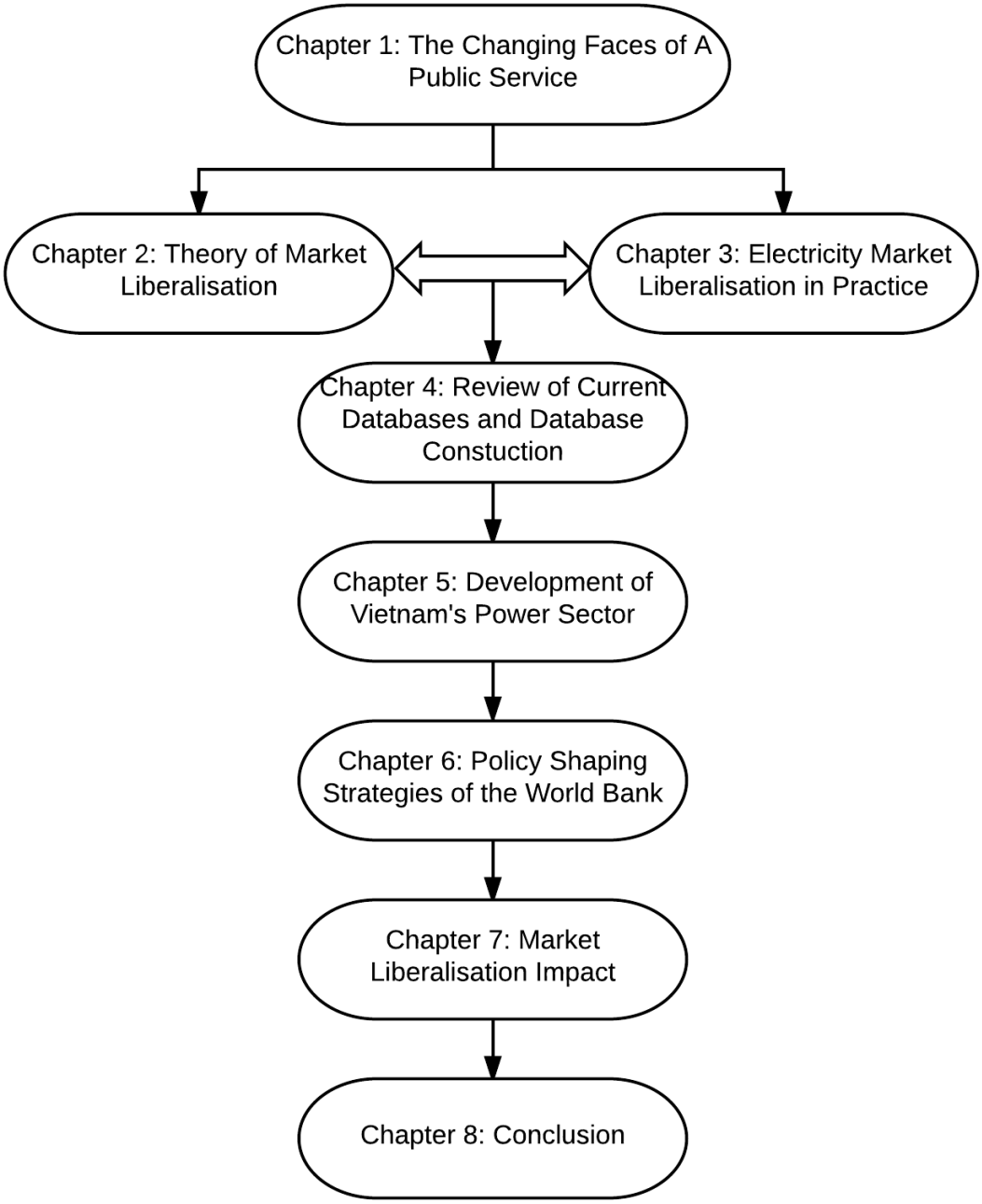


Figure 1 depicts the structure of the structure of the thesis, which contains 8 chapters.

This first chapter sets out the reason for this research, with a brief overview of how the electricity sector has changed in the last 30 years and how these changes have been similar across public services and shown signs of policy convergence towards liberalization. Then a review of theoretical and empirical literature in Chapter 2 shows the core elements of neoliberal economics and the standard model of market liberalization, together with the

empirical evidence to date on outcomes. Chapter 3 then analyses evidence for both EU countries and 13 of the largest developing countries of the impact of liberalization on policy goals, including price and efficiency in Europe, and extension and generating capacity growth in developing countries.

As noted, a main element of the research is the construction of a new database. Chapter 4 reviews the shortcomings of current databases and how they have not helped this and other related researches to shed light on the actual investment outcome of liberalization. From that analysis, a new framework has been introduced to collect secondary policy data and a database has been constructed covering all known power generation projects in Vietnam since 1961. These detailed data do not just yield results for this research but also open opportunities for future work. The chapter shows how this comprehensive database yields different and more soundly-based results than other sources.

The three following chapters set out detailed findings on specific issues.

Chapter 5 paints a historical picture of how the power sector in Vietnam has developed and what policies have been adopted in the changing political and economic contexts. In this chapter, the notion of 'Enablers of the Power Sector' is introduced covering key actors who play pivotal roles in financing, constructing, managing and regulating power generation. The database, for the first time, allows a panoramic view of all of these enablers.

Chapter 6 focuses on the World Bank, a self-acclaimed important actor in electrifiying the developing world, and how this institution has employed recurring strategies of lending, not only in Vietnam, but also in Thailand, Laos and Indonesia, to push forward electricity market liberalization policies.

Chapter 7 presents the findings of the database in terms of the actual investment from public and private sources, analysed in terms of nation of origin, equity and debt finance, and generating technology.

Chapter 8 sets out the conclusions of this thesis in three sections. The chapter summarises the analysis of investment and the actual impact of liberalisation only made possible due to the newly constructed database. The chapter also explains issues, approach and public use of the database as a crucial contribution of this thesis.

CHAPTER 2. THE THEORY OF MARKET LIBERALISATION

2.1. The Origin of Theory of Liberalisation

Market liberalisation arose from the emergence of neoliberalism in the 1980s which did not only influence the energy sector but also all other sectors in the economy. Market liberalisation is not a purely economic notion even though its direction indicates how markets should be organised, its direct impact is on economic actors and its objective is on economic gains. However, it is difficult to separate market liberalisation from its political implication, i.e. what role governments should take and on what individuals believe their private property rights should be. In order to understand the core value and implication of market liberalisation as a policy model, it is crucial to understand the history of liberalism and development of neoliberalism as political and economic paradigm that spanned and evolved since the time of Aristotle.

Liberalisation is rooted in the long history of liberal economic theory, which gives private property a central role in the economy and society. This argument can be seen in Aristotle (384–322 BC), whose work 'Politics' discussed different forms of government and the nature of men, and supported private rather than common property because:

"the regulations for the common ownership of property would give more causes for discontent; for if both in the enjoyment of the produce and in the work of production they prove not equal but unequal, complaints are bound to arise between those who enjoy or take much but work little and those who take less but work more. ... properties being divided among the owners will not cause these mutual complaints, and will improve the more because each will apply himself to it as to private business of his own..." (Aristotle, *Politics*, 1263a), implying that private ownership yields better results, economically and socially.

However, in a less quoted passage, he emphasizes the importance of solidarity in the use of goods:

"virtue will be exercised to make 'friends' goods common goods' as the proverb goes, for the purpose of use… for individuals while owning their property privately put their own possessions at the service of their friends and make use of their friends' possessions as common property… it is clear therefore that it is better for possessions to be privately owned, but to make them common property in use". (Aristotle, *Politics*, 1263a)

In the 17th century, Hobbes conceptualised the inalienable rights of nature of a rational individual to pursue his own self-interest – an individual who can be self-governing and self-regulating. Hobbes nevertheless argued that individuals must make an implicit mutual agreement to obey an absolute sovereign, a strong government against unchecked self-interests, to restrict the competition between individuals which would otherwise result in human life being "solitary, poor, nasty, brutish and short". (Hobbes, Leviathan Ch. 13 1651). The theory of liberalism was further developed by Locke through his arguments for men's natural rights – the rights to life, liberty and property (Second Treatise of Civil Government, 1689). These notions shifted the ancient discussion of property as resting on men's nobility and descent (a man can inherit wealth or earn it by his honour) into property as earned by a man's actions (a man earns what he works or exchanged for). The role of government was nevertheless legitimated by a social contract under which citizens conceded rights to that government, including the right of self-defence, and the right to tax their property, with the consent of the majority.

Adam Smith, in "Wealth of Nations", 1776, used the rational pursuit of self-interest as a core part of his economic doctrine of free trade and competition, with the key idea that if the economy is basically left to its own devices, limited and finite resources will be put to ultimately their most efficient use through people acting purely in their self-interest, rather than being distorted by government impositions or gifts of monopolies. Investments will then be made to maximize profits, and the surplus used to make further investment. He was however opposed to stock-holding companies, what today is called a "corporation", because he predicated the self-policing of the free market upon the free association of moral individuals.

Smith nevertheless acknowledged the role of the state in providing public goods which could not be profitably provided by individuals: "public institutions and those public works, which, though they may be in the highest degree advantageous to a great society, are, however, of such a nature that the profit could never repay the expense to any individual or small number of individuals, and which it therefore cannot be expected that any individual or small number of individuals should erect or maintain." The relevant institutions and works are those "necessary for the defence of the society, for the administration of justice … for facilitating the commerce of the society, and those for promoting the instruction of the people." (Wealth of Nations Book V, ch 1, part III). This limitation to the operation of markets was further

developed by John Stuart Mill with the notion of 'natural monopolies', in which the scale of investment required prohibits effective competition, of which gas and water supply were the two outstanding examples. (Principles of Political Economy,1848: II.15.9))

These rationales for an 'exceptional' role for the state in sectors such as education, water and gas supported the widespread growth of the public sector at municipal and national levels, and Keynes further enhanced the economic role of the state by arguing that governments should counter recessions by active use of public borrowing to stimulate the economy. After World War II, communist and non-communist states alike developed public services and the public sector even further.

This broad consensus was challenged from the 1960s onwards by Hayek, who argued for a return to fundamental liberal principles, and the liberal monetarism of Milton Friedman, which criticized Keynesian stimulus policies as inflationary. Even infrastructure should be in the hands of the private sector, with independent regulators to help avoid abuse of monopoly power. These positions provided the base for the public choice and property rights theories supporting neoliberalism.

2.2. Market Behaviour Theories

2.2.1. Public choice

Public Choice Theory was developed in the 1970s. Among its early exponents were James Buchanan, Gordon Tullock and William Arthur Niskanen (Niskanen 1975, Buchanan and Tollinson 1984, Rowley et al 2013). It applies the logic of microeconomics to politics, drawing upon neoclassical economics and referring particularly to the notion of individual utility maximisation. According to public choice theory, government employees, in contrast to private entrepreneurs, do not seek profit maximisation but exploit public firms to attain political goals such as limiting unemployment, or self-interested advancement within the bureaucracy by maximising budgets, at the expense of efficiency. As with property rights, the public choice theory thus argues that public companies are generally less efficient than private. Moreover, government employees are assumed, from the public choice perspective, to be vulnerable to be lobbying pressures on the part of different interest groups, spreading the costs of privileges granted to these groups over the population at large).

The long-term growth of public spending in the economy was seen as evidence of the problem identified by the theory, and the scale of the problem. Public choice thus provided theoretical support for policies of structural adjustment to reduce the role of the public sector, with the ultimate goal of a minimal government role in the economy (Buchanan and Tullock 1977, Dunleavy 2014). As part of rational choice theory, centred on the strategic action of self-interested individuals, public choice theory was seen as an element in the political outcome of the Cold War. Alongside the economic and military victories over the Soviet Union, it represented: 'the ideological triumph of democratic politics and market economics over the alternative philosophical order espoused by Karl Marx and his adherents … rational choice theory rebuilt the conceptual cornerstones of western ideals' (Amadae, 2003).

2.2.2. Property Rights

The theory of property rights, also known as 'agency theory', was developed by economists such as Armen Albert Alchian, Ronald Harry Coase and Harold Demsetz (Alchian and Demsetz 1972, Alchian and Demsetz 1973). "techniques, rules, or customs to resolve conflicts that arise in the use of scarce resources rather than imagining that societies specify the particular uses to which resources will be put." Agency theory is based on methodological individualism. Its central idea is that various forms of ownership result in different economic incentives and thus different economic results. The form of ownership is, thus, the main criterion for the varying performance of different organisations. According to agency theory, profits will decline, the share price will fall, dissatisfied shareholders sell their shares and the firm will become vulnerable to a hostile takeover bid if managers of publicly-listed joined stock companies pursue inappropriate policies. As a consequence, the management of a privately-owned firm has incentives to pursue policies which tend to maximise the firm's market value. In the public sector these incentives are absent, since the owner is unable to sell his ownership share and no takeover threat exist. Applied to developing countries the theory emphasises the role of individual property rights in land as essential for creating investment incentives: "a state structure governing property rights needs to be developed before growth can resume." (Besley 1995)

2.2.3. Austrian school

The Austrian school of thought, dating back to the 1870s, argues that private companies

must be more alert to market signals and respond accordingly whilst state-owned companies are assumed to be less responsive (Tittenbrun, 1996). The argument for liberalisation is then based on the assumptions that electricity can be considered as a commodity and that market forces can give the right signal to buyers and sellers for efficient supply and demand. The historically vertically-integrated power systems are believed by neoliberals to operate inefficiently because there is no market, no room for competition, no financial incentive to attract investment. So in order to reach optimal electricity supply, it is important to separate generation, transmission and distribution companies and officially open a market where natural monopolies do not happen (i.e. transmission). Second, private ownership is believed by the Austrian and the Chicago economists to result in economic incentives that drive better performances. The International Energy Agency (IEA) (2000) optimistically projected that market mechanisms enforce contracts between suppliers and consumers that include a clause for security of supply; therefore, investment naturally includes reserve capacity. This enshrines a neoclassical view of investment, that the firm is solely concerned with profit maximisation and will make investments which maximise the present value of the firm

Mainstream neoclassical public economics theory treats all government economic activity as exceptions. The optimal state of affairs is the operation of markets, and so government activity is permissible only in the rare cases where markets do not deliver the best results, known as 'market failures'. The only public goods strictly permissible are defined as those which are 'non-rivalrous' and 'non-excludable', such as lighthouses or armies or law courts, while education and healthcare rely on the vaguer justification of 'merit goods', involving reference to externalities, and infrastructure such as water networks can be exempted as 'natural monopolies'. (Desmarais-Tremblay 2016, Sekera 2016, Stiglitz 2000)

2.3. Reform Model of Electricity Market Liberalization

The standard reform model of liberalization of the electricity sector is supported by neoclassical economics theorists, including Friedman (in 'Capitalism and Freedom, 1962; in 'Free to Choose: A personal Statement, 1980), Megginson (in series of papers in 1994, 1997, 2001), and in the electricity sector, by Newbery (2004) and Pollitt (2007).

Public infrastructure sectors became important targets because, to allow easy central control

and protect energy security, they were vertically integrated, and so there was no room for any private company to sell through the network. So unbundling came in as a necessary step to separate generation and supply from distribution, and thus allow for bidding or contracting to privately-owned companies. Since the power sector is capital-intensive and large investment outlays are required for construction, and financing is required for upgrading and maintenance, investors can only make clear decisions when expected returns outweigh expected costs, taking account of high risks and uncertainty of politics and regulations.

Jamasb and Pollitt (2005) set out four key elements of a liberalised market, including privatisation. Bacon and Besant-Jones (2001) see it as a reform programme for the electric power sector with 4 essential stages. First, government need to prove its commitment in reform by implementing broad guidelines for all companies, including state-owned generation companies to operate under fair commercial principles, to start exposing the system to competitive market-like conditions. Secondly, the market should be restructured by unbundling previously vertically-integrated companies, so that wholesale and retail markets can be created. Thirdly, the state should withdraw its ownership in the incumbent companies because private ownership is believed to bring in financial resources and efficiency. Fourthly, the market should be regulated by an independent body that is competent and transparent. Electricity market liberalization primarily aims to 'improve performance: financial performance, supply side efficiency and demand-side efficiency' (World Bank, 1994). It is expected that liberalization attracts new investment in generation, reduces prices, ensures security of supply and provides universal coverage.

2.4. Empirical Evidences of Liberalisation Model Impacts

Liberalised systems of the north are now themselves the subject of controversy. In the USA and Europe, expectations of lower prices have been disappointed, and replaced by resentment at higher prices; in the USA, the shock of the California energy crisis in 2000 effectively halted further liberalisation, and challenged the assumption that liberalised systems are reliable; and there is a growing view that the system is unable to deliver the kind of investment needed for dealing with climate change. (Anderson, 2009; Florio, 2013).

Developing countries have been slower to implement the model in full, with the actual development of policies usually treated as a series of stages on the road to full liberalisation

– “intermediate structures” which can themselves “attract private sector participation” (Vagliasindi, 2013). A growing number of studies in developing countries have documented similar evidence that the expected impact on prices and performance is lacking, compounded by limited progress on renewables (Dagdeviren, 2009; International Energy Agency, 2016; Sen, Nepal and Jamasb, 2016). Most conclude that the reform process itself needs to be revised in various ways, but retaining the core approach: “a new consistent market framework is needed” (International Energy Agency, 2016) or “‘reform’ of electricity reforms.” (Sen, Nepal and Jamasb, 2016). The consequences of liberalisation increasingly seems that little has been gained in sector performances in terms of affordability, accessibility and reliability in all groups of countries.

In terms of extending coverage, it is difficult to say if a reduction in population without access to electricity is the result of liberalisation or central planning (IEA, 2000; Winkler et al, 2011). Notably, the South Asia and Sub-Saharan Africa regions experienced a rise in population without electricity. Doll and Pachauri (2010) found private investors are unlikely to find it profitable to invest in distribution networks in underdeveloped regions with only a few households. Besides, accessibility needs to be accompanied by affordability so that households can truly benefit from electricity coverage. Unfortunately, in order to provide more networks, companies transfer their additional costs to consumers, causing prices to rise.

As the European Commission showed in 2014, electricity prices for households, after a period of decline, increased. This was an unexpected outcome of the liberalization process. An EU-wide analysis found that both privatisation and unbundling had a negative effect: “public ownership tends to decrease prices [and] vertical disintegration tends to increase prices” (Fiorio and Florio, 2007). Meanwhile, quality of services has not been equally investigated. A series of blackouts and system failures in the early 2000s in California, US (2003), Italy (2003), Switzerland (2003), southern Sweden (2003), Northeast blackout of 2003 in America, Malaysia (2003, 2005) and Rio de Janeiro (2005) have raised questions on efficiency of unbundled and liberalized systems. The UK government also stated that the system only works if it can deliver ‘secure, sustainable and affordable electricity’ (DECC, 2010). Fiorio and Florio (2011) explored data on perceptions by European consumers, i.e. subjective data on happiness with the price of electricity and interruptions of services across the EU-15. According to the results consumers are happier with the prices they pay when in

their country there are both public ownership and liberalization. Several studies investigated the effect of unbundling, vertical integration on the cost and quality of supply in the electricity industry. Some of the most important are listed in Table 1.

Table 1 Empirical literature synthesis of ownership impact on costs and quality of electricity supply in Europe and USA

Influenced on	**Driver**	**Author (year)**	**Countries, Periods**	**Findings**
Cost and quality of supply	Ownership-vertical integration	Arocena, 2008	12 Spanish electric utilities throughout the period 1980-1997	Evidence of the existence of cost and quality gains from integrating power generation and distribution in the range of 1.1 to 4.9%, whereas diversifying the source of power generation saves between 1.3 and 4.3% of costs and quality
Cost	Ownership - vertical integration	Fraquelli et al., (2004)	25 Italian local electric utilities, 1994-2000	The estimates of a Composite Cost Function model show for the average firm that both multi-stage economies of scale and vertical economies are present. These measures increase with firm size, with the cost savings of vertical integration rising from 3% up to 40% for large operators
Cost of transmission	Ownership	Gugler et al., (2014)	28 major European electricity	Results confirmed the presence of substantial economies of vertical

			utilities from 16 European countries for the annual date for the period 2000-2010	integration
Cost	Ownership	Jara-Diaz et al., (2004)	The Spanish electric sector - data on firms from 1985 to 1996	Estimated economies of vertical integration indicated that joint generation and distribution saves 6.5% of costs, lower than what has been obtained in similar studies in the USA
Cost	Ownership	Kwoka (2002)	Data set of U.S. electric utilities, 147 investor-owned utilities, 1989	Cost savings from vertical integration to be quite substantial for all but the smallest utilities and were largest for those that are nearly fully integrated

In 2010, NUS Consulting Group report shows that global electricity prices have been increasing and will continue to increase. In particular, in 15 most expensive countries for electricity, prices are subject to rise from 3 to 33% per year. Among them are leading examples of liberalization, namely, Sweden, Austria, and the UK. The study of real electricity prices in OECD from 1978 to 2008 by IEA also shows similar results. Dagdeviren (2009) points out that in the short term when investment starts to kick in, electricity prices went down but these temporary results 'can be misleading'. Since 2000, when markets are relatively open, 'prices started to increase'. Using data from 1985-2002 from 83 countries in Latin America, the former Soviet Union and Eastern Europe, Nagayama (2007) finds little correlation between unbundling, wholesale market competition and decrease in electricity prices. On the contrary, they are associated with a rise in prices. Argentina and India also see prices rising regardless of poor quality of services (Wamukonya, 2003). As Thomas

(2005) argues, the cost of competition is not cheap. The combined cost of capital/loan, cost of market design, cost of marketing, cost of customer switching, cost of installation is additional to generation costs that, in the end, taxpayers have to pay. Several studies went further to investigate the drivers behind direct impact on prices and service interruptions, which are the most common indicators of affordability and reliability for consumers. Some of the most important are listed in Table 2.

Table 2 Empirical literature synthesis on drivers of price and quality of electricity supply servics in the EU in the last 10 years

Influenced on	**Driver**	**Author (year)**	**Countries, Periods**	**Findings**
Price	Ownership	Fiorio and Florio (2013)	EU-15, 30 years	Public ownership is associated with lower residential net-of-tax electricity prices in Western Europe
Price	Ownership	Lehto (2011)	Finland, 1997-2006	Local Ownership (in particular municipally owned companies) offers 5-15% lower retail prices than investors-owned companies
Price	Ownership	Bacchiocchi et al.,2015	EU15 countries and New Member, States (NMS) 1990-2011	Market liberalization reduces the price of energy in the EU15 countries, while having the opposite effect for the New Member States
Price & Services	Ownership	Fiorio and Florio 2011	EU-15, 2000, 2002, 2004	Consumers are happier with the prices and service quality when in their country there are both public ownership and liberalisation

Energy price Real GDP	GDP Growth	Berk, I. and Yetkiner, H. (2014)	1978 and 2011	Significant co-integration between energy prices and real GDP per capita, as well as between energy prices and energy consumption per capita.
Price	Fuel Costs	DECC (2010)	UK, 2011	Increase in household electricity prices is due to international fossil fuel prices, particularly gas prices.

2.4.1. Liberalisation and Investment

The power sector is capital-intensive, and so a large investment outlay is required for construction. However, investors can only make a clear decision when expected returns outweigh expected costs, which accounts for high political and regulatory risks. The expected internal rate of returns in the sector is therefore higher than most infrastructure of 15-25%. IEA (2000) identifies three key determinants of investment decisions in the sector as the price of electricity, cost of capital and price of input fuels, which in turn depends on the choice of technology (IEA 2000, page 11). Timing is also another challenge for investors. IEA (2007) argues that under different timing, investment could yield significantly different returns given high regulatory uncertainty and fluctuating input prices. Governments therefore need to ensure strong and clear incentives to promote private investment in desirable geographical areas, in a particular technology, at different capacities and economic times. (IEA 2007, page 14).

Woodhouse (2006) estimated that by 2030, developing countries need investment of $5 trillion, two thirds of it for new generation capacity. In fact, private investment in new generation boomed in the 1990s. Yet, as with price movements, it started to go reverse in the 2000s. Private investment in infrastructure more than halved from 1997 to 2001. The World Bank (2004) argues that this drop is due to 'falling stock markets worldwide, financial crises in emerging markets, and hesitancy caused by public opposition to privatisation'. However, Thomas (2006) believes the problem could be 'more fundamental'. Being risk averse, private investors do not have sufficient incentives to invest unless long-term contracts or capacity payment mechanism are offered to them by the government (Neuhoff

and De Vries, 2004).

Using a panel regression model, Gugler et al (2013) investigates the relationship between investments, prices and regulations in 16 European countries from 1998 to 2008 using Eurostat and IEA data. Essentially, the paper finds trade-offs between different policies and objectives and achievements in regulated network industries. Unbundling was found to reduce aggregate investment by 10% while introducing competition via market mechanisms would increase investment. Structural adjustment would increase higher electricity prices, which then induce firms to invest which might lead to future price reductions but would cause more regulatory adjustment. The authors admit "data reasons" constrained the scope of their tests.

Argentina and India have also seen prices rising even though service quality remained poor (Wamukonya, 2003). Therefore, even after privatisation, governments continue to play a key role in in ensuring adequate service delivery, quality and investment and regulating the services such as via concessional loans, dollar-pegged power purchase agreements of 20-25 years or renationalisation when multinational companies abandoned the services.

Achieving public benefits from a liberalised system depends on a system of regulation, which is expected to create incentives to compensate for the relative lack of pure market mechanisms of competitiveness. As noted earlier, the efficacy of regulation even in northern countries has been called into question, and the regulation of company behaviour is even harder in developing countries: "Developing regulatory capacity in the South with a mechanistic view of institutional and procedural replication is fraught with difficulties. Regulatory weaknesses, whether structural or transitory, have distributional consequences." (Dagdeviren, 2009).

The experience of Chile is worth examining. It was the first country in the world to introduce unbundling, privatisation and liberalisation, in 1982 under the military dictatorship, and is generally regarded as a good example of a liberalised system with a good system of regulation. However, the experience shows a stream of problems associated with the inability of the regulatory system to deliver expected benefits. A problem of under-investment gradually became apparent, as the regulatory system effectively "encouraged power firms to postpone or avoid altogether the installation of additional generation

capacity". This led to a serious energy crisis in 1998-99, initially triggered by a drought, whose effects were compounded by technical failures, delays and problems with the coordination and transparency of the private generating companies. The crisis highlighted "the relative weakness of public bodies in dealing with short-term profit-oriented private firms, and the lack of a long-term energy strategy." (Gabriele, 2004). The investment problem continued: from 2000 onwards there was very little investment in new capacity, and another energy crisis arose in 2007-09 when the impact of a drought and gas shortages was worsened by the unavailability of three key power plants, leading to a ten-fold increase in prices. The government had to spend over one billion dollars to subsidise fuel and electricity prices, and make heavy use of expensive diesel generators (Tokman, 2009). The International Energy Agency's 2009 report on Chile also concludes that the experience of 2007/08 showed that it still had real problems with security of supply, and that "the government needs to take a more proactive position with regard to monitoring energy developments and systematic risk assessment" and to develop state planning capacity.

2.4.2. Liberalisation and efficiency

In liberalized markets, all losses are expected to be included in pricing and paid for by users of the network. There then exists economic incentive estimated at millions of pounds 'to work to reduce measure losses' (Sohn Associates Limited, 2006). Economic incentives are significant enough for investors, public and private, to maintain and upgrade the networks. Analyzing transmission and distribution losses (which are primary sources of losses) produces a good view of the efforts by investors to do so (Gustafson and Baylor, 1988). With the introduction of private participation, profit-maximizing firms will be working more efficiently to reduce total losses. Countries which have further liberalized the power sector are expected to experience a faster rate of decreasing losses. However, 13/14 developing countries here experienced small changes (low standard deviations) in 23 years from 1990-2012 in the rate of system losses. There is also no consistent pattern of changes in this rate in all the countries. Thailand, Vietnam, Argentina, and Colombia show gradual reduction in losses. Brazil, South Africa and Venezuela all fluctuated slightly around the 1990 rates. Therefore, it is difficult to establish a correlation between the liberalization progress and system efficiency.

The widespread belief that the private sector is always more efficient than the public sector, in electricity as in other sectors, is not supported by empirical evidence. This evidence

includes a global study by Pollitt (1995), which compared dozens of public and private services operators all over the world, and found no significant systematic difference between public and private in terms of efficiency. More recent studies confirm this in the electricity, water and healthcare sectors in developing countries. A study of electricity companies in Africa (Estache, 2006) found that levels of efficiency in the region were independent of the degree of vertical integration or the presence of a private actor. A more complex study by the World Bank's privatisation agency, the PPIAF, did find that private infrastructure services companies were more likely to cut jobs, and so show productivity gains from this source. However, the study found no evidence of any benefits for the service in terms of higher investment, and indeed there was evidence of both higher prices and actual reductions in numbers of household connections. Any productivity gains were thus distributed to owners as increased returns on capital (PPIAF 2010). A global review of the evidence on utility sectors in 2005 by the World Bank concluded: "For utilities, it seems that in general ownership often does not matter as much as sometimes argued. Most cross-country papers on utilities find no statistically significant difference in efficiency scores between public and private providers. As for the country specific papers, some do find differences in performance over time but these differences tend to matter much less than a number of other variables." (ESMAP Report 306/05, 2005).

2.4.3. Liberalisation and Climate Change

Finally, it is now questioned whether liberalised systems facilitate or obstruct a shift to renewable energy in order to address climate change. UK institutions have argued that the system only works if it can deliver 'secure, sustainable and affordable electricity' (CCC, 2009; DECC, 2011) and the current UK liberalised system cannot deliver these three objectives, hence the need for a 'reform of reform'. Some academics stay firm with the model, claiming that the undesirable outcomes do not lie in the model itself but in the implementation process and that there is insufficient incentive to invest (MarketWatch, 2004), that the model should be applied in the correct and logical order (Jamasb, 2006). However, there is no clear definition of 'sufficient' and 'correct'.

Kessides (2012) offers a solution of distributed generation (DG) that is suited for generating renewables at a small scale in rural areas. For larger economy, she thinks a new paradigm should be in place. Newberry (2012) acknowledges that reforming existing liberalised markets to meet climate change targets is more difficult than in a state-controlled market,

but only suggests that even more reforms should be on the way to address its shortcomings.

Some neoliberal economists explore free-market-based solutions to climate change issues by imagining capitalism decarbonizing. Newell and Paterson (2010) believes that dominance of free market ideologies means that the decarbonisation process must involve creation of carbon markets and engage powerful (most polluting) actors in business under the branch of so-called 'Climate Capitalism'. This view is supported by Lovins and Cohen (2011) who interchangeably use the term 'Nature Capitalism' and 'Climate Capitalism' to refer to a new way of doing business in the era of a 'recession-riddled, carbon-constrained world'. They carried out in-depth case studies of how corporations in energy, construction, and transportation, etc. transformed to become first movers in clean technology to reap profits, hence contributing to economic growth in developed countries. However, Parr (2014) in 'The Wrath of Capital' is skeptical. She illustrates the ignorance of global powers in dealing with the biggest concern of the 21st century. She points out that neoliberal capitalism underpinned development of green technology, practices and consumption deliberately. Short-termism in capital accumulation hinders the discovery of eco-friendly alternatives because of undesirable shocks to the markets dominated by conglomerates and lobbyists of governments. Parr (2015) adds that markets and social movements under the name of 'green' and 'climate' are ideal in ideologies but, in practice, they aim at privatising public wealth while marginalizing the poor.

In response to the 2007-2008 Recession emerged the Green New Deal – a stimulus package addressing both financial crisis and environmental problems as a modern adaptation of the New Deal in response to the Great Depression in the 1930s. More than a trillion dollars in total were put into national and regional Green New Deals in the EU (300 billion EUR), the US (100 billion USD) and South Korea (38 billion USD) and significantly UNEP's Global Green New Deal (750 billion USD). These stimulus packages mainly focused on alternative energy, network infrastructure systems including transportation and waste management as well as construction (Herman, 2015). Notably, these deals highlight the role of states in imposing necessary social and business change. As Barbier (2009) reports, private investment in general was cut back during the recession and it is difficult to rely on this channel of capital accumulation to develop clean energy technologies and services. In South Korea, 'US$ 72.2 million renewable energy fund' was created 'to attract private investment' in clean technology and plant construction with exponential impacts on job creation. The US also combines fiscal stimulus with direct emission policies to encourage private

investment. The role of private entities is certainly not overlooked in the Deal but not as catalysts of changes.

2.4.4. Public and political attitudes

The implicit view of many advocates of liberalisation is that the policy remains the best possible way of organising public infrastructure services, and is only obstructed by ideological motives and vested interests. However, the start of privatisation in the 1980s and 1990s attracted widespread public support as a reaction against the experienced inefficiencies, cost and unaccountability of many public sector institutions, especially in former communist countries.

By 2003 the World Bank and others acknowledged that privatisation had become deeply unpopular, observing that there was a decreasing faith in markets as providing solutions to infrastructure problems, and few politicians now supported privatisation, which was seen as benefiting elite and corrupt interests at home and abroad, and as fundamentally unfair, both in conception and execution (Nellis, 2003; Buresch, 2003). By then, private sector interest in energy infrastructure had declined, and many multinational companies had withdrawn, due to losses and uncertainty (Gabriele, 2004). The unpopularity of privatisation and liberalisation has continued to grow, not least in the UK, where the reforms were first implemented: in the 2010s, the inability of governments to control energy price rises has become a major domestic political issue.

2.5. Debates on Electricity Market Liberalisation Models

2.5.1. Theoretical Debates

Various critiques of the liberalisation model have been advanced. Jamasb (2006) hopes to strengthen the generic model in application for developing countries by adding some policy recommendations with regard to the role of the state. Knowing that reforms are more complex and difficult in developing countries than initially anticipated in the generic model, the author does not strongly suggest reforms are plausible in any developing country because of varieties of ‘problems experienced’ and ‘incomplete understanding’. However, he suggests improvements can be made from those lessons of experience with regard to the role of the state. The state should actually be in a strong position to implement a ‘proper subsidy

schemes' to increase companies' incentive to invest; should stabilise macroeconomic conditions to attract foreign investments; should be active in rural electrification and protect low-income consumers. So rather than reducing the role of the state in the sector, the reform model should be more focused on strengthening the role of the state. The author also notes that privatisation is not an indispensable part of reform and most investment pre- and post-the 1997 financial crisis in Asia was due to the public sector – yet private participation is considered as the centre of success of reforms. Moreover, even though low cost-savings are due to insufficient competition, the results of lack of competition including limiting consumer choices, distorting investments and preventing new entries do not cause any direct harm to the market apart from the structure of the market itself.

Kessides (2012) analyses reform processes and progress in some Latin American countries to illustrate the variety in policy choices and the impacts of these reform measures on performances. Three key findings of this study are: 1. The standard reform model needs to be implemented correctly, in the logical sequence and under-pricing should be resolved before attempting restructuring; 2. The main limitation of reform model for most developing countries is the lack of commitment, industry scale, financial and legal institutional preconditions; and 3. With regard to renewable energy, Kessides offers a solution of distributed generation (DG) that is suited for generating renewables at a small scale in rural areas. For larger economies, he thinks a new paradigm should be in place. Although Kessides does not omit the limitation and debates around the feasibility and applicability of this model for developing countries, she asserts clearly his belief in the standard model. All chosen developing countries (namely Chile, Argentina, Peru, Colombia, Brazil, India and Sub-Saharan Africa) had better performances in terms of technical indicators based on a couple of empirical researches for each country. The study does not offer breakthrough empirical results or theoretical improvements on the model, it simply reaffirms that the model should be followed with care, in strict sequence and after completing preconditions (that essentially can take a developing country to the higher stage of development).

Newbery (2012) discusses the UK Electricity Market Reform (EMR) White Paper's feasibility and credibility in tackling UK electricity demand and climate change target challenges. The paper examines the UK's current electricity market issues under the internal pressure of security and affordability and the external pressure from the EU Renewables Directive. It acknowledges the present electricity market design is flawed, hence the need

for the White Paper which is concluded as 'sound'. Newberry concluded that the UK needs new sources of investment and a new arrangement initiated by the government including contracts and 'a suitable institution to design, negotiate, finance and settle the contracts'. Though he acknowledges that reforming liberalised markets to meet climate change targets is more difficult than in a state-controlled market, Newberry suggests that EMR is crucial, even more reforms should be on the way to address its shortcomings. He asserts that market failures (including positive externalities created by companies investing in R&D, hence new knowledge and public good) should not be the justification for state intervention as liberalization and competition deliver better outcomes at less risk to consumers.

Mizrahi and Tevet (2014) attempt to build a theoretical framework that addresses two key questions on the pace and timing of reforms and the role of institutions in comparison to individual players in reform processes. Using Israel as a case study, the paper concludes that reforms tend to be gradual and incremental in centralised public sectors (in electricity and other utilities sectors), while an entrepreneurial actor can play a key role in transformation process, at company, union or institutional level. The authors express fondness for the standard reform model, yet they assert that reforms should come from domestic needs rather than international influence

2.5.2. Changing Analysis by International Energy Agency (IEA)

IEA is one of the few international institutions that addresses the question of the impact of market liberalisation on investment. In 3 publications in 2000, 2003 and 2007, IEA attempts to answer this question by looking at the changes in risks and returns in power generation in OECD countries after liberalisation.

IEA (2000) criticises the state-planned system of 'investment decisions biased toward overinvestment', hence believing in investment decisions driven by current and expected prices in competitive markets: 'Provided that effective competitive markets are established more efficient investment can be expected…' First, in competitive markets, there are various financial techniques which reduce investment risks for investors; hence evidently investment in plant is increasing. Though, in the beginning stage of liberalisation, oligopolistic markets will tend to form keepings prices at high level but this however provides incentives for continuous investment. Second, with advanced technology, input fuel diversity will allow

investors to choose the most economical option. Though liberalised markets could have opposing influences on cost of capital in electricity generation, it is believed that the market level, i.e. equilibrium of price and quantity, can be reached with the efforts by investors to decrease investment costs. Exposing businesses to competition, public transparency and customer capturing would provide strong incentives to investors to introduce economic designs, productivity, reduce fuel costs, lower operation and maintenance costs. 'Markets…providing generators with new motivation for efficiency operation' (IEA 2000 page 10). Third, the business cycle is expected to influence prices, hence investment driven by electricity prices. Government when needed has to intervene to keep short-term investment decisions more stable. Fourth, IEA (2000) believes that the market mechanisms enforce contracts between suppliers and consumers that include a clause for security of supply; therefore, investment naturally includes reserve capacity.

The government, whose role is presumably minimised in a competitive market, is still believed to play an important role at critical times, for example through capacity payments for future reserve capacity. Not only ensuring an effective model of the market to start with, the government needs to constantly monitor the structure of the market, system reliability, input fuel diversity, and run costly and highly competent regulators and agencies to ensure fair competition. In need of remedial action, the government needs to balance short- and long-term investment decisions, provide incentives not just in the energy industry but other related industries, and ensure stable and complementary fiscal and monetary policies. Companies on the one hand wish to operate freely on their own playground. On the other hand, they demand assurance from the government in many shapes and forms.

Generally speaking, the government's main role is monitoring, nurturing, disciplining, shaping companies. And this job is not expected to ever end as 'the end of point of reform is not always clearly defined' (IEA 2000, page 14). Structural change allowing market forces in electricity supply was expected to primarily 'improve the economic performance of electricity supply', with the prospect to lower prices. Governments need to have a well-in-advance plan and a prominent role in introducing incentives However optimistic and well-planned, eventually, only 'experience will demonstrate how well electricity reform measures up to expectations' (IEA 2000, page 3) A decade after the key Rio meeting on the environment in 1990, the IEA still saw no impact on electricity markets resulting from climate change.

While IEA (2000) looks at the electricity market at the beginning stage of liberalisation under optimistic theoretical promises, IEA (2003) attempts to investigate in detail the highly likely issues of price volatility and public opposition along with investment risks and how companies try to hedge these risks by non-competitive movements. This was certainly influenced by the California fiasco in 2000, where large parts of the state suffered lengthy repeated power cuts, due to opportunistic behavior by Enron and other merchant power companies.

"Liberalisation has … affected the way power plants are financed" (IEA 2003, page 13). Since risks have been internalised in investment decision-making, investors need to find ways to hedge their investment: by choosing low-cost gas-fired generation, or requesting consumers to share risks in investment in nuclear plants, or signing long-term contracts with retailers or even merging with them. As expected in the previous publication, company sizes grew with merger and acquisition activities between electricity and gas producers, between producers and retailers of electricity. A newly-formed oligopolistic market is formed but surprisingly, it was not criticised for its anti-competitiveness but rather considered as a necessary step before formation of a fully functional competitive market. In this edition, the issue of "price crises" took over a whole chapter of discussion. Experience in Norway, Canada, California and others show, on the one hand, "price spikes are testing government commitment to allow markets to sort things out" and, on the other, governments need to ensure "protection of consumers from high prices" (IEA 2003, page 16). It should be noted that high prices, i.e. cost-recovering prices, "should not be a problem in OECD countries" because of higher living standards and highly-perceived value of the services than in developing and low-income countries (IEA 2003, page 17). The role of the government had also been discussed at further length and across more dimensions than in the previous edition. Before, the government was expected to establish the policies and monitor the actions in the market, now it is admitted that "there remains much for governments to do" (IEA 2003, page 3). The government needs not only to adjust their involvement in price signals and provide incentives for investment in particular technologies but also to liaise with other governments to ensure corrective measures do not cancel each other out. But all in all, the government is required to commit against "short-termism" of price rises, investment death or public opposition.

IEA (2007) was written in a different situation than IEA (2000). The earlier version was

addressing the prospect of investment given sector structural changes. At that time, liberalisation was only implemented in a handful of countries; EU Directives were still being drafted and revised, while the notion of market opening in public services was fresh and persuasive with little empirical evidence. The later version was written after 10-15 years of experience in Europe, North America and the Pacific. The sector was starting to be under pressure of environmental responsibility and replacement of ageing units. The shift in priorities and objectives from affordable, competitive to sustainable, secure electricity supply not only changes the investment environment, raises regulatory uncertainties but also puts higher pressure on the government to come up with a new regulatory framework and to take on a pioneering role in developing sustainable technology.

As a result, the two publications though from the same stance of believing in market liberalisation have two different tones. The 2000 version is clearly optimistic about minimising the role of the government and about the reduction in generation costs. The 2007 version sees the crucial role of the government in not only monitoring but also regulating, pioneering and investing in the sector. 'The recent liberalisation of markets delivers considerable benefits if implemented whole-heartedly and if backed by ongoing government commitment' (IEA 2007, page 11). Continuing from the previous edition, IEA (2007) emphasizes the necessity of maintaining a competitive market via a long-term liberalisation process. Investors are expected to be benefited "from unique contracting arrangements between utilities and large consumers" when nuclear power plants are built. Consumers are unusually expected to 'co-operate' with producers in sharing the costs of risks, which imply higher prices. Lower prices may come from signing long-term contracts or when risks become more stable (IEA 2007, page 19). Beside higher risk costs, CO2 tax is expected to be added. Full-cost pricing then becomes "vital" in incentivising investment in sustainable generation: "Experience to date shows that, with the right incentives and with a stable investment climate, investors are responsive to the needs for new generation capacity" (IEA 2007, page 13). It is clear that affordability is not expected to be delivered in this sector arrangement, which is a potential problem for developing countries.

These publications by IEA show its favour for a market liberalisation model through time and as the situation changes. It can be seen that with time, the structure of the publications changes as IEA realises the standard model needs adjustments during implementation processes. The clearest adjustment is the role of the government which has proved to be

more important than just setting up the market and leaving it to the market mechanisms to work its magic. It was realised that the government's role should not be minimised but rather its involvement should be selective in areas that do not deter investment, which is indeed hard to define. These publications conclude that investments should and would come in sufficiently under the market system based on both theoretical and empirical discussions. However, the theoretical discussion is limited to a list of recommendations that tell the government what to believe and do in what situations and the empirical evidence is limited to selective case studies in high-income countries. There is no consensus study that rounds up how much actual investment was raised. Essentially, they employ the theory of risk vs. returns (referenced by the 1984 book by Brealey and Myers titled "Principles of Corporate Finance") and explain how in some countries, prices picked up, hence higher returns, and how in some cases, investors lower investment risks.

2.6. Summary

The theoretical literature on liberalisation used classical liberal theory as a basis for theorizing away the role of the state that had grown under the post-war Keynesian consensus. Applied to the electricity sector, this called for the unbundling of the vertically-integrated public monopolies, in the expectation of sufficient private investment, lower prices and greater efficiency. The empirical literature shows that these expectations have not generally been fulfilled. The theoretical and policy literature has responded to this evidence, but mostly retains the core principles of liberalisation and unbundling.

The following chapter examines data from large developing economies on liberalisation, extension of connections to electricity network, and the growth in generating capacity. This provides the developing country context for the detailed study of Vietnam.

CHAPTER 3. ELECTRICITY MARKET LIBERALISATION IN PRACTICE

3.1. Introduction

This chapter reviews the global evidence of the extent of implementation of liberalisation and privatisation, and its relationship to key public objectives. In Europe, the focus is on affordability and reliability; in developing countries, on the extension of electricity networks and the growth in generating capacity to meet rising demand.

The liberalisation of energy markets started during the 1980s (Chile in 1983 and the UK in 1990). Deep reforms were undertaken in order to open these sectors to cross-border supply, competition and market dynamics. In the British Model (Newbery, 1989), privatisation of state-owned incumbents was the final and essential step after unbundling and competitive open markets of wholesale and retail which was expected to bring about improved efficiency.

The reform in the UK inspired the EU bloc and was widely replicated. The EU electricity market was created by a series of Directives in the 1990s and 2000s. The Directives mainly address five aspects: opening generation and retail markets; access to transmission and distribution networks, unbundling integrated companies, consumer protection, and regulatory bodies (Thomas, 2005). By 2000, all EU member countries had opened retail markets with the exception of Greece (Pollitt, 2009b).

Power sector reforms in developing countries have been introduced by individual countries rather than under regional legislation. However, the pressure to reform comes from international institutions as much as domestic politics. The pace of liberalising the market depends on the conditionalities of bilateral and multilateral structural adjustment loans on which these countries agree. The pathway to liberalisation in developing countries also depends on their economic development and the extent of rural electrification.

In the EU, electrification rate reaches 100% long before developing countries, the objectives that the power sector are aiming at are competitiveness and household welfare. In developing countries, the power systems need to be developed to support the growing economy.

Therefore, analysis of the impact of the liberalisation model would need to be based on country objectives.

This chapter then will look at 2 separate groups of countries: developed countries in the EU and developing countries. It aims to answer the question of whether different forms of market liberalisation have made any noticeable improvements in the objectives that these countries are targeting.

3.2. Electricity Market Liberalisation in the EU[1]

Since major reforms have taken place in the last 30 years, the electricity industry in Europe today looks significantly different from how it was in the 1980s. At that time, in most of the European countries, electricity was provided by a vertically-integrated company owned by the State or by local government. Such companies were usually shielded from competition thanks to government guarantees or the provision of a legal monopoly right. Such companies controlled the entire value chain, from generation to transmission and distribution to end users. Profit maximisation was generally not the top priority. In such a strategic sector, service coverage, quality improvement, protection of vulnerable consumers, and industrial relations were common goals set by the government for the incumbent enterprise.

The situation has changed since then. Today, electricity is considered as a commodity, produced in markets where numerous buyers and sellers trade. Borders between national markets have blurred and a single energy market is emerging within Europe. Networks, both transmission and distribution, have been unbundled from generation and supply activities. Independent regulatory authorities have been established to ensure national security

[1] Section 3.2. comprises of my own work as well as co-authored work with Ajla Cosic, Lea Diestelmeier, Alexandru Maxim, and Nicolò Rossetto with myself as lead author. Reference: Cosic, Diestelmeier, Maxim, Nguyen and Rossetto (2017), Does Public Ownership provide affordable and reliable electricity to household customers? Case studies of electricity sector reforms in the UK, France, Germany and Italy, in Florio (Ed), *The Reform of Network Industries: Evaluating Privatisation, Regulation and Liberalisation in the EU*, Milan: Elgar.

objectives while preventing anti-trust activities. Moreover, governments have started to step back by selling, partially or fully, their generation and retail companies, whilst commonly maintaining the control of transmission and distribution networks.

Discussions about the merits of privatisation have been rife in academia and in public debate. However, contrary to expectations, the impact on consumer welfare has not been clearly positive, both in terms of prices and quality of the electricity service. Empirical research so far has produced mixed results.

Assessing change in an institutional framework of an industry is a daunting task, especially for economists. This section aims to contribute to this intellectual endeavour, by focusing on the relationship between public ownership of electricity companies and measurable household welfare with respect to affordability and reliability of the service.

The European reform process provides an opportunity to test different hypotheses and perform empirical research. The fact that European legislation is silent with regard to the type of ownership in this sector has allowed EU member states to follow different reform pathways. While some countries like France maintain significant public ownership, others like the UK have almost completely privatised their energy companies. This study then carries out a comparative analysis of four EU countries (UK, France, Germany and Italy) with four different pathways and mixtures of ownership. By focusing on the affordability and reliability of electricity supply, this chapter concludes that changes in ownership structure are not necessarily related to improvements in household consumer welfare.

3.2.1. Liberalisation Pathways in Europe

EU Directives

The main rationale for liberalising the electricity market in Europe is to "increase efficiency in the production, transmission and distribution of this product, while reinforcing security of supply and the competitiveness of the European economy and respecting environmental protection". (Karan &Kazdağli, 2011: 11-12). This was expected to improve the EU's competitiveness and should lead to benefits for consumers of electricity. An internal electricity market should also lead to significant incentives for producers of energy to invest in new power generation including renewable energy sources (RES) (EC, 1996). The EU included all the steps as expressed by Jamasb & Pollitt (2005) in the three legislative

packages concerning the creation of the internal electricity market. In 1996, Directive 92/EC on the creation of the internal electricity market was adopted after many years of negotiation. Two directives followed in 2003 (54/EC) and 2009 (72/EC) which established stricter rules for the liberalisation of the European electricity market. However, the EU has no authority to govern the type of ownership of the companies in the internal market (Art. 345 TFEU). The Commission realized that unbundling would only be effective when vertically-integrated undertakings would be discouraged from discriminating against other companies or customers, in terms of network access or investments (European Commission, 2009). Therefore, the 2009 directive suggested full ownership unbundling.

Countries that had already unbundled their electricity sector were in favour, such as the UK, Italy and Belgium. However, mainly France and Germany opposed this idea by doubting whether it would improve the internal electricity market and lower energy prices (Buchan, 2009). This eventually resulted in three options concerning unbundling at the transmission level. Starting with the option for full ownership unbundling with two fall back options of Transmission System Operators (TSOs) and the Independent Transmission Operator (ITO). Third Party Access became the norm for accessing the transmission and distribution system, meaning that any electricity supplier from any member state should be able to supply electricity without experiencing barriers or discrimination. Relating to this, also consumers are free to choose their supplier. Consumer protection became more important over the years, resulting in specific rules for non-discrimination against consumers and protecting vulnerable consumers. Several new actors were established to stimulate the process of liberalisation. All member states have to designate a national regulatory authority which ought to be independent from other entities and has to monitor the electricity market. This also led to the establishment of the Agency for Cooperation of Energy Regulators (ACER) consisting of all national regulators. They should promote regional cooperation as a first step towards total EU electricity market integration (Commission, 2009).

Reforms in the EU in general and specifically in the following 4 countries have varied in adopted elements of the reform model as well as in the periods of policy implementation. Table 3 shows these variations.

Table 3 Variations of electricity reform stages in the EU

	Ownership Unbundling	**Open Wholesale Market**	**Retail Market (Customer Choice)**	**Privatisation of Electricity companies**
The UK	1990-1996*	1990 (Spot market)	1999**	1990-1996*
France	No***	2001	2007	Part privatisation 2005
Germany	2010*	2005 (exchange)	1998	Partly privatisation during the 1990s of municipal companies, currently re-municipalisation
Italy	2005	1999 ****	2007**	2003*

*Starting point

**Fully competitive market

***Since 2013 there is an Independent Transmission Operator

**** As per Fumagalli et al (2007)

The UK

In the 1990, in the UK, 'liberalisation was a domestic political decision': the Labour Party believed in the Keynesian model of nationalisation to boost aggregate demand through government spending, whilst the Conservative Party argued for the market mechanism as

the answer to state-owned enterprises' inefficiency and national budget deficit (Newberry, 2002). Starting with privatisation and restructuring the British electricity supply industry, the sector then embarked on full liberalisation by unbundling CEGB generation and transmission units into one privatised transmission company (NGC) and 3 generation companies (Powergen, National Power and Nuclear Electric) which were then gradually broken up into 8 generation companies. A Power Pool was set up in 1990 for generators to bid against each other, marking the creation of a wholesale market. The UK model was the most complete version of electricity liberalisation (Newbery and Pollitt, 1997). In the last two years, the implementation of the EMR means the government heavily subsidizes the electricity sector to keep the lights on. This happens mainly via the introduction of the Capacity Market, a mechanism that remunerates fossil fuels-based and nuclear plants for being able to add capacity in the electricity system when this is needed and within specific timeframes.

Italy

Italy began to reform its electricity industry in the 1990s. First, a national regulatory authority for electricity and gas was established (1995). Then, generation was liberalized and the largest consumers were allowed to choose their own supplier (1999). An Independent System Operator model was adopted, with the incumbent Enel still owning the transmission grid. Beside that Enel was compelled to divest from some of its power plants, which were sold to new entrants (2001-02). At the same time the company was partly privatised, with the government still controlling the largest share. At the beginning, competition was not working very well because Enel still enjoyed a dominant position. Wholesale prices remained high even after the starting of the official power exchange in 2004. Smaller generators like Eni and Edison preferred to avoid competition and share the gains from the high prices set by Enel's bids on the market. After a row of bad blackouts and reduced margins in transmission and generation, Italy pushed for the introduction of ownership unbundling. Terna was separated from Enel in 2005. Meanwhile a big wave of investments took place in generation with new CCGTs built in a short period of time. Natural gas became by far the main fuel for generation. In July 2007 every electricity customer became eligible for choosing its own supplier. However, in order to smooth the transition and protect households and small enterprises, it was decided that those who do not choose a supplier on the free market were going to be supplied by the Acquirente Unico and billed directly by their local distributor (Servizio a maggior tutela). For these customers the tariff

is defined every three months by the national regulator, based on the costs incurred by the Acquirente Unico. In the past several years the switching rate has been low because the tariff provided by the Servizio a maggior tutela is among the best on offer (AEEGSI, 2015). Currently discussions are on whether there is a plan to get rid of the Servizio a maggior tutela by 2018. The idea is that the transition period is now concluded, and more competitive conditions exist on the generation and retail markets. No reference tariff should exist anymore also because issues of energy poverty are addressed by the Bonus elettricità and by the Bonus disagio fisico. The first provides a rebate on energy bills for poor families, the second for families with a person using essential medical devices. The problem of electricity prices has become more relevant in the last few years because despite an improvement in the industry and a reduction in wholesale prices, end customers pay among the highest tariffs in Europe. Today this is due not so much to the particular energy mix or the difficult geographical characteristics of the Italian system but to the significant subsidies which are provided to renewable generation out of final tariffs. On service quality, Italy improved significantly in the last years and thanks to large investments by Terna and local distributors enjoys today one of the most reliable electricity service in the EU (CEER, 2015).

Germany

In Germany, referring to the 2005's energy law, Pfaffenberger and Chrischilles (2013) note that this led to the legal unbundling of transmission and distribution networks from other activities of integrated companies and the regulation of network access conditions including network pricing, thus establishing the conditions for competition in the wholesale and retail markets. Pfaffenberger and Chrischilles (2013) note though is incomplete because it fails to mention the character of Germany's unbundling of power networks, which does not necessarily mean ownership separation between the power networks and generation companies. Nevertheless, Germany's energy system is vastly unbundled today and the unbundling process stated at the beginning of this decade. So, in the previous decade, Germany's high-voltage lines were operated by the country's four large utility companies EoN, RWE, Vattenfall Europe and EnBW. Their management became separated from the parent companies following the European Commission’s guidelines.

On the power distribution front, a large percentage of the distribution lines were owned by local municipalities, who also engaged in the retail market. Unbundling of the retail market from the distribution networks is not compulsory according to the EU legislation. Today,

the four German transmission grid operators are: Amprion, which operates the grid in west Germany (RWE, 2011); Tennet, which operates about 40% or the country's grid running from north to south; 50 Hertz Transmission, which operates the grid in north and east Germany (50 Hertz is also responsible for linking the Baltic Sea's offshore wind farms to the German grid); and Transnet BW, which operates the transmission grid in Baden-Württemberg, in south-west Germany.

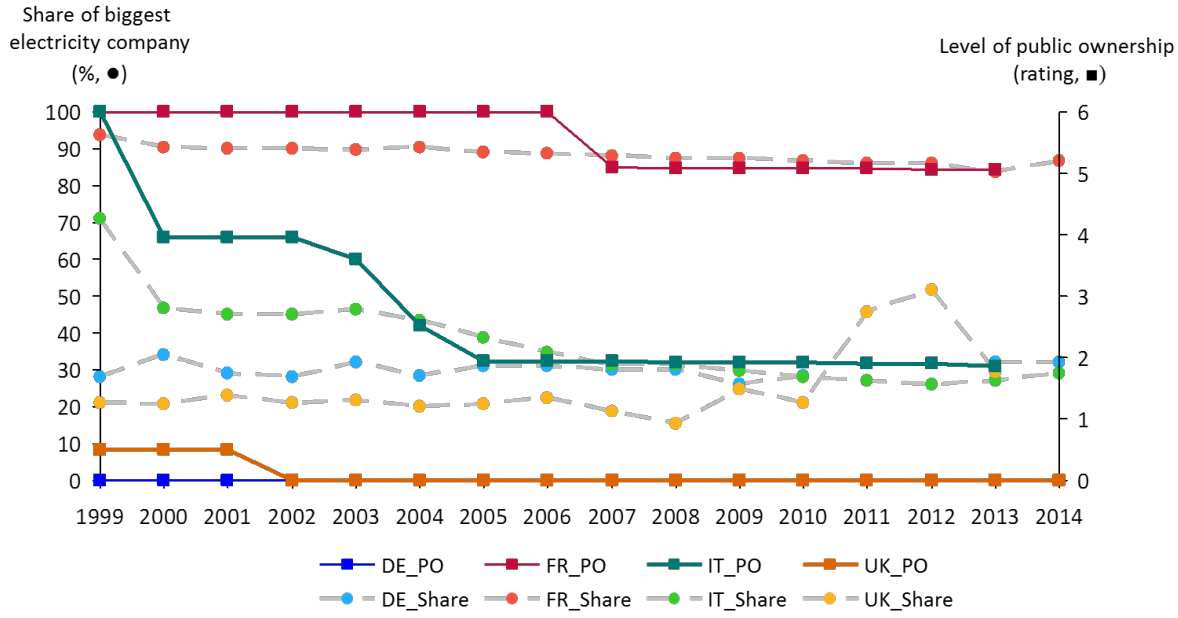
France

France transposed the EU Electricity Directive 96/92 in 2000 and thereby launched the liberalisation of the electricity sector in France. However, the changes in legislation did not substantially affect the position of EDF (Électricité de France), the former public utility. Only with the further liberalisation stemming from the subsequent Electricity Directives in 2003 and 2009 did the sector open up. Today, 85% of EDF's shares are held by the French state, and EDF is responsible for about 95% of electricity supply. Due to the fact that electricity supply has long tradition as 'service public', the task of electricity supply is subject to a concession regime. The concession is granted by local authorities for a defined territory. Under that regime EDF is responsible for about 90% of electricity supply. The transmission system of France is operated by a single transmission system operator (TSO), namely Réseau de Transport d'Électricité (RTE). RTE is a limited liability company and a subsidiary of EDF, which holds all the shares. The companies are under supervision of various regulatory authorities. Two main distribution system operators (DSOs) are responsible for the operation of the distribution system, Électricité Réseau Distribution France (ERDF), which is also a EDF subsidiary and SORÉGIES Réseau de Distribution. Additionally, there are about 150 small distribution companies.

3.2.2. Liberalisation and Market Share

Before depicting the empirical findings on ownership regimes and variables on consumer welfare, this section outlines the contexts of the electricity market of the four countries regarding the largest electricity company (generation and/or supply). One of the main aims of liberalisation and subsequent unbundling of vertically-integrated electricity utilities is to introduce a competitive market setting. By identifying the biggest electricity company in relation to the level of public ownership, this section analyses whether public ownership of electricity companies facilitates a competitive market setting.

Figure 2 Market share of the largest electricity company and evolution of the level of public ownership in Germany, France, Italy and the United Kingdom



The liberalisation-to-privatisation market reform model in the UK brought public ownership dramatically down in the electricity sector in the early 1990s. The sale of state-owned unbundled electricity companies allowed entry and growth of private companies. Since then, the market is controlled by 'the big six'.

In France, 85 percent of *EDF*'s (*Électricité de France*) shares are held by the French state, and therefore considered a publicly-owned company. *EDF* is responsible for about 95 percent of electricity supply. Under that regime *EDF* is responsible for about 90 percent of electricity supply and owns a market share of about 79 percent as of 2014.

Germany shows a less clear-cut picture of public and private ownership than the two other countries. The supra-regional level is controlled by four large electricity companies. *E.ON SE* is a private company, *RWE AG* is largely privately owned with about 15 percent of its shares held by cities and municipalities located in the federal state of North Rhine-Westphalia. *EnBW AG* is owned by the federal state Baden-Württemberg, and *Vattenfall* is owned by the Swedish state. The 'big four' own about 60 percent of the total market (2014). At the local level, various small municipal electricity companies (*Stadtwerke*) have been privatised during the 1990s. However, currently, a re-municipalisation is taking place as many of the contracts with private companies (concession contracts) are not renewed and municipalities are regaining control. (Hall et al 2013).

Similar to the UK, the electricity market in Italy is dominated by the incumbent electricity company-*Enel*. *Enel* was corporatized in 1992. However, only in 1999 did a partial sale of its shares begin. Since then, the electricity market in Italy has been subject to a gradual increase in private participation with the reduction of market share for Enel. However, the privatisation process stopped in 2006: since that year the Italian state has maintained control of around 30 percent of Enel. In the meanwhile, the market share of Enel has stabilised between 25 and 35 percent.

3.2.3. Liberalisation, Public Ownership and Affordability

Affordability is a complex concept to measure and to accurately reflect in empirical research (Kessides et al., 2009). Also, from a legal perspective, ambiguities exist in its interpretation (Pront-van Bommel, 2016). This chapter defines affordability as 'share of annual household expenditure that is spent on energy'. Since data on electricity expenditure are not accessible and electricity accounts for the majority of the energy costs of households, we take energy costs as a proxy for the actual share of electricity bills. Affordability is one of the two variables composing the concept 'consumer welfare' which is at the heart of this research. Briefly recalling, the aim of this chapter is to analyse the effect of different ownership regimes on consumer welfare across EU countries. Essentially, the question is, whether and to what extent the nature of ownership affects consumer welfare. The relation between the type of ownership and affordability is thus the first variable needed to analyse consumer welfare.

''Affordability' is a vague concept and differs from mere low prices. Fairly speaking, prices are a good proxy of affordability, but they do not tell the whole story about the ability to pay for electricity bills. As employed in Winkler et al. (2011), EBRD (2003) and Frankhauser and Tepic (2005), the ability to pay for a good depends on the relative costs of that good measured against one's income after tax. Similarly, the ability to pay for electricity can be measured by taking the proportion of the average annual cost of electricity bill per household out of their real disposable income. Whilst the payable amount of electricity vary from household to household, annual residential consumption and unit price of electricity on average are measured consistently by EU institutions. Here using Eurostat datasets, the average electricity bill per household can be composed by multiplying the unit price with

the annual consumption per household. The share of income spent on electricity under assumption of averaging household usage and income adjusted by consumer price index (as provided in final figures by Eurostat) is computed as follows:

$$SISE = (P_{el} * Cons_{el}) / Income \quad (1)$$

where P_{el} is the unit electricity price for domestic consumers at constant prices (adjusted by consumer price index, as provided by Eurostat).

$Cons_{el}$ is the annual residential consumption of electricity per capita (national average)

Income is the net disposable income of households per capita at constant prices adjusted by consumer price index) (national average).

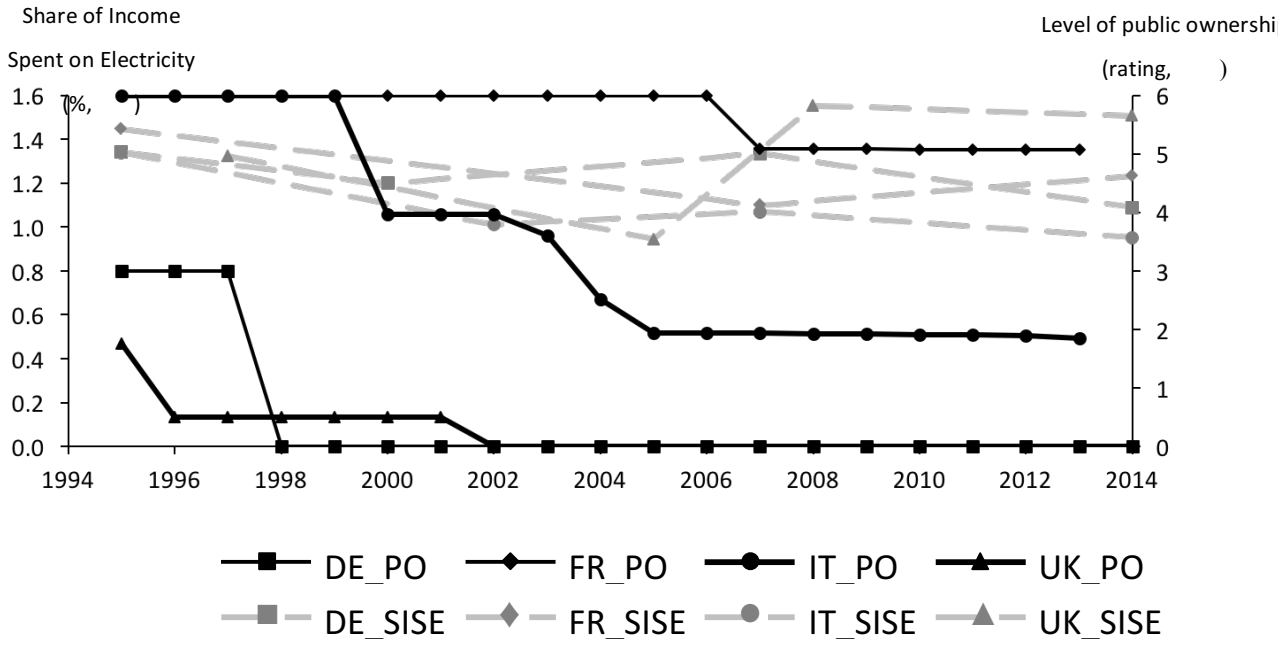
Taking this indicator as a proxy for the relative costs of electricity per year implies that the higher this share, the more unaffordable electricity consumption becomes. The lower this share, the more affordable electricity bill becomes.

The control variable, i.e. public ownership in the electricity sector (PO), is derived from the OECD database on regulation in energy, transport and communications (ETCR). For the electricity sector, the ECTR public ownership is evaluated on the basis of the ownership structure (private, mostly private, mixed, mostly public or public) of the largest company in the generation, transmission, distribution, and supply segments (OECD, 2016).

The question, 'which type of ownership is most beneficial and results in higher consumer surpluses' has been discussed for a long in in the literature (De Fraja, 1993). On the one hand, a typical argument is that under competition privatised companies generate higher efficiency reflected in lower prices for the consumer than publicly-owned companies. On the other hand, the contrary can be argued as publicly-owned companies bring a more efficient output and lower prices to consumers than private oligopoly markets. Yet another standpoint specifically focusing on the electricity sector stipulates that partly privatising companies does neither necessarily worsen nor improve the quality of output (Fumagalli et al. 2007). The overall findings of the four countries under investigation confirm the last observation that no significant changes in affordability occurred after changes in the type of ownership (apart from the UK).

The most significant increase of share of income spent on energy happened in the UK. With full privatisation in the UK in 2003, the share of income spent on energy increased from 1.2 percent to 1.6 percent. In France only a slight change occurred in the type of ownership (2007). Relevant to mention is that in 2007 when customers gained the free choice of electricity suppliers, the share of income spent on energy increased. This could be explained by the fact that creation of competitive retail markets incurs additional costs of marketing and legislation, which are then passed to the consumers. The share of income spent on energy in Germany merely shows small variations. In Italy, gradual privatisation of electricity companies did not necessarily lead to an increase in the share of income spent on energy.

Figure 3 Share of the income spent by households on electricity and the evolution of the level of public ownership of the largest electricity company in Germany, France, Italy and the United Kingdom.[2]



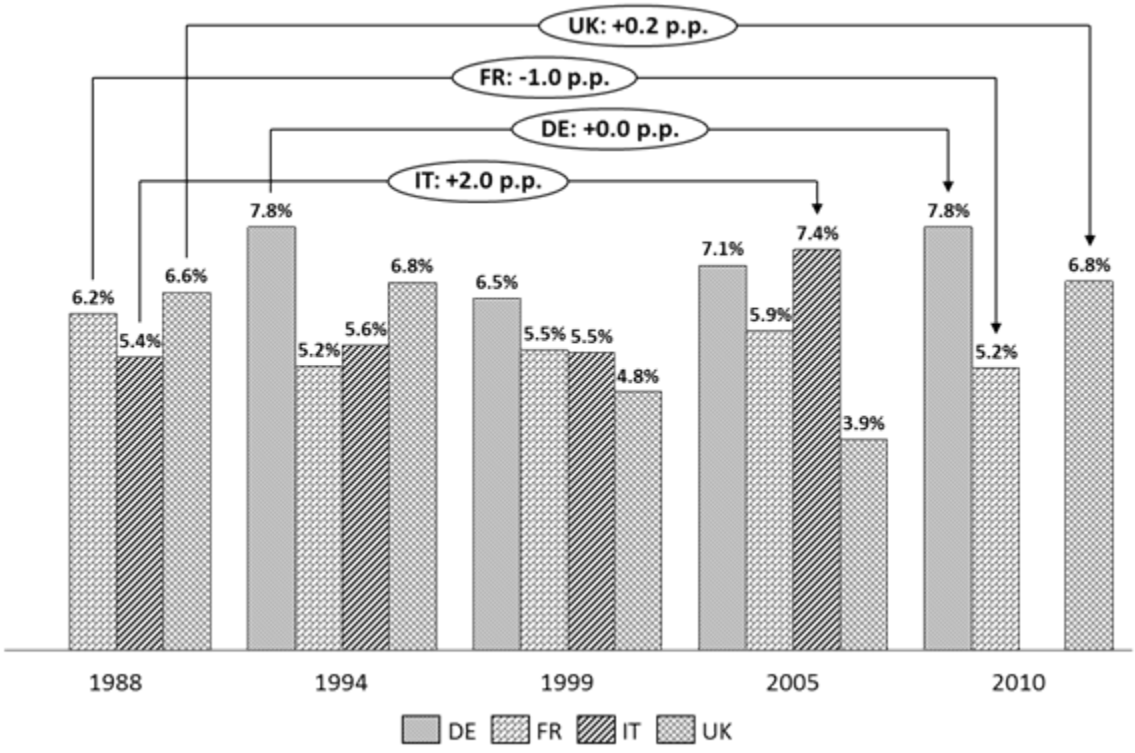
In addition, it is relevant to consider the poorest household income group per country and assess whether this group experienced an increase or a decrease of the share of income spent on energy. This assessment represents the overall goal to make electricity available to all consumers. Nowadays electricity is essential for people to take part in the society and to

[2] **Sources of data:** Eurostat (2016), OECD (2016), World Bank (2016).

possess equal opportunities. Therefore, looking at the poorest group of household consumers extends the variable 'affordability', by considering whether electricity is affordable also for the poorest group.

As Figure 4 shows, in the UK, the share of income spent on energy increased by 0.2 percent in the period from 1988 until 2010 for the poorest quintile of household consumers. In France, the share spent on energy decreased by one percent point. In Germany, the gap in this cost for different household income groups remained unchanged and there has been no significant difference between 1994 and 2010. In Italy, the share for the poorest quintile of households increased by 2 percent. The differences in the shares of income before and after reforms on average and by the poorest quintile show that reforms taking different forms have not resulted in concrete improvement in affordability for households.

Figure 4 Share of income spent on energy by the poorest quintile of households in Germany, France, Italy and the United Kingdom.[3]



[3] **Source of Data:** Eurostat (2016)

3.2.4. Liberalisation, Public Ownership and Service Reliability

Reliability of the electricity service is the second variable composing the concept of consumer welfare. Measurements of service quality vary in the literature due to availability of data and purpose of research. Since it is not easy to assess commercial quality, we decided to focus our attention on the reliability of supply, that is, on the capability of a system to provide energy to the customers when requested. 'Reliability' is usually assessed through a combination of indicators. The two most common are System Average Interruption Frequency Index (SAIFI) and System Average Interruption Duration Index (SAIDI). The first shows how frequent service interruptions were over a given period of time, while the second provides an idea of how long, on average, those service interruptions were (CEER, 2015).

In order to have a synthetic measure, we combine the two indicators and create a compound 'unreliability of electricity service' indicator. This is calculated as an average of the SAIDI and SAIFI values expressed as an index, where 100 per cent is the value of the first year for which data is available. By using this approach, the absolute values for each country are not taken into consideration in the comparison. However, this does not represent a major issue, given that the initial SAIDI and SAIFI values do not vary significantly among the four markets. The calculation of the indicator for year *t* and country *c* was performed using the following formula:

$$Unreliability_{(t,c)} = (SAIDI_{t,c}/SAIDI_{0,c})*0.5 + (SAIFI_{t,c}/SAIFI_{0,c})*0.5 \quad (2)$$

where $SAIDI_{t,c}$ and $SAIFI_{t,c}$ are the values of SAIDI and SAIFI for year *t* in country *c*,

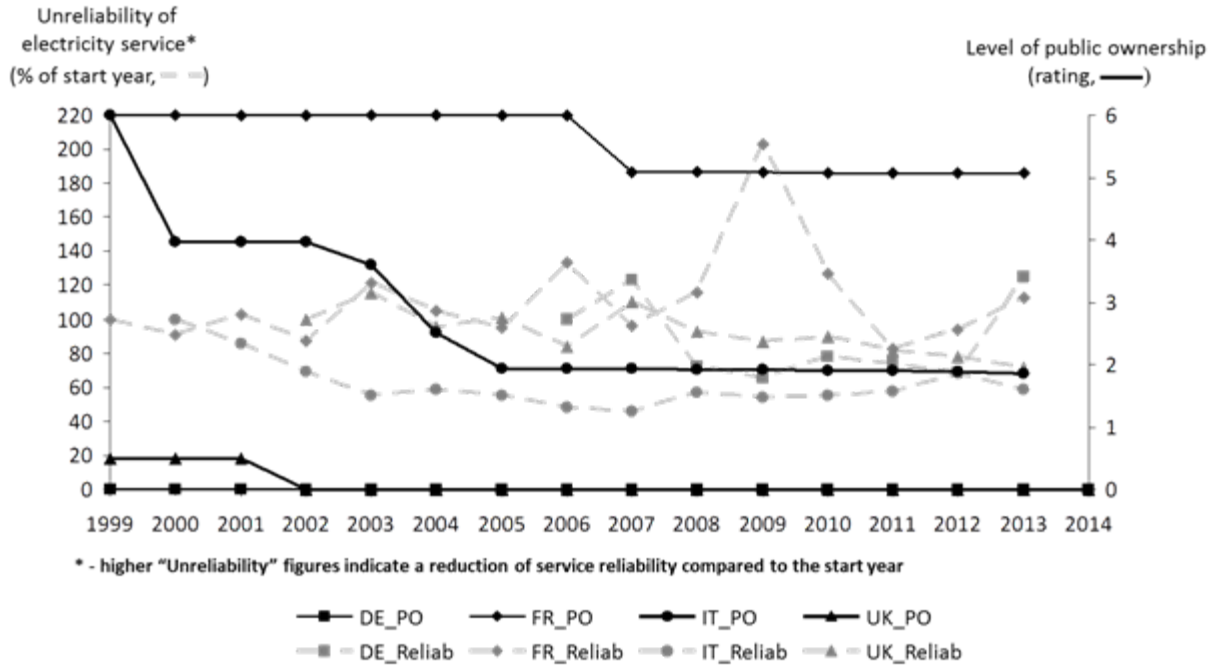
$SAIDI_{0,c}$ and $SAIFI_{0,c}$ are the values of SAIDI and SAIFI for the first year of the sample in country *c*.

The type of ownership may affect the reliability of electricity services, assuming quality of services depends on investments in electricity assets and maintenance of power plants and supply lines. Private companies under pressure of reducing costs may not prioritise continuous investment in the system, hence lower supply reliabilitiy. Some literature as

discussed above show that privatisation does not necessarily lead to improvements in the electricity sector (Fumagalli et al. 2007).

The compound index measures how regularly the transmission of power is disrupted, indicating how reliable the provision of power is to households. The higher this index is, the more interruptions there have been in comparison to the benchmark year. The lower it is, the less the provision of power is interrupted, indicating a more reliable the system of power is.

Figure 5 Unreliability of the electricity service and the evolution of the level of public ownership of the largest electricity company in Germany, France, Italy and the United Kingdom.[4]



In the UK, the reliability of electricity services has fluctuated slightly since 2002, with a negative evolution especially in 2003 and 2007. However, since then, the reliability of the system stagnates and even slightly improves. In France, the opening of the retail market in 2007 led to a sharp increase in the reliability of electricity services. Yet, this improvement

[4] **Sources of Data:** CEER (2015) and OECD (2016).

only lasted a short period, and during 2008-2010 the situation deteriorated significantly. Although the situation had improved by 2011, recent figures suggest that the situation may be worsening. Unfortunately, data on Germany are partly incomplete. The data available show a significant improvement in reliability of electricity services in 2007. After 2012, reliability appears to worsen again. Italy shows a steady improvement in service reliability during the period between 2000 and 2003. With the introduction of ownership unbundling in 2005, reliability tends to either stagnate or slightly worsen.

3.2.5. Outlook for Liberalisation in Europe

Liberalisation of the electricity sector often requires partial or whole privatisation of state-owned incumbent companies. While transfer of ownership is commonly believed to improve household welfare, this chapter suggests that the story is more nuanced. First, the share of electricity expenditure for low-income household customers did not clearly decrease in the period considered. Similarly, reliability of electricity supply after strong improvements in the 1990s stagnated in recent years, with some cases of short-lived deterioration.

As public ownership has consistently reduced in the UK, France, Germany and Italy where different reform pathways occurred, service quality and affordability perceived by consumers did not improve. We cannot totally exclude the relevance of other factors where distribution is not always unbundled and issues of reliability depend heavily on the distribution segment of the supply chain.

Whilst at the beginning of this millennium European households appeared to be better off, subsequent developments as shown in empirical evidences cast doubts that ownership transfers from public to private entities are significantly linked to such improvements. The emergence of the prosumer paradigm and the smart grid add further complexity to this picture and may reduce the relevance of the ownership structure of the incumbent for the welfare of household customers.

3.3. Electricity Market Liberalisation in Developing Countries[5]

This section examines what has happened overall and individually in 14 of the largest developing countries. The countries chosen according to the size of their economy as measured by GDP within each of three regions – Asia (5 countries), Latin America (5 countries), Africa and Middle East (4 countries). This is a manageable group representing a large proportion of the global economy and population, and which might be expected to have the capacity to develop liberalised markets. China and India are excluded because of complicated individual state autonomy in policy-making, as well as their exceptional sizes.

In order to investigate the results of liberalisation, the chapter first focuses on the extent to which stages of the British Liberalisation Model 1990 have actually been implemented in the sector and still remain at the point of writing in 2017. The 3 key stages of concern are: effective unbundling (when vertically-integrated generation, transmission and distribution companies have been legally restructured into separate companies), effective wholesale and an effective retail market (when there exists a working retail market where end-customers can choose their service providers).

Table 4 records the years in which there is an enacted legal paper stating clearly the start of each stage of liberalisation. Only 8 out of 14 countries have unbundled effectively. Market creation that promises benefit to end-users from competition actually does not come until later stages in the liberalisation process. Among these 8 countries, 4 countries followed immediately with a wholesale market, including 3 countries from Latin America and the Philippines. The swift movement in Latin America in the late 1990s was supported by the IMF, whilst the Philippines received hundreds of millions dollar project support from ADB; opening and operating a wholesale market is a costly process. Without significant financial support and foreseeable private investment, countries such as Vietnam, Thailand, and Malaysia have been reluctant to open one. Brazil and the Philippines are the only two that have followed the British Model to the final stage of creating a retail market. Theoretically, the further the country is along the line of this sequence, the better performances of the sector

[5] Section 3.3. comprises of my collaborated publication with David Hall. Reference: Hall and Nguyen (2017), Electricity Liberalisation in Developing countries, *Progress in Development Studies*, 17:2, pp. 99-115.

and more investment has resulted. Section 3 of the paper will challenge this expectation when it comes to investment in generation and networks.

Table 4 Electricity Liberalisation Measures in Large Developing Countries[6]

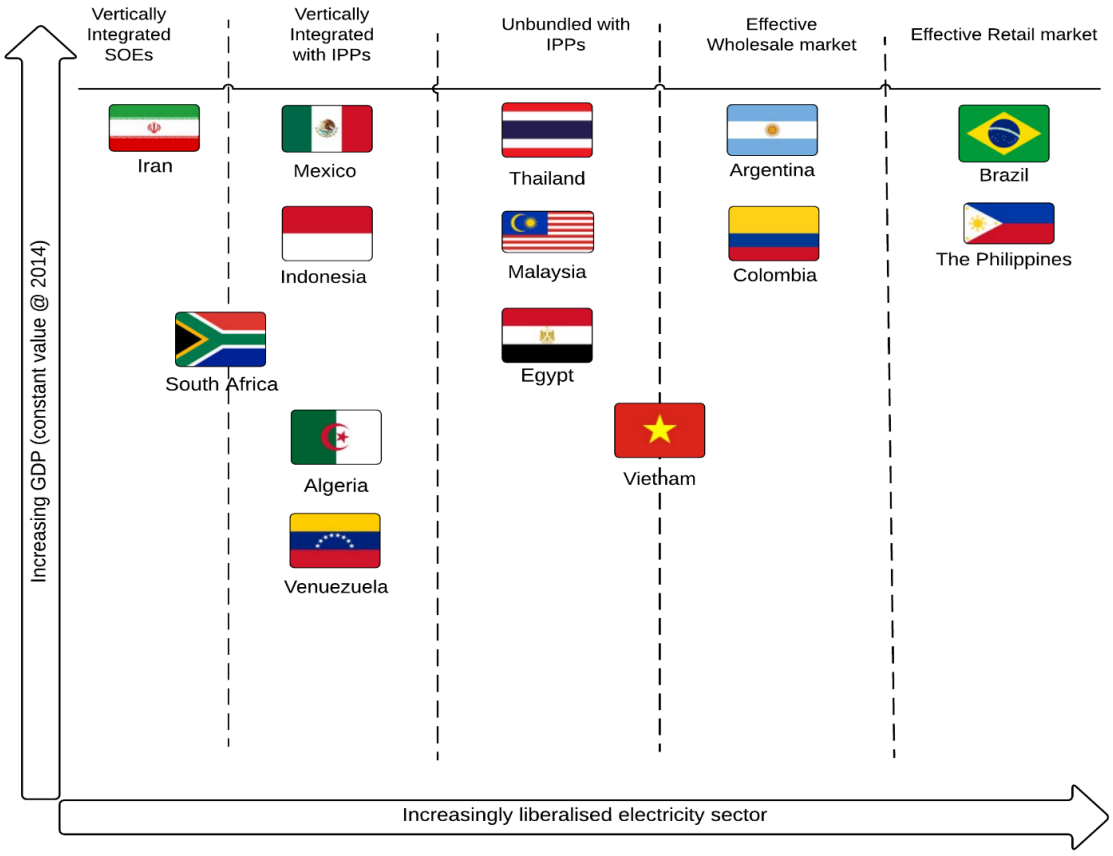
Region	Country	2014 GDP (USD$bn)	Population (at 2014)	Year of Effective Unbundling	Year of Effective Wholesale Market	Year of Effective Retail Market
Asia	Indonesia	888.648	254454778	NA	NA	NA
	Thailand	404.824	67725979	2003	NA	NA
	Malaysia	338.108	29901997	2013	NA	NA
	Philippines	284.618	99138690	2001	2002	2012
	Vietnam	185.897	90730000	2009	2016	NA
Latin America	Brazil	2,346.58	206077898	1998	1998	2003
	Mexico	1,291.06	125385833	NA	NA	NA
	Argentina	543.061	42980026	1992	1992	NA
	Colombia	377.867	47791393	1994	1995	NA
	Venuezuela	206.252 (est)	30693827	NA	NA	NA
Middle East	Iran	416.49	78143644	NA	NA	NA
Africa	South Africa	350.082	54001953	NA	NA	NA
	Egypt	286.435	89579670	2001	NA	NA
	Algeria	213.518	38934334	NA	NA	NA

Table 4 shows the progress of liberalisation in terms of the elements adopted in each country. This figure is the snapshot of where these 14 countries are today. This figure includes another way of involving the private sector, namely the use of independent power plants (IPPs). The figure thus puts countries into one of 5 sectoral structures: vertically-integrated SOEs, Vertically-integrated SOEs with IPPs, Unbundled with IPPs, Effective Wholesale Market and finally Effective Retail Market. The use of private investors through IPPs can be seen to happen regardless of the form of the sector structure. Mexico and Indonesia were both early in introducing IPPs but still have not progressed far along the reform path of unbundling, let alone the introduction of markets. The use of IPPs is not dependent on markets, though it is invariably dependent on government commitments through a power purchase agreement (PPA); indeed, the EU ruled that IPPs were incompatible with the internal market. This illustrates that unbundling by itself does not create any market mechanisms that involve interaction between wholesale or retail consumers and suppliers. IPPs only need the possibility of 'public markets' for government procurement, and this does not even require unbundling. The existence of private sector participation in the form

[6] ***Source***: GDP data from IMF World economic Outlook Database, October 2015. Population data from The World Bank Data archive.

of IPPs is thus no evidence of the existence of market mechanisms in the sense of the British liberalised model.

Figure 6 Electricity Liberalisation Progress in Largest Developing Countries



3.3.1. Latin America

Brazil

Historically, the Brazilian electricity system has been dominated by a company, Eletrobras, owned by the federal state. It owned and operated the transmission system and a large majority of the country's generating capacity through 5 regional subsidiaries. Distribution is carried out through 50 regional distribution companies. In the 1990s the country followed the advice of the World Bank, privatised most of the distribution companies, but not generation, and set up a regulator to help introduce liberalised markets. In 2001 there was a crisis due to a shortage of generating capacity resulting from the failure of the new market to stimulate investment in new generation. This was followed by the withdrawal of most of the multinational companies, and the election as President of the Workers' Party candidate, Luiz Inacio Lula da Silva, who suspended the privatisation and liberalisation programme.

Some of the distribution companies were abandoned by their buyers and were repossessed by the federally owned development bank which had provided the loans to finance their privatisation. This effectively brought these companies back into the public sector, but at a federal level under Eletrobras (Thomas, 2009).

The role of the state has been increased, firstly by the creation in 2004 of a new Energy Planning Company (EPE, Empresa de Pesquisa Energética) under the Ministry of Mines and Energy, which now employs about 250 people. It forecasts demand 20 years ahead, plans required infrastructure and generation, and commissions specified projects. The free market in generation has been replaced by what is, in effect, a Single Buyer system to supply the majority of consumers. A parallel market for large industrial users, whICH can choose their electricity supplier, exists (Thomas, 2009).

Mexico

A vertically-integrated state company, Comision Federal de Electricidad (CFE), controls all transmission and distribution (with minor exceptions), and generates 2/3 of all power. Proposals to unbundle and liberalise the system were rejected as unconstitutional by the Supreme Court in 2002, ruling that it contravened the requirement for state ownership of the system in the Constitutional Articles 27 and 28. The only private companies are IPPs, although the Supreme Court suggested that these too might contravene Article 27: and every IPP project in Mexico has explicit government guarantees (Gabriele, 2004; Carreón-Rodriguez, V. Jiménez San Vicente, A. Rosellón, 2003). Mexico actually increased the integration of the electricity system under a single state-owned utility in 2009 when it transferred responsibility for electricity distribution within Mexico City to CFE. Under new electricity laws in August 2014, the power sector became increasingly open to private investment in all parts of the sector with unbundling of CFE which will no longer be the only power trader in the market. However, (Ibarra-Yunez, 2015) criticises the programme as imperfect as incentives are misaligned.

Argentina

Argentina unbundled and privatised its electrical system in the 1990s, as part of a restructuring programme agreed with the IMF and World Bank. Most generating companies, and most distribution companies, were privatised, and a wholesale power market was

introduced. Retail competition was introduced for industry, but not for households. The country then experienced a major economic crisis in 2001, including a massive devaluation, in which the government froze power prices to protect households, leading to disputes with the companies over the impact on profits. The government of Argentina has refused to honour either the contracts or arbitration rulings in favour of the companies, because they would be unreasonably burdensome on a country whose citizens suffered great economic losses as a result of the crisis, and the companies should expect to share that risk as they had tried to profit from the good times.

There has been no further privatisation or liberalisation since the crisis. Argentina now needs investment in new generating capacity, especially in renewables, and expects that most of this will come from public finance. It also uses public finance for subsidies to poor consumers, for extension of the system – especially rural electrification, investment in transmission, and renewables (Hall, 2007).

Venezuela

In 1996, Decree 1558 marked the start of thebliberalisation process by privatising 1 of 5 major utility companies. Private sector participation accounted for 20%, 10% and 40% in generation, transmission and distribution in 2000 but there was no competition in any market (Millan, Lora and Micco, 2001). In the mid-2000s government began reversing the process, and both distribution and generating companies were renationalised (Hall, 2007). The period 2003-2012 witnessed almost 50% rise in electricity demand, in comparison to only 28% increase in capacity. In 2013, the Chavez government quadrupled public investment in the sector to deal with power deficits. Transmission lines are heavily stretched, resulting in government-announced electricity interruption in 2009 and 2010 (U.S. Energy Information Administration, 2015b). Cadafe is still the largest distributor and remains a vertically-integrated state-owned company.

Colombia

In 1994, Laws 142 and 143 laid out a privatisation plan and liberalisation pathway for the electricity sector. Colombia is a highly decentralized system in which municipal companies are primarily responsible for their local demand with the rest served by many distribution companies nominally owned bycentral government. The Colombian power system has since

been open to private participation, operating a wholesale market but only partly unbundled. The established SOEs are allowed to remain integrated but they need to operate as separate subsidiaries. In the 1990s, 70% of generation came from private companies but market power were concentrated in a few hands (Millan, Lora and Micco, 2001). However, centralised auctions of generated output created shocking volatility of electricity prices, recorded at more than 300% increase from 1997 to 1998 and again from 2000 to 2001, followed by similarly shocking plummets in the subsequent years (Larsen et al., 2004).

3.3.2. Africa

Egypt

Despite being legally unbundled in 2001 by law, the Egyptian Electricity Holding Company (EEHC) owns 90% of generation, all transmission lines and almost all distributions networks. Private companies are allowed to participate in BOT contracts with the Egyptian Electricity Transmission Company since 1996. So far, 16 private electricity producers 24 private distributors are licensed (Osman, 2015). Political unrest since 2011 has drained government finances and hampered investment. In June 2015, $9bn deal was signed with Siemens to construct three 4.8GW gas-steam power plants (Oxford Business Group, 2015). In the same year, the government introduced a new Electricity law to legalise power sector liberalisation. The plan involves both practical unbundling and privatisation. In 2016, Egypt signed a deal with Russia to build four reactors with a total capacity of 4.8GW.

Algeria

Sonelgaz is the publicly-owned company that solely provides generation and networks. The power sector thus remains vertically-integrated and has no near-future plan for liberalisation and privatisation. Electricity prices are fixed (U.S. Energy Information Administration, 2016). But as oil prices dropped, government subsidies for Sonelgaz will be either phased out ‘earlier or late’ (Fattouh and El-Katiri, 2012).

South Africa

In 2004, South Africa abandoned its earlier plans for the unbundling and privatisation of the electricity industry, and retained Eskom as an integrated state-owned electricity company. The government also decided against introducing private companies into electricity

generation, so Eskom remains responsible for virtually all generation (Gaunt, 2008). The only privatised power station, Kelvin, was abandoned twice by multinational owners – first AES, then Globeleq (Hall, 2006). The percentage of the population with access to electricity rose from 40 percent in 1994 to 66 percent in 2002, 79 percent of the population in urban areas and 46 percent in rural areas had access to electricity (Dubash, 2002). This contrasts with the rest of Africa, where "the emphasis on profitability appears to have relegated expanded electrification of the poor to the bottom of the priority list", and neither private sector participation nor regulation has made any significant contribution to the extension of access to network services (Gaunt, 2008; Estache, 2006). South Africa also provides subsidies to enable poor households to receive 50 KWh per month free, with reduced tariffs after that point.

3.3.3. Asia

Iran

The electricity system of Iran is entirely state-owned. There are separate generating and regional distribution companies, all of which belong to the state electricity holding company Tavanir. There is provision for private power stations, but only 2% of electricity is generated privately. Iran has an extensive national grid, semi-integrated with neighbouring countries. The power sector is endowed with an abundance of natural gas resources which provide for 70% for total generation (Energy Pioneers Ltd., 2015). The economy is expected by the World Bank to grow by more than 5% per annum after the removal of sanctions. But Iran still faces occasional blackouts during peak demand. The government is ambitious to develop the power sector to provide for domestic consumption as well as for exports, but due to financial constraints it is seeking foreign investment. The first move to attract this was to reduce energy subsidies by increasing the electricity prices by 25% in 2014 and a further 20% in 2015 (U.S. Energy Information Administration, 2015a).

The *Philippines*

Under administration of President Ramos (1992-1998), the Philippines went through an era of privatisation of major service state-owned companies. The nation-wide neo-liberal trend accumulated more than 40 IPPs contracts by 1994, more than any other developing countries. Following this success, Republic Act 9136 – Electric Power Industry Reform Act (EPIRA) took effect in June 2001, setting out a definitive plan for unbundling NPC (National

Power Corporation), setting up Wholesale Spot Market in 2002 (with 40$mil loan from ADB), running a retail market and privatisation of 81% assets of NPC in 2013 so far. The government has let power prices increase to a high level whilst viewing access to electricity for the poor as adequate (Mouton, 2015; Enerdata, 2014). The reform has achieved its primary goal which is security of supply but it has left a blind spot for competitiveness and social equity in its development.

Malaysia

In 2013, Malaysia had 51% of installed capacity provided by the major state company TNB (Tenega Nsional Berhad), 38.5% from IPPs and the rest is co-owned by IPPs and TNB (Zamin, Abidin and Ibrahim, 2013). But since the electricity consumption demand is above other Asian developing countries, the country's efforts to reduce energy subsidies by raising tariffs by 7.1% on average since 2011, faces opposition from the public. End-user prices in urban areas however increased by more than 15% (U.S. Energy Information Administration, 2014). MyPower Coporation was established in 2010 to manage and deliver the reform programme. Its success includes competitive bidding for generation licences and a Single Buyer Department (SB) ring-fenced from TNB.

Indonesia

The electricity system of Indonesia is still dominated by the vertically-integrated state-owned utility PLN. The first IPPs contracts were signed in 1990 with corruptly generous power purchase agreements (Nikomborirak and Manachotphong, 2007). In 1992 the former dictator, President Suharto, with the encouragement of the World Bank, introduced private sector participation through building independent power plants (IPPs). In 1994, PLN was corporatized into a government-owned limited liability company.

The first serious effort at unbundling was made in 1995 when PLN unbundled its Java, Bali and Madura generation, distribution and transmission assets. However, these assets still remain wholly owned by PLN and operate semi-autonomously. By Electricity Law No.30/2009, PLN no longer owns monopoly power to supply and distribute power to end customers. However, it is still given 'right of first priority' in provision for public use before private businesses. Practically, PLN is still a vertically-integrated state-owned company. At

2015, PLN is the single buyer and seller of electricity. 80% of IPP-generated power is currently bought by PLN (IBP and Inc., 2015 page 64).

Vietnam

EVN was a vertically-integrated utility until the end of 2008. Since January 2009, EVN has been set up as the National Power Transmission Company—a separate legal entity responsible for the operation of the transmission network, and thus legally unbundled (i.e., it has its own accounts, management, and board of directors) (Tuan, 2012). The wholesale power pool is in preparation under Decision 8266/QD-BCT by the Ministry of Industry and Trade. Trials and operation from 2016-2018. It comes into fully effective operation in 2019 (Electricity Regulatory Authority of Vietnam, 2016).

Thailand

Thailand retains an integrated state-owned utility, EGAT, with a monopoly on transmission and distribution and supply. EGAT has sole and significant role on supplying electricity to the other vertical linked distributors – PEA and MEA. It has capacity to generate 63,930.68 million kWh which means 43.14 percent of total country-wide electricity generation. It also has the sole right to purchase power from other private producers under the government regulation of enhanced single buyer scheme (ESB). There has been no further unbundling or move towards the creation of wholesale or retail markets, and electricity privatisation has itself been a central issue in a decade of political strife. In March 2006, the Supreme Administrative Court declared that the privatisation process started by then Prime Minister Thaksin, was illegal on a variety of grounds, ruling that, 'The government has abused its power in privatising the state enterprise'. [7] Since that ruling, the Thai Government has diverted its efforts from privatisation and liberalisation policies to renewable energy policies.

3.3.4. Liberalisation and Sectoral Development in Developing Countries

This section uses indicators of investment in generating capacity and investment in extension of the network, to see whether there is any evidence the promise of liberalisation has been

[7] EGAT Annual Report 2008 http://pr.egat.co.th/AnnualReport/annual2008/annual08_eng/annual2008en_p10.pdf

met. It compares three system investment indicators between countries of different liberalisation progress, and within the countries before and after each stage, to see if movement to the different stages of the liberalisation road made any significant difference to the growth of investment in generating capacity or extension of the network to more households. Since the purpose of this exercise is to see if investment levels are different with or without various elements of liberalisation, we use indicators of investment in general, rather than seeking data of private investment alone. In any case, data on private investment are particularly problematic, often out of date, sometimes unobtainable – for example private equity companies are not legally obliged to publish financial statements

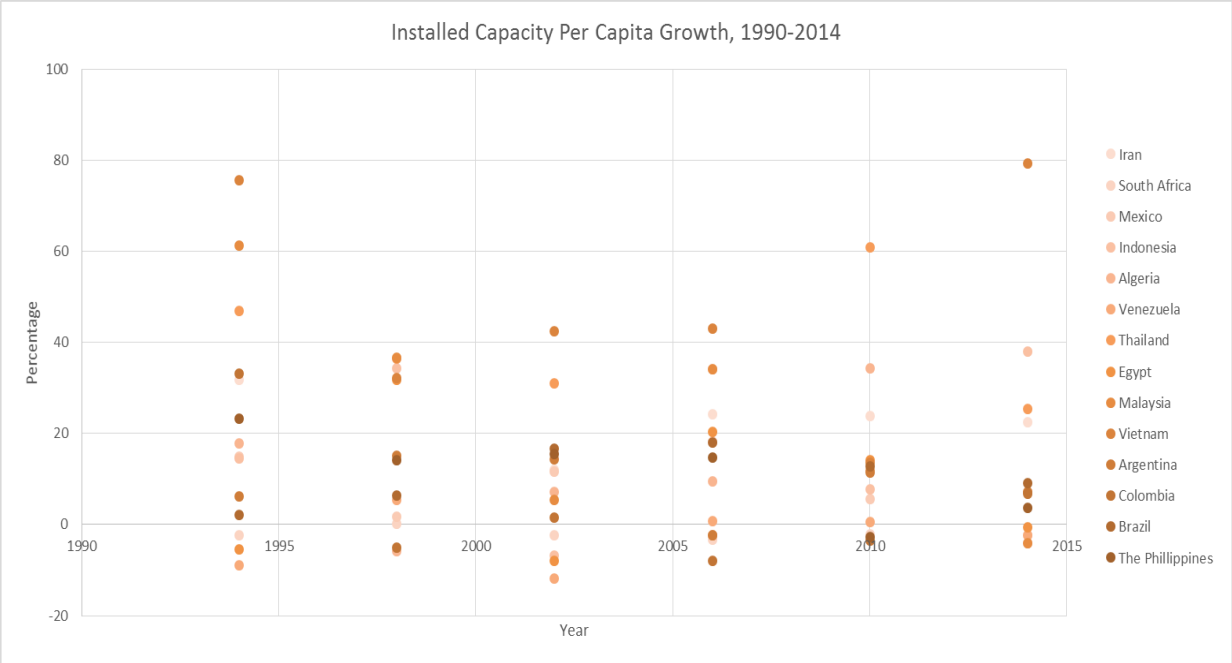
Liberalisation and Generation Capacity

Investment in generating capacity is measured by change in installed capacity, but it is important to take into account the different volume demands due to changes in population size. Any positive change in installed capacity per capita growth reflects an increase in materialised investment. The changes in this growth rate from 1990 to 2014 (the most updated data in these 14 developing countries despite differences in liberalisation implementation stages and elements have shown no significant different movement of this rate. All countries have in some years experienced reduction in installed capacity per capita, i.e. a negative investment volume in generation after 1990, and experienced high increase in capacity in other years, followed by sudden drops. In fact, this growth rate changes dramatically year by year. Contrary to the expectations of liberalisation policies, it cannot be identified from figure 7 which country has or has not liberalised power sector; investment in capacity does not bear any relation to liberalisation progress. Vietnam hit the highest investment point in 2011 at more than 43% but it is not the country that has progressed the farthest in reform. Colombia, whilst being under liberalisation programmes in the 1990s, experienced the lowest growth rate at -13.6% in 1998. Investment in capacity does not bear relation to liberalisation progress.

The parallel creation of IPPs is not part of the liberalisation process, in the sense of creating markets. IPPs are a form of private sector investment which can be, and are, implemented without any form of unbundling or wholesale or retail market structure. On the contrary, they rely on government commissioning and government guarantees through PPAs. The policy focus on renewable energy has in effect led to an increased use of IPPs – not because

of the use of market mechanisms, but because of the renewed active use by the state of its fiscal power. The private sector participation in the electricity systems thus turns out to be a form of privatisation dependent on government action, not on markets.

Figure 7 Trend of Installed Capacity per capita growth in largest developing countries (1990-2014)[8]



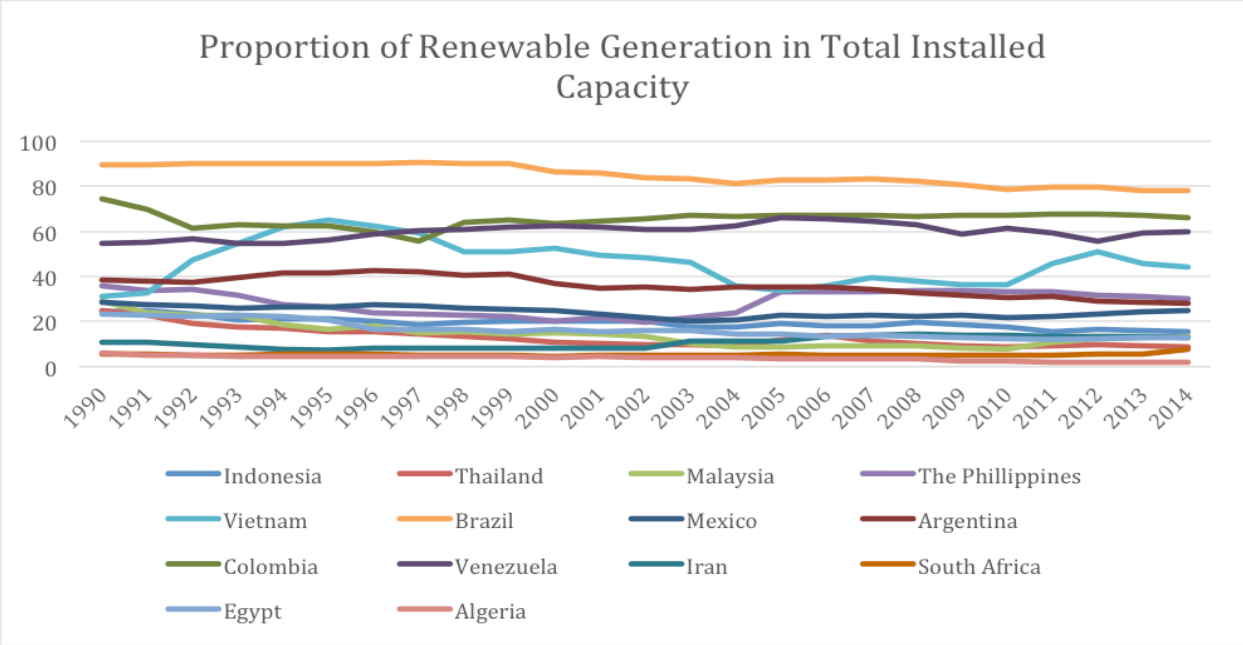
In dealing with climate change issues, CO2 tax is expected to be added to incentivise investment in sustainable generation. What matters, argued by (IEA, 2007), is the 'right incentives' and 'a stable investment climate', which seems to assume no incompatibility between investment in renewable sustainable energy and 'long-term liberalisation process, and that liberalisation delivers investment in generation regardless of the challenges, if the government persists long enough. By measuring the changes in proportion of Renewable Generation (RE) in total installed capacity from 1990 to 2014, the long-enough time series should theoretically show a positive growth in RE proportion for countries which have moved further down the path of liberalisation. The conditions for this growth are favourable: climate change issues have been globally recognised in the last 20 years, they are globally formally tackled in the last 10 years and innovative RE technologies have progressed

[8] Source: Population Data from The World Bank Data Archive; Generating Capacity Data from US EIA Historical Statistics

significantly in the last 20 years. The conditions are there alongside long-term government commitment.

However, figure 8 (below) shows a different picture. This growth rate is almost constant, buffering around the starting points in the early 1990s; in all countries, there is no significant growth in RE use for total electricity generation in the 2010s in comparison to the 1990s. In Brazil and Venezuela where reform plans were abandoned in early 2000s, there is little change in proportions of RE in total capacity. Given that total installed generating capacity grows with expanding population in these two countries, RE capacity actually increased during the period. The Philippines with an effective retail market has not made a different case either with RE standing at 28% of total capacity. This indicates that what matters in RE investment does not lie in liberalisation progress. (Byrne and Mun, 2003) suggests that any society, developed or developing, faces choices between power liberalisation and energy transformation. And they conclude that power liberalisation is 'socially, politically, economically and environmentally problematic'.

Figure 8 Growth of Renewable Generation Proportion in total capacity in largest developing countries (1990-2014)[9]



[9] Source: Data from US EIA Historical Statistics

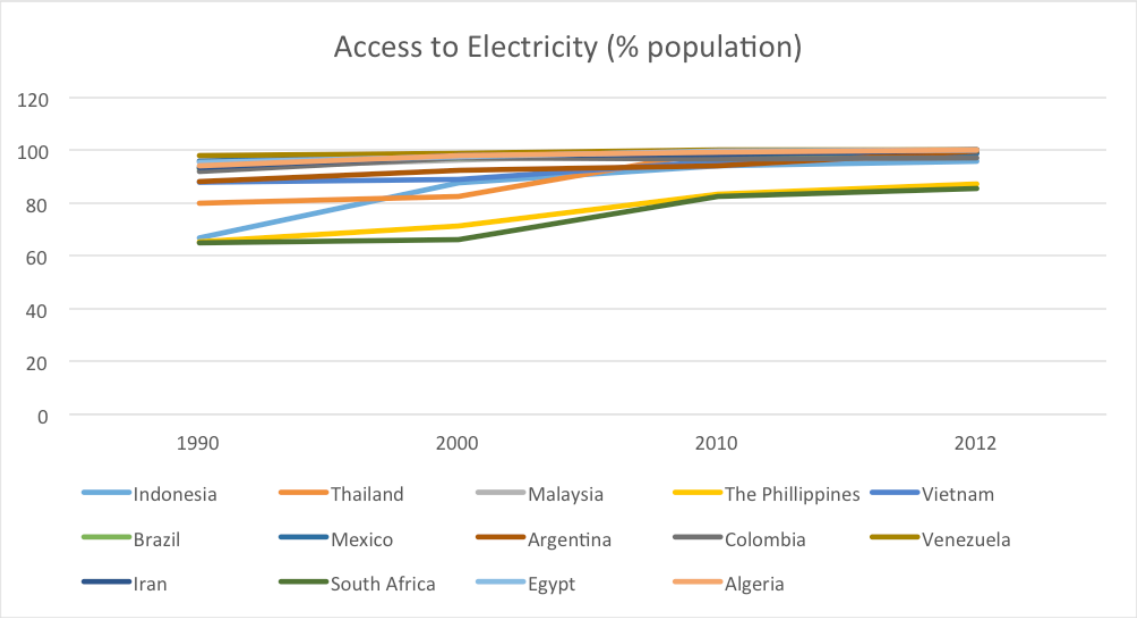
Liberalisation and Access to Networks

(International Energy Association, 2016) estimates that 17% of global population lack access to electricity. Most of these populations are from developing countries. There have been improvements in electrification rates in the largest developing countries in the last 25 years, with a convergence in higher proportion of population with access to electricity (the standard deviation of access rate is getting smaller whilst mean of access rate is getting higher).

However, this has happened regardless of power sector structures. In countries where unbundling has not happened, such as Algeria, Iran and Venezuela, the access rate has reached 100% in 2013. In contrast, the Philippines only achieved 87.5% in the same year. The access rate merely shows the status of connection. In measuring investment in expanding electricity distribution networks, this access rate adjusted by population changes should show how investment in distribution networks have been materialised into accessing electricity for more people; however, Figure 9 shows there is a downward convergence in this growth rate due to the fact that higher proportion of population are getting electricity access, hence less need for network expansion. In 1990-2000, Indonesia had a vertically-integrated system with no intention to liberalise experienced strong 52% growth in population access. As high as 32% growth was also seen in countries that remain dominated by SOEs including Iran, Egypt, Malaysia and Vietnam. Interestingly, South Africa which reversed unbundling programmes in mid-2000s hit the highest growth in population access from 2000-2010 at 44.4%.

Winkler et al. (2011) argue that it is difficult to say if this reduction in population without access to electricity is the result of liberalisation or central planning. However, populations without access in underdeveloped regions often have lower incomes than urban populations, and private investors are unlikely to find profitability in investment in extending coverage to poorer or deserted areas (Doll and Pachauri, 2010). Vietnam and Philippines started in 1990 in the same place but despite further liberalisation progress, the latter showed slower progress in developing power access for its population.

Figure 9 Access to electricitty (% population) in Large Developing Countries (1990-2012)[10]



3.3.5. Outlook of Liberalisation in Developing countries

The existing literature is at best inconclusive on the question of whether the evidence shows that liberalisation by unbundling does in practice lead to greater and significant levels of investment by the private sector. The relevance of these studies for policy in developing countries is also limited, both because of the patchiness of actual liberalisation, and because of the apparently extensive investment which has nevertheless happened. After more than 20 years of promotion, these large developing economies have created very little in the way of markets. A number have unbundled their state-owned enterprises, but by itself this is simply a reform of public, or corporate, administration. It may have beneficial effects – Sen at al (2016) find that corporatization of public utilities is one of the few reforms associated with improved performance – but it does not create a market, nor a 'stage' in creating a market. A majority of countries have now unbundled in some form or other, but only two countries have created retail markets, and only 4 to 5 have set up wholesale markets. Since 2003, there has been very little change – one more country has unbundled, one more is about to create a wholesale market, and one has created a retail market, but a number of others have frozen or reversed their reforms. To the extent that there was ever a trend, it is now

[10] Source: Data from The World Bank Data Archive and IEA

either static, or in reverse. There is no need for developing countries which have not liberalised to feel out of line; they are very much part of the mainstream.

These same countries have nevertheless made substantial progress in increasing generating capacity and extending electricity networks to deliver close to universal access. These are significant developmental achievements, which required substantial investment. But the data in this section do not show the source of the investments, except that the extent of liberalisation has no apparent relevance. The next section sets out the methodology for collecting the data necessary to analyze these investments.

3.4. Summary

The chapter has reviewed a wide range of countries including 4 developed countries in Europe and 13 developing countries in other continents and how their liberalization pathways have differed. Whilst European countries were looking for improved competition and household welfare, the latter group of countries were looking for improvements in supply services and development of new capacity.

In Europe, unbundling has been favoured as a measure to lower barriers to market entry because of the aversion to state ownership. The question for European countries is on whether private or public ownership can deliver their desirable objectives. In developing countries, the choices of liberalization mix vary more. But due to their economic development stage, attraction of further private investment has been central to policy-making. Some countries have chosen to fully liberalise whilst others chose a more cautious approach.

However, overall, the differences in approaches to liberalization have not seemed to matter. Whether a country has chosen more private ownership or a more open market, no immediate and striking differences in performances have been found in either group of countries so that it could be concluded that liberalization is the model that delivers significant improvements. Developing countries have made significant progress in achieving extension of networks and increasing generating capacity regardless of the extent of liberalization.

In this context, the experience of Vietnam will be examined as a detailed case study of how investment in generating capacity has been secured. This requires the construction of a comprehensive database of the investment that has actually happened, in order to identify the processes involved, including the role of public and private sector bodies, the role of Vietnamese and foreign investors, and the impact of an active external body, the World Bank. The next chapter sets out the methodology of constructing such a database.

CHAPTER 4. Construction of the Power Sector Database[11]

4.1. Introduction

Data are necessary in order to carry out an analysis of investment in the electricity sector of any country. Many studies of these issues use data from one or more of a number of international databases, principally those maintained by the World Bank, PPIAF, Enerdata, the IEA or others; country studies may use government data.

It is generally assumed that these data sources are good enough, that it is too difficult and time-consuming to construct a new database, and that there is little to be gained by doing so. This thesis challenges those assumptions.

This section contains the core methodology of the thesis. It provides a critical analysis of existing datasets, their limitations and problems. It then sets out how I constructed a completely new database, which I call the Power Sector Database. The gains include a data set which is comprehensive in its coverage; including all the categorisations of interest, including public/private, domestic/foreign, equity/debt, generation technology, corporate ownership; and allowing analysis to focus on features of the data itself, rather than a pre-determined hypothesis.

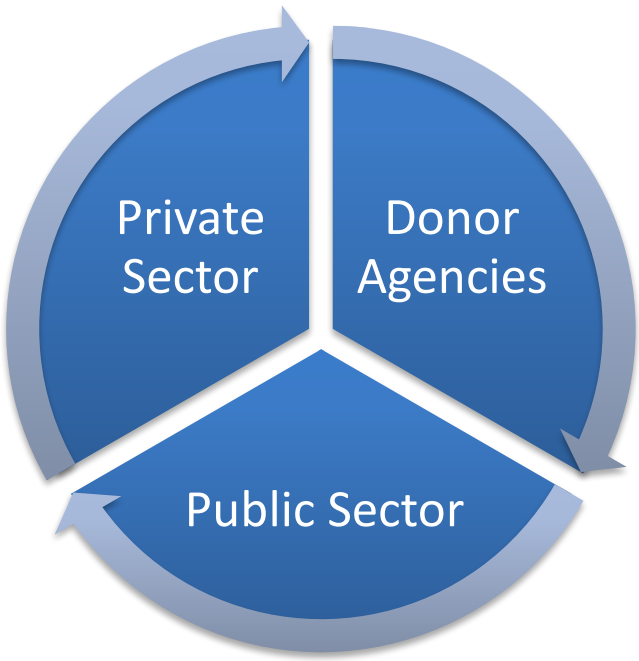
[11] The Power Sector Database (PSD) is the name of the database and data collection methodology that the author constructs. The Database contains complete datasets in Vietnam and Thailand and work in progress for Laos.

4.2. Evaluation of Existing Databases in Electricity Sector

Figure 10 Generic Data Quality Evaluation Framework

Figure 11 Major existing databases used in electricity sector studies

Figure 12 Financial Sources in Electricity Sector



4.2.1. The World Bank Group

The World Bank is the world's biggest development finance institution, focusing on supporting low- and middle-income countries to achieve developmental goals. Established in 1944, the World Bank now comprises 5 member institutions providing a different mixture of tools of finance and focusing on different groups of countries and/or organizations. IBRD (International bank for Reconstruction and Development), established in 1945, has the most member countries (188) in the 5 members of the WB Group, providing low-interest loans under guarantee of the borrowing government or government authorities. Most IBRD loans in low-income countries are for tackling poverty and building primary infrastructure; hence recipients are commonly government institutions and state-owned companies. The lending rate fluctuates slightly throughout the years, depending on the global economic outlook and credibility of borrowers; borrowers with a credit rating of BB or lower account for a very minimal part of IBRD investment (IBRD Information Statement, 2014, page 41). Lending periods could vary from 8 to 25 years. Most electricity generation projects funded by IBRD have disbursement periods of 5 years and repayment periods within 15-25 years, given the large-scale nature of the projects. From the beginning of 2014 till September 2014, IBRD has built up a funding volume of $51 billion. Despite IBRD's triple-A credit rating and highly-favoured bonds, this figure may vary from year to year (IBRD Information

Statement, 2014, page 4). Another member institution actively working in the South East Asian region is IDA (International Development Association), established in 1960. This institution provides concessional financing including grants and interest-free loans (credits) to lowest-income countries on poverty alleviation projects. Repayments of debt could be stretched to 25 to 38 years with 5 to 10 years of grace period. Some projects are partly financed by both IBRD and IDA.

The World Bank Open Data Archives accessible via the World Bank official website provide comprehensive aggregate information and detailed data on each country member and broad sector categories. Under the Data heading for each country, common economic indicator figures from 2004 to 2016 (forecast) can be found alongside a list of all projects from 1947 financed by IBRD and IDA including those past, present, cancelled and pipelined. Part of this research looks at all projects financed by the World Bank. For each project, there are two ways to collect data from this Archive.

The first, and probably, easier way, is to get the data given on each project's web page. Basic project information under Details tab including Project ID (to be useful in referring to the project rather than using the full project tiles), Project titles, Status (Active, Closed, Cancelled and Pipelines), Approval Data (to be counted as Start date), Closing Date (to be counted as the final date of active project), Borrower (for IBRD and IDA; this is commonly the Government, or Government Authority), Implementing Agency (depending on the purpose, each project could be implemented by Government Institutions or Companies), Total Project Costs (costs are in US$ including World Bank and other sources), Commitment Amount (the total finance from World Bank), Sectors (including sectors and subsectors and the percentage of cost share of each sector), Themes (the purpose of the project and the percentage of cost share of each purpose). Under the Finance tab, useful information is on the Financiers (including WB and other sources plus the commitment amount from each source). This source of data has an advantage of saving time and providing consistency across the amount of data for all projects, in all sectors and countries.

Yet this method of data collection faces certain limitations. First, the classification of purposes is based on unspecified criteria and did not exist at the time the project was approved. There is an expected discrepancy between what the project was primarily approved for and what it turned out to fulfil, between what it claims to achieve and what it also achieves as by-product, between what the implementers believe to have been achieved and what the World Bank think it did. The project completion and appraisal reports on the other hand are evaluated and signed by both parties, hence closing the potential gap of misunderstandings just listed.

Second, the project cost figures on the web page do not reflect any cancellations and modifications, which does not consequently reflect actual costs of projects. Only proposed projects and some active projects have exact matching figures on the web page and project documents. The World Bank itself admits these two limitations.

Third, the sector classification includes 7 categories, namely: transmission and distribution of electricity energy efficiency in Heat and Power, Power, General Energy Sector, Other Renewable Energy, Hydropower, Renewable Energy. In fact, some of these categories are overlapping. It is hard to argue that one project could be categorized under Power and not under General Energy Sector. The categorization method is not only not clear; it is also not consistent through time. In countries with years of relationship with the Bank, for example in Thailand since 1950, the categories also include (Historic) Thermal, (Historic) Electric Power and other energy adjustment. How this categorization is in any way different from the current method is unspecified anywhere on the website. Hence, the search results from this categorization are not precise.

36 projects in the electricity sector were identified by looking individually at a total of 221 all-sector projects in Vietnam while a search using refinement of 7 categories stated above only identifies 34 projects. Meanwhile, in Thailand, there are 38 relevant projects found by looking individually at 176 in total in comparison to 32 found by the search provided on the website. Last but not least, the financial figures are not precisely matching with the project completion reports in cases and are recorded at the time of project commitment and approval.

So there should be care taken in using these figures. GDP Deflators should be used to bring these figures to a comparable level. And to ensure the costs are actual, real costs to financiers, a close look at the project documents is crucial. In some cases, the discrepancy is significant. For example, project ID P037086 in Thailand, which costs US$ 293.378 million in 2003, is recorded on the web page at a cost of US$ 450 million, almost double the actual cost. For the reasons above, the data collected from the World Bank Open Archives are treated with caution.

A much more helpful section of the archive is the storage of a large number of project documents including Project Appraisal, Project Information Document (which records initial agreements), Loan/Guarantee Agreement, Interim Report (which tracks any modifications) and especially Implementation Completion and Results Report (which provides comprehensive look into actual investment, financing partners, purposes). Data then could be collected in accordance to what was stated in Part 1 of this Chapter.

Beside IBRD and IDA, 3 other members of the World Bank group are: IFC (International Finance Corporation), MIGA (Multilateral Investment Guarantee Agency) and ICSID (International Centre for Settlement of Investment Disputes). Within the scope of this research, ICSID is not a relevant source of data since it focuses on working with governments to reduce investment risk and facilitates conciliation of legal disputes between investors. In 1956, IFC was established to address the Bank's neoliberal ideology that private participation and competition improves economic performances. IFC primarily lends to the private sector on the basis of market or concessional interest rates. IFC operates as a corporation with shareholders as member governments of 188 countries. Hence, its Annual Financial Reports are published and consolidated financial statements are laid out under proper accounting standards. Reports from 2001 to 2014 are available on the website while previous annual reports are available on request subject to conditions. There should not be any major objection to data request based on IFC's Access to Information Policy. Not only offering debts and equity financing services, IFC also advocates on company decision-making, environmental and societal impact of projects. Key services provided by IFC include advice on risk management, guarantee, loan and equity.

IFC has its own database of IFC's projects sorted by region, country, sector (and sub-sectors) and product line. There are maximum 4 project documents revealed publicly, they are: Summary of Investment Information (which briefly present the project objective, project costs, expected impact and sponsors and/or partners), Summary of Project Information (which is a shorter version copied and pasted from the project approval document), Environmental and Social Reviews (which include, in cases of closed projects, full environmental impact reports and, for most projects, summary of assessment and mitigation measures) and Early Disclosure (which is technically the environmental and social impact reviews for a projects waiting for approval and this is not considered as final outcome from IFC). The website provides 5000 documents on over 2000 projects from 1994 until 2014 covering 188 countries.

The availability of the range documents is generally patchy. Since not all these documents are project completion or evaluation documents, project cost figures must be treated as estimated or proposed investments while the project loan figures could be counted as actual investment when the loan is confirmed to have been disbursed. The advantage of displaying all information on the website in comparison to attaching documents is clearly that it allows researchers to collect basic information uniformly. These data include: Name of borrower (this is the direct implementer of the project), sector (IFC separates power from the general energy sector), date of approval (noted as actual date of investment), purpose of loan, amount of IFC investment, project partners (these data are not available in the case of IBRD and IDA directly on the WB website).

However, despite disclosing 4 project documents to search for, the documents are not available in their original formats (signed paper format) and are all shorter versions, which may not be entirely helpful for researchers who seek details of the projects. Information found in Summary of Investment and Summary of Project is also similar, which raises the question of the limitation of total amount of information disclosed in each project. It can be known in which projects IFC has been involved, for what reason, and how much. But information of project development and outcome is completely unknown because of lack of interim and completion reports. In comparison with the IBRD/IDA Data Archive, IFC offers a much more limited look into their projects. One may argue that the nature of IFC projects

is close to business loans which only involves a straightforward process of loan approval and no further follow-up and evaluation process except for repayment of loan; hence less documentation needed. However, it should be noted that the IFC is part of the WB group and its choice of loan recipients is not purely for profitability, but also for developmental purposes. Therefore, the public deserves to know if their tax money is well spent on right purposes.

In contrast to the IBRD, IDA and IFC, MIGA does not offer loans. Its purpose is to encourage investors and lenders to take the risk in investing in emerging markets by insuring against the risk of currency, expropriation, political turbulence and breach of contract. By providing these guarantees, MIGA could help these private companies to obtain finance from bank and equity partners, lower their borrowing costs. Another difference is that MIGA could insure both new and existing investments as opposed to only new projects in other WB institutions. The amount and duration of MIGA coverage reflects the importance, scale and scope of projects.

MIGA has an easy-to-navigate website which allows a quick search of all MIGA projects in Power in each country under the Projects tab. For each project, there are 3 types of documents to be disclosed: Summary of Proposed Guarantee, Project Brief, and Environmental and Social Review Summary (for high environmental impact projects only). The availability of these documents is not thorough. In both Thailand and Vietnam, there are only Project Brief documents throughout all 5 projects.

Having said that, the amount of useful data in this document is significant. It discloses: project name, code, starting year, project status, Guarantee Holder (the company that receives MIGA political risk insurance), Gross exposure (the amount of maximum coverage), project cost, project purpose, role of guarantee holder in the project (project's direct representative or agent of banks), and any other WB arrangement. However, similar to IFC, MIGA does not disclose any copy of actual project documents as well as follow-up/reassessment reports of the projects.

These publicly-available sources of World Bank data offer a fairly good overview of WB involvement in each sector, in each country and the level of commitment and activity throughout the years. From these data sources, a table of uniformly available data could be constructed, including the following:

- Start date (if pipelined, use approval date)

- Closing date (if active, use expected closing date)

- Status (Closed/Active/Pipeline. Ignore Cancelled Projects)

- Project code (this is necessary for track down documents, will be used as name for SNA)

- Project name

- Borrower (Principal borrower of the loans)

- Implementer (Actual borrower and implementer of the project where investment lands)

- Sector (use World Bank definition)

- Project theme (use World Bank definition)

- Total Project costs (the primary source is the project completion report in the case of Closed projects. In the case of Active project, use expected project costs in the latest interim reports that may show changes. In the case of Pipelined project, use expected project costs stated in the specific project website)

- Discounted year (This is the year where the figures for total project costs were taken. This is used for discounting all project costs to US Dollars in 2013 value)

- Bank commitment (This is the amount of funds from the World Bank institutions alone. It is notable that each project may require multiple lenders and funders but all projects are initiated and commissioned via the World Bank)

- Fund for energy (Though all of these projects look at electricity sector, some projects have broader themes including finance, banking, coal and mining. It is then inappropriate to include other themes which incur more costs to be counted into loans for electricity sector)

- Purposes of projects (There are 2 main purposes: Developmental purposes – Generating capacity GE, Rural Electrification RE, Renewable Energy REW, Distribution and Transmission DS; and Institutional Reform Purposes – Ideological Reforms IRE, Developmental Reforms DRE. Some projects have more than 1 purpose and project costs are spread over different purposes. Completion Reports usually have an evaluation table that show how much/how many percent of the total project costs are used for what purposes)

- Note (whether the figures are estimate or actual)

- Link (this is the link to the project website)

- Document (This is the link to the key documents from where the figures are taken)

4.2.2. Public-Private Infrastructure Advisory Facility (PPIAF)

Beside the World Bank Institution official website's database, there is another widely-used source of data that focuses on projects in infrastructure and the role of private sector in investment, which is The Private Participation in Infrastructure Database (PPI). PPI is a joint product of the World Bank and Public-Private Infrastructure Advisory Facility.

The database covers 150 low- and middle-income countries and contains almost 5000 projects in energy, telecom, transport and water and sewerage sectors from 1984 to 2013. More than half of those projects are in the energy sector (2890 from 1990 to 2013) carried out in 111 countries. It has been therefore a main source of reference when it comes to private investment evaluation.

PPI is also fairly transparent and clear about their data collection methodology. The wide range of sources of information used include news reports, government sites, company reports, specialist reports and, in some cases, cross-checked with project companies or regulators. The database also carefully takes the amount of investment commitments at financial closure into calculation instead of planned investment, of different types of

investment (green field, brown filed or concession) instead of clustering them all under the same investment heading. This shows that PPI makes a good effort in collecting close-to-actual investment figures.

PPI provides both detailed project data and snapshots for each country. In the Project Information section, a report can be easily generated from a narrowed search that fits research interests. In the case of this PhD research, I could search for all projects in Vietnam and Thailand from 1984 to 2013 for the electricity sector. The search then yields the following columns of information on private sector-involved projects that has financial closure year from 1993 to 2013, showing: financial closure month and year, termination year (when the project ends), project name (official and related name), project status (in operation, cancellation or construction), segment (generation, distribution or transmission), type of PPI (greenfield, divestiture), Subtype of PPI (BOT, BOO, full or partial divestiture), Percent Private (the percentage of private investment out of total investment), total investment (total value of investment in the project), capacity (recorded at the year of financial closure, and updated in some cases when there is reinvestment), contract period (when there is BOT or PPA), sponsors (in other words, investors), technology (the type of energy generation), government payment commitment, Value of Funding by source (private, public, government, Local bank, donor, private equity), PPP type (in case of Public Private Partnership contract), Key Features of Revenue Cost (in case of PPA contract), Project Banks (names of banks involved). As a result, I could construct an excel sheet of 102 and 64 projects in Thailand and Vietnam, respectively. The PPI database is one of the most comprehensive data banks of infrastructure projects that have private participation.

However, the PPI database is subject to certain limitations and also serious critique of its validity. A pilot study by Izaguirre and Kulkarni (2011) for PPIAF has raised such limitations by looking at PPI Investment in 2006-2009. They found that private finance is most important in the energy sector in generation, but this finance is limited to divestiture and PPAs. During the period of research, private funding accounted for 60% of PPI investment along with 30% by public financial institutions and 8% by donor agencies. However, the role of private investors has subsided since the financial crisis and public funding has increasingly become important since 2008.

Having said that energy is the sector with most available information, information on public support (financial and non-financial contribution) is particularly scarce due to limitation of use of publicly available sources. Also data are mostly available and fuller for larger investments. The paper questions whether the sole use of the PPI Database to analyse investment in infrastructure services could produce a true picture of the role of private vs. public sectors. This conclusion is important since it shows PPIAF should acknowledge its own limitations and not overlook the role of the public sector.

In the process of gathering data from PPI to construct a full database of electricity investment, I realise there are more critical points that need to be raised. Similar to a limitation in IBRD/IDA Open Data Archive, PPI also provides country/sector snapshots and project data but the generated data sheets show non-uniformity. The snapshot summarises 91 projects in the energy sector in Thailand but the full project information shows a total of 102. Why there is an exclusion of 11 projects and based on what criteria is unknown. Besides, it is understandable that PPI does not provide project documents because of the variety of sources of information from which it collects, but it does not say what data were collected from what sources for the sake of verification and research replication. Though PPI aims to collect as detailed information as it can, the data that are available are limited to less than half of what it targets. Columns that are filled in include: financial closure year and month, project ID, project name, status, segment, type of PPI, subtype of PPI, total investment, sponsors, percent private, capacity, technology. Then columns that are half-filled include: termination year, government payment commitment, private funding, project banks, PPP type, Features of revenue costs.

Having said that, filled-in columns do not mean the data are valid and in full. Data on sponsors and project banks for example could identify the financial contributors but do not tell how much out of total/in dollars each contributed. Information on public, government, and local bank funding is almost completely missing. This could result in a biased study that might conclude that domestic financing is totally inferior in the sector. More importantly, the data collection methodology, which treats any project with at least 25% of private investment in green-field projects, or 5% of private equity in divestitures, as a wholly private investment, is seriously problematic. Additional to omitting data on public-only investment,

the PPI Database has exaggerated the total value of private investment and under-estimated public investment. These recorded figures are mostly expected investment, not actual investment, hence a bigger data discrepancy between public and private participation.

Beside the issue of data availability, the validity of data should also be questioned. A quick glimpse into the search results generated in November 2014 shows that data are not updated regularly (though indicated so on the website). Bourbon Sugar Mill Power Plant is listed as sponsored by Bourbon France – a foreign company but it was a joint venture by Bourbon France and 2 other SOEs in its conception and now it is owned by Bourbon Vietnam – a domestic company. Hiep Phuoc Power Company, a foreign private company, is no longer in operation but is listed as 'operational'. Phu My I Power Plant, a large-scale power plant, is now owned by the incumbent SOE of Vietnam, EVN, but listed as 100% privately owned by Kidwell International Power. These are just a few examples that have been examined closely. There could potentially be a larger number of incorrect up-to-date information that should not be overlooked. Hence, the claim that 'the database is updated every year through a comprehensive review of activity' and these 'aggregated data can serve as the basis for estimates and analyses of private participation in infrastructure' should be critically examined (PPI Database Methodology, 2014).

4.2.3. Asian Development Bank (ADB)

ADB (Asian Development Bank) is the major regional financial institution in Asia that supports developing member countries through development projects. ADB's structure and strategy are similar to that of the World Bank institution members but it combines all functions under one roof rather than working them separately like the World Bank.

ADB currently grows to encompass 67 members, 48 from within Asia and the Pacific and 19 outside, ranging from developed countries (e.g. Japan, UK, US) to low-income countries (i.e. Lao PDR, Timor-Leste). The majority of funding flows are from the developed countries through co-financing projects to less-developed counterparts. These funds can be used in various forms of financial products, depending on whether the requesting partners

are in public or private sectors. Different types of financial products offered to the public sector, so-called sovereign financing, include very low rate loans (London interbank offered rate-based loans, or Local Currency loans), grants, technical assistance (formulating strategies, improving government capabilities…), guarantees, debt-management products (currency swaps or interest rate swaps) or multi-tranche financing facility. ADB also provides direct funding assistance to private sector projects via various financial products such as: market rate loans at market-based fees (hard currency loans, local currency loans), equity investment (common shares, preferred stocks or convertibles; include private equity funds and enterprises), guarantees (political and credit risks) and technical assistance (capacity development, project preparatory, research and development, regional assistance…). ADB admits that its direct financial participation is limited in the private sector but it can play an intermediate role to leverage a large amount of funds from commercial sources. In 2013, they approved 22 out of 140 projects with private sector participation, among which 37% went to the energy sector, and more than two-thirds came from co-financing (ADB and the Private sector: An effective partnership, ADB website).

Similar to the WB, ADB has an open information policy that allows the public to view details of project records on their websites. The section "Projects" on their official website is organised neatly and informative enough to allow easy navigation and searches (by country, by sector or by document types). What ADB does better than WB Open Data Archives is to highlight the existence and organisation of project documents. There are 37 project document types, divided into project agreement, procurement, safeguard documents or evaluation documents. This division supports comparison and references across similar documents in different projects or countries. Each project has a project page (summary of information, similar to WB) plus a project data sheet in details and business opportunities section. This information is generally generated from the original documents and allows an overview of the project including objectives, rationale, project sponsor, relevant dates, approved funding. Documents related to the projects are organised according to their types (project documents, or safeguard documents or evaluation documents) plus any translated documents (when available). It can be seen that ADB uses a similar format of project overview as seen in IBRD/IDA projects on the WB website.

There are limitations in the ADB data archives. First, the Bank is stringent on its disclosure of financial information, decision making processes and audit reports as it believes such

information may be harmful to companies/countries' images of their abilities. They decide not to disclose any of this information anywhere on their website, stated clearly in the "Exceptions to Disclosure" under "Public Communications Policy" heading. Any attempt to request any of this information privately has been publicly declined. The section of "Information Requests" reveals all individual requests and ADB's replies which show that any request regarding pricing, costs are rejected. Second, though ADB separates clearly the recipients of funds in either public or private sectors, which suggests their consolidated reports could reflect the roles of either actor in the sector, ADB, similarly to PPIAF, exaggerates the amount of funds coming from and to the private sector as it defines private sector financing as at least 50% of capital held by private actors.

4.2.4. Enerdata

Enerdata is an energy consulting firm that has been commissioned to produce energy sector reports for the UK and Turkey governments as well as the biggest power companies including EDF and Enel. Beside such publications, Enerdata also possesses a large-scale database that covers most countries' power sector. Data are then sold per data point. The self-acclaimed 'most up-to-date power generation database', named 'Power Plant Tracker' offers timely updates on power plants in each country, sorted by fuel, technology and company. It seems the most suitable database for this research.

However, via trial use, I identified certain shortcomings in this database, at least in the case of Vietnam, which I requested from Enerdata. First, the database does not contain the full list of power plants operating in Vietnam. The total capacity of those listed does not come close to the reported total capacity per year by EVN. In this aspect, EVN's annual reports produce a good list of operating power plants connecting to the grid, hence, selling power to EVN. Comparison between these 2 sources at the beginning stage of this research shows that this Tracker does not satisfy the criteria of data completeness.

Second, the database contains investment data on 4 power projects only (in 2015). This is far from complete. Third, this database uses data from public sources, namely ERAV, MOIT and ADB.

4.3. Construction of The Power Sector Database

A significant part of the thesis involves developing a database of all investments for the electricity sector in Vietnam, focusing on actual electricity generation. The importance of

this database is that it not only is essential in helping to answer the research questions, allowing comparison and analysis of by whom, what and how investment came about in the sector but it also provides a carefully selected data source for researchers and policy-makers who are interested in finding out about investment and the role of the private sector in comparison to that of the public sector. In the later part of this chapter, I gather collection of data from a wide range of sources including international databases, government portals, company reports and press releases.

While investigating carefully what sources contain sector data, I also critically look at whether the data are valid and as much as possible free from bias. A large proportion of these data sources is subject to limitations of biased methodology that tends to exaggerate the contribution of the private sector, and none of them singularly contains the information of all projects/investments and how much from what actors and other financial and technical details. Reports and analysis made from one single database would therefore not necessarily reflect the whole picture or without bias.

The research chooses to use quantitative techniques of data collection as opposed to qualitative techniques. These 2 techniques offer differences in "breadth and depth, and between generalizability and targeting to specific … populations" (National Science Foundation, 2002). Considering the goal of collecting information on all projects from the 1980s to now in Far-Eastern countries, it is inappropriate to try and collect primary data using questionnaires and interviews. Therefore, locating the secondary data sources and retrieving information selectively is a good strategy for this research.

4.3.1. Concepts of data in Research

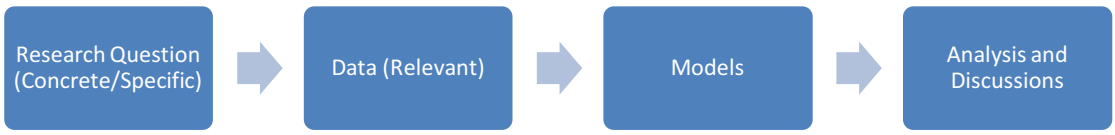
Data are generated, created, collected in all sectors of any economy for various different purposes. Their use in research, analysis, planning, decision-making and regulation are particularly important. Data can sometimes be created for multiple purposes as well as on demand. In the era of globalisation and world-wide internet, data have moved from being contained within an institution, a country to across borders, throughout many years, potentially involving thousands of objects and participants, leading to the vast amount of data, i.e. big data, which is larger than users' ability to filter and handle those. The

availability, quantity and quality of data can sometimes be as vast as seas for any researcher or decision-maker to understand and grip the essence of.

In the energy sector, the search for energy data sources involves coming across hundreds of data sets from all types of organisations such as central, local government, industry regulator, national and international financial institutions, generation and network companies, individual and organisational investors, media and consultancies. Each data source is constructed at a different time, based on different formats and serves different purposes. Collecting and merging data is a challenging activity since a lot of data coming from a lot of different sources can make analysis difficult, especially when some data are contradictory or incomplete. Researchers and decision makers will need to make informed choices of what data and what sources they should use in the seas of data sources.

This section applies a theoretical framework for issues of data sources and quality to practice and application in the electricity sector, to construct a database primarily but not limited to be used for this research.

Figure 13 Data Matters in Research Integrity (Relative Order in Research



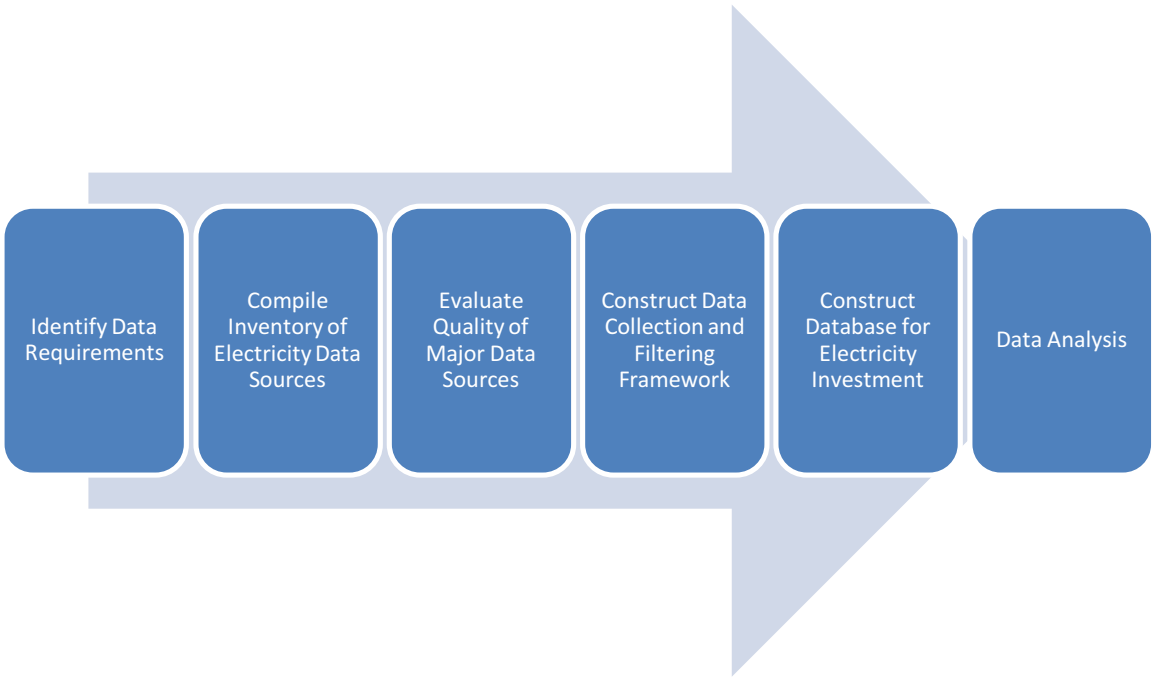
The first part reviews existing theories of data and data quality management. These theories mainly originate from the disciplines of computer science and information systems. Yet their uses have been widespread in research and businesses as an acknowledged framework for analysing data quality. It also looks at the issue of data errors and missing data, which forms a strong basis for how the new database dealing with this issue as it arises.

Part 2 then attempts to build an inventory of data sources in the electric sector in Vietnam (and Thailand as a secondary case study). By compiling this stock of all general available data sources, this part of the chapter gives an overview of the width and range of data that is helpful for a wide range of research questions. Beside a complete table of data sources and their key information, the inventory is also built into a network of linked data sources employing the visualisation technique used in social network analysis.

After gaining knowledge of data source availability, the third part of the chapter offers a criticism of the quality and usefulness of electric sector data sources, in particular common international sources that are widely used and referred by researchers and policy-makers. Part 3 then applies the theories of data quality evaluation on real databases in the electricity sectors in Thailand and Vietnam. The research introduces a hierarchy of data sources to assist data mining process and an adapted framework of data quality analysis based on sectoral desirable data quality criteria. This part then draws on the previous critique of those common data sources and highlights the needs to build a new database to serve research as well as raising the issue of inadequacy of data quality in the sector, which has not been discussed sufficiently in previous researches.

The final part focuses on the process of new database construction, their storage, usage and limitations. Part 4 also provides a comparison of this database's features with existing databases.

Figure 14 Steps in constructing the Power Sector Database



4.3.2. General Framework

(Olsen, 2012 page 8) argues that 'Data are not the same as knowledge'. In order to create new knowledge or test existing knowledge, a database, which is a collection of those related facts (Rothwell, 1993, page 11), must be created in a consistent format and become ready for analysis. A database is commonly created to serve a primary purpose, but also can be used for multiple purposes or generally for keeping track of things (Kroenke and Auer, 2011, page 20). In order to analyse data in multiple databases, one must understand the purpose of each database creation and the methodology of its construction to make sure that those data are at a comparable level.

Looking closer at good research conduct, according to Research Councils UK (2011), an unacceptable research essentially includes false data, manipulation and misinterpretation of data (page 7) whilst a good research should include relevant data (among other codes of conduct) (page 3). This view is also shared explicitly by almost every educational and research institution across fields such as University of Cambridge (2014), Medical Research Council (2012). Therefore, it is crucially important to ensure the data created and used before analysis is of the best possible quality so that any conclusion is deductively sound from the

data set. It is true that numbers are just numbers until they are made sense of. But without correct, precise numbers, any findings would be meaningless.

The research chooses to use quantitative techniques of data collection as opposed to qualitative techniques. These 2 techniques offer differences in "breadth and depth, and between generalizability and targeting to specific … populations" (National Science Foundation, 2002). Considering the goal of collecting information on all projects from the 1980s to now in Far-Eastern countries, it is not rational to try and collect primary data using questionnaires and interviews. Therefore, locating the secondary data sources and retrieving information selectively is a good strategy for this research.

Compiling an inventory of data sources for an area of research is not a common research objective. However, in the process of collecting data for a specific research question, available data sources have different strengths and weaknesses that researchers should know of and the inventory of these known sources can be used and reused for extensions of the original research. Searching for 'inventory' AND 'data sources' AND 'energy' OR 'electricity' in Article Titles does not yield a single result on Elsevier Scopus, the largest abstract and citation database of peer-reviewed literature. A more relaxed search for the same keywords in Article Title-Abstract-Keywords yields 543 results but only 1 paper is relevant (Search done on 06 July 2015). (Fazio et al., 2015) suggests a framework of assessing EU-related data quality based on two exemplary datasets on energy products and services. This is a recent proposed addition to European Reference Life-Cycle Database used by the European Platform on Life Cycle Assessment (EPLCA) established in 2006 (European Commission Joint Research Centre, 2015). ELCD version 3.1 focuses on selecting and curating datasets on life-cycle of EU-level business products and services from materials, carriers, transport and waste management. The datasets are reviewed against data quality requirements that focus on quality, consistency and applicability. Despite its relevance in the field of research, the paper does not add values to the construction of this inventory because it focuses on the process of data mining while this research inventory constructs a system of tracking data sources. Therefore, it can be said that data source inventory compilation in the energy sector has not been properly investigated by energy academics. \

However, this compilation has been witnessed in public health research and environmental science. There is only a small literature that shares data methodology attempts similar to this research. The majority of these researches searched, selected and pooled a number of databases into a data inventory which is used for a specific research question (Choi, Robson and Single, 1997) (Owens et al., 2010)(Murray et al., 2013). Among this literature, the compilation methodologies employed by (Lund et al., 2009) and (Brooks et al., 2012) form the skeleton for my methodology. Though these papers investigated different research questions in different scenarios, their data methods particularly have wider implications than their own field of public health.

Looking at general data source storages, (Lund et al., 2009) suggests 3 approaches to search for data sources including specific targeted literatures, websites of recognised institutions, and systematic literature review. The electricity inventory, built under the assumption of no previous knowledge of any energy data sources, will only be able to employ the latter 2 approaches.

The online inventory of data sources on children's lives by Department of Children and Youth Affairs, Ireland by (Brooks et al., 2012) is the closest and most relevant model of compiling data sources for general research interests within a research field. The proposed methodology in coding and structuring data sources is systematic and replicable that makes the inventory easy to navigate and manage. Besides, the online inventory avoids using jargon and serves general research and policy-making purposes, which is also the objective of my electricity inventory. Therefore, the description system of the electricity inventory (section ….) is adapted from the above-mentioned study with careful adoption.

Compiling an inventory of data sources requires a systematic methodology. The compilation process is divided into 4 steps: (1) Identify inventory approach and requirements; (2) Construct a coding system for identifying individual source, (3) Build a description system based on meta-data structure; (4) Search, Select and Pool data sources into the set-up inventory.

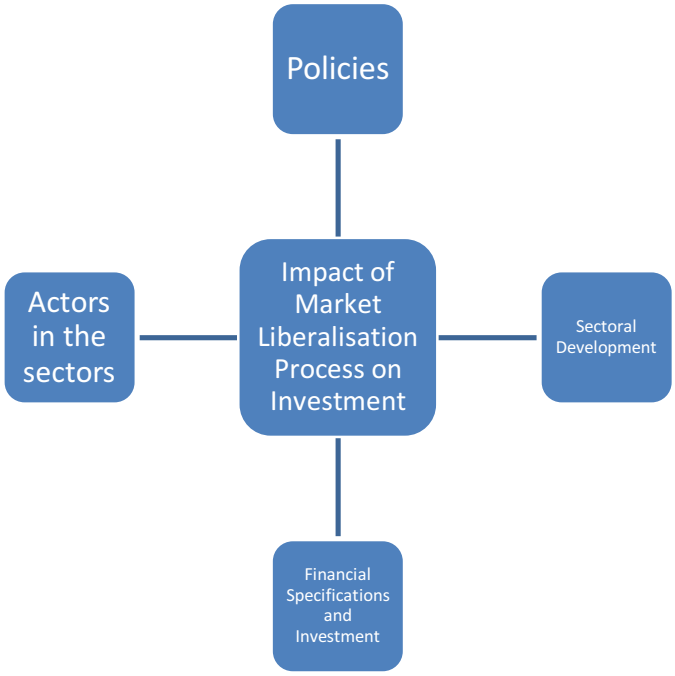
In the original inventory, the inclusion criteria to use data sources were as follows:

- data sources contain information related to all or parts of the electricity sector structure, related to political, economic movements, policies and decisions affecting the sector or decision-making of supply-side and demand-side of the

sector, related to financial figures of investments and features of investors in electricity projects.

- data sources are expected to be accessible on the Internet. However, there may be cases of access restriction which will be clearly stated in the inventory
- data sources are expected to come from recognisable institutions
- data sources are expected to be updated on an ongoing or regular basis

Figure 15 Data Requirements for the Research



4.3.3. Hierarchy of Data Sources in the Inventory

Data from government portals and government institutions are the first and foremost sources of data in the electric sector. By law, in Vietnam (and Thailand), all generation power projects must submit proposals and obtain authorisation from the relevant government bodies before construction. Therefore, the government should have the most up-to-date and correct figures of all the power plants, their status, investors, technology and proposed investment.

Network and transmission companies have to be well-informed about local and regional generation capacity and companies that are connecting to the grid, and since off-grid

generation in the 2 countries only accounts for a very small % of power, access to network companies' datasets will add reliable operating capacity and current company figures.

The databases of IFIs, including the World Bank and ADB, provide primary data on their own developmental/funding projects, categorised according to sectors and purposes, as discussed in the previous section. National banks also offer fairly reliable and high-quality data especially related to investors, investment and status of IFIs-involved energy projects, which is supplementary to the above sources.

Corporate websites of the parent and subsidiary companies, as well as project websites, provide data on project description, investors and wrap-up financial figures.

These four categories of sources provide ultimately raw data from the original sources, hence they should be prioritised when it comes to conflicting values. There exists issue of standardisation when it comes to extracting data from these sources. Projects dated farther than 10 years ago commonly do not have their own websites as well as good coverage of their information from the company's websites.

The next three categories that use secondary data commonly gathered from above sources, in combination with insider information, are media, international databases and consultancies.

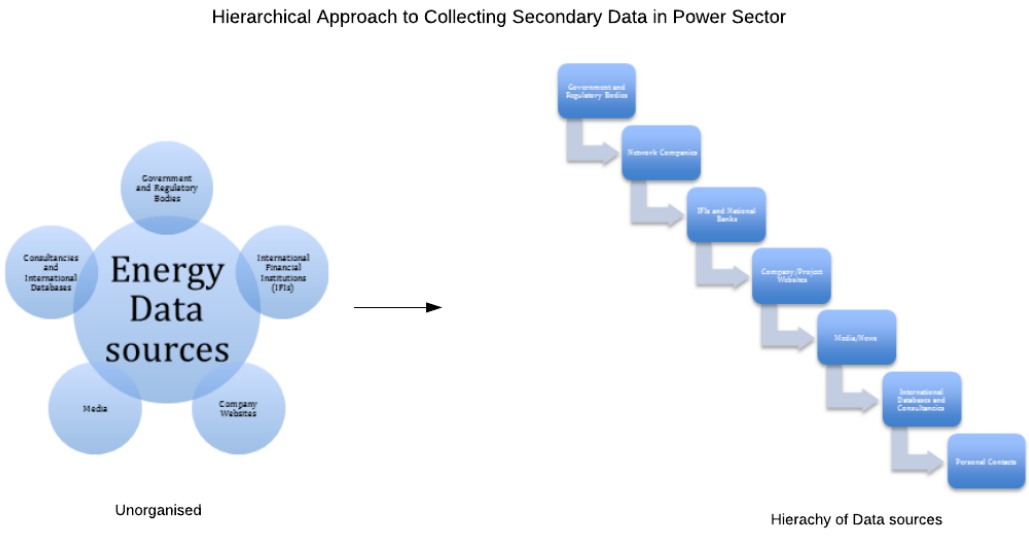
In the media category, priority is given to formal local then national newspapers that are published in print and online. Local newspapers tend to announce quickly local development and investment whilst national newspapers highlight key regional investment that attract significant government and foreign investment. These newspapers often get their information from companies' press release as well as reporting on expected and actual impacts on the development of the areas. The advantage of journalism supplements a fair

view into positive as well as negative impacts of such investment. Also within this category are the international news databases, namely Platts and LexisNexis, which systematically and historically gather and store news from all sources in most countries, including Vietnam and Thailand. Platts Asia in particular keeps an archive of local correspondents' news and analysis in public services in Asia from 1990 to 2008.

The remaining category consists of relevant international databases (including PPIAF, REN21, IEA, UNCTAD) and energy consultancies (including Enerdata). From the analysis above, it can be seen that these databases are not offering the highest quality and accessible data needed for this research. PPIAF is not sufficiently transparent and structured about their data collection methodology. Its data sources are also covered in the above categories. IEA has a major worldwide database on energy in general and consistently reviewed and published annually. However, the data are mainly cultivated from government sources (published and private). Enerdata is a leading energy consultancy in Europe but its data in Asia seriously lacks completeness. The reason for referencing these sources is that apart from above published data, they offer additional data from their own relationships with industry insiders and up-to-date regional and international conferences and meetings.

Finally, in order to fill the last gaps of data points, I could use personal contacts with government agencies and companies via email, phone and face-to-face meetings.

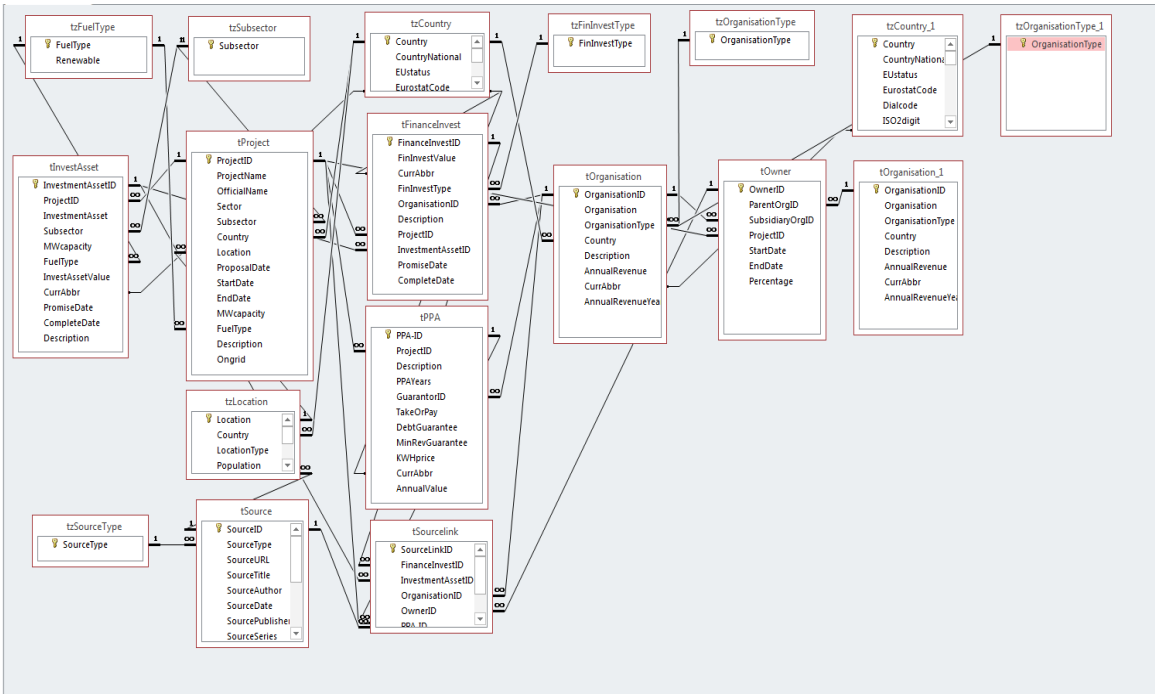
Figure 16 Hierarchical Approach to Collecting Secondary Data in Power sector



4.3.4. Structure of The Power Sector Database

The Power Sector Database contains detailed information on electricity projects, investment of such projects and background information on investors and sales contract of electricity output. To facilitate the complex structure of data required, there are 18 inter-connected data sheets, including 11 different structures of metadata. There are 7 data sheets with identical metadata structures but each contain different explanation information.

Figure 17 Relational Structure of the Power Sector Database



The Power Sector Database was first constructed from the idea of collecting data to serve this research first and foremost back in 2015. With time, the Database has taken shape and become organised and coded to allow not just the author but other future users of this database to understand and employ it for their researches into the power sector. The structure is also comprehensible to allow for future add-ons. The thesis aims to provide a framework that could be used, replicated and adapted first by researchers in economics and energy economics, then by policy-makers and other researchers who wish to collect data and build databases of high quality. So far, the Power Sector Database has collected population data on Vietnam's Power sector, some data on Thailand's power sector, and data on loans and lenders in Laos, Malaysia and Indonesia.

There are 6 core datasets: data sources, power plants, investment, technical contribution, generation companies, other companies (including technical companies and other companies, sharing the same format of variables).

Table 5 Description of variables in Data Sources spreadsheet

variable	description	unit of measurement
source_category	category that the source is described to be. 010: Government and Regulatory Bodies. 020: IFIs and National Banks. 021: World Bank. 022: ADB. 023: PPIAF. 030: Company and Project Websites. 031: Incumbent company (EVN or EGAT). 032: Network company. 033: Generation and Project Website. 034: Others. 040: Media/News. 041: National Media/News. 042: International Media/News. 050: International Databases and Consultancies. 051: IEA. 052: Enerdata. 060: Personal contacts.	01/02/03/04/05/06 + extension
source_data	name of data source	name
source_document	name of source of document/policy paper	name
souce_collection	details of data or document collected from the source and instruction to where to find the source	
soure_website	website link	link
source_ownership	name of organisation/institution which principally owns the source	
source_completeness	The degree to which the data are usable. Comment on what it provides and what not.	
source_originality	The degree of rawness to which the data are collected. Comment on whether the	

	company collects the data/document or from secondary sources	
source accessibility	The degree to which the data can be reached. Comment on whether the data/document are provided on open access, or mixed with subscription or pay-per-use.	100/50/0
source_coverage	whether the data/document provided are actual or intended. Comment on why and how judgement can be made to trust the source	100/50/0
source_error	Comment on obvious errors and limitations found from the source	
source_note		

Table 6 Description of Variables in Power Plants (pp_all) spreadsheet

variable	description	unit of measurement
pp	name of power plant (hereby known as)	name
pp_fullen	name of power plant in english	name
pp_fullvn	name of power plant in vietnamese	name
op_status	status of operation	planned/licensed/construction /suspended/operating/cancelled
install_cap	installed capacity	MW
source_cap	reference or website link to the source of data for installed capacity	fullref/weblink
gen_type	generation type	hydro/nuclear/coal/gas/natural gas/

source_gen_type	reference or website link to the source of data for generation capacity	link/ref
pp_tech	specification of the technology that the power plant uses	
source_tech	reference or website link to the source of data for generation technology	
year_construction	year of commissioned construction when the power plant actually started to be built	year/NA/year(exp)/UN
source_year_construction	reference or website link to the source of data	fullref/weblink
year_online	year when the power plant started to sell electricity	year/NA/year(exp)/UN
source_year_online	reference or website link to the source of data	fullref/weblink
grid_connection	whether the power plant is connected to the national grid at the time of research (2016)	on/off/UN
location	the province/main city where the power plant is located - in English	name/UN
location_full	the full address of the power plant or geographical coordinates - in Vietnamese	name/UN
year_wholesale_market	whether the power plant has started selling to the competitive wholesale market	year/NA/UN
source_marketsale	reference or website link to the source of data	fullref/weblink
pp_note		

Table 7 Description of variables in Investment spreadsheet

variable	description	unit of measurement
pp	name of power plant (hereby known as)	name
finance_source	state if the source to finance this power plant comes from: A: debt finance. B1: internal finance from generation company. B2: internal finance from parent company. C:equity finance. D: grant	A/B1/B2/C/D
investor_main	main Investor into the power plant	name(%total investment)
source_investor	reference or website link to the source of data	fullref/weblink
investment_initial	Total initial investment (before extension)	VND/US$(year)/UN
source_investment	reference or website link to the source of data	fullref/weblink
investor_others	Other investors in this initial investment	name(%total investment)/UN/NA
source_investor_others	reference or website link to the source of data	fullref/weblink/NA
contract_type	type of contract	BOO/BOT/BOOT/GOV/UN
source_contract	reference or website link to the source of data	fullref/weblink/NA
agreement_buyer	contract with power buyer (if there is)	PPA/GUA/UN
source_buyer	reference or website link to the source of data	fullref/weblink/NA
loan	lender(private companies/banks) and amount of loans	Lender (value of loan-year-interest rate)/NA/UN

source_loan	reference or website link to the source of data	fullref/weblink
grant	institution which gives grants to the construction of the power plant	Grantor (value of grant-year)/NA
source_grant	reference or website link to the source of data	fullref/weblink/NA
invest_note		

Table 8 Description of variables in Technical contribution (pp_tech) spreadsheet

variable	description	unit of measurement
pp	Short name of power plant	
construction_co	name of construction company of the coordinating power plant	name (fullname)
consultancy_co	name of consultant of the power plant	name (fullname)
design_co	name of design consultant or design company of the power plant	name (fullname)
equipment_co	name of companies providing equipment for the power plant construction	name (fullname)

Table 9 Description of variables in Generation Companies (gen_co) spreadsheet

variable	description	unit of measurement
pp	name of power plant (hereby known as)	name
gen_co	name of generation company (hereby known as)	name
gen_co_fullen	full name of generation company in english	name
gen_co_fullvn	full name of generation company in vietnamese	name
genco_website	official website of the generation company	website/UN
country_code	country code using ISO code	ISO code

co_type	whether the company is A:limited liability company , B: plc, C:partnership, D: NGO, E: family or one-man company	A/B/C/D/E/UN
genco_about	summary about the company: history, business	details/UN
genco_tax_code	company tax code as registered with the Government	code/UN
year_establishment	the year of establishment	year/UN
year_corporatisation	year of the company being corporatised (if that happened)	year/UN/NA
genco_email	official email address	email address/UN
genco_address_en	full address of the company's headquarter in English	name
genco_address_vn	full address of the company's headquarter in Vietnamese	name
genco_contact	phone number (with country code)	number/UN
genco_status	whether the company is operating or closed at the time of research (2016)	operating/closed
ownership_category	A: 100% state-owned. B: 50%-99% state-owned. C: 25%-49% state-owned. D: 1-24% state-owned. E: 0% state-owned	A/B/C/D/E (% - year)
parent_co_direct	name of direct parent company which states the company as subsidiary (holds more than 50% shares)	name of direct parent company/NA
status_subsidiary	whether the company is a subsidiary, affiliate or wholly owned subsidiary of a parent company	affiliate/subsidiary/wholly owned subsidiar

gen_co_stockexchange	name of stock market where shares of the generation company are exchanged	name/UN
control_shareholder	shareholders that control more than 20% of the total shares	name (%total shares-year)
control_share_vn	the percentage of shares owned by domestic entities	%
control_share_foreign	the percentage of shares owned by foreign entities	%
control_share_co	the percentage of shares owned by company entities	%
control_share_inv	the percentage of shares owned by individual entities	%
soe_share	proportion of shares held by state-owned companies	%
private_share	proportion of shares held by private shareholder	%
datasource_shareholders	reference or website link to the source of data	fullref/weblink
note		

Table 10 Description of variables in other companies (other_co) spreadsheet

co_name	abbreviated name of the company	
co_fullname	full name of the company	
co_website	official website of the company	
country_code	country code using ISO code	
co_type	whether the company is A:limited company (Ltd),B:public limited company, C:partnership, D: NGO, E: family or one-man company	A/B/C/D/E/UN
co_about		

co_tax_code		
year_establishment	the year of establishment	year/UN
co_email	summary about the company: history, business	details/UN
co_address	full address of the company	
co_contact	phone contact of the company (including country code)	
co_status	whether the company is operating or closed at the time of research (2016)	operating/closed
ownership_category	A: 100% state-owned. B: 50%-99% state-owned. C: 25%-54% state-owned. D: 1-24% state-owned. E: 0% state-owned	A/B/C/D/E (% - year)
parent_co_direct	name of direct parent company which states the company as subsidiary (holds more than 50% shares)	name of direct parent company/NA
status_subsidiary	whether the company is a subsidiary, affiliate or wholly owned subsidiary of a parent company	affiliate/subsidiary/wholly owned subsidiar
co_stockexchange	name of stock market where shares of the generation company are exchanged	name/UN
control_shareholder	shareholders that control more than 20% of the total shares	name (%total shares-year)
control_share_vn	the percentage of shares owned by domestic entities	%

control_share_foreign	the percentage of shares owned by foreign entities	%
control_share_co	the percentage of shares owned by company entities	%
control_share_inv	the percentage of shares owned by individual entities	%
soe_share	proportion of shares held by state-owned companies	%
private_share	proportion of shares held by private shareholder	%
source_shareholders	reference or website link to the source of data	fullref/weblink

4.4. Complexity in definitions and impacts on analysis

4.4.1. Complexity in Investment structure and terminologies of power projects

In analysing investment in power generation, it is common to look for total investment value of particular power plants and credit that to their main investors (or investing companies). The problem with this data collection method is two-fold: one is to omit the role of other/minor investors in each project, and two is to overlook different sources of finance that were employed. It is important to think of power plant construction projects in real life situations when it is rare to find a single company/investor single-handedly funding the project, especially in the case of large-scale projects. It is more common to find combination of different financial sources (equity and debt finance). In order to understand how power generation happened in these two countries, it is then important to understand the sources of finance, the roles of different types of financiers (international institutions, governments, MNCs, domestic companies…) and the incentives for their investment.

Here is an example of how this data richness illuminates the understanding of investment pattern.

Taking 5 random power plants in operation: The total investment value of these 5 projects at their completion was 2064 million USD (as of 2015) contributed by the two major state-owned companies, Vinacomin (811 million USD) and EVN (1263 million USD).

Table 11 Investors in Selected power plants, Vietnam (taken from the PSD)

power plant	Total investment	Main investor
Cam Pha	10,635 bn VND (2011)	Vinacomin
Cao Ngan	US$124 million (2002)	Vinacomin
Hai Phong 1	US$640 million (2005)	EVN
Hai Phong 2	US$623 million (as of 2006)	EVN
Mao Khe	577 mil USD (as of 2013)	Vinacomin

From this table alone with these data alone, it is informative to know how much investment in power generation in total happened and who were leading the investment. But to credit these two companies to these total investment values would be misleading. Look at the table below with additional data on other investors and sources of debt finance

Table 12 Equity Investors and Lenders in Selected Power plants, Vietnam (taken from the PSD)

power plant	Total investment	Main investor	Other investors	Loan
Cam Pha	10,635 bn VND (2011)	Vinacomin	NA	NA

Cao Ngan	US$124 million (2002)	Vinacomin	NA	EXIM Bank China (US$85.5 million in 2002)
Hai Phong 1	US$640 million (2005)	EVN	Vinacomin	JBIC (7.7 billion yen in 2005)
Hai Phong 2	US$623 million (as of 2006)	EVN	NA	JBIN (7.3 billion yen in 2007); EXIM China (0.557 billion USD in 2007)
Mao Khe	577 mil USD (as of 2013)	Vinacomin	NA	Sinosure China (0.275 billion VND in 2011)

From this table, it is found that out of 2064 million USD, only 794 million USD was contributed by the investors of EVN and Vinacomin. Also, in contrast to the initial analysis of all investment coming from domestic sources, this table shows that majority of funding for power generation comes from international ODA loans from Japan and China.

4.4.2. Complexity in Technical Contribution

Upon liberalisation policy implementation, governments wishing to develop infrastructure also wish to involve private entities (companies and individuals) in provision and/or financing of infrastructure projects. Commonly private participation can take the forms of 'private funds and managerial expertise' (World Bank REF). The World Bank's development-aids-in-infrastructure wing (IBRD) in cooperation with PPIAF regularly produces reports on private participation in energy and water.

These reports focus on analysing total private investment and private contractors of these projects. However, vagueness in definition of private participation and its forms is clear. First, by investment, the World Bank does not clarify whether it is equity investment in the project or debt finance. Also, within equity investment, the period when it happens also

matters. An infrastructure project can only be enabled in the first place with the initial investment. The importance of initial investment to make an infrastructure project happen differs from when investors come in and buy shares from an operating power plant. For example, Pha Lai 2 Thermal Power Project was initially invested by EVN (a state-owned company) and financed by ODA loan from JBIC (a Japan government bank). Later, EVN started to sell its shares in PPC (Phalai Thermal Power Joint Stock Company) to private investors. By June 2016, private investment in the generation company accounts for 21.72%. In the initial stage of this power plant, private investment did not occur, and private investors did not make the construction of this power plant happen. However, once the plant is in operation, private investors have a better idea of profitability in investing in the running of this plant. This difference in quantifying private investment should therefore be addressed as far as data allow.

Second, by contractors, the World Bank does not clarify what contract it is involved. In power generation, investors can award EPC (Engineering, Procurement and Construction) contract to a single contractor or can employ separately a consultancy firm, a design company and a construction company. Issues in operation of the power plants could be credited fully to EPC contractors, hence exaggerating their contribution to the power sector.

Table 13 Technical Contractors in Selected Power plants, Vietnam (taken from the PSD)

Power plant	EPC	Construction_co	Consultancy_co	Design_co	Equipment_co
Hai Phong 1	Yes	Marubeni; Dongfang	Marubeni; Dongfang	Marubeni; Dongfang	Marubeni; Dongfang
Quang Ninh 1	No	SEC	EVNPECC 1	EVNPECC 1	UN
Hua Na	No	LILAMA	LILAMA	EVNPECC 1	Song Da, Lilama, Licogi, CAVICO

The table above shows different levels of contractor involvement in a power plant projects in 3 examples. Hai Phong 1 awarded EPC to Consortium of Marubeni and Dongfang who

then takes on the job of design, consultancy, equipment provision and construction because of their wide-range business activities. Quang Ninh 1 and Hua Na, however, did not choose to use EPC. Quang Ninh 1 resorted to EVNPECC 1 (a subsidiary of EVN) for design and consultancy whilst awarding construction to SEC (a subsidiary of 100% state-owned company from China). Hua Na then chose a different mixture of 5 state-owned companies.

Third, the World Bank does not clarify the role of private involvement in terms of expertise. As in (World Bank, 2003), expertise is referred to as 'managerial expertise' but the reports by the World Bank did not mention how it is measured. Often, the notion of investment and operation in privately-funded power project are not separated because private firms may choose to invest and then operate directly. But this common practice is not universal. As commonly found, Ba Thuoc 2 is a privately funded and operated power plant by HAGL (100% privately owned corporation). However, a counter-example to this common practice includes Mong Duong 2 which was initially invested by AES (a MNC American corporation), with minor investment from CIC and COSCO (Chinese corporations) but then operated by a joint venture between AES and Vinacomin (a state-owned corporation in coal and mining). To quantify the value of managerial expertise is difficult but to acknowledge roles of different entities in different stages of construction vs. operation could shed light on what changes were actually brought into the system as result of private participation. Does the system gain operational know-how or engineering expertise? The nature of the gains is different.

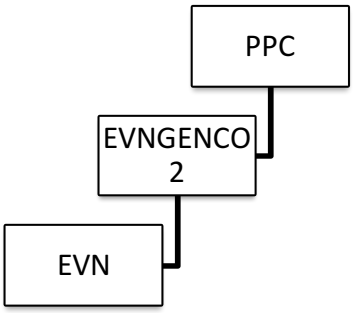
4.4.3. Complexity in Ownership of Generation companies

Modern company structures have become more complex than simple categorisation of state or private ownership. There is scope for many entities to own parts of a limited liability company. In the early 1990s, the governments of Vietnam and Thailand under the ideological influence of Western capitalist countries have started to open up the economy not just with trade but also within their state-owned company structures. One key stage was to corporatize SOEs in order to involve more private investors and to push the company to work like a private company. Not like privatisation when the state completely withdraws their ownership, corporatisation involves state and private ownership at the same time. This causes more complexity to the understanding of the role of state.

In early 2000s, stock exchanges were established in Bangkok and Hanoi, capitals of Thailand and Vietnam to assist the transfer of ownership and stakes in listed companies. It further complicates the ownership structures for our understanding. The power of the state in decision-making in these corporatized companies is then not static. And it cannot be taken for granted that the state has the say in how the companies work when there are other private investors involved. It is then important to look at modern operating companies via their ownership structures. It is important to understand not only the parent company under which a company is registered but also the companies that have voting power by owning enough proportion of shares.

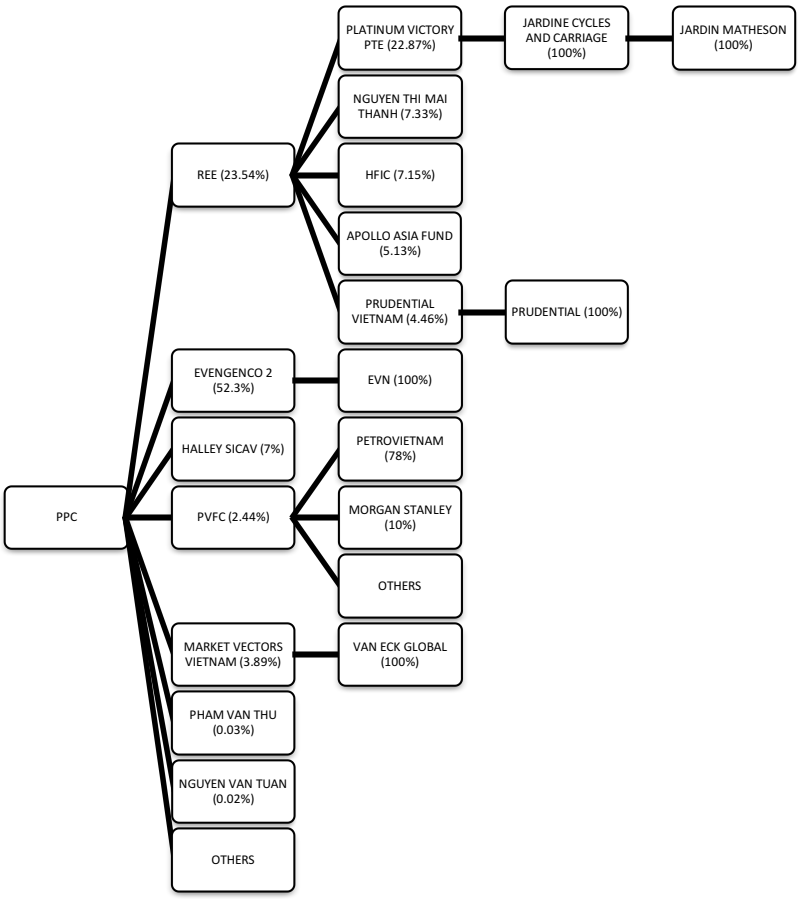
To illustrate for the increasing complexity of modern companies in the electricity sector, look at the example of Pha Lai Thermal Power Joint Stock Company (PPC) which was originally known as Pha Lai Power Plant established in 1982. This power plant was then corporatized in 2006 and renamed as above. Before 2006, the ownership structure of PPC is as follows:

Figure 18 Structure of PPC company, Vietnam



PPC was 100% owned by EVNGENCO 2, which was 100% owned by EVN – a 100% state-owned company under the management of Ministry of Industry. It is simple to say that PPC is a state-owned company.

Figure 19 Ownership Structure of PPC



The ownership structure of PPC by 30 June 2016 on stock exchange OTC is no longer as simple as before. The chart above is an extract of a much more complicated ownership structure. PPC is now only more than 50% owned by EVNGENCO 2. The other owners include REE (23.54%), PVFC (7%), and a number of companies and individuals. It is difficult to conclude here that the state only owns more than 50% via EVNGENCO 2's shares if we do not investigate the ownership structures of REE, PVFC and other companies. REE was registered as a state-owned company but it is now only officially 7% owned by the state by HFIC, a company operating as a government agency within Ho Chi Minh City Council. Actually REE now has more than 27% shares owned by foreign companies, and 93% owned by private entities. Meanwhile, PVFC is 78% owned by PetroVietnam – a 100% state-owned oil and mining corporation and 10% owned by Morgan Stanley. Thus, the question of state ownership of PPC becomes much more complicated and cannot be determined by looking at the first level of owners. Rather, a network of ownership should

be constructed to shed light on this relationship of ownership as well as its implications for power and control.

4.5. Comparative Analysis of the Power Sector Database

Since section 5.2. shows the complexity of ownership and financing structures found in power projects, it is then important that this complexity is reflected in the Power Sector Database so that a better, realistic picture of private vs. public contribution in the power sector can be seen. With the construction of the database, it has been managed to address the following issues that have been overlooked in other databases:

4.5.1. Definitions of Public vs. Private Ownership

In (Government of Vietnam, 2006), the regulation document defines IPPs as power plant projects that do not employ government funds for investment, procurement and sales. However, there exists discrepancy in this definition of private involvement and its true privateness. An example is Nam Toong Hydropower Plant which was labelled as 'IPP' in the near-future power development plants in (Government of Vietnam, 2016). But this power plant is actually managed by NO1 Jsc, a subsidiary of Vinacomin (a state-owned corporation) and initially invested by Vinacomin. It is questionable whether there is private entity involved in this power project to qualify it as an IPP. Therefore, the government's official definition of IPP and its classification in official documents would not be employed in this research. Also, as argued above about simple classification of private and public ownership, instead, it would be more meaningful to look at private participation in ownership by investigating shareholding structure and controlling ownership of generation companies that operate the power plants. The characteristics of controlling shareholders could be categorised according to geography (domestic vs international), nature (company vs. individual) and ownership (public vs private).

The World Bank's PPI Database is a well-known source of data on private participation. In Vietnam, the database covers electricity sector from 2000 to half year in 2015[12] in the format of accumulative figure from 2015 until the indicated year. The database records contractual

[12] PPI data analysis covers up to 2016 but annual data is only available for download until half 2015

arrangements for public infrastructure projects in low- and middle-income countries (as classified by the World Bank) that have reached financial closure, in which private parties assume operating risks. So, first of all, the database does not record all investment happening in the sector. And, secondly, it does not specify within its data how much comes from private and how much from public partners. These figures are mislabelled as private investment.

Besides, PPI refers to a 'private sponsor' as 'a company controlled and majority owned by private parties' and that 'partially divested state-owned enterprises or their subsidiaries that remain majority owned by government entities are not considered private sponsors in their own countries'. (See PPI's Glossary). PPI acknowledges the co-existence of public and private investment in some infrastructure projects and records both figures. This definition shows an attempt by the Bank to measure the participation by purely private entities. However, this definition sis not precise enough in the case of complex ownership structures. Explanation of what they mean by 'majority' or 'partially' is vague. This could either lead to underestimation of private investment when it comes to corporatized companies that are originally state-owned but 49% of shares are sold to private entities, for example. Or it could lead to overestimation when what they mean by 'majority' is equivalent to 'the largest shareholder' and there are a number of companies sharing equity. The World Bank's PPI Database is a well-known source of data on private participation. In Vietnam, the database covers the electricity sector from 2000 to half year in 2015[13] in the format of accumulative figure from 2015 until the indicated year. The database records contractual arrangements for public infrastructure projects in low- and middle-income countries (as classified by the World Bank) that have reached financial closure, in which private parties assume operating risks. So, first of all, the database does not record all investment happening in the sector. And secondly, it does not specify within its data how much comes from private and how much from public partners. It is rightly mislabelled these figures as private investment.

Therefore, the Database records share ownership in power companies according to the proportion of state vs. private entities at the point of data collection. By state ownership, the Database collects how many percentage of shares owned by a state agent (which is 100% state-owned by law). EVN GENCO 1, for example, is a wholly-owned subsidiary of EVN,

[13] PPI data analysis covers up to 2016 but annual data is only available for download until half 2015

which is 100% state-owned. Therefore, EVN GENCO 1 is listed as 100% state-owned. To be more precise, there are 5 categories of state-ownership reflecting the degree of state control in the companies: A (100% state-owned: complete ownership and only decision maker), B (51-99% state-owned: the state is the most major shareholder, has controlling power as well as majority of voting weights in decision-making), C (25-50% state-owned: the state has controlling power as well as strong decision influence), D (1-24% state-owned: the state has working control and voting interest) and E (0% state-owned: the state has no interest and control). This categorisation results in framing the picture of how the government gets involved in the ownership of generation companies. Table 9 shows 62 operating power plants are currently owned and managed by 53 wholly privately-owned companies. This figure is different from World Bank (2016)'s figure of 65 private projects in investment though it does not specify if these projects are 100% owned by private entities or in what proportion. It is notable that as part of this research, upon personal request, MOIT sent a single spreadsheet on power plants on their system on 25th October 2016. And this spreadsheet shows 317 IPPs (51 IPPs – over 6MW capacity and 266 SHPPs - below 6 MW). This major difference arises from how the government considers the mere involvement of private actors to any extent as purely private.

Table 14 Overview of Generation company ownership mix

Ownership Type	Number of Generation Companies (Direct)	Number of Power Plants (Operated by Direct Generation Companies)
A: 100% state-ownership	45	51
B: 50-99% state-ownership	50	57
C: 25-49% state-ownership	12	13
D: 1-24% state-ownership	0	0
E: 0% state-ownership	53	62

4.5.2. Coverage of Power Plants

The Power Sector Database covers the longest period of data on installed capacity in comparison to other popular sources including the World Bank and IEA. The total capacity in MOIT's spreadsheet was stated as 39029 MW as of 2016 whilst the Database found a total capacity of 40473 MW in the same year. While the Database records 269 power projects, MOIT states the existence of 317 plants. This difference could be explained by the

following explanations. First, in order to appear on the Database, the identification of power plants must be confirmed singularly. Their owners, generation companies, location, licence and other details must be identified. The existence of each power project (being in operation or planned) is therefore true at the point of research. Meanwhile, MOIT could name 122 power plants but did not give out the names of 266 small hydro power plants which are all IPPs. The vagueness accompanied by sheer size of these SHPPs altogether may lead to an overestimation of the existence of these power plants. When asked, the correspondent from MOIT said that very small power plants are regulated by provincial authorities. They are not required to join the wholesale market or connect to the grid. Investors need to obtain licences from these agents but do not need to report to the Ministry. The correspondent also stated that an overwhelming growth of these affordable investments implies that the Ministry deliberately does not collect their details for management. Second, in sending this dataset, there was no mentioning of whether installed capacity figures are the proposed figures or the final ones. For all completed projects in the Database, installed capacity is final and collected at the point of power plant commencement. In most cases, though, there is no difference between proposal and final numbers. Examples of such differences in records include: Ba Ria (Database: 388.9 MW vs. MOIT: 388 MW), Cam Pha (Database: 680 MW vs. MOIT: 660MW), etc. Third, importantly, MOIT's list is incomplete when it misses out data of major plants including Yaly (720 MW0) and Duyen Hai 1 (1000MW). These are among possible explanations for the difference in data collection methodologies. It partly explains my decision to construct the Database with a clarified and consistent methodology.

4.5.3. Constant Valuation and Actual Figures

In Vietnam, the PPI database covers electricity sector from 2000 to half year in 2015 [14] in the format of accumulative figure from 2015 until the indicated year. The database records 'Investments … those made or to be made by the project company under the PPI contract … adjusted by the World consumer price index'. The problem with this methodology is that investments recorded in PPI are not certainly 'expected' or 'actual' figures. Also, Table 15 illustrates the differences between Producer Price Index and Consumer Price Index in Vietnam, especially comparing Electricity PPI. Construction and equipment costs in

[14] PPI data analysis covers up to 2016 but annual data is only available for download until half 2015

Vietnam tend to inflate at different rates in each year in comparison to that of consumer products. PPI does not only just take CPI in Vietnam but also World CPI which is a long way from the reality in Vietnam. Thus, PPI's use of consumer price index in this case is unsuitable and misleading. As data from PPI were collected in 2016, the cumulative private investment as listed by PPI from 2000 to 2014 is assumed to reflect historical data. PPI values private investment at 7,361 millions US$[15] whilst the Database shows a total of 7,842 million US$ (2010) in the period of 55 years from privately-owned entities of category C, D, E. PPI seems to have overestimated private investment by using the CPI as well as taking expected project costs rather than actual costs in power construction in Vietnam.

Table 15 Producer Price Index vs. Consumer Price Index in Vietnam[16]

Year	GENERAL PPI	Electricity PPI	CPI
2000	45.26935265	54.43658138	48.1276371
2001	46.22000905	54.70876429	47.9199449
2002	47.0348574	55.79749592	49.7556758
2003	48.07605251	56.12411541	51.3577538
2004	51.78813943	58.24714208	55.3426693
2005	54.09687641	62.81981492	59.9258292

[15] Source of Data: PPI (2016)

[16] Source of Data: International Financial Statistics (IFS) by IMF; General Statistics Office, Vietnam (GSO). PPI is calculated by author - based on data provided by GSO

2006	56.36034405	63.58192705	64.3518232
2007	60.25350837	66.57593903	69.6954631
2008	78.81394296	77.68100163	85.8064868
2009	88.77320054	88.13282526	91.8597556
2010	100	100	100
2011	121.27	121.8	118.677477
2012	133.25	133.4	129.470263
2013	137.32	139.37	138.005274
2014	141.98	148.72	143.644032
2015	142.01	155.56	144.906094

4.6. Summary

When facing the challenge of lack of and inadequate data quality from major sources for researchers in the power sector investment, there emerged the need to construct a new database. The Power Sector Database was then conceptualised and constructed with the aim to collect population data of all power generation projects, their investors, financiers and investment involved as well as other details on participants in the sector from as far back in history as possible to give the clearest picture of the sector. As a result, for Vietnam, the Database has proven to address the shortcomings of other data sources and improve on other qualities.

Figure 21 compares these data sources with the Database on criteria of the following data qualities:

- Completeness: The degree to which the data is usable, as opposite to missing data. This criterion is measured in percentage (%) with 100% representing all data points are complete.
- Accessibility: The ease with which the data can be reached. This criterion is measured by the public status of the data.
- Originality: The degree of rawness to which the data is collected. Primary data are the most original, collected and owned by the source
- Coverage: Whether the data sources present actual or intended data
- Systemic Completeness: Area of datasets on Investment that the data sources cover

The figure has shown that the Power Sector Database is superior in terms of covering sufficient datasets related to finance, providing near complete data that are set out and maintaining close-to-reality data. The Database then becomes a powerful tool for research not only in this thesis but for future users. It is a major contribution by this thesis.

Figure 20 Systemic incompleteness of major data sources in the Power sector

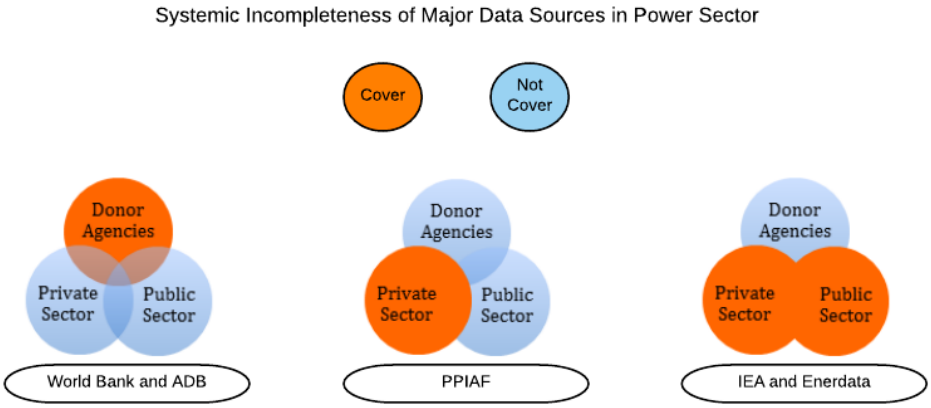


Table 16 Quality Evaluation of Data sources

	World Bank	ADB	IEA	PPIAF	Enerdata	Author's own
Systemic Completeness	Donor	Donor	Private + Public	Private	Private + Public	Donor + Private + Public
Completeness	90%	50%	60%	92%	3%	95%
Originality	100%	100%	5%	5%	0%	10%*
Accessibility	100%	75%	50%	100%	50%	100%
Coverage	Actual	Intended	Intended	Intended	Intended	Actual (94%)

CHAPTER 5. DEVELOPMENT OF VIETNAM'S POWER SECTOR

5.1. Introduction

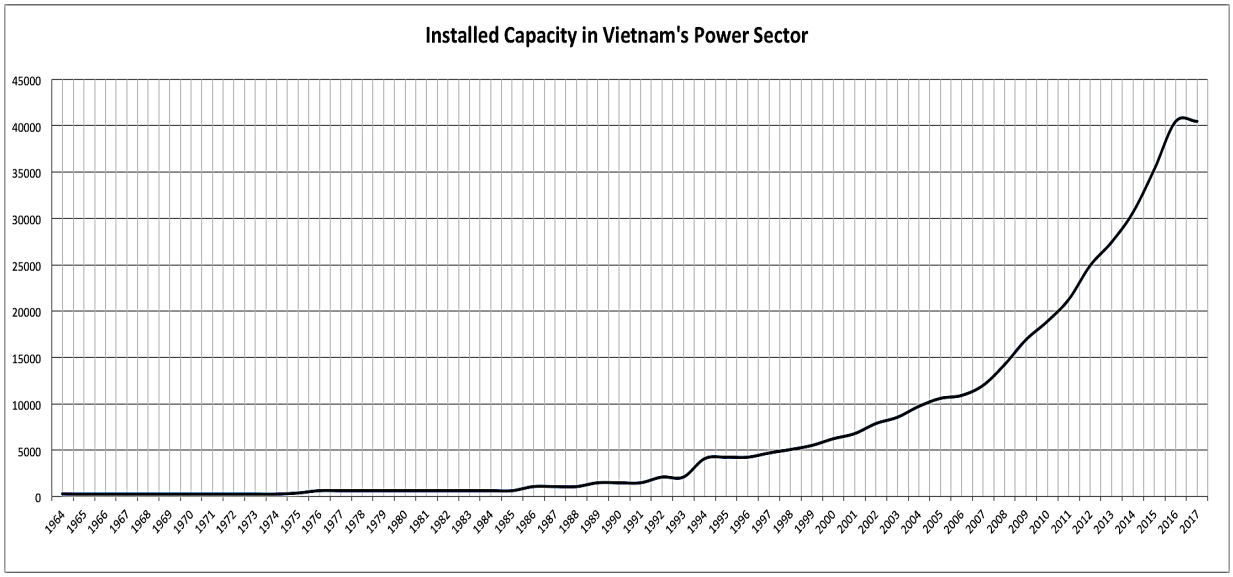
This chapter attempts to create a panorama of what has happened in the power sector in Vietnam in recent decades, employing data from the Power Sector Database specifically constructed for this research. The chapter will illustrate the dynamic relationship between so-called 'enablers' who together contributed to the witnessed power supply growth.

Vietnam's power sector has taken a major leap in its development by growing more than 152 times between 1964[17] and 2016, from 265 MW during the Vietnam War in the 1960s to over 40, 000 MW today (See Figure 13 below). Generated power picked up slowly until 1986 when the government decided to open the economy under 'Doi Moi'. Since then, Vietnam's GDP growth is at an rate average of 7.4% per annum. The economy was transformed from agriculture-based to industry-intensive. In response to industrial demand, electricity supply multiplied. In comparison to 1986's capacity at 1075 MW, today's installed capacity is more than 37 times as much. This incredible supply growth, however, still could not satisfy consumption demand (Dapice, UN). In comparison to its neighbouring countries in the ASEAN, Vietnam offers many investment opportunities in the sector, especially when the economy is becoming more open.

The chapter is structured in 3 main parts. Section 5.2. investigates the historical development of the power sector in 4 periods: the very beginning of the power sector under the French colony (the foundational years), the official start of commitment to develop national power supply (the infant industry), the period of national economic reforms from closed to market-based economy (the transitional years) and the remarkable growth period (Asian Tiger in Globalisation). Section 5.3. then analyses the problems with which the power sector is dealing as well as the opportunities private and international entities may find in Vietnam in comparison to its neighbouring countries. Then section 5.4. focuses on analysing the connections between investors, lenders, technicians and government institutions involved in building the capacity of the power sector as it is today.

[17] Total capacity in 1964 excludes capacity of the 5 French Indochinese power plants that were not able to provide consistent power and were known to be heavily bombed during the war.

Figure 21 Installed capacity in Vietnam's Power Sector (1964-2017) (MW)[18]



5.2. Historical development of the electricity sector

5.2.1. The foundation

2017 marks 123 years since electricity was first generated in Vietnam. In 1894, a commercially-contracted power plant was commissioned by the French colonial authority in Hai Phong city, east of Hanoi and Northern Vietnam's only major port. Since then, a number of companies were involved in localised power generation for commercial use.[19] A national transmission system was not yet in place.

Little has been reported about ownership and purposes of these power plants. Lack of texts and literature written on this very early beginning of the power sector is severe for a couple of reasons: one is that most of population were either illiterate or wrote in 'Chu-Nom'[20] and the other is that wars persisted for many decades later that made preservation of literature

[18] Source of Data: The Power Sector Database (2017)

[19] It was briefly mentioned in Prince Henri d'Orléans's book published in 1894.

[20] Vietnamese character language that is no longer in use in the 21st century. Since the French colonisation, this ancient language was later replaced by Latin-character Vietnamese nowadays.

impossible. However, it is known that when Northern Vietnam was seized by Viet Minh[21] from the French in October 1954, there were 5 power-generating companies[22] in operation of total installed capacity of 31.5 MW.

The biggest power plant at that time was Yen Phu Power Plant serving the capital, Hanoi. This power plant was commissioned in 1925 by the French Colonials in Northern Vietnam, started producing in 1932 and then fully completed in 1949. Because of its strategic role, Yen Phu was heavily bombed and repaired several times until 1973 throughout the French Indochina War and the Vietnam War. The production of this plant was not consistent but rather symbolic. In 1988, the power plant was officially closed and its site is now the head-quarter of EVN (EPU, 2015).

During this period, private actors were important in pioneering the use of electricity for profit. The first-mover advantage in a resourceful country like Vietnam could promise exponential returns. Yen Phu was the biggest power plant under ownership of Indochina Thermal Power Company, a French colonial-related[23] enterprise. Not only institutions but individual entrepreneurs were also stepping in. Mr. Hoang Van Ngoc, an engineer educated in France, invested and owned the Loco Ham Rong Power Plant of 0.24 MW in Thanh Hoa Province. Loco Ham Rong was completed in March 1956 (Vietnam Energy, 2014). It became the foundation for extension of power generation and network in the province and Middle Vietnam. The nation's total power production reached 53 million kWh in 1954 (VETU, 2010).

Until the Vietnamese public sector was officially established under Decision 89 in 1946, most businesses were privately owned. The Vietnamese government gradually gained control of mines that had previously controlled by the French or Japanese colonies. Though

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[21] In 1941, the Indochinese Communist Party (ICP) formed a guerilla force, the Viet Minh, to fight against colonization. ICP preceded the current Vietnamese Communist Party.

[22] It cannot be confirmed that all 5 companies generated power as their primary business. There was one light-bulb manufacturer that generated power as a by-product, the Bo Ho Lightbulb Company.

[23] It cannot be confirmed if the Indochina Thermal Power Company is a French company financed by the French government to work in Indochina or a French private company which had a strong political relationship with the French government and gained licence to operate in Indochina.

extraction was not exclusively for public sector, mines were mostly licensed to public companies.[24] The overall political change thus had impacted private and foreign participation during the period, for 'social stability reasons' (MOIT, UN).

Figure 22 Power Plants in Vietnam under French Colonisation[25]

[24] A series of decisions and regulations made in 1945-1946 were critical for political stability during the War. Literal interpretation of these decisions does not show then totality of government ownership of the power sector. However, government control was required.

[25] This map used a publicly available background map of Indochina provided by Stamp World History. The complete map (as shown here) is created by the author. The map only shows details that can be confirmed as explained in the section.

5.2.2. Infant Industry

The official beginning of the sector is marked on 21 December 1954 when the ICP took control of Northern Vietnam. From this year onwards, the government has always considered the power sector as one of the nation's strategic sectors to be kept under regulation and ownership control.

The power sector then started to strengthen its position and expand on the foundation under French colonisation. In the Northern region, the Northern Power Company (now known as EVN NPC) was established and owned by Ministry of Electricity and Coal (now known as MOIT) in 1959 to build and manage all public power plants in the North. Yen Phu was the source of power for the capital city during 1961-1965 then constantly bombed during the Vietnam War. A complete repair was not done until 1973 (EPU, 2015). In addition, 4 small-sized power plants were commissioned with technical and financial support from other communist friends next to the then existing original Loco Ham Rong. Loco Ham Rong was extended with help from the Soviet Union, which also funded the construction of Ban Thach power plant. Co Dinh thermal power plant was constructed with help from China. And Ham Rong Power plant was built on help from Hungary from 1960 to 1964 (Vietnam Energy, 2014). These 4 power plants of 6MW total capacity made up Thanh Hoa Power Company – the main source of power in the province, bridging the Northern and Central Vietnam cities. Commissioned in 1957 and completed in 1958, with help from the Soviet Union, the first completely new power plant – Vinh Thermal Power Plant of 8MW capacity was built. However, the War destroyed Vinh soon after (PCNgheAn, 2014). The Power Plant is considered as the first effort by the Vietnamese government to electrify and connect the nation.

During the war with the imperial powers for fifty years and only being unified since 1975, major power plants were built with foreign financial and technical support including Da Nhim Hydro Power Plant of 60 MW and Uong Bi Coal-Fired power station of 105 MW capacity.[26] Apart from these major constructions, cooking and heating used in households

[26] Uong Bi was first constructed at capacity of 48 MW. It was completed in 1963 (Vietnam Energy, 2014). Since then, Uong Bi has been continually expanded becoming the biggest thermal power plant in Vietnam.

were still generated by burning coal. For hospitals and manufacturing plants, electricity was mainly generated off-grid with small power generators using fossil fuels (mainly diesel). Nowadays, the use of these machines and coal-burnt cookers is no longer common. However, they are not completely extinct, especially in the rural areas and sometimes in urban cities when there is a black out during dry seasons or commonly found in street food stalls in urban areas.

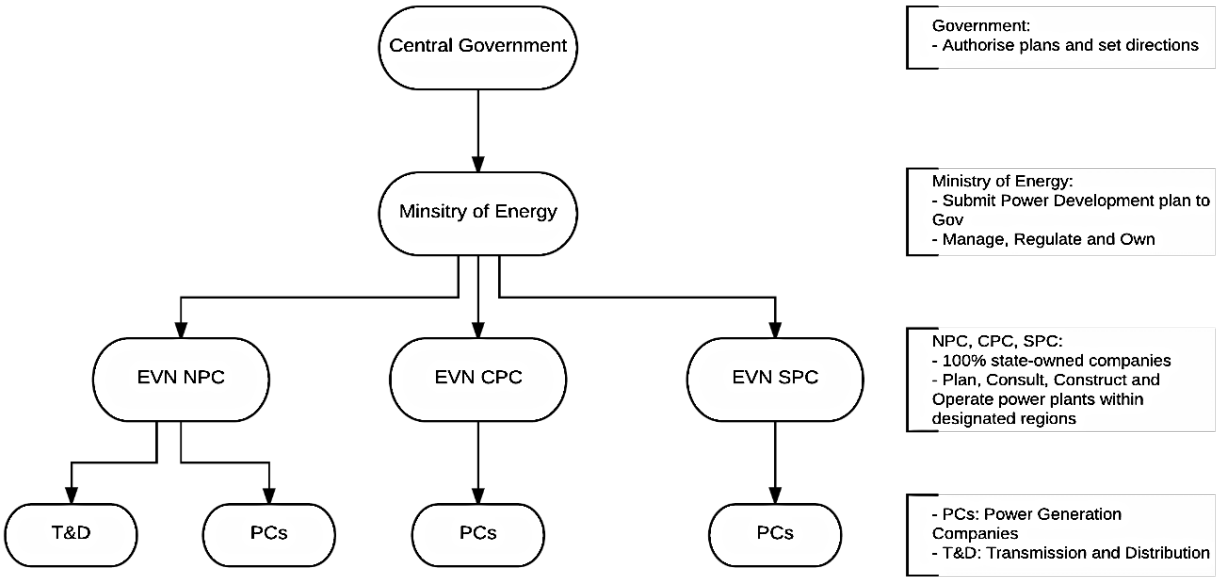
Within 1958, a 35kV transmission line between Hanoi and Pho Noi was completed, connecting with the pre-existing 30.5kV lines connecting key cities under the French colonisation such as Hanoi, Ha Dong, Thai Binh, Nam Dinh… This period marks the start of a national transmission and distribution system when old transmission lines were fixed and upgraded and new lines were commissioned. In 1962, a 110kV transmission line connecting the Northern provinces was constructed to transmit electricity from 9 out of 12 generation power plants (Vietnam Energy, 2013).

The power sector's institutional structure was fairly simple at its conception.[27] The Ministry of Electricity was established on separation from Ministry of Electricity and Coal in 1981. The Ministry directly owned and managed 3 regional power companies: EVN NPC (North), EVN CPC (Central) and EVN SPC (South). The power networks were managed by EVN NPC under Decision 49/CT in the same year.

The expansion units are recorded in The Power Sector Database as UBMR. Uong Bi (as described here) is the original site with capacity of 105MW.

[27] The complete history of institutional agents during this period involves a great deal of short-term name and function changes of institutions. What is described here is the start of a permanent sector structure, coinciding with the period of political stability. For more detailed history, see Vietnam Energy (2014).

Figure 23 Roles and Structures of Institutional Agents in Vietnam's Power sector in Infant Development Period[28]



5.2.3. Transitional period

Before 1986, the economy was closed and Vietnam was under embargo by the US. This communist model did not work for the country, total output declined, the society hardly progressed. In the Eighth Party Congress in 1986, the reformists, led by the Secretary of the Party, Nguyen Van Linh, blamed economic failure on over-centralisation. The conservatives in the party were mostly heads of provinces and their expanding powers threatened the unity of the party's decision. The Renovation Policy ('Doi Moi') was born, due to both political and economic reasons. This Reform can be considered as the primary policy paper calling for liberalisation in public utilities. From 1989, the economy was gradually opened.

As opposed to its economic growth, the power sector saw a big leap in its development. The first Power Master Plan (I) for 1981-1985 involved heavy public investment into construction of larger-scale power plants and electrification of industrial areas and cities. The networks were upgraded to 220kV, double previous capacity of 110kV, providing electricity to all the biggest Northern cities from 1979 to 1981. The core of these networks

[28] The graph depicts the sector structure at the point in this period when all institutions would be relatable to today's structure and their relationships remains. EVN NPC was once renamed into EVN GENCO1, then back to EVN NPC. I use the name 'EVN NPC' as it is consistently known in today's context.

still remain in operation in some rural areas today. It became the foundation for the current network of 550kV connecting the North and the South. In 1992, the transmission line of 1487 km from North to South started operating and was considered 'the spine of the power sector'. Also in the same years, Hoa Binh, of capacity 1920 MW, the biggest hydro power plant ever built in Vietnam, was commissioned with the Soviet Union as its financier and technical consultancy (EVN, 2011). In 1989, the Ministry of Energy also set up the Institute of Energy (IE), a research institute to explore different power generation technologies and wanted to develop their knowledge and know-how in the sector independently with foreign partners whom they had been consulting and reliant on so far. The young Vietnamese government proved that long-term development planning was within reach.

Figure 24 Installed Generation Capacity by Fuel Type in Vietnam in Transitional Period

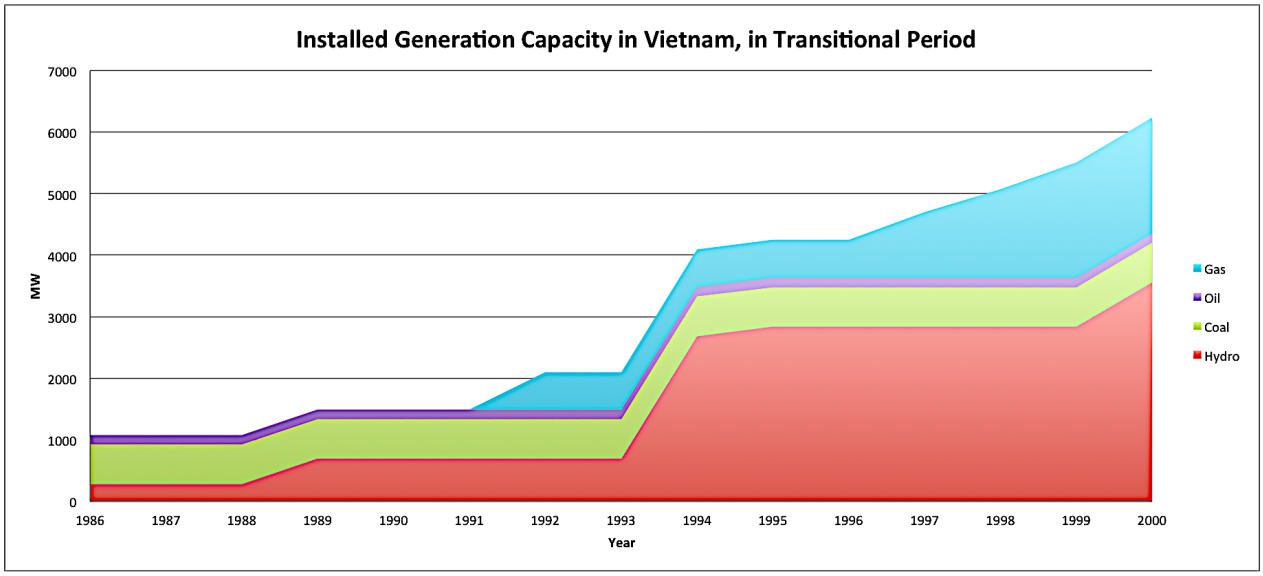
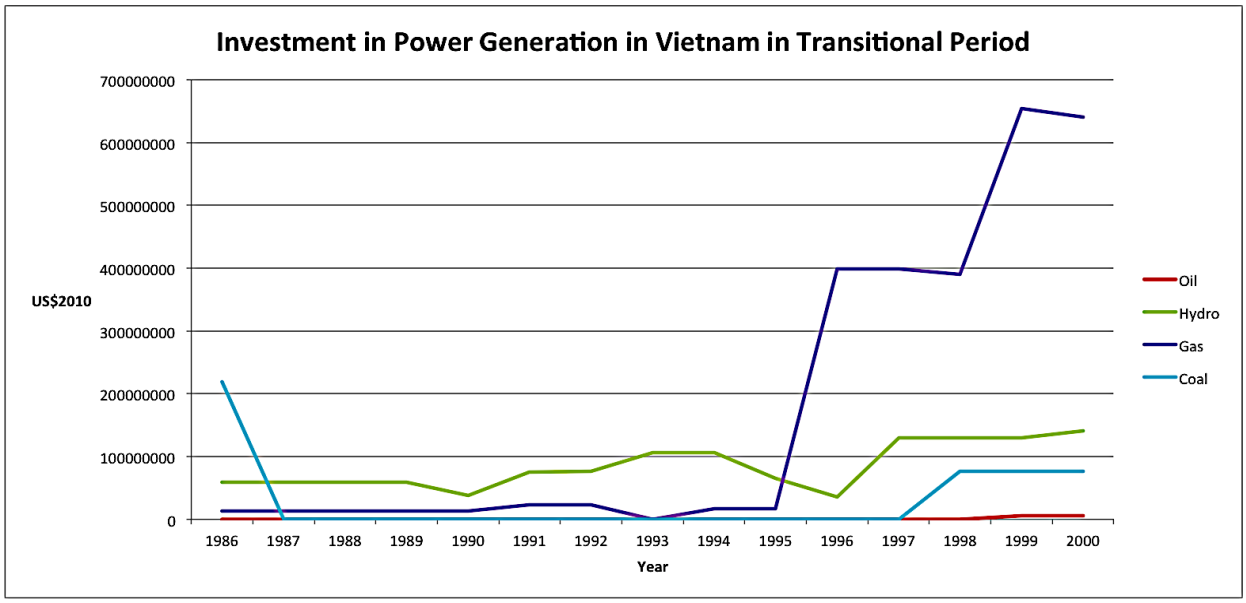


Figure 25 Investment in Power Generation by Fuel Type in Vietnam in Transitional Period

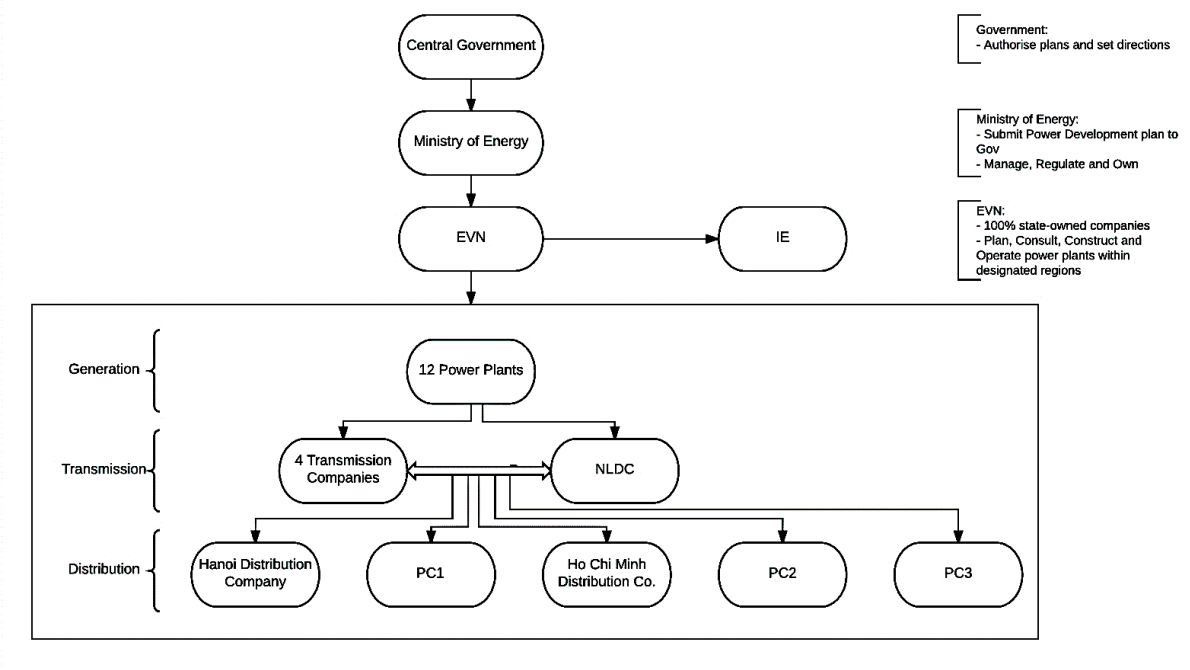


Although Vietnam started to open trade with other countries and private businesses, the power sector remained the sanctuary for public incumbents for a couple of reasons. First, financial requirements were too high for any domestic individuals or private businesses and the banking system was still young and not yet developed. Second, regulatory instability during this period was not favoured by foreign investors. A Foreign Direct Investment Law was first introduced in 1987. The law was later amended and expanded frequently (4 times in 1990, 1992, 1996 and 2000). For this reason, FDI was too minimal to create any impact within the first 3 years of enforcement of the Law. The government also stated their preferences of FDI areas as manufacturing products that were commonly imported or could be exported. Their scales of investment was also small on average (MPI, 2008). During this period, foreign investors were cautious and 'testing the water' before jumping into major projects.

The power sector's structure started to become marginally more complex than during the infant industry period. In 1995, Electricity Vietnam Company (EVN) was established, taking ownership of EVN NPC, CPC and SPC and IE. The company was 100% state-owned and report to the Ministry of Energy.[29] Its reporting and management duties were subject to the new State Enterprise Law. EVN comprised of 34 separate business units: 17 of which were engaged in generation and transmission, 5 were distribution units and the rest were in finance, design, construction and planning. The National Load Dispatch Center (NLDC) was also established to specifically be in charge of transmission control under EVN's management.

[29] Ministry of Electricity and Coal was reformed into Ministry of Energy.

Figure 26 Roles and Structures of Institutional Agents in Vietnam's Power Sector in Transitional Period



5.2.4. Asian Tiger in Globalisation

From then on, the electricity sector was subject to international and national pressures to liberalise, as seen in other developing countries. Regarding international political pressures, in 1995, when Vietnam joined ASEAN and signed AFTA, the government agreed to implement trade liberalisation.

In 1986, Renovation Policy opened a new chapter of trade and industry reform for Vietnam to change from a pure communism model to a market-based economy. In the 1990s, the country focused on rural electrification since over 80% population lived in the rural areas. In 2001, Decree No. 45 permitted private investors to participate in the power grid via PPAs with EVN (Electricity Vietnam). The Vietnamese Government only officially committed to energy sector liberalisation from 2004.

In 2004, the government passed the Electricity Law outlining the framework for a competitive electricity market. But the actual implementation plan only came in 2006 under Prime Minister Decision 26. The electricity market was expected to be competitive within 20 years, passing three stages: first, a single buyer market from 2005-2014; second, wholesale market creation from 2015-2022 and third, introduction of retail market from 2022 onwards.

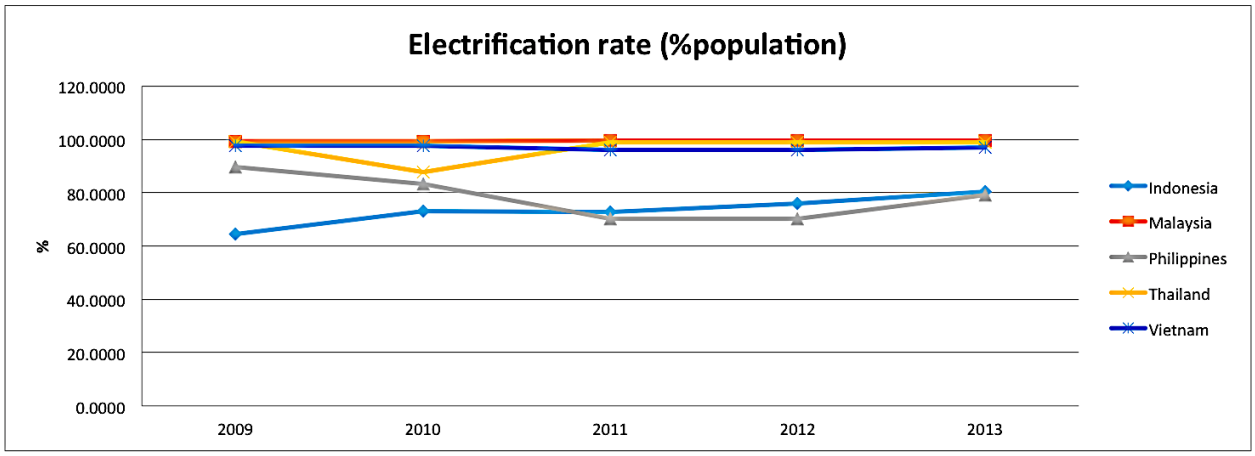
In 2006, after many failed attempts in the past since 1996 under other prime ministers, EVN was actually reorganised into a corporate group with more than 60 subsidiaries. EVN still holds complete ownership and control. Second, under Prime Minister Decision, EVN had to sell shares of five power generation subsidiaries on the stock exchange but it still keeps around 70% shares. These newly equity-based joint stock companies depended on PPAs granted by EVN. Third, EVN's corporatisation does not in fact benefit the industry. Taking advantage of its financial guarantee by the government in any case of loss, the corporation spread to other industries, including telecommunication, banking, real estate development.

In 2007 when Vietnam joined WTO and signed GATS in January, public services including healthcare, education, electricity and telecommunications became subject to liberalisation within a certain timeframe. Later that year, the 6th Master Plan pushing for a competitive market was passed and a single buyer market was created.

The movement of electricity growth synchronises with the movement of GDP growth. From 2000, when GDP growth enters a constant rising pattern, the sector also needed to introduce IPPs to provide more capacity. The period between 2001 and 2004 marks a significant increase in IPPs' market in line with GDP growth. Yet, the restriction to domestic private investment in the sector and unattractiveness to foreign investment dragged the electricity growth from 2004 and, consequentially, the economy was slowing down due to insufficient electricity. In response, the government corporatized EVN in 2006 and sold part of its subsidiaries' shares on the Stock Exchange to encourage private financing for capacity projects.

During this period, Vietnam has maintained close-to-universal electricity coverage, performing overall better than its neighbouring countries. Extension of transmission and distribution networks has always been state-owned from the previous period to now and the government has not shown any intention to privatise their network systems (Figure 19).

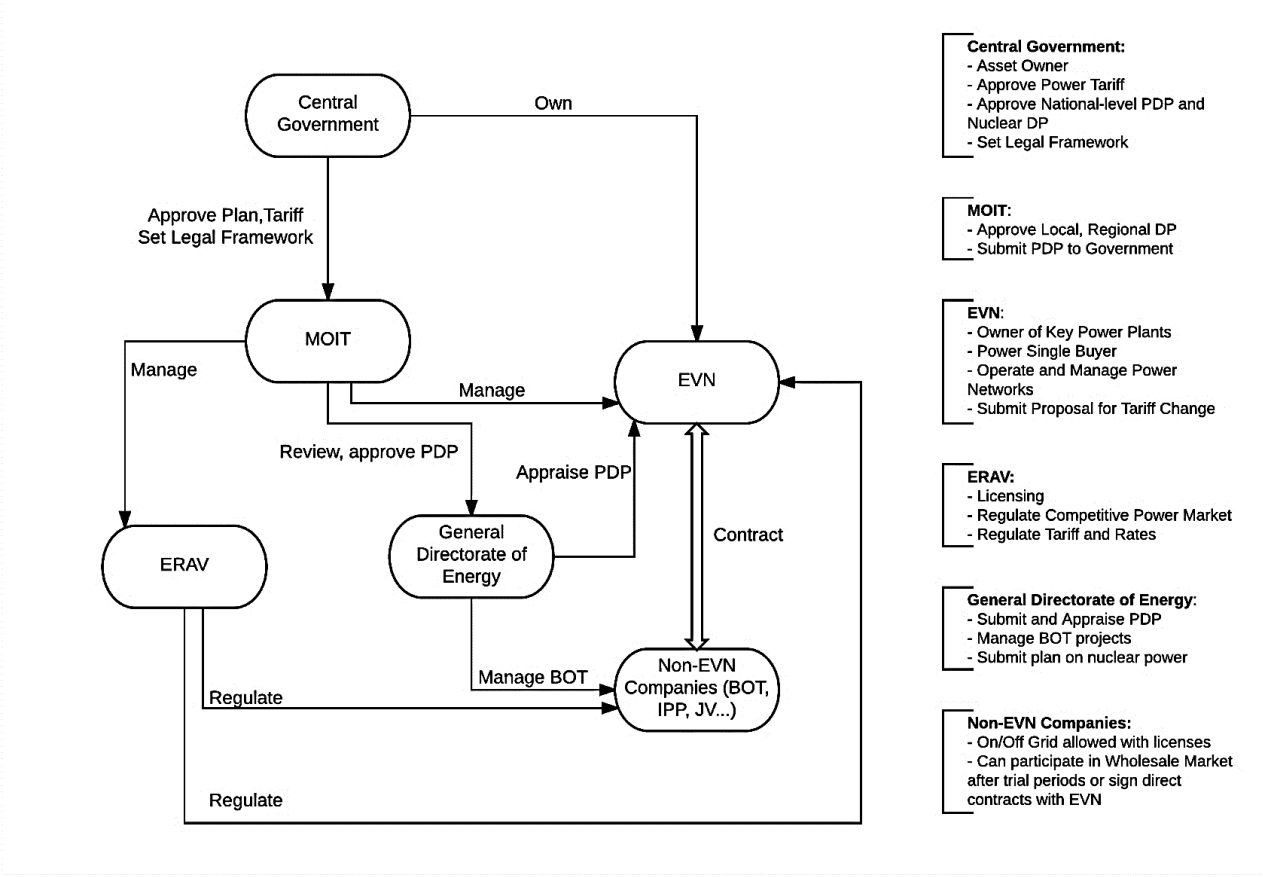
Figure 27 Electrification Rate in ASEAN-5 countries[30]



It is notable that private companies started to appear within this structure under different roles including: BOTs, Joint venture and IPPs. Figure 28 illustrates a streamline structure of these agents in the sector and their relationships with each other. MOIT now manages ERAV and GDE which are, respectively, in charge of regulating the sector, especially in the wholesale market newly established in 2016 and in charge of sectoral planning and strategies. EVN remains central in this network. The corporation remains 100% state-owned under Prime Minister's Decision, as well as its transmission subsidiary companies. Since officially unbundled and acting as a single buyer, EVN extends its business partner relationship with many other private and public companies. It can certainly submit proposals to GDE for power development plan or to MOIT for tariff changes. Despite being a monopolist, EVN does not have the legal autonomy in pricing as well as big-picture planning.

[30] Source of Data: IEA

Figure 28 Structure and Roles of Institutional Agents in Vietnam's Power sector[31]



[31] The figure is Author's Own, inspired by '*Figure 3: Government Institutions in the Power Sector'* in Nguyen (2012)

5.3. Challenges in the Power Sector

5.3.1. Supply access and Reliability

As seen, Vietnam has an almost perfect electrification rate. However, access to electricity also includes how quickly a household or business could get connected to the grid. And from this perspective, although it has much improved from 115 days from 2009-2014 to 59 days in 2015, in comparison to neighbouring countries, Vietnamese households have to wait a longer period to get connected.

Figure 29 Days Required to get Electricity in ASEAN-5 countries[32]

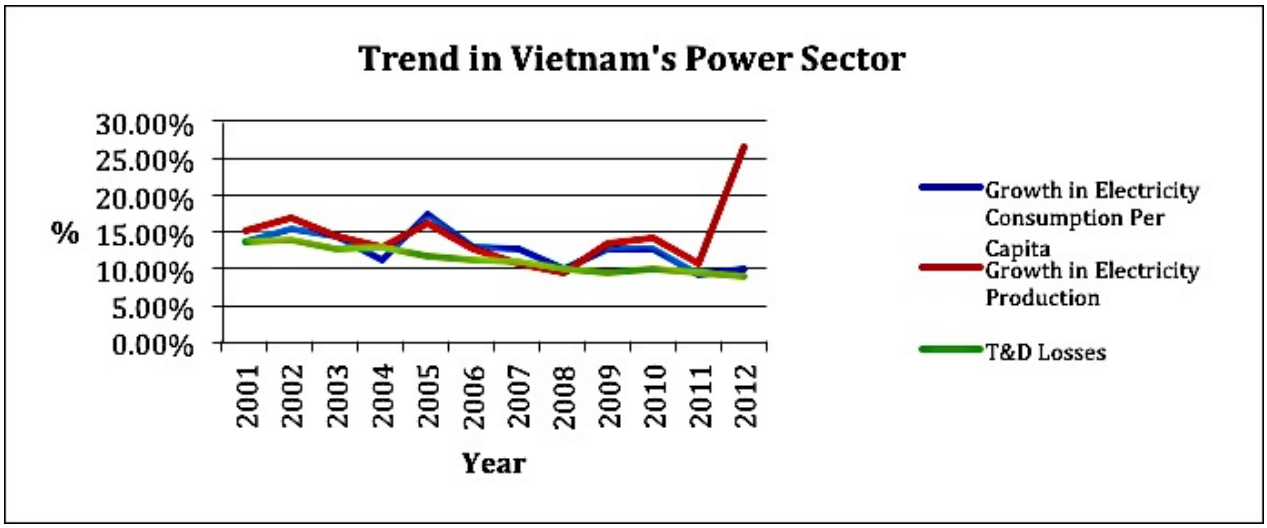
	2009	2010	2011	2012	2013	2014	2015
Indonesia	NA	NA	NA	NA	86.8	81.3	79
Malaysia	46	46	46	46	32	32	32
Philippines	42	42	42	42	42	42	42
Thailand	37	37	37	37	37	37	37
Vietnam	115	115	115	115	115	115	59

Another issue in the sector is the quality of the transmission system. The report by the ERAV forecasted that in 2012, the electricity industry would be able to meet national demand. However, in major urban cities, there were still blackouts as a result of system overloading, which was designed for only 77% of the current generation capacity. Since 2001, the Vietnamese government has acknowledged the need to increase generation capacity in the electricity sector. From 2001 to 2011, electricity supply grew in parallel with electricity consumption per capita. In 2012, there was a surge in power production but little change to actual electricity consumption. While system losses decrease consistently, the annual

[32] Source of data: World Bank (2016). The World Bank defines 'time required to get electricity' is the number of days to obtain a permanent electricity connection. The measure captures the median duration that the electricity utility and experts indicate is necessary in practice, rather than required by law, to complete a procedure.

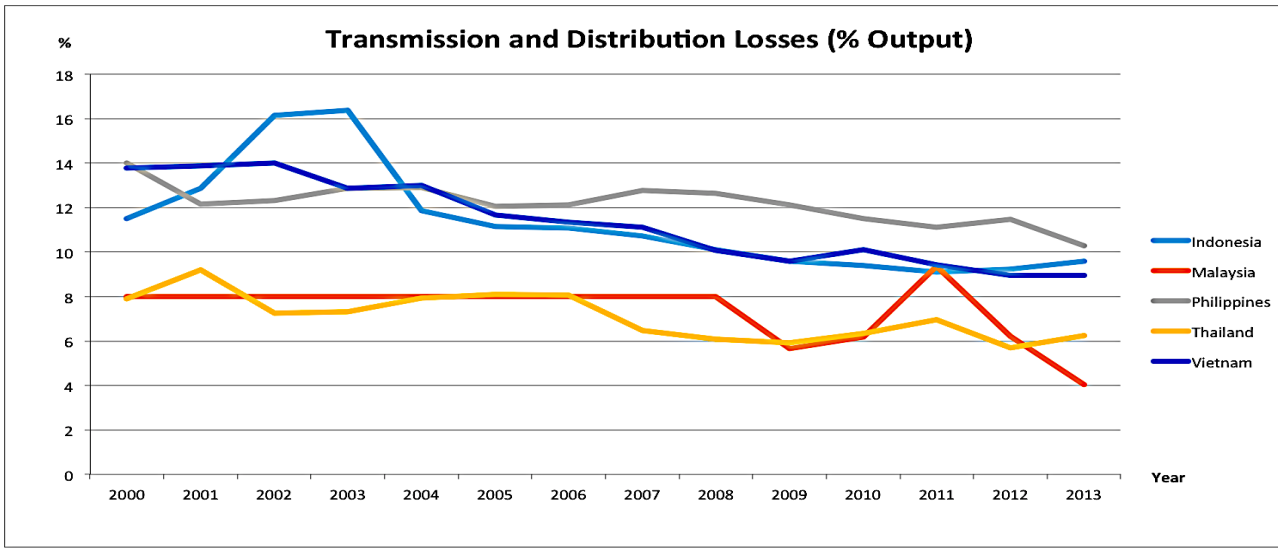
technical loss averaging 12% of output is still too high. In a World Bank report from 2011, Vietnam only ranks 88 out of 125 countries on quality of electricity supply (based on system losses). All 5 neighbouring ASEAN countries witnessed improvement in the system with reduction of transmission and distribution losses over the years (Figure 20). However, Vietnam's service quality is only at the same level or marginally better than that of Indonesia and the Philippines where geographies of scattered islands naturally hindered electricity transmission. With unprecedentedly growing demand of 14% per annum, the electricity industry, however, commonly fails to deliver, especially during peak hours and dry seasons. It is reported that 'in the whole country there were 3,000 blackout incidents due to system overloading during the first 7 months of 2008', equivalent to '14 blackouts a day' (Nguyen and Dapice, 2010). Dapice (UN) considers this as a 'pattern of blackouts', 'particularly in the dry season' by pointing out the great gap between peak and off-peak demand. The former is almost twice as much as the latter. Thus, importantly, any efforts in increasing generation would be inadequate without properly maintaining and upgrading the transmission system.

Figure 30 Trend in Vietnam's Power sector (2001-2012)[33]



[33] Source of data: World Bank (Consumption per capita, T&D losses); Enerdata (Electricity production). Calculation of growth rate is author's own.

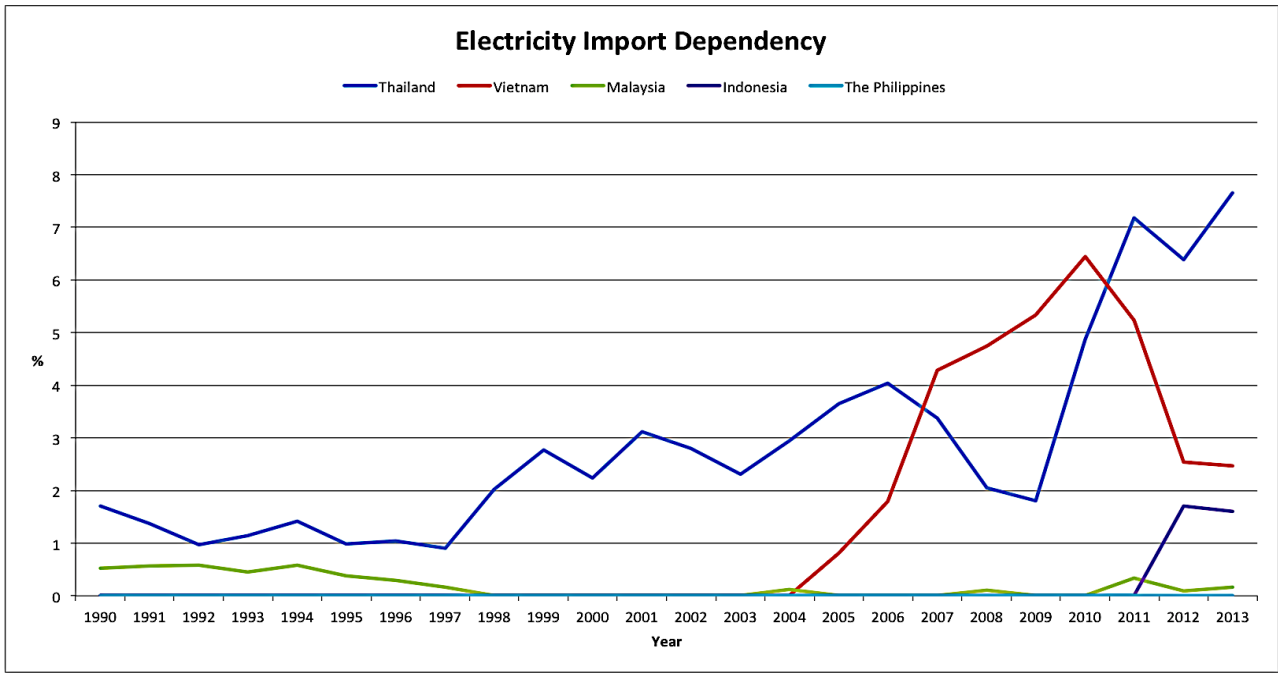
Figure 31 Transmission and Distribution Losses in ASEAN-5 countries[34]



As a way to mitigate this chronic electricity shortage, the industry's biggest player, Electricity Vietnam (EVN) has to buy in all that is produced domestically and import from neighbouring countries such as Laos and China. Electricity is imported from China at a much higher price and under undesirable contract terms that cause it to be many times more expensive than building extra power capacity. Import dependency is a good indicator of how much more electricity is required to satisfy domestic consumption. And Figure 22 indicates that there was an 8-year period from 2004 to 2012, Vietnam was in significant power deficit, much higher than Malaysia, Indonesia and the Philippines. A good sign is that this deficit started to come down in 2013, coincidental with strong generation capacity growth since 2012.

[34] Source of Data: World Bank (2016).

Figure 32 Electricity Import Dependency in ASEAN-5 countries[35]



Pricing

In 2011 the Prime Minister agreed to adjust the electricity price on the basis of actual costs, resulting in gradual price increases until the average prices would truly reflect costs. Within one year of the Prime Minister's decision, the price increased by 15.28%. EVN estimated that the 2012 price was around 62% less than the market price, for some inputs like gas, less than the production costs and was at an unsustainably low level compared to other countries. Yet, there are three other factors that will continue to push up the price of electricity in the short and medium terms.

Firstly, there is the annual increase in base salaries. The base salary increased by 26% in early 2012 to make up for inflation in 2011 of 25% and by 13.6% in 2011 to make up for inflation of 11.75% in 2010 (calculations based on General Statistics Office of Vietnam, 2012). Input costs will increase and so will the electricity price. Secondly, the international price of oil, coal and gas inputs to electricity generation is likely to continue to rise, and the devaluation of the Vietnamese Dong will make these price rises even greater. Thirdly, the operation of new nuclear power plants in 2020, in contrast to what many people

[35] Source of Input data: IEA (2016). Methodology for calculating import dependency is explained in Appendix

believe, will not reduce the price, because the huge debt incurred in its construction will have to be paid off through the electricity price (World Nuclear Association, 2012).

Therefore, the retail price, if decided by the market mechanism, will sharply increase in the future – and it will constantly fluctuate under pressure of changes in input prices and the exchange rate. The clearest consequence of such increases is a continuous rise in living costs, which will hit poorest families the hardest. It will also increase costs for companies and so possibly have a negative effect on GDP.

The increase in the electricity price after the Prime Minister's decision in 2011 shows that the government wants the sector to be able to finance itself. When the government budget is tightened and subsidies are re-allocated, negative economic and social impacts are likely to be incurred, hence offsetting the marginal financial gain by the withdrawal of subsidies. Simply, raising prices does not constitute an improvement in the economic situation.

Inefficiency of EVN

Not only cannot EVN satisfy its primary objective of ensuring a secure electricity supply, but it also suffers significant annual financial losses of hundreds of million dollars. EVN claims that too low average pricing of electricity is the cause of this loss. In addition, audit reports reveal that EVN's diversification policy had caused further losses.

Utilising a popular measure, policy makers therefore choose to apply the 'marketisation' or liberalization model that is, in theory, similar to the liberalization model that has been implemented in the UK and EU since the 1990s. The main reasons behind the policy are: 1) to assist the government in infrastructure investment; 2) to expose EVN to competitive forces through encouraging private and foreign investment which would force it to improve its financial and operational performance; and 3) to provide affordable and stably-priced electricity. These 3 major objectives are thought to be the outcomes of introducing competition to the traditional monopolistic market structure. This causal link is, however, usually assumed rather than discussed and tested.

Bad managerial practices should be considered as one valid cause for the inefficiency of EVN and the bad image of state-owned companies in the public's eyes. Since the beginning 2012, the government has tried to combat the issue of operational inefficiency by changing the organizational structure of EVN to avoid unprofitable businesses and lack of investment incentives. To avoid financial losses, it also increased prices. In response to public anger at the waste of taxpayers' money on inappropriate investment, EVN's Chairman was removed from his position. His bad managerial practices include losses in business diversification and significant overdue debts with PetroVietnam and Vinacomin. Possible cases of corruption are not yet revealed or officially judged. Any efforts in creating competition and improving efficiency will be wasted if the roots of the problems are ignored, such as bad management of the corporation, inadequacy in infrastructure investment and alleged corruption.

Decarbonisation and Environmental Impacts

One prominent issue in any power sector in the era is transition from fossil fuels to renewables in generation. But it should especially be so in Vietnam where CO2 intensity is higher than the world's average and its 2 metropolitan areas are in the top 10 most polluted cities in the world.

In comparison to other countries in the region, the outlook seems promising for Vietnam since the country has a continuing highest rate of renewables in total power out since 2000 (Figure 33). Figure 34 also shows a consistent increase in total installed capacity from renewable sources since 1964. However, further analysis into what has happened to different types of generation may reveal a less optimistic picture.

In the same figure 34, the growth in renewables has also been seen in fossil fuels in power generation. Since 2003, fossil fuelled power output has exceeded that from renewable sources. The scale would be even heavier on the side of fossil fuel vs. renewable sources by excluding hydro.

However, the use of hydropower has been subject to debates on its environmental and social impacts including deforestation, disturbances to natural habitats, rehabilitation of local homes. In Vietnam, hydro power plants have been criticised for severe damage in the way they operate the reservoir in rainy seasons. The term 'deadly water discharge' came up often

on newspapers around the same time every year. To name a few, A Vuong HPP released its dam that contributed to the death of 163 people and cost nearly $800 million in property loss. Another disaster happened in 2013 with 41 deaths. In winter 2016, Ho Ho HPP released water during heavy rain and drowned 5000 houses and caused 9 deaths (VnExpress, 2016). In many cases, water discharges should have been informed to local households to avoid loss of life but personal economic damage would still be likely to happen. Flood control is an essential duty of hydropower plants, although 90% of Mekong Basin's flow (upstream) is generated and controlled from outside the country. Yet, frequent floods should have put a big question on the practice of flood control by hydropower plants. And if for a sufficiently long time there has not been a solution, an alternative energy source should be explored.

A closer look at composition of generation types in Figure 36 shows the increasing use of coal, which is considered a major contribution to the pollution disaster in China. Coal is the main source of fuel input for power generation since early 2000s. ADB (2015) found that the price of coal in Vietnam is set below world market price, making it a cheaper input source and encouraging the use of coal in power generation. This rise also coincides with CO2 intensity. Figure 35 depicts how Vietnam is going against the wave of reducing CO2 intensity. While on average, other countries are trying to reduce the emission of CO2 per electricity output, Vietnam has seen a persistent increase from 2000.

This section aims to show that a quick glance at Renewables in the sector may mislead and cause misunderstanding of how ecologically friendly the power sector has been. Hence, it may cause the government to overlook this challenge to decarbonise power generation.

Figure 33 Renewables in Total power output in ASEAN-5 countries

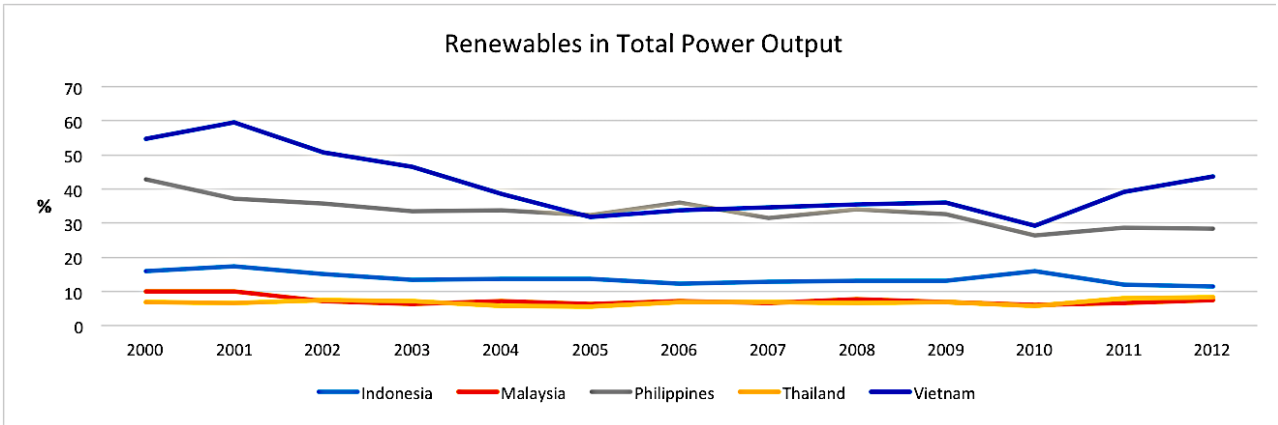


Figure 34 Renewables vs. Fossil Fuels in Power Generation, Vietnam, 1964-2017[36]

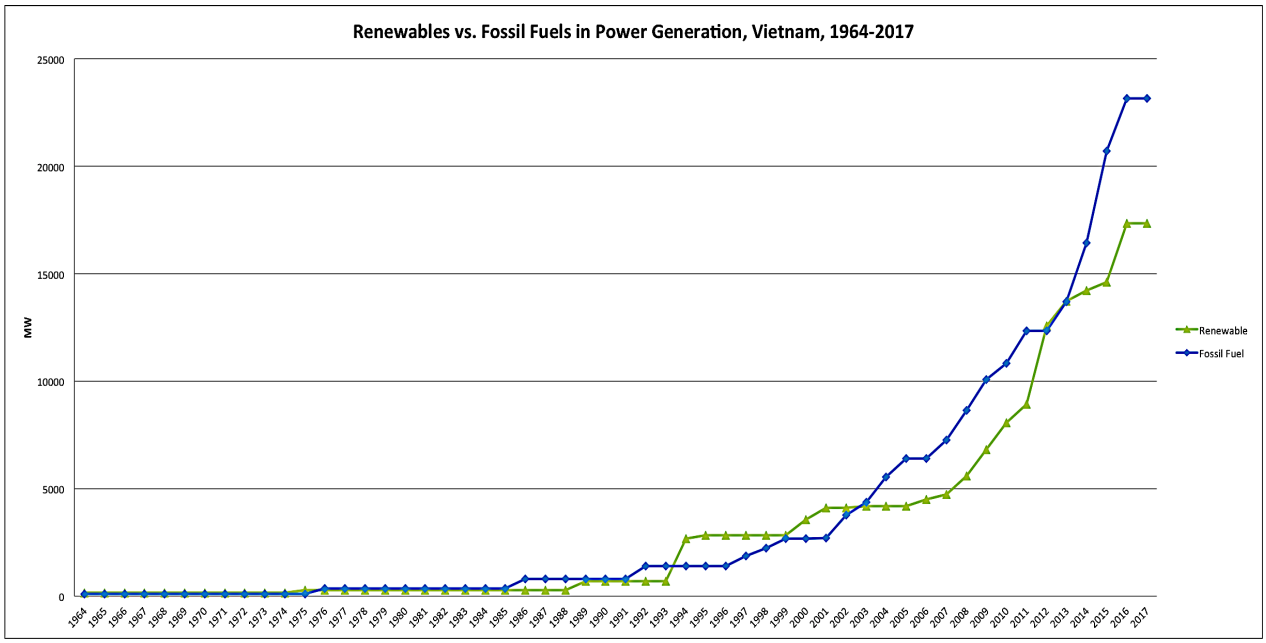
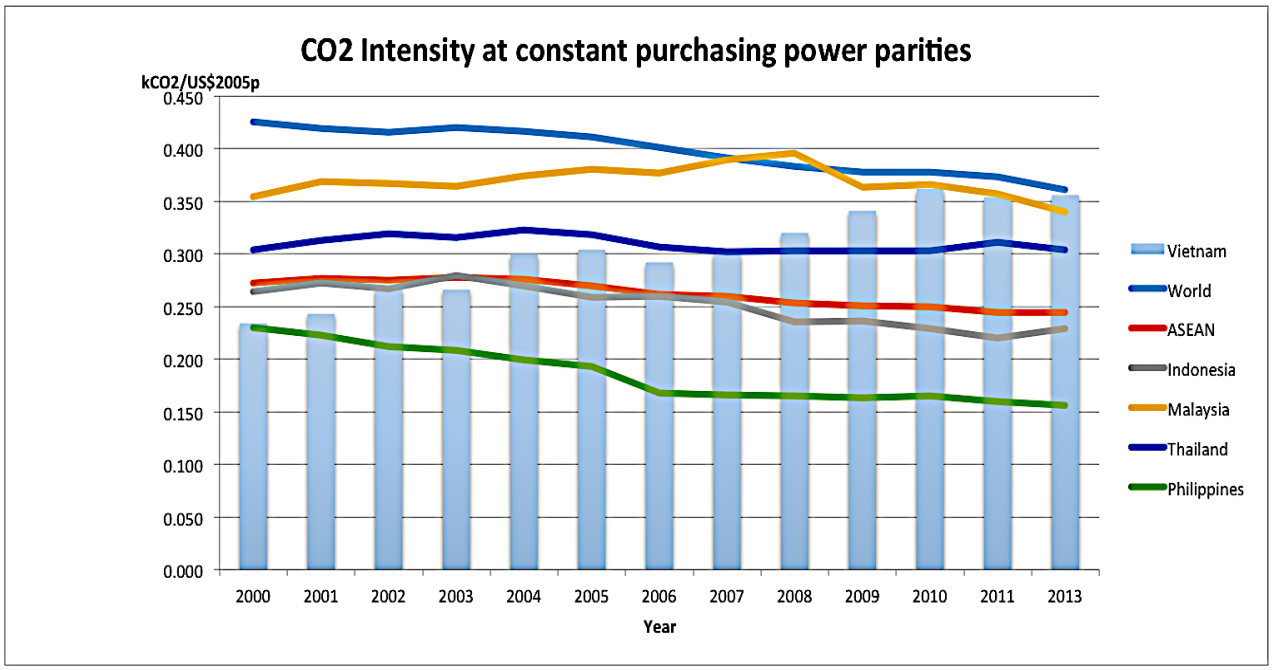


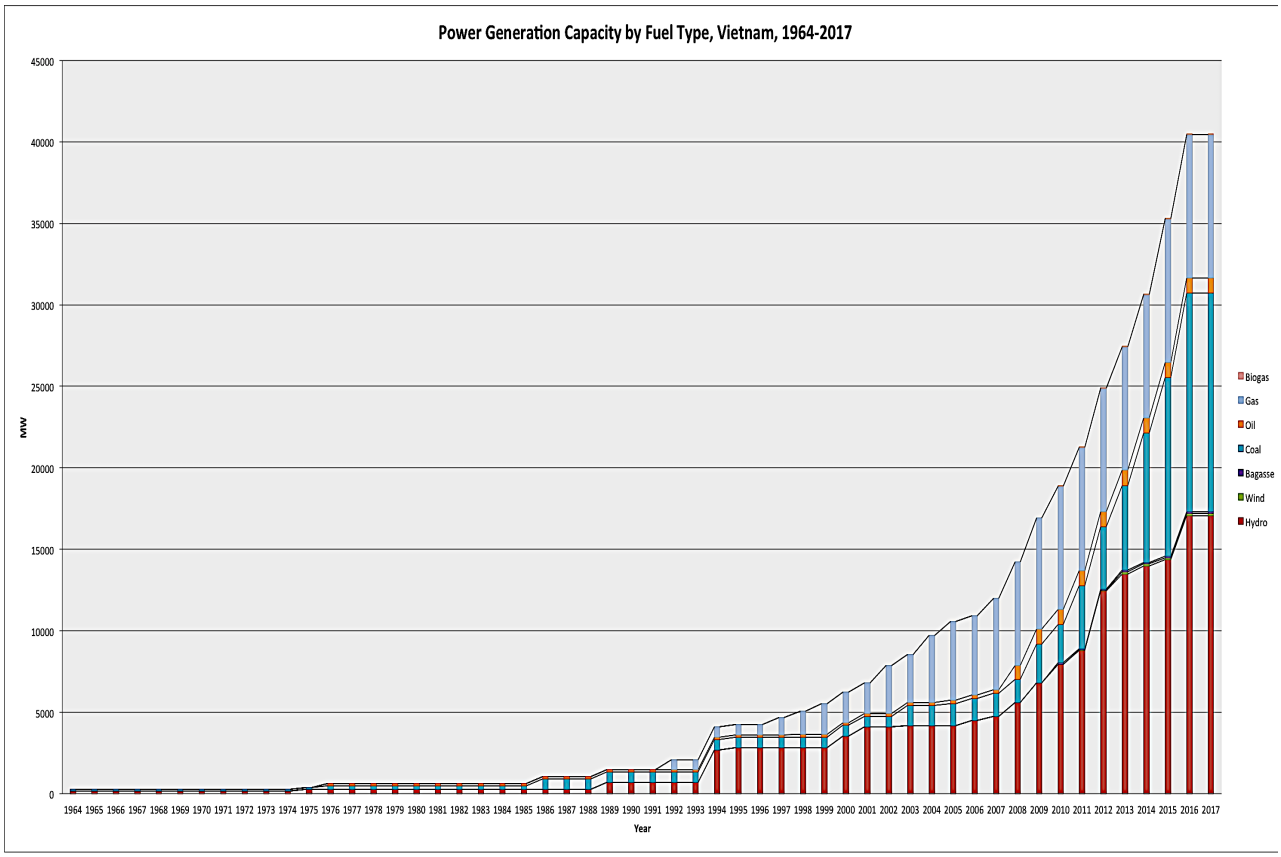
Figure 35 CO2 intensity at constant purchasing power parities (World vs. ASEAN vs. Vietnam)[37]



[36] Source of Data: The Power Sector Database (2017). Renewables include Hydro

[37] Source of Data: Enerdata (2016). The data were used with consent but detailed data cannot be published. World and ASEAN data are average. CO2 at constant PPP is kg of CO2 emissions per purchasing power parity of GDP

Figure 36 Power Generation Capacity by Fuel Type, Vietnam, 1964-2017

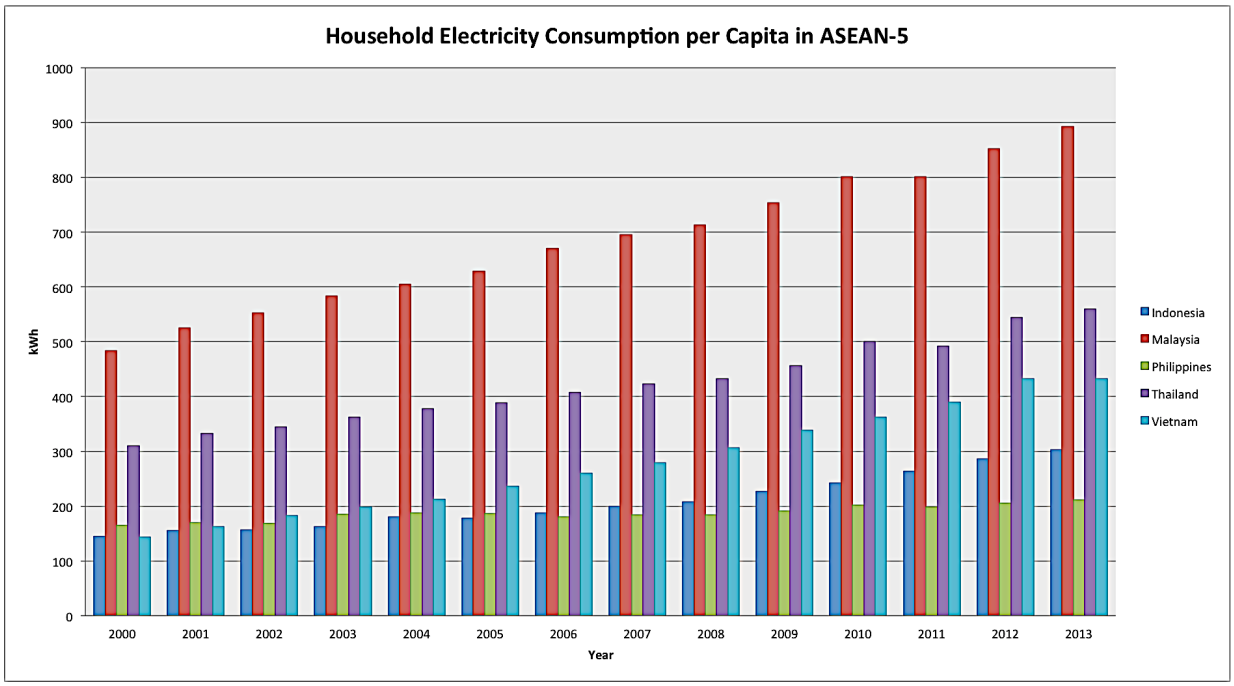


5.4. OPPORTUNITIES IN THE POWER SECTOR

5.4.1. Increasing Demand

A key driver for policy changes in the sector is how much economic growth has driven demand for electricity. While GDP growth p.a. is around 5-6% per year, energy demand has grown around 14% p.a. Power consumption per capita is ranging from 10-15% p.a. during this remarkable growth period. Power production has grown roughly 15% from 2000-2010 and shot up to above 25% from 2012. In fact, since 1990, electric supply growth has surpassed that of GDP (ADB, 2015). Power consumption by households has increased steadily, reflecting penetration of electrical appliances and tools in households. Vietnamese households are actually catching up with those in Thailand and are surpassing consumption in the Philippines and Indonesia though sharing similar economic development stages (Figure 37). There is further room for the sector to grow to meet these residential needs.

Figure 37 Household Electricity Consumption per Capacity in ASEAN-5 countries[38]



5.4.2. Abundant Resources

It is rational for Vietnam to develop hydropower generation when its estimated exploitable potential from this source is around 80-100 TWh with installed capacity of roughly 18-20,000 MW (Honningsvag et al, 2001). More optimistically, PECC1[39] estimated these as even up to 300TWh and 34, 647MW, respectively (Nguyen, UN). The country's geography endows it with 2,360 rivers that are longer than 10km. However, as pointed out above, the use of hydropower is controversial: generating low carbon but causing social damage.

The Vietnamese government has started to invest in wind turbines. Power output from wind has been almost unimportant in total electricity output. Another source that has been utilised popularly in sugar companies is biomass (including bagasse). Though power generated is a by-product and is of small scale. Especially in Vietnam, biomass resources are abundant. They can be found in many forms in all regions, to name a few, rice straw, coffee husk, fuel woods, coconuts waste, … Biomass energy from forestry and agricultural residues could

[38] Sources of Input Data: IEA (National Residential Consumption Data), World Bank (Population Data). See Spreadsheet for Input and Calculated Data.

[39] PECC1 is a subsidiary of EVN whose main business is power generation project consultancy and design.

create estimated potential at more than 2000 MW. Biogas is also being explored on a very small scale. Its potential is more than 100 MW.

The country has not explored solar power at all so far despite being close to the equator with abundant solar potential. The potential capacity generated from solar energy is estimated at 4-5000 kWh/m2. Another unexplored alternative is tidal power, which is estimated to be able to produce 100-200 MW.

Realising the national potential, the Vietnamese government has introduced a combination of subsidy mechanisms to encourage investment in alternative energy sources. To start with, small-scale hydropower, which is within financial capabilities of domestic private investors, is not subject to standard PPAs and their output is guaranteed to be purchased by EVN. Then in 2011, the National PDP VII has indicated the government's direction towards a more sustainable power sector, aiming at 5% of RE in 2020 and 11% in 2050. In 2014, the Prime Minister made Decision No.31/2014/QD-TTg and Decision No.24/2014/QD-TTg to introduce subsidy mechanism for solid waste power and biomass power, respectively. To say that energy resources are abundant and that institutions are favouring alternative sources is to acknowledge that investment in sustainable power production is a promising opportunity for investors of different interests and financial endowments.

5.4.3. Interconnected Regional Power Market

The region of the Association of Southeast Asian Nations (ASEAN) is one of the fastest developing regions in the world. With the substantial increase in electricity demand over the past decades, driven by social and economic development, these regions have been identified as playing an increasingly importantly role in world energy demand in the coming decades. The five largest energy-consuming countries in ASEAN include Indonesia, Malaysia, the Philippines, Thailand and Vietnam (ASEAN-5). These countries have a combined population of around 0.5 billion and their electricity demand accounts for more than 10 percent of the world's electricity demand. Table 7 shows how connected these 5 countries

are already trading power with each other.[40] Cross-border trading could support the current power system by providing a cushion for the strained internal systems during peak demands. Vietnam has signed this back-up contract with Chinese power providers for this purpose. It could also provide incentives for domestic generators to build larger-scale power plants, become more efficient, so that they can export to other countries. Figure 30 indicates an annual steady increase in power export from Vietnam. A profitable business that is being explored now in Vietnam is for Vietnamese companies to build their power plants in Laos PDR where the construction and labour costs are relatively cheap and it is fairly convenient for exporting electricity back to Vietnam as well as entering a new market. HAGL is a private corporation that has pioneered this business with 2 power plants in operation in Laos. A major project operating in this same principle is Nam Theun.

As ASEAN alone is getting more interconnected (as shown in Table 17), there exists incentives for investors to come to the sector envisioning not serving one single domestic market with a single buyer but also serving another market with different tariffs.

Table 17 Cross-border power trading in ASEAN-5 countries[41]

Country	Cross-border Interconnections
Thailand	Malaysia, Laos PDR
Indonesia	Malaysia
Malaysia	Thailand, Singapore, Indonesia
Philippines	-
Vietnam	China, Laos PDR & Cambodia

[40] Due to the location and geography, the Philippines could hardly construct transmission networks with its neighboring countries yet.

[41] Due to the location and geography, the Philippines could hardly construct transmission networks with its neighboring countries yet.

Figure 38 Vietnam's Transmission System in 2011[42]

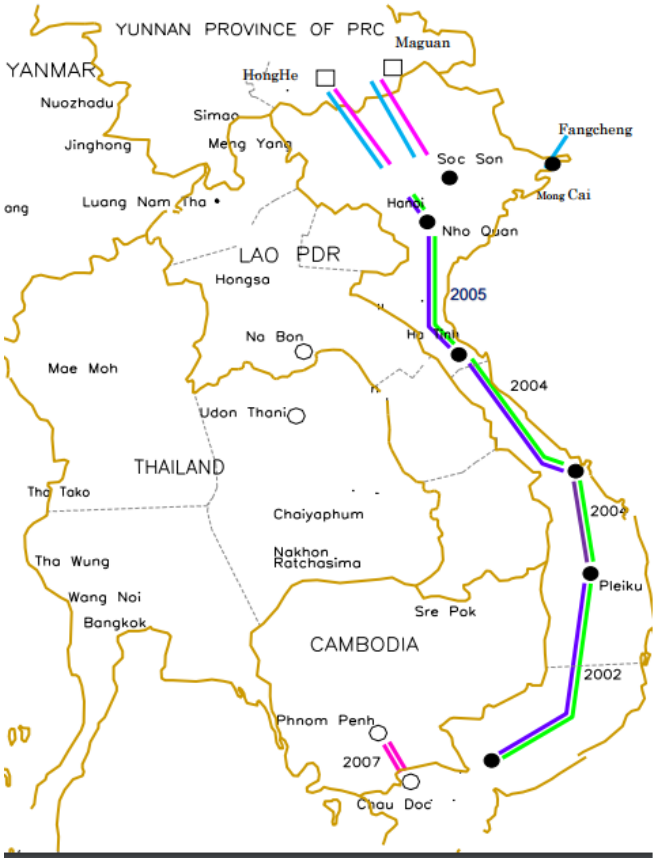


Table 18 Interconnection Projects between ASEAN-5 countries[43]

Unit: MW	**Existing**	**Ongoing**	**Future Plan**
Indonesia	0	830	1620
Malaysia	830	1130	1720
Philippines	0	0	500
Thailand	3941	6187	16200
Vietnam	1098	3860	0

[42] Source: Institute of Energy

[43] Source of Input Data: HAPUA Secretariat; ADB. There is no available data for all the power interconnection projects in ASEAN-5, therefore I searched data for APG and GMS projects, which should contain most of the interconnection projects these countries have. This table shows the total of existing and committed capacity from these projects.

Figure 39 Annual power imports and exports in Vietnam[44]

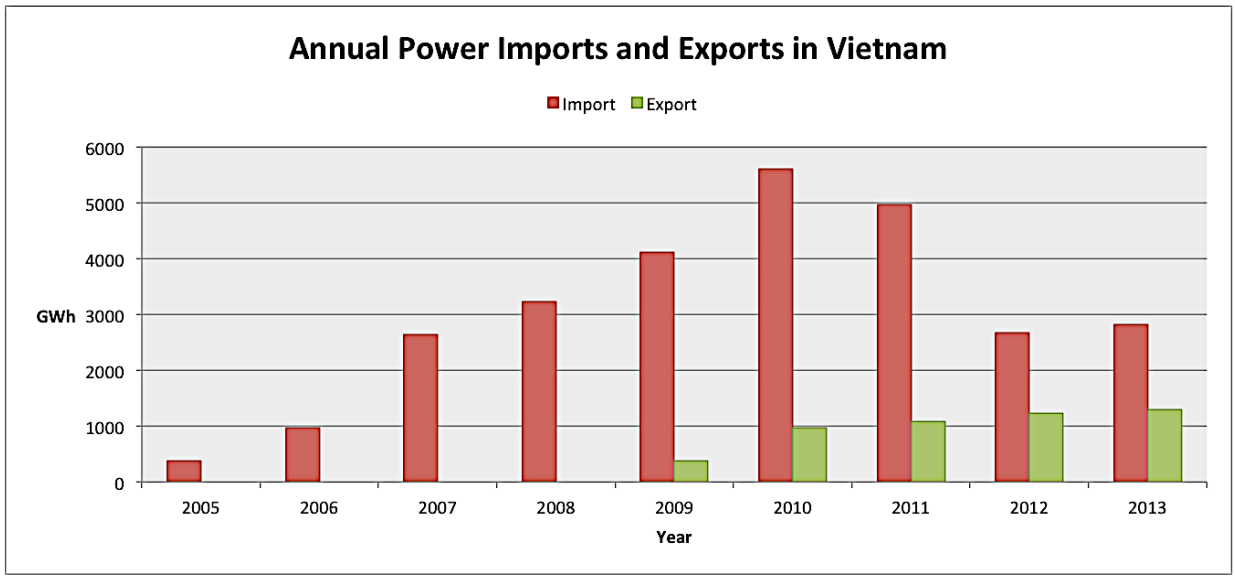


Figure 40 Cross-border trading between ASEAN countries

[44] Source of Data: IEA (2016)

5.5. Enablers of Power Sector Development [45]

The historical development of Vietnam's Power Sector through its policies has been discussed in the previous chapter. Yet, little has been known about how the power sector grew and who enabled this growth throughout the years.

Any power project would be impossible without an initial investment from an initial investor or group of equity investors as well as lender(s) (banks or institutions) at the initial stage of the power project. They are hereby referred to as 'initial investors' and 'lenders'. These institutions are pivotal to the growth of green investment into power generation. Private entities' roles in this initial stage are discussed in later sections, separated into subsections on private investors and private lenders.

The Power Sector Database collects not only the power plants that are in operation and visible on the map but also projects that were initiated, licensed, under construction or cancelled. These projects are important. 189 out of 269 projects[46] are now in use. What is more apparent is that these 189 projects account for 56% of total financing costs (Figure 41). The total financing costs as calculated in this part includes costs of completed, under construction and licensed projects. So the costs of completed projects are historical costs while 44% of the total costs represents what would be likely to come in the near future given all goes as planned. This overwhelming volume of potential financial inflow[47] in the sector

[45] To the author's knowledge, the term 'Enabler' was first used in energy economics context by the U.S. Department of Energy's Electricity Advisory Committee (2008) when referring to Smart Grid as 'Enabler of the New Energy Economy'. Standish (2009) later referred to 'Digitization of the electric grid' as 'enabler of the energy efficiency and economic gain'. However, there has not been known yet that any other author or institution has used the term 'Enablers to Power Sector Development' as a framework to analyse the relationship and coordination between actors in the sector.

[46] The Database contains data on 272 power plants from the very beginning of the Vietnam power sector but data are more complete from 1964 with 269 projects. So for analysisOF WHAT??, we only look at post-1964 period.

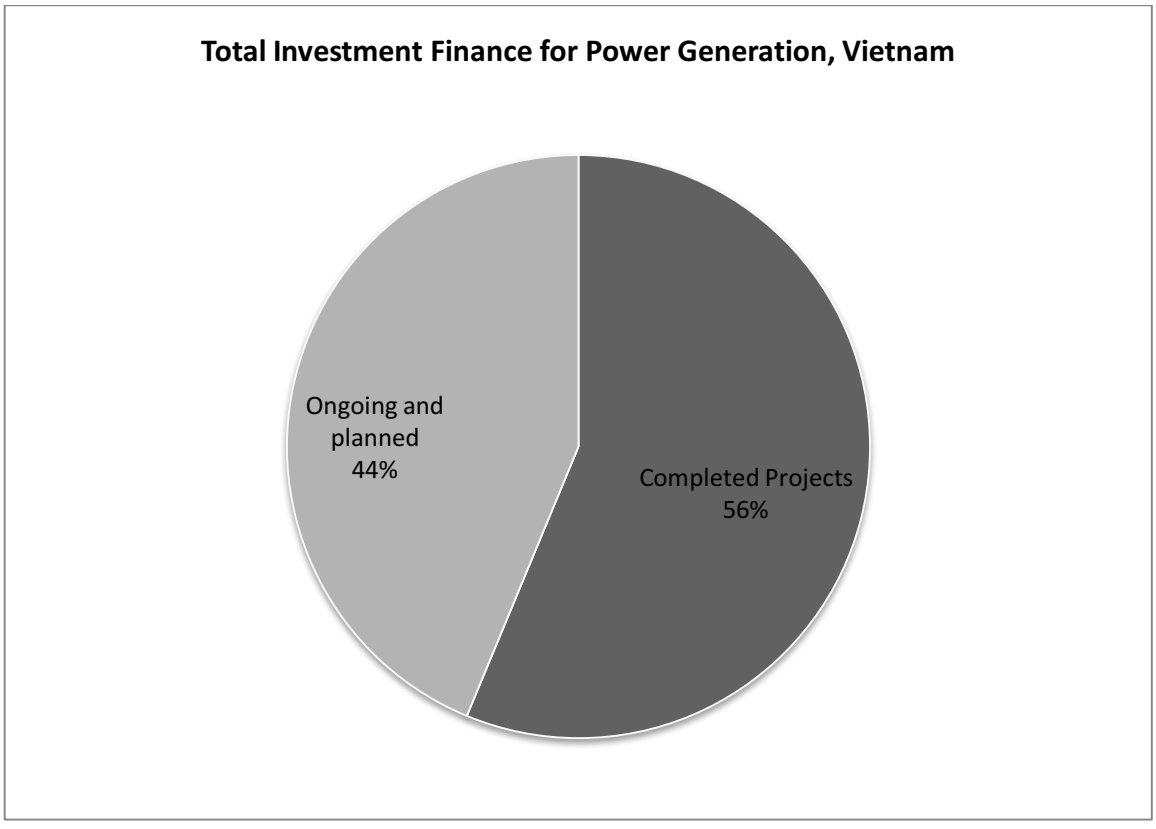
[47] In the Database, if a project has not been completed and then cancelled, the financial contribution is marked at 0. There is one project (Song Nam-Song Bac) which was in use from 2010 to 2014 then got closed down.

throughout 55 years indicates the sheer amount of genuine interest of investors in Vietnam's power sector.

Table 19 Sources of finance in All power generation projects in Vietnam[48]

	Total Costs of Power Generation	Equity Investment	Debt
Proportion (%)	100	69%	31%
In Billion USD (2010 value) (up to 2 decimal places)	111.05	76.24	34.81

Figure 41 Total Costs of Financing Power Projects in Vietnam[49]



[48] All 269 recorded projects including completed and ongoing projects

[49] Source of Data: The Power Sector Database 2017. 187 Completed vs. All 269 recorded projects since 1964.

Looking at the development of the sector since 1964 to 2020,[50] the role of financiers is undeniably important. Without their financial contribution, there would not be any projects. But the term 'financier' encompasses both equity investors and lenders and their motivations as well as actions are different in nature. Investors often come first in the stage of project appraisal. Their contributions are in forms of equity. They look for long-term returns in forms of profits. Their risks are higher than lenders. Lenders look for interest payments. And their loans often have to be guaranteed by investors' other properties, deposits or by a creditable institution. Figure PP shows the difference in the roles of investors vs. lenders in completed projects vs. all recorded projects. In both completed and expected projects, financial contributions by investors vs. lenders are 2:1. A possible explanation is that equity investors tend to carry out project appraisal based on historical records and lenders could accept what has become common in the sector. However, depending on the nature of each power generation projects, lending institutions could be more susceptible to agree on loans. Notably, biogas and bagasse power generation is a by-product which tends to be self-funded by the manufacturers. Except for these 2 fuel types, Figure 43 illustrates that gas, hydro and wind power projects tend to get a higher proportion of loans to support investment. However, it is not true that lenders prefer these types of generation. Figure 44 shows an overwhelming amount of loans given to coal-fired power stations which is 4 times as much as that to hydropower plants and much more than total of all other fuels together.

[50] Projected

Figure 42 Sources of finance in power generation projects in Vietnam

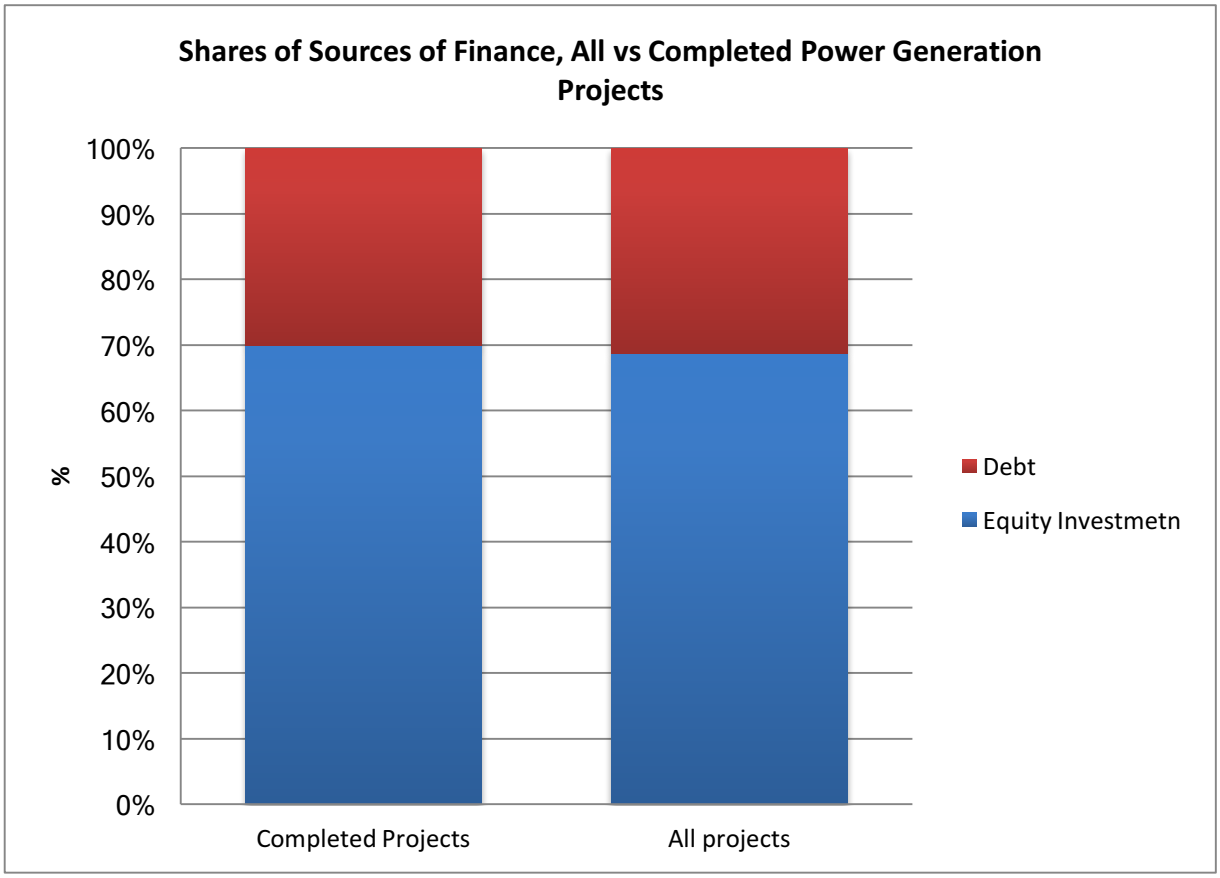


Figure 43 Proportion of Equity Investment vs. Debt in All Power Generation Projects in Vietnam

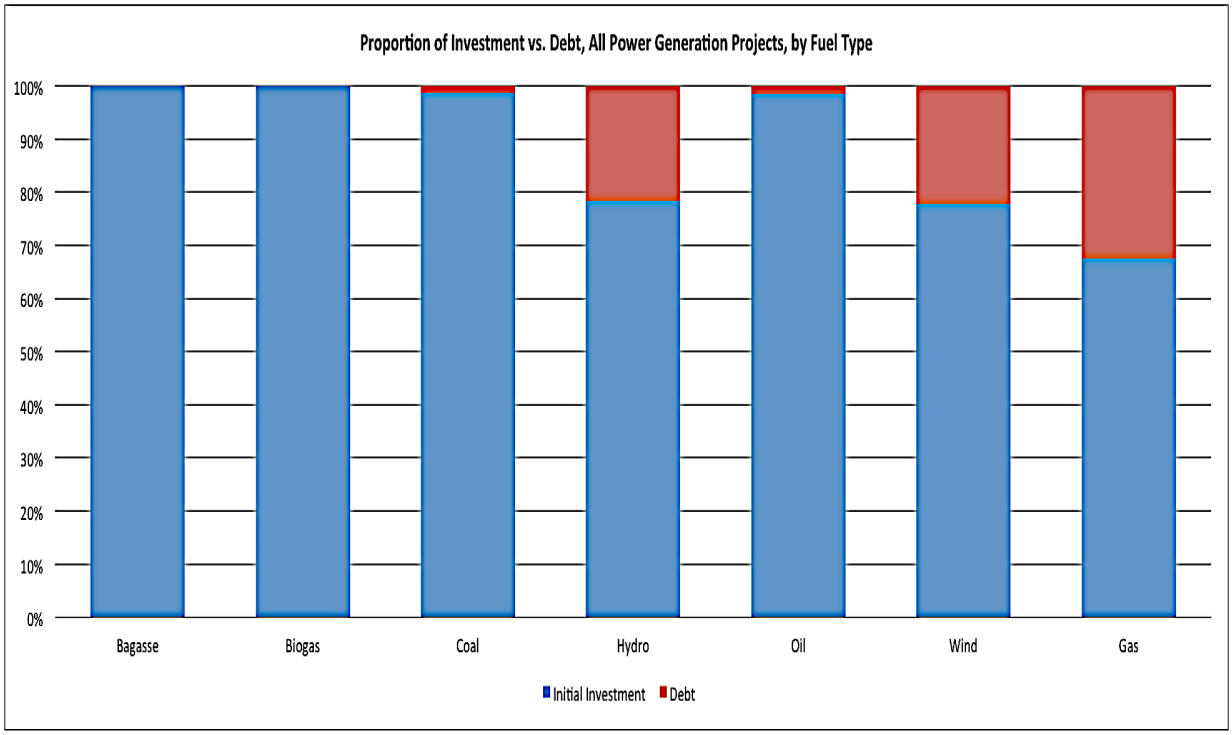
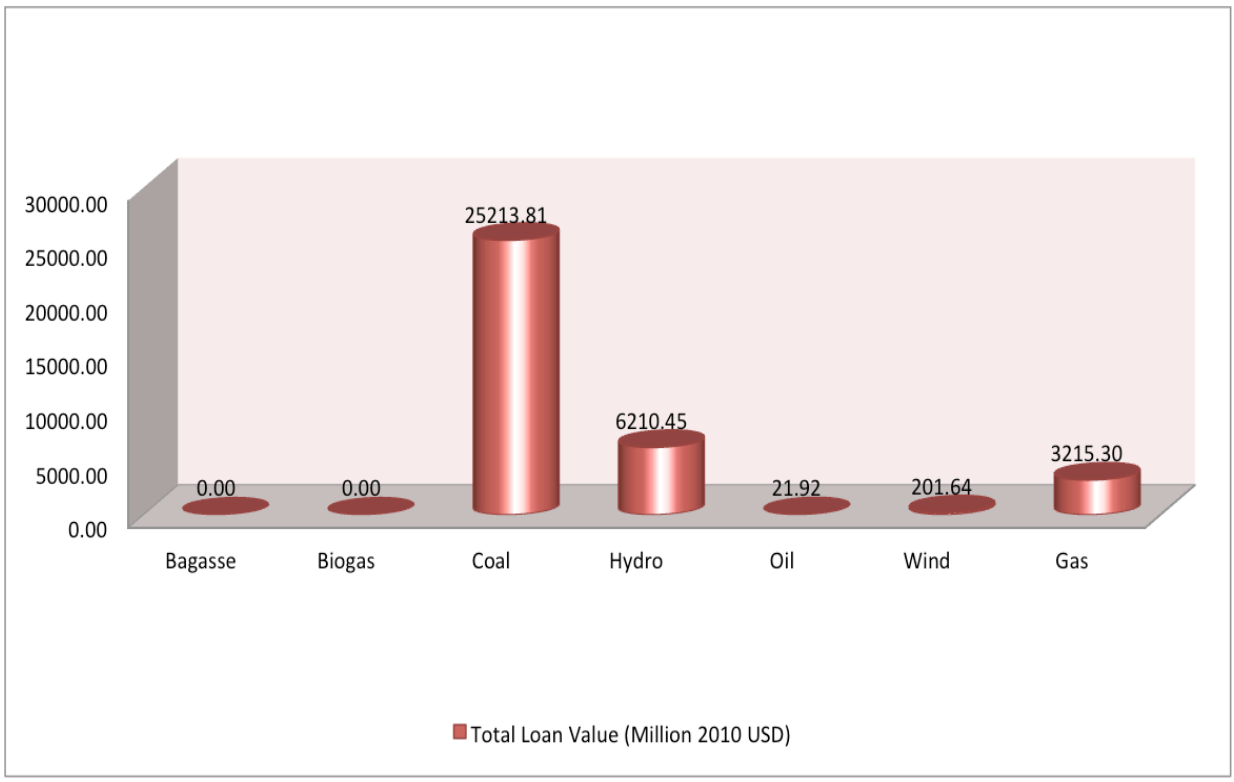


Figure 44 Loan Values in Fuel Type in All Power Generation Projects in Vietnam



While the Database collects details regarding loans, the value of loans as well as details about lenders are also collected. Figure 45 shows that the majority of loan values comes from foreign institutions,[51] accounting for an overwhelming 81% of total loan values. This figure could be explained by the fact that the Vietnamese banking system has only just been developed within the last 10 years and also their capital is limited. In addition, Figure 36 analyses the ownership of these lending institutions. The figure shows that regardless of whether domestic or international, public institutions have been lending significantly more than private ones. Internationally, public funds lend 11 times more than private funds. This ratio is even bigger in Vietnam where public funds authorise more than 20 times what is done by private funds.[52] The role of public lenders is prominent in all types of generation. In looking at the fuel type of power generation, a pattern starts to appear in what lenders tend to choose. Figure 47 shows that domestic institutions support wind and hydropower while foreign lenders support the use of gas and coal. And as seen in Figure 46, wind power projects have only obtained public funds. From the sectoral development analysis in the previous section, a possible explanation is that wind power is a fairly new alternative source

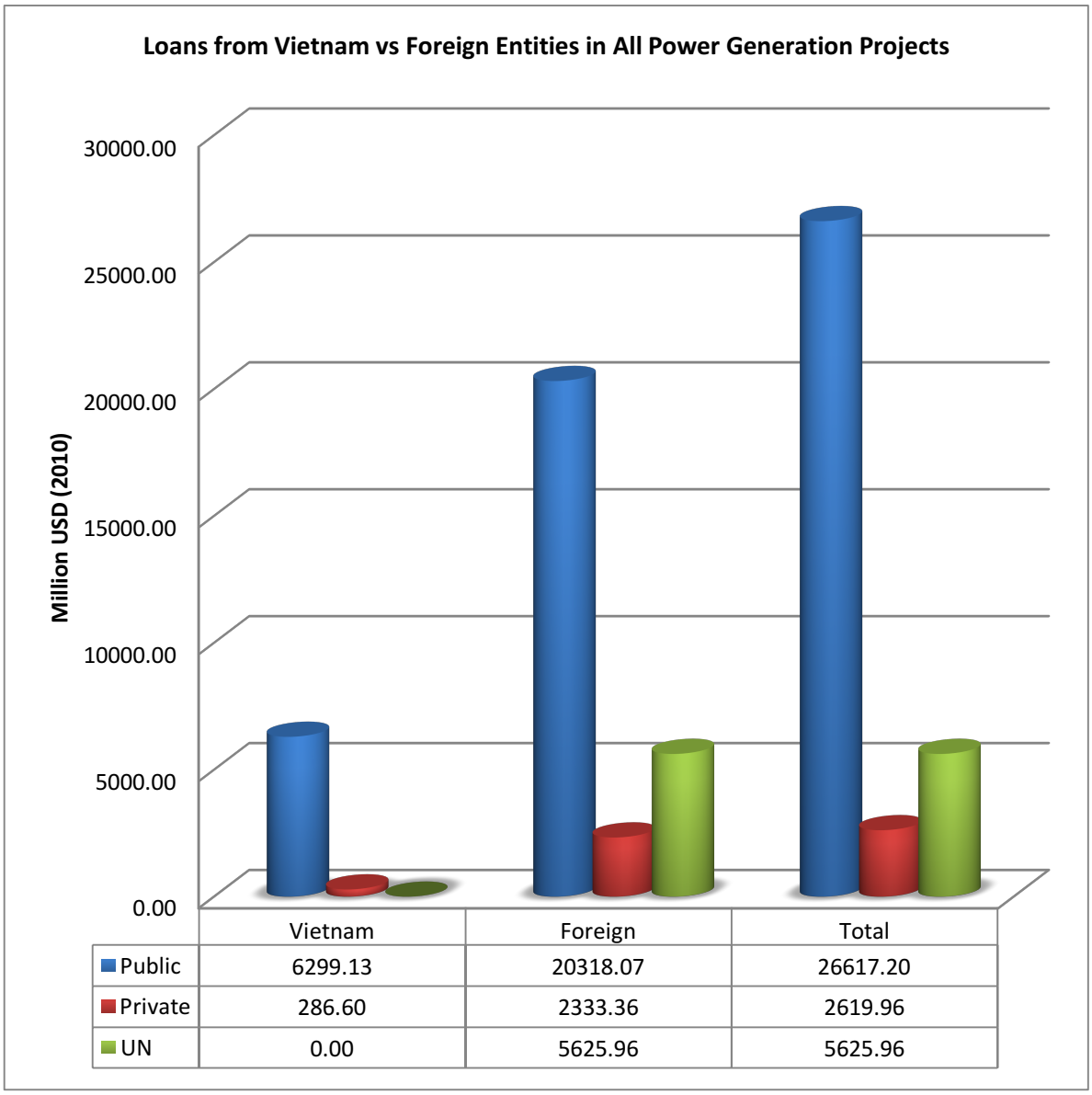
[51] The Database shows no individual lenders.

[52] The term 'authorise' is used because a loan is only recorded when there is a signed agreement.

of energy being explored in Vietnam. The risks of investment are higher, in comparison to conventional sources. Only domestic public funding can afford to take the risk following the national strategy in developing sustainable energy.

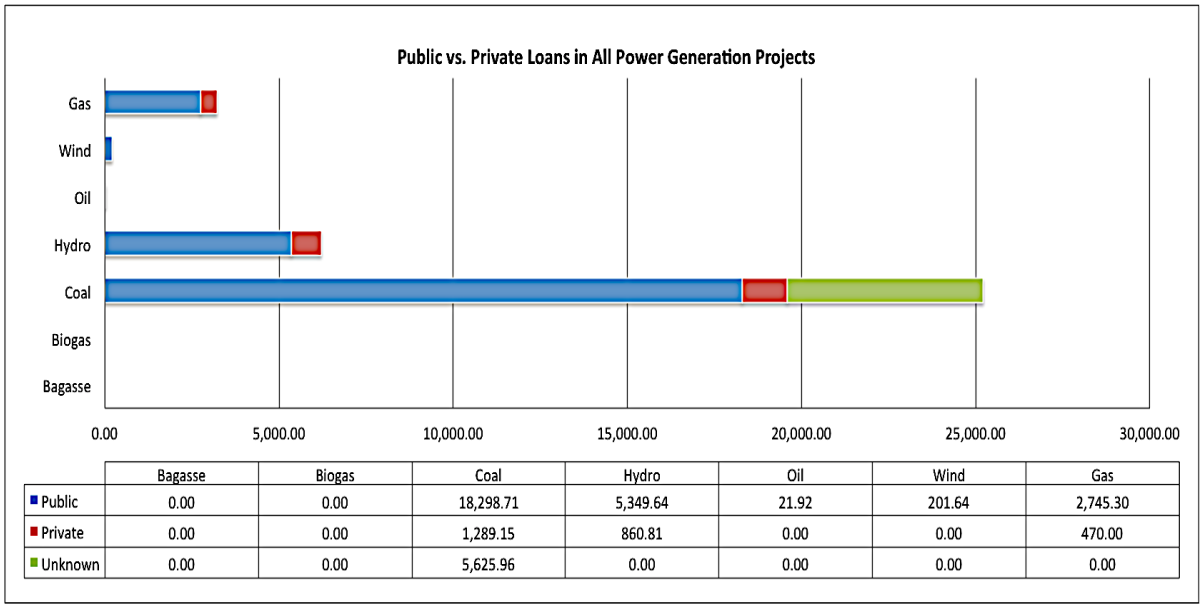
Beside Vietnamese sources, there are certain lenders whose funds have mattered to the power sector. The largest amount of loans comes from multilateral funds, mostly from the World Bank and the ADB. There is a common belief that Western banks have more capital hence their roles are more significant. On the contrary, Asian institutions from China, Korea and Japan are much more agreeable to supporting Vietnam. Chinese banks even lent more than Vietnamese banks in the power sector (Figure 48).

Figure 45 Loans from Domestic vs. Foreign Entities in All Power Generation Projects (1961-2017)



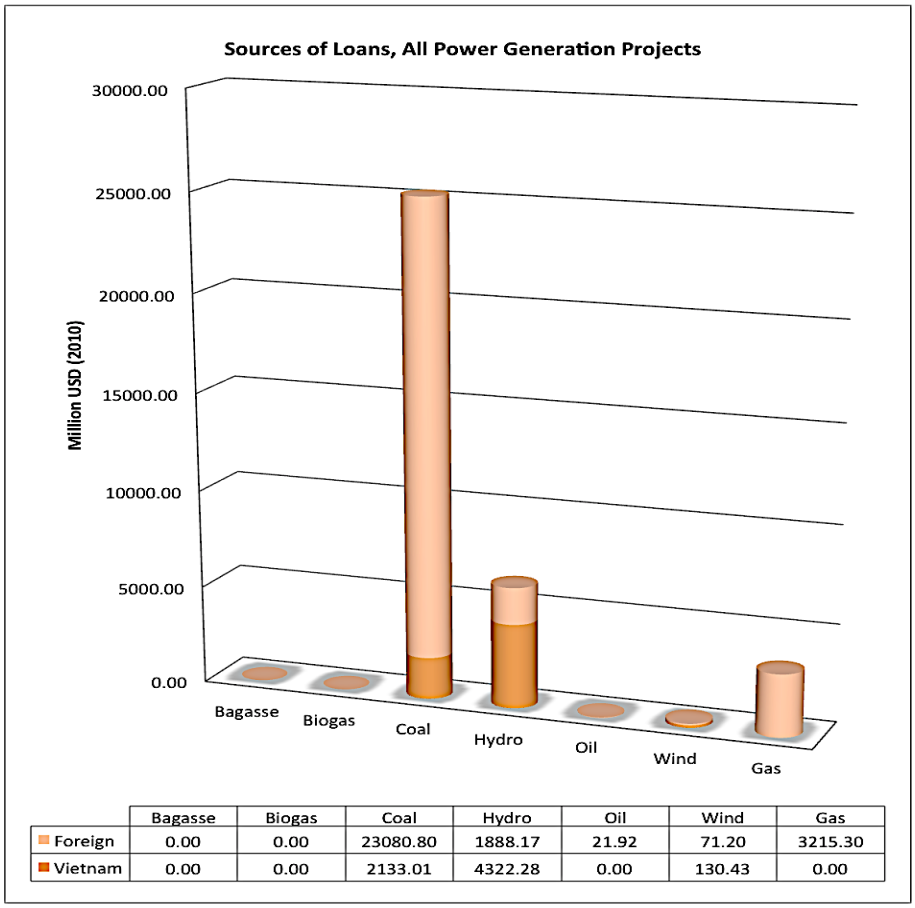
	Vietnam	Foreign	Total
Public	6299.13	20318.07	26617.20
Private	286.60	2333.36	2619.96
UN	0.00	5625.96	5625.96

Figure 46 Public vs. Private Loans, by Fuel Type, in All Power Generation Projects, Vietnam (US$2010 Mil)



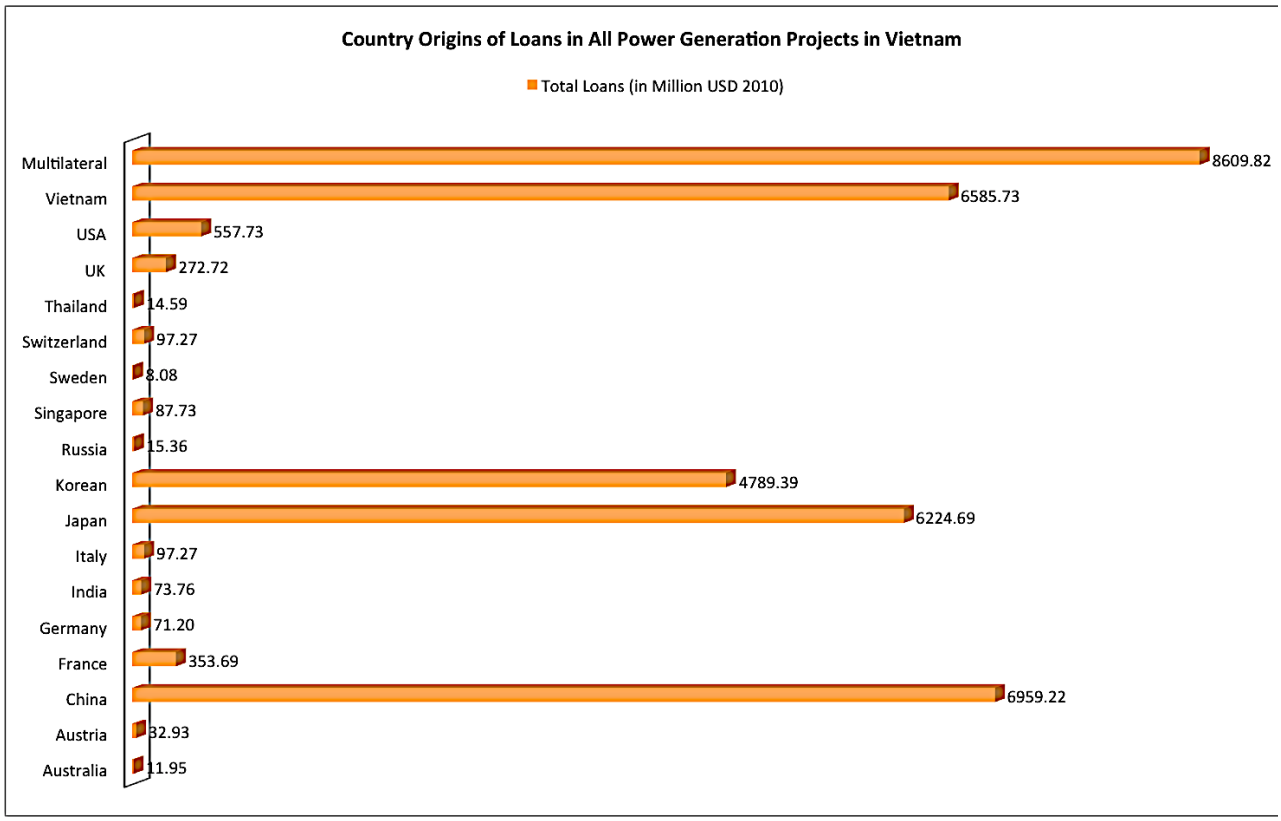
	Bagasse	Biogas	Coal	Hydro	Oil	Wind	Gas
Public	0.00	0.00	18,298.71	5,349.64	21.92	201.64	2,745.30
Private	0.00	0.00	1,289.15	860.81	0.00	0.00	470.00
Unknown	0.00	0.00	5,625.96	0.00	0.00	0.00	0.00

Figure 47 Sources of Loans, By Fuel Type, in All Power Generation Projects in Vietnam



	Bagasse	Biogas	Coal	Hydro	Oil	Wind	Gas
Foreign	0.00	0.00	23080.80	1888.17	21.92	71.20	3215.30
Vietnam	0.00	0.00	2133.01	4322.28	0.00	130.43	0.00

Figure 48 Country Origins of Loans in All Power Generation Projects in Vietnam

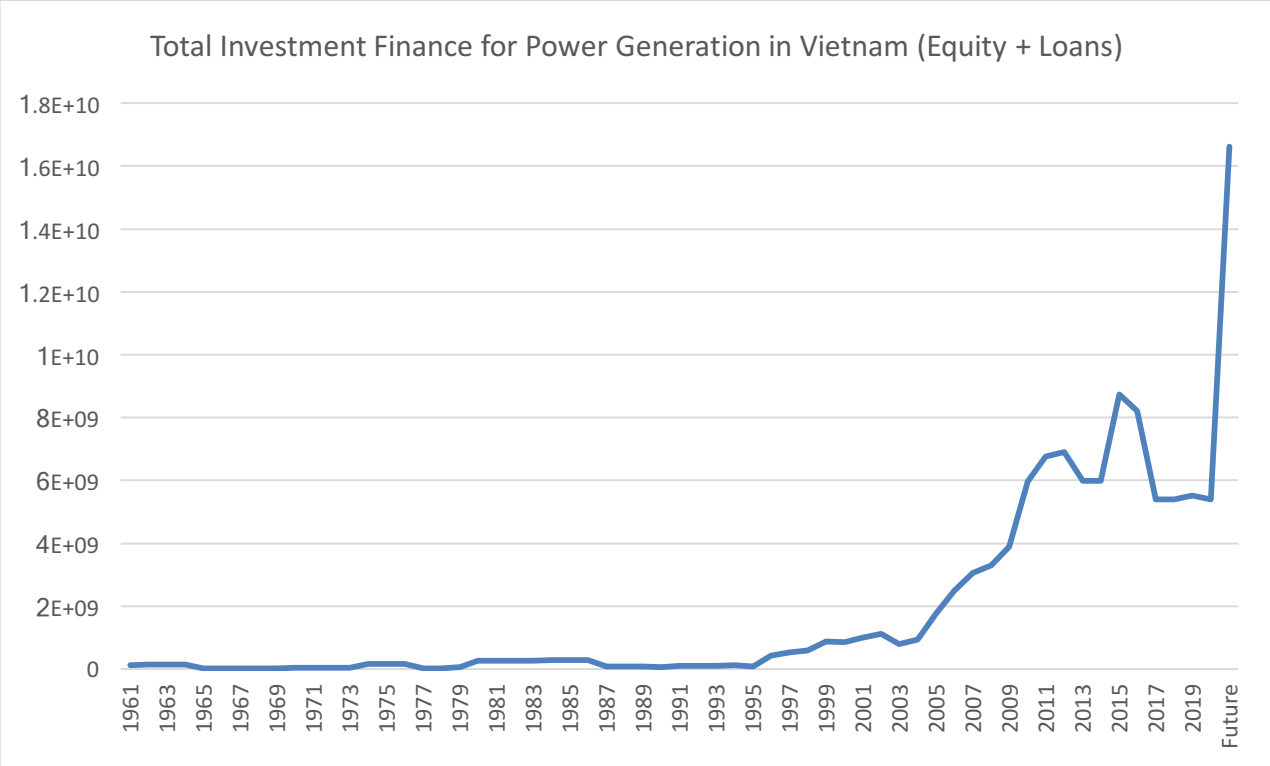


While 2% of finance comes from loans, 98% of total required funds come from investment (Table 9). It is then important to understand what has happened in investment in power generation throughout the years. This research presents the most comprehensive actual investment into power generation throughout the longest history of the power sector in Vietnam. The general trend is a significant increase in investment: starting to pick up from 1996 and accelerating from 2006. This falls into the strong economic growth period where power supply needs to grow faster than consumption demand. But looking further ahead, what is about to come in the 5-year period from 2016 to 2020 would possibly be 5 times as much of what has been observed before 2015. The power sector certainly attracts green investment[53] into power generation. Similar to lenders, investors have chosen coal and hydropower plants. 41% and 40% of total investment in power generation so far were made in these two fuel types, respectively. While investment in wind power started to show as early as in 2009, the value of funds for fossil fuels (adding coal, oil and gas) would outweigh much of hydropower, let alone alternative energies. These strong preferences by both lenders and investors could be explained by the abundance of resources as well as technological

[53] Since the graph only counts new projects, these investments are green investment.

expertise in relation to coal and hydro. These preferences have also been illustrated throughout the historical development of the power sector since 1894. Under pressure to provide much more power within a short time to meet economic growth, the choice towards conventional fuels is understandable. Yet, annually, from 2011, investment in coal power plants has surpassed that in hydropower and all other fuels (figure 52). Therefore, what is worrying is that this 'easy' choice is not solving the decarbonisation challenge that Vietnam is facing and not utilising the opportunities in renewable energy that the country offers. Investors and lenders have shown that they are attracted to the sector here. They have invested and would likely to do much more. But their choices are not balancing between easy short-term and difficult long-term objectives.

Figure 49 Looking Ahead: Investment Finance in Power Generation in Vietnam[54]



[54] Source of Data: The Power Sector Database (2017). From 2016 to 2020, this figure includes the power projects that are already being constructed and close to commencement. Beyond 2020 figure includes estimated commitment by investors that they make provisional on obtaining licences or in project plans.

Figure 50 Total actual investment made for power generation in Vietnam, 1961 - 2016

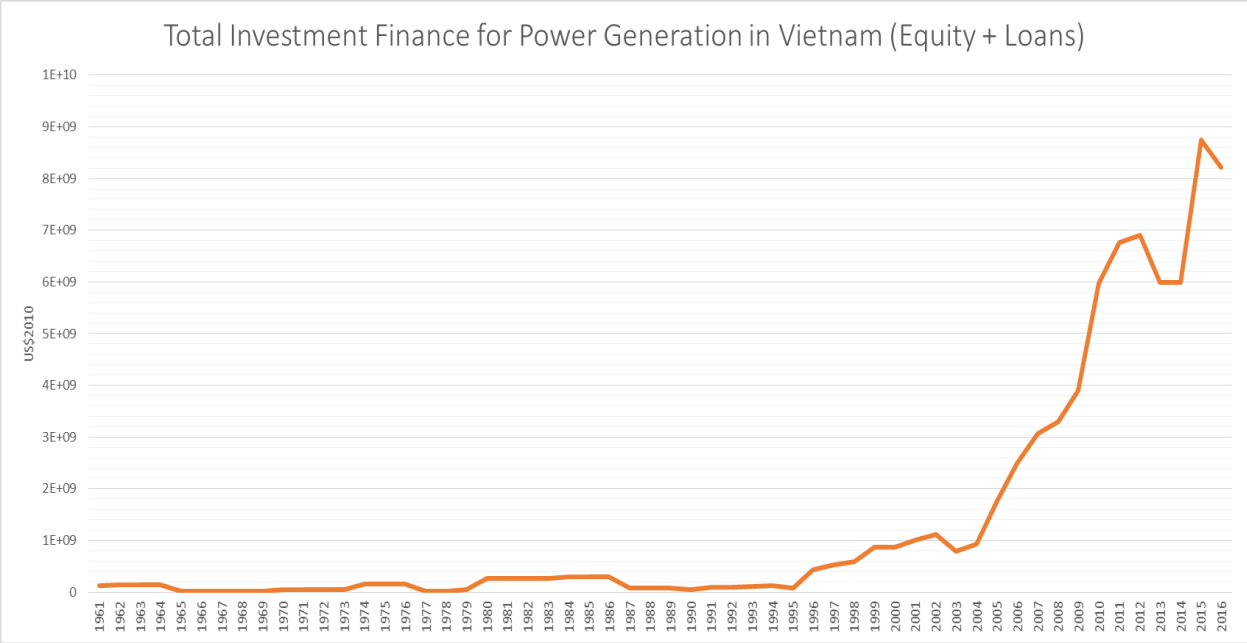


Figure 51 Total Historical Investmet in Completed Power Plants in Vietnam

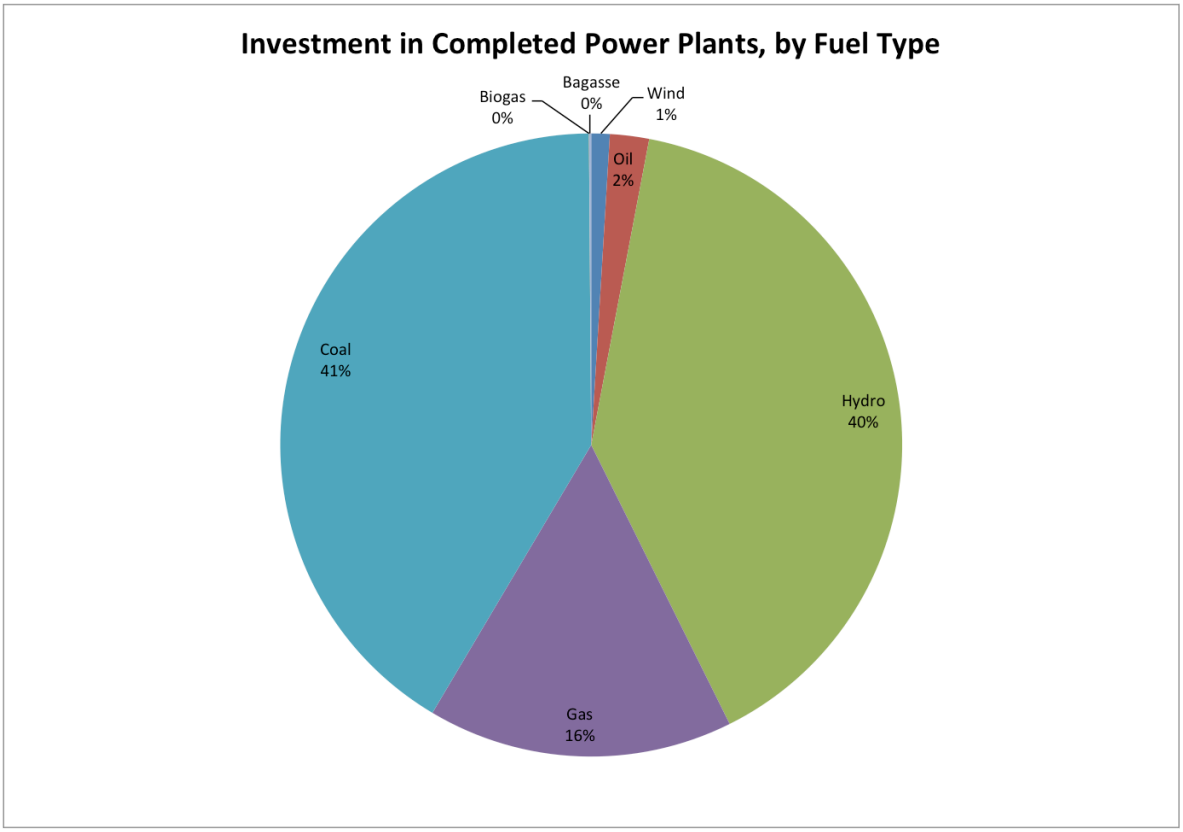
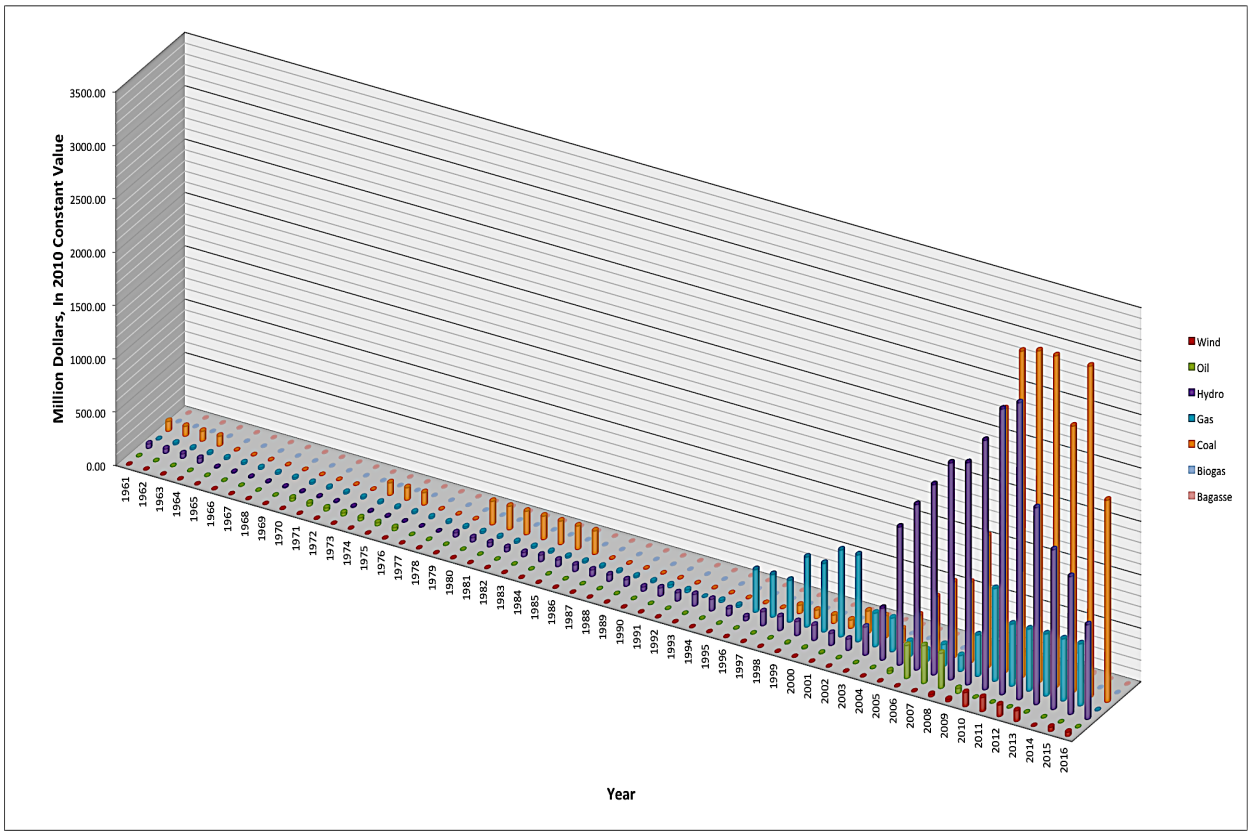


Figure 52 Comparative Annual Investment into Power Generation by Fuel Type in Vietnam



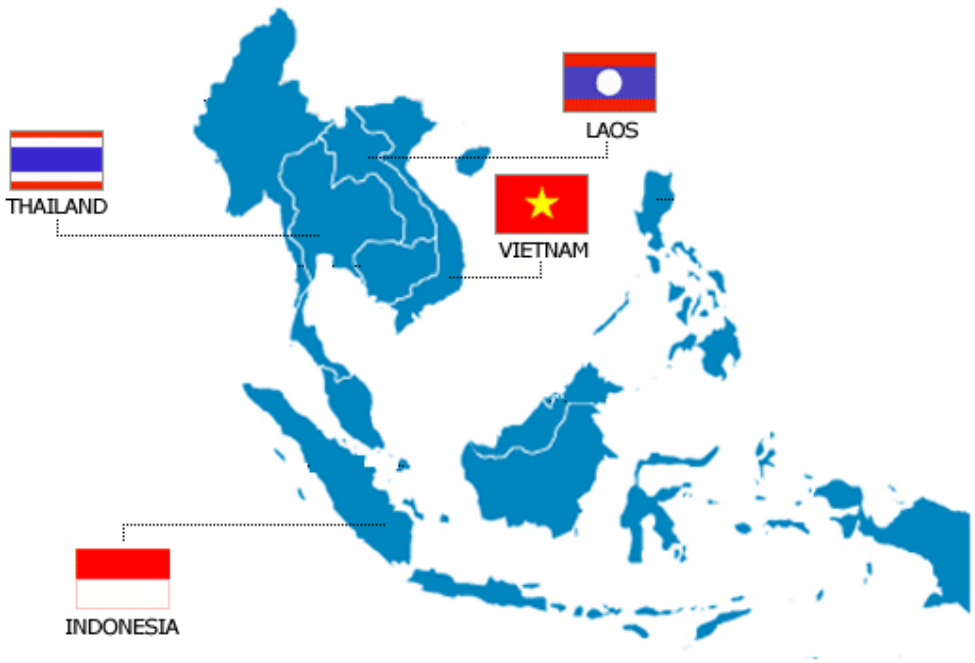
5.6. Summary

Throughout more than a century of development, Vietnam's power sector has shown remarkable growth in its capacity and structure. Despite a slow start due to the Wars, the sector has become capable of supplying power to meet demand needs of a strong growing economy, sometimes better than its neighbouring countries. Endowed with abundant renewable resources and room to grow, financing power generation has proven attractive to international and domestic investors and lenders. However, there exist various issues that may deter the required long-term growth of generating capacity including inefficiency of the monopolist EVN, lack of infrastructure investment, and inadequate pricing. The root causes of the sector's issues need to be addressed thoroughly, otherwise true competition will not happen as foreign and private investors do not have incentives to invest without government support and ever-growing market price will disturb national electricity consumption. Also, many financiers have worryingly chosen the easier option of coal-fired power stations, deterring efforts to decarbonise the sector. International lenders, especially in Asian countries, have been particularly more committed than funds from Western countries.

Multilateral funds including the World Bank and ADB have contributed even more than any other national funding institutions.

The chapter has given an overview of what and how the sector has developed. The sector has significantly attracted a lot more investment into power generation in the same period as it has started to open up the electricity market. The sector structure has also become more complex and interconnected to accommodate private participation, in comparison to a closed door in previous periods. From this first glance, it is easy to correlate market liberalisation with these outcomes. However, the chapter has only put the sectoral development in broader historical context, but not explained the driving force behind the pursuit of the liberalisation model and at what objectives the government is aiming. Also, the chapter has looked at financial contributions as a whole, not differentiating between public and private sources. The conclusion could totally be different depending on further investigation.

CHAPTER 6. POLICY-SHAPING STRATEGIES OF THE WORLD BANK IN VIETNAM AND ASEAN'S POWER SECTOR



6.1. World Bank and Electricity Liberalisation in Developing Cpountries

This chapter analyses how the World Bank, via their loans and conditionalities, build up their influence on energy policy, and how they use this influence to promote liberalisation. The process of unbundling and liberalization of electricity systems has been led by the World Bank. The core principle is that there exists a potential competitive market for generating capacity that will drive continuous commercial investment to efficiently supply electricity to meet the growing demands in developing economies. This requires upfront government commitment in creating and opening the market and eventually minimal government regulation. The WB has stated that: '…reforms … are equally or more important for emerging, developing and transition economies … where regulatory failures expose people and the environment to horrific risks' (World Bank, 2012).

The WB has driven these reforms by applying liberalisation as a condition of loans. Among 172 countries that received loans from the World Bank, more than 90 countries accepted liberalisation of the energy market as a conditionality (Erdogdu, 2013). These loans are

expected to 'leverage' private investment. A recent review published by the World Bank itself, which examines links between liberalisation policies and outcomes including price and efficiency (Besant-Jones and Vagliasindi, 2013), claims that 'unbundling is not an end itself, but rather a means to achieve better performance'.

But an analysis of the 30 energy sector loans by the World in Vietnam, and the Bank's loans to neighbouring countries, suggest otherwise, that loans are strategically used to introduce liberalisation, despite lack of serious evidence that it delivers the expected benefits. This chapter also examines over 140 loans in total, including 56 loans in Indonesia, 35 in Thailand and 19 in Laos since 1969 to 2013.

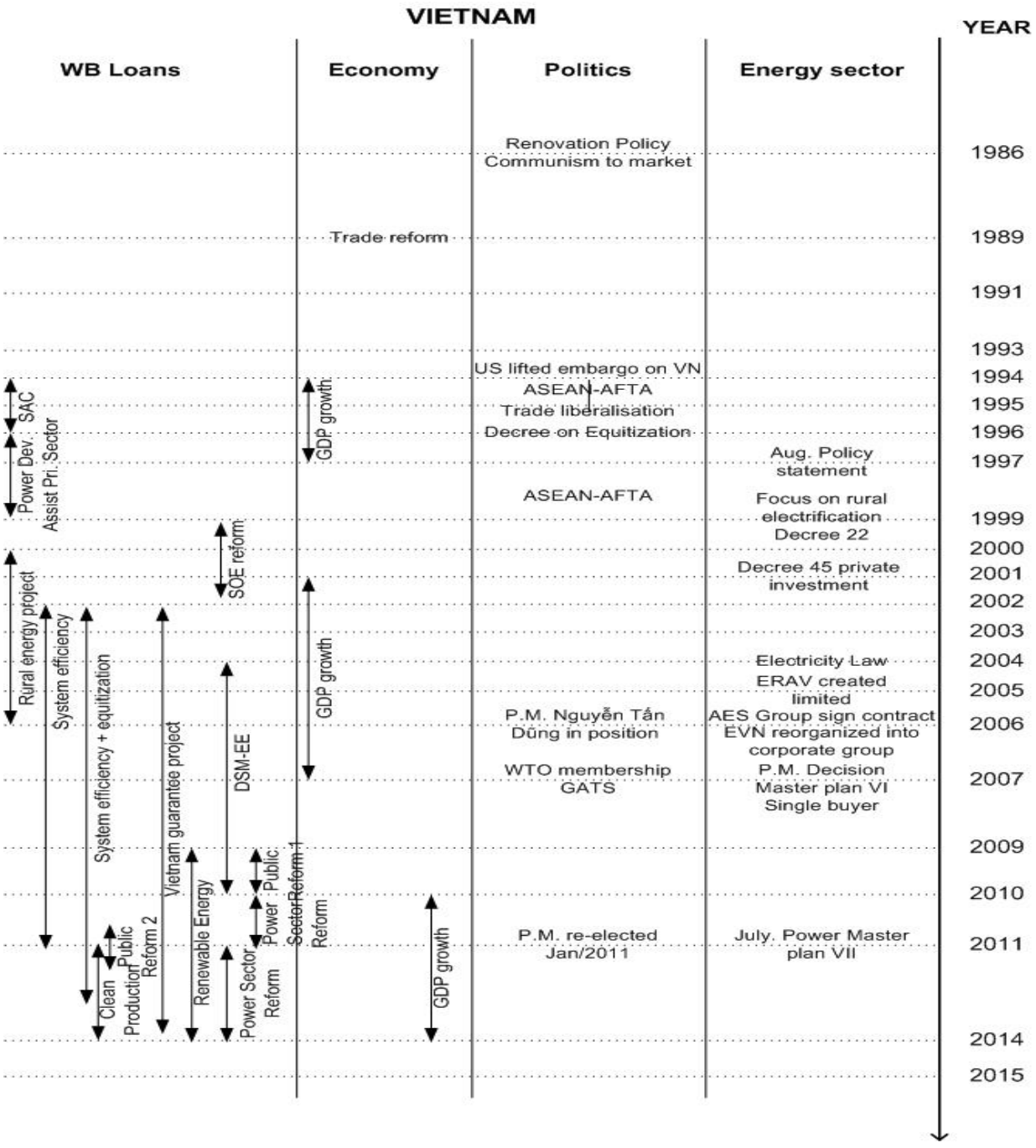
Private sector participation in energy sector is not 'free'. Millions of dollars' worth of public investment via government spending and World Bank loans are used to enable the private sector.

6.2. The World Bank and Electricity in Vietnam

The World Bank entered Vietnam in 1978 with one development project for basic services. Not until the US lifted its embargo on Vietnam in 1994, did the Bank officially offer a series of projects to the government. It may not be a coincidence that the projects underpinned many of policy reforms in the sector. First, the first structural adjustment project was commenced in 1994 to 1996. As the end of this project, the first Decree on Equitization was passed, marking the first steps towards SOE privatisation and corporatisation. Second, the Power Sector Rehabilitation and Expansion Project from 1996 to 1999 was rated as 'highly satisfactory' with the issue of a policy statement for power sector reform by Ministry of Industry in August 12, 1997. Third, from 2000 to 2006, the Bank constantly lent to the sector with 6 loans, 5 of them reform-based. This full force was rewarded with Decree 45 on opening generation market to private and foreign investment in 2001, with Electricity Law in 2004 on a competitive market plan, with the creation of ERAV (Electricity Regulating Authority of Vietnam) – a regulatory body of the industry –and with the corporatisation of EVN in 2006. From 2006 to 2009, despite promises to develop the private sector with conditionalities as in previous loans, the electricity sector is still dominated by EVN, the single buyer, the monopoly of the networks. Fourth, from 2009 to 2011, the Bank replaced multiple-objectives loans with reform loans only in order to push the liberalisation process faster.

Just in 2011, there were 4 reform-based loans, 3 for electric power sector, 1 for public administration, to support a more general economic liberalisation. The result is the Power Master Plan in the same year drawing a more detailed plan. In this, the government shows its commitment to increase efficiency in the sector, in EVN in particular, and to withdraw price subsidies, which will likely raise the unit price.

Figure 53 Timeline of Vietnam's political, economic conditions, WB loans and energy policy changes

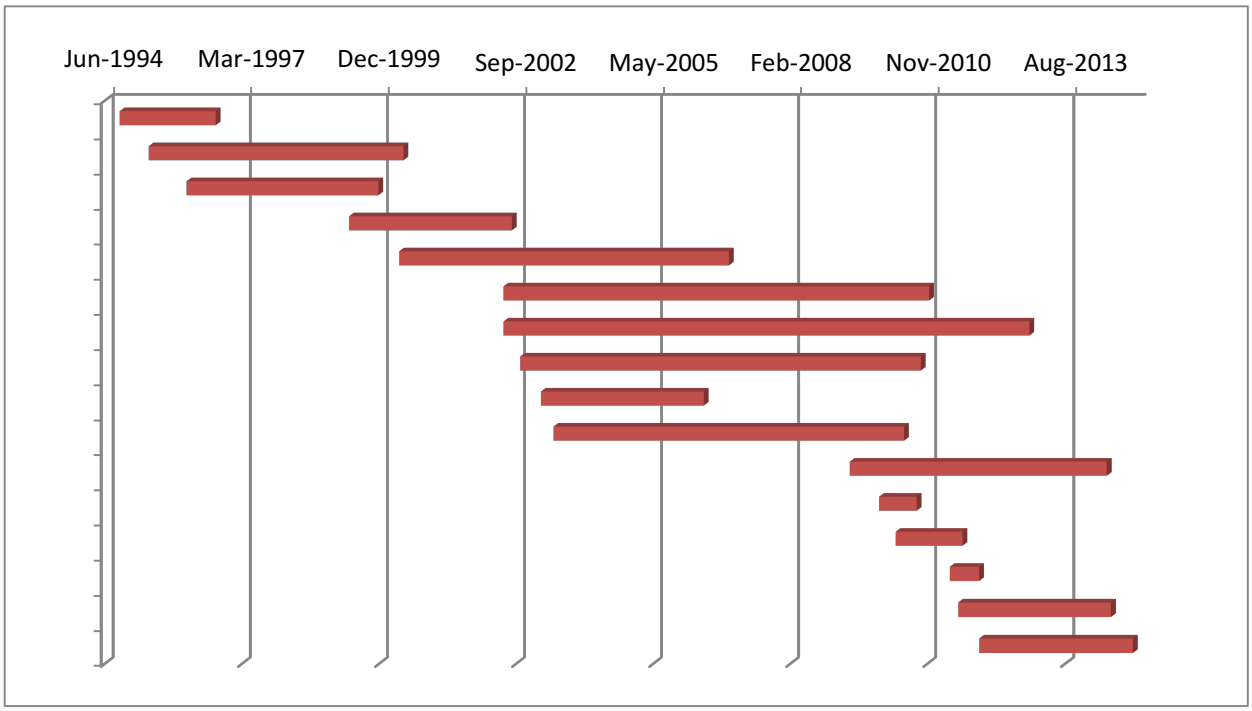


6.3. Financing strategies

6.3.1. Overlapping loans

Figure 54 shows the time periods when the loans are taken over time. Thailand and Vietnam's energy sectors have been constantly on loans with the World Bank. These loans even overlap one another. The sector has never been out of debt since 1957.

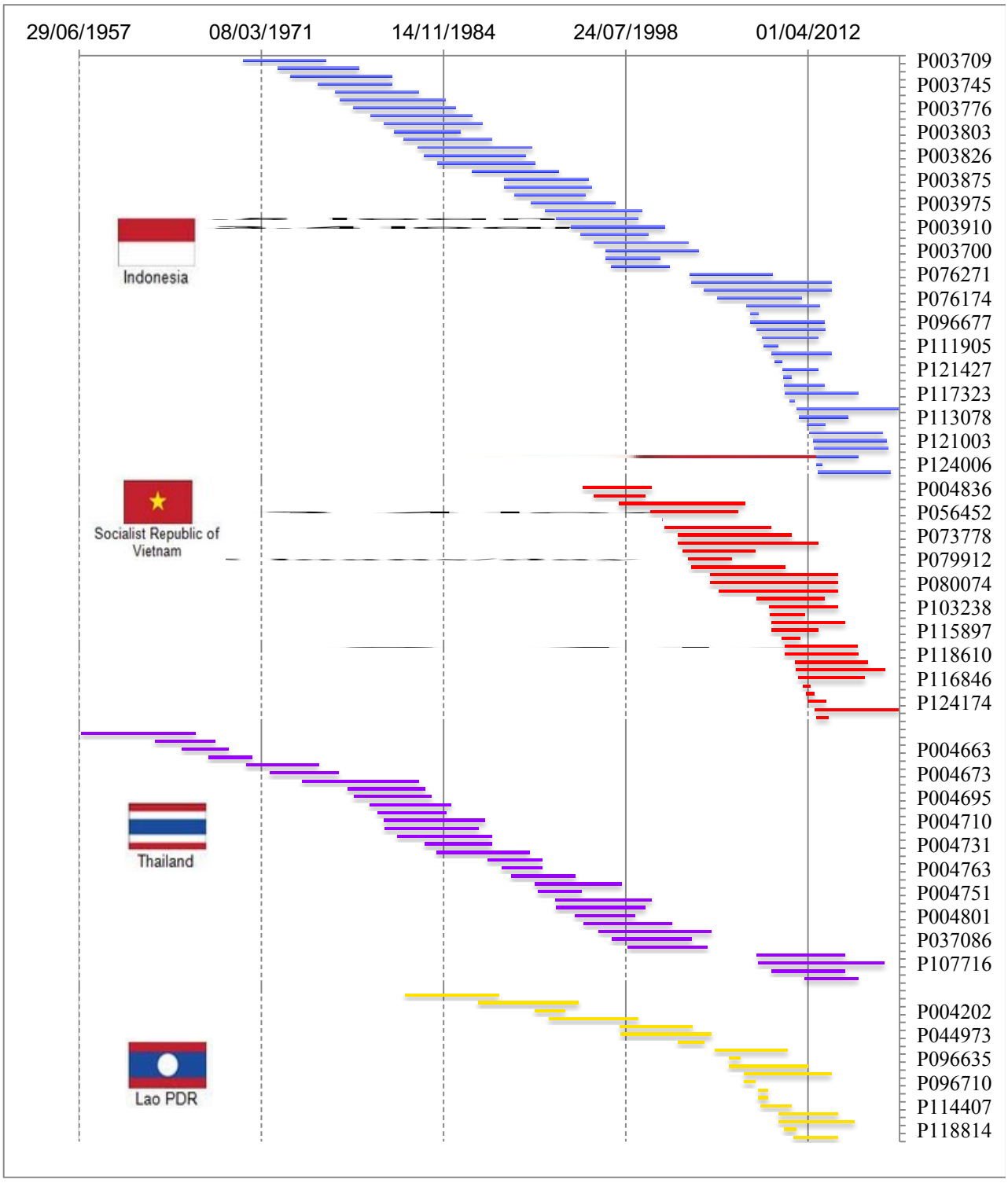
Figure 54 Overlapping World Bank loans to Vietnam in periods



When arranging the loans according to project periods, the figures show that there is no time when the Bank is not a lender to these countries. The loan periods are effectively overlapping. To say more correctly, the energy sectors are always and constantly under loans with the World Bank. When one project has not ended, the next one is already in operation. When one project just commenced, the next one is already in the authorization stage. When adding periods of all projects and divide this sum by the number of years from starting point of the first project to the ending point of the latest project, it is striking to see that on average, every day, there is always more than 1 project in operation in all countries. In Vietnam, it takes only 19 years to complete 15 projects that are supposed to be completed in 69 years. The energy sector is in fact always operating at least 3 loans at any time. But the continuous flow makes these 'captive' countries as borrowers for life. Once these countries are used to receiving loans every year, they would not want to end it by clearing loans that bulk up far over their own national financial resources. Since the same pattern occurs in all three

countries, it may be analysed as a deliberate strategy by the WB whose result is to give the WB effective power over sector policy for an indefinite period.

Figure 55 Overlapping World Bank electricity sector loans to Indonesia, Laos, Thailand and Vietnam



6.3.2. Loans for reform vs. Loans for Infrastructure

In dividing the projects according to their purposes, funds for Market Reforms account for 38% in Vietnam (and 44% in Thailand) of total financing from World Bank. These loans are directed to the government institutions as borrowers, implementers and end users. The non-reform loans are to build generating capacity and rural electrification; that produces tangible and lasting assets. Reform loans on the other hand involve working, discussing and planning policy papers that pave way for sector reform.

The published reports do not produce accounting statements of on what the funds are spent. But it raises a big question of transparency when infrastructure loans are subject to itemized accounting audit and easier to monitor financially whereas the accounts of reform loans are typically presented under broad headings only, such as 'consulting services, training, program marketing, evaluation and administration costs' (World Bank, 2003). Under the umbrella of 'Demand-side Management and Energy efficiency Project' 2003-2010, the grant (in addition to the loan fund to make up to $18.56 million) actually aims to promote private participation and marketisation in the sector. The break-down of this loan shows that the two recipients are EVN and MoI (Ministry of Industry). The costs comprises of 'control program', 'promotion', 'market transformation', 'training', etc. In the grant's cost break-down, 'consultant services' are $3.34 million whilst the cost of 'goods' is only $0.93 million. The sheer size of these projects clearly shows the discrepancies in evaluation of costs and objectives between reform projects and non-reform projects. A similar pattern can again be observed in Thailand as well

Figure 56 WB fund allocation to infrastructure and non-infrastructure items in total loans to Vietnam

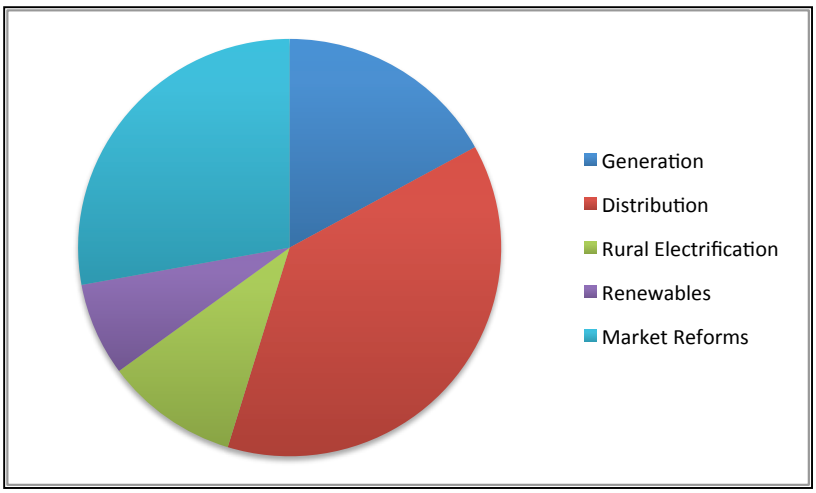
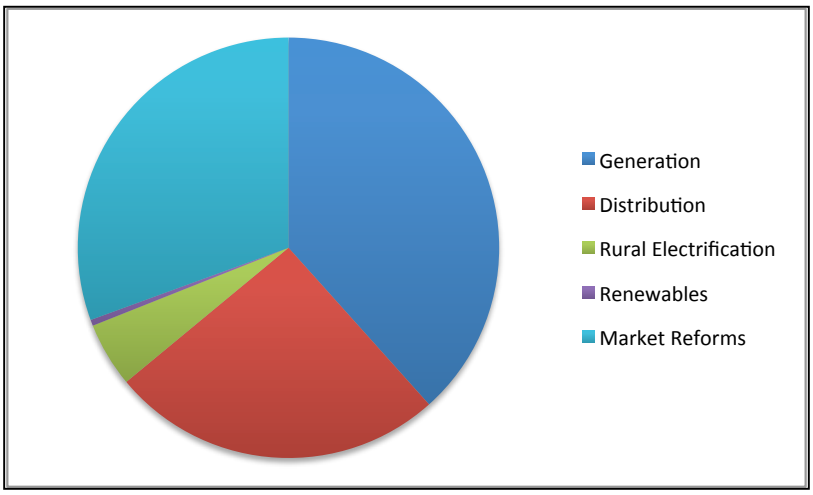


Figure 57 WB fund allocation to infrastructure and non-infrastructure items in total loans to Thailand



6.3.3. So much for Reforms, so little for Renewables

The financing of reforms also outstrips financing of renewable energy. Data on loans across 4 countries in south-east Asia - Indonesia, Thailand, Vietnam and Laos – show that over the last 40 years, the World Bank has lent more than $18 billion to the energy sector in these countries. Of this, only 4% was devoted to renewable energy projects including geothermal power plants, green policies, and sustainable technology development, while 10% was devoted to reforms projects. It is notable that all renewable energy loans are requested and also implemented by the public sector, majorly by the monopolistic national energy company, including loans from GEF and IFC which aims at promoting private sector participation.

Figure 58 Loans by Purpose in total (Indonesia, Laos, Thailand and Vietnam)

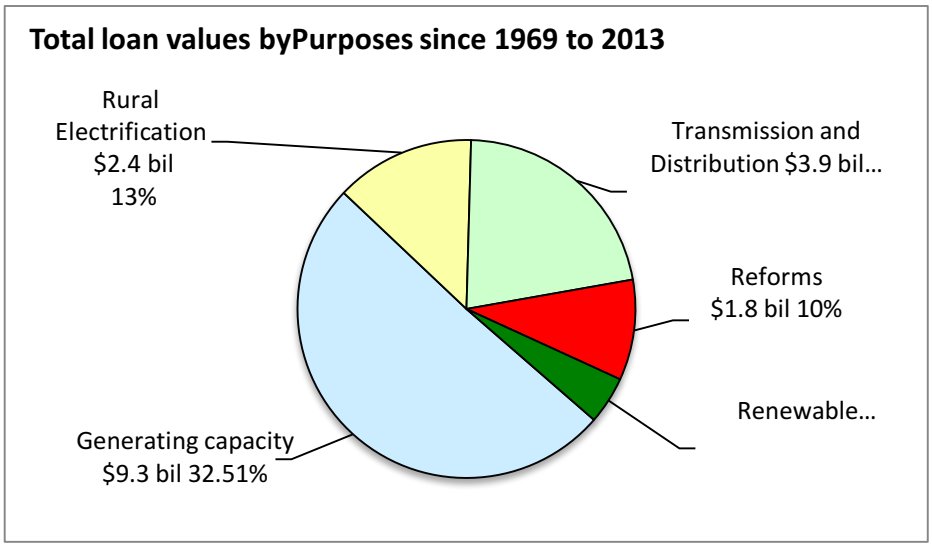
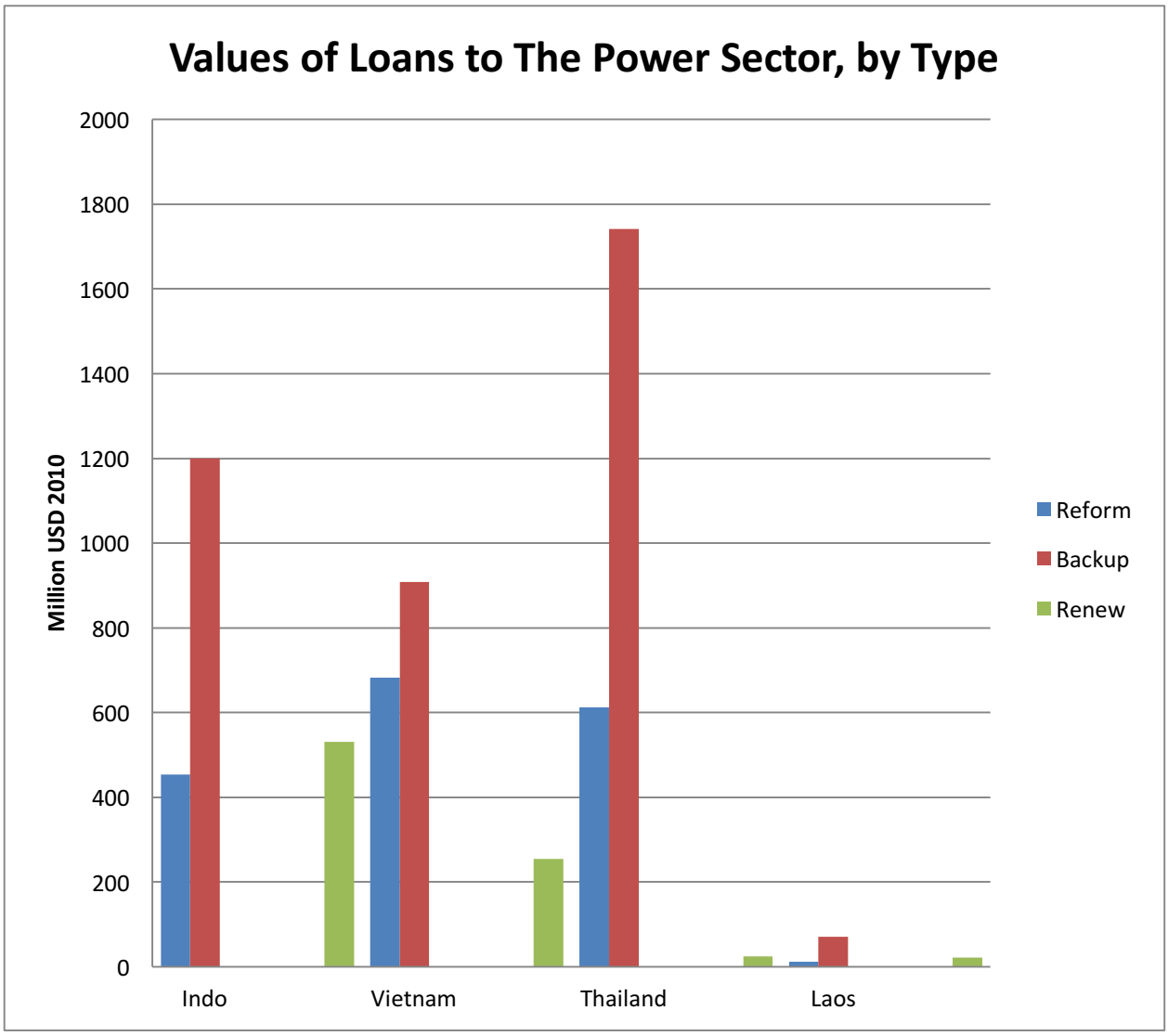


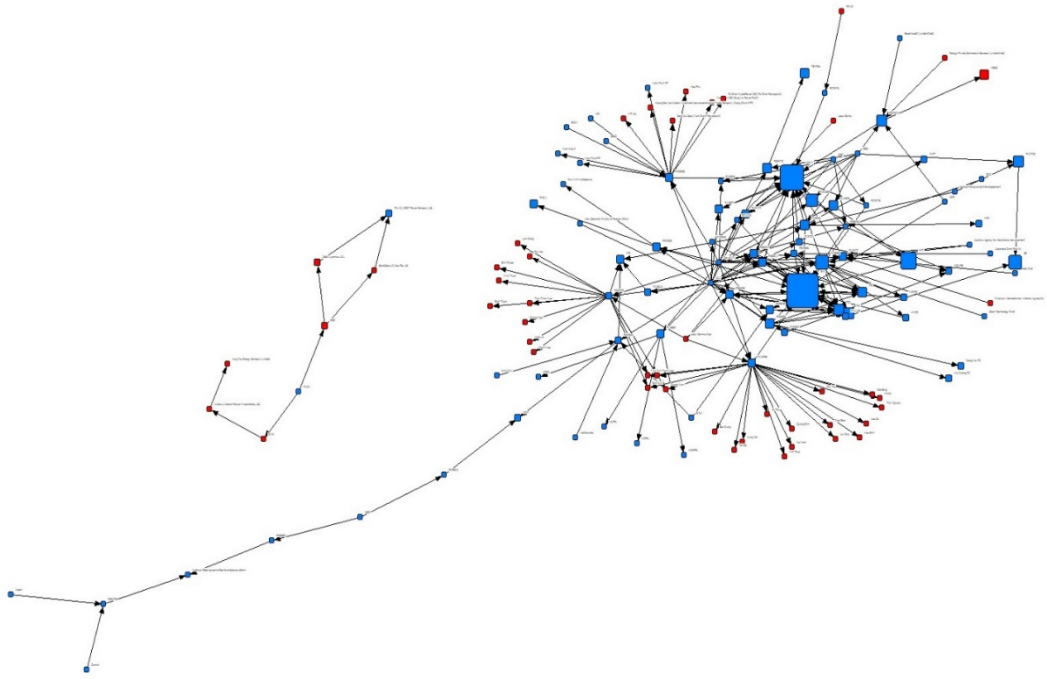
Figure 59 Total Reforms loans vs. Renewable Energy loans in Indonesia, Vietnam, Thailand and Laos



6.3.4. Public vs. Private Recipients

Figure 60 captures the network structures of all World Bank-led finance in the electricity sector in Vietnam from 1957 to 2013. The bigger nodes who receive more funds hence higher in-degree centrality, are public actors and the highest recipients are the state-owned incumbents. Despite the fact that this is a network constructed in the liberalisation process and led by the World Bank, public actors are still so important in providing services that cannot be replaced by private actors throughout the years. This finding is strengthened when looking at the same network rearranged to separate networks of public actors and private actors. It can be witnessed that the public actor networks are much denser, representing much greater range of activities and transactions among public actors whilst the private actors are much more sparse. Private actors also are smaller nodes. Their sizes show that they receive much less from financiers including government sources and other private sources.

Figure 60 Network of World Bank-led financing in electriicty generation in Vietnam



6.4. Summary

The costs of the reforms are themselves substantial, using one third or more of all World Bank financing, directed at government ministries and agencies. These 'reform' loans can be seen as a fixed overhead, without any direct increase in generating capacity or network extension, thus reducing the leverage achieved by direct project loans, and increasing the costs of direct investments. The World Bank's funds for policy reform and privatisation aims to reduce the role of governments and leverage private sector development, and costs of reforms are substantial. However, the research shows that the majority of WB funds do not actually reach and involve private actors. With increasing generation capacity, the role of government institutions grows, as well as the funds received by the dominant vertically-integrated SOEs. There then exists a contradiction in the Bank between the Bank's objectives of reducing the role of government in the market and strengthening the role of public actors in the sector.

The financial support of the World Bank is generally seen as a 'vital source' for development of the sector in developing countries (World Bank, 2011). The Bank reinforces this by

employing a flow of overlapping projects, so that lending period strategy keeps countries continuously in receipt of bank loans, 'captive for life' by layering loans on loans. However, domestic networks of financiers and recipients are much more active and dominant than the role of international donors and funds. The value of funds directly from the WB is also less significant than that from other sources. These results support the findings of other studies: private funding does not substitute for public investment in the electricity sector, or other infrastructure; national funding, and public sector funding, continues to be of the greatest importance; private participation is largely limited to thermal IPPs based on long-term power purchase agreements which are vulnerable to overcharging and corruption. (Estache 2006, Estache et al 2009, Foch 2013, WB/AFD 2010).

CHAPTER 7. ELECTRICITY MARKET LIBERALISATION IMPACT ON PRIVATE PARTICIPATION IN VIETNAM

7.1. INTRODUCTION

Whilst chapters 5 has introduced the electricity market liberalisation pathway undertaken by Vietnam and arguments for the contexts and forces behind this decision, this chapter will then attempt to find out if this reform model has yielded its expected results. This chapter attempts to investigate the pattern of private participation based on a clarified notion of 'participation' which is often vaguely discussed or implied as 'financial contribution'. This paper then answers this overarching question of ***'How has electricity liberalisation impacted on private participation in the development of power generation in Vietnam'?***. From the literature review, there is relatively little evidence about the incentives, forms, degrees and patterns of participation from private actors.

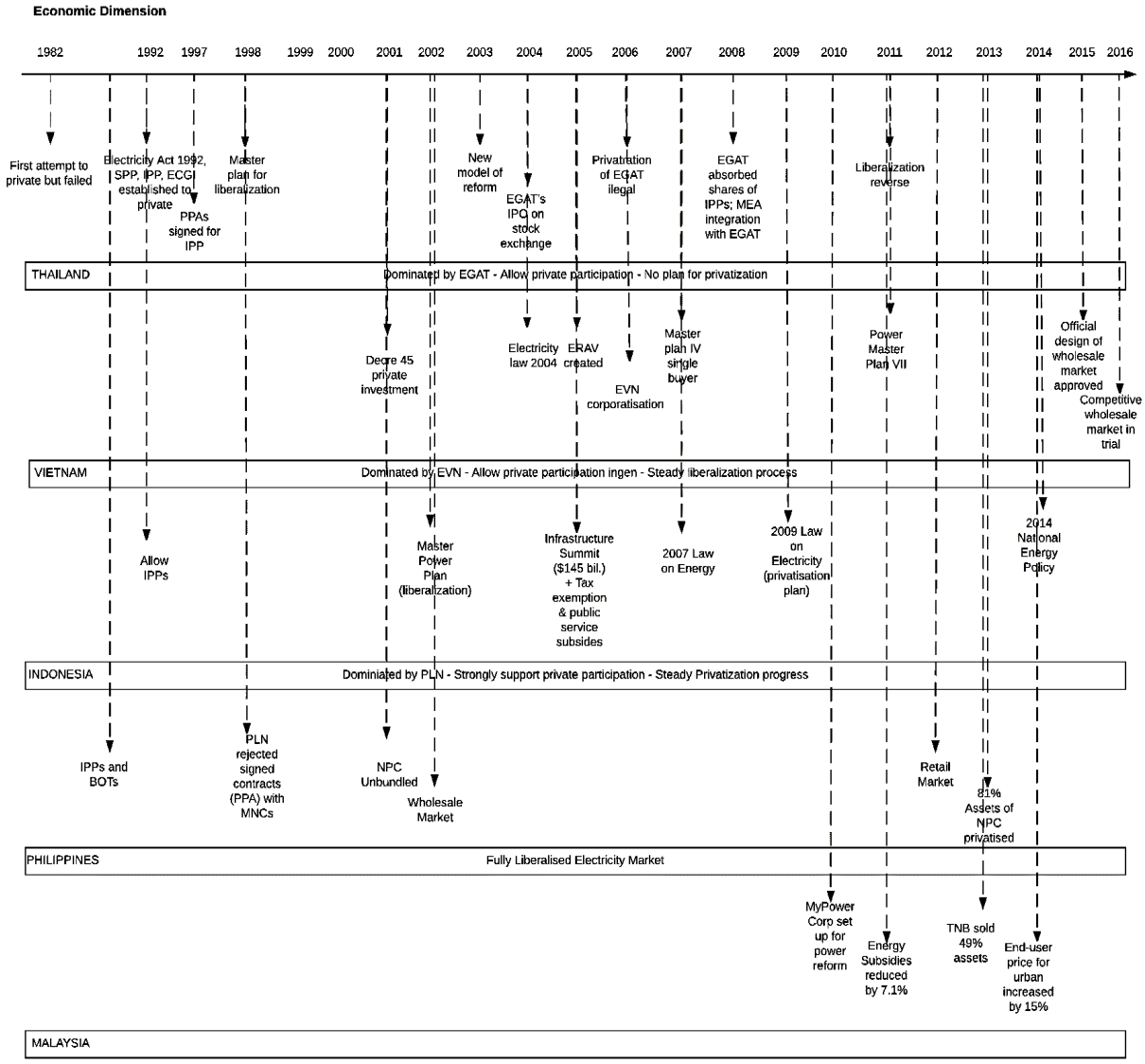
In order to assess policy impact, it is then important to carry out a cost-benefit analysis where possible. On the benefits, Chapter 6 informed that the main reason for pursuit of sectoral reform is mainly financial. The inefficient operation and increasing financial burden of the expanding power networks has put great pressure on the government to find an alternative measure to state monopoly which they believed and are persuaded as the power market liberalisation model. It is then understood that the measurement of success of this model is how much private investment comes into the sector since the reform. On the costs, chapter 7 estimated the mere costs of reforming the power sector based on costs of loans from the World Bank. The costs of policy reforms certainly do not just include these loan repayments but also other administration, paperwork and procedure costs that are not published, hence not investigable within the scope of this research. However, it should be assumed that the private investment yielded as a result of reforms should at least outweigh the costs of World Bank loans, which were calculated in chapter 6.

In doing this research, as argued in Chapter 4, different official reports and researches referred to 'investment' with different meanings, hence a controversy on actual policy impacts. Data quality and how it impacted the findings were also discussed. To reiterate, this research managed to collect not a single dataset of investment based on a single definition. The database contains several datasets that reflect differences in definitions of investment.

Beside initial financial contributions, private entities can also participate in other roles including technicality (construction, consultancy and equipment procurement) and management of power plants (i.e. daily operators of power plants after completion of construction). Being informed of these roles is important to energy policy-makers when discussing where private actors actually work and matter.

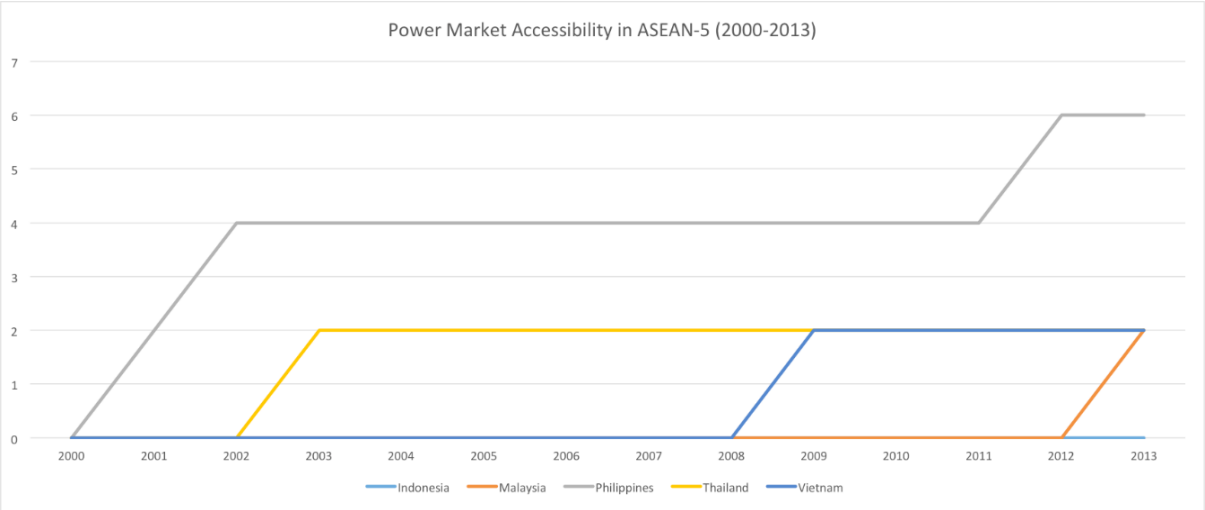
The chapter will come to concluding remarks comparing the roles and contributions by private vs. public and national vs. international actors. More importantly, private financial contributions before and after market liberalisation policies will be weighed against the costs of such policy implementation to seek a conclusive answer of the actual impact of market liberalisation.

Figure 61 Timeline of Electricity liberalisation policies in ASEAN-5 countries[55]



[55] Calculated based on Author's Own Knowledge and Methodology. The methodology is explained in Appendix.

Figure 62 Power Market Accessibility in ASEAN-5 countries (2000-2013)

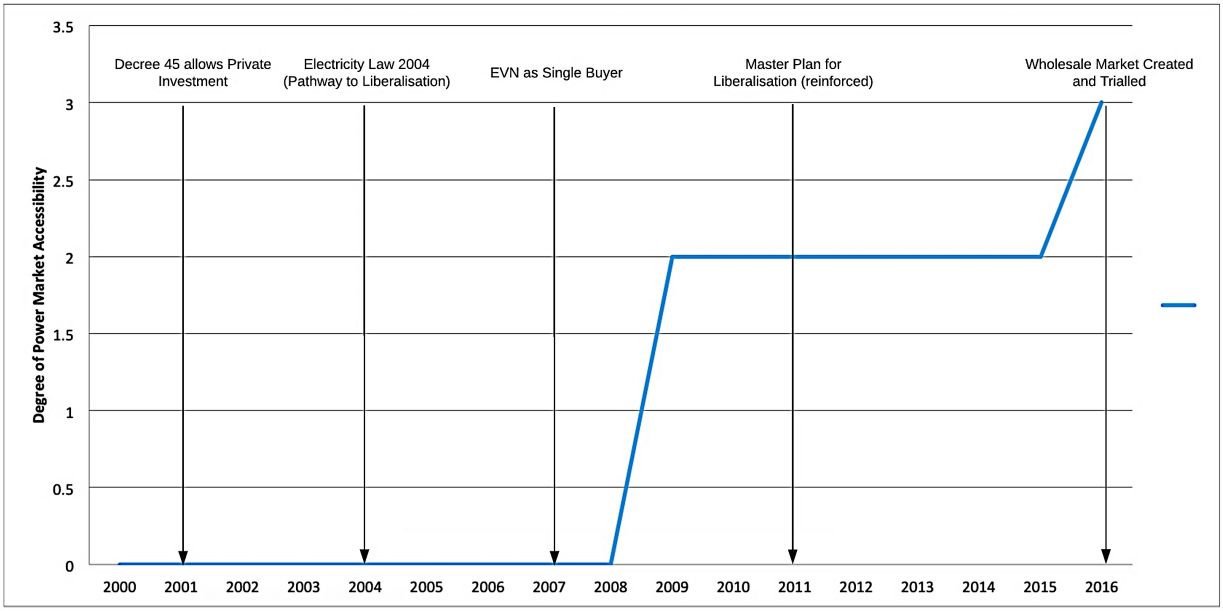


7.2. Liberalisation Progress

What has been witnessed in Vietnam is that slow progress has been made towards full liberalisation. Figure 63 below depicts this progress by measuring the degree of power market accessibility[56] and key policies made along the liberalisation pathway since 2001. On a scale of 0 to 6 with 6 implying fully accessible power market, it has taken nearly 20 years for Vietnam to reach just half way since 2016. The governments gradually introduced the idea that the power generation market welcomes private investors in 2001, then actualised this idea into the Electricity Law in 2004 with a clearly laid-out plan for liberalisation, officially known as 'Energy Master Plan for Liberalisation Pathway'. However, these moves did not affect how truly accessible the market was perceived by private actors. By 2017, there is still no progress in operating a more fully competitive wholesale market.

[56] See Appendix A for methodology to measure Power Market Accessibility

Figure 63 Vietnam's Power Market Liberalisation Policies and Progress



Formal opening of a wholesale market does not necessarily constitute market competition. There are several reasons for why wholesale markets in Thailand and Vietnam cannot be considered as competitive. First, both countries have an existing incumbent power corporation which has been unbundled in accounting but not in ownership. EVN accounts for the majority of generation in the country and also acts as Single Buyer of generated output. In Thailand, historically, EGAT, MEA and PEA (the two major transmission companies) were separate entities but they have now been merged under the corporation of EGAT and hence act as single buyer within the power market. This single buyer model combined with incomplete unbundling means it is difficult to ensure a fair treatment towards IPPs. Second, the wholesale market is designed to have 2 parallel components: a contract market for BOT, strategic plants and PPAs and a gross power pool. The governments wishing to comply with pre-signed PPAs and to ensure cost-recovery for strategic power plants require the single buyer to buy in all outputs from these plants via one-year-in-advance contracts of 90-95% installed capacity. The 5-10% output of plants other than the major ones will be up for spot market activities. And residential consumers do not have a choice of from which company to purchase power. The only progress noted is in allowing third parties, i.e. private companies to access the sector. Both Thailand and Vietnam have legally allowed private companies (domestic and international) to obtain generation license and sell to transmission companies now. Thailand has made this change since 2002 whilst Vietnam started 6 years later.

Since the liberalisation progress in the two countries has been fairly similar, it would be interesting to see whether improved market accessibility changes private investment patterns and how investors would react similarly or differently to this improved market accessibility in the two countries. Private investors are expected to positively react to lower barriers to entry by increasing their investment given all things are equal.

Acknowledging the limitation of current classification of forms of private participation, I choose to re-categorise private participation into 3 forms as below. These different forms of private participation provide a clearer foundation to answer the overarching question by testing the three hypotheses:

- ***Hypothesis 1: Market liberalisation policies increase private initial investment in power generation***
- ***Hypothesis 2: Market liberalisation policies increase private ownership in generation companies***
- ***Hypothesis 3: Market liberalisation policies increase technical private participation in construction of power plants.***

7.3. Private Financial Contributions

7.3.1. Lenders

Accounting for a third of total investment finance for power generation, lenders are certainly important financial contributors in the sector. The question, to policy-makers, remains who are the key lenders and what made them commit. Figures 58 and 59 gives an overview of location of these lenders throughout the whole historical development. An overwhelming 92% of loans are from Asian countries, including 29% from Vietnam's domestic banks. Lenders from Vietnam are the most significant in total value, closely followed by China, then Korea and Japan. European and American institutions have not actively been involved as much. Considering that this total loan value encompasses the period from 1961, it is understandable that disruptions from the Wars and embargo have played a role in deterring access to loans from western countries.

Figure 57 then provides a ranking of lenders by their commitments so far. And the biggest lenders include banks from Korea, China, Japan and Vietnam. All top 10 lenders are state-owned institutions and their loans account for 80% of total loan values (Table 20). The biggest private lender is Citibank. Whilst the World Bank declares that it would not fund nuclear power projects, there are no official announcements from these top 10 banks about

their preferences in terms of fuel type. Yet, when analysing what projects have these top lenders lent to, figure 67 shows strong preferences by Vietnamese banks in hydropower whilst 7 other lenders have mostly lent to develop fossil fuel power plants.

What can be seen in the actions by the 3 Vietnamese banks (VDB, Agribank, BIDV), also the biggest banks in Vietnam in terms of capital (excluding the State Bank of Vietnam), is that there is a need for financial support from Vietnamese power companies to make use of hydropower. As written in chapter 5, this is one of Vietnam's natural endowments that have been historically preferred in power generation and there is a scope for different plant sizes. On the contrary, what is worrying is that international lenders commit a much higher value of loans into non-sustainable sources. Figure 67 shows a strong inclination of lenders to commit to coal-fired power stations, regardless of the funders' ownership. Notably, the top 10 lenders can be considered as government agencies supporting development. They have a clear-cut high level mission that does not prioritise profits as seen in private entities. There then exists conflict in defining what 'development' actually means for the funders and for the borrower.

Figure 64 Regions of Lenders in completed power plants, Vietnam, 1964-2016

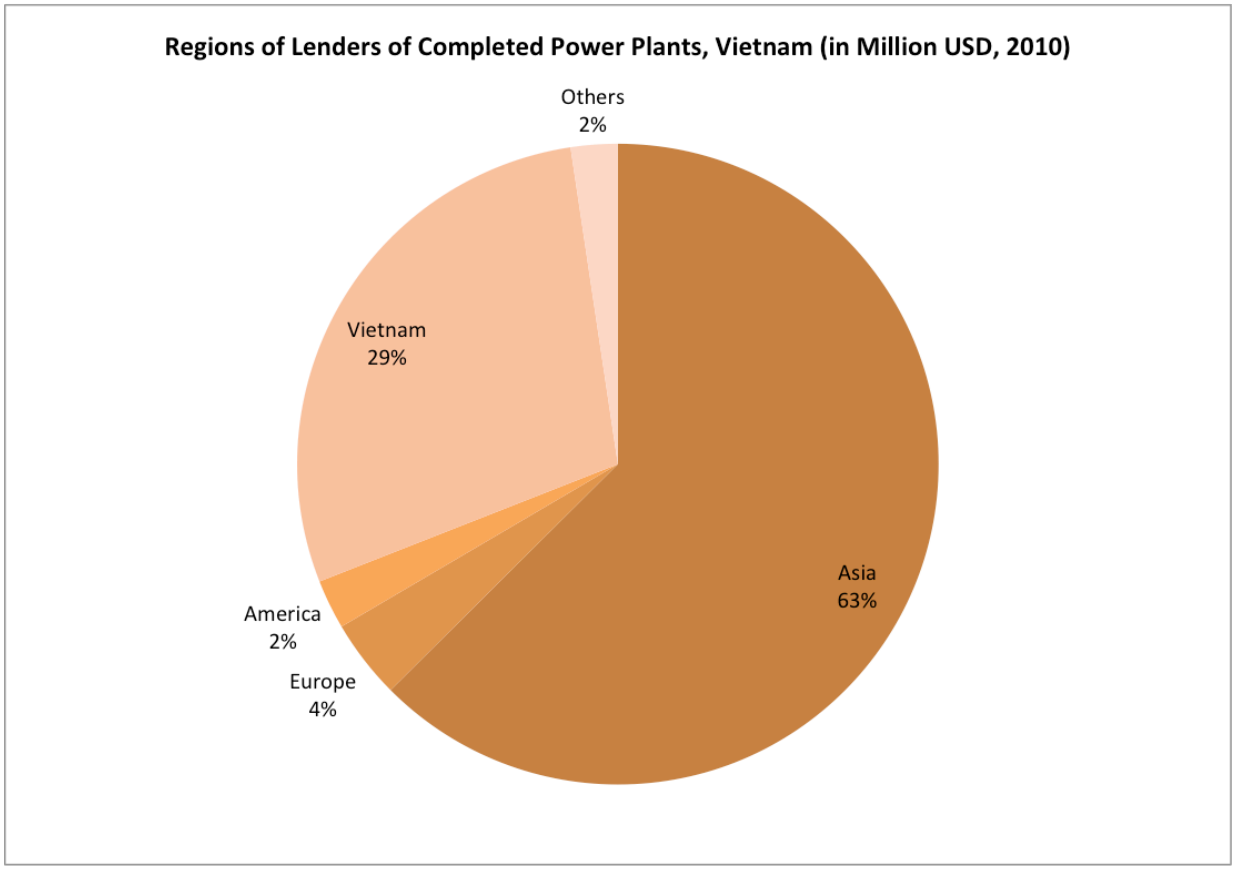


Figure 65 Country of Origin of Lenders in Completed Power Plants, Vietnam 1964-2016

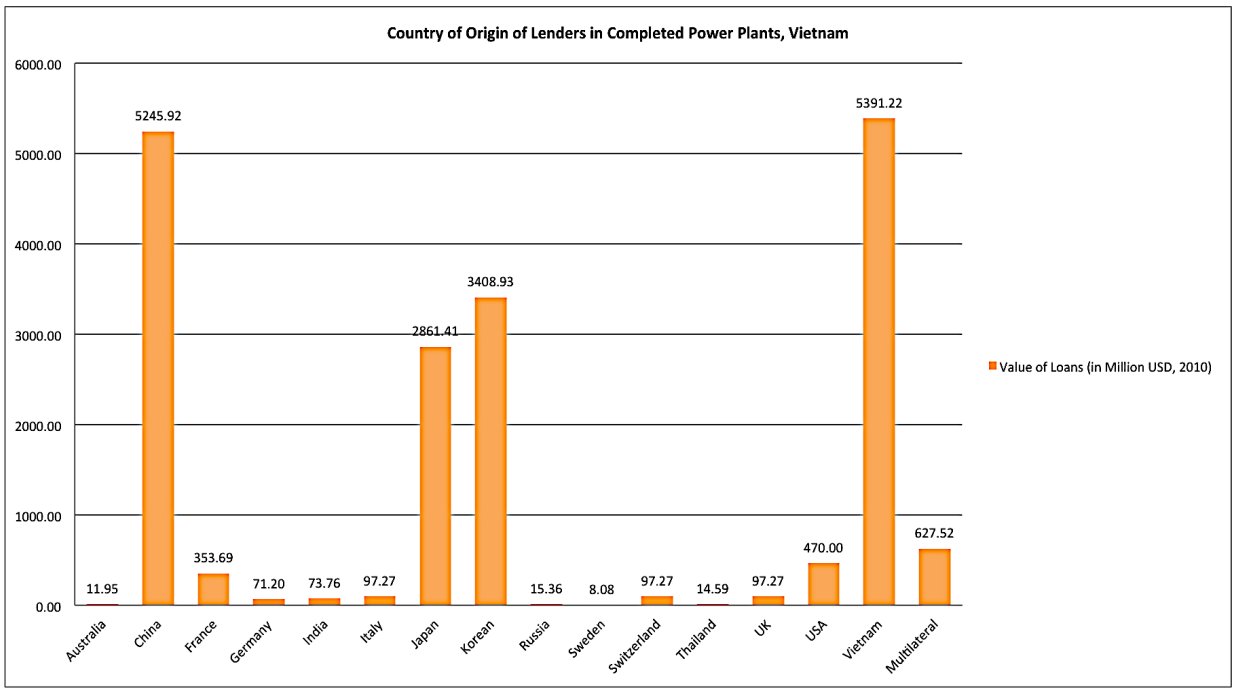


Figure 66 Lenders of Completed Power Plants, Vietnam, 1964-2016

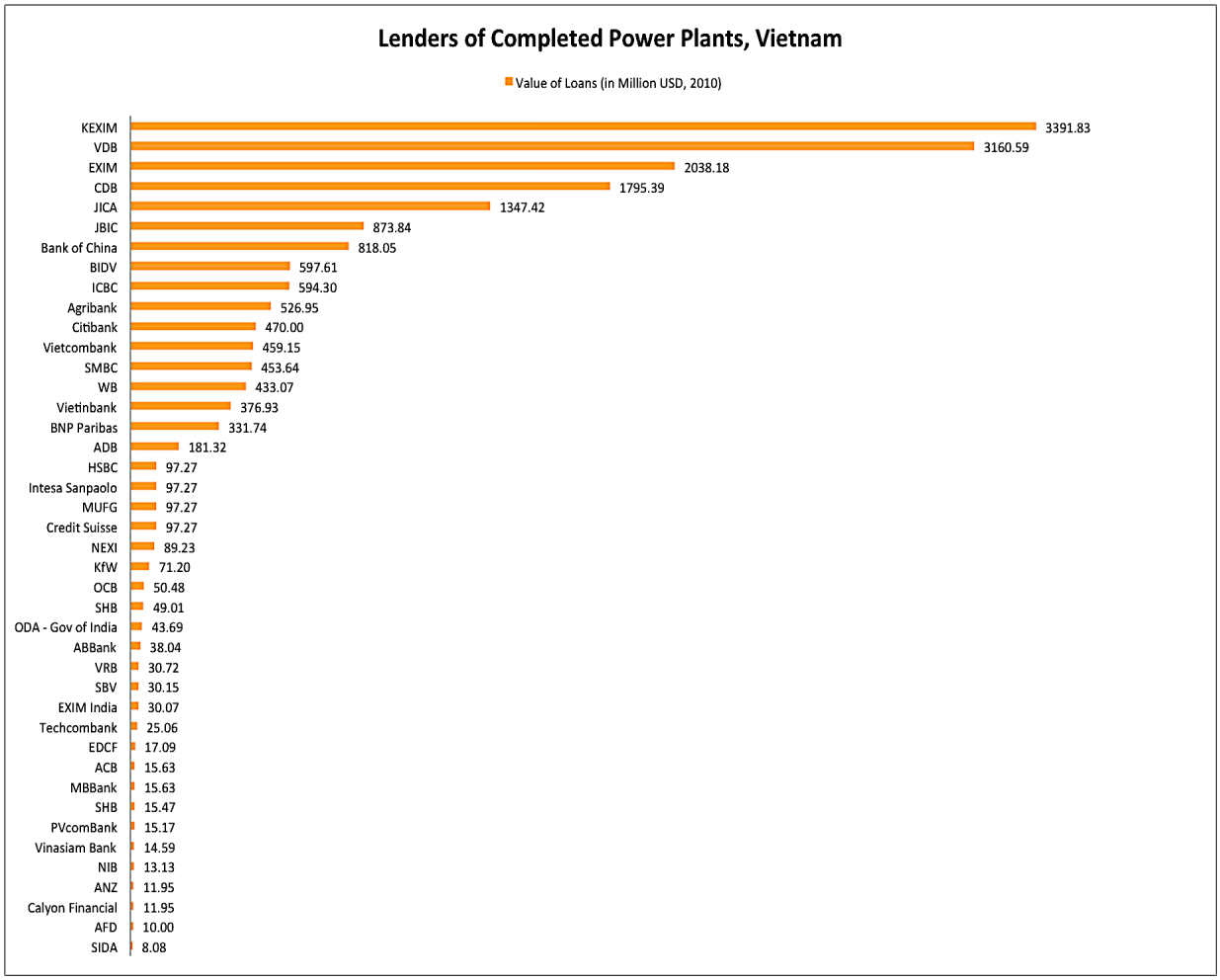


Table 20 Loan Values of 10 biggest lenders in Completed Power Plants, Vietnam, 1964-2016

	Public (Million USD, 2010)	Private (Million USD, 2010)	Total (Million USD, 2010)
10 Biggest Lenders	15144.17	0.00	15144.17 (80%)
All Lenders (Completed Projects)	16953.19	1892.23	18845.42 (100%)

Figure 67 Top 10 Bigget Lenders in Completed Power Plants by Fuel Type, Vietnam, 1964-2016 (US$2010 mil)

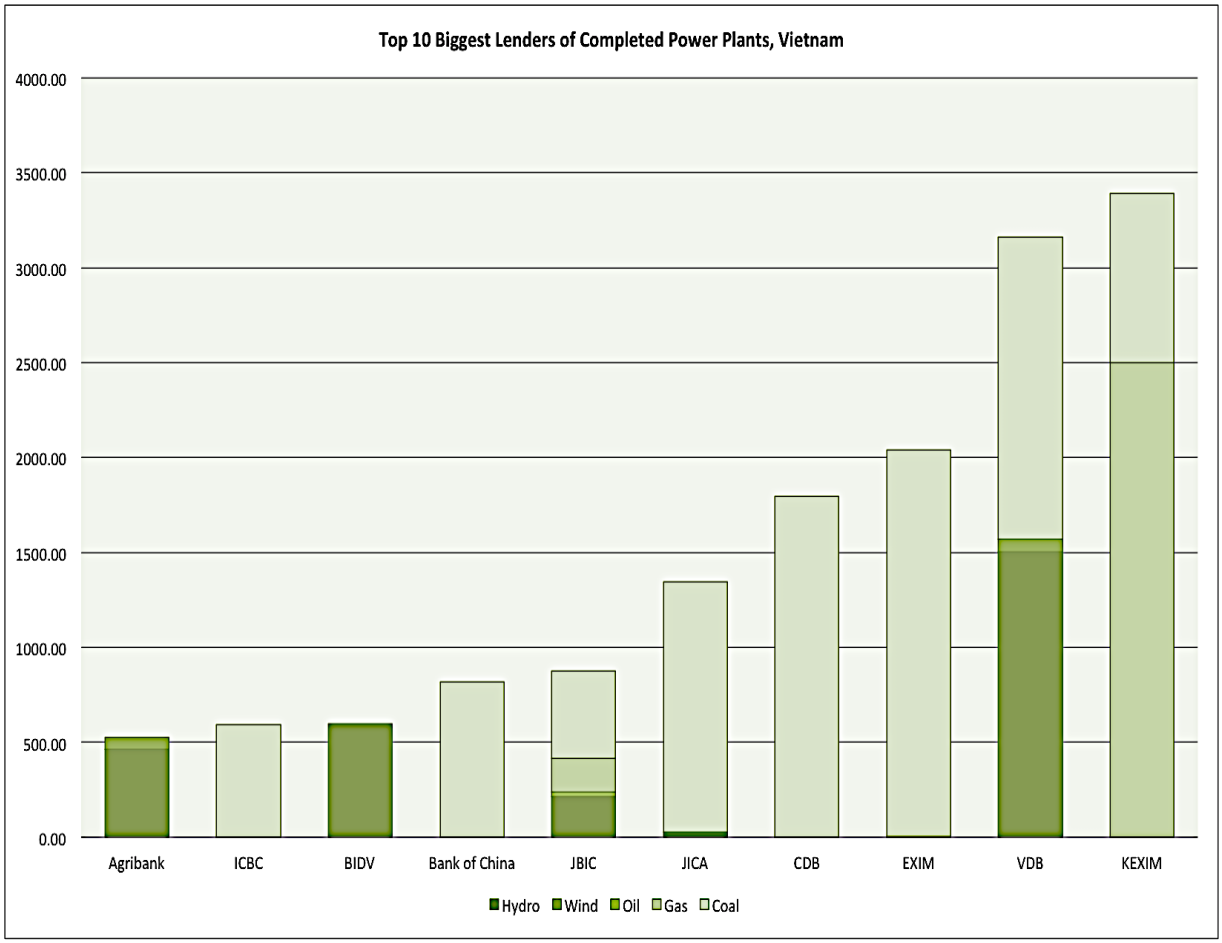
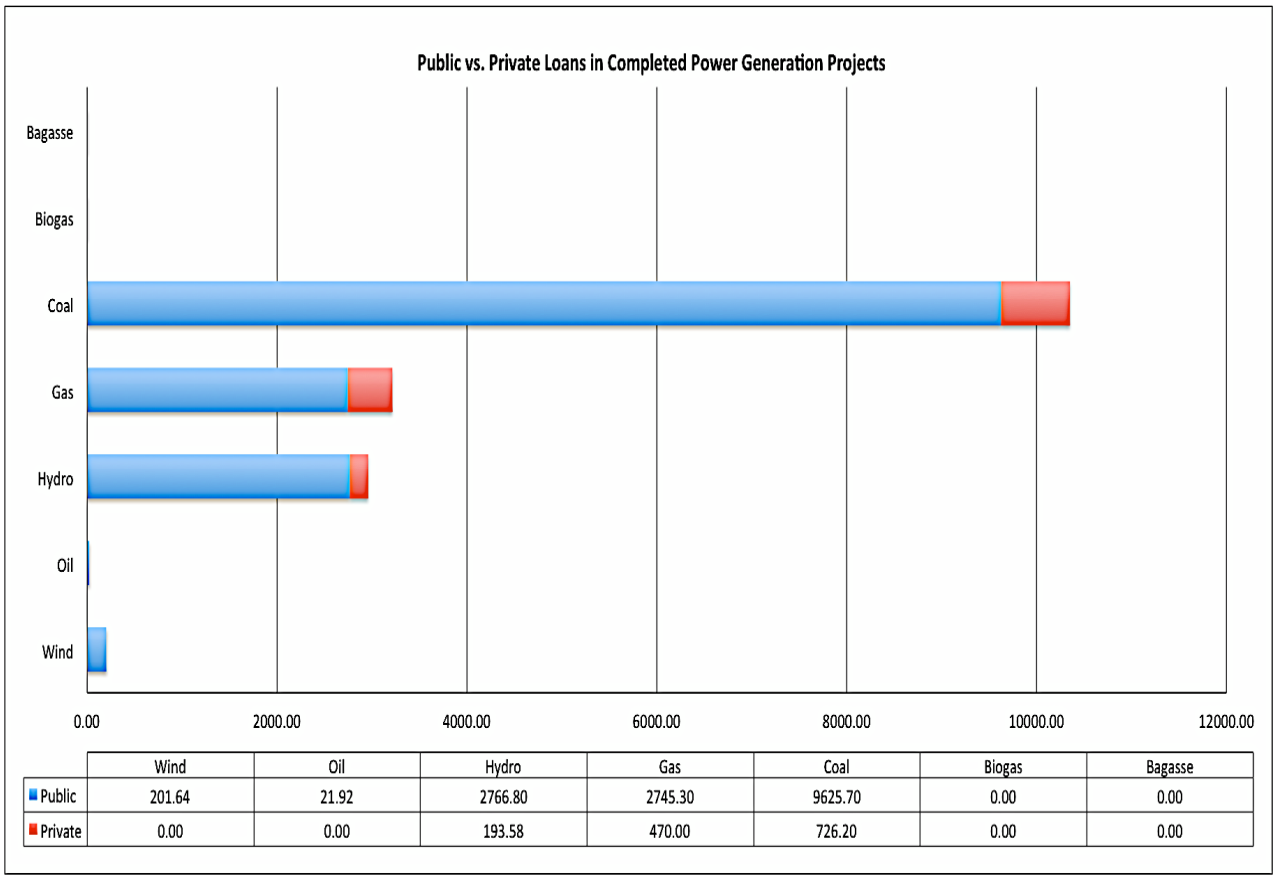


Figure 68 Public vs. Private Loans in Complete Power Plants in Vietnam, by Fuel Type (US$2010 mil)



	Wind	Oil	Hydro	Gas	Coal	Biogas	Bagasse
Public	201.64	21.92	2766.80	2745.30	9625.70	0.00	0.00
Private	0.00	0.00	193.58	470.00	726.20	0.00	0.00

Pro-reformers in arguing for liberalisation expect investment to increase, in particular private investment. As explained in the literature review, there is a discrepancy in what definition of investment is implied in liberalisation theory. So in this research, I consider the changes in both types of investors: equity and lenders. In Vietnam, the power market has not been fully liberalised, i.e. fully open at no costly barrier to entry but it has seen some openness in 2008 when EVN became a single buyer, and its functions are unbundled into separately managed units and then in 2015 when a wholesale market started its pilot before taking full effects. So what I am trying to show in figure 69 and 70 is how these changes in market openness can trigger a change in loan commitments[57] and how different actors will react to these changes.

[57] Loan commitments are the agreements between lenders and borrowers, officially signed and dated. Loans can be disbursed throughout a period of time. This disbursement would rarely be halted by market openness policies, rather by dissatisfaction of lenders towards borrowers and the project progress.

Figure 69 shows that in all 3 periods, pre- and post reforms, public institutions have played bigger roles. The total loan commitments from 2018 by public banks are even much higher than before the reforms whilst expectedly, private banks are also reacting to this reform more positively. If dissecting these public vs. private funders into their locations, all 4 groups of lenders have shown similar positive reactions to a more liberalised market. The period from 2008 to 2014 saw a big leap in the loan commitment values. This eagerness to lend is also starting to show in Vietnamese commercial private banks. However, it is not conclusive that the introduction of the wholesale market in 2015 is not affecting lenders' behaviour for 2 reasons. One, many projects sign disbursement plan that runs past 2015 towards this year or beyond. Lenders may have committed a significant amount right before 2015 to decide that they are not yet ready to further their involvement. Two, the duration of periods in comparison is not equally distributed. There has not been enough time since there is a change in the wholesale market to test if an open market can make it more attractive. Yet, confirming what is shown above, public banks are contributing most, pre and post reforms. So it is not conclusive that these reform policies have made changes to the importance of public vs. private loans.

Figure 69 Public vs. Private Loan commitment in Power Generation, Pre- and Post-reform in Vietnam

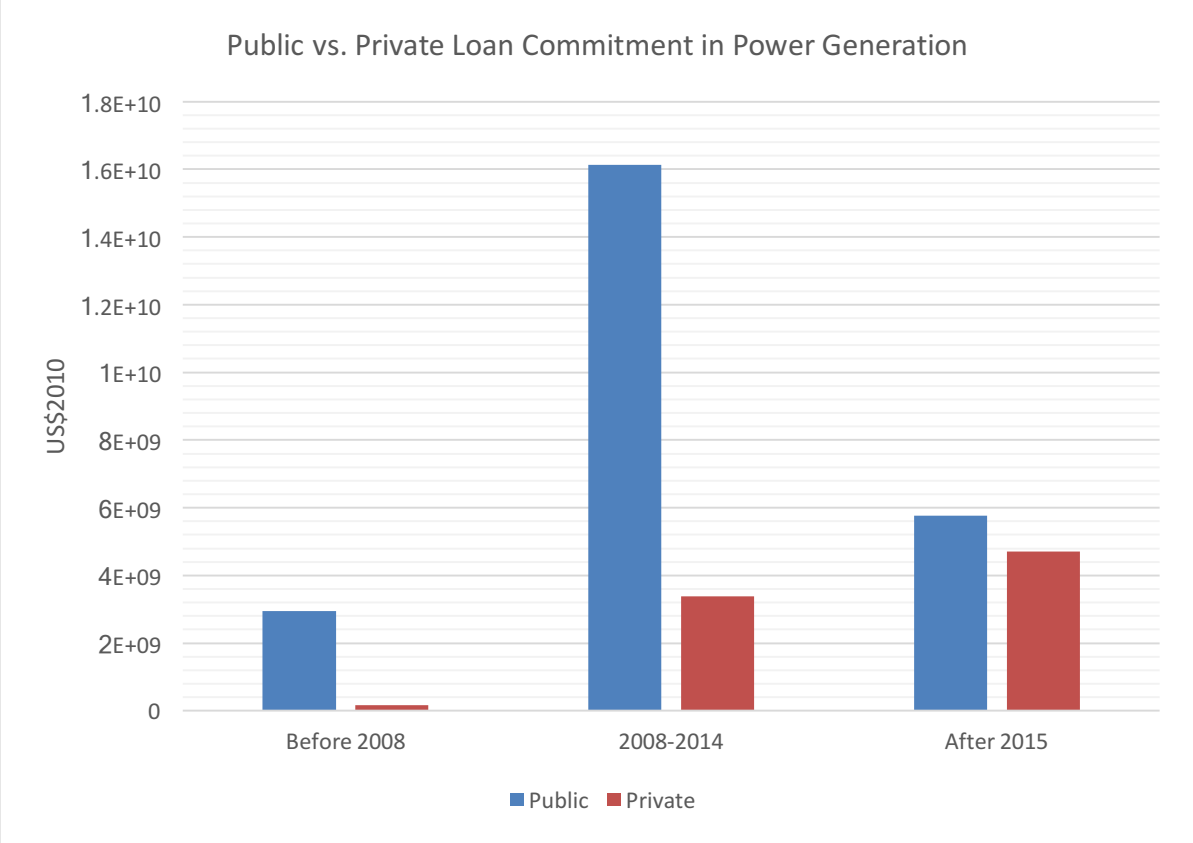
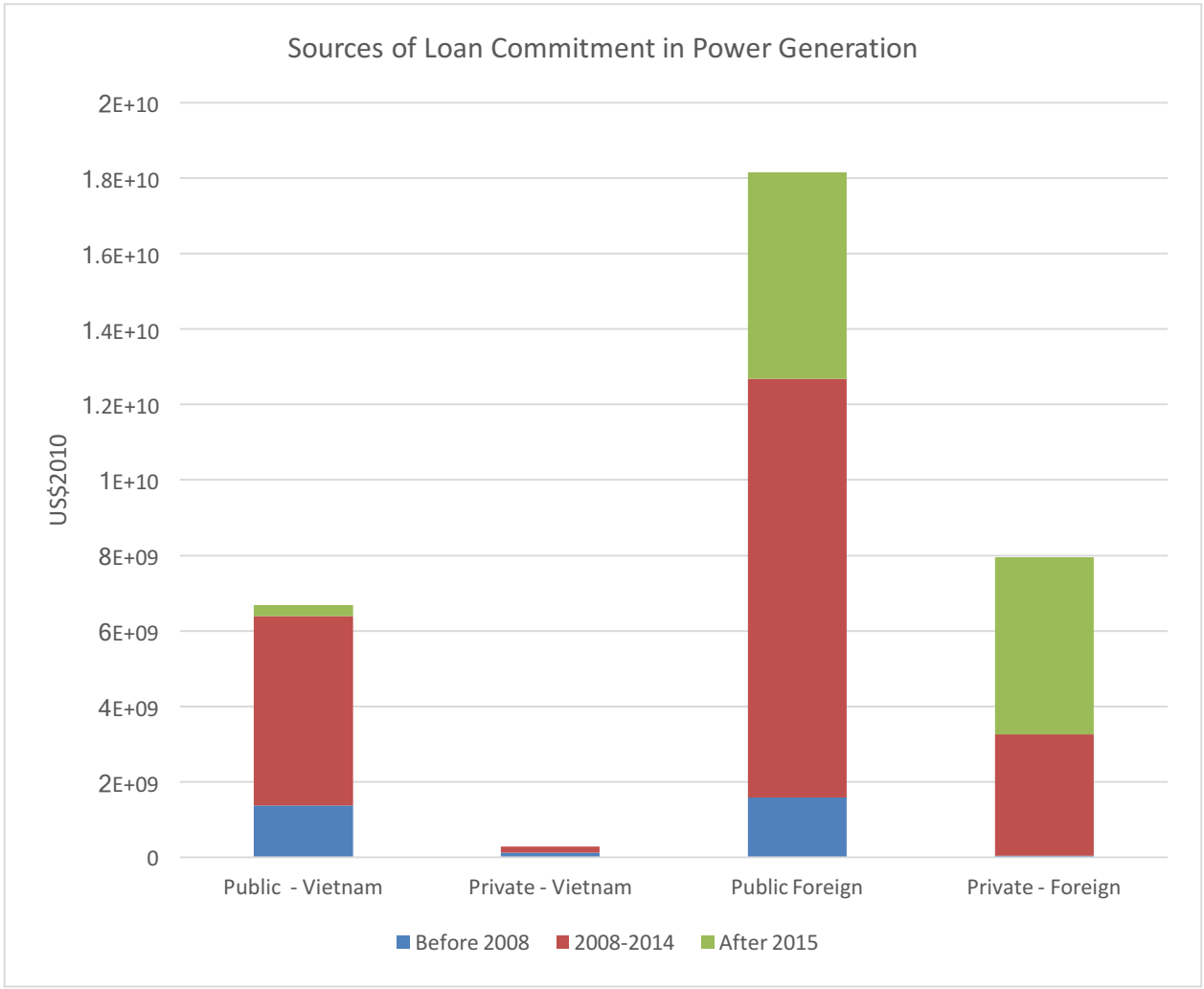
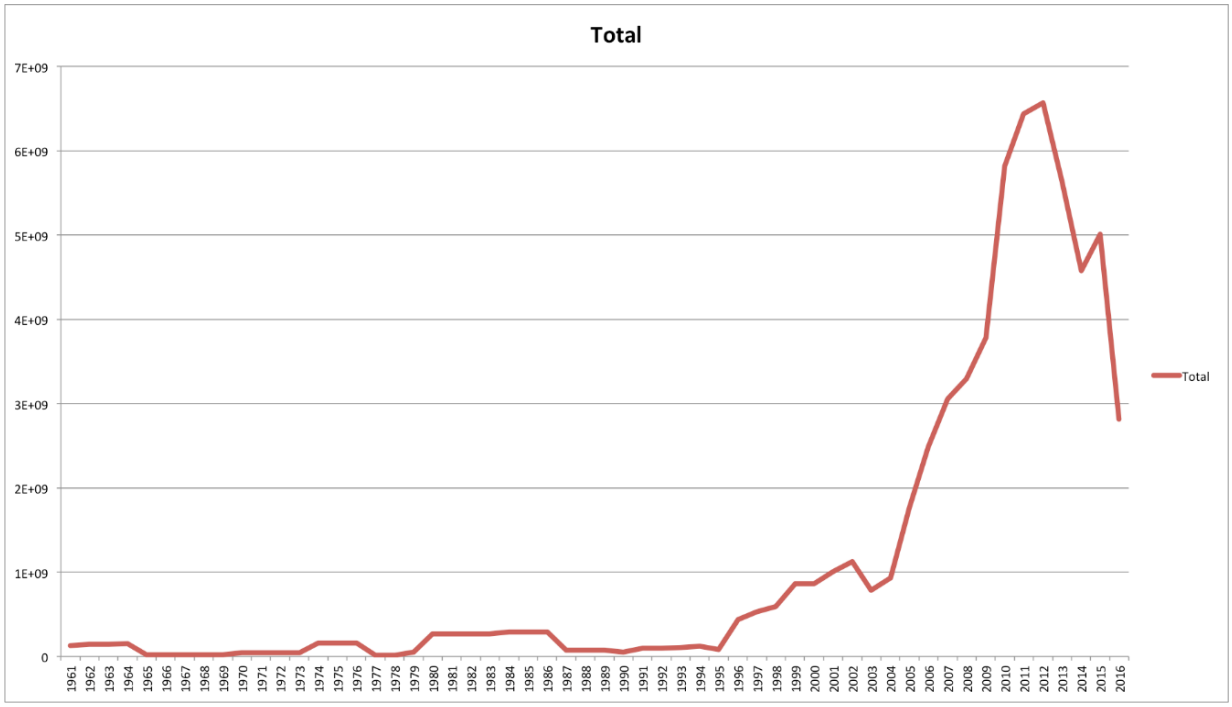


Figure 70 Sources of Loan Commitment in Power Generation, Pre-and Post-reform in Vietnam



7.3.2. Investors

Figure 71 Annual Actual Equity Investment Growth in Power Generation in Vientam (US$2010)



Consistently, equity investors have proven their interests in the growing power sector with increasing consumption demand. Figure 71 depicts a particularly strong growth in equity investment in power generation since the late 1990s, peaking in 2015. This increase in equity investment explains the increase in installed capacity which illustrates similar patterns of growth.

A key difference between this research, employing the Power Sector Database, and other research using other databases is the ability to analyse historical data in investment, i.e. what investment actually happened. When a power plant is completed, a major commencement is organised to celebrate the start of operation as well as financial closure details of the project to be submitted. In looking at details related to these completed power plants, it is enlightening to see the roles of actors involved and how much they react to policy changes (if any) as well as their patterns of investment.

First, in contrast to the belief that infrastructure investment in developing countries mainly depends on foreign direct investment, what is witnessed here is that Vietnam's domestic investors play a much bigger role, accounting for 89% of total equity investment actually

made. These domestic investors are overwhelmingly public companies. When compared to lending patterns in the previous section, what we see is that international public actors are more involved than its private counterparts in lending but not in equity.

Figure 72 Total Equity Investment from Domestic vs. Foreign Entities in Vietnam

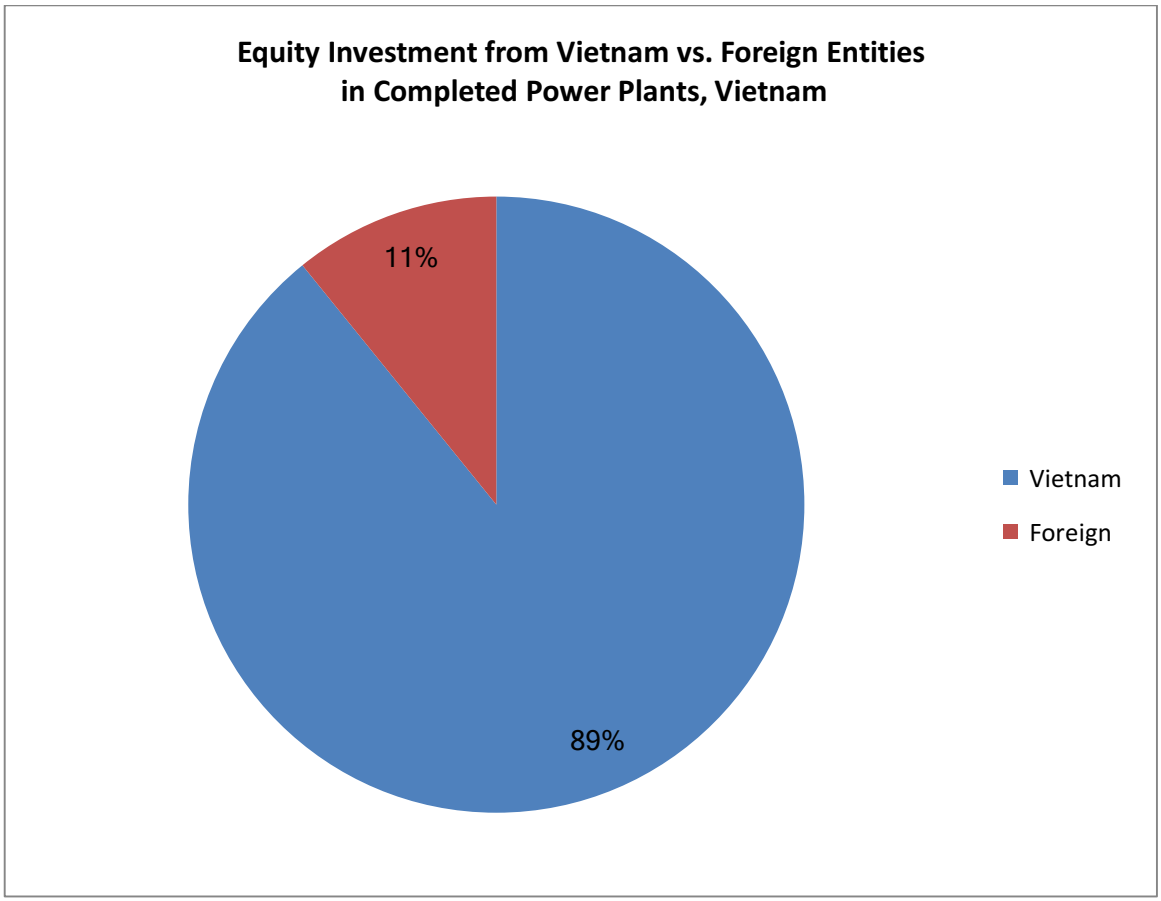


Figure 73 Equity Investment from Domestic vs. Foreign Entities in Completed Power Plants, Vietnam, 1964-2016

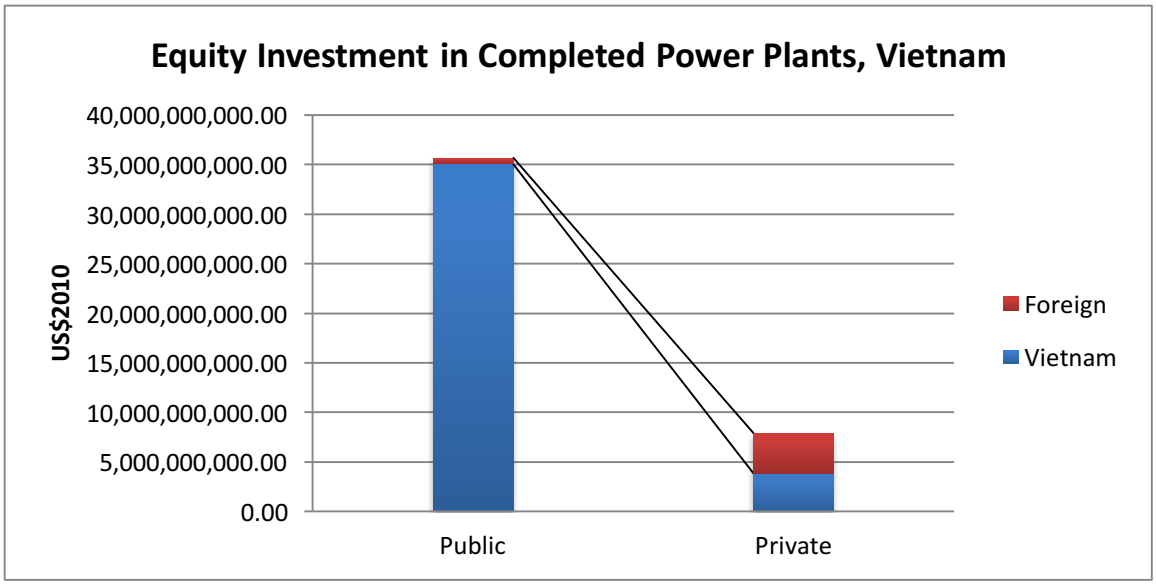


Figure 74 Private vs. Private Equity Investment in Completed Power Plants, Vietnam, 1964-2016

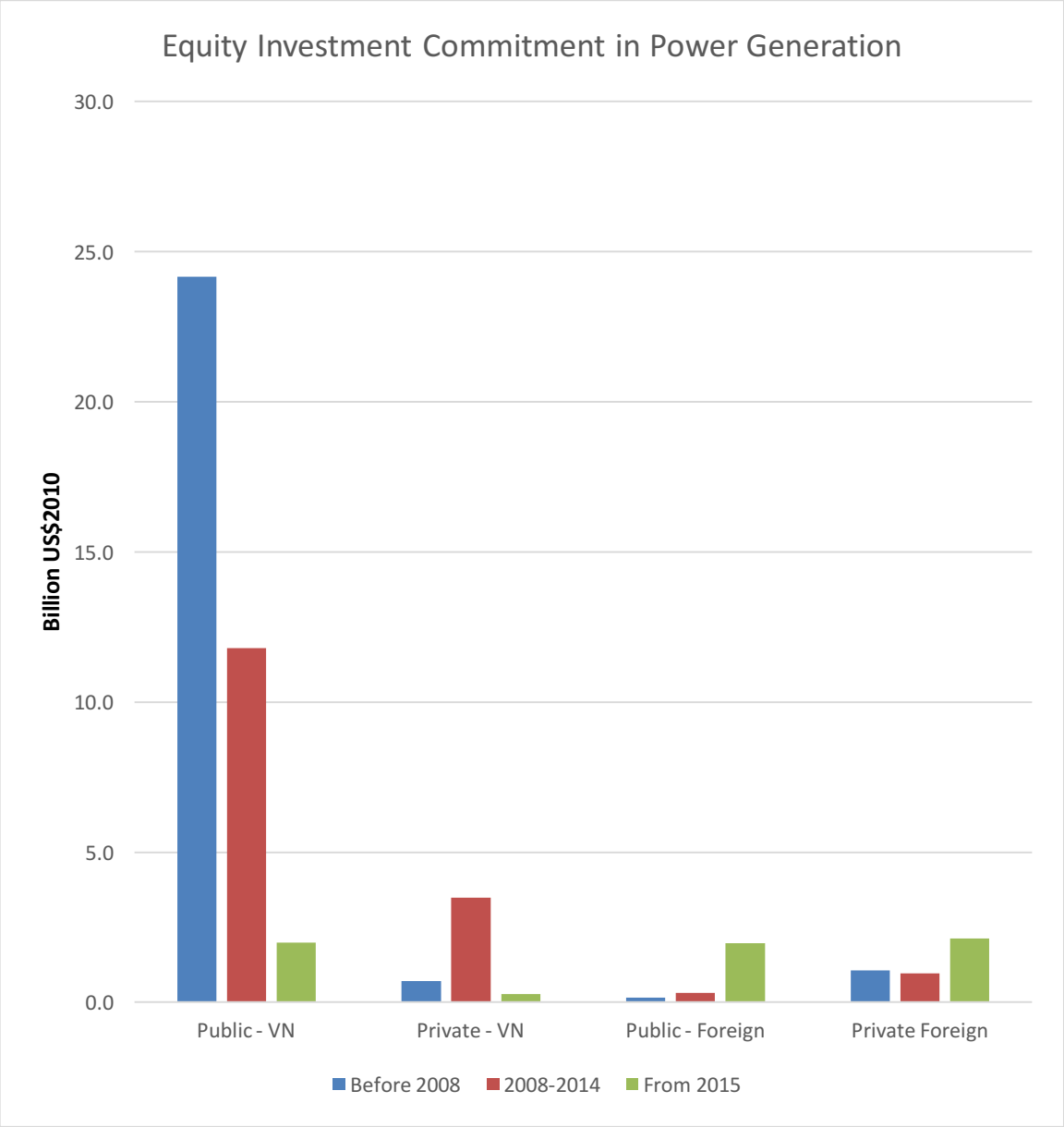


Figure 75 Equity Investment Commitment in Power Generation, Pre and Post Reform Policies

The question of whether equity investors can see a liberalised market as a sufficiently profitable investment opportunity has not been answered adequately in literature. In the literature review in chapter 2, it can be seen that impact of liberalisation on investment is a promise protected by many pro-reformers as a selling point. Yet, it is rather an assumption. In Vietnam, if counting from the year the government announced a liberalisation pathway in Electricity Law 2004, it has been more than a decade. Yet, the market has not fully opened, nor fully accessible to any investors. There has been, however, some small changes. In 2008 when EVN is unbundled and shares of many of its subsidiaries started to be traded on stock exchange, the first stage in the standard model of liberalisation was enforced. As a result,

the power market went from closed to a little bit more open. Then another subtle change is in 2015 when the government announced the implementation of a wholesale power market. The difference this policy makes is rather a hint to private and international investors that it would be possible to trade power at a market price, without the need for direct power purchase contracts with EVN. It is especially more attractive to smaller power producers who may want a competitive level playing field rather than a relationship-based business. These 2 changes gradually opened up the power market in the eyes of non-domestic-public actors.

The theory then would predict that such openness would shift the weight from Vietnamese public investments towards more private ones. Figure 74 compares the financial contribution of public vs. private, Vietnam vs. foreign companies in each of the 3 identified stages. Notably, in order to show actual reaction, rather than looking at annual equity investment paid out, it is more rational to look at the commitment made starting from 2008 and from 2015. If the change in policies has impacted prospective investors, then new commitments would be signed then. So what this figure shows is that there are certain reactions. Foreign investors seem to think of liberalised markets as a good sign. There has been an increase in equity investment commitment from 2008 and further from 2015. Yet, this attitude is only seen in domestic private companies from 2008 to 2014. It could be explained by the fact that since 2015's announcement, there has not been a wholesale market in full operation. In 2016, there was a pilot of this wholesale market but only applicable to government-assigned power plants. Basically, to domestic private firms outside this circle, there is no short-term gain. In contrast, Vietnamese public companies have reduced their commitments through each period. Despite this decrease, Vietnamese public actors are still the biggest investors. In fact, EVN – the incumbent power corporation – has invested in equity worth 46% of completed equity investment.

Looking at the whole history and into near future, EVN is the biggest equity investor in power generation, surpassing the second biggest (PetroVietnam) by nearly 4 times. In the top 10, there are 3 Vietnamese 100% state-owned corporations, each is considered a monopolist in its field: EVN in electric sector, PetroVietnam in oil and Vinacomin in coal. PetroVietnam and Vinacomin have sufficient capital and cheaper access to fuel input (due

to their primary business) that enable them to venture into the high-risk, high-sunk-cost business. The other companies in this top 10 also include private foreign companies from South Korea, India, Taiwan and Japan, whose investment has only been made recently in projects under construction. The outlook of ownership structure in the power sector would probably be competition between major Vietnamese public companies and foreign private companies.

Figure 76 Top 10 Equity Investors in Power Generation, Vietnam (US$2010 Mil)

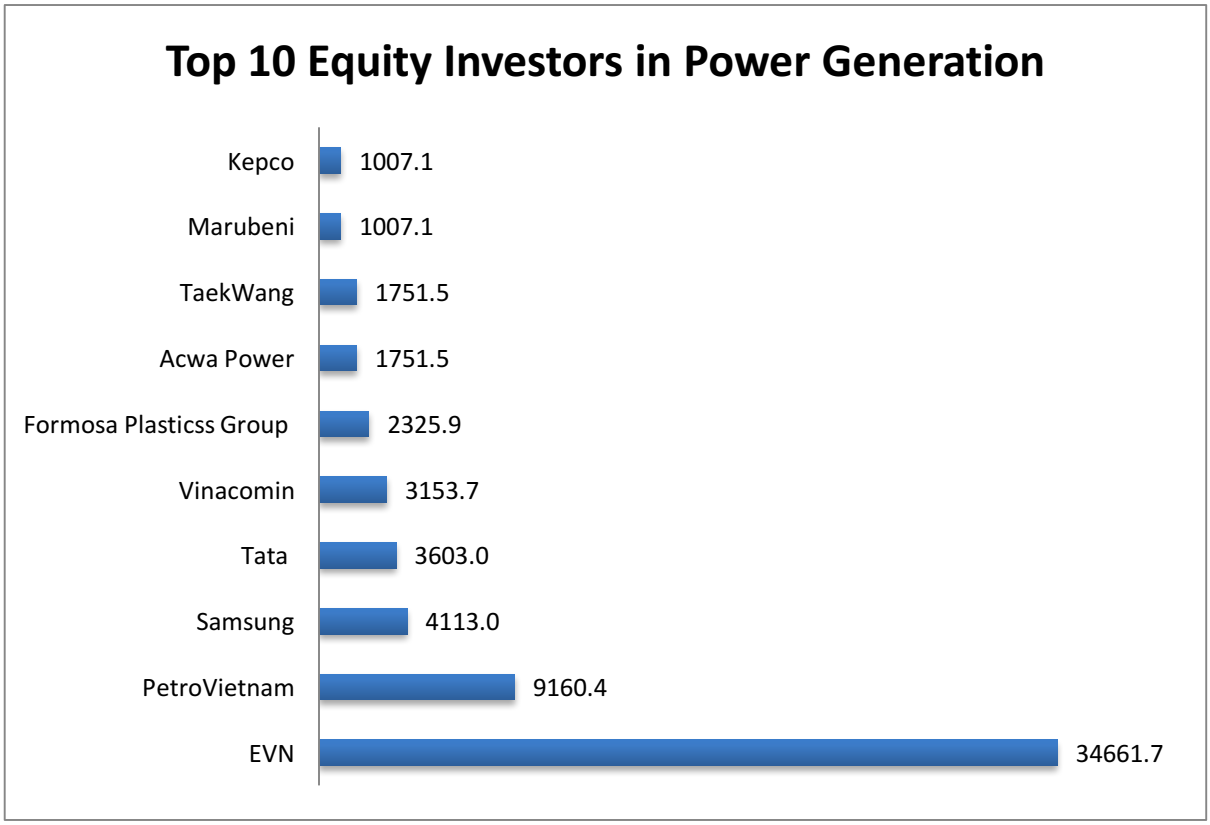


Table 21 Value of EVN vs. Top 10 Biggest Equity Investors in Completed Power Plants, Vietnam, 1964-2016

EVN	34.7 bn US$2010	46%
Top 10 Investors	62.5 bn US$2010	83%
Total Equity Investment	75.7 bn US$2010	100%

Going back to the complexity in definitions of public vs private entities as argued in chapter 4, the Power Sector Database allows researchers to look further into ownership structure in more details. Figure 77 confirms the aforementioned prediction.

In the exchange with the Ministry's energy expert, private companies would choose a well-known cheaper technology. The Ministry may not have sufficient individual-level data on very small-scale hydropower plants but they are sure of a remarkable boom of these power plants. Their estimate in 2015 was 266 SHPPs built in the Northern hilly regions. In terms of costs, these generation companies would not have to build their own dams. A large-scale government investment would ensure water flow control from upstream. SHPPs then could be constructed close to the dam without paying for rehabilitation of local communities, deforestration or complex water control systems. The clusters of hydropower plants in these regions explain the rationale for this.

Beside hydro, with cheap coal, investors would be likely to choose this generation type. Overall, there is little difference between share of renewable sources that are used in projects invested by public or private companies. This action shows that liberalised markets actually do not have the impact on generation mix towards sustainability. The introduction of power markets has not changed the business strategies made by public companies or gives private companies opportunities to go with their own strategies. What we have witnessed via concrete data is that it is not the ownership of the companies that matter.

Figure 77 Ownership Structure of Equity Investors in Power Generation, Vietnam (based on investment values)

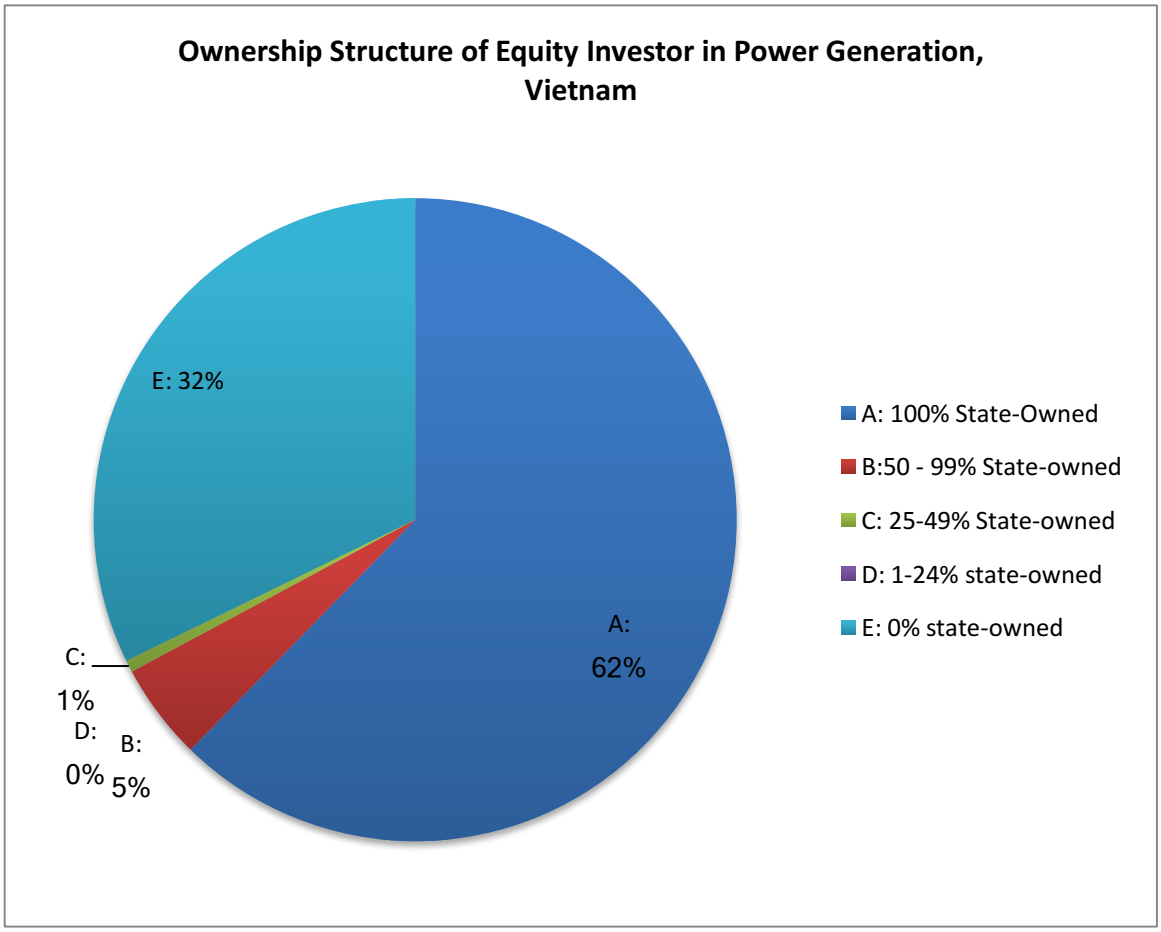


Table 22 Ownership Structure of Completed Power Plants by Installed Capacity

	Number of Power Plants	Total Capacity (MW)
A	51	15271.7
B	57	12906.6
C	13	1458.7
D	0	0
E	62	10787.5

Figure 78 Ownership Structure of Equity Invseors in All Power Generation Projects in Vietnam, by Fuel Type

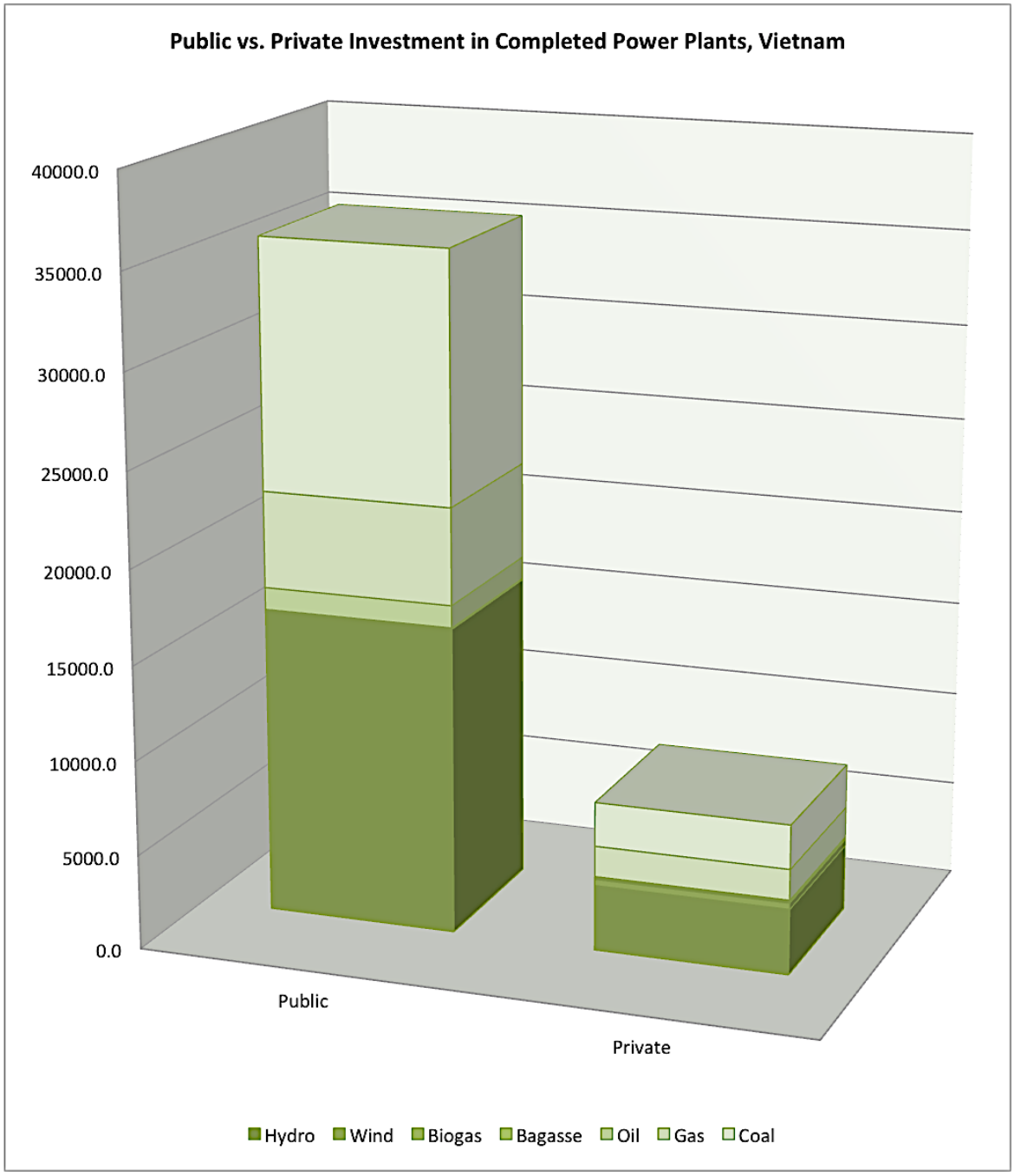
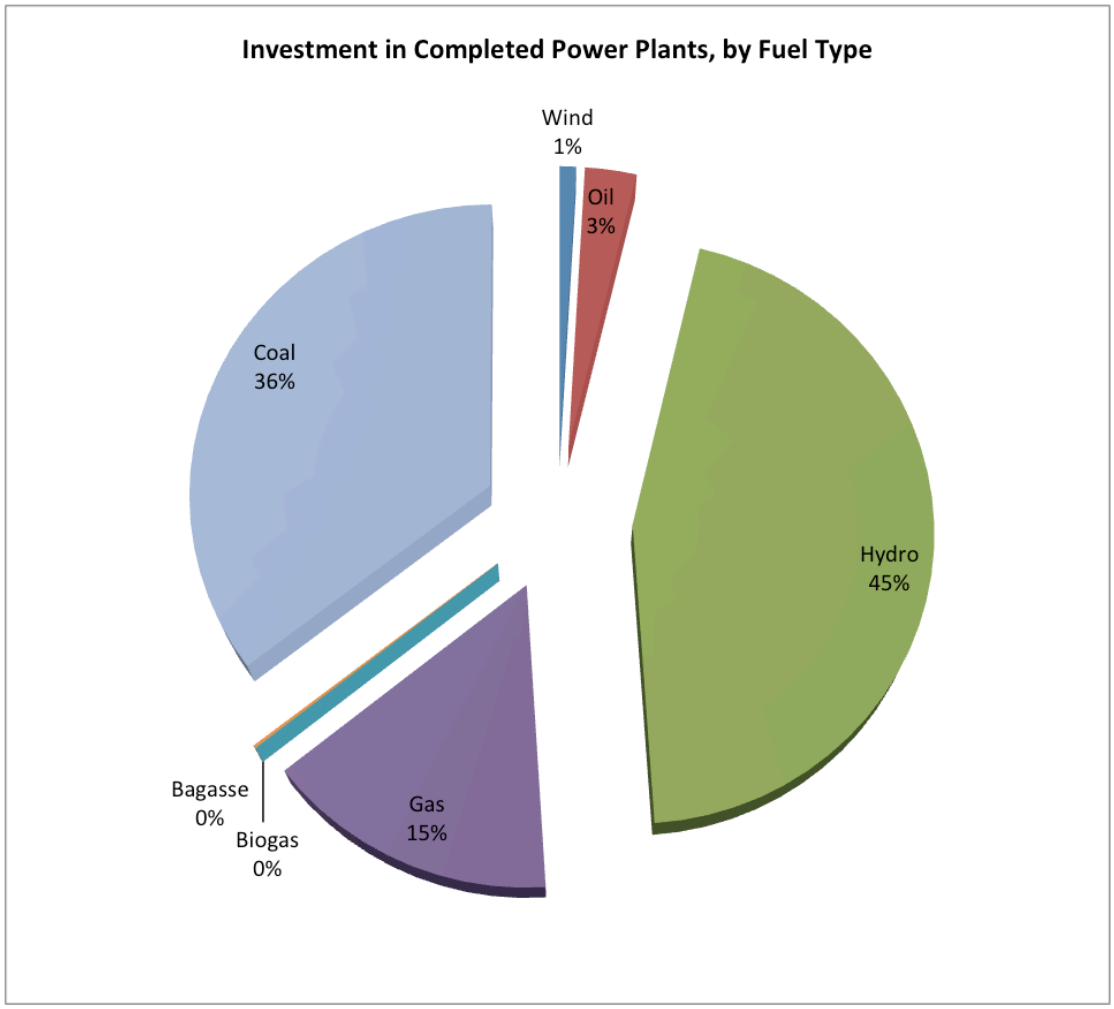


Figure 79 Equity Investment in Completed Power Plants in Vietnam, 1964-2016 by Fuel Type



CHAPTER 8. CONCLUSION

This thesis has presented a database of Vietnam's power plants and initial investment into power generation backdated to the 1960s. This Power Sector Database (PSD) was constructed in response to the lack of a historical dataset of power generation and investment in Vietnam capable of answering the key research questions of how investment happens in power generation, and the relative roles of public and private sectors.

The database makes a significant contribution in two ways. Firstly, it demonstrates the need for, the possibility of, and the methodology for constructing such comprehensive national databases. Secondly, it enables analysis to generate results and insights which would not be possible without such a database. These contributions are elaborated in the first two sections of this concluding chapter. The final part of this conclusion shows how the PSD is of value to policy-makers, both by providing information about future generation capacity, and by contrasting the role of the public sector with that of liberalisation reforms.

8.1. Database methodology

8.1.1. Database Construction and Methodology

This sub-section sets out the motivation for, the background to and the process of establishing and maintaining such a database and attempts to expose the difficulties met and assumptions made in establishing the structure of the data capture.

Motivation and approach

The evaluation of data quality and completeness of the 5 international and major databases, set out in chapter 4, showed that these databases cannot provide sufficient and reliable data to answer the overarching question "What is the impact of market liberalisation on investment in power generation in Vietnam?". There is a critical lack of detailed financial information in relation to the construction and operation of power plants. As a result, these databases cannot provide adequate data to answer questions related to public vs. private investment and participation in the power sector; nor data to illuminate the issue of the relative roles of national vs. international investment. Yet to developing countries, in this case in particular, Vietnam, the financial question is crucial: it is the main goal of market liberalisation policies in which favour of creating a competitive open market for private and

international investors, to reduce the burden on state finances in this sector. The PSD was thus necessary to address these issues, rather than the more limited role of testing hypotheses on liberalisation.

There was no precedent database that could provide useful guidance. The PPIAF database is certainly not informative on their step-by-step data collection methodology. Energy consultancies, including Enerdata, conveniently use the data provided to them by the government, however limited and incomplete they are, and their database construction methodology is not publicly available. My efforts to contact the PPIAF and Enerdata were not successful either.

The PSD was hence constructed from the basic theories of data, data quality management, evaluating the trustworthiness of different data sets, creating a framework for collecting data and cross-validating and merging data, as laid out in chapter 4.

Construction process

The first element was the basic structure of the data, and starting with the aim of covering "all power plants in Vietnam" was ambitious but necessary. This goal helped me not to lose out on any name mentioned, any historical, cancelled or initiated plants of any size that at the point of data collection. Data was not excluded on grounds of size, or negative information, as I could not predict the potential uses of such data. Reflecting on the breadth of the database, this mentality was crucial to start with.

It was then necessary to structure the data by creating categories and definitions of key variables. There were problems at first with too many variables and the difficulties of putting all information related to each power plant in a single record. Take the example of the variable "equity investor". For each project, the number of equity investor could vary from one to many. Their contributions can come in the beginning or in later stage of construction. The contributions could be recorded in different currencies in different years. There are also possibilities of transfer of equities from one investor to another. All these complications had to be recorded somehow. But recording them all in a single table would not be helpful for data analysis. I had to divide this information into separate tables with fields for "name of main equity investor" and "names of other equity investors", and the amount of their investments at a specified year at the specified currency. Total investment amount was recorded in another table. The amount of debt and debtors were also recorded

in other tables. The fact that there could be many unknowns should not justify for the omission of clearer data structure.

Identification of sources

The second step was to identify and evaluate all the potential sources. It was clear from the critical evaluation of the existing major databases that government sources should be the first resort. Within this, it was necessary to understand the system of Vietnam's power sector, its institutions and their functions, in order to know which particular institutions hold the key information on the power development strategy, licensing of power plants, government contracting and transmission systems: the research findings of chapter 5 shed light on this matter. The hierarchy of data sources (set out in Figure P, chapter 4) was the result of this understanding.

Instead of treating all sources of data equally and unanimously, it is important to know which one to search first. Ministry of Industry and Trade (MOIT), formerly Ministry of Industry, is in charge of strategy building and licensing. Its divisions, Institute of Energy and ERAV, took on various roles in BOTs, price adjustment and licensing. On top of these state-level institutions, local governments also play an important role in licensing and delicensing, supporting development of strategic power plants, and checking upon their operations. The appearances of local government officials at the inaugurations of power plants validate their existences, but this local knowledge had not been used before by researchers. However, official newspapers (local and national) that report on the completion of power plant construction, accompanied by photos, are tremendously useful sources to validate the time, capacity, address, technology and financial sources of each plant.

Besides, the unique structure of the energy sector from generation to transmission to distribution and retail was helpful in data collection as well. The transmission company, in this case, only the single-buyer EVN, must hold information with regards to power plants that connect to the national grid. The distribution companies, in this case, EVN subsidiaries, must hold information with regards to power plants that deliver locally, in addition to above. The retail company, in this case, again only EVN subsidiaries, must hold information to the amount of power consumption that is the benchmark for the completeness of the database.

Since the focus on financial figures is the key contribution of this thesis, sources had to be identified for the complexities of company structure and shareholding structure Chapter 4,

parts 4 and 5 explained these complexities and how I dealt with them. The determination to seek true owners and influencers of the power sector led me to look at detailed financial statements published over a number of years by publicly owned companies; to look for independent audit reports or financial announcements of companies that are about to be listed on the stock exchange; and to look at available contracts between debtors and investors of a power project. The lists and links of all these documents and sources are also part of the PSD, and are available in the full version. It was also important to recognise that a company may not be required to publish its financial statements, but there are other sources (including press releases, contracts, independent reports. In the spreadsheet regarding generation companies ("gen_co") in accordance with each power plant, there is more than sufficient information including their Vietnamese and English names, business summaries, tax codes, addresses, contacts and most importantly, their ownership structure, i.e. their parent company, and how much comes from public vs. private sources.

Unifying data from various sources

Fairly speaking, there is no single source of data that could have provided all what is now in the Power Sector Database. International sources including WB, IEA and Enerdata depend heavily on the government as a source, so they cannot go beyond the limitations of their sources.

One example of this is the lack of good information on small plants. Upon my personal request, a sub-unit within MOIT provided me with a list of power plants in Vietnam as of 2015, including their abbreviated names and capacity, with more than 200 very small hydro power plants whose names cannot be specified. The reason given was that very small power plants are not under management of the state-level institutions but under local authorities. Since they are too small in scale (under 3MW), they are not crucial to the security of national power supply. Even the central government and the transmission company (EVN) do not wish or have data of all power plants that add up to the total power generated in the country. But these are serious limitations, especially in light of the growing role of small renewable energy installations.

Therefore, there must be an effort to merge different data sources. Consideration of press releases of turbine providers, overseas development aid agencies and individual companies' website was actually pivotal to filling in missing values. Not only did they contain historic data but they also could say about what has been initiated, signed, contracted and is about to

happen in the near future. The analysis in later parts of this chapter shows how inclusion of these sources has been helpful.

Missing values and Related Assumptions

It cannot be said that the Database is 100% complete. The power sector in a developing country like Vietnam is growing by the month. I have had to revise the database twice before submission of this thesis due to the expansion of the network. Another reason is that there is no consistent format for data and information publications required for the power companies or the power sector, so that it is extremely difficult to find data on buyer agreements (power purchase agreements); details of contractors and their contracts; and technical specifications of all power plants. Where values are missing and there is no source to validate whether it is not applicable (e.g. whether there is no debtor or not), I decided to prudently put unknown (UNK) into the boxes. Where there is a mentioned name/value without validation from other sources, I marked this clearly. In the case of analysis of investment by equity vs. debt, if there is an unknown, assumptions made were based on contingency.

Where the investment costs of power plants were unknown, I used three methods to estimate the costs, in the following order of priority. First was to calculate costs based on average construction costs based on government costing (given by MOIT to me), fuel type and capacity; second, when costing of an individual power plant is not known but the total costs of the couple of power plants being built in the same complex are known, it is assumed that the costs would be proportionate to their capacity; third, in other cases, costing of a power plant could be assumed to be similar to that of a power plant of similar fuel type, scale and location, which in fact is not difficult to find.

Data in local language

There is often more and better information in the original local language version of sources. The PSD itself shows the disparity of information displayed in the Vietnamese vs. the English version of a website: translation is not on 1:1 scale. Government documents are often scanned and uploaded onto the Vietnamese version of the official portal whilst these are not available in the English version. Vietnamese private companies also display the same pattern in treating Vietnamese language users as their main customers rather than thinking of international counterparts. In addition, searching for power plant names alone in English would result in much less than that in Vietnamese. A collaboration with a native speaker researcher hence sometimes becomes crucial in getting data and understanding documents.

In this database, I tried to translate to my best understanding Vietnamese into English in the published version while maintaining columns written in Vietnamese for double-checking and when the researcher is capable of using and understanding the language. I experienced similar patterns in the process of data collection for Thailand: it is a barrier for researchers, if the language of the country they are researching is not one that they know. Google Translate is a helpful but limited tool that can be used.

8.1.2. Accessibility, expansion and replication of the database

Accessibility and Publicness of the Database

The PSD aims to be a public database for energy economists and policy-makers who wish to investigate the topic of managing generation in the power sector. This section explains how it can help researchers in Vietnam and other countries to develop their own methods of enquiry in a manner that will produce comparable results in other countries and so, potentially, at an international level.

The period of constructing and refining the database was almost 2 years. During the time, new data kept coming up. The need for regular update is existent so as to make sure the data stays current and useful for researchers. In addition, historical data as collected in this database has not been seen outside the small circle of myself, my supervisors and several conference attendees. Together, they create an issue of a potential database which has not been useful and may not stay useful outside this single thesis.

Given the limited time available for this thesis, I have decided to publish the database in its simplified excel format on my personal website (www.jennytanguyen.com) . Excel sheets are displayed on the website for view as well as downloadable in full. Accompanied the sheets are explanations of methodology, terminologies, glossary, preliminary data analysis and graphs. In this way, researchers could access and work with the data conveniently.

Potential users of this database include researchers, policymakers, journalists and students. Since the levels of expertise may vary, it is important to make the database user friendly. By that, I meant to make variables and column structures (even in brief formats) as comprehensible and common-sense as possible. One single sheet of all power plants could provide all information related to its technical specification, location, and financial figures.

All information and data were written in simple English. To make the data useable for quick researches, conversion of financial figures has been made and the formulae can be found in the guidance file. To assist users further, upon requests, users can contact me to obtain the full version containing Vietnamese versions of some columns, data sources to validate and sections of the research findings done in this thesis.

Understanding that there are potential errors and missing values, I hope that the publication of the database will allow government, researchers and consultancies to provide feedback on the usefulness, errors and rooms for improvement of this database. I hope that the PSD may also provide similar feedback for these institutions' own data management.

My commitment to full disclosure of the data collection process, methodology, limitation and assumptions hopefully could encourage other researchers or interested parties to replicate and/or improve this approach so that there would be publicly available data on power generation and investment in many more countries that are comparable across different datasets of different countries. My first step was to make sure that all information and data were recorded in English. Another consideration is the use of producer price index and foreign exchange to bring all figures to the constant value of USD in 2010 in the electricity sector. The method of calculation is clearly explained in chapter 4 of the thesis and also in the Guide attached to the database online. A third consideration is the mentality and prudent approach to maintain high quality of data as explained above. This consideration is up for public discussion. When a researcher/an institution wishes to replicate this study or its approach, a discussion with me in the first hand to bring them to the same comparable standard would be helpful.

Replication and resources

It took a number of staff in the World Bank to work on the PPIAF database focusing on private participation alone around the world. A single researcher therefore would need a multiplied amount of time and effort to create better and more complete database than that. It was indeed a significant task to take on, individually during the limited time of a PhD research. Therefore, the initial ambition to create a comparative case study of Vietnam vs. Thailand could not be fulfilled. 2 years were required to start from scratch with creating a data collection system and data cleaning for Vietnam alone. The need to constantly revising, updating and validating Vietnam data during the years also consumed much time that should have been dedicated to completing data for Thailand. In the end, the database contains a

fairly complete dataset of all power plants in Vietnam from the beginning of sectoral history and a subset of that in Thailand. For the PhD thesis, I have decided to showcase and analyse the former. The focus on Vietnam illustrates how a complete database could tell a whole story that tells reality apart from theoretical predictions, and its many possibilities of research findings.

As indicated in the beginning of this chapter, the initial intention was to collect complete datasets for both Vietnam and Thailand. However, given restricted time, only Vietnam dataset was completed on time. Currently, a similar dataset on Thailand's power plants, and a dataset on power loans in Laos, Malaysia and Indonesia are also available but not yet included in the published spreadsheets. A prudent approach to completing and validating data would also be applied to this expansion. Hopefully, the database can live up to its name as "Power Sector Database", not only as "Vietnam's Power Sector Database".

8.2. Results and insights from database

The PSD for Vietnam is a dataset which has enabled in-depth analysis of how investment in power generation happened and how networks of investors have together developed the power sector in Vietnam. This is the primary question of this thesis. Without this dataset, an answer could have not been reached and an analysis based on pre-existing datasets could have been misleading. Additionally, the dataset has stretched longer and further than purely the liberalisation process of 20 years. It covers the over 50-year period from the conception of the power sector under French colonisation to the current year of writing, and including projection into the near future. It permits longitudinal analysis to understand the trajectory of development of the power sector from its roots.

Because it is comprehensive, detailed and precise it has made possible the analyses set out in the preceding chapters of this thesis. The benefits can be seen in four key dimensions of analysis: the relative role of public and private sectors; the contribution of domestic and foreign actors; the distinctive roles of equity and debt investment; and the distribution of actual investment between fossil fuel and renewable energy technologies.

Public vs. Private Participation

Participation by public and private entities include equity investment, loans, ownership, and technology and equipment. First, as lenders, the great majority of these entities, comprising

of banks and agencies, have been state-owned. While the growth of private funds is many-fold, the overwhelming proportion of state-funded loans in comparison to private commercial bank funds was observed both before liberalisation policies were formally introduced in 2008, and after. Second, the detail of this spreadsheet can show that one company could be owned at various degrees by both public and private entities. A single division of public and private as conventionally referred to does not reflect the reality of complex company ownership structure. The analysis of 5 types of company ownership in chapter 7 shows that the government is interested in whole or majority ownership of power plants. And effectively, the state is in charge of nearly 70% of equity investment. Further possible analysis into what type of business, or type of power plants, is the government keen on controlling could also illuminate the question of "where private investment is actually essential or additional". The biggest equity investor in power generation so far has been EVN, the state-owned incumbent. Its total investment even surpassed the total of the rest of top 10 biggest equity investors including other national SOEs and multinational corporations.

Domestic vs. Foreign

International players have contributed to the development of power supply in Vietnam from the beginning years. However, the scale of their contribution and investment has been commonly been discussed with reference to absolute figures rather than in comparison to national institutions. In lending to power plant construction projects, the most surprising finding is that the biggest lender is KEXIM, a Korean Development Bank for export and imports, followed by development state banks of China (CDB, Bank of China), development agencies of Japan (JICA, JBIC). The main source of loans into Vietnam's power generation so far has mainly come from Asian countries that are in more developed economies with history of development aids to Vietnam. Their contributions have constantly been on the rise, regardless of the liberalisation process. Besides these foreign financial institutions are Vietnam's development and state banks, whose loan values amount to 29% of all completed power plants. It could be said that the liberalisation policies have not reduced the role of Vietnamese and foreign public financial institutions. Apart from these lenders, foreign private firms from Asia have also made increasing equity investment into Vietnam's power generation. The expectation from market liberalisation model that the market would be more open and deregulated could explain for this rise.

Debt vs Equity

To construct a power plant requires funding, commonly from both equity investors and lenders. In both completed and projected/under-construction power plants, the average ratio is 30:70 between debt and equity. This ratio differs depending on the type of fuel, which implies different construction costs per MW. In my correspondence with MOIT in 2015, these unit construction costs in Vietnam for gas and coal are the highest, which could explain for the higher ratio of debts in initial funds for these fuel projects.

Fossil vs Renewable fuel type

As argued in chapter 5, Vietnam has abundant resources of renewables, especially in hydro, wind, solar and biomass. What has been witnessed is the national focus on developing hydro power plants at different scales in the highlands. Investment in hydro accounts for 40% of total historical equity investment in power generation. Meanwhile, exploration of wind and biomass has only started in recent years. The government has not clarified their goals and coordinated policies to support development of renewables. In oppose to this vagueness is the consistent use of coal. Annual investment into coal has been on the rise. Coal is also the most invested fuel type for power generation, followed by hydro and gas. Lenders, especially foreign and private ones, also have so far chosen to support the use of these 3 fuel types as they have been conveniently and technologically comfortably applied in the country. Fossil fuels are not seen to be ruled out anytime soon.

The PSD has allowed me to illuminate research questions that have not been answered due to insufficiency and inadequacy of data. Policy makers also could not have got a full understanding of how to tailor energy policy to the actual context of the country, instead of relying on foreign consultancies (including the World Bank) and their theoretical speculation. The research findings as presented in this thesis are only few amongst possible researches that could employ the data in the PSD. Analysis at annual intervals, and at the level of individual power plants can be made, alongside with rigorous statistical tests to understand the magnitude of policy impacts.

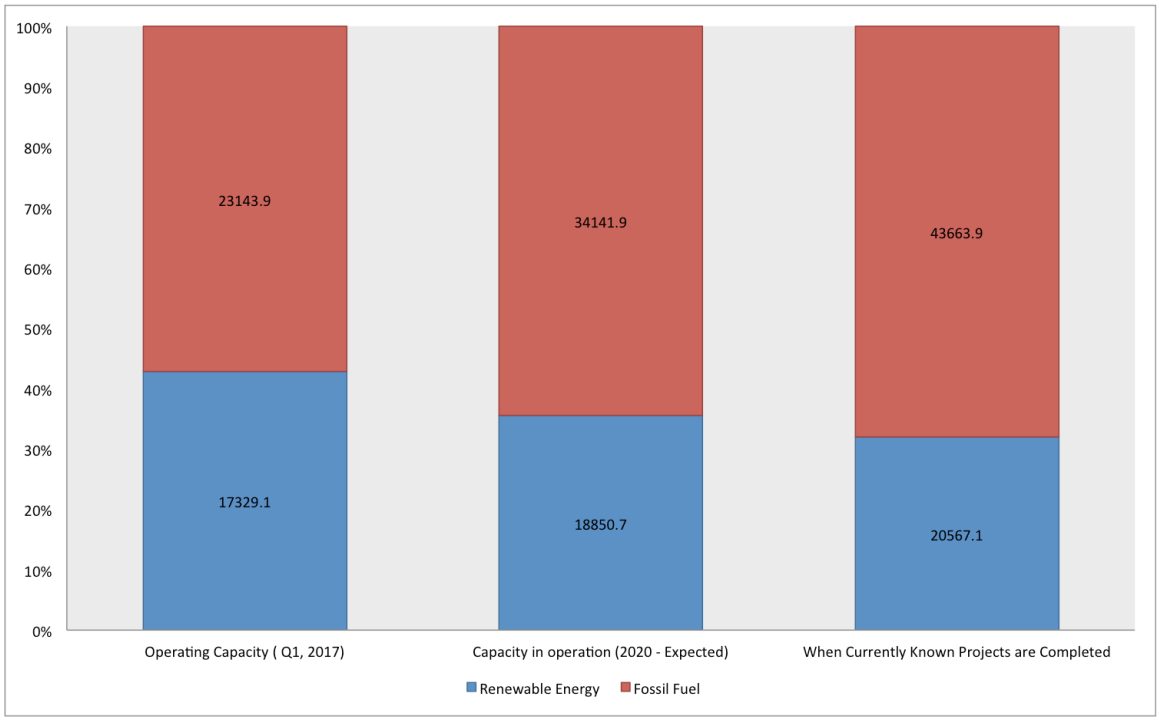
What the PSD has made possible depends on its qualities in comparison to pre-existing databases. First, the PSD covers the longest period of power sector development with comprehensive annual figures. Second, it covers almost complete population of power plants including in operation, under construction, cancelled, initiated and licensed. The World Electric Power Database (IEA) only covers the first 3 categories of power plants, let alone

the much smaller number of listed ones. Third, its classification as discussed in chapter 4 has shown careful consideration of the complexities of company, ownership structure and the unique feature of the power sector. Classification of ownership types includes 5 types instead of conventional 2 – all public vs all private; 4 types instead of 2 – foreign public, private, national public and private. Classification of technical companies includes consultancies, design and equipment providers covering more than just generator providers. The accuracy of classification is a highlight and a feature that makes this database useful for many future further researches.

8.3. Concluding remarks

My intention in collecting the data is not merely to look at the static picture, but also the future dynamics. The power sector in Vietnam went through many years of virtually no growth, and then into a period of unmatched growth. The sector continues to change during the development of installed capacity to serve the expanding economy. Under international pressure from the World Bank as well as internal pressure to address negative attitudes towards public monopolies, the government has introduced and amended its liberalisation pathway. Their policy changes have not been drastic overnight, but rather cautious, with trials.

Figure 80 Expected Share of Renewables vs. Fossil Fuel in Power Generation in Vietnam



Based on construction proposals announced by investors and construction licences issued by local authorities, figure 80 compares the types of power generation that are of interest to investors so far. Hydro and coal will continue making up the majority of the power sector: there is almost no known interest in the near future in bagasse, biogas and oil. Investment in wind turbines starts to grow in the next few years, but remains a minor source of generation. What is more surprising is that coal generation will surpass hydro generation in 2020 and will continue to dominate more than 50% of total power generation if all projects are completed. From 2017 to 2020, there will be 13 more coal power plants built in Vietnam and, after 2020, there are an additional 8 coal power plant projects which are waiting for licences. Based on the power plants that are being constructed and expected to be complete by 2020, Vietnam's power sector is not getting more sustainable in the near future. In fact, power capacity generated from fossil fuels (including coal, oil and gas) is not only increasing in real terms (MW) but also in their proportion of total generation capacity.

What hinders good policy-making is not the lack of intentions to make things better, but the lack of credible close-to-reality reports on their progress. This research has then made a significant contribution by creating a complete database of power plants, financial figures and contributors, in the longest period publicly available by comparison to other data sources. Besides, it has analysed the changes to investment throughout policy changes from various perspectives, and with more precise definitions. One key finding is the great amount of multilateral debt, attached with strict structural adjustment conditionalities, drives the country towards a policy model that yields little benefits: little private investment under similar business strategies. In short, all that private investors have contributed could have been fulfilled by public ones. Whilst the benefits gained so far are minimal, the costs to the power sector as well as the society are much larger: repayments of debts from tax revenues, likely increase in electricity tariffs and certainly more pollution. Since the government cannot direct private actors, it is easier to use its public agents to address sectoral challenges. And they could do this without the need to go through liberalisation reforms.

The ability to mobilise and utilise resources for the public good is the advantage of the public sector. The ability to invest for long-term yield instead of short-termism is also the characteristic that makes the public sector work more efficiently, if remains truly public. To liberate our economy from fossil fuels to renewables, the public sector can invest in solar and wind power which after some years of operation will incur zero marginal costs.

This research, like many others, has found no evidence that markets are providing these social needs, whereas we can see governments and other public sector bodies doing so constantly. Chang (2002) comments that 'markets are, in the end, man-made devices for utilitarian purposes, not a force of nature that we should not try to resist. If they end up serving the interests of only a tiny minority, as is increasingly the case, we have the right – and indeed the duty – to regulate them in the interest of greater social good'. The market economy may well be functioning on our commodities but may not function at all without the public economy. The existence of a public economy, from more than 20 years of mistakes, should be realised to deserve its own place, to remain rightfully public. The publicness in a public service and a public economy should remain.

POWER SECTOR DATABASE

The spreadsheet containing the database, revised to make it more user friendly, is submitted to the examiners along with the thesis. The filename is datamatrix_vn (120917) .xlsx

APPENDICES

APPENDIX A: Power Market Accessibility

This Appendix A explains the method of composing Power Market Accessibility used in Figure 14, chapter 6 above. The name 'Power Market Accessibility' was co-authored by Dr. Liu Xiying (National University Singapore), Dr. Peerapat Vithayasrichareon (Energy Intelligence and IEA) and Tue Anh Nguyen (myself) in our in-progress work, presented at IAEE Bergen Conference in June 2016 titled 'Comparative Study of ASEAN-5 Power Sustainability Using Power Sector Synergy Index. We were inspired by the OECD's Sectoral Indicator of Regulatory Reform in Electricity (aka. ETCR), which measures the progress of electricity market reform.

OECD ETCR is a commonly used tool to analyse the status of market mechanism in infrastructure service sectors. For the electricity sector, the degree of market liberalisation, i.e. market accessibility, is measured by a compound of third party access, consumer choices and wholesale pool from 0 to 6 where the higher the more liberalised the market is.

ETCR is composed of measurement of 4 key elements of liberalisation: entry regulation, ownership, vertical integration and market structure. Since definitions of public ownership, integration and market structure in the context of ASEAN countries are not as clear-cut, as argued above in this thesis, we decided to use the element of entry regulation as measurement of power market accessibility, i.e. how accessible it is for new entrants to enter the power market. In this measure, the higher it is, the more accessible the market is for new entrants. The scale of measurement is (0,6) where 0 means absolutely closed market and 6 means fully open market. This is opposite to ECTR, which associates higher number with higher barriers to entry. The table below shows the composition of this measure:

	Question weight	Coding of data						
Entry Regulation		0	1	2	3	4	5	6
How are the terms and conditions of third party access (TPA) to the electricity transmission grid determined?	1/3	regulated TPA			Negotiated TPA			No TPA
Is there a liberalised wholesale market for electricity (a wholesale pool)?	1/3	no						yes
What is the minimum consumption threshold that consumers must exceed in order to be able to choose their electricity supplier?	1/3	no consumer choice		>1000	between 501 and 1000	between 251 and 500	<=250	no minimum consumption threshold

(Input and calculated data are included in the spreadsheets attached to this thesis)

APPENDIX B: Electricity Intensity

This Appendix B explains the method of composing Electricity Intensity used in Figure 13, chapter 6 above. The name 'Electricity Intensity' was co-authored by Dr. Liu Xiying (National University Singapore), Dr. Peerapat Vithayasrichareon (Energy Intelligence and IEA) and Tue Anh Nguyen (myself) in our in-progress work, presented at IAEE Bergen Conference in June 2016 titled 'Comparative Study of ASEAN-5 Power Sustainability Using Power Sector Synergy Index'.

The electricity intensity is calculated by dividing the total electricity consumption of a country by its Gross Domestic Product (GDP). It measures the total amount of electricity necessary to generate one unit of GDP. GDP is expressed at constant exchange rate and purchasing power parity to remove the impact of inflation and reflect differences in general price levels and relate energy consumption to the real level of economic activity. Using purchasing power parity rates for GDP instead of exchange rates increases the value of GDP in regions with a low cost of living, and therefore decreases their electricity intensities.

Calculation of Electricity Intensity:

Electricity Intensity (kWh/US$2005) = Electricity Domestic Consumption / PPP based on GDP

Sources of Input Data include: Enerdata (Electricity Domestic Consumption in TWh); World Bank (PPP based on GDP of constant year 2005). Output data is then coded in the range from 0 to 6. The higher the number, the lower the intensity is, the less electricity is required to generate a unit of GDP.

(Input and calculated data are included in the spreadsheets attached to this thesis)

APPENDIX C: Import Dependency

This Appendix C explains the method of composing Import Dependency used in Figure 13, chapter 6 above. The name 'Import Dependency' was co-authored by Dr. Liu Xiying (National University Singapore), Dr. Peerapat Vithayasrichareon (Energy Intelligence and IEA) and Tue Anh Nguyen (myself) in our in-progress work, presented at IAEE Bergen Conference in June 2016 titled 'Comparative Study of ASEAN-5 Power Sustainability Using Power Sector Synergy Index'.

Import dependency is the proportion of net imported electricity in total power consumption per year. Net import is the difference between total imported electricity minus total exported electricity per year. It indicates how far the power supply in the country requires interconnection with neighbouring countries. The higher the rate, the more dependent the system is on the support from other countries. It's notable that a country may have increasing imports as well as exports of power.

We take net imports as proportion of total consumption to see how quickly the power system can catch up with power consumption. In developing countries where power consumption is expectedly increasing, to avoid paying extra costs for imported power and clinging to short-term solutions of annual purchase contracts, the country should aim to keep this proportion at least constant or decreasing.

Calculation of Import Dependency:

Import Dependency (%)

= (Power Imports – Power Exports)/Total Power Consumption *100%

This research uses input data from IEA (2016). The details of input and calculated data can be found in the spread-sheets attached to this thesis.

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