increased electrification and reduced carbon emissions - An oxymoron?
a case study of the Indonesian electricity sector

økt elektrifiseringsrate og reduserte karbonutslipp - en selvmotsigelse?

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“Small is Beautiful?”

This thesis is a contribution to the wider research project “Small is Beautiful?” which aims to identify the barriers and needed qualities of small-scale renewable energy projects in making them beneficial both for economic and environmental reasons. The project is a joint cooperation between the Department of Economics and Resource Management (IØR) at the Norwegian University of Life Sciences (UMB), the independent research agency FNI, and Differ AS, a private investment company specializing in small-scale technologies for reducing greenhouse gases. The main financer is the Norwegian Research Council. The research process included a field trip to Jakarta in March/April 2011.

Two more students – Erlend Aas Guldbrandsen and Tiril Reutz – have been writing their theses’ within the same project, focusing on the Indonesian electricity sector. The research process and field trip to Indonesia have been conducted in a fruitful collaboration, while the theses’ have been written individually. All opinions expressed, and potential errors in this thesis are the responsibility of the author alone.

Preface

This thesis has been written as part of a two year master course in Business Administration at the University of Life Sciences, Department of Economics and Resource Management.
Writing this thesis has, since the first tentative research in December 2010, been an increasingly rewarding task. Although the process has had its ups and downs, the positive aspects have dominated.

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Executive Summary

The idea about small-scale private participants supplying green electricity to help relieve some of the capacity deficiencies of the Indonesian electricity sector seems like an optimal scenario. To achieve this outcome, the regulatory framework must provide the correct incentives, as well as being open for private participation. My thesis is an analysis of the organization of the Indonesian electricity sector following the implementation of the new electricity law in 2009, with an emphasis on private participation, as well as social and environmental issues. I evaluate the electricity sector reform and the government's goals by investigating the incentive structures provided for various stakeholders, as well as the reform's overall sustainability. My analysis is based on the framework of a competitive contemporary electricity sector mainly implemented in developed countries, and previous experiences of electricity sector reform in Argentina, India, and South Africa. I also analyze previous reforms in Indonesia, as these may affect the current reform and its sustainability.

The recent electricity sector reform in Indonesia is another attempt at improving the conditions of the electricity sector. Partial liberalization of the sector through the opening of the end-user market to private participation, as well as reduced transaction costs for power purchase agreements with PLN may stimulate private participation. Moreover, specific regulations creating positive incentives for increased use of renewable energy sources have been included to a much larger extent than in previous reform attempts.

Main barriers for a complete reform of the electricity sector are identified as the constitutional protection of PLN, as well as the electricity tariff system. The social tariffs create disincentives for private participation which makes the participation of small-scale renewable electricity producers for rural electrification highly unlikely. Furthermore, PLN may end up with more financial troubles due to their obligation to ensure social benefits through electrification, as well as being obliged to purchase electricity from renewable energy sources. Cross-subsidizing is shown to create incentives for cream-skimming by IPPs, which may increase PLN's subsidy need. Moreover, a non-specific subsidy to PLN may increase the use of coal for electricity generation under the current regulatory framework.

Due to conflicts in the government's goals, the recent reform seems unsustainable in its current form. The current regulations may lead to increased use of renewable electricity sources for electricity generation and electrification, but it may also lead to an increased use of coal. Consequently, it is still uncertain if the combination of increased electrification and reduced carbon emissions will remain an oxymoron in Indonesia's electricity sector.

Sammendrag

Ideen om private små-skala aktører som leverer grønn elektrisitet for å motvirke noe av kapasitetsmangelen i den indonesiske kraftsektoren kan virke som et optimalt scenario. For at dette skal bli et reelt scenario må regelverket gi riktige insentiver, samt åpne for privat deltakelse. Min masteroppgave er en analyse av organiseringen av den indonesiske kraftsektoren etter innføringen av den nye elektrisitetsloven i 2009, med vekt på privat deltakelse, samt sosiale og miljømessige hensyn. Jeg evaluerer reformen av kraftsektoren og regjeringens mål ved å undersøke insentivstrukturer i perspektiv av berørte interessenter, så vel som reformens samlede bærekraftighet.Min analyse bygger på rammeverket for en konkurranseutsatt moderne kraftsektor, i hovedsak implementert i utviklede land, samt tidligere erfaringer fra restrukturering av elektrisitetssektoren i Argentina, India, og Sør-Afrika. Jeg analyserer også tidligere reformer i Indonesia, da disse kan påvirke den aktuelle reformen og dens bærekraftighet.

Det er åpenbart at den siste reformen av kraftsektoren i Indonesia er et nytt forsøk på å bedre forholdene i kraftsektoren. En delvis liberalisering av sektoren har blitt gjennomført gjennom åpningen av sluttbrukermarkedet for privat deltakelse, samt reduserte transaksjonskostnader for kraftkjøps-avtaler med PLN. Dette er endringer som vil kunne stimulere privat deltakelse. Spesifikke reguleringer for å bedre mulighetene for økt bruk av fornybare energikilder er også inkludert i betydelig større grad nå enn i forrige reformforsøk.

De største barrierene for en fullstendig reform av kraftsektoren er identifisert som den konstitusjonelle beskyttelsen av PLN og tariffsystemet for elektrisitet. De sosiale tariffene vanskeliggjør privat deltakelse, som videre fører til at deltakelse av småskala elektrisitetsprodusenter for elektrifisering av rurale områder, er svært lite sannsynlig. PLN kan også ende opp med større finansielle problemer på grunn av deres forpliktelse til å sikre sosiale ytelser gjennom elektrifisering og forpliktelsen til å kjøpe elektrisitet fra fornybare energikilder. Kryssubsidiering har vist seg å skape insentiver for ”cream-skimming” for private aktører, noe som kan øke PLN's subsidiebehov. Videre kan en uspesifisert subsidie til PLN føre til økt bruk av kull i kraftproduksjonen, som følge av dagens regelverk.

På grunn av målkonflikt i myndighetenes seneste mål, fremstår ikke den siste reformen som bærekraftig i sin nåværende form. Selv om dagens regelverk kan føre til økt bruk av fornybare energikilder for kraftproduksjon og elektrifisering, kan det også føre til økt bruk av kull. Det er derfor usikkert om kombinasjonen av økt elektrifisering og reduserte karbonutslipp vil forbli en selvmotsigelse for Indonesias elektrisitetssektor.

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1 Introduction

Indonesia's electricity sector is yet again in trouble. After experiencing power deficiencies with consequent blackouts and energy saving measures for more than 20 years, the Indonesian electricity sector is today headed towards a crisis. The country's strong economic growth has stimulated a rapid surge in demand for electricity, which has not been matched by a similar increase in supply (Wu and Sulistiyanto, 2006).

The slow growth in supply is often blamed on the inability of the state-utility, PT Perusahaan Listrik Negara's (PLN), to provide sufficient generation capacity (Purra, 2010). After enjoying monopolistic powers in the Indonesian electricity sector for more than 50 years, PLN is criticized for being inefficient and incapable of solving the sector's problems. PLN on the other hand, blames the rapidly increasing input prices on fuels for their problems.

Several reforms of the Indonesian electricity sector have taken place since the early 1990 (Sari and Seymour, 2002). None of these have provided sustainable solutions. The rapid increase in state-subsidies needed to ensure the financial viability of PLN and the Indonesian electricity sector, following the strong growth in oil prices, has pushed forward a new reform attempt.

The government expects that the problem with generation capacity will be solved by opening up the electricity sector to more active private participation (Praptono, 2009). Moreover, through implementing plans for fuel efficiency, by switching to alternative energy sources for generation, the government expects that the financial viability of PLN will improve. The government also believes that private participation will have a positive impact on both electrification rates and the use of renewable energy sources for electricity generation.

With the abundance of renewable energy sources, as well as a growing number of foreign investors interested in participating in the development of the Indonesian electricity sector, it seems like Indonesia's electricity deficiency could be easily solved (DGEEU, 2005). The idea of private participants supplying the rural population with green electricity, and thereby solving PLN's financial problems, the government's social issues, as well as the problems of the electricity sector in general, stand out as the perfect scenario. However, a public unwillingness to private participation, an investment climate previously characterized by corruption, as well as restrictions for complete liberalization of the electricity sector complicate matters (Purra, 2010).

Furthermore, as a consequence of the social tariff scheme, little power generation for end-users has been profitable without state-subsidies. This in turn deters private participation, as the main driver for any business is profitability and risk compensation. The possibility of private

investments in renewable power generation consequently seems farfetched, as renewable technologies are still characterized by relatively large investment costs and long time horizon.

The government's initiatives for a new reform of the electricity sector seem a promising start for solving Indonesia's capacity problems through more competition in the electricity sector. The main issue, which will determine the success of the reform, is how sustainable this reform will be, and if it manages to address the structural problems experienced in the Indonesian electricity sector. Structural problems identified by previous studies, for example by Purra (2010), are:

- High subsidization of the state-monopoly.
- Failure to unbundle the state-monopoly.
- Heavy political protection of national champions (previous state-monopolies).
- Low electricity tariffs.

1.1 Electricity Sector Reform

The Indonesian government passed the new electricity law in 2009. It marks the start of the new reform of the Indonesian electricity sector. The government has also lately initiated plans, enacted policies and formulated several goals, all with the aim of improving the conditions of the Indonesian electricity sector (See Chapter 4.3). The main goals of the reform can be summarized as:

1. Supplying electricity at reasonable prices.
2. Increased participation of private partners in the supply of electricity.
3. Increasing national electrification rate to 90% by 2020.
4. Increasing the use of renewable energy sources for electricity production to 17% by 2025.
5. Reducing/phasing out state-subsidies for electricity generation.

1.2 Research Question and Hypotheses

It seems relatively straightforward to suggest a complete liberalization of the Indonesian electricity sector, as we as economists are skeptical towards monopolies as they will inhibit well functioning markets. Markets generally increase competition, which in turn leads to lower prices, increased quantities and larger total public benefits. In a market setting, excess demand will produce higher prices, which will attract new entrants and increase supply, so that equilibrium prices and quantities are attained.

In developing countries, where markets rarely are completely developed, a large share of the population lack the most essential of services, and poverty alleviation is high on politicians'

priority list; the strategy for electricity sector reform may have to be altered to fit the conditions (Sari and Seymour, 2002). When, in addition, public infrastructure has been used as a public benefits scheme, it may become difficult to simply privatize these services, as large parts of the theoretical literature suggests.

Previous experiences suggest that electricity sector reforms in developing countries can be fragile, a consequence of the reforms not only being driven by financial goals, but also social and to some extent environmental goals (Sari and Seymour, 2002). To further complicate the process, electricity sector reforms will be shaped by previous regulations, and the process may well be prone to path-dependency, which means that past regulations and policies may impede the implementation of a new reform (Wu and Sulistiyanto, 2006).

Indonesia's previous experiences with electricity sector reforms have not been successful nor have the reforms been sustainable. There are several possible reasons for this including bad timing, exogenous factors, such as global macroeconomic conditions, or purely due to poor Indonesian design and lack of contextual fit. Consequently, it seems useful to evaluate the recent reform of the Indonesian electricity sector, its sustainability and its ability of helping the government in reaching its goals. The main research questions of this thesis are therefore:

"Does the regulatory framework create the incentives needed for the government to achieve its goals?"

"Does the design of the recent reform of the Indonesian electricity sector provide for a sustainable reform?"

To shed light on these two main research questions I have developed the following hypotheses based on the government's goals.

1. *Social tariffs for electricity will reduce private participation in rural areas*
    - Main motivation: Private investors are more likely to participate in markets where they can make a profit. The low electricity prices and high costs of building grid will function as deterrents on private participation.
2. *Increased rural electrification implies continued practice of government subsidies*
    - Main motivation: Due to the low likelihood of increased private participation, the state-company will be solely responsible for rural electrification. The combination of high costs and low revenue will increase the need for state subsidies if rural electrification goals are to be met.
3. *Use of renewable electricity sources is negatively affected by the social tariffs*

- Main motivation: Social tariffs usually imply lower prices in the short run, which in turn means less economic space for investments in new energy sources, including renewable.

4. *Cross-subsidizing will increase the need for government subsidies in the long run*
   - Main motivation: Cross-subsidizing may lead to increased cream-skimming unless strictly regulated. Increased government subsidies will be needed to ensure rural electrification, whilst maintaining prices at publicly acceptable levels.

The results of this thesis may be useful both for private investors and regulatory authorities in evaluating financial, social and environmental outcomes of electricity sector reform and organization of other countries similar to Indonesia.

1.3 Key Words, Definitions and Acronyms

When I am discussing the recent reform of the Indonesian electricity sector, I am referring to Law No. 30/2009, *Law on Electricity 2009*, which was enacted from September 23rd, 2009. *Social tariffs* are understood as the prices, set by the government, which a consumer will have to pay for consumption of electricity (EEA, 2011). Private participation in electric power supply is characterized by *Independent Power Producers* (IPPs). I define IPPs as any non-public company, cooperation or cooperative which owns facilities to generate electricity for sale to utilities (RAP, 2000). *Rural electrification* is defined by IEA (Niez, 2010) as the process by which access to electricity is provided to households or villages located in remote areas of a country. A full list of acronyms used in this paper is to be found in Appendix 9.2.

1.4 Structure of Thesis

Chapter 2 reviews the most relevant of the previous research on this subject. I try to point out the most important findings and summarize these. In Chapter 3, I provide relevant frameworks and theories that are used in the analysis and that increase insight and provide guidelines for answering my research questions. A part of the theoretical framework is an analysis of electricity sector reform of a selection of other developing countries, which function as a benchmark for evaluating the Indonesian electricity sector reform.

Chapter 4 starts with an analysis of historical electricity sector reforms in Indonesia. I continue by providing an overview of the recently implemented laws and regulations, before analyzing the most recent reform attempt. In Chapter 5, I discuss some of my main findings, before presenting my conclusions and recommendations for future research in Chapter 6.

2 Previous Research

2.1 Electrification

There are many social benefits associated with electrification (WRI, 2002), such as increased economic activity, improved health standards, and empowerment of poor groups of society.

Some of these aspects were investigated in a report on electrification in Indonesia presented by the Innovation Energy Development (IED) (IED, 2004). The report shows that for electrification of areas close to the existing grid, grid-extensions have been the favored electrification process. Problems with grid-extensions are the high investment cost and that this adds to the already large congestion problems. The report is critical to the government's handling of rural electrification through decentralized off-grid models, particularly for not applying a more critical stand regarding the state-company's use of diesel generators in the electrification process. Governments have historically preferred to install diesel generators for rural electrification, as the investment costs of these are low. The downside of this policy choice is high operating costs which are covered by government subsidies. From a social perspective however, the development of small-scale renewable electricity generators is found to have larger benefits and lower life-time costs (IED, ibid.).

The World Bank has for a number of years supported rural electrification by loans and other financial arrangements. In a report prepared by the Independent Evaluation Group (IEG, 2008), an in-depth study of rural electrification is presented. The World Bank's support to off-grid electrification has grown quickly in recent years, and the report discusses both grid expansion and off-grid electrification. To avoid supporting off-grid electrification through diesel aggregates, the World Bank has recently linked its support system to development of renewable electricity sources, such as photovoltaic, micro-hydro and wind power.

IEG finds that the electricity connection fee is the largest barrier for electrification. Moreover, technical problems with off-grid electrification reduce the social benefits largely. The IEG study also concludes that most rural customers prefer grid-connection, i.e. the local off-grid generation ends once the centralized grid reaches the village. Experiences from other countries show that technical problems with both PV-systems and mini-hydro prevent use, in addition to the relatively lower cost for grid-connected electricity at subsidized prices (IEG, ibid.).

The International Energy Agency (IEA) estimates in a report published it 2010, that nearly 85% of the population in rural areas lacks access to electricity (Niez, 2010). The social benefits in regards to electrification of rural households mainly derive from the longer days that lighting provides, which increases activities such as studying and leisure. Furthermore, they

found that increased electrification is essential for economic development in rural areas, as it stimulates industry and business, thereby creating job opportunities for rural people (Niez, ibid.). The most common challenges for electrification of rural areas are found to be the large distance to national grids, difficult access and climatic conditions plagued by earthquakes and tsunamis, as well as low income and willingness to pay for electricity, which makes many electrification projects dependent on financial support.

2.2 Distributed Generation by Renewable Energy Sources

Meier (2001) discusses, in the book *Mini Hydropower for Rural Development*, the use of renewable energy sources and distributed generation for increasing the electrification rate in Indonesia. He focuses on the use of mini-hydropower for electricity generation. His findings suggest that the results from these types of projects lack many of the perceived benefits, such as increased economic activity. The hydro-generated electricity was found mainly used for household chores and most of the turbines were not operated during daytime. The revenues generated were thus modest, and several of the projects had problems keeping up with the maintenance work, which consequently led to disrupted services and distrust in the local communities (Meier, ibid.).

Despite this, there have recently been several successful small/micro-scale projects in Indonesia. *The Cinta Mekar Micro-Hydro Power Plant* is one of these. Factors that were important in the success of this project include strong collaboration with the local community in all the stages of the process, as well as the Power Purchase Agreement (PPA) which allowed the community to sell electricity to PLN. The community ownership was found to be the factor which ensured sustainability of the project (Tumiwa and Rambitan, 2009).

This supports the findings of IED's report (IED, 2004), which points out that a traditional top-down strategy in the implementation process of small-scale electricity generation projects is likely to lead to less sustainability of projects. In many early small-scale power generation projects the local communities had not been properly prepared and trained, which led to little feeling of ownership, and projects often collapsing only six months after installation (IED, ibid.).

The existence of a grid was also pointed out by IED (2004) as a main factor for the financial viability of independent power generation, as IPPs can improve their profitability by selling excess electricity to the state-monopoly. In case of an off-grid situation, it is of high importance to study the purchasing power of the rural communities, especially tariffs and consumption patterns. Private medium-scale electricity generation is claimed unfeasible by the studies conducted by IED (ibid.), due to the low energy absorption of the rural communities.

Furthermore, non-optimal utilization of the stand-alone systems capacity is shown to lead to a low plant factor, with a higher per unit price due to the set fixed costs, as well as a longer pay back period for the investment. It is consequently important to increase the energy use of the project villages for maintaining profitability and continued operations of a non-grid system (IED, ibid.).

2.3 The Clean Development Mechanism

Clean Development Mechanism (CDM) funding may have a large potential for introducing more renewable energy sources into the Indonesian electricity sector, as this can increase the financial viability of private investments in renewable electricity generation. This will, however, depend on the emission mitigation potential of the project, as well as transaction costs, barriers for implementation and financial additionality.

In 2001 the Centre for Research on Material and Energy published the report *CDM Opportunities in Indonesia* (PPE ITB, 2001). Here, they present nine cases of climate change mitigation projects active in Indonesia in 2001, as well as ten potential identified CDM projects. The potential CDM projects are divided into four categories, renewable energy, transport, industrial and power generation. They found rice husk-based small-power generation to have the largest emission mitigation potential in power generation. Furthermore they identified micro-hydropower generation to have the lowest potential for emission mitigation, out of the selected fields (PPE ITB, ibid.).

A report prepared by the New Energy and Industrial Technology Development Organization (NEDO) in 2006, identifies several barriers to the implementation of CDM projects in Indonesia. They estimate a theoretical potential of about 125 million tons of carbon dioxide equivalent, which could provide US$ 625 million financial additionality. However, by 2006 only a small fraction of projects had been implemented.

The barriers NEDO (ibid.) identifies are lack of awareness and capacity, including information, language difficulties and several institutional factors. Policies such as the current electricity feed-in tariffs and conditions of the PPAs are also pointed out as barriers. With regards to finance, there seems to have been several misunderstandings on how large share of the financing that CDM should cover, compared to that of traditional finances. Finally, the report points out some barriers in regards to the governance structure. Unclear authority lines in the processing of permits, issuing PPAs, as well as the size of the environmental impact, present the largest barriers (NEDO, ibid.).

2.4 Electricity Sector Reform

In the article *Electricity Sectors in Transition*, Joskow (1998) discusses the transformation of electricity sectors from state-regulated natural monopolies controlled by government to the recent liberalized market-based electricity sectors. He points out that countries with a state-owned electricity sector, where regulation of prices, investment decisions and cost estimation are the responsibility of government, often have complex regulatory processes defined by little transparency. Furthermore, Joskow points out that the combination of legal supply monopolies, "cost plus" pricing and inability to implement price increases will lead to inefficiencies in the electricity sector. He therefore argues for liberalization of the electricity sector with competitive markets in generation and distribution, which consequently makes governmental regulation a residual task.

Pre-reform electricity sectors of developing countries are often unable to keep up with increasing demand, leading to blackouts and severe power deficiencies. Many of these governments define electricity as an essential infrastructure service that should be supplied at "affordable" prices, which may lead to tariffs below generating units' marginal costs (WRI, 2002). In countries where governments are unable to increase tariffs due to political pressures the result is too little investments. This results in power shortages and low performance as plants are being operated well beyond the time that they would in a competitive market. The low electricity tariffs have also been proved beneficial to the population who actually has the financial resources to pay more for electricity (WRI, ibid.). This largely contradicts the idea of social equity. The cost-savings that may arise from a liberalization of the electricity sector in developing countries may be substantial.

Joskow (1998) sees sector deregulation as a powerful vehicle to increase investments in electricity infrastructure. Several developing countries operate with wholesale competition through PPA contracts, which could help increase investments in generating capacity. However, several regulatory practices have to be in place for this to work. For example a competitive procurement process, established criteria for selection processes and credible contracts that tie payments to performance. The retail level should also be included in the reform process, as customers have to be obliged to pay their electricity use and by that taking part in maintaining a sound investment level in the sector (Joskow, ibid.).

The introduction of competition in electricity production is likely to lead to more generation from smaller, less capital-intensive generation technologies, which will seek out markets that can be served at a lower cost, or with a higher service standard, than what is present

in the tariff regulated market. This will have the greatest effect under a retail-wheeling system[1], and may lead to more distributed electricity generation, as a means to avoid transmission and distribution costs. Furthermore, competition is known to lead to lower construction costs, shorter construction time as well as reducing the tendency to favor costly domestically produced inputs and production equipment (Joskow, ibid.).

2.5 Previous Reform Attempts of the Indonesian Electricity Sector

Indonesian electricity sector reforms since 1985 have been widely debated. In the article, *The Indonesian Electricity Sector: Institutional Transition, Regulatory Capacity and Outcomes*, Purra (2010) finds that the monopolistic situation of the state-company PT Perusahaan Listrik Negara (PLN) is the main root to several of Indonesia's problems. He therefore strongly recommends complete unbundling of the state-company. Purra also argues that more competition in the electricity sector is essential to solve the power situation in Indonesia, as well as more support from both the international and local agencies, is needed for the success of the Independent Power Producers (IPP). He is skeptical to the effect the new electricity law will have on the inclusion of IPPs in electricity generation, as long as all roads still lead to PLN.

Others authors point out the dangers of introducing more competition in the electricity sector. An example of this is Gulati and Rao (2007), who discuss the many difficulties governments are facing when trying to introduce private investments in infrastructure. They point out that one of the main problems when privatizing the electricity sector is corruption. Corruption in the electricity sector can take a variety of forms, such as politicians awarding private entities favorable conditions and lucrative PPAs, as well as electricity theft and non-payment (Gulati and Rao, ibid.).

During the restructuring of the Indonesian electricity sector in the late 1990, Indonesia experienced a large increase in corruption. The IPPs received PPAs with extremely advantageous conditions, which nearly led PLN to bankruptcy and cost the Indonesian government a significant amount of money (Gulati and Rao, ibid.).

The failure of the first attempt to reform the Indonesian electricity sector, by the use of IPPs, will be difficult for the Indonesian government to overcome. Wu and Sulistiyanto (2006) discuss the long term effects of this and conclude that the introduction of private power producers is extremely fragile unless the necessary environment has been established.

[1] Retail-wheeling system: Unbundling of power prices and transmission and distribution costs, so that the consumer can buy power directly in the wholesale market, and pay a separate fee for transmission and distribution services.

They also point out how the PPAs between PLN and the IPPs can create large obstacles for the implementation of a competitive market. Furthermore, the failure of electricity sector reform by IPPs led to an increasing skepticism of foreign investors, mainly a result of the Indonesian government's costs in terminating PPAs (Wu and Sulistiyanto, ibid.).

In a report from 2000, Bayliss and Hall discuss the incentives for participation of IPPs and the conditions of PPA contracts. They argue that IPPs are an expensive source of power, which also manages to shift all the risk to the state-owned company. The long contract period of PPAs, often up to 30 years, contributes to the large risk for the state entity. The main problem with the arrangement of pre-negotiated long-term prices is that IPPs face no real competition, apart from in the negotiations with the state-company (Bayliss and Hall, 2000).

2.6 Summary

1. Large population without electricity access
    - *Barriers:* High connection fee, difficult access, low willingness to pay, technical problems
2. Rural electrification mainly by grid-connection or diesel aggregates, even though decentralized power generation is found to have a larger social benefit
    - *Barriers:* Low electricity consumption and low willingness to pay
3. Variable results for small-scale renewable electricity projects
    - *Success:* Grid-connection, PPAs with PLN, community based
    - *Barriers:* Theft and vandalism of technical equipment, lack of technical knowledge, "second-rate" electricity
4. Large potential for CDM, but few projects
    - *Barriers:* Little information, electricity feed-in tariffs, unclear authority lines between national and regional government
5. Electricity Sector Reform
    - *Success:* Increased investments, lower production costs, better service quality
    - *Barriers:* Corruption, political risk, skepticism towards privatization, social equity issue in regards to tariffs, market power of PLN

3 Theoretical Framework

To be able to analyze the Indonesian electricity sector and consequently answer my research questions, I need a theoretical framework. In this chapter I therefore present the main underlying theories and frameworks, under which my analysis in chapter 4 will be conducted.

3.1 Electrification

The electrification process of developed countries started in the 19th century, and as o today most developed countries have an electrification rate of 100%. In developing countries the electrification rate varies greatly between urban and rural areas, with electrification rates as low as 40% in certain rural areas. Rural electrification (Niez, 2010) has for a long time been a focus area for the World Bank for poverty alleviation, and the benefits of rural electrification are well understood. Table 3.1 below summarizes these.

Table 3.1 Main Benefits of Rural Electrification

Social Benefits
Increased day-length
Improved leisure and study time
Increased access to information
Improved communication
Improved health services
Economic Benefits
Increased efficiency of production processes
Growth of businesses and farms
Improved living standards
Increased self-sufficiency of rural population

Source: Niez, A. (2010)

In the following section, I will outline the two main models used for rural electrification, grid-based electrification or electrification by distributed generation.

3.1.1 Grid-Based Electrification

Grid-based electrification is preferred over non-grid alternatives when the costs of connecting to the grid is lower than the costs of the alternatives, and grid connection gives additional benefits like more efficient use of generating capacity (Niez, ibid.). However, for many rural electrification programs, grid-connection is only performed as a last step, due to remoteness or difficult topology increasing the costs of grid-based electrification.

3.1.2 Electrification by Distributed Generation

A more commonly used strategy for rural electrification has been distributed generation, which means that the generation of electricity is performed close to end-users, instead of extending the central network to the rural area (Niez, ibid.). Traditionally, this has been implemented through the use of diesel generators, disposable batteries and kerosene. However, lately environmental concerns have encouraged developing countries to focus their efforts on more sustainable alternatives for distributed generation. Sources of energy that can be used for distributed electricity generation are solar, hydro, and biofuels, which are often both accessible and vastly available in rural areas (Niez, ibid.).

Distributed generation has been found to have several positive aspects not only deriving from the benefits of electrification (Zhao and Foster, 2010). By the use of renewable technologies through distributed power generation, there is a large potential for deferred investment costs in transmission and distribution. Furthermore, distributed generation systems can reduce transmission losses otherwise experienced by grid-connection.

Often distributed generation takes the form as captive generation, which means generation for a specific electricity requirement (Sari and Seymour, 2002). Generally, captive generation units are installed in areas without easy access to the centralized grid, and are mainly built for business purposes by industries located in rural areas.

3.2 Electricity Sector Organization

Electricity generation and distribution all over the world were, until the early 1990 (WRI, 2002), either owned by or regulated by national government and considered a textbook natural monopoly. Governments were historically thought to be the most suited for mobilizing the large amounts of capital needed for developing the sector, as well as the most able to bear the long time horizon for cost recovery.

3.2.1 Traditional Electricity Sector Organization

The electricity sector, when considered a natural monopoly on all levels, was characterized by vertically integrated geographic monopolies, where the utility was responsible for generation, transmission, distribution and the supply to end-users (Joskow, 1998). In addition, the entity was normally also the network and systems operator, as well as in charge for balancing loads and operating resources in real time. These monopolies were also typically publicly-owned.

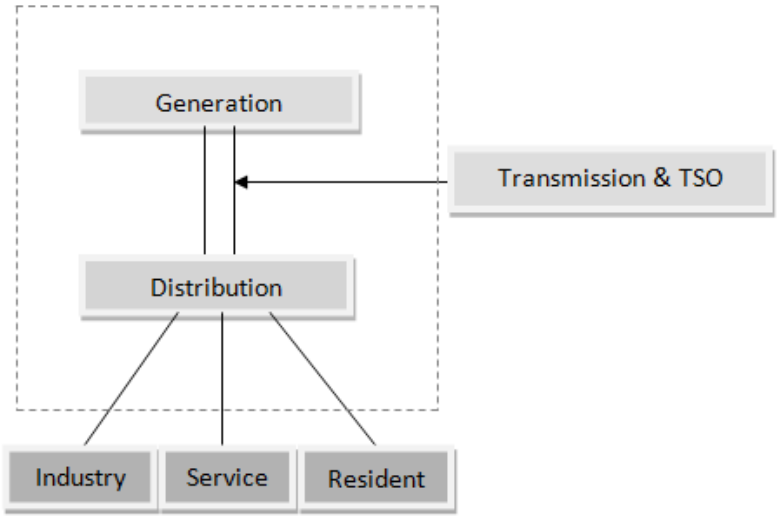

Figure 3.1: Vertically Integrated Electricity Sector Monopoly
Source: Joskow (1998)

In some cases generation and transmission was operated as a state monopoly, selling their services to distribution companies who enjoyed the position as geographical monopolies. These monopolies then had to be regulated by the state agencies to avoid them exploiting their monopolistic powers (Joskow, ibid.).

3.2.1.1 Natural Monopoly

A natural monopoly is characterized by falling average costs of production (Joskow, 2005). The initial investment needed to produce even a small amount of the good is very high, but once the investment has been made, the average cost will fall by every new unit supplied. Examples of traditional natural monopolies are railways, telecommunications, as well as electricity services, where it would be non-optimal with several suppliers due to the high initial investment costs. Competition in these areas is undesirable unless the existence of several firms would provide a better social solution, without the need to duplicate capital equipment. The main rationale for natural monopolies is *economies of scale*, derived from investments, start-up costs, and specialization and also from learning by doing.

Finding justification in *Public Interest Theory*[2], there will be a need to regulate sectors that are optimal as natural monopolies (Church and Ware, 2000). Avoiding duplication of capital equipment, especially doubling of fixed costs, justifies entry regulation, i.e. governmental agencies will in general limit the sector to one supplier. This causes other needs for regulation, as this single supplier will be a monopolist (Joskow, 2005).

[2] Public Interest Theory justifies regulation of markets finding its basis in market failure. Regulation is warranted when unregulated market outcomes are inefficient and regulation can improve social benefits.

3.2.1.2 Allocative Inefficiency

Under monopolistic market conditions the monopolist will have an interest to reduce the quantity supplied to be able to charge a higher per unit price of output (Grønn, 2008). Instead of achieving the optimal solution of $P^*=MC$, the monopolist solution will be $P^m=MR$, as the monopolist is profit maximizing. This leads to a wealth transfer from the consumers of a product to the sellers, causing a loss of efficiency.

3.2.1.3 X-Inefficiency

X-inefficiency[3], also called slack, is regularly used to indicate the internal waste of resources that are likely to occur when a firm is not faced by competition due to its monopolistic situation (Depoorter, 1999). Under perfect competition firms are believed to reduce costs to increase their profit margins at the existing market equilibrium prices. Firms that are not cost-minimizing will soon find themselves in a market dominated by competitors who can sell at a lower price due to their lower costs. A monopoly has no competitors to push for lowering costs, which could lead to technical inefficiency[4].

3.2.1.4 Technological Progress

A monopoly firm is commonly believed to discourage technological progress (Depoorter, ibid.). Due to the firm's protected position, it does not encounter competing firms' technological advances, and hence lacks the incentives for investing in research and development programs. The ownership of the firm seems to have little impact, as slow technological advancement has been found in both privately-owned and state-owned monopolies.

3.2.1.5 Cross-Subsidization and Cream-Skimming

Governments can in several cases feel the need to provide certain services or goods to a lower-than-cost price, often justified by the social equity idea. This can lead firms with service obligation to *cross-subsidize* (Depoorter, ibid.). This means in practice that customers, for example in urban areas, are used to subsidize the cost for providing the services for customers in rural areas. Another issue of concern regarding firms with service obligations is *cream-skimming*. This occurs when a firm concentrates at supplying the customers in the least-cost areas, for example due to geographical location. If the market is opened for competition, this can be detrimental for the service provider, as the new entrants will try to capture only the low-cost, high-profit segments of the market.

[3] First used by Harvey Libenstein
[4] Technical inefficiency: Could produce the same output for less input

3.2.2 Regulation of Natural Monopolies

As outlined above, there are several reasons for the need to regulate natural monopolies. In the following section I will outline some methods for regulation of natural monopolies in the electricity sector.

3.2.2.1 Public Ownership

Since the 1950 public ownership has been a common method for controlling natural monopolies (Depoorter, 1999). This is possibly the most severe form for regulation. By taking charge of the natural monopolist, the government ensures that there are no profit-maximizing shareholders exercising their monopoly position to increase revenues by reducing volumes. When the state is in control of the firm, it can presumably control all aspects of its operations, thus the government should be able to minimize the deadweight loss.

One of the most common critiques of public ownership is based on the principal-agent model, and the lack of financial incentives for cost-efficiency (Grønn, 2008). The lack of financial stakeholders is considered to result in inefficiency and slack, as the management team of the publicly owned firm faces little or no threat of being replaced. Another important issue is that the management lacks private incentives to operate cost-efficiently, as the financial losses do not affect them personally. Moreover, the management team of a publicly owned firm is often thought to invest too little, as their time perspective is shorter than what might be optimal for the firm. Public ownership is consequently no guarantee for optimal outcomes, as long as the goals of the management team might differ from what is socially optimal.

3.2.2.2 Price Regulation

Another common way to regulate natural monopolies has been through price regulation (Joskow, 2005). The state then allows private ownership of the entity, but regulates the price of the monopoly's goods or services. The goal of price regulation is to minimize the deadweight loss associated with monopoly. A major challenge under price regulation is to provide consumers with efficient price signals to guide their consumption patterns. Furthermore, the price regulation should provide guidelines for the firm regarding efficient levels of outputs, efficient levels of investment, and also the correct quality of goods or services.

As can be seen from Figure 3.2, the average costs *(AC)* are always higher than the marginal costs *(MC)* for a natural monopoly. The main reason for this is the high fixed costs, as natural monopolies are characterized by very large capital costs. In a perfect competitive market, the price providing the optimal solution would be P^0 with the corresponding quantity Q^0.

However, at this price the firm would not be able to recover all its costs and would soon be run out business. If the firm was allowed to act as a monopolist it would produce the quantity Q^m and charge the price P^m. The firm would then recover all its costs. The monopolist solution, however, is not optimal, and produces a deadweight loss, equal the area *ABC*. The problem for the regulator is to minimize the deadweight loss, and at the same time allow the firm a fair rate of return.

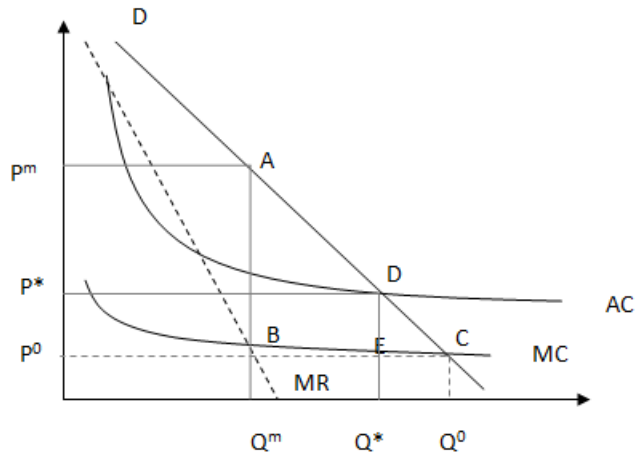

Figure 3.2: Natural Monopoly Pricing
Source: Joskow (2005)

3.2.2.3 Ramsey Pricing

The first-best allocation, with the price equal the firm's marginal costs (Joskow, ibid.), as outlined in point (a) below, will produce the optimal social solution with no deadweight loss. However, in the case of a natural monopoly, with falling marginal costs and $MC < AC$, this pricing strategy will not be sustainable as the firm's profits will be negative. As shown in the graph above, the price P^0 will give the quantity Q^0, causing the firm to lose money on all produced units from Q^* to Q^0. In the long-run, the firm will not be able to recover its costs and consequently be driven out of business unless subsidized.

a) *First-Best Allocation*: ***P* = MC***

For the firm to break even, the prices it charges will have to be higher than its marginal costs, which lead us to the second-best allocation as outlined in (b) below, also called *Ramsey-pricing*. In the case of linear prices and a single product, the regulator can set a single price for each unit of the product equal to the firm's average costs.

b) *Second-Best Allocation*: ***P* = AC***

In Figure 3.2 (previous page) this will produce the quantity Q^* and the price P^*. The second-best allocation will not erase the deadweight loss, but will minimize it and at the same time provide the possibility of cost-recovery for the firm.

Some assumptions are needed for this strategy to work. First, the regulator must be assumed to have perfect information in regards to the regulated firm's costs, as well as the attributes of the demand for the regulated firm's services. Second, for non-storable goods such as electricity, the regulator also has to consider peak-and off-peak pricing (Joskow, ibid.). Furthermore, although price regulations, such as Ramsey-pricing, may minimize the social deadweight loss, it cannot replace the information value of market prices. This has been shown to be the main problem with price regulation of natural monopolies. Today several other methods for regulating natural monopolies have been developed, such as *Dynamic Yardstick Competition*[5].

3.2.2.4 Peak-Load and Non-Peak Load Pricing

Since electricity is a non-storable good where the demand varies greatly between night and day, as well as between seasons, the need for capacity also varies greatly (Church and Ware, 2000). Production capacity needs to be sufficiently large to handle peak demand in a reasonable way, which consequently means that a lot of the capacity will be idle in off-peak periods.

The long-run cost of increasing capacity for an increase in peak-load demand will therefore consist of both operating costs and capital costs, whereas for an increase in off-peak demand, the long-run marginal cost of increasing capacity will only include short-run marginal operating costs of running more of the surplus capacity. In brief this means that for the price to reflect the total costs of supply and give efficient price signals to the consumer, the cost in peak-load periods will need to be higher than in off-peak periods.

3.2.2.5 Social Tariffs in Developing Countries

In developing countries electricity access is often considered to be of importance in regards to poverty alleviation and for social equity. A consequence of this heavy subsidization of electricity consumption often takes place through electricity tariffs set below marginal generation costs (Mourougane, 2010). As already mentioned, for a natural monopoly the price needs to equal average costs to ensure financial viability, which shows that social tariffs are unfeasible in the long-term, unless some other funding is secured, usually from the state.

Social tariffs also blur price signals which may lead to overconsumption and distorted investment decisions, as well as resources misallocation and inefficient investment decisions

[5] See Agrell et al, (2005), "*DEA and Dynamic Yardstick Competition in Scandinavian Electricity Distribution*", Journal of Productivity Analysis, 2005, for more information

(Mourougane, ibid.). Subsidies to certain types of technology can lead into a "lock-in" to this type of technology at the expense of others. Furthermore, social tariffs, through the use of subsidies, hinder competition and can lead to inefficiency, increased corruption, as well as a growth in administrative costs.

3.2.3 Contemporary Electricity Sector Organization

Most developed and some developing countries have gone through privatization, restructuring and deregulation programs of their electricity sector over the past 25 years, following the examples of Chile and the UK (WRI, 2002). As experienced by several countries, the conditions in the electricity market have changed since the implementation of vertically-integrated utilities, with lower growth in demand, higher costs of maintenance due to mature generation facilities, diminishing productivity and deteriorating economic performance. Several changes to management and operations have been instituted. The incentives driving these processes have generally been the goal of improved cost-effectiveness, as well as providing long-term benefits to society by improving service standards and reducing environmental impacts. In addition, the importance of conveying the true consumer valuation of electricity services has been a driving factor.

Joskow (2008) outlines ten prescriptions for successful liberalization of the electricity sector, which have been used as a guideline for many reforms world-wide.

Table 3.2: Prescriptions for Successful Electricity Sector Reform

	Prescriptions for Successful Liberalization of the Electricity Sector
1.	Creation of hard budget constraints through privatization of state-owned monopolies
2.	Vertical separation of potentially competitive segments, such as generation and retail supply
3.	Horizontal restructuring to create competitive conditions in potentially competitive segments
4.	Horizontal integration of transmission services and network operations
5.	Creation of voluntary public wholesale electricity spot market, as well as an operating reserve market to help the systems operator in balancing the real-time balancing of supply and demand
6.	Creation of institutions supporting an active demand side, giving consumers the possibility to respond to supply-side changes
7.	Regulations and framework which promotes efficient access to the transmission network for wholesale buyers and sellers
8.	Unbundling of retail tariffs for electricity and service tariffs, transmission and distribution costs
9.	If no retail market, the distribution companies should buy the power in the wholesale market
10.	Creation of independent regulatory agencies to oversee the firms supplying regulated network services, such as transmission and distribution

Source: Joskow, P. L. (2008)

As can be seen from the electricity sector organization model in Figure 3.3, market competition is stimulated both in generation and sales activities, through many competing agents. Due to economies of scale, the transmission system is functioning as a state monopoly, whereas the distribution segment is regulated as natural monopolies. The system operations function is separated from generation and controlled by the transmission state-monopoly, whilst an independent agency is regulating transmission and distribution functions (NVE, 2010). A retail-wheeling system has been implemented (Johnsen, 2001), where purchasers are free to choose from whom to buy electricity, as well as generators, distributors, customers and traders are also free to establish bilateral contracts in the wholesale market[6].

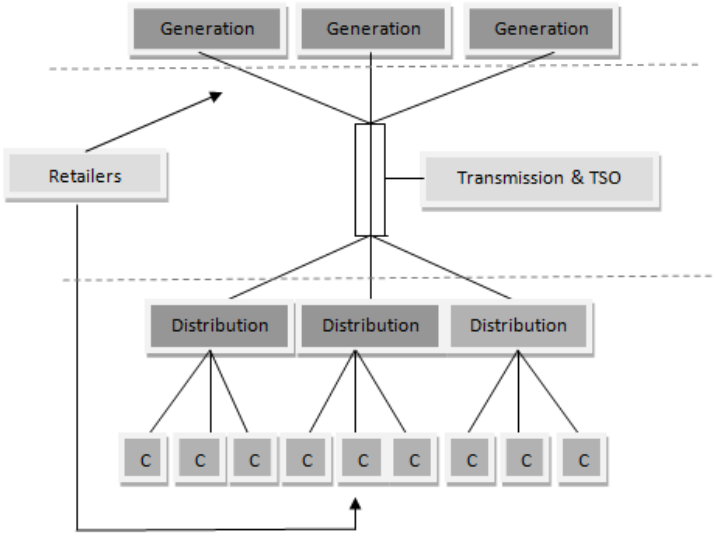

Figure 3.3: Electricity Sector Organization after Reform Stage 1-4
Source: Johnsen, T., A. (2001)

The electricity tariffs are unbundled to reflect separately transmission and distribution costs, as well as the price of electricity generation. Institutions facilitating an active demand side have been developed and implemented (Joskow, 1998).

[6] A further development is the establishment of both a voluntarily power exchange/pool responsible for electricity traded in the day-ahead market, as well as in the futures and forwards market (Johnsen, ibid.). A third market may also be established, the real-time market, which is used by the systems operator for balancing demand and supply and relieving short-term transmission constraints.

3.2.4 Stages and Methods of Electricity Sector Reform

Electricity sector reform can be implemented both by liberalizing the ownership of utilities and by the introduction of competition in some or all segments of the electricity sector. There are mainly three different stages of change in ownership and management (WRI, 2002).

Table 3.3: Changes of Ownership

Stages in Change of Ownership and Management
1. **Commercialization:** Government surrenders detailed control over state-owned enterprise. Change of practice rather than reform
2. **Corporatization:** Government establishes a corporation and legally and formally gives away its ownership and management rights. The corporation will still remain under regulatory control
3. **Privatization:** The government sells the corporation to private owners. The private company participates in commercial markets, but can still be regulated by the government

Source: WRI (2002)

For the introduction of competition in the electricity sector, the reform process normally develops through four steps (Hunt and Shuttleworth, 1996) from the initial monopoly situation to a highly competitive sector with competition in both generation and sales to end-users. In table 3.4 below, I have outlined the different phases.

Table 3.4: Stages of Reform

Stage 1: Monopoly
No competition at any level: One entity handles the entire value chain
Stage 2: Single Buyer
Competition in generation: IPPs sell to a single buyer on a PPA basis. Transmission company has monopoly in supply to end-users
Stage 3: Wholesale Competition
Competing generators sell directly to distribution companies: All generators have open access to transmission networks. Distribution companies have monopoly on supply to end-users
Stage 4: Retail Competition
Competing generators sell directly to distributors, retailers and end-users: Generators have open access to transmission and distribution wires based on regulated prices. End-users can purchase electricity directly from generators or from retailer

Source: WRI (2002)

3.2.5 Competitive Markets in the Electricity Sector

By introducing competitive markets for electricity generation, and consequently abandon the cost of service regulation, major efficiency gains should be possible (Joskow, 1998). Price regulation weakens incentives for cost-minimization, in the same way as soft-budget public ownership.

The main advantage of using a competitive wholesale and a retail market in the electricity sector is the increased responsiveness of market participants which follows from the price determination process. The regulating agencies are relieved of the somewhat impossible task of determining the "right" costs of electricity generation in a tariff-setting process, as the price is endogenously determined in the market. Furthermore, spot prices will reflect the true marginal costs of electricity generation in both peak and off-peak periods, which a pre-set tariff cannot do. By using competitive markets the price will be responsive to the supply/demand situation (Joskow, ibid.), which can give strong signals for investments in generating capacity and generally help decrease capacity deficiencies. The efficiency of electricity use is also expected to improve, as consumers are exposed to the true opportunity cost of supplying electricity.

3.2.6 Social and Environmental Issues of Electricity Sector Reform

One of the main challenges for developing countries when designing policies for electricity sector reform derives from the need to balance economic goals with social and environmental issues (WRI, 2002). Pure economic efficiency of the electricity sector may not be sufficient to ensure the inclusion of these public benefits. Monopolies, which do not face competition from private domestic or foreign companies, can have negative consequences for both the public and the environment.

Competition in electricity generation is likely to stimulate sector research and development, as well as innovation, which may stimulate more environmentally friendly technology (Joskow, 1998). Furthermore, it is likely to improve metering procedures and metering equipment of electricity consumption, which can lead to higher electricity efficiency. The World Resources Institute (WRI) (2002) has identified the most important social and environmental concerns for electricity sector reform of developing countries.

Table 3.5: Social and Environmental Concerns

Social concerns
Access: Profit incentives alone are insufficient to increase electricity access as the costs of rural electrification makes it unprofitable
Price: Price increases are generally needed for an improved electricity sector, however this may affect the poorest the most
Quality: Competition is believed to improve reliability and quality of electricity supply, may not be a sufficient incentive
Labor: Increased efficiency in general means job cuts, which brings social costs and labor union protests
Environmental Concerns
Technology/Fuel Choice: Market structure implemented through reform can affect technology choice by changing the relative attractiveness of capital-intensive generation
Regulatory decisions: Regulators can affect how level the playing field is for different technologies
Incentives for efficiency: Increased financial discipline should increase efficiency of supply, but may also increase transaction costs and decrease end-user energy efficiency

Source: WRI (2002)

3.3 Regulatory Tools and Green Electricity

3.3.1 Subsidy to Green

The main reason for increasing the use of renewable resources for electricity generation is for reducing carbon-emissions, i.e., for environmental concerns. However, so far the costs of renewable energy generation, so-called green energy, have been well above that of coal, oil and gas[7]. This has consequently prevented entry or at least slowed down the use of these energy sources. To increase the use of green technologies, some regulatory tools may be used (Bye and Bruvoll, 2008).

As can be seen from Figure 3.4 (next page), the market price is too low to stimulate participation of green energy in the electricity market and consequently acts like a barrier to renewable energy sources. One obvious solution to this problem would be to lower the marginal costs of green energy, which could be done by the use of a subsidy. This will increase the use of green energy, reduce the use of traditional brown energy, as well as increase total electricity supplied by the sector. The price would also decrease.

There are several positive impacts of this strategy, but the downside is the large state-borne costs of subsidies to green energy. For developing countries this will be particularly troublesome given the high cost of public funds. On average for developing countries, one unit of

[7] Excluding large-scale hydro electricity generation

subsidy needs three units of public income, which makes such a state-subsidy for green electricity financially unviable in the long-run.

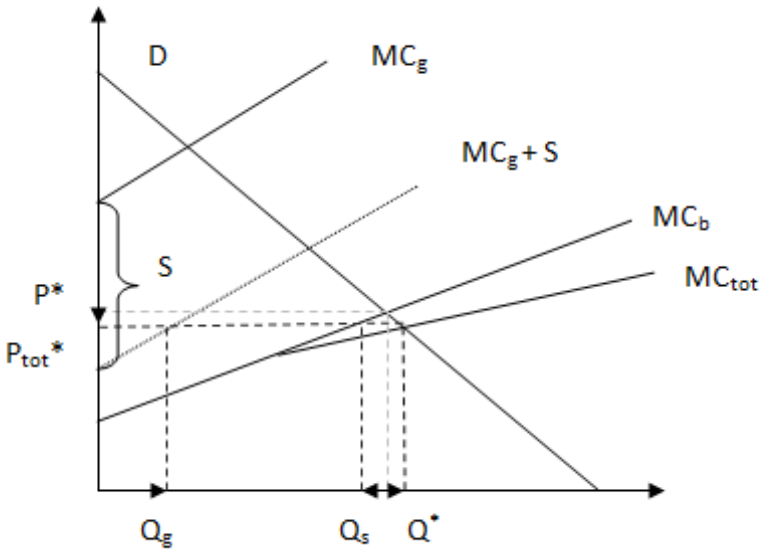

Figure 3.4: Subsidy to Green Energy
Sources: Bye and Bruvoll (2008)

3.3.2 Tax on Brown

A different solution could be to tax the supply of brown energy, i.e., making electricity generation by the use of brown energy sources relatively more expensive (Bye and Bruvoll, ibid.). As can be seen in Figure 3.5 (next page), a tax on brown energy would increase the use of green energy, as well as reduce the use of brown. However, the total supply of energy would be reduced, and the price would increase. Regarding the higher price, the tax retrieved from the suppliers of brown energy could be used as a subsidy towards electricity consumption of poor groups of society. The largest concern with this method is the contraction of the electricity sector, which would be especially negative in an electrification process.

Green certificates are a relatively new method for stimulating the use of green energy sources for electricity generation, which includes a combination of a subsidy and a tax. The subject of this is will not be discussed further here, as it is mainly used in developed countries because of the before-mentioned public finance issues in developing countries[8].

[8] Interested readers should study: Bye, T., *On the Price and Volume Effects from Green Certificates in the Energy Market*, Discussion Papers No. 351, June 2003, Statistics Norway, Research Department

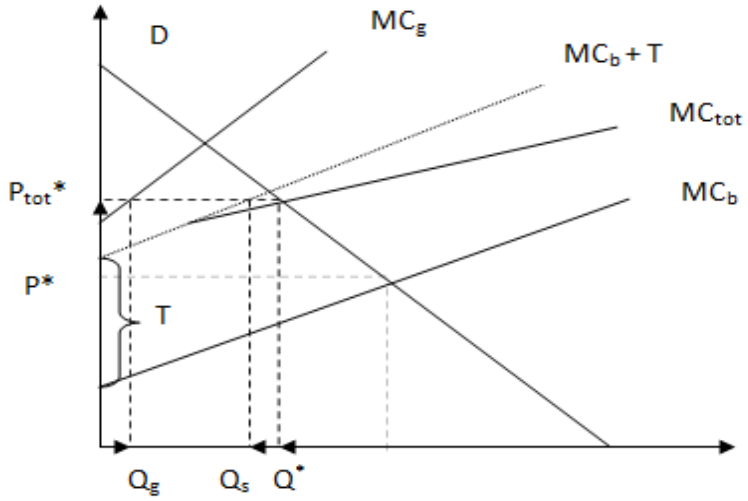

Figure 3.5: Tax on Brown Energy
Sources: Bye and Bruvoll (2008)

3.4 Electricity Sector Reforms of Developing Countries

Several reforms of the electricity sectors of developing countries have been attempted since the 1980. In many cases the developed world's prescriptions for liberalization and contemporary electricity sector organization have been tried, commonly as part of a development aid scheme following economic crisis. The results have not always been as expected, as culture, national politics and previous regulations make the starting point for new electricity sector reform, which again affects the outcome of reform.

When analyzing the reforms of the Indonesian electricity sector, it seems valuable to build on experiences from electricity sector reforms in other developing countries, as the conventional theories may come short in understanding the complexity of electricity sector reform in developing countries.

In the following section I will analyze electricity sector reforms (and attempts) of three countries, Argentina, India and South-Africa. Although not identical to Indonesia, they are all characterized by being *Newly Industrialized Countries* (Bozyk, 2006). These countries all share a past as former colonies of highly industrialized countries, which in relatively recent times have gained both political and economical independence. In the early 1990 Argentina, India and South-Africa went through a radical liberalization process, through the transformation from previously state-dominated economies, to more market oriented principles. The transitional process of these countries varied to a large extent.

The reform of the Argentinean economy may serve as an example of a dramatic, overall reform process driven by emergency decree (Saxton, 2003), whereas the economic reforms of India have been piecewise and incremental (Panagariya, 2001). The economic reform in South-Africa was blended with other political processes and characterized by the inclusion of social goals (DTI, 2011). Indonesia has followed the above countries in liberalization and economic reform, however, the process in Indonesia did not start until the fall of the Suharto regime in 1998 (Sato, 2003).

3.4.1 Argentina

The reform of the Argentine electricity sector was framed by two financial crises, one in the 1980 and the other one in 1991-1992 (EIA, 1997). The reform was based on previous experiences from Chile and the UK, with vertical and horizontal unbundling of state utilities, opening of a wholesale market, as well as marginal cost pricing. The wholesale electricity market is operated by an independent non-profit corporation, CAMMSEA, and jointly owned by stakeholders, such as government, brokers, generators and large customers. Competition has been introduced in the generation segment by privatization of several of the largest generation facilities, whereas transmission concessions are awarded through a competitive bidding process and strictly regulated, as this sector is still organized as a natural monopoly. The independent regulator, *Enre*, has the responsibility of safety and operating standards, as well as tariff-setting for transmission and distribution services. The distribution sector is operated as geographical natural monopolies, which is regulated through a price-cap mechanism (EIA, ibid.).

To give leverage to the privatization process, and attract and retain private investments in the new utilities (Bouille et al, 2002), the Argentinean government started a marketing campaign towards private investors in the US and Europe. Utilities were sold without a lower price-cap and favorable conditions were granted private investors, all to show that Argentina was committed to market-based reforms and deserving of better financing terms from capital markets. The government had a strong belief that the new competitive structure would lead to large efficiency improvements and cost-savings of the electricity sector, with positive spillover effects to both the social and environmental arena. The privatization and reform process of the Argentinean electricity was strongly supported by the World Bank.

The electricity sector reform of Argentina was a drastic step from the previous state-monopoly to a stage 3 post-reform sector, including all of the elements of a contemporary electricity sector. The Argentinean government did, however, take the liberalization process even

further when it privatized all levels of the sector, including transmission and distribution services, which normally is left under state-control.

The liberalization process seemed to create a number of social benefits (EIA, 1997), such as improved quality of service, reduction in both technical and non-technical losses, lower electricity prices, and an increased electrification rate. The generation sector saw a strong increase in private participation, the main investors being foreign. As the generation facilities were sold separately, there was also a strong increase in competition, with more than 40 independent power generating companies, as well as 10 government-owned generators.

Before liberalization Argentina's electrification rate was 91%, whereas after it increased to 95% (Bouille et al, ibid.). This "improvement" was mainly due to a formalization of previously illegal connections, rather than expansion of electricity services. Privatization of distribution companies affected the poorest customers negatively, as illegal connections were removed to improve efficiency. A price-cap regulation, on distribution, also made rural areas less attractive for private distribution companies, as the cost per urban customer was much lower than for rural customers. On the positive side the non-technical losses of distribution companies were greatly reduced and made the distribution companies financially self-sustained. Moreover, by 2009, the average electrification rate was 97.2% (WEO, 2010), indicating that further electrification has taken place after reform.

By 1995 wholesale electricity prices had fallen by 50% compared to pre-reform levels (Bouille et al, 2002). Overall, this was a significant social benefit. However, the distribution of these price decreases was not socially optimal. The largest price decrease was experienced by residential and household customers with large electricity consumption, whereas poor customers only experienced marginal price decreases. Post-reform pricing was based on electricity prices reflecting the cost of supply, which implied that larger consumption gave a lower per unit price. Table 3.6 below outlines the percentage price changes per consumer group and on average.

Table 3.6: Electricity Prices Argentina

USD/kWh	Pre-reform (1991)	Post-reform (1998)	%-change
Residential low consumption	0,082	0,081	-1,6 %
Residential high consumption	0,159	0,047	-70,4 %
Industrial low consumption	0,140	0,105	-24,7 %
Industrial average consumption	0,084	0,074	-11,5 %
Industrial high consumption	0,056	0,037	-33,4 %
Average	**0,104**	**0,069**	**-33,8 %**

Source: Bouille et al. (2002)

Labor unions had significant political power (Bouille et al, ibid.), but as a result of a guarantee scheme giving employees company shares, the labor unions did not oppose the privatization process. Privatization displaced 350 000 workers due to job losses in the public sector. Distribution companies laid off workers in an effort to save costs, and although many employees were rehired through the new third-party contractors, under less favorable conditions. A series of new laws removed restrictions on foreign investments in infrastructure. The new laws allowed foreigners to acquire 100% of Argentinean companies which led to a boost of foreign direct investment in the period following the electricity sector reform.

The World Bank believed that reform would create strong incentives for energy efficiency, as well as price signals would reflect scarcity values and ultimately encourage the rational use of energy sources (Bouille et al, ibid.). The largest environmental benefit was seen in the reduced transmission and distribution losses; however this was not truly a consequence of increased energy efficiency. Another benefit was the increased efficiency in thermal generation, through the investments in new and improved production technology. Post-reform most private investments went to large petroleum-based projects rather than to green generation facilities, and both wind and small-scale hydro attracted little investments, due to the limited commercial viability, a consequence of falling electricity prices.

Lessons to be learned from the Argentinean reforms are that social and environmental benefits do not flow automatically from a financially solvent and efficient electricity sector, and unless specific attention is paid, even adverse outcomes can be experienced.

3.4.2 India

The Indian electricity sector has gone through several regulation regimes and also several attempts at electricity sector reform (Dubash and Rajan, 2002). Before 1991, the sector was characterized by geographically vertically integrated generation, transmission and distribution services controlled by the each state's State Electricity Board (SEB). By 1991 these entities controlled 70% of generation and nearly all distribution, as well as functions such as tariff-setting, policy planning, project approvals and long-term planning. The results of this organization seemed positive with an electrification rate of 80% in 1991.

However, by 1991 India was facing an electricity crisis due to de-metering, extremely high electricity losses and burnouts following a subsidy scheme to the agricultural sector (Dubash and Rajan, ibid.). To recover some of its losses, the SEB started cross-subsidization from industry to poor consumer groups, which consequently led several industries to set up their own captive power plants, leaving the SEBs in a poor financial situation. The first steps towards electricity

sector liberalization were implemented to ease this situation. IPPs were allowed to sell excess electricity to the SEBs with a guaranteed 16% return on equity, as well as a fast track program, offering government payment guarantees, was implemented. The Enron subsidiary, the Dabhol Power Company, was one such IPP receiving a 20-year contract. By the time of Enron's collapse in 2002, the Dabhol project was only 90% finished and had not yet produced any electricity. Moreover, it left the SEB with a USD 300 million loss.

At the same time, another reformation process was taking place in the state of Orissa to help solve the state's problems with 43% transmission losses (Dubash and Rajan, ibid.). The main goals of the reform included unbundling of generation, transmission and distribution, allowing private participation in generation and distribution utilities, as well as reforming tariffs of bulk electricity, transmission and retail. This process was soon put on hold, following the problems with post-reform competitive markets in California[9] which shook India, creating an increased skepticism towards private participation. The policies that followed were more restricted, focusing on tariff increases, removing cross-subsidies, as well as reducing transmission and distribution losses.

In 2003 the new Electricity Act was passed which signified a landmark in the Indian electricity sector reform process (Anantaram, 2010). The main feature was the unbundling of generation, transmission and distribution sectors. Furthermore, a complete liberalization of the generation segment, as well as "open access" was implemented. This allowed large-scale consumers to choose from whom to purchase electricity, as well as producers to sell electricity across markets[10].

The reform process of the Indian electricity sector has been a lengthy process going through several steps. Experiences from the first reform attempt show that liberalization led to an increase in generators and increased the total capacity which improved electricity security. However, it also led the state-owned transmission company into debt from buying expensive from the generation companies through PPAs, and not being allowed to pass this cost on to the distribution companies. Furthermore, it shows how a cross-subsidization scheme can lead to increased captive power by private power producers, and consequently a decreased market share for the state company.

The Orissa reform attempt was in many ways the largest, taking the reform directly to stage 4, even including a spot market. Although the Enron scandal and the consequent skepticism

[9] Especially the Enron scandal

[10] The permission of "merchant sales" (Anantaram, ibid.) is another mechanism to support the establishment of a nation-wide market for electricity, as power suppliers can sell excess electricity in the market to market determined prices.

towards private participation prevented stage 4 reforms at the time, the most recent electricity sector reform is a new attempt. Today, after a complete liberalization process, including stimulation of foreign direct investment, private participation is still growing at a slow rate (Dubash and Rajan, 2002). This may be due to the previously failed attempts of electricity sector reform and the uncertainty of the long-term prospects of this, which pose an extra risk to private investors.

In Orissa funds from privatization did little to improve the electricity sector, as the revenues were absorbed by the government for other uses (Dubash and Rajan, ibid.). Moreover, although the financial viability of the state improved, the reform led to several tariff increases, but hardly any improvement in the quality of service. Even though distribution and transmission losses seemed to be relatively easy to improve in the short run, as rural villages responded positively to bill collection, by 2004 India's average transmission losses were still over 26% (Smith, 2004). In 2008 the electrification rate was 64.5%, and although the rates increased to 66.3% in 2009, there has still been a significant decrease since 1991 (WEO, 2010).

One of the main problems of the Indian electricity sector had been the low electricity price, electricity theft, as well as the subsidies to the agricultural sector. The extremely low electricity prices prior to reform benefitted industrial consumers, but did not encourage electricity efficiency. Furthermore, electricity was perceived as a free good as metering had been incomplete, which resulted in extremely high rates of electricity theft. When the cross-subsidization scheme was implemented it resulted in a flight of industrial customers, as these were saving costs by producing their own electricity. In 2005 nearly 20% of electricity generation was captive (Lamb, 2006).

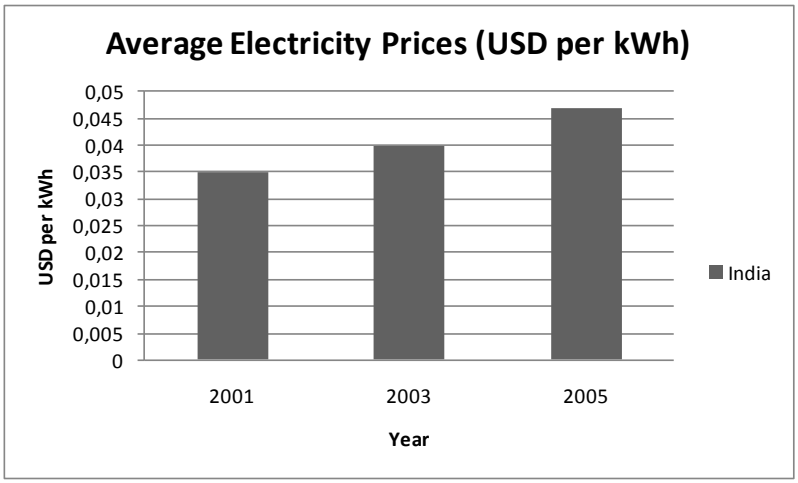

Figure 3.6: Average Electricity Prices India
Source: EIA, (2009)

The electricity sector reform in India has not sufficiently addressed social concerns as tariffs have increased and electrification rates have dropped (Dubash and Rajan, 2002). One of the reasons for this may be that electricity sector reform often is conducted by economist's technical staff, which are not used to combining social concerns with economic goals.

3.4.3 South Africa

During the apartheid era the state-owned monopoly *Eskom* was responsible for nearly all electricity generation in South Africa (WRI, 2010). The National Party implemented several high investment projects for centralized electricity generation; but, by the time of Mandela's presidency only 40% of South Africans had electricity access.

Two separate electricity sector reforms were attempted in South Africa from the early 1990, one in the electricity distribution industry (EDI), and one in the electricity supply industry (ESI) (WRI, ibid.).

In 1998 the *White Paper on Energy Policy* was announced, outlining specific plans for breaking up the generation sector into competing units, as well as introducing a market for electricity (WRI, ibid.). By 2001, the previous state-monopoly was corporatized into a public company with the state as a sole shareholder. Plans were made to make 20% of Eskom available for foreign investment, although the state was to remain the largest shareholder. Eskom as a public enterprise would continue to be the dominant actor in the sector, holding 70% of the generation business.

By 2005, the generation sector was still dominated by Eskom, responsible for 95% of generation, and included only a few private participants mainly producing for own-use (WRI, ibid.). Eskom was in charge of the transmission system and nearly half of the country's distribution. The remaining 50% of distribution was the responsibility of the municipalities who purchased electricity from Eskom in the wholesale market (Philpott et al, 2002).

Although the electricity sector was supposed to be opened up for competition, the effect of private generation companies has been minimal. In 2004 (WRI, 2010) the electricity sector restructuring policy was reversed and by 2008 neither the problems in generation nor distribution had been solved. Today the South-African electricity sector is once again in crisis.

The reform of the South-African electricity sector was in large a part of a wider development process which influenced both the goals and strategy. The process was a step-wise reform, including both step 2 and to some degree step 3, although this was reversed in 2004. Today, the market power is still highly centralized, Eskom being the sole buyer of electricity

from other suppliers (WRI, ibid.). Furthermore, Eskom remains vertically integrated in generation, transmission and distribution, due to the failure of the EDI reform.

The EDI reform was mainly driven by the poor financial situation of the municipal distribution companies, generally operating at a financial loss (WRI, ibid.). Low demand due to unstable economic conditions, political protests in the form of boycotts and non-payment, affected the distribution companies' ability to provide a steady supply. Excessively high costs of distribution, due to many administrative functions being duplicated across adjacent areas, affected the distribution companies' ability to pay Eskom. The EDI reform was criticized for neglecting social benefit considerations such as increased electrification, electricity security, and increased use of renewable energy sources.

The ESI reform, towards more competition and private investment in generation, was driven by concerns about prices and service, but most strongly concerns about the country's generation capacity. There were concerns that increased funds for electricity generation would affect funds for other social benefit schemes, making it a difficult political decision. Furthermore, Eskom was highly critical to the ESI reform, asserting that it was fully capable of fulfilling public benefit strategies on its own.

Through the *Reconstruction and Development Program* Mandela managed to increase electrification rates from 40% in 1994 to 66% in 2002. The electrification process was largely driven by social goals, which was mainly paid by cross-subsidies. By 2009, the electrification rate had increased further to 75% (WEO, 2010).

As one can see from Figure 3.7 below, the electricity prices increased relatively strongly in the period from 2002 until 2005. Despite this, South African electricity prices are still among the lowest in the world.

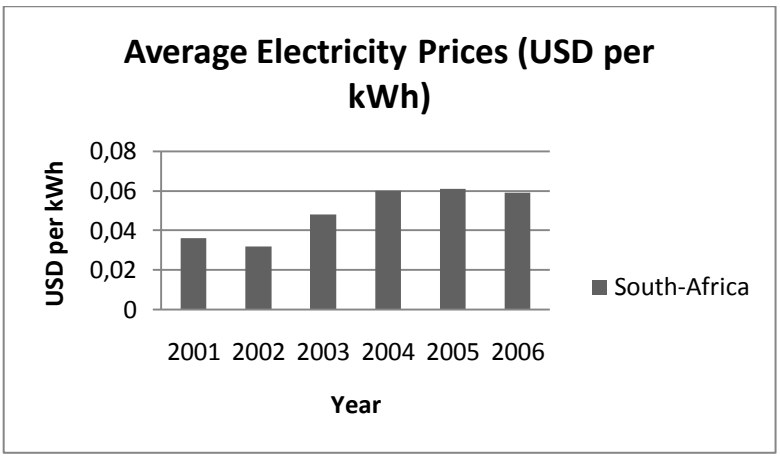

Figure 3.7: Average Electricity Prices South Africa
Source: EIA, (2009)

The electricity sector reform of South Africa did not specifically include any environmental issues, perhaps due to the large variety of other core development policies being addressed at the same time. South Africa's first move towards a more competitive model seems mainly driven by electrification goals, as well as an aversion towards financial risk in the electricity sector[11]. Although Eskom ensured the government of its capacity to supply electricity and fulfill its social obligations, by 2008, the level of electricity generation was again extremely low (WRI, 2010). In the current electricity sector reform discussion, both social and environmental concerns are included to a much larger degree, although the result of this reform process is still to come.

3.4.4 Analysis

As can be seen from the examples above, countries may choose various strategies when implementing electricity sector reform, both in regards to the ownership structure of previous state-monopolies, as well as in regards to implementing competition in one or several segments of the electricity sector.

The pre-reform electricity sector organization, with vertically integrated state-monopolies, clearly results in a shortage of supply, as well as relatively low levels of investments, leading to power deficiencies and unstable power supply. The problem of this is further exuberated in developing countries where the demand for electricity grows at a fast rate. In a traditional natural monopoly model this allocative efficiency problem comes from the natural monopoly using its market power to reduce quantities to push prices up. However, in the case of the countries analyzed, the electricity prices are set by the government, often below marginal costs. These prices make it virtually impossible for the natural monopoly to break even without substantial subsidies. As well as being a large financial drain on the government, the low electricity tariffs also functions as a disincentive for private participation unless they are offered favorable PPAs. The risk of this practice can be substantial for the state-utility, as experienced in India.

Several developing countries have implemented cross-subsidization schemes in the electricity sector, charging higher prices to certain customer groups to subsidize low income groups. A result of this can be an increase in captive power generation, as seen in for example India. This leaves the state-monopoly with a growing base of either non-paying or low income customers, further worsening its financial situation. The use of electricity sector regulation as a social benefit scheme, by subsidizing state-monopolies, supplying electricity at tariffs below

[11] In a state-monopolist model, the state as the sole owner faces all the financial risk of the large investments needed in electricity generation.

marginal costs, as well as incomplete metering and billing systems, has severe negative long-term effects for the state.

Electricity sector reform of step 2 has in many cases not been very successful, although in the short-term electricity generation has increased. The conditions of PPAs, the long time horizon, exchange rate risk, as well as the poor financial viability of the state-monopolies have created large scandals in the past. This does not only increase the criticism of liberalization of the electricity sector, but can also reduce future interest from private agents[12].

This may also be a consequence of unsuccessful electricity sector reform attempts, such as in South Africa. Although the country managed to take several steps towards a competitive electricity sector, by 2005, the state-monopoly was still responsible for 95% of the country's generation, and the country's electricity sector is today facing yet another crisis. The lack of private participation could well be a consequence of the government's inability of implementing and upholding a complete reform of the electricity sector.

The reform process of Orissa shows that unbundling of generation, transmission and distribution, and the privatization of distribution companies may lead to reduced electricity losses and increased financial viability of the distribution companies. This is further supported by the reform in Argentina, where electricity sector reform of stage 3 led to both improved quality, as well as a reduction in both technical and non-technical distribution losses. Furthermore, the privatization of the electricity sector in Argentina resulted in cost savings despite improved quality which indicates that the previous state-monopoly had operated with relatively large slack.

From the case studies above it seems evident that privatization of transmission and distribution companies may lead to reduced rural electrification and a growth in cream-skimming unless regulated strictly. Privatization will lead to more efficient services of existing customers, as well as increased measuring and better billing systems, although it may also reduce the "social benefits" from electricity theft.

The largest concern in regards to social benefits and liberalization of the electricity sector in developing countries is electricity prices. The tariffs for end-users have in several developing countries been kept artificially low as a means to provide basic needs for the poor (Appendix 9.3). This system neither promotes electricity efficiency nor long-term financial viability of the sector[13].

[12] Due to the risks of financial default of the state-monopoly

[13] After Argentina introduced a spot market for electricity the electricity price decreased significantly, although the largest gain was achieved by the largest consumers. Furthermore distribution companies did not pass on the price decrease to its customers, which show that this part of the electricity sector needs strict regulation.

Regarding environmental issues, none of the countries analyzed seem to have targeted environmental issues specifically. When opening up the generation segment to private participation in Argentina, nearly all the private investments were in thermal and large-scale hydro generation. Unbundling of generation and distribution could also lead to less energy efficiency. Finally, if electricity is provided for free or sold at very low rates, there are no incentives for electricity efficiency.

Table 3.7: Summary of Findings

Stage 1: Monopoly	
Capacity	Insufficient investments in capacity Increased captive power generation
Financial Issues	Low financial viability of the state-monopoly due to low tariffs Growing of low-income customer base Large non-technical electricity losses
Social Issues	Low service quality Stagnant electrification of rural areas Cross-subsidizing by state-utility
Environmental Issues	Mainly thermal generation
Stage 2: Single Buyer	
Capacity	Increased capacity due to IPP participation
Financial Issues	Reduced financial viability of the state-utility due to the conditions of the PPA's
Social Issues	Stagnant electrification of rural areas Cross-subsidizing by state-utility
Environmental Issues	Little incentives for energy efficiency
Stage 3: Wholesale Competition	
Capacity	Increased capacity due to increased private investments
Financial Issues	Improved financial viability of T and D Increased efficiency of supply Reduced non-technical transmission losses Increased efficiency of T and D
Social Issues	Increased electrification Improved service quality Reduced electricity tariffs Non-equitable gains from tariff system Job losses
Environmental Issues	Little incentives for energy efficiency

3.4.5 Implications for Electricity Sector Reform in Developing Countries

The above analysis of previous electricity sector reforms in developing countries gives several indications on how fragile this sector may be. The complex mix of financial, social and environmental goals has proven difficult to implement in the reform processes. Furthermore, it

shows how previous policies and practices may affect or limit a country's government's options today, confirming the idea of path-dependency of electricity sector reforms.

The electricity sector organization involving a state-monopoly, although securing several social benefits in the short-run, is not financially viable in the long-run. Evidence of too little investment, slack in operations as well as stagnant technological progress is common. Furthermore, the state's cross-subsidization schemes have led the state-utility into even deeper financial trouble, as industries and larger customers have increased the use of captive power generation.

The first step towards liberalization of the electricity sector involving IPPs and a single buyer, the state-utility, seems to have been the least successful, both in financial terms and social terms. The large risk faced by the state-utility, as the sole purchaser of electricity, has set back the development of the electricity sector in these countries rather than improving it.

The findings from Argentina support Joskow's (2008) prescriptions. The separation of the generation segment and the following competition increased generation capacity as well as service quality. Privatization of state-owned monopolies improved efficiency of supply as well as efficiency of the transmission and distribution segment. However, if privatized, distribution companies need to be guarded by strict regulation to avoid cream-skimming and to ensure increased electrification. Price-cap regulation should be avoided, as this makes rural areas less attractive. The introduction of a wholesale market for electricity, in combination with competition in the generation segment resulted in decreasing prices. Furthermore, the largest benefits went to large-scale consumers, which call for further reform through the unbundling of electricity prices and distribution services.

It seems evident that electricity sector reforms in developing countries are a complex process, where financial goals need to be carefully implemented alongside social and environmental considerations.

4 Reforms of the Indonesian Electricity Sector

In this chapter I will start by briefly presenting previously attempted electricity sector reforms in Indonesia before analyzing these using the frameworks provided in Chapter 3. Chapter 4.2 provides a brief overview of the Indonesian electricity sector (See Appendix 9.4 for more details). I outline recently implemented laws and policies in Chapter 4.3 (See Appendix 9.5 for more details), before analyzing the implications of these on the Indonesian electricity sector as of 2011. Chapter 4.4 is an evaluation of the latest electricity sector reform in Indonesia, both compared to historical electricity sector reforms in Indonesia, contemporary electricity sector organization and to the outcome of reforms in other developing countries.

4.1 Historical Electricity Sector Reforms

4.1.1 Previous Reforms and Reform Attempts

The electricity sector of Indonesia has since 1945 been dominated by the state-owned enterprise (SOE) PT Perusahaan Listrik Negara (PLN), which position is governed by the 1945 *Constitution*[14] and provides the government with the mandate as the sole provider of electricity for the country (Appendix 9.6) (Purra, 2010). PLN has been operating as a traditional vertically-integrated state-monopoly, largely shaped by the country's command-and-control industrial policy.

Until 1985 the Indonesian electricity sector was operated as a strict state-monopoly. However, the Law Number 15/85 *Concerning Electricity Business* can be seen as a first step in modernizing the Indonesian electricity sector, pushed forward by the prospects of future electricity deficiencies (Purra, ibid.). The law attempted to improve the condition of the electricity sector by, for the first time, allowing independent power producers (IPPs) and cooperatives to supply electricity for the Indonesian market. PLNs market power and dominance was to remain intact, as the sole provider of electricity business permits, as well as supply to end-users.

It would take 7 years before the effect of the electricity law materialized in the Presidential Decree 37, which opened up for private participation in the electricity sector (Wu and Sulistiyanto, 2006). The first IPP and the partial opening of the Indonesian electricity market occurred in 1992, following a period of strong economic growth and rapidly increasing demand for electricity. Furthermore, the government had been reluctant to provide public sector funding

[14] Article 33

for electricity sector infrastructure, which in addition to the artificially low electricity prices, had led PLN into a poor financial situation and created perverse incentives for capacity expansion.

Turning to foreign borrowing to support its inefficient operations, PLN and the Indonesian electricity sector had become a target for both the World Bank (WB) and the International Development Agency[15] (Sari and Seymour, 2002). In the 1980s Indonesia was the World Bank's largest borrower in the electricity sector, and by 1985 the World Bank had financed 18 projects in the sector. Technocrats and the World Bank worked in a close partnership to solve the poor situation of the electricity sector, which was heavily influenced by their wish to corporatize PLN. The possibility of introducing competition between power generators, as well as breaking PLN up into smaller units, was discussed in a 1989 sector report. The introduction of IPPs was consequently at first embraced by the agencies that saw this as a first step of liberalization.

From 1992 Indonesia saw a rapid increase of IPPs, and soon 27 IPP operating large-scale power-plant projects had Power Purchase Agreements (PPA) signed by PLN (Sari and Seymour, ibid.). The IPPs were dominantly large foreign enterprises looking for new investment possibilities in the developing world. In 1994 PLN was corporatized[16], changing the status from a public utility to a public company. This was part of the liberalization efforts to separate policy and strategic decision-making from operations.

Attracting capital from foreign investors was a lucrative business for the Suharto regime (Gulati and Rao, 2007), especially as it reduced the need for unpopular tariff increases. However, to attract this capital PLN was forced to accept unfavorable terms of the PPAs, such as take-or-pay clauses, prices denominated in US dollars, as well as long-term contracts. Furthermore, the fresh capital started a new wave of corruption as Suharto's regime used the conditions of the PPAs to gain personal benefits. The increase in corruption that followed from the introduction of IPPs quickly ended World Bank support.

By the time of the financial crisis in 1998 the power deficiencies of the Indonesian electricity sector were history, and with the declining demand the country started to experience a capacity surplus (Sari and Seymour, 2002). During the period of the financial crisis, when the economy experienced a negative growth of 15%, the electricity sector experienced a 4% growth rate per year. PLNs obligations to the IPPs, obliged the state-enterprise to buy electricity that there existed no demand for. Furthermore, the PPA terms provided the IPPs with commitments for extremely high return on equity as a margin of safety. PLN's costs increased rapidly as many PPAs were denominated in USD.

[15] IDA had argued for privatization of the Indonesian electricity sector since the 1970s
[16] Government Regulation No. 23

Over the first half of 1998, PLNs net loss accumulated to USD 1.4 billion (Wu and Sulistiyanto, 2007). As the rupiah depreciated strongly against the dollar, PLN's financial commitment to IPPs grew rapidly and soon amounted to USD 133 billion for a 30 year period (Purra, 2010). In 1998 PLN's power purchases amounted to 32% of its operating revenues, and the following year this had increased to 42% (ADB, 2003).

The Indonesian government and PLN had no choice but to suspend most contracts (Purra, 2010). Honoring their commitments to the IPPs and preventing them from defaulting to their foreign debtors, came at a substantial cost. One of the worst cases was the USD 260 mill compensation paid to the US firm Cal Energy by the Indonesian government.

The rapidly worsening financial state of PLN forced the government to increase tariff rates in the midst of the financial crisis (Wu and Sulistiyanto, 2007). In 1998 the Indonesian electricity tariffs where increased by 30% which caused civil unrest and furthermore led to the exit of President Suharto's government. The tariff increase came too late as PLN was already bankrupt, and the Indonesian consumers and tax payers ended up shouldering the private and public debt incurred.

The fall of Suharto launched a new era known as the period of *Reformasi* (Purra, 2010), which was dominated by several institutional reforms imposed by IMF in exchange for its assistance during the financial crisis. The IMF reforms were of a neoliberal character, and also included the Indonesian electricity sector. One of the main features of this was the development of the Ministry of Energy and Mineral Resources (DEMR) in 2000, which would become the epicenter of administrative power in the Indonesian electricity sector. Furthermore, following strong advices from IMF the Indonesian government started on the process of restructuring the electricity sector (Sari and Seymour, 2002) by outlining policies for unbundling of PLN, creation of competitive markets, rationalizing power purchases from PPAs, as well as establishing spot markets for electricity. In August 1999 the Indonesian *White Paper* was released, outlining four objectives for the electricity sector reform: (1) *Restoration of financial viability*; (2) *Competition*; (3) *Transparency*; (4) *More efficient private participation*.

This process materialized as the 2002 *Law on Electricity* and was considered a large step in liberalizing the electricity sector with its multi-buyer multi-seller organization (Appendix 9.7) (Purra, 2010). The law included all the recommendations for electricity sector reform, down to the implementation of zonal distribution pricing and market-determined electricity prices. With the 2002 electricity law PLN no longer had the monopoly of supply to end-users (Purra, ibid.).

However, in 2004 the law was found to be in direct violation of article 33 in the *Constitution*, as a competitive market for electricity would no longer guarantee PLN the position

as main provider of electricity (Sebayang, 2010). The law was consequently annulled, and the Indonesian electricity sector was once again dominated by PLN (Appendix 9.8). By 2009, IPPs generated only 23% of the total electricity generation, mainly by captive generation[17].

4.1.2 Analysis and Implications for Future Reforms

Electricity sector reforms in Indonesia seem to be facing several difficult hurdles. The first attempt at reform through the use of IPPs ended in failure causing even larger problems for the Indonesian electricity sector. The failed attempt at introducing competition, by the use of IPPs, could be difficult for the Indonesian government to overcome, as it may shape the path of future reforms.

The Indonesian case shows how electricity sector reforms of stage 2 can be extremely fragile and lead to increased corruption and rent-seeking unless sufficient transparency has been established. The PPAs between PLN and the IPPs created large obstacles for the implementation of a competitive market (Wu and Sulistiyanto, 2006), as well as leading to increased skepticism of foreign investors.

IPPs in Indonesia proved to be an expensive source of power (Bayliss and Hall, 2000), due to the take-or-pay clauses of the PPAs, as well as the high return on equity as risk compensation demanded by the foreign IPPs. IPPs consequently managed to shift all risk to PLN, which was further increased by the long time period of the contracts. In addition, the PPAs committed PLN to purchase electricity there was no demand for, which further contributed to the detrimental financial state of the state-owned company.

Some have argued that the playing field was not level when Western professional negotiators met with the technical staff of PLN who pushed by corrupt government officials, were forced to sign contracts that were unfavorable for the company in the long-term. The main problem with a single-buyer system seems to come from the lack of dynamic competition, as the IPPs only needed to secure favorable pre-negotiated prices in the initial negotiations with PLN.

Furthermore, IPPs faced no risk once the financial crisis hit Indonesia (Purra, 2010), as the Indonesian government felt obliged to uphold their side of the PPAs to maintain foreign investors' faith in the Indonesian investment market. The attempt at reform of the Indonesian electricity sector by the use of reform of stage 2 resulted not only in bankruptcy of the state-utility, but also in an underlying skepticism towards both IPPs and privatization of the electricity sector.

[17] Some IPPs had renegotiated previous PPAs and were still allowed to supply to PLN.

The largest obstacle to previous electricity sector reforms in Indonesia has proven to be electricity tariffs. The tariff increases following the problems with IPPs during the financial crisis, not only contributed to President Suharto's surrender of his position, but also increased the skepticism towards liberalization. Although supported by development agencies, which see tariff increases as a necessity to increase efficiency and secure the long-term viability of the sector, the pro-tariff increase politicians faced strong political resistance.

On one side tariff hikes may be necessary to increase electrification of rural areas, which plays a large role in the Indonesian social benefits scheme (Sari and Seymour, 2002). On the other side, as argued by the opposition, tariff increases may affect the poor negatively[18]. What the opposition failed to address, which was obvious to several NGOs, was that the largest benefits of the low electricity tariffs did not go to the poor.

Another source of resistance against electricity sector reform came from PLN's own labor union, and was based on the fear of job losses (Sari and Seymour, ibid.). Instead of voicing this publicly, PLN used article 33 of the Indonesian constitution, arguing against the unbundling and privatization of PLN. Furthermore, the Indonesian textile industry, hotel sector, as well as the Indonesian railways, threatened with large-scale job cuts if tariffs were increased. The consequence of this coalition and its lobbying was the annulment of 2002 Law on Electricity.

Although the short-term effects of liberalization might affect the poor negatively by increased prices and job losses, the long-term consequences with increased supply, lower prices and new employment opportunities is pro-poor (Sari and Seymour, ibid.). Furthermore, the largest subsidy from the low electricity tariffs went to non-poor households already connected to the grid, as 60% of the poor population still lacked grid connection. How this was benefitting the poor was never explained by the opposition.

Environmental benefits were largely neglected in the first reform attempts in Indonesia (Sari and Seymour, ibid.). Although PLN had been asked to address environmental preservation by the World Bank, environmental matters were dealt with on a project basis with no overall sector plan. Energy efficiency was never directly addressed, although indirect environmental benefits, from a switch to cleaner energy sources[19], were believed to occur as a part of the deregulation process. Demand side management regarding environmental benefits was also largely neglected.

[18] The opposition argued that although poor households use relatively little electricity, they will be strongly affected by the increase of for example food prices, following increased electricity tariffs.
[19] Through the reduction of subsidies to diesel and fuel oil

The Indonesian experience supports the findings from other developing countries, such as power deficiencies and stagnant rural electrification as a consequence of an electricity sector dominated by a state-monopoly. The reform involving IPPs produced similar results as those seen in India, showing again that in a system with a single-buyer, as well as price regulations for sales to end-users, the state-utility ends up in an even larger financial squeeze. Moreover, in Indonesia, this practice ended with several other negative and unexpected results, such as the indirect cross-subsidizing from the end-consumers to the private power producers[20].

The private participation in the Indonesian electricity sector in this period was dominated by financial investment in large-scale petrol-based projects. In addition to investments being highly concentrated and centralized, the effect of private participation had little or non-existent positive social and environmental benefits. One of the reasons behind the dominance of private interest in large-scale projects could be the large transaction costs associated with individual negotiations with PLN[21].

The second reform attempt was similar to that of Argentina, i.e., an electricity sector reform of stage 4. If implemented, one may have seen some similar outcomes as seen in Argentina, with falling electricity prices, improved efficiency and a more well-functioning electricity sector in the long-run.

The protection of national champions, based in the country's socialist history and protected by the Constitution, impeded the implementation of a new reform and set the electricity sector reform process back by several years. Parallels can be drawn with electricity sector reform processes in South Africa and the country's inability to maintain a sustainable reform. The failure of the two previous reform attempts of the Indonesian electricity sector will certainly affect the recent reform. A successful and sustainable electricity sector reform may well call for changes in the Constitution, as well as long-term goals and an overall plan. This will most certainly demand a strong political will, possibly pushed forward by another crisis.

[20] Due to the tariff increases implemented to protect PLN from defaulting on its payments to IPPs

[21] High transaction costs will stimulate large-scale projects, as the costs will be divided between a larger volume of produced units. For example, if a private investor "won" the negotiation and received a favorable feed-in tariff and quota, the total financial gains would be exceptionally larger for large-scale projects, due to the economies of scale.

Table 4.1: Summary of Findings

Stage 1: Monopoly	
Capacity	Insufficient investments in capacity
Financial Issues	Low financial viability of the state-monopoly due to low tariffs
Social Issues	Low service quality Stagnant electrification of rural areas Cross-subsidizing by state-utility
Environmental Issues	Mainly thermal generation
Stage 2: Single Buyer	
Capacity	Increased capacity due to IPP participation
Financial Issues	Reduced financial viability of the state-utility due to the conditions of the PPA's Strong growth in corruption
Social Issues	Stagnant electrification of rural areas Cross-subsidizing by state-utility
Environmental Issues	Energy efficiency by fuel switch Little or no environmental benefits

4.2 Electricity Sector Overview

Indonesia was in 2010 ranked as the fourth largest country in the world. The country is today experiencing annual economic growth of approximately 6%, as well as high population growth, which all affects the Indonesian electricity sector.

Furthermore, Indonesia experienced growth in electricity consumption by nearly 700% in the period from 1985 to 2009. The largest increase came from the business segment, but also household consumption increased (Statistics Indonesia, 2010). In 2010 PLN estimated that the average growth in demand from 2009 to 2019 would be 9.1% per year, with the largest growth in Eastern Indonesia at 10.6% (Sebayang, 2010).

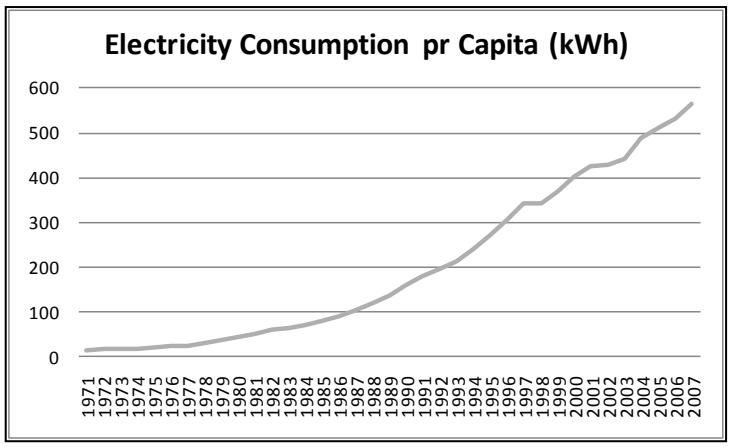

Figure 4.1: Average Yearly Electricity Consumption per Capita
Source: WDI (2011)

From being a net exporter of oil, in 2004 Indonesia became a net importer, and a major shift away from domestic use of oil for electricity generation was implemented (IEA, 2007). The substitution was mainly achieved through increased use of coal and natural gas, as well as a small increase in the use of large-scale hydro and geothermal.

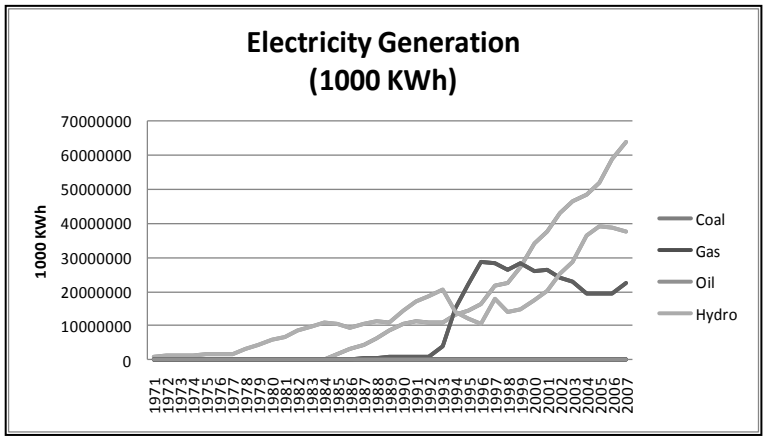

Figure 4.2: Yearly Historical Electricity Generation by Source

Source: WDI (2011)

The largest share of Indonesian electricity generation has traditionally come from thermal energy sources However, the country has a substantial potential in renewable electricity generation, such as geothermal, hydro, as well as biomass and good conditions for the use of PV-based electricity generation (DGEEU, 2005). Hydro is one of Indonesia's largest renewable energy sources, but it has been exploited minimally, as shown in Figure 4.2 (Ariati, 2008).

The generation costs by different technologies vary to a large extent (USAID, 2007). Large-scale hydro generation was in 2006 estimated to have the lowest cost per kWh, closely followed by coal-fired power plants. Solar PV was estimated to be the most expensive source for electricity generation, closely followed by diesel generation. Furthermore, coal and diesel generation had the lowest estimated cost per installed kW. PLNs average generation cost, based on the 2010 energy mix, was 1100 Rp/kWh (Witular, 2010).

Diesel generation has been widespread in rural areas due to its low investment costs and ease of distribution (Sari and Seymour, 2002). In 2002 approximately 60% of captive generation, electricity generation for own use, was estimated to come from diesel generators. Captive diesel generation is mainly used by extractive industries in the outer islands with high peak-load needs, or lack of grid-connection due to difficult access[22]. Moreover, diesel aggregates have been a

[22] High costs of connection

favored method for rural electrification and has been heavily subsidized. The subsidized price of diesel for electricity generation has been estimated to 605.5 Rp/kWh[23].

In 2009 the average electrification rate of Indonesia rate was 65% which is far below the government's goal of 90% electrification by 2020 (OBG, 2007). Furthermore, the average electrification rate of rural areas was only 32% (D'Agostino, 2010). PLN predicts an increase in national electrification rates to 91% by 2019, which will be a major challenge.

Several rural electrification programs have been tried implemented. In 1997 the government initiated the *Solar Energy for 1 Million Households Program*, aimed at electrifying one million households by the use of solar home systems which were distributed free of charge to rural communities (Sudrajat, 2005). Due to technical problems and lack of financing for maintenance, the program was not sustainable. By 2008 diesel generators contributed to 44% of the distributed generation in rural areas. Hydropower generation accounted only for 13%, whereas geothermal accounted for less than 1% (Sudrajat, ibid.).

Of total electricity production in 2009, PLN contributed by approximately 77%, whereas electricity production by IPPs was only 23% (Sebayang, 2010). PLN operates in both generation, transmission, distribution and sales segment of the Indonesian electricity sector (Appendix 9.4.6), and although corporatized in 1994, is still 100% state-owned. IPPs have historically been restricted to captive power generation, or to selling their electricity to PLN through PPAs, as PLN has had the monopoly in supplying end-users.

In 2009 PLN presented a plan where they outline future goals for both private participation and use of renewable energy sources[24] (Praptono, 2009). Main components of this plan include increasing IPP participation to 38.5% of total capacity, and commit to capacity expansion of renewable energy sources for geothermal and hydro. 57% of total capacity of green energy power production will be expected from IPPs (Sebayang, 2010)[25].

Figure 4.3 (next page) outlines PLN's energy mix in 2009, with a total capacity of 29 373 MW (Sebayang, 2010).

[23] Tumiwa, F., (2011), Interview at the IESR Office in Jakarta on the 28th of March, 2011
[24] Power Generation Development Plan 2009-2018 (PDGP)
[25] In addition, the PDGP outlines for electricity efficiency through technology improvements, as well as suggestions for demand side management, such as peak-clipping (Praptono, 2009).

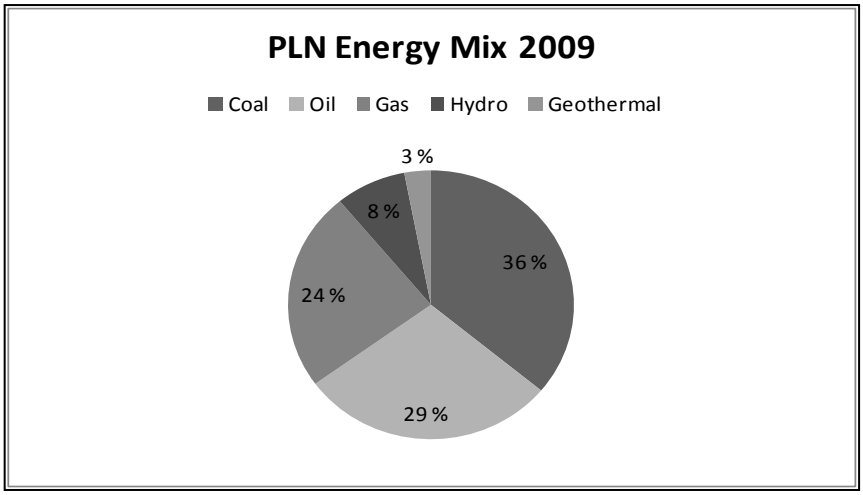

Figure 4.3: PLN Energy Mix 2009
Source: Sebayang, N., (2010)

All Indonesian transmission and distribution grids are operated by PLN (Silviati, 2005). The Indonesia Power System consists of eight interconnected systems and more than 600 isolated systems (ASIEAP, 2011). The main interconnected grid has been suffering from high transmission losses and electricity theft[26].

The average electricity tariff has been increased from USD 0.025 in 2001, to USD 0.61 per kWh in 2008 (IEA, 2009). As the electricity tariffs have been set lower than PLN's marginal costs, PLN depends on government subsidies to be able to provide electricity. In 2008 the government subsidy to PLN amounted to USD 8.7 billion. The subsidy was, however, reduced to USD 6.1 billion in 2009 (PT PLN, 2009).

4.3 Current Electricity Sector Reform

With the establishment of the Ministry of Energy and Mineral Resources (DEMR) in 2000[27] (Purra, 2010), the policy-making and regulatory function of the Indonesian electricity sector seems to have seen some progress. The largest effect on the Indonesian electricity sector is believed to be the passing of Law No. 30/2009 (Purra, ibid.), which marks the start of the latest reform attempt of the electricity sector. The passing of this law is supposed to complement other recent policies, which are all expected to help improve the financial condition of the Indonesian electricity sector, and help the government in achieving its social and environmental goals[28]. In Table 4.2 (next page) I outline some of the main implications of the new electricity law.

[26] In 2009 PLN launched plans to build 40km underwater power cables connecting Sumatra and Java to improve this situation, costing the state company an estimated USD 2.2 billion (EIN, 2009).
[27] Part of IMF imposed reforms following the financial crisis
[28] Although the law was passed in 2009, the law will not be practically implemented until the year 2012-2013, with the passing of the *Government Guidance of Electricity Business* (ASIEAP, 2011)

4.3.1 Law on Electricity 2009

Table 4.2: Regulatory Framework Provided by Law No. 30/2009

Law No. 30/3009	
PLN	Ends PLN's monopoly
	Corporate bodies, cooperatives and self-supporting communities are for the first time allowed to participate in the supply of electrical power to end-users
	"First right of refusal": PLN has the first rights in regards to supplying electricity in Indonesia[29]
	"Obligation to serve": Appointed by law to serve areas where no private interest has been shown[30]
	Not unbundled
	Monopoly rights for the existing transmission and distribution grid
	Systems operator
	Obliged to purchase electricity generated from smaller than 10 MW renewable power plants
Regional Authorities	More autonomy regarding electricity supply
	May provide licenses for projects that do not involve PLN or grid-connected IPPs[31]
	Private companies may sell electricity directly to the regional government through PPAs, or cooperate with local government for small-scale projects
IPP	Promotes more actively participation by private investors
	Areas not already served by PLN may be served by private businesses[32] as long as the specific area is not included in PLN's plans for electrification[33]
	Areas already served by PLN may only be served through PPA contracts
	Private business will need an IUPTL granted by the central government to be allowed to sell electricity directly to end-users
	Have to build transmission and distribution grid if supplying directly to end-users[34]
	IPPs wishing to generate electricity in areas already served by PLN (where a grid exists) may only sell electricity to PLN through PPAs[35]
	Captive generation: May be conducted by government agencies, regional government, state-owned companies, regional-owned companies, private corporate bodies, cooperatives and individuals. Needs to hold a government issued permit[36]

[29] Captive generation is an exception
[30] Rural electrification through PLN has been supported by the government through yearly funding, which has been around 850 billion IDR (IED, 2004).
[31] IPPS selling electricity to PLN through PPAs
[32] Tumiwa, F., (2011), Interview at the IESR Office in Jakarta on the 28th of March, 2011
[33] Business Plan for the Supply of Electricity 2009-2018
[34] Tumiwa, F., (2011), Interview at the IESR Office in Jakarta on the 28th of March, 2011
[35] Tumiwa, F., (2011), Interview at the IESR Office in Jakarta on the 28th of March, 2011
[36] Responsibilities of permit holders include quality standard requirements, safety conditions and service requirements.

4.3.2 Recently Implemented Policies and Goals

In table 4.3 I have outlined some of the most relevant, recently implemented, policy changes.

Table 4.3: Recently Implemented Regulations and Policies

Policy	Program	Goal
Blueprint for Development of National Electricity Industry (2003-2020)/2003	Plan for the development of the Indonesian electricity	90% electrification by 2020
National Energy Policy/2006	Energy Diversification Policy	Reducing oil use by 20% by 2025 Increase the new and green energy mix to 17% by 2025
Presidential Regulation No. 71/2006	1st 10 000 MW Fast-Track Program Crash-program to add 10 000 MW capacity Substituting oil for coal in electricity generation Conducted solely by PLN	Increasing generation capacity through fuel switch Reducing PLN's need for state subsidies
Presidential Decree No. 4/2010	2nd 10 000 MW Fast-Track Program Crash-program to add 10 000 MW capacity Energy Sources: Geothermal, hydro and biomass PLN, IPP projects or IPPs in cooperation with the Indonesian government	Increasing generation capacity Increasing use of RE Increased participation by IPP
Ministry of Energy Regulation No. 7/2010	Cross-subsidization through electricity tariff system	Providing electricity at reasonable prices

4.4 Evaluation of Electricity Sector Reform

4.4.1 Compared to Contemporary Electricity Sector Organization

Although it is too early to evaluate all the practical consequences of the latest reform of the Indonesian electricity sector, the passing of the new electricity law in 2009 provides the organizational framework for the sector, as well as the foundations for future policies and regulations. It is therefore of interest to analyze this framework provided by the Law on Electricity 2009.

Comparing to Joskow's (2008) prescriptions it becomes evident that the recent electricity sector reform of Indonesia is missing several of the recommendations for successful liberalization. First, PLN has not been privatized, and although it was corporatized to a limited liability company in 1994, the state is still the main shareholder[37].

Second, and more important, there has been no unbundling of PLN. Hence generation, transmission and distribution services still remain under PLN's control, as a vertically integrated state-utility. Competition is attempted in the generation segment, through IPPs, although so far these have no efficient access to the transmission and distribution network. Due to PLN's dominant position in the generation segment, as well as its control over transmission and distribution, there seems to have been little effort made to create competitive conditions in these segments. This becomes even more complex when the government, as the main shareholder of PLN, is also the regulator, i.e., no independent regulator has been established.

Third, minimal effort seems to have been made in regards to supporting an active demand side, as the system of state-tariffs for electricity has not been abandoned. The electricity tariffs also remain unbundled, and do not reflect the specific cost of generation, transmission and distribution to the consumer. Finally, as part of the system of state-tariffs for electricity, the Indonesian government continues their cross-subsidization scheme by charging different tariffs to different consumer groups. The tariff increases in 2010 supports the government's intentions of keeping this system, as the increases varied greatly among consumer groups.

The recent reform of the Indonesian electricity sector does not fit directly into the theoretical framework for various stages of reform, as it cannot be classified as either a stage 2, 3 or stage 4 reform, but is more of a hybrid between the three.

The Indonesian reforms are still focused on introducing private participation in the Indonesian electricity sector through the use of IPPs, although this time without a single-buyer system. As PLN's monopoly rights in the supply for end-users have been abolished, as well as regional autonomy being strengthened, PLN is no longer the single buyer of electricity in Indonesia[38]. Consequently the recent reform is slightly more market oriented than the first reform.

The lack of implementation of a wholesale or retail market means that the recent reform cannot be categorized as a distinct stage 3 or stage 4 reform, although certain aspects of these stages are evident in different areas. Where PLN already supplies, i.e., areas with existing grid[39],

[37] PT PLN was the largest issuer of *Local Currency Yield* bonds (LCY) by the end of June 2009 (ABM, 2009).
[38] When excluding captive generation
[39] Or diesel aggregates

PLN is still the single buyer, as IPPs will not be granted an IUPTL to sell directly to end-users in these areas. IPPs may supply there, but only directly to PLN through PPAs[40].

In areas where PLN has used their "first right of refusal", IPPs may sell electricity to the regional government through PPAs[41], collaborate with the regional government in supplying electricity or receive an IUPTL for selling directly to end-users. The regional governments may act as monopolists in distribution, as they have the authority to choose the IPP to purchase electricity from when being responsible for supplying end-users after receiving an IUPTL. It can be argued that this is a special form for wholesale competition, i.e., a stage 3 reform, if this is done through competitive bidding.

When the IPP is the IUPTL holder in a specific area the reform is taken yet another step further. There is no problem of free access as the independent power producers have to build their own distribution networks. When consumers are also allowed to purchase electricity directly from the generator this may be categorized as a reform stage 4[42].

In addition, the contemporary electricity sector organization continues to allow for captive generation, i.e., electricity generation for own use. This means that a company can set up its own generation unit and distribution grid and "sell" electricity to itself outside the entire framework outlined above. This practice falls outside the regular framework for electricity sector organization, but does have implications on the competitiveness of the Indonesian electricity sector[43].

Figure 4.4 (next page) portrays the main elements of today's electricity sector organization in Indonesia. Some simplifications have been necessary to be able to convey the complexity of the above in a visual image.

[40] Reform stage 2: Single Buyer
[41] Reform stage 2: Single Buyer
[42] Even though no retail market has yet been introduced
[43] The reason behind this is that captive generation is an alternative to purchasing electricity from PLN, regional authorities or IPPs, which may become a better alternative if the purchasing prices become sufficiently high.

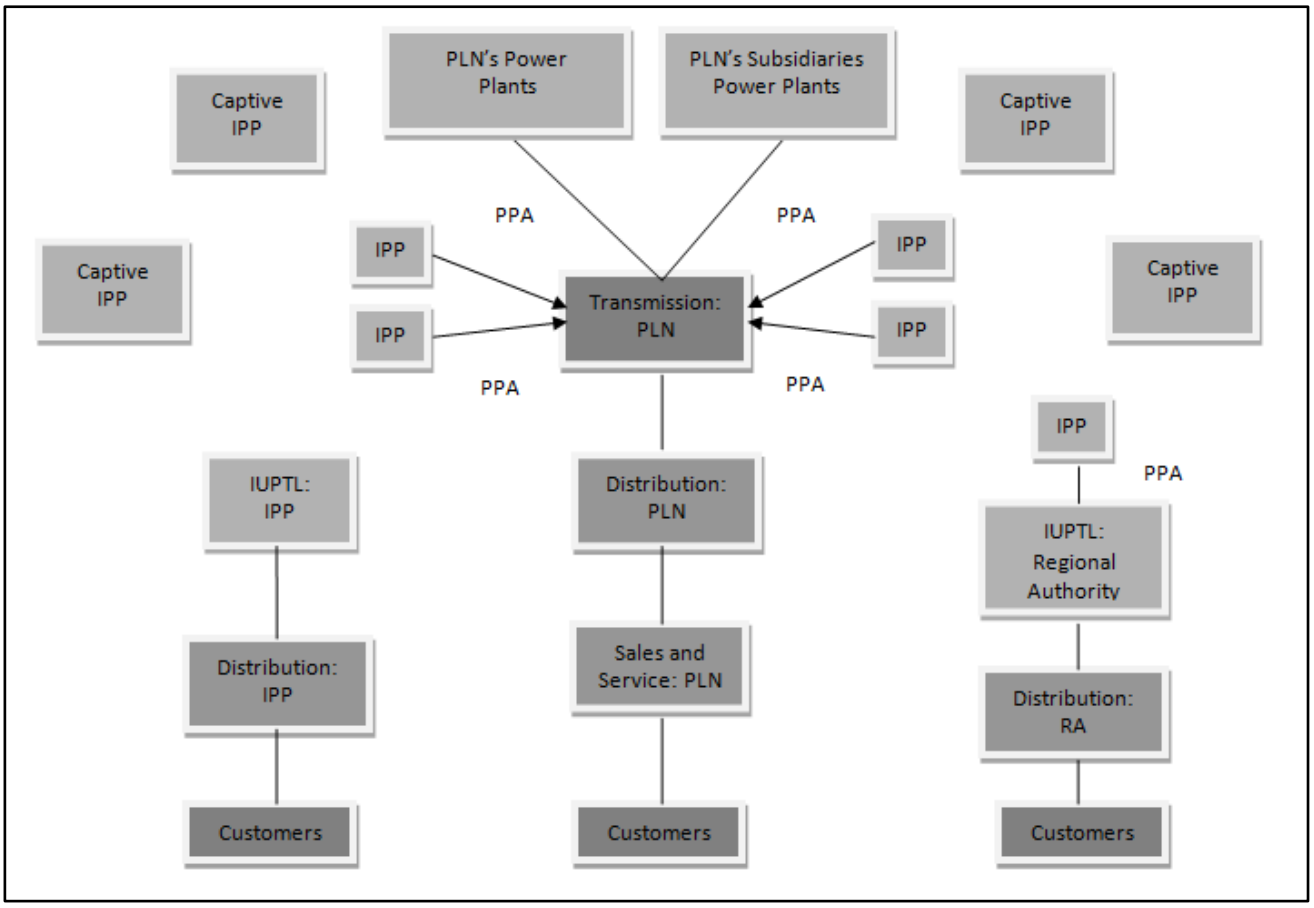

Figure 4.4: Indonesian Electricity Sector Organization 2011

4.4.2 Social and Environmental Benefits

The recent reform of the Indonesian electricity sector can seem to be an improvement regarding social and environmental benefits. The specific goals outlined for electrification show that access to electricity for the population scores high on the government's agenda. One of the instruments used to achieve this is the yearly funding provided to PLN for rural electrification. However, so far PLN's expansion plans have focused on the Java-Bali region, and their plans for electrification of remote islands have been moderate.

Rural electrification may improve with the abandoning of the restrictions in regards to sales to end-users, although this depends on the financial viability of these types of projects. PLN will still have the main responsibility for rural electrification, but the practical implications of this are still to be laid out.

The social tariff system has not been abandoned; rather its position has been strengthened with the new law. This may imply two different things. First, the government finds the system of social benefits through electricity prices optimal, and does not wish to remove it. Or second, the current social tariff system is such a political "hot potato" that the government is unable or

unwilling to remove it. What they have realized is that tariff increases are necessary to ensure cost-recovery in the sector, as well as a means to reduce the state-subsidies to PLN.

Environmental benefits have been included to a much larger degree in the new electricity sector organization. Several of the policies and regulations already implemented are specifically aimed at stimulating technology and fuel in a more sustainable direction. The standardization of PPAs and the simplified negotiation processes with PLN can be seen as initiatives to make the playing field more level. Specific goals for the use of renewable energy sources have been established by the DEMR, and are outlined in nation-wide plans with set time horizons and specifications for state and private contributions. Furthermore, the active stimulation of private participants in infrastructure may also contribute to environmental benefits from improved technology, energy efficiency and knowledge-sharing.

The government subsidies for electricity supply are to be phased out. According to PLN's financial statement in 2009 (Appendix 9.4.6), there was a large decrease in subsidies from the previous year. However, for the state-subsidies to be phased out, PLN needs to be able to recover all its costs from the sales of electricity to end-users.

The main problem with these subsidies regarding environmental benefits is that they are indifferent to which technology that has been used to generate the electricity. This means that the true effect of the subsidy is only to make all electricity cheaper for end-users, which stimulate neither electricity efficiency nor the use of green electricity sources. To improve the conditions for green electricity generation the government subsidy/tax have to change the relative costs of generating electricity with traditional or renewable resources. Today's subsidy system can therefore be seen as contributing negatively to environmental benefits.

4.4.3 Comparison with Reforms in Other Developing Countries

The electricity sector reform in Indonesia has been modest compared to that of for example Argentina. The main reason for this is the heavy protection of state-companies guarded by the Indonesian constitution. As long as the state has the main responsibility for the provision of electricity for end-users by law, no privatization of the state-utility is plausible unless the constitution is amended.

In Argentina the privatization process was almost taken too far when generation, transmission and distribution services were offered to the highest bidder. Although electricity prices fell after the introduction of a wholesale market, the largest social benefits did not go to the poor. The price-cap regulation of the privatized distribution companies gave incentives for cream-skimming, as rural areas were relatively more expensive to supply. Based on this perhaps

state-ownership is the better solution for the Indonesian electricity sector, where infrastructure services are a commonly used instrument for the distribution of social benefits.

The case of the Indian electricity sector reforms illustrate the path-dependency found in electricity sector regulation, and may help explain some of the political difficulties in electrification and in removing the social tariff-system in Indonesia. The electricity subsidy scheme to the Indian agricultural sector continued to haunt the electricity sector for a long time[44].

One of the problems in Indonesia is the lack of awareness of the cost of electricity, which has its roots in both the social tariff-system, as well as previous electrification attempts[45]. The Indonesian government's previous electrification attempts, by supplying diesel generators or solar home systems for free, may impede private participation in electrification of these areas, due to the rural communities' perception that electricity services are free[46]. Once this perception has been established, it may be extremely hard to change and will affect the success of future electrification projects. The social tariffs and cross-subsidization scheme has not been removed despite the long-term desirable effects such as increased information from market prices, improved service quality and reduced deadweight losses. Using the previous experiences from India, we should be aware of the danger of increased captive generation and the effects this may have on PLN's financial viability.

The main point to be taken from the previous experiences of electricity sector reform in South Africa may be the uncertainty associated with a fragile reform, as well as a monopoly's incapacity to meet the rapidly increasing demand for electricity. Private participation in generation in South Africa remained minimal although the sector was opened up for competition. The lesson to be learned by Indonesia is that it is not sufficient to merely open the electricity sector to competition; the market structure will also have to provide private companies with incentives to participate. If these incentives are missing, or if the risk associated with participation is large, no private participation will take place.

Both in South Africa and in Indonesia, the dominant state-company has been highly protective of its position and claimed to be capable of serving the rapidly increasing demand. The experience of all countries studied shows the exact opposite, i.e., that an electricity sector dominated by one state-owned vertically integrated company is not able to expand its capacity at the needed rate. For Indonesia, with its constitutional protection of PLN, the focus on alternative

[44] Although, possibly a good short-term instrument, the long-term effects of de-metering practices and high non-technical electricity losses in India were still not solved more than 15 years later.
[45] Free electricity under the conditions that rural villages will cover fuel and/or maintenance costs
[46] In the case of solar home systems the rural villages lacked the technical understanding and financial capacity for handling the systems. Consequently, once the systems broke down, the village expected the government to give them a new system.

ways for introducing competition seems extremely important. The success of this will depend on the incentives for private participation, shaped by the recent reform.

4.4.4 Important Features of the Recent Reform

From the analysis above several important features of the recent reform of the Indonesian electricity sector have become evident. Table 4.4 summarizes the main findings and outlines some key issues which will be further discussed in Chapter 5.

Table 4.4: Summary of Findings

Stage 2: Sale by IPPs to PLN or RA through PPA	
Capacity	Lower negotiation costs due to standardization of PPA process should imply increased private participation, although PLN still has the main responsibility for electricity supply
Financial Issues	Stricter restriction on conditions of PPAs compared to previous reform attempts should reduce the financial risk of PLN and RE, as well as reduce the risk of corruption
Social Issues	Social tariff system is not abandoned, however tariff s have been increased System of cross-subsidizing is not removed which may increase cream-skimming and captive generation
Environmental Issues	More specifically addressed compared to previous reform attempts Non-removal of state subsidy may impede the use of RE Little focus on demand-side incentives for energy efficiency
Stage 3/4: PLN, RA and IPPs Selling Directly to End-Users	
Capacity	Opening up for direct sales to end-users should imply increased capacity, however this depends on the profitability of electricity supply in the given area
Financial Issues	Improved financial viability of PLN if IPPs participate in rural areas IPP participation will be dependent of electricity tariffs and demand of a given area Increased costs for IPPs due to the need for grid development
Social Issues	Social tariff system is not abandoned, however tariffs have been increased System of cross-subsidizing is not removed which may increase cream-skimming and captive generation
Environmental Issues	More specifically addressed compared to previous reform attempts State-subsidy negatively affects the use of RE Little focus on demand-side incentives for energy efficiency

5 Implications for the Future of the Indonesian Electricity Sector

5.1 Goals, Incentive Structures and Sustainability

In the introduction of this thesis I outlined the Indonesian government's goals for electricity sector reform. The goals seemed promising both for increasing generation capacity through private participation, as well as in addressing social and environmental issues. To evaluate the effectiveness of these goals I formulated two research questions:

> *"Does the regulatory framework create the incentives needed for the government to achieve its goals?"*
>
> *"Does the design of the recent reform of the Indonesian electricity sector provide for a sustainable reform?"*

I will continue this thesis by taking a closer look at the likely effects of some of the recently implemented policies and consequent incentive structures, before evaluating the sustainability of the recent reform of the Indonesian electricity sector.

5.1.1 Goals and Incentive Structures

In the following section I will take a closer looks at the goals set by the Indonesian government and provide some simplified examples as to how the incentive structures may affect the outcome of the electricity sector reform. I have on purpose chosen to disregard the effects of international funding for development and poverty reduction, as well as the various international mechanisms for carbon emission reductions, as I want to focus on the domestic incentive structures implemented in the recent Indonesian electricity sector. Each subsection is devoted to a separate goal for electricity sector reform outlined in the introduction of this thesis.

5.1.1.1 Supplying Electricity at Reasonable Prices

As stated in the *Law on Electricity 2009*, one of the main goals for the Indonesian government is to supply electricity at reasonable prices (Appendix 9.5.1). The outcome of this is that the social tariff system has not been removed. Although tariffs have been increased, what is essential for the Indonesian electricity sector in the long run is that generators are able to recover their legitimate costs.

One measure implemented by the Indonesian government, which may help generators in cost recovery, is the cross-subsidization scheme. By charging various customer groups different prices, the generators may be able to cover their costs on average, given that they are serving a

well-balanced group of customers. The average price a generator would receive by doing this is 747.6 Rp/kWh[47].

Such a cross-subsidization scheme also means that certain customer groups become relatively more attractive to serve, as they may provide the supplier with higher profits. In the case of a pure state-monopoly this sort of cream-skimming can be strictly regulated and enforced, but in the case of a partly liberalized electricity sector, like in Indonesia, this could lead to some unexpected outcomes.

5.1.1.2 Increased Participation of Private Partners in the Supply of Electricity

The Indonesian government has made a serious attempt at improving the conditions for IPPs. However, as previously stated, it is not sufficient merely to allow for private participation, the incentive structures, i.e., profitability, must also be in place if any private participants are to freely enter the market.

As outlined in Appendix 9.5.2 (Table 9.5) there are now five ways for an IPP to participate in the Indonesian electricity sector. This may be simplified into three alternatives: through PPAs with PLN or regional authority, by supplying directly to end-users or by captive generation.

I will beneath use the example of a small-scale generator of hydro-electric power in Sumatra[48] to exemplify what may happen under the incentive structure provided by the current policies[49].

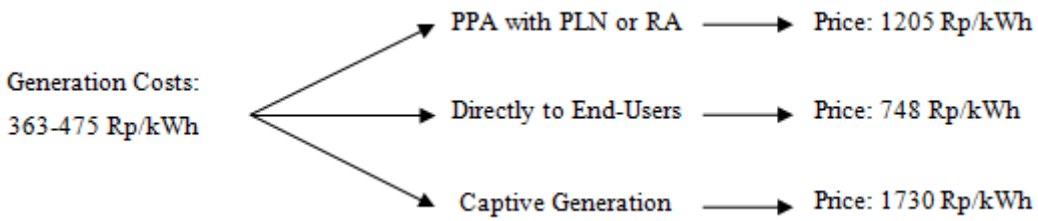

Figure 5.1: Strategy Alternatives for Small-Scale Hydro Generator

In the example above I have outlined the three different strategies available for IPPs under the current regulatory structure. The PPA price is based on the low voltage price and the regional price multiplier $F = 1.2$ (Appendix 9.5.3, Table 9.8). The price for supplying directly to end-users is the average tariff. Furthermore, I have chosen to use the generation cost for a private diesel plant as the alternative cost for captive generation (Appendix 9.4.2, Table 9.2).

[47] The average of 2010 tariffs outlined in Appendix 9.5.5, table 9.11, is 747.6 Rp/kWh
[48] Sumatra has very good small-scale hydro potential.
[49] Sari, A., (2011), Interview at IklimCarbon in Jakarta on the 29th of March, 2011

What becomes evident from this simple example is that private participants, assumed to be profit-maximizing, would never choose to supply to end-users, purely due to this being the least profitable option. Moreover, when adding the costs of building grids, it is easily established that small-scale renewable electricity generation by private companies in rural areas is highly unlikely[50].

At first sight it may seem as if supplying directly to regional authorities may be a good option. When adding the transaction costs associated with establishing a partnership with regional authorities, corruption costs, as well as the time consuming process of gaining an IUPTL[51], a PPA with PLN seems like a much more attractive option. The standardized PPAs for small-scale hydro have significantly reduced the transaction costs of negotiation with PLN, but the profitability of this option is highly dependent on the distance to PLN's grid, as the connection grid will have to be built by the IPP[52].

This leaves the option of captive generation. In this case the IPP will avoid all the transaction costs associated with permits and setting up local partnerships. There will be limited need for transmission or distribution grids, so the initial investment cost will also be lower than for the other alternatives.

In the case of a non grid-connected private business in rural areas, the alternative cost is the non-subsidized cost of diesel generated electricity[53]. As can be seen from Figure 5.1 (previous page), this will by far be the most profitable option for the IPP. Moreover, for this consumer group the average electricity tariff, at 793 Rp/kWh, is relatively high and will likely become higher. What this implies is that even if PLN would extend the grid to this area, the IPP would be able to make a profit by charging a slightly lower price[54].

5.1.1.3 Increasing National Electrification Rate to 90% by 2020

An increase of the electrification rate from approximately 65% to 90% by 2020 will require a substantial effort, especially due to the rapid population growth. Moreover, most of the non-electrified areas are rural and is home to the poorest population of Indonesia. IPPs have already been allowed to supply for end-users for nearly two years, although so far no such projects have materialized[55]. This may not come as a surprise after the example outlined above.

[50] Small-scale hydro electricity generation has the lowest generation costs of all small-scale RE
[51] See Master Thesis "*Why Transaction Costs Matter for Small-Scale Hydropower Development in Indonesia*" (in progress), Tiril Reutz for further information on transaction costs and corruption
[52] Sari, A., (2011), Interview at IklimCarbon in Jakarta on the 29th of March, 2011
[53] An example of this could be a resort or hotel in the rainforest or similar location
[54] Could also sell the excess electricity to PLN through a PPA.
[55] Pedersen, A. C. (2011), Interview at GTZ Offices in Jakarta on the 30th of March, 2011

In reality this implies that PLN may become solely responsible for increasing the electrification rate due to their "obligation to serve". PLN receives government funding for this purpose every year, however, so far the funding earmarked for rural electrification has been blended in with their total budget which makes it little transparent as to how the money has been spent.

In the following example I will show how the incentive structures surrounding PLN might actually reduce rural electrification now that the state-utility has been corporatized and operates under profit-maximizing principles.

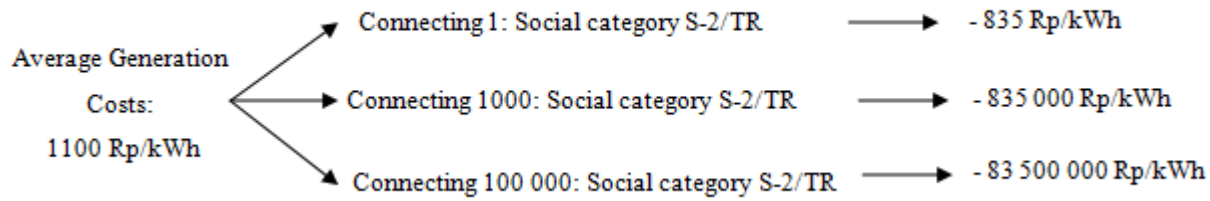

Figure 5.2: Strategy Alternatives for Rural Electrification by PLN

In the above Figure 5.2 I have outlined a simple strategy tree for PLN regarding rural electrification. As an estimate of PLN's costs I have used the average generation cost, assuming that the supply to end-users by PLN will not be site-specific, but grid-based. To exemplify the costs of connections I have used the social tariff category S-2/TR, which covers consumption between 30kWh and 60 kWh[56] at 265Rp/kWh[57] (Appendix 9.5.5, Figure 9.9).

What the different strategies represent are the losses PLN will suffer per kWh of electricity used, by newly connected rural households[58]. For example, if PLN is to connect one new household, in addition to the initial cost of connection, PLN will lose 835 Rp per kWh supplied. As is evident from figure 5.2 this loss will increase rapidly with the number of new connections and kWh supplied, and will consequently worsen the financial viability of PLN at a growing pace.

For PLN this means that the only rational option, as a profit-maximizing company, is to reduce the amount of new connections to any consumer groups with a tariff below their average generation costs. So far their losses have been covered by the state, but with the government's intention of phasing out subsidies, PLN will have an even stronger incentive to reduce rather than expanding rural connections.

[56] 450VA connection
[57] Average consumption of rural households has been estimated to approx 50kWh per month
[58] At the current social tariff

An alternative way to fulfill their social obligation of supplying electricity to rural households would be to balance social connections with connections of groups with higher tariffs. However, neither of today's average tariffs are high enough to cover PLN's average generation costs (Appendix 9.5.5, Table 9.11). Furthermore, as seen in the example in the previous section, IPPs will focus on captive generation and consumer groups with the highest electricity tariffs, which may drain PLN of their more profitable customers and create an even larger imbalance and larger loss in the long run.

Within today's regulatory framework, with electricity tariffs, high generation costs as well as little transparency and enforcement in regards to the funding for electrification, PLN has all the incentives to reduce, rather than increase, rural connections. It actually makes perfectly sense under the current regulatory framework, for PLN to make each new connection as expensive as possible, spending the funding, but limiting their losses from future supply obligation.

5.1.1.4 Increasing the Use of Renewable Energy Sources for Electricity Generation to 17% by 2025

The use of renewable energy sources has received a lot more attention from the Indonesian government in recent years. The growing use of geothermal, the standardization of PPAs for small-scale hydro, as well as PLN's obligation to purchase power generated from small-scale renewable electricity generators, are all measures implemented to increase the share of renewable energy sources in the Indonesian electricity sector. Favorable regulations are in place today, but some barriers may still exist.

The physical location of the renewable energy sources may be one of these barriers. Although Indonesia has a large potential in renewable energy sources, these renewables are often located in rural areas with low population density, minimal economic activity and limited infrastructure, i.e., areas with low demand[59]. Due to underdeveloped infrastructure, the geography and the demography, large investments are needed to physically connect the supply and demand[60]. When in addition the grid may have to be sea cables, the costs of implementation can increase rapidly.

Another barrier for increasing the share of renewable energy sources is the relatively high investment costs of generation plants, compared to for example coal or diesel-fired plants. Moreover, only large-scale hydro generation has lower per unit costs than coal-based electricity

[59] These locations may be different from where the demand for electricity is the highest. As such a nice parallel to Norway where much demand is in the Eastern Norway while generating capacity is in the West and South-West
[60] PV is an exception

generation, which implies that the use of coal will be relatively more profitable at the current prices ignoring environmental issues such as carbon emissions.

In the following example I will outline some specific challenges that may arise as a consequence of PLN's obligation to purchase electricity from small-scale renewable energy generators within the current price and cost structures.

In figure 5.3 I have tried to visualize the possible effects of PLN's obligation to purchase electricity from small-scale renewable energy generators through PPAs. This example is based on today's situation with an average electricity tariff of 793 Rp/kWh as the max price, p^{max}, consequently assuming that there exist no cream-skimming possibilities (Appendix 9.5.5, Table 9.11). As the marginal costs of PLN, MC^{PLN}, I have, for simplicity, used the average generation costs 1100 Rp/kWh. The PPA price is based on the standardized low-voltage price for small-scale hydro generation multiplied by 1.25, 1255 Rp/kWh (Appendix 9.5.3, Table 9.7). Demand has been randomly set.

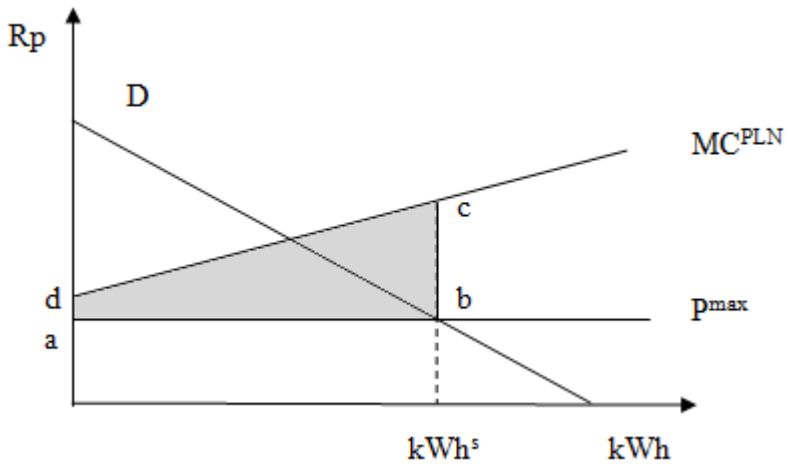

Figure 5.3: Subsidy Need Before PPA

In the initial situation, it is evident that PLN would need subsidies to be able to fulfill its supply obligation, i.e., supply the quantity kWh^s, as P^{max} is below MC^{PLN}. This is represented by the area *abcd* in Figure 5.3.

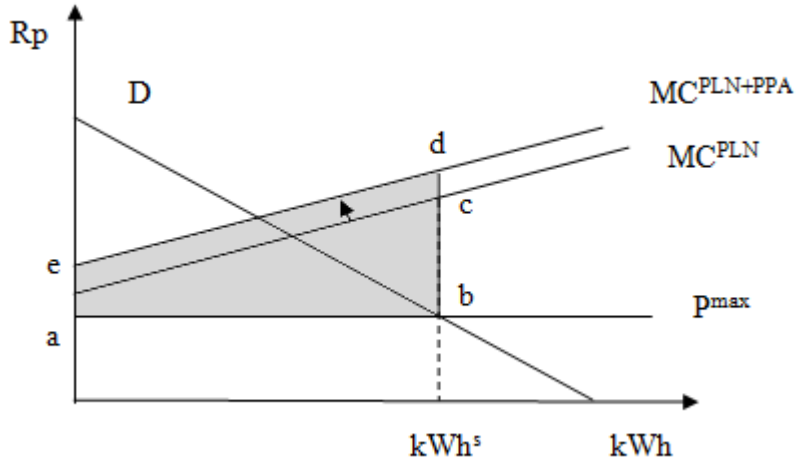

Figure 5.4: Subsidy Need After PPA

Under the current purchase obligation of PLN, the difference between PLN's costs and the costs of purchasing green electricity, 155 Rp/kWh, can be seen as having a tax effect on PLN, causing an upward parallel shift in the supply curve. If PLN is to continue supplying the social quantity, kWh^s, their need for subsidies will increase to the area *abde*.

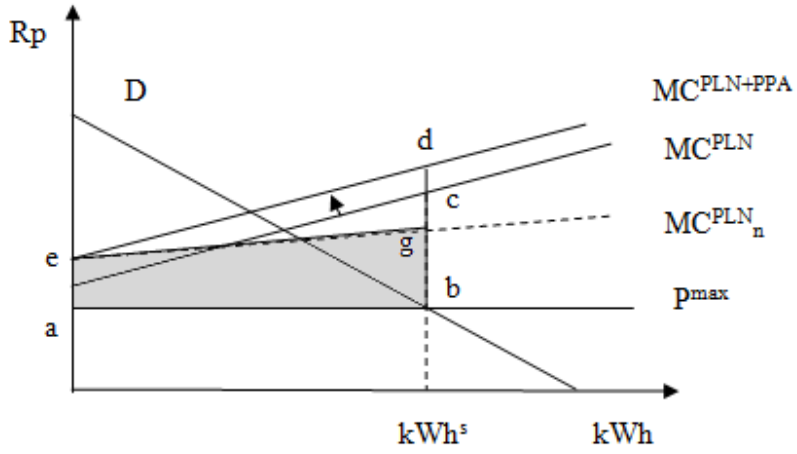

Figure 5.5: PLN's Obligation to Purchase RE PPA

The only way PLN can reduce their losses, and consequent need for subsidies, is by reducing their own marginal costs, as shown by $MC^{PLN}{}_n$ in Figure 5.5.. In this situation the subsidy needed is represented by the area *abgf*, which is smaller than the area *abde*.

What this example shows is that under an obligation to purchase electricity through PPAs, PLN is indirectly being taxed. This regulation will most likely stimulate the supply of renewable energy sources from IPPs, assuming the connection costs between the energy source and PLN's

grid are not too high, which may help the Indonesian government in achieving its goal of 17% renewable energy sources.

For PLN the rational option would be to reduce their own costs to minimize their losses and consequent subsidy need. This will normally be viewed as a positive aspect due to increased efficiency and cost-minimizing. However, within the current regulatory system the simplest method for cost reduction for PLN would be substitution to cheaper inputs, i.e., an increase in the use of coal, a process already started several years ago[61]. As long as the subsidy is not specifically aimed at renewable energy sources, this is the optimal strategy for PLN.

The irony of this example comes from the fact that increased use of renewable energy sources for electricity generation in Indonesia by private participation, may in fact lead to an overall increase in carbon emissions.

5.1.1.5 Reducing/Phasing Out State-Subsidies for Electricity Generation

Price regulations distort market signals which affect investments in capacity, and acts as an entry barrier for new market participants. The recently implemented policies are aimed at reducing such barriers and improve the structural problems of the country's electricity sector. One structural problem has been the large cost of state subsidies to PLN. However, from the examples above, it seems like the prospect of a total reduction of state subsidies to PLN may be farfetched. Some of the new regulations actually increase PLN's costs which consequently increase their need for subsidies. As long as the electricity sector is partially open for private participation, without strict regulations on cream-skimming, PLN may still end up in a situation where they cannot recover their costs, a consequence to the cross-subsidization scheme. In the following example I will explore this further.

I have simplified reality by assuming that the cross-subsidization system consists of only two different price categories. One can think of this as the price charged to the business segment, p^{bus}, and the price charged to the social segment, p^{soc}. The demand curve is the aggregated demand of the two segments. When horizontally added, the top part can be seen to represent the demand from the business segment, whereas the lower part is the demand from the social segment. Furthermore, I have assumed tariff increases, so that the tariff is higher than PLN's marginal costs.

Under the obligation to serve, PLN has to supply for all demand with a WTP higher than p^{soc}, which gives point *b* in the graph. In this situation PLN experiences a loss of the size *abc*[62].

[61] Or an increased use of geothermal. As coal is cheaper, this is the most likely scenario
[62] If all demand was from the social segment

This loss may be balanced by gains from the p^{bus} segment[63]. In the graph this is represented by the area *aefgh*. We can easily see that the gains are smaller than the loss, i.e., in this situation PLN will suffer a net loss. In a perfect cross-subsidization scheme, the gains in one segment should equal the loss in another, and net out to zero.

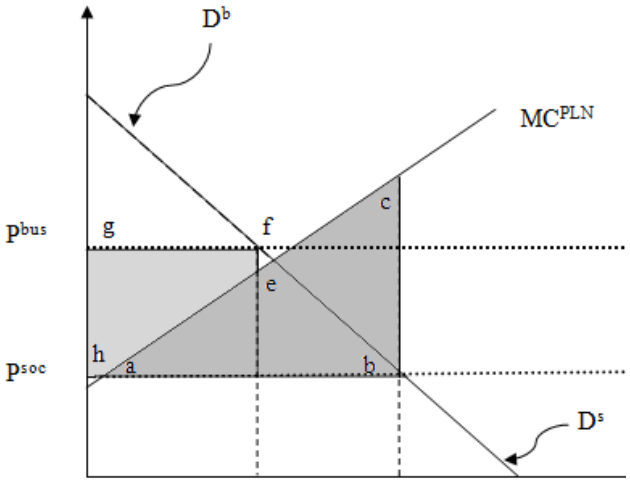

Figure 5.6: Cross-Subsidization and PLN

With only one provider in the market, it is possible to price discriminate and generate revenues to avoid or reduce subsidies needed to serve the low end of demand. In Indonesia, where anyone is free to generate electricity for own use (captive generation), it is easy to understand that if the business tariff becomes sufficiently high, several more businesses would start generating their own electricity. Previously, captive generation has mainly occurred in rural areas. However, as the business tariff increases one could also expect to see this happening in more urban areas[64].

Figure 5.7 (next page) shows what would happen if the business segment starts with captive generation instead of purchasing electricity from PLN at the tariff p^{bus}. The top part of the demand curve, which represents the demand of the business segment would disappear from the market, which causes an inward shift. In the new scenario the quantity to be supplied by PLN is reduced, the distance from *b* to *d*. Moreover, their losses have been reduced from the previous area of *abc*, to the new area of *adi*. The troubling part is that their gains from the business segment have been reduced to zero, which still leaves PLN with a net loss. If this net loss is larger than the net loss of the previous example, PLN's situation has worsened.

[63] PLN will sell to this segment as long as there is demand at the price p^{bus}, represented by the point *f*.
[64] An example could be a chain of hotels setting up a joint-venture with a power generator (IPP) to supply electricity to their hotels, then selling their excess electricity to PLN through a PPA

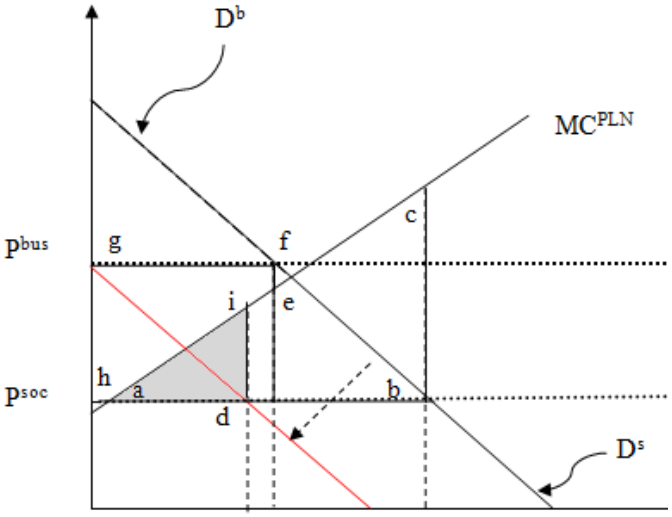

Figure 5.7: Reduced Subsidy Need

In the last example of this section I show how PLN's obligation for electrification may further worsen the situation.

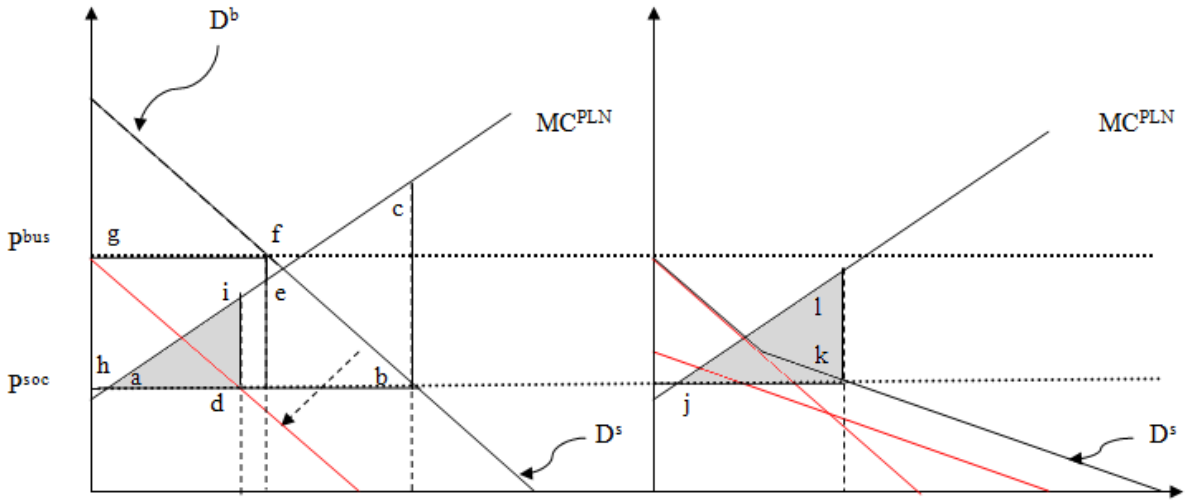

Figure 5.8: Increased Rural Electrification

The left panel of Figure 5.8 shows the previous example of the market after a flight of customers from the business segment. The right hand panel shows the residual demand from the last example. In addition I have added a new demand curve, symbolizing the demand curve of rural areas to be electrified by PLN[65]. When aggregating these demand curves, it becomes evident that PLN's need for subsidies increases, with everything else held constant, as the area *jkl* is larger than the area *adi*.

[65] Social tariff segment

It seems like the current regulation and cross-subsidization scheme of Indonesia, may lead the country into a similar situation as that experienced in India. The subsidies to PLN may be reduced by the participation of IPPs in the electricity sector. However, as long as the state-company has an obligation to serve rural areas, and reduced possibility for balancing losses with gains, its financial viability will slowly worsen. Once again, a solution for PLN could be to reduce its own marginal costs by substitution to cheaper fuels.

5.1.2 Sustainability of Electricity Sector Reform

Although the incentive structures, as discussed above, may be the most important factors for the Indonesian government to achieve its goals, the sustainability of the reform is also an important factor.

When evaluating the sustainability of the recent reform it might be useful to draw on previous experiences to analyze the overall reform, but also to look at it from the different stakeholders' perspective. The political history, strength and motivation, in addition to the economic outcomes, will all affect the sustainability of the reform, and in itself have an impact on the final outcome. The uncertainty associated with an ever changing regulatory framework affect the participants' behavior. Moreover it affects the strength of the incentive structures.

From the perspective of the end-users, the recent reform of the Indonesian electricity sector has not resulted in any major negative changes. The electricity tariff system has not been abandoned, and although the tariffs have been increased, the resistance seems to have been weaker than before. The new regulations may have an overall positive impact on service levels, quality of supply, and reliability, in comparison to the poor conditions experienced over the past years. The most important issue regarding end-users may be the path-dependency of their rural electrification programs. It will take a major effort to overcome the public unwillingness to pay for infrastructure, and the common idea that these services should be supplied by the state for free. This will most probably also affect the actions of other stakeholders in the Indonesian electricity sector, such as IPPs.

When looking at the recent reform with the perspective of the regional authorities, some barriers for a sustainable reform seems evident. The increased autonomy of regional authorities also implies an increased responsibility for the supply of electricity. For many regions this can be a large challenge, as they may have no previous experience with supplying electricity, i.e., they lack the capacity needed. More than often regions lack even the basic infrastructure, with little or no technical expertise to be found locally. To improve the sustainability of the current reform, regional capacity must be strengthened.

The electricity sector reform has in many ways improved the conditions for IPPs, through the partial liberalization of the sector, various regulations implemented and through governmental stimulation of private participation. As IPPs can freely enter and exit the electricity market, IPPs may seem to have limited impact on the sustainability of the reform. What affects IPPs and any private participation, maybe particularly in renewable electricity generation, is the sustainability of the reform itself.

During the first reform of the Indonesian electricity sector IPPs received more favorable PPAs compared to today. This was also the main cause for the lack of sustainability of the reform, which led the IPPs into a turbulent period with high uncertainty, which showed that the financial viability of the state-utility is important for IPPs with PPAs. In a long term perspective, it may be implied that a sustainable electricity sector reform and a predictable regulatory framework, is more important to private generators than short-term profits. What is most likely to be challenged by IPPs in the future, is PLN's monopoly on transmission and distribution grids.

Taking PLN's perspective for evaluating the sustainability of the electricity sector reform, the overall picture is positive compared to previous reforms. PLN has maintained its dominant position as the main supplier, unlike in the last reform attempt. Furthermore, the standardization of PPAs for hydro and geothermal generated electricity has limited PLN's risk associated with private participation. This is a large improvement compared to the reform of 1992. The lower costs of negotiation, decreased risk of corruption, as well as a possible increase in private participation, may improve the overall efficiency of the Indonesian electricity sector.

The main future problem for PLN may be the social tariffs and the cross-subsidization system. Their obligation to serve, the price of PPAs and the likely participation of IPPs through captive generation, may force PLN into financial troubles yet again. When, in addition, the government has a strong intent of reducing state-subsidies, PLN might find their options limited. Although CDM support could help stimulate PLN's initiatives for rural electrification by the use of renewable electricity generation, their need for subsidies seem difficult to eliminate under the current tariffs. On one hand, as long as PLN may freely substitute oil fuels for coal or geothermal, as well as receiving increased funding for rural electrification, the sustainability of the reform seems fairly intact. On the other hand, if IPPs drain PLN's customer base of all the high tariff consumers, subsidies are cut, and the cross-subsidization scheme is not abandoned by the government, PLN may take strong political actions for regaining their monopoly in the supply of electricity.

The electricity sector reform is the result of the central government's decision to take drastic actions to solve the Indonesian electricity sector's problems. Through the creation of

goals, a new electricity law, regulations and policies, it seems like the central government has finally realized that the previous organizational structure of the Indonesian electricity sector was unable to solve its many challenges. The main problem for the central government in providing an efficient, reliable and sustainable electricity sector is not only the country's rapidly increasing population, its geography and high economic growth rate, but also the path-dependency of electricity sector organization and the political strength of the parties involved.

The government's social obligation to the country's rural poor, and the political resistance from the majority of end-users, prevent the removal of the tariff system, although this system seems to be causing not only the majority of the problems today, but also in the future's electricity sector. Furthermore, the continued dominant position of PLN is protected by the Constitution and prevents the implementation of a complete electricity sector reform, which limits private participation and hinders competition. Moreover, the political strength of the government has been challenged several times by other stakeholders, which may affect their willingness to implement radical changes.

The recent policies and regulations implemented are clearly dictated by the above and by their previous experience with electricity sector reform. By taking a precautious approach the government is trying to implement a sustainable electricity sector reform through adaption to the current regulatory framework. Several of the recently implemented changes are positive and may improve the Indonesian electricity sector. However, when analyzing the long-term combined impact of the various regulations, several flaws of the incentive structures which may deter the sustainability of the reform, become evident.

One such flaw is PLN's continued need for government subsidies due to their obligation to serve rural areas at the current social tariffs. Another flaw is PLN's right of first refusal which hinders competition, and in combination with the current electricity tariffs, may prevent the participation of private generators. Furthermore, the difference between PLN's average costs and the PPA price may increase PLN's need for subsidies, especially if all high-value customers switch to captive generation. Government subsidies that are non-energy source specific, do not stimulate an increase in the use of renewable energy sources for electricity generation and may even, under the current regulatory framework, lead to increased carbon emissions in total.

Consequently it seems like there are conflicts between the government's goals for the electricity sector reform, which is a threat to its sustainability and will affect the future direction of the Indonesian electricity sector organization and outcome.

6 Conclusions and Recommendations for Future Research

The contemporary methods and theories for electricity sector reform used in developed countries depend in many cases contextually on certain economic, geographic and demographic factors being in place. Developing countries struggle with large social inequalities, which often overshadow other issues in the political debate; however, it may be argued that this is the way it should be.

In Indonesia, with its vast renewable energy sources, the idea about private participants supplying the rural population with green electricity, and thereby solving PLN's financial problems, the government's social issues, as well as the problems of the electricity sector in general, stand out as the perfect scenario. I have shown in the previous analysis and discussion, that the path-dependency of electricity sector reform and the conflict between social, financial and environmental goals may impede such a scenario in the current Indonesian electricity sector.

The partial liberalization and end of PLN's monopoly, is a step in the right direction, as my analysis repeatedly has shown that a monopoly will not be able to solve the sector's problems and provide for a sustainable electricity sector in the long run. The current reform is consequently a large step forward[66].

In the examples in Section 5.1.1 I identified several aspects of the new regulatory framework that threaten the sustainability of the reform, and may in fact increase the negative environmental impact of the Indonesian electricity sector, rather than decreasing it. To conclude this thesis I will first attempt to answer my hypotheses, before returning to my research questions and provide some answers for these. Finally, I will offer some suggestions for future research.

A reminder of my hypotheses:

1. *Social tariffs for electricity will negatively affect private participation in rural areas*
2. *Increased rural electrification implies continued practice of government subsidies*
3. *Use of renewable electricity sources is negatively affected by social tariffs*
4. *Cross-subsidizing will increase the need for government subsidies in the long run*

The simplified examples of Section 5.1.1, although not conveying the full complexity of reality, offer some insights into my previously formulated hypotheses.

In 5.1.1.2 I show that under the current electricity tariffs, the rational option for private participants would be to focus on captive generation and high-value consumers. It also seemed

[66] Compared to the first attempt at introducing IPPs in the Indonesian electricity sector through the use of PPAs and individual negotiations with the state-monopoly

implausible that private investors would participate in the supply of electricity to end-users in rural areas. It may consequently be implied that social tariffs negatively affect private participation in rural areas.

Since private investors may be reluctant to participate in the electrification process, PLN may become solely responsible for rural electrification. My example in Section 5.1.1.3 indicated that the rational choice for PLN would be to minimize the number of connections, i.e., make each connection as expensive as possible, and thereby minimize their financial losses. PLN's subsidy needs will increase due to their obligation to serve, as long as the electricity tariffs in are set below their marginal costs, especially if electrification is more strictly enforced. The combination of rural electrification and removal of subsidies may lead to an increased rate of fuel switch[67].

It seems unclear if the social tariffs will impede the government's goal of increasing the use of renewable energy sources, as the number of IPPs with PPAs might increase rapidly following the standardization of the contract and process. However, what my example did show was that the standardized PPA for small-scale hydro may lead PLN into deeper financial trouble.

Combining the examples in 5.1.1.4 and 5.1.1.5, one could get a situation where IPPs are supplying the high-value consumers which reduces PLN's income, as well as PLN being indirectly taxed from their purchase obligation for small-scale renewable electricity generation. Although the use of renewable energy sources potentially increases, the financial viability of PLN will still depend on state-subsidies. Such flaws in providing the market participants with the correct information and incentives, given a cross-subsidization scheme, may have severe negative long-term effects on the Indonesian electricity sector.

The problem for the Indonesian government is that when all the stakeholders of the electricity sector act rationally, i.e., utility maximizing or profit maximizing, neither would like to take the responsibility for rural electrification or for environmental issues. To avoid this being the stakeholders' optimal choice, the government must provide incentives that are in line with their goals. One such measure may be to distinguish the subsidies for green electricity from today's universal subsidy structure, as an instrument to make the supply of green electricity relatively cheaper than the supply of petroleum based electricity. This way they could create incentives for PLN to focus to a larger extent on renewable electricity generation, rather than coal based[68].

For rural electrification, one solution for the Indonesian government may be to divert the subsidies from PLN, and distribute them directly to the regional authorities. This has to be

[67] To coal or geothermal

[68] PLN does have several renewable projects being implemented at the moment, mainly hydro and geothermal. However, a more specific subsidy for green electricity to speed up the process

followed up by an increase in capacity and knowledge, as well as a standardized process of gaining an IUPTL. Although, the increased autonomy of regional authorities is a step in the right direction, the real effects of this are yet to materialize.

More direct support to rural cooperatives operating small, mini and micro-generation projects for captive generation is another measure the government may implement to ensure social benefits of rural areas. In addition, this would also relieve PLN of some of their obligation to serve, which consequently could improve PLN's financial viability. Several such projects have already been implemented, many of which are successful. It will be important that the central government is active in this process, working with the regional authorities to ensure that the capacity is in place to not only implement, but also maintain these projects.

What I have not yet discussed is the incentive structures provided by both development agency funding and international mechanisms such as CDM. After previously pushing for a complete liberalization of the Indonesian electricity sector, the World Bank today focuses on rural electrification on a project to project basis, providing funding directly to the local communities. This supports my earlier suggestion of increased support directly to the rural communities.

The CDM scheme may improve the conditions for renewable energy projects in Indonesia. Several new small-scale projects are in the validation process as of today. However, as the process of receiving CDM support is still time-consuming and not widely understood by even the central government, it may take a long time before any major effects of this will have an impact.

What has to be kept in mind when evaluating my results in Sections 5.1.1 and 5.1.2 is that I have chosen to ignore both potential CDM support, as well as the transaction costs associated with implementing private renewable electricity generation projects[69]. Additionally, I have also ignored the costs of corruption, which sadly even today have not been eradicated. This implies that international mechanisms for stimulating carbon emission reduction by increasing the profitability of electricity generation by renewable energy sources, such as CDM, must be large enough to cover for transaction costs, corruption costs as well as covering the gap between the electricity tariff and generation costs, to offer any real incentives. Since the CDM does not cover all these costs[70], the existence of such funding does not seem to alter my results.

[69] See Master's Thesis "Why Transaction Costs Matter for Small-Scale Hydropower Development in Indonesia" (forthcoming) by Tiril Reutz for more information on transaction costs

[70] See Master's Thesis "The Art of CDM Participation – Decision Analysis Applied to Solar PV" (forthcoming) by Erlend Gulbrandsen for more information on CDM

To conclude this thesis I need to return to my research questions and attempt to provide some answers. Today's regulatory framework provides the correct incentives for the government's goals if viewed individually. However, it has been shown that it appears almost impossible for the government to achieve all goals simultaneously without further regulations. The most conflicting goal seems to be the removal of subsidies to PLN, without removing the social tariff system for electricity. Furthermore, the current regulations may lead to increased use of renewable energy sources for electricity generation, but may also lead to an increased use of coal.

This implies that the sustainability of the recent reform of the Indonesian electricity sector, although an overall improvement compared to previous reforms, may be challenged. Several adjustments in the regulatory framework are likely to happen, although none as dramatic as the annulment of the *Law on Electricity 2004* or the chaos created by the first attempt at liberalization. The risk of regulatory uncertainty seems to have been reduced, which may have a positive impact on private participation in the development of the Indonesian electricity sector.

What seems to have become evident, through the writing of this thesis, is that increased electrification and reduced carbon emissions are in fact possible, but highly dependent on the incentive structures provided by the regulatory framework and the strength of the social considerations guiding the government's actions. Indonesia has announced plans to reduce their carbon emissions by 26% before 2020, which is positive news. However, as shown in this thesis, it is still too early to determine if the current regulatory system of the Indonesian government will be able to support both rural electrification and reduced carbon emissions.

This thesis has by far covered all the aspects of the Indonesian electricity sector and the recent reform. The regulatory framework is still under development, and further research will be needed to be able to determine whether the reform has been successful or not, and if the government's goals have been achieved.

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8 List of Interviews

Interviews conducted during field trip to Indonesia 25.03.2011-04.04.2011.

28.03.2011

Fabby Tumiwa: Institute for Essential Services Reform (IESR), Jakarta
(Executive Director)
Terry Lacey: Jakarta Post, Jakarta
(Development Economist)

29.03.2011

Irhan Febijanto: Badan Pengkajian Dan Penerapan Teknologi, Jakarta
(Energy Conversion Researcher/CDM Facilitator)
Soedjono Respati: Indonesian Renewable Energy Society (IRES), Jakarta
(IRES Chairman of Solar Energy Focus Group)
Eivind S. Homme and Constatin N. Karame: Royal Norwegian Embassy, Jakarta
(Ambassador)
Agus Sari: Iklimkarbon, Jakarta
(President Commissioner, Non-Executive Director)

30.03.2011

Timothy Brown: The World Bank, Jakarta
(Sr. Natural Resources Management Specialist)
Hari Ywono: CTI PFAN, East Asia, Jakarta
Anders Cajus Pedersen: GIZ, Jakarta
(Energy Advisor)

31.03.2011

Arnfinn Jacobsen: IndoPacific Edelman, Jakarta
(Technical Advisor)
Ishmid Hadad: National Council on Climate Change - Indonesia, Jakarta
(Chair Working Group on Financial Mechanism)

01.04.2011

Marc Pop: Indonesian Clean Power Ventures, Sanur
(Clean Tech & Carbon Space Entrepreneur)

9 Appendix

9.1 Tables and Figures in Appendix

9.2 Acronyms

ABM – Asian Bond Monitor

AESIEAP – Association of the Electricity Supply Industry of East Asia and the Western Pacific

CDM – Clean Development Mechanism

CIA – Central Intelligence Agency

DEMR – Ministry of Energy and Mineral Resources

DGEEU - Directorate General for Electricity and Energy Utilization

EDI – Electricity Distribution Industry

ESI - Electricity Supply Industry

EIA – Energy Information Administration

IDA – International Development Agency

IEA - International Energy Agency

IED – Innovation Energy Development Inc.

IEG – Independent Evaluation Group

IMF – International Monetary Fund

IPP – Independent Power Producer

IRG – International Resources Group

MEA – Ministry of Economic Affairs

NEDO - New Energy and Industrial Technology Development Organization

NGO – Non-Governmental Organization

NPV - Net Present Value

NVE – Norges vassdrags-og energidirektorat

PLN - PT Perusahaan Listrik Negara

PPA – Power Purchase Agreement

PPE ITB - Pusat Penelitian Energi, Institut Teknologi Bandung

RA – Regional Authorities

RAP – The Regulatory Assistance Project

RE – Renewable Energy

SEB – State Electricity Board

SOE – State-Owned Enterprise

TERI – The Energy and Resources Institute

USAID - United States Agency for International Development

WB – World Bank

WEO - World Energy Outlook

WRI - World Resources Institute

9.3 Historical Electricity Prices of Selected Developing Countries

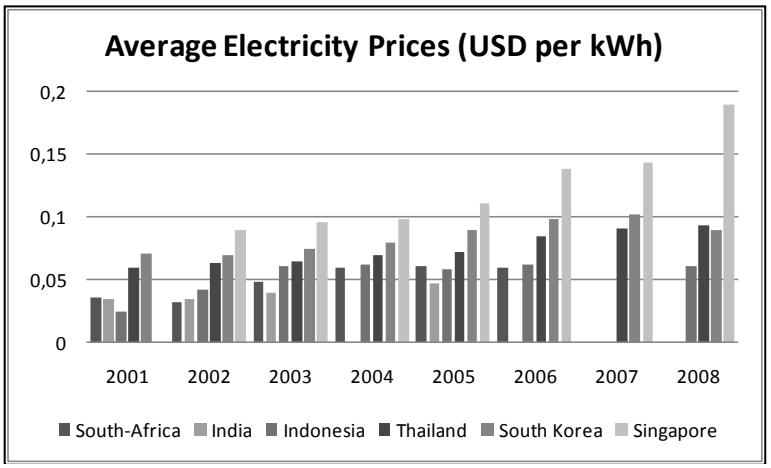


Figure 9.1: Historical Electricity Prices of Selected Developing Countries
Source: EIA (2010)

9.4 The Indonesian Electricity Sector

In 2010 Indonesia ranked as the fourth largest country in the world with a population of 242 968 342, with a yearly growth rate estimated at 1.097%. The GDP per capita was only US$ 4 300, and 13.3% of the population was living below the poverty line. The unemployment rate was 7.1%. Moreover, 44% of the Indonesian population lived in what is characterized as urban areas, with more than half of the total population on Java, out of which 9.6 million living in Jakarta. The high population increase of Jakarta puts pressure on infrastructure in the form of traffic and pollution control (Arifin and Ananta, 2010).

Table 9.1: Country Statistics (2010)

Country Statistics (2010)	
Population	242 968 342
Population Growth Rate	1.097%
Population below Poverty Line	13.3%
Urban Population	44%
Rate of Urbanization	1.7% per annum
Economic Indicators	
GDP per Capita (PPP)	US$ 4 3000
Economic Growth	6%
Inflation Rate	5.2%
Commercial Bank Prime Lending Rate	14.5% (2009)
Unemployment Rate	7.1%
Energy Indicators	
Electricity Production	134.4 billion kWh (2007)
Electricity Consumption	119.3 billion kWh (2007)
Environmental Indicators	
Environmental Issues	Deforestation, water pollution, air pollution in urban areas

Source: CIA (2010)

The economic growth stagnated a little following the financial crisis in 2008-2009. However, by 2010 the Indonesian economic growth rate was back at 6% and is expected to increase (CIA, 2010).

9.4.1 Consumption

In 1971 the average yearly electricity consumption per capita was 16kWh. By 1985 this had increased to 81kWh, and in 2009 the average yearly electricity consumption was 566kWh, an increase of nearly 700% since 1985 (Statistics Indonesia, 2010).

The largest increase was by the business segment which has increased its yearly electricity use by nearly 280% since 2005. Household electricity use increased rapidly from 1995, but seems to have stagnated since 2001. The growth in electricity use by industry may seem low at 102%. However, several of the large industrial factories rely on captive generation, which is not reflected in these numbers (Statistics Indonesia, ibid.).

In 2010 PLN estimated that the average growth in demand in the period from 2009-2019 would be 9.1% per year, with the largest growth in Eastern Indonesia at 10.6% (Sebayang, 2010). In a forecast the EIA predicted that the energy consumption of non-OECD countries would on average increase by 84% from 2007 to 2035 (EIA, 2010).

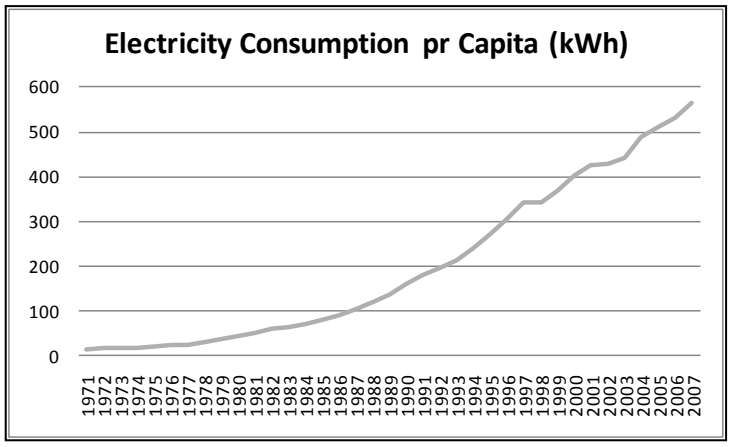


Figure 9.2: Electricity Consumption per Capita
Source: WDI, World Development Indicators (WDI) & Global Development Finance (DGF), World Data Bank

9.4.2 Generation

Until 2004 Indonesia was a net exporter of oil, but has since been a net importer as the domestic consumption rose above production at close to 1100 barrels per day (EIA, 2007). Furthermore, by 2006, Indonesia's oil production had dropped by 32% since 1996 due to mature fields and extraction problems. A major shift away from domestic use of oil for electricity generation was implemented, and by 2006 oil accounted for 51.66% of the total energy mix. The substitution was

mainly achieved through increased use of coal and natural gas, as well as a small increase in the use of large-scale hydro and geothermal.

Although hydro is one of Indonesia's largest renewable energy sources it has been exploited minimally, as can be seen in Figure 9.4 below (Ariati, 2008).

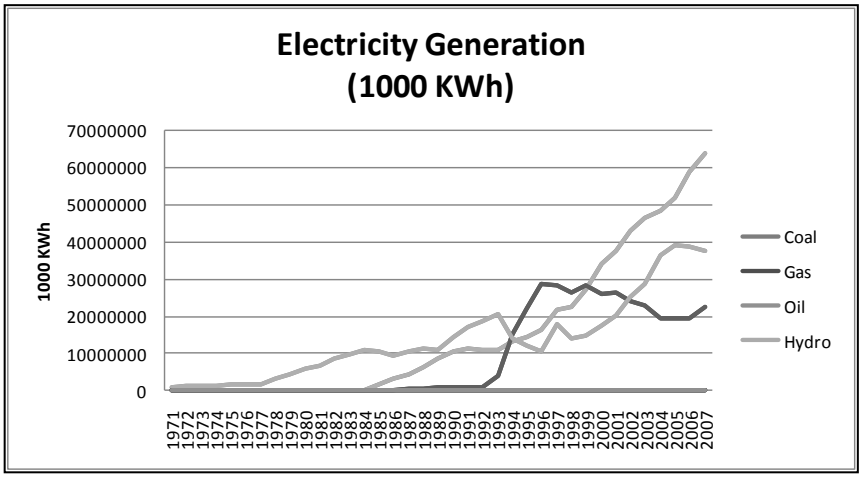


Figure 9.3: Electricity Generation

Source: WDI, World Development Indicators (WDI) & Global Development Finance (DGF), World Data Bank

In 2007 the total generation capacity was 29 705MW (Praptono, 2008). The Jamali region accounted for 22 302MW of this, followed by Sumatra at 4 364MW. The region with the lowest generating capacity was Papua, where the total installed capacity was only 170MW.

As can be seen in table 9.5, the generation costs by different technologies vary to a large extent (USAID, 2007). Large-scale hydro generation was in 2006 estimated to have the lowest cost per kWh, closely followed by coal-fired power plants. Solar PV was estimated be the most expensive source for electricity generation, although diesel power plants were nearly as expensive. Furthermore, it is evident that both coal and diesel generation has the lowest estimated cost per installed kW.

Diesel generation has been widespread in rural areas due to its low investment costs and ease of distribution (Sari and Seymour, 2002). In 2002 approximately 60% of captive generation was estimated to come from diesel generators, mainly used by extractive industries in the outer islands with high peak-load needs. Moreover, diesel aggregates have been a favored method for rural electrification which has been stimulated by government subsidies for hydrocarbon fuels. The subsidized price of diesel for electricity generation has been estimated to 605.5 Rp/kWh, nearly 1000 Rp lower than the actual price[71].

[71] Tumiwa, F., (2011), Interview at the IESR Office in Jakarta on the 28th of March, 2011

Table 9.2: Generation Costs by Technology

Power Plant Type	Estimated Cost Installed per kW (Rp)	Estimated Generating Cost per kWh (Rp)
Small-Scale Hydro	900 - 1600	363.33 - 475.75
Large-Scale Hydro	800 - 1200	302.75 - 389.25
Solar PV	5000 - 6500	1750.00 - 4325.00
Large-Scale Geothermal	1400 - 1800	389.25 - 475.75
Coal-Fired Power Plant	700 - 1000	328.70 - 389.25
Diesel Power Plant	275 - 450	1730.00 - 2162.50

Source: USAID (2007), USAID ECO-Asia Clean Development and Climate Program, 2006

9.4.3 Transmission and Distribution

The Indonesia Power System consists of eight interconnected systems and more than 600 isolated systems (ASIEAP, 2011). The main interconnected grid stretches across Sumatra, Java and Bali. The Sumatra grid consists only of MV and LV transmission grids, whereas the Jamali grid has HV transmission grid as well as MV and LV. The Jamali grid has for a long time been the only HV transmission grid in Indonesia, and has been suffering from high transmission losses and electricity theft.

However, a new interconnector grid between the ASEAN[72] countries is planned implemented before 2020. This will link Malaysia to Sumatra, as well as Singapore to the region of West-Kalimantan. 70V and 150kV grids exist on all the major islands, although the length of these varies greatly, for example from 3603 km on Java to 142 km on Papua (ASIEAP, ibid.).

In 2009 PLN launched plans to build a new transmission line connecting South-Sumatra to West-Java by 40km underwater power cables, costing the state company an estimated USD 2.2 billion. The project is expected to commence in 2011 and is hoped to relieve some of the generation deficiencies on Java (EIN, 2009).

9.4.4 Electrification

In 2004 the eight major islands had an average electrification rate of 67% and a total of 72.7 million people were without even the basic electricity services (WB, 2005). Bali had the highest electrification rate at 86%, whereas the region of Papua only had an electrification rate of 22%. Even the industrialized island of Jakarta would need an electrification increase of 16% to achieve

[72] ASEAN countries of 2010: Indonesia, Laos, Malaysia, Vietnam, Thailand, Singapore, Cambodia, Philippines, Myanmar, Brunei Darussalam

the government's goal of 90% electrification by 2020 (OBG, 2007). In 2004 PLN issued expansion plans for the period 2005-2010, where the main focus was on increasing connections of the Java-Bali region (WB, 2005). Remote islands were given little focus with a planned expansion rate of only 17%, mainly due to the high cost of supplying to these areas.

In rural areas of Indonesia the electrification process has generally been implemented through the use of diesel generators (Praptono, 2008), although in 1997 the government initiated the *Solar Energy for 1 Million Households Program* (Sudrajat, 2005). The program aimed at electrifying 1 million households by the use of solar home systems and mainly giving them away as a social benefits scheme. Due to technical problems and lack of financing for maintenance, the program was not sustainable, and by 2008 diesel generators contributed to 44% of the total electricity generation in the outer-Java region. Hydropower generation accounted only for 13% of distributed generation, whereas geothermal accounted for less than 1%.

By 2008 the Indonesian country's electricity rate had actually fallen to 64.5% mainly due to rapid population growth and PLN's inability to increase capacity at the appropriate rate (Sebayang, 2010). In rural areas, the average electricity rate was only 32% (D'Agostino, 2010). In 2010 PLN presented estimates for expected electrification rates for 2019 where they predict a growth from 65% in 2009 to 91% by 2019.

9.4.5 Electricity Sector Organization

According to the *Constitution of the Republic of Indonesia*, any services in branches that is of strategic and operational importance to national life is to be controlled and performed by the state. This also applies to the electricity sector (Law No 30/2009, 2009).

The Indonesian electricity sector has been dominated by the state-owned integrated electricity company PT Perusahaan Listrik Negara (PT PLN) since the 1950 (Guerin, 2002). PLN has until recently benefitted from being an integrated monopolist in generation, transmission and electricity distribution for end-users in the Indonesian market.

Of total electricity production in the year 2009, PLN contributed by approximately 120 000GWh, whereas IPPs produced only 35 000 GWh (Sebayang, 2010). IPPs have traditionally been restricted to generating electricity for their own use, so-called captive power generation, or to selling their electricity to PLN through PPAs as PLN has had the monopoly in supplying end-users. During the first period of liberalization, in the late 1990, this caused severe financial problems for PLN as the PPAs provided extremely favorable conditions to the IPPs, shifting all risk to PLN. This led to a large reduction in the number of IPPs and by 2009 IPPs generated only 23% of the total electricity generation.

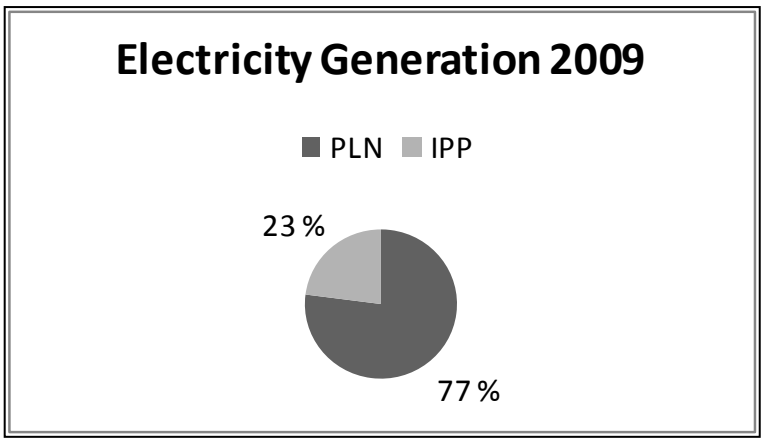


Figure 9.4: Electricity Generation 2009
Source: Sebayang (2010)

PLN needs to purchase energy sources for electricity generation in the market and at the existing market price (ADB, 2006). Consequently the company is subject to risk as the prices are volatile. Historically PLN has minimized this risk by relying on domestic energy sources, such as oil, and in more recent time coal and natural gas.

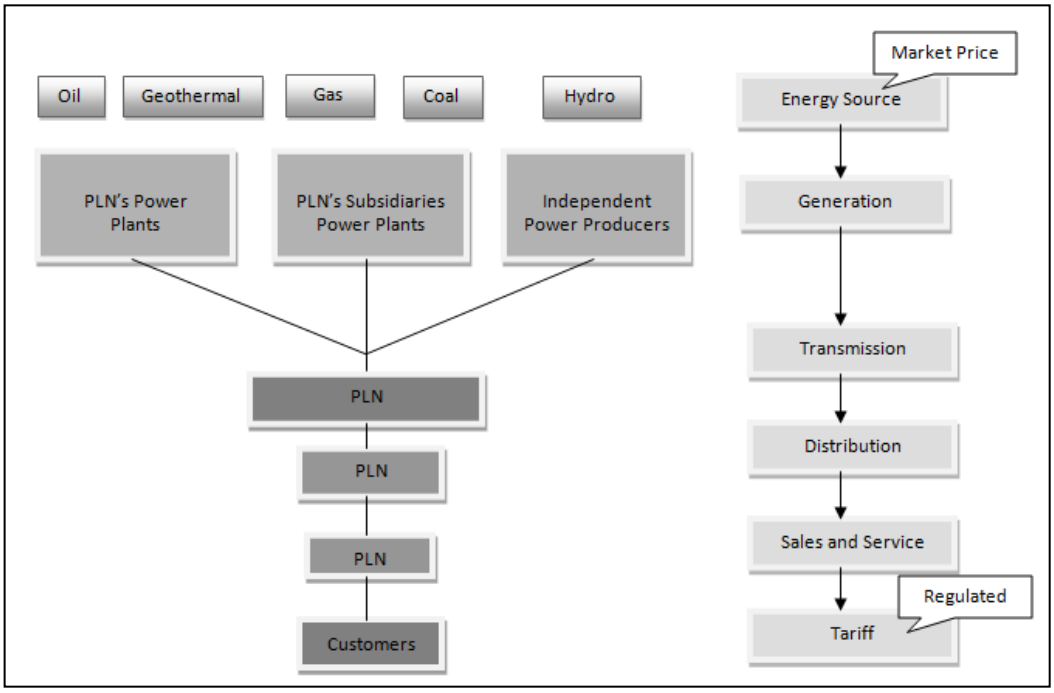


Figure 9.5: Organizational Structure
Source: ADB (2006)

To further increase the risk PLN is exposed to, the electricity tariffs, i.e., the price that PLN can sell its electricity for is regulated by the government. This implies that PLN cannot shift any of its risk over on its customers (Tumiwa, 2010). Furthermore, the tariff has traditionally been lower than the state-utility's marginal costs, which has made PLN depend on government subsidies to

be able to provide electricity. In 2008 the government subsidy to PLN amounted to USD 8.7 billion.

9.4.6 PT Perusahaan Listrik Negara (PLN)

PT Perusahaan Listrik Negara (PLN) was established in 1950 and had more than 50 000 employees by the late 1990 (World Bank, 2005). The company operates in the generation, transmission, distribution and sales segment of the Indonesian electricity sector. In 1994 PLN was corporatized (TERI, 2006). However, the utility is 100% state-owned. In 2004 PT PLN had issued 63 million shares worth Rp 46 107 147 million, all owned by the state (PT PLN, 2004).

In 2004 the state-owned company operated 45 power plants, being responsible for nearly 70% of the country's total generation capacity (IEA, 2004), which amounted to 83.3% of the total electricity sold (Silviati, 2005). Furthermore, PLN had approximately 33 million customers, of which 31 million were households.

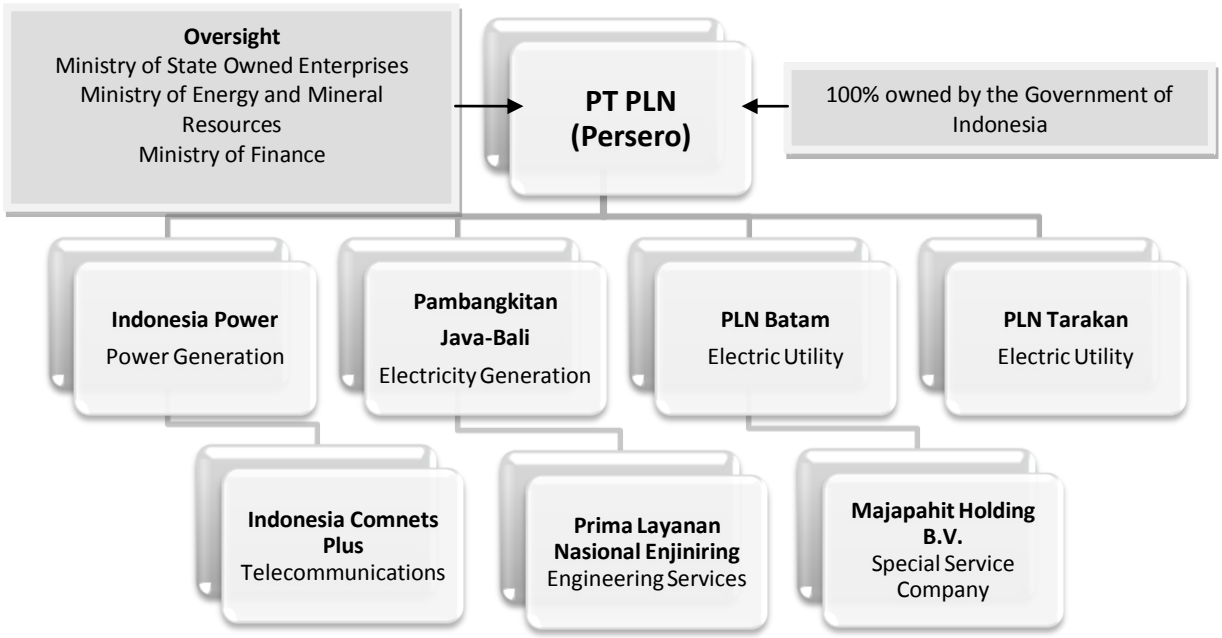


Figure 9.6: PLN's Organizational Structure
Source: Praptono (2008)

In 2009 PLN had two subsidiaries in generation, Indonesia Power and Pambangkitan Java-Bali, as well as two electric utilities, PLN Batam and PLN Tarakan (Praptono, 2008). All Indonesian transmission and distribution grids are operated by PLN, and in 2009 total grid lines at all voltage levels amounted to 63 375MVA.

In 2009 the total capacity of the PLN's generating plants was 29 373MW (Sebayang, 2010). Coal was the largest energy sources contributing to 36% of total electricity generation.

PLN has managed to reduce its use of oil for generation, which in 2009 accounted for 29%. The use of natural gas for electricity has been increasing in recent years, and in 2009 natural gas contributed to 24% of the electricity generation. Green energy sources such as hydro and geothermal accounted for only 11% of total electricity generation. PLNs average generation cost (Witular, 2010), based on the 2010 energy mix, was 1100 Rp/kWh.

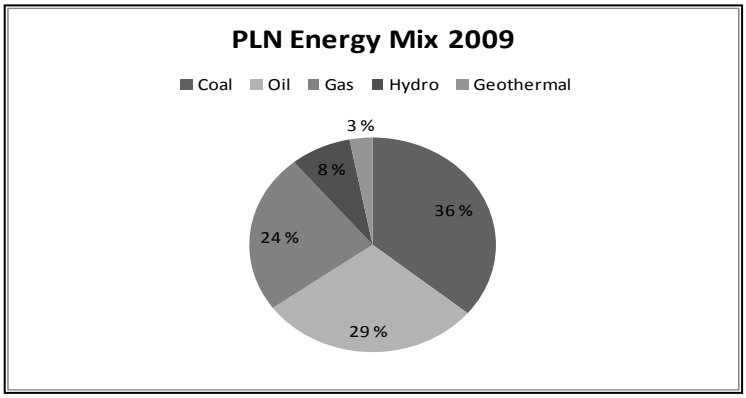


Figure 9.7: PLN Energy Mix 2009
Source: Sebayang (2010)

In 2009 PLN achieved a net income of approximately 1.18 billion US dollars, which was a significant improvement from the year before when the company experienced a net loss of USD 1.4 billion (PT PLN, 2009). The largest difference between the two years was a substantial reduction in fuel costs, as well as nearly 2 billion improvements in foreign exchange losses. Although the financial situation of PLN seems to have improved, the company would have experienced a large loss had it not received government's electricity subsidies of USD 6.1 billion in 2009. The subsidy was, however, reduced by nearly 2.8 billion from the year before, which may be a sign that PLN's financial situation is improving as a consequence of increased use of coal for generation.

Table 9.3: PLN Financial Statement 2008-2009

Revenues in USD billion	**2009**	2008
Sale of electricity	10,247	9,574
Government's electricity subsidy	6,105	8,929
Customer connection fees	0,074	0,067
Other	0,077	0,090
Total Revenues	**16,502**	**18,660**
Operating expenses		
Fuel and lubricants	8,663	12,248
Purchased electricity	2,892	2,357
Maintenance	0,905	0,866
Personnel	1,109	0,948
Depreciation	1,345	1,292
Other	0,459	0,538
Total operating expenses	**15,372**	**18,250**
Income from operations	**1,130**	**0,410**
Other income		
Interest income	0,042	0,053
Financing charges	-0,675	-0,766
Forex loss	0,861	-1,056
Other	0,029	-0,026
Loss before tax	**1,387**	**-1,385**
Tax	-0,210	-0,013
Net loss	**1,177**	**-1,398**

Source: PT PLN (2009)

9.4.7 Historical Electricity Prices

The average electricity price saw a large increase from USD 0.025 in 2001 to USD 0.042 in 2002 (IEA, 2009). The following year the price increased significantly again to USD 0.061, but since 2003 the price seems to have stabilized. Except for a minor fall in 2005, the price has averaged USD 0.061 per kWh.

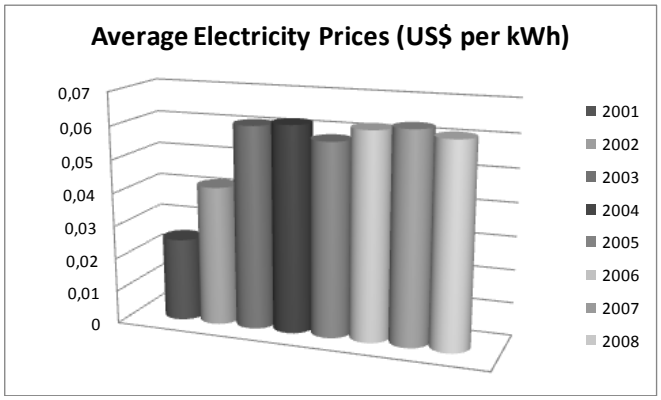


Figure 9.8: Average Electricity Prices
Source: International Energy Agency, Energy Prices & Taxes, Fourth Quarter, 2009

9.4.8 Generation Potential from Renewable Energy Sources

Although the largest share of Indonesian electricity generation traditionally has come from thermal energy sources, the country has a large potential in renewable electricity generation. The country's renewable energy sources include geothermal, hydro, as well as biomass and good conditions for the use of PV-based electricity generation. The renewable energy potential was estimated by the Directorate General for Electricity and Energy Utilization in 2005 (DGEEU, 2005).

Table 9.4: RE Generation Potential

Hydropower	75.67 GW
Geothermal	27 GW
Mini/micro hydro	500 MW
Biomass	49.81 GW
Solar	4.8 kWh/m2-day
Wind	3-6 meters/sec

Source: DGEEU (2005)

9.5 Electricity Sector Reform

"*The development of electricity shall be aimed at ensuring availability of electrical power in adequate quantities, with good quality, and at reasonable prices as part of efforts to improve welfare and prosperity of the people in a just and evenly manner as well as to create sustainable development*" (Law No. 30/2009, 2009).

9.5.1 Recent Policy Changes

A recent attempt at increasing the use of new and renewable energy in the Indonesian electricity sector was the passing of the National Energy Policy in 2006[73] with policies regarding electricity diversification and energy conservation (Boedoyo and Sugiyono, 2010). The energy diversification policy aims at reducing oil use by 20% by 2025, and to increase the new and green energy mix to 17% by 2025.

To relieve the power deficiency of the Indonesian electricity sector the first acceleration program was implemented through the *1st 10 000 MW Fast-Track Program 1*[74] (EIA, 2007). This was a "crash-program" mandated in 2006[75], to improve the fuel mix of the Indonesian electricity sector, by substituting oil for coal in electricity generation. The *Fast-Track Program 1* was to be

[73]Presidential Decree No. 5/2006
[74] Presidential Regulation No. 71/2006
[75] Under the *Law on Electricity 1985*

conducted solely by PLN which was instructed to expand and rebuild generation facilities to be based on fuels other than oil.

The *2nd Fast-Track Program* from 2010 states government plans for an additional 10 000 MW increased generation capacity[76] (Patrick and Farhan, 2010). Energy sources to be used now also include specific geothermal, hydro and biomass. The other main difference from the first fast-track program is that private participation is allowed. Projects can be carried out solely by PLN, through IPP projects or IPPs in cooperation with the Indonesian government.

In regards to electrification, the Department of Energy and Mineral Resources (DEMR) established the long-term goals for this in 2003. Although not directly linked to the recent reform, many of the policies and regulations may have an effect on the government's goals of 90% electrification by 2020 (Holland and Derbyshire, 2009).

9.5.2 Electricity Sector Organization Post-Reform

The new electricity law, Law No 30/2009, is perhaps the most significant recent measure implemented to improve the state of the Indonesian electricity sector (Purra, 2010)[77].

The *Law on Electricity 2009* can be seen to be a small improvement from the previous law, although it is not nearly as liberal as the attempted law of 2004 (Purra, ibid.). The supply of electricity in Indonesia will still be controlled by the government, although the supply may be conducted by either the central or regional governments through PLN, or regionally owned utilities. The largest change in the new electricity law is that it promotes more actively participation by private investors (IPPs), and thereby ends PLN's monopoly (PWC, 2011). Corporate bodies, cooperatives and self-supporting communities are for the first time allowed to participate in the supply of electrical power to end-users.

Captive generation, i.e., supply for own interest, may be conducted by government agencies, regional government, state-owned companies, regional-owned companies, private corporate bodies, cooperatives and individuals (Law No. 30/2009, 2009). Although captive generation is still open to for all participants, anybody wishing to conduct the supply of electrical power needs to hold a government issued permit[78].

PLN has been awarded with the "first right of refusal", which means that PLN has the first rights in regards to supplying electricity in Indonesia[79]. If PLN refuses to serve a given area, it

[76] Presidential Decree No. 4/2010
[77] Following the annulment of the Law on Electricity of 2002, the new law on electricity was passed in 2009 and replaced the previous electricity law (AESIEAP, 2011).
[78] Responsibilities of permit holders include quality standard requirements, safety conditions and service requirements.
[79] Captive generation is an exception

will be opened for private businesses to compete for the right to supply electricity. If no private company is willing to serve the specific area, the government can instruct PLN to provide the electricity. Areas not already served by PLN may be served by private businesses[80] as long as the specific area is not included in PLN's plans for electrification[81]. However, the private business will need an IUPTL granted by the central government, to be allowed to sell electricity directly to end-users, which is only granted to projects in areas where PLN has used its "first right of refusal".

PLN has not been unbundled and is still an integrated-utility in generation, transmission and distribution, as well as the holder of monopoly rights for the existing transmission and distribution grid. What this implies is that IPPs wishing to generate electricity in areas already served by PLN (where a grid exists) may only sell electricity to PLN through PPAs[82]. As the monopolist of transmission and distribution system, PLN still holds the position of systems operator and is responsible for real-time balancing of the electricity system (Law No.30/2009).

PLN is also responsible for rural electrification under the "obliged to serve" clause (PWC, 2011), which means that PLN is appointed by law to serve areas where no private interest has been shown. Rural electrification through PLN has been supported by the government through yearly funding, which has been around 850 billion IDR (IED, 2004).

With the passing of the new electricity law PLN became obliged to purchase electricity generated from less than 10 MW renewable power plants (Law No. 30/2009). This is an improvement from the previous regulations, where PLN was only obliged to purchase from IPPs generating electricity at a lower cost than the state-utility.

In 2009 PLN presented a plan where they outline future goals for both private participation and use of renewable energy sources[83] (Praptono, 2009). Main components of this plan include increasing IPP participation to 38.5% of total capacity, and commit to capacity expansion of renewable energy sources for geothermal and hydro. 57% of total capacity of green energy power production will be expected from IPPs (Sebayang, 2010)[84].

Regional governments (PWC, 2011) have been given more autonomy in regards to electricity supply, and can now provide licenses for projects that do not involve PLN or grid-connected IPPs[85]. This implies that private electricity generators which have been granted an

[80] Tumiwa, F., (2011), Interview at the IESR Office in Jakarta on the 28th of March, 2011
[81] Business Plan for the Supply of Electricity 2009-2018
[82] Tumiwa, F., (2011), Interview at the IESR Office in Jakarta on the 28th of March, 2011
[83] Power Generation Development Plan 2009-2018 (PDGP)
[84] In addition, the PDGP outlines for electricity efficiency through technology improvements, as well as suggestions for demand side management, such as peak-clipping (Praptono, 2009).
[85] IPPS selling electricity to PLN through PPAs

IUPTL can provide electricity for end-users. However, they will have to build their own transmission and distribution grid[86]. Private companies may sell electricity directly to the regional government through PPAs, or cooperate with local government for small-scale projects (Patrick and Farhan, 2010).

IPPs are allowed to supply electricity to:

Table 9.5: Sale by IPPs

1. PLN by the use of PPAs (License granted by the Central Government).
2. The regional government through the use of PPAs (Regional government needs IUPTL).
3. To the local government through Public Private Partnerships (PPP) (Partnership needs IUPTL to sell to end-users).
4. To end-users after being granted an IUPTL permit and building its own transmission and distribution network.
5. Own use (captive generation) after being granted an Operation License.

9.5.3 Power Purchase Agreements (PPA)

For IPPs producing electricity in areas supplied by PLN, the electricity will still have to be sold to the state-utility through PPA contracts. Some specific changes have been implemented in this process, as part of the *2nd Fast-Track Program,* with the aim stimulating electricity generation from renewable energy sources. The main regulation in regards to renewable electricity generation for medium-scale projects specify how the price paid by the utility to the IPP should be calculated[87] (Bratasida, 2008).

Table 9.6: Electricity Price by Utility

Electricity Price by Utility: Small-Scale Projects (1-10MW)
60% of utility's production costs, if connected to the low-voltage grid
80% of the utility's production costs if, connected to the medium-voltage grid

Source: Ministerial Regulation No. 2/2006

The most specific regulatory change occurred with the standardization of PPAs for small-scale hydro generation by the Ministry of Energy Regulation No. 31/ 2009[88]. This regulation is applicable for small-scale hydro up to 10MW, and specifies both the price received by the IPP and the time period of the contract which is set at 15 years, but subject to yearly review[89]. Furthermore, the standardized PPA for small-scale hydro (1-10MW) does not involve any

[86] Tumiwa, F., (2011), Interview at the IESR Office in Jakarta on the 28th of March, 2011
[87] Ministerial Regulation No. 2/2006
[88] Sari, A., (2011), Interview at IklimCarbon in Jakarta on the 29th of March, 2011
[89] Tumiwa, F., (2011), Interview at the IESR Office in Jakarta on the 28th of March, 2011

quantity specifications, which means that neither party commits to a specific quantity. This is a radical change from the previously PLN cost-based feed-in tariffs.

Table 9.7: PPA for Small-Scale Hydro

Ministry of Energy Regulation No. 31/ 2009[90]	
Applicable for:	Small-scale hydro up to 10MW
Contract period:	15 years, but subject to yearly review[91]
Quantity specifications:	None
Standardized price (2009):	
Medium voltage price (20 KV):	656 rupiah/kWh * F[92]
Low voltage price:	1004 rupiah/kWh * F [93]

Source: Ministry of Energy Regulation No 31/2009, Article 2

The base price is then modified according to which area the electricity generation is supplied, i.e. the price is modified according to the cost of generation of various regions. The price multiplier, F, has not changed after new electricity law was passed.

Table 9.8: PPA Price Multiplier

PPA Price Multiplier: F	
Java and Bali	1
Sumatra and Sulawesi	1.2
Kalimantan, East Nusa Tenggara	1.3
Maluku and Papua	1.5

Source: Ministry of Energy Regulation No 31/2009, Article 2

Specific regulation has also been implemented in regards to geothermal electricity generation through a several new ministerial regulations[94] (Indonesia Today, 2011). This regulation defines the ceiling price that IPPs should get from PLN purchasing their generated power, and also makes PLN obliged to purchase power generated by geothermal sources[95]. Furthermore, the regulation standardizes the process for obtaining a PPA for geothermal, as no negotiations with PLN will

[90] Sari, A., (2011), Interview at IklimCarbon in Jakarta on the 29th of March, 2011
[91] Tumiwa, F., (2011), Interview at the IESR Office in Jakarta on the 28th of March, 2011
[92] Price multiplier, *F*
[93] Ministry of Energy Regulation 31/2009, Article 2
[94] Ministerial Regulation No. 2/2011
[95] Previously this was reserved for renewable energy projects of less than 10MW

occur, only competitive bidding by the IPPs. The ceiling price that PLN may buy electricity generated by geothermal sources is set at USD 9.7 cents/kWh.

9.5.4 Foreign Ownership

There is little doubt about the necessity of private participation in the development of the Indonesian infrastructure, and it is also widely recognized by the Indonesian government. In 2010 the Indonesian Ministry of Economic Affairs issued a report where they outline their willingness to stimulate private participation in infrastructure through improved conditions for private investments (MEA, 2010).

Although private investments are stimulated, Indonesian infrastructure projects are typically only open to 95% foreign ownership shares, which imply that foreign investors will have to join with a local Indonesian partner (MEA, ibid.).

Table 9.9: Maximum Foreign Ownership in Electricity Infrastructure

Maximum Foreign Ownership in Electricity Infrastructure
1. Power Plant: 95% (Power plants of less than 10MW is closed to foreign investments)
2. Transmission of Electricity: 95%
3. Distribution of Electricity: 95%

Source: MEA, (2010)

Table 9.10: Foreign Ownership in Generation Capacity

Foreign Ownership of Generation Capacity
Under 1 MV: 100% Local interest
1-10 MW: 95% Ownership share
Over 10 MW: Foreign investors can be very active

Source: MEA, (2010)

Furthermore, construction of electricity infrastructure, power plants, transmission and distribution grids, must fulfill the '*Local Content Level*'[96] (WTO, 2010). The implications of this are that local or foreign bidders for energy service contracts must use a minimum of 35% domestic content in their operations.

9.5.5 Electricity Tariffs: Ministry of Energy Regulation No. 7/2010

The consumer electricity tariffs are set by the central government, whereas regional governments set tariffs according to the guidance provided by the central government (PWC, 2011). This

[96] Minister of Industry Regulation No. 48 of 2010

implies that the electricity tariffs can be set differently for each region in one business area. The tariffs include all the expenses related to the use of electrical power by the consumer; charge costs, usage costs, reactive power usage costs, and/or maximum kVA cost paid based on the subscription price according to maximum power used (Law No. 30/2009, 2009). Permit holders are banned from applying other tariffs than what is provided by the government in charge[97].

Although initiatives to increase tariffs have been met with large political and public resistance in the past, the basic electricity tariff was increased in 2010 by 10% (Barbotte, 2010). The electricity tariffs are regulated by the ESDM and divided into five general categories, which are again divided into several sub-categories (ASIEAP, 2011). Table 9.18 shows the operational tariffs of 2011[98].

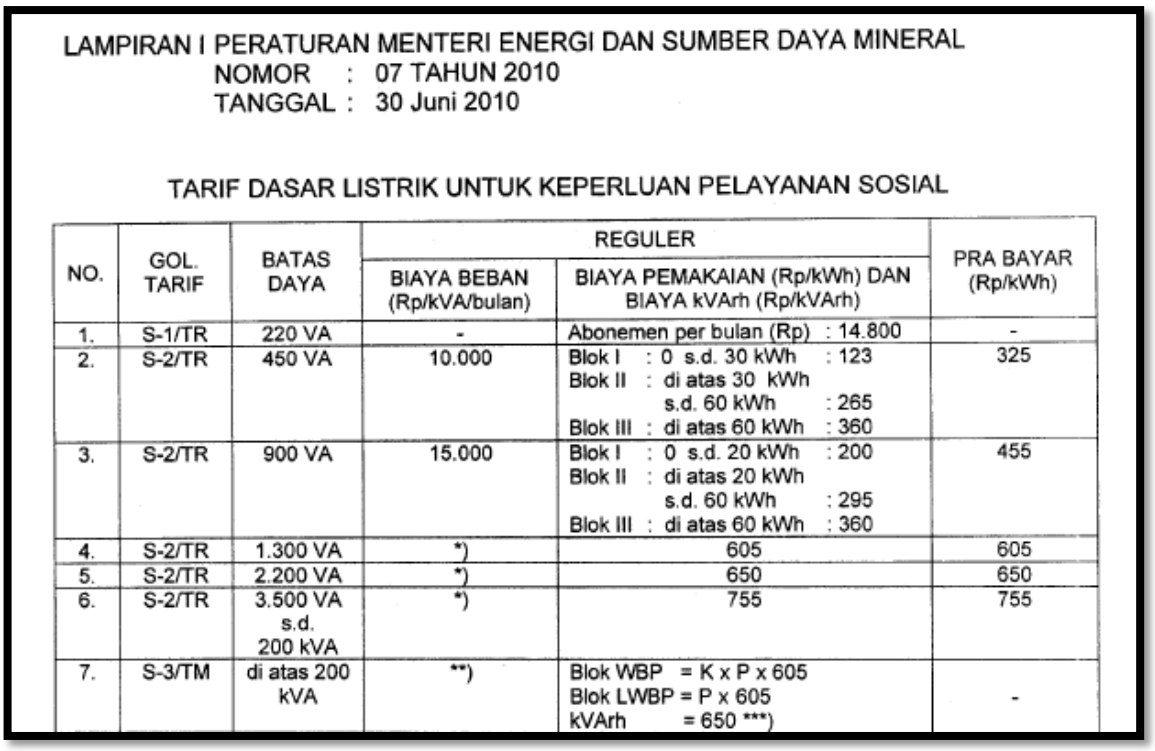
Table 9.11: 2010 Tariffs

2010 Tariffs in Rp/kWh[99]	
Business	793
Industry	711
Public	872
Residents	804
Social	558

Source: Ministry of Energy Regulation No. 7/2010

Within each category the tariffs are further divided into separate groups according to voltage of power connected, as well as quantity kWh used (MER, No.7/2010). The tariff system for electricity applies to all electricity supplied to end-users, expect captive generation, i.e., generation for own use. Furthermore, tariffs may vary between business areas, which means that the previous practice of a uniform tariff has been abandoned (PWC, 2011).

[97] Anybody using electric power that he/she is not entitled to can face a maximum penalty of 7 years of prison
[98] Tumiwa, F., (2011), Interview at the IESR Office in Jakarta on the 28th of March, 2011
[99] Calculations based on Prepaid Electricity Prices (Batas Daya), Ministry of Energy Regulation No. 7/2010



LAMPIRAN I PERATURAN MENTERI ENERGI DAN SUMBER DAYA MINERAL
NOMOR : 07 TAHUN 2010
TANGGAL : 30 Juni 2010

TARIF DASAR LISTRIK UNTUK KEPERLUAN PELAYANAN SOSIAL

NO.	GOL. TARIF	BATAS DAYA	REGULER		PRA BAYAR (Rp/kWh)
			BIAYA BEBAN (Rp/kVA/bulan)	BIAYA PEMAKAIAN (Rp/kWh) DAN BIAYA kVArh (Rp/kVArh)	
1.	S-1/TR	220 VA	-	Abonemen per bulan (Rp) : 14.800	-
2.	S-2/TR	450 VA	10.000	Blok I : 0 s.d. 30 kWh : 123 Blok II : di atas 30 kWh s.d. 60 kWh : 265 Blok III : di atas 60 kWh : 360	325
3.	S-2/TR	900 VA	15.000	Blok I : 0 s.d. 20 kWh : 200 Blok II : di atas 20 kWh s.d. 60 kWh : 295 Blok III : di atas 60 kWh : 360	455
4.	S-2/TR	1.300 VA	*)	605	605
5.	S-2/TR	2.200 VA	*)	650	650
6.	S-2/TR	3.500 VA s.d. 200 kVA	*)	755	755
7.	S-3/TM	di atas 200 kVA	**)	Blok WBP = K x P x 605 Blok LWBP = P x 605 kVArh = 650 ***)	-

Figure 9.9: Ministry of Energy Regulation no. 7/2010

Source: MER, (2010), *Ministry of Energy Regulation No. 7/2010*

- Social category S-2/TR (450 VA), Blok 3 (30-60 kWh): 360 Rp/kWh
- Social category S-2/TR (1300 VA): 605 Rp/kWh
- Business category B-1/TR (450 VA), Blok 1 (0-30 kWh): 254 Rp/kWh
- Business category B-1/TR (1300 VA) : 795 Rp/kWh

9.6 History of the Indonesian Electricity Sector

Table 9.12: History of the Indonesian Electricity Sector

History of the Indonesian Electricity Sector
1945: Constitution of the Republic of Indonesia
1985: Electricity Law passed
1989: World Bank sector review recommends competition and possible eventual privatization
1990: Suharto approves the first Independent Power Producer (IPP) project
1992: Adjustments made to the Energy Law of 1985 to encourage private participation in the sector
1994: Government regulation number 23. Corporatizes PLN
1994-1997: 25 additional IPP projects accepted
1997: Asian financial crisis bankrupts PLN
1998: World Bank suspends new lending to the electricity sector
1998: Civil unrest as a reaction to increased tariffs – forces President Suharto to step down
1998: New electricity sector restructuring policy is announced, white paper
1999: Asian Development Bank (ADB) and Japan Bank for International Cooperation lends $800 million for the energy sector restructuring program
2000: Controversy erupts in parliament and the press following announcements to increase tariffs
2001: Government presents new draft electricity legislation to Parliament
2002: Electricity Law of 2002
2004: Electricity Law of 2002 annulled by the Constitutional Court due to certain key provisions were found to contravene with the Constitution
2004: Foreign electricity suppliers who want to supply to PLN must work through a local, Indonesian-owned limited liability company
2004: Foreign suppliers are restricted to contracts worth over $ 1 million for goods and services
2006: Electricity Generation Program 1: PLN instructed by the government to carry out a crash-program for non-oil dependent electricity generation
2009: Law on Electricity 2009
2010: Electricity Generation Program 2: Further diversification away from oil-dependent electricity production. More focus on attracting foreign investors for electricity generation

Source: Sari, A., P., Seymour, F., (2002)

9.7 Electricity Sector Organization by Law on Electricity 2002

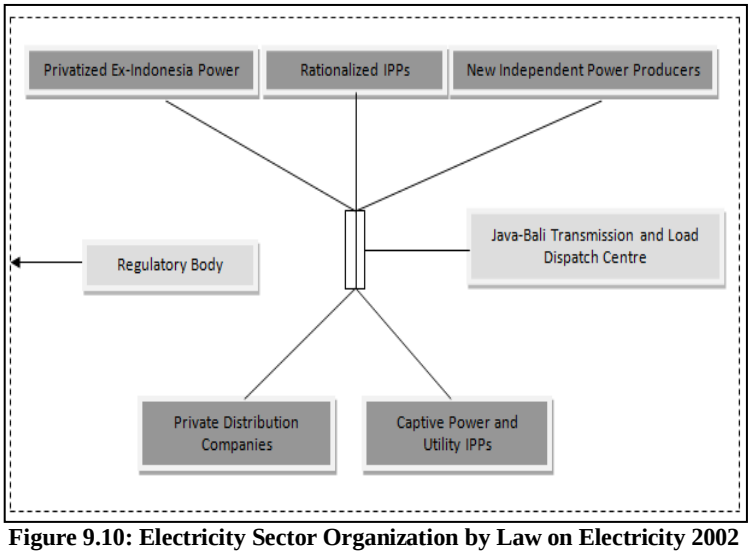


Figure 9.10: Electricity Sector Organization by Law on Electricity 2002
Source: Sari, A., P., Seymour, F., (2002)

9.8 Indonesia's Electricity Laws

Table 9.13: Indonesia's Electricity Laws

1945: Constitution of the Republic of Indonesia
Sectors of production which are important for the country and affect the life of the people shall be controlled by the state (Article 33 paragraph 2 of the 1945 Constitution of the Republic of Indonesia)
1985: Law on Electricity 1985
PLN's role as monopolist (from Constitution) reaffirmed. PLN exclusive rights in both generation and distribution to end users. IPP's allowed to produce for own use, but not for sales to end customers.
2002: Law on Electricity 2002
Attempt to open up the energy sector to the private sector. Opening of the electricity sector to competition supported by the World Bank.
2004: Law on Electricity 2002
Law on Electricity 2002 revoked by the Constitutional Court due to Law No. 20 found to contravene with the constitution, i.e. privatization of electricity generation found to be unconstitutional
2009: Law on Electricity 2009

Source: Purra, M., (2010)