

## **Electricity Sector: Design to Ensure Energy Security**

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### **Abstract**

There are different frameworks used in many countries around the world to organize, govern and own their electricity sector such as public, private or mixed models. The objective of this paper is to analyze the achieved performance and economic contributions provided by a well designed electricity sector under a mixed model in comparison with a privatized model and as well as a state monopoly model. It is clear that the purpose of this paper is not to criticize a particular politic-economic model from the under study countries.

The different sources that a country uses for producing this commodity compose its electricity matrix, which defines how affordable is the price of providing the service. Furthermore, the governance, organization and ownership are important issues designing the electricity sector in order to provide lower prices. For the preceding reasons, the appropriate device of these elements for an electricity sector can play a vital role in ensuring energy security. And thus the main purpose of this paper is to identify an optimal model to design an electricity sector based on a successful case.

*Key words:* Electricity sector design; Policies; Industrial organization; Electricity matrix; Energy security.

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### **1. Introduction**

Energy security is a notorious concept that governments have been addressing within their policies with the objective to strengthen economic growth and cover the provision of energy by means of combustibles and electricity. It also involves price's affordability (Bhattacharyya 2011). However, to achieve energy security, a well designed electricity sector is required to develop and contribute in reaching energy security at least in one of the required areas (Electrification Coalition 2009). It would be possible to realize an international comparison of electricity market designs for contrasting the used models to organize, govern and own the electricity sector.

Based on three different types of industrial organization for the electricity sector, the selected countries for the present study are: The Republic of Cuba, which has a state monopoly model; the Republic of Guatemala, which has an almost-privatized model; and the Republic of Korea, which has a mixed model. The factors that the electricity sector bears upon are e.g. policies; industrial organization, governance, and ownership structures; and the electricity matrix.

These indicators allow determining the achieved performance by these countries in their electricity sectors (Jamasb, Newbery and Pollitt 2004). Also, they emphasize the achieved economic contributions. Through this analysis if the adopted models by these countries have been enough or not for acquiring economic growth and energy security will be determined with this study. All of this can be useful to propose a model for designing an electricity sector that play a part to reach energy security and supports economic development.

This paper is organized in six sections. The second section describes the approach utilized in this study. The third section analyzes the current design of the electricity sectors in the countries under study. The fourth section presents the accomplished performance and discusses the results based on the statistical analysis of the indicators. The fifth section presents the model proposed designing an electricity sector for achieve energy security and support economic development. Finally, the conclusions are given in the sixth section.

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## 2. Approach

The utilized approach in this study is a descriptive investigation which is divided into two areas. The first area consists of the theoretical framework of the policies that ruling the electricity industry in the under study countries. The idea is to present the actions undertaken by the governmental authorities and the accomplished results. In the second area, we present an examination of how the electricity sectors are organized, governed and owned.

These types of analyses cannot be possible only through utilizing the legal frameworks affecting these industries and consulting statistical data. Therefore, later on, all of this can be contrasted with the performance and economic contributions achieved for each electricity sector with the objective to determine the most appropriate model for reaching energy security.

This research paper covers, for the statistical data from the under study countries, the time period from 1999 to 2008. Some academics like Baca<sup>1</sup> consider that at least 10 years is the time needed for analyzing the changes and effects in some areas under study. The selection of this period obeys to the fact that it is the time when the current electricity sector's design for Guatemala and Korea were established.

The preparation, data collection and interpretation of the information in this research have been carried out using a qualitative approach. Through an analysis of the historical background and with the support of statistical data from the under study countries, it is possible to conduct this investigation. What might be accepted as a limitation is the nature itself of the qualitative method which can affect the results of the current study.

Compared with the quantitative method, the examination and understanding will be based mostly on secondary sources of information. Another limitation is the fact that some statistical data is still not available for the period under study based on the fact that governmental agencies in charge of providing it have not yet published it.

## 3. Electricity Sector Design Model

### 3.1. Policies

Electricity's sector design refers to the way to organize, govern and own this industry (Viljainen 2005). However, the way to make it possible is through policy making, which involves decisions about regulation or deregulation. The success of this field can be possible if it is accomplished through well-defined policies, laws, regulations, and institutions (Zhang, Kirkpatrick and Parker 2002). Also, taking into account the provision of incentives

and settling controls for a well managed electricity industry.

#### 3.1.1. The Republic of Cuba Case

With the triumph of the revolutionary movement the Republic of Cuba issued the Fundamental Law, which established the basic outlines of a new political, economic, and social context. As a result like in any other historical process of transformation, the political and productive private institutions in this country were transformed radically into a State Monopoly model. Table 1 provides the policy, laws and actions implemented by the State and the reached results.

Table 1 Policies Implemented in Cuba

<i>Policy</i>	<i>Law</i>	<i>Action</i>	<i>Results</i>
Nationalization of assets owned by foreign companies or citizens from U.S.	Law on Compensations for Assets Expropriated	It intends to compensate the former owners with long-term bonds financed by future revenues from the sugar quota, annual sales that the U.S. government would have guaranteed	Transfer of assets into the hands of the Cuban State, including the electricity company which transformed into a State Owned Enterprise (SOE)
	Law on Expropriation of Private Property	Nationalize by expropriation of all industrial and commercial enterprises	

Source: Republic of Cuba Executive Branch and Gaceta Oficial de la República de Cuba (1960)

The policies and laws adopted by the Republic of Cuba led to the establishment of a State Monopoly Model on the electricity industry, which is commanded by the Ministry of Basic Industries. Under this scenario have been concentrated the different activities related with the electricity sector through one or several SOEs (Sullivan and Sheffrin 2003).

#### 3.1.2. The Republic of Guatemala Case

The Guatemalan electricity industry started between 1996 and 1998 a new era under competitiveness and market practices. The electricity sector was re-designed (deregulated) through the establishment of new policies, laws, regulations, and institutions that at this time are ruling the different business involved in (Comisión Nacional de Energía Eléctrica 2011).

<sup>1</sup> Baca, Gabriel. 2004. Project Evaluation. Mexico DF: McGrawHill.

With these actions, the Guatemalan government ensured the participation of private investments in order to cover in the short and mid-term requirements to have the infrastructure available for producing electricity and cover the demand. Furthermore, these actions carried out technological transfers since the new investors decided the type of technology required for producing electricity in a short period of time, based on the established regulations. Table 2 provides the policies, laws and actions implemented by the government and the reached results.

Table 2 Policies Implemented in Guatemala

<i>Policy</i>	<i>Law</i>	<i>Action</i>	<i>Results</i>
Design the electricity sector based under a competitive and efficient framework	General Law on Electricity	Segregation of activities concerned in the sector	Decrease the government participation and increase private capitals participation
		Constitution of the National Electricity Commission	Regulating the activities involved with the electricity sector
		Constitution of the Administrator of the Electricity Wholesale Market	Realize commercial transactions among the participants in the electricity sector
		Sell for complete the electricity distribution area and promote rural electrification	Increase the coverage of the national electrification rate
Promote sound investment and foreign capital	Law on Foreign Investments	Recognizing foreign investors in equal conditions like domestic investors	The distribution area was privatized it is expected the entrance of private investors in the transmission area
Exploitation of renewable energy resources	Law on Incentives for Renewable Energy Generation	Tax exemptions from produce electricity with renewable resources	It has been installed around 500 Megawatt by private investors
Economic infrastructure development	Law on Alliances for the Development of Economic Infrastructure	The law and its regulation have been enacted	It is expected to install around 2,500 Megawatt for the period 2008-2010

Source: Congress of the Republic of Guatemala (1996, 1998, 2004 and 2010)

Through these actions State of Guatemala adopted a market model, which currently is characterized by the fact that private investors have

large participation in the activities related with the industry (Ramanadham 1995).

### 3.1.3. The Republic of Korea Case

The Republic of Korea has enacted several laws in order to achieve economic growth and energy security through a well designed electricity industry. Under this scheme, private investors started to perform in its electricity sector. The objective was to attract private investments for increasing the country's power installed capacity. Table 3 provides the policy, laws and actions implemented by the State and the reached results.

Table 3 Policies Implemented in Korea

<i>Policy</i>	<i>Law</i>	<i>Action</i>	<i>Results</i>
Restructuring the electricity sector with the purpose to make it more competitive and efficient	Act on the Promotion and Restructure of Electricity Industry	Approval from the Ministry involved with the electricity sector for segregate the activities related with the electricity industry	Establishment of State Corporate Model, encouraging Korea Electric Power Corporation to become in a publicly traded corporation, and be more competitive
		Act on Special Measures for the Deregulation of Corporate Activities	Deregulate corporate activities of the Korea Electric Power Corporation
		Act on Assistance to Electric Power Plants-Neighboring Areas	Provide subsidies for build infrastructure for produce electricity with renewable energies
Regulating the government ownership in corporations with great influence on the national economy	Korea Electric Power Corporation Act	Act on Special Cases concerning Electric Source Development	Ensure the production of electricity with technologies which let to provide lower prices and promote environmental protection
		Government must be owner of 51 % of the Korea Electric Power Corporation shares	Ensure the government ownership of the corporation delimiting private capital participation

Source: Roh, T. (1989); Kim, Y. (1995-1996); Kim, D. (2000); Kim, D. (2002); Roh, M. (2003)

The republic of Korea as Guatemala's case has adopted a market model. However, Korea is a special

case where the ownership has been delimited in this industry by the government, which has to continue being the main actor. This case can be considered as a mixed model. Under this scheme we can find a publicly traded company that involves the ownership of both government and private sector (Bajay 2006).

3.2. Industry's Organization

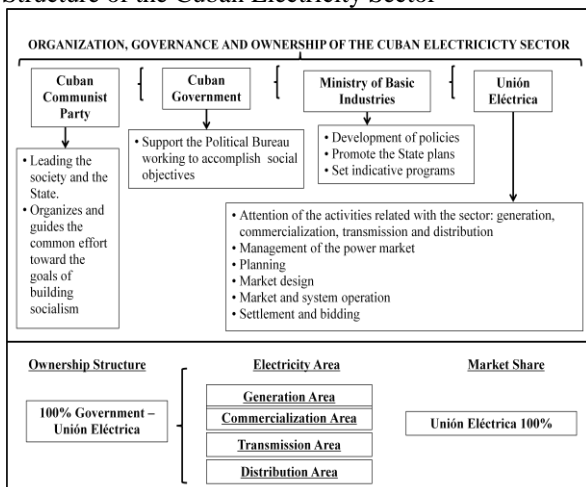
The study of the industrial organization allows determining the way that is structured, governed and owned a specific industry in a determined place (Tirole 1988). The importance of this analysis is the fact that it allows understanding how policies, laws, and institutions are materialized for the industry's functioning. Also, it identifies the way that the different activities and participants related with the industry under study have been designed. This part can be defined as the design's portrait (Shy 1995).

3.2.1. The Republic of Cuba Case

It is clear that the active political regime in the Republic of Cuba is 'Communism'. For the foregoing reasons, the situation in this country is a centralized structure that integrates vertically the governance and ownership of the productive enterprises and industries. This integration starts from the government, passing through the ministry related with the industry, and reaching the agencies in charge to attend the activities concerned within the electricity sector (Rodríguez 2002).

This model of industrial organization attempts to reach common economic growth for its society members. However, later on that will be analyzed and studied if it has been enough for achieving energy self-sufficiency and economic growth. Figure 1 illustrates how the Cuban electricity industry is currently organized, governed and owned.

Figure 1 Organization, Governance and Ownership Structure of the Cuban Electricity Sector



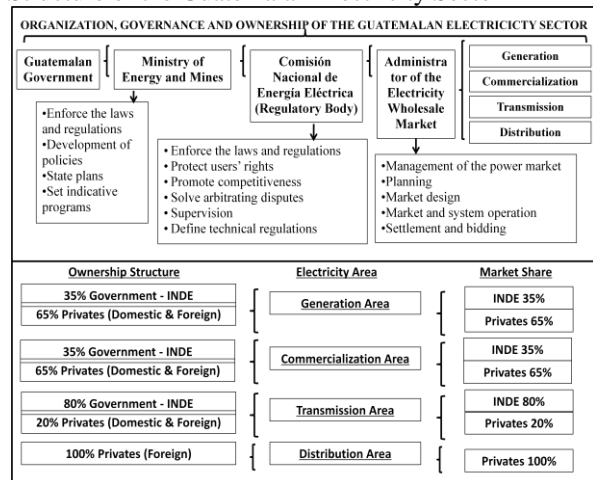
Source: López (2007)

It can be argued that the Cuban government has a large influence through its electricity sector. The own nature of the political regime creates an extensive bureaucratic systems (Di Tella 1982). Under the State Monopoly Model the governmental policies, plans, and programs can be reinforced strongly. Furthermore, it can produce considerable impact on the country's economy due to the direct intervention in the industry. However, the political regime, the bureaucracy, and other factors can delay the achievements by different factors, as in the case of the economic blockade imposed by the U.S. against Cuba (Dunning 1998).

3.2.2. The Republic of Guatemala Case

The electricity sector is organized, governed, and owned under an almost privatized model. With this action, the Guatemalan government reduced its participation in the industry. Also, ensured the attraction of investments in order to increase the country installed capacity (Aldana 2010). The government has reduced its participation in almost all the activities involved in the sector and the Ministry of Energy and Mines is only limited to enforce policies and laws, and regulate market activities. Figure 2 illustrates how the Guatemalan electricity industry is currently organized, governed and owned.

Figure 2 Organization, Governance and Ownership Structure of the Guatemalan Electricity Sector



Source: Administrador del Mercado Mayorista (2011a)

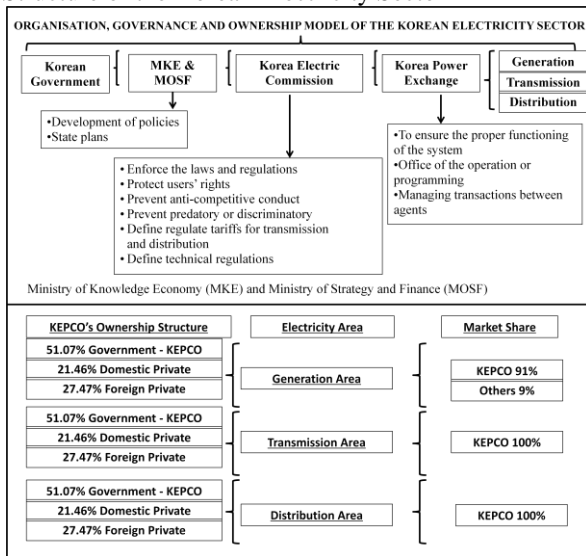
The image about how is conceived the electricity sector in the Republic of Guatemala is clear with respect to the government's role inside the industry. Also, it illustrates that it is organized, governed and owned through governmental institutions. Some entities have participants in their directorate from both the state and the private sector. This phenomenon is common in Comisión Nacional de Energía Eléctrica, Administrador del Mercado Mayorista, and Instituto Nacional de Electrificación (United Nations Economic Commission for Latin America and the Caribbean 2002).

Under this model the Electricity Wholesale Market has given place for the formation of cartels or pools from the private participant's side. It is because they own high measure areas such as generation, commercialization and distribution. Guatemala has reached the advanced stages of privatization in almost all the activities concerned with the electricity sector. Also, the electricity transmission area will face the same situation (Comisión Nacional de Energía Eléctrica 2008).

3.2.3. The Republic of Korea Case

The Korean electricity sector involves the participation of private capitals. However, this industry is controlled by the government (Byrne et al. 2004), through its Ministry of Knowledge Economy and the Ministry of Strategy and Finance. These institutions are in charge of developing policies for the country's energy self-sufficiency (energy security) and promote economic growth. Figure 3 illustrates how the Korean electricity industry is organized, governed and owned.

Figure 3 Organization, Governance and Ownership Structure of the Korean Electricity Sector



Source: Korea Electric Power Corporation (2011)

The Korean electricity sector is organized, governed owned under a mixed model (publicly traded company) due to the government considerable ownership of the concerned activities. This figure also illustrates that the Korea Electricity Power Corporation market participation is over 90% in the production of electricity while in the electricity transmission and distribution areas it is 100%. This corporation is the referential institution of the Korean electricity sector.

This model is constituted by assets which are represented by capital and issued through shares. The capital is increased through the issue of new shares which could represent the admission of new members

and ensure the acquisition of financial resources in order to increase the power installed capacity. This kind of initiative also transfers social rights through the expansion of equity (Denis and Sarin 1999).

4. Electricity Sector Performance

The performance of the electricity sector depends on several factors. First, the employed approach in designing the organization previously, governance and ownership structures through the policies, regulations and established institutions. These will influence the country's capability, raising its power installed capacity and electricity production to cover the demand's requirements.

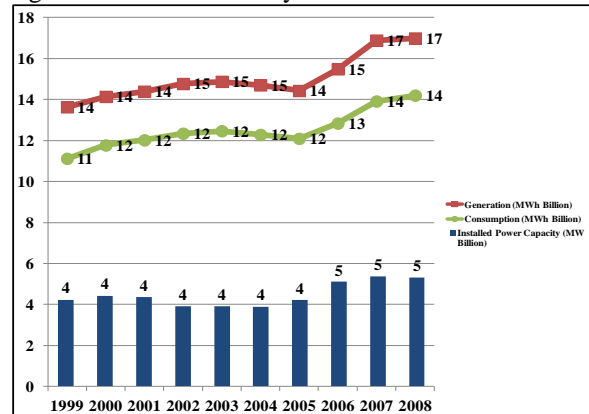
The previous design will affect in the selection of technologies that will compose the electricity matrix since the main actors in the power area will take their decision based on their economic interests. Finally, everything will be reflected positively or negatively on the electricity prices.

4.1. The Republic of Cuba Case

The Cuban Revolution has provided, as much it has been possible, all type of social services for its inhabitants. Compared with other countries of its region, improvements have been achieved in several areas of the country's society. The electrification coverage has not been an exemption since the country has reached a national coverage rate of 96% (Cuba National Statistics Office 2008).

However, The Cuban electricity sector has been beaten by macroeconomic difficulties that have impacted different sectors of the economic activity (Mills and Koslosky 2009). In addition, technical issues affected the performance of the electricity industry. Power supply systems in a large number of facilities in Cuba are old and their use increased the electricity loads affecting the service's quality. Figure 4 illustrates the reached performance by the Cuban electricity sector.

Figure 4 Cuba's Electricity Sector Performance



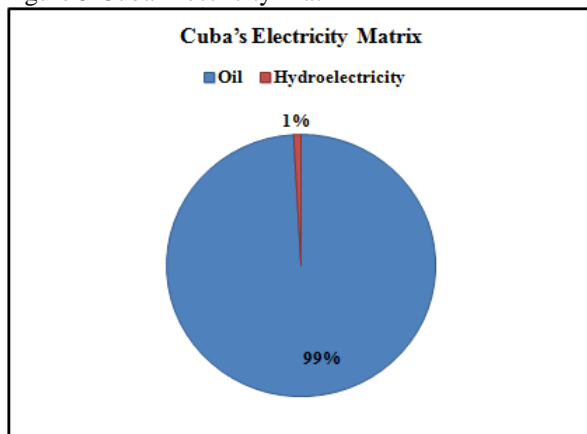
Source: United States Energy Information Administration Office (2011)

Considerable increments of its installed power capacity have not been possible due to the country's lack of economical resources because the economic blockade imposed by the United States since 1962. However, the government using its extensive power over the industry has undertaken programs and actions in order to meet demand requirements.

It has implemented an electricity saving program in the less competitive areas of the economy. The result produced with this program has been reorganizing the supply according to the importance of the consumers inside the social-economical context. As a result this action has shifting demand positively.<sup>2</sup> However, these results have been translated into the reduction of energy security due to the electricity shortages faced and the corresponding negative impact for reaching economic growth.

Figure 5 confirms the fact that Cuba's dependency on its oil imports for producing electricity, seems to continue for the future. The country's supported the sector performance during the last 50 years based on its foreign policy towards oil imports. Strategic alliances were realized with related countries that have large oil production.

Figure 5 Cuba Electricity Matrix



Source: United States Energy Information Administration Office (2011)

This policy has not been enough since it has suffered negative setbacks as it was with the case of the Soviet Union collapse in the early 90s and also other friendly regimes in the Middle East during the period under study. (Cereijo 2008). Also, through observation, it is clear that the three indicators referred previously in Figure 4 decreased when the regime of Saddam Hussein was defeated in Iraq. Furthermore, there is uncertainty about the future with respect the regime in Bolivarian Republic of Venezuela, which currently is a strong ally supplying around 63 thousand barrels of oil per day and that area utilized for electricity production.

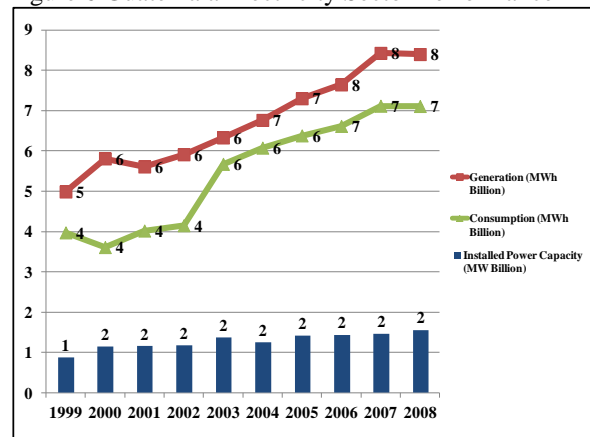
<sup>2</sup> Energy Saving Program in Cuba (PAEC 2007)

Regarding the price in the provision of the service, it cannot be said that it is expensive for the final users of the service. This argument is based on the particular nature of the politic, economic, and social regime existing in Cuba, which subsidizes this type of public goods. Also, there is no available data about this indicator. However, based on the country's electricity matrix and the energy resources used to generate the electricity, it is reasonable to assume that it has been expensive for the State during the production process, and it increases energy in security by this mean.

#### 4.2. The Republic of Guatemala Case

The implemented policies have led changes on the power generation area in the Guatemalan electricity sector. After the deregulation of the industry different power plants have been constructed with a total installed capacity of 950.846 MW (Administrador del Mercado Mayorista 2011a). Figure 6 illustrates the reached performance by the Guatemalan electricity industry.

Figure 6 Guatemala Electricity Sector Performance



Source: Administrador del Mercado Mayorista 2011a

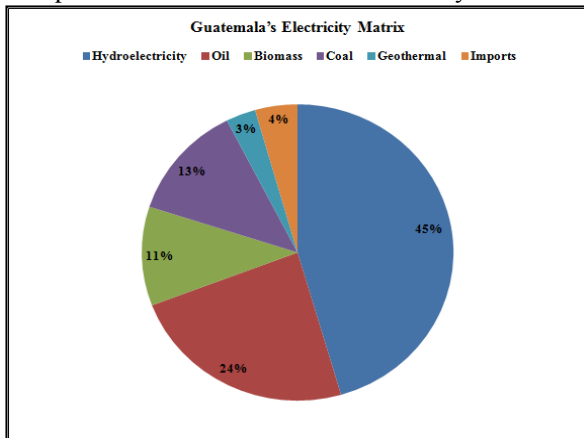
Guatemala has seen growth in its installed power capacity through private sector investments in the power area. However, some critics like Hugo Maul<sup>3</sup> have argued against that, explaining that it has been mostly in order to cover the increasing demand without enhancing the development of new and large industries during the under study period.

The creation of new infrastructure to produce electricity has not been accomplished by means of the best strategy. The country's electricity matrix is mostly composed by thermal power plants, which employ resources that need to be imported because the country does not possess them. Additionally, the costs of the resources to produce electricity are not exempted from being put up with increases in the international markets (Comisión Nacional de Energía

<sup>3</sup> Director of the Guatemalan National Center for Economic Research (CIEN, 2008)

Eléctrica 2011). Figure 7 illustrates the Guatemalan electricity matrix.

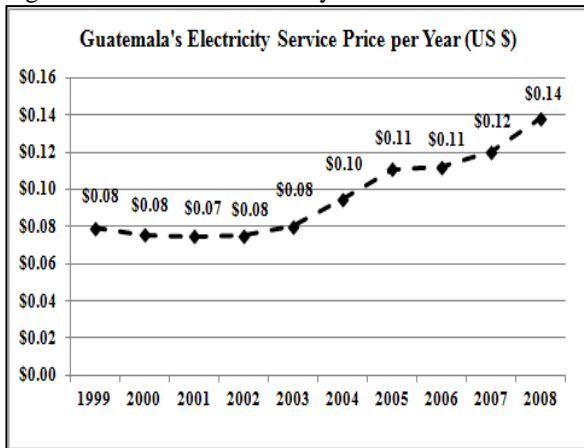
Figure 7  
Composition of the Guatemala's Electricity Matrix



Source: Comisión Nacional de Energía Eléctrica (2008)

This type of electricity matrix drives up the cost of the electricity and reduces its possible contribution to the economy. Guatemala has not been efficient in the offered prices in the provision of electricity as it is shown in Figure 8. The offered prices for the supply of electricity in Guatemala have been very expensive, affecting the development of Small and Medium Enterprises.<sup>4</sup> Guatemala's government contributes only with 35% of the energy produced in the country, which is based on hydropower. The remaining 62% is contributed by private generators through employ thermal power plants.

Figure 8 Guatemala Electricity Service Price



Source: Administrador del Mercado Mayorista (2011b)

It is obvious that Guatemala may face under its almost privatized governance structure the same situation as California, if it manages the sector through a model based under total market practices. This has been the factor that has determined the

<sup>4</sup> World Bank Report N° 54242-GT (2010)

failure of the Guatemalan electric sector due to the high costs of the electricity service and low quality.

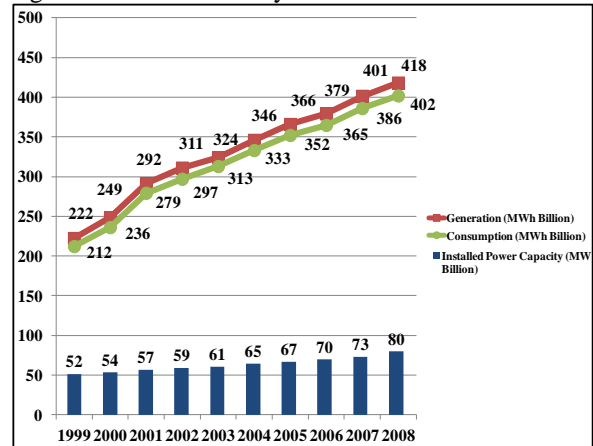
Joskow (2001) argued that under this model, it might be unfeasible in the long-term to provide the service for customers and cover the increasing demand due to the different costs involved in producing electricity and import restriction among others. The author insists that this situation improves the intervention of state authorities and institutions with the objective of fixing the problems which the private sector was not able to solve by itself via the market and the type of service.

The author's statements were confirmed when Guatemala faced again electricity shortages from 2007 till 2009. The problem was solved only because the government intervention, which contributed to build an international electrical interconnection with Mexico that, allowed covering the demand (Administrador del Mercado Mayorista 2011b).

#### 4.3. The Republic of Korea Case

Jung (1996) has observed that Korea has accomplished economic prosperity through government sustenance by designing a proper plan for its electricity industry focused on the long term and by establishing and implementing appropriate policies and programs. The levels of electricity produced and consumed by Korea during recent years have enabled it currently to play a leading role among the world's largest economies. Figure 9 illustrates the reached performance by the Korean electricity sector.

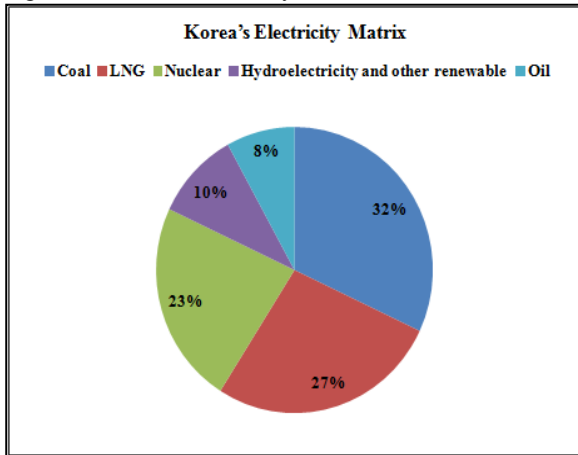
Figure 9 Korea Electricity Sector Performance



Source: United States Energy Information Administration Office (2011)

The investments made by the Korean government together with the private sector have been significant based on the incremental amounts of installed power capacity settled and electricity produced. The country has been able to cover the incremental demand and has achieved being among the world's top ten countries in electricity production (Central Intelligence Agency 2008). Figure 10 illustrates the Korean electricity matrix.

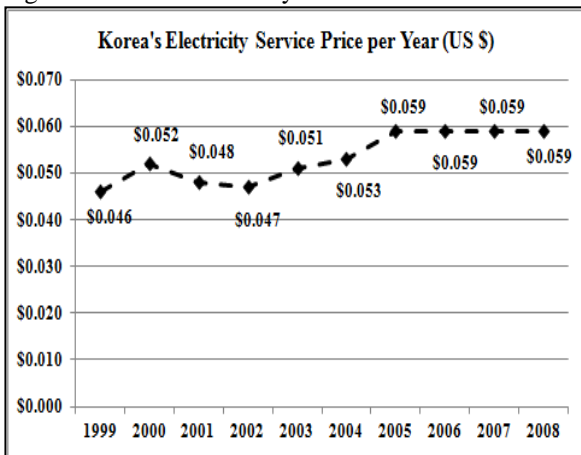
Figure 10 Korea Electricity Matrix



Source: Korea Electric Power Corporation (2011)

It is crucial to note that Korea lacks sufficient natural or fossil resources to generate electricity. However, Korea has made efficient use of its available resources and has established an appropriate electricity matrix to produce this commodity and satisfy its demand for consumption, especially for its industries, at lower prices as shows Figure 11.

Figure 11 Korea Electricity Service Price



Source: Korea Electric Power Corporation (2011)

The diversification of resources producing electricity has been as an objective to provide the service at lower prices for supporting the consumption of the industrial sector. This statement is supported by the analysis of *Figure 10*, which shows how the Korea's electricity matrix is composed.

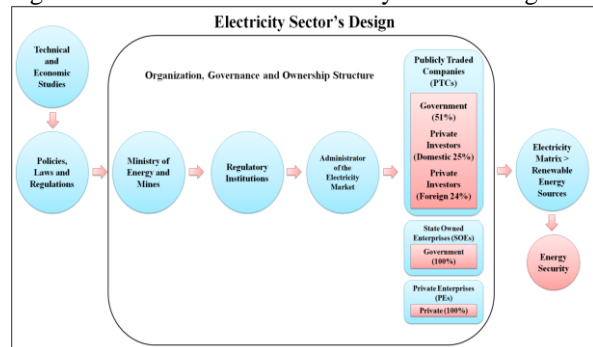
Also, it illustrates that Korea's electricity matrix is composed of coal, gas, nuclear, hydropower and other renewable energies, as well as to oil to produce electricity. Continuing with the analysis, it can be argued that Korea has employed a strategy of producing electricity through the use of renewable resources. Under this design of its electricity matrix, Korea has been more efficient than both Cuba and Guatemala.

According to Asia Pacific Partnership on Clean Development and Climate<sup>5</sup> Korea is an investing leader in new and renewable energies around the world. This investment aims to reduce the country's dependency on petroleum derivatives, while maintaining lower prices for the service. The achievements that Korea have obtained in its electricity production, allowed it to become one of the principal producers and consumers of electricity in the world, by achieving energy security through self-sufficient as much as it can be possible.

## 5. Proposed Model for Designing an Electricity Sector

The model proposed for designing an electricity sector is based on policies and regulations; organization, governance and ownership structure; as well as to the electricity matrix that policy makers can address. The scheme is presented as a general overview. That is because an accurate electricity industry design requires not only a broad conceptualization of itself it also requires a complex planning by business area, which includes technical and environmental regulations, and deep economic analysis. However, it can be useful for scholars interested in carrying out more researches about it. On the other hand, for young policy makers concerned in comprehending more about the industry's functioning or policies with the aim to improve their country's model. Figure 12 illustrates the proposed model.

Figure 12 Elements of an Electricity Sector Design



Source: Elaborated by the authors

### 5.1. Technical and Economic Studies

The technical studies are allowing establish the feasibility of a project. For the proper design of the electricity sector these studies contribute to identify the type of energy and technology that a nation can employ, based on the availability of fossil and renewable resources that it has. They also set the environmental impact that is generated in order to decide on its implementation or not. Moreover, economic studies can determine the best option in terms of how to finance the required projects, but

<sup>5</sup> <http://app-korea.kemco.or.kr>



commonly they are not realized prior to deregulate the electricity industry. The cost of capital can be determined so as to establish how affordable the prices could continue being on the provision of the service.

Conducting more researches in this regard can help determine the optimal levels essential for the private investments. It would be possible through further researches to set the costs on which an electrical industry can operate without deteriorating its competitiveness in the provision of electricity service. Additionally, the economic studies may determine appropriate costs of electricity service in order to be able to stimulate national economic growth.

### *5.2. Policies and Regulations*

The electricity sector is a traditional industry that must support the economic growth of a nation. The policies and regulatory framework should be based on the social-economical commitments of political leaders towards the inhabitants. The legal framework must produce an environment where it is ensured the provision of the service with quality. In other words, quality means supplying the service continuously, covering the increased demand and increase the country's installed power capacity, and reducing technical losses through utilizing the optimal technologies. Therefore, regulatory and monitoring institutions must be developed.

### *5.3. Organization, Governance and Ownership Structure*

The appropriate design of the electricity sector can generate inflows of capitals from private investors which may contribute to intensifying the installed power capacity and employ more efficient electrical infrastructure. However, through the regulatory framework, it must ensure that it will be with an affordable cost for the country's society. Otherwise, it can undermine the competitiveness of domestic export oriented industries in the international markets and reduce the country's wealth.

The balance in the electricity sector ownership structure can be designed by delimiting, through regulations, the participation of investors and the type of investors. As a result, the institutions which are created by this scenario are required to establish the proper control mechanisms to tackle any extreme raise of the prices in the provision of service that would be promoted by private investors. By these control mechanisms, it also can contribute to restrict the constitution of private investors in monopolies, oligopolies, and at the same time avoid collusion through pool or cartel formation.

#### *5.3.1. Governmental Role*

The ministry related with this sector, commonly energy and mines, must develop policies, laws and

regulations that strengthen the participation from both the State and the private sector in order to carry out the settlement of new infrastructure. The regulatory institution should reinforce and monitor the policies, laws and regulations developed by the State in order to ensure the appropriate performance of the industry; also, planning the development of the sector should be in accordance with the country's economic growth and needs.

The administrator of the electricity market should manage the operations which are carried out domestically and internationally between the participants of the industry, without allowing the formation of cartels or pools from the private sector side. The electrical infrastructure or assets that make up the electricity sector in any of the various areas that integrate it should be owned by the State by at least 51%.

#### *5.3.2. Establishment of Publicly Traded Companies*

If a country wants to boost its national economy through providing low prices for the electricity service, it must be through the establishment of Publicly Traded Companies with major ownership from the State side. In these types of institutions both State and private investors, whether domestic or foreign, will be constituted as owners of the assets of the country's electricity facilities (generation, transmission and distribution). This business model is composed by assets which are represented by capital and issued through shares (Ramanadham 1995).

The capital is increased through the issue of new shares which could represent the admission of new members. This kind of initiative also transfers social rights through the expansion of equity. The expansion of capital and future entrance of new members is proposed and subject to the approval of the shareholders (usually by a majority of ownership representation), and it could be with the objective of financing increments on the installed power capacity. Regarding the liability of partners for the debts of the corporation, it is only to the amount of their invested capital (Hitchner 2011).

The private investors can be holders of preferential shares, it means, they will receive a preferential interest payment, which must be higher than the government side, and it will make attractive their investments. This action could make the electricity's service price sustainable in the long-term if the government responds for private investments through paying a preferential rate of interest in return for their investments in the electricity industry.

This interest rate must be competitive compared with other investments outside of the electricity sector. This preferential interest must be absorbed by the State from its own earnings, since its purpose is providing welfare for its inhabitants instead of making and accumulating profits. With these measures, the government instead of transferring expensive tariffs

for the final customers, it is going to provide them affordable prices. Domestic industries as well as the export oriented industries can be favored with this benefit to keep competitive prices for their products domestically and in the international markets. With these actions a nation will improve its economy and reach energy security, because that will keep the continuity in the provision of the service and at low prices.

#### 5.4. *Electricity's Matrix*

The selection of an appropriate electricity matrix can oblige a country to use renewable resources by reducing the country's dependency on petroleum derivatives for producing electricity. Also, by these means of production a nation will be capable to provide lower prices for the service to all its citizens. These actions can facilitate achieving energy security and economic growth in a dramatic way. Obviously, that in time of crisis, the price of electricity plays a vital role in shaping and affecting the economy. But it is important to say that the prices would rise if a country requires a high measure of petroleum derivatives to generate electricity. Through this fact, the economy can be affected by the inflation derived from increasing the costs of the produced goods and provided services.

#### 5.5 *Energy Security*

Energy security will be achieved as a result of the continuity in the provision of the electricity service, with affordable prices, and with a minimum of losses in electrical systems that make up the industry. Electricity industry can support domestic industries in maintaining competitive prices compared to imported products, as well as export industries with respect with their competitors in international markets. In addition, it will determine the electricity sector contribution to the national economy. The self-sufficient supply of electricity consumption will shape how successful it can be in this regard. If the decisions of private investors participating in the industry do not affect the prices of the service, it will be a strong indicator to achieve energy security, since it will not have any negative impacts on other productive industries of the nation.

### 6. **Conclusions**

The economic contributions from a well designed electricity sector can be materialized through the efficiency in providing the electricity service to the final consumers. The quality of the service depends on the permanent flows of electricity that contribute to maintain continuity in the productive processes in export oriented industries. Furthermore, the quality is related with the installed power capacity and produced amounts, which are correlated with the identification

and acquisition of the best technologies to generate electricity at lower costs and within a minimum margin of technical losses (Sorrell 2007). However, all electricity sectors, by their own nature, require large capital investments that can be canalized through the model under which is organized, governed and owned the electricity industry. The definition of the ownership in the different activities related with the electricity sector can contribute to prevent the formation of cartels and pools that attempt to increase prices of the service provision. The proper handling of these factors can play a part in improving the energy security of a country.

At this regard, the Republic of Korea is the most successful case. Since, it has accomplished considerable growth in installing power capacity through appropriate technologies, producing large amounts of electricity and providing the service at lower prices. Also, it is the world's 10<sup>th</sup> larger producer of electricity and the 9<sup>th</sup> in consumption. Also, the country's main policy has been providing the service at lower prices for supporting export oriented industries and keeping competitiveness in the international markets (Kang and Ha 1997).

The Korean model has allowed the injection of capital flows coming from private sector. In one hand, it has made it possible to improve the electric infrastructure in the industry. On the other hand, it has allowed the government to diversify its budgetary expenditure in this sector and allocate its remaining resources into other areas that also need its intervention as it has been with the case of gas and petroleum business. These large flows of capital from private sector together with the contribution of labor and technology have helped improving the productivity of the country and hence a positive impact on the growth of the national economy (Barro 1998).

Korea during the past 50 years has grown economically with a higher rate of 5% on average in its gross domestic product growth (Sung 2010). All of these provided contributions by the Korean electricity sector to the nation's economic growth have been materialized into reaching energy's self-sufficiency, or in other words, energy security. However, that situation has not been reflected by the other two Latin American countries analyzed in this research. In the case of Cuba and Guatemala both countries have suffered electricity shortages affecting in some way the economy's productive activities. Furthermore, both nations have not evolved their status as developing countries in comparison with Korea.

If the power installed capacity is mostly based on fossil fuels, as is the case of Cuba and Guatemala, the country is going to stay utilizing always its peak power plants to produce electricity. As a consequence the price of electricity service will be expensive for both the state and final consumer, affecting the nation's economic development, since domestic

products will be expensive and less competitive compared with foreign goods. Furthermore, the export oriented industries will lose competitiveness in international markets. For these reasons it is important to design accurately the electricity matrix based on renewable resources has been the Korea's case.

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