UNIVERSIDAD PONTIFICIA COMILLAS

ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA (ICAI)

OFFCIAL MASTER´S DEGREE IN THE ELECTRIC POWER INDUSTRY

Master´s thesis

ANALYSIS OF THE MEXICAN MARKET.

Barriers for the sale of energy to customers

Author: Javier Oscar Cuesta Castro

Supervisor: Patricia Blanco Fernández

Co-Supervisor: Alejandro Gros Irurita

Madrid, July, 2017

Master's Thesis Presentation Authorization

THE STUDENT:

Javier Oscar Cuesta Castro

.....

THE SUPERVISOR

Patricia Blanco Fernández

Signed: ..... Date: 28/06/ 2017

THE CO-SUPERVISOR

Alejandro Gros Irurita

Signed: ..... Date: 28/06/2017

Authorization of the Master's Thesis Coordinator

Dr. Luis Olmos Camacho

Signed: ..... Date: ...../ ...../ .....

SUMMARY

This thesis has been born with the mission of understanding the changes that are taking place in the liberalization of Mexico power system and assess how these changes would affect consumers, incumbent companies and new entrants.

The focus has been put on the commercialization of electricity as it is a part of the value chain which gains weight day after day. In fact, we may not know what the future of the power sector will look like, but we know the customer would be at its centre.

To evaluate the liberalization, a simulation and benchmarking analysis of different consumer type bills has been done before and after the reform. For it, a regulatory analysis of the current tariff and a forecast of the new additive tariff structure has been done. Along the document, the aim has been on identifying any temporal or permanent barrier that may appear because of the process.

In fact, some temporal distortions have been found due to the transition which will materialize in the figure of self-consumption societies but which due to its relatively small market share will not affect the success or failure of the retail market.

Finally, some key parameters preventing more private involvement in the retail market have been also identified and some proposals have been suggested to create a playing field where the retail market can be developed in its full potential.

Acknowledgment

This thesis has been possible thanks to the effort and patience of my colleagues of Iberdrola while helping me understand the multiple details and complexities of the new Mexican Power system. Specially, I would like to mention Patricia Blanco and Alejandro Gros, whose patient and commitment has been fundamental for the elaboration of this document.

Furthermore, my acknowledgement to Luis Olmos for the interest shown as Director of the Master and for following the evolution of the thesis, giving us orientation and advices to improve as much as possible and beyond. And thank you to the rest of the ICAI teachers for their implication in the "Master in the Electric Power Industry" which I believe provide an excellent understanding of the power sector.

And finally, but not least important, my recognition and gratitude to my family. They are always with me, helping me and encouraging me in all the things that I have done. Without them, this wouldn´t have been possible and neither would have made sense. They are my strength and my reason.

Index

Figure Index

1. EXECUTIVE SUMMARY

Mexican power system is facing big changes. From the amendment of the constitution to the creation of a new legal framework: La Ley de la Industria Eléctrica (LIE), the political commitment has been total.

In this journey from a vertical integrated utility to a liberalized system, nothing would remain as it was, among it, the commercialization of electricity which will go through a deep transformation in search of a well-functioning retail market.

In hindsight, the change to the Constitution, the highest legislative order, was probably a preamble of the changes that were to come and which, still nowadays, are being discovered.

Introduction and motivation

Mexico is a paradigmatic example in the power system history of South America. Its development, although conditioned in the same manner than the rest of Latin America power systems by foreign investments and the 80s defaults, have taken a different path than the rest, tackling indeed the liberalization 30 years later.

It is hence not surprising that this liberalization process has created much interest from academics and private agents alike as the investment requirements and regulatory challenges are daunting. Moreover, under the current situation of almost free capital and hungry searches for positive rates of return, the potential of Mexico seems nevertheless to deserve some attention.

Methodology

The focus of this document has been on the commercialization of electricity from the point of view of a company already in the market and of a new entrant. In the current structure, private companies can participate in the commercialization of electricity through the figure of self-consumption societies (Considered the incumbents for the rest of the document).

While some literature has been written on the topic, it has been mainly consultant´s reports and not academic papers, which nevertheless highlight the fact that private interest in this matter does exist. The contribution of this study has therefore been the creation of knowledge with regards to the retail market, with an emphasis on analysing what temporal distortions may have been created because of the transition of one scheme to the other and whether any barrier to the development of the retail activity may exist.

To do this study, an analysis of the current tariff structure and a forecast of the new additive tariff, which is soon to be approved by the Mexican authorities, has been done. Once the tariff was forecasted, a simulation and benchmarking of the resulting bills for different types of clients have been carried under both the integer and additive tariff to assess consumer situation. Finally, these bills have been decomposed in their different components to evaluate whether the reform may have any impact on the commercialization activity either for an incumbent or for a new entrant.

Conclusions

The study made has brought to stage the following things:

- Consumers:
  - Domestic consumers were subsidized by industrial loads under the integer scheme. With the new tariff, the formers are going to see a considerable increase in their final bill while the later would see a reduction.
  - Such increases in domestic consumer bill poses many political challenges so it is expected that some form of subsidy would need to be in place, although it won´t be in the tariff structure.
  - Additive tariff would present a better cost-reflectivity than the integer one.
- Incumbent private companies:
  - Incumbent companies would have an incentive to remain in the old scheme until their contracts expires as the regulated costs before the reform were lower.
  - This incentive to remain in the old scheme would lose strength as time goes by. Reduction in losses or energy prices above the expected will further weak that signal.
  - Incumbent companies would need to reduce their margin on self-consumption societies in the rage of 15-25$/MWh to remain competitive with respect to the new reference: the additive tariff.
- New Entrants
  - Publication of the additive tariff is a much-needed step to attract private agents interest in retail markets.
  - Self-consumption societies constitute a competitive advantage for private companies although its market share does not constitute a barrier in itself to the overall success of the market.
  - The reform has contributed to the improvement of the market but still, much work is needed to promote customer engagement and empowerment tools to create a more effective playing field.
  - Market concentration is very high as CFE accounts for most of market share. This may create an implicit barrier with respect to imbalance pricing and portfolio effects.

2. INTRODUCTION

2.1 INTRODUCTION

The life of South America power sector is a convulsive history of movements back and forth, like if from a pendulum we were speaking. The history has basically been a series of changes between private and public initiatives, and although the reason for the changes may have been different, the always prevalent leit motiv has been derived from the need of investments to keep up with the evolution in demand.

This history defines what power systems today are in South America, where they come from and what its more probable evolution is. In fact, understanding power system nowadays is almost impossible if one doesn´t take some time to understand the very deep nature of the reforms that have carried us to the place we are today.

The power system evolution in South America in its first years is not very different from other countries as the United States or Europe: Its birth was due to the initiative of private entities which were run under the quite passive view of the state, which by that time in South America, was more worried in creating regulation for mining and hydraulic resources. All this changed progressively with the development of major changes in technology and economics: the appearance of transmission assets, which based on alternate current and transformers, allowed the transport of energy from very distant places, calling hence for new economies of scale and making possible the realization of much bigger scale projects.

At the same time, the crisis of the 1930 and World Wars made the perfect mix for the first wave of reforms: the nationalization of the power sector. Companies were in weak financial position due to the crisis, which together with the biggest financial requirements that the new projects demanded, made them unable to cope with the situation and thus, opened the door for the State to take action. This resulted in the nationalization in almost all Latin America sectors and the undertaking of formidable hydraulic projects, which nowadays is the main different characteristic of these systems.

The 50s and 60s were years of formidable growth; WWII created a profound impact in our society, but the come-back was stronger than ever and growth rates for the whole world were remarkable in that time. Latin countries, which are very rich in natural resources, saw a strong growth in foreign demand and exports launched the country in a growth race against themselves that looked to have no-limit. Meanwhile, the truth was that the power sector was not facing its golden years as it could have been expected; the sector was being used mainly with political aims: Inflation control, employment, deficit measures, ... And the truth is that while the wheel

was spinning, no one was worried about how the party was going to end. Still, the last one leaving was in charge of turning off the light.

In 1973 took place the first big announcement that the power sector may be under some stress and perhaps needed some adjustments: Demand for electricity skyrocketed due to the oil crisis and demand for electricity did the same with the consequent ramping increases in prices. Governments needed to step in and took some measures that prevented the system from collapsing under the pressure that was being built around the prices and scarcity conditions; nevertheless, it was made clear that the system required important further investments as the system was getting old and unable to meet the new demand.

However, the party dance that were the 50s and 60s were already way over and the budgetary situation of the countries were at least, worrying. In fact, the 80s saw one of the most remarkable periods in financial history of country defaults, maybe only comparable to the Far-East defaults in the late 90s which, on the other hand, in the case of China, would settle the more solid foundation that will make the 2008 crisis less dramatic for them.

In any instance, this situation (Governments under huge financial pressures and big investments requirements) made the perfect storm for the liberalization process, which was seen as a solution to both problems. Chile took the lead and proposed a comprehensive reform where marginalism theory played the main role: Networks would be a regulated business but generation would be a liberalized activity. Agents, therefore, would be free to install generation where they wanted and would recover their investment through market incomes. Still, some capacity payments would be required in order to fully recover their investment derived from the "missing money problem" (Arriaga, s.f.). This, although a little bit contradictory, was solved through some capacity markets and the general scheme was very successful being emulated by the rest of Latin America countries with different lagging periods. The main exceptions were Venezuela and Mexico.

The history however played a tough lesson on South America and the scheme wasn´t finally as successful as it initially seemed. The first years after the reform saw a fantastic performance in countries like Chile and Argentina, which caused that all the countries launched their own initiative, but after a couple of years, the investments started to not materialize and security of supply problem reached a new dimension with measures such dramatics as that one in Brazil, where energy consummation was rationed by 20% for 9 consecutive months, from June 2001 to February 2002 (See (Batlle, et al., 2010).

Although the government response was strong and specific programmes for investments were put in place, the fact that the current design may be flawed was already on stage. Moreover, other countries as Chile or Dominic Republic faced similar situations. The blame was put on the intrinsic characteristic of the system, whose hydro dominance made prices to be very volatile hence not giving investors enough certainty about the recovery of their investment. In addition, capacity markets were also put on stage ((Batlle & Arriaga, 2010) and bankability of the projects were also criticized as cash flows were not very stable.

Whatever the particular details are as to why the mechanism was flawed it is not important per se, but something more general emerged from this experience which I think is relevant in the overall history of South America: The difficulty in materializing foreign investments. Again, whether this was due to the higher discount rate (country spread rate) investors were applying to value the projects or whether the 80s defaults were still in the mind of investors is not really important. It is important, however, to bear in mind investors showed a more cautious attitude than the one it could have probably been expected under normal conditions. It makes sense therefore to think investors may present the same bias in the future.

The truth is that this experience, whatever its causes, brought on the 3º wave of reforms, when the pendulum swung again, this time back towards a more regulated business. In fact, there were countries which were still on a liberalization path when they took again measures from a more regulated scheme. Brazil and Chile were the main exponent of this movement when in 2005 and 2006 they implemented respectively energy auctions and reliability options as a measure to ensure investor rate of return and tackle the security of supply problem.

Afterwards, many countries have taken the same path and have pursued a reform based on long term auctions as a way to guarantee the security of supply problem. Although nothing is intrinsically wrong with this approach, some may argue what is the sense of having everything secured under long term auctions in a liberalized market approach? And moreover, some further questions may be raised as to what the impact of this can be on the wholesale market? How would one agent, which income is almost completely hedged, coexist in the market with others which incomes are based on market prices?

These questions and others have been tackled for example by the winter package and PJM market report in extensible length without reaching a clear definitive conclusion. So far, it seems clear private agents are campaigning for the implementation of long term contracts as they see them as a needed feature to guarantee the smooth running of the system. Meanwhile, regulators are taking different positions across the world being South America a strong example of the implementation of long term contracts. Another further discussion could be what the design of these instruments should be, whether firm energy based, capacity based or more complex alternatives as reliability options.

And where does Mexico stand in all this?

Well, the case of Mexico is a paradigmatic one as it is going to tackle the reform in a very deep, comprehensive way. While the other systems have danced at the rhythm of the pendulum: first, liberalizing in the 90s and then coming slightly back towards a more regulated scheme in the first decade of this century, Mexico is making the full journey from a regulated integrated business model towards a new scheme with no intermediary steps.

The process started on the 12th August of 2013 when the President Enrique Peña Nieto presented the reform for the Energy sector, which had been approved by the Senate on the 11th December of 2010. In this manner, the "Ley de la Industria Eléctrica (LIE)" was born. In addition, changes to the highest legislative order, the Constitution, were required.

In hindsight, these amendments to the constitution were probably a preamble of what was to happen: The new reform was there to completely change the Mexican power system and the scope of this change is something that still today, needs to be discovered.

2.2 MOTIVATION

Mexico is changing. No one would be surprised by that statement, but the extent to what all stakeholders will be affected is still quite uncertain despite all the literature that has already been written.

Liberalization processes always create a lot of excitement, both for academics and private entities alike. The first can´t avoid seeing a great opportunity to experiment with new ways to increase market and system efficiency while the others see a great opportunity to make business. Whatever point of view you choose, the case of Mexico, of course, is not different. The size and complexity of its market size poses many challenges that have taken everyone attention, including mine.

The Mexican liberalization has been exhaustive in its form, from the amendment of the constitution to the abolishment of the old "Ley de Servicio Público de Energía Electrica" in favour of the new born "Ley de la Industria Eléctrica" of 2014, few things have remained as they were. Going through all the legislation that the process is creating would require a lot of space, but in general terms, and as a brief comment, it could be said that many international good practices

are being followed. It seems all the authorities involved in the process are up to date with regards to the latest energy regulatory trends.

From CFE vertical and horizontal unbundling to the celebration of long term auctions, nothing seems to have been left unattended. There are, however, some questions that remain open, and are the consequence and heritage of the old system. How the transition would take place? How would CFE compete in the new liberalized system? Would additional requirements be needed as for example the transition to the competence payments seen in other countries? Would cross-subsidies appear between the old and the new scheme? Would private entities migrate to the new system?

Besides all these, the tariff is also suffering some major changes as it is moving from an integral one to an additive one. How the tariff would look like and what it would be is very relevant for private entities acting as retailers for qualified users, as their offer consist in applying a discount over the tariff. What value hence the tariff would take has a huge impact on the liberalization of the retail sector. So far, given the state of the system and its costs, expectations are that the amounts to be recovered through the tariff should be high; however, this is not so straight forward. Tariff design has many political implications that make its value and design difficult to forecast. Would the government subsidize basic consumers? Would the inelastic demand account for a higher part of the amount to be recovered (Ramsey)?

The importance of tariff forecasting and its complexity gets even enhanced by the fact that private entities can decide to remain in the old scheme where interconnection charges would remain as they were previous to the reform. What are then the economies behind this decision? Meaning by this, how those interconnection charges calculated ad hoc would compare with the values coming from the new tariff design and structure? It won´t take long to the reader to realize that it is almost impossible that these values would match. This, of course, is important. If old interconnection charges are lower than the corresponding tariff, it would create an incentive for private agents to remain in the old scheme until the bilateral contracts expire. Furthermore, in that case, retailing would be a very lucrative activity as transmission and distribution costs wouldn´t be any more a direct pass through. Consumers would be paying the regulated tariff while agents would be paying the ad hoc previously calculated connection charge of the self-consumption society scheme.

Other question that remains open could be what the evolution of electricity prices to be recognized in the tariff would be in the future, as new efficient generators enter the market and displace CFE inefficient plants. And moreover, what value, if any, could be created by the liberalization of the retail sector if the tariff is very low? And what value would private agents be able to capture in that part of the value chain? Would the margins be appealing enough to create private interest?

As it has been briefly explained, Mexico liberalization is still in an uncertain stage with many pending issues unclear. It is hence not surprising that Iberdrola, as the biggest private agent in the system, has also a strong interest and motivation in forecasting and developing an accurate understanding of all these issues and what the impact on its operations this could mean. The study, however, would be developed from a general point of view to make the study more didactic and would only represent my opinion and understanding on the matter.

As I hope is understood and share by the reader, all the questions raised are a good argument for the realization of this study, either from the academic or the corporate perspective. Whatever the case, they have been enough reasons to motivate me to the realization of this document.

2.3 REGULATORY SCHEME. TOWARD A LIBERALIZED SYSTEM

In this point, the major authorities and its functions and responsibilities are going to be briefly explained. Then, an overall picture of the Mexican Power system is going to be presented covering capacity installed, energy consumption and planned investments.

Finally, past and current power system structure is going to be presented making on emphasis on what the allowed contractual relationships are mainly from the point of view of the commercialization of electricity.

2.3.1 Main authorities

SENER

It is the Secretary of Energy. Its major responsibilities are the design of the national energy policy and the planning of the SEN (National power system). In addition, it is also in charge of establishing the Green Certificates requirements (CELs). Finally, it has a coordination and supervisory duty in one of the most important task of the reform, which is the transformation of CFE.

CFE

CFE was previously a vertical integrated public company. After the reform, CFE has gone through a legal and functional unbundling and now is a productive company for the state through the figure of the state dividend (Article 5 LIE). Among its functions, is in charge of the transmission

and distribution service and is authorized to commercialize and generate electricity under the legal schemes approved by the LIE.

Figure 1. CFE legal unbundling

CRE

It is in charge of defining clear and concise rules and procedures for the functioning of the MEM (Mexican electricity market) as well as supervise that they are followed. Besides, it has to approve the licenses for generation and interconnection contracts and issue the tariff regulation.

CENACE

It is a new figure that was born as a result of the liberalization process started by Peña Nieto. Its main responsibilities are the operation and control of the SEN (National power system) and the MEM (Mexican Power Market). Moreover, it is charge of celebrating the CFD auctions to be signed by suppliers on behalf of the demand and generators. Its role is that of an independent system operator (ISO) and its allowed income are recovered through the tariff.

2.3.2 System figures & Market structure

Located in the north of Latin America, connected with US, Mexico has a strong strategic position as the frontier between both worlds. Nevertheless, its economy and development has always been more linked to other South American countries than to its richer neighbour.

With a population currently of 120 millions and clear expectations of further demographic expansion, its power system is always under continuous expansions pressures to keep up with the increase in energy consumption.

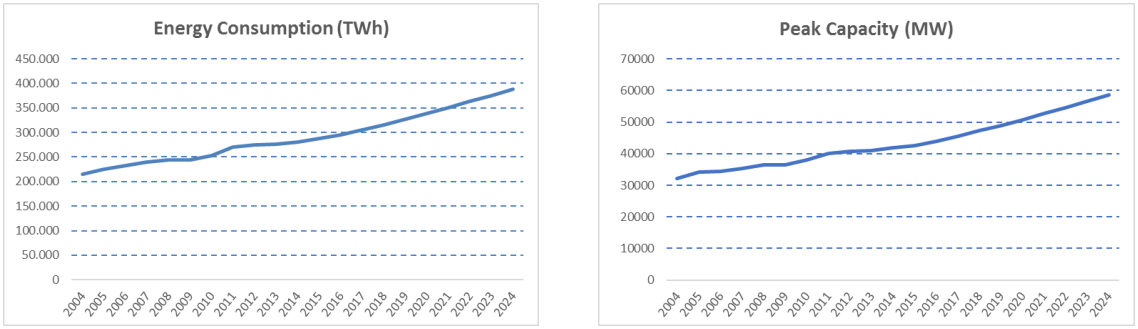


Figure 2. Energy consumption and peak demand. Data from SENER

With regards to capacity installed, the system is still today formed by a big amount of thermal units and a small penetration of renewable technologies. Besides, Mexico doesn´t count with big amounts of hydro resources as it is the case for example of Brazil and Colombia.

Getting into the numbers, we find a system in european standards short of capacity with a capacity instlled in 2016 of 73.150 MW. This together with the thermal mix causes that CCGTs run almost as base loads with peakers being other more expensive technologies as turbo gas or hydro (oportunity cost), when storagable. Energy consumtion for 2016 was 289 TWh.

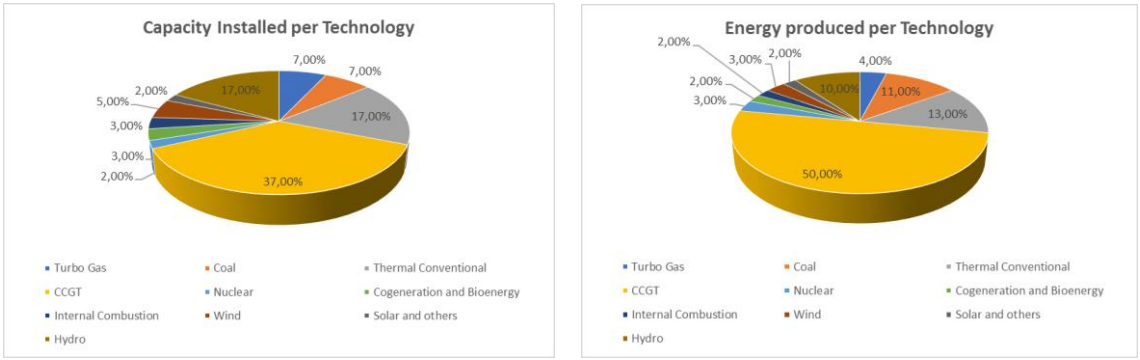


Figure 3. Capacity installed and energy produced per technology 2016. Data from SENER

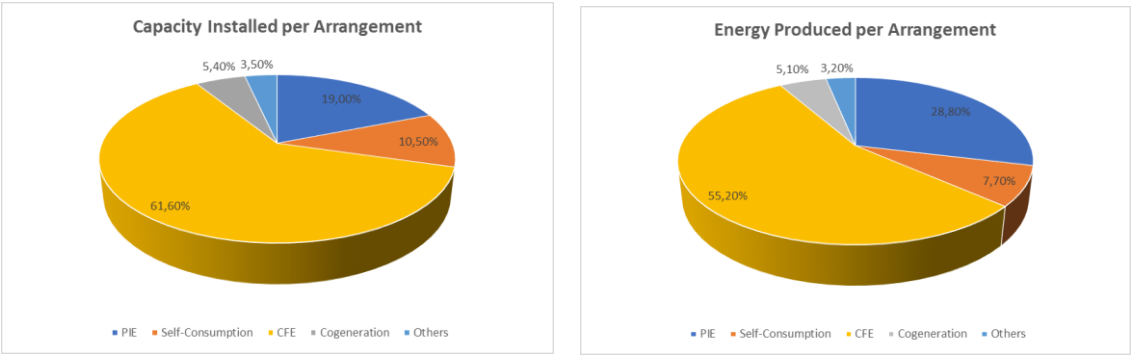


Figure 4. Capacity installed and energy produced 2016. Data from SENER

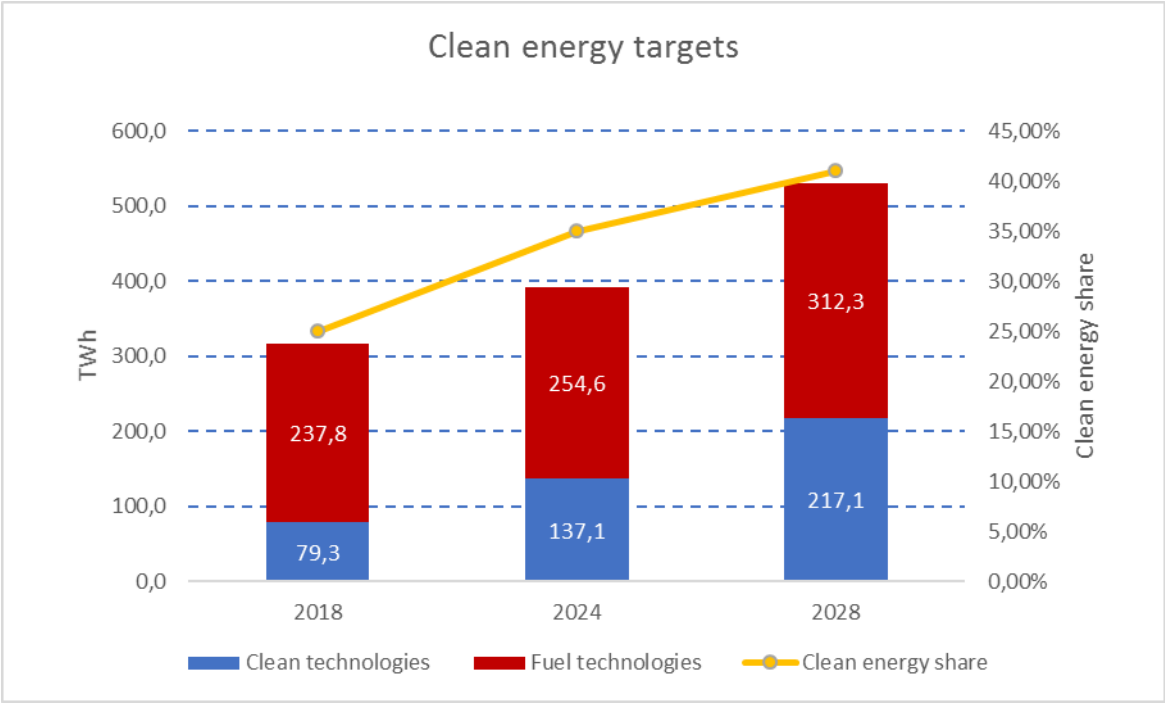
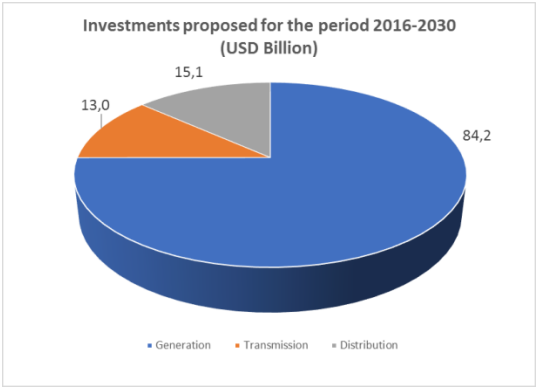


Figure 5. Clean energy targets. Data from SENER

These two aspects together with the fact that the country comes from a very long period with a public vertical integrated utility makes the situation similar to other south American countries in the 80s and 90s: Important investments are required in almost all parts of the value chain. Moreover, this time the situation is even tougher due to the requirements imposed by the climate change issue, probably the biggest challenge of our society.



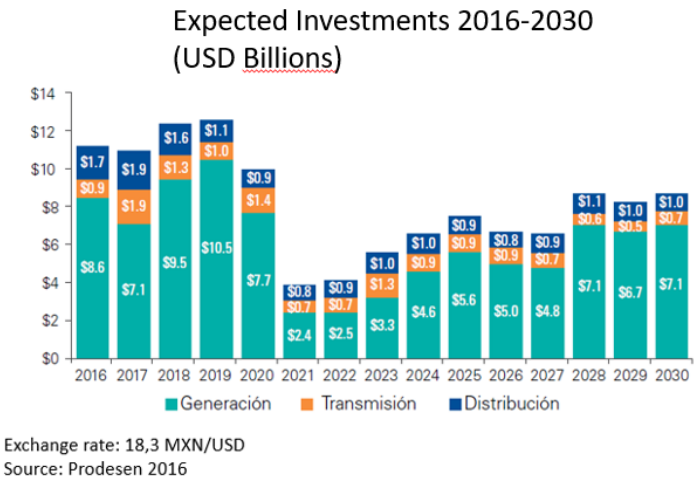


Figure 6. Investment required in the period 2016-2030. Source: SENER

There are many reasons why this is relevant, but the most important one from the point of view of the constitutional reform, is probably the constraint that this imposes on policy makers: Foreign investments are more required than ever. How this would concretely materialize is a difficult task, but in my opinion, and looking to the past experience of South America, I believe they would try to create a framework where rates of return seems stable enough in order not to step away investments.

In addition, if there is something good in learning from past experiences is that you may avoid suffering them in your own skin, and perhaps, 2001 made clear that foreign investment have some important bias which should be taken into account, and perhaps, that the materialization of investment is a requirement which may cause the failure or success of all the scheme.

MARKET STRUCTURE.

The structure before the reform was a vertical integrated utility with a public monopoly hence that the processes were quite straight forward and non-excessively complex.

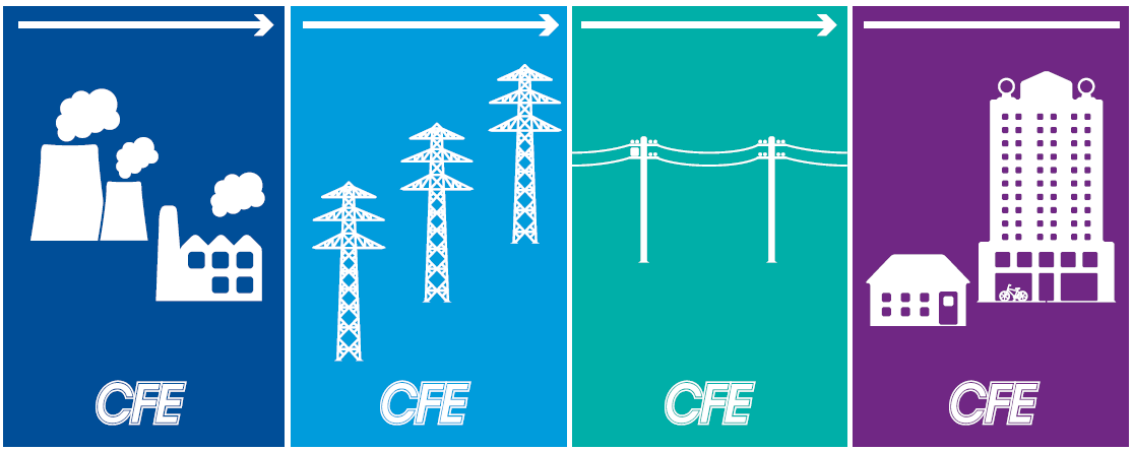


Figure 7. Structure previous to the reform. Source: KPMG

Private agents could participate in the scheme basically under three schemes which were the following:

- Independent power producers. This was probably one of the preferred ways for private agents to participate in the system. Basically, private agents were awarded a PPA with CFE for a period that was enough to guarantee the viability of the investment. The process was done through an auction where financial and economic criteria were used.
- Cogeneration. A mixed process of heat and electricity production equal to what we know. Only particularity is that the net energy injected to the network is paid at 0,85 CTCP (Short term marginal costs)
- Self-Consumption. This is probably the most complex arrangement from both an economic and administrative point of view. Indeed, the administrative burden is important which some may argue has supposed a barrier to its higher penetration. In this structure, a legal society is constituted where the generator and the clients among which the energy is going to be commercialized, need to submit some equity. Once the legal procedure is in place, the commercialization of electricity can take place under the self-consumption regulation. Billing and payments are agreed between the parties, which are usually structured in the form of long term contracts. When energy from the generator is not enough, CFE steps in and supplies the remaining requirements of the consumers, which later would also receive a bill from CFE. Net injections to the network are paid at 0,85 CTCP. Finally, payments to CFE for the use of the network need to be made, which is done through and ad hoc study.

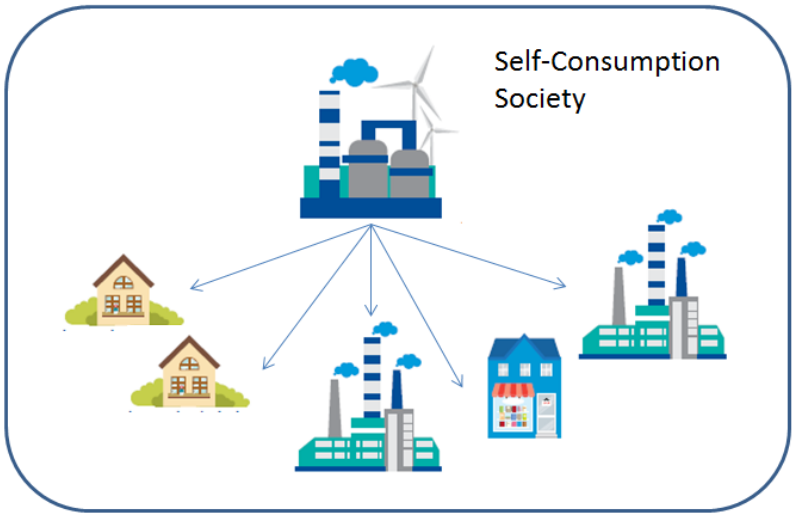


Figure 8. Self-consumption society

Meanwhile, the reform has created a framework similar to that of European and North America systems. Without getting much into the details, it could be said that the structure and the functioning of the market is quite similar to that of PJM (Pennsylvania-New Jersey-Maryland)

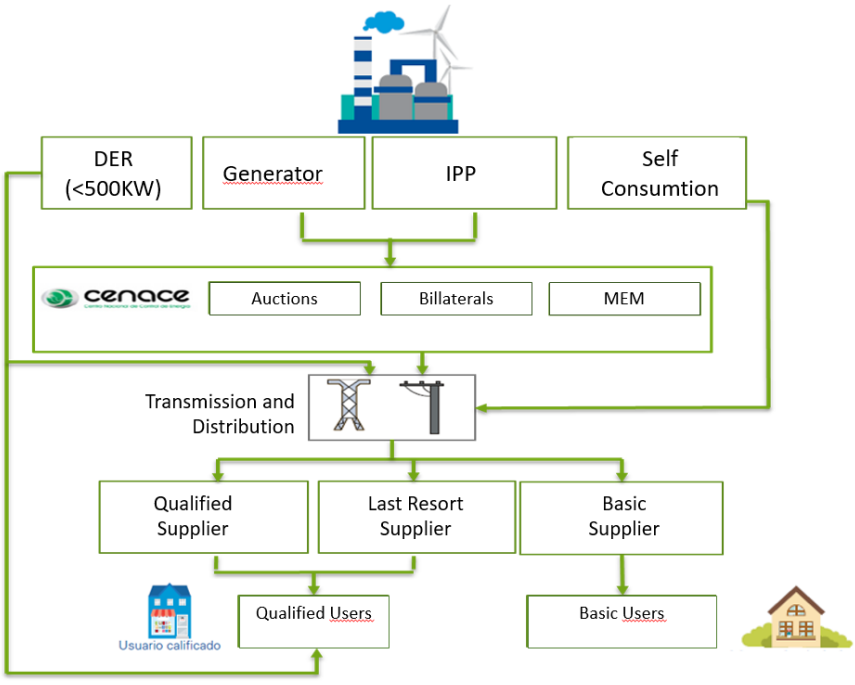


Figure 9. Market structure after the reform

Furthermore, on top of this, it is going to be a major change in the tariff which is going to evolve from an integer tariff to an additive formula in an attempt to better reflect the real costs of the system.

The situation thus now is quite challenging as private agents have been given the chance to remain in the old scheme until their contracts expire or migrate to the new structure. Given that the focus of this document is in the retail activity, self-consumption societies are the main figure to be analyzed, as they are the only option private agents have to commercialize electricity under the old scheme.

Something else, that although basic, needs to be clear before continuing is the fact that they commercialize electricity with respect to the tariff, basically, applying a discount over that reference. Therefore, when the new tariff is approved and comes in place, the de facto opportunity cost for the commercialization of electricity would be the value of this new tariff, as consumers would otherwise leave to the liberalized market. Prices of old contracts may then be important or not, all will depend on which value the new tariff takes.

$$Opportunity\ cost = \max(old\ contract\ price, new\ tariff\ value)$$

$$Retail\ price = Opportunity\ cost - discount$$

In this manner, the question becomes whether to remain as they are, migrate to the new system or whether the option is not even there if consumers would decide to migrate by themselves. The question at the end can be simplified in 2 components. Basically, from the company point of view is a matter of costs (In which scheme they are lower), as their opportunity cost in the end would be given by the new tariff. Meanwhile, for consumers, it is a simply matter of price in their final bill (They will not care about the internal structure of costs of the commercialization company)

- Company point of view → Regulated costs
- Consumer point of view → Final Bill

3. OBJECTIVES

The objective of the thesis is to analyse the Mexican reform, identifying the main barriers of entry for the sale of energy to clients either from the point of view of an incumbent agent or from a new entrant perspective. A special emphasis is placed on the possible transitory phenomena that can happen during the transition. In order to accomplish this, we would need to cover other objectives.

- Understanding and forecasting the new additive tariff: Transmission, Distribution, CENACE operation, supplied energy for regulated consumers and the margin for the retailing activity.
- Identify main drivers for these components.
- Analyze critically assumptions behind the tariff and whether they can materialize (Losses reduction profile, wholesale markets prices (SENER forecast…)
- Asses and evaluate CFE situation in the new regulatory regime.
- Development of a methodology to compare performance in both regimes from the consumer point of view.
- Identification of the incentives for incumbent companies to stay or migrate to the new scheme.
- Identification of the attractiveness or the barriers that may determine the decision of new entrants with regards to the retail activity.

4. METHODOLOGY

The scope of the thesis is quite large as has already been seen in the objectives. Indeed, many of the concepts and techniques that have been learned though the Master would be applied along the development of the study.

First, all the material learned in the Master has been required to navigate through the incredible amount of regulation and legislation that operates the Mexican power system. Once this was clear, the forecast of the tariff took place. To do this, many techniques have been used as time series analysis, forward values as spot predictions, implicit volatilities for the creation of various scenarios of currency movements…

Getting more into the details, the most laborious areas have been forecasting losses and energy prices.

- For losses, a multi-regression analysis has been used. Basically, the critical explanatory variables for losses have been identified and then a multi-regression analysis based on past data have been used to forecast losses evolution. The variables used have been energy consumption, number of consumers and network investments. Once losses

forecast was ready, they have been monetized according to the different nodal prices to see what their monetary impact can be on the tariff.

- For energy prices, the methodology used has been that dictated by the document A/045/2016 which explains that energy prices would be the resulting price of an option on CFE most efficient plants with strike price the MEM price. To compute these values, data from CFE most efficient plants have been collected and those costs have been updated according to future fuel costs per node, US and Mexico inflation and exchange rate. This expected future costs with its associated location have been compared with current SENER forecasts for the MEM to see whether the option would be called or not. With that resulting price, updated nodal prices have been computed for the nine regions where the study is being carried out and which would be the energy price to be reflected by the tariff.

Second, and once the new additive tariff was forecasted, an equivalence system between the old tariff and the new one has been established for the different types of clients. In this way, a direct comparison is possible. With this equivalence system in hand, an average consumer has been identified for the main relevant sectors (domestic, commercial, services and industrial) and its average monthly bill has been calculated in both schemes. Very high loads as the ones in HT has been omitted as there is still nothing published about how these loads are going to be recognized in the tariff.

In the comparison, apart from merely identifying the increase or decrease in the

A critical review of the results has been made with a focus on whether the new situation is sustainable or what second order effects these prices may have for the system.

	Contracted capacity (kW)	Load factor	Peak consumption	Valley consumption
Domestic consumer	3,3	0,15	70%	30%
Commercial	10	0,2	55%	45%
SME (services)	40	0,35	50%	50%
Industrial load	8000	0,9	45%	55%

Figure 10. Energy contracted for analysed consumers

Third, a simulation of the resulting bills for the different types of consumers have been carried out under both the integer and the additive tariff. This bill simulation has been done decomposing the price in its different components: Transmission, distribution and other regulated costs like the CENACE. The aim is to identify which components are a direct pass-through (regulated costs) and which compose the gap to the commercialization activity (Energy price and commercialization margin). That gap for the commercialization activity is defined as Mark-up which is understood as the room a retail company will have to create value (The non-pass-through components of the tariff)

$$Mark - up = Retail\ price - regulated\ costs$$

After the bills have been decomposed, mark-up values for different areas have been compared for self-consumption societies between the integer and the additive tariff with the focus on analyzing what incentives they may have in migrating to the new scheme or remaining in the old structure until their contracts expire. Key parameter here is whether any cross subsidy between the two schemes would appear and whether any additional profit margin for the company may appear. Moreover, if any cross subsidy exists, the next question should be who would capture it?

Price differentials between the mark-up under the integer and the additive tariff have also been computed as these values would give an idea of how would the margin of self-consumption societies evolve.

$$Price\ differential\ = \frac{Markup\ (integer) - Markup(additive)}{Energy\ consumption}$$

Basically, if the mark-up is lower under the additive tariff scheme, this would mean that the gap for the commercialization activity is lower. Therefore, assuming generation costs are the same under both schemes, a reduction in the margin would be required to remain competitive.

Fourth, in view of all this, an analysis of the main barriers to the commercialization of energy for new entrants is exposed with a focus on the possible future evolution this may take. For this, the methodology developed by Acer and CEER in its 2017 Handbook *How to Assess Retail Market Functioning* for National Regulatory Authorities has been used.

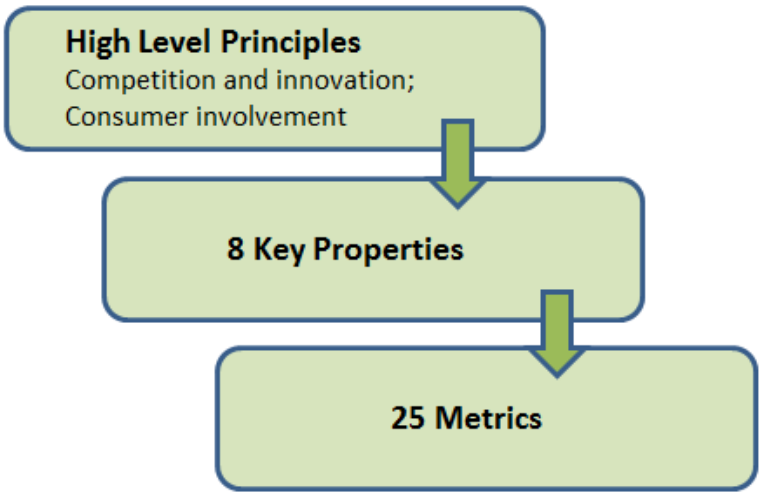


Figure 11. ACER and CEER methodology. Retail market

Finally, to close the document, conclusions are presented and some further lines of research are identified.

5. TARIFF STUDY AND FORECAST

This chapter is probably the most quantitative part of the document. On it, different forecasting techniques have been used to derive a sound and meaningful forecast for the tariff in the next years.

At the same time, some analysis has been made with regards to the schemes they have employed to regulate the different parts of the sector. Special attention has been devoted to distribution, where a deep analysis of losses recognized and losses evolution has been carried out, and to the energy price to be reflected in the tariff, where a study of the CFD mechanism and the price evolution has been done for the nine regions in which the Mexican sector is divided.

Moreover, some comments have been made about what the implications of these regulatory schemes can be for the different unbundled areas of CFE. The focus has been above all on whether they may be able to recover their investment or what problems may appear in the future under these schemes.

Although this chapter is therefore not strictly necessary for the overall aim of the document, we believe the interested reader may get some interesting insight from the reading of it which will make the effort worth it. Otherwise, please skip to chapter 6 with no overall impact on the main conclusions to be derived from the study.

5.1- Transmission

The power sector is a network business as it is well known; hence that transmission cost, which is a natural monopoly and regulated business, should somehow be recovered. In line with this, some may argue that investment cost of the network could be recovered though congestion rents, however, varies studies proved that these can only recover around 20% of the investment. How and whom should therefore pay for those residual costs caused by the investment in the network?

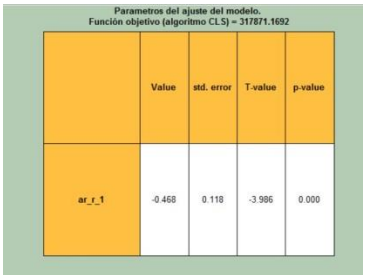
Beforehand, however, the first question would be how much money should be paid. This indeed is a common problem to all the countries with a well-functioning power sector. Therefore, international praxis stipulates that the cost of the transmission can be derived into a capital cost (Return on capital plus depreciation) and an O&M component, which is the methodology followed in Mexico. The following figures have been based on the audited cost facilitated by CFE.

Recognized cost (Millions USD)			
	2016	2017	2018
O&M	1169,1	1068,0	1041,8
Capital cost	1223,8	1071,5	1045,2
Allowed revenue (Total)	2392,9	2139,4	2086,9

Figure 12. Recognized cost for transmission activity

The next question is how these values are going to be updated which is fixed by the article 43 of the agreement A45/2016.To do it, it has been needed to forecast the inflation for Mexico and the exchange type between USD and the peso.

The methodology used to forecast the inflation index for Mexico has been time series analysis: an ARIMA model has been fit to past data. It hasn´t been possible to use public forecasted data from some financial provider as the index composition is not exactly the one published by most financial sources. Indeed, the index has needed to be elaborated from data from INEGI. Exchange data forecast has been taken as forward values in future contracts from a Bloomberg terminal (There are theories which claim that forward values are in theory the best estimate for future spot values). Another 2 scenarios have been built for the exchange forecast based in the mean +/- one standard deviation. Standard deviation value has been taken again from a Bloomberg terminal as the implicit volatility of option contracts.



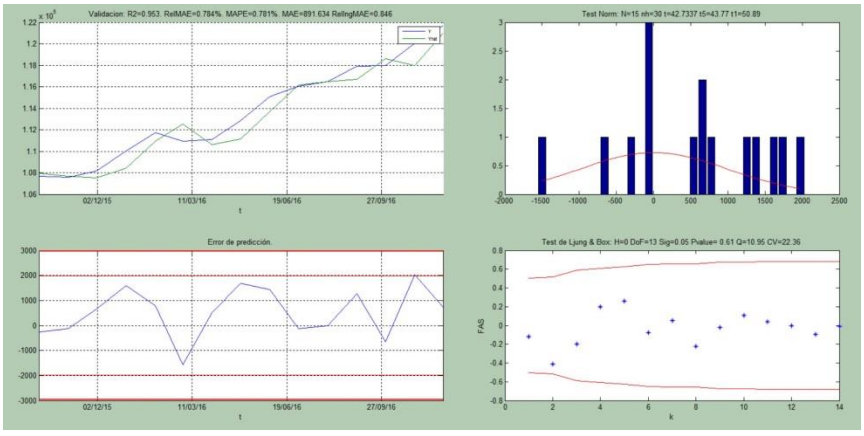


Figure 13. Inflation forecast. ARIMA. Adjusted coefficients

Regulatory discussion and allowed revenue allocation

Once the total amount has been calculated, who and how this would be paid can be decided. Who would pay for it has been solved easily saying it would be 30% generators, 70% consumers. The reasoning behind this is however more challenging, but the more probable answer is that they have allocated a bigger part to those whose consumption is more inelastic (Ramsey pricing)

With regards to how this would be recovered, some apparent mismatches have been found in the regulation. Articles 23 and 24 of the transmission tariff article states that capital cost would be recovered proportional to the demand while the O&M would be recovered though the energy consumed. What initially was understood from this was that capital cost would go in a USD/MW term while O&M would go in the energy term, USD/MWh. This, although not the first best solution, was considered reasonable. However, it has been a surprise to discover that the tariff proposed is only volumetric and it just differentiates according to two voltage levels.

Tarifas de transmisión de energía eléctrica
pesos / kWh

Nivel de tensión	**Generadores** Generadores interconectados	**Consumidores** Servicios de suministro
Tensión ≥ 220 kV	0.0499	0.0625
Tensión < a 220 kV	0.0904	0.1424

Notas:
1. *La tarifa para generadores aplica a todos los generadores que participen en el MEM, y para inyecciones de energía en el primer punto de interconexión del territorio nacional asociado a importaciones*
2. *La tarifa para consumidores es aplicable a todos los Usuarios Calificados participantes de Mercado, Suministradores, Comercializadores que adquieran energía en el MEM o sus representantes, y extracciones de energía en el último punto de conexión del territorio nacional asociado a exportaciones.*

Figure 14. Proposed transmission tariff

It is true that they have made some mention to the long-term capacity marginal price, but still, there is no easy way to understand what it is being accounted for by those factors. Moreover, the fact that the factor for the low voltage is 1 makes it just negligible. The fact that the values are different for consumers and generators at the higher voltage also raises some questions as to whether further differentiation was needed on top of the 30-70 previously mentioned.

Factores de ponderación por nivel de tensión

Nivel de tensión	**Generadores** Generadores interconectados	**Consumidores** Servicios de suministro
Tensión ≥220 kV	0.55	0.44
Tensión < 220 kV	1.00	1.00

$$Td_{i,j} = 70\%IRn \times 1/(MWhd_{i,j} + MWhd_{k,j} * FPd_{i,j})$$

$$Tg_{i,j} = 30\%IRn \times 1/\ (MWhg_{i,j} + MWhg_{k,j} * FPg_{i,j})$$

Where: Tdij is the tariff applicable to consumer i connected at the voltage level j; IRn is the yearly net allowed revenue; FPdij is the weighting factor for the voltage level; MWhdij is the energy consumed and MWhdkj is the energy consumed by the remaining consumers.

Figure 15. Weighting factors to compute tariffs

Derived from this, it can be observed that they are increasing the contribution from low voltage consumers and generators in favor of high voltage consumers besides increasing the contribution from generators in favor of consumers at the same voltage level. While the difference between high and low voltage can be somehow explained, based for example, on the need of further transformers, the difference between generators and consumers at the low voltage is not really well understood. Finally, how this relates to the long-term capacity marginal price is not very clear.

In any case, the final truth is that the transmission is recovered though a fully volumetric term which is not the best alternative. This for example creates the challenge of how to regulate self-consumption, as by netting your own demand with your own generation, you can avoid paying the network. Moreover, this poses another challenge which is that you are linking long term decisions as investments in the network with short term decisions (The decision to consume energy)

In conclusion, from the three possible alternatives of recovering the network costs: €/MWh, €/MW or a fixed term, CRE has opted for the first, which although common practice in many countries, many voices have started to claim it is not the most efficient option. In addition, it is believed that by going by this path they have missed the chance to design a better suited tariff for the future to come, as for example, in the form of higher penetration of self-consumption.

Another relevant comment has to do with how the new and the old scheme would coexist at the same moment in time. Indeed, the challenge is in deciding how much people would stay in the old scheme and how much people would move to the new scheme as this needs to be forecasted in order to calculate the tariff. At the end, what they would do, basically, is assume everyone is in the new scheme and adjust ex post by comparing allowed revenues with recorded revenues and subtract any excess to revenues from coming years. In principle, as more people migrate to the new scheme, allowed revenues and recorded revenues should get closer.

5.2- Distribution

The way in which this section is structured is the following; first, a brief description of the methodology is going to be presented, second, the methodology would be developed and CRE assumptions and computations would be tested and third, some analysis and conclusions would be made.

With regards to the methodology used, distribution regulation is a well-developed area hence that the process followed has already been done in other countries. The methodology is basically composed of two tasks:

- Compute the allowed revenue for CFE distribution.
- Allocate this revenue through the different agents in a way that ensures a fair and transparent use of the network.

CFE allowed revenue is divided in capital costs and exploitation costs, being the former depreciation costs and a return on capital while the latest, being mainly O&M costs. Many different methodologies exist to compute these values but the ones used in Mexico have been Net Replacement Value (NRV) and the O&M is taken from the audited books of CFE.

The scheme followed has been the incentive revenue cap with a regulatory period of 3 years, 2016, 2017 and 2018. Allowed revenues are adjusted for inflation, efficiency and economies of scale. The efficiency incentive has been designed differently for the different divisions. With regards to the rate of return, this has been calculated based on an estimated WACC by the CRE. The value initially proposed for the first regulatory period is 10,07%.

$$T_t^i = T_{t-1}^i * (1 + inflation - FEC - FEE)$$

Where T is the tariff in different moments of time and FEC and FEE are the efficiency and economies of scale factors.

The scheme works in the following manner. Any additional efficiency gain with respect to the proposed by CRE would serve to increase its profit margin. The same way, if the efficiency path proposed by CRE is not achieved by CFE, this money would appear as a loss for CFE.

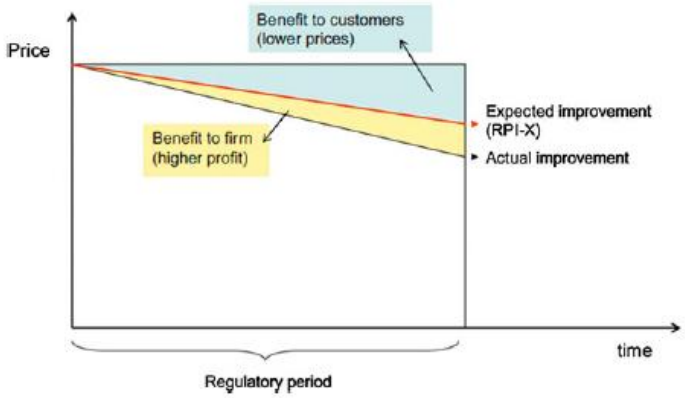


Figure 16. Incentive based regulation

Finally, losses are also used as an incentive as they are recovered on top of the tariff and are shared between distributors and consumers. Moreover, losses below the threshold stated by CRE would be credited to CFE as additional income. With respect to consumers, the way in which consumers would pay for losses is by the additional volume of energy they would need to contract to account for them (Loss factors).

5.2-1. Efficiency and economy of scale factors.

Economies of scale are added as they are important characteristics of network business. Different efficiency measures are also added to the different divisions as an incentive to improve. Higher values can be observed on those areas where higher margin to improvement exists.

Efficiency and Economy of Scale		
DIVISION	EFICIENCIA (%)	ESCALA (%)
Baja California	1,70%	1,00%
Bajo	0,10%	1,00%
Centro Occidente	0,00%	1,00%
Centro Oriente	1,30%	1,00%
Centro Sur	1,20%	1,00%
Golfo centro	0,50%	1,00%
GolFo Norte	1,00%	1,00%
Jalisco	0,90%	1,00%
NorOeste	1,00%	1,00%
Norte	2,60%	1,00%
Oriente	1,70%	1,00%
Peninsular	0,90%	1,00%
Sureste	3,20%	1,00%
Valle Mexico Cent	4,00%	1,00%
Valle Mexico NTE	4,90%	1,00%
Valle Mexico Sur	4,60%	1,00%

Figure 17. Efficiency and economy of scale factors for the distribution activity

5.2-2. Loss factor.

The methodology used to allocate losses is based on loss factors, which is found consistent with the nodal pricing scheme. Nodal prices are used to account for the losses at the transmission level while the loss factor method is being used to account for the losses at the distribution level. The reason to use both methods is probably simplicity, as running the nodal price method at the distribution level would have probably posed some important computation challenges (Number of nodes would grow exponentially). This way of leading with losses is indeed one of the most advanced as economic signals are sent both at the transmission and distribution level.

In the loss factor scheme, agents are obligated to account for losses through their volumes of energy sold or bought, which at the end, increases effectively the price they pay for electricity, sending therefore the desired signal. Another interesting feature in this mechanism, and open to debate, however, is who buys the losses and how are then passed to consumers; It can be the distributor who buys the losses and then bill them to the consumers or it can be the suppliers directly.

5.2-3. Losses forecast. Multi-regression analysis.

Losses are always a controversial issue whose importance can be crucial for the agents of the system, especially, in developing countries where the values may be very high. The question indeed is twofold, first, who is responsible for the losses and second, what regulatory scheme would produce the most efficient outcome.

In previous sections, it has been presented briefly the measures the CRE has opted to implement for regulating the allocation of losses. Now, in this part, it would be analyzed the losses estimated by the CRE and whether there is data evidence that suggest that this trend can be achieved. In order to do this, the losses percentage at the distribution level are computed from loss factors under the assumption that 40% of consumption is in medium voltage and 60% is in low voltage. The methodology to do it comes basically from the definition of the loss factors and can be found in Annex A.

Loss Factors					
2016		2017		2018	
BT	MT	BT	MT	BT	MT
1,153945	1,010646	1,153945	1,010646	1,153945	1,010646
1,256225	1,023953	1,242006	1,021995	1,240491	1,021753
1,134384	1,015281	1,134384	1,015281	1,134384	1,015281
1,303908	1,018129	1,23744	1,018129	1,221356	1,018129
1,411552	1,022964	1,35495	1,022964	1,298348	1,022964
1,172325	1,016816	1,172325	1,016816	1,172325	1,016816
1,392461	1,011161	1,311093	1,011161	1,24187	1,011161
1,354496	1,011934	1,291694	1,011906	1,229188	1,011906
1,181434	1,013286	1,150642	1,013286	1,150642	1,013286
1,249104	1,02625	1,2034	1,02625	1,2034	1,02625
1,303991	1,022741	1,238811	1,020884	1,205873	1,019399
1,251517	1,019918	1,210323	1,019918	1,210323	1,019918
1,249001	1,03482	1,200109	1,031946	1,190002	1,029315
1,473152	1,008133	1,396004	1,007477	1,321047	1,006875
1,727678	1,006909	1,617684	1,006353	1,512148	1,005842
1,70653	1,009948	1,622678	1,009283	1,549106	1,009283

Figure 18. Losses factors

	Technical and non-technical losses recognized at middle voltage.										
	Technical losses				Non-Technical losses				TOTAL		
DIVISION	Base year	2016	2017	2018	Base year	2016	2017	2018	2016	2017	2018
Baja California	4,20%	4,20%	4,20%	4,20%	3,90%	3,90%	3,90%	3,90%	8,10%	8,10%	8,10%
Bajo	7,90%	7,30%	6,70%	6,60%	5,10%	5,10%	5,00%	5,00%	12,40%	11,70%	11,60%
Centro Occidente	6,10%	6,10%	6,10%	6,10%	2,20%	2,20%	2,20%	2,20%	8,30%	8,30%	8,30%
Centro Oriente	5,20%	5,20%	5,20%	5,20%	8,10%	8,10%	5,60%	5,00%	13,30%	10,80%	10,20%
Centro Sur	6,10%	6,10%	6,10%	6,10%	14,40%	14,40%	11,90%	9,40%	20,50%	18,00%	15,50%
Golfo centro	6,20%	6,20%	6,20%	6,20%	3,40%	3,40%	3,40%	3,40%	9,60%	9,60%	9,60%
GolFo Norte	4,00%	4,00%	4,00%	4,00%	9,60%	9,60%	7,10%	5,00%	13,60%	11,10%	9,00%
Jalisco	6,30%	5,80%	5,80%	5,80%	10,30%	10,30%	7,80%	5,30%	16,10%	13,60%	11,10%
NorOeste	3,90%	3,90%	3,90%	3,90%	6,60%	6,60%	5,00%	5,00%	10,50%	8,90%	8,90%
Norte	5,10%	5,10%	5,10%	5,10%	6,80%	6,80%	5,00%	5,00%	11,90%	10,10%	10,10%
Oriente	8,70%	8,00%	7,40%	6,90%	8,60%	8,60%	6,10%	5,00%	16,60%	13,50%	11,90%
Peninsular	4,80%	4,80%	4,80%	4,80%	6,60%	6,60%	5,00%	5,00%	11,40%	9,80%	9,80%
Sureste	9,60%	8,90%	8,20%	7,50%	7,00%	7,00%	5,00%	5,00%	15,90%	13,20%	12,50%
Valle Mexico Cent	7,10%	6,50%	6,00%	5,50%	14,00%	14,00%	11,50%	9,00%	20,50%	17,50%	14,50%
Valle Mexico NTE	9,50%	8,70%	8,00%	7,40%	15,80%	15,80%	13,30%	10,80%	24,50%	21,30%	18,20%
Valle Mexico Sur	6,20%	5,70%	5,30%	5,30%	20,70%	20,70%	20,70%	15,70%	26,40%	26,00%	21,00%

Figure 19. Technical and non-technical recognized losses

	Percentage Distribution Losses		
DIVISION	2016	2017	2018
Baja California	8,43%	8,43%	8,43%
Bajo	13,17%	12,55%	12,48%
Centro Occidente	7,71%	7,71%	7,71%
Centro Oriente	14,70%	12,23%	11,59%
Centro Sur	18,39%	16,62%	14,69%
Golfo centro	9,48%	9,48%	9,48%
GolFo Norte	17,35%	14,68%	12,13%
Jalisco	16,17%	14,02%	11,66%
NorOeste	9,74%	8,38%	8,38%
Norte	12,99%	11,16%	11,16%
Oriente	14,88%	12,38%	11,00%
Peninsular	12,84%	11,21%	11,21%
Sureste	13,31%	11,24%	10,72%
Valle Mexico Cent	19,59%	17,32%	14,85%
Valle Mexico NTE	25,55%	23,16%	20,55%
Valle Mexico Sur	25,23%	23,39%	21,64%

Figure 20. Losses at the distribution level (Loss factor based)

These losses however, are still an estimation derived from loss factors and may not be exactly the ones recognized in the system. Besides, how can it be checked whether the trend is correct?

Not surprisingly, this kind of problem is not new in the industry and one approach that has proved itself meaningful in the past is a multi-regression analysis. Data, however, is the main challenge as Mexico is still in an infant stage of its development, hence that the quality of old data is questionable. Moreover, some could argue that liberalization processes may pose further challenges in data collection due to the different incentives the regulator may have.

Identifying thus the drivers for losses is quite complex as not only the variables should be meaningful but also data for them must be available. Finally, it has been decided to run a regression analysis against 3 variables which are energy consumption, numbers of customers and the investment made in the distribution network by the different areas in which the tariff has been proposed. One further problem identified is that the data made available by the SENER for the values of the losses doesn´t correspond exactly with the data used by the CRE for designing the tariff. Nevertheless, this is not a critical issue because as it was said before, the previous percentage losses were an estimation derived from the loss factors while these ones are the ones currently recognized by SENER. Be aware that what is being tried to do here is get an insight on the reasonability of the values proposed, but not assessing the accuracy of them.

Electricity losses at Distribution (Gwh)										
Año	1 Central	2 Oriental	3 Occidental	4 Noroeste	5 Norte	6 Noreste	7 Peninsular	8 Baja California	9 Baja California Sur 1/	TOTAL
2004	10.882	4.998	4.743	1.285	1.795	3.088	823	795	102	28.509
2005	12.017	5.180	4.906	1.480	1.869	3.507	859	866	109	30.793
2006	13.098	5.408	5.226	1.556	1.968	3.513	937	871	133	32.710
2007	13.997	5.009	5.046	1.652	2.129	3.725	981	907	127	33.573
2008	13.954	5.244	5.470	1.673	2.141	3.796	984	878	152	34.293
2009	13.888	5.287	6.004	1.713	2.221	4.147	1.074	802	147	35.283
2010	16.442	6.011	7.221	1.778	2.605	3.933	1.154	893	187	40.224
2011	15.574	6.368	8.116	1.876	2.985	4.276	1.219	897	181	41.491
2012	14.120	6.294	8.034	1.946	2.978	4.306	1.196	983	160	40.017
2013	12.504	6.425	7.969	2.059	3.051	4.291	1.249	947	168	38.663
2014	11.610	6.321	7.949	2.072	2.724	4.248	1.201	925	179	37.230
2015	10.705	6.512	7.632	1.973	2.534	4.371	1.348	933	180	36.187

Fuente:Elaborado por SENER con datos del CENACE.

Figure 21. Current losses published by SENER-Prodesen. Distribution only

Percentage of losses at Distribution.										
Año	1 Central	2 Oriental	3 Occidental	4 Noroeste	5 Norte	6 Noreste	7 Peninsular	8 Baja California	9 Baja California Sur 1/	TOTAL
2004	21,6%	13,5%	9,8%	8,2%	9,8%	7,8%	11,0%	7,3%	12,4%	12,4%
2005	23,0%	13,4%	9,7%	9,0%	9,6%	8,5%	11,2%	7,8%	6,6%	12,9%
2006	24,5%	13,7%	10,0%	9,2%	9,9%	8,3%	11,5%	7,4%	7,4%	13,3%
2007	25,4%	12,3%	9,2%	9,4%	10,3%	8,6%	11,1%	7,6%	6,5%	13,2%
2008	25,2%	12,7%	9,9%	9,5%	10,5%	8,6%	10,5%	7,3%	6,9%	13,3%
2009	25,1%	12,8%	10,9%	9,5%	10,8%	9,4%	11,0%	6,8%	6,5%	13,7%
2010	28,7%	14,2%	12,3%	9,7%	12,1%	8,6%	11,8%	7,7%	8,2%	15,0%
2011	26,8%	14,2%	12,8%	9,2%	12,8%	8,6%	11,9%	7,4%	7,5%	14,6%
2012	24,4%	13,6%	12,4%	9,2%	12,6%	8,6%	11,4%	7,8%	6,5%	13,8%
2013	22,1%	13,9%	12,3%	9,6%	12,8%	8,6%	11,6%	7,5%	6,7%	13,4%
2014	20,9%	13,5%	12,0%	9,4%	11,3%	8,4%	10,8%	7,0%	7,0%	12,7%
2015	19,2%	13,5%	11,3%	8,8%	10,3%	8,4%	11,2%	6,8%	6,8%	12,1%

Figure 22. Percentage of losses at distribution

Drivers.

Once the variables were identified, the main challenge was finding data for investments in the distribution network. Here, many issues require some further comments:

- Different nature and characteristics of technical and non-technical losses. (Different types of investments required, non-technical losses can be subject to more sudden improvements while technical are more progressive)
- Which value should be used as a driver to account for this effect of network improvements? Yearly investment or asset value?
- How is the effect of the investment in the network, immediate or should a lag operator be added?
- How reliable are SENER investment plans for the coming years? Would the investment plan materialize in actual investments?

As it can be seen, accounting for the network development effect is a quite complex issue which could be the topic for a master thesis in itself. For simplicity´s sake, in this document, we opted for taking the yearly investment value as the driver for the aggregated values of losses (Despite the relationship between non-technical losses and investments may be quite different from the one of technical ones). Furthermore, having considered the asset base would have posed other questions as for example, what the suitability of using past data and suddenly changing to the net replacement value would have been.

On top of that, another important shortcoming of the analysis has been the lack of investment data for the different areas in which we are doing the study. Instead, only total values have been published by SENER which are the ones that have been used for the regression. The study hence assumes the investments are done evenly in all the areas, which doesn´t necessarily need to be the case. Indeed, the investment could have been made progressively in the different areas, first year, Mexico Valley, second year North-East… Still, it is believed, that for the majority of divisions the analysis can get an idea of the reasonability of the values proposed. This doesn´t negate however the fact that some results don´t make much sense as some cases present a regression coefficient for the investment that is positive, thus implying that a higher investment in the network increases the losses. In those cases, the values have been discarded and the regression has been done only against 2 variables: energy consumption and number of customers.

	Planned Investments. (Millions pesos)
Year	Distribucion
2007	11279,000
2008	13657,000
2009	14204,000
2010	11817,000
2011	11062,000
2012	11672,000
2013	9327,000
2014	9625,000
2015	10050,000
2016	30645,000
2017	35151,000
2018	29413,000
2019	20437,000
2020	16027,000
2021	14016,000
2022	16261,000
2023	18846,000
2024	17969,000
2025	16696,000
2026	14231,000

Figure 23. Network investment proposed

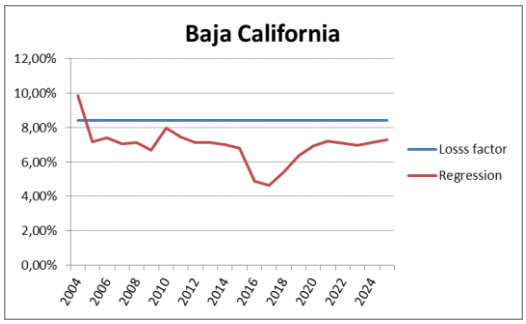
Distribution Losses. (GWh)											
Año	1 Central	2 Oriental	3 Occidental	4 Noroeste	5 Norte	6 Noreste	7 Peninsular	8 Baja California	9 Baja California Sur[1/]	SIN	SEN
2004	10881,55	4997,62	4742,76	1284,94	1795,48	3087,78	822,59	794,82	101,52	27612,72	28509,05
2005	12016,74	5179,66	4906,44	1480,49	1868,92	3506,60	859,16	865,75	108,86	29818,01	30792,62
2006	13097,75	5408,01	5226,28	1556,24	1967,60	3513,10	936,72	870,63	133,46	31705,69	32709,78
2007	13996,93	5009,09	5045,56	1652,01	2128,63	3725,11	981,43	906,82	127,49	32538,76	33573,07
2008	13953,82	5244,16	5469,76	1673,08	2141,40	3796,17	984,42	878,22	151,78	33262,80	34292,81
2009	13887,85	5287,27	6004,43	1712,79	2220,83	4146,87	1073,75	801,92	147,02	34333,78	35282,72
2010	16441,94	6010,62	7220,58	1778,46	2605,49	3932,87	1153,81	892,79	187,33	39143,76	40223,87
2011	15573,69	6368,19	8115,96	1876,30	2984,77	4275,62	1218,57	896,75	181,25	40413,10	41491,10
2012	14119,57	6293,66	8034,39	1945,61	2978,04	4305,80	1196,40	982,72	160,39	38873,47	40016,59
2013	12504,20	6424,87	7968,75	2059,30	3051,22	4291,40	1248,62	947,11	167,56	37548,35	38663,03
2014	11609,78	6321,37	7948,83	2072,06	2724,23	4248,46	1201,24	925,47	178,79	36125,97	37230,24
2015	10705,10	6511,98	7631,85	1972,55	2533,60	4370,79	1348,40	932,72	180,13	35074,26	36187,12
2016	11540,05	5908,30	8632,98	1726,81	3115,63	4586,29	1137,66	564,36	158,42	36647,72	37370,51
2017	12087,93	5823,43	9107,46	1697,18	3241,60	4670,83	1126,42	487,71	172,40	37754,85	38414,97
2018	13085,37	6186,66	9609,05	1858,30	3374,90	4758,56	1233,71	609,40	205,92	40106,55	40921,87
2019	14327,16	6700,52	10137,95	2083,07	3511,82	4849,93	1380,47	793,56	245,01	42990,91	44029,47
2020	15421,30	7033,24	10667,31	2221,18	3652,85	4944,24	1480,84	891,97	285,44	45420,97	46598,37
2021	16152,64	7250,96	11201,03	2315,93	3788,27	5046,66	1557,36	945,62	314,00	47312,85	48572,47
2022	16821,53	7287,93	11749,61	2330,60	3916,53	5152,35	1587,89	918,39	335,46	48846,43	50100,29
2023	17503,23	7321,61	12298,59	2340,29	4054,47	5262,52	1619,18	885,49	357,60	50399,88	51642,97
2024	18289,13	7506,22	12879,80	2417,95	4193,63	5366,39	1690,33	918,78	387,98	52343,46	53650,22
2025	19210,36	7727,52	13499,73	2505,87	4335,77	5477,14	1767,97	960,00	420,57	54524,35	55904,93

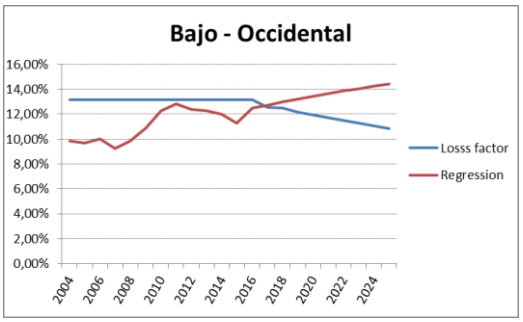
Figure 24. Forecasted losses

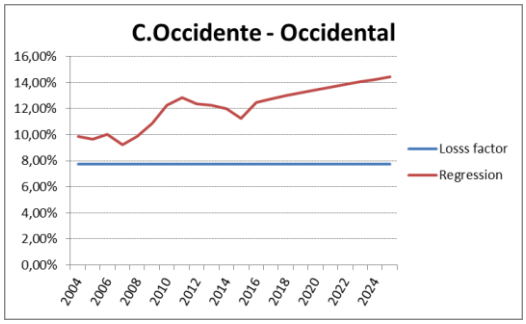
Distribution Losses (%)											
Año	1 Central	2 Oriental	3 Occidental	4 Noroeste	5 Norte	6 Noreste	7 Peninsular	8 Baja California	9 Baja California Sur[1/]	SIN	SEN
2004	21,59%	13,53%	9,84%	8,25%	9,79%	7,76%	10,99%	7,27%	12,44%	12,74%	12,44%
2005	22,99%	13,45%	9,66%	8,97%	9,62%	8,53%	11,19%	7,78%	6,59%	13,18%	12,88%
2006	24,52%	13,66%	10,04%	9,22%	9,92%	8,26%	11,47%	7,43%	7,37%	13,64%	13,30%
2007	25,42%	12,33%	9,23%	9,38%	10,34%	8,56%	11,09%	7,59%	6,53%	13,51%	13,18%
2008	25,17%	12,68%	9,87%	9,48%	10,47%	8,58%	10,52%	7,27%	6,94%	13,64%	13,29%
2009	25,14%	12,77%	10,87%	9,52%	10,79%	9,44%	11,00%	6,82%	6,55%	14,06%	13,67%
2010	28,66%	14,17%	12,27%	9,70%	12,07%	8,56%	11,85%	7,68%	8,23%	15,40%	15,00%
2011	26,81%	14,23%	12,82%	9,25%	12,80%	8,56%	11,88%	7,45%	7,47%	14,97%	14,59%
2012	24,45%	13,64%	12,38%	9,20%	12,58%	8,56%	11,44%	7,77%	6,48%	14,17%	13,82%
2013	22,15%	13,87%	12,27%	9,61%	12,84%	8,61%	11,57%	7,54%	6,70%	13,73%	13,40%
2014	20,91%	13,49%	11,99%	9,42%	11,28%	8,39%	10,83%	7,04%	6,96%	13,06%	12,74%
2015	19,20%	13,45%	11,26%	8,77%	10,27%	8,39%	11,17%	6,84%	6,81%	12,38%	12,08%
2016	20,30%	11,99%	12,49%	7,34%	12,25%	8,57%	9,39%	4,06%	5,69%	12,64%	12,19%
2017	20,71%	11,47%	12,74%	6,88%	12,34%	8,40%	8,99%	3,41%	5,86%	12,60%	12,12%
2018	21,69%	11,81%	12,98%	7,23%	12,44%	8,24%	9,47%	4,12%	6,65%	12,92%	12,47%
2019	22,87%	12,38%	13,22%	7,78%	12,52%	8,09%	10,18%	5,19%	7,55%	13,36%	12,94%
2020	23,77%	12,54%	13,44%	7,97%	12,61%	7,93%	10,48%	5,62%	8,24%	13,61%	13,20%
2021	24,31%	12,52%	13,65%	7,98%	12,68%	7,77%	10,57%	5,74%	8,64%	13,72%	13,31%
2022	24,71%	12,18%	13,86%	7,73%	12,75%	7,62%	10,36%	5,38%	8,80%	13,70%	13,28%
2023	25,09%	11,83%	14,05%	7,46%	12,82%	7,48%	10,14%	5,00%	8,94%	13,68%	13,23%
2024	25,58%	11,74%	14,24%	7,42%	12,89%	7,35%	10,16%	5,00%	9,25%	13,75%	13,30%
2025	26,14%	11,65%	14,43%	7,40%	12,95%	7,22%	10,20%	5,05%	9,56%	13,84%	13,39%

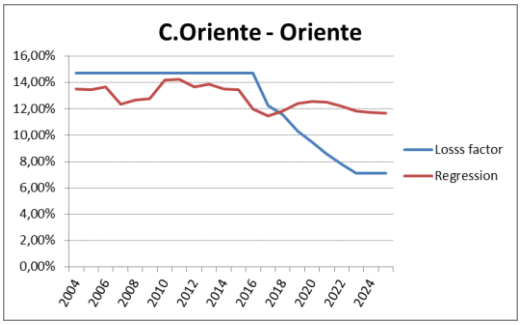
Figure 25. Forecasted percentage losses

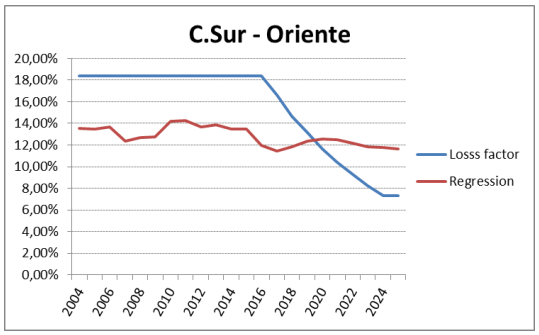
The logic question now is how this compares with the path proposed by the CRE for the loss reduction. In order to increase the length of the comparison, it has been assumed that the loss reduction rate proposed until 2018 will continue at the same rate in the coming years.

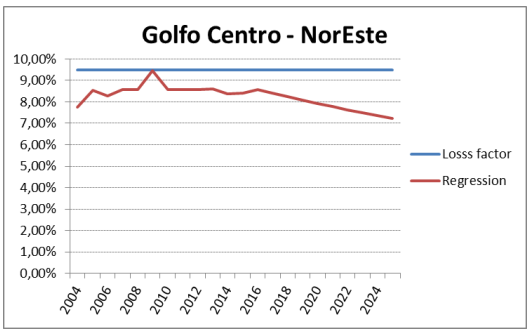












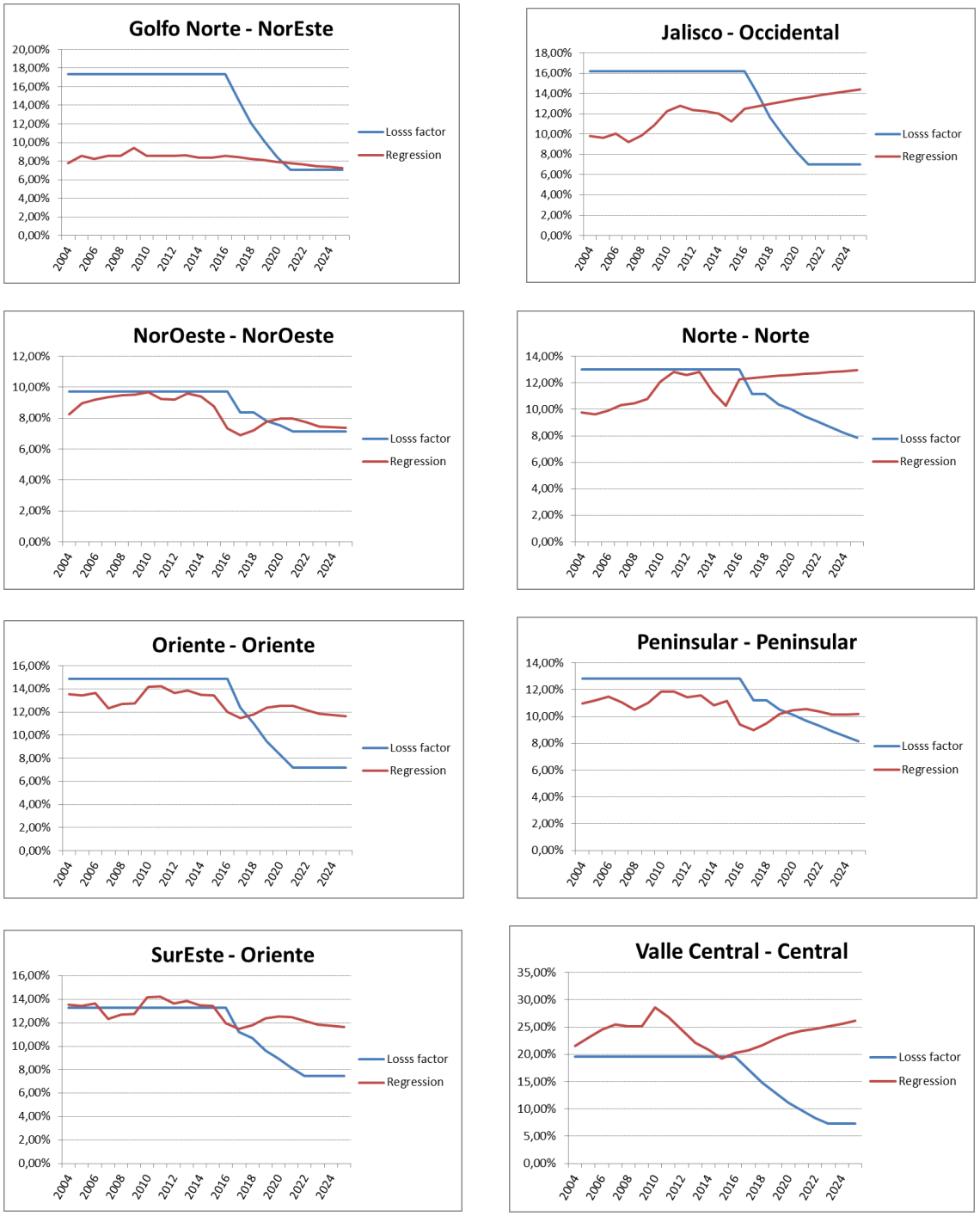


Figure 26. Forecasted path for the losses and proposed by the CRE

Once the trend has been analyzed, it is important to take into account what the losses that the CRE has decided to approve and recognize as a recoverable cost for the Distributors are, and how this are going to evolve in the coming years. It should be bear in mind that this has an important impact on CFE distribution activity as values above this would be recorded as a financial loss for CFE while lower values would be recorded as credits.

Now, by combining these values and the loss factors, it can be computed on one hand the amounts to be recovered in the different areas (From the recognized losses table) and on the other hand, the amount of losses that would not be recognized and therefore would be charged against distributor companies, in this case, the unbundled part of CFE: CFE distribution.

On top of the reasoning made so far, it should not be forgotten that these estimates are computed with the loss factors proposed by CRE. Whether these trends would effectively materialize or not would hence influence the final profit or loss to be recorded by CFE.

	Recognized Losses (MEM 2015, millions pesos)		
	2016	2017	2018
DIVISION	BT	BT	BT
Baja California	1415,355	1459,853	1514,845
Bajo	3101,053	3023,718	3103,599
Centro Occidente	2082,232	2154,249	2230,308
Centro Oriente	1689,135	1440,703	1411,346
Centro Sur	2552,785	2332,102	2096,921
Golfo centro	2734,487	2839,665	2949,690
GolFo Norte	3679,020	3154,656	2695,881
Jalisco	3787,737	3338,554	2856,093
NorOeste	2464,094	2219,824	2313,588
Norte	3291,511	2950,535	3049,137
Oriente	2099,616	1781,842	1642,074
Peninsular	1738,709	1571,417	1632,969
Sureste	2087,166	1814,523	1768,699
Valle Mexico Cent	4307,637	3784,828	3253,170
Valle Mexico NTE	5116,000	4573,261	4047,028
Valle Mexico Sur	5530,265	5587,563	4690,499
TOTAL	47676,805	44027,292	41255,849

	Recognized losses (MEM 2015, USD millions)		
	2016	2017	2018
DIVISION	BT	BT	BT
Baja California	75,788	69,751	70,214
Bajo	166,052	144,472	143,854
Centro Occidente	111,497	102,929	103,376
Centro Oriente	90,448	68,836	65,417
Centro Sur	136,694	111,427	97,194
Golfo centro	146,423	135,678	136,720
GolFo Norte	197,000	150,728	124,956
Jalisco	202,822	159,514	132,382
NorOeste	131,945	106,062	107,236
Norte	176,250	140,975	141,329
Oriente	112,428	85,135	76,111
Peninsular	93,103	75,081	75,689
Sureste	111,761	86,697	81,980
Valle Mexico Cent	230,661	180,837	150,786
Valle Mexico NTE	273,946	218,508	187,582
Valle Mexico Sur	296,129	266,971	217,407
TOTAL	2552,947	2103,600	1912,233

Figure 27. Recognized losses per area

	Non-Recognized losses (MEM 2015, millions pesos)		
	2016	2017	2018
DIVISION	BT	BT	BT
Baja California	694,292	716,119	743,095
Bajo	1350,240	1382,261	1435,928
Centro Occidente	491,819	508,830	526,795
Centro Oriente	1004,012	831,212	797,239
Centro Sur	815,119	776,946	703,629
Golfo centro	935,515	971,498	1009,140
GolFo Norte	3537,913	2180,922	1848,436
Jalisco	2062,028	1871,060	1580,563
NorOeste	808,422	689,535	718,660
Norte	1433,733	1151,428	1189,907
Oriente	576,276	489,940	440,670
Peninsular	971,408	838,302	871,138
Sureste	143,085	384,900	491,351
Valle Mexico Cent	2267,185	2174,236	2020,251
Valle Mexico NTE	3531,996	3474,302	3329,690
Valle Mexico Sur	2835,275	2479,160	3006,714
TOTAL	23458,319	20920,650	20713,207

	Non Recognized Losses (MEM 2015, USD millions)		
	2016	2017	2018
DIVISION	BT	BT	BT
Baja California	37,177	34,216	34,443
Bajo	72,301	66,044	66,556
Centro Occidente	26,335	24,312	24,417
Centro Oriente	53,762	39,715	36,952
Centro Sur	43,647	37,122	32,614
Golfo centro	50,094	46,418	46,774
GolFo Norte	189,444	104,203	85,676
Jalisco	110,415	89,398	73,260
NorOeste	43,289	32,946	33,310
Norte	76,772	55,015	55,153
Oriente	30,858	23,409	20,425
Peninsular	52,016	40,054	40,378
Sureste	7,662	18,390	22,774
Valle Mexico Cent	121,401	103,884	93,640
Valle Mexico NTE	189,128	166,000	154,333
Valle Mexico Sur	151,820	118,453	139,363
TOTAL	1256,121	999,577	960,069

Figure 28. Non-recognized losses per area

In order to check this, a quick number can be done to at least confirm the order of magnitude of the figures. Reading previous data, total losses for the system were approximately 40.000GWh and the average price for the system is 1,8pesos/kWh or 90$/MWh.

$$Losses\ (\$) = Total\ losses * MEM\ price$$

$$Losses\ (M\$) = 40TWh * 90\ {}^{\$}/_{MWh} = 3600M\$$$

It is hence observed that the number is consistent with the value derived from adding both the recognized and not-recognized losses shown in the tables.

Finally, even though the law stipulates that the losses would be computed and recovered on an energy basis, that is, by considering the additional energy that a customer would consume due to the losses, it has been computed what the monetary effect of losses on the tariff can be.

	Losses recognized (MEM 2015, pesos/kwh) (Per unit of consumption level)					
	2016		2017		2018	
DIVISION	BT	MT	BT	MT	BT	MT
Baja California	0,162	0,019	0,162	0,019	0,162	0,019
Bajo	0,270	0,043	0,252	0,039	0,250	0,039
Centro Occidente	0,165	0,027	0,165	0,027	0,165	0,027
Centro Oriente	0,295	0,031	0,228	0,031	0,212	0,031
Centro Sur	0,491	0,040	0,413	0,040	0,341	0,040
Golfo centro	0,193	0,029	0,193	0,029	0,193	0,029
GolFo Norte	0,327	0,020	0,251	0,020	0,193	0,020
Jalisco	0,382	0,021	0,308	0,021	0,239	0,021
NorOeste	0,206	0,022	0,170	0,022	0,170	0,022
Norte	0,254	0,046	0,208	0,046	0,208	0,046
Oriente	0,367	0,039	0,284	0,036	0,244	0,034
Peninsular	0,290	0,041	0,241	0,041	0,241	0,041
Sureste	0,333	0,060	0,266	0,055	0,251	0,051
Valle Mexico Cent	0,588	0,016	0,476	0,015	0,373	0,013
Valle Mexico NTE	0,825	0,014	0,672	0,012	0,537	0,011
Valle Mexico Sur	0,876	0,020	0,821	0,018	0,633	0,018

Figure 29. Monetary impact of recognized losses on consumers

	Losses recognized (MEM 2015, USD/MWh) (Per unit of consumption level)					
	2016		2017		2018	
DIVISION	BT	MT	BT	MT	BT	MT
Baja California	8,680	0,999	7,745	0,891	7,513	0,865
Bajo	14,458	2,276	12,058	1,865	11,586	1,790
Centro Occidente	8,814	1,452	7,864	1,296	7,629	1,257
Centro Oriente	15,818	1,684	10,877	1,502	9,836	1,457
Centro Sur	26,269	2,133	19,756	1,903	15,814	1,846
Golfo centro	10,356	1,573	9,240	1,404	8,964	1,362
GolFo Norte	17,523	1,044	12,015	0,932	8,952	0,904
Jalisco	20,481	1,134	14,722	1,010	11,092	0,979
NorOeste	11,019	1,196	8,116	1,067	7,874	1,035
Norte	13,603	2,465	9,925	2,200	9,628	2,134
Oriente	19,655	2,112	13,574	1,730	11,315	1,559
Peninsular	15,520	2,210	11,513	1,972	11,169	1,913
Sureste	17,821	3,234	12,720	2,647	11,617	2,356
Valle Mexico Cent	31,490	0,855	22,745	0,701	17,311	0,626
Valle Mexico NTE	44,191	0,726	32,116	0,596	24,897	0,532
Valle Mexico Sur	46,893	1,046	39,210	0,871	29,329	0,845

Figure 30. Monetary impact of recognized losses on consumers

5.2-4. Comments and CFE assessment.

First comments should probably be with regards to the methodology used. While revenue cap incentive regulation is a sound methodology, a regulatory period of 3 years is believed not to be enough to send a proper incentive to CFE to improve efficiency beyond the value proposed by CRE. The key here is whether the level of efficiency achieved by CFE would be used for the new regulatory period or if it would be the efficiency level coming from the path proposed by the

CRE. In the first case, CFE incentive to improve would be much lower. The second case would still send a good signal although it will still carry a higher administrative cost due to the fact that every three years the process is done again. Moreover, whether the asset base would need to be assessed again every three years is not clear.

Another interesting thing that has been found at the higher regulatory level is the use of the Net Replacement Value to compute the asset base. Although this has been the norm in the liberalization processes of other LATAM countries due to poor accounting, it shouldn´t be forgotten that the actual asset base value can be very different from that one. In line with this, the fact that O&M costs are taken only from accounting books may raise some questions. If accounting is unreliable and NRV is being used, why O&M costs are not checked through a network reference model? What measures are taken to avoid the asymmetry of information between distributor and regulator? Here, it is believed that the use of benchmarking techniques should have been proposed to deal with this situation, for example, frontier techniques. Otherwise, it is difficult to get an insight on how CFE is performing or how much margin to improve still exists.

Another issue that requires some attention is the use of WACC as the rate of return on the asset base and the article 10 of the agreement A/074/2015. First, the WACC proposed is 10,07%, which presents a 3% spread with the 10 year Mexican bond yield (7%). This value raises some concerns as to whether CFE would have an incentive to overinvest. The reasoning behind it is that if CFE gets a higher return on capital than its actual, real funding cost, CFE would get as profit the spread between those two values (Averch-Johnson effect) (Averch H, 1962). Second, article ten of above mentioned agreement makes a remarkable quote which is “reasonable return, the same that not guaranteed” which is found not very clear.

Moving towards more specific issues, efficiency factors are found initially reasonable except for Valle de Mexico, where much margin to improvement seems to be expected. Whether this improvement may be achievable is questionable as big investments would be required. Besides, it is again missed a benchmarking study to cross check the feasibility of this. Economies of scale factors are the same for all the areas which is found to make sense with the fact that all the divisions belong to CFE.

Losses are another component that deserves special attention and that can be regulated in different ways being the two more representatives the following:

- Retailers / basic suppliers are forced to buy in the wholesale market the whole amount of energy consumed by their clients (Thus implicitly buying the losses)
- Distributors are responsible for buying the losses.

The second one has the advantage that the inventive created for the DSO to reduce losses can be much higher and is easier to regulate, being all that needs to be specified the amount of losses recognized. Meanwhile, in the first method, an explicit mechanism is required. In Mexico, CRE seems to have opted for the second option although Article 48 of the agreement A/074/2015 is not very clear in the way losses would be billed or bought. Indeed. it is not known whether retailers would buy them implicitly and then be compensated by CFE or directly bought by CFE. In theory, both cases should be similar from the point of view of retailers although in reality, retailers would prefer have losses bought directly from CFE distribution in order to avoid any temporal or monetary mismatch between those quantities.

In any case, to understand what the impact of losses can be, it has been compared the total allowed revenue for the year 2016 with the total expected value of losses, both recognized and not recognized.

	Allowed revenues 2016 (Millones dolares)		Recognized losses (Millones dolares)	Recognized losses (Percentage)	Non recognized losses (Millones dolares)	Non recognized losses (percentage)
	BT	MT				
Baja California	150,039	135,206	75,788	26,57%	37,177	13,03%
Bajo	218,953	242,514	166,052	35,98%	72,301	15,67%
Centro Occidente	119,035	145,059	111,497	42,22%	26,335	9,97%
Centro Oriente	186,558	166,799	90,448	25,60%	53,762	15,21%
Centro Sur	195,553	138,419	136,694	40,93%	43,647	13,07%
Golfo centro	102,542	101,686	146,423	71,70%	50,094	24,53%
GolFo Norte	170,815	215,580	197,000	50,98%	189,444	49,03%
Jalisco	183,987	183,612	202,822	55,17%	110,415	30,04%
NorOeste	174,777	182,542	131,945	36,93%	43,289	12,11%
Norte	177,026	271,644	176,250	39,28%	76,772	17,11%
Oriente	221,095	184,683	112,428	27,71%	30,858	7,60%
Peninsular	103,774	127,174	93,103	40,31%	52,016	22,52%
Sureste	178,258	242,889	111,761	26,54%	7,662	1,82%
Valle Mexico Cen	76,090	111,485	230,661	122,97%	121,401	64,72%
Valle Mexico NTE	128,995	133,546	273,946	104,34%	189,128	72,04%
Valle Mexico Sur	98,419	150,628	296,129	118,90%	151,820	60,96%
TOTAL	5219,382		2552,947	48,91%	1256,121	24,07%

Figure 31. Revenue recognition and losses

Results are from all points of view relevant. The recognized losses are going to increase allowed revenue in 50% while the non-recognized losses still suppose a 25% loss. Digging deeper into the data, it is observed that the losses not recognized in Valle de Mexico are huge thus meaning a quite big challenge to the financial viability of CFE in those areas. This being the case, it is expected that CFE will have a strong incentive to invest in the improvement of the network in order to decrease the losses.

The fact that the losses are recovered though the energy consumption on top of the tariff is thought to be the most appropriate approach, as otherwise tariff would have been very high and could have raised some political concerns. Indeed, it seems that regulatory authorities are already worried about how people would react under a very big change in the tariff in the new scheme, above all, if this change is an increase. From that regulator´s perspective, this scheme thus makes perfect sense as an increase in energy consumption may be less noticeable than a direct increase in the tariff.

Looking at the reduction proposed in recognized and non-recognized losses and the multi regression analysis done, it is believed that the figures proposed by the CRE for the remuneration may have been perhaps optimistic and that they probably won´t be achieved (Look at regression analysis forecasts). Moreover, it is believed that investments in the network would present diminishing marginal efficiencies in reducing losses which has not been captured by the linear multi regression. Basically, investments in the network can attain much higher losses reduction at the beginning, when losses are at high levels. One example of this can be for example non-technical losses, which may be reduced a lot at the beginning by focusing in key areas with high levels of non-technical losses. Whether CRE and SENER have considered this non-linear effect of investment is unclear.

Regarding the Valle of Mexico, the situation is specially challenging. Last years have seen already very relevant loss reduction and whether this trend can continue is not sure. Some may argue that the losses which are easy to reduce have already been reduced and that the ones remaining would require higher investments (Non-linearity of the investment-loss reduction function). Although the reasoning is sound, I would disagree because of the level in which losses still are (20%). This level still corresponds to a very inefficient system in both the technical and non-technical losses, so marginal effects of investments are still believed to be high. Multi regression analysis for this area could be therefore quite far from what it is really expected to happen. Nevertheless, the path proposed by the CRE still is believed to be too optimistic.

Speaking about the grouped monetary figures for non-recognized losses, same line of reasoning is kept. The proposed reduction of 20% seems too high (See table below). There is no doubt that CFE would push for investments in the network to try to lower these figures, however they seem not consistent with reality and with current investment plans. This leaves CFE distribution in a worrying position as they would have to either carry these values in their balance sheet or move them to the income statement as a loss. Meanwhile, the resulting 5% from 2017 to 2018 seems much more achievable; however, its implications are worrying for CFE too, as it means it would require more than 20 years to stop losing money. I consider this improbable, nearly impossible. In my opinion, first, it is important to see what loss reduction CFE manages to achieve in the first year and in how much money not recognized this ends up resulting. If the percentage reduction of non-recognized losses (millions) is in the range 10-25%, I believe CFE would be happy and no major pressure on the CRE would be exerted. However, if this value comes closer to 5%, I think CFE would ask CRE to increase the recognized losses as it will make no sense to have CFE losing money for 20 years. At the end, the key issue is that the incentive for loss reduction is so large (25% of allowed revenue) that either the reduction will be achieved quickly or the recognized losses would be increased, hence reducing the incentive signal.

	Non Recognized Losses (MEM 2015, millones de dolares)		
	2016	2017	2018
TOTAL	1256,121	999,577	960,069

Figure 32.Non-recognized losses. Total amounts

5.2-5. Distribution tariff

Finally, the current tariff proposed and a forecast for the coming years within the current regulatory period is shown with and without the estimated impact of losses:

DISTRIBUTION TARIFF															
	2016					2017					2018				
	Tarifa DB1	Tarifa DB2	Tarifa PDBT	Tarifa GDBT	Tarifa GDMT	Tarifa DB1	Tarifa DB2	Tarifa PDBT	Tarifa GDBT	Tarifa GDMT	Tarifa DB1	Tarifa DB2	Tarifa PDBT	Tarifa GDBT	Tarifa GDMT
	USD/MWh	USD/MWh	USD/MWh	USD/MW-mes	USD/MW-mes	USD/MWh	USD/MWh	USD/MWh	USD/MW-mes	USD/MW-mes	USD/MWh	USD/MWh	USD/MWh	USD/MW-mes	USD/MW-mes
Baja California	33,20	38,02	30,52	8578,22	4090,99	31,66	36,25	29,11	8180,13	3901,14	30,39	34,80	27,94	7852,16	3744,73
Bajo	49,80	42,84	40,70	16094,61	4265,55	48,20	41,46	39,39	15577,48	4128,50	47,01	40,44	38,42	15194,71	4027,05
Centro Occidente	66,93	57,30	54,62	21564,43	6742,63	64,84	55,51	52,91	20890,80	6532,00	63,31	54,20	51,66	20397,74	6377,84
Centro Oriente	64,26	55,15	52,48	20807,27	6726,03	61,50	52,79	50,23	19915,93	6437,90	59,28	50,88	48,41	19194,72	6204,77
Centro Sur	72,82	62,11	58,90	23441,25	9931,35	69,77	59,51	56,43	22457,99	9514,78	67,31	57,41	54,44	21666,51	9179,45
Golfo centro	48,73	39,62	49,26	16542,79	5469,82	46,99	38,21	47,50	15952,22	5274,55	45,65	37,12	46,15	15498,35	5124,48
GolFo Norte	36,41	29,45	36,41	12210,31	2579,89	34,95	28,27	34,95	11719,93	2476,28	33,79	27,33	33,79	11329,63	2393,81
Jalisco	72,82	62,65	59,44	23560,12	7123,89	69,96	60,19	57,10	22634,95	6844,14	67,70	58,24	55,26	21903,10	6622,85
NorOeste	40,16	31,59	34,27	9484,24	4045,47	38,55	30,32	32,89	9103,34	3883,00	37,26	29,31	31,80	8800,17	3753,69
Norte	63,19	55,69	59,44	16057,12	3415,22	59,75	52,66	56,20	15183,01	3229,31	56,83	50,09	53,46	14441,71	3071,64
Oriente	71,22	61,04	57,83	23005,38	9230,96	67,91	58,21	55,15	21937,76	8802,58	65,19	55,88	52,94	21058,20	8449,65
Peninsular	45,51	37,48	43,91	13196,65	4045,47	43,73	36,01	42,18	12678,43	3886,61	42,31	34,85	40,82	12268,50	3760,95
Sureste	64,79	55,69	53,01	20973,80	6737,81	60,92	52,36	49,84	19719,75	6334,95	57,59	49,50	47,12	18642,17	5988,78
Valle Mexico Cent	36,95	31,59	29,99	11925,98	2982,57	34,47	29,48	27,98	11127,77	2782,94	32,32	27,64	26,23	10433,34	2609,27
Valle Mexico NTE	48,73	41,77	39,62	15794,74	4372,64	45,08	38,64	36,65	14610,76	4044,87	41,87	35,89	34,05	13571,41	3757,13
Valle Mexico Sur	46,59	40,16	38,02	15091,14	3384,70	43,22	37,26	35,27	14000,30	3140,04	40,27	34,72	32,86	13045,11	2925,81

DISTRIBUTION TARIFF WITH LOSSES															
	2016					2017					2018				
	Tarifa DB1	Tarifa DB2	Tarifa PDBT	Tarifa GDBT	Tarifa GDMT	Tarifa DB1	Tarifa DB2	Tarifa PDBT	Tarifa GDBT	Tarifa GDMT	Tarifa DB1	Tarifa DB2	Tarifa PDBT	Tarifa GDBT	Tarifa GDMT
	USD/MWh	USD/MWh	USD/MWh	$/kW-mes	$/kW-mes	USD/MWh	USD/MWh	USD/MWh	$/kW-mes	$/kW-mes	USD/MWh	USD/MWh	USD/MWh	$/kW-mes	$/kW-mes
Baja California	41,88	46,70	39,20	9607,61	4581,91	39,40	44,00	36,85	9161,75	4369,27	37,90	42,31	35,45	8794,42	4194,09
Bajo	64,26	57,30	55,15	18025,96	4777,42	60,26	53,52	51,45	17446,78	4623,92	58,60	52,03	50,01	17018,08	4510,30
Centro Occidente	75,75	66,11	63,43	24152,16	7551,75	72,71	63,37	60,78	23397,69	7315,85	70,94	61,82	59,29	22845,46	7143,18
Centro Oriente	80,07	70,97	68,29	23304,15	7533,16	72,38	63,67	61,10	22305,85	7210,45	69,11	60,71	58,24	21498,08	6949,34
Centro Sur	99,09	88,38	85,17	26254,20	11123,12	89,52	79,26	76,19	25152,95	10656,55	83,12	73,23	70,26	24266,49	10280,98
Golfo centro	59,08	49,98	59,62	18527,93	6126,20	56,23	47,45	56,74	17866,49	5907,50	54,62	46,09	55,12	17358,15	5739,42
GolFo Norte	53,93	46,97	53,93	13675,55	2889,48	46,96	40,28	46,96	13126,32	2773,43	42,74	36,28	42,74	12689,18	2681,07
Jalisco	93,30	83,13	79,92	26387,34	7978,75	84,69	74,91	71,83	25351,14	7665,44	78,79	69,34	66,35	24531,47	7417,59
NorOeste	51,18	42,61	45,29	10622,34	4530,93	46,66	38,44	41,01	10195,74	4348,96	45,14	37,19	39,67	9856,19	4204,13
Norte	76,79	69,29	73,04	17983,98	3825,05	69,67	62,58	66,13	17004,97	3616,82	66,46	59,71	63,09	16174,72	3440,24
Oriente	90,87	80,70	77,49	25766,02	10338,67	81,49	71,78	68,72	24570,30	9858,89	76,51	67,19	64,25	23585,19	9463,61
Peninsular	61,04	53,00	59,43	14780,24	4530,93	55,24	47,52	53,70	14199,84	4353,00	53,48	46,02	51,99	13740,72	4212,26
Sureste	82,61	73,51	70,83	23490,66	7546,35	73,64	65,08	62,56	22086,12	7095,14	69,21	61,11	58,73	20879,23	6707,43
Valle Mexico Cent	68,44	63,08	61,48	13357,09	3340,47	57,22	52,22	50,72	12463,11	3116,90	49,63	44,95	43,54	11685,34	2922,38
Valle Mexico NTE	92,92	85,96	83,82	17690,11	4897,36	77,19	70,75	68,77	16364,06	4530,25	66,77	60,78	58,94	15199,98	4207,99
Valle Mexico Sur	93,48	87,05	84,91	16902,07	3790,87	82,43	76,47	74,48	15680,33	3516,85	69,60	64,04	62,19	14610,52	3276,91

Figure 33. Forecasted distribution tariff

In the case of losses, fragmented data for demand has not been found, hence that it hasn´t been possible to make estimation for the USD/MW term.

Another thing that deserves a comment is the fact that the tariff is volumetric for low voltage, low load consumers. This, although common in many countries, is quite inefficient as long term investments decisions are being linked to short term operational decisions. Basically, imagine you carry out a considerable investment in the network because you have a very big load concentration but then, due to efficiency improvements in buildings they reduce their energy consumption. How are you going to recover your network investment? Moreover, the driver for investments in the network is simultaneous capacity in the peak, not energy or capacity contracted. This although complex to implement is being proposed in some countries. Other possible form of recovering the network cost which maybe could have been more efficient is through an annual fixed cost per consumer.

This although may not be a very short-term problem, will for sure pose some challenges in the future as DERs penetration in the system increases and net metering starts to be common among some hours of the day. This would create a cross subsidy between DER owners and normal consumers as the former would pay a lower amount of the network when, in fact, they may be responsible for quite a big part of the latest investments.

It is believed that the reasoning probably behind that structure for the tariff has been that lower voltage demand is more inelastic than high voltage, high consumption loads and therefore, they would not change its energy consumption. This, although it is a reasonable argument, is changing and demand management programs are changing the way in which consumers participate in the market.

In my opinion, with this regulation, CRE misses the opportunity to lead the international regulatory community in which DERs penetration refers and although it is understood that CRE´s preoccupations nowadays may probably be others, it was a great chance to settle the proper foundations for the utility of the future to come.

5.3- CENACE operations.

By this payment, CENACE should get enough revenue in order they can run the SEN and the MEM safely and efficiently. Moreover, this payment should guarantee the free and non-discriminatory access to the national transmission network (RNT) and to the general distribution networks (RGD).

CENACE, therefore, has submitted the following requests for revenue to CRE, which are composed by O&M costs, investments and others.

Composición del Ingreso Requerido propuesto por CENACE
Pesos

	2016
Costos de operación y mantenimiento[1]	2 972 910 310
Ingresos misceláneos	-231 685 460
Inversiones	680 524 000
Ingreso Requerido	3 421 748 850

Nota:
1. En este concepto se incluye la operación del MEM

Figure 34. Revenue requested by CENACE

After reviewing the methodology and the values proposed, CRE decided to make some adjustments to the values proposed.

Composición del Ingreso Requerido
Pesos

	2016
Costos de operación y mantenimiento[1]	2 371 373 044
Ingresos misceláneos	-231 685 456
Inversiones	592 589 831
Ingreso Requerido	2 732 277 419

Nota:
1. En este concepto se incluye la operación del MEM

	Allowed revenues composition (pesos)
O&M	2371373044
Investments	-231685456
Others	592589831
Allowed revenues	2732277419

Figure 35. Approved CENACE revenue

And the structure proposed for the tariff has been the following one, which is proposed by a fixed part and a variable term linked to the energy consumption:

Quota (Pesos)	Payment frequency	Concept
8647	Yearly. Per measurement point	O&M of the measurement system
30000	Unique	Per registration of new participants
1000	Yearly, generators only	Per MW

	2016	
Approved charges(pesos)	Consumers	Generators
Volumetric tariff (pesos/MWh)	6,4824	2,4807

Figure 36. CENACE payment structure

Something that surprises is the size of the first payment. Number of measurement points in Mexico is around 36 million so the numbers don´t seem to make much sense initially. After reviewing the economic memory to the agreement A 075/ 2015 which is the one that dictates this payment, it is found that the amount to be recovered by this payments is 121,7 million of pesos, or what is the same, 14378 number of measurement points.

From this, what is deduced is that the fixed term is only charged to those which make the move to the new regime, while the energy term is charged through a postage stamp to all the participants of the power system. Percentage wise, 94% is allocated through the postage stamp and 6% in the fixed term.

ALLOWED INCOME			
Components	Generators	Consumers	TOTAL
Income	$819.683.226,0	$1.912.594.193,0	$2.732.177.419,0

ALLOWED INCOME			
O&M quota	$60.797.660,0	$60.941.650,0	$121.739.310,0
Registration quota	$300.000,0	$300.000,0	$600.000,0
Capacity quota	$32.605.000,0		$32.605.000,0
Remaining income	$725.980.566,0	$1.851.352.543,0	$2.577.333.109,0

Figure 37. Final allowed income

Finally, a forecast of the tariff has been proposed according to the latest publications in 2017. No consideration has been made for the fact that the migration from the old regime to the new one may be faster or slower than the one proposed in the tariff. In any case, revenue reconciliation would work in the following manner: if migration is slower than planned, current income would be lower than the one required, hence creating a deficit. This would probably be recovered in the coming years through a higher "*others*" component and therefore a slightly higher tariff than the one forecasted. Nevertheless, with the information reviewed and to the best of my knowledge, no explicit mention has been found for this situation.

	2016		2017		2018	
Approved charges(pesos)	Consumers	Generators	Consumers	Generators	Consumers	Generators
Volumetric tariff (pesos/MWh)	6,4824	2,4807	6,994	2,676	7,546	2,887

Figure 38. Approved CENACE tariff

5.4- Regulated users supplied energy. Generation price.

The approach taken here has been reasonable with the overall picture of the liberalization: A fair deal for consumers while they try not to compromise the financial viability of CFE.

To accomplish both these objectives, the law LIE (Ley de la Industria Eléctrica) stipulates that the energy bought for basic consumers will not be subjected to the full volatility of the wholesale market, and that a contract in the form of an option should hence be celebrated between agents registered as basic suppliers and the more efficient CFE generators, which will be contractually represented by SENER.

The process proposed has been the following: first, to provide a fair deal for consumers, SENER recollected from CFE the different costs from its generators with the purpose of assigning the more efficient ones to basic consumers. In order to choose among them, the methodology used has been to calculate the NPV of the different generators and choose those which resulted in a

positive value. Income for the generators has been based on revenue coming from the wholesale market. This has resulted in 154 generators between CFE generators and independent power producers with PPA contract. Second, SENER has asked CRE for its opinion about the generators chosen and about how the contract should be celebrated and what features should they include. CRE has emitted its opinion where they have stated that the contract should be in the form of an option, thus being the price paid by the consumer the minimum between the wholesale price and the one coming from the contracts. By this, CRE understands consumer interest should be placed first. Furthermore, CRE has carried out a benchmarking analysis between the costs proposed by CFE and standard costs from data based in a report from the International Energy Agency. This has led to the publication of 3 scenarios for the total cost to be recovered through the tariff, 2 with the comparison previously mentioned and a third one, where the annual investment cost of the technologies recognized by CFE has been changed by the data coming from the 2º long term capacity auction celebrated recently in the country.

TOTAL COST TO BE RECOVERED IN THE TARIFF		
		2016 (Thousand millions pesos)
SCENARIO A	Capacity payment	117,6
	Fuels	120,7
	O&M	16,2
	Others	13,6
	TOTAL	**268,1**
SCENARIO B	Capacity payment	101,1
	Fuels	120,7
	O&M	16,2
	Others	13,6
	TOTAL	**251,6**
SCENARIO C	Capacity payment	50
	Fuels	120,7
	O&M	24,1
	Others	13,6
	TOTAL	**208,4**

Figure 39. Scenarios proposed by the CRE

Difference between scenario A and B is the cost of the gas network pipeline which in scenario B is not included.

Although these values are useful to get an idea of what range they expect the tariff to get, something that remains unanswered and indeed is very relevant is how these values compare with the wholesale price, as it shouldn´t be forgotten that the contract is structured as an option. And in addition to this complexity, it should also be bear in mind that we are interested in forecasting this value too, so we can get an insight in what the future level playing field would be for the commercialization activity.

This can be divided in two tasks which are the following:

- Evolution of the strike price of the option
- Evolution of the price of MEM

With regards to the evolution of the strike price, the methodology to be deployed has been proposed by the CRE in the agreement A045/2016, articles 24, 25, 26 and 27, but basically it needs to be updated by four factors which are fuel prices, US inflation, Mexico inflation and currency exchange.

For these factors, fuel prices for the different nodes of the system have been obtained from the PRODESEN report published by SENER and therefore have been applied node by node to the different generators. For this, it has also been needed to assign the different generators to one of the nine nodes in which the study has been done (The main nine divisions). Data for all generators can be found in annex B.

Figure 40. Regions considered

Inflation for US and Mexico has been forecasted with the software R by testing an ARIMA model and an exponential smoothing model. The second has been chosen as its fit for the validation data set was better. Exchange type has been taken from a Bloomberg terminal based on forward values as was already previously commented for the transmission and distribution part of the tariff.

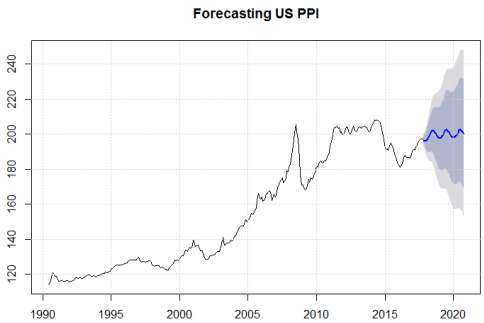


Figure 41. US producer production all commodities index forecast

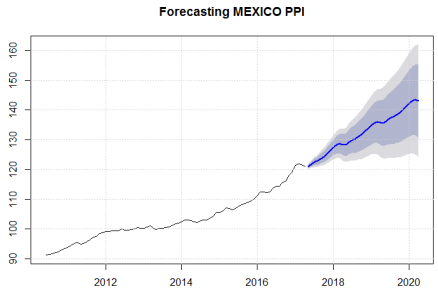


Figure 42. Mexico producer production index forecast (excluding crude)

Once this was forecasted, the strike price (variable cost of generators and fuel costs according to the article 15 of the same agreement), has been forecasted for the coming years.

Forecasting wholesale prices has been easier as they have been directly taken from SENER´s PRODESEN, which published these values until 2033. Values however have been slightly corrected as PRODESEN values seem to be slightly optimistic. For doing this, a comparison between real observed values in the wholesale market have been compared with expected values that were published by SENER and this ratio has been applied to future SENER forecasts.

	2016		
	MEM Observed Prices (USD/MWh)	Prodesen values (USD/MWh)	Ratio
Peninsular	52,73	38,14	1,38
Oriental	47,26	36,52	1,29
Noreste	43,48	35,68	1,22
Norte	46,07	35,04	1,31
Noroeste	48,03	32,35	1,48
Occidental	46,98	37,72	1,25
Central	46,19	37,18	1,24
Baja California	30,44	36,74	0,83
Baja california Sur	116,08	102,33	1,13

Figure 43. MEM Prices. SENER forecast against observed

Of course, the methodology has some flaws and a proper network constrain unit commitment model based on fundamentals should have been run, however, for the purpose of the study, this assumption has been considered valid. The interested party however may consider the option of cross checking these values against those coming from a model as the one proposed.

MEM Prices (USD/MWh)			
	2016	2017	2018
Peninsular	52,73	52,11	55,85
Oriental	47,26	47,85	51,55
Noreste	43,48	44,05	47,74
Norte	46,07	48,13	49,63
Noroeste	48,03	57,31	55,16
Occidental	46,98	46,81	50,30
Central	46,19	46,20	50,15
Baja California	30,44	27,46	31,48
Baja california Sur	116,08	135,93	137,94

Figure 44. MEM prices forecast

Once that the two parts of the equation are derived, we can proceeded with the comparison and obtain therefore the final price to be paid by the consumer under the contract. The evaluation is made assuming generators and the load serving entity with whom the contract is celebrated are in the same node, as otherwise the comparison would have needed to be done across nodes and it will have been much more difficult to rationalize the election of one node over another. Data per generator can be found in annex B. Here only the resulting price for the consumer to be paid through the tariff is shown.

Divisions	Energy production	Price for 2016 tariff	Price for 2017 tariff	Price for 2018 tariff
Peninsular	6131,69	47,17	46,89	46,40
Oriental	53436,66	49,52	49,38	49,66
Noreste	72999,02	42,47	42,49	43,01
Norte	23745,45	47,96	47,85	47,12
Noroeste	13611,71	47,62	51,24	49,40
Occidental	56246,69	50,68	47,12	47,73
Central	18104,16	46,31	46,10	46,70
Baja California	13346,40	37,59	36,20	37,92
Baja California Sur	2480,10	84,68	94,99	92,84

Figure 45. Price forecast to be recognized in the tariff

As can be observed, the value is very competitive which in truth, was already expected derived from the methodology that initially used SENER to choose the generators that were going to the basic supply (NPV positive). Total amount to be recovered though the tariff has also been calculated:

	2016 (Thousand millions Pesos)
Default Sceanrio	279,91
Scenario A	268,1
Scenario B	251,6
Scenario C	208,4
Option Scenario	218,92

Figure 46. Scenarios proposed by the CRE

Result for the scenario considering the option feature seems to be very reasonable. In fact, it is between the different values proposed by the CRE, but above scenario C, which is consistent with economic fundamentals. This makes sense as Scenario C is based on the capacity payment obtained from the 2º long term capacity auction, whose bids come from new, efficient, up to

date technologies, therefore that they should, in theory, require a lower payment than the ones already in the market. This is indeed what can be observed and is why option C is below all other options.

5.5- Commercialization margin.

This value has been taken from a study made by the CNMC about what the margin should be for a retailer acting as the supplier of last resort. The study can be found in their website and was published on the 19/05/16 (CNMC, 2016).

The study is very exhaustive but for the purpose of this document what is important is that the range proposed as a reasonable value for the margin on an average consumer has been 26-37€/contract-year. Derived from this, the value taken for Mexico has been 32€/contract-year which is exactly two times the current situation in Spain. The structure for the charge has also been taken from the Spanish regime, hence that the only thing that has been done is multiply those values by two.

	2016	2017	2018
Fixed term ($/kW-año)	3,4608	3,4608	3,4608
Volumetric term ($/MWh)	1,904	1,904	1,904

Figure 47. Commercialization margin Spain

	2016	2017	2018
Fixed term ($/kW-año)	6,9216	6,9216	6,9216
Volumetric term ($/MWh)	3,808	3,808	3,808

Figure 48. Proposed commercialization margin Mexico

5.6- Forecasted tariff.

After having made this forecasting exercise, the final tariff is shown. Values are presented for those divisions where private interest seems to be major, but final tariff for the others divisions could be perfectly derived from the data presented in this document.

It can be observed that two tables are presented; one where losses are omitted and other where the values of losses have been charged directly through the tariff in order. That way its impact can be observed in a more comparable way.

					2017						
	DIVISIÓN	TARIFF	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (Pesos)
NO LOSSES	ORIENTE	DB1	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,808	67,91	7,510031886	0,334164696	49,38	128,942	2698,694781
			Capacity	$/kW-mes	0,5768					0,577	12,0721356
		DB2	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,808	58,21	7,510031886	0,334164696	49,38	119,240	2495,641405
			Capacity	$/kW-mes	0,5768					0,577	12,0721356
		PDBT	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,808	55,15	7,510031886	0,334164696	49,38	116,177	2431,519286
			Capacity	$/kW-mes	0,5768					0,577	12,0721356
		GDBT	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,808		7,510031886	0,334164696	49,38	61,030	1277,321149
			Capacity	$/kW-mes	0,5768	21,94				22,515	471,2185668
		GDMT	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,808		7,510031886	0,334164696	49,38	61,030	1277,321149
			Capacity	$/kW-mes	0,5768	8,80				9,379	196,3056697

					2017						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (Pesos)
WITH LOSSES	ORIENTE	DB1	Fixed	$/mes							
			Energy	$/MWh	3,808	81,49	7,510031886	0,334164696	49,38	142,516	2982,797094
			Capacity	$/kW-mes	0,5768					0,577	12,0721356
		DB2	Fixed	$/mes							
			Energy	$/MWh	3,808	71,78	7,510031886	0,334164696	49,38	132,815	2779,743718
			Capacity	$/kW-mes	0,5768					0,577	12,0721356
		PDBT	Fixed	$/mes							
			Energy	$/MWh	3,808	68,72	7,510031886	0,334164696	49,38	129,751	2715,621599
			Capacity	$/kW-mes	0,5768					0,577	12,0721356
		GDBT	Fixed	$/mes							
			Energy	$/MWh	3,808		7,510031886	0,334164696	49,38	61,030	1277,321149
			Capacity	$/kW-mes	0,5768	24,57				25,147	526,3161385
		GDMT	Fixed	$/mes							
			Energy	$/MWh	3,808		7,510031886	0,334164696	49,38	61,030	1277,321149
			Capacity	$/kW-mes	0,5768	9,86				10,436	218,4136938

Figure 49. ORIENTE. Final Tariff 2017

					2018						
	DIVISIÓN	TARIFF	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (Pesos)
NO LOSSES	ORIENTE	DB1	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,808	65,19	7,401604531	0,349750421	49,66	126,408	2727,213053
			Capacity	$/kW-mes	0,5768					0,577	12,44428696
		DB2	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,808	55,88	7,401604531	0,349750421	49,66	117,095	2526,292155
			Capacity	$/kW-mes	0,5768					0,577	12,44428696
		PDBT	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,808	52,94	7,401604531	0,349750421	49,66	114,154	2462,84345
			Capacity	$/kW-mes	0,5768					0,577	12,44428696
		GDBT	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,808		7,401604531	0,349750421	49,66	61,218	1320,766769
			Capacity	$/kW-mes	0,5768	21,06				21,635	466,7687359
		GDMT	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,808		7,401604531	0,349750421	49,66	61,218	1320,766769
			Capacity	$/kW-mes	0,5768	8,45				9,026	194,7429899

					2018						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (Pesos)
WITH LOSSES	ORIENTE	DB1	Fixed	$/mes							
			Energy	$/MWh	3,808	76,51	7,401604531	0,349750421	49,66	137,723	2971,340536
			Capacity	$/kW-mes	0,5768					0,577	12,44428696
		DB2	Fixed	$/mes							
			Energy	$/MWh	3,808	67,19	7,401604531	0,349750421	49,66	128,411	2770,419638
			Capacity	$/kW-mes	0,5768					0,577	12,44428696
		PDBT	Fixed	$/mes							
			Energy	$/MWh	3,808	64,25	7,401604531	0,349750421	49,66	125,470	2706,970934
			Capacity	$/kW-mes	0,5768					0,577	12,44428696
		GDBT	Fixed	$/mes							
			Energy	$/MWh	3,808		7,401604531	0,349750421	49,66	61,218	1320,766769
			Capacity	$/kW-mes	0,5768	23,59				24,162	521,2876697
		GDMT	Fixed	$/mes							
			Energy	$/MWh	3,808		7,401604531	0,349750421	49,66	61,218	1320,766769
			Capacity	$/kW-mes	0,5768	9,46				10,040	216,6188343

Figure 50. ORIENTE. Final Tariff 2018

					2017						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (Pesos)
NO LOSSES	SurEste	DB1	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,808	60,92	7,510031886	0,334164696	49,38	121,948	2552,300544
			Capacity	$/kW-mes	0,5768					0,577	12,0721356
		DB2	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,808	52,36	7,510031886	0,334164696	49,38	113,389	2373,171207
			Capacity	$/kW-mes	0,5768					0,577	12,0721356
		PDBT	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,808	49,84	7,510031886	0,334164696	49,38	110,872	2320,486108
			Capacity	$/kW-mes	0,5768					0,577	12,0721356
		GDBT	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,808		7,510031886	0,334164696	49,38	61,030	1277,321149
			Capacity	$/kW-mes	0,5768	19,72				20,297	424,7966637
		GDMT	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,808		7,510031886	0,334164696	49,38	61,030	1277,321149
			Capacity	$/kW-mes	0,5768	6,33				6,912	144,6594556

					2017						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (Pesos)
WITH LOSSES	SurEste	DB1	Fixed	$/mes							0
			Energy	$/MWh	3,8080	81,4867	7,5100	0,3342	49,3775	142,5164	2982,7971
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		DB2	Fixed	$/mes							
			Energy	$/MWh	3,8080	71,7849	7,5100	0,3342	49,3775	132,8146	2779,7437
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		PDBT	Fixed	$/mes							
			Energy	$/MWh	3,8080	68,7212	7,5100	0,3342	49,3775	129,7509	2715,6216
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		GDBT	Fixed	$/mes							
			Energy	$/MWh	3,8080		7,5100	0,3342	49,3775	61,0297	1277,3211
			Capacity	$/kW-mes	0,5768	22,0861				22,6629	474,3236
		GDMT	Fixed	$/mes							
			Energy	$/MWh	3,8080		7,5100	0,3342	49,3775	61,0297	1277,3211
			Capacity	$/kW-mes	0,5768	7,0951				7,6719	160,5699

Figure 51. Sur Este. Final Tariff 2017

					2018						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (Pesos)
NO LOSSES	SurEste	DB1	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,808	57,59	7,4016	0,3498	49,6590	118,8073	2563,2316
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		DB2	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,808	49,50	7,4016	0,3498	49,6590	110,7163	2388,6704
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		PDBT	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,808	47,12	7,4016	0,3498	49,6590	108,3366	2337,3289
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		GDBT	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,808		7,4016	0,3498	49,6590	61,2183	1320,7668
			Capacity	$/kW-mes	0,5768	18,64				19,2190	414,6435
		GDMT	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,808		7,4016	0,3498	49,6590	61,2183	1320,7668
			Capacity	$/kW-mes	0,5768	5,99				6,5656	141,6504

					2018						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (Pesos)
WITH LOSSES	SurEste	DB1	Fixed	$/mes							0
			Energy	$/MWh	3,8080	76,5051	7,4016	0,3498	49,6590	137,7234	2971,3405
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		DB2	Fixed	$/mes							
			Energy	$/MWh	3,8080	67,1923	7,4016	0,3498	49,6590	128,4106	2770,4196
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		PDBT	Fixed	$/mes							
			Energy	$/MWh	3,8080	64,2514	7,4016	0,3498	49,6590	125,4697	2706,9709
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		GDBT	Fixed	$/mes							
			Energy	$/MWh	3,8080		7,4016	0,3498	49,6590	61,2183	1320,7668
			Capacity	$/kW-mes	0,5768	20,8792				21,4560	462,9074
		GDMT	Fixed	$/mes							
			Energy	$/MWh	3,8080		7,4016	0,3498	49,6590	61,2183	1320,7668
			Capacity	$/kW-mes	0,5768	6,7074				7,2842	157,1551

Figure 52. Sur Este. Final Tariff 2018

					2017						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (Pesos)
NO LOSSES	Baja California	DB1	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,8080	31,6584	7,5100	0,3342	36,1966	79,5072	1664,0461
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		DB2	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080	36,2540	7,5100	0,3342	36,1966	84,1028	1760,2293
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		PDBT	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080	29,1053	7,5100	0,3342	36,1966	76,9541	1610,6110
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		GDBT	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080		7,5100	0,3342	36,1966	47,8488	1001,4509
			Capacity	$/kW-mes	0,5768	8,1801				8,7569	183,2782
		GDMT	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080		7,5100	0,3342	36,1966	47,8488	1001,4509
			Capacity	$/kW-mes	0,5768	3,9011				4,4779	93,7210

					2017						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (Pesos)
WITH LOSSES	Baja California	DB1	Fixed	$/mes							0
			Energy	$/MWh	3,8080	39,4031	7,5100	0,3342	36,1966	87,2519	1826,1383
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		DB2	Fixed	$/mes							
			Energy	$/MWh	3,8080	43,9987	7,5100	0,3342	36,1966	91,8475	1922,3215
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		PDBT	Fixed	$/mes							
			Energy	$/MWh	3,8080	36,8500	7,5100	0,3342	36,1966	84,6988	1772,7032
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		GDBT	Fixed	$/mes							
			Energy	$/MWh	3,8080		7,5100	0,3342	36,1966	47,8488	1001,4509
			Capacity	$/kW-mes	0,5768	9,1617				9,7385	203,8229
		GDMT	Fixed	$/mes							
			Energy	$/MWh	3,8080		7,5100	0,3342	36,1966	47,8488	1001,4509
			Capacity	$/kW-mes	0,5768	4,3693				4,9461	103,5188

Figure 53. Baja California. Final Tariff 2017

					2018						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (Pesos)
NO LOSSES	Baja California	DB1	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,8080	30,3891	7,4016	0,3498	37,9234	79,8719	1723,2121
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		DB2	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080	34,8005	7,4016	0,3498	37,9234	84,2832	1818,3852
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		PDBT	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080	27,9384	7,4016	0,3498	37,9234	77,4212	1670,3382
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		GDBT	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080		7,4016	0,3498	37,9234	49,4828	1067,5755
			Capacity	$/kW-mes	0,5768	7,8522				8,4290	181,8523
		GDMT	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080		7,4016	0,3498	37,9234	49,4828	1067,5755
			Capacity	$/kW-mes	0,5768	3,7447				4,3215	93,2356

					2018						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (Pesos)
WITH LOSSES	Baja California	DB1	Fixed	$/mes							
			Energy	$/MWh	3,8080	37,9022	7,4016	0,3498	37,9234	87,3850	1885,3043
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		DB2	Fixed	$/mes							
			Energy	$/MWh	3,8080	42,3135	7,4016	0,3498	37,9234	91,7963	1980,4774
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		PDBT	Fixed	$/mes							
			Energy	$/MWh	3,8080	35,4515	7,4016	0,3498	37,9234	84,9342	1832,4304
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		GDBT	Fixed	$/mes							
			Energy	$/MWh	3,8080		7,4016	0,3498	37,9234	49,4828	1067,5755
			Capacity	$/kW-mes	0,5768	8,7944				9,3712	202,1813
		GDMT	Fixed	$/mes							
			Energy	$/MWh	3,8080		7,4016	0,3498	37,9234	49,4828	1067,5755
			Capacity	$/kW-mes	0,5768	4,1941				4,7709	102,9306

Figure 54. Baja California. Final Tariff 2018

					2017						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (Pesos)
NO LOSSES	Baja California Sur	DB1	Fixed	$/mes							
			Energy	$/MWh	3,8080	31,6584	7,5100	0,3342	94,9862	138,2968	2894,4837
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		DB2	Fixed	$/mes							
			Energy	$/MWh	3,8080	36,2540	7,5100	0,3342	94,9862	142,8924	2990,6669
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		PDBT	Fixed	$/mes							
			Energy	$/MWh	3,8080	29,1053	7,5100	0,3342	94,9862	135,7437	2841,0486
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		GDBT	Fixed	$/mes							
			Energy	$/MWh	3,8080		7,5100	0,3342	94,9862	106,6384	2231,8885
			Capacity	$/kW-mes	0,5768	8,1801				8,7569	183,2782
		GDMT	Fixed	$/mes							
			Energy	$/MWh	3,8080		7,5100	0,3342	94,9862	106,6384	2231,8885
			Capacity	$/kW-mes	0,5768	3,9011				4,4779	93,7210

					2017					
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)
WITH LOSSES	Baja California Sur	DB1	Fixed	$/mes						
			Energy	$/MWh	3,8080	39,4031	7,5100	0,3342	94,9862	146,0415
			Capacity	$/kW-mes	0,5768					0,5768
		DB2	Fixed	$/mes						
			Energy	$/MWh	3,8080	43,9987	7,5100	0,3342	94,9862	150,6371
			Capacity	$/kW-mes	0,5768					0,5768
		PDBT	Fixed	$/mes						
			Energy	$/MWh	3,8080	36,8500	7,5100	0,3342	94,9862	143,4884
			Capacity	$/kW-mes	0,5768					0,5768
		GDBT	Fixed	$/mes						
			Energy	$/MWh	3,8080		7,5100	0,3342	94,9862	106,6384
			Capacity	$/kW-mes	0,5768	9,1617				9,7385
		GDMT	Fixed	$/mes						
			Energy	$/MWh	3,8080		7,5100	0,3342	94,9862	106,6384
			Capacity	$/kW-mes	0,5768	4,3693				4,9461

Figure 55. Baja California Sur. Final Tariff 2017

			2018						
	DIVISIÓN	TARIFA	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD	TOTAL (Pesos)
NO LOSSES	Baja California Sur	DB1						0,000	0
			3,8080	30,3891	7,4016	0,3498	92,8375	134,7860	2907,9683
			0,5768					0,5768	12,4443
		DB2						0,0000	0,0000
			3,8080	34,8005	7,4016	0,3498	92,8375	139,1974	3003,1414
			0,5768					0,5768	12,4443
		PDBT						0,0000	0,0000
			3,8080	27,9384	7,4016	0,3498	92,8375	132,3353	2855,0944
			0,5768					0,5768	12,4443
		GDBT						0,0000	0,0000
			3,8080		7,4016	0,3498	92,8375	104,3969	2252,3317
			0,5768	7,8522				8,4290	181,8523
		GDMT						0,0000	0,0000
			3,8080		7,4016	0,3498	92,8375	104,3969	2252,3317
			0,5768	3,7447				4,3215	93,2356

			2018						
	DIVISIÓN	TARIFA	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD	TOTAL (Pesos)
WITH LOSSES	Baja California Sur	DB1							
			3,8080	37,9022	7,4016	0,3498	92,8375	142,2991	3070,0605
			0,5768					0,5768	12,4443
		DB2							
			3,8080	42,3135	7,4016	0,3498	92,8375	146,7104	3165,2336
			0,5768					0,5768	12,4443
		PDBT							
			3,8080	35,4515	7,4016	0,3498	92,8375	139,8484	3017,1866
			0,5768					0,5768	12,4443
		GDBT							
			3,8080		7,4016	0,3498	92,8375	104,3969	2252,3317
			0,5768	8,7944				9,3712	202,1813
		GDMT							
			3,8080		7,4016	0,3498	92,8375	104,3969	2252,3317
			0,5768	4,1941				4,7709	102,9306

Figure 56. Baja California Sur. Final Tariff 2018

					2017						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (pesos)
NO LOSSES	Tarifa NorEste	DB1	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,8080	34,9496	7,5100	0,3342	42,4869	89,0887	1864,5816
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		DB2	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080	28,2680	7,5100	0,3342	42,4869	82,4071	1724,7403
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		PDBT	Fixed	$/mes						0,0000	0,0000
			Energy	$/kWh	3,8080	34,9496	7,5100	0,3342	42,4869	89,0887	1864,5816
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		GDBT	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080		7,5100	0,3342	42,4869	54,1391	1133,1042
			Capacity	$/kW-mes	0,5768	11,7199				12,2967	257,3645
		GDMT	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080		7,5100	0,3342	42,4869	54,1391	1133,1042
			Capacity	$/kW-mes	0,5768	2,4763				3,0531	63,8995

					2017						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (pesos)
WITH LOSSES	Tarifa NorEste	DB1	Fixed	$/mes							0
			Energy	$/MWh	3,8080	46,9650	7,5100	0,3342	42,4869	101,1041	2116,0573
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		DB2	Fixed	$/mes							
			Energy	$/MWh	3,8080	40,2834	7,5100	0,3342	42,4869	94,4225	1976,2160
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		PDBT	Fixed	$/mes							
			Energy	$/kWh	3,8080	46,9650	7,5100	0,3342	42,4869	101,1041	2116,0573
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		GDBT	Fixed	$/mes							
			Energy	$/MWh	3,8080		7,5100	0,3342	42,4869	54,1391	1133,1042
			Capacity	$/kW-mes	0,5768	13,1263				13,7031	286,7995
		GDMT	Fixed	$/mes							
			Energy	$/MWh	3,8080		7,5100	0,3342	42,4869	54,1391	1133,1042
			Capacity	$/kW-mes	0,5768	2,7734				3,3502	70,1187

Figure 57. Golfo Norte. Final Tariff 2017

					2018						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD	TOTAL (Pesos)
NO LOSSES	Tarifa NorEste	DB1	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,8080	33,7857	7,4016	0,3498	43,0130	88,3580	1906,2976
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		DB2	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080	27,3266	7,4016	0,3498	43,0130	81,8990	1766,9461
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		PDBT	Fixed	$/mes						0,0000	0,0000
			Energy	$/kWh	3,8080	33,7857	7,4016	0,3498	43,0130	88,3580	1906,2976
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		GDBT	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080		7,4016	0,3498	43,0130	54,5723	1177,3819
			Capacity	$/kW-mes	0,5768	11,3296				11,9064	256,8776
		GDMT	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080		7,4016	0,3498	43,0130	54,5723	1177,3819
			Capacity	$/kW-mes	0,5768	2,3938				2,9706	64,0901

					2018						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD	TOTAL (Pesos)
WITH LOSSES	Tarifa NorEste	DB1	Fixed	$/mes							
			Energy	$/MWh	3,8080	42,7375	7,4016	0,3498	43,0130	97,3099	2099,4314
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		DB2	Fixed	$/mes							
			Energy	$/MWh	3,8080	36,2785	7,4016	0,3498	43,0130	90,8508	1960,0798
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		PDBT	Fixed	$/mes							
			Energy	$/kWh	3,8080	42,7375	7,4016	0,3498	43,0130	97,3099	2099,4314
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		GDBT	Fixed	$/mes							
			Energy	$/MWh	3,8080		7,4016	0,3498	43,0130	54,5723	1177,3819
			Capacity	$/kW-mes	0,5768	12,6892				13,2660	286,2096
		GDMT	Fixed	$/mes							
			Energy	$/MWh	3,8080		7,4016	0,3498	43,0130	54,5723	1177,3819
			Capacity	$/kW-mes	0,5768	2,6811				3,2579	70,2876

Figure 58. Golfo Norte. Final Tariff 2018

					2017						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (pesos)
NO LOSSES	Tarifa NorEste	DB1	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,8080	46,9882	7,5100	0,3342	42,4869	101,1273	2116,5430
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		DB2	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080	38,2102	7,5100	0,3342	42,4869	92,3493	1932,8237
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		PDBT	Fixed	$/mes						0,0000	0,0000
			Energy	$/kWh	3,8080	47,5045	7,5100	0,3342	42,4869	101,6436	2127,3500
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		GDBT	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080		7,5100	0,3342	42,4869	54,1391	1133,1042
			Capacity	$/kW-mes	0,5768	15,9522				16,5290	345,9442
		GDMT	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080		7,5100	0,3342	42,4869	54,1391	1133,1042
			Capacity	$/kW-mes	0,5768	5,2746				5,8514	122,4658

					2017						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (pesos)
WITH LOSSES	Tarifa NorEste	DB1	Fixed	$/mes							
			Energy	$/MWh	3,8080	56,2283	7,5100	0,3342	42,4869	110,3674	2309,9342
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		DB2	Fixed	$/mes							
			Energy	$/MWh	3,8080	47,4503	7,5100	0,3342	42,4869	101,5894	2126,2149
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		PDBT	Fixed	$/mes							
			Energy	$/kWh	3,8080	56,7446	7,5100	0,3342	42,4869	110,8837	2320,7413
			Capacity	$/kW-mes	0,5768					0,5768	12,0721
		GDBT	Fixed	$/mes							
			Energy	$/MWh	3,8080		7,5100	0,3342	42,4869	54,1391	1133,1042
			Capacity	$/kW-mes	0,5768	17,8665				18,4433	386,0089
		GDMT	Fixed	$/mes							
			Energy	$/MWh	3,8080		7,5100	0,3342	42,4869	54,1391	1133,1042
			Capacity	$/kW-mes	0,5768	5,9075				6,4843	135,7131

Figure 59. Golfo Centro. Final Tariff 2017

					2018						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (Pesos)
NO LOSSES	Tarifa NorEste	DB1	Fixed	$/mes						0,000	0
			Energy	$/MWh	3,8080	45,6512	7,4016	0,3498	43,0130	100,2236	2162,2939
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		DB2	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080	37,1230	7,4016	0,3498	43,0130	91,6953	1978,2993
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		PDBT	Fixed	$/mes						0,0000	0,0000
			Energy	$/kWh	3,8080	46,1529	7,4016	0,3498	43,0130	100,7253	2173,1171
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		GDBT	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080		7,4016	0,3498	43,0130	54,5723	1177,3819
			Capacity	$/kW-mes	0,5768	15,4983				16,0751	346,8165
		GDMT	Fixed	$/mes						0,0000	0,0000
			Energy	$/MWh	3,8080		7,4016	0,3498	43,0130	54,5723	1177,3819
			Capacity	$/kW-mes	0,5768	5,1245				5,7013	123,0034

					2018						
	DIVISIÓN	TARIFA	CHARGE	TYPE	Commercial Margin	Distribution	Transmission	CENACE	Energy	TOTAL (USD)	TOTAL (Pesos)
WITH LOSSES	Tarifa NorEste	DB1	Fixed	$/mes							
			Energy	$/MWh	3,8080	54,6150	7,4016	0,3498	43,0130	109,1874	2355,6851
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		DB2	Fixed	$/mes							
			Energy	$/MWh	3,8080	46,0868	7,4016	0,3498	43,0130	100,6591	2171,6905
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		PDBT	Fixed	$/mes							
			Energy	$/kWh	3,8080	55,1167	7,4016	0,3498	43,0130	109,6890	2366,5083
			Capacity	$/kW-mes	0,5768					0,5768	12,4443
		GDBT	Fixed	$/mes							
			Energy	$/MWh	3,8080		7,4016	0,3498	43,0130	54,5723	1177,3819
			Capacity	$/kW-mes	0,5768	17,3581				17,9349	386,9411
		GDMT	Fixed	$/mes							
			Energy	$/MWh	3,8080		7,4016	0,3498	43,0130	54,5723	1177,3819
			Capacity	$/kW-mes	0,5768	5,7394				6,3162	136,2704

Figure 60. Golfo Centro. Final Tariff 2018

6. OLD AND NEW SCHEME.

6.1- Price comparison from the consumer point of view.

Now that a sound forecast of the additive tariff has been made, the tariff remaining in the "Ley de Sevicio Público de Energía Eléctrica" equivalence is needed to create a field where the comparison can take place. This issue has already been solved by CRE who have specified the tariff equivalence. Values for the old tariff can be found in the annex C.

Cuadro tarifario Vigente	Cuadro tarifario simplificado
Tarifa 1	DB1/DB2
Tarifa 1A	DB1
Tarifa 1B	DB1
Tarifa 1C	DB1
Tarifa 1D	DB1
Tarifa 1E	DB1
Tarifa 1F	DB1
Tarifa 2	PDBT
Tarifa 3	GDBT
Tarifa 5	PDBT
Tarifa 5A	PDBT
Tarifa 6	PDBT/GDBT
Tarifa 9	GDBT
Tarifa 9CU	GDBT/GDMT
Tarifa 9M	GDBT
Tarifa 9N	GDBT/GDMT
Tarifa HM	GDMT
Tarifa HMC	GDMT
Tarifa OM	GDMT

Figure 61. Tariff equivalence between the old and new scheme

Therefore, the average consumers that were proposed in the beginning of this document would be charged according to the following tariffs:

	Contracted capacity (kW)	Load factor	Tariff old scheme	Tariff new scheme
Domestic consumer	3,3	0,15	1B	DB2
Commercial	10	0,2	2	PDBT
SME (services)	40	0,35	3	GDBT
Industrial load	8000	0,9	HM / HMC / OM	GDMT
Industrial laod (HV)	8000	0,9	HS / HS-L / HT	No distribution

Figure 62. Average consumers analysed

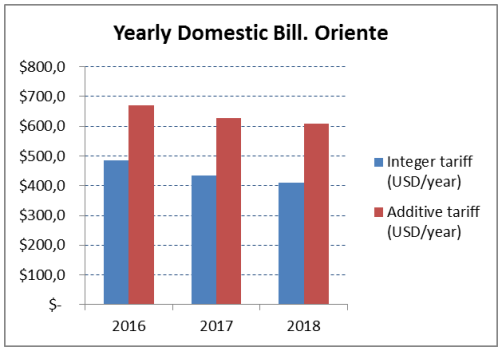
In order to make the study as comprehensive as possible, load factors have been taken averaging real values of consumers in Mexico. Nevertheless, it is true that important differences have been observed across the different regions, being for example energy consumption in Monterrey quite higher than in the rest of the country (probably due to a higher disposable income). These particularities have been omitted with the intention of making a more general comparison despite losing some accuracy in the data.

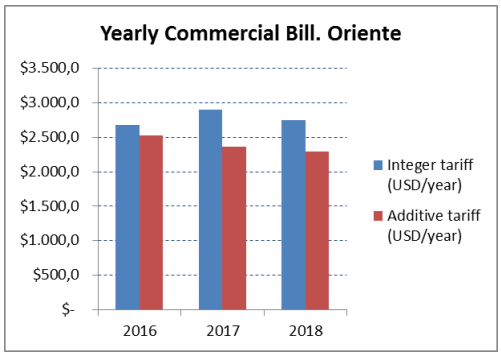
The separation between peak and valley consumption has been done based on load demand profiles and observed MEM prices. For the old scheme bill, the computation has been made using the particularities of the tariff that is being analyzed. Therefore, in some cases, it has been needed to distinguish among peak, valley and intermediary consumption.

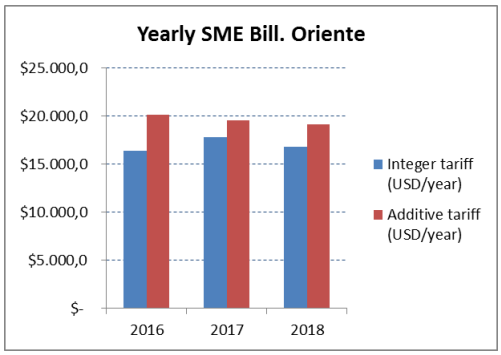
With regards to the values applied for the calculations, tariffs can be found in CFE website and forecasts for the year 2018 have been based on the Producer Price Index and expectations about future fuel prices. Resulting bills for the different regions, tariffs and clients are now presented based on a yearly consumption basis, 55% summer, 45% winter consumption and a ratio between peak and valley price of 1,25:

Finally, data is presented for the divisions of Oriente, SurEste and Golfo Centro. In this way, a quite industrial region as Golfo Centro has been represented as a counterpoint to more domestic, representative areas as Oriente or SurEste.

Premium / discount of the additive tariff with regards to the value of the integer tariff are also represented to see what the increase / decrease consumers are going to face in their bill is. In line with this, similar values are expected to cause a more smoothly transition, therefore, it makes sense to think that from a political point of view they would try to make the transition when the gap among consumer bills is as narrow as possible (Although high-level policy objectives may be many and bill equality may not be the priority at this particular moment of the transition).







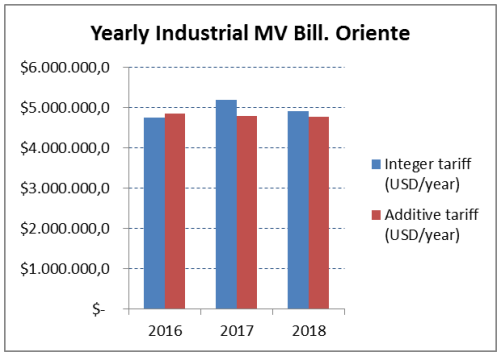
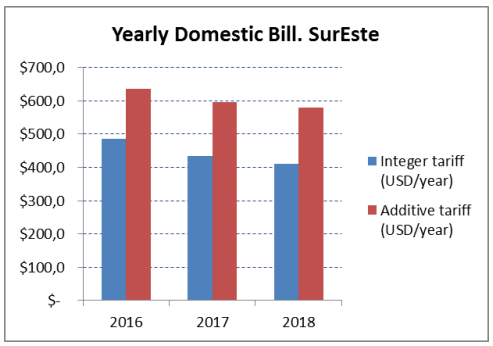
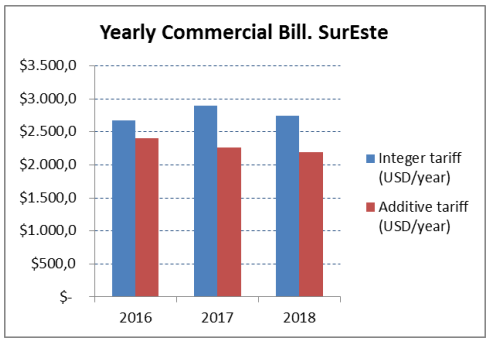
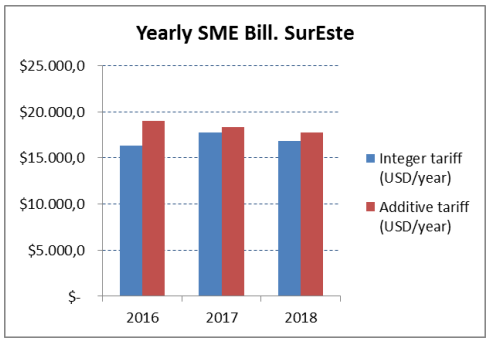


Figure 63. Representative yearly bills. Oriente







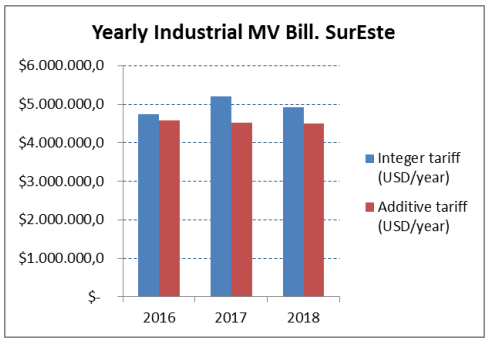
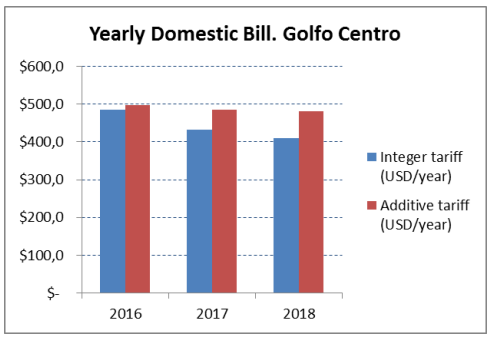
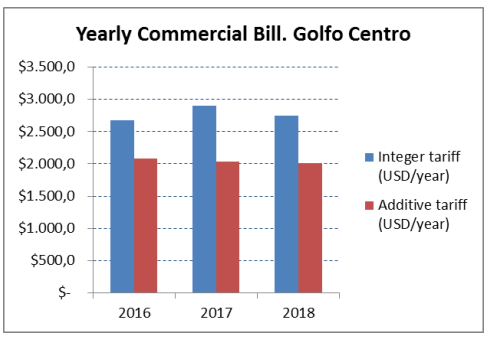
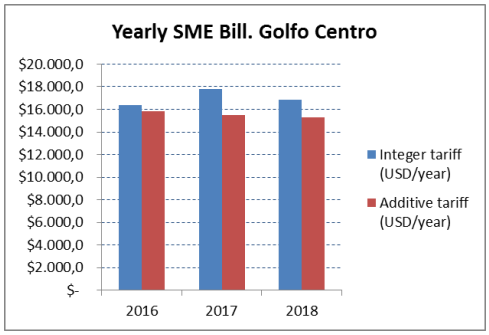


Figure 64. Representative yearly bills. Sur Este







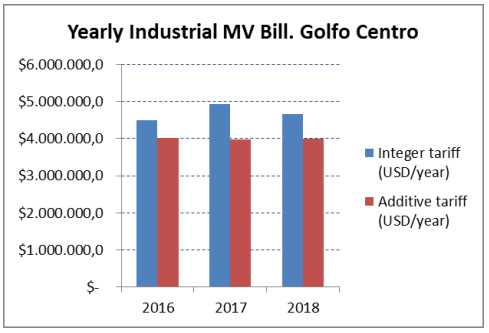


Figure 65. Representative yearly bills. Golfo Centro

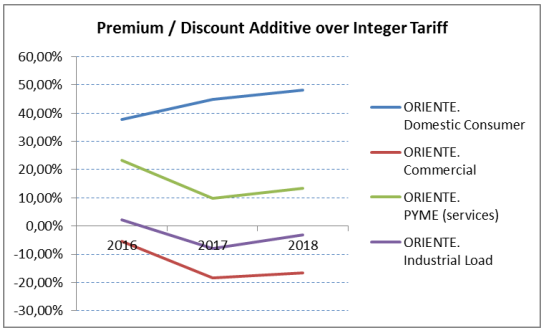


Figure 66. Premium discount tariff evolution. Oriente

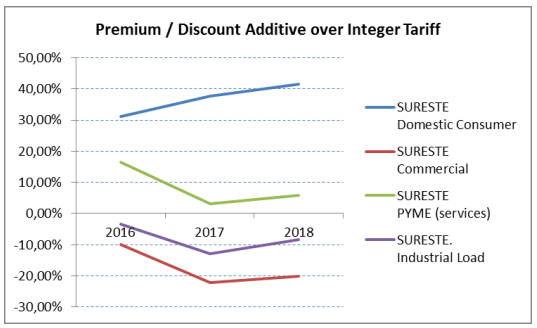


Figure 67. Premium discount tariff evolution. SurEste

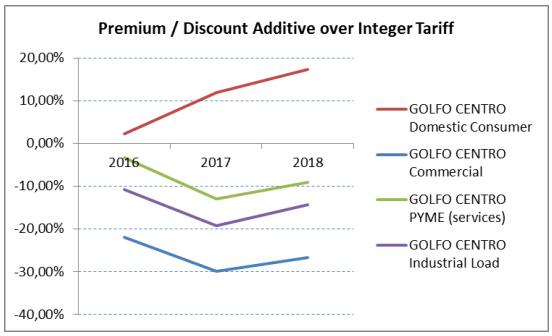


Figure 68. Premium discount tariff evolution. Golfo Centro

Some interesting insights can already be derived from this data. First, we observe a strong variability in the data depending on the location, being consumers much more affected in non-industrial areas as Sur Este and Oriente. Second, high loads as those in GDMT and GDBT are going to see a non-negligible reduction in their tariff apparently all across the national territory. Third, the reduction in the industrial loads bill is going to be higher in those areas already quite prone to industry as Golfo Norte, Golfo Centro and Central, which can be understood as a strong push towards its competitiveness. Fourth, premium / discount gap tends to increase for domestic consumers while for the rest it seems to be narrowing, although no clear trend can be identified. Fifth, two readings appear clear with regards to cross subsidies, either domestics users were subsidized in the integer tariff by industrial loads or now, in the additive tariff, domestic consumers are going to pay a subsidy for the competitiveness of industry across the nation but in particular, in some areas.

In addition to all this, some of the previous comments require a further analysis under a world full of bias and where second best-settings are as important as first best theoretical options. The point specially challenging therefore from my point of view is the increase in domestic consumer bill. My reading of the situation is that what is being tried to be done is eliminate the perhaps subsidy that existed in the integer tariff between industrial loads and domestic consumers, hence, creating a domestic bill artificially low. This, although ideally the best option, as you make consumers receive a more appropriate price signal for their consumption, is nevertheless challenging from a political point of view. How would domestic consumers react to an increase in their bill of 30%, 40%? Should the transition maybe be more progressive?

Another point that deserves some comments and related to the previous one is the reduction in industry bill. While this may make perfect sense and in fact, is what should happen, the question is whether the locational signal sent in Golfo Norte, Golfo Centro and Central is so strong that it may create some inter regional tensions among politic figures of the different areas because of the competitiveness implications that this may have. Moreover, would this cause a higher than expected concentration of the industry in some areas in detriment of others which should reinvent their economy? And although some may argue that the integer tariff already favored some areas for industry location, the truth is that the signal sent by the additive one is even stronger. The problem therefore, as I see it, is whether industries electricity-intensive could relocate to these new areas if the competitiveness effect is very strong. If electric intensive companies were already located in those areas, the problem is not as such, and it becomes more an issue of competitiveness across countries.

Another issue that has been observed is the concentration of tariff types; while in the integer tariff, there were many types, now only 5 tariffs have been created (DB1, DB2, PDBT, GDBT, GDMT). By making this aggregation, it is explicitly being said that for example an HM is the same than an HMC, OM or 9N client, which nowadays, are clearly not. This, again, although correct

from a simplicity and fairness point of view, is going to create winners and losers as for example, an agricultural client in the 9N is going to see their favorable treatment over.

Something else that should be taken into account is the fact that the structure of the tariff has changed too, and this will therefore affect consumers in a different way depending on their load factor.

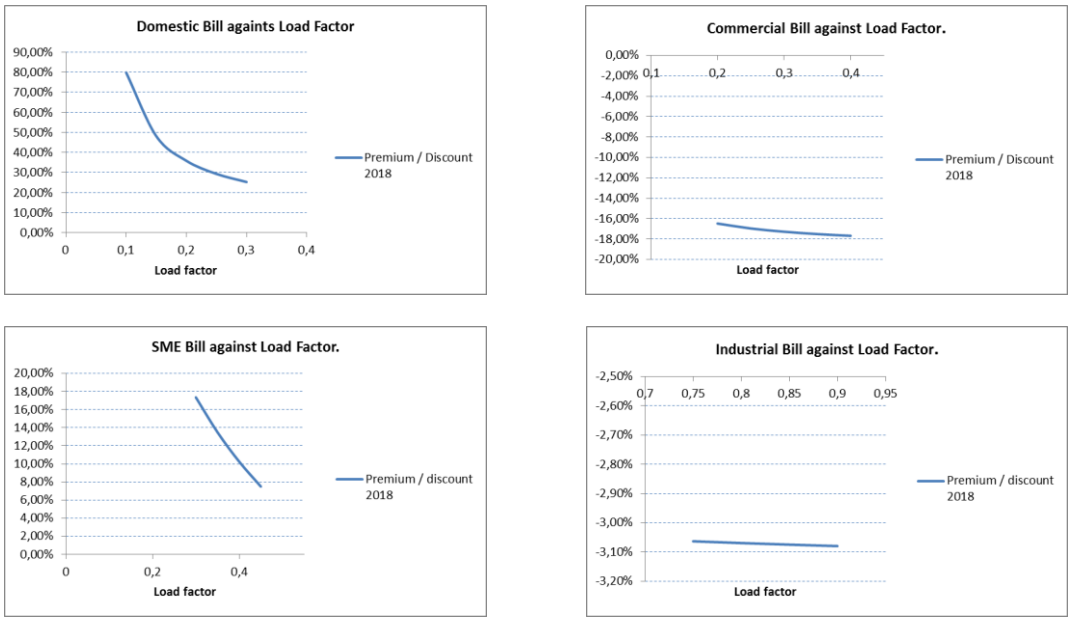


Figure 69. Consumer bill against load factor. ORIENTE

It is therefore observed that the tariff structure is quite different mainly for domestic users while for the others it remains reasonably similar. The reason for this is how the tariffs 1 in the integer scheme are structured; where the first KWh are charged at a very low price, in this manner, as the load factor increases, more energy is charged at the higher price and therefore the gap with the additive tariff gets closed.

For the other type of consumers, although there are some differences in the structure of the tariff, I will not consider that this affect in any meaningful way the previous results that we have obtained, hence making them quite robust with respect to changes in the load factors.

In conclusion, it has been observed that consumer's bills are going to experience a notable change. In particular, on one hand, domestic consumers are going to see their bill importantly increased. It is expected this may probably end up in political pressure on the regulatory authorities as public opinion would perhaps question the suitability of the reform if all it has been achieved is an increase of 30% in their final bill. On the other hand, industrial loads would see their bill reduced with the more noteworthy reduction in Golfo Centro, Norte and Central,

which are the locations where the industry is mainly already located. Some may argue that this reduction has been possible due to the fact that previous cross subsidy between domestic and industrial consumers has been eliminated by the new tariff, in any case, concise and definitive proofs of this are difficult to be given.

Something else that has been noticed is a desire to unify tariffs in favor of simplicity and a more transparent system of payments. Although a good idea, this poses some challenges too, because previous consumers in favored tariffs as for example the agricultural 9, would now converge with medium voltage tariffs as HM, HMC and thus see their bills increase. In this manner, it is believed the discriminatory power policy makers may have had to assist some industries through favored electricity tariffs over another's is now probably going to be lost under this standardization process.

Finally, at a macro level, what is observed is that there will be a welfare movement from domestic consumers to higher consumption loads, which will apparently see their bills reduced and hence see their competitiveness increase against other countries. This together with the fact Peso seems to be losing ground against the dollar could probably end up in an important increase in the exports of the country.

7. ANALYSIS OF RESULTS. MAIN BARRIERS FOR THE COMMERCIALIZATION

7.1- Analysis from the incumbent point of view.

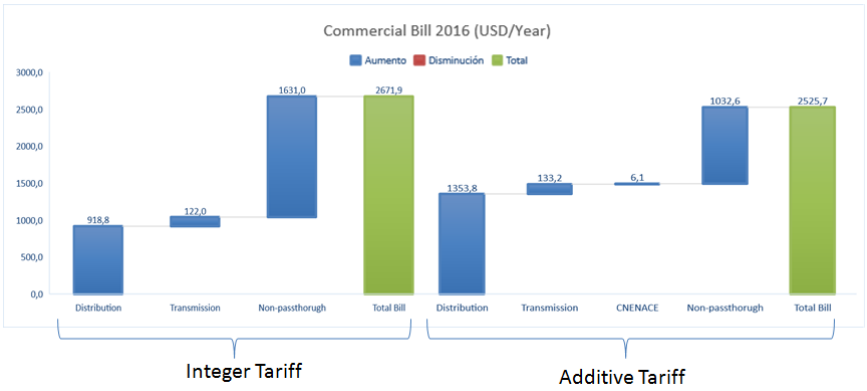
Retail activity seems to be a part of the value chain gaining weight day after day. In fact, those days were all that matter was generation activity seems to be giving birth to a new ecosystem were everything revolves around putting the customer at the center, whatever that means.

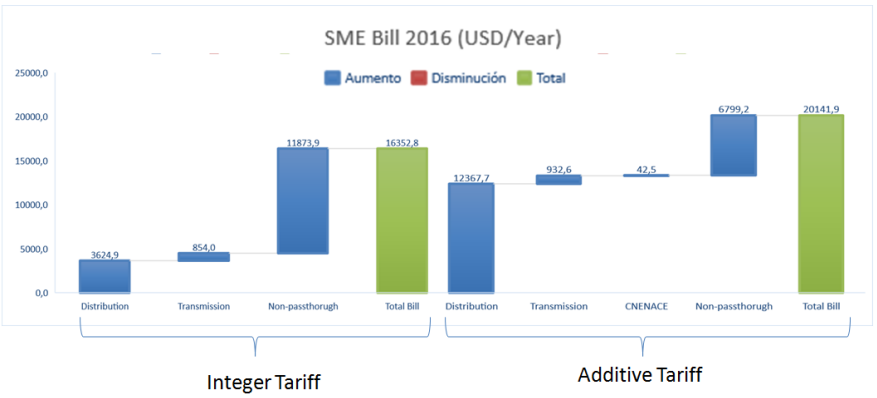
Someone could then ask what is really behind retail activity as such. Well, without getting into the almost metaphysical discussion on whether electricity is a differentiable good or whether "green, blue or red electrons really exist" the truth is that pricing and customer service are key factors. Of course, there are many complexities involved in this part of the business, but taking it into it most essential component it could be decomposed in the following equations:

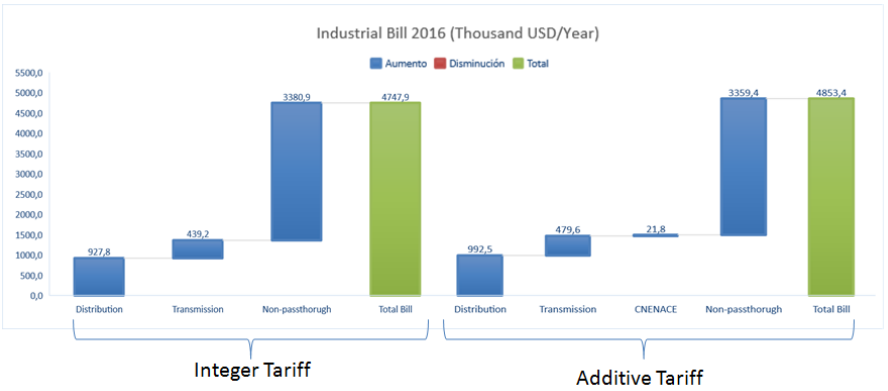
$$Retail\ price = Opportinity\ cost - discount$$

$$Retail\ price = Cost + mark\ up$$

Under this framework, it makes therefore sense to look at these components in the liberalization process and see what the decomposition of customer bill is in both schemes (Self consumption societies under the integer and additive tariff):







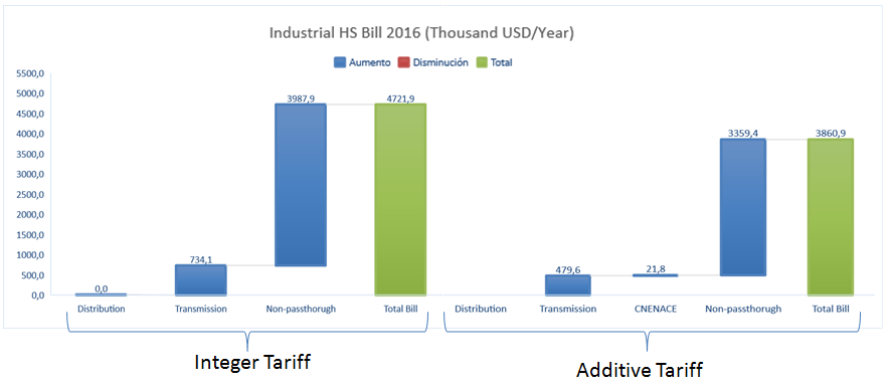


Figure 70. Bill decomposition. Oriente

Going now back to the two equations that run the retail dynamics we see that cost is another relevant component. For the next study, the regulated pass-through is taken as the cost, therefore defining mark up as Generation price plus commercialization profit which are the values where a private agent can try to beat the tariff.

$$Mark - up = Retail\ price - regulated\ costs$$

As a comparison between the situations in both schemes is being made, the aim is to remain in the scheme were the mark-up is the highest. Moreover, it is going to be assumed retail price comes from the previous formulas and is going to be given. Basically:

- $If \quad additive\ tariff\ bill > integer\ tariff\ bill$

  $$Retail\ price = Additive\ tariff\ bill - discount$$

- $If \quad additive\ tariff\ bill < integer\ tariff\ bill$

  $$Retail\ price = Additive\ tariff\ bill - discount$$

Therefore, the value the additive tariff takes is not relevant for the decision to stay or migrate to the new schemes as the decision will be taken de facto by the additive tariff becoming the new reference. The decision can thus be rewritten as:

$$Decision \quad \rightarrow \quad MAX\ (Mark - up) \quad \rightarrow \quad MIN(Regulated\ costs)$$

Which can be plotted easily:

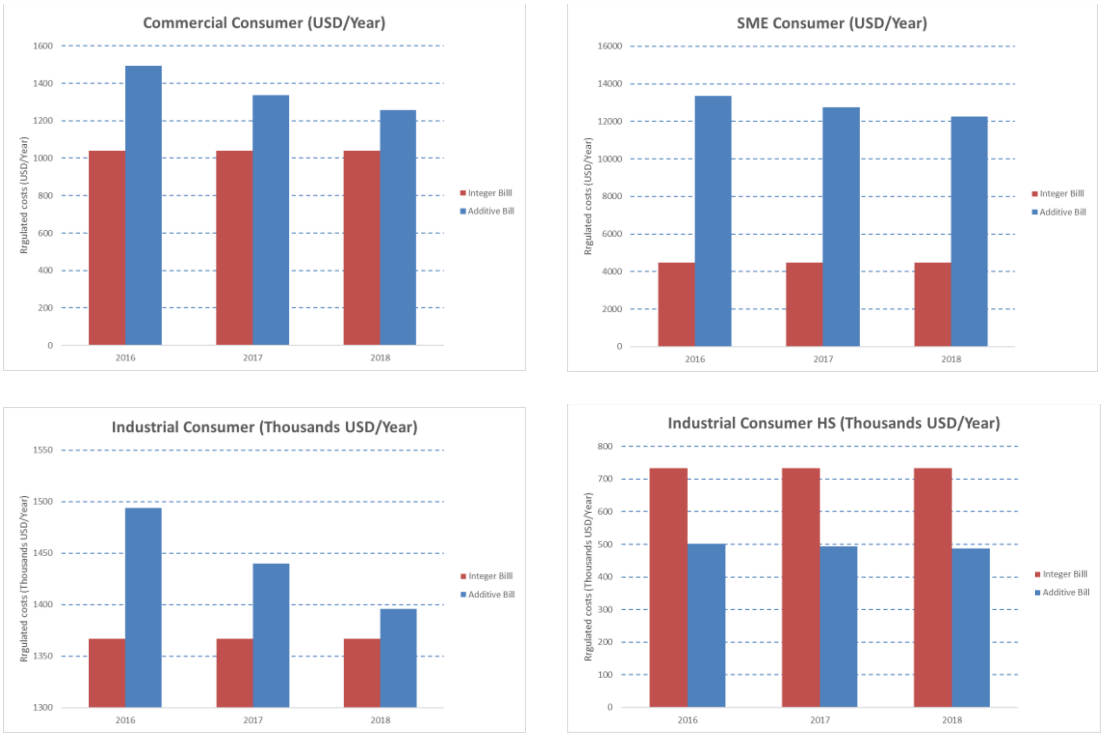


Figure 71. Regulated cost component of the bill. Oriente

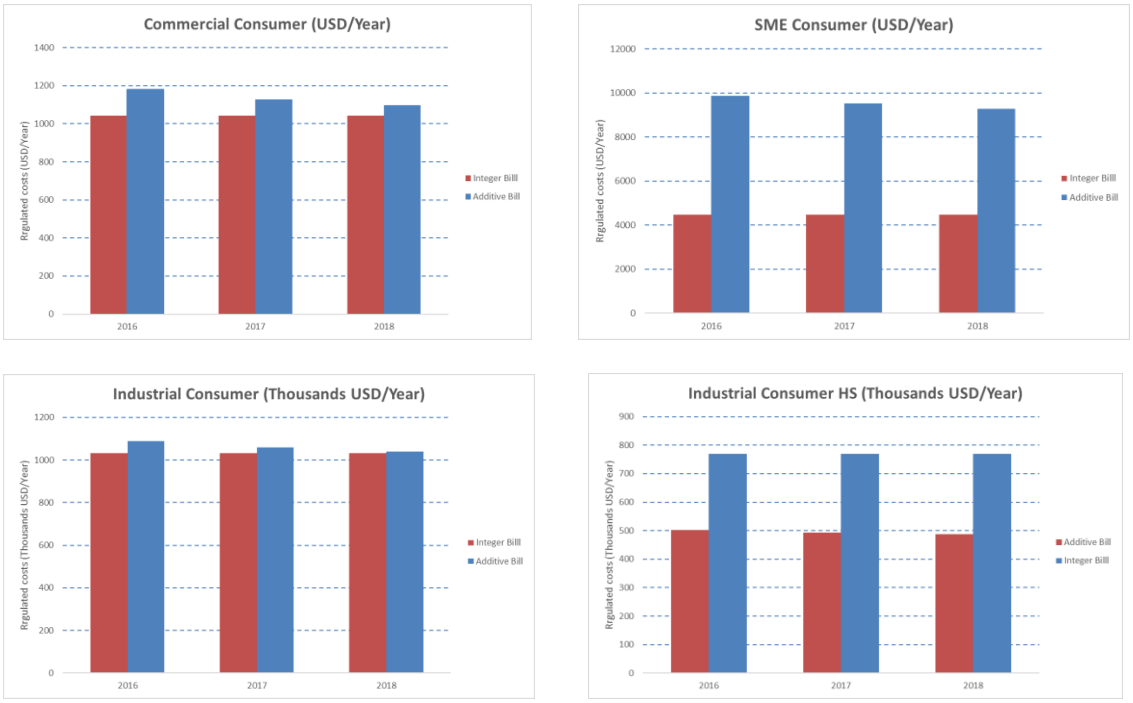


Figure 72. Regulated cost component of the bill. Golfo Centro

It is therefore observed that the decision should be to stay in the self-consumption societies until the contract expires, except in the case of loads in high voltage (Tariffs HS and above, where the location of the generation and the load in the S-C society takes special relevance). In this manner, the most general conclusion that can be probably derived is the following:

- Consumers with tariffs below HS should stay in self consumption societies.
- Consumers with tariffs HS and above should stay as they are if they are located in the same node than the generator (Diagonal of the matrix below). Otherwise, a particular study for this situation is needed.
-

		TRANSMISSION TARIFF (USD/MWh)					
	Receiving End	Monterrey	Huasteca	Reynosa	Acapulco	Temascal	Grijalva
Sending End	Monterrey	3,51	3,51	3,51	3,51	3,51	3,51
	Huasteca	18,39	9,54	7,23	12,39	9,26	20,53
	Reynosa	3,51	3,51	3,51	4,38	3,51	4,13
	Acapulco	15,82	6,95	4,69	9,89	4,58	17,82
	Temascal	8,41	3,51	3,51	4,37	3,51	9,89
	Grijalva	3,51	3,51	3,51	3,51	3,51	3,51

Figure 73. Transmission costs under Self-consumption societies arrangements

Once the cost component has been covered, let´s now see how the mark-up is going to compare with that it would have been obtained in the case the integer tariff would have remained in place.

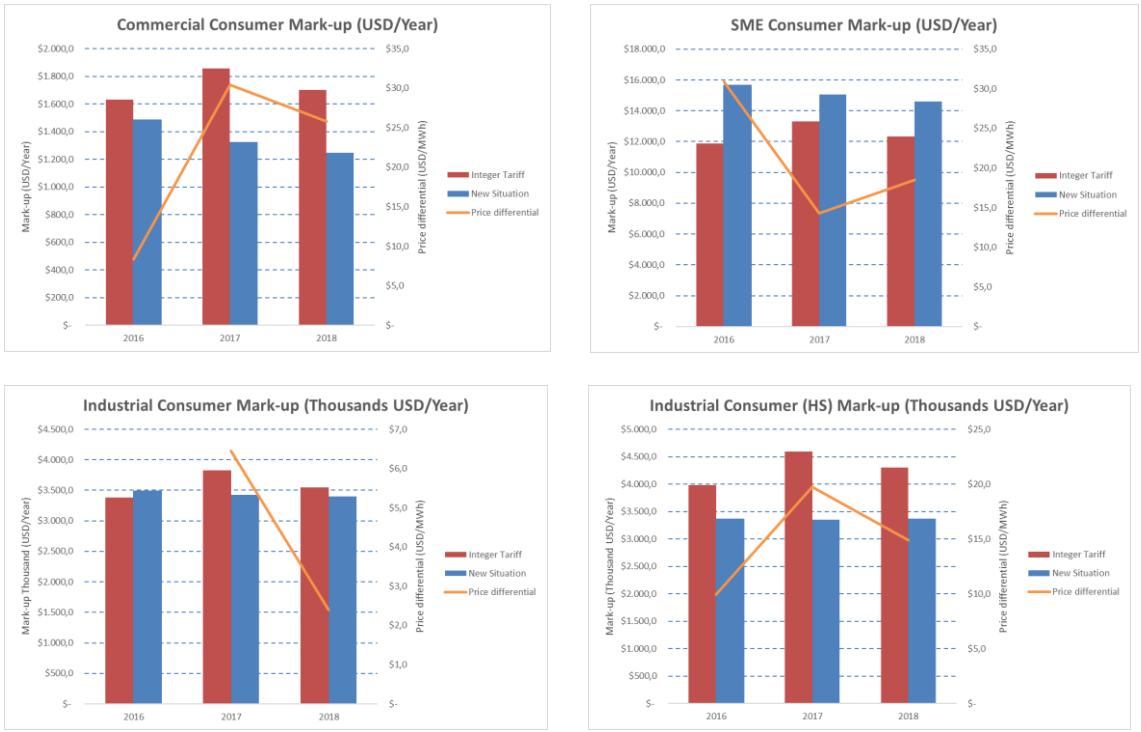


Figure 74. Mark-up component of the bill. Oriente

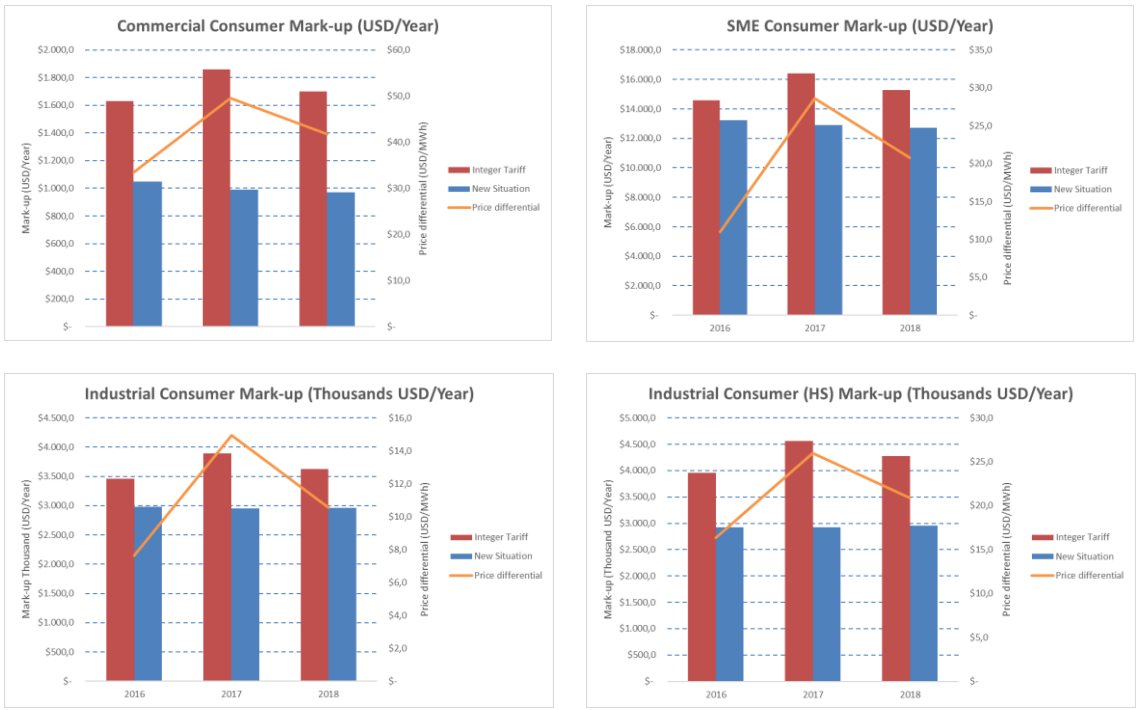


Figure 75. Mark-up component of the bill. Golfo Centro

From the graphs above, there are already two general conclusions that can be derived:

- Integer tariff mark-up volatility is higher than the new situation due to a bigger influence of fuel prices. In the additive tariff, this value according to SENER forecast of fuel prices, is much more stable mitigating the variability in the mark-up. Moreover, 2017 real integer tariff values are based on a strong increase of fuel prices, while SENER forecast for this period may not reflect such a steep increase.
- In general term, except for SME consumers whose tariff structure for distribution is different and causes some ambiguities, the mark-up before the reform was higher in the range of approximately 15-30$/MWh.

In view of all this, the tariff reform from the incumbent point of view, has therefore some clear consequences:

- Incumbents should remain in the self-consumption arrangement unless their transmission costs are very high. This could be the case if generators and loads are located on distant nodes whose connection charges are especially high. For consumers below HS, remaining in the old structure is the best option without considering any administrative complexity this may involve and only based on economic terms.
- Incumbents are going to see a reduction in their margin on self-consumptions societies. This reduction would need to be in the range of 15-25$/MWh to stay competitive with the new reference value, which is the additive tariff.
- The decision is merely based on a regulated costs basis as the others part of the equation, income on one hand and operation costs on the other are in principle not subject to the control of the agent. (Assuming operations cost should be the same in both schemes)
- Some consumers in the SME category (Tariff 3, 6 and 9) may remain captured by the incumbent as their bill under the new additive tariff is higher than the one they have in the integer scheme. In those cases, incumbents would see their mark-up and final profit margin / client increase.
- Domestic consumers (Tariffs 1) have not been analyzed because it is not common to have them in self-consumption societies (Probably because their bill is considerably low and the administrative burden to get them into the society was not worth the effort)

7.2- Analysis from the new entrant point of view.

From a new entrant point of view, the question is slightly different as the ad-hoc costs of self-consumption societies is something that it doesn´t apply to them. While of course this is a competitive advantage for the incumbents already in self-consumption societies, the share of them in the overall Mexico retail market makes then not a real barrier for new entrants, just something anecdotic in the overall development of the retail market.

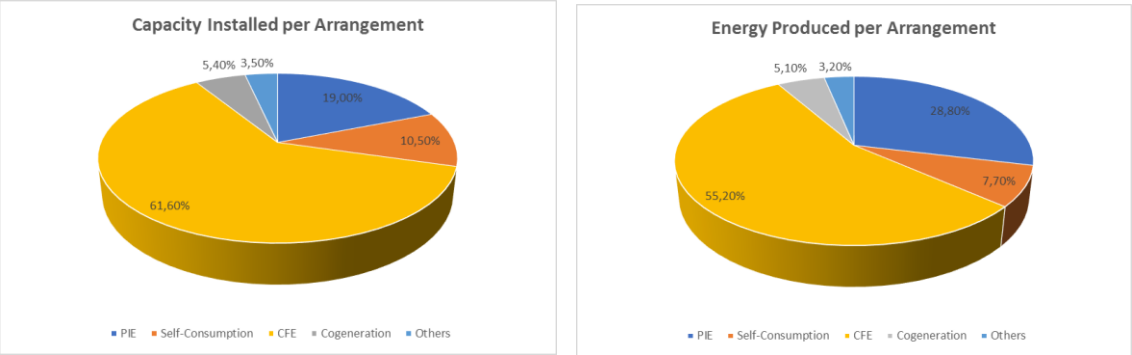


Figure 76. Self-consumption societies in the overall system. 2016 SENER

This is one of the reasons why it has been decided to opt for a general methodology as the one proposed by CEER: Handbook for National Energy Regulators, How to assess retail market functioning. This methodology, although developed for European markets, can be applied with some modifications to the Mexican case. Of course, some of the metrics should be understood in the context of a reform and in the context of South America power systems history, but it is still believed to be a sound approach.

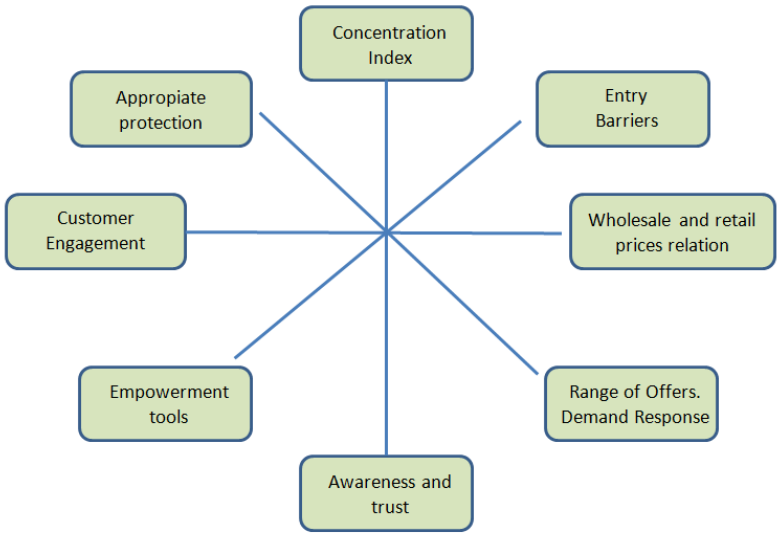


Figure 77. CEER Methodology retail markets. Key parameters

Concentration index (2 → 5)

The KPI proposed is the HHI (Herfindahl-Hirschman Index), which is a well-known index in competition issues usually used by regulators in legal procedures. The index is defined as the sum of the squares of companies share in the target market.

$$HHI = \sum_{i=1}^{N} S_i^2$$

One of the problems usually found with this index is the definition of the target market as this can have different granularity. The challenge is with regards to some of the following questions:

- Define the market as one product or substitutes should be included too.
- Define the market locally or across the national territory.
- Define the market only as product base or supplier base (Different type of clients)

The truth is that these questions are incredible challenging and are always played in litigation procedures as they may have a huge impact on the final results. Defining a market as one city can result in a completely different conclusion than if the market is defined at a national level; for example, at city level it can be maybe only two companies while at a national level there are 10 companies with relevant market share.

At the end, there is not a rigid, absolute framework to define the market, which is probably why the problem arise. There are however some reasonable guidelines to help regulators avoid any subjective bias.

In the case of Mexico, it is slightly more difficult as there is even a change in the structure of the market, but an appropriate classification is thought to be Basic Suppliers and Qualified Suppliers at a national level, as these cover all the retail spectrum and therefore gives an accurate representation of the market.

- Basic Suppliers (Domestic consumers): Before the reform, these were all supplied by CFE. Now, private agents could qualify as basic supplier and compete with CFE but so far, there hasn´t been any company submitting a formal request. It is believed this could be because the final additive tariff hasn´t been yet published, therefore there is no price reference to check how the market would look like. The concentration in this market is therefore absolute and the HHI is 10.000.
- Qualified suppliers (Here it has been accounted for self-consumption societies too): Before the reform, the comparison would be the self-consumption societies and CFE and after the reform, a further category should be added which is qualified supplier per se as defined by the LIE. Before the reform, the HHI value was approximately 7500 which corresponded to a very concentrated market, while after the reform, 12 new Qualified Suppliers have been registered although they still only account for a very small market share and thus haven´t had a very relevant impact on the HHI.

Looking at the market as one, it could have given the impression of a more fragmented market as CFE unbundling in Qualified and Basic Supplier will have caused a strong numerical reduction in the overall market HHI. However, the distinction made is thought to provide a better photograph of the competitive environment of the Mexican Power Sector, which in any case, is despite the liberalization still very concentrated.

Nevertheless, this could change quickly once the additive tariff is in place. It is hence important to notice that despite the concentration, all the procedures are in place for agents to break into the market. In line with this, it would be relevant to assess whether this concentration can implicitly constitute a barrier due to the economies of scale that may be present in the retail activity, as for example, the impact of imbalance pricing and the possible advantages derived from the portfolio effect.

Entry barriers (3→ 5,9)

Entry barriers are effectively targeted with 5 KPI which are the following:

- **Time needed and cost of accessing wholesale markets (4→6,5):** Although there is no explicit mention of the required time, the process is very clear and transparent with the requirements well-defined in the respective websites: CRE and CENACE. Moreover, the process has gone through a significant simplification making the administrative procedure much lighter. The party interested in registering in the MEM would need to pre-register in the Electronic part Office (Oficialia de Partes Electrónicas), submit physically all the information required to CRE and once pre-registered and all the physical information validated, proceed online with the rest of submissions with CRE and CENACE.
- **Percentage of consumers connected to "bundled" DSO (1 → 6):** Despite CFE unbundling, this has been only legal hence that CFE distribution and CFE generation can still belong to the same holding. Ownership unbundling would have been more effective although majority of countries only have legal and functional unbundling therefore this is not considered any red flag. Nevertheless, it should be controlled that the name of the distribution company doesn´t cause any confusion in the consumer.
- **Percentage of consumers with regulated energy prices (1 → 6):** Before the reform, close to 90% of consumers had regulated prices being self-consumption societies the main exception. This changed slightly with the reform, although a much-needed step in this path is the publication of the new additive tariff as this would become the benchmark for the commercialization of electricity and hence it is key for the attractiveness of this activity from a merchant point of view.
- **Number of common standards for consumer data and DSO-Supplier contract or existence of a national data hub (5 →5):** Given CFE is the only DSO, there is no need for standards as the same methodology is applied by CFE for all the clients**.**
- **Availability of time of use metering and time of use price vs traditional metering / pricing (4 → 6):** While for industrial loads there has been more innovation than for domestic consumers, there is still much room for improvement. Before the reform, the only differentiation was that dictated by the tariff which in the most advanced case considered 4 periods per day. Due to the fact, already commented, that the tariff was a strong reference, private agents have not offered more complex schemes as all consumers wanted were a discount over the tariff. After the reform, as the retail market takes off, it is expected this would improve: First, with industrial loads and progressively for domestic consumers as smart meter rollout progress too.

Wholesale and retail prices relation (4 → 7,5)

KPI for this parameter are the following:

- **Correlation between wholesale and retail energy prices (4→8)**: Before the reform, in the integer tariff, the value is not very good. This is because the retail activity offer is mainly structured as a discount to the tariff and the tariff is not very accurate in reflecting wholesale energy price. The reason why it doesn´t reflect so well the energy price is because the tariff update, although based on fuel costs, is made to the whole integer tariff, which accounts for more costs others than energy and then create some distortions. Meanwhile, in the additive tariff, correlation is expected to be higher as the new tariff is supposed to reflect in a better way wholesale price and therefore retail price would probably reflect it also in a better way as commercialization would be made with the tariff as a reference. Still, it is difficult to give concise values as commercialization of electricity with regards to the additive tariff hasn´t still started.
- **Mark-up between wholesale and retail price (4→7)**: On one hand, apparent mark-up in the integer tariff seems to be considerably high perhaps because of the administrative burden that commercialization in this scheme supposes (Self-consumption societies). On the other hand, in the new additive tariff, the mark up is going to reduce in the range of 15-25$/MWh which will suppose a strong push towards competition. It would be interesting to see how the mark-up evolves after the additive tariff comes in place.

Range offers. Demand response (3 → 4,8)

This parameter, which has the aim of getting an understanding of the innovation present in the retail market, consist in 5 KPI:

- **Availability of a variety of pricing and billing options (4→6):** The availability of different options is incredibly low, although it seems is more due to a consumer bias than to a lack of retail competition. Consumers still perceive CFE as a strong reference therefore the commercialization is made almost 100% based on a discount to the tariff. Innovative pricing options based on fixed price or more complex proposals are not developed yet. Billing options are good and many options are available, even paying from the supermarket.
- **Availability of value added services for implicit demand response and self-generation (5→6):** There is no firm offer for demand response services while for self-generation there is a net metering scheme in place and some fiscal measures too.
- **Availability of online offers (1→1):** There is no online offer available.
- **Availability of contracts guaranteeing the origin of energy (4→6):** There are green contract offers both in self-consumption societies and now in the liberalized market.
- **Availability of demand response offers (1→5)**: Although the LIE and the new market rules and procedures allows for it, there are still no explicit offers in the market.

Awareness and trust (2,7 → 4)

- **Percentage of consumers knowing they can change supplier (2→4):** Before the reform, few consumers knew they could change their supplier as almost the only option was becoming part of a self-consumption society which was only suitable for big loads. With the liberalization, it is expected more people start to know they can change supplier but it is still a figure below 15%. As new entrants break into the market and invest in marketing, this would probably change exponentially.
- **Percentage of consumers who know that DSO are responsible for continuity of supply (2→2):** Less than 5% people are aware of this. Considerable investments are planned for the network so as those materializes probably this percentage would increase as CFE would highlight some of the improvements that are achieved.
- **Percentage of consumers trusting the energy market (4→6)**. It has not been found any explicit measure on this, but a general search has given the impression that trust is improving with the reform as prices are supposed to better reflect the reality behind electricity value chain.

Empowerment tools (3 → 3)

- **Percentage of consumers having access to at least one independent and verified price comparison pool (1→1):** It hasn´t be found any independent, verified comparison tool.
- **Percentage of consumers having online access to historical consumption information (7→7).** Consumers both under CFE and self-consumption societies have online access to their consumption with just log in the respective website. Nevertheless, the percentage of consumers registered is way below the 100% available.
- **Percentage of consumers having access to standardized supplier switching process and its duration (1→1)** There is still nothing developed as we are in the first steps towards the liberalized well-functioning retail market. As agents start showing interest in the commercialization activity it is expected this would be developed.

Customer engagement (2,7 → 3,7)

- **Supplier switching rate (2→4)**: So far, it is almost non-existent as the only changes that were possible before were from CFE to self-consumption societies. In the new scheme, it is expected the switching rate increases although it would be difficult to see values above 10% in the domestic area based on past experiences in other countries. Industrial loads would probably be more active. Nevertheless, it still hasn´t been much movement probably because the uncertainty with regards to the tariff.
- **Inactive consumers (3→4):** Majority of consumers are inactive except for industrial loads and minor changes among tariff types. It is expected this will change with the reform as much more options are available.
- **Percentage of prosumers (3→3):** These are above all in the form of PV installations and cogenerations. Given its above average solar conditions, solar technologies have a huge potential in Mexico but despite a very step increase in the last years, only less than 1%

of the approximately 40 million houses in Mexico have any type of solar technology installed. These values are still very far from countries like Spain and Germany were the figures are around 10% and with worse environmental conditions. Figures for other technologies, like cogenerations, at the domestic and small commercial level are similar (Cogeneration at the industrial load are different and represent % of the capacity installed). Solar associations are nevertheless optimistic for the development of new installations at the domestic level and new business models are being proposed (leasing arrangements) which they expect would cause an exponential penetration in the coming years.

Appropriate protection (8 → 8)

- **Time between notification to pay and disconnection for non-payment (9→9):** 3 weeks which are in the normal international praxis.
- **Percentage of disconnection due to non-payment:** No explicit data has been found.
- **Percentage of suppliers using minimum standards for key information in advertising and billing (7→7):** Before the reform, it has been satisfactory and standards have been respected as the option was SC societies and CFE and it was easy to control. Now, a tighter control should be made of this as the market starts to be more active and more companies would participate in the commercialization of electricity.

Results

As can be observed, the reform has effectively improved some of the areas of the retail market (Higher numbers are better performance) although still much improvement is required.

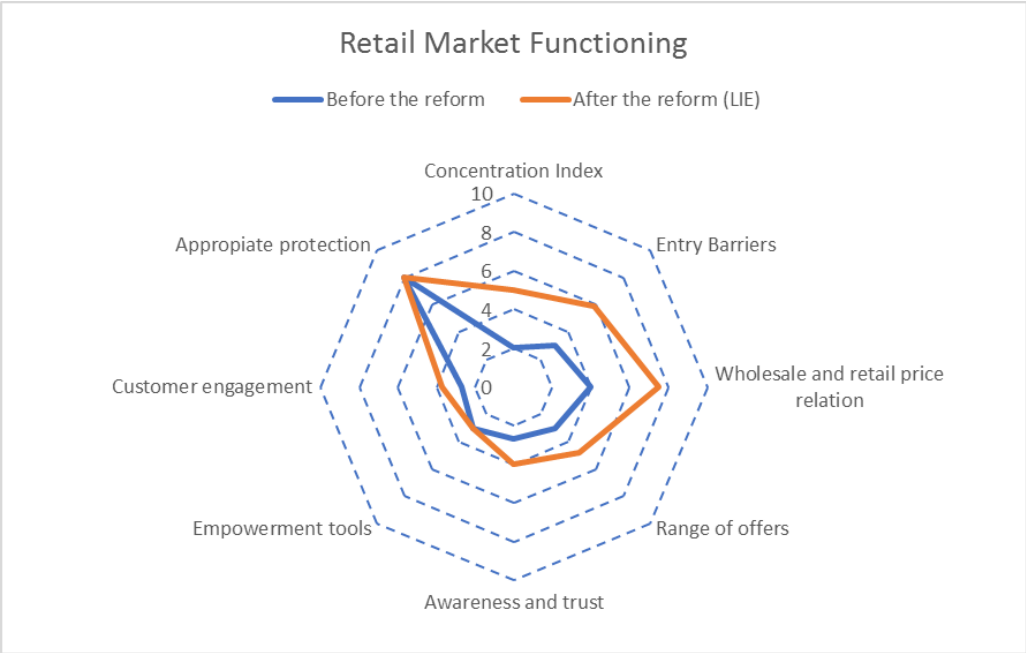


Figure 78. Retail Market Functioning

In general terms, some points have emerged as especially critical in the development of the retail market:

- Uncertainty around the publication of the additive tariff and the legal framework.
- Regulated prices being a constraint to the retail activity as they may be a competitive force impossible to beat if not fixed at a reasonable price.
- Strong reference to CFE tariff which is blocking innovation with regards to the range of solutions offered by private agents (Lack of information and consumer bias which only value tariff discounts).
- CFE legal unbundling may cause confusion in consumers. Branding issue with regards to distribution company having the same name than the commercialization company.
- Smart meter roll-out would be required to improve innovation in offers for domestic consumers.
- Highly concentrated market with CFE serving majority of the population. Economies of scale may constitute a competitive advantage.
- Lack of empowerment tools and information to the consumer which is not aware of the situation with regards to its electricity supply.

The truth then becomes than even though the changes have been in the proper direction and the retail market is improving, the publication of the tariff is a critical step that is blocking all the rest from really materializing.

The issue basically rests in the fact that private agents are not sure what the rules of the game are going to be. Remembering the previous discussion we had with respect to the equations that control retail dynamics it can be easily observed that we still have no reference for the opportunity cost (Which is going to be given by the bill under the additive tariff). Because of that, private agents are not registering as Basic Suppliers; they simple don´t know with certainty what the rules are going to be and whether there is going to be room to compete.

The situation for Qualified Supplier (QS) is similar with the exception that they have a price reference from the old scheme which is more trustable than for domestic consumers (Domestic consumers were captured by CFE and hence have no private reference). Merchant assumption for QS therefore has been that prices coming from the previous integer tariff will somehow remain similar in the new scheme and under this situation, they have decided to take a bet on the game.

Moving forward, when the additive tariff gets published and assuming the values are reasonable, there would still be the great challenge of how to activate consumer switching rate. In lines with this, some steps have already been given with the reform as can be seen in the

improvements in customer engagement and empowerment tools, but again, a bigger effort by regulators and private agents would be required if the market is to success.

- Ensure switching process is done in a simple and non-discriminatory way.
- CFE Basic and qualified supply are registered with different names.
- Official price comparison tools are prepared
- Strong investment in marketing by agents
- Education programs for consumers.

Of course, these measures are not guarantee that the market would be a complete success but at least would create a playing field where all the conditions for it may be present and by then, hopefully, it would be just on the consumer´s roof to decide.

8. Conclusions

Power system liberalizations are key national turning points which test government willingness to climb the liberal ladder. In fact, although they never answer only to a democratic will, it is nevertheless true that they require a big commitment from policy makers.

The case of Mexico is not very different although It is paradigmatic in the South America case; it carried out the liberalization 30 years later then its neighbors and in a much longer and complex journey: from a vertical integrated utility towards a fully liberalized system with no intermediary steps. While Latin America countries have gone through some regulatory waves (80s, 90s and 2000s), Mexico would make it all in one movement, perhaps trusting they have learned the lessons taught by international past experiences.

Whatever the case, the truth is that the process is being comprehensive in its form: few things have remained as they were. From the vertical and horizontal legal unbundling to the long-term auctions, (probably heritage from the 2000s regulatory wave), everything seems to have been analyzed and mechanism designed to tackle any malfunctioning that may appear, whether security of supply, firmness or adequacy issues.

With regards to the structure and master thesis topic, the focus has been on the commercialization of electricity from different points of view: Consumers, incumbent companies and new entrants, with special attention to any distortions that may appear along the transition or in the new scheme. To do this, a study and forecast of the tariff has needed to be done as the tariff structure is changing from an integer to an additive formula.

Conclusions for the different points of view are now presented:

Consumers.

First, before entering in any political reading of the reform and of the tariff change, what has been observed is an important welfare movement from domestic consumers to industrial loads. In the figure below, it can be observed the simulation of different types of consumer bills before and after the introduction of the additive tariff.

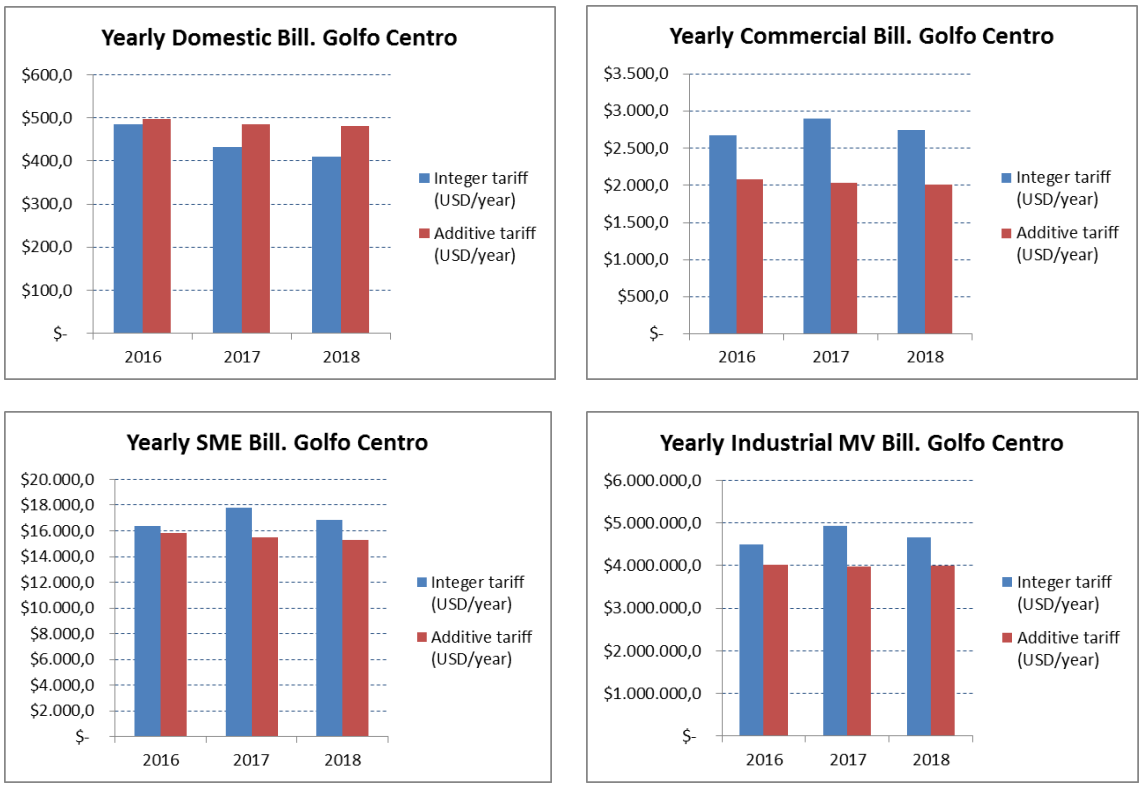


Figure 79. Representative yearly bills. Golfo Centro

This tendency although here only shown for a region, has been identified at a national level but with an important locational component. In fact, what it has been observed is a push towards the competitiveness of those areas already prone to be hosting industrial loads (Nor-Este and Central). This has been done through the distribution component of the tariff which is lower in those areas.

No major change in the structure of the tariff has been observed except for tariff 3 which in the additive tariff has a very relevant capacity fixed term and causes that the capacity factor can have a strong impact on the resulting bill. For the rest, results seem robust.

Another issue that deserves some comments are the standardization that has been carried out in the tariff design. Different consumer types belonging to different tariffs have been unified in

the additive tariff which may cause that some type of consumers would see an increase in their bill as tariff 3,5,6 and 9.

With regards to the evolution of this premium/discount between both scheme what has been identified is that the gap tends to narrow within the coming years except for domestic consumers for whom it tends to widen. Nevertheless, this tendency depends on forecast for electricity prices and losses forecast (Which are approximately 40% of the distribution charge). Moreover, it has been observed that the integer tariff is more sensitive to fuel prices variations which has caused, for example, that the increase of integer tariff in 2017 was higher than the additive one. At the end, additive tariff has the energy price component isolated while the integer tariff doesn´t. This highlight that additive tariffs may have a better cost-reflectivity than integer formulas.

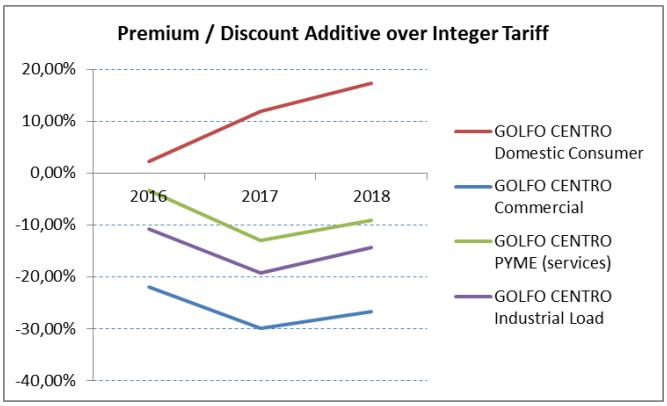


Figure 80. Premium / discount additive over integer tariff

Finally, from a politic and macro point of view, is very relevant the welfare movement with which this point was open. The results observed highlights that before the reform, domestic consumers were subsidized by industrial loads and that this distortion is going to try to be eliminated. However, this poses a huge challenge and is how the transition for domestics would be carried out. While the convergence of the bills for the rest of consumers makes these transition much easier, domestic consumers would not be able to withhold a 30, 40% increase in their bill. This situation makes very probable that the transition will be done progressively, first industrial loads and then domestic consumers in an attempt to lower the impact for domestic consumers.

Another point relevant is the locational component of the new tariff. The fact it has a favourable treatment for the areas already prone to industry location supposes an important push for international competitiveness but is not known whether it may end up in industry relocations inside the country and therefore, maybe causing interregional tensions or leaving industries in some areas unable to compete.

Incumbent private companies.

First, it is very important to bear in mind that self-consumption societies, which are the incumbents relevant from the commercialization point of view, represent only 10% market share, hence that any temporal competitive advantage they may have will not have an impact on the overall success or failure of the retail market.

That been said, it has been identified an important incentive for incumbent companies to remain in the old self-consumptions societies until their contract expire. To take this decision, the problem has been reduced to a cost minimization problem as Self-consumption societies income is an exogenous variable which doesn´t depend on them and in fact, is going to be given by the new reference: the additive tariff.

In addition, it has been observed that this incentive would lose strength as time goes by. Indeed, if energy losses are reduced more than expected or energy prices reduction is steeper than forecasted, the decision to migrate to the new scheme may happen before than expected.

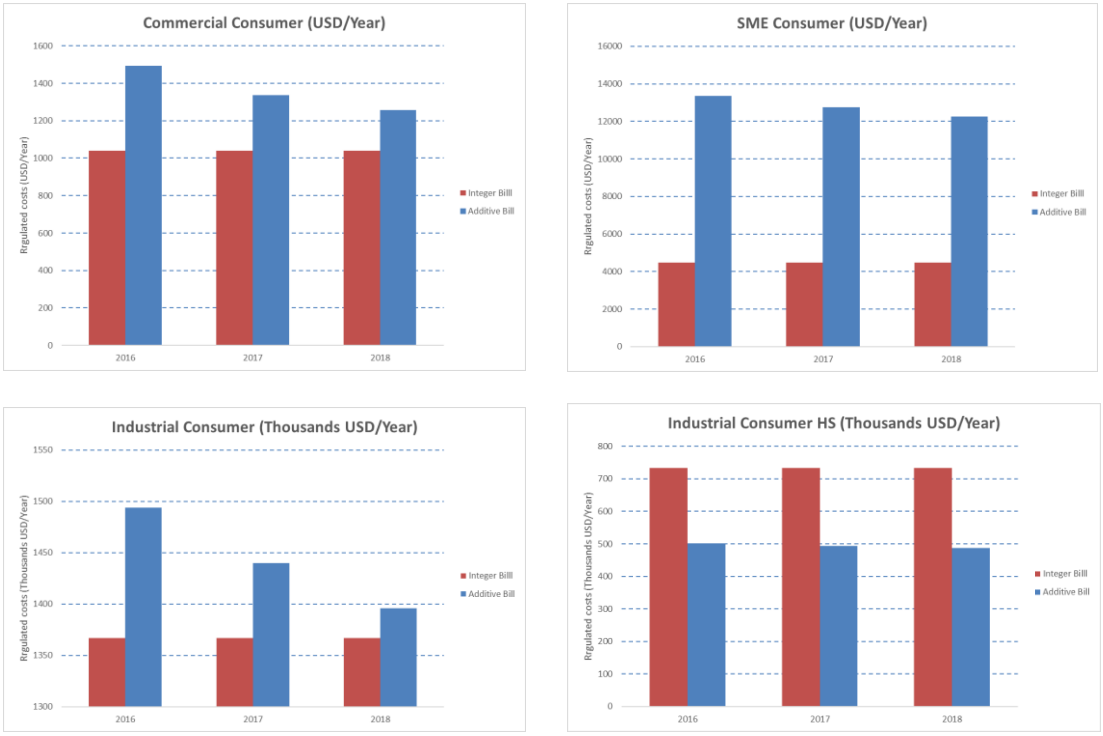


Figure 81. Regulated cost component of the bill. Oriente

Moreover, it has been observed that despite having a temporal advantage from remaining in their old interconnexion contracts from self-consumptions societies, they would still need to reduce their margin in approximately 15-25 $/MWh in order to remain competitive with the new reference and therefore maintaining consumers in the societies.

This is not the case with SME consumers which represent an increase in their margin. For these consumers, in principle, they would be able to charge an extra margin while they would be captured in the self-consumption society as they have no other better option. Ideally, that additional margin would be shared between generators and consumers in a way that guarantees that consumers remain in the contract and don´t leave the self-consumption societies in favour of regulated prices which at the end would be detrimental for both. Consumers in tariffs 3,5,6 and 9 may present similar characteristics.

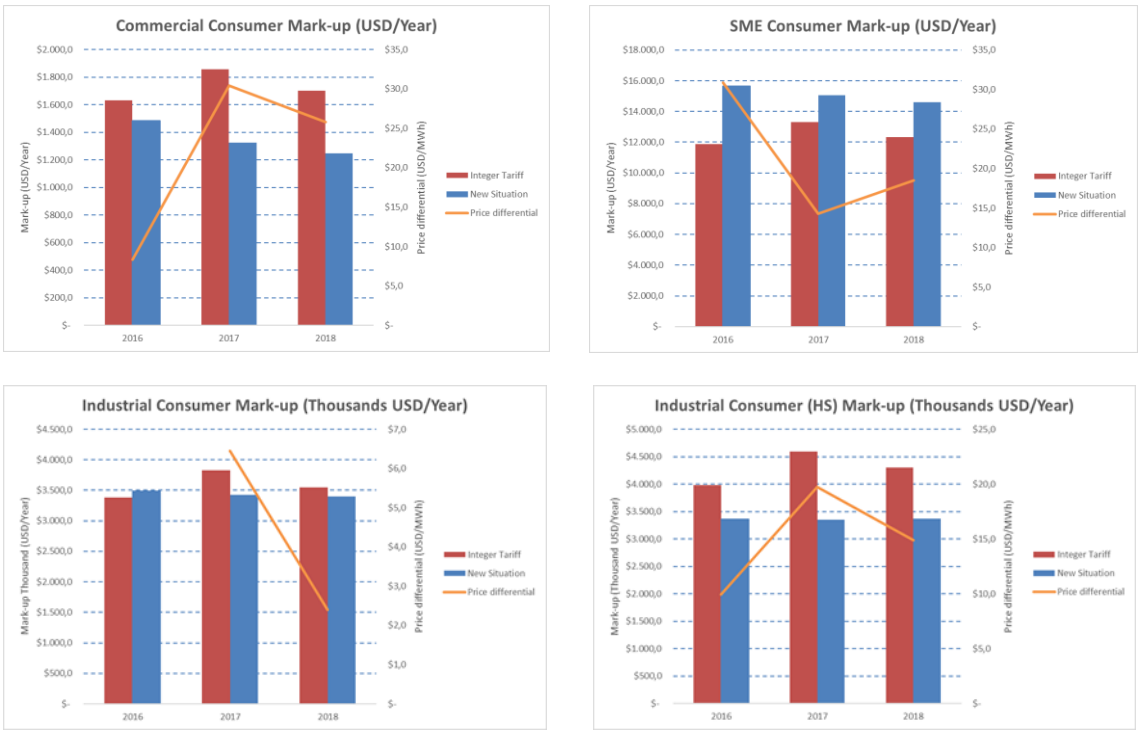


Figure 82. Mark-up component of the bill. Oriente

New entrants.

The methodology used to evaluate this situation has been different than the one applied to incumbent companies, as regulated costs offered to self-consumption societies are not offered for them.

The methodology used has been the CEER Handbook 2017 How to assess retail markets which provides a sound methodology.

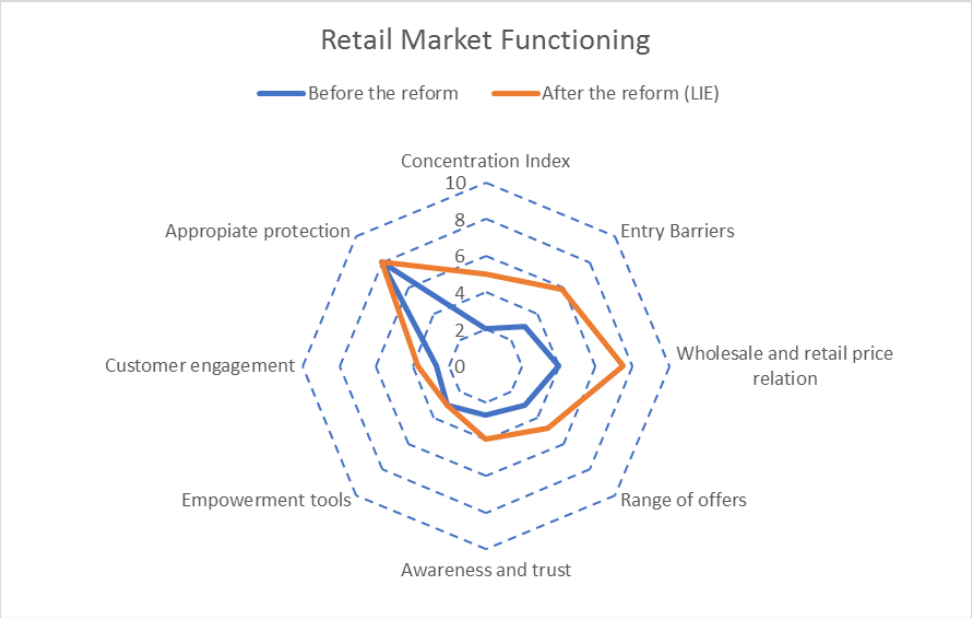


Figure 83. Retail Market Functioning

Looking at it, it is observed that the reform has been in the proper direction but still some critical areas have been identified which are conditioning private interest in the retail market:

- Uncertainty around the publication of the additive tariff and the legal framework.
- Regulated prices being a constraint to the retail activity as they may be a competitive force impossible to beat if not fixed at a reasonable price.
- Strong reference to CFE tariff which is blocking innovation with regards to the range of solutions offered by private agents (Lack of information and consumer bias which only value tariff discounts).
- CFE legal unbundling may cause confusion in consumers. Branding issue with regards to distribution company having the same name than the commercialization company.
- Smart meter roll-out would be required to improve innovation in offers for domestic consumers.
- Highly concentrated market with CFE serving majority of the population. Economies of scale may constitute a competitive advantage.
- Lack of empowerment tools and information to the consumer which is not aware of the situation with regards to its electricity supply.

In addition, once these issues are tackled, it will remain the huge challenge of activating the switching rate, which is probably the most critical health indicator in the functioning of a retail market. One short-term proposal for that would be:

- Ensure switching process is done in a simple and non-discriminatory way.
- CFE Basic and qualified supply are registered with different names.
- Official price comparison tools are prepared
- Strong investment in marketing by agents
- Education programs for consumers.

9. Future lines and closure.

In summary, Mexico retail market is moving in the proper direction but still some much-needed actions are required if private interest is to materialize in a meaningful way. Otherwise, companies would probably make a bet on the market just in case they hit jackpot, but the commitment may be lower and the results may be much more uncertain.

The aim should be in laying down the proper foundations where a retail market can be developed. However, still it would remain the immense challenge of activating customer switching rate, whose complexity calls for a great effort from private agents and regulators alike. In line with this, customer engagement and empowerment tools would show themselves critical in achieving this mission.

Self-consumption societies would have a strong incentive to remain in their old interconnexion contracts until their societies expire, although losses or energy price reduction steeper than expected may precipitate its movement. In any case, its reduced market share would not affect the overall destiny of the market.

With regards to future lines of research, some assumptions that have been made along the project could have been validated in different ways if more time would have been available:

- Unit commitment model based on fundamentals to check prices forecasts from the Prodesen, SENER.
- Fuels forecast taken from Prodesen, SENER.
- Future prices to be recovered through CFD contracts. It has been assumed capacity factors for generation plants constant instead of running a generation model.
- Conclusions robustness with respect to different evolution of energy prices or demand.

Moreover, some ideas that have been left behind along the study has been the following:

- Impact of green certificates in the decision of self-consumption societies to either remain or migrate to the new scheme and possible evolution of the green certificate price. This has been omitted because the current obligations for load serving entities are in the 5% range, therefore its impact is negligible, but as the obligations increase they could perhaps play a more significant role.
- Analysis of the situation merely from the point of view of a generator (current PIEs versus market incomes optimizing the operation strategy).

10. Bibliography

Arriaga, I., n.d. *Regulation of the Power Sector.* s.l.:s.n.

Averch H, J., 1962. Behavior of the firm under regulatory constraint..

Batlle, C. & Arriaga, I., 2010. The changing role of the State in the expansion of electricity in South America.

Batlle, C., Rodilla, P. & Barroso, L., 2010. Electricity auctions in South America. Towards convergence of system adequacy and RES-E support.

CNMC, 2016. *Margen Comercial-Comercializadoras de referencia,* s.l.: s.n.

Joskow, Paul L. (2006). Lessons learned from electricity market liberalization.

MIT. The utility of the future

CEER Handbook 2017. How to assess retail market functioning.

ACER Market Monitoring Report 2015. Key insights and recommendations

PWC 2015. Transformación del sector eléctrico

PWC 2015. Resumen de las bases del mercado eléctrico

PWC 2016. Reforma energética de México. Implicaciones y oportunidades e el sistema eléctrico nacional.

Iberdrola 2016. México. Tarifa aditiva de generación.

CENACE. http://www.gob.mx/cenace

SENER. https://www.gob.mx/sener

DOF http://www.diariooficial.gob.mx/

CRE http://www.gob.mx/cre

A/045/2015

A/074/2015

A/075/2015

A/045/2016

Preguntas frecuentes sobre la regulación en temas eléctricos