



**UNIVERSIDAD AUTÓNOMA DE SAN LUIS POTOSÍ**

**FACULTADES DE CIENCIAS QUÍMICAS,  
INGENIERÍA Y MEDICINA**

**PROGRAMA MULTIDISCIPLINARIO DE POSGRADO  
EN CIENCIAS AMBIENTALES**

**AND**

**COLOGNE UNIVERSITY OF APPLIED SCIENCES**

**INSTITUTE FOR TECHNOLOGY AND RESOURCES  
MANAGEMENT IN THE TROPICS AND SUBTROPICS**

**ENERGY GOVERNANCE FOR CLIMATE ADAPTATION IN SANTIAGO DE CHILE  
CASE STUDIES: COMUNAS OF MAIPÚ AND PROVIDENCIA**

**THESIS TO OBTAIN THE DEGREE OF**

**MAESTRÍA EN CIENCIAS AMBIENTALES**

**DEGREE AWARDED BY UNIVERSIDAD AUTÓNOMA DE SAN LUIS POTOSÍ**

**Y**

**MASTER OF SCIENCE**

**“TECHNOLOGY AND RESOURCES MANAGEMENT IN THE TROPICS AND SUBTROPICS**

**FOCUS AREA “ENVIRONMENTAL AND RESOURCES MANAGEMENT”**

**DEGREE AWARDED BY COLOGNE UNIVERSITY OF APPLIED SCIENCES**

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**LA MAESTRÍA EN CIENCIAS AMBIENTALES RECIBE APOYO A TRAVÉS DEL PROGRAMA  
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*Eine Folge von kleinen Willensakten liefert ein bedeutendes Ergebnis*  
*Charles Baudelaire*

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## List of acronyms

CAS	Climate Adaptation Santiago
CDM	Clean Development Mechanism
CNE	Comisión Nacional de Energía de Chile
CONAMA	Comisión Nacional de Medio Ambiente en Chile
GDP	Gross domestic product
HDI	Human Development Index
IEA	International Energy Agency
INE	National Institute of Statistics of Chile
IPCC	Intergovernmental Panel on Climate Change
MINVU	Department of Housing and Urbanism
NAMAs	Nationally Appropriate Mitigations Actions
NGO	Non-Governmental Organization
OPEC	Organization of Oil Exporting Countries
OECD	Organization for Economic Cooperation and Development
PLADECO	Plan de Desarrollo Comunal
SNCAE	National System of Environmental Certification of schools
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework on Climate Change
WMO	World Meteorological Organization

## Resumen

Los impactos del cambio climático se hicieron más evidentes en las últimas décadas especialmente por la intensa quema de combustibles fósiles que causó la frecuencia e intensidad de los fenómenos naturales. Varios países se ven afectados por estos impactos, siendo algunos más vulnerables que otros tal es el caso de la República de Chile. Uno de sus efectos más importantes es la disminución de glaciares que no sólo generará la escasez de agua a largo plazo sino también la reducción de energía hidroeléctrica, principal fuente de abastecimiento para la zona central del país. En este sector además se ubica la mayor parte de la población chilena y la concentración del desarrollo económico. A esto se suma la vulnerabilidad de su matriz energética por la carencia de recursos energéticos fósiles que ha generado la importación de energía constante para satisfacer las grandes demandas del crecimiento poblacional e industrial. Como resultado de este complejo escenario surgen proyectos e iniciativas por parte del Gobierno Nacional, ONGs, instancias públicas, sector privado entre otros para coadyuvar en el desarrollo de medidas contra el cambio climático.

La presente investigación buscó contribuir también con la construcción de medidas de adaptación mediante el análisis y entendimiento de la gobernanza energética de Chile tomando en cuenta la escala nacional, regional y local. El enfoque de mayor interés fue el local a través del trabajo participativo en las comunas de Maipú y Providencia.

Se utilizó la metodología del análisis de actores para identificar a los distintos miembros que forma parte del proceso. Se analizó las relaciones entre ellos determinando los conflictos y acciones de cooperación. Asimismo, se llevó a cabo un diagnóstico en las comunas donde se tuvo un involucramiento directo con la población y se evaluó el grado de educación, conocimiento respecto de la problemática, el nivel de conciencia de los efectos a los cuales están expuestos y la participación social como principal medio vinculante en la construcción de políticas.

Los resultados reflejan el estado actual del proceso de adaptación, mostrando aún los primeros pasos de avance sobre todo a nivel local debido a la reciente creación de entidades ambientales. Sin embargo, se determinó que existe una falta de integración de proyectos desde un nivel nacional a local donde se incluya directamente la participación ciudadana. La definición de impactos potenciales por la implementación de medidas muestra varias ventajas ambientales, económicas y sociales a largo plazo. Finalmente, la revisión de las políticas relacionadas con el área de interés confirma las primeras iniciativas para afrontar el cambio climático.

**Palabras clave: cambio climático, energía, medidas de adaptación, gobernanza**

## Abstract

The impacts of climate change became more evident in the last decades especially by the intense burning of fossil fuels which caused the rise in frequency and intensity of the natural phenomena. Several countries are affected by these impacts, some being more vulnerable than others such as is the case of the Republic of Chile. One major effect is the decrease of glaciers that not only will generate a shortage of water in a long term but also the reduction of production of hydroelectric power, the principal source of energy supply for the central zone of the country. In this sector, most of the Chilean population and economic activities are concentrated. Adding to this, Chile's energy matrix is highly vulnerable due the lack of domestic fossil resources that has generated the constant import from other countries to satisfy the large energy demands of population and industrial growth. As a result of this complex scenario, projects and initiatives were started and promoted by the National Government, NGOs, public instances, private sector among others to contribute to the development of measures against climate change mitigation.

The paper presented investigates also the contribution of adaptation measures through the analysis and understanding of the energy governance in Chile taking account the national, regional and local scale. The approach of major interest was the local level with especial consideration of the participative work in two comunas in larger Santiago de Chile, Maipú and Providencia.

The methodology of stakeholder analysis was used to identify the different actors that take part of the process. The relations between them were determined such as the conflicts and actions of cooperation. Likewise, a diagnosis in the comunas was undertaken, with a direct involvement of the population to evaluate the degree of education and knowledge concerning the problem, the level of awareness regarding the effects to which they are exposed and the social participation as an integrative way in the construction of policies.

The results reflected the current state of the adaptation process, showing especially the first steps of advance in a local level due the recent creation of environmental institutions. Nevertheless, a lack of integration in projects from a national to local level was detected where the civil participation could be included directly. The definition of potential impacts of the implementation of adaptation measures shows several environmental, economic and social advantages in a long term. Finally, the review of the policies related to the area of interest confirms the first initiatives to confront the climate change.

**Key words: climate change, energy, adaptation measures, governance**

## Zusammenfassung

Die Einflüsse des Klimawandels verursacht durch das intensive Verbrennen von fossilen Brennstoffen wurden in den letzten Jahrzehnten immer offensichtlicher, besonders durch die zunehmende Frequenz und Intensität der natürlichen Phänomene. Viele Länder sind von diesen Einflüssen betroffen, einige jedoch mehr als andere wie der Fall der Republik Chile zeigt. Eine besonders große Auswirkung des Klimawandels ist hier der Rückgang der Gletschermassen, was langfristig nicht nur Wassermangel verursachen, sondern die Produktion der hydroelektrischen Energie verringern wird. Die Wasserenergie ist die Hauptquelle der Stromversorgung für die Zentralzone Chiles. In dieser Region lebt der größte Teil der chilenischen Bevölkerung und hier konzentriert sich auch die wirtschaftliche Entwicklung des Landes. Dies verstärkt eine besondere Gefahr im Energiemix Chiles, das nicht. Da Chile nicht über ausreichende fossile Ressource verfügt. So werden ständig Importe benötigt, um die steigende Nachfrage durch die Bevölkerung und Wirtschaftswachstum zu befriedigen. Infolge dieses komplizierten Szenarios begannen Projekte und Initiativen gefördert durch die nationale Regierung, NGOs, und den privaten Sektor um Maßnahmen gegen den Klimawandel mitigation zu entwickeln.

Die vorliegende Studie untersuchte mögliche Mitigations wie auch Anpassungsmaßnahmen (Adaption), aus Sicht der Energie-Governance basierend auf der Analyse und dem Verständnis der chilenischen Energiepolitik von der nationalen, zur regionalen und lokalen Skala. Dabei lag das Hauptinteresse auf der Arbeit auf zwei Vororten Santiago de Chiles, in den Kommune Maipú und Providencia.

Anhand einer Stakeholder-Analyse wurden um die verschiedenen Akteure erfasst, die an diesem Prozess teilnehmen. Dabei wurden die Beziehungen zwischen ihnen analysiert und die potenziellen Konflikte und Kooperationsfelder identifiziert. Ebenso wurde der Ausbildungsgrad und Wissensbestand der lokalen Bevölkerung im Bezug auf den Klimawandel und seine möglichen Folgen bestimmt, sowie ihre partizipativen Möglichkeiten im politischen Prozess untersucht.

Die Ergebnisse spiegeln den gegenwärtigen Stand des Anpassungsprozesses wieder. Dabei wird gezeigt welche ersten Fortschritte es vor allem auf den entsprechenden lokalen Ebenen auf Grund des erwachenden Umweltbewusstseins gibt. Dennoch wurde, ein Mangel an Integration zwischen der nationalen und lokalen Ebene festgestellt, insbesondere bei der Projektbeteiligung der Bevölkerung. Die Darstellung der möglichen Auswirkungen bei der Umsetzung der besprochenen Maßnahmen zeigt auf, welche verschiedenen ökologischen, wirtschaftlichen und sozialen Vorteile es langfristig zu erwarten wären. Abschließend bestätigt der Bericht, dass die genutzten Strategien erste Initiativen sind um sich mit dem Klimawandel auseinander zu setzen.

**Schlüsselwörter: Klimawandel, Energie, Anpassungsmaßnahmen, Energiepolitik**

## 1. INTRODUCTION

The severe anthropogenic activity of the last centuries, based on the production and consumption model, has modified the composition of the Earth's atmosphere, causing changes<sup>1</sup> in the weather patterns and increasing the frequency and intensity of the natural disasters. All these consequences derive, according to studies of Intergovernmental Panel on Climate Change (IPCC) in the phenomena called climate change (IPCC, 2008).

The main human activity which causes the climate change, in conformity with the IPCC and the International Energy Agency (IEA) is the extensive and intensive burning of fossil fuels such as oil, coal and natural gas. Also remarkable is the recognition that urban activities are responsible of use over two-thirds of the actual energy in the world and account more than 70% of global CO<sub>2</sub> emissions. Driven by growing urbanization, urban energy use is set to increase significantly to 2030 to 73% of the global total and CO<sub>2</sub> emissions to 76% (IEA, 2008).

This tendency is also a current situation in the country of Chile and specifically in the Metropolitan Region of Santiago, the major urban agglomeration, where the used of energy is directly related with the development of its economy. In the last years, because of the major consumption of energy, the production per capita of CO<sub>2</sub> emissions raised. Another fact important to mention, is the vulnerability of his energy matrix which has turned Chile in a big proportion dependent of the imports of fuels. As a result of this complex scenario, and taking into account the role of urban areas in addressing the challenges created by climate change, both in terms of mitigation and adaptation, was initiated strategies and projects by different actors such as Government, Non Governmental Organization (NGOs), Climate Adaptation Santiago project (CAS), between others to look for the implementation of adaptation measures in the city of Santiago and to avoid in a long term the effects of climate change.



Figure 1. Urban concentration in Santiago city (Author)

One main part from the adaptation measures is the social assessment which placed a relevant role in the moment to develop and apply actions. Good governance and social participation are keys for a sustainable development. It encourages communities to achieve the highest degree of involvement. On the other hand, with an effective

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<sup>1</sup> The changes are measured by the elevation of the global temperature, melting of glaciers, increase of the sea level between others. The natural disasters that were intensified are droughts, floods. Diseases like yellow fever were introduced in areas not previously registered. See [www.ipcc.ch](http://www.ipcc.ch) (11.04.2011).

participation of the stakeholders it is possible to develop policies taking into account people voice, interests and rights. Participation looks for the integration of the relations between Government, civil society and private sector.

### **1.1 Intentions**

The present study is developed with the intention to contribute through a social analysis to the construction of climate adaptation measures in Santiago. In the assessment, it tries to integrate the national, regional and local scale. It focuses mainly in the smaller scale, through the study of two comunas of Santiago: Maipú and Providencia. These were chosen due their differences in socioeconomic characteristics, population size, level of education and geographical situation which are interesting at the moment to contrast and understand the necessary capacities that must be developed in the comunas before applying measures. The research searches to understand the energy governance to recognize the institutions and stakeholders that are involved in the process. On the other side, the identification of the problem by people from comunas, the level of knowledge, participation, present conflicts and cooperation are important to define future actions.

The contribution to improve is complex considering that any intervention will affect many areas of study and stakeholders that interact each other. However, this study will present some alternatives that can help to improve the local adaptation process. Finally, this research intends to contribute to the understanding of the current energy governance in Chile and to have a comprehensive approach of the local level through the comunas of Maipú and Providencia. As this scale usually is neglected and not taking properly into account in the development of actions and policies; the paper may help avoiding long term disagreement and conflicts between the main stakeholders.

### **1.2 Problem approach**

On a global level the excessive use of energy, mainly the transformation of fossil fuels presents growing problems, among them:

- These resources are limited, so consequently there is a decline expected in production, extraction costs are higher and prices are rising in a long term.
- The geopolitical aspects produce energy insecurity, conflicts and power axes around the energy, such as the geographic concentration of reserves, uncertainty in the prices of fuel and in the supply.
- These produce the greenhouse gases, causing global warming and as consequences extreme events in the environment (AIE, 2008).

In the specific case of Chile, energy consumption plays an important role in its economy. The use and generation of secondary energy<sup>2</sup> are closely related to its economic development. Its growing population has increased the energy consumption to satisfy their demands. However, the vulnerability of its energy matrix and the lack of fossil resources situate Chile in a large dependency of other countries (CNE, 2006).

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<sup>2</sup> The secondary energy are the products resulting from the conversion of primary energy resources (CNE, 2006).

On the other hand, this continuous burning of fossil fuels is the major source of greenhouse gases emissions in Chile that comes mainly from energy industries, transport, manufacturing construction and mines. Comparing globally, the percentage of Chile's contribution is not high (between 0,2 – 0,3 % of the total emissions). However, per capita emissions are not low, the data of World Bank (2011) showed that Chile has increased its emissions since 1984 up to now from 1,8 to 4,3 t CO<sub>2</sub>/year. As a consequence of this rapid increase of emissions in Chile and joint with the rest emitters countries of the world, it was reported by the IPCC (2008) the twelve warmest years in the registers of global temperature since 1850, rising temperature to an elevation of 0,74 °C and causing a series of impacts derivating in the phenomenon known as climate change.

The climate change impacts for Chile, according to the IPCC, are evaluated with the melting of glaciers of the Cordillera de los Andes where the most affected areas will be the North and centre, which in the long term will generate a lack of water and therefore, the decline of the principal resource for the hydroelectric plants and agricultural production. Also, this reduction affects the Basin Maipo which is the main source of water supply of all the Metropolitan Region and it is predicted to reduce between 50 and 70 % until finishing the XXI century. It will be a further reduction of rainfall from North to South, intensifying the current pattern of aridity. The phenomena of El Niño and La Niña will be more frequent, intense and can affect with high impact on energy and water availability mainly in the center area of the country. Other expected effects are the variations in sea level with the possible alteration of the Humboldt current; as a result the modification of the weather type Mediterranean in Chile and the possible change of the upwelling affecting the fishing production. On the other hand, decrease in yields of some crops such as corn and wheat, changes in the agricultural calendar, relocation of crops. In drier areas, such as Northern and central Chile, there will be salinization and desertification of agricultural land. Regarding human health, changes in climate will increase sickness such as Hantavirus<sup>3</sup> after prolonged drought, the introduction of Yellow fever, Dengue vectors in areas not previously registered.

Especially for the Metropolitan Region of Santiago, model calculations of the University of Chile (CONAMA, 2006) predicted significant impacts projected to the end of the present century. Among them, increase of the average temperature between 3 to 4 °C in every month with regard to the current climate. On the contrary, the rainfall will decrease during March and May between 40 to 60 %, from June to August even more from 70 to 80 % and the already insufficient rainfall between September and November (1-5 mm) will reduce from 50 to 70 %, extending in this way the dry periods. These projections are observed in Fig. 2.

Adding to this scenario of impacts, Chile ratified the Convention Framework of the United Nations on Climate change (UNFCCC) and the Kyoto Protocol to lower the emissions between 25 and 40 % for the 2020 respect to the levels of 1990. In 1994, the emissions were of 7.387,7 Gg of CO<sub>2</sub>, reaching in 2000 to 60.000 Gg of CO<sub>2</sub> for the increase of the use of energy and it is predicted for 2020 according to the inventory of emissions of CONAMA (1999) to achieve to 68.282.26 Gg of CO<sub>2</sub> if any mitigation

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<sup>3</sup> It is a virus that is found in some wild mice, such as colilargo and can infect humans causing serious disease that attacks the lungs.



measure is applied, however if actions will implement is predicted to reach just the amount of 47.445,85 Gg of CO<sub>2</sub>.

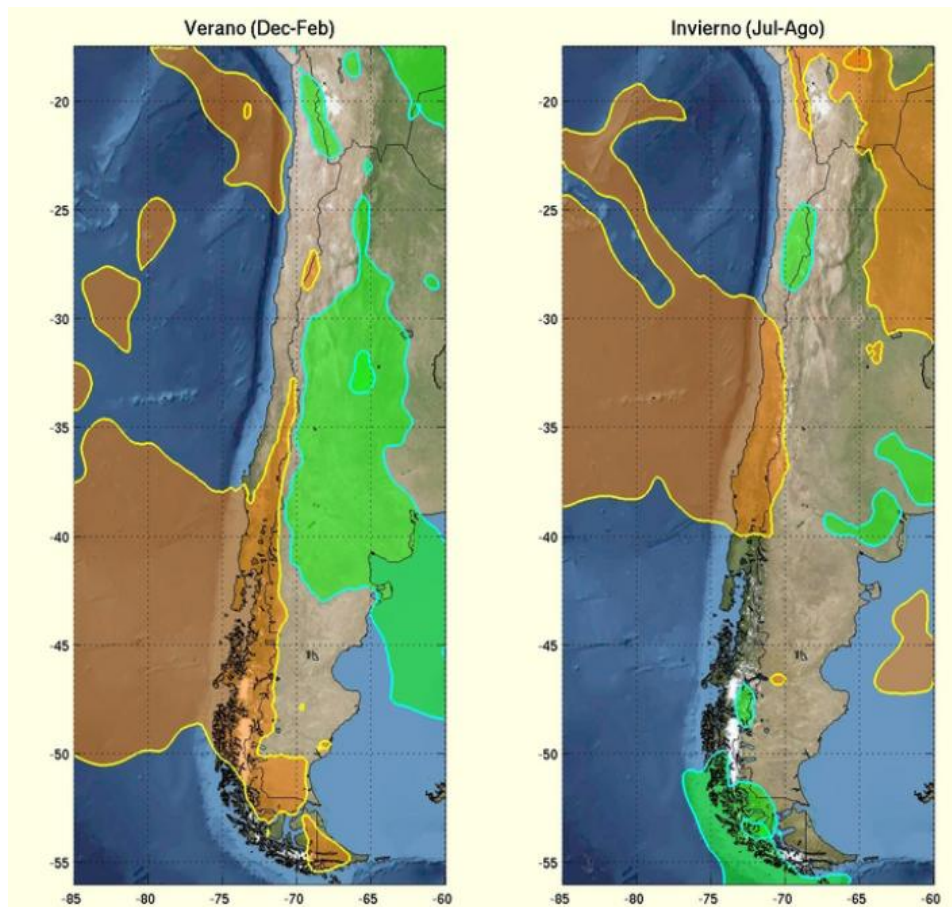


Figure 2. Variations in rainfall for summer and winter (CONAMA, 2006)

It is presented in brown color the drop of precipitation in 15 % or more as the case of Santiago and the increase of precipitation in 15 % or more in green. This results show a critical and worried scenario for the center of Chile.

In this perspective, it is urgent to take the necessary measures to reduce such impacts, anticipate the potential damage and minimize the threats to the economic development, energy security, the national infrastructure, human health and ecosystems and it is also a good opportunity to modify or create new policies.

In response to this problem, it started an important project in the city of Santiago de Chile in December of 2009, called Climate Adaptation Santiago (CAS), their objectives are:

- To develop measures of adaptation to climate change for the Metropolitan Region of Santiago de Chile, in the areas of energy, water and land use.
- To establish a regional network of learning in the megacities of Latin America.

It is sponsored by the Federal Ministry of Environment, Nature Conservation and Nuclear Safety of Chile and the support of the following organizations: University of Chile, Pontificae Catholic University of Chile, Karlsruhe Institute (Germany), Chilean

Governments and the Economic Commissions for Latin America (ECLAC). The development of the project in the Metropolitan Region of Santiago de Chile is crucial because this urban agglomeration with more than six million inhabitants will be affected by climate change. Due to the high demand for resources and the concentration of economic power and functional systems in the region, the elaboration of measures is an important challenge.

As a part of this project, the present study is developed because it was analyzed that the social assessment plays an important role during the development and application of adaptation measures to climate change. It helps to determine the level of knowledge of the main stakeholders and citizens in this problem. On the other side, the success of new politics is related directly with good governance, involvement of the principal stakeholders and social participation. It is also necessary to assess the capacities and resources in population to have in the future a better application of policies.

### **1.3 Research Questions**

- What is the current state of energy governance from top to bottom in the area of study?
- Who are the stakeholders that take part of this process? How is the level of participation? How is the interaction between stakeholders?
- Which is the level of awareness in the local stakeholders respect to the problem of climate change focus in energy?
- Do the local stakeholders find important the application of climate adaptation measures?
- Which are the potential impacts of climate adaptation measures application in affected comunas?

### **1.4 Objectives**

#### **1.4.1. General objective**

The general objective of this study is to evaluate the governance in the energy sector through a multilevel stakeholder analysis in two comunas of Santiago de Chile, contributing to the development of local climate adaptation measures and their sustainability.

#### **1.4.2. Specifics objectives**

To accomplish the general objective, it is proposed to realize the following specific objectives:

- To evaluate the current state of governance in the energy sector of the site of study.
- To identify the important stakeholders that are involved in the climate adaptation process focus in energy.
- To determine the interaction (cooperation and conflicts) between stakeholders in the actual process.

- To make a diagnosis in the comunas to evaluate the level of knowledge, awareness and social participation.
- To identify potential impacts of climate adaptation measures in comunas of study.

### **1.5 Structure of the thesis**

The chapter one is a brief introduction to the thesis, the problem approach, likewise general and specific objectives that want to be reached in this research. The intentions of the thesis also were defined in this chapter.

The second chapter describes the basic concepts used in the study, based on secondary data and supported by a bibliographic review.

The third chapter explains the methodology used for the collection of data in the area of study, for which was necessary the use of different tools of social participation and the determination of key actors to obtain important information from them. The methodology is explained step by step based in a flowchart designed to understand better the whole field work.

The case of study is divided in two chapters the fourth and fifth. In the fourth is presented the general characteristics of the site of study Chile. After, a general review of the energy governance from top to down is explained, for this purpose was collected data of the three areas of energy governance (energy access, energy security and climate change). It was important also to develop the stakeholder analysis where is described the main actors, level of participation, interaction, cooperation and conflicts between them which are part of the process of climate adaptation.

The fifth chapter focuses specifically in the local level, so there is a description of the location and characteristics of the comunas of Maipú and Providencia. It is presented a diagnosis where was necessary to collect primary data to assess the level of knowledge, participation, awareness in population. In addition, there is an analysis of the possible impacts due the future implementation of adaptation measures in the comunas.

Chapter six realizes a discussion of the obtained results guided by the conceptual framework and contrasting the different results between both comunas of study. The energy governance is assessed taking into account the scale, strength and weaknesses of the process. It was determined what actions are necessary to develop in population before implementing measures. And some alternatives to improve the construction of adaptation measures are proposed.

In the last chapter are the conclusions and recommendations to respond to the respective objectives.

Finally, the annex is described where are the questionnaires and guides of interviews that were used as participatory methods.

## 2. CONCEPTUAL FRAMEWORK

The present study will be focused in the following concepts as it is shown in the scheme (Fig. 3).

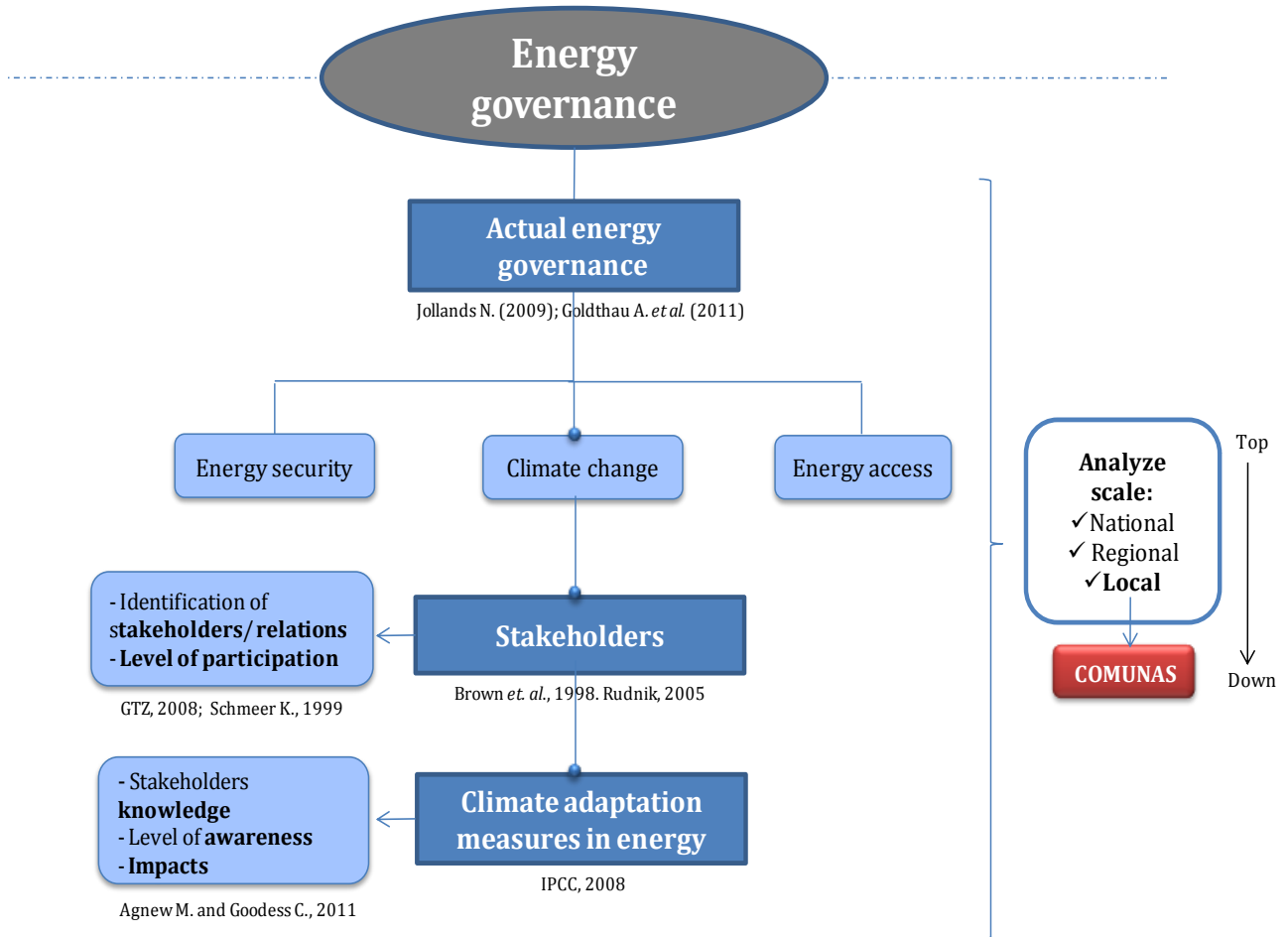


Figure 3. Conceptual framework flowchart (Author)

The point of start of this research is the energy governance as the main concept in which is analyzed its three areas of approach: energy security, climate change and energy access. Continuing with the study, the principal focus is the climate change where was necessary to identify the different stakeholders that participate in the process of adaptation. At the same time, these stakeholders are important actors in the taking decision, construction of strategies to enface climate change and during the development of climate adaptation measures, for this reason was necessary to evaluate their knowledge related with the problem, level of awareness respect to the effects that are exposed and finally to estimate the potential environmental, social and economical impacts that can happen during the future implementation of these actions. All of these concepts are integrated through the analysis of the scale from national, regional and local level; being the comunas the space of interest to involve directly with the stakeholders in this study.

## **2.1 Energy governance**

### **2.1.1 Definition**

Energy governance is the use of political authority, institutions and resources by decision-makers and actors to deliver energy services that meet social, economic and environmental goals. It has three dynamic areas of focus: energy security, energy access and climate change (Jollands, 2009; Goldthau *et al.*, 2011).

The energy security area is one with limited actor and industry participation but a strong focus on exploitation of the existing strengths of the system and efficiency. Energy access is similar in its exploratory character, focused on facilitating flows of financial and technical assistance which in many cases are not able to support effective exploitation of known solutions and technologies. The climate change area is a largely explorative space with a large inclusion of diverse actors in which will give more attention in the present study.

### **2.1.2 Energy governance areas**

The energy security, energy access and climate change are the three areas of the energy governance system that should be resolved simultaneously and integrally. This implies a transformation ensuring energy security for every nation, providing access to modern forms of energy to all sectors of the population and minimizing the effects of energy systems with the emissions on the climate. These areas are different in their historical origins, key actors, goals, scope, mechanisms and interfaces with non-energy systems, however, need to construct links and ways to interact, to solve the actual energy problems.

The energy security it has been working along the history through imposing rules, looking for the oil market stability and focusing mostly in the oil, gas supply. In contrast, the energy access and climate change areas are more diverse and inclusive with respect to energy sectors, technologies and actors.

Historically, energy security started in the 1970s in response to the oil crises. Due the conventional energies are resources that are not equally distributed; this divided the countries in producers and consumers. On the other hand, this area is dominated by national and private oil companies in exporting countries, nation states and their alliances such as the Organization of Oil Exporting Countries (OPEC) uniting major oil exporters, and the International Energy Agency (IEA) closely affiliated to the Organization for Economic Cooperation and Development (OECD).

The energy access focuses in the provision of energy mainly in the developing countries and has been strongly linked to the global development. It emerged in the 1960s and has dynamically evolved over the last several decades. It is dominated at the first stage by the international development community and includes international development organizations, banks, aid agencies of industrialized countries and large international NGOs. They look to provide infrastructure and decentralized systems with modern forms of energy such as electricity producing with wind, solar energy for cooking stoves to communities that don't have access to energy. It also interacts with other poverty

alleviation and environmental sustainability efforts such as reducing the use of traditional fuels and the associated pollution and deforestation.

The climate change area of the energy governance focus on reducing the negative impacts of energy systems on the climate, looking for mechanisms via the Clean Development Mechanism (CDM), also comprises investment, trade and joint implementation from the Kyoto protocol and industry initiatives. It emerged within the environmental sustainability movement in the early 1990s. Then, it became in an international context due the Rio de Janeiro Earth Summit in 1992. In the climate change area interacts multiple actors such as nation states, intergovernmental organizations and NGOs. The principal institutions that work in this topic are the UNFCCC and IPCC.

In this complexity one can clearly differentiate the three areas with their distinct and occasionally overlapping groups of actors, goals, scopes and mechanisms of governance. Each of them has certain features necessities for governing complex energy transitions. The energy security area features facilitating efficient exploitation of complex systems. The energy access and climate change areas on the other hand, feature more exploration, learning and adapting for dealing with complexities, uncertainties and innovative solutions (Goldthau *et al.*, 2011).

### **2.1.3 Energy governance, complexity and challenges**

Energy systems are considered as a complex because they have large number of interacting elements with their collective relations producing feedback and intricate networks. They are nonlinear because minor changes can cause major consequences. The limits of a complex system are not clearly defined because their elements are constantly interacting with the surrounding environment (Snowden and Boone, 2007; Axelrod and Cohen, 2001).

In this context the energy governance must be understood as a patchwork of institutions, organizations and regimes, coexisting on various levels of analysis and involving both state, no state actors and hybrids such as networks or public - private partnerships to find the potential solutions in a simultaneous way and avoiding the sequence of the acts through the necessary coordination across sectors and scales (Florini and Sovacool, 2009).

This coordination should find a balance in the centralized and decentralized forms. The traditional centralized form coordinates through top to bottom vertical linkages where centralized and power leadership drives decisions. This form can allow transmit of information and intentions, efficient division of functions and responsibilities; however sometimes exclude important connections particularly since many of them are unknown or dynamically changing. Additionally, governance arrangements in this way are likely to be rigid, static and are inevitably limited by the knowledge and capacity at the top of the hierarchy. Asymmetric top-down decision making can also limit the formulation of solutions because it can lead to the suppression of information of knowledge of actors on lower levels.

To respond to these obstacles first is necessary the flows of information, knowledge in a horizontal and vertical interaction, across scales, sectors and trust-building mechanisms. This action helps to facilitate adaptive governance structures for keeping different options open and allowing flexibility to the system. Another option is the multi-stakeholder involvement in a long term goal formulation, planning, commitment investing resources for their achievement and the integration of energy policies across scales of governance in the supply and demand sides of energy systems and technologies (Cash *et al.*, 2006; Folke *et al.*, 2005).

## 2.2 Stakeholders

Stakeholders are all those who affect and are affected significantly by the policies, decisions making and actions in the systems. They can be of any form, size, level and capacity; such as individuals, communities, social groups or institutions. There are different types of stakeholders:

- *Primary stakeholders*: are those affected, either positively or negatively by an organization's actions. Without whose continuing participation, the project can not be realized. In the present study, population is the primary stakeholder.
- *Secondary stakeholders*: are those who influence or affect the project. The project is not dependent on secondary stakeholder groups; however they can cause impacts to the project. Such as private sector, comunas Municipalities between others.
- *Key stakeholders*: have significant influence upon or importance within an organization. They can also belong to the first two groups such as Government, NGOs (Brown *et al.*, 1998. Rudnik, 2005).

Knowing who the actors are, their knowledge, interests, positions, alliances, and importance related to the program, policy allows managers and policy makers to interact more effectively with key stakeholders and increase support for the project. By carrying out this analysis before implementing a policy or program, it is possible to detect and act to prevent potential misunderstandings and opposition to the implementation.

The involvement of stakeholders is essential in: designing the project, determining the analytical approach to be used, evaluating candidate policies and measures, continuing the process and communicating results of the efforts.

Focusing in the context of climate change, it is important the stakeholders engagement in the process which can vary from quite passive interactions, where the stakeholders provide information, to self-mobilization where the stakeholders themselves initiate and design the process. Working closely with local communities through stakeholder engagement can help decision-makers gain greater insight into the communities, enabling them to work more effectively and produce better results. In turn, the communities can learn how the decision-making process works and how they can influence it effectively. The process of working and achieving things together can strengthen communities and build adaptive capacity through developing awareness of the issues within the community, as well as finding ways to address them. It can reinforce local organizations, and build up confidence, skills and the capacity to cooperate. In this way it increases people's potential for reducing their vulnerability.

Stakeholder participation in planning, through priority-setting and voicing preferences, as well as in implementation, accords with people's right to participate in decisions that affect their lives. Processes of engagement can improve the equity in the development of actions and provide solutions for conflict situations (Conde C. and Lonsdale K., 2005).

### **2.2.1 Stakeholders and social participation**

The social participation is a process in which people are proactively and significantly involved in all decision-making processes that affect their lives. Participation plays a vital part in safeguarding human rights, good governance and a living democracy (BMZ Participation Concept, 1999. Cited in GTZ, 2007).

The concept of participation has to be seen as the constitutive value of any successful democratization and decentralization reform process. Thus, participation finds its way into national policy processes and must be integrated through legislation, policies and quality standards (Maennling C.; 2007. Cited in GTZ, 2007). The stakeholder's participation is the expression of the extension and the deepening of the democratic system. In this scenario there is a route where the citizenship can exercise directly their right to take part of the public matters, closing the gap between governed and leaders, opening new routes of civil sovereignty exercise (Mayntz, 2001). Promotion of participation calls for more holistic and systemic approaches than in the past. Guaranteeing participation is thus not limited to state institutions, it expands the myriad of inter-relations linking Government, civil society and the private sector.

In addition, governance should interact with social participation to offer a suitable link to the crisis of representation and a way to advance towards the democracy. In this respect, governance appears as a way of governing more cooperative, where the state and not state institutions, public and private stakeholders take part, often cooperating in the formulation of the public policies. Likewise, looks for the solution of collective problems and of the achievement of the public well-being. As a result, public policies are more appropriate and efficient when the Government has worked as a whole with the civil society (Navarrete, 2010).

### **2.2.2 Principles of participation**

The principles of stakeholder's participation are convictions of how the participation must work to answer the standards that validate it to the population. Between them, it is possible to mention:

- *Access to the information:* it is the duty that State organizations have to put the information which possess to the disposal of the citizenship.
- *Transparency:* it consists on the veracity, clarity and advertising with which there are announced to the citizenship the intentions, aims, scopes, processes, results, between other aspects relative to the processes, managed by the State and civil participation.
- *Equity:* is to guarantee that all who take part in a process have equality of opportunities and treatment.



- *Not exclusion*: means that all who have a significant interest in a matter or affected by the agreements of the process could have the possibility of taking part.
- *Respect for the diversity*: the participation supposes the recognition of the legitimacy in the existence of diversity of perceptions, positions and interests concerning the topic or situation of interest.
- *Reciprocity*: consists in the incorporation of the participatory results, according to the criteria and conditions that have remained established in the process.
- *Willfulness*: it means that all those who join to the process, must be done by their own interest and voluntarily. The participation made by constraint or by obligation loses legitimacy (Navarrete, 2010).

### **2.3 Climate adaptation measures and the adaptive capacity**

The IPCC is the leading international body for the assessment of climate change. It was established by the UNEP and the World Meteorological Organization (WMO) to provide the world with a clear scientific view on the current state of knowledge in climate change and its environmental and socio-economic impacts potential. This important institution refers climate change to any change in climate over time, whether due to natural variability or as a result of human activity. To face this phenomenon is necessary to develop measures of adaptation and mitigation to reduce their effects. As the interest for this research is adaptation, the concept of IPCC defines climate adaptation as the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2008). Adaptation means to deal with consequences and to mitigate potential damages as well as to exploit opportunities that come up.

The extent of climate change impacts upon different ecosystems, regions and sectors of the economy will depend not only on the sensitivity of those systems but also on the system's ability to adapt to climate change. Adaptive Capacity is the degree and ability to which adjustments in practices, processes or structures can moderate or offset the potential for damage or take advantage of opportunities created by a given change in climate (Schneider and Sarukhan, 2001). The capacity to adapt is dynamic and influenced by many different factors such as socio-economic and institutional conditions, technology, social factors and access to knowledge and information. Stakeholders have the current and past experience of adapting to climate variability and extremes. The principal resource for responding to climate change impacts is people themselves, and their knowledge and expertise. Through an ongoing process of negotiation, they can assess the viability of adaptive measures by combining scientific or factual information with local knowledge and experience of change and responses over time too.

On the other side, processes of adjustment must be integrated carefully in the territorial planning without forgetting the economical resources and risks management. In these respective, the planning emerge as an anticipate exercise to reduce risk, promote well-being in the cities, regions. It is not just a process to minimize the vulnerability, helps also to identify ways of maximizing opportunities (Lira, 2006).

Penny and Wiedtz (2007) also mention the necessity to include planning in the process of adjustment. They propose a serie of steps where first should be developed a conscience and the involvement of stakeholders. After, the evaluation of impacts comes supported by studies of the present state, historic tendencies and scenarios for the future; as evidences of the changes caused and the future effects. Then, the adjustment divided into planning of actions and implementing them. The first one identifies options and makes a general review of present policies, and the second create institutions, policies and put in action the measures (Fig. 4).

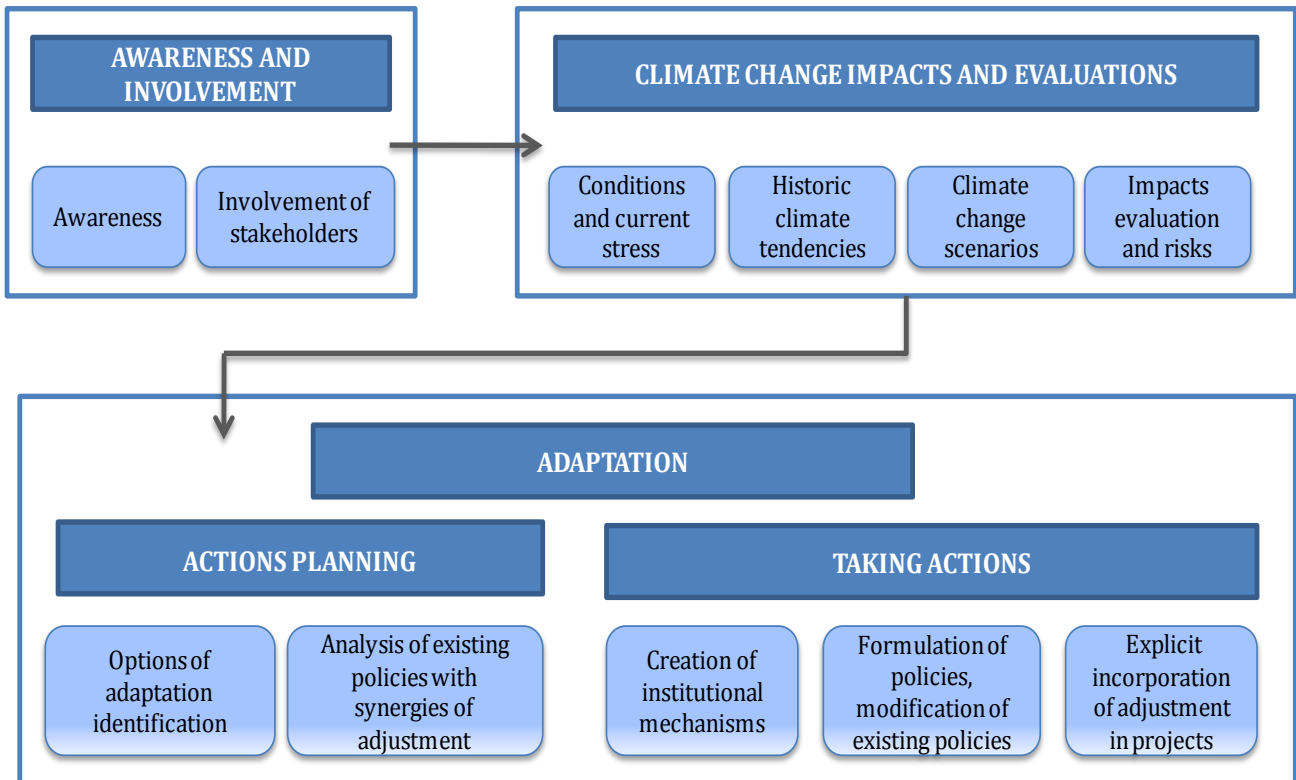


Figure 4. Planning process of adaptation to climate change (Penny and Wiedtz, 2007)

Planning adaptation also can be implemented to local level. To reach this aim, Mukheibir and Ziervogel (2007) describe a Plan of Municipal adjustment of major local application where it is important the evaluation of socioeconomic and environmental impacts, then come the establishment of strategies combining both issues. In addition, vulnerable areas are identified to proceed with the development of measures. Some actions must necessary to implement first due their urgency to prevent or face effects and strength communities. Finally, the result is the Plan of Municipal adaptation for applying by authorities in smaller scales (Fig. 5).

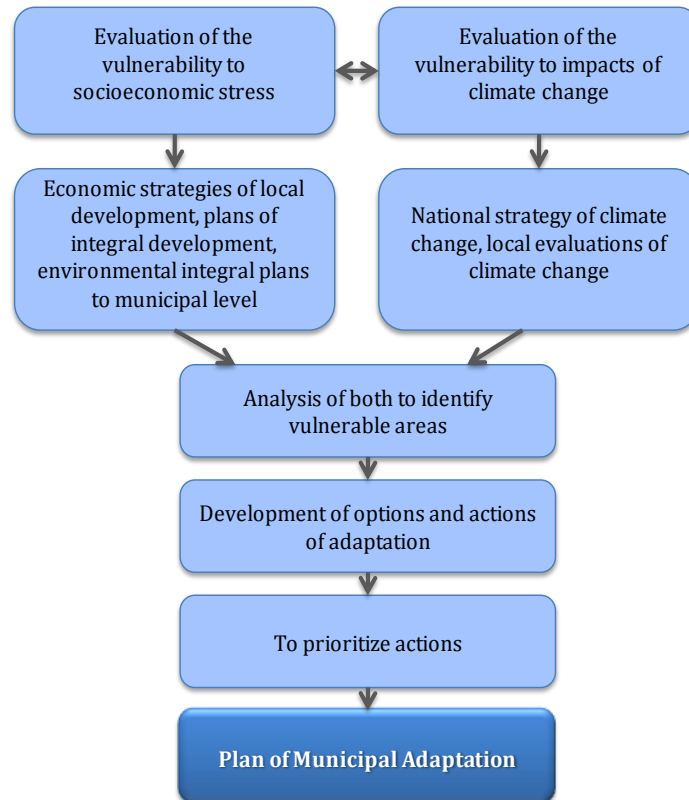


Figure 5. Plan of Municipal adaptation (Mukheibir and Ziervogel, 2007)

One example of integrated process in the develop of adaptation measures is the case of the city of London, which offer contrasts in terms of scale, resources availability and socio-ecology circumstances of the local system. In its first phase 2008 - 2011, the program of adjustment re-adapts the plan to the Environment Agency, in existence from 2005, for its own control activities of floods, quality and soils monitoring, water resources and residues. The national program has priorities in terms of improvement the evidence in scenes to predict better the future changes, reaching with more impacts levels of awareness in the topic and association in the construction of actions of response, evaluation, audit, advances indicators and the narrow link with public policies and investments. Besides, it is incorporate the development of the scientific integrated capacity, the need to increase participation of diverse stakeholders in the formulation of coordinated and comprehensive answers (Barton, 2009).

## Impacts

Impacts are measurable outcomes or system responses to climate variability and climate hazards. They are typically modulated by changes in environment and social systems (Agnew M. and Goodess C., 2011).

For our case study, potential impacts are evaluated as the impacts that can be produced in the future due the implementation of possible measures of adjustment, focusing in three categories of analysis environmental (e.g. air quality) economical (e.g. economical savings in a long term) social (e.g. increase of education and awareness).

## **2.4 Relations between energy governance, stakeholders and climate change adaptation**

Once presented all the important concepts that intervene in the investigation, it will proceed to establish the way they are interrelated for our case of study.

The research starts from the concept of energy governance because it is important to have an overview of how are proceeding Chilean Government and its different dependences in order to provide energy services. It is realized a general analysis of the three areas of governance to define the current state, the law that regulates, actors who intervene and the actions that are carrying out across a national, regional and local scale.

Continuing with the study, it will centre on the area of climate change of the energy governance because Chile was defined as a vulnerable country that must work in strategies to face this problem. In this respect, present process is evaluated, to define which programs and stakeholders are taking part of the adaptation. The participation of the key stakeholders in this process is relevant. They become active across the contribution in decision-making and construction of measures. For this reason, the good governance allows the opening not only of the Government leaders but also of those who are affected to express their voices and reach objectives according to their necessities. Actors should be brought together to develop a joint understanding of the issues and to create appropriate forms of adaptation. Active stakeholder's participation, at different levels and stages, are crucial to the success of adjustment. That is why this aspect is taking into account carefully in the present study.

On the other hand, the assessment of the adaptive capacity of comunas to climate change is made because this is developed if people have availability to strengthen networks, knowledge, resources and the willingness to find solutions. All these aspects were used to make a diagnosis in comunas and to define the potential impacts for the future implementation of climate adaptation measures.

### 3. METHODOLOGY

#### 3.1 Data needs

The methodology that was applied in the present study, allowed making a compilation of information from the bibliography review and the visit to the site of study Santiago and specifically the two Comunas: Providencia and Maipú. Therefore, the data came from primary and secondary sources. According to the defined objectives, it was necessary to collect the following data:

Table 1. Data needs and methods to reach the objectives (Author)

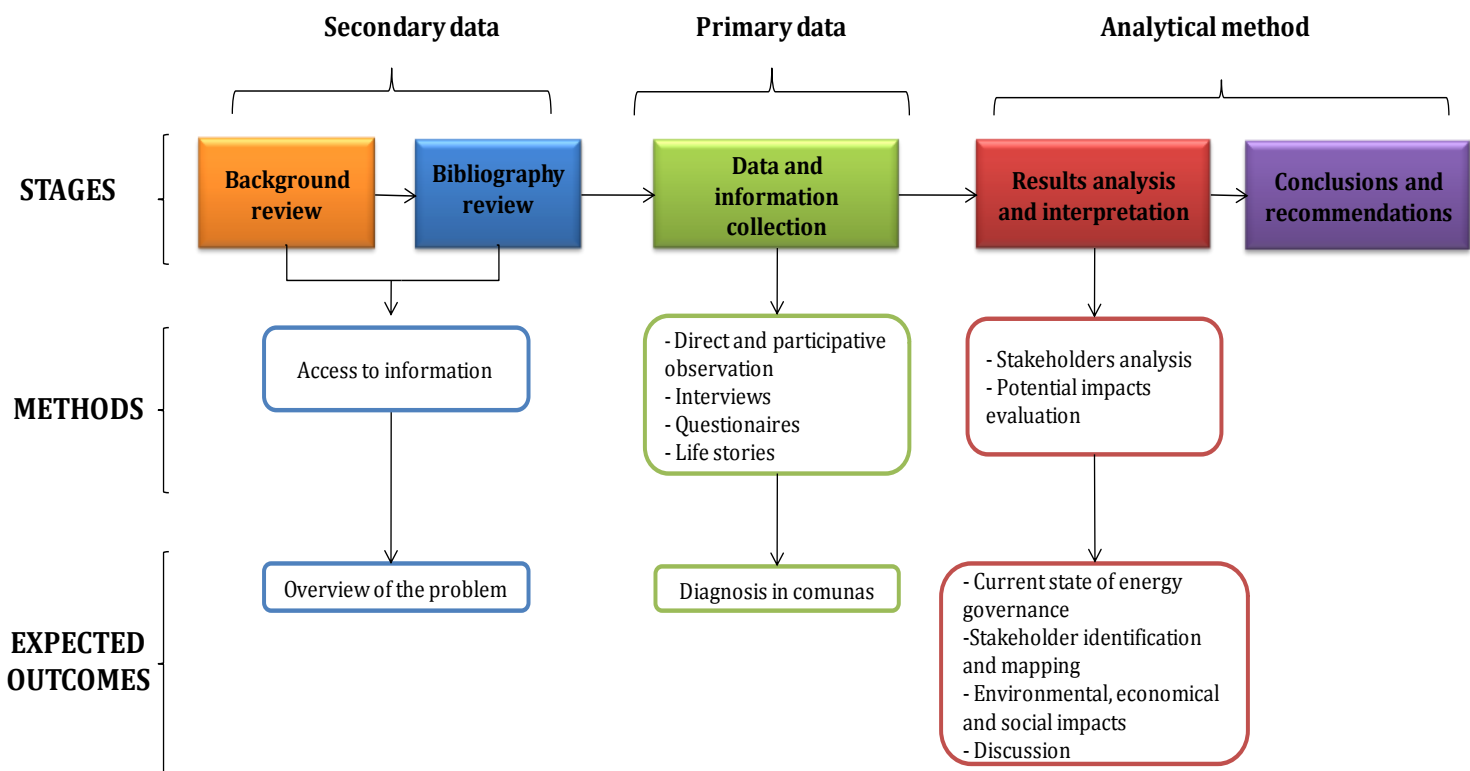
	<b>Objectives</b>	<b>Data needs</b>	<b>Methods</b>
1	<b><i>To evaluate the current state of governance in the energy sector of the site of study.</i></b>	<ul style="list-style-type: none"> <li>- Identification of the three areas of energy governance.</li> <li>- Identification of key stakeholders and Institutions that take the decisions and do the functions in energy.</li> <li>- Review of the future projects and plans concerning the energy governance.</li> <li>- For climate change, level of knowledge, participation and awareness of stakeholders about climate change.</li> <li>- Stakeholder's perception in climate adaptation process and relations with energy.</li> </ul>	<ul style="list-style-type: none"> <li>- Interviews</li> <li>- Questionnaires</li> <li>- Direct and participative observations</li> </ul>
2	<b><i>To identify the important stakeholders that are involved in the climate adaptation process.</i></b>	<ul style="list-style-type: none"> <li>- Primary stakeholders</li> <li>- Secondary stakeholders</li> <li>- Key stakeholders</li> <li>- The relations between them: conflicts, cooperation.</li> </ul>	<ul style="list-style-type: none"> <li>- Direct and participative observations</li> <li>- Interviews</li> </ul>
3	<b><i>To determine the interaction (cooperation and /or conflicts) between stakeholders in the process.</i></b>	<ul style="list-style-type: none"> <li>- Identify how the relations between stakeholders are.</li> <li>- Evaluate level of participation of stakeholders.</li> <li>- Determine who influence in other stakeholders.</li> <li>- Determine who depends on other stakeholders.</li> <li>- Define who else must be included to apply better climate adaptation measures in the future.</li> <li>- The obstacles, problems, conflicts, agreements and interests that are between the stakeholders</li> <li>- Define the lack of information.</li> <li>- Define if there is concentration of power.</li> </ul>	<ul style="list-style-type: none"> <li>- Direct and participative observations</li> <li>- Interviews</li> <li>- Life stories</li> </ul>
4	<b><i>To identify potential impacts of climate adaptation measures in affected comunas.</i></b>	<ul style="list-style-type: none"> <li>- The strengths and weakness that every comuna has in the energy governance.</li> <li>- Their strengths that could help to develop the climate adaptation measures.</li> <li>- The necessary aspects that must be improve.</li> <li>- Identify if can exist support in the measures construction by the national, regional government.</li> <li>- Socioeconomic data.</li> <li>- Review public policies and system of incentives.</li> <li>- Identify impacts produce due the application of climate change measures on actors.</li> </ul>	<ul style="list-style-type: none"> <li>- Direct and participative observations</li> <li>- Interviews</li> <li>- Questionnaires</li> </ul>

### 3.2 Stages of the methodology

The methodology is divided in the following stages:

- Stage I: Background review
- Stage II: Bibliography review
- Stage III: Data and information collection
- Stage IV: Results analysis and interpretation
- Stage V: Conclusions and recommendations

Figure 6. Flowchart of the methodology (Author)



### 3.3 Secondary data sources

Secondary data is the data that was not personally collected. It has been already gathered for other purposes, however is readily available in books, articles, newspapers, web pages among others (Curran and Perecman, 2006).

In the present study, the secondary data were in the stages I and II of the flowchart visualized in Fig. 6. Now, these stages will be described:

- **Stage I: Background review**

Because the study wants to contribute to projects and strategies of the Chilean Government to enface climate change, it was necessary to make a background review to know the current projects, lines of work, limitations, what has been done in the development of the programs, who takes part on it.

- **Stage II: Bibliography review**

The bibliographical review is the obtaining of information from books, articles, electronic sources of studies previously realized, analysis, essays, theories, different methodologies and methods that was useful for the development of the research and web pages of main institutions involved in the study. With it was established the precedents and background of the problem of study. It is important to mention, that the bibliographical review continued along all the work.

### **3.4 Primary data sources**

Primary data are collected by the investigator or his/her team for the purpose of answering the research questions and also to acquire a direct experience. The data comes directly from entities and people involved in the activity.

The primary data was collected in the present study, through the Stage III of the methodology flowchart. The description of this stage is as follows:

- **Stage III: Data and information collection**

In this stage, first was necessary to select the methods to collect the data. In this way, every of them will be described:

- ✓ ***Direct and participative observations***

Once the ethnographers have determined their essential aims, one important tool to approach to study group is observing them during specific times, in certain locations, and during the course of particular events and routines. This helps to study and analyze their attitudes or behavior towards the issues of interest (Bruce, 2000).

The fact of living long time near to the groups of study generated ties of trust, gain a close and intimate familiarity through intensive involvement with people in their environment. These values can be a good help in the collection of data for the research.

- ✓ ***Interviews***

Interviewing has been described as conversations with a purpose and although the conversations vary across a range of structured, semi-structured and unstructured formats, their purpose is to give an authentic insight into people's experiences.

The interviews are useful when the researchers wish to consider ourselves as active and reflexive in the process of constructing information, gives voice to others as an integral part of the research process. It looks understanding the position adopted by one or more social groups on a particular place, practice or process, or focus on a particular individuals in the form of oral histories, life histories or life stories (Webb and Webb, 1932; Burgess, 1984; Silverman, 1993. Cited in Cooke, Cloke, Crang et al. 2004).

✓ **Questionnaires**

The questionnaire is an instrument of data construction comprising a carefully structured and ordered set of questions designed to obtain the needed information and evaluate the research questions without either ambiguity or bias. Questionnaires are important when the researcher is interested in constructing data based on the responses of a large number of people; when the time is constrained to do a face-to-face access to the respondents and therefore only limited interaction is possible (Johnston, 2000. Cited in Cited in Cooke, Cloke, Crang et al. 2004).

This method allows researchers to count up differing kinds of responses to questions, particularly when the questions are closed. The questions involved semantic differentials (such as very good, good, satisfactory, bad and very bad). The practices of counting up produce numeric measurements of what people think and how they behave, alongside information about their gender, age, occupation and so on. This information can then be cross-tabulated and used to make quantifiable inferences.

✓ **Life stories**

People tell stories as a way of describing their life. Open ended stories could be used to ask what if questions in problem solving. Facilitates discussion, especially useful in non-literate groups with rich oral background. Oral histories can provide insights into the past that might otherwise remain inaccessible to social scientists. Such method has usefully revealed the ways in which particular people recall past livelihoods, conflicts, political authority, self conceptions and social practices (Chambers, 2003).

The field work was based in the use of these social participation tools in a total of 50 people. This help to have as an outcome the diagnosis in the comunas. In the whole work, was important to collect data from people of different ages: young (from 17 to 22), adults (from 30 to 55) from the comunas, Municipal Authorities and Neighbors Associations.

Table 2. Data from people that participate in the questionnaires

Maipú				Providencia		
Age	Men	Women	Occupation	Men	Women	Occupation
15-22		20	Students			
30-45	3	7	Teachers, Administrator Housewives.	2	10	Police, Engineer, Housewives, accountant.
46-55	2	3	Pensioners, Guard, Secretary, Housewives.	1	2	Government employee, seller.

Specifically, in questionnaires it was evaluated three areas of knowledge:

- *Climate change*: To evaluate the level of education and knowledge in people.
- *Energy habits*: To analyze the level of awareness.
- *Social participation*: To perceive the level of motivation, confidence, awareness and participation in decisions-making of the comunas, environmental activities and actions of respond in climate change.



For the interviews were used semi-structure guides (See Annex) and key actors were selected involved in the problematic. Between them: Municipality authorities from the Environmental division of Maipú and Providencia, Presidents of Neighbors Association of both comunas, member of CAS project and Catholic University of Chile, representative of the Energy Ministry.

The interaction with different key actors, direct and participative observation gave an overview of the current state of knowledge, advances, actions, development of projects, from their different positions and functions in climate change related with energy. In addition, they helped to determine in the present study which are the relations, conflicts between them, level of participation. The stories life listened from some neighbors helped to establish conflicts and agreements among Government and people from comunas.

### **3.5 Analytical method**

To this point corresponds the stages IV and V from the methodology flowchart, which are described as follows:

- **Stage IV: Results analysis and interpretation**

In this phase, the information generated in the previous phases was used to organize, analyze, interpret and discuss the data collected from primary and secondary sources. As a result, it was obtained the actual energy governance in Chile, the identification and map of stakeholders. These last outcomes were focus in the stakeholder analysis which contributed to identify the key actors, relations between each other, probable conflicts and agreements that can happen during the development of climate adaptation measures. The information from conceptual framework was used as well to contrast and proposed some alternatives to improve the process.

- ✓ **Stakeholder analysis**

It is a process of systematically gathering and analyzing qualitative information to determine whose interests should be taken into account when developing or implementing a policy or program. It is an important instrument used to implement interventions in every stage (Schmeer K., 1999).

Information generated from stakeholder analysis may serve for several purposes: to provide input into other analyses; to inform the development of action plans to increase support for a reform policy; to guide a participatory, consensus-building process. It also identifies the relevance of each role player for the process of change and to establish which goals they are pursuing. In the analysis are noted the strengths and weaknesses, patterns of communication and relationships. In the practice is important to have a constructive way of dealing with resistance from specific role players, as well as to build alliances and develop joint activities aimed at achieving common goals.

The Stakeholder Analysis tool is divided into individual “building blocks” that can be used in a flexible way depending on the context. Needs, wishes and ideas of the

stakeholders involved are taking into account. This analysis can be done also in group or individually. The central point with the blocks is not to have the final word, but to appreciate differences in perspectives and interests in a systematic way (GTZ, 2007). The present study is based in the method of the GTZ due the advantages explained previously. Its flexibility allowed developing the first two blocks: Identifying key stakeholders and Stakeholder mapping. Other approaches to make the stakeholder analysis were also reviewed, such as the Schmeer or Svendsen A. and Laberge, however according to the data collected, the time and resources to realize this study, the GTZ accommodated better to the evaluation. Now is described the two blocks of analysis:

### **Identifying key stakeholders**

This block looks for the identification of key stakeholders classified in primary, secondary and key stakeholders. Then, they are characterized based on three functions: legitimacy (institutional position formalized by law), resources (knowledge, expertise, capabilities, as well as material resources that allow the key stakeholder to influence), and connections (the number and quality of relationships with other actors who are under obligation to or dependent on key stakeholder). The analysis determines who are significantly able to influence decision-making by virtue of their position, capabilities, knowledge, connections and scope of influence. At the same time, discuss the forms of involvement of the key stakeholders.

### **Stakeholder mapping**

The second block is focused in visualizing the stakeholder's relationships through a map. Mapping helps to see the whole system around an issue by making the network of existing relationships visible. It can also contribute to gain a better understanding of the quality of those relationships and the leverage points for building or strengthening the network over time (Svendsen A. and Laberge M., 2007). In order to produce a map of stakeholders that provides useful information, it is important to take account three points:

- Defining and delimiting the specific area of analysis.
- Establishing the point in time and deciding on periodicity.
- Separating out different perspectives (GTZ, 2007).

This diagrammatic form represents the relevant actors and their relationships through graph elements. The mutual dependencies, alliances, problems, conflicts among stakeholders, their power relations and also the gaps in information and areas of insufficient participation are drawn with symbols.

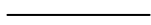
There are different forms to visualize the stakeholder mapping, in the present study it is used the rainbow shape and the symbols, based in the GTZ methodology, that will be described the relations:



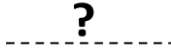
Represent the primary and key stakeholders who have a direct influence on the project. The letter V means that is a veto player, without these actors it is not possible the development of the project.



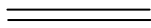
The squares represent secondary stakeholders who are not directly involved but still have an influence.



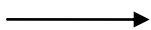
Solid lines mean close relationships in terms of information exchange, contacts, interests, coordination and trust.



Dotted lines symbolize weak or informal relationships; the question mark reflects an unclear relationship.



Tramlines mean alliances and cooperation.



Arrows means the direction of dominance in the relation.



Solid lines crossed by a bolt of lightning symbolize tensions, conflicts, clashes of interest in the relation.

After applying the stakeholder analysis, it was also defined the future potential impacts due the implementation of adjustment measures. For this analysis was taking into account environmental, economical and social aspects.

To conclude this stage was developed the discussion where all the results were analyzed contrasting with the different concepts used for this research.

- **Stage V: Conclusions and recommendations**

For the culmination of the study, there are the elaboration of the conclusions and recommendations derived from the different realized works, answering to the general and specifics objectives.

## 4. ENERGY GOVERNANCE IN CHILE

### 4.1 Study area

Chile is located in the Southwestern region of South America (Fig. 7).

It has a population of 17.094.275 inhabitants, with a density of 22,62 hab/km<sup>2</sup>, addressing the sixth place in South America.

From this population; 29,5 % (5.040.028 hab) are concentrated in Santiago, the capital of the country.

The country has a surface of 756.096 km<sup>2</sup>, its GDP per capita is 14.331 US \$ and the HDI is high 0,878; with this data reach the first places in South America (INE, 2010).

The eastern border of Chile follows the ridge of the Andes mountain chain, whose height varies from over 6.000 m in the north to under 2.000 m in the south. In central Chile a coastal mountain range, about 1.000–3.500 m high. In their glaciers originate the water through the snow and ice melt. This represents a local resource for freshwater supply, hydropower generation and irrigation.

An increasing number of evidence of glacier retreats, permafrost reduction and snowfall decrease have been observed in many mountainous regions, thus suggesting that climate modifications may seriously affect stream flow regimes, in turn threatening the availability of water resources, increasing the downstream landslide and flood risk, impacting hydropower generation, agriculture, forestry, tourism and last but not least the water dependent ecosystems. As a



Figure 7. Geographical location of Chile

consequence, socio-economic structures of downstream living population will be also impacted, calling for better preparedness in developed countries and strategies to avoid the impacts (Benison, 2007).

Administratively, Chile is organized in 15 regions, from these the most important is the Metropolitan Region of Santiago because there is located the capital of the country. Santiago is the main economic, administrative and urban centre of Chile. In the last years, it has been growing in the suburbs and peripheries because wealthy houses and social housing<sup>4</sup> were developing in these zones. It is 567 m in elevation.

The climate for Santiago is warm temperate with winter rains and dry long station. In this region, the Mediterranean climate develops with all its characteristics: rainfall concentrated in the winter months and a very dry station extending for six or seven months as it shown in the climogram for Santiago (Fig. 8). The coastal chain opposed to the spread of the influence of the sea, producing a notable thermal daily and annual oscillations.

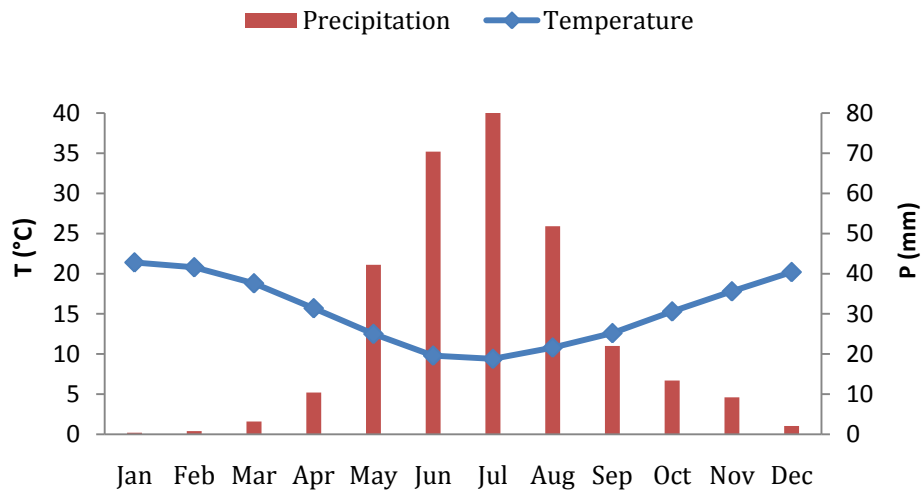


Figure 8. Climogram for Santiago City

All the regions of Chile are divided into provinces which are divided into comunas (Fig. 9). A comuna is a smaller territorial unit with direct forms of governance, which enables a more efficient local organization. It is equivalent to municipality in others countries. Its highest authority is the local Mayor (Alcalde). Different representatives from the comuna are normally mentioned as Municipal authorities (Barriga; Medina, 2004).

<sup>4</sup> These houses are constructed by the Government to help people with few resources.

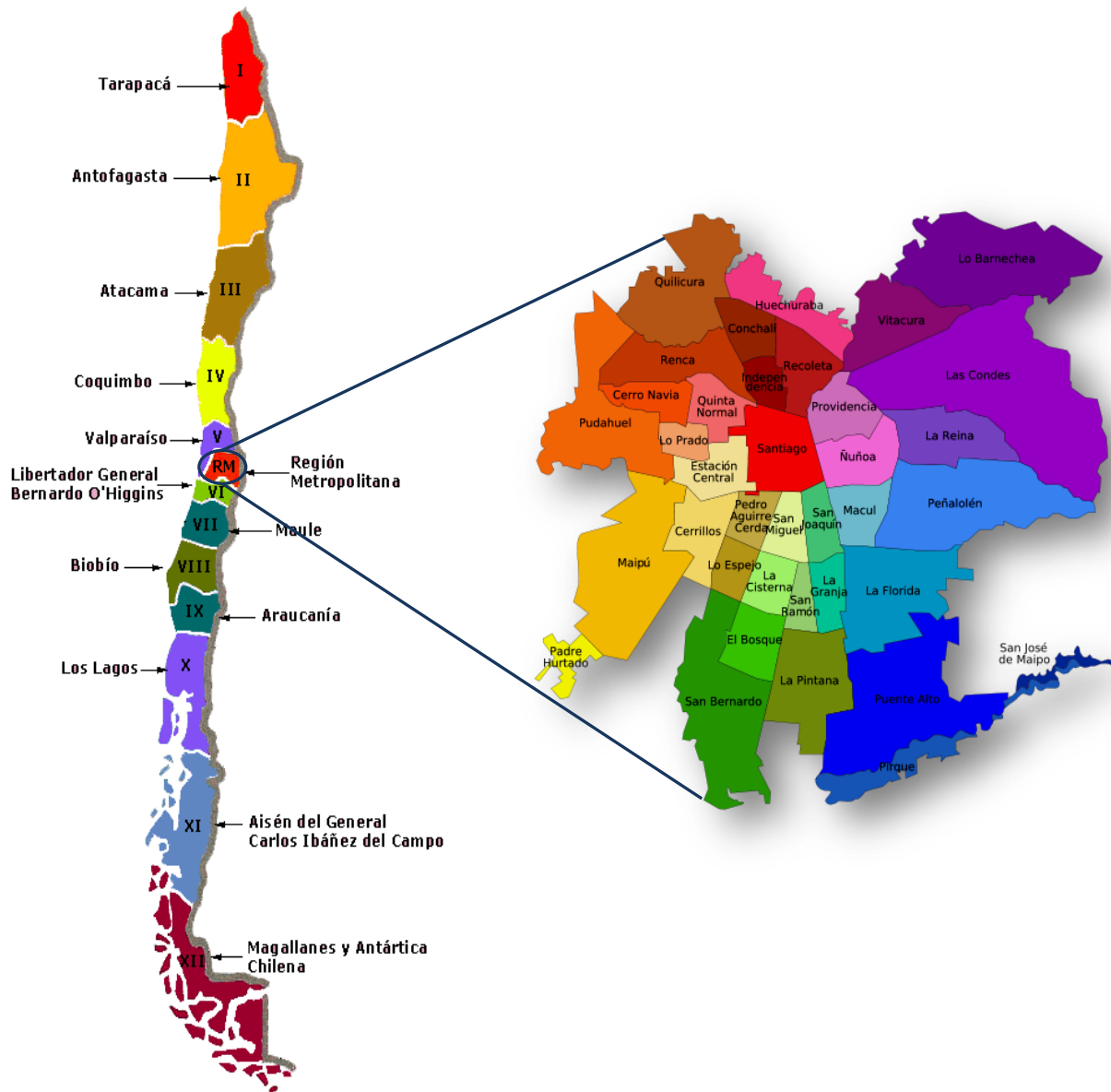


Figure 9. Political division of Chile, regions and comunas from Santiago  
<http://www.newworldencyclopedia.org> (18.3.10)

The Metropolitan Region of Santiago is divided into the provinces of Chacabuco, Cordillera, Maipo, Melipilla, Santiago y Talagante. It has 37 comunas. 32 in the province of Santiago, three in Cordillera, one in Maipo and one in Talagante (Table 3).

Although each comuna is an autonomous Municipality, there is still direct intervention from central Government institutions, and the fields and responsibilities of the different authorities are not clearly stated. A distinctive characteristic of Santiago are the massive socioeconomic differences that exist between the comunas (Dockendorff *et al.*, 2000).

Table 3. Distribution of the comunas in the different provinces of the Metropolitan Region of Santiago

Metropolitan Region of Santiago								
Santiago Province				Cordillera Province	Maipo Province	Talagante Province	Chacabuco Province	Melipilla Province
Cerrillos	La Cisterna	Macul	Quinta Normal	Pirque	San Bernardo	Padre Hurtado	Tiltil	Curacaví
Cerro Navia	La Florida	Maipú	Recoleta	Puente Alto			Colina	María Pinto
Conchalí	La Pintana	Nuñoa	Renca	San José de Maipo			Lampa	Melipilla
El Bosque	La Reina	Pedro Aguirre Cerda	San Joaquín					San Pedro
Estación Central	Las Condes	Peñalolén	San Miguel					Alhué
Huechuraba	Lo Barnechea	Providencia	San Ramón					
Independencia	Lo Espejo	Pudahuel	Santiago					
La Granja	Lo Prado	Quilicura	Vitacura					

Once the site of study was described, now it is analyzed the energy governance of Chile.

#### 4.2 Energy governance overview

The energy governance in Chile is been developing more in a national level, concentrating all the organization and the creation of Programs in the Ministry of energy<sup>5</sup>. It was created the first of February of 2010, through the 20.402 law. It is the main organ of collaboration of the President of the Republic in the functions of Government and administration of the energy sector. The aim of this Ministry is to elaborate and coordinate the plans, policies and procedures for the good functioning, development of the energy section and contribution with the Government in the tasks that this sector demands (Ministerio de Energía, 2011).

The Energy Ministry works with different organisms and institutions (Fig. 10):

These institutions are decentralized and work in different areas to contribute with the functions of the energy Ministry.

In a **national** level, there are the following:

- a) *National Commission of Energy (CNE)*: It is a technical organism which analyzes prices, rates and technical procedure which must fulfill the companies of production, generation, transport and distribution of energy, to offer a sufficient, sure and a quality service (CNE, 2011).

<sup>5</sup> See [www.minenergia.cl](http://www.minenergia.cl) (18.04.2011).

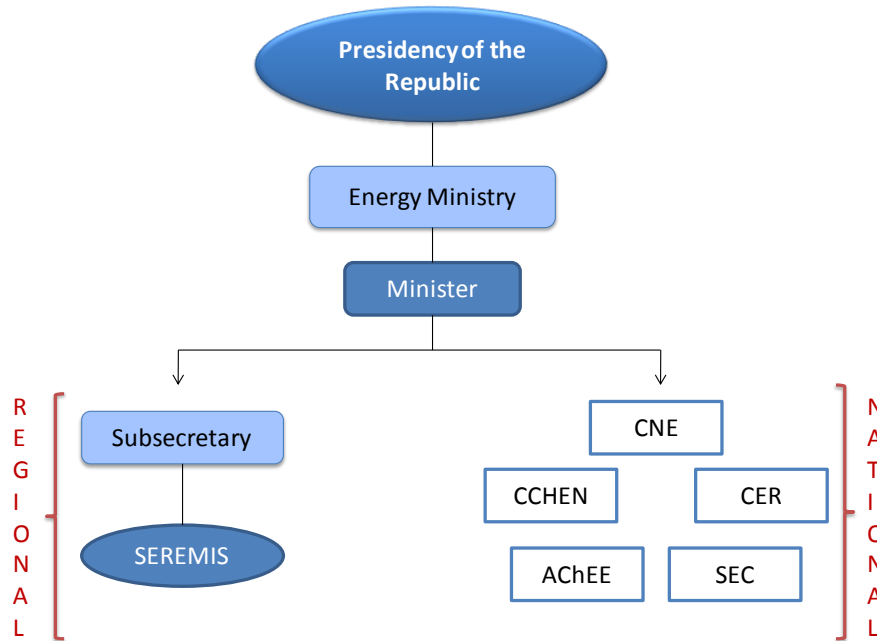


Figure 10. Organisms and institutions that work with the Energy Ministry (Author)  
**CNE**= National Commission of Energy; **CER**= Center of Renewable Energies; **CCHEN**= Chilean Commission of Nuclear Power; **AChEE**= Chilean Agency of Energy Efficiency; **SEC**= Superintendence of Electricity and fuels

*b) Center of Renewable Energies (CER):*

It is an institution that consolidates the efforts of the Chile State to develop the renewable energies. Its mission is to ensure the major participation of renewable energies in the energy matrix to contribute to the sustainable development of the country. It is in charge to design the new policies in this matter and plays an important role in the energy market of Chile (CER, 2011).

*c) Chilean Commission of Nuclear Power (CCHEN):*

This Commission was created to advise the Government in all the matters related to the nuclear power, especially, in the study of agreements with other countries or with international organizations, in the credit contracts, in the study of legal or regulation dispositions related to the regime of property of the deposits of minerals, fissionable and radioactive materials, related with the dangers of the nuclear power (CCHEN, 2011).

*d) Chilean Agency of Energy Efficiency (AChEE):*

It is a foundation which promotes and consolidates the efficient use of the energy articulating the relevant actors in a national and international level, and implementing public-private initiatives in the different sectors of the energy consumption, contributing to the competitive and sustainable development of the country (AChEE, 2011).



e) *Superintendence of Electricity and Fuels (SEC):*

Its mission is monitoring the suitable operation of the electricity, gas and fuels services, in terms of security, quality and price (SEC, 2011).

In a **regional** level, it works through a Subsecretary that has six Regional Ministerial Secretaries along the regions of the country. These were distributed in macrozones which are:

- Arica-Parinacota and Tarapacá-Antofagasta
- Atacama and Coquimbo
- Valparaíso, Metropolitana and Libertador General Bernardo O'Higgins
- Maule, Biobío and Araucanía
- Los Ríos, Los Lagos and Aysén del General Carlos Ibáñez del Campo
- Magallanes and Antártica Chilena

In a **local** scale (Comunas) there is not governance in the energy sector. It doesn't exit any dependence in the Municipalities. Authorities from comunas inform that the energy supply comes from the SIC<sup>6</sup> coordinate directly by the enterprise CHILECTRA<sup>7</sup>.

In this section, also it is described a general review of the laws and decrees<sup>8</sup> that intervene in the topic of interest of the present research. The importance of this review is to determine the current rules imposed by the Chilean State to proceed in face of climate change and the implementation of renewable energies.

In the country of Chile, the principal environment law is 19.300 regulated by the Environment Ministry, a public organism in charge of the design and application of policies, plans and programs in environmental matter. The last important law is the 20.417 which establish the new Environmental competences. The new Minister must create programs and action plans to work in the problem of climate change, it must cooperate with the different State organisms to determine the effects and the definition of mitigation and adaptation measures.

The decrees established to face the problem of climate change and to assume the international and national commitments are detailed in the Table 4, by chronological order. Also it is presented the decrees and laws defined for the renewable energies. To conclude, it is described the new laws to create the new environmental competences destined to regulate this area:

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<sup>6</sup> SIC is the system called "Sistema Interconectado Central" situated in the center part of the Chile. The major part of the supply energy in this system comes from hydroelectric plants.

<sup>7</sup> CHILECTRA is the enterprise that provides electricity to the Metropolitan Region of Santiago.

<sup>8</sup> This information was obtained of the National Library of the Congress of Chile. Check [www.bcn.cl](http://www.bcn.cl)

Table 4. General review of the current law to manage the energy governance (Author)

<b>Decrees and laws which focus in energy governance</b>			
<b>Ministries creation</b>			
	<b>N°</b>	<b>Publication date</b>	<b>Goal</b>
<b>Law</b>	20.402	3-12-2009	It is created the Energy Ministry, passing the functions of the National Commission of energy and turning into the highest administrative level. Its functions include the formulation and evaluation of public policies, technical-economic regulation, the taxation of the norms fulfillment, application of sanctions and resolution of conflicts.
	20.417	26-01-2010	It creates the Environment Ministry, Environmental Evaluation Service and Environment Superintendence. In its organization, the Ministry will be composed by the Minister, Subsecretary, the Regional Ministerial Secretariats and the National Consultative Commission. Likewise, it will create the environmental evaluation to administer the System of environmental evaluation impact, the Superintendence of Environment for the inspection of the instruments of environmental management and the application of sanctions. Finally, the units of environment in the Municipalities and that current Unit of Cleaning and Ornament also could develop environmental tasks in a local level. With this law, new definitions are incorporated as climate change and it is pretended to improve the access to environmental information. The creation of the new divisions is a positive impact for the environmental care and the fulfillment of procedures.
<b>Renewable energies</b>			
<b>Decrees</b>	142	28-06-2000	The study prepared by the National Service of Geology and Mining industry identifies probable sources of geothermal energy.
	15	06-04-2002	It is promulgated the agreement between Government of the Chile Republic and the Program of the United Nations for the Development on the project called Chile: Barrier removal for the Rural Electrification with Renewable Energies, signed in dates August 30 and September 12, 2001.
	32	28-10-2004	It was approved the regulation for the application of the law n ° 19.657, about concessions of exploration and exploitation of geothermal energy.
	331	26-05-2010	It was approved the regulation of the law n ° 20.365, which establishes the tributary tax respect to the solar thermal systems.
<b>Law</b>	19.657	07-01-2000	It establishes the concessions of geothermal energy, biddings for exploration and exploitation. The functions of the State related with the geothermal energy. The safety conditions that should be adopted in the development of the geothermal activities and the relations between concessionaires.
	20.365	19-08-2009	It establishes the tributary tax respect of solar systems. It creates by the aim to reduce the dependence of fossil fuels, establishing a tributary credit to finance the installation of solar thermal systems to warm the drinkable water in housings. With this incentive, beside of being benefit to the projects through credit, the construction companies will be able to

			develop this technology and with the time lower costs and to turn it more competitive.
	20.257	01-04-2008	It introduces modifications to the general law of electrical services respect to the electric power generation with sources of renewable energies like geothermal, wind, biomass, wave, small hydroelectric power stations, cogeneration and others similar determined by the Commission.
<b>Climate change</b>			
<b>Decrees</b>	123	13-04-1995	It promulgates the Conventional Framework of the United Nations on climate change, adopted in New York on May 9, 1992.
	466	29-05-1996	Through this decree the National Committee in climate change was created. Its objective is to advise and coordinate the different institutions linked to the topics of climate change and of global change, especially to the External Relations Ministry, the National Commission of the Environment and entities in charge of these topics in these years. Also the functions of the committee were defined.
	659	11-07-1997	It is promulgated the agreement with the Program of the United Nations for the development of the project named training of Chile to fulfill its commitments with the Conventional Framework of the United Nations on the climate change.
	349	16-02-2005	It promulgates the Kyoto Protocol of the Conventional Framework of the United Nations on climate change and its Annexes A and B. It was ratified to the General Secretary of the United Nations Organization and came into force On February 16, 2005.

After reviewing the energy governance focus in the institutional and law matter. Based on Goldthau (2011), the description will continue on the three areas which compose the energy governance: energy security, energy access and climate change for the present case of study, centring more in climate change.

#### 4.2.1 Energy security

In this area, the actual situation of the energy matrix will be analyzed, problems and vulnerabilities, the potential of renewable energies in Chile and how Government is enfacing this situation to ensure in the future the energy security of the country.

Actually, Chile is an energy import dependent country because it does not possess big energy reserves. Most of the fossil fuels such as oil, natural gas and coal are imported from Argentina, Australia, Indonesia and Colombia, being its few deposits in the southern zone.

The energy dependence of Chile was growing in the last years because of its higher demands that are directly related with the growing of its economy, increasing in its population. In 1990, 47.7 % of their primary energy<sup>9</sup> consumption in the country was

<sup>9</sup> Primary energy are natural resources that are available to use in their direct form without suffering any process of transformation. These resources can be for example: hydraulic, solar power.

supplied by imports. Today Chile imports more than 65 % of its primary energy matrix (CNE, 2008) (Fig. 11).

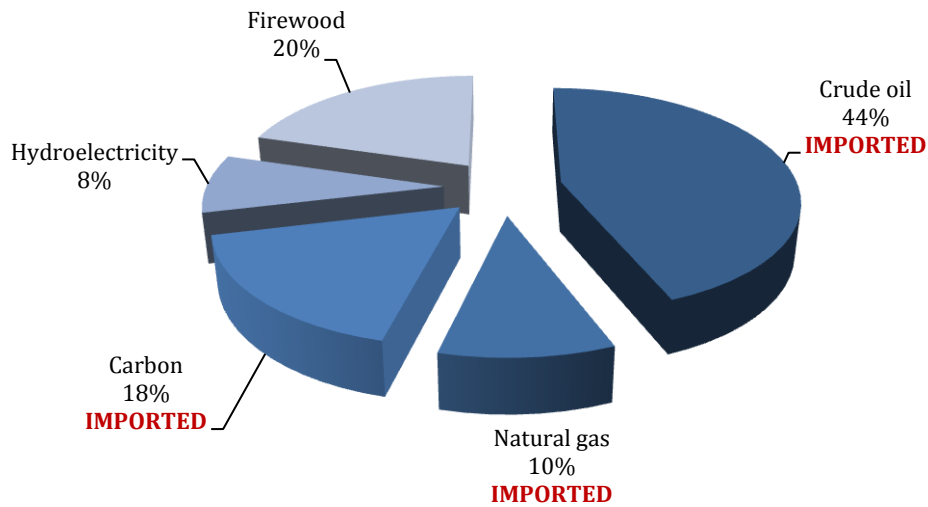


Figure 11. Primary energy consumption in Chile for 2008 (CNE, 2008)

On the other hand, it is important to mention that as a part of the primary energy started the energy production of wind parks, which contribution is minimum just 33 teracalories (0,03 % of the primary energy production) according to the energy balance (CNE, 2008); however, it is expected to grow in the future.

The secondary energy are the products resulting from the conversion of primary energy resources. Among them, there is petroleum, natural gas and coal, as well as wood and electricity (Fig. 12).

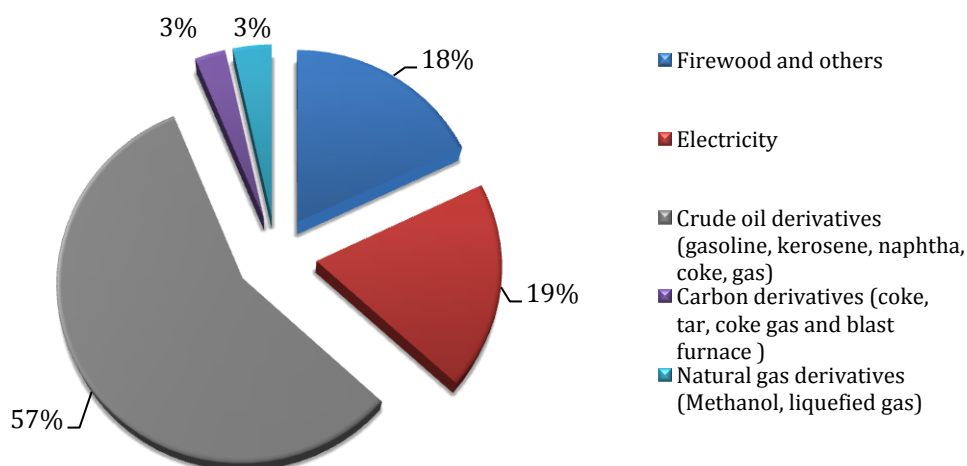
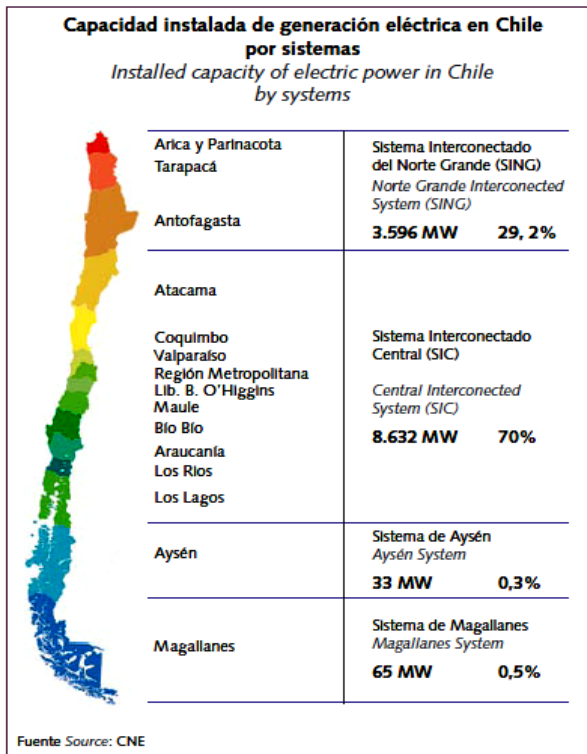


Figure 12. Secondary energy production for Chile in 2006 (CNE, 2008)

The electricity sector in Chile is organized in four different systems:



- 1) Norte Grande Interconnected System (SING)
- 2) Central Interconnected System (SIC)
- 3) Aysén System
- 4) Magallanes System

The most important is the SIC because is the largest power grid, supplying approximately 93 % of the population and represents 70 % of the generation available in the country. In this generation, the major part 53.46 % is given by hydropower. In contrast, the SING is structured by thermoelectric plants using gas and coal.

Figure 13. Electricity generation by systems (CNE, 2008)

In regard to the demand, the most important consumers are the processing centers<sup>10</sup>, followed by the industrial and mining, transport sector which consumes about 82 % of energy. The commercial, public and residential areas cover only 18 %. It is also important to emphasize that the first three are mainly supplied by the imports of fossil fuels while the last one from hydroelectric power plants.

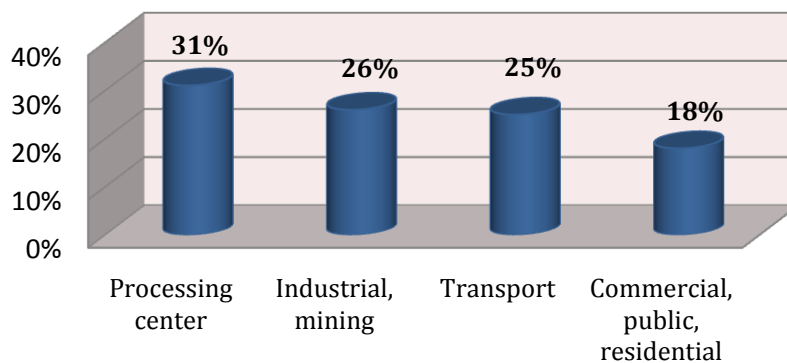


Figure 14. Electricity consumption in Chile by sectors (2008) (CNE, 2008)

In the year 2006, the installed capacity came to a total of 12.326 MW compared with 5.635 MW in 1995 and 3.324 MW in 1985. According to projections of the CNE of Chile, the country will need to duplicate this capacity for the year 2020, which means a major

<sup>10</sup> Consumption of companies that transform energy into different forms of secondary energy such as electricity, gasoline, etc.

use of energy to satisfy the demands. The present scenario of Chile shows that it is necessary to look for new energy sources in a long term, in order to satisfy the necessities of different sectors of the country and leaving the dependency especially from Argentina, from where Chile imports gas.

To achieve energy security does not imply necessarily avoiding all the interruption of the energy supply or achieving total autonomy, it means decreasing the risks of the supply and the level of dependence, to a cost that a nation can afford paying (Rudnick, 2006). The decisions of the present will define the energy condition of the future having serious impacts in 20 or 30 years, mainly in the case of Chile which presents reduced fossil resources and where the next important energy source is the hydroelectric power. This can be affected by the variability that imposes the nature and climate phenomena. That is why it is urgent to look for new alternatives that provide Chile more energy security, the diversification of its matrix is an important key to avoid the dependence because Argentina in some occasions caused the decreased in the supply of energy affecting different industries and economical sectors of Chile. Another central aspect that must be stimulated in parallel is the energy efficiency as an element integrated to the development of the country. Nowadays to fulfill with this aim, the Energy Ministry is carrying out the Program of energy efficiency. On the other hand, Government has invested, in the last years, in many studies for alternative energies and also has created the different organisms to investigate renewable energies (solar, wind, geothermal) in which the Government is investing 90 million of Chilean pesos equivalent to (189.000 US\$). And it is also a fact that Chile is looking for the scientific research and developing human capacity in nuclear energy trough the CCHEN and CER.

Chile is a country that presents a big potential to exploit in renewable energies due its variety of resources among them it has solar, wind, geothermal and wave energy. That is why these can be an important opportunity to develop economically and technologically. In the north is situated the Atacama's desert, zone in which there is registered one of the highest index of radiation of the world, reaching the 3.000 kWh per m<sup>2</sup>. The project of major magnitude until now is the photovoltaic park Atacama Solar designed for a capacity of 250 MW, which is planned to be built in the limits of the communes of Pozo Almonte and Pike, in Tarapacá's Region, north of Chile.

In the topic of geothermal energy, there are also big advantages to be located in the belt of fire of the Pacific, a volcanic zone, which potential is superior to 16.000 MW, technically feasibly of generating 1.500 MW, projected for the year 2025. According to Mr. Fernando Allende, president of the Chilean Association of Geothermal Energy it hopes that the first geothermal plant of the country will be installed in 2013 in the pampas Pile, north of Calama, estimating for 2018 to have a 1000 MW of power generated (Allendes, 2011. Cited in Revista Científica Energías Renovables, 2011).

In addition too, in the north of Chile has developed wind farms that show promising results, the private sector is answering satisfactorily, particularly the mining industry, which in the immediate term, faces two challenges: to obtain new energy sources due its increasing demand and also to low its carbon footprint. The State Office Corfo<sup>11</sup> and GTZ estimated a potential for Chile which reaches 40.000 MW and technically feasibly 1.500

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<sup>11</sup> CORFO: Promotion Corporation of the Production in Chile.

MW for 2025 (Revista Científica Energías Renovables, 2011). Finally, to conclude the analysis in the energy security for Chile, it is important to mention the last decisions of the Government which approved the projects of HydroAysén in the Region Aysén to produce power through hydroelectric plants in the rivers Pascua and Baker situated in the south of the country. And the approval of the Castilla thermoelectric which is planning to be install in the sector of Punta de Cachos (Copiapó) north of the country.

#### 4.2.2 Energy access

The area of energy access shows a big development in Chile. According to the data collected in the CASEN<sup>12</sup> 2006, the results present a highest level of electrical coverage. In a national level, the urban coverage of energy supply is 99.2 % and 94.3 % for the rural sector (Fig. 15).

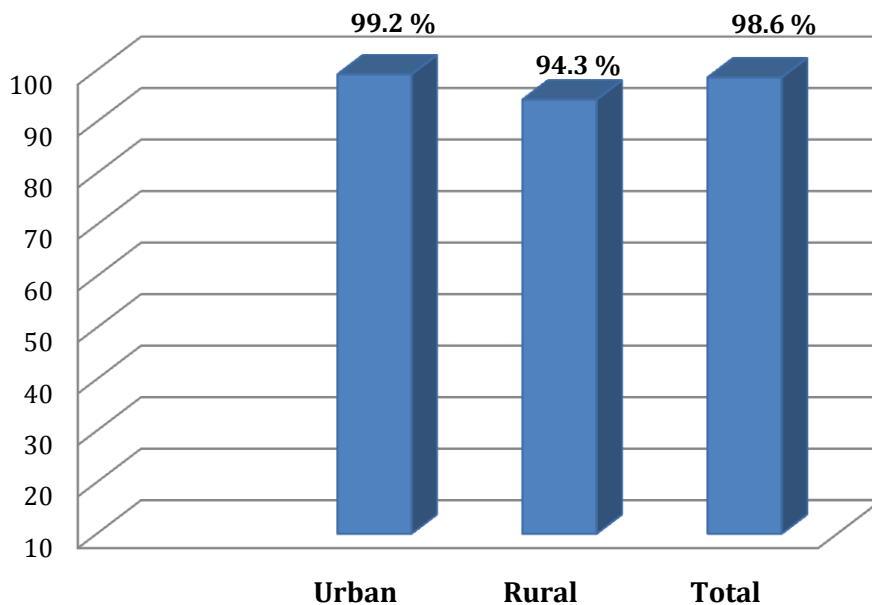


Figure 15. Electrical coverage according to urban and rural zones for 2006.  
Percentage of houses with electricity access (CASEN, 2006)

The majority of kitchens in rural areas use fuel wood and gas in urban areas. Since nineties of XX century, the gap between urban and rural areas decreased in a big percentage providing energy access to more families (Fig. 16).

<sup>12</sup> It is the principal instrument to measure socioeconomic data for the design and evaluation of the social policy of Chile.

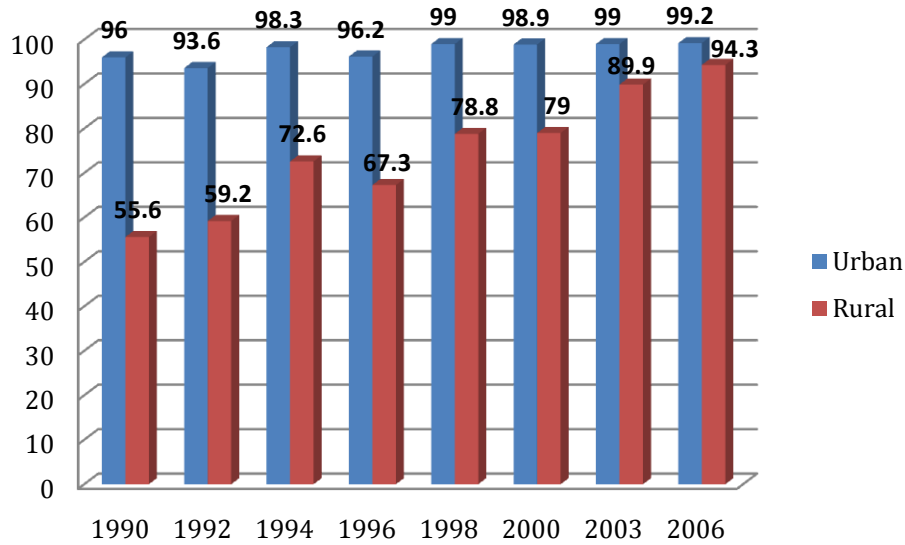


Figure 16. Electrical coverage evolution by zone from 1990 to 2006. Percentage of houses with electricity access (CASEN, 2006)

Specifically, for the Metropolitan Region of Santiago the coverage is near to 100 % in both areas urban and rural.

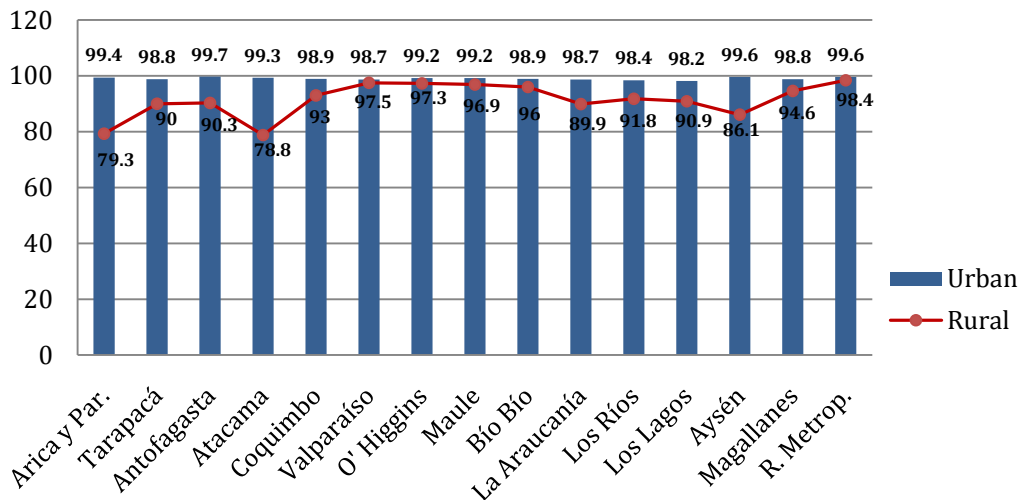


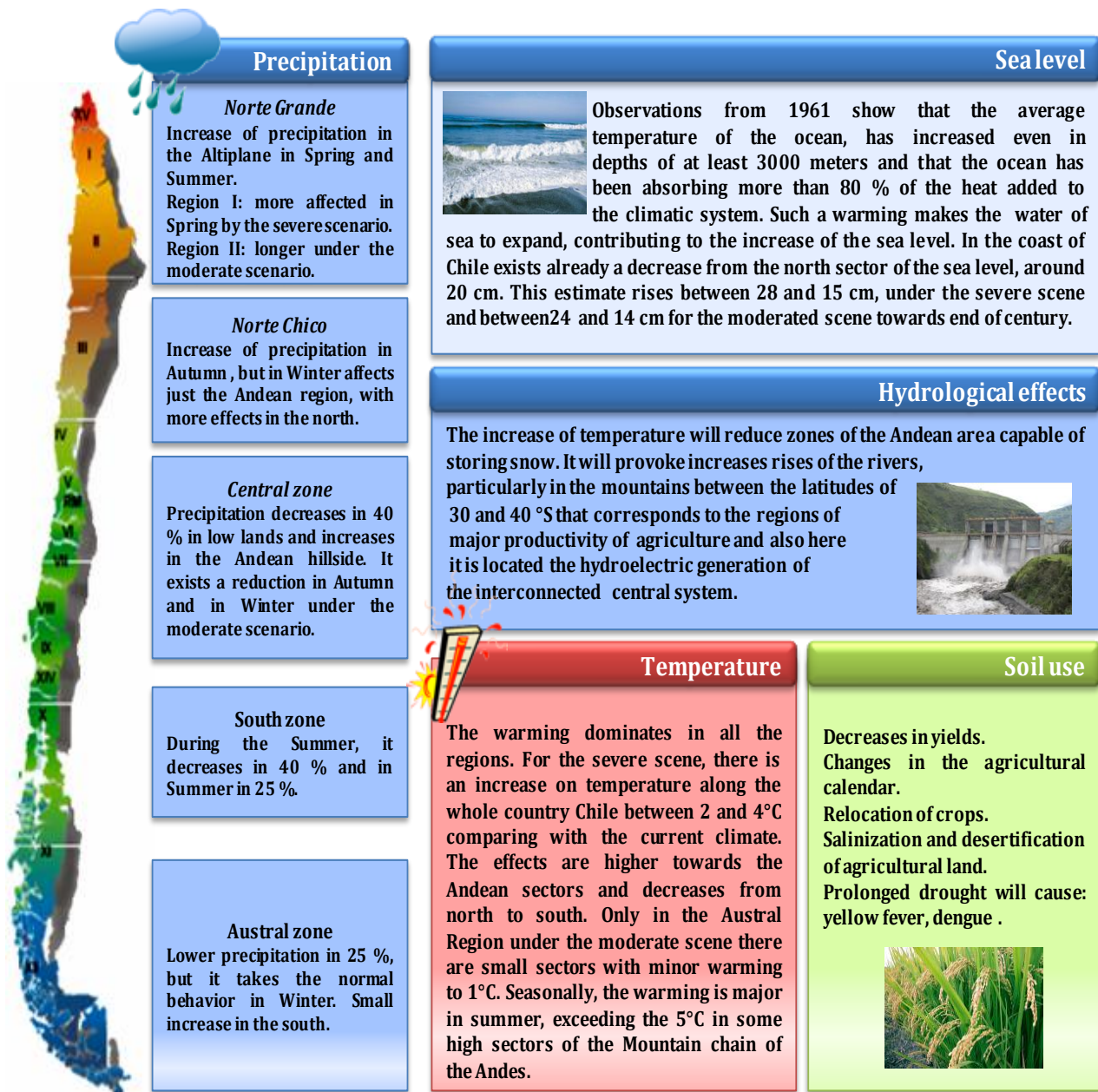
Figure 17. Urban and rural electrical coverage of regions in Chile 2006 (CASEN, 2006)

### 4.2.3 Climate change

Regarding climate change, it is interesting to analyze the case of Chile because its main electric system SIC can be affected by this phenomenon. 53 % of the energy produced in SIC comes from hydroelectric plants and the water that feeds them is in function of the climate and environmental factors, influencing directly to the energy availability. In addition to, studies of the IPCC and CONAMA (2007) showed another impacts for Chile in: precipitation, temperature, sea level, hydrologic effects and soil use (Fig. 18).



Figure 18. Climate change impacts in Chile. Based on CONAMA (2007); IPCC (2008)



As it was described in previous figure, the future impacts of climate change will increase the vulnerability of Chile in different areas. Besides this scenario, the green house gases emissions in this country are actually growing due the intense activity of transport, processing centers of energy, mining, industry among others. In addition, the actual consumption model in population produced as a result the fast production of CO<sub>2</sub> per capita which took Chile to occupy a critical place in an international level (Fig. 19).

Another important fact is that the carbon is converting in the competitive fuel to replace the gas for the production of electricity, growing in this way the thermo electrical generation, in the last month was approved by the Government the installation of thermoelectric plants in the north of the country (Copiapó and Iquique). Although, there

is a search for cleaner processes, the risk in a long term to increase the emissions is a fact, comparing with other kind of energy production.

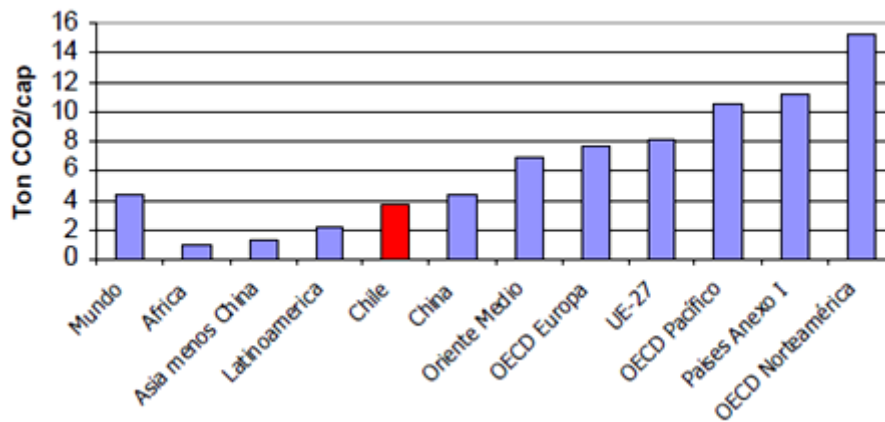


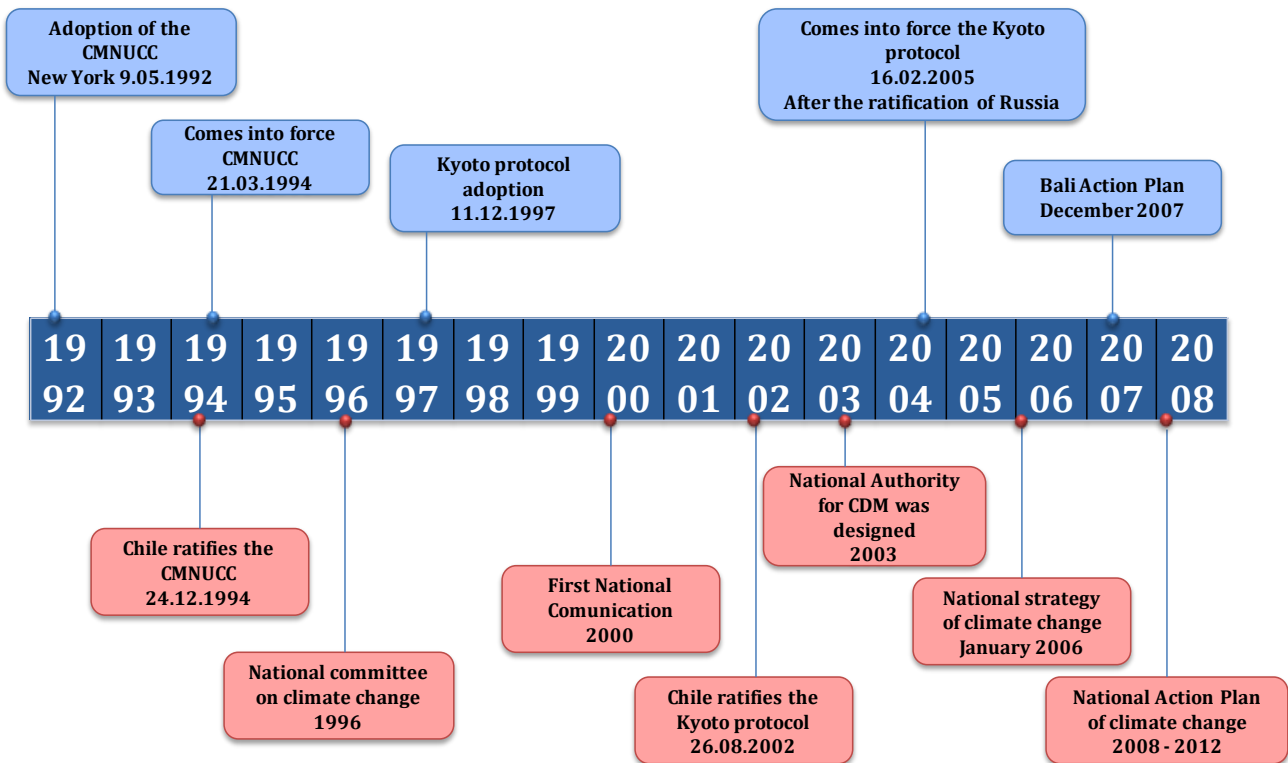
Figure 19. Comparison of CO<sub>2</sub> emissions per capita in different countries for 2006 (IEA, 2006)

Now, it will be presented a time line to describe the actions that Government is developing in a national level since the end of XX century to present, comparing with important events happened in a global level (Fig. 19). Chile was working in these strategies to enface climate change impacts because the IPCC, Universities studies have predicted scenarios which reflect the vulnerability of the country.

Chile has so far signed and ratified the Convention Framework of the United Nations on climate change in 1992. As a response, a National Committee on climate change was established in 1996. Its first activities were to prepare a list of emissions and inform about vulnerabilities of the country, concluding that Chile was counting seven of the nine vulnerability conditions mentioned in the Convention Framework. In 2000, the First National Communication on climate change was produced as a diagnostic tool to assess the status of the country. In 2002, the commitments of the Kyoto protocol were ratified to fulfill the obligations that correspond as a member of the Annex I. During this decade, the actions on climate change focus more on mitigation. For this purpose, was created in 2003 the National Authority designed for the Clean Develop Mechanism (CDM) and the approbation of around 70 projects that generated carbon credits in international markets. Additionally, were developed studies by CONAMA to predict future impacts in temperature and precipitation. As a result of this research was determined the urgency to establish adaptation measures in Chile. Later in 2006, was defined the National Strategy on climate change that included an action plan designed under the lead of the External Relations Ministry. The last important strategy defined in a national level was the National Action Plan against the climatic change, prepared by the period of 2008 to 2012 in which they look for minimizing the adverse impacts to the climate change, across integrated actions to determine the vulnerability and adaptation measures and mitigate greenhouse gases. The lines of work are:

- Adaptation to the climate change impacts.
- Mitigation of the greenhouse gases emission.
- Creation and promotion of capacities.

## GLOBAL ACTIONS



## CHILEAN ACTIONS

Figure 20. Time line of actions in climate change for Chile. Adapted from Ferreiro (2010)

Respect to the international commitment of Chile to reduce in 20 % its CO<sub>2</sub> emissions for 2020, it was analyzed the following strategies:

- Chilean Government has a partial commitment because it considers that is necessary the international financing to support the mitigation reduction.
- The principal measures of mitigation defined by the Government include: the early actions or NAMAs (Nationally Appropriate Mitigations Actions), for the efficient use of the energy and the introduction of the renewable energies. It hopes that the NAMAs could reach 18 % and 2 % remaining it is expected to be realized by international financing. In this way, it will be completed the 20 % of emission reduction.
- To demand major standards to the charcoal plants, concerning thermoelectric plants and in addition a better management of the energy efficiency.
- The environmental education is a fundamental tool to reach or even to overcome this commitment of 20 %. The agreement includes an article of environmental education and civil participation.
- Given the geographical position of Chile and its productive structure highly orientated to the export, the resultant emissions of the transport are a very relevant topic. Nevertheless, Chile rejects to assess these responsibilities because it generates a barrier on the market. It would be an option for this topic, for example, if there were established measure tariffs (Escenarios energéticos Chile, 2030).

In a **regional** level, the fast develop of the city of Santiago produced in the last 10 years: urban pollution, transport problems and a fast urbanization, decreasing especially the green areas. The scientific studies predict that the climate change impacts will increase the frequency in floods, heat waves and droughts around Santiago. These hazards are often related with high physical, economical and social damages. They can destroy the natural environment, causing high financial losses, damaging human health and interrupting the vital urban infrastructures for energy, transport, communication, food supply and waste removal. To enface this situation was born in Santiago the project Climate Adaptation Santiago (CAS)<sup>13</sup> which aim is to elaborate adaptation measures to climate change for the Metropolitan Region of Santiago of Chile in the sectors of energy, water and use of soil. The activities include the estimation of the essential climate changes in the regional - urban level, as well as the estimation of consequences and effects with explorative scenarios and the participation of principal actors.

In a **local** level, the tendency shows low development in the topic of climate change. Some reasons are because of the change of Government which starts new projects and the recently creation of the Environmental divisions who direct their actions in other areas.

### **Development of climate adaptation measures across levels**

It is possible to observe in the Fig. 21 how there is been carried out the climate adaptation measures against the climate change from a national, regional to local scale with their different actors and actions. Still it is necessary to work more improving links from top to bottom. Unfortunately, there exist communication limitations of the strategies, actions and projects that are realized from Ministries to Municipalities. Municipal authorities affirm that the lack of this communication produces the individual work and every Environmental division looks for his own aims. Therefore, an integral planning and process do not exist.

Urban administration and other local authorities play a critical role in the adaptation to climate change. They can serve as a bridge between the household and national policies. In Chile organization in climate change is been organized in a sectorial way. It is necessary to link answers of infrastructure with answers in education, coordination, communication and planning. Not relating the regional Government, local Governments, Department of Housing and Urbanism (MINVU) and the Inter-ministerial Committee of City and Territory, will cause the lack of territorial dimensions and integrity. More successful results can be waited if in the National Plan there is an integration of climate change with other normative, such as instruments like the regulatory plans in Municipalities, the strategy of regional development, plan of territorial classification, the Agenda 10<sup>14</sup> and the Agenda of Cities 2006-2010 elaborated by the MINVU<sup>15</sup> (Barton, 2009).

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<sup>13</sup> This project is working since 12. 2009 until 11.2012

<sup>14</sup> It is the current presidential agenda for the regions.

<sup>15</sup> It is the Department of housing and urbanism of the Government of Chile.

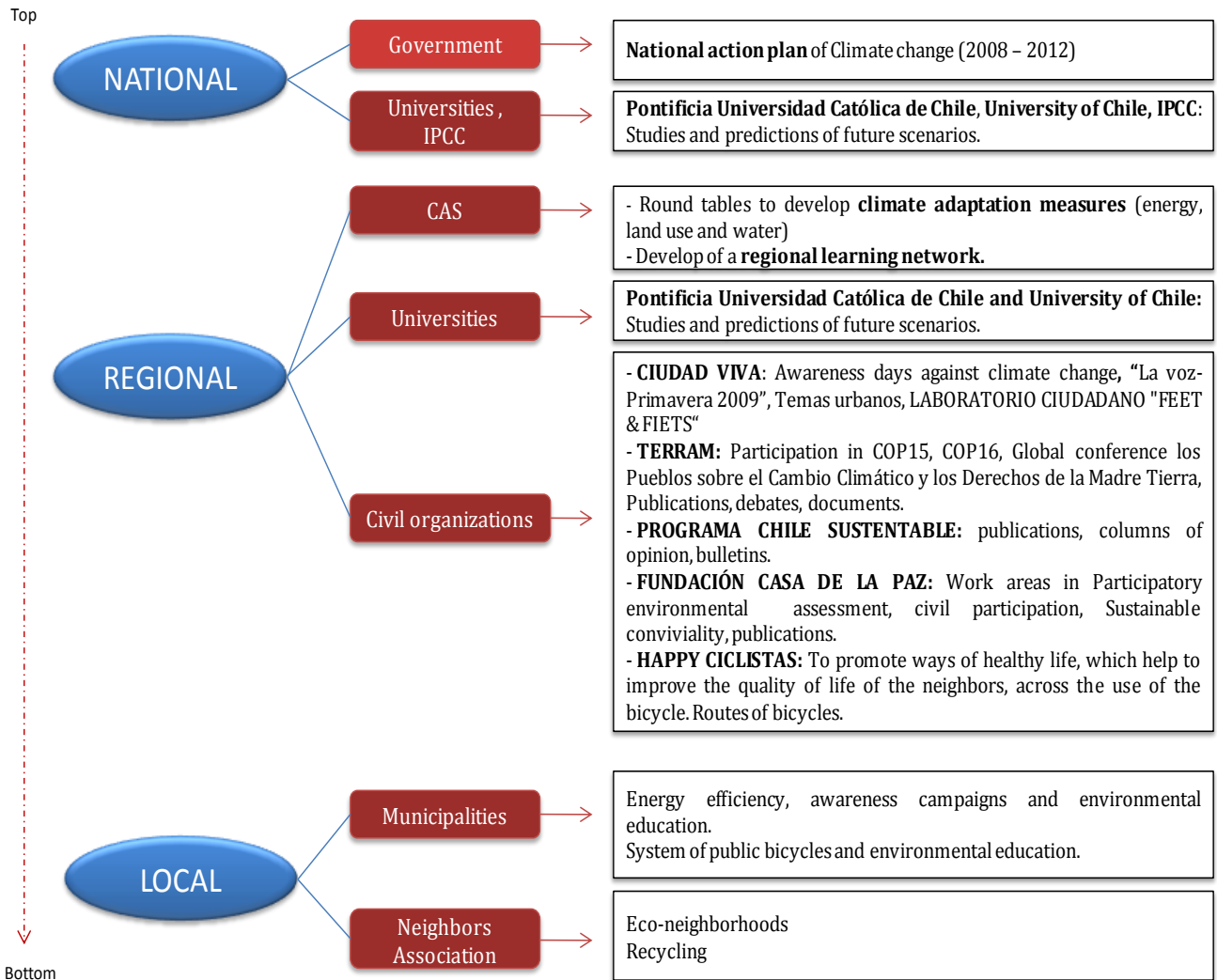


Figure 21. Organizations and actions to develop climate adaptation measures in different scales (Author)

Nevertheless, in a **national** level an Action plan against the climate change is taking place, it was designed for the period of 2008 – 2012. It is also present the IPCC and the academy through Universities<sup>16</sup> which work and research determining the probable impacts for Chile across future scenes.

In a **regional** level, the universities are present making research especially for the centre of the country where it is located the capital and the largest part of the population that can be affected. The project CAS which started its work since 2009. They are working through round tables in order to develop climate adaptation measures in the areas of energy, land use and water with the participation of different actors between them: Representatives from Government, private, public sector, civil organizations, academic institutions, universities. Also, they are creating a regional learning network in Santiago and other cities of Latinamerica.<sup>17</sup> In this level, it is also important to mention the work that realizes the civil organizations, foundations (Fig. 19). Across different programs, publications, actions, activities, between others, they

<sup>16</sup> The Universities that are working are: Pontificia Universidad Católica de Chile, Universidad de Chile.

<sup>17</sup> See [www.climate-adaptation-santiago.ufz.de](http://www.climate-adaptation-santiago.ufz.de)

look to be in touch with the population. For their part, they mention that they are fighting for the civil commitment against climate change and they ask also the commitment of the authorities.

In a **local** level, there are the Municipalities with the Environmental divisions, they have initiatives detailed in the previous figure (Fig. 21) and expect to initiate projects of major incident, specifically in the area of climate change. Likewise, it is necessary to emphasize the labor of the organized neighbors who motivated themselves to realize their own projects as eco-neighborhoods, recycling and also they request major attention and support of the authorities.

#### **4.2.4 Summary of the energy governance**

To finish the analysis of energy governance in Chile, as a summary, it is presented Table 5 where is defined the current situation in each area, actors that are involved, goals, time terms to make the actions, how are enfacing the governance and the necessary challenges to achieve in the future.

The energy security is an area centralized and developed in a National level by the Government trough the Energy Ministry and the different divisions and institutions of the State. It has investigation centers to look for the scientific research and developing human capacity in other forms of energy such as nuclear energy and renewable energies to invest in the future. Its main challenge is to leave the energy dependence of imports through studies, consolidation and investment of new energy projects mainly hydropower in the south (Hydroaysen), thermoelectric in the north (Iquique) and research in solar, geothermal plants, wind farms in the north of the country. Diversify the energy matrix in function of their resources (water, solar, geothermal, wind) to develop technical, economically and lowing at the same time the emissions. Therefore, in a regional and local scale, population is acting as consumers that actually demand not only a good service, also clean energy production with an affordable cost. On the other hand, in this area actually there are conflicts due the last decisions of the Government. Population, NGOs are against the projects in hydropower in the south and thermoelectric in the north. They made protests in streets because they consider these will cause serious migration and pollution to people that live in these regions.

The energy access in Chile shows a big improvement, satisfying the electrical demand in population with high percentages in a national, regional and local level, according to the data of the table 5. Its major challenge is to provide electricity to sectors that still don't have access, prioritizing the use of renewable energies (solar panels and collectors) in social housing, schools from rural sectors where electricity connections are difficult to reach.

Table 5. Analysis of the energy governance in Chile for the three areas of approach (Author)

<b>Energy governance in CHILE</b>							
<b>Energy security</b>							
	<b>Current situation</b>	<b>Main actors</b>	<b>Central goals</b>	<b>Sectors</b>	<b>Time terms</b>	<b>Governance mode</b>	<b>Challenges</b>
<b>National</b>	Centralized and develop more in this level.	Energy Ministry, SEREMIS, CNE, CER, CCHEN, SEC, AChEE.	- Research and work in strategies to provide services for the present and future.  - Implement energy efficiency and promote clean modern forms of energy.	Supply side	Short term	- Efficiency - Establishing research centers. - Working to leave the energy dependence of energy imports.	- Avoid the actual dependence of energy imports. - Diversify the energy matrix in function of their resources.
<b>Regional</b>	Population acts as consumers that demand good service, clean and an affordable cost.						
<b>Local</b>	Energy conflicts						
<b>Energy access</b>							
	<b>Current situation</b>	<b>Main actors</b>	<b>Central goals</b>	<b>Sectors</b>	<b>Time terms</b>	<b>Governance mode</b>	<b>Challenges</b>
<b>National</b>	Electrical coverage of 99.2 % in the urban zone and 94.3 % in the rural sector.	- Government - Energy companies - Energy users	Distribute energy to great part of the country, providing an efficient and secure service to every user.	Supply side	Medium term	- Developing Programs for rural electrification. - Promoting new technologies improving the efficiency. - Efficiency to teach population with different habits.	- Supply energy s in sectors that still don't have. - Prioritizing the use of renewable energies to vulnerable zones.  - Construction of social houses with solar collectors and panels, also in public buildings and demonstrative projects.
<b>Regional</b>	In the Metropolitan Region of Santiago the electrical coverage are: 99.6 urban 98.4 rural	- Regional government - Chiletra - Energy users			Medium and short term		
<b>Local</b>	Electrical coverage is totally satisfied.	- Municipality - Chiletra - Energy users			Short term		
<b>Climate change</b>							
	<b>Current situation</b>	<b>Main actors</b>	<b>Central goals</b>	<b>Sectors</b>	<b>Time terms</b>	<b>Governance mode</b>	<b>Challenges</b>
<b>National</b>	- Ratification of the Conventional framework of the United Nations and Kyoto protocol. - Action Plan (2008-2012)	- Government - Environmental and Energy Ministry	- Working in its three axes of action through its Action Plan.	Supply and demand side	Medium and large term	Developing strategies, regulation and laws.	- Lowing the emissions by different sectors. - Applying energy efficiency. - Education and awareness in population. - Adjust its energy demands and necessities taking account environmental aspects.
<b>Regional</b>	Projects in education	- Municipalities - NGOs and Civil organizations: Ciudad viva Terram, Chile sustentable, Fundación Casa de La Paz between others. - Neighborhood associations.	- Change of habits. - Create awareness in population.			- Developing education modules, awareness newspapers and awareness campaigns.	- Investing in more programs and projects. - Appling demonstrative projects in energy efficiency. - Working closer with civil organizations and take advantage of their motivation to work in climate change projects.
<b>Local</b>	- Few projects directly related with climate change. - Population developed initiatives in education and infrastructure of sustainable transport						

In its Action Plan, Government has three lines of work: adaptation measures to climate change impacts, mitigation of green house emissions and creation and promotion of capacities. Its main challenges are to low emissions through the development of law, politics and regulation for the different sectors and population. Create strategies of greater incidence in education and awareness in population. Adjust its energy demands and necessities taking account environmental aspects. In a regional level is evident that NGOs, civil organizations and population undertaken projects especially in education to enface this problem. In a local level, few projects are developing more focus in education and developing infrastructure for sustainable transport.

### 4.3 Stakeholders analysis

For the present study, it was applied the stakeholder analysis developed by the GTZ<sup>18</sup> to implement participatory systems of cooperation in different countries. The focus was in the two first blocks of this methodology to identify the stakeholders and mapping them to analyze the mutual relations, cooperation and conflicts.

#### 4.3.1 Identifying stakeholders

In the next Table is presented the different stakeholders that interview in the process of climate adaptation construction classified in primary, secondary and key stakeholders. A characterization of them was made based in three concepts:

- *Roles and legitimacy*: Institutional position ascribed or acquired rights.
- *Resources and responsibilities*: Knowledge, expertise and capabilities as well as material resources that allow a formative influence.
- *Relations*: The number and quality of relationships to other actors who are under obligation or dependency.

The evaluation is done according to criterias of strong, medium and weak. And besides it is explained the relations between whether different stakeholders are being appropriately involved in this process.

Table 6. Stakeholder identification taking account the position, core functions and relations (Author)

Stakeholders identification				
Stakeholders	Position and core functions of the Stakeholder			Discussion on forms of key stakeholder involvement
	<i>Roles and legitimacy</i>	<i>Resources and responsibility</i>	<i>Relationships</i>	
<b>Primary</b>				
Population	▲	●	▲	As a result of the surveys and questionnaires it is possible to affirm that the relation of the Government with the population is not completely effective. The programs are given more in a Ministerial level. In a local level, the efforts are small. The participation of the population is low and it demonstrates that it does not exist a proper integration in plans, strategies, programs that could motivate population. It is necessary to strengthen the integration axis from top to down and a constantly feedback to know the state of the advances.

<sup>18</sup> It is the German Technical Cooperation.



<i>Secondary</i>				
IPCC	■	■	■	IPCC is an international important organism due his scientific contribution of probable impacts for the country. The studies from IPCC and universities help in the construction of different scenarios of impacts and to define scientific and academic strategies. These contribute to transmit knowledge in the rest of actors and to define the most urgent actions that they must work.
Universities	■	■	●	
Chilectra	■	■	●	
<i>Key</i>				
Government (Environmental and Energy Ministries)	■	■	▲	The relations of the Government from top to down still need to improve and work more. In a Ministry level programs are realized, but going down grows the lack of integration and common aims with Municipality projects. The topic of the climate change needs to be approached by the active participation and the constantly feedback of actions, from all actors and especially those who will be affected by the impacts.
Comunas Municipalities	●	●	●	Due its recently initiation (2010), still is necessary to improve organization and increase personnel to work in projects, focusing more in climate change and involving directly people from comunas. Linking Government, Municipalities and local Neighbors associations and are crucial to develop effective adaptation measures.
Neighbors association	●	●	●	The Neighbors association is a useful tool that allows the relation between neighbors and Municipal authorities. Their action must be motivated and supported by the Government. In addition, it is relevant to strengthen the confidence creating spaces of dialog and taking into account their opinions, ideas and projects.
CAS	■	■	■	The work of the CAS project is to relate different sectors: public, private, academic and government. This represents a great advance for the construction of integrate and participative measures.
NGOs	●	■	■	The civil organizations play a key role in the development of adaptation measures because nowadays they are in major relation with the population, informing, promoting the environmental education and the awareness in the use of transport to lower the emission for example. Also they relate with authorities through demands, studies that they realize for the improvement of the city.

■ Strong    ● Medium    ▲ Weak

As a conclusion of the criterias analysis, Government, a key stakeholder, is situated as strong in legitimacy and resources, having all the institutional position and resources to develop, promote actions to establish adaptation measures, work through its different dependencies in the energy area and the rest sectors affected by climate change. As well universities show a strong position in legitimacy and resources due their capacity to generate knowledge and expertise in the area.

CAS and IPCC with their studies and estimations contribute in a strong way with the three criterias; contrasting the population as the weakest and most affected in legitimacy not exercising for complete the right of citizen participation and at the same

time this lack of good channels of dialog with authorities produce lack of trust and nonchalance in population. Government also must create spaces where people can communicate their position in the construction of measures, in which actions they are capable to contribute.

In addition, NGOs present a strong capabilities and knowledge to continuing in the awareness actions with population and show a good relation especially with people, involving them in their actions because they will receive directly the impacts of this phenomenon.

Government also needs to improve the axis of integration in the programs against the effects to climate change, as a consequence relations between stakeholders will advance.

Comunas Municipalities and Neighbors associations showed a medium results. They play a key role that must be improved in the participation of the process and in the use of their rights as neighbors. They also need to increase the level of knowledge and involved more to construct together the measures. In their part, Municipalities must to advance in their organization and define projects of specific focus in climate change, involving population.

Chilectra as a part of the private sector shows strong in legitimacy and resources, this capacity and knowledge must be transfer to population especially continuing the programs of energy efficiency and focusing in the decentralized use of renewable energies.

#### **4.3.2 Stakeholder mapping**

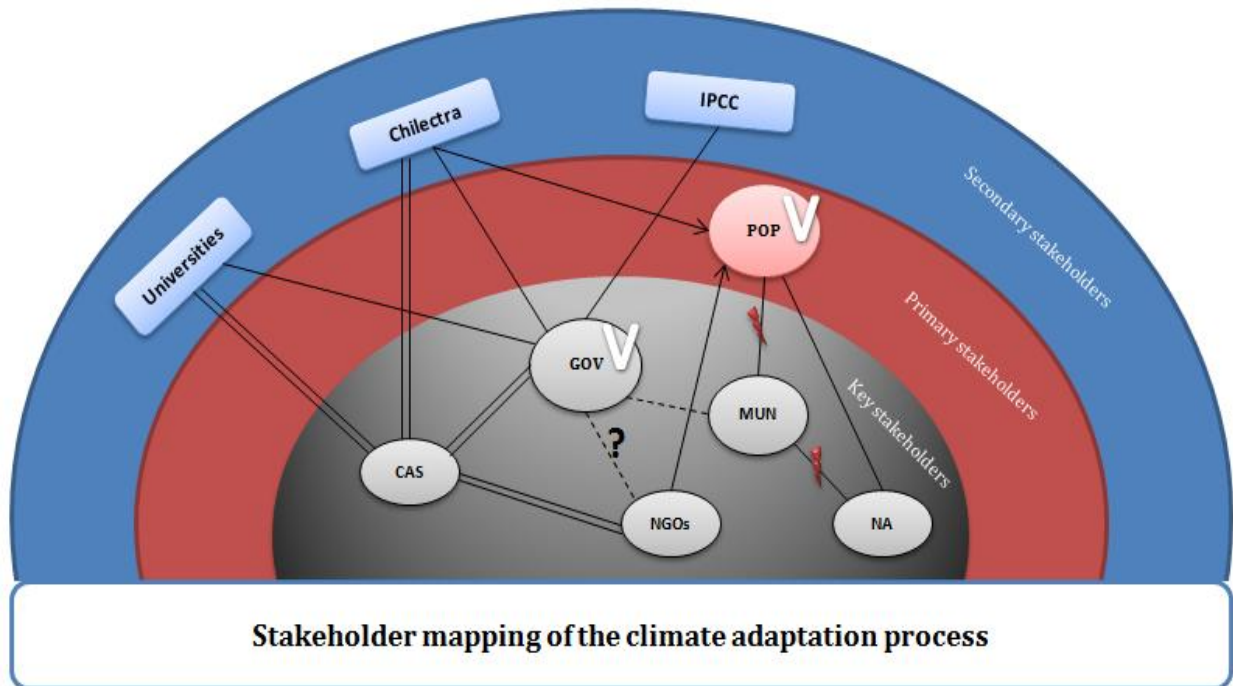
To present the map of stakeholders firstly will be define three important points:

- *Delimiting the specific area of analysis:* climate adaptation measures in energy from top to bottom and focus in a local level: Maipú and Providencia.
- *Establishing the point in time and deciding on periodicity:* analysis of the current situation.
- *Separating out different perspectives:* Main stakeholders which contribute to construct effective adaptation measures in energy.

After defining these criterias is presented the stakeholders map in Fig. 22.

To start describing the present diagram, it is presented the *veto players* who are the Government and population, without their participation it is not possible the construction of climate adaptation measures. Government does not relate directly with population. For this goal they have comunas Municipalities in a local level. However, as it is shown in the map, there is not a fluid communication between them. The actions that they are developing to face climate change have different objectives and they do not present an integral plan from top to down.

Figure 22. Stakeholders mapping



**GOV** = Government; **CAS** = Climate Adaptation Santiago; **MUN** = Comunas Municipalities; **NA** = Neighbors Association; **POP** = Population; **V** = Veto players

Municipalities of Maipú and Providencia, by their way, had environmental conflicts with Neighbors association. These were produced due the intensive population growing where authorities wanted to expand zones of urbanization and devastate green areas. As a result, neighbors fought against its actions and consolidated better their associations to defend the health of the environment. Besides that, relations are improving in certain way, they want to work together, hopping relations and active participation could contribute to improve the quality of life and environmental education of population.

People from comunas, due these last events also show low trust to Municipalities; they demand more effective activities and Municipalities also pretend to apply projects of better results with their news Environmental divisions. On the other hand, population has good relations with NGOs and neighbors association, for them these are good channels to complain their demands, to support activities, to learn through environmental campaigns to low emissions, to reach and to be heard by authorities. By its side, it is not clear the relations between NGOs and Government, because these organizations usually demand actions to authorities, pressing them and at the same time contribute with studies showing their good capacities.

Another important key stakeholder for the construction of adaptation measures is the CAS project. They are linking many institutions (Government, NGOs, universities, private sector) to construct measures in a participative environment. This is crucial to take account the voice and necessities of every interested sector and will facilitate the implementation. That is why in the diagram it is shown a mutual support between these actors.

IPCC body is important for Government because its studies promote different actions especially in a national level that means in the Ministries. Universities as well present studies of vulnerabilities and possible impacts of climate change for Santiago to support authorities in the future making of decisions and politics. As the main focus is the adaptation measures in energy, Chilectra plays an important role. This private institution is also promoting in a local level decentralized renewable energy systems such as solar concentrators and they also contribute with good energy habits through media services.

## 5. LOCAL ENERGY GOVERNANCE IN THE COMUNAS OF MAIPÚ AND PROVIDENCIA

To start is important to mention that the area of energy governance to be analyzed in the present chapter is the climate change focus in adaptation.

The present study was developed in two comunas of the city of Santiago: Maipú and Providencia (Fig. 23).

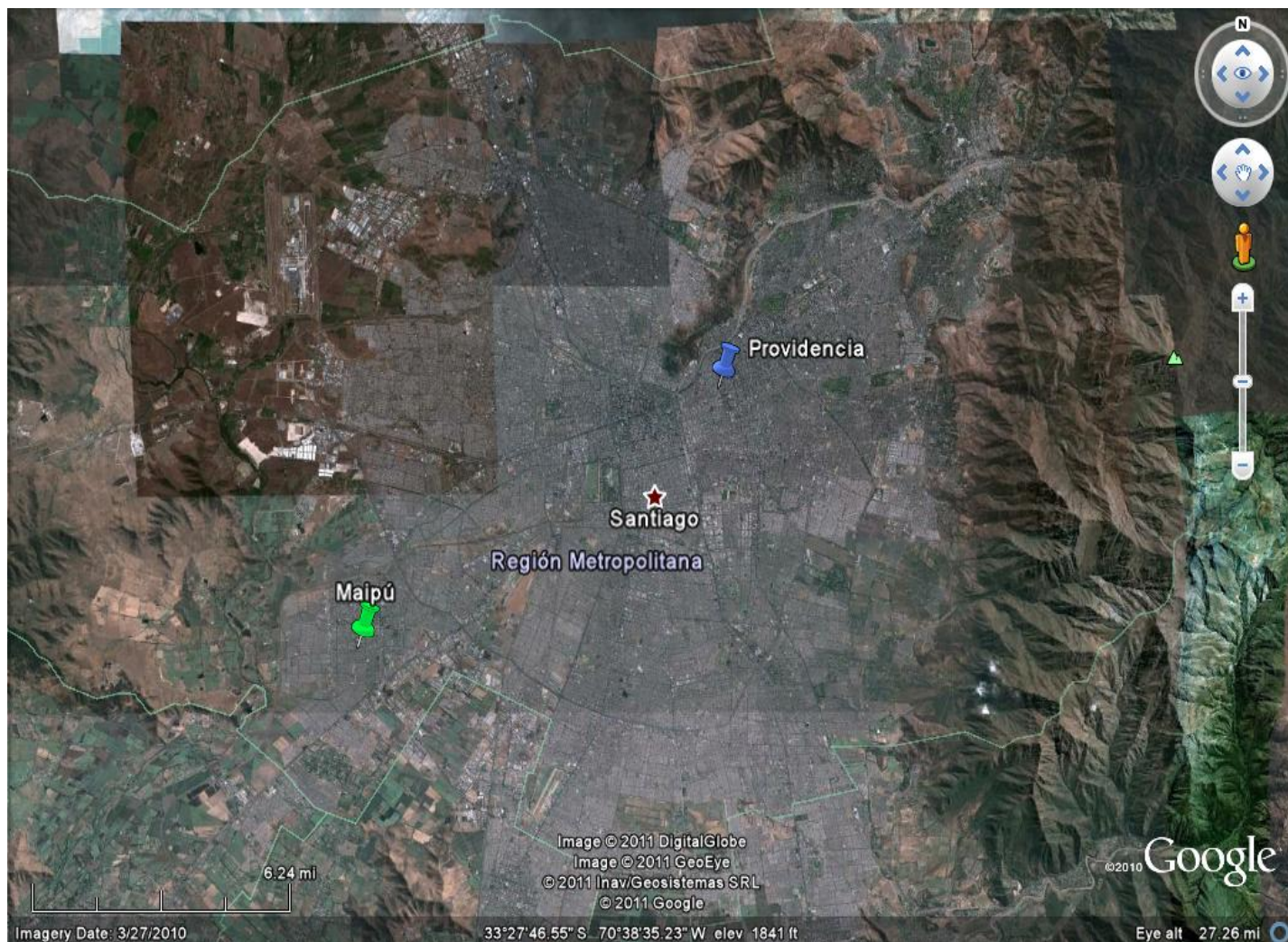


Figure 23. Geographical location of the study comunas in the Metropolitan Region of Santiago

These were chose because of the differences and contrasts on socioeconomic characteristics, level of education, size and location (Table 7).

Table 7. Differences and contrasts of the comunas of study

Comunas	Socioeconomic characteristics				Size (hab)	Density (hab/Km <sup>2</sup> )	Green areas (km <sup>2</sup> )	Location
	Income <sup>1</sup> (ADIMARK) <sup>2</sup>	Population in poverty <sup>3</sup> conditions (%)	Level of education (ADIMARK)	Basic services <sup>4</sup>				
<b>Maipú</b>	\$ 500.000 to \$ 1.200.000	9,06	C2/C3 (School complete or Technicians)	Water, electricity and gas: 100 % cover Telephone: 81,73%	698.732	8874,4	2,24	Southwest part of Santiago
<b>Providencia</b>	\$ 600.000 to \$ 3.500.000 or more	3,5	ABC1/C2 (Technicians or University complete)	Water, electricity and gas: 100 % cover Telephone: 91,31 %	125.584	5092,8	0,73	North east of Santiago

1. \$ = Chilean pesos by father of family.
2. ADIMARK is an institution that estimates the socioeconomic levels in Chile.
3. Poverty in this case means that a person possesses income under the sufficient minimum to satisfy his own basic needs.
4. In the case of gas is important to mention that in Providencia they use more natural gas (71,75 %) and in Maipú more liquid gas (91,76). [www.observatoriorurbano.cl](http://www.observatoriorurbano.cl)

These characteristics are important at the moment to take decisions to construct and apply the climate adaptation measures with population. If people are not conscious of the problem, if they are not well informed and they do not feel affected by climate change is more difficult to invest economically in actions. The socioeconomic aspects help to understand which are the priorities of people from comunas according to their necessities. If it is required to apply certain facilities to adapt better the measures. The size and location were also analyzed to develop strategies according the characteristics of the zone and how many people are affected and needed certain incentives to apply actions.

About the use of energy in comunas of Maipú and Providencia, it is possible to define differences, analyzing the data of CASEN 2006. These are in function of number of people, energy sources and consumption habits (Table 8).

Table 8. Energy data in comunas of Maipú and Providencia (CASEN, 2006)

	Total population hab	Total kWh/ per capita	Total kg firewood/ per capita	Total m <sup>3</sup> gas/per capita	Total kg gas cylinders/per capita
<b>Maipú</b>	698.732	0,062	1,89	0,0051	0,033
<b>Providencia</b>	120.874	0,31	0,001	0,0252	0,043

Now, it is presented a general description of every of them.

## 5.1 Comuna of Maipú

The comuna of Maipú belongs administratively to the Santiago Province and it is situated in the southwest part of the city. Its main economical activity was the agriculture in the past (around ten years ago), however with the fast population grow in Santiago, this turned to a residential place, creating commercial and services areas.

It borders the north with the comuna Pudahuel, the Estación Central by the northeast, Cerrillos with the east, San Bernardo by the southeast and Padre Hurtado by the south (Fig. 24). It is 450 m in altitude. It has a surface of 137, 2 km<sup>2</sup>. From this total; 55, 7 km<sup>2</sup> are in the urban area and 81, 5 km<sup>2</sup> are in the rural area.

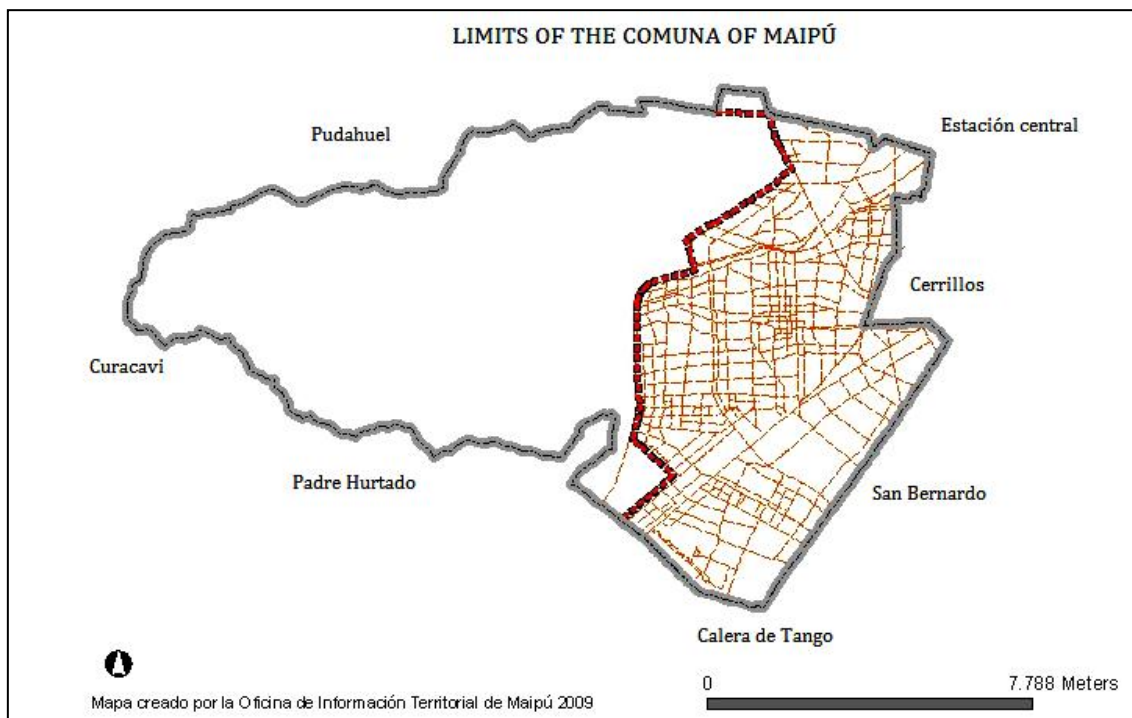


Figure 24. Limits of the comuna of Maipú ([www.maipu.cl](http://www.maipu.cl))

The principal characteristic that distinguish Maipú from the rest comunas of the Metropolitan Region of Santiago is its extense territory, where the part that is not urbanize is occupied by green areas which constituted the doors for the coast winds of the Basin Santiago. Maipú has an estimated population at 2009, according to the National Institute of Statistics of Chile (INE) of 698. 732 hab, it is the second largest comuna in the Region. It is divided in 27 neighborhood units.

For the better organization, every comuna in Santiago designs his own Plan de Desarrollo Comunal (PLADECO). This is an instrument to develop the planning and assessment of the comuna for a period of time. It allows proposing and evaluating concrete actions for the integral development of the comuna. These basic lines of work were developed in Maipú for the 2009 to 2012, to use it as an instrument of territorial planning updated to answers the current conditions, population needs and growth. It has five strategies to work:

- Axis on April 5 - Sector civic center: the modification is orientated to strengthen cultural and historical aspects of the comuna.
- Modification Pajaritos axis: The modification is orientated to promote vocations around underground Maipú, with a more modern, rapid and functional vision.
- To generate zones or zoning of major housing density: to make possible the incorporation of population that can postulate to solidary funds.
- Sectional Plans: this document will be elaborated to detail the road tracings that nowadays are function and that do not coincide with the regulatory communal Plan, concerning many lands.
- Adjustments and incorporation of regulation according to the SEREMI-MINVU<sup>19</sup>.

## 5.2 Comuna of Providencia

The comuna of Providencia belongs also to the Santiago Province and it is situated in the northeast of Santiago. Its main activities are the commercial, financial and services providers that articulates around Providencia and 11 de Septiembre Avenue. This Avenue is the prolongation of the principal axis of the city, the Libertador Bernardo O'Higgins.

It limits in the northern part with the line of summit of the Hill San Cristóbal, in the eastern part from his river mouth until the river Mapocho up to the street Eliecer Parada. In the southern part, the limit goes from Pedro Lautaro Ferrer crosses the streets Eliecer Parada, Jaime Guzmán E., Archbishop Fuenzalida, Diagonal Orientates, Manuel Montt, Rengo, José Manuel Infante, Caupolicán and Malaquías Concha, up to Vicuna Mackenna and finally in the western part with the Avenues Vicuna Mackenna, Pío Nono up to his intersection with the street Dominica, a straight line up to the summit of the Hill San Cristóbal (Fig. 25).

It is 597 m in altitude. It occupies an approximate extension of 14,2 km<sup>2</sup>. Of these, 12,50 km<sup>2</sup> correspond to urban areas and 1,70 km<sup>2</sup> is part of the hill San Cristóbal. At the same time, the urban area is composed of 8,60 km<sup>2</sup> of particular lands; 3,01 km<sup>2</sup> of streets and 0,73 km<sup>2</sup> of green areas and river. It has a population according to the INE of 126. 016 hab. It is divided in 13 neighborhood units.

Its PLADECO focus on the unification of 13 sectors of development: education, health, ancients, youths, sports and recreation, culture, community development, territorial classification, justice, municipal management, traffic, civil security, communal emergencies; towards 6 areas of development to realize in a period of 6 years from 2006 to 2012 (PLADECO Providencia, 2009).

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<sup>19</sup> SEREMI-MINVU: They are Government secretaries, which are in charge of making concrete the national policies of housing and urbanism in its territorial area, for which realizes activities of planning, programming, evaluation, control and promotion of this politics. See [www.seremi13minvu.cl](http://www.seremi13minvu.cl) (18.04.2011).



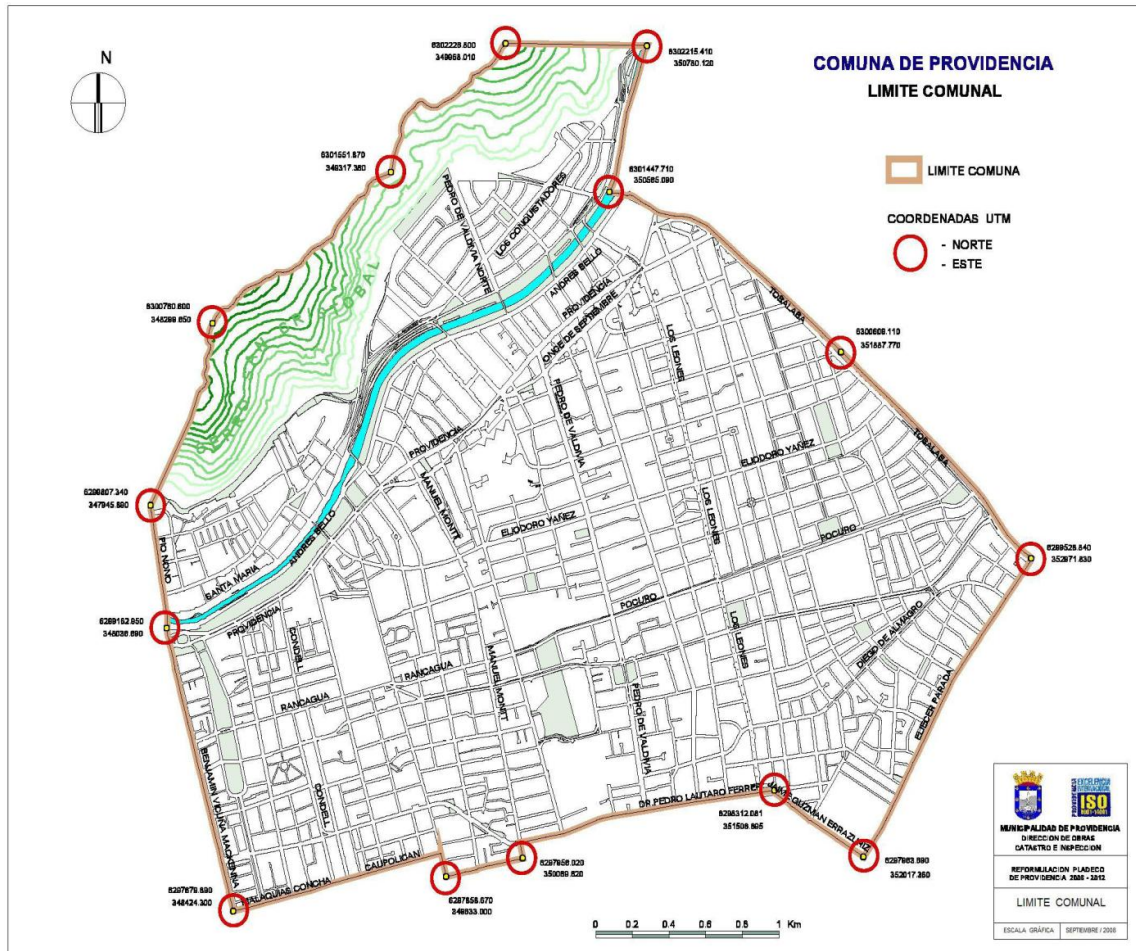


Figure 25. Limits of the comuna of Providencia (PLADECO Providencia, 2009)

These areas of development are the following:

- Area of territorial management: It focuses in the harmonic and equitable development between the communal space and the social actors.
- Area of economic development: Looks for the promotion and capacities development of services and goods for the comuna, development of new business and initiatives that involve the public and private sector.
- Area of social development: Takes account all the aspects related with the improvement of life conditions of population.
- Area of environmental management: Focus in the sustainable development of the comuna.
- Area of civil security: Looks for the protection of goods, the care of the personal integrity and life quality.

### 5.3 Diagnosis in the two comunas

The diagnosis focused in the area of climate change from the energy governance in which was important to evaluate in people that participated in this study the level of education, awareness and participation respect to climate change, the energy habits related with the practice of energy efficiency to evaluate the adaptive capacity of the comunas in energy.

As a result of the diagnosis, was determined in both Municipalities the lack of projects specifically in climate change promoting by authorities. They support this as the change of Government and the lack of integral planning. As a consequence, people and projects sometimes are changed, do not have continuity and are defined by the new interests of the current Mayor and his collaborators.

*Often the vision of the new Mayor not necessarily is the environmental topic; as a consequence he does not designate so many resources and is centralized in his topics of interest.*

*Christian Bravo  
Coordinator of Environmental division  
of Providencia Municipality*

The results of the questionnaires made in both comuna, show that the totality of people who took part, know in a general way what it is the climate change problem and the impacts which they more perceive in their localities are presented in Fig. 26:

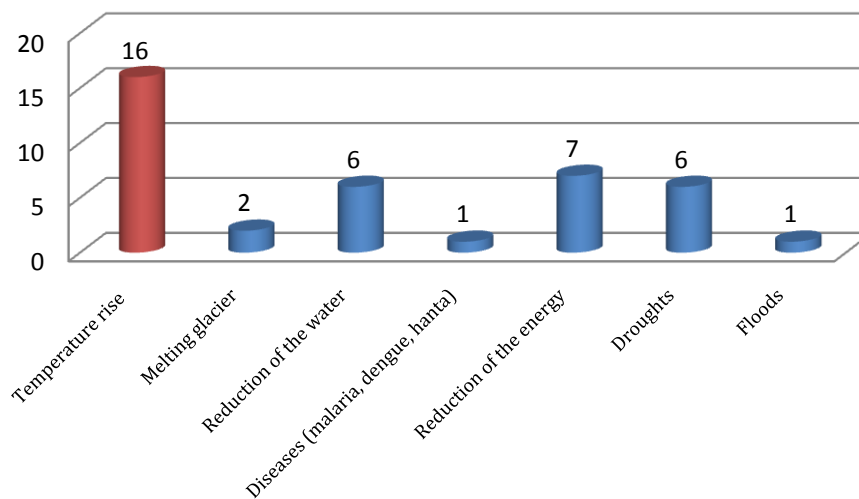


Figure 26. Different climate change impacts perceive from people of comunas Maipú and Providencia

In addition, a 100 % of people interviewed feel the duty to support actions and adaptation against the climate change because they think it is a way to prevent damages, they feel responsible for the changes and impacts that are happening but sometimes they do not know how to do it. Besides, they want to avoid more pollution and diseases.

Specifically in the comunas started some initiatives related with this topic to low the emissions and also important actions from the neighbors. All of them will be described.

### 5.3.1 Maipú

Maipú is a comuna that grew fast in the last 20 years in population and urbanization. However, this growing brought at the same time environmental problems such as atmospheric, water and acoustic contamination, conventional managing of solid and industrial residues, problems of congestion in the transport, pressure on green areas due the construction demand, producing a series of environmental conflicts. Likewise,

the low environmental education, the trend of consumption habits was affecting the life quality of the inhabitants of this comuna.

Specifically to analyze and know closely certain energy consumption habits and knowledge in citizens of Maipú, was realized questionnaires destined for young and adults. The results show the following behavior:

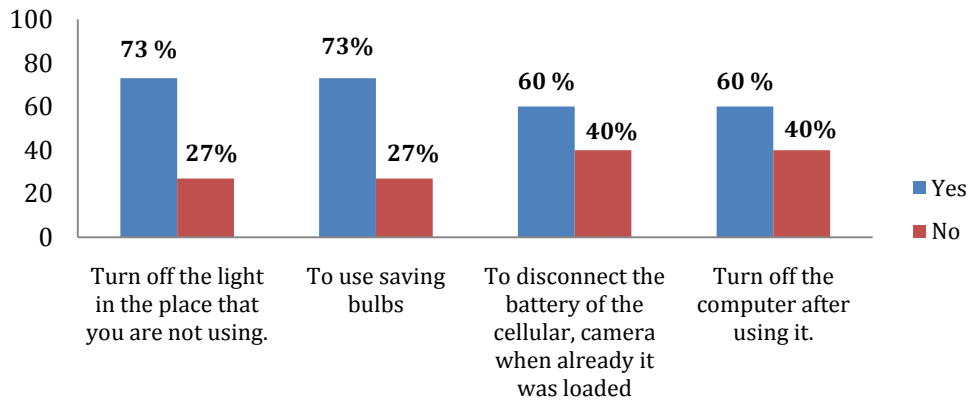


Figure 27. Percentage of energy habits in adults of Maipú

The energy consumption habits in adults of Maipú show important positive percentage specially utilizing saving bulbs and saving energy turning off the light in places that they are not using. A lower amount, 60 %, is happening in habits of disconnecting certain electronic devices. The same behavior is shown by the use of computer. Actually, there are campaigns to improve energy habits, made especially by Chilectra, however must be complemented with other activities in order to increase the level of awareness in people.

Now is presented the results for young people (Fig. 28). The numbers show higher percentages in every energy habit comparing with adults which is a good answer because it means at the same time that the level of environmental education and awareness is growing in young population of Maipú and it is also an advantage because most of the people that lives in this comuna are young people according to the INE data.

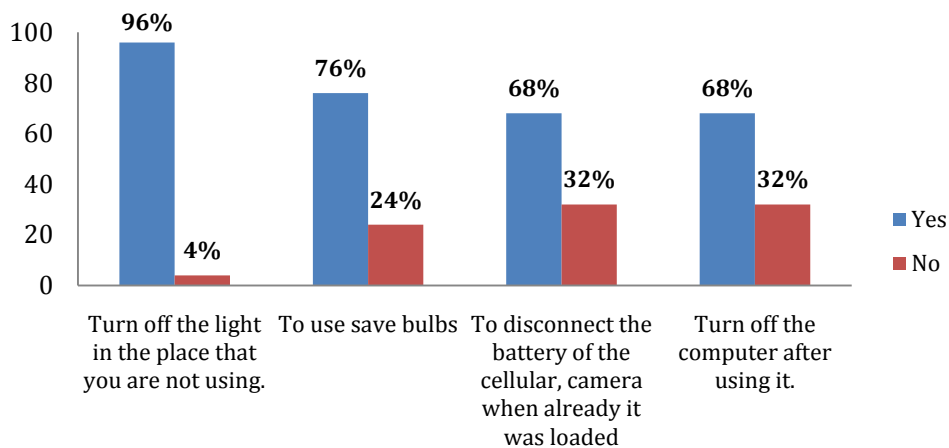


Figure 28. Percentage of energy habits in young people of Maipú

Turning the light in places where they are not using show good results for young population, the use of saving bulbs also have an important percentage. And for good use of electronic devices the positive percentage is a bite lower, 68 %, but it is an important amount that must be encouraged. In addition, through the questionnaires was analyzed the principal type of transport that people from Maipú usually use. This was asked with the objective to assess the emissions per capita related with transport, being this area one of the main producers in Santiago (Fig. 29).

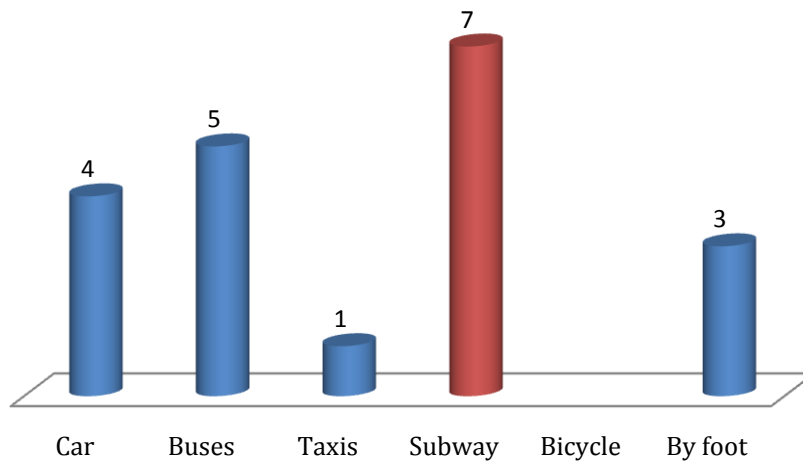


Figure 29. Number of adults that use different types of transport service

As the Fig. 29 shows the subway is used with more frequency by adults. It is an advantage if the emissions amount is considered, comparing with other services. According to studies made in the United States, Bradley (2007), to compare the contribution of CO<sub>2</sub> to certain transportation modes, the one that less contributes is the subway (177 CO<sub>2</sub> g/pass-mi), then transit bus (299 CO<sub>2</sub> g/pass-mi) and car ( 371 CO<sub>2</sub> g/pass-mi).

On the other hand, the arrive of Transantiago<sup>20</sup> to Maipú approximately three months ago provided the opportunity to connect this comuna with the center of the city and to make horizontal rides, however there are much expectancy in users that these service can improve in the future in less cost and time of rides.

If we observe now the behavior of young people in Maipú, there is a difference of transport used. Car and buses are mainly preferred, and these can be associated to the cost and times spending with cars depending the hours of the day.

<sup>20</sup> New transport system in Santiago constituted by subway and buses.

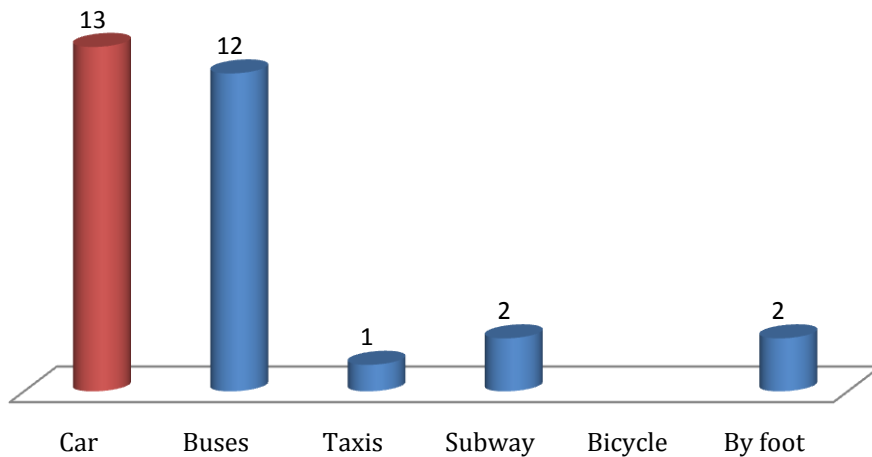


Figure 30. Number of young people that use different types of transport service

On the other side, it is important to mention that bicycle it is not an option of transport, either for adults or young people. Unfortunately, most of the young people affirm that the use of bicycle in Maipú is very dangerous there is not respect between cars, bikes and pedestrians. There are not good bicycle routes or they are in bad conditions. The distances are long. Municipal authorities have to work to improve these conditions.

People are not motivated to use bicycle that is why most of them do not have it, they are in bad condition and as they do not use they do not repair. Another important assumption through the questionnaires is that young people are not interest because they do not see bikes as a transport, they perceive more as a hobby or to make exercise so they answered that they do not have time to do it. These results are presented in Fig. 31.

*“I do not use bicycle because it is very dangerous it should improve the bike routes and the respect towards the cyclists”.*

*“It is insecure, the laws of traffic are not respected”.*

*Young people from Maipú*

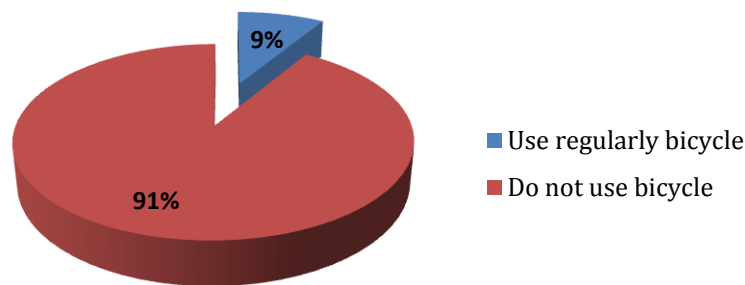


Figure 31. Number of young people that use bicycles in some occasions

Another point that was evaluated through questionnaires was the will and the economical capacity of people from Maipú to accede to renewable energies (solar panel and concentrators). Most of the people answered very motivated to participate with this action because they consider the actual energy expensive and they think it is a good

opportunity to avoid economic expenses. They also think is a good step to low the emissions, change habits in the future and prevent possible climate effects. Some mention that is necessary the support of Government through economical incentives because it is a change where both population and authorities must participate.

*“Besides lowing the emissions to the environment, there are money savings”  
“It helps to clean the atmosphere and is more economic in a long-term”*

*Two neighbors from Maipú talking about renewable energies*

On the other hand, people recognize the potential of the country in renewable energy so they expect authorities can increase the participation of these clean energies in the actual energy matrix to low costs in future. The results are showed in the following graph (Fig. 32).

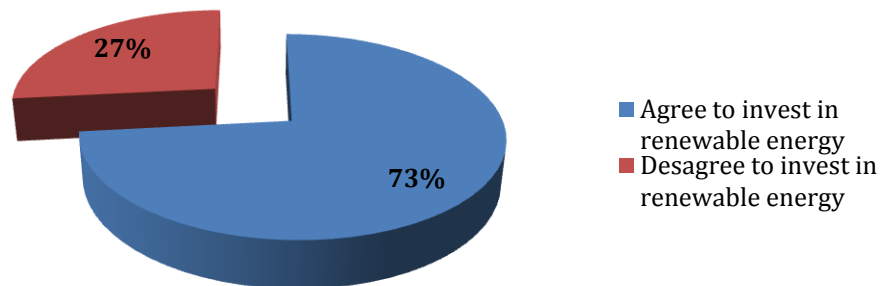


Figure 32. Position of people of Maipú to invest in renewable energies

73 % of people from Maipú agree to invest in renewable energies. On the other hand, people that disagree are mainly because of the lack of economical resources. After having analyzed some habits in the energetic consumption of the adult population and young people in Maipú, it will be described the activities and initiatives that authorities from the Environmental division are developing to lower the emissions against the climate change and motive the change of behavior that it was analyzed previously.

With the creation of the Environmental Ministry last year, also was started the division of Environment to work and focus more specifically in this area. Its work is guided by the PLADECO and the Environmental Politic<sup>21</sup>. Talking about projects of the Municipality, their major obstacle is the lack of economical resources to invest in actions and also the interests of the Mayor in function. However, authorities are showing will in general. His main efforts are traduce in the following initiatives:

- Provide population with certain number of saving bulbs.
- The construction of social houses with solar panels or solar concentrators for people with low incomes in the comuna.

<sup>21</sup> It is a key instrument that allows establishing foundations and principles to make an environmental municipal management.

- Awareness campaigns to conserve and give good use to the resources such as water and energy.
- They have a pilot project to work in energy efficiency in public buildings of the comuna called Consultorio Municipal, Consistorial building and a school. With this project authorities want to diminish energy consumption measuring certain criterias, making studies in the construction materials, characteristics of the windows, number of the windows, walls, floors and ceilings, with this information they have been done modeling to determine after, where are the energy lost and see how was possible to isolate.
- They have environmental workshops to share knowledge with neighbors in recycling garbage and create new things.

At the moment, these are the actions to face climate change in Maipú, manage by the Municipality authorities but they are motivated to continue working in awareness campaigns developing simultaneously work lines of major incidence, otherwise there are not big change especially in people behavior and education.

*We want to attack the basic problem. For the present, we are focusing on changing habits and in activities that makes people think in the basic problem which is our **model of consumption**. This chain of consumption, exploit the resources in an unlimited way, using one by one the resources until finishing. This is altering the balances of the nature and later the nature will look to get in equilibrium again by itself, and this not necessarily will make a good for humans. That is why people must create **awareness**.*

*Yovanka de Negri  
Coordinator of Environmental sub-division of Maipú Municipality*

Maipú is also a comuna that has an important quality, the level of organization of the neighbors. These are organized in groups called Neighbors association. They are social organizations without profit purposes with strict respect to religious and political freedom where the neighbors organize because of the problems that take place in the neighborhood. It is aim is to inform to the Municipality the needs of the neighborhood and present offers and projects in order that they could carry out and improve the quality of life of the citizens. They inform to other neighbors the benefits of the Municipality as scholarships, workshops for the young people and elders. They have a President, Secretary and Treasurer.

Actually, the majority of these associations are active and after the dictatorship<sup>22</sup> of past Government (Augusto Pinochet) their work grew more because they had much freedom of communication. During the study, it was important to visit the Villa 4 Álamos in Maipú because this association started the first project called Eco-neighborhoods in Chile and has a lot positive impacts in the environment as well as high level of social participation.

<sup>22</sup> The Dictatorship of Augusto Pinochet took place in Chile from 1973 to 1990. With this kind of political action the organizations disappeared or went down its actions, the discouragement was in many populations of the country.

### Villa 4 Álamos an example for climate adaptation measure

The Neighbors association 4 Álamos was born in 2003, due to the environmental conflict given between the Municipality and the community (Fig. 33).



Figure 33. Environmental conflict due to the deforestation of the green area (Marquéz, 2011)  
 a),d) neighbors complaining and defending the trees. b) In the moment of cutting the trees. c) After devastating the green area

The Mayor of that time, Mr. Roberto Sepúlveda ordered to take control of the green area and to fell down the trees of the local park to construct a school. The neighbors tell that the old people were the most affected for that decision. They fought to defend the park because it was their space to have recreation, to rest especially sick people with asthma. They used to go out to breathe fresh air. In spite of these benefits, nothing stopped the Mayor who gave the orders to the police officers to detain people who was doing manifestations and who were opposite to the actions to the construction. There were cut 119 trees of the 120 that existed and only one survived, a Ceibo (*Erythrina umbrosa*) in which there were tied several adult neighbors to avoid the cut of the tree. From this fact, the neighbors association 4 Álamos was reactivated, this helped local people to know each other and join more because they fought for the same aim, to defend the natural resources. It also motivated the creation of the ecological education Center "El Ceibo", a demonstrative center of renewable energies, the Club of ancient people and the folklore group called "Los zorzales" to remember the trees that were in the park.



After the loss of the park, people from comuna demanded the action of the Municipality and in compensation was donated 4.900 m<sup>2</sup> of green areas. The suffering created an environmental conscience in the community and as a result, it started the first econeighborhood of Chile. In this project collaborated many people among them the young Luis Marquéz who stimulated neighbors in continuing with the green fight across concrete actions. And also the comuna received the help of a university student of the career of Ecology and Landscaping who realized her thesis and designed the eco-neighborhood.

*“The conflict was very sad because it was a place with a lot of biodiversity. There were many species of birds and while the trees were felling down we saw also the nests fall down. It was really painful”*

*Neighbor from 4 Álamos*

With the time, the neighbors were organizing better and they achieved the construction of a “SEDE”<sup>23</sup> with the help and mutual collaboration. They defined themselves a quota, every neighbor contributed with materials (bricks, cement, etc) and Luis Márquez collaborated very much to look for international financial help. People of Norway visited them and they gave them courses and also people from the SEDE went to Norway to receive training from this country. As a result, it was formed the first eco-neighborhood of Chile that is not a sum of squares, it is a community that lives in a city and freely organizes, is a model of environmental management who looks for the improvement of the quality of life of their inhabitants integrating the social well-being and the environment across practices and spatial interventions. It is based on a participative and active community that strengthens their human relations and commitments with the care and respect of the environment. The following works were realized:

- **The Arboretum:** It is a botanical garden that possesses: more than 150 trees of 35 species and an indeterminate number of native shrubs identified taxonomically, from Copiapó to Concepcion. This is important because it helps to preserve the species of the country, they need less water and it helps to educate population that pass for the place. Educational signs were designed with the necessary scientific information.
- **The square of the fruit trees:** They are trees that are supported by the same neighbors. The idea of cultivating fruit trees was because when they will give fruit, people of the Villa will be able to use them as a help, due its low production, for the food supply or in some cases of necessities. This considering also the low economical resources from people that live there. Then all the neighbors who take care have the right to take fruits for their own consumption.
- **The garden of medicinal herbs:** It was initiated with the aim of recover the knowledge of the grandparents, local ancestors and indigenous people to return to use the medicinal herbs. In this place, also each neighbor can take the plants for his daily consumption. In addition, the neighbors were acquiring knowledge of the benefits and curative properties of every plant.

<sup>23</sup> SEDE is the place where the neighbors make usually their meetings and activities.

- **Ronald Wood's mural:** This mural was created with the help of all the neighbors in honor of the young Ronald Wood who belonged to the neighborhood and was murdered by a military patrol in the year 1986 receiving 3 shots in the head.



Figure 34. Works made in the eco-neighborhood of Villa 4 Álamos (Márquez, 2011).  
a) The Arboretum b) The Square of fruit trees c) Garden of medicinal herbs d) Ronald Woods mural

Hereby the first eco-neighborhood works in Maipú with a high social participation, where the neighbors are motivated to take care and realizing different activities. The Villa 4 Álamos changed its face; before it was an insecure site where the free spaces were occupied by drug addicts, dust-bins, now the people take care, clean, the children play, run and learn, in spite of the loss of the park.

*“With the eco-neighborhood went down the number of people with problems of drugs, alcohol because the association is active, the media came, the police monitor more, then these people have gone away.”*

*Ricardo Acuña  
President of the Neighbors Association from 4 Álamos*

The next challenges of the eco-neighborhood is to illuminate with alternative energies the green areas of the Villa, to do a system to recycle gray waters of some departments and reuse them to irrigate the parks, to continue with the task of the environmental education with campaigns and workshops of energetic saving, taken care of the water.

They want to have an ecological point for the separation of the garbage (tins, glasses, plastic, paper, batteries and cellular) for recycling and reusing. Nowadays, they began with the separation of the organic residues, the neighbors little by little take the organic garbage to the SEDE and with it, they do holes in the land to turn it into compost.

### 5.3.2 Providencia

Providencia due its location, close to the center of Santiago city, has mainly air and acoustic pollution. In order to define certain energy habits in this comuna, questionnaires were also applied to some neighbors. The results (Fig. 35) show a very high level in the habits of use saving bulbs, turning off the light and electronic devices. In the case of disconnecting the battery of some electronics such as the cellular and camera got just 50 %. Finally, in turning off the computer it is necessary to continue working. In general, people from Providencia show a high level of education. However, must be encouraged by Municipality in specific habits to increase the awareness.

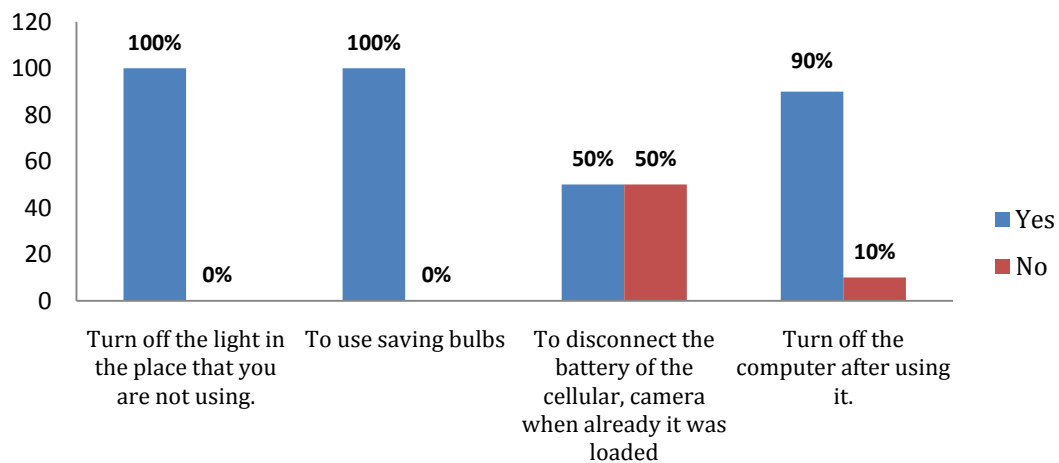


Figure 35. Energy habits in people from Providencia

On the other hand, people that participated in questionnaires were very conscious in the position of invest in renewable energies. The 100 % are motivated because they consider it is a good opportunity to save money in the future, they want to increase the life of natural resources, lower the emissions and take care of the environment.

On the other side, it is presented the use of different types of transport by people of this comuna and the results show a preference for the use of car follow by subway. This can be associated once again to the position of the comuna and the high level of economic resources which facilities the accessibility to this kind of transports. Authorities also mention that this is a comuna that have an especial characteristic: the presence of floating population receiving every day around 700.000 hab, between them students that commonly go to study but not live there.

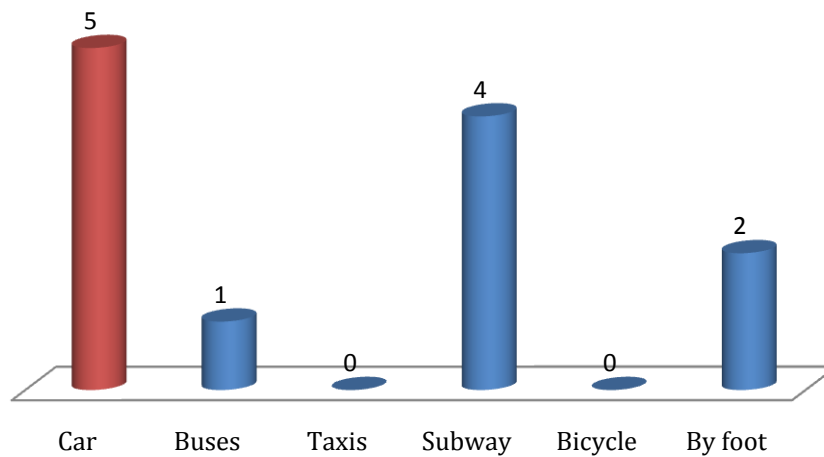


Figure 36. Number of people from Providencia that use different types of transport service

Now, it will be described the actions that Providencia Municipality is developing in order to educate people, low the emissions and pollution. The projects are not directly design for climate change or renewable energies. However, it will be mention the projects that are more related with the topic as an integral part. The projects are the following:

- **Parks and integrated squares:** It consists of structuring the diverse avenues and streets, in which will be plant in a coherent form trees, keeping their road roles and will be connecting as a totality the diverse squares, parks and neighborhoods construction as an important part of recreation the paths and bicycle routes.

The aim of this urban project is to generate an improvement of the public space, the health of the people and to promote the healthy life, besides a change in the habits of transport of the inhabitants of the city of Santiago, helping in the change of mentality, valuing the not motorized alternatives to transport as an sustainable option to move inside the city.

The project of the Integrated Parks Circuit is divided in 14 sections that by its characteristics is planned and constructed in an independent form and therefore to constitute stages in the general development of the project, which would be implemented in conformity to the priorities of the Municipality. This project is being developed since 1997 and already 5 circuits having been realized.

- **System of public bicycles:** It allows delivering a service to the resident and user of the comuna, of a new clean and sustainable system of transport for the movement inside the comuna across the borrowing of bicycles destined to the public in general. It focused in the first stage to urban cyclists who use the bicycle routes of Pocuro and Antonio Varas<sup>24</sup>, contemplated a growth in the time towards other areas where it will exist infrastructure for cyclists. The system considers an inscription of 1.000 PCL<sup>25</sup> monthly, or a membership of 8.000 PCL

<sup>24</sup> Places from the comuna Providencia.

<sup>25</sup> PCL means pesos chilenos, the Chilean currency.

per year. The bicycle routes possess more than 10 km located in different points of Providencia. It has 15 stations and 150 bicycles for borrowing.

- **Environmental Education:** Forty courses and educational activities were realized to the Educational Establishments linked directly to the environmental subject matter taking part actively about 1.600 person between students, teachers and parents, in addition, the schools were stimulated and supported to take part actively in the National System of Environmental Certification of Educational Establishments (SNCAE) achieving the certification of 3 schools.



Figure 37. System of bicycles and routes in comuna Providencia (Author)

These are the actual projects developed by the Environmental Department of Providencia, to help the reduction of emissions and mainly to inculcate education and awareness in people. According to the authorities, this year they pretend to open more to the population to know better their necessities and work with them.

In the topic of the neighbor's organization, Providencia also possesses its own association that is divided in 16 territorial Units and has actually two active groups. The neighbors association is a useful tool and it was born with the initiative of the Fray Montalva in the decade of 60s, destined specially to the women of the house. Its objectives are to promote the development of the comuna, defend its interests and rights and to collaborate with the comuna and regional authorities to improve the quality of life of the neighbors.

The association of Providencia as the Villa 4 Álamos joined more in order to protect squares, green areas, in opposition to the urbanization. An example is the case of the Antonio Varas square where there were many neighbors movements due authorities wanted to remove the palms to construct an underground parking. Due this fact, people objected.

In the past, this comuna was known as a garden because it had squares and private areas, but with the urban growth the authorities were devastating the trees of the east sector for the building construction of 14, 12 floors. Other problems detailed by the President of Neighbors was that often authorities after realizing constructions want to create green spaces but without arboreal species, therefore it does not replace the complete function of the trees. On the other hand, there are initiatives to separate and recycle the garbage and last year were implemented 80 areas of composting in the comuna, with the support of the Municipality.

*“It is necessary to still working in the environmental education, the level is low, people are not conscious of the environmental problems, there is no commitment.”*

*María Josefa Razuriz  
President of the Neighbors Association from  
Providencia*

#### **5.4. The weakness in social participation**

The social participation is a key instrument to incorporate population needs in the projects development, to define common agreements between actors, to develop efficiently the public policies in a joint work. Through the social participation, the citizenship exercises their right to give their voice and vote in the public matters reducing the gap among authorities and population.

In the context of climate change and in the specific case of the adaptation measures, it is a crucial topic because the citizenship is the one who must take part actively. Their decisions are fundamental in the moment to invest, to support changes of habits, active assistance in awareness campaigns, being informed and being educated. If people are not conscious of the problem they are living, it is more difficult that they could support changes and most if in those intervening economic efforts. That is why authorities must offer the necessary mechanisms to work together with population in the necessary strategies of action.

In the case of Chile, civil participation is the expression of the extension and the deepening of the democratic system (Navarrete, 2010). This conception is related to the dictatorship epoch of this country, which avoided civil associations to grow and have free expression, now that system is changing. After dictatorship time, took a lot of work to take out people to the streets and to take part in participatory activities. That is why; participation must re-arise towards a democratic system which reflects the incorporation of the needs, voice of the citizenship in projects, improving the quality of life of the population. It is necessary the creation of other channels of participation to take account the opinions, ideas and ways of thinking of people. Authorities must not conform just to the vote of the citizen.

The current situation of the participation in comunas of study reflects that there are spaces of consultation. Nevertheless, these opinions are not binding, they do not materialize. According to Municipal authorities, the citizen takes part only with their vote and do not intervene in the PLADECO. On the other side, neighbors association describe that projects realized by them, related with their necessities, several times were not taking into account or supported by authorities, rather are forgotten, the projects execution are chosen by other criterias.

In agreement to the realized questionnaires, the majority of people in Maipú do not participate. This is because there are not mechanisms to make civil participation binding with decisions in Municipality. They have their own opinion; however, they think these do not have weight against the decisions of the Government. On the other hand, citizens of active participation mentioned they feel supported by authorities because when they attend to the comuna and complain, they receive answers.

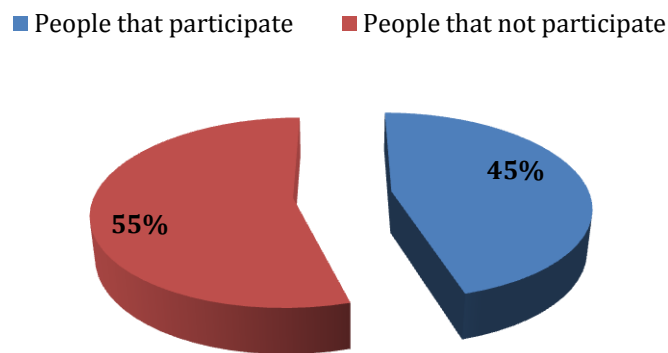


Figure 38. Level of civil participation in the comuna of Maipú

For its part, Maipú Municipality manages awareness campaigns in resources conservation and the assistance in these activities are described now:

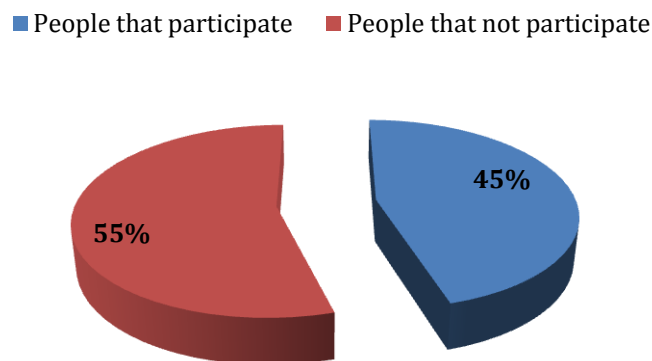


Figure 39. Level of civil participation in environmental campaigns of Maipú

It is possible to notice persistence in the lack of participation in awareness campaigns; many neighbors mention that these campaigns are not well informed, not effective. For their part, people who assist, do it because they want to avoid the long-term effects,

improve the cleanliness of their comuna and it is a way of taking care of the environment. Likewise, it was analyze the participation of the young people in environmental activities and the results showed a big nonchalance, the participation is very low and they associate to that lack of environmental groups, they do not have time and because they are not informed.

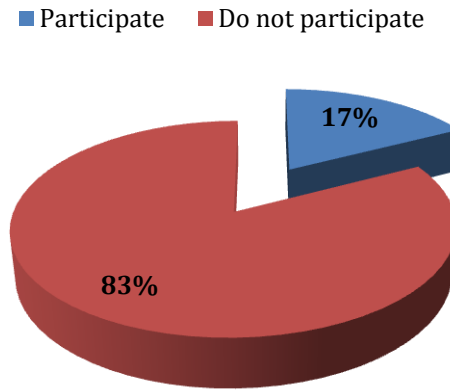


Figure 40. Level of civil participation of young people in environmental campaigns of Maipú

This behavior in the citizenship, demonstrates that there must be realized activities of major incident and interest. The information and transmission of knowledge is important, across mass media and environmental education in schools, colleges, educational institutions which should give emphasis to the possible impacts that can be given in the country, so people can be realized they are vulnerable to this problem. With regard to the assistance to environmental groups, participation does not exist; it is assumed that there are not programs of this type or the complete lack of interest.

In the case of Providencia, the situation is not very different, exists 50 % of the population who shows active participation and another part is not motivated due to the fact that they think authorities are not interested in their opinions and there is not a good organization. Unfortunately, the small participation that exists is not binding in the processes and making of decisions with local municipalities as well. The neighbors affirm that Government allows the access to information but this does not mean participation, for a real participation many political will is needed.

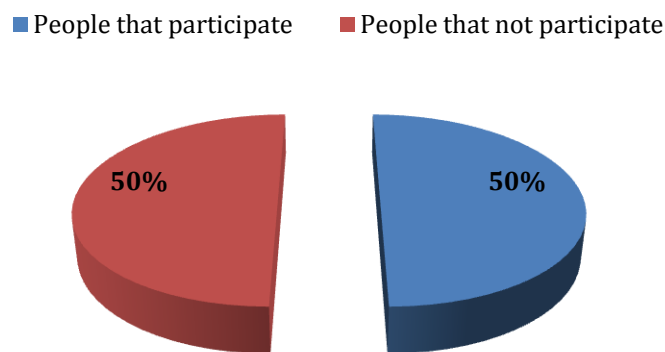


Figure 41. Level of civil participation in the comuna of Providencia



The communication still is not very fluid between authorities and population, it is necessary to work more. The only participatory mechanism is across the vote, however, there was created in Providencia Municipality, the Office of attention to the neighbor who has facilitated the communication. Suggestions, claims, congratulations are received by telephone and e-mail. In this way, Providencia Municipality is attending the neighbor in the minor possible time or up to a maximum of 20 days depending on the request.

Respect to the awareness campaigns of natural resources conservation, there is more support showing an important percentage (Fig. 42) and it is reflected in the streets of Providencia, especially with the cleanliness and the garbage recycling.

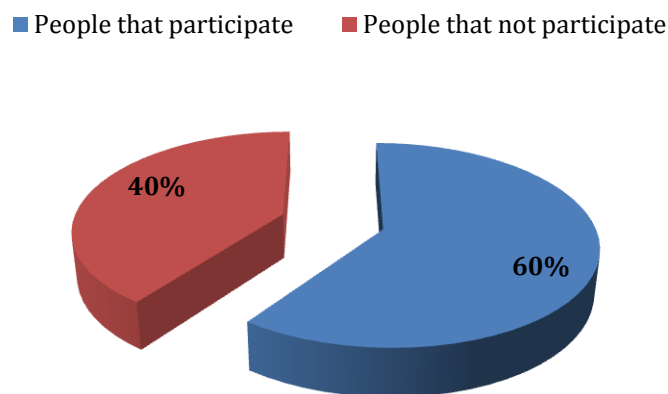


Figure 42. Level of civil participation in environmental campaigns of Providencia

## 5.5 Potential impacts of climate adaptation measures application in the comunas

As it was described along the entire chapter, the adaptation to climate change in the city of Santiago and specifically in the comunas of study show their first steps. There are not yet defined the adaptation measures. It is in process to develop through CAS project and their different partners. However, in the present state is possible to make a theoretical analysis of the potential impacts in people from comunas. These impacts will be determined taking into account environmental, economic and social criterias.

### 5.5.1 Environmental impacts

The environmental aspect is very important to pay attention because their impacts do not just affect the local level, the scale of pollution does not have limits. Focus on energy, different sectors mainly transport and energy generators produce the increase of emissions, however, production per capita is growing due the consumption model and not effective environmental education. The principal environmental problem, both in Maipú and Providencia is the atmospheric pollution due these emissions.

Future adaptation measures can provide better quality of air to live if Municipalities motive people in the sustainable use of other types of transport such as bicycles, by foot. Talking about large distances is evident that this is not a practical solution especially for

people that has to transport long distances every day, however could help the improvement of Transantiago. If subway and buses give better service (on time, cost, comfort, security, creation of new lines and environmental friendly) more people could take the option to use it, instead of taking normally a particular car. The maintenance of cars is also essential; this control must be done regularly by Municipalities to reduce the toxic emissions that cause health problems in population and pollution.

Another positive impact against climate change is the use of bicycle routes, actually being developed in Providencia and a challenge for Maipú. This provides people an opportunity to reduce pollution, to make exercises, traffic and low stress. This must be complementing with education courses to incentive respect between pedestrian, cyclist and drivers to avoid accidents. In addition, the construction of better routes with the respective signs is necessary, especially in Maipú where this project is not so developed.

Other impact of adaptation to climate change is the improvement of environmental education and increasing awareness. As a result, it brings in the energy sector, the efficiency use of electronics devices in houses; changing the consumption habits, lowering costs in a long term. In this action is taking part, Chilectra and also Municipalities.

If Government takes the decision of apply decentralized renewable energies in houses, this could provide better energy security for the city, considering that it is predicted a reduction of hydroelectric power. And also this could be a big contribution in the reduction of emissions and electricity costs in a long term. Population in both comunas showed a large support to this change, because they are conscious of the pollution that brings thermoelectric plants and also the expensive costs of other fuels such as gas because of the imports. However, at the beginning it is necessary to support trough economical incentives especially in Maipú that has lower economical incomes comparing with Providencia. According to previous results from CAS project, they are planning to provide energy in the future installing solar power in the roofs of the buildings, there will be the use of biowaste from the households for producing energy. To compensate the lack of the water from the glaciers, it will be more importation of energy from the north (solar power) and the south (windmills). It will consider also the insulation of buildings to protect them from the growing heat in summer. Finally, it is planned for 2020 also the production of wave energy. These strategies undoubtedly will increase the energy security in population and will reduce the emissions in a long term, improving air conditions to live.

### **5.5.2 Economic impacts**

The economic aspect is crucial at the moment to apply adaptation measures. This determines a series of impacts because not all the population has the same economical condition, even more in the cases of Maipú and Providencia where the economic differences defined the accessibility to implement actions and to prioritize the environmental topic in neighbors. The inversion is vital because prevention is less expensive instead of not taking any measures.

Providencia is a comuna composed by people classified<sup>26</sup> under economical level in ABC1 and C2 that means they have incomes over the media in Santiago. This allows people from this comuna to access to other alternatives fuels, if technology changes to establish new sources of energy. In the case of Maipú, the majority correspond to a classification of C3. This can mean obstacles in the possibility to access to new source of energy that is why they demand to authorities to work together with population through incentives to reach this objective. In a long term, for both comunas the use of renewable energies brings environmental and economical advantages representing savings in the future. It is important to mention that is necessary to make an economical study to determine precisely which the specifics amounts are. These can also help to promote these types of technologies in a local level.

The use of sustainable transport demands economical inversion by the Municipalities in order to create routes for bicycles. In the case of Transantiago, still is looking to improve the new system and lowering costs to provide better service.

### **5.5.3 Social impacts**

The social impacts can be reflected by the improvement of the level of education respect to the problem of climate change. People from comunas could transform in an active part of the transition of technologies if is the case in the future. The increase of awareness in families is an important impact with the change of habits in the better use of energy, efficiency. If people are conscious of the problem, implementation and inversion of measures facilitates.

The social participation in the making decisions is another positive impact because allows the construction of democracy and the inclusion of necessities. If the adaptation measures take account positions, opinions, requirements of population; the implementation will have better acceptance and results. If this communication is fluid and transparent, is expected to have good politics supported by population. As a summary is presented the specific potential impacts in the comunas of study classified in the respective areas of analysis:

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<sup>26</sup> This classification was made by ADIMARK an institution that realized market research and public opinion. They determined the socioeconomic level in houses of Chile based on statistical information.

Table 9. Potential impacts in comunas of study focus in environmental, economical and social criterias (Author)

Comunas	Potential impacts		
	Environmental	Economical	Social
<b>Maipú</b>	<ul style="list-style-type: none"> <li>- Less emissions due the improvement of the public transport Transantiago and maintenance of particular cars.</li> <li>- Less air pollution.</li> <li>- Less traffic.</li> <li>- Less consumption of energy due the efficiency use of electronics devices in houses.</li> <li>- Better conservation of natural resources.</li> <li>- Increase energy security.</li> </ul>	<ul style="list-style-type: none"> <li>- Inversion in infrastructure, bicycles routes by Municipalities.</li> <li>- Lowering costs in a long term because of the change of habits.</li> <li>- Economical saving in a long term because of the use of renewable energy.</li> <li>- Inversion to apply measures in houses with decentralized renewable energies (solar, biowaste, insulation in buildings).</li> <li>- To facilitate transfer of technology in this comuna is necessary to apply a program of incentives.</li> </ul>	<ul style="list-style-type: none"> <li>- Improvement of environmental education.</li> <li>- Higher level of awareness to climate change.</li> <li>- Growing the social participation, due the better organization of neighbors.</li> <li>- Improve communication between authorities and population.</li> <li>- Less stress as a consequence of less cars and better system of transport.</li> <li>- Improvement of the quality of life especially health due the less emissions.</li> <li>- Changing the consumption habits.</li> </ul>
<b>Providencia</b>	<ul style="list-style-type: none"> <li>- Less air pollution.</li> <li>- Convert in an example comuna for the actual sustainable use of transport (bicycles).</li> <li>- Less traffic.</li> <li>- Less acoustic pollution.</li> <li>- Better conservation of green areas.</li> <li>- Increase energy security.</li> </ul>	<ul style="list-style-type: none"> <li>- Inversion to complete the bicycle routes and provide more bicycles to people.</li> <li>- Economical saving in a long term because of the use of renewable energy.</li> <li>- Inversion to apply measures in houses with decentralized renewable energies (solar, biowaste, insulation in buildings).</li> <li>- Less obstacles to invest and prioritize in environmental technologies due its better economical incomes.</li> </ul>	<ul style="list-style-type: none"> <li>- Improvement of the respect between pedestrian, drivers and cyclists.</li> <li>- Growing of environmental education and awareness of climate change in people.</li> <li>- Less accidents.</li> <li>- Improve the organization of neighbors in the comuna.</li> </ul>

## 6. DISCUSSION

The previous stages from the research gave the following outcomes:

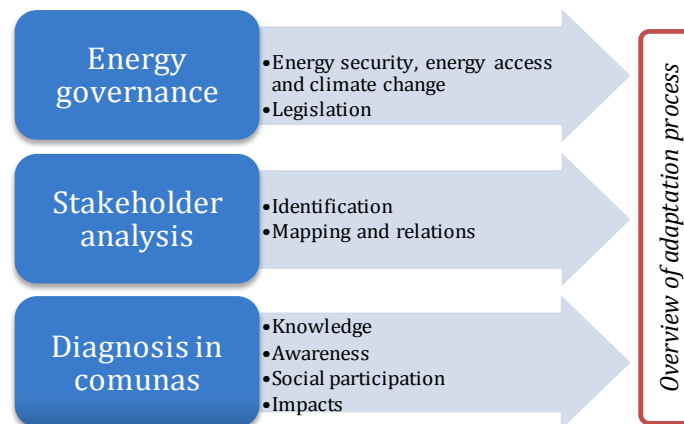


Figure 43. Outcomes of the study

These results show an overview and constitute an important part of the present process of adaptation from top to bottom. The scale was taking into account as well in the analysis, given major emphasis in the comunas of Maipú and Providencia through the diagnosis. Every of these outcomes will discuss now supported by theory.

### 6.1 Multilevel energy governance

The analysis of the energy governance in the present study was realized taking account the scale that means from a national, regional and local stage. The level consideration is important because the energy governance usually has been seen more in a global level. In the case of Chile, there is still existing the typical vision of the institutions that work in a sectorial way, separated one to the others. Organizations work isolated without forgetting that in a national level is observed an institutional development, practice by the functions and administration of their different dependences of Government and the aims that they prosecute are to assure the energetic future, energy efficiency and centers of investigation of alternative energies. Nevertheless, if the scale descends the organization and work of governance loose force. In a regional level, there are the SEREMIS fulfilling their functions in the macrozones. However, in a local stage, the case of study of Maipú and Providencia do not present specific directions to assume roles. This undoubtedly is a sample of lack of governance in smaller scales, integration absence in planning and execution of projects, links of interaction between actors across levels which in a long term can cause a lack of energetic sustainable future. In the governance was also reviewed the laws and decrees established by Government to regulate climate change and renewable energies. However, they do not show a further development and they are mainly focus on the new creation of Ministries, introduction of application of renewable energies especially geothermal, solar systems and the procedures to fulfill international commitments of climate change. There are not politics specifically for adaptation. On the other hand, some laws such as 20.257 present irregularities in its fines which must be adequate to improve the introduction of these new technologies.

Based on the discussion of Goldthau (2011) that determines the energy governance as a complex system where its areas of action: energy security, energy access and climate change, must complement and interact providing access of energy to the citizenship, assuring the energetic security to the nation and minimizing the effects of the energy systems in the environment, was analyzed the Chilean case focus in these areas from national to local.



Figure 44. Conflicts in Chile due the Hydroaysen project

The results determined the energy access as the area with fewer conflicts. This is because the Government across the private sector works to satisfy the demands of the users in a high and important percentage, despite the high costs which can attribute to the lack of fossil energetic resources and the constant import of them which raise the prices considerably. Nevertheless, if the assessment takes the systematic vision, this area can be directly affected by the decrease of the water, principal source that feeds the hydroelectric plants in the center of the country where is located Santiago and the major quantity of Chilean population. The water decrease in a long term will be due to the impacts of the area of climate change, part of the energy governance and will also generate another serious environmental impacts such as the decrease of rainfalls and the temperature elevation. In this scene, comes the energy security handled by the National Government that looks for energy alternatives for the future. Its present actions means the approval of projects in the north of the country to produce energy through thermoelectric plants and in the south of Chile the Hydroaysen project based in hydroelectric plants. These decisions have caused conflicts and manifestations against by the citizens because it concerns the emission production, the environmental pollution, ecosystems modification, necessity of living the zone by people that lives near to the these areas.

These conflicts show again the lack of interaction and relation of the areas of energy governance in order to satisfy the demands and the well-being of population with options that could provide a better future. On the other hand, with the selection of the already mentioned energies by the Government, the investment in renewable energies that possess Chile are postponed even having a big potential in solar, geothermal, wind and wave power and whose development could generate a significant technological advance for the country.

One alternative to respond with this complexity based on Cash *et al.* (2006) is the flow of information, knowledge and the multistakeholder participation vertical and horizontal, in the Government institutions, citizenship, public and private sector; to integrate and develop regulation, programs and governance of energy services across levels. And also the interaction between areas to avoid future energy and environmental problems, contradictions to the Government decisions by population.

## 6.2 Multilevel stakeholder relations

Through the identification and stakeholder analysis realized in chapter 4, it is possible to discuss in a general way how the main actors are relating in the adaptation process for the present case of study. Government actors are developing strategies in a national level through the Action Plan 2008–2012. In a regional stage project CAS, NGOs, Universities are acting involving different stakeholders from the public and private sector. Nevertheless, adaptation needs a more local approach where undoubtedly the protagonists must be the Municipalities and population. In this respect Maipú and Providencia show a large weakness. The Municipal authorities should work as a bridge between citizens, the regional and national Government. They should improve the communication with both key actors. On the other hand, citizenship represented by the Neighbors Associations have not narrow links due to the last environmental conflicts and because population believe their opinions, voices, projects most of the time are not taking into account.

According to Edmundo Claro (2008) the public sector, Parliament, academics, private sector and social organizations have a preponderant role to play. The State must lead these initiatives and be capable of involving the rest of the actors, looking for coincidences and common approximations to all of them. This must result in a vision with regard to the coherent and integrated national adaptation, which marks clear routes, lasting in time, so it could be stable not matter the changes of Government. In this respect, the national Government in Chile is in the obligation to create spaces where the different key actors could interrelated and construct actions that answer with the minimization of impacts, analysis of economic aspects that often needs incentives and regulations which direct the initiatives such as the case of Maipú where not all the people are in the conditions to invest in the environmental topic because other priorities exist.

On the other side, taking the results of the comunas diagnosis, exposed in chapter 5, the population participation is low, mainly in young people in Maipú. This disinterest owes to the lack of awareness over the problem and the lack of education which are important in the moment to apply measures. Therefore, the principal actors in a regional and local level are not being an active part of the process. The private sector Chilectra and the NGOs are working in awareness campaigns to create good habits in population such as the well use of electronic devices, energy efficiency in houses, the use of sustainable ways of transport like the bicycle. The universities cooperate as a source of information in the evaluation and prediction of impacts. All this cooperation is vital, however once again, the work of the main stakeholders are separated and without common aims. The involvement of the actors is urgent to strength the process through the application of good governance and democracy. It is relevant to change the behavior of the citizenships from passive interactions to self mobilization by education programs and diffusion of information through media. This contribute to motivate, engage and increase awareness in people respect to the future effects and they could initiate the projects in a local scale joint to the local authorities such as the case 4 Álamos in Maipú where the good organization of the neighbors must be an example for the rest of comunas and can bring benefits, growing confidence, reducing vulnerabilities and building step by step the adaptive capacity.

In this respect, having analyzed the relations between stakeholders and defining the participation as a vital key to engage and involve people in the process. The analysis comes now to the principles of participation, the way stakeholders are practicing them in the adaptation development:

- *Access to information:* it is not complete open by the central Government to minor scales, mainly in a local level. There is not also a fluid exchange of information between local authorities and citizenship. It hopes to improve with the new Environmental divisions creation.
- *Transparency:* there is not a developed veracity and clarity to announce new projects that is why there are the actual conflicts and manifestations against the last decisions for energy production. The binding forms are few to integrate stakeholder's positions to the public programs.
- *Equity:* as decision-making most of the time is centralized by the Government, other stakeholders such as population, Neighbors association do not have the same opportunities to participate.
- *Not exclusion:* not all the key stakeholders are taking part of the process; all the efforts are centralized in a national and regional level. However in a regional scale, through the CAS project are trying to integrate most of the actors in the construction of adaptation measures.
- *Respect for the diversity:* as the process does not have a high level of participation mainly in Maipú, the different positions, interests and perceptions from all stakeholders are difficult to gather and apply to the project.
- *Willfulness:* this principle goes join to the awareness in people. If population is conscious of the problem, they are going to have more will to full fill measures and participate actively.

### **6.3 Preconditions for efficient adaptation measures implementation**

The results found along the study show the necessity to establish some conditions before implementing measures in the comunas of study. It is urgent to consider that exist the following weakness:

- Few conscious of the problem.
- The competences for the project development on climate change in a local level are insufficient.
- Do not exist a specific budget destined for this area.
- The plans of national action are orientated to fulfill more international commitments and not local.

On the other hand, if a satisfactory response is wished in the majority of the citizenship, it is necessary to consider a previous application of incident programs of environmental education, massive utilization of mass media for the diffusion of impacts that they are exposed. This will contribute to develop awareness and involve people to the problem. As well as, to guide population by authorities on the form they can contribute. Many citizens express their good intentions to help but they do not know how to do it. Also many times there are will in population but they are not well informed or do not possess economic resources. That is why Government must destine a necessary budget for the specific development of awareness projects in climate change. In addition, is a



priority the incorporation of personnel in the environmental Municipal divisions to work specifically in this area.

Contrasting the present case of study with the process defined by Penny and Wiedtz (2007) in the conceptual framework, it is possible to understand up to now, that Chilean actions are more determined by the evaluations of impacts and studies. The awareness and involvement of the actors in the case of the comunas show a low interest in population that took part of the questionnaires and even least a priority for authorities because there are not concrete actions for adaptation in local level. Nevertheless, the planning takes their first steps in regional scale thanks to the different initiated projects such as the case of the CAS, NGOs and some neighbors associations as the 4 Álamos that looks for the education and undertake works in the neighborhoods.

A good alternative to improve the adaptation in the future, with more positive effects in population is the integration of actions against climate change in the PLADECO of the Municipalities. This might contribute to accomplish strategies in the planning. Hereby, it might come easier to the citizenship and inclusive destine economic resources to establish awareness programs, develop decentralized technology and the generation of major human capacity in Municipalities. These can be applied following the Plan of Municipal adaptation designed by Mukheibir and Ziervogel (2007) which have a major local contribution and takes into account not just environmental aspects also socioeconomic to develop measures.

#### **6.4 Adaptive capacity of Maipú**

Remembering that the adaptation to climate change needs a local approach where the natural and human systems must adjust to the new conditions or effects, the first focus is Maipú, where the results of the diagnosis gives a tendency of the adaptive capacity of this comuna.

In spite of the fact that the topic of climate change was approached in Chile from the 90s through the participation in the different worldwide conferences, the work focused more in the area of mitigation to expire with these agreements. It is from the accomplishment of the Action plan 2008-2012 that the adaptation takes place in the Ministerial level, nevertheless do not exist fluency of communication and strategies towards minor levels. It is possible to assume that it owes to the recent organization, definition of environmental authorities and functions of agreement to the law 20.417 that created departments and defined in the Municipalities who would be in charge of developing actions. This Environmental division was established last year in Maipú and its plans and projects have other environmental approaches because they subject to the decisions and interests of the actual Municipal Mayor. This is undoubtedly a lack of integration in the planning according to the national aims and a little local approach to construct adaptation measures. However, a major incorporation of personnel specifically for this area is planned for the future.

Based on the energetic topic, there was analyzed the practice of the energy habits which showed a considerable development. The results showed good levels in young people which reflect a better preparation in this sector of the population through the schools,

mass media and families that provide knowledge. The education must be a priority for the Municipality supported by the private sector Chilectra, with the investment of economic resources destined to activities of great incident as education programs, periodic campaigns well informed to neighbors, use of mass media massive, creation of environmental groups in order to promote constant awareness in young and convert them in multiply leaders of education and example. The local adaptation needs undoubtedly the technical part but a better application of measures is obtained in a population who has major level of education and engages with the solutions of the problem.

The transport is one of the sectors of major contribution of emissions in Santiago, according to the studies and Environment policy of Maipú (2008) that is why the behavior of population was necessary to determine in this comuna. In adults, thanks to the arrival of the subway it converted in the principal way of mobility, which contributes to the reduction of emission for being an electrical system. In the case of young people, they use particularly cars and Transantiago buses, due to the cost and the considerable distances that must travel every day, therefore it is more rapid to realize it hereby. Unfortunately, they are more pollutant systems, which generate major emissions, traffic and accidents. In spite of it, the only use of one type of transport would not supply with the demands of the population of Maipú for its large size and location that demands to move long distances. Because of it, the public transport should be optimized to motivate the major use instead of cars; providing safety, accessible prices and an efficient service. Also other types of transport such as bicycles as an alternative to buffer the pollution in the initial use of short distances, until Municipality could construct infrastructure, programs of vial education to motivate the use and creation of respect between cyclists, drivers and pedestrians, installation of public bicycles in zones of the comuna. Another option in this area would be the control of the condition of motorized from the public and private transport by local authorities to reduce toxic emissions produced in the combustion of fuels mainly diesel. The maintenance of the motorized systems according to studies of Bickel from Swisscontact (2001) low the risks to produce toxic gases that affect the human health<sup>27</sup> and environment. In Santiago, there are around of 200 centers of vehicular revision, so this has to be an active part of the measures to reduce emissions. The new public transport Transantiago that arrived to Maipú represents an opportunity to offer better services and to use fuels more friendly with the environment because the Department of Energy is trying to implement the use of biofuels in the buses of Transantiago to diminish the air pollution.

Continuing with the technical part, the electricity use in houses will be affected in Santiago, according to the climate change studies described in the previous chapter, where the hydroelectric plants will reduce the energy production because of the lack of water in a long term. For this reason, it is needed to provide alternatives to population to assure the access to electricity in the future. A good option is to start studies to determine the feasibility to install decentralized systems of renewable energies due the large potential of Chile. Good alternatives could be solar panels and concentrators in houses. The response of the actors to this measure was positive in the major part of the population of Maipú that participate in the questionnaires. Nevertheless, due to the

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<sup>27</sup> The high levels of emissions especially of carbon monoxide and free hydrocarbons from cars provoke respiratory, pulmonary, cardiovascular and cerebral diseases, being the children and elders who more suffer the consequences.

socioeconomic conditions of this comuna not often the environmental topic is the center of the needs, the citizenship demands to the Municipality the support across the creation of incentives. People recognized that it will be a good investment for a long-term because economical savings will be comparing with the actual situation that must pay considerable sums due to the import of energetic resources. This future measure should be a shared responsibility of authorities and citizenship to assure in the future the access and the energy security of the comuna. The Municipality, by its way, could invest in renewable energies for public buildings, hospitals, public schools between others.

Analyzing the topic of the social participation as a democratic tool to link the needs of adaptation and the support of the population of Maipú in the construction and implementation of new measures. The results show a low involvement of the actors especially of young people. The reasons are different: lack of interest and confidence in authorities because there are not binding mechanisms that include their opinions and needs in projects. Likewise, the activities that are realized are not well informed and do not have a great incident. Therefore, the creation of consulting spaces is suggested in the Municipality, where the population could take part not only in the decision to apply measures but also in the construction. There must exist a constant feedback of the information and decisions that authorities are taking across different mass media to give the opportunity to people to analyze the new policies and avoid the constant social conflicts due to the impositive measures that Government takes.

To conclude the Maipú analysis, it is necessary to emphasize that this is a comuna with a high level of local organization, which must be valued and exploit for the construction of local adaptation measures. The neighbors association might be centers of diffusion of information and knowledge decentralized for the development and construction of actions by the citizenship. The case of Villa 4 Álamos it is an example of this organization. Its contribution and work is relevant because between the neighbors are created a joint awareness, environmental education among children, young, adults and ancient people, conservation and care of natural resources. As a consequence, these citizens will be conscious of the impacts that climate change can cause and the application of measures will facilitate because they are informed neighbors and aware of the effects. Analyzing specifically their current tasks, they contribute to the care of green areas in the cities buffering the emissions and contributing to the sustainable development because not only work for environmental benefits but also for social like increasing local education, major civil participation, develop of cultural activities and improvement of security in the zone.

The assessment of the different points shows that the adaptive capacity of Maipú must be encourage in a joint work of the key stakeholders and with more effective actions and programs that could strength the comuna to the effects to climate change in the future.

### **6.5 Adaptive capacity of Providencia**

In the case of Providencia comuna, the creation of the Environmental division was also since the instauration of 20.417 law, fulfilling its functions from the year 2010. The

results show that projects of Providencia are not linked also to the national plans to face impacts of climate change. This demonstrates again the lack of integral planning in different scales.

Analyzing the energy habits in population, a high level of education is observed and this owes to the work of the environmental authorities destining economic resources to increase the good practices in schools principally. These efforts must be complemented with the diffusion of information and knowledge across mass media to decrease their consumption model which raised the electricity use.

In the topic of transport, the major utilization are cars and subway. This is because of the central location of the comuna and the presence of commercial and public institutions which generate a large floating population that day after day frequent the comuna due to work, visit or study. As a result, air and acoustic pollution exist in Providencia. Nevertheless, as a measure of response to these environmental problems is developing the project of parks and squares integration and the public system of bicycles, these are programs of importance to reduce the traffic, the emissions and to offer transport alternatives to the citizenship, more friendly with the environment. It is necessary to emphasize that an important development exists in the bicycle routes, however the respect between cyclists, drivers and pedestrians should also develop across programs of education to diminish the number of accidents.

The acceptance in the decentralization of renewable energies systems as a measure of adaptation to climate change was a great reception by population who consider this an important option for the economic saving and decrease of emission to the atmosphere. In the case of Providencia, due its better economic levels, the availability to this new technology is larger, so Municipal authorities must take as an advantage to invest with the neighbors in new technologies and assure in a long term the power supply for the comuna.

Finally, the topic of civil participation shows a division in the population that took part of this study. The neighbors who do not show involvement is due the fact that there are not binding forms to integrate to the PLADECO. In spite of it, the Municipality created spaces of suggestions and claims, which it is not an element that takes accounts the needs in direct projects, but in somehow the voice of the citizen in Providencia comes to the authorities. On the other hand, the participation in educational topics and campaigns of environmental awareness are acceptable and supported because the neighbors believe that it is a direct way of being careful and keeping their comuna clean. Undoubtedly, it is necessary to create channels of integration to the PLADECO, the principal management instrument of the Municipality, where the requirements of the citizens must be the impulse for new projects.

In the case of Providencia, the adaptive capacity presents more strength in education and economic aspects to invest in measures, however, the better economical conditions produced in this comuna a higher consumption which affect in the more use of electricity, according to the data collected. This situation must be taking into account carefully in the campaigns of awareness.

## **6.6 Potential impacts and comparison of the two comunas**

The results from the potential impacts evaluation showed a serie of effects more positive for the categories of environment and social for the two comunas. This represents a strengthening in the future to face effects of climate change. On the other side, to reach positive impacts in the economical aspect will be necessary the support of Government, private sector and population, otherwise the implementation can convert an obstacle due to the lack of resources. This can be achieved if there is for example the application of incentives, credits during the transition of technology, mainly for the citizenships that do not have a high level of incomes.

Nevertheless, at this moment it is an interest to contrast the strengths and weaknesses that each comuna possess, to show what they can learn from each other and face the better way the impacts caused by climate change. In this respect, the effort and support of the principal actors involved will be needed to diminish the negative impacts with the most viable options, as well as to maximize the utilization of the positive impacts that could arise.

One of the principal strengths of the comuna of Providencia is its level of education which facilitates the implementation of measures of adaptation because people are conscious to the probable effects that they are exposed. In this respect, Maipú does not remain behind, the education is developing but it is an opportunity to take the example of Providencia to realize major campaigns of awareness and educational courses in every level. On the other hand, it is important to analyze that Providencia in spite of its good level of education it has five times more the electricity consumption per capita comparing with Maipú which can mean that its better economical condition made them more consumers.

The organization of the neighbors in Maipú must be an example for Providencia because hereby it is possible to decentralize actions, share information, uses as a bridge between authorities and citizenship. Therefore, it is needed to reactivate the neighbors association of Providencia and to use them as binding tools of participation where the citizens could intervene with their needs, priorities; decisions among others, in the moment of apply measures. Continuing with the topic of social participation inside the process of measures construction, it might take advantage of the spaces created in the Municipality of Providencia to involve more the citizenship; in this respect Maipú must develop these mechanisms where the Municipality plays an important role. And both comunas are called to open not just spaces of consulting, spaces of involvement and active social participation are needed specifically for the topic of climate change, which results could be an important part to develop strategies for the PLADECO.

The public system of bicycles and the integration of parks of Providencia is an important project because it offers a sustainable option of mobilization reducing the pollution in the environment, traffic and improvement of the health across the exercise. In this way, Maipú has an example to improve its bicycle roads infrastructure and to undertake efforts, because it possesses more green spaces due its physical location comparing with Providencia which is an opportunity to value the landscapes of this comuna.

The eco-neighborhoods are a good initiative in Maipú not only for Providencia, also for the whole Metropolitan Region of Santiago where a high degree of involvement and organization of the neighbors is observed. They prosecute the improvement of their environmental education, the care of green areas, their constant training and search of sustainable development, their next challenge is the application of renewable energies in the zone. Following these actions, it is possible to motivate this project also in Providencia and expand step by step the environmental awareness, the forestation and care of green areas in citizens that buffer with the air pollution principally in the comunas.

Respect to the technical topics, in agreement to the preliminary results of the project CAS, it propose the development of renewable energies in building ceilings that for the infrastructure of the Providencia comuna applies satisfactory in public and private buildings. Besides, there are the local neighbor's support in this measure for the economic and environmental advantages that offers. In the case of Maipú, given more its residential condition, it might take again the project of construct social houses with thermal isolation as was realized in previous years. To facilitate the implementation especially in Maipú, due its large population and lower incomes comparing with Providencia, it is necessary to stimulate in the planning, the definition of subsidies and incentives to promote more this technology. It is vital to show to the consumers of electricity that this system turns them into producers of electricity and they deliver their surpluses to the public network of supply, discounting in their bills the cost of generation, therefore they pay to the distributor only the amount they consume.

Another measure of adaptation is the production of renewable energy through the garbage produced in the comunas. In the case of Maipú, it is a viable alternative being in this zone the center of collection and treatment of solid residues of the whole city of Santiago, which offers an opportunity of better managing and utilization of this garbage as raw material to provide future energy and in Providence to still inculcate the separation to value the residues.

## 7. CONCLUSIONS AND RECOMMENDATIONS

### 7.1 Conclusions

The study evaluated the governance of the energy sector through a multilevel stakeholder analysis in two comunas of Santiago de Chile, according to the stated objectives; the following conclusions can be drawn:

- The evaluation of the energy governance allowed having a general vision of the three areas that constitute it: the access to the energy, the energy security and the climate change. For the mentioned evaluation, it was taking into account the national (Chile), regional (Santiago) and local scales (Maipú and Providencia Municipalities). In the particular case of Chile, there is still lacking a close relation and interaction between these levels, a more integrative multilevel planning of strategies is required.
- A review to the legislation of energy governance determined the existing regulation and the institutional (governmental) setup regarding climate change and renewable energies. As a result, a lack of public specific policies that promote the adaptation can be stated.
- The stakeholder analysis defined the actors who play active part in the current process, showed conflicts and agreements between them and also determined who should have a major role in participation. Government and population are undoubtedly the veto players because without their intervention the successful construction of adaptation measures, especially on local level, is not possible. Supporting this process are Neighbors associations, Universities, IPCC, NGOs and the private sector (namely Chilectra). Cooperation is observed between the international institutions as the IPCC, the universities (University of Chile, Pontificate Catholic University of Chile), the project CAS with the National Government. In addition, the actions of Government are decentralized to other levels. However, the multilevel interaction with the Municipalities does not show a fluid communication and at the same time these local authorities do not possess a narrow relation with the local Neighbors association for past environmental conflicts.
- Regarding climate change, a closer diagnosis in the comunas of study allowed a more local approximation and evaluation of the current state of the adaptation process to climate change, specifically in regards to the energy use. As a result, it should be mention that Chile undertook the first steps in the adaptation since the National Plan 2008-2012. However, specific measures still have not materialized on a local level. Due to the lack of integration in the project planning stage which pursue different aims from top to down. This situation could improve with the implementation of the new law 20.417 that allowed for the creation of environmental institutions and defined their competences and functions in every level.

- Regarding the process of local adaptation: the level of education, knowledge, socioeconomic information and the social participation in the population were studied. This indicates a general knowledge in the subject of climate change in both comunas, a higher level of education in Providencia comparing with Maipú concerning energy habits and a considerable weakness in the social participation in both comunas. The latter deficit is attributed to a lack of binding procedures where the needs of the citizens become effective in the management tools, such as the PLADECO in Municipalities.
- In Maipú and Providencia comunas, no specific actions in the area of climate change are performed on local level. However, the projects that are realized in the Environmental divisions of the Municipalities can contribute in the decrease of emission such as the case of the public bicycles system in Providencia or the energy efficiency in public buildings of Maipú. Likewise, the particular case of Villa 4 Álamos from Maipú served as an important example of adaptation for other comunas of Santiago due to its local approach, the presence of good local organization forms, the education in conservation of natural resources and the diffusion of knowledge in renewable energies.
- From the preliminary work of the CAS project and the evaluation in the comunas, the potential impacts of the future implementation of adaptation measures were analyzed. These focused in the environmental, economic and social categories. In the majority, the defined impacts are positives especially in their environmental and social aspects. For the economic issue, an initial investment is needed and must be supported through e.g. a system of incentives by the National authorities.
- Working in a local level with two comunas, different in their socioeconomic aspects, level of education, location, green areas and size; allowed to compare their adaptive capacity.

## **7.2 About the methodology**

- The methodology of the stakeholder analysis allowed to have a general vision of the different actors (primary, secondary and key stakeholders), and to define the relations of cooperation and conflict that intervene in the process of adaptation. The methodology explains clearly the steps to follow by the researcher in the construction of the blocks. Due its flexibility it was possible to select the specific blocks of analysis for the present study that is why the focus was on the two first ones.
- To obtain better results it is necessary to adjust the method in every case of study especially during the definition of the core functions where a critical analysis is needed.
- The tools to compile information helped to have a close approximation with the social actors during the fieldwork. These methods were participative especially the interviews that achieved a direct contact with the actors involved in the



study. For the size of the comunas the questionnaires were used, which contributed to the fast compilation of data. The life histories helped in the best comprehension of conflicts, differences and cooperation produced in the comunas between the population, authorities and NGOs. Finally, the observation and direct participation in activities of the comunas contributed to develop trust and confidence between actors and researcher for the best collection of information. In Maipú this aspect was reached satisfactorily so that it was possible to interact even with young people of the zone. In the case of Providencia, more difficulties existed with the compilation of information because there was not a good involvement with the actors due the limited time of the research.

### **7.3 Recommendations**

Thus, the study evokes several recommendations, on scientific-methodological and on material respectively practical level of implementing the findings:

- Methodologically, it is recommended to work in a smaller scale due the fact that the comunas of Santiago possess a large population. Therefore, to obtain more precise and deeper results more time and involvement with key actors is needed.
- It is recommended to the authorities to take into account the organized neighbors, their initiatives and needs. Due to the fact, that these associations enjoy public confidence and local trust, they can serve as bridges to transfer information and knowledge to educate and prepare the citizenship in the awareness of climate change, their effects and the application of measures.
- It is important to continue with the social research in a participative environment not only in the comunas of Maipú and Providencia but also in other comunas of Santiago in order to prepare people and create consciousness of the effects to which they are exposed. Without participation, measures will be perceived as imposed, creating possible conflicts and opposition within the population. For better interaction, it is possible to use the mass media, but it seems necessary to create interactive spaces where people take an active part in the process and, moreover, in taking definitive decisions.

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**ANNEX**

**CUESTIONARIO JÓVENES**

**Hola!!! Gracias por participar, tú contribución es muy importante. Sólo te pido que respondas lo más sinceramente posible.**

1.- Edad..... Sexo.....

2.- ¿Conoces qué es el cambio climático?  
Si  No

Si tu respuesta es No, ve directo a la pregunta 4.

3.- ¿Dónde lo aprendiste?

Escuela  Medios de comunicación (televisión, internet, radio, etc.)   
 Familia  Campañas de tú Comuna   
 Grupo ambientalista  Otro  .....

4.- ¿Qué medio de transporte utilizas más?

Auto  Buses  Taxis  Metro   
 Bicicleta  A pie  Otro.....

5.- ¿Manejas bicicleta regularmente? Si  No

Por qué?.....

6.- ¿Crees que es seguro manejar bicicleta en Santiago? ¿Qué se debería mejorar?

.....

7.- En casa, tienes los siguientes hábitos:

	Si	No
Apagar la luz en el lugar que no estes		
Usar focos ahorradores		
Desconectar la batería del celular, cámara cuando ya se cargó		
Apagar la computadora después de usarla		

Otro hábito que quieras compartir .....

8.- ¿En tu Comuna existen campañas de cuidado al medio ambiente, educación ambiental, reciclaje, etc.?  
Si  No

Participas? Si  No

Por qué?.....

9.- ¿Pertenece a algún grupo ambientalista o de cuidado al medio ambiente? Si  No

10.- ¿Qué cosas aprendes ahí?  
.....  
.....



**CUESTIONARIO ADULTOS**

**Hola!!! Gracias por participar, su contribución es muy importante. Sólo le pido que responda lo más sinceramente posible.**

1.- Edad..... Sexo.....

2.- ¿Conoce usted qué es el cambio climático?

Si  No

3.- ¿Cómo se ve afectado en su Comuna por el cambio climático?

Elevación de temperatura  Reducción del agua  Sequías  Inundaciones   
 Derretimiento de glaciares  Enfermedades (malaria, dengue, hanta)  Reducción de la energía   
 Otro.....

4.- ¿Estaría usted dispuesto en aplicar medidas y acciones para evitar las consecuencias del cambio climático?

Si  No

Por  
 qué?.....

5.- ¿Usted estaría dispuesto en invertir en energías renovables (panel solar, concentrador solar, etc.) para disminuir las emisiones al medio ambiente y asegurar a largo plazo la seguridad energética de su país?

Si  No

Por  
 qué?.....

6.- ¿Qué medio de transporte utiliza más?

Auto  Buses  Taxis  Metro   
 Bicicleta  A pie  Otro.....

7.- En casa, tienes los siguientes hábitos:

	Si	No
Apagar la luz en el lugar que no se encuentra		
Usar focos ahorradores		
Desconectar la batería del celular, cámara cuando ya se cargó		
Apagar la computadora después de usarla		

Otro hábito que quisiera compartir:  
 .....

8.- ¿La participación ciudadana es efectiva en su Comuna? ¿Siente que sus necesidades son tomadas en cuenta?

Si  No

Por  
 qué?.....

9.- ¿De qué manera participa en la toma de decisiones de su Comuna?

.....

10.- ¿En su Comuna existen campañas de cuidado al medio ambiente, educación ambiental, reciclaje, etc.?

Si  No

Participa? Si  No  Por  
 qué?.....

## Guía de entrevistas COMUNAS

- Datos generales de la Comuna (Ubicación, población, PIB, actividades económicas)

### Cambio climático

- Conoce qué es el cambio climático? Cuáles son los impactos para Chile?
  - o reducción del agua
  - o sequías
  - o inundaciones
  - o elevación de la temperatura
  - o derretimiento de glaciares
  - o enfermedades
- Cómo enfrenta Chile el problema del cambio climático? A nivel nacional, local, comuna
- Existen políticas actuales para desarrollar medidas de adaptación al cambio climático? Si es el caso cuáles se aplican a nivel comunal?
- Sabía que uno de los principales causantes del cambio climático son los combustibles fósiles? La gente está conciente del problema?
- Qué debilidades y fortalezas posee la Comuna para desarrollar medidas de adaptación al Cambio Climático?
- Chile está en la posición de bajar las emisiones? Qué medidas están llevando a cabo para cumplir con el Protocolo de Kyoto y la Convención Marco de las Naciones Unidas?

### Sector energético

- Cuál es la situación energética en Chile? A nivel nacional, local, comuna. Cómo se abastecen de energía en la Comuna de Maipú. En qué estado se encuentra el acceso a la energía para las personas de la Comuna?
- Estaría la comuna dispuesta a gestionar e implementar energías renovables?
- Qué debería gestionar el gobierno para que se apliquen estas nuevas tecnologías a nivel comunal?
- Cómo están planificando la seguridad energética de su comuna para los próximos años?

### Participación social

- Quiénes deberían ser los involucrados, actores principales para el desarrollo de medidas de adaptación al cambio climático? Cuál es el nivel de participación? De qué manera se involucran los actores principales en la toma de decisiones?
- Qué obstáculos, problemas, conflictos, acuerdos existen entre los actores involucrados? Es buena la relación? La comunicación es fluida? Existe falta de información?
- Poseen políticas o sistema de incentivos relacionados con la temática?
- Qué impactos puede causar en los actores involucrados, en la gente de las comunas la aplicación de medidas de adaptación al cambio climático?

### Guía de entrevista Junta vecinal

- ¿En qué consiste la Junta Vecinal?
- ¿Cómo están organizados?
- ¿De qué manera participan de las decisiones de la Comuna? ¿Sus necesidades son tomadas en cuenta?
- ¿Cuál es la relación entre la Junta Vecinal y autoridades o Gobierno local?
- ¿Se tratan temas ambientales de la Comuna en la Junta Vecinal? (Protección del medio ambiente, cambio de hábitos, reciclaje, cambio climático, etc.)
- ¿La gente está conciente de los problemas ambientales que existen en la Comuna? Se preocupa o es indiferente?
- ¿Conoce usted qué es el cambio climático?
- ¿Cómo se ve afectado por este problema?
- ¿Estaría dispuesto a invertir tiempo y recursos para desarrollar medidas y acciones que ayuden a resolver este problema ambiental?
- ¿De qué manera se vería afectado por nuevas políticas y medidas de adaptación al Cambio climático?
- Como ciudadano de Santiago, usted cree que vive actualmente una crisis energética? ¿Cuáles serían las posibles causas de este problema?
- ¿Estaría dispuesto a invertir económicamente para asegurar a largo plazo la seguridad energética de su ciudad?
- ¿Conocen qué son las energías renovables? (paneles solares, concentradores solares, energía eólica, etc.)
- A nivel comunal, ¿usted cree que los vecinos estén en las posibilidades de invertir en este cambio de energías por ejemplo un panel solar para su casa?
- El Gobierno debe ser parte activa de estos cambios. ¿Cómo cree usted que debería apoyar el Gobierno?

### **Guía de entrevista Sector energía**

- ¿Cómo se puede determinar la gobernanza en el tema energético en Chile desde un nivel nacional a local?
- ¿Cuál es la dinámica de trabajo desde el Ministerio de energía con los Municipios, empresas de electricidad?
- La comunicación, participación de actores en distintos niveles es efectiva, qué se debe mejorar?
- ¿Qué programas actualmente se desarrollan desde el Ministerio de energía, y se aplican a nivel comunal?
- ¿Qué programas están relacionados con la temática del Cambio climático, medidas de adaptación, mitigación, reducción de emisiones? ¿Qué acciones realiza el Ministerio para concientizar a la población?
- Chile realmente vive una crisis energética? ¿Qué medidas, acciones se están tomando en cuenta para mejorar la seguridad energética de su país a largo plazo?
- En cuanto al acceso a la energía, en qué estado se encuentra Santiago, especialmente a nivel Comunal (Maipú y Providencia)?
- En qué estado se encuentra el tema de energías renovables a nivel nacional, regional comunal? Existen estudios, se ha implementado algo? Qué políticas se tienen?
- Qué capacidades o incentivos debería desarrollar el Ministerio de energía, el Gobierno para poder aplicar a largo plazo energías renovables con éxito?