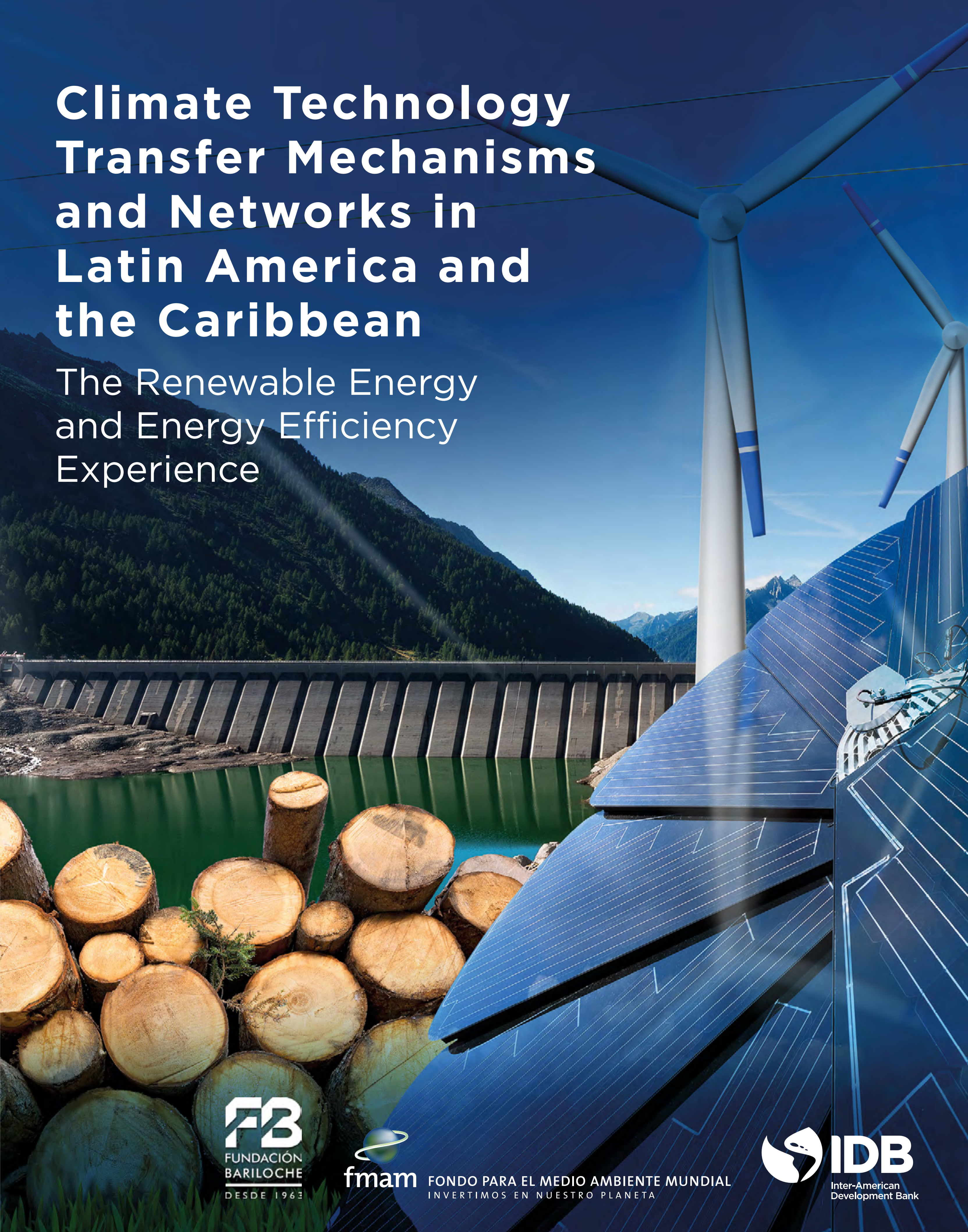
# Climate Technology Transfer Mechanisms and Networks in Latin America and the Caribbean

## The Renewable Energy and Energy Efficiency Experience



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This document is based on the studies on the transfer of climate change technologies (CCT) (also called environmentally sound technologies, EST, or TAR, for its Spanish acronym) related to energy efficiency and renewable energies, which were led by the Bariloche Foundation as part of the project Mechanisms and Networks for the Transfer of Climate Change Technologies in Latin America and the Caribbean, implemented by the Inter-American Development Bank (IDB) and financed by the Global Environment Facility (GEF). The document offers an overview of the state of the art of CCTs, their potential, main barriers to implementation, and lessons learned.

Technical peer review:
Edwin A. Malagon Orjuela (Energy Division, IDB)
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The project **“Climate Technology Transfer Mechanisms and Networks in Latin America and the Caribbean (LAC)”** was implemented by the Inter-American Development Bank (IDB) and financed by the Fund for the Environment (FMAM).

Bariloche Foundation led the project actions aimed at the transfer of climate change technologies (CCT) (also called environmentally sound technologies, ESTs, or TAR, for its acronym in Spanish) related to energy efficiency and renewable energies.

This document offers an overview of the state of the art of CCTs to date, their potential, and the main regulatory, economic, financing, institutional, and market barriers to their implementation. Similarly, it describes the lessons learned from carrying out the different studies that comprise the project and focuses on overcoming the aforementioned barriers.

The information provided in this document does not intend to offer an exhaustive analysis of the work conducted by the Bariloche Foundation, but rather represents a summary of the work carried out over the course of the past four years. Readers who are interested in learning more details can follow the links included for each subject.

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# General index

# Main Acronyms

| | |
|---|---|
| AFAM | Family Assignments (Uruguay) |
| ANCAP | National Administration of Alcohol Fuels and Portland (Uruguay) |
| ANTEL | National Telecommunications Administration |
| APP | Public-Private Partnerships |
| APRA | Environmental Protection Agency of the Autonomous City of Buenos Aires |
| BEU | Useful Energy Balance |
| BCA | Border Carbon Adjustment |
| BID | Inter-American Development Bank |
| CC | Climate Change |
| CCT | Climate Change Technologies |
| CEV | Household Labeling Course for Certifiers |
| CIP | Allowable Installed Capacity |
| EERR | Renewable Energies |
| EE | Energy Efficiency |
| ERNC | Non-conventional Renewable Energies |
| ESCO | Energy Service Company |
| ETS | Emission Trading Systems |
| FICEM | Inter-American Cement Federation |
| FiT | Feed-in-tariff |
| FMAM | Global Environment Facility (also known in Spanish as Fondo para el Medio Ambiente Mundial) |
| FONAFIFO | National Forest Financing Fund (Costa Rica) |
| FV | Photovoltaic |
| GDS | Solar distributed generation |
| GEI | Greenhouse Gases |
| GLP | Liquefied Petroleum Gas |
| GW | Gigawatt |
| HRT | Technological Road Map |
| I+D+I | Research, Development, and Innovation |
| ICC | Critical Gaps Index (Uruguay) |
| ICH | Cement and Concrete Institute (Chile) |
| IDEs | Energy Performance Indicators |
| INECC | National Ecology and Climate Change Institute (Mexico) |
| INTECO | Costa Rica Institute of Technical Standards |

| | |
|---|---|
| IPE | Energy Performance Index |
| IVA | Value Added Tax |
| kW | Kilowatt |
| kWh | Kilowatt hour |
| LAC | Latin America and the Caribbean |
| MACC | Marginal abatement cost curve |
| MEF | Ministry of Economy and Finance (Ecuador) |
| MIEM | Ministry of Industry, Energy and Mining (Uruguay) |
| MEER | Ministry of Electricity and Renewable Energies (Ecuador) (currently the Ministry of Energy and Non-renewable Natural Resources |
| MVOTMA | Ministry of Housing and Territorial Planning (Uruguay) |
| OLADE | Latin American Energy Organization |
| ONG | Non-governmental Organizations |
| PSFV | Photovoltaic Solar Park |
| PyMES | Small and Medium-sized Businesses |
| RESCO | Renewable Energy Service Company |
| SWH | Solar Water Heating |
| TCB | Basic Consumption Rate (Uruguay) |
| TIC | Information and communication technologies |
| Ton | Tons |
| TUS | Uruguay Social Card (Tarjeta Uruguay Social) |
| TW | Terawatt |
| UBA | University of Buenos Aires |
| UDENAR | University of Nariño |
| UE | European Union |
| URSEA | Regulatory Entity for Energy and Water Services (Uruguay) |
| USD | United States Dollar |
| USEs | Significant Uses of Energy |
| UTE | National Administration of Power Plants and Transmission (Uruguay) |
| UTN | National Technical University (Costa Rica) |

# Acknowledgements

This publication has been made possible thanks to the technical support of the Inter-American Development Bank (IDB), the implementing agency for the project, "Climate Technology Transfer Mechanisms and Networks in Latin America and the Caribbean: The Renewable Energy and Energy Efficiency Experience", and the Global Environment Facility (GEF), which provides funds through the IDB's Regional Non-reimbursable Technical Cooperation agreement, Num. ATN/FM-14836-RG.

The Bariloche Foundation (Fundación Bariloche in Spanish) carried out a series of case studies related to the renewable energy and energy efficiency component portion of this project; their analyses cover: Argentina (City of Buenos Aires and the Municipality of Uspallata); Colombia (national level, Nariño, and Bucaramanga); Brazil (national level and Fortaleza); Costa Rica; Chile (national level and Santiago); Ecuador (national level and the Galápagos Islands); El Salvador (Sonsonate); Guatemala; the Dominican Republic; and Uruguay. It also includes comparative analyses by country, carried out for: Argentina, Barbados, Brazil, Colombia, Chile, Jamaica, Mexico, Nicaragua, Panama, Peru, the Dominican Republic, and Uruguay.

We thank each person who has collaborated with us directly and indirectly to carry out the work that resulted in the creation of this document: consultants, local and national authorities and public entities, energy service companies involved in the study, and, of course, the coordinators at the IDB, without whose support and understanding it would have been impossible to carry out this project successfully.

# Executive Summary

This document presents the main results, lessons learned, and proposals generated in the implementation of the project, "Climate Technology Transfer Mechanisms and Networks in Latin America and the Caribbean: The Renewable Energy and Energy Efficiency Experience"

As can be observed in the map below, a significant number of the region's countries were beneficiaries of the project, and the topics of study were fairly heterogeneous and inclusive.

The methodology that was used took as its point of departure the critical, exhaustive review of 22 main studies, the 10 secondary studies that comprise the project[1], and the different activities carried out in the course of the study.[1]

All of these items contributed sufficient elements to be able to compose a reasonable overview of the state-of-the-art climate change technologies (CCT) in the region, providing solid support for the determination of actions to promote the development and transfer of said technologies.

[1] In the table in Appendix 1, we present the main details of all the studies conducted and links to those for which supporting documents can be obtained.

## Map 1: The Geography of the Project

- HRTs for biomass and solar thermal, Costa Rica.

- Economic valuation of the energy potential of forest biomass in the North Huetar Region of Costa Rica.

- Sustainable behavioral standards for buildings in the Galápagos, Ecuador.

- Action plan for energy transition in the Galápagos Archipelago, 2020-2040.

- Taking advantage of energy from biomass residuals from African palm and rice (husk) agribusiness in Ecuador for the generation of distributed energy.

- Carbon Management Plan for Jalisco, Mexico.

- Fiscal policy for the use and leveraging of distributed electric generation via photovoltaic solar energy.

- HRT for building envelopes, Dominican Republic

- FV systems for 104 schools in Sanquianga, Nariño, Colombia.

- Evaluation of photovoltaic solar system and their sustainability schemes in non-interconnected zones.

- Structuring of a user regularization program for electric services focused on vulnerable populations.

- Distributed FV generation for Santa Fe, Argentina.

### Regional Renewable Energy Studies

- Case studies of Net Balance (Chile, Mexico), and Auctions (Brazil, Uruguay, and Panama).

- Comparative analysis of regulatory and commercial frameworks for solar roofs (Brazil, Mexico, and Chile).

- Case study of quality and verification standards in consumer information tools for SWH.

- Low-carbon development in Chilean cement and steel industries.

- Structuring of a management system of energy for buildings that are representative of the UBA.

- Comparative analysis of energy solutions for the Mendoza Andes, replacing the use of liquid fuels for the energy supply.

- Pilot of Household Energy Labeling in the Autonomous City of Buenos Aires – CABA.

### Regional Studies of Energy Efficiency

- Comparative evaluation of EE standards in buildings for: Argentina, Brazil, Costa Rica, Colombia, Dominican Republic, Jamaica, Panama, Peru, and Uruguay.

- Study of successful business models for public lighting in the LAC: Buenos Aires, Mexico City, Bucaramanga, Fortaleza, Santiago, Sonsonate.

- Comparative study of commercial and regulatory frameworks for industrial co-generation.

Source: Original graphic by the Bariloche Foundation

Energy Efficiency

Renewable Energy

# The document is comprised of two parts:

In the first, a cross-sectional view is developed, providing valuable information about problems that are common among most of the countries, contributing to the search for solutions to overcome difficulties and remove barriers that exist in the implementation of CCT projects.

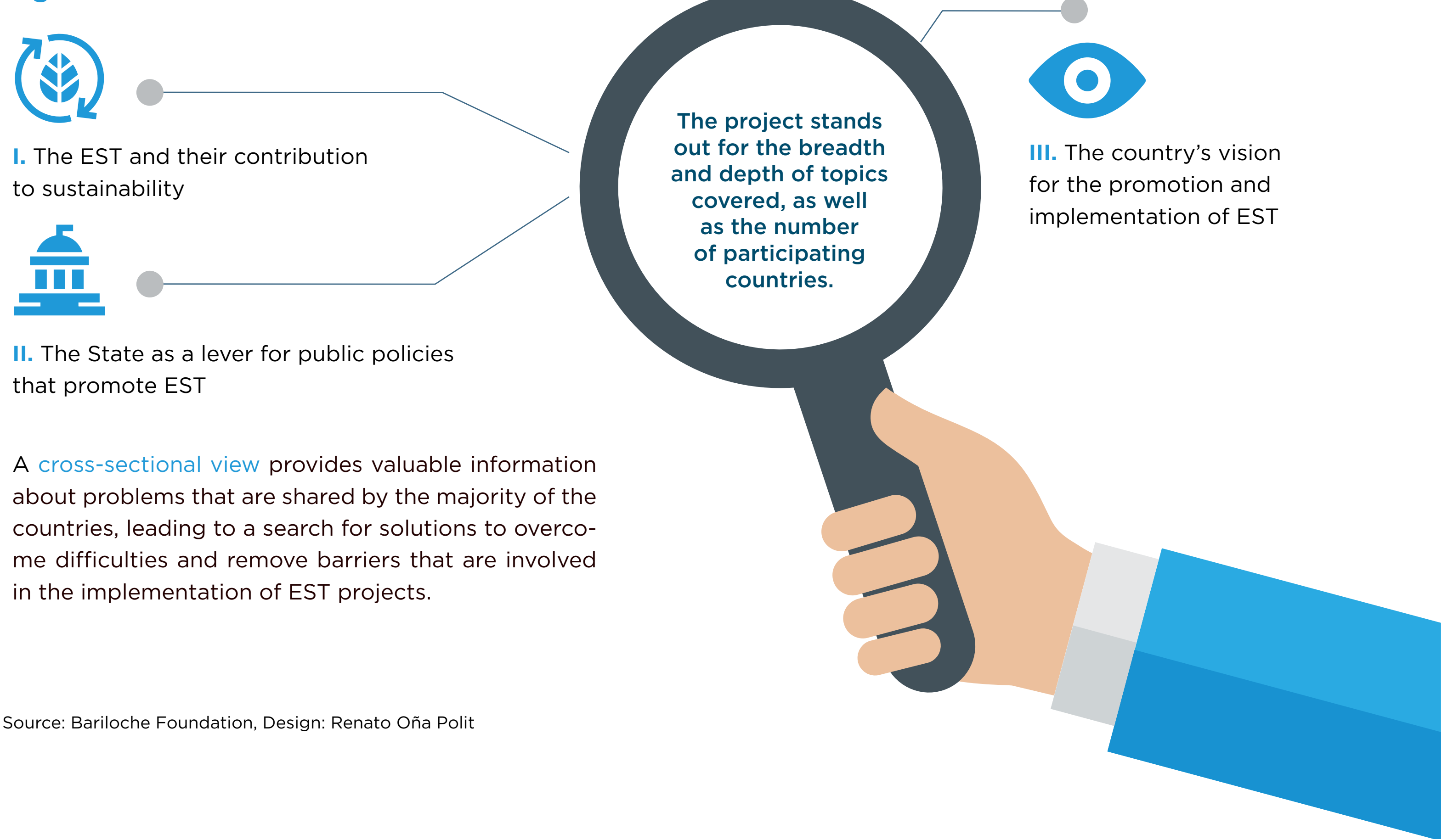
The second part presents the reviews of seven studies developed within the project's framework with the goal of illustrating the different topics addressed in Part One.

In this Summary, the contents are presented in both narrative and in visual representations in order to support ease of reading.

## 1. Part One: A cross-sectional view

The analytic framework developed rests on three conceptual pillars:

Figure 1: A cross-sectional view




Source: Bariloche Foundation, Design: Renato Oña Polit

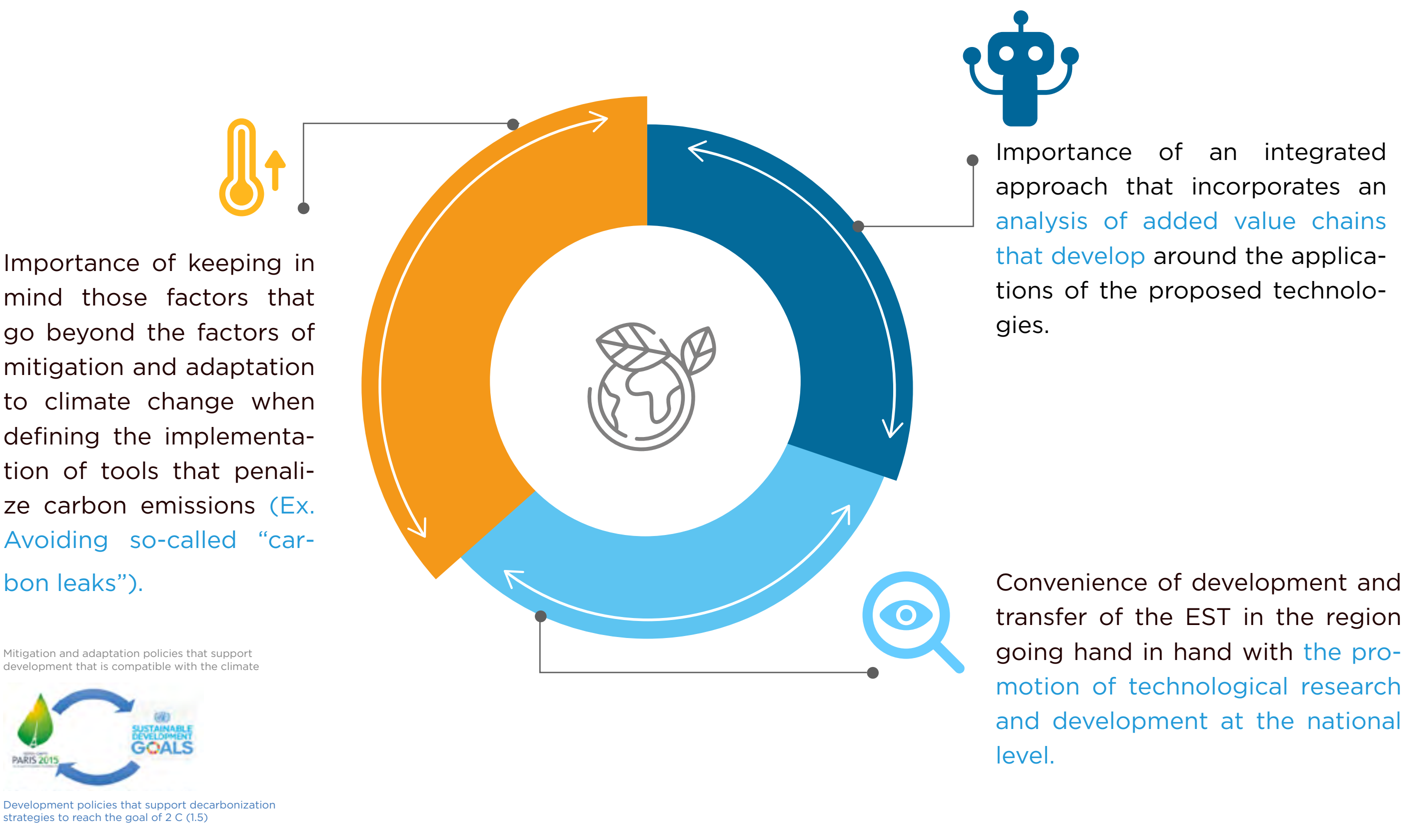
Within this framework, the main recommendations that have been collected are enumerated below, alongside their respective pillars:

## 1.1 First Pillar: The CCTs and their contribution to sustainability

Achievement of objectives that go beyond the mitigation of environmental impact and the most immediate cost-benefit analysis, or the result of a partial, non-comprehensive analysis of CCTs' role may contribute to sustainability in the promotion of a specific CCT. It is necessary to take into account the various clauses that often influence sustainability itself, for example: local content, promotion of specific locations, stakeholder power, and goals defined by sources and technologies.

The following diagram illustrates the proposed considerations:

**Figure 2: The CCTs and their contribution to sustainability**




Source: Bariloche Foundation, Design: Renato Oña Polit

## 1.2 Second Pillar: The State as a public policy lever for its promotion

The State must play a key role in the preparation and implementation of a public policy portfolio (general and sectorial) that facilitates the development and transfer of CCT, taking the following recommendations into account:

Figure 3: The State as a Public Policy Lever for Promotion of the CCTs


There is a need for countries to have clear and stable energy policies (where possible, state policies).

Source: Bariloche Foundation, Design: Renato Oña Polit

It is of vital importance to foster the widest participation of all relevant stakeholders (both public and private), both in the design phase and in the definition of support mechanisms, to ensure the long-term sustainability of these public policies and to promote the creation of permanent inter-agency and multi-sectoral entities that will foster the development and transfer of CCTs.

The experience of those countries that have made significant progress in CCT implementation reveals the relevance of putting into practice an entire battery of complementary policy instruments, that cover multiple dimensions of the problem.

A significant part of creating an "ideal environment" consists of implementing incentive programs that factor in means of support such as: investment subsidies, preferential financing, tax benefits, standard portfolio programs, special rates, land use rights, construction of connection infrastructures, etc. More than 50 instruments were collected from the analysis of different studies, summarized in Table 1 in the Appendix, and then associated with the studies that were conducted.

One of the major challenges when implementing support mechanisms is related to their flexibility or capacity to adapt to rapidly changing conditions, as well as the establishment of time limits for policy revisions and evaluations. These actions send signals so that the market can develop in a stable, predictable manner, controlling the introduction of new technologies and giving certainty to investments.

Because of their volume, the state's purchases can play a dynamic role within a specific market, generating a critical mass (a baseline of demand) that allows it to take advantage of the economies of scale; to consider the possibility of executing pilot projects; to foster confidence in a specific technology, especially if it's a novel technology; and to promote the role of the State as an example, to the extent that speaking in favor of the CCTs is legitimized by its implementation within the state administration itself.

The deficit of human technical capacities constitutes one of the main barriers to the further advancement of TCCs within the countries in the region. In this sense, the need to strengthen local technical capacities as part of human development policies deserves particular emphasis within the framework of the role of the State as a generator of an "ideal environment" for the development of these technologies. For capacity-building investment to bear fruit, it is vital to insert this effort into the framework of state policies, with a sense of continuity and long-term perspective.

## 1.3 Third Pillar: The Country's Vision in the Promotion and Implementation of the CCTs

All of the countries in the region have expressed, in one way or another, their willingness to move forward with the transition to a new energy paradigm, without losing sight of t

rabilities that are presented by the economic and socio-regional contexts (which have, of course, been exacerbated by the pandemic).

### Figure 4: Country's Vision

It is the responsibility of the decision-makers to define the technologies that meet the conditions for the implementation of incentive programs that consider methods of support, and at the optimal moment, to put them into practice, all while taking into account the country's vision (comprehensive, multidimensional, and systemic), and considering the specific national priorities.


Source: Bariloche Foundation, Design: Renato

It is of primary importance to identify sectors where the effort will be emphasized, trying to avoid the burden falling on lower-income sectors, particularly in those cases that will require support measures or additional investment efforts.

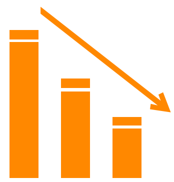
The Pilot Projects. One relevant recommendation addresses the implementation of pilot projects as a strategy to reduce the uncertainty inherent in the use of this type of novel technologies. The pilot project's reduced scale makes it possible to better understand and manage risks and minimize losses in the event that the promoted technology is not feasible given the specific conditions of a particular country. Pilot projects provide useful information that allows better implementation of the global project (improvement in processes, etc.). They allow fine-tuning of the structures that are necessary for the formation of a framework that is conducive to the development of the TCCs, such as the existence of specific training profiles, financing strategies, incentive programs, required deadlines, etc. They help increase users' confidence in these technologies. One element to keep in mind when addressing the economic-financial aspects of a pilot project for non-modulable (or poorly modulable) technologies, is that cutting economies of scale significantly reduces the potential benefits, thereby increasing the unit cost of the project. In such cases, a simple extrapolation of results can introduce significant errors. Thus, it is important to include a study of the technology in question in the potential market, which provides a solid basis for evaluating scalability and cost-benefit impacts. It is of vital importance to disseminate the results and knowledge acquired through communication and dissemination campaigns.

The importance of good management. Often, analyses tend to focus too much on aspects related to investments in technology, overlooking those aspects that are pertinent to the area of management, when in fact, inadequate management can become the main obstacle preventing the implementation of a particular technological option. It is important to have models that facilitate adoption of the appropriate technologies and assure the sustainability of the technological options that have been chosen and imply a substantial reduction in the total of necessary investment, contributing to the success of the measure to be implemented. It is also relevant to implement a set of performance indicators that allow continuous, objective project monitoring, with the goal of evaluating the degree to which objectives have been met, and to contribute to correcting or strengthening the strategies and orientation of resources, helping achieve established goals.

Finally, the following figure underscores the importance of a lack of good background information.

## Figure 5. Background Information

**Lack of good background information,** generally the product of a lack of reliable, comprehensive statistics on all energy and socioeconomic activity in the countries within the region.



This lack constitutes **an important barrier to the development and transfer of EST** to the extent that it does not foster the attainment of indicators that offer a level of confidence that allows appropriate decision-making with the greatest likelihood for success.

The need to **expand and improve the processes for collecting and processing information and developing useful energy balances** to facilitate, among other things, the evaluation of the development initiatives for the development of EST, providing background information for the analysis of the possibilities of substitution among energies, and the competitiveness of prices and rates among diverse sources.

Source: Bariloche Foundation, Design: Renato Oña Polit

# 2. Second Part: Seven studies developed within the project framework

Reviews of the seven studies are presented here, with the goal of illustrating the recommendations and reflections offered in the first part. The seven studies were selected from the total, based on the following criteria: inclusion of the themes of renewable energies and energy efficiency; representation of the three geographic regions (Mexico, Central America, and the Caribbean; North and South America; and the Southern Cone); possibilities for replicability; originality or potential for implementation; and anticipated impacts during implementation.

The selected studies are as follow:

- Economic valuation of the energy potential of forest biomass in the North Huetar Region of Costa Rica, which serves as a basis for the formulation of policies that consolidate forest participation within sustainable energy options

- Action Plan for the Transition to Sustainable Energy in the Galápagos Islands Archipelago, 2020-2040

- Comparative analysis of energy solutions for the Mendoza Andes, replacing the use of liquid fuels for energy supply

- Courses of action for taking advantage of sustainable energy of residual biomass from the African palm and rice (husk) agribusiness in Ecuador for the distributed generation of electrical energy

- Low carbon development of Chilean industries: Cement. Roadmap proposal

- Preparation of inputs that allow the design of a regularization program for connecting users to the electricity grid, focused on socioeconomically vulnerable households in Uruguay

- Pilot Project of energy labeling homes in the Autonomous City of Buenos Aires CABA

This document seeks to be accessible to readers with differing levels of previous specific understanding of and experience with the subject. It is hoped that reading the document will provoke ideas that can be transformed into reality and can confer sustainability to the multiple CCT projects planned in the energy sector, but which to date have not managed to be implemented in Latin America and the Caribbean (LAC).

For those readers who are particularly interested in delving into a particular topic, they can find general information on the projects developed in Appendix 1, as well as links that will lead them to an online repository where all of the documents can be found.

**It is hoped that the bleak prospects for growth, climate risks, and post-COVID-19 recovery will catalyze decisive action. Indeed, even though the future presents challenges, particularly in a post-COVID-19 world, this project indicates that there is enormous potential with respect to energy, for favoring and participating actively in economic growth and in changing lives, especially for the most vulnerable.**

# Introduction

The project "Climate Technology Transfer Mechanisms and Networks in Latin America and the Caribbean" was implemented in 2014 by the Inter-American Development Bank (IDB), financed by the Global Environment Facility (also known by its Spanish acronym, FMAM), approved by the IDB Board of Directors in the same year, and completed recently.

The general objective of the project was to promote the development and transfer of climate change technologies (CCT, also called environmentally sound technologies, TAR or EST) in Latin American and Caribbean (LAC) countries, with the purpose of contributing to the final goal of reducing greenhouse gas emissions and vulnerability to climate change effects in specific sectors

[3] In this TCC document, climate technologies or environmentally sound technologies (TAR), are understood as those technologies that have the potential to significantly improve environmental performance compared to other technologies. Improvements can be reflected in different ways, whether by causing a reduction in pollution or promoting more sustainable resource use, among other impacts. The concept of EST also includes organizational and management procedures to improve environmental performance.

of the region (energy, transportation, forest monitoring, and agriculture).

To reach this goal, the project set out to encourage regional cooperation efforts and, by conducting studies, to support the planning and policy definition projects at the regional and national levels. It was also proposed to serve as a platform for the demonstration of policies and mechanisms that facilitate the implementation of such technologies, as well as focusing on the mobilization of public and private resources. The following diagram summarizes the objectives and strategies of the project.

**Figure 6: Objectives and Strategies**


Source: Original design by the Bariloche Foundation.

Mexico's National Ecology and Climate Change Institute (INECC) led the first component of the project, while a group of four executing institutions were responsible for the implementation of the other three components. Within the latter group, the Bariloche Foundation was responsible for coordinating the execution of activities in the energy sector.

The energy sector is one of the priority sectors for the implementation of climate change adaptation and mitigation measures in the region. An example of this is the generation of energy from renewable resources and the implementation of energy efficiency measures, prioritizing specific initiatives according to criteria that include climate change technologies, replicability, capacities, priorities, and national circumstances.

The following figure summarizes the types of studies that were carried out in the framework of the energy project.

Figure 7. Types of Studies Carried out Within the Framework of the Project's Objectives and Strategies

## What types of studies were included?

- Pre-feasibility and feasibility studies for EE and ER projects
- Analysis, establishment and improvement of the regulatory and normative frameworks of EE and ER
- Energy audits
- EE and ER project modeling
- Analysis and comparison of efficienct technologies for EE and ER projects
- Analysis of business models for EE and ER projects
- Technical, economic, and environmental analysis for the substitution of efficient technologies in the place of traditional ones
- Development of roadmaps to incentivize EE and ER projects

Source: Original Design

A process for identifying investment opportunities, evaluating technologies, and feasibility studies for the adoption of CCT (which included a cost-benefit analysis, market studies, business and financial models, and the design of financing mechanisms) were also carried out within the project framework[4].

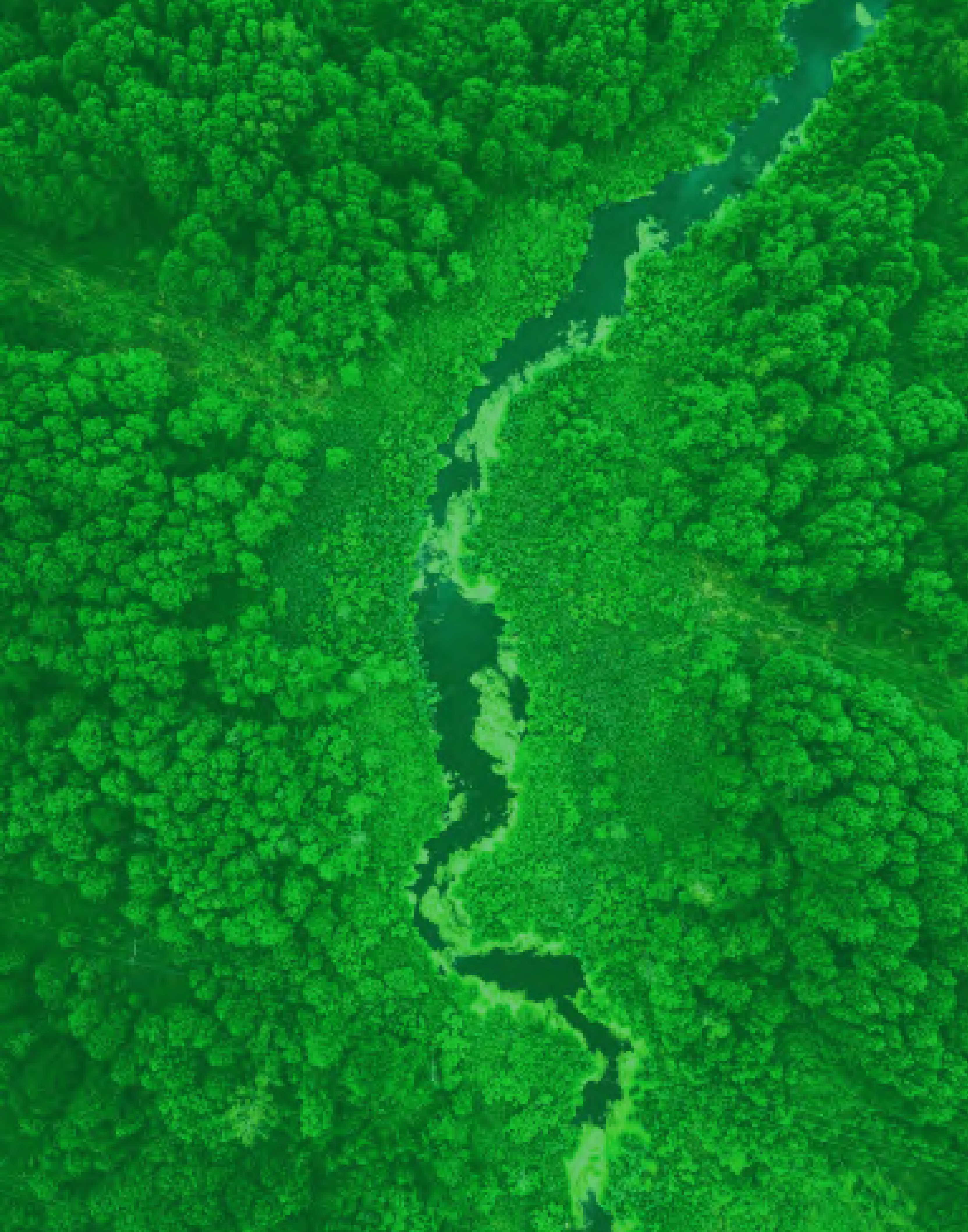
The products that were developed reflected the feedback and procedures approved by the IDB and adopted by the Bariloche Foundation. Said procedures were established to ensure transparency, consistency, and efficiency, and to prioritize the CCTs based on criteria such as cost-effectiveness, mitigation potential, replicability, and congruence with circumstances, capacities, and national priorities.

Next, we present the development of "A cross-sectional view of the development and transfer of CCTs in the region," which provides valuable information about the problems that are common to most of the countries, contributing to the search for solutions to overcome difficulties and remove the barriers that arise in the implementation of CCT projects.

Then, in order to illustrate the lessons learned from the case studies that were carried out within the framework of the project, seven reviews are presented that correspond to a selection that was carried out based on the following criteria: inclusion of the topics of renewable energies and energy efficiency; representation of the three geographic regions (Mexico, Central America, and the Caribbean; North America and South America; and the Southern Cone); possibilities for replicability; originality or potential for implementation; and anticipated impacts during the execution.

Appendix 1 shows a summary table containing information on all of the studies developed.

[4] For this, calls were extended to public entities (beneficiaries) of a regional, national, or local nature, aimed at defining and implementing public policies about energy efficiency and renewable energies and identifying the possibility of accessing funds (non-reimbursable) to carry out the studies, which were aimed at fulfilling the objectives of training about and transferring environmentally sound technologies (ESTs). The form requesting agents were required to complete can be accessed here: http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/objetivos/



# Chapter 1

## A cross sectional view of CCT development and transfer in the region

The implementation of a project of the size and characteristics that define the project Climate Technology Transfer Mechanisms and Networks in Latin America and the Caribbean" – both in terms of the breadth and the depth of topics discussed, as well as the involvement of a significant number of countries in the region – provides a unique opportunity to obtain a panoramic view of the state of the development and transfer of CCTs in the region's energy sector.

The possibility of a cross-sectional view provides valuable information about problems that are common among the majority of the countries and allows us to attain an overall view of the issue and its interdependencies, all of which contributes to the search for solutions to overcome difficulties and remove obstacles that arise in the implementation of CCT projects.

The analytical framework developed for the project rests upon three conceptual pillars:

- The CCTs and their contribution to sustainability
- The State as a lever for CCT promotion in public policies
- The country's vision in the promotion and implementation of CCT

Below, we present the themes that were raised in several of the studies, which allows a cross-sectional approach.

## 1.1. The CCTs and their contribution to sustainability

As we have already signaled, the project seeks to promote the development and transfer of climate change technologies (CCTs) (also called environmentally sound technologies, or TARS) in Latin America and the Caribbean, with the end goal of contributing to the overall objective of reducing greenhouse gas emissions and climate change vulnerability within specific sectors in the region. For this reason, it is proposed that CCTs be prioritized based on criteria such as cost-effectiveness, mitigation potential, their niche with respect to satisfying energy needs, the possibility of replicability, and congruence with circumstances, capacities, and national priorities[5].

Although the emphasis is inarguably placed on the fight against climate change, it cannot be forgotten that the concept of CCT is not foreign to the broader notion of sustainability, and that it incorporates other dimensions, such as social, economic, and political. This approach includes the proposals put forward by various multilateral entities and agencies, and, in particular, the United Nations Development Programme, with respect to integrating climate-related questions with development, promoting joint action in the search for sustainable development and the fight against climate change. Particularly for developing countries, it is of fundamental importance that the development agenda and the climate agenda are developed and implemented in a coordinated manner, with the objective of strengthening synergies between both and avoiding undesired collateral effects. This acknowledgment raises the issue that, in many cases, the decision to adopt a certain CCT can be defining in the pursuit of other objectives that go beyond mitigation of environmental impact and of the most immediate cost-benefit analysis, or the result of a partial and non-comprehensive analysis of the role of CCTs in contributing to sustainability.

A typical case in this type of situation is the incorporation of electrical energy auctions, those

[5] While taking into account that national circumstances and capacities sometimes constitute the barriers to be overcome through public policy implementation.

Sometimes, there are also clauses that limit the size of projects or the market power of the actors, in order to promote diversity of participants and to focus on forming more competitive markets. In other cases, goals are set by sources and technologies as a contribution to the diversification of the matrix and of energy security.

With respect to local content clauses, cases analyzed in the study show the need to evaluate in depth the extent of demand and its possible evolution over time, taking into account the size and maturity level of the market, as well as local capacities (industrial, human, infrastructure, financial, etc.), because the real effect may be the opposite of what was intended. In particular, some empirical studies about the application of these clauses are mentioned, in which it is shown that cutting economies of scale reduces possible savings, thereby increasing project and energy costs, as well as limiting access to capital. As if that were not enough, the benefits sought with respect to the creation of local equipment manufacturing capacity were not obtained.

A telling fact mentioned in the study "Photovoltaic Solar Energy in Buildings" is that, based on the comparative analysis of the selected countries in the region, it appears that those that have advanced the most in terms of the amount of surface installed, represent an important component of local manufacturing (such is the case in Barbados, Brazil, and Mexico). The study does not delve into the factors that led to this situation, but the analysis of this would be of interest to determine whether any other general conclusions could be drawn.

Several studies highlight the importance of carrying out a holistic approach with respect to the subject of promoting CCTs, incorporating the analysis of the added-value chains that are developed for the proposed technological applications. In this way, it would be possible to have a more complete vision of CCTs' contribution to the four dimensions of sustainability, while at the same time having greater elements of judgment to promote the creation of added-value circuits that contribute to the country's socio-economic development, making it more attractive to invest in these technologies.

Some studies also emphasize the need for CCT development to go hand in hand with the promotion of research and technological development at the national level. Such is the case for the Technological Roadmaps (HRTs) for "solar water, heating and cooling in buildings" and for "thermal energy generation in the industrial sector, based on biomass residues" (both in Costa Rica), in which the willingness to adopt an approach with such characteristics has clearly been made manifest, both with regards to the analysis of value chains and interest in scientific and technological development. With respect to this last item, what stands out is the call to the Academy to agree on a research agenda to support future actions. In the same sense, what is also illustrative is the explicit mention made in the study "Low-carbon Development for the Steel Industry in Chile," of the need to increase the levels of investment in research, development, and innovation (RDI), within the framework of program implementation, to promote innovation within the steel industry, within a set of public policy proposals aimed at overcoming the identified barriers.

Factors that go beyond climate change mitigation and adaptation measures must be taken into account when defining the implementation of measures that penalize carbon emissions. Studies on low-carbon development for Chile's steel and cement industries are revealing in this regard. At present, these industries face a difficult situation, characterized by strong competition from imported products, and the lack of sufficient margins to lower their price of sale. In such circumstances, the possible implementation of fiscal mechanisms such as carbon price instruments would require that they be supplemented by concomitant taxes on imports in order to avoid closure of Chilean steel and cement companies[6], as well as to prevent market penetration of products from unregulated countries (a phenomenon known as "carbon leakage")[7].

In sum, the implementation of carbon price policies is an unavoidable part of the facilitating frameworks required to transition toward a low-carbon economy that is aligned with the reduction goals agreed upon at a global level. It should be factored in that these State-generated incentives can be a window of opportunity for a technological upgrade that permits higher levels of competition and lower levels of emissions, but they can also become a burden that the industry is unable to bear. The aggravating factor is the risk that situations may arise that end up causing an increase in global emissions.

[6] According to the referenced study, the steel sector could be considered strategic, thanks to Chile's comparative advantages in mining. Technological improvements in cutting-edge mining sectors could benefit the sector as a whole (the use of hydrogen is an example). A steel mining cluster that produces green metal products could become an important lever of growth for Chile in the coming years, thus the importance of not letting this industry die.

[7] Both studies suggest that an efficient way to manage competition between imports and local production is to implement a Border Carbon Adjustment (BCA), which consists of imposing on imports the same price for carbon that is applied to local production.

## 1.2 The state as a generator of a "favorable environment" for the development of the CCTs

Based on the analysis of the studies carried out within the Project framework, it can be inferred that the State's role is of fundamental importance in the preparation and implementation of a public policy portfolio (general and sectoral) that facilitates the development and transfer of CCTs. In particular, this support becomes crucial when it comes to recent or disruptive technologies, or nascent innovative industries (without a prior market).

A cross-cutting theme in nearly all of the studies is the need for countries to have clear, stable energy policies with short-, medium-, and long-term objectives. To the extent possible, these state policies should transcend a country's inevitable political ups and downs. Without these characteristics, CCT development and transfer in the energy field is extremely difficult. Said policies must also advance the generation of adequate institutional, regulatory, human, financial, and infrastructure capacity, as well as the generation of ideal conditions for investment (legal security, access to capital, etc.).

As a result, it is necessary for the State to play a key role vis-a-vis the implementation of public policies that facilitate the development of local markets, in order to allow a period of maturity for these technologies, which, in turn, allows optimizing processes and the achievement of competitive products or services. Likewise, it is of vital importance to ensure the sustainability of these public policies over time, which, both in the design phase and in the definition of support mechanisms, promotes the greatest participation of stakeholders (both public and private), and promotes the creation of permanent inter-institutional and multisectoral entities that will defend the development and transfer of CCTs.

Figure 8: Clear and Stable Energy Policies (among the possible State policies)


Source: Bariloche Foundation, Design: Renato Oña Polit

It has been observed that, on many occasions, debates focus on the relevance (or lack thereof) of applying a specific support instrument, when in reality, it is rare that the success of CCT implementation will depend upon the application of a single instrument; instead, it depends on the combination of several instruments and the details of their design and, above all, the ways in which they adapt to national conditions. In this regard, it should be noted that the experiences of countries that have made significant progress in CCT implementation reveal the importance of putting into practice an entire battery of complementary policy instruments that aim to create an "enabling environment," one which addresses the multiple dimensions of the problem. A significant part of this "enabling environment" consists of the existence of additional support measures, such as: investment subsidies, subsidized financing, financial guarantees, tax benefits, land use rights, construction of connection infrastructure, etc. In addition, the efforts of the different agencies involved in the generation of the aforementioned environment should be trained on the same general, common objective, ensuring that the support resources that are implemented don't create obstacles for one another; for this, a state policy that aligns and consolidates all efforts is required.

Because of its characteristics with respect to the significant number of studies and the breadth of the issues addressed, the Project provides valuable information regarding the institutional and regulatory frameworks that contribute to the generation of a favorable environment for the development and transfer of technologies related to climate change. Likewise, among the most important contributions obtained from the studies that were carried out, were the identification and formulation of a significant number of proposals for public policy measures, which aim to generate a framework of incentives for technological progress toward less carbon intensive methods.

The ultimate goal of public policies is to promote changes that government authorities consider desirable for society as a whole. These changes may be institutional, legal, financial, or cultural in nature. Therefore, to have a practical impact, these policies must be expressed through instruments that allow modification of behavior of economic agents, so that the desired goals can be reached. Obligations, rights, rewards, and sanctions for stakeholders are some of the instruments typically used to help achieve the desired effect.

Among the main findings, it is worth highlighting the enormous variety of instruments proposed by different studies, with the goal of supporting the adoption of the promoted technologies. Considering it of interest to the countries in the region, a survey of the aforementioned instruments was carried out, which are indicated below, and are grouped into four categories: (a) command control (or direct regulation); (b) based on economic incentives; (c) based on goods provided by the government; and (d) based on information and voluntary schemes. The following classification is presented below, keeping in mind that this is not exhaustive and many of these instruments could be placed in more than one category:

### Table 1. Classification of the Proposed Instruments

| Command and control | Economic incentives | Goods provided by the government | Information-based instruments and voluntary schemes |
|---|---|---|---|
| • Minimum performance standards<br>• Technological standards<br>• Product standards<br>• Certification of teams<br>• Inspection tasks<br>• Technical standards of EE<br>• Special rates<br>• Local content clauses<br>• Environmental certification<br>• Energy certification<br>• Land use rights<br>• Energy audits<br>• *Border Carbon Adjustment* | **Market**<br>• Standard renewables portfolio programs (specific or neutral)<br>• Facilitating the sale of surplus energy<br>• Compensation plans<br>• Exoneration of charges for infrastructure use<br>• Local content clauses<br>• Tradable issuance permits<br>• State purchases (catalyst role)<br>**Financing**<br>• Subsidies (investment in equipment, installation)<br>• Subsidized financing<br>• Financial guarantees<br>• Trusts<br>• Structured financing<br>• Concessional funds<br>• Revolving funds<br>Access to sources of international financing and cooperation resources<br>**Taxes**<br>• Tax/customs exemptions on imports (equipment and assets)<br>• VAT exemption (equipment, generation surplus)<br>• Accelerated depreciation of investments<br>• Reduction of income tax<br>• Tax credits<br>• Carbon tax<br>• Tax Credit Certificates | • Investment in connection infrastructure<br>• Investment in research, development, and innovation<br>• Technology transfer programs<br>• Technical assistance programs<br>• Innovation development programs | • Communication and dissemination campaigns<br>• Product labeling<br>• Dissemination of incentive programs<br>• Certificates of recognition<br>• Clean Production Agreements<br>• Training programs<br>• Awareness campaigns<br>• Creation of Best Practices Guides for Efficient Energy Use<br>• State purchases (demonstration effect)<br>• Establishment of APP<br>• HRT |

Source: Design by Bariloche Foundation.

In the Appendix 1 Table, we present each project, noting the instruments used in each one.

One of the greatest challenges governments face in implementing such support mechanisms is related to their ability to adapt to rapidly changing conditions. This signals the need to periodically review the relevance of the established mechanisms and to adapt them based on results and new conditions. As a result, the greater the flexibility of the instruments, the better the results. For example, one of the main strengths of the auction mechanism for the promotion of electricity generation based on renewable resources is its flexibility, to the extent that it allows a bespoke design based on the market's evolution, the characteristics of the electricity system, and the desired renewable energy development goals.

Establishing time limits for policy reviews and evaluations and for regulation to support CCT development is a desirable measure, whether based on a calendar or on market development objectives, to the extent that this sends signals for the market to develop in a predictable, stable way, controlling the introduction of viable new local technologies and ensuring certainty for investments. To achieve this, the maintenance of the existing scheme for a guaranteed, pre-established period of time, must be set for existing facilities.

A recurring theme in the distinct studies carried out, is related to the fact that in order to advance in CCT development and transfers in the energy sector, political and institutional will of the governments is required, and this will must be expressed in concrete deeds, and not just words. One way of visualizing the degree to which this will is realized, is made manifest in the commitments assumed by the public administration.

Public procurement is a favorable environment for the purposes of filling this commitment. Thus, due to their volume, purchases by the state can play a dynamic role in a market, generating a critical mass (a demand floor[8]) that allows the entity to take advantage of economies of scale, enabling the execution of pilot projects, and helping generate confidence in the chosen technology, especially if it is a novel technology. To all of this, we add the instructive role of the State as an example, enhanced to the extent that supporting the CCT is legitimized by the state administration's implementation of it.

As an example, there is the study on cogeneration, which proposes recommendations for the promotion of said technology as part of public procurement. In the study on low-carbon development for Chile's steel industry, it is proposed that green steel be promoted in public infrastruc-

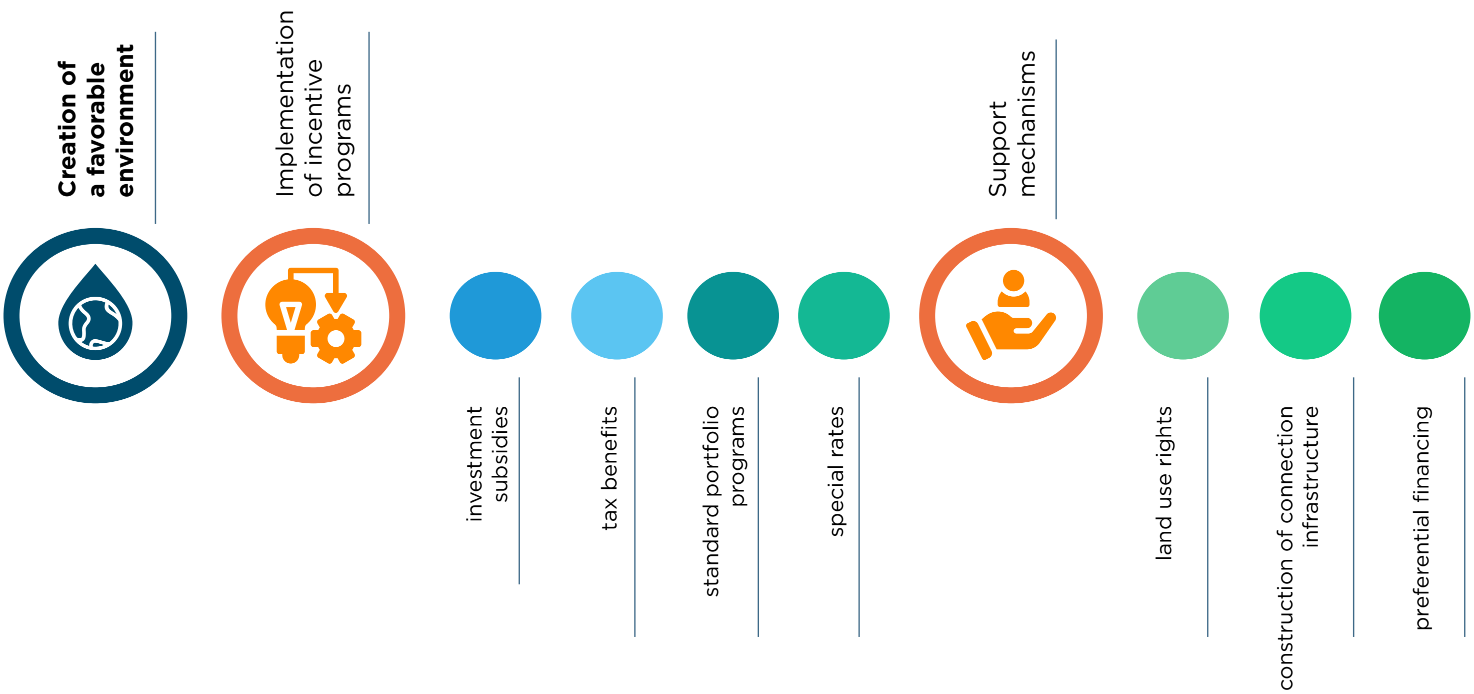
[8] Without this captive demand, betting on large investments in technological updates in incipient markets could be very risky for companies.

ture and housing projects (via green steel quotas), and the special relevance of its application in the early stage of product development, in order to ensure an initial demand, which is essential for launching pilots and start-ups to allow specific capacities in this sub-industry to be developed and perfected. In this way, the specific policy to leverage in this industry would be promoted by the Ministry of Housing and Public Works, which in its tenders would establish the green steel quota for each project. Also, in the case study on Solar Water Heaters, reference is made to the fact that in several countries in the region, the implemented promotion regimes are associated with Public Housing Programs.

An important number of studies suggest that the deficit of human technical capacities is one of the primary barriers to further advancement of CCT among the countries in the region. In this sense, special emphasis is placed on the need to strengthen local technical capacities as part of human development policies within the framework of the State's role as a generator of a "favorable environment" for the development of these technologies. The study about cogeneration systems, which underscores the need to generate strategies that strengthen countries' technical capacities through training programs and sharing of experiences, is illustrative in this regard.

Furthermore, for the capacity building investment to bear fruit, it is essential that this effort be part of the framework of state policies that give it continuity and long-term perspective. Another interesting example of the role that the State can play as a lever for public policies in environmental issues – and especially in the promotion of instruments that support CCT adoption – is in the study of low-carbon development for Chile's steel industry. In that study, it is proposed that the State subsidize "X" percentage to those sectors that offset emissions from strategic sectors, which, in this case, is the steel industry. Thus, for example, if the market price of offsets were US$5/ton, the State could subsidize 20% of the price (US$1/ton) to those companies from these sectors that are offsetting emissions.

**Figure 9: The State as a Lever for Public Policies that Promote CCT**




Source: Bariloche Foundation, Design: Renato Oña Polit.

Several of the studies refer to the existence of cultural barriers in the development of CCT. Overcoming these barriers generally requires behavioral changes to promote new habits (behavior change). For this to happen, the existence of state policies on the matter is also key, since all actions that are aimed at changing cultural norms are always a long-term bet, requiring great perseverance and consistent signals over time.

## 1.3 Country Vision

We have already pointed out the importance of addressing the issue of promoting CCTs with a systemic, global vision of the energy sector's performance, including the definition of policies, programs, plans, instruments, and goals for the entire sector, all framed within a strategy that establishes specific short-, medium-, and long-term objectives. This comprehensive, multidimensional vision should not be limited to the energy sector, however; it should take into account the relationships between the sector and the rest of society, taking into account policies and national commitments (including, obviously, those related to the environment), with particular emphasis on the socio-economic context of the country and its national priorities.

In the studies that were carried out within the framework of the Project, positive impacts of the implementation of a specific CCT are highlighted, and reference is made to the fact that technological advances have made them increasingly competitive. Nevertheless, in practically all cases, within the framework of creating the "enabling environment," as mentioned above, there is a need to implement incentive programs that include complementary support measures (investment subsidies, preferential financing, tax benefits,

standard portfolio programs, special rates, etc.). In addition to these support measures, in some cases the implementation of these technologies also requires additional investment efforts, which will fall on large sectors of the population. Such is the case, for example, of the promotion of distributed generation at the urban-rural level, which requires significant investments in distribution networks. Likewise, in the case of the promotion of self-consumption, it is proposed that implementation should be carried out in a synergistic way with the increase in the use of information technologies in the electrical system, developing to the maximum the introduction of smart meters and energy efficient, smart consumer devices, all of which will require additional investments.

All of the countries in the region have, in one way or another, expressed their willingness to advance in the process of transitioning to a new energy paradigm, characterized by decarbonization, the decentralization of generation, the electrification of the economy, a more active participation on the part of consumers, and a more sustainable use of resources. However, in order to facilitate an energy transition in a regional economic and social context that is characterized by vulnerabilities (which are exacerbated by the ongoing COVID-19 pandemic), it is imperative to evaluate the relevance of providing the aforementioned complementary support within the framework of the priorities established at the country level. This requires being very selective when it comes to defining implementation, prior evaluation within an opportunity cost approach, and a rigorous analysis of its impact on society as a whole (social, economic, and environmental), in addition to the identification of the sectors that will bear the brunt of the efforts.

In sum, we cannot lose sight of the fact that each study provides a partial view, focused on a specific technology or instrument, in which benefits, and attributes stand out. It is the responsibility of decision makers who, endowed with the country's vision and unique priorities and specificities, define the technologies that meet the conditions to merit support and, the ideal moment to put it into practice.

Within the energy transition process framework described above, and based on an overview of energy systems, it should be sought to combine the emphasis on the promotion of EERR use with the role of other energy sources that can figure into the transition framework, as an acceptable complement to renewable resources. Such is the case of natural gas, which many experts consider to be the ideal complement to the development of EERR, in the context of the current energy transition. In accordance with the latter, the very fact that one of the studies focused on natural gas as an energy solution for the Mendoza Andes, essentially replacing liquid fuels for energy supply, serves as a clear example of the role that natural gas could play as a bridge in the process of creating a cleaner energy mix.

The analyses carried out in the studies "Photovoltaic Solar Energy in Buildings" and "Use of the net balance mechanism to promote decentralized electricity generation from renewable sources," provide clear examples regarding the need to incorporate a comprehensive, systemic vision at the country level.

In the first study, referring to the promotion of self-consumption, it is stated that "in the context of Latin American countries, it is neither fiscally nor politically viable to define a compensation feed such as feed-in-tariff." In other words, it takes into account the countries' socio-economic context to reject the promotion of a specific support instrument. However, it raises the existence of other options, such as net billing and net metering, and adds that "by themselves, they cannot achieve the financial closure of solar roof acquisition, but when accompanied by other incentives that reduce system costs, they can make the investment viable." They then propose the application of investment subsidies as an initial way to overcome this barrier.

After listing the advantages of decentralized electricity generation and, in particular, of self-consumption, the second study recommends the implementation of preferential financing recommendations, given the high cost of initial investment. But it does not go unnoticed that the large-scale implementation of self-consumption implies an additional effort for the distributor in the planning and management of the network[9]. Furthermore, for the consumer, it presents the inconvenience that non-producer consumers may see an increase in their bills, since fixed costs would be borne by a smaller number of consumers[10]. The dynamics of this process pose a challenge in terms of social equity, since households with the highest incomes are those that would be in the best condition to invest in distributed microgeneration, and the remaining households would see an increase in their electricity bill as a consequence of network charges being assigned among a lower number of users. All of this would contribute to a regressive redistributive effect, which is obviously unwanted.

9 The connection of a self-consumption installation implies administrative costs for the distributor and sometimes requires investments for infrastructure updates, as well as, in many cases, the installation of a bidirectional meter.

10 The study emphasizes the multiple benefits that self-consumption provides to the electricity system: the reduction of losses in transmission and distribution, and the reduction of investment needs for centralized generation, transmission, and distribution. Although an in-depth analysis of the subject is not conducted, all signs seem to point to the fact that said benefits would not be sufficient to offset the increase in the bills of non-producing consumers, as a consequence of large-scale implementation of self-consumption.

The need to promote technological progress toward less carbon-intensive methods also requires a country vision that defines its priorities when establishing the contribution of the different sectors to the global carbon budget, established according to the objectives established by each country under the Paris Agreement. The study "Low-carbon development for the steel industry in Chile," is illustrative in this regard. Since "sectoral emissions budgets"[11] have not yet been defined for determining the objective of reducing emissions for the sector and for the path that should be followed to achieve it, it was taken as a reference that the worldwide steel sector would set a total budget of 112 Gt-$CO_2$ between the years 2011 and 2050[12]. Under this premise, the carbon budget corresponding to the Chilean steel sector was obtained by considering Chile's participation in the steel production market as a fraction of emissions for the steel sector worldwide. Although this approach makes it possible to overcome the identified deficiency, there is a risk that technologies ranked by sector according to their cost-effectiveness to reduce emissions, do not actually correspond to an optimization of abatement measures to be implemented at the country level.

The issue of energy tariffs and price subsidies – a subject explicitly raised in some of the studies carried out – deserves separate treatment, as it cuts directly or indirectly across sectors. As an example, among the relevant conclusions of "Comparative Analysis of Energy Efficiency Standards in Buildings," it is suggested that the distortion in energy prices due to subsidies sends an erroneous signal to consumers and makes EE projects less attractive due to a long return on investment. As a result, the study proposes to eliminate inefficient energy subsidies that exist in the countries that were studied. Similarly, the Technological Roadmap for Biomass-based Thermal Generation in Costa Rica proposes a scenario of scaling-up technologies for the use of biomass, in which the national government is recommended to gradually eliminate or reduce hydrocarbon subsidies so that bioenergy can move into competitive spaces.

The analysis of the very existence of subsidies and their function is the subject of multiple analyses, intense debates, and tackles various conceptual approaches that are beyond the scope of this chapter. Nonetheless, the analysis of studies that were carried out shows that their existence is one of the main barriers in CCTs becoming widespread and competitive. Because it is a complex issue and there is no one-size-fits-all solution for all countries and all circumstances, it is a challenge to find solutions that allow incentives to align properly when rates do not represent costs. In this sense, it is noted with concern that, in many cases,

[11] In July of 2020, the Senate's Environmental Committee approved the Framework Law on Climate Change. The draft of the law establishes emissions standards that define the "Sectoral emissions budgets," which set the maximum amount of GHG emissions accumulated at the sectoral level within a given period, which is determined by the Long-term Climate Strategy. Said strategy defines the general climate change guidelines in a cross-sectional, integrated way, so as to guide and link all climate change management tools. http://leycambioclimatico.cl/leyccchile/

[12] Transition Pathway Initiative, 2019. Carbon Steel Performance. Available at: http://www.lse.ac.uk/GranthamInstitute/tpi/the-toolkit/.

the application of energy subsidies occurs in a generalized way, without taking into consideration national or sectoral policy objectives (or even in cases of obvious discrepancy). In response to this situation, recommendations proposing the application of systematic, targeted subsidy policies are gaining more and more strength in minimizing the problems of inclusion and exclusion. Such targeting would make it possible to achieve the sought-after objectives and, at the same time, reduce the impact on State coffers, making it possible to redirect resources toward promoting CCT development, thereby contributing to reduction of GHG emissions and the fulfillment of the goals proposed by governments in the Paris Agreement.

Several of the studies that were carried out are good examples of how to address the subsidy problem with a comprehensive approach to all subsidies. In the study of energy solutions for the Mendoza Andes, for example, the net impacts on the set of monetary transfers from the national and provincial levels to the target population are analyzed, as a result of the substitution of liquid fuels for natural gas and promoting the generation of electricity using photovoltaic energy. A similar approach to subsidies was made in the study of energy policy options for the Galápagos Islands. In this case, the results of the consolidated analysis of the subsidies are revealing, showing that when the national price and tariff scheme is maintained, the monetary transfers to the islands remain and, in some of the proposed policy scenarios, manage to be reduced by half[13].

[13] The impact on subsidized energies relies heavliy upon each scenario's premises with respect to trajectory and degree to which savings and substitution policies are complementary.

## 1.4 Other cross-sectional themes

### 1.4.1 Pilot projects

Several of the studies carried out highlight that the implementation of pilot projects is highly recommended as a strategy to reduce the inherent uncertainty in these types of technologies, since they are relatively new technologies for the region and have limited information available about them. In those cases in which the adoption of a CCT involves substantial investments, the implementation of a pilot project on a reduced scale allows better understanding and management of the risks and minimizes losses in the event that the promoted technology is not feasible under the specific conditions of a particular country. It can also help to contain the budget by providing valuable information to improve the overall project implementation (process improvement, etc.).

What is more, in a region where lack of information and awareness about CCTs is commonplace, the implementation of pilot projects in which the operation of specific CCTs for specific applications is seen, contributes to overcoming many of the identified barriers. In this sense, the dissemination of pilot project results is essential for transmitting trust to users. Likewise, the formulation of a pilot project is also an ideal means of fine-tuning the structures that are necessary for the formation of a framework that is conducive to the development of CCTs, such as the existence of specific training profiles, financing strategies, incentive programs, required deadlines, etc.

Based on the analysis of the set of studies that was carried out, it can be inferred that one of the main barriers to adoption is the lack of knowledge of potential CCT users with respect to the potential for economic savings and taking advantage of concomitant benefits (such as access to markets with para-tariff barriers that are linked to environmental or climatic effects). In this sense, the execution of pilot projects is an excellent opportunity to undertake market studies and cost-benefit evaluations, as well as identify opportunities such as those mentioned previously.

One element to take into account when facing the financial-economic aspects of a pilot project is the case of modulable or (barely modulable) technologies, in which cutting economies of scale considerably reduces possible benefits, thereby increasing the project's unit cost. As a result, in these cases, making a simple extrapolation of the pilot project results could lead to significant errors, all of which increases interest of including a study on the potential market of the study in question, in turn, providing a firm basis for assessing scalability and its impacts on costs and benefits.

Similarly, it should be emphasized that it is of fundamental importance to disseminate knowledge acquired and results via communication and outreach campaigns in order for pilot projects to fully achieve their objectives.

As an example of what's referenced in the preceding paragraphs, the study on Solar Water Heaters (CSA) states that "the execution of pilot projects is essential for the purposes of evaluating the technological, economic, social, and environmental aspects of CSA use, and that it is in these initial experiences that all of the relevant variables are adjusted. In fact, Barbados, Brazil, Colombia, Chile, Mexico, and Uruguay implemented pilot programs that made it possible to show the operation of CSAs, and to adjust the instruments required for their promotion (incentive mechanisms, inclusion of CSAs in public housing policies, etc.).

Another example is provided by the study that undertook the development of a Technological Roadmap (HRT) for technologies for solar water heating and heating and cooling of buildings in Costa Rica. In this study, the importance of "implementing pilot projects that allow proposed technologies and their impacts to be tested in a real way" is emphasized, and as such, it proposes the execution of multiple pilot projects in the industry, commerce, and service sectors.

### 1.4.2 Dissemination campaigns

One cross-cutting aspect of all the studies is related to the importance of implementing dissemination strategies for incentive programs and the results of pilot projects. Thus, several studies emphasize that the existence of deficiencies in the dissemination of information about a specific CCT translates into ignorance about the technology and makes it difficult to implement new projects. As such, given the lack of information that exists about CCTs and their attributes, it's critical to promote a dissemination policy across different levels and among all relevant parties (users, authorities, companies, banks, and institutions), all of which result in greater efficacy of policies for the promotion of these technologies.

Similarly, several studies underscore the importance of developing awareness campaigns, dissemination, information and educational programs that make it possible to combat the lack of knowledge and awareness about energy efficiency and CCT generally. Analysis and learning about the experiences related to these issues (both at the national level, as well as regionally and globally) contributes to the dissemination of acquired knowledge, with the purpose of LAC countries being able to discuss these matters and adjust experiences in the region to their own local realities.

### 1.4.3 Business and management models

Some of the studies carried out make reference to the importance of having management models that ensure the sustainability of the chosen technological options. To the extent that an instrument promotes the adoption of appropriate technologies and ensures their sustainability, the selection of an appropriate management model can imply a substantial reduction in the number of necessary investments and can be an important contribution to the measure's success.

Figure 10. Management and Business Models

Often times, analyses tend to focus excessively on those aspects related to investments in technology, overlooking those aspects relevant to the area of management, when in reality, inadequate management can become the primary obstacle impeding the implementation of a specific technological option.

The choice of an adequate management model can imply a substantial reduction in the amount of investment needed, and can play an important part in the success of the measure to be implemented.

Source: Bariloche Foundation, Design: Renato Oña Polit.

It is also worth noting the importance of implementing a group of performance indicators that allow continuous, objective monitoring of a project's management, with the aim of evaluating the degree of compliance with the established objectives and contributing to the correction or strengthening of strategies and resource allotment, helping to achieve the established goals. In this sense, it is highly recommended to carry out ex-ante y ex-post energy and economic impact evaluations of each project. The ex-ante analysis, operating on certain assumptions, makes it possible to identify potential energy impact, as well as to determine the project's costs and benefits, as well as those of the stakeholders, especially those of the users. The ex-post evaluation makes it possible to identify the real impact of the implementation of a specific CCT, both at the energy level and economic level, providing inputs that allow adjustment of the initial hypothesis, the identification of possible market modifications, and the correction of all those variables that are outdated.

Various studies also reference the importance of proposals with the aim of promoting the development and transfer of CCT being accompanied by the development of business models that adapt to the country's specific conditions and the technology to be promoted. The possibility of having this analytical tool can constitute a valuable contribution to the proposal's success to the extent that it provides a systemic vision of the business and its central attributes, including its purpose, processes, strategies, organizational structure, target market, and the income sources and income streams, among others. Thus, several studies carried out within the framework of the Project have focused on the development of business models that contribute to the creation of a framework that is appropriate for the implementation of a specific CCT.

## 1.4.4 Selection of representative studies

Below, by way of example, we present some case studies that address the previously mentioned issues:

- The importance of ex-ante and ex-post analyses is emphasized in the comparative analysis of Energy Efficiency Standards in Buildings. This study points out that the ex-ante analysis is not carried out in many countries, and the methodology is not transparent in those countries where it is carried out. Even so, despite these deviations from best practices, the countries that develop cost-benefit analyses ex-ante to the implementation of a standard, are on the right track. When it comes to the ex-post evaluation, the study indicates that when it is carried out annually, it indicates the opportune moment to update the technologies' minimum performance levels. It also indicates that, within the framework of a standards and labeling program, this analysis makes it possible to understand the market evolution and to adjust standards and labels to reality and its changes. Similarly, the study signals that the annual ex-post evaluation indicates the optimal moment for updating the technologies' minimum performance levels.

- The study "Photovoltaic Systems in Educational Institutions in Nariño (Colombia)" reveals the importance of having a management model that guarantees the environmental, social, economic, and technical sustainability of the proposed technological solution. Because of its innovative nature, it's worth pointing out that one of the strategic components of the model proposes that the educational center operate as an energy services company focused on renewable sources (RESCO), initially offering the service of renting solar lanterns, which would be financed by the project. In this way, the financial balance between costs and revenue is sought, depending upon donations, revenue in current currency that comes from services offered by RESCO, and the implementation of a social currency to cover Operational Costs related to staff and students.

- Three strategic opportunities were identified for development in the study "Economic valuation of the energy potential of forest biomass in the North Huetar Region of Costa Rica," each with a different scope and different levels of environmental and socioeconomic reach and impact (sawmills and furniture stores; replacement of basement boilers by forest biomass boilers in process industries; and steam and electricity generation through cogeneration systems). For each of these, a business model was designed to facilitate the achievement of the desired objectives. This same study underscored the relevance of developing a management model for the implementation of the public policy proposal and its follow-up, organized by levels, components, functions, and stakeholders. All of these actions worked toward the purpose of coordinating actions related to biomass resource supply and demand and collaborating in the creation of an environment that is conducive to public institutions, civil society, and private companies working in synergy.

### 1.4.5 Background Information

An important aspect that cut across most of the studies was the lack of good background information in many countries, which is generally the product of the lack of reliable, comprehensive statistics on the energy and socioeconomic activities of the countries as a whole. This deficit represents an important barrier to the extent that it does not allow the attainment of indicators with a level of reliability that facilitate informed decision making with the greatest possibilities for success. In this sense, by way of example, it is worth mentioning the need for countries to have updated useful energy balances, which serve as a baseline for the analysis of the possibilities of energy source substitutions, and of competitiveness of prices and tariffs among the varied sources. Thus, it is advisable to expand upon and improve the information gathering and information processing methods, and to develop useful energy balances to facilitate, among other things, the assessment of initiatives to promote CCT development. At present, this task is facilitated by the immense potential of computing and Big Data to measure energy use on a large scale within the sectors.

One fact to highlight is the general population's growing interest in issues related to the environment and energy. This underscores the need to expand the scope of dissemination activities and to try to reach beyond specialized spaces, generating clear, brief messages that are in a language accessible to the majority of the population, and which can be broadcast by mass media (digital, TV, social media, etc.). As civil society occupies more and more spaces for participation in these matters and struggles for its voice to be heard in decision-making spaces, it is of fundamental importance to dedicate efforts and resources to allow a broad segment of society to access information that is honest, objective, and timely. There is no doubt that the informed and responsible participation of all interested stakeholders contributes to the enrichment of the decision-making process, improves the country's institutional quality, privileges the development of the most appropriate policies, and generates an optimal framework for its implementation.

Nonetheless, the aforementioned underscores the importance of continuing with the publication of documentation in specialized spaces, and to promote its use as technical inputs when developing countries' energy policies.

Based on the experience obtained in the development of the Project, it is recommended that some spaces are designated for face-to-face participation, even as it is recognized that use of the most advanced information and communication technologies allows optimization of time, costs, and emissions associated with the movement of people. As has already been pointed out, in-person participation in fora and seminars that call for the participation of authorities, middle managers, and decision-makers, enhances networking through direct, person-to-person contact, thus facilitating the identification of needs that are specific to countries and entities.

The creation of the database constituted a fundamental contribution to achieving greater dissemination, both of the results of the studies that were developed, as well as the calls issued to hire consulting firms and experts for developing the technical assistance requirements that countries required. As the database was built up with new contacts gathered at different national and international events, they were consolidated within a group of regional renewable energy and energy efficiency specialists, and the participation and degree of interest in gatherings, as well as requests for details of complete studies, increased significantly. In this sense, it is understood that it is important that this effort doesn't stop, and that the dynamic nature of the database must continue through a permanent updating process.

Recently, there has been a growing trend in terms of the offerings of events related to the subjects of energy and the environment. This is positive to the extent that it accounts for the growing importance of these subjects in our societies, but it also raises the need to develop a series of criteria that permit adequate selection of those events in which participation is justified and to determine the most appropriate form of participation. In particular, when deciding whether to organize a side event, assigning a time that coincides with a main or anchor event should be avoided, since the success of the side event depends largely upon the people who attend it; if it occurs at the same time as a main event, it is unlikely that the message to be shared will reach relevant recipients.

# Chapter 2

## Selected studies carried out within the framework of the project

Within the framework of the Project, a process was carried out to identify opportunities for investment, evaluation of technologies, and economic and financial feasibility studies in the adoption of the CCT (which included a cost-benefit analysis, market studies, business and financing models, and the design of financing mechanisms)[14].

The resulting products responded to the requests that originated within the countries, those that were evaluated, prioritized, and approved in alignment with the criteria and procedures approved by the IBD and adopted by the Bariloche Foundation. Said procedures were established as a means of ensuring transparency, consistency, and efficiency, and to prioritize the CCT based on criteria such as the efficacy in terms of costs, mitigation potential, the possibility of replicability, and congruence with national circumstances, capacities, and priorities.

[14] For this, calls were extended to public entities (beneficiaries) of a regional, national, or local nature, aimed at defining and implementing public policies about energy efficiency and renewable energies and identifying the possibility of accessing funds (non-reimbursable) to carry out the studies, which were aimed at fulfilling the objectives of training about and transferring environmentally sound technologies (ESTs). The form requesting agents were required to complete can be accessed here: http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/objetivos/

Each study is presented in summary form, highlighting the most relevant aspects of a technological, regulatory, policy, and market nature, followed by a description of the types of barriers that were identified, a sharing of the results, an articulation of the conclusions, and the formulation of recommendations for concrete actions that can be put in place to achieve the elimination of barriers. Given that one of the main objectives of this Project is to facilitate the implementation of TCC pilot projects, whether by private or public entities, those studies that, upon their termination, demonstrated a significant interest in carrying forth their short-term execution, were incorporated as a follow-up action item with potential for implementation.

Below is a selection of seven projects, which are offered here in order to illustrate the variety of studies that were conducted within the framework of the project[15].

## 2.1 Economic valuation for the energy potential of forest biomass in the North Huetar Region of Costa Rica, which serves as a basis for the formulation of policies that consolidate forest participation among the sustainable energy options.


[15] The selection has been made based on the following criteria: inclusion of the two themes -- renewable energies and energy efficiency; representation of the three geographic regions (Central America and the Caribbean; the Southern Cone; and North and South America); possibilities for replicability; originality or potential for implementation; and anticipated impacts during implementation

The current study was developed at the request of the Costa Rican Ministry of Industry, the Environment and Energy and the National Forest Financing Fund (FONAFIFO, in Spanish)[16], following an initial technical assistance exercise carried out for MINAE regarding the "Development of a HRT for Costa Rican adoption of thermal energy generation technologies" in the industrial sector, based on biomass residuals with a vision for 2030, to be carried out in two phases: i) planning and preparation of the HRT, and ii) definition of the state of technologies in the energy conversion to biomass in Costa Rica, in addition to having defined strategic objectives, identified barriers, and building out technological deployment scenarios for the adoption of technologies to generate thermic energy in the industrial sector based on biomass residuals.

Among the primary conclusions of the study, we highlight that in the case of end uses for heat in the industrial sector's processes, there is still an important space for growth to support biomass, principally in the agroindustry, which generates its own biomass residuals and where there exist market opportunities related to the base of biomass resources, the existence of an early added-value chain around the proposed technological applications, the development of start-ups, and projects in progress that lead the way in productively demonstrating and implementing within the industrial sector.

This antecedent led to the next step, which was the development of the study valuation of forest biomass, which is described below.

## i) Objective and scope

The general objective of the study was the economic valuation of the energy potential of forest biomass in the North Huetar Region (RHN) of Costa Rica, to serve as a baseline for forming policies for consolidating the participation of forests within the country's sustainable energy options.

The specific objectives proposed for the study included:

**1)** Identifying lessons learned in international cases, favorable policies, and environmental valuation methods for forest biomass for the generation of energy, once approved, which could be applied in Costa Rica;

**2)** Carry out the social/economic, energy, and environmental valuation of the energy potential of forest biomass in the North Huetar Region of Costa Rica;

**3)** To take the information obtained from the fulfillment of objectives 1 and 2 to identify financing sources and mechanisms for projects that take advantage of forest biomass residuals for energy proposals in Costa Rica, with the development of at least two proposals for green business models;

[16] The consulting firm BIOMATEC was in charge of the study and its execution during the period of November 2018-April 2020.

**4)** Create a proposal for a portfolio of public sector policies, to consolidate the participation of the forest sector among the sustainable energy options for the Costa Rican state.

## ii) Description of the most relevant aspects of the tasks performed

The use of forest biomass as a source of clean, renewable energy is an interesting option for decreasing the consumption of other energy sources that originate in fossil fuels, which cause high greenhouse gas emissions (GG) and other undesirable effects for the environment. The North Huetar Region supplies approximately 13% of logs and 19% of sawed wood in the Costa Rican economy. These statistics support the idea that the region represents a significant portion of the national forest sector and, as such, the success of innovative business models that generate added value to productive activity can permeate the national sector as a key strategy to revitalize the economy.

The cases of the United States, Finland, Uruguay and Honduras were analyzed to identify lessons learned and to identify environmental valuation methodologies for forest biomass in international cases. The resulting exploration focused on aspects such as national governance schemes with respect to energy and climate change; the legal and political framework in each country with respect to these subjects; the government incentives for renewable energies; and the main business models in each country as they related to biomass fuels.

One important finding made at this stage was that, in each of the countries analyzed, the design and implementation of climate change policies had permeated energy policies, mainly with respect to the strengthening of energy security and the substitution of petroleum-derived fuels. This propelled the exploitation of renewable energy sources, such as biomass. Furthermore, central governments have proposed incentives for the generation and use of energy that originates from renewable sources. In the case of biomass, among those incentives there is the entry of companies that produce energy from biomass into the free zones, which has conferred upon them favorable tax benefits and tributary benefits over the long-term, depending upon the type of project or investment.

With these lessons learned in mind, the study proceeded to research what occurs in the RHN in Costa Rica. In this region, the generation of forest biomass residuals is comprised in the actions of two groups that belong to the forest sector: the forest industry and the wood producers (reforestation, agroforest systems, and permits for natural forest management). The first group, comprised of stationary sawmills, portable sawmills, and furniture stores, generates sub-products with energy potential, such as kindling, sawdust, and shavings, while the second generates residuals through harvests and thinning.


Between 2015 and 2018, there was a reduction of approximately 46% recorded in the total supply of residual forest biomass in the region as the result of forestry industries, which suggests a worrying downward trend. The data as of 2018 show that the total supply of forest biomass in the form of forest industry by-product in the region was 51,487 wet tons in 2018, equivalent to 466 TJ. Sixty-nine percent of these residuals were concentrated in San Carlos. However, only 29.24% of the total supply of forest industry residuals (15,054 wet tons, equivalent to 80 TJ) is available for insertion in the energy market, either in the RHN or outside it. Yet, based on the survey carried out in the sector, at present, available forest industry residuals are given away or wasted; the residuals of harvests and thinning are not valued in the biomass market for energy purposes, and most decompose on site. As of 2018, these residuals represented 114,250 wet tons of supply, which, in turn, represent 608 TJ of raw energy. The energy demand (from fossil fuels and electricity) of the most important RHN industries contacted for this study is estimated to be 622 TJ/year, with the bunker representing a share of approximately 475 TJ/year.

Overall, the study established a robust methodology for determining the supply of residual forest biomass in the RHN, which included a detailed analysis of technical aspects so as to provide decision makers with a technical base that provides the fundamental data needed to justify measures to promote the use of this resource with different technologies analyzed as viable for the area. The study of three potential business models was also incorporated into the methodological framework.

For context, it is important to note that the RHN has high unemployment rates. However, national government, local governments, and private companies have proposed a portfolio of projects that would promote economic revitalization of the RHN with new consumption points that would demand energy, both electrical and thermal. These projects could generate new product chains to strengthen the forestry sector and to contribute, directly and indirectly, to the commerce, transportation, energy, industry, and banking sectors in the region. In this way, the revitalization of the area would have a positive effect on the entire value chain associated with the sale of wood, serving as an example to revitalize other socioeconomic regions of the country in terms of forestry.

## iii) Results and Conclusions

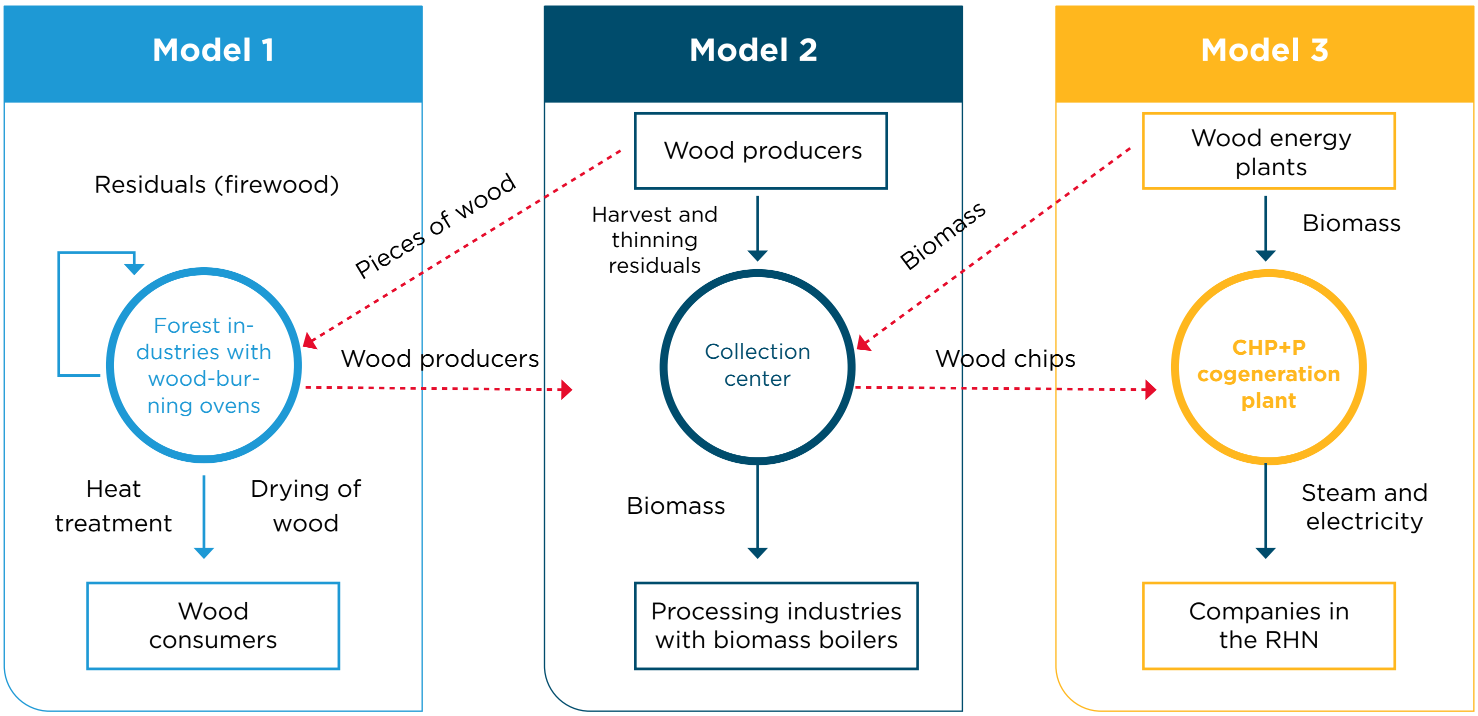
- The main result of the study consisted of the identification of three strategic opportunities to develop in the RHN, with different reaches and levels of environmental and socioeconomic impact in the region, which formed the base of the three business models that were proposed:

**1)** The first business model identified has a scope limited to forest industries (sawmills and furniture stores), which can add value to their products with the inclusion of drying processes of heating treatments for the wood. The use of ovens for wood can be technically and financially feasible as part of this model, as it involves lower operating costs. In these cases, the primary savings are found in the use of fuel for the furnace, since it would be fed with the wood residuals generated from the sawmill itself as by-products. Compared to the use of LPG, there would be savings of 40-80%, depending upon the size of the business.

**2)** The second business model proposed focuses on the replacement of bunker boilers for boilers powered by forest biomass from the region's processing industries, which would reduce the cost of steam production. This proposal would involve the creation of a key agent in the value chain: a collection center, which would be an additional provider of biomass in the form of wood chips from the region. The use of wood chips as fuel for boilers was studied based on a cost-benefit analysis, in which factors like energy capacity, GG generation, and associated transport costs were all taken into account.

**3)** The third business model proposed has the greatest reach of the three and could confer benefits to the development of the two previous models. This model rests upon the generation of steam and electricity through cogeneration systems. For this, the participation of the region's electricity distributor (COOPELESCA R.L) is key, which has already expressed interest in participating in the use of forest biomass within its generation activities. Each proposal presents multiple benefits, as it produces reliable, manageable, and non-seasonal energy, thanks to the characteristics of forest biomass attainment. In this way, it would provide direct report to the reactivation of the forest sector of RHN and its economy.

Figure 11: Proposed Business Models




Source: Biomatec. 2020. Economic valuation of the energy potential of forest biomass in the North Huetar Region of Costa Rica, that serves as a basis for the formulation of policies consolidating forest participation in sustainable energy options

**4)** Another important result of the study was the creation of a public policy proposal directed toward the use of forest residuals in place of fossil fuels in Costa Rican industry, especially in the RHN. This policy was proposed as a key tool for the success of the aforementioned business models, which are comprised of strategic objectives and actions intended to develop a low-emission economy, as well as the strengthening of the forest sector. The proposal's title is "Policy for the use of forest biomass residual as energy in the North Huetar Region of Costa Rica," and its creation was based on a guide by MIDEPLAN. Its general objectives correspond, loosely, with the six thematic axes around which the proposed strategic actions are grouped. Said axes are infrastructure, technical information gaps, interactive businesses, staff capacity building, organic social integration, and coordination of legal and political tools. There are 63 strategic actions in total, presented and articulated as a road map: 40 of a cross-cutting nature for the revival of the RHN forest sector; 7 specifically regarding the implementation of model 1; 4 for model 2; and the remaining 12, for model 3.

**5**) Finally, a management model was proposed for the implementation of the public policy and its follow-through. This model is organized into levels, components, functions, and stakeholders. In essence, the level of directorship has a leadership component directed by MINAE through assigned entities (SEPSE and FONAFIFO), and a component of inter-organizational technical coordination, with the Forest Cluster of the RHN and the RHN Development Agency as primary stakeholders. Said components would be in charge, respectively, of coordinating actions related to the supply and demand of the biomass resource. The second level (execution) has as components, public institutions, civil society, and private companies within the RHN, which are expected to work together in synergy.

The study also identified a cluster of activities whose execution would be essential to achieve the established objectives. These include:

- An increase in reforestation for wood production and wood energy.

- The reactivation of reforestation activities on land where reforestation efforts are stagnant.

- Improvements on canton and national roadways to optimize transport of materials and people.

- Technical assistance programs driven by the North Huetar Region Forestry Cluster, and technical personnel from TEC, UTN, CIA, ETAI and CODEFORSA[17], for wood producers who wish to improve their extraction processes ETAI and the commercialization of residual biomass from harvesting and thinning.

- Application of the INTECO solid biocombustible guideline, which is currently in development.

In April 2020, the project results were presented in a webinar conducted online. The link for the webinar, as well as the Project file, the Executive Summary, the infographics, and the final presentation, can be found in Table 1 of the Appendix.

[17] TEC: Tecnológico de Costa Rica, UTN: Universidad Técnica Nacional de Costa Rica, CIA: Centro de Investigaciones Agronómicas, parte de la Facultad de Ciencias Agroalimentarias de la Universidad de Costa Rica (UCR), ETAi: Escuela Técnica Agrícola e Industrial de Costa Rica, CODEFORSA: Comisión de Desarrollo Forestal de San Carlos (CR).


## 2.2 Action Plan for the Transition to Sustainable Energy of the Archipelago of the Galápagos Islands, 2020-2040. Supply and Demand Scenarios and Energy Policy Options.

The current project was developed at the request of the Governing Council of the Galápagos Islands (Ecuador)[18].

### i) Objective and scope

The objective of the study was the formulation of an "Action Plan for the Transition to Sustainable Energy in the Archipelago of the Galápagos Islands for the period 2020-2040," in accordance with what is outlined in the plans formulated by the Government of Ecuador with respect to energy and the natural environment of the archipelago. Similarly, it sought to bring together the results and available information from area studies that cut across the energy sector, in order to develop a holistic vision of the energy system that permits prioritization of the actions that lead toward the total replacement of fossil fuels.

### ii) Description of the most relevant aspects of the tasks performed

#### Information gathering: Analysis of the energy demand in the Galápagos

To develop the energy model, available information was collected, both from open sources, as well as government entities and national companies. The information collected was used to develop an energy balance for the period of 2009-2018, centered on the information requirements and the calibration of an energy model. The initial work plan suggested the most detailed bot-

[18] Its execution was under the direction of the Consulting Team comprised by G. Barbarán, N. Di Sbroiavacca, M. Fun Sang, S. Insuasti, F. Lallana, G. Nadal, I. Sagardoy, R. Soria, and was conducted during the period of August-December 2020.

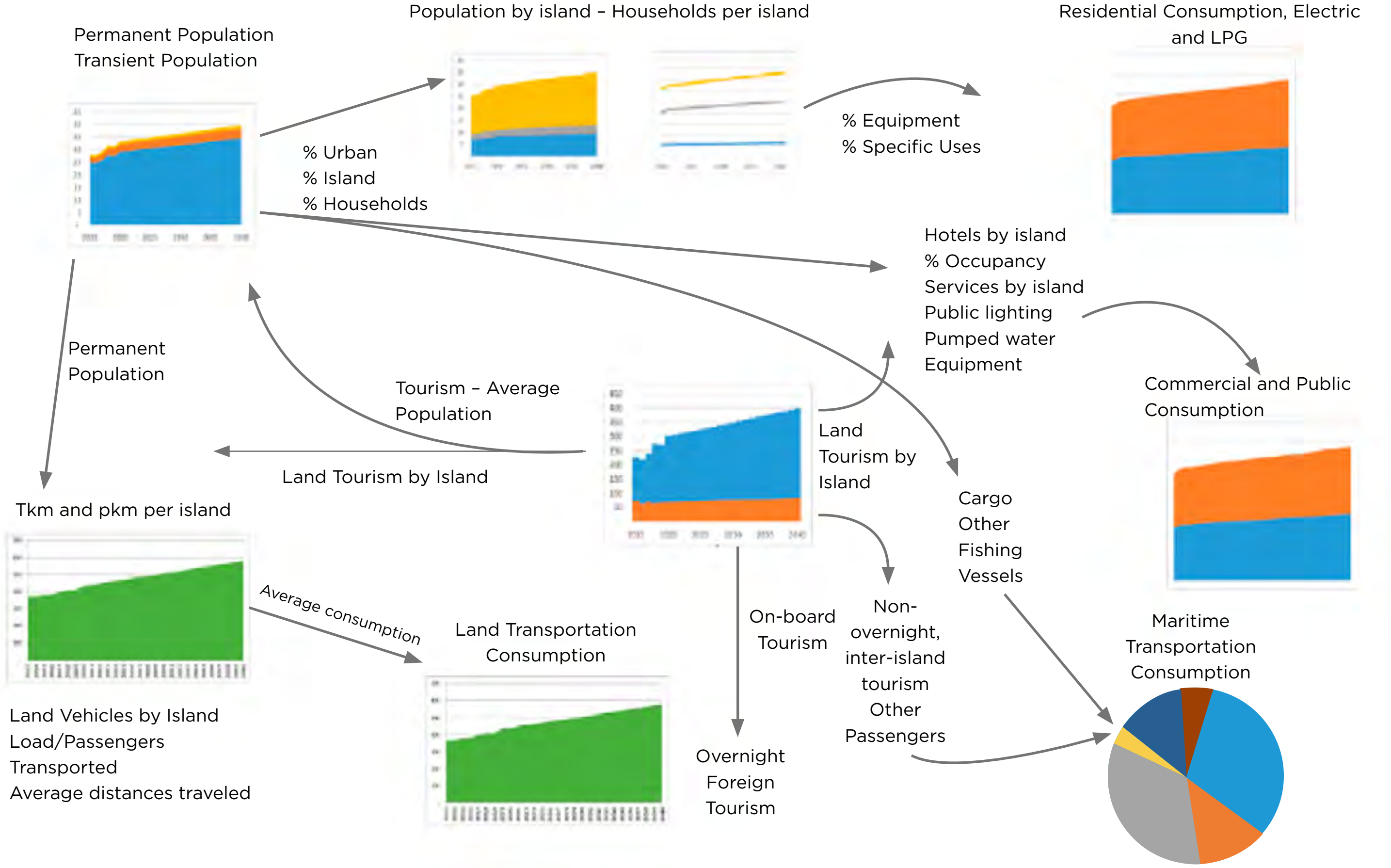
tom-up approach possible for the establishment of the energy requirements. This meant establishing a socioeconomic structure with intensities of use and forms of energy consumed. With all of the information gathered, four relevant use sectors were identified from the energy perspective:

- **Residential sector**: in turn, disaggregated into urban and rural areas, with the disaggregated urban areas in turn divided into houses and apartments.
- **Commercial and public sector:** disaggregated into tourist businesses (hotel consumption and other uses) and the rest (public lighting, public establishments, industrial use, and pumping water.
- **Land transportation sector:** disaggregated into passenger transportation (private, conventional cars; electric vehicles; taxis, buses, and motorcycles) and cargo (cargo trucks and special vehicles). Likewise, mobility demands characteristic of urban mobility were covered under the micro mobility category (bicycles, scooters, and travel by foot).
- **Maritime transportation sector:** due to its special relevance, information gathering for this sector was based on a detailed description of the maritime movements of large vessels and tourism mobility among the islands. This made it possible to adjust the energy use model based on requirements, making possible the adjustment for different fuel replacement scenarios. Maritime transport was disaggregated into inter-island cargo, passenger vessels, fishing vessels, overnight and non-overnight tourist boats, inter-island ferries, and foreign boats.

### Conceptual model for estimating demand

The model for estimating energy requirements is based on the socioeconomic structure of the Galápagos Islands. Based on the analysis of the collected information and specialized reports, it is seen that tourism is the principal driver of activities on the island and can also be used to explain the population of the islands. Thus, the different consumer subsectors were related to some of these variables. In the following figure, one can see the relationships among the energy requirements of the diverse sectors, with explanatory notes about each.

## Figure 12: Diagram of proposed methodology



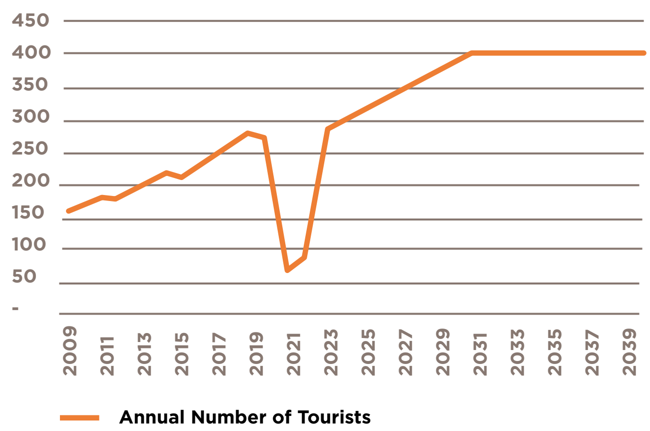

Source: G. Barbarán, et al. 2020. Prospective Energy Synthesis for the Galápagos Islands.

The model manages to explain the main energy demand of the islands, with the exception of diesel, where 20% of use is not explained. This would require additional information for its explanation.

## Assumptions for the energy demand and supply projections

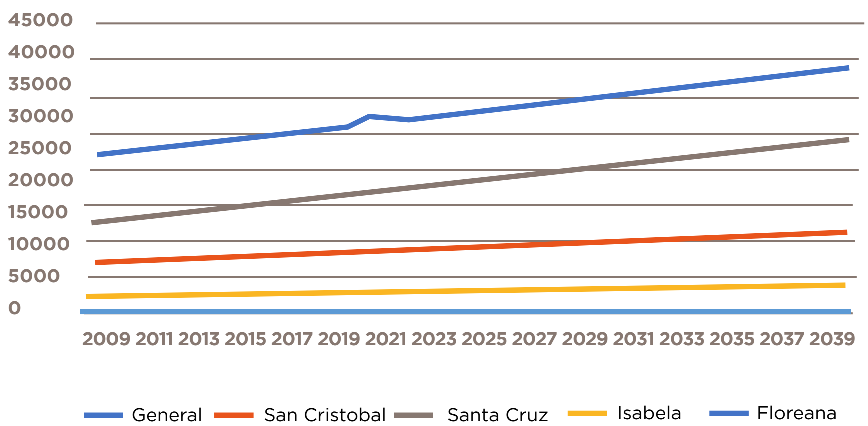
Given that tourism is the almost exclusive economic activity of the islands, a model was proposed in which the permanent **population** is directly related to the number of **tourists.** The following figures show relevant projections:

### Graphic 1: ESC Reference Annual Number of Tourists (thousands of people)




Source: G. Barbarán, et al. 2020. Prospective Energy Synthesis for the Galápagos Islands.

### Graphic 2: ESC Reference Population (people)




Source: G. Barbarán, et al. 2020. Prospective Energy Synthesis for the Galápagos Islands.

To develop demand scenarios, we worked with the four aforementioned sectors, each with its own patterns of use, growth projections, and policies for the replacement of fossil fuel use:

- **Residential sector:** Five policies were proposed to address the replacement of direct and indirect use of fossil fuels on the islands: i) the expansion of the induction kitchens program; ii) replacement by solar collectors, GLP water heaters, electric heaters and showers; iii) incorporation of LED lamps; iv) programs for the exchange of more efficient home appliances (air conditioners, refrigerators, and washers); and v) promotion of sustainable buildings. Policies for low, medium, and high implementation scenarios were developed, except in the case of lighting, which included a single scenario. The establishment of these scenarios took into account issues such as familiarity with the change, costs, and the technological possibilities for change.

- **Commercial and public sector:** This was modeled with two groups of decarbonization policies: 1) measures for technological substitutions and 2) measures for improvement of infrastructure. First, the replacement of sanitary hot water equipment with solar water collectors with storage capacity was analyzed, and advances were made with the expansion of induction kitchens and electric stoves. Second, the recommendations made by the Tecnalia consultants were considered, and three were selected: 1) reflective coatings for windows; 2) interventions around the finishing of exterior surfaces; and 3) thermal isolation.

- **Land transportation sector:** This is the second largest consumer of fuels and one with the greatest growth. Four measures were worked on, both those of a technological replacement nature and those of a structural nature: 1) implementation of public mass transit; 2) use of renewable energies (electricity and biodiesel); 3) higher occupancy levels in passenger vehicles; and 4) promotion of non-motorized mobility and micro mobility. All measures are evaluated in three levels of implementation (high, medium, and low).

- **Maritime transportation sector:** This is a sector of vital importance and the one that presents the greatest energy demands. Six strategies were analyzed for 17 types of vessels in the islands, with strategies applied in a distinct manner for each type of vessel: a) Lowering maximum speeds of operation; b) Sails; c) Efficiency of the main motor; d) Solar panels for auxiliary motors; e) Liquefied natural gas; f) Marine biofuels; and g) electricity-propelled motors. The distinct decarbonization strategies were proposed with low, medium, and high impact scenarios.

For the development of the reference scenario (REF) of energy supply, the expansions that were foreseen and articulated by the Electricity Master Plan were taken into account[19]. Three main scenarios were created for the optimization of the

[19] In the case of Santa Cruz, it was decided to incorporate a reference expansion that was different from the one established in the electric plans of the Ecuadorean Ministry of Energy and Non-renewable Natural Resources, in light of the progress on the Conolophus project that was made in recent months.

electricity generation supply. The optimization of the model that integrates demand with supply was carried out, under certain restrictions regarding the maximum annual incorporation capacity by technology, and the year from which they can come on-line; in addition, the expansion needs until 2040 were approximated.

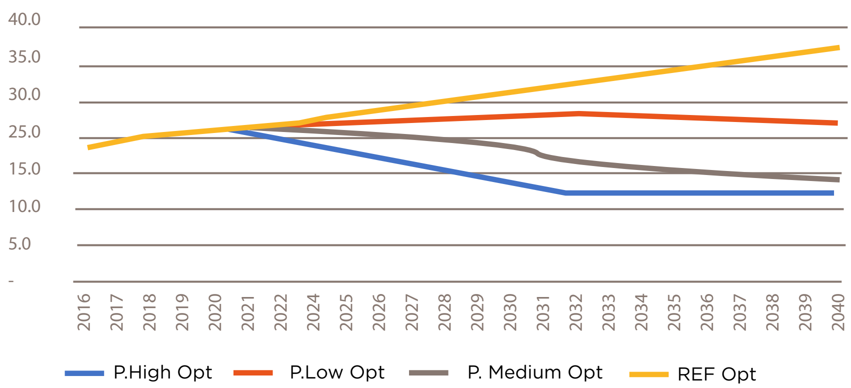
## iii) Results and conclusions

### » Demand scenarios

#### Residential, Commercial, and Public Sectors

In the Residential Sector, we highlight the fact that in the high implementation scenario, demand stabilizes from 2030 onward, given the early elimination of total consumption of LPG, which is approximately half the residential demand in the REF scenario. In terms of implementation costs, the residential sector shows important savings in the low and medium-level implementation scenarios[20]. The scenario of high implementation is penalized by the high cost of implementation of the sustainable building measures, which impact only 10% of residential electricity consumption. The implementation of this scenario would cost 132 MUSD.

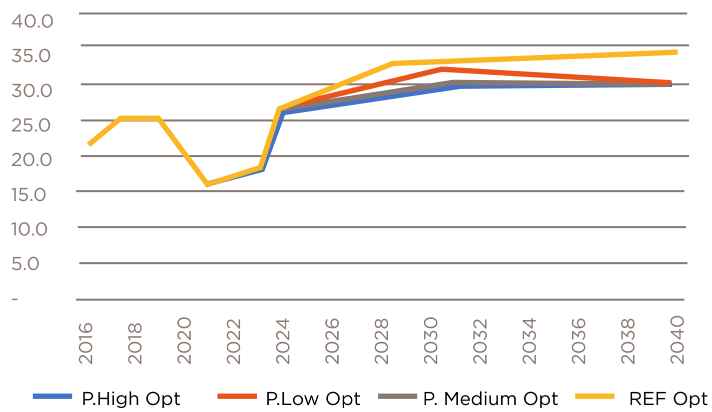
Graphic 3: Projections for the final demand for residential energy (thousands of bep)




Source: G. Barbarán, et al. 2020. Prospective Energy Synthesis for the Galápagos Islands.

[20] 75 MUSD and 59 MUSD for the low and medium scenarios, respectively.

**Graphic 4: Projections of final demand for Commercial and Public Service Energy (thousands of bep)**



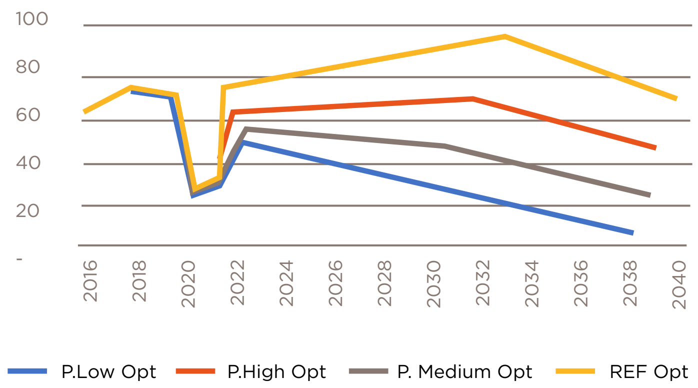

Source: G. Barbarán, et al. 2020. Prospective Energy Synthesis for the Galápagos Islands.

The evolution of demand in the Public and Commercial Sector presents similar results in the different scenarios, and the reduction with respect to the REF scenario is not as notable as in the residential sector, since that number of tourists increases the population substantially and the GLP represents only 14% of final demand within the sector. From the analysis of the results, one also learns that the measures for replacing technologies generate savings that outstrip the costs incurred in the implementation of the policy, though the savings generated by infrastructure measures do not compensate for the costs of implementation. It is estimated that the required investment in the high scenarios is 52 million USD; 29 million for the medium scenario; and 13 million for the low scenario. Independent of which entity is in charge of the investment, it is possible to visualize the feasibility of the policies because the methodology used allows comparison of the systemic costs with the savings produced.

### Land and Maritime Transportation Sectors

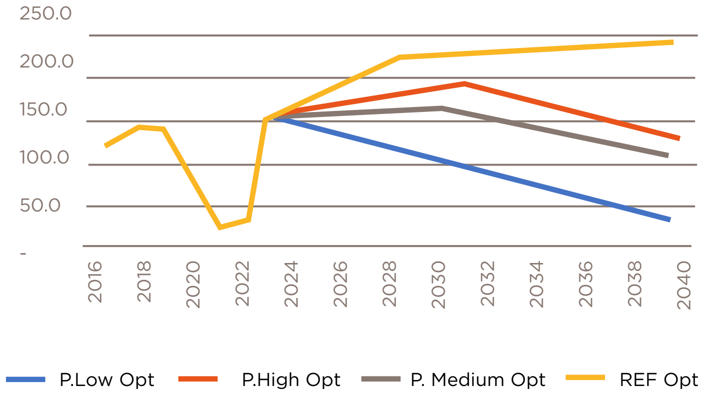
In the REF scenario, the final demand of land transport is 76.5 kBEP (45.6 kBEP of gasoline; 30.8 kBEP of diesel and 0.1 kBEP of electricity). With the implementation of different savings and replacement policies, the final energy demand for the sector experiences a substantial reduction, landing at 9.9 kBEP in the high scenario. The big savings are produced as much by the replacement of technology as much as the changes made toward more efficient energy use. In the high impact scenario, we arrive at the goal of zero fossil fuels on the islands, with a complete conversion to electric and biodiesel-powered vehicles.

**Graphic 5: Final demand projections in land transport (thousands of bep)**




Source: G. Barbarán, et al. 2020. Prospective Energy Synthesis for the Galápagos Islands.

**Graphic 6: Final demand projections in Maritime Transport (thousands of bep)**

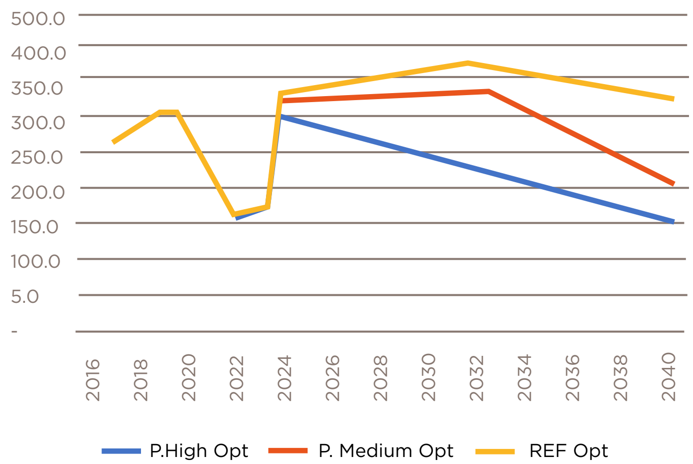



Source: G. Barbarán, et al. 2020. Prospective Energy Synthesis for the Galápagos Islands

In aggregate terms, the maritime transportation sector represents a final demand of 206.5 kBEP in the REF scenario. That demand is reduced by 39%, 50%, and 68% for the low, medium, and high impact scenarios, respectively. This reduction occurs mainly vis-à-vis energy efficiency policies and the reduction of fuel uses such as slow steaming or the use of sails on some boats, and, to a lesser extent, the development of electric motors, the implementation of efficient motors, or solar panels. Finally, biodiesel replaces fossil fuels on some vessels, and LNG is used as a transition fuel, in accordance with global policies in the maritime sector.

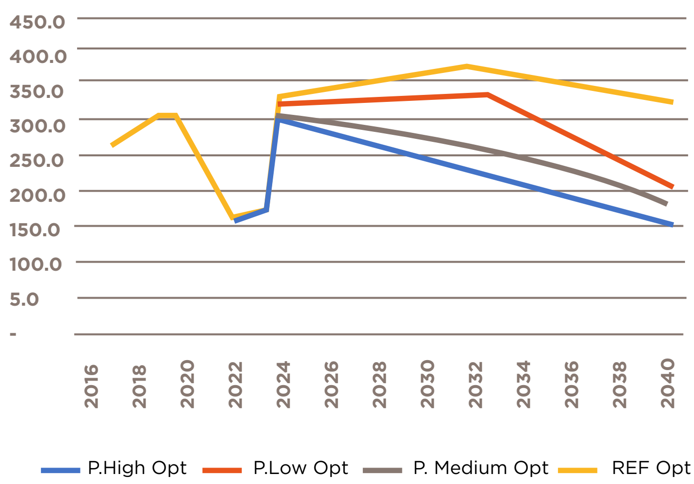
Grouping the four sectors, we see the following evolution:

### Graphic 7: Final demand projections in all sectors (thousands of bep)




Source: G. Barbarán, et al. 2020. Prospective Energy Synthesis for the Galápagos Islands.

**Graphic 8: Final demand projections for fossil fuels (thousands of bep)**

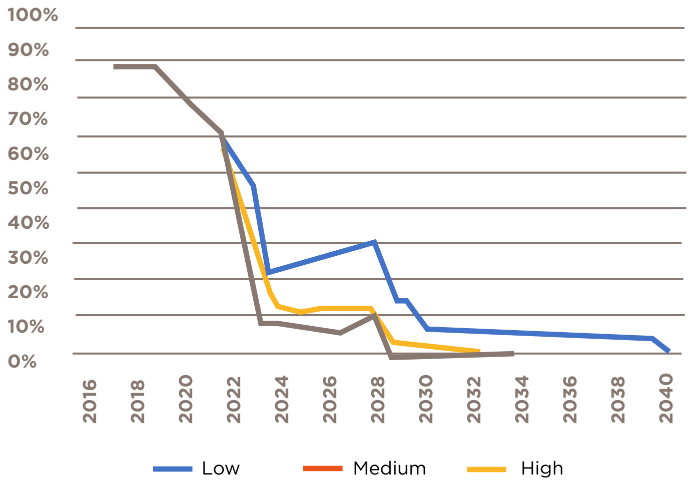



Source: G. Barbarán, et al. 2020. Prospective Energy Synthesis for the Galápagos Islands.

## » Energy supply scenarios

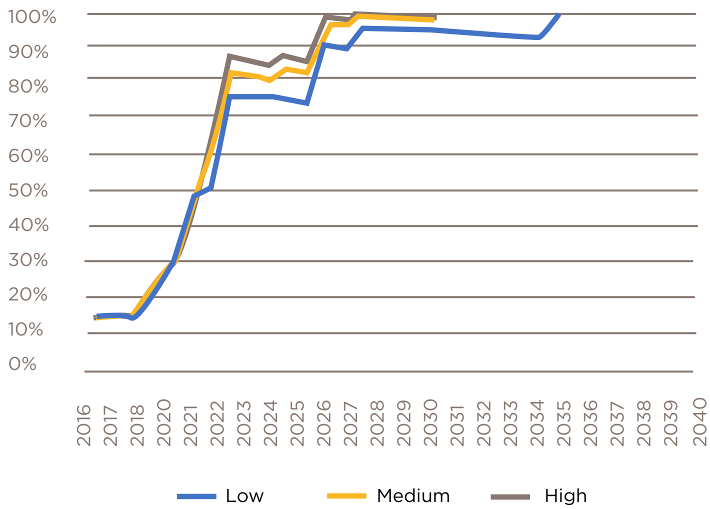
The three scenarios simulated in the model force **absolute decarbonization** in electricity generation, with distinct speeds of incorporation from the **ERNC** (years 2030, 2035, and 2040 in the high, medium, and low scenarios, respectively).

## Graphic 9: Decarbonization scenarios Percentage of Renewable Generation (%)




Source: G. Barbarán, et al. 2020. Prospective Energy Synthesis for the Galápagos Islands.

## Graphic 10: Decarbonization scenarios Percentage of Diesel Generation (%)




Percentage of electricity generation with fossil fuels (left) and percentage of electricity generation with renewable energies (right) in the Galápagos Islands Archipelago.

Source: G. Barbarán, et al. 2020. Prospective Energy Synthesis for the Galápagos Islands.

The technologies used in the simulations to achieve different expansions of generation with ERNC included those that are already in use in the archipelago, such as photovoltaic solar and wind, as well as others that are considered apropos for the island, such as geothermal and concentrated solar. Similarly, the scenarios incorporated electric energy storage in batteries, with charge/discharge cycles of at least four hours, as means of working in conjunction with photovoltaic and wind generation.

Finally, with respect to investment costs implied by the three scenarios, the results show that investment needs grow in relationship to the goals for achieving decarbonization in electricity generation (USD 97, 110, and 136 million for the low, medium, and high scenarios, respectively). For the three scenarios, the total generation costs obtained produce average costs that are less than those of the REF scenario. Nonetheless, when the complete replacement of hydrocarbons is reached, an important jump in average costs is recorded.

Additionally, it is worth mentioning that even with the implementation of decarbonization policies, the average costs will remain well above those on the mainland. Maintaining a final rate for users that is equivalent to those on the mainland will require transfers to cover costs that are not recovered by rates/fees.

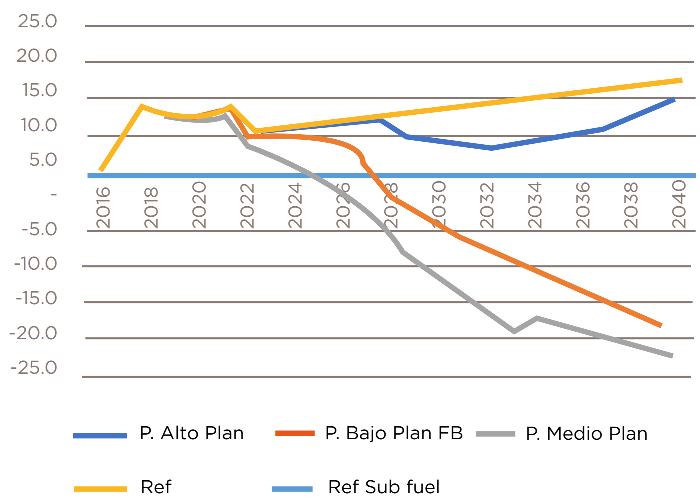
## » Analysis of subsidies

An important factor to consider when establishing energy policies is the islands' restrictions with respect to the transfer of energy costs to final prices. By law, electricity prices and GLP are regulated at the national level. This suggests that around 14 million USD in energy subsidies will be needed each year to cover the costs that will not be recovered through billing (of which 3 million USD correspond to the subsidy for electricity generation).

This situation produces distortions in relationship to the point of implementation of an energy efficiency policy. If the user pays the full rate, with relevant economic incentives, the same user must take the initiative to effect the changes mentioned, which would eventually benefit the system as a whole. Currently, it is the generating company that incurs the operating loss because it cannot recuperate its generation costs. For this reason, the incentive of applying distinct policies should fall upon the company, encouraging substitute and energy efficiency plans in such a way that the user benefits indirectly, and allows the company to reduce its deficit. Such effects are elaborated upon in the scenarios where energy costs are "subsidized" (LGP and diesel for electric generation) in such a way that said cost represents the final rate to be paid by the user (0.10 USD/average user's electricity use and 0.10 USD/kg GLP).

The following figure is illustrative with respect to the results of the analysis for different scenarios. The REF scenario, with established prices, presents growing social costs (between 10 and 20 MUSD per year). In contrast, the policy scenarios present lower social costs in the REF scenario; both in the medium and low scenarios, savings begin to accrue in the decade of 2030.

Graphic 11: Social Costs (Differences vs REF SUB fuel) (millions USD)




Source: G. Barbarán, et al. 2020. Prospective Energy Synthesis for the Galápagos Islands.

In November 2020, the results of the project were presented in a webinar online. The webinar link, along with the Project file, the Executive Summary, the Infographic, and the final presentation, can be found in Table 1, in the Appendix.

## 2.3 Comparative analysis of energy solutions for the Mendoza Andes, replacing the use of liquid fuels for the energy supply


This project was developed at the request of the Mendoza Energy Company (EMESA) of the Republic of Argentina[21].

### i) Objective and scope

The objective of the project consisted in carrying out a comparative analysis of the integral energy solutions for the medium- and long-term, for the town of Uspallata (Mendoza Province), taking into account the associated environmental, economic, and social risks. All of this was done with the goal of increasing the reliability, quality, and efficiency of the area's energy supply, reducing costs, decreasing the use of liquid fuels and GG, and leading toward a decarbonization scenario. Through a detailed analysis of the town's current energy demand and its likely future evolution, we sought to determine the best energy solution to implement, taking into account all the dimensions of sustainability.

### ii) Description of the most relevant aspects of the tasks carried out

#### » Analysis of context

One key milestone of the study consisted of conducting a contextual analysis that allowed us to understand in detail the energy situation in the town of Uspallata, the distinct sources to which its residents have access, and, likewise, the evaluation of other potential supply sources. To do

[21] The company Quantum S.A.was in charge of this study and conducted it in the period between November 2019 and November 2020.

this, a survey was carried out to evaluate the energy demands of the area and to draw up their annual use curves. Likewise, a survey was conducted about the potential energy resources that could supply the demand of Uspallata, which included an analysis of the potentials for wind and photovoltaic solar generation; the identification of wells that are venting gas in the area; and the technical analysis of the area's existing thermal generation park. Finally, a 10-year projection of annual demand of all energy inputs by user type was drawn up, giving rise to two prospective demand scenarios, one with natural gas, and one without.

## » Pre-feasibility for the energy supply of Uspallata

### Technical pre-feasibility for the supply of natural gas to the network

The town of Uspallata does not currently have a gas network system and is isolated from the gas pipeline network. The preliminary project foresaw that the provision of natural gas will need to occur through a virtual pipeline. The sources of gas under consideration are isolated gas wells in distinct reservoirs of the Neuquina Basin in the south of Mendoza, including those in the Calmuco and Rincón Amarillo basins. The gas from these wells will be pre-treated and liquefied in modular treatment and liquefication units before being transported by trucks with cryogenic tanks to Uspallata, where it will be stored in horizontal tanks in its liquid state and, later, will be converted to its gaseous state by regasification units.

The distribution facilities will be comprised of a Chromatography, Measuring, and Odorization Plant, the distribution network, and services to homes. With respect to the distribution network, a preliminary project of the integrated distribution network was carried out (216,000 m of different diameters, which could supply approximately 3,000 parcels).

The optimal size of the network that constitutes the first phase was defined (61,775 m and 1,217 homes served), as a means of covering the greatest number of users with the least possible amount of pipework installed). Later, the second phase of network construction was determined (10,980 m and 223 homes served) to achieve the number of users defined in the demand estimate, and whose construction is expected to begin in 2025.

**Table 2: Total Client Projection**

| Total Clients | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| year 1 | year 2 | year 3 | year 4 | year 5 | year 6 | year 7 | year 8 | year 9 | year 10 | year 11 | year 12 |
| | | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
| | | 437 | 766 | 988 | 1133 | 1204 | 1251 | 1298 | 1344 | 1392 | 1440 |

Source: Quantum SA. 2020. Synthesis Document. Comparative analysis of the energy solutions for the Andes to replace liquid fuels, December 2020.

## Economic pre-feasibility of supplying the network with natural gas

At the date when this study was carried out, none of Argentina's isolated localities was supplied with LNG by the virtual pipeline system, which is why there was no history of Tariff Tables that could be used as a direct reference. Neither was there a specific procedure available in the existing guidelines for the calculation of rates for towns supplied with LNG by the virtual pipeline. As a result, for the purposes of the evaluation, the best possible reference to use was the case of the town of Malargüe (Mendoza Province), which is supplied with vaporized LNG and is transported by trucks.

The economic feasibility analysis for the investment project reveals that the current rates of the distributor ECOGAS Cuyana applied in Mendoza are not viable[22]. For this reason, an Economic Rate was developed that would permit the repayment of investments and other costs. In addition, considering that the weather conditions in Uspallata are similar to those of Malargüe, as is also the case for projected gas use, it was proposed to use the Differential Rates of each locale as a point of reference, which are paid by the end user and arise from the incorporation of this town into the Patagonian Subsidy.

### Table 3: Rate comparisons (USD/MMBTU)

| | Ecogas Cuyana - Mendoza | Ecogas Cuyana - Malargue | Ecogas Cuyana - Malargue | Affordable Rates [FF to 35 years] |
|---|---|---|---|---|
| Rate--> | | Total | Differential | |
| Category/Unit --> | [USD/MMBTU] | [USD/MMBTU] | [USD/MMBTU] | [USD/MMBTU] |
| R1, R2, R3 | $ 6,36 | $ 7,37 | $ 3,69 | $ 17,27 |
| P1-P2 | $ 4,60 | $ 5,96 | $ 2,98 | $ 10,69 |
| Interruptable CNG | $ 3,60 | $ 3,53 | $ 1,77 | $ 9,73 |
| Solid CNG | $ 3,84 | $ 3,55 | $ 1,77 | $ 9,80 |

Source: Quantum SA. 2020. Synthesis Document. Comparative analysis of energy solutions for the Andes, replacing liquid fuels, December 2020.

[22] The VAN of Net Flow, considering investment is - 5.229.734 USD

As a result, it is recommended that the Government of the Mendoza Province, along with the Municipality of Las Heras, carry out the actions necessary before the national authorities to include the users in the town of Uspallata in the Patagonian Subsidy program, with the goal of financing at least a part of the costs involved in the supply of natural gas, which is not covered by regular rates. The difference between the Economic Rate and the Differential Rate needs to be covered by a subsidy.

Internal facilities are the last link in the value chain in the natural gas industry; the execution, ownership and maintenance are the responsibility of each user. For these purposes, the average cost of new installations and updating installations was considered, at a cost of $1,321 US[24] per dwelling. To achieve the incorporation of users to the new energy, taking into account the socio-economic level of the town's inhabitants, it is important that the costs of construction or updating of the internal facility could be financed by low interest credits or even through Non-Reimbursable Contributions on the part of the Government of Mendoza and the Municipality of Las Heras.

## Pre-feasibility of the supply with ERNC

The legal, technical, and economic pre-feasibility of the supply to the town of Uspallata with ERNC was analyzed, and the option of photovoltaic electricity generation and its eventual complementation with batteries was studied in greater detail. The results showed that in the case of solar generation, the option of integrating collective distributed generation in a Solar Community (SC) scheme, is the most technologically and economically convenient choice. This is essentially explained by: i) economies of scale that are achieved by building a single park, with respect to the installation of the roofs of various homes; ii) the best plant factor (PF) achieved by installing in a centralized form; and iii) the additional benefits such as the reservation of the VAT for distributors and the reduction of subsidies on the part of the National Government.

It's worth noting that, from the legal point of view, Solar Communities are not yet included in relevant legislation. Nonetheless, Law N° 9084 provides for the existence of the user/generator collective, which could be used for the legal establishment of the Solar Community. In the event that this scheme is determined to be ideal, Enforcement Authority should push for regulation of the institute.

A demand study was carried out, determining that the total installed power in the park would be equivalent to the power that's currently injected from the CT of Uspallata in times of lower demand, so that most of the generated energy is consumed in Uspallata itself[25].

[24] The November 2019 exchange rate of 59 Argentinean pesos per dollar was used.

[25] The installed power value for the park was determined to be 1.80 MW, made up of monocrystalline panels with 440 Watts of power, arranged on fixed axis support structures that are modularly concentrated on inverters of 150 kVA.

Considering a useful life of 25 years, the investment, operation, and management costs across the entire time period, a LCOE of 27.12 USD/MWh was obtained (without factoring in the costs of connecting to the EDEMSA distribution network). The analysis of the option of complementing with batteries concluded that this option still represents too high a cost in relationship to the limited budget that's available.

### Pre-feasibility of thermal generation in addition to Natural Gas

It was determined that the incorporation of thermal generation to gas for supplying energy demand was neither feasible nor necessary, given that, in the short-term, the demand for electricity would decrease as a result of supplying the network with natural gas.

Existing diesel-fired thermal generation should exist solely as a back-up to supply energy to the town at moments when weather conditions impede solar generation and the demand thus outstrips the capacity of supply lines.

## » Business model

An expansion project that is not included in the Mandatory Investment Plan should be subjected to an economic viability analysis to determine its profitability. In the event that the outcome is negative, a third party acting in the role of sub-contractor can carry out the expansion. In such a case, the most likely scenario is that the Provider (ECOGAS) will conclude that the project is not economically viable[26], in accordance with Resolution ENARGAS I-910/09, and that the Mendoza Province and the Municipality of Las Heras, acting as a third party, will arrive at an agreement with ECOGAS and submit the project to ENARGAS for its authorization. The interested third party should substantiate that it is in compliance with the requirements established in the regulatory framework to be considered as a sub-distributor. Taking into account the regulations that are in place and the size of the job, it is suggested that the construction of the network be carried out by the Mendoza Province or the Municipality of Las Heras, partially or totally financed by investments. Based on the aforementioned and the socioeconomic situation of the residents of Uspallata, it is proposed that the investment fall 100% within the scope of responsibility of the Mendoza Province or the Municipality of Las Heras, acting as an interested third party. The estimated cost will be 6,385,000 $US.

[26] It has already been noted in the project's economic feasibility of investment that it is not viable for the Distributor with the current rates.

Within the Solar Community scheme, the users cooperate through an entity that, bringing them together, channels the construction, operation, and maintenance of a photovoltaic solar park (PSFV), which injects the energy it produces into the distribution network. Each user acquires the right to a discount on their bill as a part of participating in the Solar Community, and for the energy injected by the PSFV. Thus, it is understood that the formation of a cooperative entity (Law N° 20.337) would be the natural means for constituting an entity that brings together the users of Uspallata, taking into account that the cooperative model is used widely for electricity service provision across the entire country, and is linked at the federal level to the Argentinean Federation of Electricity and Other Public Service Cooperatives (FACE). Notwithstanding, the organization could be an independent initiative of the Municipality of Las Heras, of EMESA, or of the Mendoza Province.

## iii) Results and conclusions

Below are presented the main results and conclusions of the study with respect to the four main vectors of analysis:

### Energy

- Incorporating NG supply via networks would confer energy supply advantages to Uspallata, ensuring service continuity, with minimal risk of disruptions.
- The construction of the NG network should be carried out, considering the costs of investment and operation, by an interested third party (the province/municipality), operating as a sub-distributor through ENARGAS. The operation of the LNG storage system (the LNG virtual pipeline) should be carried out by the storage entity authorized by ENARGAS.
- Complementing the electric supply via ERNC within a Solar Community scheme, is technically feasible and presents advantages for all involved stakeholders. The additional use of batteries as a complement is not feasible.
- Existing thermal generation in adequate conditions, that can be maintained as a cold reserve. It is not feasible nor necessary to incorporate thermal generation to gas.

### Social

- Supplying the town of Uspallata with Natural Gas through networks would improve the quality of life and the comfort of the inhabitants, especially in the peak consumption period of winter, thereby avoiding the logistical difficulties of supplying users with liquid gas or firewood.
- In the case of the Solar Community, the incorporation of the community itself within the management yields community development benefits that are of significant value for towns

like Uspallata and which can be replicated in towns with similar situations. This type of local initiative can be a point of departure for collaborative problem solving in a way that is autonomous and sustainable, in accordance with the new municipal ideas that have been incorporated into the Constitutional Reform Project in the Mendoza Province.

## Environmental

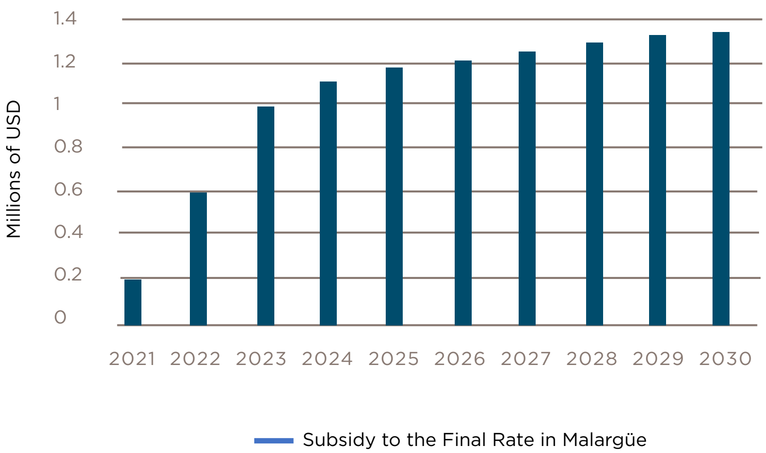
- The use of NG in the town of Uspallata will, over the long-term, reduce the carbon footprint by approximately 1,700 Ton $CO_{2\ Eq}$ annually, in relation to current energy.

- The installation of a solar community of 1.8 MW will, over the long-term, reduce the carbon footprint by an order of an additional 1,750 Ton $CO_{2\ Eq}$ per year.

## Economic

- Using the Differential Rates of the town of Malargüe as a reference, and considering the savings from the other replaced energies, the average user in the town of Uspallata will receive significant savings in their energy bill[27]. Nevertheless, arriving at an economically-financially viable scenario will require important subsidies that will need to be approved by National Law. Furthermore, these should be considered as a mechanism to support users in facing the costs of local conditioning for the connection of the new NG network, given that this is a barrier that can be defining at the moment of developing the network.

### Graphic 12: Subsidies – Users who pay Differential Rates in Malargüe (millions of USD)




Source: Quantum SA. 2020. Synthesis Document. Comparative analysis of energy solutions for the Andes to replace liquid fuel use, December 2020.

[27] By an order of 29% for the average customer.

### Table 4: Cost, savings, and subsidy avoided by a Solar Community

| Concept | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | Total 2021-2030 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GN Rate Subsidy (Malargue) | 0.2 | 0.60 | 0.98 | 1.12 | 1.18 | 1.22 | 1.26 | 1.28 | 1.30 | 1.33 | 10.47 |
| Subsidy Avoided in EE by the GN network | -0.06 | -0.14 | -0.22 | -0.25 | -0.26 | -0.27 | -0.27 | -0.27 | -0.28 | -0.28 | -2.29 |
| Subsidy Avoided in “Social” GLP by the GN network | -0.00 | -0.00 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.05 |
| User savings caused by substituting other energy sources with GN (Malargue Rates) | -0.09 | -0.27 | -0.39 | -0.44 | -0.45 | -0.47 | -0.49 | -0.50 | -0.51 | -0.52 | -4.13 |
| Subsidy Avoided in EE by Solar Community | -0.11 | -0.11 | -0.11 | -0.11 | -0.11 | -0.11 | -0.11 | -0.11 | -0.11 | -0.11 | -1.11 |

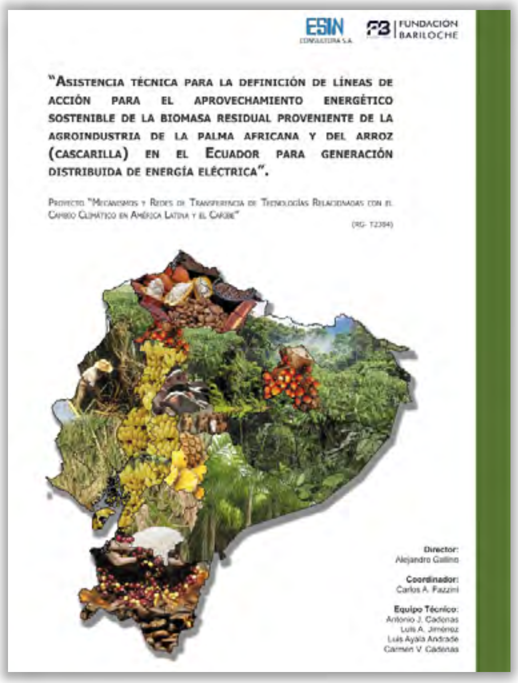
Source: Quantum SA. 2020. Synthesis Document. Comparative analysis of energy solutions for the Andes in the replacement of liquid fuel use, December 2020.

- The installation of a Solar Community in the town will bring clear economic benefits to customers, to the distributor, and to the National State, as well as offer a fundamental advantage: its scalability. Nonetheless, the scheme for the solar community has the disadvantage of not yet being regulated.

For all of the reasons noted here, the Consultant considers the option of adopting a Solar Community scheme to be most attractive, and in accordance with the objectives of the current study; therefore, it is highly recommended. Similarly, initiatives related to specific programs promoting energy efficiency in homes were formulated, which can be of great use in the short-term.

The results of the project were presented in December 2020 in a webinar that was conducted online. The link to the webinar, along with the Project folder, the Executive Summary, the infographic, and the final presentation, can be found in Table 1 of the Appendix.

## 2.4. Courses of action for the sustainable use of residual biomass from the African Palm and rice (husk) agribusiness in Ecuador for the distributed generation of electrical energy.




The current project was developed at the request of the Electricity Corporation of Ecuador (CELEC EP)[28].

### i) Objective and scope

The general objective of the consultation is to design a set of courses of action that make possible the sustainable use of residual biomass in the agrobusiness sector of the African Palm and rice in Ecuador, with the goal of producing manageable electrical energy, with a holistic vision that takes into account technical, economic, environmental, social, and political factors, and with a focus on medium-term planning. All of this takes into account the potential impacts on economic and environmental development, possible business models, and the policy instruments that are needed to promote it.

### ii) Description of the most relevant aspects of the work carried out

#### » Residual biomass of the African Palm

##### General Information

The African Palm produces fruits that are considered Fresh Fruits (FF), which are used for the production of palm oil in an industrial process that generates organic residuals with an energy content of a magnitude that justifies its use as

[28] The study was carried out by ESIN Consultora S.A. during the period between February 2020 to November 2020.

a biofuel for the generation of heat. To evaluate the availability and amount of these residuals, the data regarding production volumes of the palm's FF were reviewed for the years 2011 to 2019 and were disaggregated by province. These data show the relevance of production volumes in the Province of Esmeraldas, and lesser production in the Provinces of Los Ríos, Sucumbíos and Santo Domingo, as well as a declining trend in said volumes in recent years[29], with a consequent decline in the production of oil and the availability of residuals.

Considering the past production and the projected production of palm FF, we have accepted as a hypothesis for the development of electric energy generation plants, that the minimum estimated production value for the year 2022 will not exceed 80% and is estimated to be 1.2 million tons.

With respect to season variations in the production of oil and, by extension, the availability of residuals, the study showed the existence of a peak production period from the month of May to its plateau in September[30]. These variations in oil production can be offset by the accumulation of residuals in the production/cogeneration plants, with the goal of adapting the residuals' use for energy to operate the plants themselves.

A survey of the cultivation and harvesting areas was carried out, as was a survey of the location of processing plants for the palm FF, in order to analyze the alternatives for the locations and sizes of the generation plants.

Then, the production of agro-industrial residuals as part of the palm FF processing was analyzed, presenting in detail those products and subproducts that are generated as part of the process, as well as the quantities of resulting residuals and their energy value. For every 100 Ton of FF bunches, 240,000 MJ of thermal energy can be obtained from the fruit's mesocarp and 100,000 MJ from the stems.

### Options for energy generation plants

The analysis of technological alternatives of the generation systems to be developed, focused on whether the power generation plant would have a cogeneration scheme or would exist solely for the generation of electric energy. In terms of location, the cogeneration options suggest that the energy project should be located in proximity to where the demand for energy is. Outside of the extractors themselves, no potential steam-demanding plant could be found within a reasonable radius that could permit transportation of the steam in conditions that were technically sound.

An initial analysis looked at 11 options that were considered feasible for plants operating with residuals from the palm FF. Distinct processing volumes were considered for each plant or with the support of a third-party, with the support of the electrical grid or solely for self-use, and with or without co-generation.

[29] This is explained by the biological attack of bud rot. But it should be kept in mind that production is expected to recover starting in 2022, due to a planting of a PC-resistant species.

[30] The monthly average for September is 35%, lower than the corresponding average for May.

### Energy use

The stem, fiber, and pit are extracted residuals that can be classified as ligno-cellulose. By comparison, the effluents extracted from the oil contain an interesting amount of total and dissolved solids. In other words, the former is suitable for use in thermochemical transformation, while the extracted effluents are suitable for use through anaerobic digestion. On the other hand, due to the high moisture content (approximately 70%) of the stem and the fiber, it was determined that a pressing process to extract moisture would be required to be able to use these efficiently.

After rejecting the production of biogas through anaerobic digestion, the alternative technologies selected for the residuals extracted from the palm oil are generation or cogeneration for stems, fibers, or shells.

## » Rice husk

### General information

In Ecuador, rice is a main food crop, forming part of the population's basic diet. Its production fluctuates from year to year[31], but a growth trend is observed, due mainly to the increase in the yields caused by improvements in production technologies.

The processing of paddy rice is carried out at 523 processing plants, which range considerably in terms of their capacity. It's also worth noting the great spatial concentration of the plants, which is of primary importance for the transport of the husk, which, because of its low energy density, significantly influences logistical costs. Both the paddies and the plants are found mainly in the Provinces of Guayas and Los Ríos.

With respect to the seasonality of the availability of rice husks, of the three harvests that are made, the one in winter is of the greatest relevance, representing 46% of total production. With this in mind, the packing companies have different means of storage to ensure sufficient year-round input for industrial processing.

With respect to the energy analysis of the rice husk, its primary components are cellulose, hemicellulose, and lignin. The remaining contents are ashes. The useful PCI is estimated to be 1,942.3 kcal/kg.

### Alternatives to power generation plants

In the analysis of power generation plant alternatives, the focus was a consideration of the density of the plant's capacity, with the goal of accounting for the elements for the location of disposable biomass within the capture's radius. By establishing alternatives to the geographic center of husk collection and proposing diverse capture radii, 18 potential plants were identified, which determined the area involved, the biomass quantities, and the generative potential.

[31] The volatility of prices, biological variables, and illnesses, land pathogens, and natural conditions such as, for example, the phenomena of La Niña y El Niño, are some of the variables responsible for such variability.

Five options were selected for the purposes of the economic analysis, covering power ranges of around 10 MW, 9.5 MW, and between 4.6 and 8.5 MW. For the first two ranges, the options with the lowest logistical costs were chosen, while for the last range, three identified options were considered.

The cost of transport and logistics for moving residuals from the plants to the generation plant was calculated, taking into account the waste needs of the generation plants and the production capacity of the waste from the plants. This cost was calculated for each of the selected alternatives and is expressed in USD/ton of residual.

#### Energy use

Rice husks can be classified as ligno-cellulosic, so thermal processes are the ideal means for transforming them into energy. Because of the ashes' composition and their tendency to stick together, it is recommended that combustion boilers be used, thereby avoiding the need for fluidized bed combustion. Cogeneration has not been considered for this residual; instead, the focus was on identifying capture radii, keeping in mind that more than 500 processing plants operate in the region.

### » Proposed methodology for the selection of alternatives

A matrix with multiple criteria was designed to evaluate the various proposed alternatives, assigning each of the criterion an importance relative to the weighting of the global weighting of each alternative. This competitive matrix profile considered internal and external factors of the proposed projects and allowed the summary and evaluation of decisive variables in order to make a decision about the profiles to be developed. The determining factors included: i) biomass resource, ii) location, iii) logistics, iv) economic-financial, v) technological, vi) social and political, and vii) environmental.

### iii) Results and conclusions

Six options (4 with African Palm residuals and 2 with rice husks) were selected as a result of the multi-criteria analysis. Proposals for thermal plants with the proposed fuels were prepared for each of the options at the conceptual engineering level, offering a description, basic operational characteristics, the main and supplemental equipment, P&I, basic arrangements, and a chronogram of the acquisition, investment, and cost of operation and maintenance.

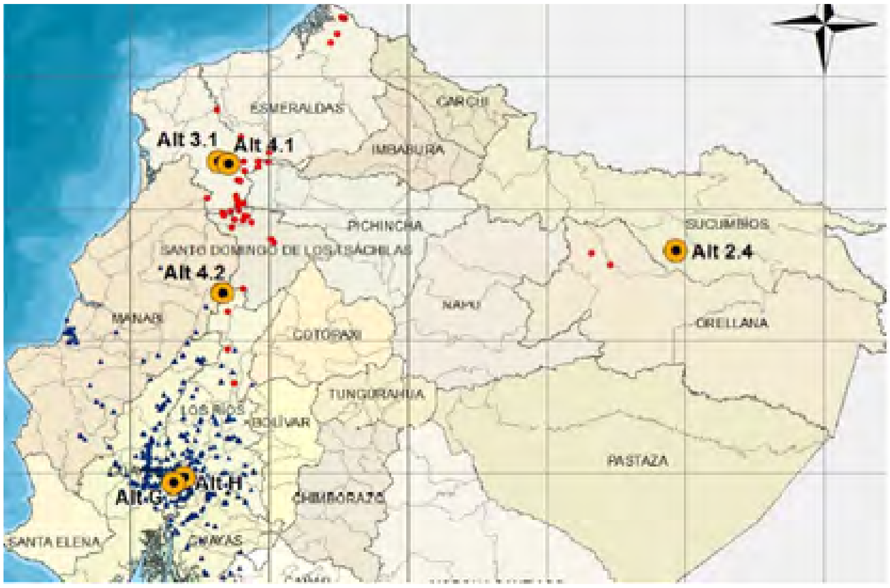
Presented below are the identified options and their respective locations:

## Table 5: Projects for thermal plants and proposed fuels

| | Alt. 3-1 | Alt. 4-1 | Alt. 4-2 | Alt. 2-4 | Alt. H | Alt. G |
|---|---|---|---|---|---|---|
| Technology | Rankine Cycle | Cogeneration | Cogeneration | Cogeneration | Rankine Cycle | Rankine Cycle |
| Power (MW) | 13 | 15 | 9 | 7 | 10 | 8.5 |
| Location | Quinindé (Esmeraldas Province) | Quinindé (Esmeraldas Province) | Oleodavila Extracting Plant (Manabí Province) | Shushufindi (Sucumbíos Province) | El Salitre (Guayas Province) | El Salitre (Guayas Province) |
| Fuel | Stems, Fiber | Stems, Fiber | Stems, Fiber | Stems, Fiber | Husk | Husk |

Source: Esin Consultora SA. 2020. Synthesis report on "Courses of action for the use of biomass residuals for sustainable energy for distributed generation in Ecuador." November 2020.

## Map 2: Locations of the proposed facilities




Source: Esin Consultora SA. 2020. Synthesis report on "Courses of action for the use of biomass residuals for sustainable energy for distributed generation in Ecuador." November 2020.

With respect to the role to be played by the proposed plants within the operation of the field of electricity generation in Ecuador, the study concludes that the current dependence on hydraulic supply, and the strong and sustained growth of demand, raise concerns about what could happen in the future to cope with annual seasonality and the multi-year cycles with dry periods. Thus, in a context of water deficit, the main coverage would need to be provided by a conventional thermic energy plant, especially by internal combustion equipment and gas turbines, and, to a lesser extent, by dispatchable ERNC (such as the proposed biomass)[32], and plants with combined power cycles. However, in this role, the main contribution of the proposed plants is direct, in that all of its energy production would be earmarked to replace the use of fossil fuels, with a consequent reduction in the use of conventional thermic equipment, which would be in a better condition to not only respond to the problems of seasons or cyclical events, but also to satisfy short duration demands.

To the positive environmental impacts derived from the substitution of renewable resources for fossil fuels, in the case of rice husks, the elimination of the impacts from the disposal of residuals should be added. These consist of aerobic and anaerobic decomposition, contamination of the air, water, and land by residuals being carried off by wind and rain; incomplete, uncontrolled combustion; and the visual impact. Likewise, side benefits of a socioeconomic character include the reconsideration of waste as a useful raw material for which there is a new demand for services, and thus, new jobs.

If the intention is to advance to the construction phase, be sure to consider the convenience of executing the best-rated alternatives that do not compete for the use of resources. Under these guidelines, the development of projects identified by options 4-1, 4-2, 2-4 a H is recommended. These plants represent a total investment of 93.4 million dollars, presenting remunerative prices to the generating entity[33] of 136 U$S/MWh; 122 U$S/MWh; 102 U$S/MWh and 118 U$S/MWh, respectively, making it possible to save 151,000 tons of $CO_{2eq}$ annually.

One fact to highlight is that entry into the operational phase for the four selected projects implies the use of 60% of agro-industrial residuals from the processing of the palm FF and the use of 45% of the available rice husk.

If the bidding, development, and construction phases are approached in a sequential manner, the commissioning of the selected plants can be estimated to take place 35 months from the launch of the bidding process.

The study identifies obtaining financing for this type of project as one of the main obstacles,

[32] Considering that the annual generation limit is fixed by the availability of biomass, one could assume that this option would offer flexibility, generating at maximum capacity during seasons with low rainfall and compensating by providing less energy contribution during the rest of the year.

[33] Defined as the economic amounts, in dollars, per MWh generated that is remunerative to balance the economic equation that corresponds to each option.

along with cost competitiveness and a lack of political and institutional support. All of this should be considered within in the regional context, where the debate about renewable energies focuses mainly on economic matters and not on emissions reduction.

Using information from IRENA, the study identifies three major financial mechanisms: a) Green Bonds: Fixed income securities whose income is intended to be allocated for sustainable assets. Most of the green financial flows in the region are in the clean energy and climate change mitigation group (56%). The main green funds are administered by the Green Climate Fund (GCF) (Fondo Verde para el Clima, in Spanish); the Global Environment Facility (GEF), and Climate Investment Funds (CIF) (Fondos de Inversión Climática, in Spanish); b) Institutional assets: Renewable energy assets give investors the opportunity to diversify their portfolios and to benefit from relatively strong and stable long-term returns, similar to bonds, which equalize long-term liabilities of institutional investors and minimize risk of fixed assets; and c) Sovereign Guarantees: This is the guarantee that a government gives that it will comply with the obligation if the primary investor defaults. Generally speaking, sovereign guarantees are related to defaults, but can cover all kinds of obligations and commitments.

The four development banks that provide the majority of financing for renewable energy projects in Latin America are the IDB, the World Bank, the CAF, and the China Development Bank. Total placements of these four funds for the period between 2007 and 2014 were approximately 85%, with green financing being one of the main focal points.

The results of the project were presented in a webinar conducted online in November 2020. The webinar link, along with the Project file, the Executive summary, the Infographic, and the final presentation can be found in Table 1 of the Appendix.

36 Defined as the economic amounts, in dollars, per MWh generated that is remunerative to balance the economic equation that corresponds to each option.

## 2.5. Low-carbon development for the cement industry in Chile. Proposed roadmap.


the green werk.

CEMENTIS

Proyecto Mecanismos y Redes de Transferencia de Tecnología Relacionada con el Cambio Climático en América Latina y el Caribe

**Hoja de ruta para el desarrollo de bajas emisiones en la Industria Chilena del Cemento**

Resumen

Versión 1.2

Fecha: 10 de febrero de 2020

Autores: Laurent Grimmeissen, Andrés Jensen y Stefan Wehner

FUNDACIÓN BARILOCHE gef IDB

The current study was developed at the request of the Ministry of Energy of Chile[34].

### i) Objective

The general objective of the study was to carry out an analysis of the technological needs related to climate change (or TNA) in the cement and concrete sector in Chile, with an emphasis on the energy component.

Specific objectives included: 1) identifying and prioritizing technologies, making particular note of the existing technological gaps that should be addressed to achieve a migration of the cement and concrete sector toward the use of cleaner technologies, evaluating them based on distinct feasibility criteria (economic, cultural, technical, legal, etc.); 2) analyzing the barriers that hinder the diffusion and operation of the prioritized technologies and identify/propose facilitating frameworks that favor the transfer and adoption of new GHG mitigation techniques; 3) analyzing the cement and concrete market according to their uses in order to understand the potential for innovation according to market needs and threats that could arise because of the need to reduce the carbon footprint of certain sectors; 4) creating an Action Plan for Technology Transfer, which includes actions both within the industry and work with and from the public sector, providers, consumers, etc.; 5) creating an sector-level investment plan; and 6) designing a technology road map (HRT) for the

[34] The consortium EQO - NIXUS, IMPLEMENTA SUR was responsible for its execution.

incorporation of the proposed technologies.

### ii) Description of the most relevant aspects of the tasks performed and topics addressed

Cement (in the form of concrete) is the most widely used construction material in the world and there is no other type of material that can compete with it, due to its attributes of cost, the amount of it that's available, and its technical characteristics. The cement industry is responsible for 8% of anthropic $CO_2$ emissions, which is why it is highly relevant for climate change management to look for emission reduction solutions related to the production and use of cement.

Cement-producing companies in Chile can be classified into those that have integrated plants (producing clinker and cement), and those that focus on cement production using imported clinker from grinding stations. The total installed capacity for cement production is 10.4 million tons per year, more than 2.5 times the annual estimated consumption of 3.9 million tons in 2018. Despite the important fact of this overage in capacity, the Chilean cement industry faces a high level of imports due to: (I) the high cost of limestone (the essential raw material in clinker production), due to the fact that limestone low in calcium carbonate requires an expensive process to improve its quality, or, if it is of high quality, it is found in areas that are far from the plants; (II) low cost of imports, which benefit from the low return freight price of vessels used to export Chilean raw materials to Asia.

According to FICEM-ICH[35], the direct $CO_2$ emissions per ton of clinker produced in Chile in the year 2014 were 893 kg $CO_2$/ton clinker, 6% above the world average, according to GNR (GCCA "Getting the Numbers Right"). Meanwhile, $CO_2$ emissions per ton of cement were 581 kg $CO_2$/ton cement, 10% below the world average according to GNR. This finding is explained mainly by the fact that Chilean cement has a low clinker content (one of the lowest in the world, mainly due to the use of natural pozzolana as a replacement material, and the fact that the cement industry began, many years ago, to condition the market to accept these types of cements with additives and low clinker content.

The study focused on the production of cement and concrete, and analyzed the main axes for reducing emissions, which include:

#### » At the clinker level:

- Coprocessing of alternative fuels
- Thermal energy efficiency

#### » At the cement level:

- Reduction of the clinker content in cement (the clinker factor)
- Electric energy efficiency

#### » At the concrete level:

- Reduction of the amount of cement in the concrete

[35] Chilean Institute of Cement and Concrete (ICH) and the Inter-American Cement Federation (FICEM).

Below, we present an exhaustive analysis of the potential of each one of the technologies surveyed, and the possible barriers to their implementation. Facilitating frameworks that favor the transfer and adoption of new GHG mitigation technologies were identified, and an HRT was designed to incorporate a corresponding investment plan into the proposed technologies.

### iii) Results, conclusions, and recommendations

The HRT only considers axes adapted to the Chilean situation, particularly in terms of economic and regulatory feasibility. Four main axes were identified:

**Co-processsing** focuses on the industry's potential role to reduce environmental loads throughout the product's entire life cycle, one of the main objectives being to convert an industry's or community's waste into the raw material or energy resources for another. In the cement sector, the use of waste residuals as fuel and alternative raw materials is an example of this. The objective is to increase the ratio of substitution from 12.6% (2017) to 30% (2030), which would represent the consumption of up to 148,000 tons of fuel derived from residuals each year. The level of investment needed would be between 32 and 42 million USD and could reduce net emissions by up to 118,000 tons of $CO_2$ per year. Achieving this result would require removing obstacles that are currently in place, many of them regulatory in nature.

Two major mitigation measures are recommended: (I) Adapt Chilean legislation to the European model, recognizing co-processing as an alternative of value; (II) Under the framework of a formal instrument of public-private cooperation (like a Clean Production Agreement), develop a discussion process whose objective is to formalize the industry's commitment to the development of environmentally-friendly technologies, with emphasis on reducing $CO_2$ emissions, and, at the same time, promoting and regulating co-processing through different regulatory instruments and guidelines.

**Reducing the clinker factor:** Despite the fact that the clinker factor in Chile is one of the lowest in the world (67% in 2014), it is believed that the factor could be optimized to a level of 55% by producing a new type of cement with a calcined clay base.

All of this should be carried out with the understanding that other raw materials, such as blast furnace slag, ash, or natural pozzolana, are not available in sufficient quantity and quality.

The level of investment needed would be between 10 and 12 million USD, and could reduce emissions values by up to 165,000 tons of $CO_2$ per year, not counting the cumulative effect from other axes.

No regulatory barriers to the implementation of this measure were identified. Existing barriers, which are more related to technical knowledge and market acceptance, can be overcome with technical assistance and awareness campaigns.

**Reduction of the amount of cement in concrete:** Producing concrete in centralized plants saves around 50 kg of cement per $m^3$, compared to manual on-site production, with bagged cement. It is estimated that 40% of Chilean cement sales correspond to bags (<10% in Europe). The roadmap proposes as an objective, the reduction of this percentage to around 30% by 2030.

The level of investment needed would be approximately 550.000 USD for 50.000 m3 of concrete, which could reduce emissions by up to 68,000 tons of $CO_2$ per year, not counting the cumulative effect from other axes.

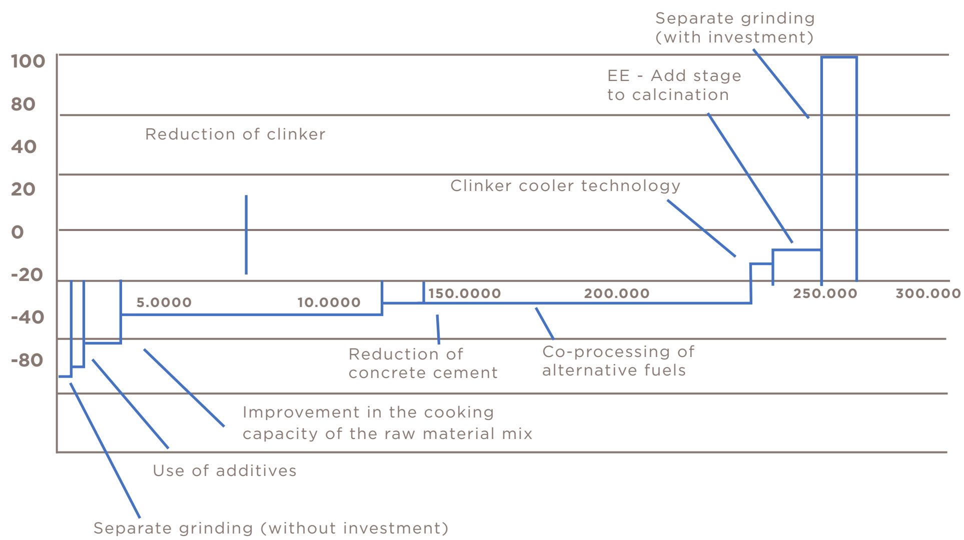
No barriers to implementation were identified on this axis. It is suggested that concrete production in centralized plants be incentivized through, for example, discounts on housing taxes.

**Allow separate grinding of cement**, which is a standard practice at the international level, but is not permitted in Chile. No investments are foreseen, given the level of overcapacity and the emissions savings of nearly 6,240 tons of $CO_2$ per year. This axis involves modifying the technical regulations that, at present, do not consider the possibility of separate grinding.

Most mitigation options have a negative marginal abatement cost, meaning that they are economically viable. Repayment periods show a value of three to seven years for co-processing, less than five years for cement based on calcined clay, and less than two years for the reduction of manual concrete production. Neither separate milling (an option without investment) nor the incorporation of additives would require investment. Attractive options under this criterion include co-processing, reduction of clinker in cement, separate grinding (no investment), the use of additives, and the reduction of cement in concrete.

The comprehensive implementation of mitigation actions will not be achieved all at once in the short-term. The estimated potentials, relative to the priority actions and their respective mitigation volumes and costs, assume a complete implementation of all axes by 2025. This will depend on

## Graphic 13: Marginal abatement cost curve in cement




Source: Cementis GmbH and the Greenwerk GbR 2020. Synthesis of the document "Low-carbon development for the cement industry in Chile. Proposed roadmap."

If the Roadmap is implemented with the cadence that has been established, mitigation potential would reach some 15% by 2030, compared to the situation in 2017. That is, from almost 2.3 $MtCO_2$/year to 1.9 $MtCO_2$/year, while the total reduction of emissions relative to the four main axes identified in this study, could reach a cumulative of up to 2.1 $MtCO_2$ by 2030.

The Chilean cement industry does not generate sufficient margins to lower its sales price in order to reduce imports (which already account for 40% of local cement and clinker consumption). Thus, any additional cost, including a price of carbon such as the green tax, that is not also applied to imports, would most likely force the three large integrated companies to stop clinker production in Chile and resort to imports.

The need to reduce carbon emissions to achieve climate change mitigation goals requires penalizing emissions in one way or another. The main problem faced by these emission control systems are so-called "carbon leakage." The majority of the emissions trading systems (ETS) include different flexibility mechanisms to mitigate this risk, such as the free allocation of emissions rights to industries most affected by carbon leakage, complementation with emissions compensation systems, or the possibility of having temporary flexibility, among others.

An efficient way to maintain balanced competition between imports and local production is to implement a Border Carbon Adjustment (BCA), which consists of imposing the same carbon price on imports that is applied to local production. The European Union (EU) is preparing a reform of its ETS that will include a BCA.

In conclusion, the recommendations for the Chilean cement industry are to evaluate the possibility of including an ETS-type carbon price in the HRT in order to accelerate and make viable the proposed measures, including the countries of the Pacific Alliance, but with the necessity of including a BCA (Border Carbon Adjustment).

The results of this project were presented in the webinar "Contribution of the Private Sector to Carbon Neutrality: Case Study of the Chilean Cement and Steel Industry," on July 20, 2020. The link to the webinar, the Project file, the Executive summary, the infographic, and the final presentation can be found in Table 1 of the Appendix.

## 2.6 Preparation of inputs that allow the design of a regularization program to connect users to the electricity grid, focused on households in socioeconomically vulnerable situations in Uruguay.

Proyecto "Mecanismos y Redes de Transferencia de Tecnología Relacionada con el Cambio Climático en América Latina y el Caribe"

**"Elaboración de insumos que permitan el diseño de un programa de regularización de la conexión de usuarios a la red eléctrica, enfocado a hogares en situación de vulnerabilidad socioeconómica en Uruguay"**

Resumen Ejecutivo

Fecha: mayo de 2020

SEG Ingeniería

FUNDACIÓN BARILOCHE gef IDB

The present study was developed at the request of the Ministry of Industry, Energy, and Mining of Uruguay[36].

### i) Objective and scope

The general objective of the study was to offer advice on the design of an inter-institutional regularization program, which would ensure the rapid, efficient, and sustainable incorporation into the electricity energy grid of households in socioeconomically vulnerable situations, focusing on the social, cultural, and technical aspects, and considering energy efficiency as a fundamental pillar.

To this end, the following specific objectives were proposed: 1) An analysis of best practices, successful cases, and lessons learned from initiatives implemented at the urban level in no fewer than five countries (or cities) linked to the subject of the study. The analysis should include the applicability or adaptability to the context of Uruguay; 2) A survey and contextual analysis that familiarize us with the current situation with respect to irregular services and programs related to the problem raised. Said analysis should delve into the regulatory aspects of the electricity sector that are related to the regularization of grid-connected services, and carry out a description of the

[36] The project was carried out by SEG Ingeniería during the period of July 2019-May 2020.

population to be regularized, which should include: socioeconomic and cultural conditions, limitations and difficulties in regularization, energy use habits, characterization of the energy-consuming equipment used, household characteristics; 3) Preparation of inputs that contribute to a draft of the program, including a proposal with objectives, goals, timelines, responsibilities, and an estimated budget for the execution of the Program.

## ii) Description of the most relevant aspects of the tasks performed and topics addressed

In 2018, the percentage of losses with respect to all of the electrical energy delivered in the UTE's distribution networks was valued at around 18%, approximately one-third of which (6.4%) occurred in vulnerable neighborhoods. As of that date, it was estimated that approximately 70,000 households had irregular access to electricity. It was a multidimensional problem in which, in addition to just energy, other aspects had an influence, such as the quality of homes, the household appliances used, the neighborhood's characteristics, rate schemes, and subsidies, etc.

It was essential to have an accurate characterization of the target population, to have a successful outcome. To this end, a survey was conducted of 500 people who live in vulnerable neighborhoods and who identified themselves as being in an irregular situation. Another, complementary survey focused on the energy use of 84 households. In addition, discussions were held in six focus groups. Thus, a qualitative and quantitative description of the socioeconomic and cultural conditions was obtained, and a general overview of the energy use by this population. Among the results, are highlighted:

- Surveyed households had deficiencies in several areas (access to basic services, health, education, housing, income, and employment). In general, they are multi-person households whose members are busy for much of the day and do not have the resources to acquire efficient equipment and to improve the envelope (insulation) and electrical installations of their homes, and they lack knowledge about the efficient use of electrical appliances and energy efficiency in general.

- Cultural resistance to regularization was not detected. Irregular connections are experienced as a source of danger, marginality, poor service quality, stigma, and lack of access to other rights, which none of the participants wishes to perpetuate. It is not perceived as a desired practice, but as a necessary one, due to economic limitations.

- Electrical energy is the primary source of energy used. While the equipment is not the most inefficient (refrigerators and hot water tanks in particular), a significant presence of resistive electrical media without accumulation was detected. In heating, halogen stoves, electric radiators, and fan heaters predominate. The vast majority of households use LPG for cooking, using 13 kg. jugs in two-thirds of cases;

the rest use 3 kg micro-jugs. The latter have the problem of not having a regulated maximum price, but low-income households resort to this option, which allows partial recharging, even though the unit cost is more expensive and there is no access to subsidies to the GLP (15%). According to UTE data, a non-regularized household consumes an average of consume 500kWh/month, while post-regularization and training, consumption is reduced to approximately 207 kWh/month.

- With respect to the characteristics of the dwellings, 36% of surveyed households have waste material as the predominant roofing material, and in 21%, the roofs are lightweight and have a false ceiling. Similarly, vulnerabilities were detected in the materials for exterior walls and openings such as doors and windows, and floors. Given all of the above, these homes have great difficulty maintaining a comfortable temperature.

- The main program enacted that is aimed at encouraging regularization in the electric power service is the Social Inclusion Prioritization project (PIS), which is carried out by UTE. The next most relevant program is the Service Basket (PCS). Other programs are focused on providing a housing solution for the population in extreme situations; in these, electricity access is discussed, but is not the focus.

The PIS is based on the conviction that access to energy is a right, and that through it, the quality of life is improved for citizens in vulnerable situations. For this, all households must have regular access to safe, good quality electrical services. By 2026, it is expected that a total of 70,000 regularizations will be reached, at a rate of 7,000 connections annually.

The approach to the plan in the target population was carried out by a team made up of two social workers and two technicians from the social commercial area, per neighborhood. Broadly speaking, the methodology consisted of a survey of the homes, holding conversations, meetings, and passing out brochures. The plan had a transition period of nine months so that the home, once regularized, could adapt its energy consumption, and the rate was applied gradually, billing a percentage of total consumption and showing how much would have been paid for total consumption. Follow-ups were carried out when deviations were detected (such as unusual consumption or late payments), and advice was provided so that the household could reduce its energy consumption. In the case that the household had difficulty making payments, there was the option of a payment plan. The process consisted of a period of up to four years. In the case that the household had outstanding debts, they could be frozen just once for a period of 12 months; if proven to be a reliable payer during that period, the debt would be forgiven.

Regularized users in the vulnerable neighborhoods have access to commercially discounted rates known as TCB-D and TCB-T, which extend discounts on the Basic Consumption Rate (TCB), open to all residential users. In this way, a significant reduction in the amount of the bill is sought until reaching a basic consumption level (of approximately 210 kWh). The TCB-T rate for TUS[37] households grant an additional discount according to the number of members of the household (TCB-T).

Between 2013 to 2018, some 25,000 homes have been regularized, of which 87% have remained in service and 73% have kept payments up to date. The project appears to be successful; however, it's not clear what impact it has when looking at the indicators. A significant reduction in the losses within socioeconomically vulnerable neighborhoods would be expected, but as UTE indicates in its annual reports from 2016, 2017, and 2018, these have remained at 6.4% during the years indicated.

The PCS arose in 2012 as the result of an inter-institutional social policy coordinated jointly by MIEM, MIDES, MEF, MVOTMA, including Plan Juntos, in addition to the state companies UTE, OSE, ANCAP and, recently, ANTEL. Its general objective is to "facilitate regular and sustainable access to households in a socioeconomically vulnerable situation related to energy, potable water, and information and communication technologies (TIC)". Up to 2020, 1950 households make up this pilot program.

The neighborhoods in a vulnerable situation that were selected are those with previous housing interventions carried out by MVOTMA. The MIDES field team begins its work with the families who opt into the PCS, whether they are regularized or choosing to regularize. Based on this intervention as it relates to energy aspects, the PCS determines the subsidies or commercial discounts to be granted: subsidies for LPG refills, subsidies for the purchase of gas and electricity-based household appliances, and discounts on electricity rates (same rates as in the PIS). The granting of these benefits is differentiated based on the Critical Deficiency Index (ICC), which defines the socioeconomic vulnerability situation of a household. The survey of household information starts with the application of a standardized form, carried out by the MIDES field teams. The household can be classified as a TUS household (Tarjeta Uruguay Social/ Uruguay Social Card), AFAM (Family Allowances), or Rest of the Neighborhood household. For example, TUS households receive a 75% subsidy on the cost of LGP refills, while AFAM households receive a 50% subsidy and the rest receive a 25% subsidy.

In different training instances, work has been carried out on issues related to the management, efficiency, and safety in the use of energy, accompanied by individualized visits to the home, which have involved energy audits.

[37] Tarjeta Uruguay Social (Uruguay Social Card), granted by the Ministry of Social Development for households in extreme socioeconomic situations.

### iii) Results, conclusions, and recommendations

As a result of the analyses carried out, a list of aspects emerged that could improve the actions currently in place: i) that the state itself set the objective of eliminating irregular connections in vulnerable neighborhoods, taking into account the socioeconomic situation of the affected population; ii) expand the dedication of resources to attack the problem with greater speed; iii) have a single organization that coordinates and leads efforts of all stakeholder institutions; iv) adapt rates to the realities of the number of family members and increase the range considered as basic consumption; v) promote rational use and awareness through the use of smart meters. This empowerment of the user is necessary since it is the best way to connect the consumer to the reality of their energy use.

Throughout the consultancy, several relevant findings were made in the preparation of the National Electric Power Regularization Plan (PNREE). With these inputs as a guide, recommendations were made that are adapted to the national context.

**Protected networks –** For the standard technical solution, the use of a system with smart meters in a low voltage network is recommended, which includes pre-assembly, meters and height panels, and connections with concentric cables. This solution can be improved with the use of spacers, which distance the pre-assembly from the column or post, making access to cables difficult. For neighborhoods in which higher degrees of danger and complexity for the circulation of operation mobiles are observed, a special technical solution is recommended, consisting of medium-voltage power distribution, based on the installation of several low-power transformers in the neighborhood from which energy boxes concentrate the measurement modules of homes that are served by the transformer. Each transformer typically feeds fewer than ten households.

**Smart meters and communication capacities –** UTE has a short-term migration plan for all its clients to this type of meter. Once these meters are installed, it's possible to show the user their consumption at all times through an app. This could increase the benefits of the current UTE mobile app, offering the possibility of: i) showing the consumption in kWh and the cost in pesos, updated to the current day; ii) raising alarms through notifications once the user crosses a tariff consumption threshold, increasing the cost of consumption per kWh; iii) show a projection of end-of-month consumption and cost based on the energy consumption of the current month and behavior within the past 24 hours; iv) raise alarms when the household consumption is close to the limit of contracted power. It is also recommended to consider these functions through SMS, WhatsApp messaging, through automatic systems (chatbots), and phone calls, to take into account the full range of users.

**Beneficiary schemes –** Reaching high levels of regularization requires affordable rates, according to each household's ability to pay. To this end, it is proposed that a rate scheme be developed that considers three possibilities to apply to vulnerable households: 1) an emergency rate intended for clients in extreme vulnerability, in which situations might include loss of a job or income and low-income, single-parent homes with dependent children. Consumption must be measured, but the household would pay a symbolic fixed cost or even nothing in very extreme cases. The generation of debts or lack thereof should be analyzed, so that they can be addressed once the household has exited the extreme situation. 2) A rate for very vulnerable households, but those who can afford to pay a certain amount for electric use. The TCB-T rate could be used, taking into account the number of members in the household. In addition, these households could eventually be beneficiaries of subsidies for LPG refills and receive subsidies for the purchase of efficient household appliances. 3) A rate for vulnerable households that takes into account those cases where a household may be able to pay a discounted rate, even as they may not be beneficiaries of subsidies for LPG purchases or household appliance purchases. Financing the full cost of efficient appliances through the electricity bill could also be considered.

The classification of households into these categories requires a household-level socioeconomic analysis, for which the intervention of MIDES would be required. It is recommended that beneficiaries be determined based solely on their socioeconomic status, so that resources can be directed to the population in greatest need. The origin of funds to subsidize these homes will need to be decided: whether a cross-subsidy among UTE users, or whether funds will be allocated from the public budget.

**Training and social work –**The sustainability of the regularization process depends upon dedicating efforts to educational issues and access to information, to the extent that these foster a better understanding of the causes of high consumption, how electricity rates work, which household appliances consume the most, which equipment is more efficient, and how to save energy. In addition, during the focus groups that were carried out, some important challenges were exposed with respect to the relationship between the target population and UTE, including criticisms of complexity of procedures, existence of pending debts as a barrier to regularization, the fear of punishment by the company, and the perception of high costs of materials for works that enable regularization of connections. All of these difficulties can be overcome through good communication, training, and education policies to be carried out during the plan.

In the preparation of the material about energy efficiency, suggestions should be collected about the contribution of each stakeholder institution, and it is the responsibility of MIEM to define the content and preparation of materials. Those materials about the safety aspects in the management of electric power, regularization plans, and other related topics, could be assigned to UTE.

Community social work is a fundamental part of the plan's success, but it has also proven to be the bottleneck that limits the speed of implementation when there is a lack of human resources or there is complexity in hiring. This should be a point addressed in the plan's design. Currently, the methodology applied by UTE in the PIS, involves carrying out various actions of a social nature, which has required that UTE hire more professionals in this area. It would be more efficient and profitable for some of these tasks to be carried out by MIDES staff; as such, a set of resources should be considered to ensure the hiring of staff that facilitates fluid coordination of each institution's interventions.

**Organization of the Plan and the different stakeholders –** The lack within vulnerable households manifests in different ways and requires a comprehensive approach to address, requiring the participation of a number of stakeholders. The stakeholders identified for the regularization process are UTE, MIEM, MIDES, MVOTMA, Intendencias, MEF, OPP and URSEA. In general, all of the interested stakeholder groups should be kept in mind, too, and these include the press, academia, ANTEL, OSE, regulated users, NGOs and civil society organizations, and beneficiaries who are both in favor of and opposed to the regularization plan.

One of the organizational aspects in need of improvement is the need for greater coordination in order to ensure the necessary inputs and to avoid duplicating efforts. The idea for the necessity of the PNREE arises from this reality. It is essential that all of the institutions involved take ownership of the proposed objectives and that there is acute coordination and collaboration in all areas (fieldwork, technicians, managers). The OPP is the entity that can visualize the cross-sectionality of public policies and, thus, act as coordinator of the execution of these policies, promoting inter-institutional cooperation. This point was emphasized by all institutions repeatedly during the workshops that were held. The leadership of PNREE could be comprised of representatives from each of the institutions, as well as its own full-time staff. The plan will require resources to cover roles for coordinating actions throughout the course of its implementation. Institutions that are involved in the plan and assume specific responsibilities should include these in their institutional objectives, so the fulfillment of these can be evaluated.

Among the varied objectives that the plan should pursue, it is recommended that numbered goals should be assigned to some key indicators, which will show efficacy of the implementations. To this end, a series of indicators considered relevant for program monitoring and evaluation are proposed, and these must be included in the regular monitoring plan.

**Table 6: Objectives at the end of the Plan**

| | |
|---|---|
| Non-technical losses in vulnerable neighborhoods | <1% |
| Timeline for execution | 4 to 5 years |
| Sustainability | >80% |
| Unit cost of regularization | < al actual |
| Irregular households at the end of the plan | <10.000 |

Source: SEG Ingeniería. 2020. Synthesis document "Preparation of inputs that allow the design of a regularization program to connect users to the electricity grid, focused on households in socioeconomically vulnerable situations in Uruguay".

The results of this work were presented on June 8, 2020 in the webinar "National plan for the regularization of connections in Uruguay." The link to the webinar, as well as the Project folder, the Executive Summary, the infographic, and the final presentation can be found in Table 1 of the Appendix.

## 2.7 Pilot Project for household energy labeling in the Autonomous City of Buenos Aires.


PRUEBA PILOTO DE ETIQUETADO ENERGÉTICO DE VIVIENDAS – CIUDAD AUTÓNOMA DE BUENOS AIRES

ETIQUETADO DE VIVIENDAS

09/09/2020 RESUMEN EJECUTIVO

Revisión 2 PREPARADO PARA FUNDACION BARILOCHE

FACULTAD DE CIENCIAS EXACTAS, INGENIERÍA Y AGRIMENSURA, UNIVERSIDAD NACIONAL DE ROSARIO

This project was developed at the request of the Environmental Protection Agency of Buenos Aires and the Assistant Secretary of Energy Efficiency and Savings[38].

### i) Objective and scope

The study's objective was an energy survey of at least 200 households in the Autonomous City of Buenos Aires, based on the IRAM 11900 Standard (2017), carried out within the framework of the National Household Labeling Program promoted by the nation's Secretary of Energy. The study also had as an objective to validate the established procedure for calculations and the projected implementation system, as well as making corresponding adjustments that take into account the particular climate, socioeconomic, and local construction practices. Likewise, the study would allow a definition of the range of values of the Energy Performance Index (IPE) that must be associated with each letter of the scale as proposed in the IRAM 11.900 (2017).

This pilot project is also proposed to evaluate the most influential factors in the energy requirements of the selected households, in order to identify potential savings in CABA and to work in conjunction with the Environmental Protection Agency of the Autonomous City of Buenos Aires (AprA) on a series of measures to be taken so the sector can improve its energy rating for existing homes and set minimum standards for new builds.

[38]Carried out by the Foundation for the School of Engineering of Rosario (Argentina), in the period between November 2019 and September 2020.

## ii) Description of the most relevant aspects of the tasks performed

The main activities developed in the present study included the following:

- **Contextual Analysis -** A review of the household energy efficiency labeling systems was carried out in existing programs in Spain, Chile, and Brazil. These countries were selected based on the distinct political relationships they have with Argentina. In the case of Chile, it is a country that is at the same latitude as Argentina, with different and similar climatic zones. On the other hand, Brazil is part of the same region, has a vast territory, and a federal government system (like Argentina). Spain, for its part, served as an example of how it works in a country that has already had mandatory energy rating systems in place for years.

Similarly, in the course of this analysis, a study was carried out at the local level (CABA) that included the development of a SWOT matrix, the result of which strengthened the experience acquired through the six pilots for household labeling that were carried out in the country; identified the existence of a computerized application for Household Labeling by the nation's Secretary of Energy based on a solid calculation procedure; and confirmed the presence of a good number of professionals throughout the country who are trained on the subject. In terms of weaknesses, what stand out are the difficulty in intergovernmental coordination (nation, province, municipality levels), the lack of technical training in the construction framework, and the lack of a budget for research and development.

- **Strategy and selection of households –** An online application was created to choose the 200 households via a registration form created by the professionals who were authorized to participate in the pilot test. The goal was to ensure that CABA's 15 communes nominated households, ensuring representation for each. For the purposes of characterizing household types, it was taken into account whether the household was a Collective Dwelling (a horizontal property with hallways, ground floor, intermediate floor, and top floor), or a Single-Family Dwelling (semi-detached, isolated, walled).

One hundred and ninety-seven homes were nominated initially, but as a result of the restrictions imposed by the preventive, mandatory social distancing in response to COVID-19, 150 homes were ultimately surveyed, of which 130 (87%) were collective and 20 (13%) were single family. As such, the objective of having homes representing all of the CABA communes was achieved, with a higher concentration from the communes located in the North and East zones (Commune 1, Commune 4, Commune 12, Commune 13, Commune 14), and a lower concentration in the West zone (Communes 8, 9, and 10). Within the collective housing stock, the type of household with the highest representation was the intermediate floor apartment (93)[39], followed by top floor apartment (21) and hallway apartment in PH (13). In the case of single-family dwellings, the most common type was the semi-detached house with two or more floors (8).

Requirements that professionals had to meet to participate in the pilot test included: approval of

[39] The majority of these were located in neighborhoods with high socioeconomic levels.

the House Labeling Course for Certifiers (CEV) by the Secretary of Energy and professional enrollment in CABA. The initial roster of professionals included 22 architects (44%), 18 engineers (36%), and 10 master builders (20%). As a result of conditions imposed by COVID-19, seven professionals shared that they would be unable to participate, so the roster was reduced to 43.

- **Determination of IPE and energy performance analysis –** Based on the information collected in each household, a general assessment of the home and its surroundings was made, a sketch was drawn up for each level, and spaces (thermal zones), construction systems, openings, and systems were surveyed, as were asset systems for the production of sanitary hot water, heating, and energy production via renewable sources. Mean values were then calculated for an important set of relevant magnitudes (sorted by type) associated with the calculation of IPE, to be able to then determine the Energy Performance Index (IPE) for the selected households. Criteria with Likert scales were developed for the purpose of evaluating energy performance in these homes, resulting in an individual report that synthesizes the most important information obtained from the IPE calculation. Finally, preliminary recommendations were made, using a color code (red, yellow, or green) to guide potential improvements.

A complementary study was also carried out to analyze in detail the characteristics of the intermediate floor apartment (representing 62% of the total), and the PH-type hallway apartment (representing 8.7% of the total). This study took into account the new requirements established in the Building Code (Law 6100/2018) of the Government of the City of Buenos Aires for buildings larger than 1,000m2. Proposed interventions were then quantified, and a cost-effectiveness analysis was carried out for the different proposed interventions, with the aim of determining which had the highest incidence at the lowest cost (cost of interventions / potential for improvement).

- **Creation of a report for each household analyzed –** Each owner/tenant of the surveyed household was presented with a report that included, among other items, information about the balance of the final energy requirement, IPE in relation to the average that was obtained in the pilot, and an analysis of envelope elements (solar gains and losses). Based on this information, a proposal for potential improvements to implement was prepared and submitted to each owner/tenant for their consideration.

## iii) Results and conclusions

From the analysis of results obtained from the relevant magnitudes associated with the IPE calculation, sorted by type of housing and average values, it was found that:

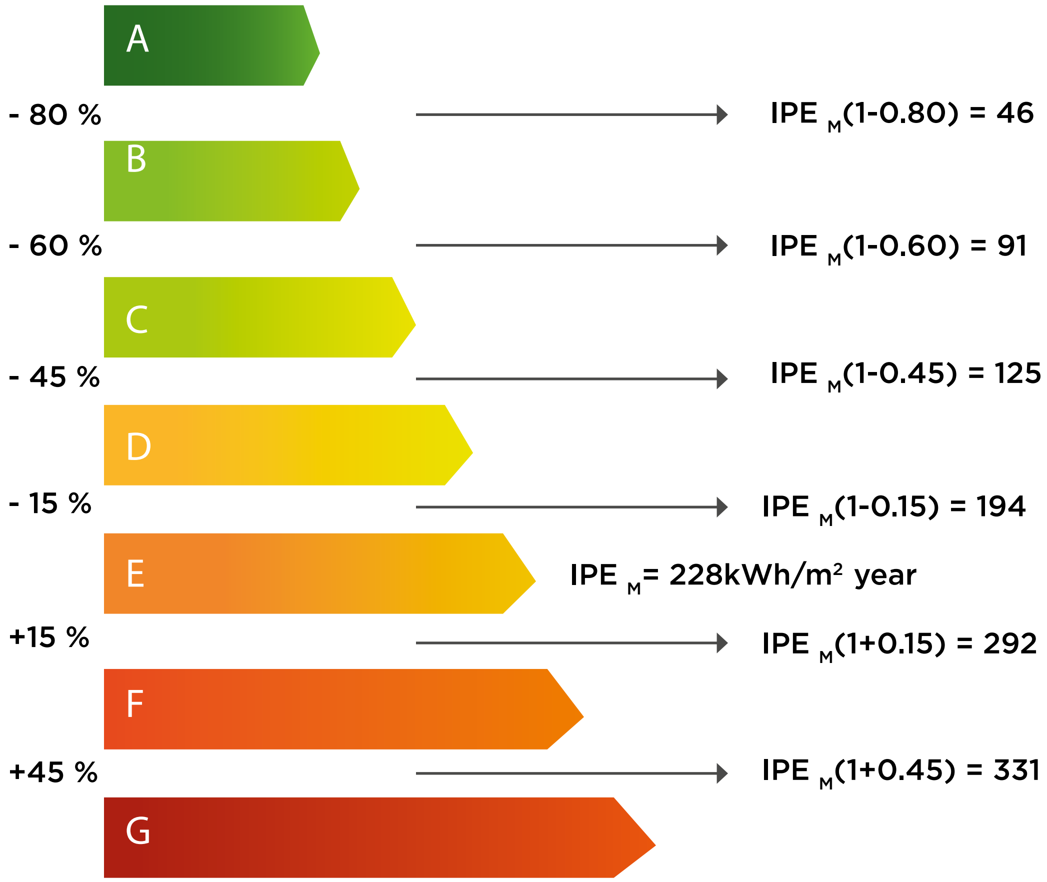
- The calculation of the average value of the Energy Performance Index ($IPE_{M)}$ for the 150 homes surveyed, yielded a figure of 228 kWh/ $m^2$year. The scale of the energy label associated with the pilot test of the Autonomous City of Buenos Aires was built using this figure, employing the criteria of the Ministry of Energy. This label represents the first step in the construction of a definitive scale for CABA. The distribution of the surveyed household by type was obtained using this criterion. The figure also includes the breakdown of the primary energy requirements for heating, cooling, ACS, and lighting.

## Table 7: Average of variables associated with IPE, by type and total average (150v)

| Variable | PH Apt | Ground Floor Apt | Intermediate Floor | Top Floor | 2p Single Dwelling | 1p Single Dwelling | 1p Isolated | 2p Comp | Total Avg |
|---|---|---|---|---|---|---|---|---|---|
| Number | 13 | 13 | 93 | 21 | 8 | 7 | 2 | 3 | 150 |
| AU [m2] | 72.6 | 72.6 | 56.0 | 61.9 | 135.5 | 101.7 | 152.7 | 139.3 | 68.6 |
| IPE [kWh / m2year] | 307.9 | 307.9 | 193.9 | 308.4 | 227.0 | 243.8 | 208.5 | 285.3 | 227.9 |
| EPI [kWh / m2year] | 230.8 | 230.8 | 131.7 | 233.3 | 165.9 | 168.3 | 159.0 | 220.7 | 162.0 |
| ES;I/AU [kWh / m2year] | 147.3 | 147.3 | 78.7 | 137.4 | 98.8 | 100.7 | 71.0 | 171.3 | 98.4 |
| EU;I/AU [kWh / m2year] | 118.3 | 118.3 | 69.7 | 111.0 | 68.1 | 87.7 | 80.0 | 103.3 | 81.8 |
| EPV [kWh / m2year] | 40.8 | 40.8 | 17.6 | 37.4 | 23.6 | 31.3 | 20.5 | 25.3 | 23.4 |
| ES;V/AU [kWh / m2year] | 12.3 | 12.3 | 5.3 | 11.3 | 7.1 | 9.5 | 6.0 | 7.7 | 7.1 |
| EU;V/AU [kWh / m2year] | 33.0 | 33.0 | 14.7 | 31.7 | 17.9 | 25.3 | 16.5 | 21.7 | 19.4 |
| EPACS [kWh / m2year] | 28.2 | 28.2 | 34.3 | 31.6 | 22.9 | 32.8 | 23.0 | 26.0 | 32.6 |
| ES;ACS/AU [kWh / m2year] | 22.5 | 22.5 | 21.7 | 21.2 | 18.1 | 17.0 | 18.5 | 20.7 | 21.3 |
| EU;ACS/AU [kWh / m2year] | 12.2 | 12.2 | 13.0 | 12.4 | 9.4 | 11.7 | 8.0 | 10.0 | 12.4 |
| EPIL [kWh / m2year] | 9.0 | 9.0 | 10.3 | 8.5 | 14.3 | 11.3 | 6.5 | 17.3 | 10.4 |
| ES;IL/AU [kWh / m2year] | 2.8 | 2.8 | 3.1 | 2.6 | 4.3 | 3.5 | 1.5 | 5.3 | 3.1 |
| EPREN [kWh / m2year] | 1.2 | 1.2 | 0.0 | 2.4 | 0.0 | 0.0 | 0.0 | 4.3 | 0.5 |
| $\gamma Y_{inv}$ | 0.3 | 0.3 | 0.4 | 0.3 | 0.3 | 0.3 | 0.2 | 0.2 | 0.3 |
| $\eta_{gr}$ | 0.8 | 0.8 | 0.9 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| $\gamma_{ver}$ | 0.6 | 0.6 | 0.5 | 0.6 | 0.6 | 0.6 | 0.6 | 0.5 | 0.5 |
| $\eta_{disp}$ | 0.5 | 0.5 | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| AU clim [m2] | 70.7 | 70.7 | 55.1 | 59.8 | 104.4 | 96.8 | 94.5 | 132.9 | 64.6 |
| V clim [m3] | 202.7 | 202.7 | 146.1 | 157.2 | 288.1 | 287.2 | 304.5 | 381.6 | 176.2 |
| S/V [m2/m3] | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 | 1.3 | 1.3 | 1.4 | 1.5 |
| $b_{tr}$ | 0.5 | 0.5 | 0.4 | 0.6 | 0.5 | 0.5 | 0.7 | 0.5 | 0.4 |
| Km, walls [W / m2K] | 2.2 | 2.2 | 2.0 | 2.1 | 2.0 | 2.1 | 2.0 | 1.6 | 2.0 |
| Km, roofs [W / m2K] | 2.4 | 2.4 | ----- | 2.1 | 2.5 | 2.6 | 1.8 | 2.2 | 2.2 |
| Km, floors [W / m2K] | 0.6 | 0.6 | ----- | 3.0 | 0.5 | 0.9 | 1.6 | 0.5 | 0.9 |
| Km, openings [W / m2K] | 3.9 | 3.9 | 4.2 | 3.6 | 4.2 | 4.1 | 3.6 | 4.0 | 4.1 |
| $H_{inv}$ [W / K] | 305.7 | 305.7 | 224.5 | 314.9 | 365.5 | 370.5 | 622.5 | 287.3 | 268.6 |
| $\gamma t_{inv}$ [h] | 13.3 | 13.3 | 20.5 | 14.5 | 17.9 | 16.9 | 15.7 | 16.4 | 18.6 |
| $H_{ver}$ [W / K] | 466.4 | 466.4 | 427.6 | 555.3 | 587.8 | 626.8 | 842.0 | 445.0 | 475.4 |
| $t_{ver}$ [h] | 8.9 | 8.9 | 11.4 | 8.4 | 10.3 | 10.9 | 11.2 | 10.6 | 10.7 |
| Rend Eq.Calef | 0.80 | 0.80 | 0.89 | 0.81 | 0.69 | 0.87 | 1.13 | 0.60 | 0.83 |
| Rend Eq.Ref | 2.68 | 2.68 | 2.78 | 2.81 | 2.51 | 2.67 | 2.75 | 2.83 | 2.75 |
| Rend Eq.ACS | 0.54 | 0.54 | 0.60 | 0.59 | 0.52 | 0.69 | 0.43 | 0.48 | 0.59 |

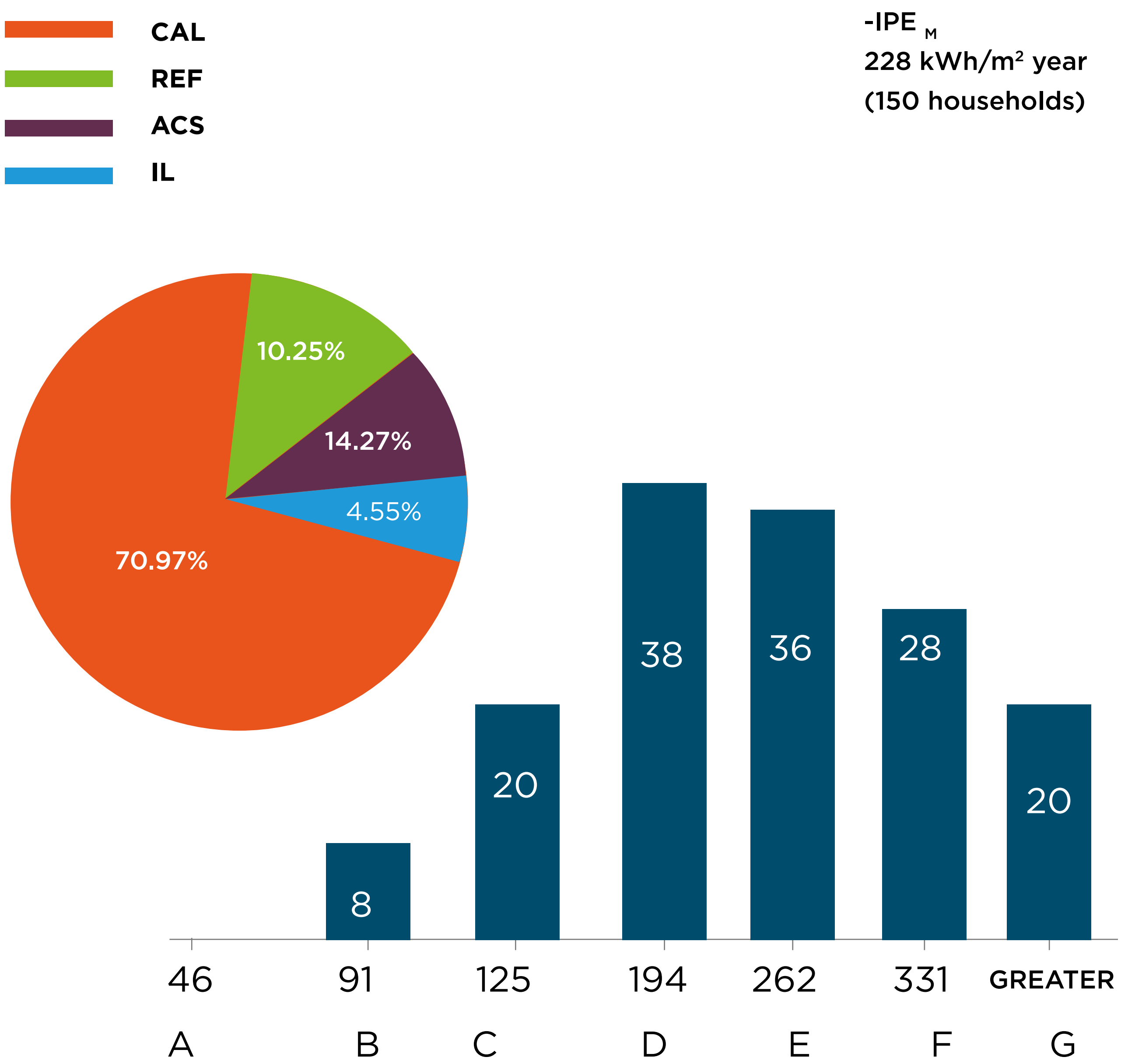
Source: Foundation for the School of Engineering of Rosario (Argentina). 2020. Synthesis document “Pilot Test of household energy labeling in the Autonomous City of Buenos Aires.”

Graphic 14: Energy labeling scale associated with the pilot test




Source: Foundation for the School of Engineering of Rosario (Argentina). 2020. Synthesis document "Pilot Test of household energy labeling in the Autonomous City of Buenos Aires."

Graphic 15: Distribution of households surveyed by level




Source: Foundation for the School of Engineering of Rosario (Argentina). 2020. Synthesis document "Pilot Test of household energy labeling in the Autonomous City of Buenos Aires."

- For an $IPE_M$ of 228 $kWh/m^2year$, the specific primary energy requirements for heating were 162 $kWh/m^2year$ (70.93%), which is much higher than the weighting of the other uses. It should be noted that these values were of the same order of magnitude as those obtained in the Rosario and Santa Fe pilots.

- The Energy Performance Index for the types of collective dwellings was on the order of 300 $kWh/m^2year$ for hallway apartments in PH and top floors, and on the order of 200KWh/$m^2year$ for intermediate floor apartments. For its part, the Energy Performance Index corresponding to single-family dwellings was on the order 240 $kWh/m^2year$.

- It was found that the average transmittance of walls (2.0 $W/m^2K$), roofs (2.2 $W/m^2K$) and openings (4.1 $W/m^2K$) far exceeds values currently established in the Building Code.

- The average heat transfer coefficient is low (btr= 0.4) due to the fact that the type of dwelling most frequent in the selected sample is the intermediate floor apartment.

- Average equivalent performance of active heating equipment (n = 0.83) is higher than that of balanced type gas stove, Label A (n = 0.71), reflecting the combined use of gas and electric equipment.

- Average equivalent performance of active cooling equipment (COP=2.75) is intermediate between that of a Class D split-type air conditioner (COP=2.70) and a Class C split type air conditioner (COP= 2.90).

- Average efficiency of the active equipment for ACS (n = 0.59) corresponds to that of a conventional Label E water heater E (n =0.59).

In relation to the comparative analysis of the experiences of the House Labeling program at the international level that were analyzed in the consultancy, some data that may be of interest are presented as a preliminary approach, even though the energy efficiency indicators and procedures defined by and developed in each country are different. As such, a comparison in absolute terms will not yield useful information.

## Table 8: Comparative analysis of household labeling experiences

| | Argentina | Chile | Brazil | Spain |
|---|---|---|---|---|
| **Indicators** | kWh/m2year | kWh/m2year | C/year (degrees per hour, natural cooling) kWh/m2year | kWh/m2year kgCO2/m2year |
| **Calculation process (thermic balance or percentage)** | Thermic Balance | Thermic Balance | Weighted numerical equivalent | Thermic Balance |
| **Average specific requirement of primary energy** | 332 kWh/m2year * 228 kWh/m2year** | Demand: 212 kWh/m2year Use: 355 kWh/m2year | Between A and B: 4-5 | Etiqueta E // E Label (Madrid) 238kWh/m2 |
| **(Mandatory/Voluntary)** | Voluntary (Sta. Fe mandatory unregulated) | Voluntary | Voluntary | Mandatory |
| **Minimum Standard** | None | None | None | None |

*Average of pilot projects at the national level. ** CABA

Source: Foundation for the School of Engineering of Rosario (Argentina). 2020. Synthesis document "Pilot Test of household energy labeling in the Autonomous City of Buenos Aires."

- In the case of Chile, a theoretical estimate of demand (equivalent to useful energy) for energy used for heating, cooling, domestic hot water, and lighting, is used as an indicator, with the average value being 212 kWh/$m^2$year, 81% higher than the usual energy value of 117 kWh/$m^2$year obtained for CABA. In addition, energy consumption in heating, sanitary hot water, lighting, and ventilation is used as a complementary indicator, accounting for equipment energy performance, primary energy type, and contribution of non-conventional renewable energies (NCREs) for heating, sanitary hot water, lighting, and mechanical ventilation. In this case, the average value of 355 kWh/$m^2$ayear, is 56% higher than the average value of the specific primary energy requirement of 228 kWh/m2year for CABA.

- With respect to Brazil, it is not possible at present to establish a comparison in relation to the average requirement obtained for CABA, as the indicators used to evaluate energy efficiency of residential dwellings are the °C/year (degree hours of natural cooling) and relative consumption for heating in kWh/$m^2$year, which are converted into weighted numerical equivalents to establish a scale of labels between A and E. Since the certification of residential dwellings is not mandatory, only those that have obtained an A or B label have been registered.

- In the case of Spain, the average primary energy consumption corresponding to a Type E label for Madrid was taken for the purposes of making a comparison. This consumption includes heating, cooling, and ACS.

The following results were obtained from the detailed analysis of the intermediate floor and PH hallway apartment types:

### Conclusions:

A letter D can be obtained on the scale proposed for the Household Labeling Pilot of Buenos Aires without having to modify current systems, by applying the city government’s Building Code requirements to improve passive systems (insulation in walls, improvements in openings and insulation in roofs for PH hallway apartments).

- The most cost-effective intervention for the intermediate floor apartments is given in Case 2 (improvement of wall insulation and replacement of openings within the construction system).

- The most cost-effective intervention for the PH-hallway apartments is given in Case 1 (improvement of roof insulation within the construction system).

As expected, a higher investment will be required relative to expected savings in order to reach the highest levels on the scale that is proposed.

### iv) Follow-up, implementation potential

Household Labeling in CABA is a first step to analyze and determine the application of energy efficiency policies and regulations at the household level. The results of this project will allow priority measures to be implemented that will improve household energy performance and reduce energy consumption, which will inevitably cause social, economic, and environmental benefits.

The household labeling pilot in CABA is a source of and guide for important information regarding the development of new studies and analyses related to household energy efficiency, a topic that is gaining greater interest and importance in Argentina and in our region.

The Environmental Protection Agency of the Autonomous City of Buenos Aires AprA is planning new actions and strategies that will allow it to expand the analysis of energy labeling in the city, and will help determine cost-effective measures to reduce household energy consumption.

The results of this work were presented Thursday, 09/17, 11hs (GMT-3, Buenos Aires time). The link to the webinar, as well as the Project folder, the Executive summary, the infographic, and the final presentation can be found in Table 1 of the Appendix.

# Primary References

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# Appendix 1

**Tables with facts about the projects carried out**

1. Project Name
2. City/Country
3. Subject
4. Consultant
5. Direct beneficiary
6. Proposed/analyzed instruments
7. Projection of new energy produced
8. Projection of emissions avoided (tonCO2eq)
9. Link to Synthesis Report
10. Link to final presentation

# Table 1. Studies of TCC in Renewable Energies

## Renewable Energies

| | Project Name | City/country | Subject | Consultant | Direct beneficiary | Proposed/ analyzed instruments | Projection of new energy produced | Projection of emissions avoided (ton-$CO_{2eq}$) | Link to Synthesis Report | Results of the Final Presentation |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Auctions of electricity from renewable energy sources in Latin America and the Caribbean: Brazil, Panama, and Uruguay (2017) | Brazil Panama Uruguay | Renewable Energy Auctions | Factor (ES) | Public entities in Latin America and the Caribbean that are charged with renewable energy management | Command control; Economic incentives; Goods provided by the government. | N.A. | N.A. | http://fundacionbariloche.org.ar/wp-content/uploads/2019/04/2.-Resumen-Ejecutivo-Balance-Neto.pdf | https://www.youtube.com/watch?v=EekGz9O0B7A |
| 2 | Use of the net balance mechanism for the promotion of the generation of decentralized electricity to renewable sources in Latin America and the Caribbean: Chile and Mexico (2017) | Chile Mexic | Net Balance | Factor (ES) | Public entities in Latin America and the Caribbean that are charged with renewable energy management | Command control; Economic incentives; Goods provided by the government | N.A. | N.A. | http://fundacionbariloche.org.ar/wp-content/uploads/2019/04/2.-Caso-Estudio-Balance-Neto-Chile.pdf | |
| 3 | Case studies about solar water heaters for residential buildings in 6 countries in Latin America and the Caribbean (2018) | Barbados, Brazil, Colombia, Chile, Mexico and Uruguay | Solar Thermal Heaters | Christian Navntoft | Public and private entities in Latin America and the Caribbean that are interested in solar thermal energy | Command control Economic incentives; Instruments based on information and voluntary schemes | Barbados: 178923 MWh/año<br>Brazil: 10043482 MWh/año<br>Colombia: 80000 MWh/año<br>Chile: 199803 MWh/año<br>Mexico: 2028960 MWh/año<br>Uruguay: 35630 MWh/año | Barbados: 19.889 ton$CO_{2eq}$/año<br>Brazil: 1'353.898 ton$CO_{2eq}$/año<br>Colombia: 19.220 ton$CO2_{eq}$/año<br>Chile: 63.327 tonCO2eq/año<br>Mexico: 470.569 ton$CO_{2eq}$/año<br>Uruguay: 1.360 ton$CO_{2eq}$/año | http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/fichas-e-informes/ | http://ledslac.org/es/2018/07/analisis-integral-del-mercado-de-calentadores-de-agua-solares-para-seis-paises-de-america-latina-y-el-caribe/ |
| 4 | Roadmap of Technologies based on biomass residuals for thermal energy generation in the industrial sector in Costa Rica to 2030 (2017) | Costa Rica | Biomass | Consortium: EMA-CICR and Chirropó Consultores | Ministry of Industry, the Environment, and Energy of Costa Rica (MINAE) | Instruments based on information and voluntary schemes | The contribution of biomass will surpass the current 18.000 TJ to approximately 26.000 TJ. | 1'321.311 tonCO2eq from2017 to 2030 | http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/fichas-e-informes/ Enlace: http://fundacionbariloche.org.ar/wp-content/uploads/2019/04/BIOMATEC_Valorizaci%C3%B3n_Biomasa-forestal_RHN_Costa-Rica_RE-1.pdf | |
| 5 | Roadmap of Solar Technology for the heating of water, heating, and refrigeration in residential, commercial, and industrial buildings in Costa Rica to 2030 (2017) | Costa Rica | Solar heating | Consortium: EMA-CICR and Chirropó Consultores | Ministry of Industry, the Environment, and Energy of Costa Rica (MINAE) | Instruments based on information and voluntary schemes | 18,13 GWh from 2017 to 2030 | 5.126 tonCO2eq from 2017 to 2030 | http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/fichas-e-informes/ | http://fundacionbariloche.org.ar/wp-content/uploads/2019/04/4.-Resumen-Ejeuctivo-Hoja-de-Ruta-Tecnol%C3%B3gica-Costa-Rica-Solar.pdf |

## Renewable Energies

| | Project Name | City/country | Subject | Consultant | Direct beneficiary | Proposed/ analyzed instruments | Projection of new energy produced | Projection of emissions avoided (ton-$CO_{2eq}$) | Link to Synthesis Report | Results of the Final Presentation |
|---|---|---|---|---|---|---|---|---|---|---|
| 6 | Comparative analysis of the regulatory and commercial frameworks for the adoption of solar photovoltaic energy for commercial, residential, industrial, and public buildings in selected countries of Latin America and the Caribbean (2018) | Brazil, Chile and Mexico | Roof-installed solar photovoltaics | Ernst&Young SAS Colombia | Public and private entities in Latin America and the Caribbean interested in distributed generation with solar photovoltaics | Command control; Economic incentives | N.A. | N.A. | http://fundacionbariloche.org.ar/wp-content/uploads/2019/04/4.-Resumen-Ejeuctivo-Hoja-de-Ruta-Tecnol%C3%B3gica-Costa-Rica-Solar.pdf | http://ledslac.org/es/2018/09/analisis-comparativo-de-marcos-regulatorios-y-comercial-para-la-adopcion-de-energia-solar-fotovoltaica-en-brasil-chile-y- mexico |
| 7 | Distributed generation with solar photovoltaics and storage for the northeast of the Santa Fe Province, Argentina (2017) | Ceres, Tostado, San Cristobal (Santa Fe, Argentina) | Solar photovoltaic parks | ESIN-TTA Consortium | Secretary for the State of Energy in the Santa Fe Province of Argentina | Goods provided by the government; Economic incentives | 56,591,42 MWh/year | 39,614 tonCO2eq/year | http://fundacionbariloche.org.ar/wp-content/uploads/2019/04/Resumen-Ejecutivo-Sistemas-Solares-Caso-Argentina.pdf | |
| 8 | Photovoltaic Systems in 104 Educational Institutions in the Sanquianga" Subregion of the Government of Nariño, Colombia (2018) | Sanquianga (Nariño, Colombia) | off grid photo voltaic solar | Consorcio TTA, Hemeva, Ecotourism | Government of Nariño, Colombia | Economic incentives; Goods provided by the government; instruments based on information and voluntary schemes | 0,211 MWh/year | 168.71 tCO2eq/year | http://fundacionbariloche.org.ar/wp-content/uploads/2019/04/Resumen-Ejecutivo-Sistemas-Solares-Caso-Colombia.pdf | |
| 9 | "Carbon Management Plan" of the Government of the State of Jalisco, Mexico. | Guadalajara (Jalísco, Mexico) | Roof-installed photovoltaic solar | Consorcio TTA, Hemeva, Ecotourism | Secretary of the Environment and Territorial Development(SEMADET) of Jalisco | Command control; Economic incentives; Goods provided by the government; instruments based on information and voluntary schemes | 88.967,41 MWh/year | 43.683 tonCO2eq/year | http://fundacionbariloche.org.ar/wp-content/uploads/2019/04/Resumen-Ejecutivo-Sistemas-Solares-Caso-M%C3%A9xico.pdf | |
| 10 | Economic valuation of the energetic potential of forest biomass in the North Huetar Region of Costa Rica, which serves as a basis for formulating policies that consolidate forestry participation among sustainable energy options. | Costa Rica | Forest biomass | Biomatec | MINAE-FONAFIFO Costa Rica | Command control; Economic incentives; Goods provided by the government; instruments based on information and voluntary schemes | [Wood-burning ovens]: 8.388,65 MWh/year<br>[Replacement of bunker boilers]: 84.719,85 MWh/year<br>[CHP+P Plant]: 554.984,46 MWh/year | [Wood-burning ovens]: 18.74 tonCO2eq/year<br>[Replacement of bunker boilers]: 23.589 tonCO2eq/year<br>[CHP+P Plant]: 917,271 tonCO2eq/year | http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/fichas-e-informes/ Enlace: http://fundacionbariloche.org.ar/wp-content/uploads/2019/04/BIOMATEC_Valorizaci%C3%B3n_Biomasa-forestal_RHN_Costa-Rica_RE-1.pdf | https://www.dropbox.com/s/rtqg1mznoh68ns8/BIOMATEC%20 |

## Renewable Energies

| | Project Name | City/country | Subject | Consultant | Direct beneficiary | Proposed/analyzed instruments | Projection of new energy produced | Projection of emissions avoided (ton-$CO_{2eq}$) | Link to Synthesis Report | Results of the Final Presentation |
|---|---|---|---|---|---|---|---|---|---|---|
| 11 | Analysis and technical foundations for the formulation of a fiscal policy proposal that promotes the use and exploitation of distributed electricity generation derived from renewable energy sources, from the perspective of corporate responsibility. | Guatemala | Fiscal policy for distributed generation of solar photovoltaics | Factor (ES) | Ministry of Finance of Guatemala | Economic incentives; Goods provided by the government | N.A. | N.A. | http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/fichas-e-informes/ | http://ledslac.org/es/2020/08/propuesta-de-lineamientos-de-politica-fiscal-para-generacion-distribuida-a-rtar-de-la-energia-solar-fotovoltaica-en-guatemala/ |
| 12 | Action Plan for the Sustainable Energy Transition of the Archipelago of the Galápagos Islands, 2020-2040 | Galápagos (Ecuador) | Prospective energies | Independent researchers contracted by the Bariloche Foundation | Governing Council of the Special Regime of the Galápagos (CGREG). Ministry of Energy and Non-renewable Natural Resources (MERNNR | Command control; Economic incentives; Goods provided by the government; Instruments based on information and voluntary schemes | Assuming no changes until 2040, the reference scenario projects a final energy demand in 2030 of 440 KBEP; the scenarios for decarbonization by 2040 estimate reductions of: Low Scenario, approx. 25%; Medium Scenario, approx. 45%; High Scenario, approx. 90%. | By 2040, in the reference scenario, emissions will reach a PER CAPITA value of 4,2 tonCO2eq (currently, they are 6 tonCO2eq).<br><br>For low, medium, and high impact decarbonization scenarios, the PER CAPITA emissions are 2.3, 1.4, and 0.25 tonCO2eq, respectively. | http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/fichas-e-informes/ | https://youtu.be/n8V8Z5fZjM0 |
| 13 | Evaluation of isolated solar photovoltaic systems and their sustainability schemes | Colombia | Access to energy | Polytechnic University of Madrid | Mining and Energy Planning Unit of Colombia | Command control; Economic incentives; Goods provided by the government; Instruments based on information and voluntary schemes | N.A. | N.A. | http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/fichas-e-informes/ | https://www.youtube.com/watch?v=yHcS-peLAtN8 |
| 14 | Courses of action for the sustainable use of residual biomass from the African Palm and rice (husk) agribusiness in Ecuador for the distributed generation of electrical energy | Ecuador | Agrobusiness biomass residuals | ESIN Consultores | Electric Company of Ecuador (CELEC EP) | Command control; Economic incentives; Goods provided by the government; Instruments based on information and voluntary schemes | 262.2 GWh/year | 150.974 tonCO2eq/year | http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/fichas-e-informes/ | https://www.youtube.com/watch?v=m-PaID_PZ-XY&ab_channel=Fundaci%C3%B3nBariloche |

## Energy Efficiency

### Table 2: Studies of TCC in Energy Efficiency

| | Project Name | City/country | Subject | Consultant | Direct beneficiary | Proposed/ analyzed instruments | Projection of new energy produced | Projection of emissions avoided ($tonCO_{2eq}$) | Link to Synthesis Report | Results of the Final Presentation |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Innovative Business Models for Public Lighting in Latin America and the Caribbean | Buenos Aires, Bucaramanga, Fortaleza, Mexico City, Santiago, Sonsonate | Public lighting | Econoler | Municipalities, technology companies, investors | Command control; Economic incentives; Goods provided by the government; instruments based on information and voluntary schemes | N.A. | N.A. | http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/fichas-e-informes/ | http://fundacion-bariloche.org.ar/proyecto-gef-bid-fb/fichas -e-reports / |
| 2 | Roadmap for the adoption of energy efficient envelopes in public, residential, and commercial buildings in the Dominican Republic | Dominican Republic | Energy efficiency in buildings | Natural Gas Fenosa Engineering | National Energy Commission (DR) | Command control; Economic incentives; Goods provided by the government; instruments based on information and voluntary schemes | 3.678 kTep (153´990.504 GJ) | 194.500 TonCO2eq/year | http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/fichas-e-informes/ | |
| 3 | Comparative analysis of energy efficiency standards in residential, commercial, and public buildings in Latin America and the Caribbean | Argentina, Brazil, Colombia, Costa Rica, Jamaica, Mexico, Panama, Peru, Dominican Republic, and Uruguay | Energy efficiency in buildings | Econoler | Public entities in Latin America and the Caribbean that are charged with incentivizing energy efficiency in buildings | Command control; Economic incentives; Goods provided by the government; instruments based on information and voluntary schemes | N.A. | N.A. | http://fundacionbariloche.org.ar/wp-content/uploads/2019/04/3.-Resumen-Ejecutivo-An%C3%A1lisis-Comparativo-Est%C3%A1ndares-EE-en-Edificaciones.pdf | http://fundacion-bariloche.org.ar/wp-content/uploads/2020/02/presentacion-resultados-Envolventes-2.pdf |
| 4 | Comparative analysis of the regulatory and commercial framework for cogeneration systems in Latin America and the Caribbean | Brazil, Colombia, Guatemala, Mexico, Nicaragua and Uruguay | Cogeneration | Alejandro Rivera Alvarez | State entities charged with fostering development of efficient energies; industries; investors | Command control; Economic incentives; Goods provided by the government; instruments based on information and voluntary schemes | N.A. | N.A. | http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/fichas-e-informes/ | http://fundacionbariloche.org.ar/wp-content/uploads/2019/04/4.-Executive-Summary-Cogeneration. |
| 5 | Proposal of sustainable behavior standards for buildings in the Archipelago of the Galápagos in Ecuador, in the residential, commercial, and public sectors | Galápagos (Ecuador) | Energy efficiency in buildings | Fundación Tecnalia Research & Innovation | Ministry of Electricity and Renewable Energy (MEER) now MERNNR | Command control; Economic incentives; Goods provided by the government; instruments based on information and voluntary schemes | N.A. | N.A. | http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/fichas-e-informes/ | |
| 6 | Preparation of inputs that allow the design of a regularization program to connect users to the electrical grid, focused on households in vulnerable socioeconomic situations in Uruguay | Uruguay | User regularization | SEG Ingeniería | Ministry of Industry, Energy, and Mining of Uruguay (MIEM) | Command control; Economic incentives; Goods provided by the government; instruments based on information and voluntary schemes | According to data provided by UTE, a non-regularized household consumes 500kWh/month; following regularization, consumption decreases to approximately 207 kWh/month. The plan accounts for the regularization of 70,000 households by 2026 (1,931 GWh avoided). | 47 KtONCO2eq within five years of the plan's implementation | http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/fichas-e-informes/ | https://us.bbcollab.com/guest/0c-61d914f2214db-5b82a789acd0110e4 |

## Energy Efficiency

| | Project Name | City/country | Subject | Consultant | Direct beneficiary | Proposed/ analyzed instruments | Projection of new energy produced | Projection of emissions avoided (ton-$CO_{2eq}$) | Link to Synthesis Report | Results of the Final Presentation |
|---|---|---|---|---|---|---|---|---|---|---|
| 7 | Low-carbon development for the cement industry in Chile | Chile | Environmentally sound technologies | Cementis – The GreenWerk | Chile's Ministry of Energy, institutions related to cement in Chile | Command control | N.A. | 2.100 ktonCO2eq by 2030 | http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/fichas-e-informes/ http://fundacionbariloche.org.ar/wp-content/uploads/2020/02/Fact-Sheet_Hoja-de-ruta-del-desarrollo-bajo-en-carbono-para-la-industria-chilena-del-cemento_2020-02-10-2.pdf | https://bit.ly/2z4Im-qp (compressed link) |
| 8 | Low-carbon development for the steel industry in Chile | Chile | Environmentally sound technologies | EQO – NIXUS, IMPLEMENTA SUR | Ministry of Energy | Command control; Economic incentives; Goods provided by the government; instruments based on information and voluntary schemes | N.A. | 205 ktonCO2eq/year | http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/fichas-e-informes/ http://fundacionbariloche.org.ar/wp-content/uploads/2020/02/Fact-Sheet_Hoja-de-ruta-del-desarrollo-bajo-en-carbono-para-la-industria-chilena-del-cemento_2020-02-10-2.pdf | https://www.4echile.cl/ presentations-events / contribution-of-the-private-sector-towards-carbon-neutrality-cement-and-steel |
| 9 | Structuring of an Energy Management System based on the ISO 50001 guideline, for 4 representative buildings of the University of Buenos Aires | Argentina | Energy management | WSP | University of Buenos Aires – Assistant Secretary of Energy Efficiency and Savings – | Command control; instruments based on information and voluntary schemes | 2.54 GWh/year (9´144.000 Megajoules) equivalent to 31% of the energy consumption of the four buildings (energetics, electricity, and natural gas). | 1.218 tonCO2eq/year | http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/fichas-e-informes/ | https://us.bbcollab.com/collab/ui/session/playback/load/8b06a-0b53adf4910a5a-09fe32449ac22 |
| 10 | Comparative analysis of energy solutions for the Mendoza Andes, replacing the use of liquid fuels for the supply of energy | Argentina | Sostenibilidad energética | Quantum S.A. | Empresa Mendocina de Energía S.A. (EMESA) | Comando Control; Incentivos económicos; Bienes provistos por el Gobierno. | 3200 MWh/año parque solar en Uspallata, F.P.: 0,18. | 3.450 tonCO2eq/año | http://fundacionbariloche.org.ar/proyecto-gef-bid-fb/fichas-e-informes/ | https://www.youtube.com/watch?v=5Qb-gbic9siE |
| 11 | Pilot of Household Energy Labeling in the Autonomous City of Buenos Aires - CABA | Argentina | Energy labeling | Foundation for the School of Engineering, Rosario | CABA Environmental Protection Agency, Assistant Secretary of Energy Efficiency and Savings, Secretary of Energy | Command control | N.A. | N.A. | http://fundacionbariloche.org.ar/en/proyecto-gef-bid-fb/fichas-e-informes/ | https://www.youtube.com/watch?v=COOK-jJc_aVs&feature=-youtu.be |

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