Climate Investment Funds

CTF/TFC.9/4
April 13, 2012

Meeting of the CTF Trust Fund Committee
Washington, D.C.
May 3, 2012

Agenda Item 4

# INVESTMENT PLAN FOR CHILE

**Proposed Decision by CTF Trust Fund Committee**

The Trust Fund Committee reviewed document CTF/TFC.9/4, *CTF Investment Plan for Chile*, and endorses the plan as a basis for the further development of activities for CTF funding. The Trust Fund Committee also notes the request for US$200 million in CTF funding to finance the proposed projects and programs.

Recalling the decision by the Trust Fund Committee on document CTF/TFC.9/5, *Options for Managing the Development of Projects Arising from New Investment Plans*….

# Clean Technology Fund
# Investment Plan for Chile

*April 2012*

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# Section 2. Executive Summary

Chile is a country with excellent prospects for the development of a clean energy matrix but it faces major challenges in order to achieve this transformation. The country must meet a rapidly growing energy demand at competitive prices in an environmentally sustainable way. Chile is today going through an intense internal debate regarding the future of energy development. At stake is how to reduce the dependence on imported fossil fuels with volatile prices, while also avoiding the negative environmental impacts of large projects. Roughly 75% of its energy sources are imported, representing more than 50% of the total value of Chilean imports.

Chile is highly committed to tackle domestically the complex drivers of climate change. In 1994, Chile ratified the United Nations' Framework Convention on Climate Change and subscribed to its Kyoto Protocol. Later, in 2009, a presidential mandate led to the creation of the Inter-Ministerial Committee on Climate Change. In 2012, the government launched the National Energy Strategy (ENE), which links the need to increase Chile's energy security with its commitment to tackling Climate Change, by aiming to more than double its non-conventional renewable energy resources (NCRE) in the next decade. This is a crucial issue for the Chilean government, as it is located in the intersection of a global environmental issue, and a national energy security issue. Important reforms and incentives have resulted in an uptake of certain types of renewable energy investments, but major gaps remain in order to maximize the country's excellent potential and develop a clean resilient and stable power matrix. In order to reach these ambitious goals the government will need not just policy actions and budgetary commitments, but also support to the market in terms of reducing barriers to investment.

This document analyzes the challenges and opportunities to scale-up NCRE and proposes an Investment Plan with three components that utilize CTF co-financing to support the Chilean ENE's efforts, by reducing costs, risks, and liquidity and capacity barriers in the flow of financing to NCRE projects. The first component is a Concentrated Solar Power Project (CSPP) in the northern region of Chile. The second component is a Large Scale Photo Voltaic Program (LSPVP) to scale up photo voltaic power installations across the country. Finally, the third component aims to scale-up Renewable Energy Self-Supply and Energy Efficiency (RESSEE) for individual energy end-users. The total size of the Investment Plan (IP) is USD1,209.4M, where CTF co-financing represents a 15%, or USD200M, divided as follows: CSPP (USD100M), LSPVP (USD50M), RESSEE (USD49M), and RESSEE's preparation grant (USD1M). For each individual component (except the preparation grant), the CTF intervention represents less than 21% of the total cost.

The structure of this document is as follows: section three offers an economic and energy overview of Chile, and summarizes the current GHG mitigation actions adopted by the Chilean government. Section four describes the priority sectors for GHG abatement, by analyzing the inventory of GHG emissions by sectors, and the cost-effectiveness of mitigation actions. Section five presents the programs and projects for CTF intervention, and describes the rationale and methodology used to identify the projects. Section six summarizes the Chilean energy policy institutions and regulatory framework that enables the deployment of the project and the programs selected. Section seven evaluates the implementation potential and offers a risk assessment for the Chilean CTF investment plan. Section eight discusses the gender issues at stake. Section nine shows the monitoring and evaluation framework that is proposed for the components. The financial plan in section 10 describes how the different sources of finance will complement each other in supporting the four components. Finally, section eleven summarizes the public consultation process. A more detailed description of the components is included in the annexes.

***"We have committed ourselves to be the first country in Latin America to overcome poverty and leave underdevelopment behind…" "This means that we have to double our power generation capacity during this decade. This is a formidable challenge, and we want* secure, clean and economical *energy". (President Piñera of Chile)***

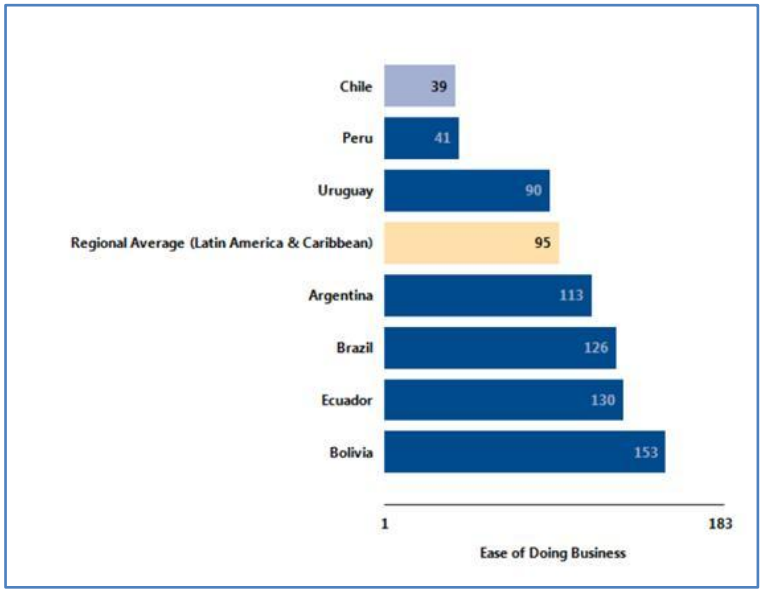
# Section 3. Country and sector context

## 3.1. Chilean Economy Overview

Chile has a modern, dynamic economy, with stable policy and regulatory frameworks and a market-based growth orientation. The economy has been growing at a fast pace and GDP is expected to grow at 4% until 2030[1]. Chile's economy is characterized by an increasing share of manufactured products and by increasing exports of minerals and foodstuffs.

Chile's successful approach to development is based on an economy open to trade and technological innovation. The World Bank's Doing Business index ranks Chile 39 out of 183 countries. This indicator measures ten areas in the life cycle of a business such as: starting a business, permitting, getting credit, protecting investors, and enforcing contracts among others. Chile is amongst the highest ranked in the region (see Figure 1).

*Figure 1. Doing Business Index, 2012*




Source: World Bank, bit.ly/doing_business_WB, 2012, p7

Although Chile is not one of the largest global GHG emitters – it is responsible for only 0.2% of the global emissions - its per-capita emissions from fuel combustion (3.84 ton $CO_2$) are well above the Latin American average (2.16)[2]. Similarly the carbon intensity of Chile's economy is 0.33 kg $CO_2$/USD of GDP ppp, above the Latin American average (0.26) and above countries such as Spain (0.27) or Italy (0.26)[3]. Moreover, in terms of carbon intensity per energy used (kg of $CO_2$

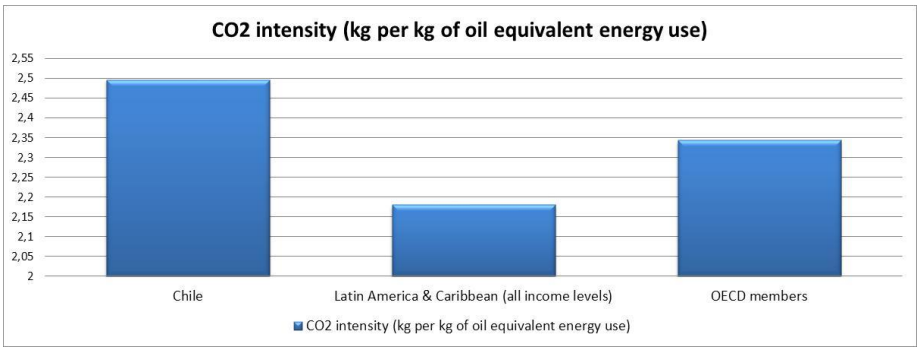
1 bit.ly/economist Chile

2 bit.ly/CO2emissionsIEA

3 Ibid

per kg of oil equivalent), Chile is above the average of both Latin America and the Caribbean and OECD members, as shown in the graph below.

*Figure 2. $CO_2$ intensity per energy unit used, 2008*




Source: World Bank, World dataBank (databank.worldbank.org/ddp/home.do)

## 3.2. Chilean Energy Sector

In Chile, the provision of power and energy services is 100% in the hands of the private sector under a market-based regulatory framework. The approval of the 1982 Electricity Act (*Ley General de Servicios Eléctricos*) set the legal foundations for a deep, pioneering reform of the Chilean electricity market, which shifted from a sole publicly-owned and vertically-integrated utility to a 100% privately driven, vertically and horizontally unbundled system.

The successful implementation of this model, whose associated regulatory framework has been continuously improved, has attracted a significant amount of Foreign Direct Investment into the sector, and has allowed the industry to meet continually growing energy demand over the last 29 years.

Due to limited domestic fossil fuel sources, energy security and its links with environmental issues are of supreme importance for Chile. Similarly to other parts of South America, hydropower was historically Chile's single largest power source. However droughts periodically reduced hydropower production causing supply shortfalls and blackouts and revealing hydro to be an uncertain supply of baseload energy. In response, as part of a global trend during the 1990s, Chile began to diversify its energy mix by investing in other fuel sources, and especially in natural gas transportation and power generation infrastructure. Gas facilities were relatively inexpensive and fast to construct, power was dispatchable on demand, gas was relatively clean and environmentally friendly compared to coal or diesel, and, while it had to be mostly imported, there was an abundance of natural gas available from neighboring Argentina, making it relatively cheap. By 2004 up to 40% of generation ran on Argentinean gas. However in 2004, due to domestic fuel shortages, Argentina passed a law suspending gas exports to its neighbor, which resulted in widespread blackouts in Chile. The country then turned to other markets and to an increased reliance on coal (see Figure 3 and Figure 4).

Chile is therefore highly dependent on imported fuels. Energy imports increased from 48% to 76% of total primary energy consumption between 1990 and 2010.[4] Moreover, fuels represent more than 50% of total Chilean imports.[5] This dependence on imported fuels, and the concomitant exposure to fossil fuel volatility, represent significant risks for the Chilean economy, and have led the country to undertake a number of progressive regulatory changes to

[4] bit.ly/ChileBNE

[5] bit.ly/CambioClimaticoChile, pg 72, 2011

make its power system more flexible and to encourage the development of stable, indigenously sourced, clean power.

The expected economic growth of the country (see above) will result in a sustained expansion of energy demand. Even if more conservative economic growth rates are considered, almost 800 additional MW of generation capacity will be needed per year (totaling 4 GW by 2016). And, if the business as usual scenario persists, most of this new annual capacity installed will be coal-fired technology. Diesel-fired supply is also expected to increase, especially in the Northern grid (SING). Therefore two important medium term goals of the Government of Chile (GoC) in the energy sector are to reduce the carbon footprint of the economy and increase the participation of renewable energy sources in the power matrix.

The country presents a unique opportunity for low-carbon growth. Favorable conditions that would enable it to effectively pursue a low-carbon transformation of its energy sector include: (a) a serious national concern with the vulnerability associated with its high dependence on imported energy and a strong political commitment to reduce this through energy efficiency and renewable energy; (b) an institutional, regulatory and investment climate in the energy sector that are globally recognized as stable and attractive to investors; (c) high domestic energy prices[6] make other non-fossil options comparatively affordable; and (d) a large and diversified renewable energy resource base, including significant hydro, wind, marine, geothermal and solar energy resources.

In this context, the GoC developed the National Energy Strategy (ENE) that aims to increase the participation of non-conventional renewable energy (NCRE[7]) in the energy matrix. More details of the ENE are found in section 3.4.4.

There are four main power grid systems in the country,[8] with the first two being by far the largest. The two smaller systems are operated by vertically integrated utilities:

- The Northern Interconnected System (SING): 16,000 GWh generated in year 2011, 4,000 MW of installed capacity, almost 100% fossil-fuel facilities supplying 90% of its electricity to industry, mainly mining.
- The Central Interconnected System (SIC): 46,000 GWh generated in year 2011, 12,365 MW of installed capacity, with 51% fossil-fuel-fired capacity, 47% hydro, 2% wind power, and 2% of biomass.
- The Aysen System (SEA): 145 GWh generated in the year 2011, 52 MW of installed capacity, with 57% diesel, 39% hydro and 4% wind power.
- The Magallanes System (SEM): 276 GWh generated per year, 99 MW of installed capacity; natural gas is used in 86% of the power production facilities, and the rest is diesel-based.

For 2011 the combined capacity of the four grids was made up by 36% hydro, 26% natural gas, 20% coal, 16% oil, and 1% for both biomass and wind.[9]

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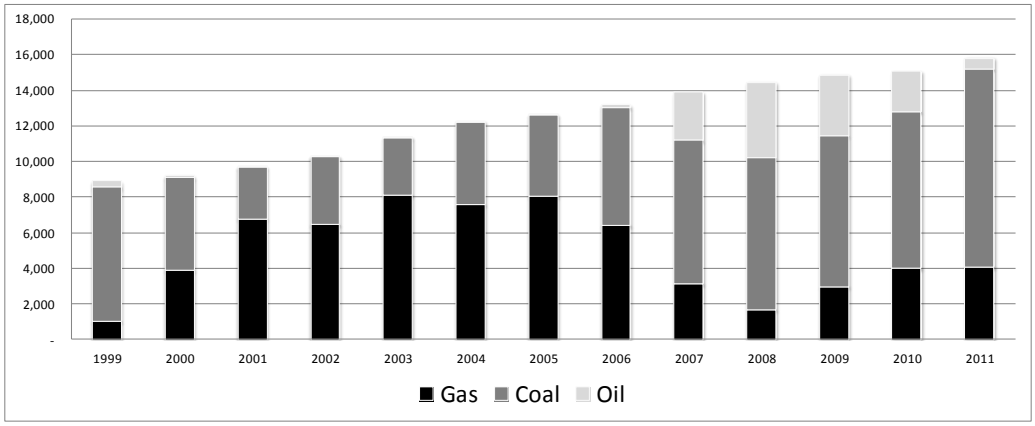
6 For example, electricity nodal prices averaged 11 US cents/ kWh in the Northern grid and 9 US cents/kWh in the central grid in mid 2009, and were even higher in the first half of 2008. For more information visit www.cne.cl.

7 As defined by Law in Chile, "non-conventional" renewable energy (NCRE) refers to renewable energy sources and technologies that are not generally used in Chile at present. This definition includes wind power, geothermal energy, any form of solar energy (thermal and photovoltaic), biomass (including biogas), marine (current, wave, tidal and other technologies), and hydropower (restricted to small hydro facilities with capacity under 20 MW).

8 bit.ly/ChileCNE

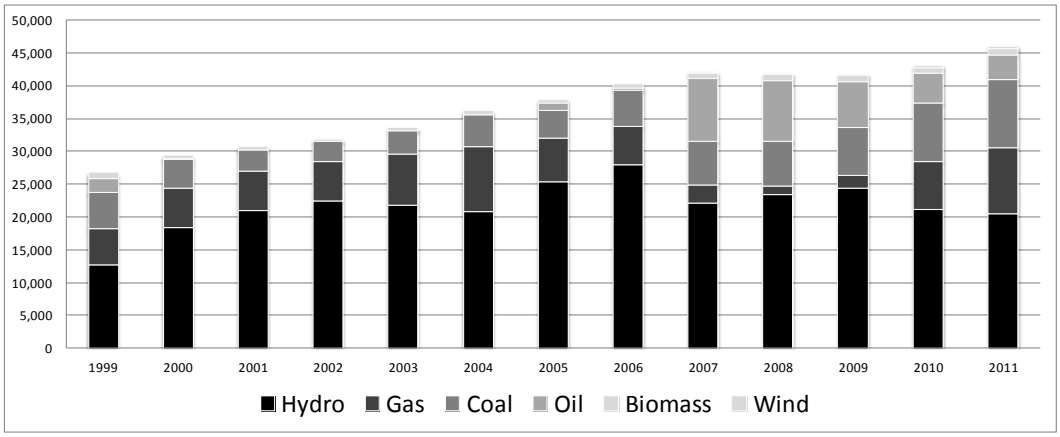
*Figure 3: Generation by fuel type in the SING, 1997-2008 (GWh)*




Source: CNE, modified from IEA data (Chile Energy Policy Review 2009, bit.ly/Chile_IEA2009, p. 138)

The emission factor for the SING - around 738 tons $CO_2$e/GWh in 2011[10] - is likely the highest in South America. The mining industry, the main user of energy in the SING, is expected to grow significantly in the next five years, investing an estimated USD18 billion into company operations. In order to meet demand, and given the lack of gas supply, generators have had to add additional diesel-fired generation capacity in recent years.

*Figure 4: Generation by fuel type in the SIC, 1997-2008 (GWh)*




Source: CNE, modified from IEA data (Chile Energy Policy Review 2009, bit.ly/Chile_IEA2009, p. 138)

## 3.3. Renewable Energy in Chile

Studies regarding NCRE have estimated its technical potential generation capacity to be 10.8GW just in the SIC grid area[11]. The economically feasible potential of NCRE in the same area, based on power dispatch cost scenarios, has been estimated at between 3.33 and 5.75 GW by the year 2025[12].

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[9] Note that these figures do not included off-grid self supply systems. There are 700MW of biomass-fired capacity (5% of the total) under this category.

[10] Ministerio de Energía. Reportes de Emisión para el SING (bit.ly/Chile_huellaCO2_SING)

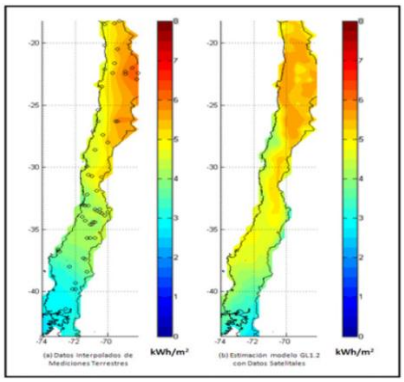
[11] Universidad de Chile/Universidad Técnica Federico Santa María (2008): Aporte potencial de Energías Renovables No Convencionales y Eficiencia Energética a la Matriz Eléctrica, 2008 - 2025

[12] Ibid

### *3.3.1 Resource Endowment*

Chile has world-class resources available for the generation of renewable energy[13]. Of particular interest is Chile's large potential for solar energy, with one of the highest irradiation rates worldwide (>3100 kWh/m²-year) located in the northern SING region.

*Figure 5: Solar Radiation Assessment, Based on Site Measurements and Satellite Data (2009)*



Source: Proceedings of the ISES Solar World Congress 2009:
The state of solar energy resource assessment in Chile

The country is also endowed with a very significant marine energy potential along its coast, which has been estimated in hundreds of GWs. The Central and Southern areas of the country have large amounts of biomass available to be used for the generation of electrical or thermal energy. Furthermore, particularly in coastal areas and in some valleys in the interior, Chile has natural conditions favorable for the development of wind energy. Chile also has promising geothermal resources. It is located in what is known as the "Pacific Ring of Fire", an area of the planet with intense seismic and volcanic activity. The country has thus a number of areas where there is geothermal activity associated with the existence of volcanoes. All these NCRE resources, if deployed, have the potential to significantly change the emission path and carbon intensity of the economy, even potentially converting Chile into an exporter of zero carbon energy to the region.

### *3.3.2 Portfolio of Renewable Energy Projects*

Currently, there are 67 NCRE projects in operation in the country, with a total installed capacity of 721 MW. The entire potential pipeline as a whole represents more than 5,000 MW of NCRE capacity that can be connected to the grid in upcoming years (see Table 1). In addition, a number of projects with a combined capacity of 4,500 MW are in earlier stages of development. A significant amount of these NCRE projects in planning stages will require either financial or policy support to overcome barriers to their deployment.

[13] As defined by Law in Chile, "non-conventional" renewable energy refers to energy sources and technologies, which are not generally used in Chile at present. This definition includes wind power, geothermal energy, any form of solar energy (thermal and photovoltaic), biomass (including biogas), marine (currents, waves and others), and hydraulic energy (restricted to small hydro facilities less than 20 MW installed capacity).

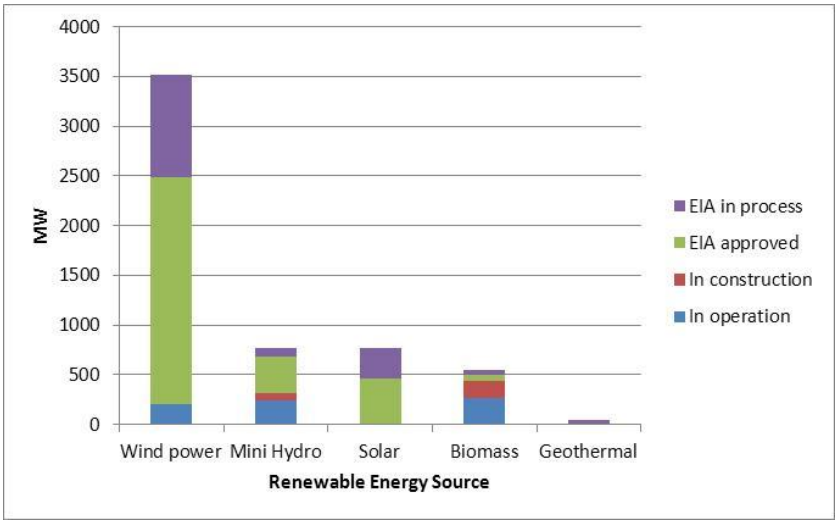
*Table 1: NCRE project portfolio by technology and development stage (MW)*

| Energy Technology | In operation | In construction | EIA approved | EIA in process |
|---|---|---|---|---|
| Small Hydro Power | 246 | 64 | 368 | 93 |
| Wind Power | 205 | 6 | 2269 | 1041 |
| Biomass | 270 | 170 | 55 | 49 |
| Solar | 0 | 1 | 467 | 302 |
| Geothermal | 0 | 0 | 0 | 50 |
| **Total** | **721** | **241** | **3159** | **1535** |

Source: CER, 2012

Biomass is the renewable energy technology most widely used in Chile, mainly because of forest industry companies that harness the residues in order to supply heat and power to their operations and power to the grid. Due to the large amount of available biomass resources, this has become an established practice. Wind power has a significant share in the NCRE project portfolio, with over 246 MW of installed capacity and 3,310 MW of planned capacity for different regions in the country. In addition to biomass and wind, small hydropower projects also have a relevant place in the pipeline. Finally, some solar and geothermal projects have been approved in recent months (see Figure 6).

*Figure 6: NCRE project portfolio by technology*




Source: CER, 2012

## 3.4. Chilean GHG Mitigation Actions and Commitments

### *3.4.1 GHG Emissions Inventory*

The country's net GHG emissions grew by a factor of 6.5 in the 1984-2006 period (see Figure 7). According to its Second National Climate Change Communication, in 2006 Chile's net emissions were roughly 60 teragrams (or 60 million tons) of carbon dioxide equivalent[14] (Tg $CO_2e$) and are growing at a rate of 6 to 8% annually. This amount is made up of 58 Tg $CO_2e$ from fuel combustion, 22 Tg $CO_2e$ from other emitting sectors (agriculture, waste, and industrial processes), and negative 20 Tg $CO_2e$ from land use and forestry (which means that the sector is capturing more carbon than it emits).

[14] 80,000 gigagrams = 0.08 gigaton; 1 gigatonnes = $1*10^6$ gigagrams

Although Chile's emissions are relatively low on a global scale, the country expects the rate of economic growth to continue during the coming decades, thus increasing GHG emissions at a rapid pace. For this reason, the GoC has decided to take measures to curb its GHG emissions growth, by adopting policy actions supported by Annex I countries.

### *3.4.2 Mitigation Options for Addressing Climate Change*

On the 15th of March of 2012, the Mitigation Action Plans and Scenarios (MAPS) initiative was officially released by the GoC. This initiative has its roots in the Long Term Mitigation Scenarios Project that was developed in South Africa between 2005 and 2008. Given the positive national and international evaluations of that process and its outcomes, MAPS-International was established in 2010. This programme assists emerging countries in devising development plans compatible with the challenges posed by climate change. Currently, there are MAPS projects being developed in Brazil, Colombia and Peru.

MAPS-Chile is a two-year government-driven project that follows the international design, although it maintains complete autonomy regarding its focus and methodology. Two main components of the project are a rigorous research effort – through the modeling of scenarios and long term mitigation actions – and a facilitated multi-stakeholder participatory process. An inter-ministerial Committee manages the project with representatives of the following ministries: Foreign Affairs, Finance, Transport and Telecommunications, Agriculture, Energy, and Environment. The administrative management of the project is carried out by the United Nations Development Programme (UNDP). MAPS-Chile is funded through various sources: the Children's Investment Fund Foundation (CIFF), the Climate and Development Knowledge Network (CDKN), the Danish Ministry of Climate, Energy and Building, and the GoC, among others.

The main expected result of MAPS's project is a portfolio of quantified scenarios and options for Chile to accomplish the desired goals for 2020, 2030, and 2050, along with a detailed analysis of possible mitigation actions by sector.

### *3.4.3 Strategies and Policies for GHG Emission Reduction*

Early in 2009, the Economic Commission for Latin America and the Caribbean (ECLAC) undertook a study on "Economics of Climate Change in Chile" funded by the IDB and following the Stern methodology. The results show an economic cost associated with climate impacts for the Chilean society of up to USD320 billion for the business as usual scenario (A2 as defined in the 2007 IPCC Report). This study helped the GoC to define a course of action to identify strategic actions to be implemented in different economic sectors (Climate Change Action Plan 2009-2012), in order to reduce the vulnerability of the economy to the consequences of climate change. From that time on, several other studies started to focus on mitigation options, technologies and policies to tackle the climate issue in Chile. These studies enabled GoC to define a long-term mitigation target.

Chile signed the Copenhagen Accord on 29 January 2010. On 26 August 2010, the country presented information for inclusion in Appendix II of the Copenhagen Accord, as follows:

> *Chile will take nationally appropriate mitigation actions to achieve a 20% deviation below the "Business as Usual" emissions growth trajectory by 2020, as projected from year 2007. To accomplish this objective Chile will need a significant level of international support. Energy efficiency, renewable energy, Land Use and Land Use Change and Forestry measures will be the main focus of Chile's nationally appropriate mitigation actions.*

Since then, the Chilean Government has continued working on several instruments that will provide further information for decision-making about mitigation. In particular, the GoC through the Ministry of Energy, has established the Chilean Energy Efficiency Agency (AChEE, which builds on the Programa País de Eficiencia Energética) and the Renewable Energy Center (CER). Both agencies have become important cornerstones for institutional development in Chile. Furthermore, the Production Development Corporation (CORFO, Chile's Economic Development Agency) has played a crucial role, through agencies such as InnovaChile (for the promotion of entrepreneurship in new technology development) and InvestChile (for the enhancement of local and foreign direct investment).

Other concrete steps that have occurred or are expected in this area include:

- The strengthening of capacities related to the country's emissions inventories through the creation of a national GHG Inventory Office;
- the generation of information to enable Chile to produce NAMAs in the short term, especially in the energy, mining and LULUCF sectors (an activity coordinated by the Ministry of Environment), and
- the implementation of mechanisms to assure compliance with the renewable energy law 20.257, which requires a participation of renewable energy generation (renewable portfolio standard) of 10% in 2024. The responsibility of communicating the compliance of Law 20.257 is on the grid operators themselves, and the auditing of some of the key variables of the law is on the hands of the Bureau of Fuels and Electricity (SEC).

### *3.4.4 National Energy Strategy*

In 2012 Chile developed a National Energy Strategy (ENE)[15] based on fundamental principles such as energy independence and security; environmental protection; market competitiveness, and technology innovation. ENE aims to more than double, in the next decade, the current contribution of NCRE in Chile's energy matrix. To achieve this, ENE developed the following six pillars.

The first pillar is "**energy efficiency**", which involves decoupling economic growth and energy consumption. The goal of this pillar is to reduce by 2020 12% of the projected energy demand, equivalent to a reduction of 1,122 MW or 4,150,000 toe. From 2005 to 2010 Chile developed the Country Program of Energy Efficiency (Programa País de Eficiencia Energética), which was replaced by the Chilean Agency of Energy Efficiency (AChEE), an institution that seeks to strengthen the private-public energy efficiency commitment. The ENE includes the following five lines of action within the energy efficiency pillar.

1a The **2012-2020 Energy Efficiency Action Plan (PAEE20)** is focused on diverse economic sectors. In the construction sector, energy efficiency (EE) standards are going to be implemented in new buildings. Similarly, in the transport sector, new EE standards and energy labels will be implemented. In the industry sector, the PAEE20 is designing incentive mechanisms to promote EE technologies such as cogeneration.

1b The **energy efficiency labelling** action plan aims to identify and reward those companies with the highest EE standards. The criteria for awarding the EE label are based on the achievement of energy savings beyond pre-defined thresholds, and on the assessment of the implementation of energy programs. The energy efficiency label will be implemented by economic sectors.

[15] www.minenergia.cl/documento/descargar/id/5805. An English version is also available at: www.minenergia.cl/documento/descargar/id/5928

1c The **Minimum Energy Performance Standard (MEPS)** is an EE action plan which limits the maximum amount of energy that may be consumed per product or device. As a result, only those devices that fulfill the MEPS can be commercialized in Chile. Additionally, all the devices will have an energy performance label to help those buyers looking for energy savings identify the products, and to increase awareness among the public.

1d **Public and residential lighting efficiency programs**. This action plan complements the MEPS and is focused on increasing the transition speed of rural communities to more energy-efficient practices.

1e **Inter-ministerial Commission for Energy Efficiency Policy Development**. Given that the execution of energy efficiency policies depends on more than one ministry, an inter-ministerial commission was created in order to embrace the energy efficiency agreements as part of each ministry. This commission reports its performance to the President of Chile on a timely basis.

The second pillar is the "**scale-up of non-conventional renewable energy resources"**. As shown in section 3.3, Chile has a large potential to increase its NCRE in its energy matrix. However, it requires policy interventions to unlock the NCRE market. These policy interventions are described in the following lines of action:

2a **Project bidding mechanism to incentivize the development of NCRE**. In order to attract more NCRE investors, the tenders will be issued by type of technology or blocks of NCRE. Each block could have a specific incentive from the GoC, depending on the market spread needed to reach grid parity.

2b **Geographic Information System (GIS) – Economic potential for NCRE**. To enable the decision making of NCRE investors, an information system, GIS, would be created to integrate, store, and display geographic information regarding energy demand, energy resources, available government land, and environmental protection zones, among others.

2c **Promoting and Financing**. With the aim of unlocking the financial barriers of NCRE projects, new financial instruments will be designed to offer risk mitigation, credit lines and access to credit in the international markets.

2d **Strong boost for NCRE**. In addition to the current objectives of the Renewable Energy Center (CER), its scope will be enhanced.

2e **Technology-specific strategies**. With the collaboration of the public and private sectors, researchers, and citizen representatives, a strategy would be designed by type of NCRE -solar, wind, bioenergy, biomass, geothermal, mini-hydro, and tidal. Additionally, subsidy and incentive plans will be implemented for those pilot projects that contribute to scale-up NCRE.

The third pillar is "**the role of conventional energies – greater weight assigned to hydro resources, and less external dependence"**. Chile has a significant potential of hydropower -roughly 9,000 MW -, which is envisioned to be a main player in the energy matrix. However, hydropower needs to comply with environmental, social and economic standards. For instance, a new plan will be developed to protect the Chilean Patagonia, increasing its protected areas and excluding initiatives of energy generation and transmission within these areas. To scale-up conventional hydropower in the most socially and environmentally beneficial way, greater coordination and planning with regards to transmission is needed, and new reforms will be developed to obtain a more coordinated system. The GIS system mentioned before will help displaying the geographic information of protected zones and transmission lines.

Since coal must necessarily continue to be part of the energy matrix in the next decades, a technical and economic assessment of carbon capture and storage (CCS) will be performed.

Moreover, with the purpose of enabling a more efficient use of coal in the Chilean energy matrix, coal gasification technology for use in combined cycle plants will be evaluated.

Due to its flexibility and ability to source fuel from diverse locations, the usage of liquefied natural gas (LNG) is expected to increase in Chile in the coming decades. Global LNG availability and production expansion in the international markets, along with new exploration and production techniques and processes, suggests that LNG may continue to play an important role as a lower-carbon fuel option in the future, with more numerous potential suppliers leading to greater energy security. Currently, Chile has two LNG regasification terminals – Quintero and Mejillones.

The fourth pillar is "**a new approach to transmission - towards a public power path"**. In order to increase reliability of electricity supply by increasing diverse energy generation sources, it is necessary to have a new approach for the transmission system, assuring coverage in remote areas where NCRE might take place. The ENE has the following lines of action:

4a **Improvement of procedures for granting energy concessions**. To facilitate the smooth development of energy concession processes, new improvements will be presented to the National Congress for approval.

4b **Creating transmission corridors**. In order to ensure the required reach of the transmission system, the State could declare transmission corridors.

4c **Regulatory changes in transmission, subtransmission and additional transmission**. In transmission, the policy change goes hand in hand with the concept of public power road. In terms of subtransmission, work will improve connection to these networks, security and long-term development. Finally, regarding additional transmission, the policy would define the conditions for the existence of open access third party transmission lines, and a remuneration scheme.

4d **Enabling the connection of small generators and smart grids.** To achieve this, the current regulation will be modified. The information regarding the connection to the distribution system, as well as the costs to get this information, will be more transparent, under the supervision of the Bureau of Electricity and Fuels (SEC). Additionally, in order to foster the deployment of smart grids the technical and economic viability of these technologies will be assessed.

The fifth pillar is "**towards a more competitive electricity market"**. In order to achieve a more reliable and competitive electricity market, the ENE has established the following lines of action:

5a **Creating an independent electric operation center**. An independent operation center will be created for each electricity grid, replacing the Centers for Economic Load Dispatch (CDEC). The aim is to ensure that market transactions are timely and transparent to all market agents.

5b **Safe and affordable electricity for distribution**. In order to generate the most effective mechanisms for allocating blocks of energy at prices that reflect long-term conditions, the regulatory framework for tenders will be enhanced. Also, new measures will be designed to introduce more competition at the level of tariffs to final customers, through the design of flexible tariffs for regulated customers. In the same context, one of the measures proposed is to extend the limit that defines the classification of unregulated customers from 500KW to 100KW. Additionally, an assessment will be performed on implementing the selection of energy providers through trader agents.

5c **Consolidating the tariff payment of residential generators, net metering**. The Net Metering regulation was approved by the National Congress, but it has not yet been implemented. Net metering allows consumers to offset the cost of electricity they buy

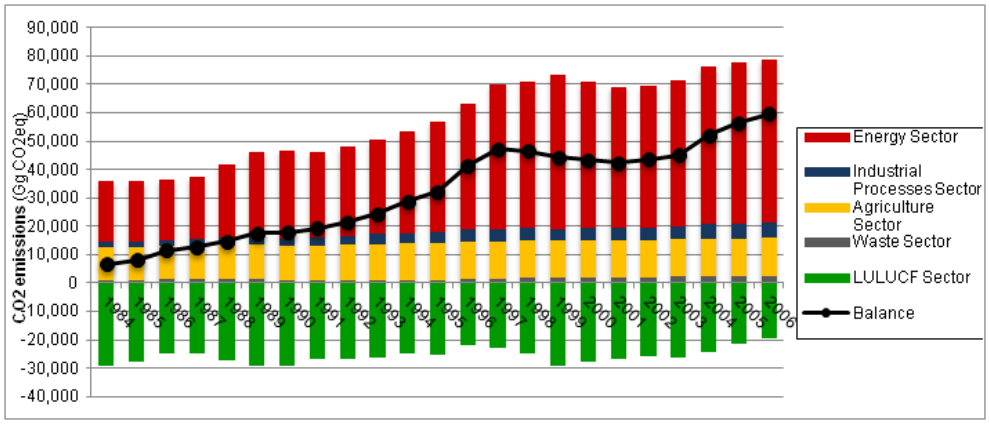
from a utility by selling renewable electric power generated at their homes or businesses back to the utility. A customer's electric meter can run both forward and backward in the same metering period and the customer is charged only for the net amount of power used.

The sixth pillar is "**sustained advances in regional electricity interconnection options".** Given that regional electric integration amongst South American countries could enhance security, flexibility, competition and cost reductions, Chile is supporting integration agreements and interconnections with other South American countries.

## Section 4. Priority Sectors for GHG Abatement

As with many countries, the energy sector in Chile has the highest contribution to GHG emissions. The following figure summarizes Chile's GHG emissions from 1984 to 2006 divided in 5 sectors: energy, industrial processes, agriculture, waste, and land-use changes and others (LULUCF). Note that in the case of Chile LULUCF emissions are negative because of the GHG captured by forests. The black line represents the net GHG emissions (captured emissions minus generated emissions) which correspond to the difference between the first four sectors minus the LULUCF sector. From 1986 to 2006, Chilean net GHG emissions increased by a factor of 6.5, and since 2000 by 37%. Two sectors explain the Chilean GHG emissions trend: The energy sector, which has the biggest contribution (75% of the GHG emissions), and the LULUCF sector that reduces the GHG emissions by 25%. The acceleration of net emissions, as reflected in the increased slope since 2000, is explained by the decrease in LULUCF negative emissions (-29%) and the increase of emissions from the energy sector (20%).

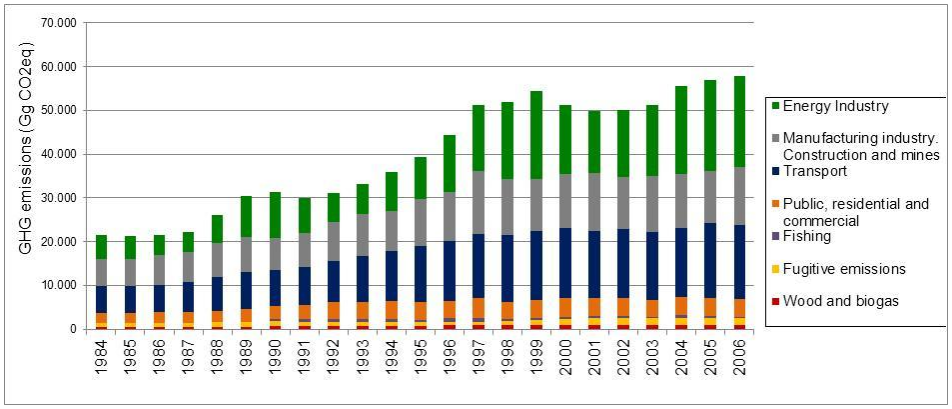
*Figure 7: Chile's $CO_2$ emissions by source, 1984-2006 (Gg $CO_2$e)*




Source: 2nd National Communication to the UNFCCC (bit.ly/CambioClimaticoChile, pg 45, 2011)

Figure 8 summarizes GHG emissions from 1984 to 2006 within the energy sector. This sector has seven categories, of which three are the main drivers of GHG emissions. In 2006, the category with the highest contribution was the energy industry (36%), which includes de production of electricity and heat, oil and gas refining, and transformation of solid fuels among others. The next category is transportation (30%) that includes air, land and sea transport. Finally, the manufacturing industry, construction and mines (22%) which include the production of steel, cement, and mines among others. For instance, it includes fossil-fuel used in mining processes.

*Figure 8: Evolution of $CO_2e$ emissions by energy sector*[16]




Source: 2nd National Communication to the UNFCCC (bit.ly/CambioClimaticoChile, pg 105, 2011)

Given the importance of industry emissions, and in particular the mining industry, in Chile (the mining sector accounts for 18% of final energy consumption[17]), this is one promising subsector to curb GHG emissions. The mining industry is in addition a main driver of the Chilean economy, representing 19% of GDP[18], and makes Chile the biggest player in the global copper industry, with 34% of the worldwide production[19]. To note, copper has a high thermal and electrical conductivity and therefore contributes to a more efficient use of energy worldwide (for instance, it is used in the construction of high-efficiency motors, wind turbines, solar panels, and transformers).

The mining sector offers a two-pronged potential opportunity for GHG reduction. First, by increasing energy efficiency (in order to reduce its consumption of fossil fuels), and second, by minimizing its indirect emissions (i.e. by contributing to reducing the carbon footprint of the electricity systems it relies on, in particular in the SING). The indirect GHG emissions of copper production represent up to 73% of the mining sector emissions[20], which results in very carbon-intensive mining operations (see Figure 9). More than 2/3 of the Chilean mining companies are located on the northern SING system, which generates 96% of its energy from fossil-fuel sources.

16 ibid

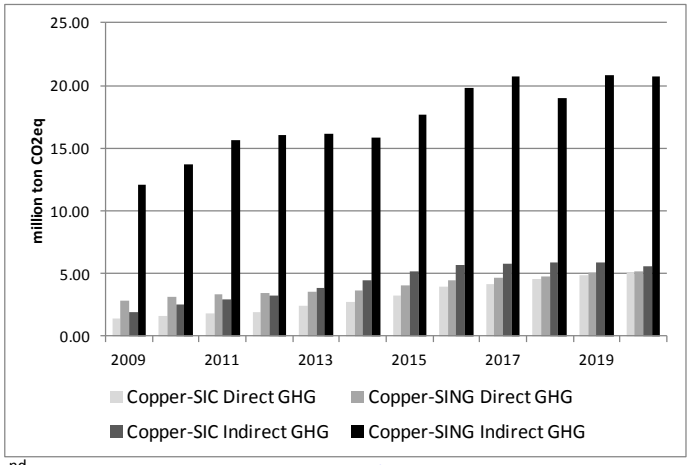
17 National Energy Balance 2010 (bit.ly/ChileBNE)

18 bit.ly/Chile_cuentas_nacionales

19 bit.ly/CambioClimaticoChile; pg 222, 2011

20 bit.ly/CambioClimaticoChile; pg 224, 2011

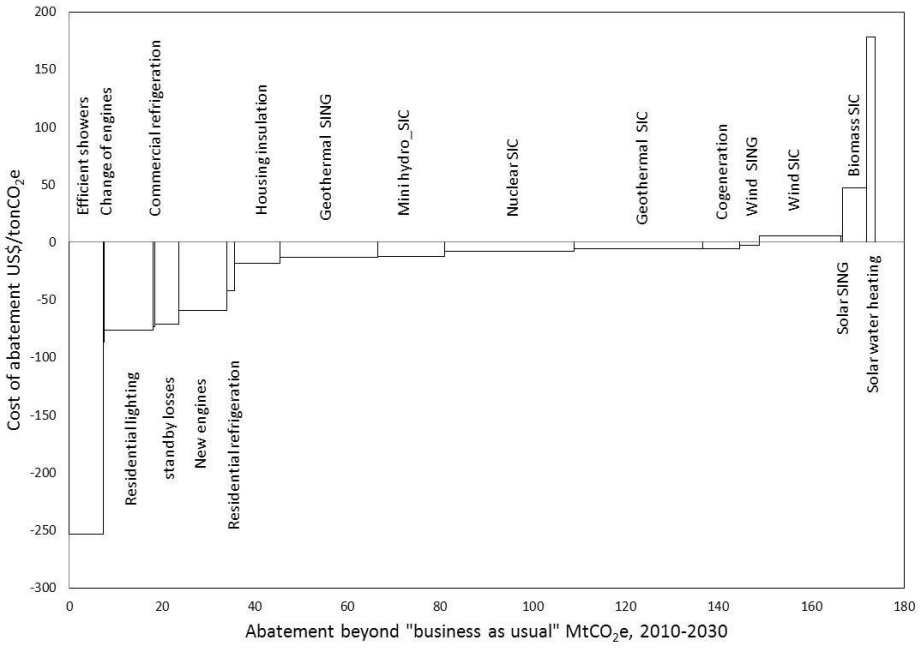
*Figure 9: Forecast of direct (fuel use) and indirect (electricity) $CO_2e$ emissions of the copper mining sector, in the North (SING) and Central (SIC) regions*




Source: 2nd National Communication (bit.ly/CambioClimaticoChile; pg 224, 2011)

Examining a cross-section of emission abatement activities can also be useful in determining reduction opportunities. The figure below shows the marginal cost of reducing a ton of GHG for different mitigation actions in the Chilean power sector. As demonstrated in similar studies, energy efficiency measures are the most cost-effective actions.

*Figure 10: Abatement Cost Curve for the power sector*




Source: Second Climate Change National Communication 2011 (bit.ly/CambioClimaticoChile, pg203, 2011). Note that solar SING appears here as a narrow bar because this study assumed a very modest scenario with only 55MW of installed capacity from solar energy.

# Section 5. Rationale for Selected Sectors

The studies referred to above have been used in part to define general priority areas for a low-carbon transformation plan utilizing the CTF funds. Given the substantial contribution of the energy sector to Chile's GHG emissions (Figure 7 and Figure 8), the power sub-sector (with a special focus on the SING region) has been identified as a key potential sector for CTF intervention with a focus on low-carbon NCRE technologies. Additionally, given that energy

efficiency actions are the most cost-effective (Figure 10), it is proposed that the Clean Technology Fund (CTF) resources would be used to scale-up the current energy efficiency program PAEE20, described in Section 3 as well. Other measures, in particular in the transport sector, although important, are already receiving different forms of support.

Within the realm of NCRE power generation and energy efficiency, this section identifies the more specific areas in which the CTF could assist in implementing Chile's national energy strategy (ENE). In order to explain how these potential CTF projects were selected, the first subsection links the potential CTF projects with the ENE. The second subsection illustrates the rationale for selecting the potential CTF projects. Finally, the last subsection presents the potential projects with investment priorities for CTF intervention.

## 5.1. Policy Linkage

The 2008 Energy Policy Report published by the National Energy Commission (CNE) - reflected in the legislative proposal for the creation of a Ministry of Energy - sets out the country's six energy priorities: (i) strengthening institutions; (ii) promoting energy efficiency; (iii) optimizing diversification, especially through investment in development of renewable energy; (iv) ensuring sustainable development; (v) supporting equal access; and (vi) contingency planning. Later, in 2012, The GoC defined the ENE which set in place specific programs targeting each of these strategic directions. CTF intervention would target two ENE action plans: Technology-specific strategies (see paragraph 2e in section 3.4.4), and PAEE20 (see paragraph 1a in section 3.4.4).

## 5.2. Rationale

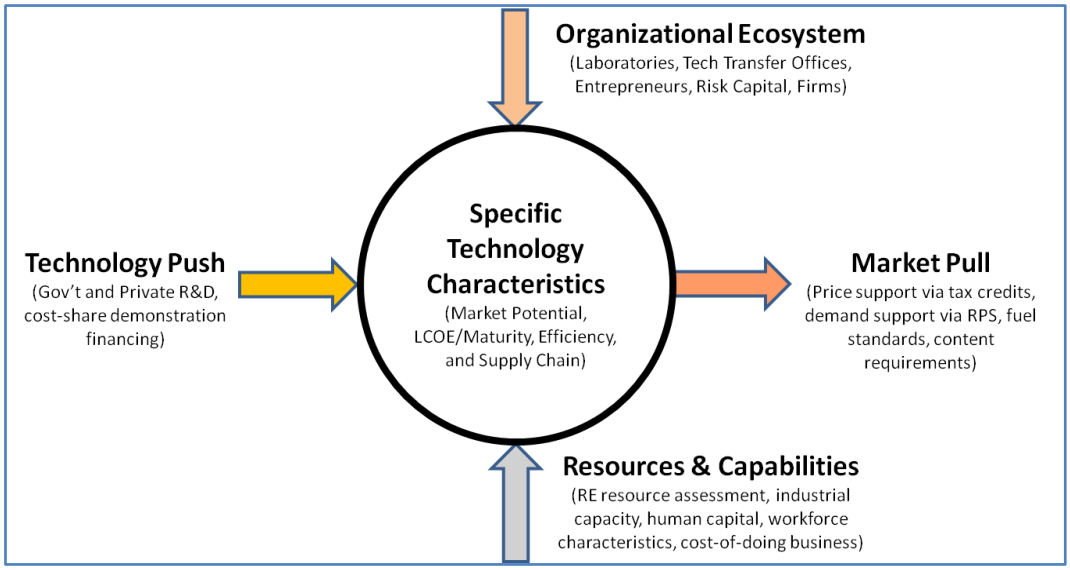
### *5.2.1 Selection of Areas for Intervention*

As noted earlier, Chile's energy sector relies on a fully privatized system. The private sector in Chile is not just the basis for economic growth; it also provides 100% of the energy generation and transmission in the country. This investment plan (IP), which is focused on transforming energy production and usage in the Chilean economy, will therefore focus on direct interventions with the private sector, in partnership with other actors including public institutions in Chile.

In order to choose and prioritize target subsectors to receive CTF support within the renewable energy and energy efficiency industries, a brief analysis was performed of the key elements that are involved in the successful development of the NCRE system, taking into consideration the Chilean framework and resources. Each NCRE technology is in a different position in terms of its market readiness in Chile, and the investment plan considers this fact as a relevant aspect in terms of the additionality of the measure and in terms of the enabling environment.

For each renewable energy generation technology, Michael Porter identified a set of drivers that are relevant to its development and that are the basic information for the definition of promotion strategies. These can be used to identify areas for CTF intervention:

*Figure 11: Five drivers for low carbon technology deployment*




Source: Michael Porter's pivotal "Five Forces" organizational strategy theory for assessing market attractiveness (Porter, 1979)

- *technology push*: policies and initiatives that encourage the provision of technological services;
- *organizational ecosystem* (energy and environment awareness, entrepreneurs, venture capital);
- *market pull*: policies and initiatives that encourage demand for specific technology services and enhance financial viability at a project finance or market level;
- *resources* (natural and infrastructure) *and capacities* (human capital), and
- *technological features* (particular attributes of the technology).

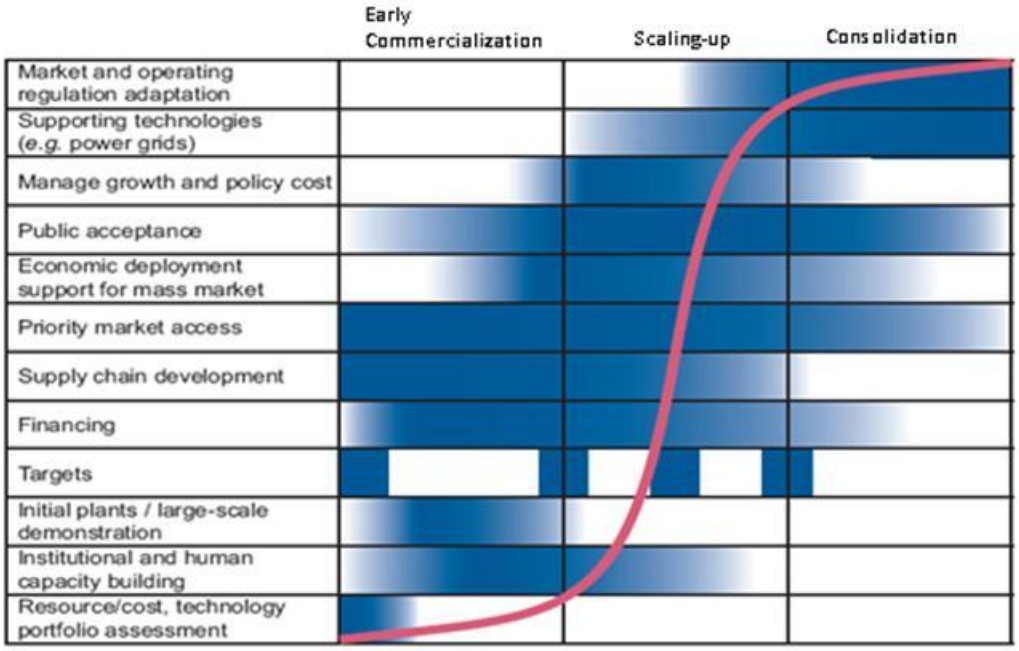
These five forces are the main drivers for the development of a given technology in a country and can be reinforced and promoted with public policies, international cooperation, and foreign investment. The balance between promotion policies and actions from the demand side (*market pull*) or from the supply of technology and ancillary services (*technology push*) is a result of the characteristics of a certain technology and the economic conditions of the market in which it is incorporated. Lack of adequate human resource capacity forms a barrier in the *resources and capabilities* area and is a candidate for CTF intervention. These factors can explain why, in some cases, certain technologies that are commercially feasible are not being implemented.

For instance, during the CTF joint mission, large Chilean power producers mentioned the high risk perception by banks as a barrier for the deployment of renewable energy technologies. Commercial banks explained the barriers from their viewpoint, and mentioned that a major obstacle was the lack of secure cash-flow and revenues. Risk reduction through financial instruments can give a *market pull* to a given type of technology. The Ministry of Energy is currently analyzing some financial mechanisms in order to increase the market pull, like soft loans or geothermal exploration guarantees, among others, depending on the stage of each technology. These actions and the experience gained through successful programs within CORFO and other initiatives provide an excellent base for learning how to strength the five drivers described by Porter to scale-up NCRE.

CTF co-financing interventions have the potential to reinforce the *market pull*, diminishing the risk return imbalances through partial credit guarantees or off-setting the incremental costs faced by early entrants. Also, CTF can strengthen the *resources and capacities* through technical assistance to ESCOS, CORFO and the industry. As a result, CTF co-financing would have a

crowding-in effect, because it encourages investors to undertake projects that otherwise would not happen.

*Figure 12: Deployment phases and policy responses: aspects needing support as a function of commercial deployment phases*




Source: International Energy Agency. Renewable Energy Policy Considerations for Deploying Renewables, 2011 (bit.ly/IEA_energy_policy, p. 51)
For purposes of this analysis the stages where relabeled

In order to scale-up renewable energy projects, it is important to identify which aspects of project development may require policy support. As shown in the figure above, there are three stages – early commercialization, scaling-up, and consolidation - with corresponding potential policy actions. For instance, the *resource/cost technology portfolio assessment action* only takes place in the early commercialization stage while the *public acceptance* action takes place across all the three stages. Note that the dark shading indicates a high need for policy intervention, while the light shading suggests that intervention is required but not with the highest possible priority. The red line articulates the path of policy intervention effort across stages. In other words, during the scaling-up stage, policy interventions are required the most (steeper slope) compared to both the early commercialization and consolidation stages, where policy intervention is less necessary.

The *financing* aspect requires the most important effort in terms of policy intervention between the early commercialization and scaling-up stages. For instance, energy efficiency is largely unexploited in Chile, and one main barrier to address is the lack of adequately structured financing mechanisms and related experience. Likewise, solar projects such as CSP and solar PV have not benefited from widespread financing and uptake of the technology because of cost and risk barriers faced by early entrants across the phases listed above.

The commercial deployment phase may differ in a given market from the prevailing global status. In particular, globally, solar projects are in the *scaling-up* stage of commercial adoption, but to date there are only two PV projects in Chile (as shown in Table 1, there is only 1MW in construction, as compared to 361MW approved). Following the scheme of the above diagram, CTF interventions could contribute to *financing* and *initial plants/large-scale demonstration* actions, via financing and technical assistance. Likewise, renewable energy self-supply and EE are also in the *scaling-up* stage globally, but in early commercial adoption stage in the specific

context of Chile. For example, there are currently 170MW RE self-supply biomass projects in construction and 270MW in operation (Table 1); most of them co-generation plants that use industrial waste from the pulp and paper industry. CTF intervention would take place in the *financing* and *institutional and human capacity building* actions, through financial and technical assistance.

These concepts were used to examine potential areas of assistance for various clean technologies in Chile, within the previously identified general areas of power generation and energy efficiency. Although technological maturity and environmental conditions are dynamic, which affects the risk management strategies related to each technology, a selection of priority areas was made by the GoC. The priorities were defined taking into consideration both the government's and the CTF's objectives:

- *Potential*: Technologies that harness energy resources where Chile has an outstanding potential, such as solar, and that have the potential to scale-up in the short to medium term.
- *Lack of consolidation in the market*: Technologies that have potential but have not been implemented in Chile due to a lack of financial resources or other barriers.
- *Technical viability*: Technologies that have had a successful implementation in other countries and should be economical in Chile, but need projects in order to reduce risk perceptions and to build capacity to boost the local industry and develop best practices in the use of these technologies.

Based on this analysis it was concluded that large-scale solar energy, and renewable energy self-supply and energy efficiency are the best fit for the criteria listed above.

- Scaling-up solar energy technology projects (CSP and PV). As shown in Section 3, solar energy technologies have enormous potential in Chile, with important opportunities for large-scale deployment. Chile proposes a targeted, programmatic intervention across several solar technologies in order to provide needed support to scale up commercial viability. PV will be supported anywhere in the country, and concentrated solar power will be supported for the northern SING system, since its flatter generation profile (when storage technologies are included) provides a better fit with the flat demand of that grid.
- Renewable energy for self-supply and energy efficiency (RESSEE) in the industrial and commercial sectors: As indicated previously (see Section 4), the most cost-effective action to reduce GHG emissions in Chile is energy efficiency. However, energy efficiency projects, as well as projects for companies to generate their own electrical or thermal power with renewable energy sources (*inside the fence self-supply*), face various barriers to be further discussed below. The technologies considered as part of the renewable energy self-supply and energy efficiency (RESSEE) component are solar PV, solar water heating, wind, biomass and biogas for thermal applications or electricity generation, as well as a number of energy efficiency technologies, such as cogeneration, high-efficiency motors and boilers, waste heat recovery, and thermal insulation.

Several additional technology candidates that were discussed earlier under NCRE resources were assessed for CTF co-financing. Some were not selected because they are at an earlier phase of commercial viability and therefore not eligible for CTF: marine energy (wave and tidal energy) and geothermal energy. Support for piloting and implementation of these technologies is a strategic objective of the GoC and is a part of the Chilean ENE, but other financial sources will be pursued for their support. Other technologies, such as wind or small hydropower, were not selected because they are now at a more advanced deployment stage in the Chilean market and do not require the specific type of support that CTF can provide.

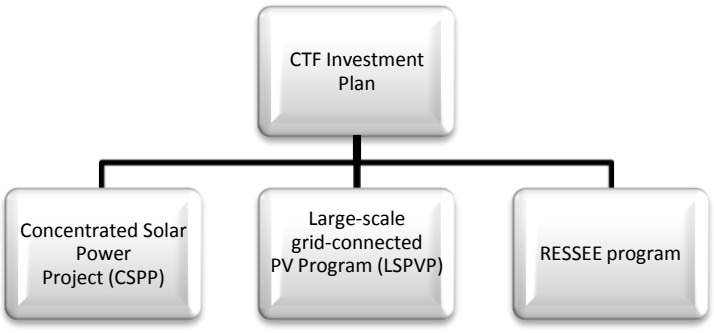
### *5.2.2 Use of CTF Funds for Transformation*

Technology cost, risk and capacity barriers of solar energy and RESSEE can be reduced through CTF interventions. Clean energy and energy efficiency investment have been just taking off in Chile but continue to face risk and cost barriers when compared to traditional alternatives. The objective of this CTF investment plan (IP) will be to bridge risk, cost, and liquidity barriers through concessional financial instruments, and capacity or knowledge barriers through technical assistance. Concessional resources will improve the internal rate of return of the targeted projects in order to make them financially viable and able to attract additional capital. The resources will be invested with the minimum concessionality necessary to overcome the cost and/or risk barriers, and thus will "crowd in" the private sector by enabling projects to happen that otherwise would not come to fruition, all by offering transaction conditions that are as close to market as possible. For Chile it is strategically attractive to facilitate investments in these technologies in order to generate local experience, fostering the development of the market and including potential local ancillary industries for local consumption and regional export purposes.

Increased track record, knowledge, demonstration, and data in sectors that are in the early commercial stage will allow entry of the private sector in the future unaided by concessional finance or with reduced amounts of public support. A successful CTF-assisted portfolio of projects developed using best practices of the MDBs will reduce risk perceptions and build capacity in the local market, boosting industry and best practices in the use of these technologies. It is expected that the mobilization of CTF and other resources will also provide a track record and technology-specific information reflecting local conditions and proving viability in the Chilean market. This information set will be available for planning financial/investment structures (capital expense and operational costs for the industry) and technical specifications (performance parameters, operational environment, and site-specific troubleshooting) under Chilean conditions. Simply creating and making available this information will enable better project planning and will lower perceived risks by banks, thereby lowering the cost of capital for projects.

## 5.3. CTF Investment Plan Components

*Figure 13*: CTF Investment Plan




This Investment Plan focuses on scaling-up technologies that will pave the way for low-carbon development in a region that increasingly relies on carbon-intensive fossil fuels for its power supply. There are three components selected for CTF co-financing intervention in this Investment Plan. Two are focused on large-scale solar grid-connected systems: one on a concentrated solar power project (CSPP) and the other on a large-scale grid-connected solar PV program (LSPVP). Given its decision to focus on the solar sector described above, the GoC has chosen to implement a focused, programmatic approach to this technological category in order to better transform the market. Instead of supporting implementation of several small NCRE

technologies, the GoC considers that it is better to support a few very high profile and successful examples of the two types of solar technology that hold promising potential to provide stable and clean energy for Chile's grids. In this way, demonstration potential, acceptance, and risk reduction and learning will be maximized.

The third component is targeted to take advantage of the most cost-effective opportunities in the economy and is related to renewable energy self-supply and energy efficiency (RESSEE). These three components are consistent with the Chilean National Energy Strategy (ENE): the first two fall within the *scale-up of NCRE* pillar, and the third one within the *energy efficiency* pillar.

### *5.3.1 Technologies*

Two main types of solar technology offer promising potential for meeting clean energy generation demand in Chile and form part of a coordinated solar market transformation approach: Concentrated Solar Power (CSP) and Photo Voltaic technologies (PV). CSP technology uses mirrors and a tracking system to focus solar energy into a concentrated beam. The concentrated energy is then used as a heat source to power a conventional thermal power plant. Although a wide range of CSP technologies exist all of these use a working fluid that is used for power generation or energy storage. Just as in a traditional thermal power plant, this fluid directly or indirectly drives a turbine that generates electricity. There is particular interest in CSP because of its capacity to store energy and then dispatch it as needed, thereby extending the hours that the plant is able to deliver electricity and potentially providing a better fit with a given demand profile (in the case of the SING, a profile that is virtually flat). In effect, CSP can utilize relatively efficient energy storage technologies such as molten salts, which allow power to be dispatchable when needed as opposed to being delivered to the grid in an uncontrolled way when the solar resource is available.

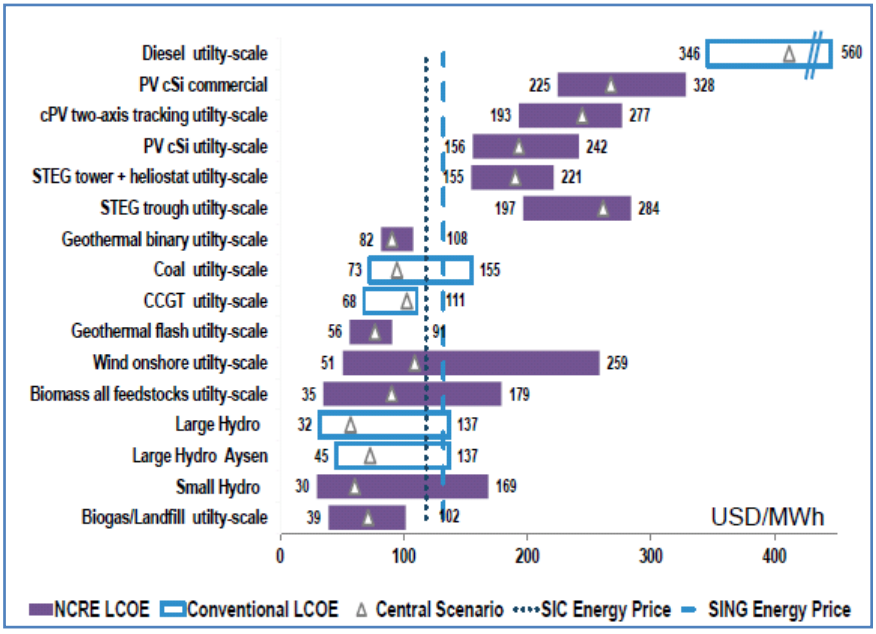
In contrast to CSP technology, PV solar systems convert light directly into electric current using the photo-electric effect. This solar technology delivers the electricity directly into the grid when the sun is shining. The current technology does not allow for large scale energy storage. However, due to intense competition in the PV manufacturing market, the price of PV solar panels has dropped dramatically and this technology has become a relatively economic option, scalable, and easier to install than CSP. Chinese makers of PV panels are pushing costs down by pushing up factory capacity about 40% in the last year to reap economies of scale. In Chile, due to the presence of high energy prices on the SING, and the sunniest solar resources in the world, some PV plants could already produce power below the marginal price.

In terms of RESSEE, there are a number of renewable energy self-supply and energy efficiency technologies that are readily available to energy users (industrial and commercial businesses) and offer viable opportunities to reduce their requirements of electricity and/or fuels. The aim in this case is to reduce energy consumption by unit of output, leading to less waste and to reductions in GHG emissions.

A comparison of the costs of various types of energy through their levelized cost of energy (LCOE) can demonstrate future competitiveness of various technologies. LCOE is equivalent to the average price that would have to be paid over the lifetime of the plant to exactly repay the investors for capital, O&M and fuel cost with a rate of return equal to the financial discount rate. Thus LCOE displays the minimum tariff at which energy must be sold for an energy project to break even excluding targeted Return on Equity. This metric is useful in comparing technologies with very different cost characteristics, for instance fossil generation often requires lower upfront costs but large fuel costs over time, while RE typically requires higher upfront costs at first but low operation and maintenance costs over time because fuels are free.

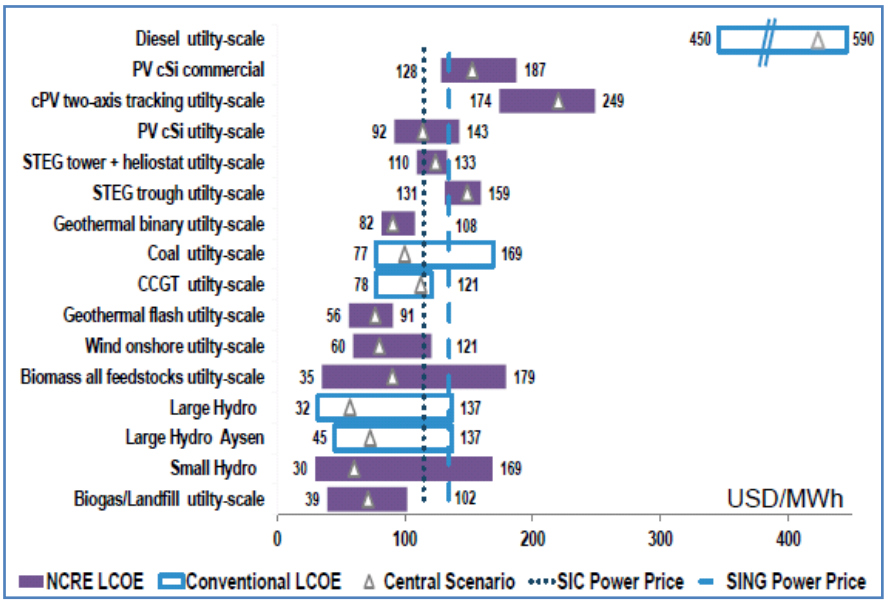
In the following figures, prepared by Bloomberg New Energy Finance for Valgesta Energia in a recent report, it is possible to see that solar technologies are expected to become competitive with fossil fuels in terms of Chile's avoided cost of power by 2020 (the picture by 2030 is even more favorable). By 2020 utility scale PV and CSP will be cost-competitive technologies without subsidies. Investing in their early deployment in Chile will drive down their costs through learning, and it will also ensure acceptance by market actors, reduced risk perceptions, and therefore early and wide adoption when costs come down. A market with widespread experiences and examples of solar technologies and excellent solar resources will be well placed to rapidly adopt and deploy them once their economics become more favorable.

*Figure 14. 2011 Chile LCOE for Various Technologies*




Source: Chile's Levelized Cost of Energy. Bloomberg New Energy Finance, April 2011

*Figure 15. 2020 Chile LCOE for Various Technologies*

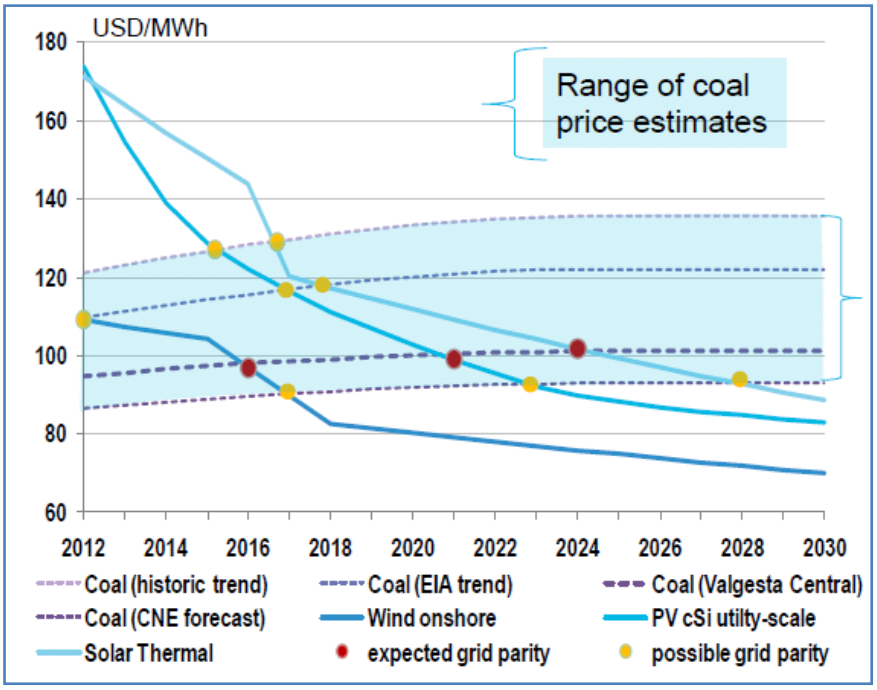



Source: Chile's Levelized Cost of Energy. Bloomberg New Energy Finance, April 2011

Grid-parity may happen at different times depending on the future fluctuating price of coal imports in Chile. In the following figure from the same report, one can observe that depending

on various price-of-coal projections shown in the blue band, projected steadily declining costs of solar energy technologies will hit grid parity (at or below the avoided cost of power on the grid) at different times. Most reasonable pricing projections imply that this transition would take place in the medium term, creating a tremendous opportunity for providing clean, stable and scalable clean energy in Chile if the right support is provided.

*Figure 16. Impact of Coal Price Forecasts on Solar Power in Chile*




Source: Bloomberg New Energy Finance, April 2011

### *5.3.2 CSPP*

Due to the greater potential additionality of this first component, the CTF Concentrated Solar Power Project (CSPP), the GoC puts it at the highest level of CTF co-financing priority. This component would support the development of a single CSP plant on the northern SING system. Solar thermal technology has a broad range of applications that include electrical power generation, industrial process heat, and metallurgical and chemical production. These uses are of particular relevance to the industrial consumers in the SING, as discussed in Section 3 and Section 4, and represent significant emission reduction opportunities. Additionally, the deployment of this low-carbon technology would bring environmental benefits to the northern region of Chile. In terms of global environmental benefits, a 50MW CSP plant with a capacity factor of 40% would abate emissions of 129,300 t $CO_2e/yr$[21] over 20 years. Large-scale solar projects are linked to the ENE as mentioned before.

CSP is also of particular interest in the SING region because by using energy storage it can better meet the particular demand profile of consumers on that grid (24-hour flat demand). Therefore this more flexible technology has a better chance of getting a power purchasing agreement with an off-taker. More generally, for higher penetration rates of NCRE it is necessary to have more flexible grids, and CSP with thermal energy storage (TES) provides this flexibility, reducing the intermittent generation constrains of NCRE. Given that ramp rates of conventional energy (costs of complementing the intermittency of renewable generation) limit the use of NCRE, the flexibility of CSP-TES allows greater opportunities for incorporating NCRE.

[21] Potential reductions= 50MW*40%*8760*0.738; (SING emissions factor: 0.738 $tCO_2/MWh$)

CSP technology offers the following benefits to energy consumers in the SING: it decreases the negative impacts of fossil fuel price volatility, increases consumer energy security for 15-20 years, and lowers the carbon footprint, both creating a competitive advantage for their products (in the view of possible trade barriers for carbon-intensive commodities), and contributing to their corporate social responsibility objectives.

The principal barrier for solar CSP projects is their high capital investment cost, and certain technical and contractual details are also key factors in the ability of a project's cash flows to cover costs and still provide an adequate return to investors. However, the availability and terms of financing are key inputs that can be hampered by inexperience and perceptions of risk, and can make an otherwise technically good project infeasible. The support of the CTF through a preferential credit facility would be paramount for the development of the first solar CSP plant in the country and to enhance its demonstration potential as the first in the region.

For this component it is envisaged that lower priced senior debt would be used to offset the high costs of this technology, and to fill in the lending gap where other lenders perceive too much risk. This CTF co-financing intervention would reduce the additional financing costs and low financing availability faced by early entrants, as financial institutions perceive as highly risky the financing of the first-of-a-kind project of a certain technology in a given country/region. The first project will also serve as a reference for lenders to future projects.

The deployment of these projects would allow organizations in the Chilean solar industry to learn and gain capacity in producing and executing solar technologies, so that they can be scaled up more rapidly in the future. While this technology is too expensive to reach grid parity in the short term, it is anticipated that global deployment will drive costs down and reduce the need for public support. Successful implementation of this first-of-its-kind project in Latin America will provide information and proof of viability in a new market, allowing second-movers to enter the market with lowered perceived risks and therefore a lower cost of capital. As this technology reduces in cost in the medium term, the Chilean market would be better equipped to match it to ample technical opportunities and resources.

#### *5.3.3 LSPVP*

The large-scale grid-connected solar PV program has the second highest CTF co-financing priority. This component is focused on medium- to large-scale installations connected to the grid, excluding "inside the fence" self-supply installations, which are covered by the third component of this investment plan. The project is also aligned with and benefits from other efforts being carried out currently. This includes the technical cooperation assistance of IDB's "ATACAMATEC" project, which will assess the financing gap of individual projects currently under development in Chile. It also includes the IDB/GEF "Development and Promotion of Solar Energy" project, which incorporates the implementation of pilot, grid-connected CSP and PV plants, with additional technology transfer activities.

In the case of Chile, high solar radiation coupled with very high energy prices present a favorable context for the implementation of solar technologies. PV generation in Chile would displace diesel or coal generation during daylight hours. However, capital costs for the PV technology that are higher than those of other renewable energies have prevented this technology from reaching grid parity and widespread uptake. In addition, there is a high perception of risk and a lack of technological familiarity associated with PV installations amongst LFIs and off-takers. Initial measurements indicate excellent solar resources in Chile, but these are as of yet unproven by actual power generation data.

For this component lower-rate debt would be utilized to offset the higher costs of this technology, and subordination may be utilized to offset risks. In each instance, the minimum

concessionality needed to catalyze a project and attract investment will be utilized. Projects would be eligible anywhere in Chile, allowing the flexibility of targeting power purchasing arrangements that are well matched to the intermittent supply of PV. By providing financing for PV projects, this initiative is intended to promote learning and capacity-building, including familiarity by off-takers, project promoters, and financiers. Following market trends, costs for PV solar component production are expected to continue decreasing, and hence by increasing learning in the market and lowering risks, the program is expected to lead to a financially sustainable market in the medium term. Lower perceived risks and greater demonstration and data on the Chilean context will decrease the cost of capital in domestic markets in the future.

### *5.3.1 RESSEE*

The renewable energy self supply and energy efficiency (RESSEE) category has the third CTF co-financing priority. As mentioned in the beginning of this section, the RESSEE is linked to the energy efficiency and the renewable pillar of the National Energy Strategy. RESSEE includes low-carbon development technologies that may be replicated at scale in a given industry. In the Chilean context, the following technologies could be part of RESSEE: energy efficiency measures, and self-supply generation technologies including solar PV, solar water heaters, wind, biomass and biogas.

As indicated previously (see Section 4, Figure 10), the most cost-effective action to reduce GHG emissions in Chile is energy efficiency. However, these energy efficiency projects, as well as projects for companies to generate their own power ("self-supply"), confront various barriers that result in an increased cost especially for new-entrants, including: (i) financial barriers, lack of knowledge and experience among financial institutions related to project-based financing for self-supply and EE projects which translates into an organizational cost; (ii) lack of information on potential technologies and use of alternative energy resources; (iii) lack of experience among energy end-user clients and technical service providers on the associated technologies and energy business models.

The measures targeted in this category are very small scale and it would be inefficient to finance them directly through an MDB. Therefore this program will focus on providing concessional finance and training to local financial institutions that have lower transaction costs, are closer to the market and have greater capillary contact with potential clients, and these institutions will in turn provide financing. Given that financial institutions lack track record on revenue potential and loss performance for RESSEE loans, there is a cost barrier in terms of a learning curve and implementation of new procedures. CTF co-financing intervention could stimulate the *technology push*, *organizational ecosystem* and *resource and capabilities* (explained in section 5.2, Figure 11), by working with financial institutions that would like to develop energy financing lines, and with the industrial sector developing RESSEE projects.

To reduce the barriers faced by RESSEE, the proposed Program will support local financial institutions (LFIs) to develop appropriate lending programs for private companies to invest in RESSEE projects. Favorably priced debt, guarantees and risk sharing products would be used as necessary to mitigate financial institutions' perceived risks regarding RESSEE projects until a track record can be developed, which is expected to help leverage significant private sector financing flows. Subsidy elements in pricing these tools would offset the LFIs' internal costs and risks in undertaking a new financing area. The specific instrument to be used would depend on the liquidity needs and funding profile of each financial institution. The financial support would be complemented by a package of technical cooperation for financial intermediaries, technical intermediaries, and energy users.

### *5.3.2 Investment Plan Financial Plan*

The requested CTF co-finance totals USD200M which would be distributed as follows. CSPP USD100M, LSPVP USD50M, and RESSEE USD50M. The following table (Table 2) summarizes the existing and planned synergies with additional efforts in the Chilean market by MDBs, sovereign entities and international programs (such as assistance and partnerships strategies), to scale-up NCRE and RESSEE. The Chile CTF Investment Plan components will be designed to capitalize on existing efforts and seek to work synergistically with them.

*Table 2: Assistance and partnerships*

| Agency | Year | Contribution to the National Energy Strategy | | | Description | Amount |
|---|---|---|---|---|---|---|
| | | Energy Efficiency | Scale-up of NCRE | The role of conventional energy | | |
| **BMZ-KfW** | 2004 | X | X | | €80M soft loan for NCRE and energy efficiency; €3M non-reimbursable grant | €83M |
| **IDB** | 2009 | | X | | Marine energy potential. | |
| **IDB** | | | X | | GEF project –Solar. | |
| **IFC** | | | X | | Sustainable Energy Finance. | $7M |
| **UNIDO** | | | X | | Research of NCRE –industry and commercial sectors. | |
| **UNDP** | | X | X | | GEF project –Solar and EE. | |
| **CIFF CDKN** | | X | X | X | Mitigation Options for Addressing Climate Change. MAPS-Chile. | |
| **BMZ & GIZ** | 2004 | | X | | Technical cooperation for NCRE. | €4.2M |
| **BMU & GIZ** | 2008 | | X | | Identification and pricing of areas in northern Chile for deployment of solar and wind energy technologies. | €1.2M |
| **BMU & GIZ** | 2009 | | X | | Strategy development to expand NCRE connected to the grid. | €3M |
| **BMZ &GIZ** | 2006 | X | | | Technical assistance in energy efficiency | €1.8 |
| **BMU &GIZ** | 2011 | X | | | Co-generation and energy efficiency in hospitals. | €1M |
| **UNDP** | 2001 | | X | | GEF –Rural electrification via NCRE | $6M |
| **IDB** | 2010 | X | | | GEF –energy efficiency in the industrial sector | $5M |

# Section 6. Enabling Policy and Regulatory Environment

## 6.1. Energy Policy Institutions

Chile's energy institutional framework is based on the subsidiary role of the state and is embedded in the country's legal principles, which seek to encourage private initiative to foster competitiveness wherever possible, and to correct market failures when these occur (IEA, 2009). In this context, the main public institutions in charge of ensuring the proper functioning of the electricity market are:

a) The **Ministry of Energy,** whose goal is to develop policies and coordinate plans and regulations for the proper functioning and development of the sector, ensure compliance and advise the GoC on all matters relating to energy. Particularly, the Ministry of Energy develops different mechanisms to support the renewable sector.

b) The **National Energy Commission** (CNE) was established by decree in 1978 as the regulatory supervisory authority and put in charge of preparing and coordinating plans, policies and standards for the proper operation and development of the sector, ensuring compliance and advising the government on energy-related matters. Its main responsibilities for the power sector include: (i) proposing standards and regulations; and (ii) calculating and enforcing regulated prices in generation and distribution. In terms of NCRE, the CNE develops the future work plans for both transmission and generation, including the renewable energy projects, and analyzes the sector trends of power generation.

c) The Bureau **for Electricity and Fuels** (SEC) was set up to oversee the proper operation of electricity, gas and fuel services, in terms of safety, quality and price. It is responsible for supervising enforcement of and compliance with existing laws, regulations and technical norms related to the generation, production, storage, transport and distribution of liquid fuels, gas and electricity. The SEC has responsibility for data collection for the purposes of enforcement and regulation, handling of customer complaints, and the implementation of service quality fines and customer compensations (IEA, 2009). Regarding renewable energies, the SEC enforces Law 20.257 and ensures the payment of the penalty by those power generators that don't meet the established quota.

d) The **Economic Load Dispatch Centers** (CDECs) are responsible for planning and co-ordinating load dispatch in each of the two large electricity systems (SING and SIC). The two CDECs are made up by representatives of generation and transmission companies and, since August 2008, of large users. The CDECs ensure the optimum operation of the system, based on least-cost dispatch, and determine values of economic transactions carried out between companies (IEA, 2009). In terms of NCRE, the CDEC monitors and supervises the real renewable generation and notifies the SEC when generators do not meet the established renewable quota (see below).

e) The **Production Development Corporation** (CORFO) is an agency under the the Ministry of Economy. Its mission is to promote the country's economic development by supporting production companies. CORFO uses management tools, direct subsidies and financial instruments. With regards to renewable energy, CORFO handles subsidies for studies in pre-investment stage and long-term credits for financing.

f) The **Chilean Renewable Energy Center** (CER) is envisaged as a clearinghouse for renewable energy development initiatives, taking advantage of new developments in

technologies around the world, identifying clean technologies and best international practices for renewable energies. The CER is also an implementation agency that follows the guidelines of the Ministry of Energy, and aims to create knowledge transfer through demonstration projects implemented at the local level. CER is a CORFO Committee.

g) The **Chilean Energy Efficiency Agency** (AChEE) is a private, nonprofit organization whose mission is to promote, strengthen and consolidate the efficient use of energy by bringing together relevant stakeholders, nationally and internationally, and by implementing public private partnerships in various sectors, thereby contributing to the competitive and sustainable development of the country. The AChEE has a board made up by representatives from the Ministry of Energy, Ministry of Finance and the Confederation of Production and Trade.

## 6.2. Renewable Energy –Regulatory Framework

Regarding the mentioned changes in the regulatory framework, over the last few years, new market pull policies and conditions for renewable energy development were adopted. This support has been achieved through new laws.

- The Law 19,940, March 2004, modifies aspects of the electricity market affecting all generators by introducing elements especially applicable to Non-Conventional Renewable Energy (NCRE) (Palma et al., 2009). It opens the spot market, guaranteeing small-scale plants (i.e., the size of many clean energy plants) the right to connect to distribution networks and exempting them from main transmission tolls (full exemption for plants producing less than 9MW and partial exemption for plants producing between 9MW and 20MW).
- The Law 20,257, April 2008, made it mandatory for the power companies selling directly to final customers to incorporate 5% of Non Conventional Renewable Energy into their electricity sales. This percentage will increase gradually to 10% by 2024. Companies who do not comply with this request have to pay a penalty.
- In order to favor NCRE within the electricity generation matrix, amendments to the Electricity Act in 2009 (Law 19,940 and 20,018) have been made, improving the market conditions of NCRE by guaranteeing companies access to distribution networks and the right to sell their energy in the electricity market at spot price, reducing the toll fees for renewable energy projects with power outputs of less than 20 MW and allowing the connection of small power stations of less than 9 MW into the distribution networks.
- The Law 20,365, August 2010, creates a tax benefit that incentivizes the investment in solar thermal collectors for new constructions. The current administration is analyzing the first results of this law and improving this mechanism in order to apply it also for old installations.

Renewable energy data is increasingly available to developers with the support of the government. For instance The Geophysics Department of the University of Chile and the Ministry of Energy created an online *wind and solar explorer* that gives information on wind velocity as well as solar radiation by simply inserting longitude and latitude coordinates. Several studies and private sector guides to investment have been available through government cooperation activities with agencies like GIZ.

Even though investments in NCRE projects have an appropriate and transparent regulatory framework for development, there are still important and various barriers that obstruct the deployment of these technologies, which were discussed earlier in Section 5.

# Section 7. Implementation Potential and Risk Assessment

The GoC is widely recognized as having a strong capacity for implementation of policies in the energy sector through the promotion of private investments as the primary option and the use of public-private partnerships where necessary. The regulatory framework is based on calculating prices in the power system based on total costs of provision of electricity services, providing transparency of costs across the system. This has created a favorable environment for local and foreign private investment in the last 15 to 20 years, which has not been significantly affected by regional and global crises. The country is perhaps one of the most important examples worldwide of the crucial importance of institutional capacity for creating a structural and regulatory framework for successfully promoting investments in the infrastructure sectors.

The risk assessment in Table 3 shows negligible required risk mitigation actions and a relatively low risk for the operations.

*Table 3: Risks and mitigation actions for the Chile CTF investment plan*

| Risk | Mitigation | Residual risk |
|---|---|---|
| Policy and regulatory framework | Policy and regulatory framework for investment in the energy sector and promotion of renewable energy and energy efficiency is clear and applied with transparency. CADE suggestions are expected to be indicative of adjustments in power sector regulations; no major market distortion is expected. | Low |
| Implementation capacity | Institutional strength of the Ministry of Energy, Ministry of Environment, Renewable Energy Center, Chilean Energy Efficiency Agency, and robust participation of private sector in the country reduce the implementation risk significantly. | Low |
| Technology | Particular interest in the less developed RESSEE. Selection of RESSEE technologies will be done by the market reducing the technology risk. | High |
| Finance | The country is perceived as very attractive for investment in infrastructure by foreign and local investors. However, there is financing risk access in NCRE technologies, as a result of a risk return imbalance. | Medium |
| Environmental | Chilean environmental legislation is being updated and institutional capacity of implementing agencies strengthened. | Low |
| Performance | While there are very few existing solar plants developed the country shows excellent natural conditions for development of solar, together with a very positive business environment and a long tradition of enforcement of clear and transparent policies and regulations. | Medium |
| Procurement | Risk of improper practices in procurement is low. Country ranks very high (always first in the region and above several OECD countries) in governance and transparency. | Low |

## Section 8. Gender Issues

Given the nature of this Investment Plan, the GoC considers that the incorporation of gender issues is mainly related to the realm of the employment opportunities in the growing industry of renewable energy and energy efficiency. As it can be seen below, an unbalance exists between men and women, and the GoC intends to contribute to reversing this trend, in line with its Plan for Equal Opportunities, developed by the Council of Ministers for Equal Opportunities, which was created in 2000 with the aim of fostering gender equality and women's empowerment. This plan aims to increase the participation of women in the labor market and eliminate the discrimination. Additionally, Chile is working together with UNDP in a program of gender equality and women´s empowerment. This program is focused on promoting women's political participation and creating capacity building for developing gender policies among others. [22]

## Section 9. Monitoring and Evaluation Framework

*Table 4: M&E framework*

| Result | Indicator | Baseline | Target | Means of verification | Timing of reporting |
|---|---|---|---|---|---|
| CTF Transformative Impact | | | | | |
| Transformed energy supply to low-carbon development pathways | GHG emission factor per unit of electricity generation (weighted average) [Ton $CO_2$e/MWh] | 0.468Ton $CO_2$/MWh (2011) | 0.444 Ton $CO_2$/MWh (2030) | National Statistics | 2019, 2030 |
| Decreased carbon footprint of Chilean industry | Carbon footprint of Chilean copper [Ton $CO_2$e / Ton copper] | [tbd] (2011) | [tbd] (2030) | Energy Ministry, national statistics | 2019, 2030 |
| CTF Catalytic Replication Outcomes | | | | | |
| Increased employment generated | Number of people finishing EE+RE-related technical, undergraduate or graduate studies men/women per year | Men: 13,216 (2011) | Men: 15,860 (2019) | Ministry of Education, CONICYT | 2016, 2019 |
| | | Women: 3,504 (2011) | Women: 5,040 (2019) | | |
| | New EE+RE-related enterprises per year | [tbd] (2011) | [tbd] (2019) | | 2016, 2019 |
| | % of CSP plants supplied locally | Not applicable (2011) | 70% (2030) | Questionnaire to be sent by Energy Ministry | 2019, 2030 |
| Increased development of solar power plants | Number of MW of capacity of solar PV in pipeline | 0 (2011) | 280 MW (2030) | Environment impact assessment | 2016, 2019, 2030 |

[22] See also: http://www.sernam.cl/pmg/documentos.php

| | | | | | |
|---|---|---|---|---|---|
| | Number of MW of capacity of CSP projects in pipeline | 0 | 150 MW (2019) | system (Environment Ministry) | |
| Increased investment in RESSEE | Number of operations / finance by commercial banks to RESSEE measures | 0 (2011) | (2019) tbd with the prep. grant | Commercial banks participating in program | 2016, 2019 |
| CTF Project/Program Outputs & Outcomes | | | | | |
| Direct GHG emissions avoided | M Tons of $CO_2e$ mitigated | 0 (2011) | (2016) RESSEE: tbd with the prep. Grant CSP: 129,300 t $CO_2eq/yr$ | Energy Ministry[23] + experimental impact evaluation considered for RESSEE | Annually (March) |
| Increased energy generation and capacity from solar power plants | Number of MWh generated by RE CTF-funded projects/ programs | 0 (2011) | CSP: 175,200MWh/yr (2016) LSPVP & RESSEE: TBD with prep grant | CNE, MDBs | Annually (March) |
| | Number of MW of capacity of CTF-funded projects in operation | 0 (2011) | CSP: 50MW (2016) LSPVP & RESSEE: TBD with prep grant | CNE, MDBs | Annually (March) |
| Leveraging – new and additional resources for clean technology projects | Leverage factor of CTF funding | Not applicable (2011) | [1:4] (2016) | Energy Ministry, MDBs | Annually (March) |

[23] Renewable energy emission reduction data will be based on energy generation data from the Dispatch Centers (CDECs) and emission factors for each of the national grids from the Energy Ministry using standard IPCC methodologies. Renewable energy self-supply and energy efficiency emission reduction data will be based on the climate change monitoring framework to be developed by the Energy Ministry with the support of the World Bank's Partnership for Market Readiness, on the verification tool for energy efficiency measures, to be developed by the Energy Ministry is collaboration with the AChEE, as established on the ENE, and finally on the verification tool for RE self-supply, to be developed (a request for the support of the UK's Prosperity Fund has been submitted for this purpose).

| | | | | | |
|---|---|---|---|---|---|
| Increased investment in RESSEE | Number of operations by CTF-participating commercial banks to RESSEE measures | 0 (2011) | tbd with prep. grant | Commercial banks participating in program | 2016, 2019 |

## Section 10. Financing Plan and Instruments

This IP aims at developing an adequate financial package from various available sources including multi-lateral, bi-lateral, and public and private financial institutions, in order to leverage sufficient resources to achieve the plan's ambitious transformational objectives.

In the case of Component One - CSPP, the CTF loan will be complemented by a grant of at least USD14M from GoC, and an expected bilateral grant of USD40M from the International Climate Fund of the UK. This contribution by the GoC, with high opportunity costs, reflects its strong commitment to the development of low-carbon technologies. The financial plan will be completed by an equity contribution by the private developer, as well as debt financing from IDB, IFC, and commercial banks.

For Program Two - LSPVP, the CTF loan will be complemented by loans from IFC and IDB in the amounts of USD50M each, and private participation of USD150M. Both programs 1 and 2 will benefit from technical cooperation grants from IDB and from the GEF in the total amount of USD2.6M.

For Program Three - RESSEE, CTF resources in the form of loans or guarantees and grant components will be complemented with IDB and IFC loans or guarantees in the total amount of USD100M. Private sector resources are expected in the amount of USD250M, including commercial loans and resources from end user clients. The GoC has assigned USD20 in tax credit incentives and grants for this program. This program would also benefit from two GEF projects, for a total of USD2.8M. For the preparation of this program, the MDBs will submit to the CTF a request for a preparation grant of USD1M.

In terms of implementation, both CSPP and LSPVP would be ready to be submitted by July 2012 (subject to the availability of resources); of these, the GoC assigns the highest priority to CSP. Program 3 would require further preparation, and would therefore be ready for submission by November 2012.

*Table 5: CTF funded components of the Chile CTF investment plan (USD M)*

| **Financing source** | **Component I (CSPP)** | **Component II (LSPVP)** | **Component III (RESSEE)** | **Component IV Prep Grant** | **TOTAL** |
|---|---|---|---|---|---|
| CTF loans and grants | 100 | 50 | 49 | 1 | **200** |
| GoC | 14 | 0 | 20 | 0 | **34** |
| IDB loans | 100 | 50 | 50 | 0 | **200** |
| IDB grants | 1 | 0 | 0 | 0 | **1** |
| GEF | 1 | 0.6 | 2.8 | 0 | **4.4** |
| IFC Loan | 100 | 50 | 50 | 0 | **200** |
| Bilaterals | 40 | 0 | 0 | 0 | **40** |
| Other private sector | 130 | 150 | 250 | 0 | **530** |
| **TOTAL** | **486** | **300.6** | **421.8** | **1** | **1,209.4** |

# Section 11. Public Consultation Process

A Joint Mission of the Multilateral Development Banks (MDBs), in support of the preparation of the Investment Plan (IP) for the Clean Technology Fund (CTF) for Chile was carried out between November 16th and 18th, 2011. The mission was coordinated by the Energy Ministry (MinEnergía), as technical focal point for the CTF[24].

The Joint Mission included meetings with:

The national government:

- The Budget Directorate of the Ministry of Finance (DIPRES)
- The Renewable Energy Center (CER)
- The Ministry of the Environment
- The Sustainable Development and Energy Efficiency divisions of MinEnergía
- The Foreign Affairs Ministry

Private sector representatives:

- Local financial institutions
- Large utilities
- Brokers
- AChEE
- Renewable energy project developers
- The Association of Energy Service Companies
- Representatives of the mining sector (as the main power consumers in the country)

Development agencies:

- German cooperation agency (GIZ)
- Japanese cooperation and trade agencies (JICA and JETRO)
- British Embassy
- Economic Commission for Latin America and the Caribbean (ECLAC)

Civil society representatives:

- Representatives of the Citizen - Parliamentary Energy Commission that prepared the report "Chile Needs a Large Energy Reform"[25]

A first draft of the Investment Plan was prepared considering the proposals by all stakeholders. A final draft was submitted for public consultation through the website of the Energy Ministry on March 28th, 2012, following the Chilean laws regarding public consultation processes. This final version considers their inputs.

[24] bit.ly/joint_mission_CTF

[25] Comisión de Energía Ciudadana Parlamentaria. *Chile Necesita una Gran Reforma Energética*. (bit.ly/CNUGRE).

# Annex I: Concentrated Solar Power Project (CSPP) (an IDB project)

## I.1. Problem Statement

The Chilean economy is expected to grow at 4% per year until 2030, which will require roughly 4GW of new power generation capacity in the SING and SIC. The second largest power grid system in Chile, SING, consists of almost 100% fossil fuels, and supplies 90% of its electricity to large industries, mainly to the mining sector, the main driver of the Chilean economy (19% of the GDP). Currently, Chile's per capita emissions are estimated at 3.84 tons $CO_2$e/pp, significantly larger than the Latin American average of 2.16. Without a policy intervention, it is expected that most of the 3GW needed in the next decade in the SING will come from fossil fuels, increasing emissions even further. Dependence of the Chilean economy on external energy sources creates a large potential negative price volatility impact on the country's economic growth.

Meanwhile, the northern region of Chile has the highest irradiation rate worldwide, and is also where most of growth on demand for electricity will occur, due to the expected new investments in mining operations. Large-scale solar projects have the potential to reduce the fossil fuel energy dependence of the SING, decoupling economic growth from GHG emissions. Solar PV is a technology that has a very promising potential for the northern region in terms of resource abundance, however PV's intermittent generation profile is not an optimal fit for the flat demand of the SING network (the grid with highest marginal emissions). Utilizing a CSP plant with energy storage would allow for a flatter generation profile (delivering power to the grid during more hours of the day) and therefore a better technological fit.

However, while this technology is well-proven worldwide, the international banking industry has experience in financing solar CSP projects in other countries (Spain, MENA and USA), and there is tremendous potential in Chile, currently there are no CSP projects in Latin America. This inexperience leads to several barriers:

As there is no other solar CSP project in the country, the legal/contractual (PPA) framework has not been developed and there is no previous contractual format accepted by counterparties (off-takers, generators, financial sector).

Local financial institutions are already financing more common renewables like wind and hydro and are fairly comfortable with their technical aspects. However solar represents a challenge for them and is perceived to have high risk because of lack of technical familiarity. Furthermore, in today's financial environment, liquidity is very low and international finance for infrastructure projects that would normally be present is much more difficult to find. In particular, as this project would be the first solar CSP plant in Chile, the commercial financing that would be available as of today would be expensive as a consequence of the financial industry not having any benchmark in the country to measure the technical and financial reliability of this technology. These risks make capital more expensive and unaffordable for the project compared to expected returns. In spite of the proven reliability of solar CSP technology in other regions, and as there is no solar CSP plant in Chile, potential local off-takers also perceive this technology as risky and as not reliable to provide the electricity load they require.

In addition, although gradually decreasing, the capital cost of a solar CSP plant is still high and makes any potential solar CSP project economically unviable as potential off- are not willing to pay a PPA price above the currently paid prices. Lack of a track record also implies high costs of entry for the first mover that develops the project, risks in terms of proving the regulatory framework, interconnection issues etc.

## I.2. Proposed Transformation

The development of reliable and dispatchable solar CSP projects in Chile will reduce the country's dependence on imported fossil-fuel for electricity generation. It will also serve as a hedge against the impact of fossil-fuel price volatility on the country economic activity.

The goal of the CSP initiative is to enable the construction of the first CSP power plant in Latin America. The approximate capacity is targeted for 50MW and a minimum load-factor of 40%. CTF resources will be allocated to the project which wins the competitive tender issued by the GoC. This process will follow existing practices in the power and energy market. In this way, it is guaranteed minimal market disruption, if any. Within this process, there will be a transparent market-based solution to close the financial gap between conventional power solutions and low-carbon technologies and ensure the most efficient use of resources.

For the CSPP, the Government will provide a subsidy in the form of a grant, and preferential interest rate debt will be provided directly to the project through a CTF loan of approximately USD100M. The project will satisfy the remainder of its debt financing requirements through market-based MDB loans and additional commercial financing.

The GoC grant, to be provided to the project's developer and to be capped, reflects its commitment to the development of the CSP industry. Considering this specific project as a key initial step, the Government will provide a capped grant to the project developer. This grant will be determined by a competitive tender process designed to maximize the efficient use of public resources, and to ensure that the project is not over-subsidized. The GoC will also help the project by providing permitted sites and assisting in the negotiations of a PPA with a creditworthy offtaker. However, these supports alone will not be enough to finance the project.

The CTF preferential-interest rate funding (maximum USD100M) is critical for the commercial scaling-up of CSP technology in the country, which has been successfully proven in other regions in the world (i.e. Spain, USA and the Middle-East) and demonstration to the market of the potential for solar technology to meet demand.

CTF financing will feature a minimum leverage ratio requirement of 1:5 vis-à-vis total project costs. A fixed interest rate, to be specified in the bidding documents, would provide certainty with regards to the financing terms available and allow the developer to structure its bid. Debt with the financial terms required for a CSP project is not currently available in the market, and cannot be provided by the GoC or MDBs on their own. In terms of risk, CTF financing will be ranked *pari-passu* with the senior MDB funding for the project, which will be offered at market-based pricing to be determined after the award of the bid.

## I.3. Rationale for CTF Financing

The main barriers to scale-up CSP grid-connected systems are risk-return imbalances and cost barriers faced by early entrants. A CTF private sector intervention could reduce those barriers, and off-set the incremental costs faced by early entrants with a concessional loan given to the project.

As this project will be the first solar CSP project to be built and financed in the country, it will serve as a valuable benchmark for the financing of future similar projects and will provide the necessary experience to the financial industry for future project assessment in the Chile. As the first solar CSP project in the country with a PPA accepted by the mining (off-taker) and financial ("bankable") industry, it will set an invaluable precedent to built upon for future similar projects.

Thanks to the CTF funding, the project will have access to financing that is inaccessible because of perceptions of risk and would not be available in the financial market. The potential off-takers for solar CSP projects will be reassured by the construction and operation of the first CSP plant in Chile and will be able to measure its performance vis-à-vis their electricity requirements. This lowering of risk perceptions by financiers and off-takers will facilitate and make less expensive the financing of future similar projects.

The reduction in financing costs through the CTF funding will help to offset the high capital investment required by solar CSP projects and will allow the project to sign a long-term, fixed-price PPA with an off-taker at a competitive price vis-à-vis current electricity prices in the SING. Additionally, this project will add to the already decreasing cost curve of the industry and will help to reach future market competitiveness of the technology.

This temporary support to the first CSP project in Chile will allow lower entry costs for later entrants, therefore there are no market distortions or crowding-out effect. On the contrary, CTF co-financing would actually have a crowding-in effect, because it will encourage investors to undertake large-scale CSP solar projects where today none exist in Chile and South America. This project will be a market-creating initiative.

This project proposal will also include non-reimbursable components for technical assistance that will increase the crowding-in effect. For instance, supporting the policy action described in Section 3 "Geographic Information System (GIS), economic potential for NCRE" that is within the National Energy Strategy, could facilitate the decision making of NCRE investors.

## I.4. Implementation Readiness

This procedure does not require any changes to the legal framework, as energy and power tenders have already been reviewed and supervised by the CNE. The Chilean Ministry of Energy is leading a GEF project, alongside the IDB as an implementation agency, which will focus on the technology transfer required to create the national solar energy market. In addition, the solar energy implementation program will be supported by the technical cooperation assistance of ATACAMATEC which will define the financial requirements of every individual project on the portfolio.

The main solar CSP developers worldwide are already present in Chile in order to assess the market opportunities and to find the best locations for potential projects. In addition, some solar CSP projects have been submitted to the environmental authorities for approval.[26] This is a clear sign of the industry's readiness to step in once the financial conditions to breach the gap between solar CSP's levelized cost of energy and current electricity prices are met.

In addition, the GoC has shown a clear commitment with this initiative not only from an institutional perspective, but also with its financial support (through a grant) to the project. Furthermore, the agreement between the Ministry of Energy and the "Ministry of National Goods" regarding the use of national land for renewable energy projects is another clear sign of the strong support to the initiative by the GoC.

As far as potential off-takers are concerned, the mining industry (which consumes 90% of electricity generated in the SING) has shown its preliminary support to an initiative promoted by the GoC to set the regulatory and contractual bases for a potential PPA with a solar CSP plant (subject dealt with in a meeting held in 2009 among CORFO, CNE and mining companies). The

[26] Spain's Ibereolica Plans USD2.6 Bln Solar Energy Project In Chile - WSJ.com

above is a clear sign of the positive approach by the mining industry to a competitive PPA with a solar CSP project.

Finally, all the energy industry's stakeholders are well aware of the vulnerability of the country to international price shocks and demonstrate clear interest in finding a solution to internal energy generation through domestic renewable resources (i.e. sun and other renewable sources).

## I.5. Financing Plan

This project will include financial support from both the private and public sectors as outlined below. CTF financing will be channeled by IDB. However if possible IFC will also provide financing to the project, maximizing the potential for synergistic leverage.

*Table 6: CSP financing plan (USD M)*

| CTF loan | GoC | IDB loans | IDB grant | GEF | IFC Loan | Bilaterals | Other private sector | Total |
|---|---|---|---|---|---|---|---|---|
| 100 | 14 | 100 | 1 | 1 | 100 | 40 | 130 | 486 |

## I.6. Project Preparation Timetable

*Table 7: CSP timetable*

| Milestones | Date |
|---|---|
| Submission to CTF committee | July, 2012 |
| Bid posted | October, 2012 |
| Approval by MDB board | March, 2013 |
| Deadline bid application | June, 2013 |
| Bid adjudication | June, 2013 |
| Project constructing start-date | August, 2013 |
| Project constructing completion | August, 2015 |

# Annex II: Large-Scale Photo-Voltaic Program (LSPVP) (an IDB/IFC Program)

## II.1. Problem Statement

In the case of Chile, high solar radiation coupled with very high energy prices present a favorable context for the implementation of solar technologies. PV generation in Chile would displace diesel or coal generation. The PV market has increased its competitiveness during recent years, offering an attractive price which is more competitive in the market. This technology requires low water consumption, is scalable (hence enables participants of different scales), and has been proven in installations worldwide. In the case of Chile, high solar radiation coupled with very high energy prices present a favorable context for the implementation of these technologies. As the marginal unit of power is very carbon intensive in some areas of Chile, PV generation would displace diesel during daylight hours.

Despite this potential there is a lack of financing for these projects and only two exist (and are still in construction) so far in the country. In the northern grid, PV's generation profile and the availability of solar energy resources are not an appropriate complement for the demand of energy (permanent load). Hence, it is not easy to find suitable contracts to make the intermittent nature of PV supply fit into the requirements of big clients. There is an availability of capital in the market and other RE projects do receive financing, but banks will not provide debt without a power purchasing agreement, and despite the new requirement that offtakers should include 5% RE generation which will steadily increase, there are currently no special financial incentives for this technology[27].

High capital costs have prevented this technology from reaching grid parity. It has slightly higher capital costs than more common RE technologies like wind and hydro. For instance the average LCOE of PV connected to the grid in Chile is $130 USD/MWh, whereas the most recent nodal price projection was 90 USD/MWh.

Solar power has not yet gained acceptance in the market as a reliable and practical generation alternative. For solar financing, there is a high perception of risk and lack of technological familiarity amongst LFIs, leading to a lack of domestic debt for large PV projects, and high interest rates where available. Local financial institutions are already financing more common renewables like wind and hydro and are fairly comfortable with their technical aspects. However solar represents a challenge for them and is perceived to have high risk because of lack of technical familiarity. Furthermore, in today's financial environment, liquidity is very low and international finance for infrastructure projects that would normally be present is much more difficult to find.

Finally, despite the favorable legal framework for the development of PV, there is a lack of clarity regarding norms and practices for interconnection to the grid. There is a lack of experience in the grid integration of PV systems. Currently there is a lack of performance record and data on costs because there are no PV projects connected to the grid.

[27] Except of a tax credit incentive for locations at the extremes of the country, such as Arica, which are not representative to the general market conditions.

## II.2. Proposed Transformation

With just two projects so far domestically but vast demonstrated international potential, PV technology is in the early scaling-up stage of adoption in Chile. This component is focused on medium- to large-scale installations connected to the grid, excluding "inside the fence" self-supply installations, which are covered by the third component of this investment plan. By providing CTF and MDB financing, and taking into account the expected cost reduction in the technology, it is expected that in the medium term these barriers will be sufficiently reduced in order to allow PV technology to reach financial sustainability and to achieve market transformation, while reduction in technology costs per MW of PV power enables closing the gap vis-à-vis grid parity.

In this proposal, the IDB and IFC will channel CTF resources directly to PV projects via loans or guarantees (one MDB per project). The bank channeling the CTF resources to a given project would provide additional financing with its own resources. To the maximum extent possible, the opportunity for the second MDB to also provide financing will be sought. The financial terms provided to each project will follow the principal of minimal concessionality, with MDBs negotiating the minimum needed embedded subsidy to overcome investment barriers.

The project is also aligned with and benefits from other efforts being carried out concurrently. This includes the technical cooperation assistance of IDB's "ATACAMATEC" project, which will assess the financing gap of individual projects currently under development in Chile. It also includes the IDB/GEF "Development and Promotion of Solar Energy" project, which incorporates the implementation of pilot, grid-connected CSP and PV plants, with additional technology transfer activities.

## II.3. Implementation Readiness

Chile has a well established history of over 30 years of private participation in the energy sector, which has attracted investment from both national and foreign corporations. The energy sector reforms, as well as institutional and regulatory frameworks that laid the foundation for this investment, will also provide favorable market conditions for this component. In its short-term agenda the Ministry of Energy will undertake further regulatory improvements for connecting small and medium independent power generators to the grid.

The very first solar PV investments have already started and there is great interest from international and domestic solar developers in the Chile market, as well as readiness to respond to incentives. Leading solar firms have representation in Chile. According to consultations during the CTF Joint Mission LFIs are interested in RE finance but perceive solar to be risky.

## II.4. Rationale for CTF Financing

Through this Program, MDBs will provide a mix of low cost and subordinated debt to solar PV projects in order to offer the minimum subsidy required to reduce barriers of risk and costs to the point where projects become bankable. Because cost is a barrier for this technology but a few companies have entered, demonstrating that short-term concessional financing has the potential to provide a reduction in the first-mover costs experienced by new companies making the first grid interconnection, proving contractual practices, technical reliability in the Chilean context, etc. Likewise, risk perceptions have been a major barrier for solar financing, therefore subordination of CTF funds could prove to be a powerful tool in attracting local debt and thereby creating capacity and a track record with local banks. Lower perceived risks and greater demonstration and data on the Chilean context will decrease the cost of capital in domestic markets in the future.

By providing financing for PV projects, this initiative is intended to promote capacity in the market, including familiarity by off-takers, project promoters, and financiers. Following market trends, costs for PV solar production are expected to continue decreasing to a point where subsidy and incentives are no longer needed, hence the program is expected contribute to a financially sustainable market in the medium term.

## II.5. Financing Plan

*Table 8: PV financing plan (USDM)*

| CTF loans and grants | GoC | IDB loans | GEF | IFC Loan | Bilaterals | Other private sector | Total |
|---|---|---|---|---|---|---|---|
| 50 | 0 | 50 | 0.6 | 50 | 0 | 150 | **300.6** |

CTF resources would be executed 50% by IDB and 50% by IFC. Building on earlier experiences of cooperation in the CTF, this shared execution will be practiced in a way to maximize efficiency, learning, and leverage. For any given financial operation just one MDB will channel CTF resources (reducing transaction costs to CTF), but whenever possible the other MDB will also provide financing to the project. This will maximize the amount of financial resources available to projects, and each MDB will learn from the lead of the other.

## II.6. Project Preparation Timetable

*Table 9: Solar PV timetable*

| Milestones | Date |
|---|---|
| Submission to CTF committee | July, 2012 |
| First approval by MDB board | March, 2013 |
| First disbursement | June, 2013 |

# Annex III: Renewable Energy Self-Supply and Energy Efficiency (RESSEE) (an IDB/IFC Program)

## III.1. Problem Statement

At present, Chile has the most expensive electricity in South America, and its greenhouse (GHG) emissions are 3.84 tons $CO_2e$ per capita, significantly higher than the Latin America average of 2.16 tons $CO_2e$ per capita (IEA, 2009). Indeed, Chile's carbon intensity per unit of energy used is higher than both the Latin America and the OECD average (0.4 $kCO_2$ / kWh for Chile instead of 0.2 $kCO_2$ / kWh for the average of Latin America, based on IEA 2009). As such, Chile's competitiveness and economic success is particularly threatened by having much higher electricity costs compared to other countries. In addition, increased awareness and interest in more environmentally sound practices is making "greener" processes and products a must.

As indicated previously (see Section 4), the most cost-effective action to reduce GHG emissions in Chile is energy efficiency (EE). However, these energy efficiency projects, as well as projects for companies to generate their own power ("self-supply"), confront various barriers that result in an increased cost (in particular for new-entrants), including: (i) financial barriers resulting from a lack of knowledge and experience among financial institutions related to project-based financing for self-supply and EE projects; (ii) lack of information on potential technologies and use of alternative energy resources; and (iii) lack of experience among energy end-user clients and technical service providers on the potential technologies and energy business models.

## III.2. Proposed Transformation

The proposed transformation is to fast-track the scale-up of Renewable Energy Self-Supply and Energy Efficiency (RESSEE) projects. The proposed Program is designed to scale up the use of RESSEE practices through encouraging investments among end-users by increasing access to appropriate finance for such investments. The measures targeted in this category are very small scale and it would be inefficient to finance them directly through an MDB. Therefore this program will focus on providing concessional finance and training to local financial institutions that have lower transaction costs, are closer to the market and have greater capillary contact with potential clients, and these institutions will in turn provide financing. The supply of finance is to be developed in coordination with capacity-building activities among private sector entities to promote the connection of supply and demand, adequate flow of information, and proper alignment of incentives.

The proposed Program will include both investment and advisory services components. The investment component aims to provide financing products to transform the financial sector towards low-carbon, climate-conscious behavior, and in doing so, support the economic competitiveness and sustainable development of the country. The advisory services component will encourage local financial institutions to develop appropriate lending programs for private companies to finance RESSEE projects, and identify RESSEE opportunities among end users and technical services providers. The aim is to reduce energy consumption by unit of output and reduce the use of inputs, leading to less waste and to GHG emission reductions.

## III.3. Investment Component

Debt, guarantees and risk-sharing products would be used as necessary to mitigate financial institutions' perceived risks regarding RESSEE projects until a track record can be developed, helping to leverage flow of private sector finance. The specific instrument to be used would depend on the liquidity and funding profile of each financial institution. Financial institutions

would be offered a financing package that includes a combination of CTF funds with IDB and/or IFC funds. The concessional nature of the CTF funds would allow some of the initial product line development costs to be offset and to mitigate risks for financial institutions during the early stages of their heightened risk perceptions. Once financial institutions develop their internal capacity as well as a track record and experience in sustainable energy finance, they will be able to scale-up financing on their own without the need for further subsidies. In addition, the entry of these financial institutions is expected to have a demonstration effect among other financial institutions, resulting in their entry in the sustainable energy finance market.

## III.4. Advisory Services Component

*Capacity building in financial institutions*: Through the program, a select number of financial institutions in Chile would be supported to increase their capacity to develop, assess and monitor a portfolio of suitable RESSEE projects. This would include combining targeted financial support, training for bank staff, investment screening tools, and transaction-level support in order to facilitate the development of new lines of business within local financial institutions. Only if internal capacity is developed will financial institutions have the ability to continue financing RESSEE projects beyond the life of the CTF Program.

*Technical service provider support*: Technical service providers, such as energy services companies (ESCOs), equipment suppliers and vendors and local consultants (firms and individuals) are crucial actors in a sustainable energy market as they are the entities that are able to identify, analyze and present RESSEE projects to financial institutions for financing. Many technical service providers, however, may have the technical knowledge and skills to identify and develop potential RESSEE projects, but often times lack the business acumen and financial skills needed to be able to present such opportunities in a coherent structure to financial institutions. Therefore, training and capacity-building for such entities is needed to provide them with a better understanding of financing so that they are able to present projects to financial institutions.

*Market awareness*: Targeted market awareness-raising activities will be organized in order to build a sufficient pipeline for potential investments as well as to develop an understanding of the RESSEE market in Chile. These activities will include conferences, seminars, development of market intelligence, among other possibilities.

*End-user support*: End-users need financing and technical support to make their RESSEE investments happen. They also need training to set up effective energy management systems, and learn how to monitor their energy consumption and efficiency over the time. The Program will also support the development of specific RESSEE projects. Performing an energy audit for a prospective RESSEE customer is the beginning of the project sales cycle. By supporting energy audits, the Program will assist in building a pipeline of projects for financing. Participating FIs and RESSEE service providers can use that support to identify prospective clients and analyze the opportunities for RESSEE and present possible projects for financing by the participating financial institutions.

## III.5. Implementation Readiness

The GoC has already assigned a USD10M grant to promote self-supply industrial applications and a tax credit incentive in the amount of USD10M to promote installation of solar water heating (SWH) systems. Both of these activities are expected to provide an additional impetus to both end users and technical service providers to utilize these technologies and approaches.

The IDB and IFC have already begun exploring partnerships with key market actors and have several programs already in place that can be scaled-up. Several local financial institutions have

expressed strong interest in participating in the program and developing new lines of business in the energy efficiency sector under the right conditions.

Currently, IFC is carrying out regulatory analysis work to identify specific gaps or areas of needed reform that could be undertaken in the short-term. This work is expected to help contribute to a more favorable environment for RESSEE projects by reducing or eliminating any regulatory impediments. Moreover, IFC recently carried out some market studies and mapping work that has identified opportunities for sustainable energy finance in the country and which will be used as input for a training program for different service providers interested in entering the sustainable energy finance market.

The IDB is executing several projects in the energy sector in Chile, such as funding for an equity investment fund focused on smaller hydropower plants that is expected help increase interest in renewable energy projects, a direct loan to a commercial bank to finance green projects (mainly small hydropower plants), a project for the promotion of clean energy market opportunities among small and medium enterprises with Fundación Chile, and a program with the Chilean Energy Efficiency Agency and with support of the GEF, to promote energy efficiency in the industrial and commercial sectors through support for strengthening technical service providers and to increase access to finance for these entities through a partial guarantee.

## III.6. Rationale for CTF Financing

CTF financing is necessary to address capacity, cost and risk barriers among financial institutions, increase end user demand, and build local technical expertise among key stakeholders in order to scale up RESSEE investments in a systematic and sustainable way in Chile. The CTF program would coordinate existing programs and actors in energy efficiency and self supply initiatives, including those activities being carried out by IFC and IDB, as well as unlock financial resources which are currently constrained by risk perceptions. Because the benefits of RESSEE technologies have not been demonstrated sufficiently in this market, and because the sufficient technical capacity required does not yet exist in the market, scaled investment in RESSEE under current conditions will not take place. Launching such a coordinated effort will require significant financial resources and know-how, which are not currently being mobilized at a sufficient scale and scope in the market. CTF resources could grow, and serve as a center of gravity and coordinating mechanism for all of the individual players and initiatives within the sector.

Given that CTF concessional financing is temporal and is aimed at closing the cost and risk barriers among financial institution, there is no crowding-out effect. Moreover, CTF non-reimbursable funding used for technical assistance to financial institutions would increase the crowding-in effect. Previous attempts to solve only a single barrier have been unsuccessful. It is only through this programmatic approach for addressing knowledge and financial barriers that the market can be transformed.

Many RESSEE investments generate a positive return, but until the financiers and end-users understand that RESSEE investments are good business – through firsthand experience or the experience of their competitors – those returns will not be generated. The use of CTF funds for technical assistance and concessionary finance, such as loans and guarantees, provides the necessary catalyst to engage the stakeholders to implement RESSEE investments. In the absence of such a source of funds, Chile is expected to remain as it has been: a country of significant, but untapped, RESSEE potential. In addition CTF funds are expected to make possible a set of programs that will build a comprehensive and coordinated sustainable energy market, allowing Chile to adopt improved industry practices and avoid wasting valuable resources through the trial and error of isolated pilot programs.

## III.7. Financing Plan

The following is a conceptual financing plan for indicative purposes to address the knowledge and financial barriers through the use of technical assistance and financial instruments. The specific allocations between technical assistance, performance-based incentives, and investments, as well as actual contributions of individual MDBs and stakeholders will be outlined at the program proposal stage.

*Table 10: RESSEE financing plan (USDM)*

| CTF loans and grants | GoC | IDB loans | GEF | IFC Loan | Bilaterals | Other private sector | Total |
|---|---|---|---|---|---|---|---|
| 49 | 20 | 50 | 2.8 | 50 | 0 | 250 | **421.8** |

CTF resources would be executed 50% by IDB and 50% by IFC. Building on earlier experiences of cooperation in the CTF, this shared execution will be practiced in a way to maximize efficiency, learning, and leverage. For any given financial operation just one MDB will channel CTF resources (reducing transaction costs to CTF), but whenever possible the other MDB will also provide financing to the project. This will maximize the amount of financial resources available to projects, and each MDB will learn from the lead of the other.

## III.8. Project Preparation Timetable

Based on the assumption that the Chile Country Investment Plan is approved by the CTF Trust Fund Committee in May 2012, the program is expected to be prepared along the following timetable:

*Table 11: RESSEE timetable*

| Milestones | Date |
|---|---|
| Program preparation and design | November 2012 |
| Submission to CTF Committee | January 2013 |
| First approval by MDB Board | March2013 |
| First individual project implementation start | May 2013 |

A preparation grant will be requested for the development of this component (see next annex).

# Annex IV: Preparation Grant for RESSEE (an IDB/IFC project)

## IV.1. Problem Statement

A recent study by the Energy Studies and Research Program, at the Universidad de Chile, estimated the potential for energy efficiency in the largest consumption sectors in the economy. Without energy efficiency measures, demand could double in the period from 2007 to 2021. However, if energy efficiency measures are added, this demand could be reduced by 20% at the end of this period. For Chile's electricity requirements alone, projections indicate that without energy efficiency, by 2020 the economy will need an additional 14,500 MW of installed capacity. Reducing incremental consumption by 20% in the 2008-2020 period will reduce the additional installed capacity needed by 1,600 MW (or slightly more than 11% of the total). However despite all these reasons and the apparent profitability of EE measures, investment in this sector is not taking off.

Chilean government support mechanisms for energy investment have not had a large impact on the development of small-scale thermal and/or electrical energy self-supply projects in the industrial, public and commercial sector. This is essentially because these projects have a different scale of investment costs and most of the times are not connected to the grid therefore the policies are not accessible for them. An example of this situation is that tools managed by the Economic Development Agency (CORFO) that covered the costs of pre investment studies for NCRE projects required a minimum investment of USD400,000, an amount that was not achieved for most self-supply systems in small-medium companies or public infrastructure. Moreover, these instruments did not consider the possibility of heating or cooling projects.

Among the barriers that such projects face, one of the most important is that there are few experiences in commercial operation with similar characteristics in the country. Therefore, it is quite difficult to disseminate the technologies and their benefits, local investment and operational costs, need for labor, all facts that prevent the replicability of such experiences. In addition, the level of technical capacity available in the country in these areas is low and the initial investment is considerable and often entails high risk which is reflected in high interest rates offered on debt to these projects. The opportunity cost of the capital needed for small self-supply NCRE projects is rather high and these are not therefore prioritized within the investment portfolio of a company.

The need for greater levels of energy efficiency (EE) in Chile is evident. Factors such as high energy prices faced by consumers, the growing public concern for the environment, reduction of domestic resources and national energy security contribute to a growing awareness of the need for greater EE.

The recent creation of the Chilean Energy Efficiency Agency represents a key action for the implementation of a robust energy policy with a long term perspective. Empirical evidence has shown recently that EE is not implemented to its full potential (including some measures whose implementation costs are much lower than its benefits) due to the existence of certain barriers. These include barriers related to information available, economic barriers, technical barriers, institutional barriers and cultural barriers.

In the industrial sector, companies that are aware of the potential to invest in EE measures will evaluate that investment against a portfolio of other potential investment projects mainly

focused on increasing production or marketing. Often energy efficiency projects are not selected for inclusion in the annual budget, because it seems more attractive to allocate the company's capital on growing the core business, even if EE measures would be more profitable. In this case access to alternative ways to finance these initiatives can be an opportunity to develop energy efficiency projects.

## IV.2. Proposed Transformation

This grant support includes four activities: (1) Market Development, where concrete actions towards reducing the entry barriers for EE and energy self-supply production schemes must be assessed; (2) Capacity development, aimed to increase the knowledge and expertise of all the key actors of the market; (3) Project development, to develop a series of EE and energy self-supply production projects to the point of being fully prepared for funding ; and (4) funding of projects through a series of different governmental and private schemes.

*Table 12: Preparation grant deliverables*

| Activity | | Deliverables |
|---|---|---|
| Activity 1: Market development | i) | Study and categorize the different segments of the energy consumption market in terms of market size, economic feasibility, replicability and green house gas capture. |
| | ii) | Develop feasibility profiles for EE and energy self supply production schemes for a range of prioritized segments of the energy consumption market from letter (i). |
| | iii) | Study the different entry barriers for EE and self-supply energy production schemes for a range of prioritized segments of the energy consumption market and propose solutions to reduce each identified barrier. |
| Activity 2: Capacity development | i) | Five regional consultation/training workshops orientated towards reducing barriers for energy consumer segments. |
| | ii) | Two regional consultation/training workshops orientated towards increasing the knowledge and capacity of project developers. |
| | iii) | Two regional consultation/training workshops orientated towards increasing the knowledge and capacity of finance analysts. |
| Activity 3: Project development | i) | Provide funds for demonstrative project design, where the final product should be a fully fundable project. |
| Activity 4: Funding | i) | Propose funding alternatives to increase the amount of EE and local energy production project development, through private bank loans, governmental loans and programs, etc. |
| | ii) | From the feasibility profiles, develop standard evaluation parameters and spreadsheets for EE and energy self supply production projects. |
| | iii) | Propose strategies for evaluation, information gathering and publication of the technical and economic outcome from the funds delivered. |
| | iv) | Propose how CTF resources should be channeled |

## IV.3. Implementation Readiness:

The different assignments proposed for this preparation grant will be managed by the Ministry of Energy, assigning different tasks among its depending divisions and agencies. Throughout the development of the tasks associated to the preparation grant, different actors will be involved, such as possible project developers, banks, consultants and governmental organizations, among others.

## IV.4. Rationale for CTF Financing

The implementation of the grant program is designed to address the barriers previously described, mainly by providing access to debt financing for RESSEE. By implementing such projects, small and medium companies will improve their energy management, a key issue for increasing their productivity, considering the high cost of energy in Chile.

The grant program will also assist different sectors that provide goods and services to identify and quantify the effects that NCRE projects have on their respective chains, such as a reduction in operational costs, need for technical human resources and ancillary benefits which are not always considered in traditional economic evaluations of public and private projects. This information is relevant to promote investment in such systems, thus the grant program can work as a catalyst for the early adoption of these technologies in several sectors of the Chilean economy.

## IV.5. Financing Plan

*Table 13: RESSEE preparation grant – financing plan.*

| CTF loans and grants | GoC | IDB loans | IDB grant | IFC Loan | Bilaterals | Other private sector | Total |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | **1** |

CTF resources would be executed 50% by IDB and 50% by IFC.

## IV.6. Project Preparation Timetable

*Table 14*: RESSEE preparation grant – timetable.

| Milestones | Date |
|---|---|
| Submission to CTF committee | June, 2012 |
| MDB approval | July, 2012 |
| First disbursement | August, 2012 |

# Annex V: Chile as a Player in the International Climate Agenda

Chile is an important player renewable energy player in the developing world, and its government has a strong commitment to reduction of emissions which it is actively pursuing. This is shown in several cooperation activities that different actors within the Chilean arena are co-developing with other multi-lateral and bilateral agencies.

In the context of Chile's incorporation to the OECD, the GoC asked the IEA to conduct an energy policy review. This document was published in 2009 and has been a very valuable input for the creation of the Ministry of Energy. The document makes the following important points:

1. Chile is the leading country in the Energy and Climate Change of the Americas (ECPA) initiative for renewable energy. In this framework, the CER has realized successful cooperation activities with National Renewable Energy Laboratory (NREL) of the United States of America. There is also a Mutual Cooperation Agreement between CER and Centro de Energías Renovables de España (CENER, Spanish Renewable Energies Center), aimed to promote renewable energies.

2. In 2004, the governments of Chile and Germany began cooperation in the subject of Non Conventional Renewable Energy (NCRE) and Energy Efficiency. This cooperation was based on a soft loan of EUR80M and a non-reimbursable donation of EUR3M.

3. Also in 2006, co-operation between CER and GTZ (today GIZ) started, focused on research regarding the insertion and uses of renewable energy applications in the industry and commercial sectors in Chile.

4. In 2009 IDB funded a study to estimate the potential of marine energy in Chile and identify preliminary sites for marine energy projects. This study was an important input for the definition of actions that promote this kind of energy in the country.

5. IDB jointly with the Ministry of Energy and the National Energy Commission is executing a Global Environmental Facility (GEF) project focusing on solar energy and the regulatory framework required for different renewable energies to be integrated into the energy matrix. Particular interest is focused on low temperature solar energy projects which fit with Law 20.365.

6. Other multi-lateral financiers are active in low carbon development-related studies, such as the IFC with its Sustainable Energy Financing Facility, and World Bank's Market Readiness Program.

7. Chile has been actively working with United Nations Industrial Development Organization (UNIDO), to research about the insertion and uses of renewable energy applications in industrial and commercial sectors in Chile. Also the United Nations Development Program (UNDP) is implementing a Global Environment Facility (GEF) project oriented towards the reduction of barriers for penetration of Solar Systems in Chile and energy efficiency activities.

8. As for bilateral assistance, there have been several activities undertaken lately in the field of renewable energy and energy efficiency, such as mutual cooperation agreements between the Ministry of Energy and Department of Energy of the United States of America (for development of green energies), California Energy Commission (for geothermal and energy efficiency), and the European Union (develop small hydro projects in the agricultural sector).

9. Also the Chilean National Service of Geology and Mining (SERNAGEOMIN) developed a program of geothermal resources exploration, utilizing German funds from KfW.

10. Currently and based on the prioritization of studies for future mitigation actions, the Ministry of Environment is preparing strategic NAMAs with a sectoral approach.

# Annex VI. List of Acronyms and Abbreviations

| | |
|---|---|
| AChEE | *Agencia Chilena de Eficiencia Energética* (Chilean Energy Efficiency Agency) |
| BMU | Federal Ministry of the Environment (Germany) |
| BMZ | Federal Ministry of Economic Cooperation and Development (Germany) |
| CADE | *Comisión Asesora para el Desarrollo Eléctrico* (Advisory Commision for the Development of the Power Sector) |
| CDEC | *Centros de Despacho Económico de Carga* (Centers for Economic Load Dispatch) |
| CDKN | Climate and Development Knowledge Network |
| CER | Centro de Energías Renovables (Renewable Energy Center) |
| CNE | *Comisión Nacional de Energía* (National Energy Commission) |
| CIFF | Children's Investment Fund Foundation |
| $CO_2$ | carbon dioxide |
| $CO_2e$ | carbon dioxide equivalent |
| CORFO | *Corporación de Fomento de la Producción de Chile* (Production Development Corporation) |
| CSPP | concentrated solar power project |
| CTF | Clean Technology Fund |
| ECLAC | Economic Commission for Latin America and the Caribbean |
| EE | energy efficiency |
| EIA | environmental impact assessment |
| ENE | *Estrategia Nacional de Energía* (Chilean National Energy Strategy) |
| ESCO | energy services company |
| FI | financial institutions |
| GEF | Global Environment Facility |
| GHG | greenhouse gases |
| GIZ | Gesellschaft für Internationale Zusammenarbeit (German technical cooperation agency) |
| GDP | gross domestic product |
| GoC | Government of Chile |
| Gg | gigagram |
| GW | gigawatt |
| IDB | Inter-American Development Bank |
| IFC | International Finance Coorporation |
| IP | investment plan |
| JETRO | Japan External Trade Organization |
| JICA | Japan International Cooperation Agency |
| KfW | Kreditanstalt für Wiederaufbau (German development bank) |
| LCOE | levelized cost of energy |
| LFI | local financial institutions |
| LNG | liquefied natural gas |
| LSPVP | large-scale photo-voltaic program |
| LULUCF | land-use, land-use change, and forestry |
| M | million |
| MW | megawatt |
| NCRE | non-conventional renewable energy |
| O&M | operation and maintenance |
| PAEE20 | *Plan de Acción de Eficiencia Energética 2012-2020* (2012-2020 Energy Efficiency Action Plan) |
| PPA | power purchase agreement |
| RE | renewable energy |

| | |
|---|---|
| RESSEE | renewable energy self supply and energy efficiency |
| SEA | *Sistema Eléctrico de Aysen* (electrical system of Aysen) |
| SEC | *Superintendencia de Electricidad y Combustibles* (Bureau of Electricity and Fuels) |
| SEM | *Sistema Eléctrico de Magallanes* (electrical system of Magallanes) |
| SIN | *Sistema Interconectado Central* (Central Interconnected System) |
| SING | *Sistema Integrado del Norte Grande* (Northern Interconnected System) |
| T | ton |
| TES | thermal energy storage |
| Tg | teragram |
| UNDP | United Nations Development Program |
| UNFCCC | United Nations Framework Convention on Climate Change |
| USD | United States Dollars |