Climate Investment Funds

CTF/TFC.8/CRP.3
November 4, 2011

Meeting of the CTF Trust Fund Committee
Washington, D.C.
November 4, 2011

BACKGROUND INFORMATION – CHILE CTF INVESTMENT PLAN PREPARATION AND PRESENTATION BY GOVERNMENT OF CHILE

Background Information
Chile CTF Investment Plan preparation[1]

"We have proposed 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. And this is a formidable challenge, and we want* secure, clean and economical *energy" (President Pineras of Chile)

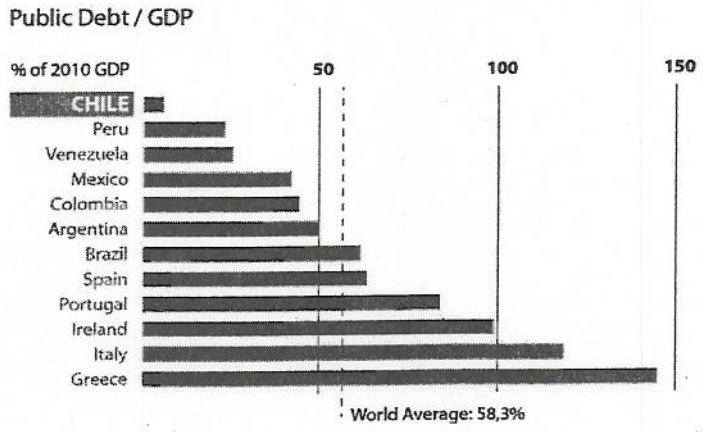
Section 1 Country and sector context

1. Chilean Economy Overview

Chile has a modern, dynamic economy, with stable policy and regulatory frameworks and a market based vocation. The economy has been growing at fast pace and is expected to grow at 6% for the next 5 years and 4.5% for the following 5 years. Within Chile economy there is an increasing share of manufactured products and healthy exports of minerals and foodstuffs.

Chile's successful approach to development is based on an economy open to trade and technological innovation. The public debt is small and the country's credit rating is amongst the highest in the region.

Figure 1. Public debt as a fraction of 2010 GDP.



Although Chile is not one of the largest GHG emitters – is responsible for only 0.2% of the global emissions- its per capita emission (3.6 ton CO2/hab) is well above the Latin America average (2.14). Similarly the carbon intensity of Chile's economy is 0.33 kg CO2/GDP ppp, above the Latin America average (0.28) and above countries such as Spain (0.31) or Italy (0.29).

[1] This is introductory work prepared by the Government of Chile in vizier of the fore coming CTF Joint Mission where further background information, discussions and definitions are expected to be met.

2. Chilean Energy Sector

The provision of power and energy services is in the hands of the private sector under a market based framework.

Primary energy consumption in Chile is highly dependent on imported fossil fuels (oil, natural gas and coal). Reserves of oil and coal are equivalent to 1 to 3 years at the current rates of use. Energy imports increased from 45% to 76% of total primary energy consumption between 1990 and 2007[2].

Power consumption, grew more rapidly than GDP, coupled with the increase in mining activity, with an average annual increase over 6%. The later has resulted in a constant increase rate of GHG, as shown in figure 2.

Chile's economy is expected to continue to grow at a healthy rate of 4 to 5%. This will require a sustained expansion of energy demand. If the more conservative economic growth rates are considered, almost 800 MW will be installed per year (totaling 4 GW by 2016). And if the current scenario persists, most of this new annual capacity installed will be coal-fired technology. Such carbonization is contrary to the goals espoused by the government of reductions in the carbon footprint of the economy and a larger participation of renewable energy sources in the power matrix.

On the other hand, the country presents a uniquely favorable opportunity for low-carbon growth. Conditions that would enable it to effectively pursue a low-carbon transformation of its energy sector include: (a) a serious concern with the vulnerability associated with high dependence on imported energy and a strong commitment to reduce this through energy efficiency and renewable energy; (b) an institutional, regulatory and investment climate in the energy sector that are widely recognized as stable and attractive to investors; (c) domestic energy prices reflecting high costs of supply[3]; and (d) a large and diversified renewable energy resource base, including significant hydro, wind, marine, geothermal and solar energy resources.

In this context, the Government of Chile has appointed an Advisory Commission for the Electric Development (Comisión Asesora de Desarrollo Electrico, CADE) to present recommendations for long-term development of the power sector. Results of these multi-stakeholder expert consultations will be available by the end of 2011 but are already contextualized in this draft investment plan.

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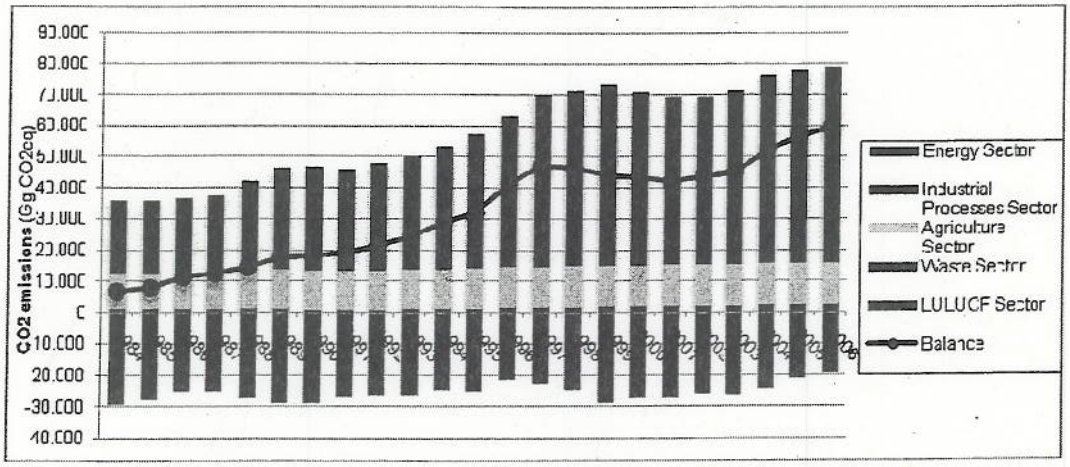
[2] Source: Balance Nacional de Energia (BNE) 2010 http://anuario.cne.cl/anuario/

[3] 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

[3] Plan Nacional de Acción de Cambio Climático (2008-2012) - Page 17 – Original Source: United Nations Development Program, UNDP.

*Figure 2: **CO2 emissions** (Gg CO2eq) by source per year, 1984-2006 period (Source: 2da Comunicación Nacional de Chile ante la convención marco de las naciones unidas para el cambio climático)*

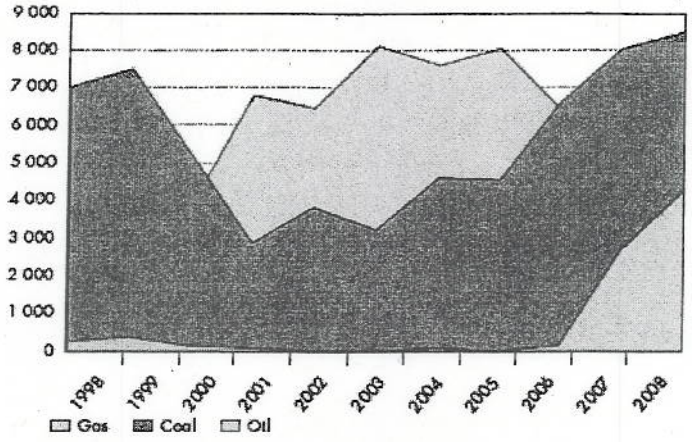


There are four main power grid systems in the country:

- The Northern Interconnected System (Sistema Integrado del Norte Grande, SING): 15,000 GWh generated per year, 3500 MW installed, almost 100% fossil-fuel facilities to supply 90% of its electricity to the industry, mainly mining.
- The Central Interconnected System (Sistema Interconectado Central, SIC): 43,000 GWh generated per year, 12,167 MW installed, with installed capacity of 54% fossil-fuels, 45% hydro and 1% wind power.
- The Aysen System (Sistema Eléctrico de Aysen, SEA): 135 GWh generated per year, 49 MW installed, with 57% diesel, 39% Hydro and 4% wind power.
- The Magallanes System (Sistema Eléctrico de Magallanes, SEM): 269 GWh generated per year, 99 MW installed, natural gas used in 85% of the power production facilities. The other 15% is diesel basedFor 2009 the combined power supply of the four electric systems was characterized by 48% coal-driven, 31% hydro, 12% natural gas and 9% biomass with negligible participation of wind energy.

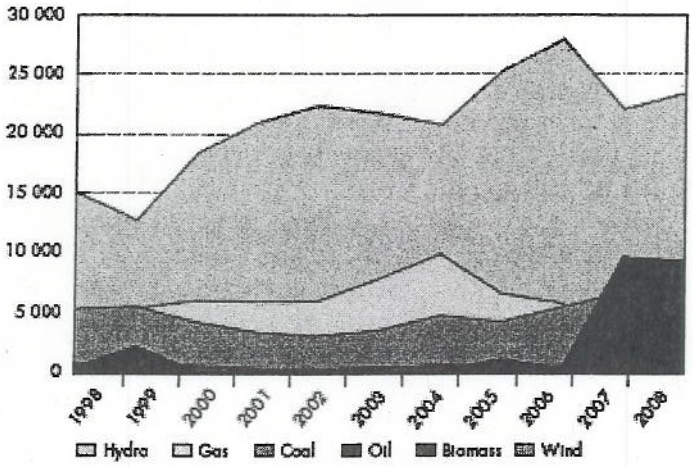
Figure 2: Generation by fuel type in the SING, 1997-2008[4] (GWh)

[4] IEA Chile energy policy review (2009) – Page 138 – Original source:CNE



In 2008 the emission factor for the SING was around 900 tons CO_2eq/GWh (Comisión Chilena del Cobre, Cochilco). This is likely the highest regional carbon footprint in South America. The mining industry is the main user of energy in the SING and it is expected to grow significantly in the next five years channeling most of their investments, estimated in 18,000 million USD for 2012-2018, to production development, infrastructure and water supply for their operation.

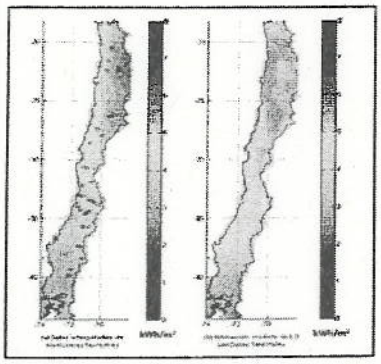
Figure 3: Generation by fuel type in the SIC, 1997-2008[2] (GWh)



3. Renewable energy in Chile

3.1 Resource Endowment. Chile has world class resources available for the generation of renewable energy[5]. Of particular interest for the energy demand profile in the northern region is Chile's large reservoir of solar energy in the arid north with one of the highest radiations worldwide (>3100 kWh/m2-year).

Figure 4: Solar Radiation Assessment, Site Measurements / Satellite data [6](2009)



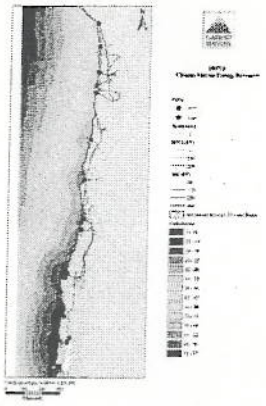
It is also endowed with a very significant marine energy potential, along its coast, which has been estimated in hundreds of GWs as shown in the figure below.

Figure 5: Chilean Marine Energy Resource[7] (2009)

[5] As defined by Law in Chile, "non-conventional" renewable energy (NCRE) 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).

[6] Proceedings of the ISES Solar World Congress 2009: The state of solar energy resource assessment in Chile.

[7] Chilean Marine Energy Resources – Preliminary Site Selection (2009)



In addition, the central and southern areas of the country have large amount of biomass available to be used for the generation of electrical or thermal energy.

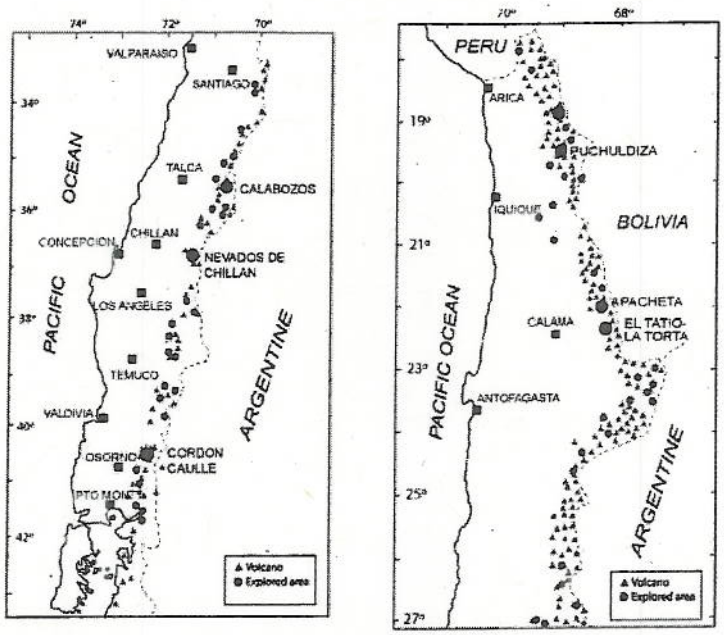
Particularly in coastal areas and in some valleys in the interior, Chile also has natural conditions favorable for the development of wind energy.

Figure 6: Chilean Wind Energy Assessment[8]

In addition, Chile 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 a number of areas where there is geothermal activity associated with the existence of volcanoes. These resources, if deployed, have the potential to significantly change the emission path and carbon intensity of the economy, even potentially converting Chile in an exporter of zero carbon energy to the region.

[8] Mesoscale model, developed by Universidad de Chile for the Ministry of Energy (2009-2011)

Figure 7: Geothermal Exploration Regions in Chile[9]



Portfolio of Renewable Energy Projects. Currently, there are 63 NCRE projects in operation in the country, with a total power installed of 675 MW. However there are still significant amount of NCRE projects under development that require either financial or market access to overcome hurdles to be deployed. As a whole, they represent more than 5.000 MW of NCRE installed capacity that can be incorporated to the grid in following years. In earlier stages, to this day, there are additional identified projects that sum more than 4.000 MW.

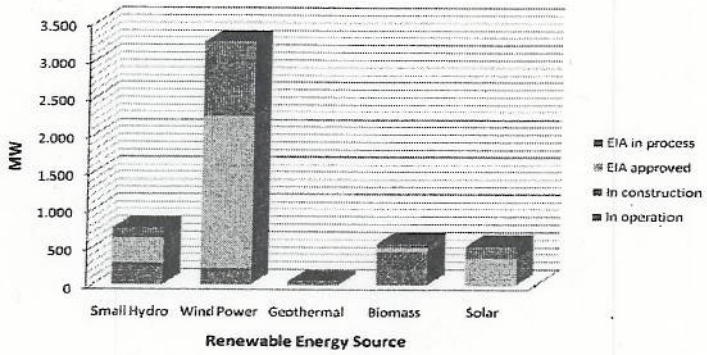
Table 1: NCRE project portfolio by technology and development stage (CER, 2011)

State	In operation	In construction	EIA approved	EIA in process
SHP	241	49	327	141
Wind Power	182	42	2029	1001
Biomass	221	230	55	49
Solar	0	1	361	166
Geothermal	0	0	0	50
Total	643	321	2771	1408

[9] Proceedings of the World Geothermal Congress 2005: Present status of geothermal exploration in Chile.

Small hydropower is the technology most used in Chile, due to its lower costs and its low technological risk. Nevertheless, wind power has a significant share in the NCRE project portfolio with over 3.000 MW located in different regions in the country. In addition to the three technologies now in operation in the country and connected to major grids (wind, hydro and biomass), in the last months a relevant increase of possible solar projects has been detected. The current NCRE status is show in the following.

Figure 7: NCRE project portfolio by technology (CER, 2011)



4. Chilean GHG mitigation actions

4.1. *GHG emissions inventory*

The country's net GHG emissions grew 3 times in the 1984-2006 period (See Figure 1). According to its Second National Climate Change Communication, Chile's emissions of GHG are about 80 Million tons per year and are growing at a rate of 6-8% annually. Chile's net emissions were in 2006 about 60 million tons of carbon dioxide equivalents (Gg CO2eq), out of which about 58 Gg CO2eq came from the energy sector.

Although Chile's emissions are relatively low on a global scale, the country acknowledges that the rate of economic growth over the last decades is expected to continue, thus increasing GHG emissions at a fast pace. For this reason, the Government has decided to take measures to deviate its GHG emissions growth, by adopting nationally financed actions and enhance this level of mitigation with the financial support from Annex I countries.

4.2. Strategies and policies for GHG emission reduction

Early in 2009, ECLAC funded by the IDB undertook a study of "Economics of Climate Change in Chile" following the Stern methodology. The results show economic cost associated to climate impacts for the Chilean society of up to 320 billion USD for the Business as Usual Scenario (A2 as defined in the 2007 IPCC Report). This study helped the Government of Chile to define a course of action to identify strategic actions to be implemented in different economic sectors (Climate Change Action Plan 2009-2012) to reduce the vulnerability of the economy to the consequences of climate change. From there on, several other studies started to focus on mitigation options, technologies and policies to tackle the climate issue in Chile.

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

In accordance with its commitments under the Convention, Chile considers it necessary to take firm and concrete steps toward achieving a lower carbon economy. In this context, the Chilean Government began working in 2010 on several instruments that will provide information for decision-making about mitigation.Currently, the Government of Chile is studying different strategies for mitigating its emissions.

As part of the starting points developed by the Government thought the Ministry of Energy, promotion of energy efficiency through a nationwide Chilean Energy Efficiency Agency (previously named as Programa País de Eficiencia Energética) and the Renewable Energy Centre have been important milestones for the institutional development in Chile. Also the support from CORFO (Chile's Economic Development Agency) has been crucial, through the promotion of 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 advances that have occurred or are expected in this area include:

- Strengthening capacities related to the country's emissions inventories through the implementation of a national GHG Inventory Office (more details of this can be found in Chapter 6 of this National Communication);
- Integration of sector-specific efforts to prepare emission projections for the coming years, to establish a Government-sanctioned national baseline that will enable ministries to conduct their emission projection exercises in a complementary fashion and from a common foundation;
- Generation of information to enable Chile to produce NAMAs in the short term, especially in the energy, mining and LULUCF sectors.
- Assure compliance of the renewable energy law, 20.257, that asks a participation of renewable energy generation of 5% in 2010, increasing 0.5% annually to reach 10% by 2024.

- Chile's voluntary commitment announced at the 16th Conference of the Parties of UNFCCC in Cancun, for national emission reductions of 20% for 2020 below the business as usual, (base year 2007).

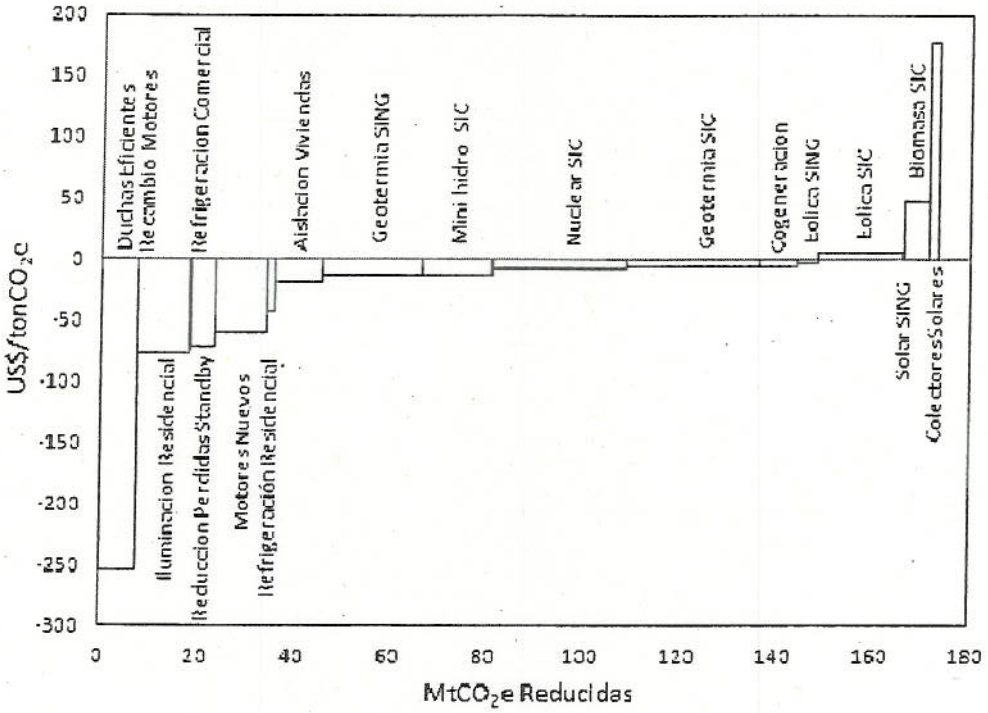
Section 2 Priority sectors for GHG abatement

Given the substantial contribution of the energy sector to Chile's CO_2 emissions, and the cost effectiveness of energy efficiency, the energy sector and specifically the power sub-sector has been identified as the key sector for interventions under the CTF with a focus on the demonstration, large-scale deployment and transfer of low-carbon technologies for renewable electricity generation and energy efficiency improvement. Furthermore, this energy efficiency – energy security – environment nexus is consistent with the Government's strategic priorities and energy policy.

The figure below shows the marginal cost of reducing a tone of CO_2 for different mitigation actions for the Chilean energy sector. Energy efficiency measures are the most cost-effective

actions, thus have a negative marginal cost, as they produce cost savings during their operation, for example, changes in lighting devices and engine replacement. Nevertheless, it is important to highlight that this criteria is only presented as a reference to identify opportunities, given that there are other GHG mitigation alternatives that within a specific context, that can be attractive cost-competitive alternatives. Energy efficiency measures can be hard to sketch as an investment project considering the level of atomization of the measures and that the ESCO commercial model has not settle in the country.

Figure 8: Abatement Cost Curve as presented in the Second Climate Change National Communication 2011, Source GreenLab UC-DICTUC, 2011.



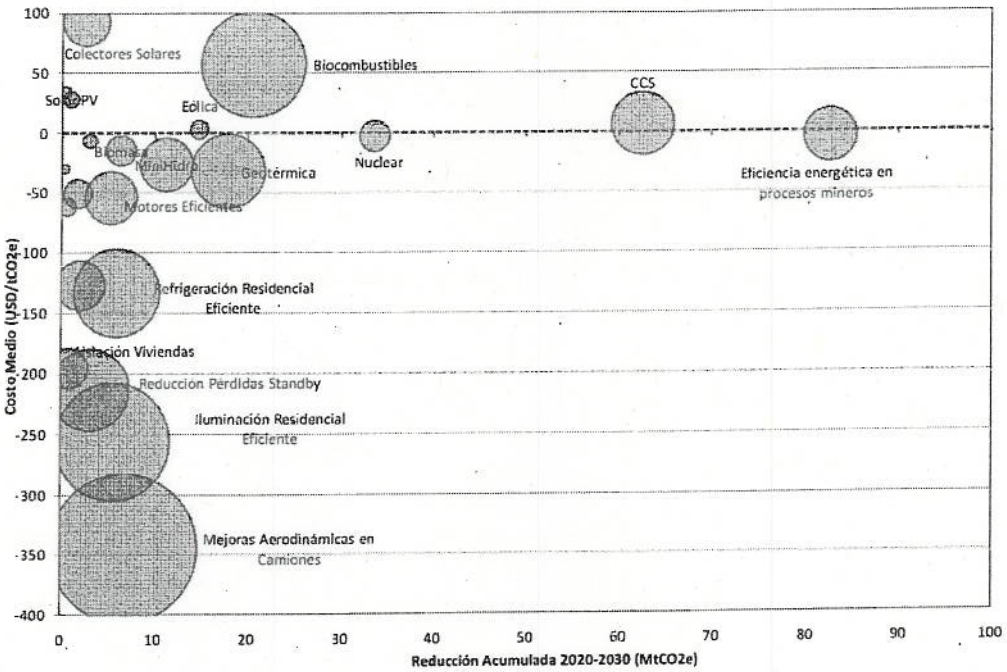
Another study commissioned by the Ministry of Energy[10] identified and prioritized the subsectors within the energy sector for GHG abatement measures according to the following criteria:

- Composition of the GHG emission matrix in the energy sector.
- Projected economic development and energy demand for the country.
- Competitiveness of exports.
- Transfer and finance of technology change.
- Policies and national programs of the energy sector that have an impact on the mitigation of GHG emissions.

[10] Centro de Cambio Global/Pontificia Universidad Católica de Chile (2010): Análisis de opciones futuras de mitigación de gases efecto invernadero para Chile en el sector energía.

The main results of this study show that the prioritized subsectors for the implementation of GHG mitigation activities are **the mining and manufacturing sectors (energy efficiency) and the renewable energy generation industry**, as actions taken in these subsectors can have the greatest impacts in terms of emission reductions considering their costs, as shown below.

Figure 9: Summary of mitigation activities in the energy sector analyzed for prioritization of technologies and future mitigation actions.



CTF resources will enable Chile to eliminate information and technology barriers to permit market entry of other sources of energy such as NCRE local available resources. Moreover CTF contribution can be used to address commercial barriers that impede a faster and more comprehensive penetration of low carbon options in its economy. For example it could bridge the short term financial gap that would allow solar energy technologies to compete with coal and other fossil resources in the provision of energy to its manufacturing sector, including mining and agro industry.

Section 3 Rationale for selected sector

1. Priority Activities

The 2008 Energy Policy Report published by the National Energy Commission - reflected in the legislative proposal for the creation of a Ministry of Energy - set 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. The Government has set in place specific programs targeting each strategic direction. CTF

support would be targeted specifically towards helping meet the objectives of these programs relating to optimizing diversification through investments in renewable energy.

Currently, the NCRE represent a 3,6% of the total power generation of the country. As mentioned above, the predominant technologies are those who have achieved technological maturity, such as small hydropower, combustion of biomass residues in the pulp and mill industry and wind power. However, there are more than 4.000 MW in portfolio, gathering wind power, geothermal, solar, biomass and small hydropower projects in different stages of evaluation and development and also with different levels on uncertainty of their effective implementation.

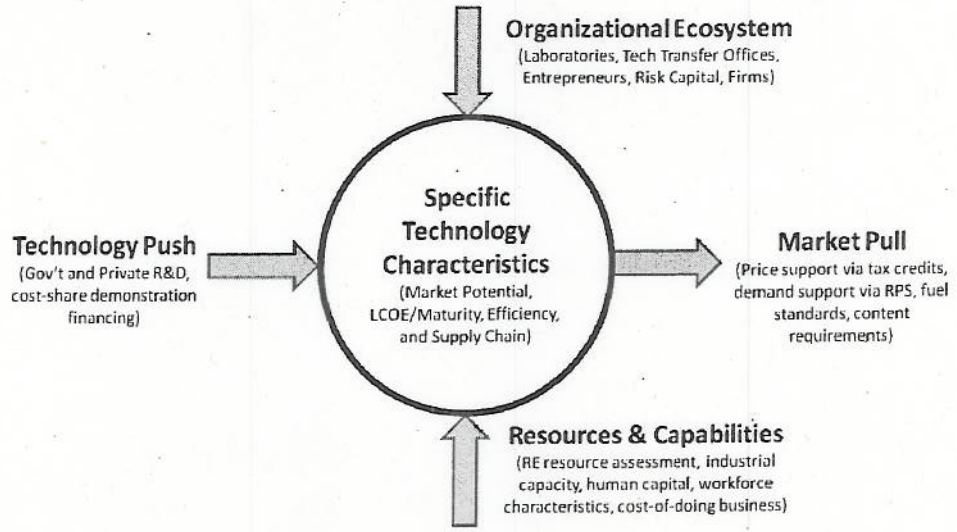
To choose and prioritize specific subsectors within the renewable energy industry for the CTF-co-financing, a brief analysis has to be done of the key elements that are involved in the successful development of a certain NCRE system, taking in consideration the Chilean framework and resources. Each technology will be on a different position for its market readiness, and the investment plan should consider 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, a set of drivers can be identified that are relevant to their development and are the baseline information for the definition of promotion strategies. These are:

- Technological features (particular attributes of the technology)
- Organizational Ecosystem.
- Resources (natural and infrastructure) and capabilities (human capital)
- Technology Push: policies and initiatives that encourage the provision of technological services.
- Demand Pull: policies and initiatives that encourage demand for specific technology services.

In conjunction, as portrayed in the figure below, these five forces are the main controllers for the development of a certain technology in a country and can be reinforced and promoted with state policies, international cooperation and foreign investment.

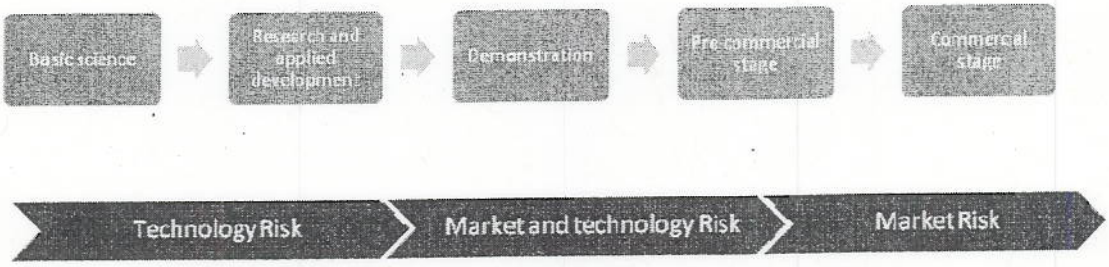
Figure 10: Five technology drivers for low carbon deployment



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 relationship between the characteristics of a certain technology and the economic conditions of the market in which it is incorporated. In addition, these forces can explain why, in some cases, certain technologies that are commercially feasible are not being implemented, mainly due to the lack of proper infrastructure and human resources.

To understand technology transfer processes, it is important to recognize the different paths that innovation takes in each stage of the clean energy technology value of chain. These phases are: basic sciences, research and applied development, demonstration, pre-commercial stage and commercial implementation.

Figure 11: Stages of the technological development and its associated risk[11]



Although technological maturity and environmental conditions are dynamic, affecting the risks management strategies related to each technology, a prioritize selection of areas was made for the Chilean context, taking in consideration the following criteria:

- Technologies that harness energy resources where Chile has an outstanding potential, such as solar and marine energy, and can be implemented on a pre-commercial scale in the short-medium term.

[11] http://www.energy.ca.gov/2007publications/CEC-500-2007-035/CEC-500-2007-035.PDF

- Technologies that have had a successful implementation in other countries and have not been implemented in Chile at a commercial stage, due to the regulatory framework or lack of finance alternatives.
- Technologies that have not been implemented in the country, creating the need for demonstration projects in order to build up new skills to boost the local industry and best practices in the use of these technologies.

Projects without technological risk and under a commercial stage (such as wind power or small hydro projects) have been able to access soft loans from bilateral cooperation programs like the German-Chilean renewable energy credit line (KfW-CORFO). This has created more awareness on local financial institutions over these technologies, which are also starting to offer debt to technologies at the commercial stage. Therefore, it is expected that projects at a commercial stage will not require special purpose loans.

The technologies chosen to be supported by the CTF-co-financing, based on the Chilean context, are primarily those that are in the **pre-commercial stages**. These face a combination of market and technology risks that prevent their large scale deployment. It is expected that CTF-related funds mobilization will provide technology-specific information in particular for the Chilean market. This information set will enrich future references on financial features (capital expense and operational costs for the industry) and technical specifications (performance parameters, operation environment, and site-specific troubleshooting) under Chilean conditions. That will support and ease scale-up NCRE projects implementation. A brief description of some alternatives is given next:

- Implementation of pre-commercial projects of solar energy technologies (Solar thermal as CSP and Solar PV)

  As shown in section 1, solar energy technologies have enormous potential in Chile with important opportunities for large-scale deployment in the Chilean context. Particularly interest in the northern region of the Atacama Desert linked with the energy intensive mining industry. For Chile is strategic to facilitate investments in these technologies to implement local experiences, fostering the development of the solar market including potential ancillary industries for local consumption and export purposes.

- Implementation of pre-commercial projects of marine energy (wave and marine energy).

  Although the potential in Chile is one of the biggest in the world, this is probably the renewable energy source with the smallest development in the country and with the largest potential for power supply in small isolated systems. Several technologies for harnessing marine energy have been developed in the world, and although very site-specific, wave and marine technologies application suits the Chilean context of small isolated power demand centers along the coast, particularly in the southern regions. However technology deployment requires adaptation and validation under Chilean site specific conditions. These create the technology incubator conditions to deploy large-scale of small systems application within Chilean specifics for marine technologies in pre-commercial stage to anticipate the needs and barriers for the development of this industry in the next 20 years.

- Catalyzing geothermal project development and technology deployment through resource risk mitigation actions, including resource management and best practices.

  Although the great potential estimated for the country, Chile does not have any geothermal project in operation, with more than 50 geothermal concessions given

though. Currently, Chile not only has to import technical services and heat/power technology applications. Although private developers are active there is a very small market of services providers that need support activities to deal with exploration risks and further development activities. The development of such concessions will help to build up local capacity to provide these vital services and promote the geothermal energy market development.

- District heating systems using renewable resources: In January of 2012, a new regulation that sets limits of emissions of PM 2.5 will come into force. Several cities of the southern regions of Chile will be declared as severely polluted with this compound, which mainly comes from the burning of humid firewood used for residential heating purposes. As part of the plan of decontamination for these areas, there is the need to develop sustainable heating systems and find appropriate synergies between the industry and the residential and commercial sector.
- Renewable energy applications for self supply as an energy efficiency measure within the industry: Analyzing further the indirect emissions of the copper industry for 2008, based on a study that Cochilco published in 2009, indirect emissions of the mining industry were 70% of their total emissions. This indirect factor reflects the energy suppliers' high carbon intensity: the copper produced with power supplied from SING is almost four times more carbon intensive than the one produced in the SIC. This explains Chile's special interest in allocating low carbon energy alternatives in SING so the private sector, mainly energy and mining industry (as applications of renewable in the field of energy efficiency in the mining industry). This effort can leverage public resources with their own fresh funding to improve their carbon footprint and Chile overall CO2 emission factor.

2. Chile as a player in the International Climate Agenda

Chile is an important player in the renewable energy developing world. 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 Government voluntarily asked 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.

1. Chile is the leading country in the ECPA initiative for renewable energy. In this framework, the CER has 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 Energias 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 € 80 million and a non-reimbursable donation of €3 million.

3. Also in 2006, co-operation between CER and Gesellschaft für Technische Zusammenarbeit (GTZ) started focused on research about 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 in solar energy and regulatory framework required for different renewable energies to be integrated into the energy matrix. Particular interest is focused in low temperature solar energy projects to match the 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. From the multilateral agencies, Chile has been actively working with United Nations Industrial Development Organization (UNIDO), to research about the insertion and uses of renewable energy applications in the industry and commercial sectors in Chile. Also the United Nations Development Program (UNDP) is implementing a Global Environment Facility (GEF) oriented towards the reduction of barriers for penetration of Solar Systems in Chile and energy efficiency activities.

8. As from the perspective of the bilateral relations, there have been several activities undertaken lately in the field of renewable energy and energy efficiency, such as a 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), 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, using German funds from KfW.

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

3. Results Framework

It is expected that the investment in renewable energy technologies under the demonstration phase will generate a strong potential of replicability, especially considering the transfer of knowledge based on successful cases. This will create a market pull effect which will provoke the need of more human capital and skilled workforce at the national and regional level. Based on this financial intervention, the national market – as well as the regional context – will be more prepared to identify the more effective drivers to remove barriers over the introduction of renewable energy technologies. Some of the currently existing barriers that can be confronted with technologies under the demonstration phase are: i) lack of experience and qualified human resources, ii) lack of knowledge about the impact of NCRE Generation Systems to electric grid, iii) low availability of information on potential and quality of energy resources, iv) lack of knowledge of the associated NCRE technologies among the different actors that are part of the supply chain.

The Ministry of Energy is currently analyzing some financial mechanisms in order to reduce the technological risk, like soft loans or exploration warranties, 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 scale-up efforts with the assistance of CTF support.

For instance, sharp increases of domestic prices of energy products and services in 2007 and 2008, combined with changes in investment costs of conversion equipment, significantly reduced the competitiveness gap (price per firm KWh supplied) between some power projects based on renewable resources (mainly mini-hydro and wind) and conventional coal-fired thermal plants. However, the current scenario still does not represent a level playing field for all options. In particular, small and medium-size projects based on NCRE do not have access to the sources of financing available for conventional thermal and large hydropower plants developed by credit worthy Chilean utilities.

As part of the results framework it is expected to include the following indicators that will be measured through the existing monitoring, verification and reporting mechanisms in Chile:

- NCRE capacity installed as % of total power system capacity (% of MW)
- Energy dispatched from NCRE sources (MWh)
- Number of NCRE projects in the national pipeline, as reported by the Ministry of Environment (Sistema de Evaluacion de Impacto ambiental del Ministerio del Medio Ambiente)
- Number of marine energy projects in operation
- Number Geothermal resource exploitation Concessions as reported by the Ministry of Environment
- Production energy intensity in the mining and power industry
- Communities exposed to NCRE projects implemented
- Number of companies active in the NCRE markets in Chile
- Fossil-fuel for power production as % of the energy matrix, as reported in the National energy Balance by CNE
- Companies in the industry who implemented measures to be supplied by NCRE sources (thermal or electrical) at a national and regional scale
- NCRE technology providers present in the Chilean market

Studies regarding the potential for NCRE showed a gross energy potential (based on physical national area) in the order of 191 GW. However this figure is reduced due to technical constraints to 10.8 GW as a technical NCRE potential. Subsequently and based on economic scenarios for power production following a cost-based dispatch, the NCRE economic potential is estimated between 3.33 and 5.75 GW for the year 2025[12]. However in the same study it is pointed out that the level of participation of NCRE in the power systems can be impacted by economic signals within targeted incentives to promote the shift toward low carbon development. Based on these results in the energy sector future mitigation options analysis[13], a sector based approach for renewable energy scale-up will maintain the CO_2 pattern as expected by the GoCh.

[12]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

[13] Centro de Cambio Global/ Pontificia Universidad Católica de Chile

4.- Enabling policy and regulatory environment

1. Energy Sector

After the approval of the 1982 Electricity Act (Ley General de Servicios Eléctricos) which set the legal foundations for a deep reform of the Chilean electricity market that shifted from a sole public-owned sector to a 100% private driven, the country set the basis for the creation of a pioneering system with a minimum global cost operation and where the vertical and horizontal unbundling of generation, transmission and distribution took place.

The successful implementation of this model drove a significant amount of Foreign Direct Investment in the sector to cope with the energy demand growth in the last 29 years but has also needed a continuous improvement of the associated regulatory framework over the last years.

2. 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 ensure the proper functioning of the electricity market are:

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

b) The **National Energy Commission** (Comisión Nacional de Energía – 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 sector norms and regulations; (ii) coordinating planning, policies and norms for efficient functioning of the market; and (iii) calculating and enforcing regulated prices in generation and distribution (IEA, 2009). In terms of NCRE, the CNE develops the future work plans for both the transmission as well as the power sector, including the renewable projects and analyzes the sector tendency of power generation.

c) The **Superintendence for Electricity and Fuels** (Superintendencia de Electricidad y Combustibles – 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 on the renewable energies, the SEC enforces the Law 20.257 and ensures the payment of the penalty of those power generators whose don't meet the established quote.

d) The **Economic Load Dispatch Centres** (Centro de Despacho Económico de Carga – CDEC) are responsible for planning and co-ordinating load dispatch in each of the two large electricity systems (SING and SIC). The two CDECs are composed of 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 warns the SEC about those generators that don't meet the established renewable quote.

e) The **National Economic Development Agency** (Corporación de Fomento de la Producción – CORFO) is an agency administratively dependent on 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 Centre for Renewable Energy** (Centro de Energías Renovables – CER) is envisaged as a clearinghouse for renewable energy developments, 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.

3. Renewable Energy

Regarding to the mentioned changes of the regulatory framework, over the last years, new market pull policies and conditions for the renewable energy development were adopted. This encouragement has been done 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].
- 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.
- The Law 20.365, August 2010, creates a tax benefit that promotes the investment in solar thermal collectors for new constructions. Nowadays, the administration is analysing the first results of this law and improving this mechanism in order to apply it also for old constructions.

Even though the investments on NCRE projects have an appropriate and transparent regulatory framework for development, there are still important and different barriers that obstruct the boost of deploying the proper development of these technologies. Some of them are the followings:

1. Lack of experience and qualified human resources; required for the evaluation and development of NCRE projects. As it is expected in an early stage of development of the NCRE market. In this scenario, further development of professional knowledge in critical areas such as engineering, electric market, assembling, among others is

required to close the gap that are limiting the growth of an industry new to the region.

2. Lack of knowledge about the impact of NCRE Generation Systems to electric grid; there is little experience regarding the integration and management of generation quotas of energies such as wind power. This hinders the willingness of companies to integrate Tx and Dx NCRE projects, as it must resolve the predictability of the generation daily variability and the consideration of the additional services it can offer.
3. Low availability of information on potential and quality of energy resources: Lack of precise identification of many of the places where resources are economically exploitable.
4. Lack of knowledge of the associated NCRE technologies among the different actors that are part of the supply chain: There are important gaps in their modes of delivery, performance, yield, and cost, which keeps investors and financial institutions from increasing their investment and funding, and hinders the exploitation of business opportunities between service providers and NCRE resource owners.
5. Little knowledge and experience regarding NCRE projects financing in the national bank system: The financing issue of projects with innovative technologies for the domestic market, is difficult due to the higher price for the additional risk that the financial institutions must take. The financing criteria are focused mainly on the customer's history, rather than on the merits of the project.
6. Lack of local Machinery and Equipment suppliers: In the absence of domestic manufacturers, the local market must import its supplies. The fledgling industry has little bargaining power with suppliers in terms of price, quality and dispatch times.

Regarding the regulatory framework and also the previous mentioned barriers that impede a faster and more comprehensive penetration of low-carbon options in the economy, the CTF resources could be used to address them. For example it could bridge the short term financial gap that would allow solar energy technologies to compete with coal and other fossil resources in the provision of energy to its manufacturing sector, including mining and agro industry.

The Chilean renewable energy market has experienced important evolvements during the last five years, in particular thanks to international cooperation efforts and the establishment of an appropriate regulatory framework. For example, the flexible loan provided by the KfW and its non-reimbursable grant package, which has allowed local banks to learn from this market and support more than ten renewable energy from new actors of the electrical market – mainly for hydroelectricity projects. It could be stated that there is even an appropriate environment for project finance schemes on investments with low technological risk. CTF resources can therefore be committed for technologies under the demonstration phase, and be used to eliminate information and technology barriers. Therefore, the conditions are met to create an enabling environment for assessing the projects on their own commercial risk, and mitigating part of the knowledge gap that could be present. This funding will also be helpful to identify the pending regulatory gaps that investors should overcome for the replicability of these innovative and low carbon technologies.

5.- Implementation Potential (including risk assessment)

The Government of Chile is widely recognized as having a strong capacity for implementation of policies in the energy sector through promoting private investments as the primary option and using public-private partnerships where necessary. The regulatory framework is based on setting prices reflecting 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 crisis. The country is perhaps one of the most relevant examples worldwide on the crucial importance of institutional capacity for creating a structural and regulatory framework for successfully promoting investments in the infrastructure sectors.

The Government of Chile is very much interested to allocate the amount of CTF resources to the private sector due to a national policy of market-based activities to perform the most of the investments and to assure the accurate execution of the funds and defined liabiliaty for the projects implementation. Within this framework it is expected that a significant component of MRV will also be transfer to the funds beneficiary as part of their responsibilities to operate in the energy market. The supervision of these activities is performed by the CEDEC and the role of policy design is performed by the Ministry of Energy.

All CTF allocations will be guaranteed by the financial institutions as to comply with the standard fiduciary standards during the investment period. Among these environmental and social safeguards and benchmark in community participation shall be included as part of the investment in order to secure the long-term and efficient deployment of the low carbon technologies.

The risk assessment in Table 2 shows negligible risk mitigation actions and a relatively low risk for the operations.

Table 2: 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	Strenght of the institutionality through the Ministry of Energy, Ministry of Environment, Renewable Energy Center, Chilean Energy Efficiency Agency and prívate sector relevant role in CTF allocation reduce the implementation risk significantly.	Low
Technology	Particular interest in the less developed renewables: solar, geothermal and marine. Geothermal risk resources is significant although there are more than 50 concessions already given to the prívate sector developers. Selection of technologies will be done by the market, significantly reduces the technology risk.	Low
Finance	There is no significant risk. The country is perceived as very attractive for investment in infrastructure by foreign and local investors. Risk of access to financing for new renewable developers in the existing pwoer market.	Low
Environmental management	Chilean environmental legislation is being updated and institutional capacity of implementing agencies strengthened.	Low
Technology and performance risk	The country shows excellent natural conditions for development of solar, geothermal and marine power, together with a very positive business environment and a long tradition of enforcement of clear and transparent policies and regulations.	Low
Procurement	Risk of wrong practices in procurement is low. Country ranks very high (always first in the region and above several OECD countries) in governance and transparency.	Low

6.- Financing Plan and Instruments

The Government of Chile would evaluate the allocation of CTF resources through a suitable mechanism. This procedure will follow existing power and energy practices in the power market. In this way it is guaranteed minimal market disruption, if any. Within this process it will be a transparent market-based solution to close the financial gap between conventional power solutions and low carbon technologies. Renewable energy technologies can be allocated as hedging fossil-fuel power generation.

The proposal is to allow new renewable energy proposals to access CTF funding that would enable their positioning as the lowest cost bidders. Participation of renewable energy developers' proposals in the next auctions would make them eligible for an incentive. Those requesting the lowest support would receive resources from CTF. This procedure does not require additional legal framework changes, as energy and power tenders have been reviewed and supervised by the Energy National Commission (Comisión Nacional de Energía, CNE in Spanish) in the past. Moreover CNE has established an indicative threshold for a node-specific power price for energy and power tenders to help developers in their estimations for financial sustainability. It is yet to be defined if the modality of the auctions could involve CORFO as a second tier bank, and local commercial banks as the proponents of a portfolio of projects.

The programs/investments are currently under preparation and it is expected by the Government of Chile to discuss them as part of the Joint Mission to start the preparation of the Chile CTF Investment Plan.

Table 3: CTF funded programs for Chile CTF investment plan (MM$)

Financing source	Program I	Program II	Program III	Program IV	TOTAL
CTF					
GoCh					
GEF					
IDB loans					
IDB grant					
IFC					
KfW					
JICA					
Carbon finance					
UK-ICF					
UK-CMCI					
Other private sector					
TOTAL					

Chile's energy future based on its endowment of renewable energy resources

Gobierno de Chile

Vice Minister Sergio del Campo

November, 2011

Government of Chile | Ministry of Energy

THE CHALLENGE

"We have proposed to be the first country in Latin America to overcome poverty and leave underdevelopment behind…"

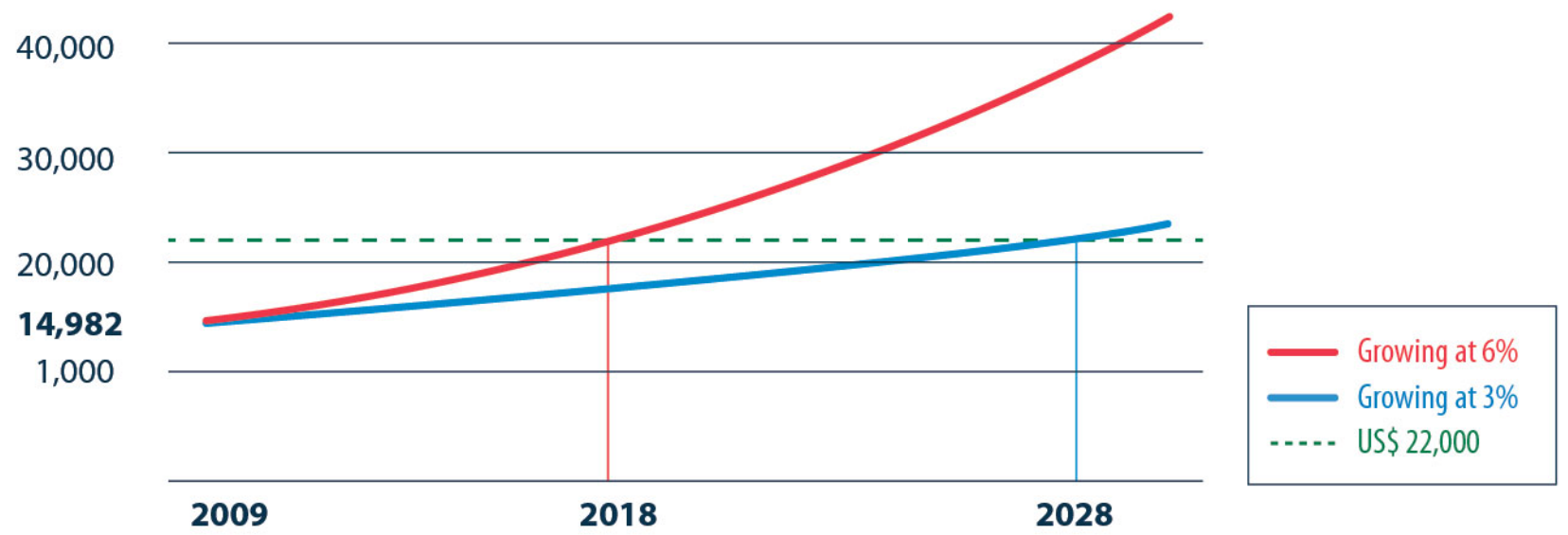
"This means that we have to double our power generation capacity during this decade. And this is a formidable challenge, and we want **secure, clean and economical** *energy"*

OUR GOAL

To become a developed country and defeat poverty

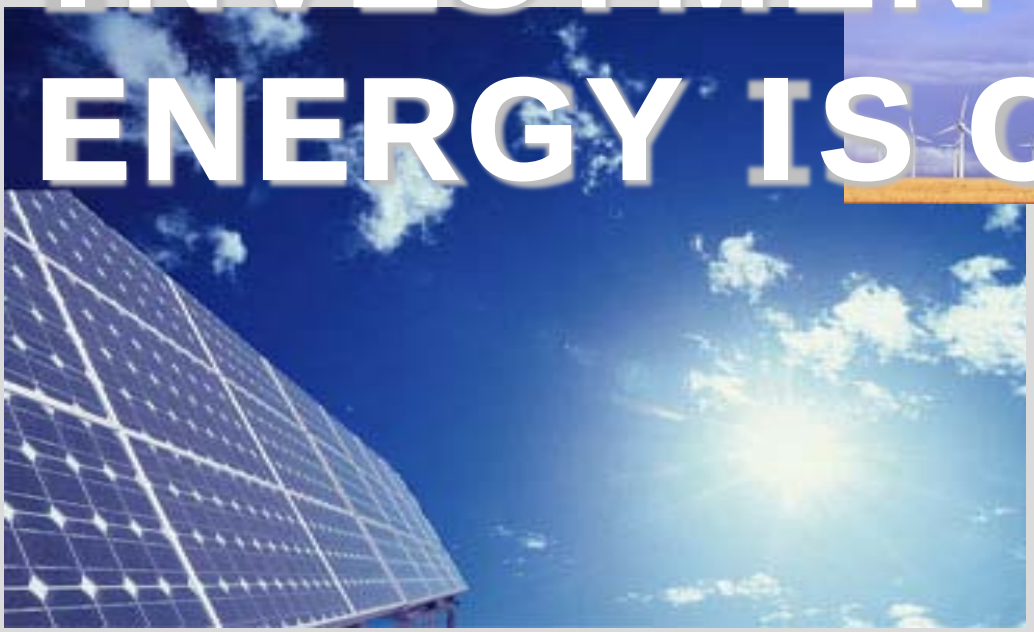
To reach it, our per capita GDP should be **US$22.000** (equivalent to Portugal's GDP).

We need a **6% GDP annual growth** rate for the next years



Source: Ministry of Finance of Chile

AND WE WILL NEED MORE ENERGY AND NEW SOURCES



INVESTMENT IN ENERGY IS CRITICAL

Ministerio de Energía

Gobierno de Chile

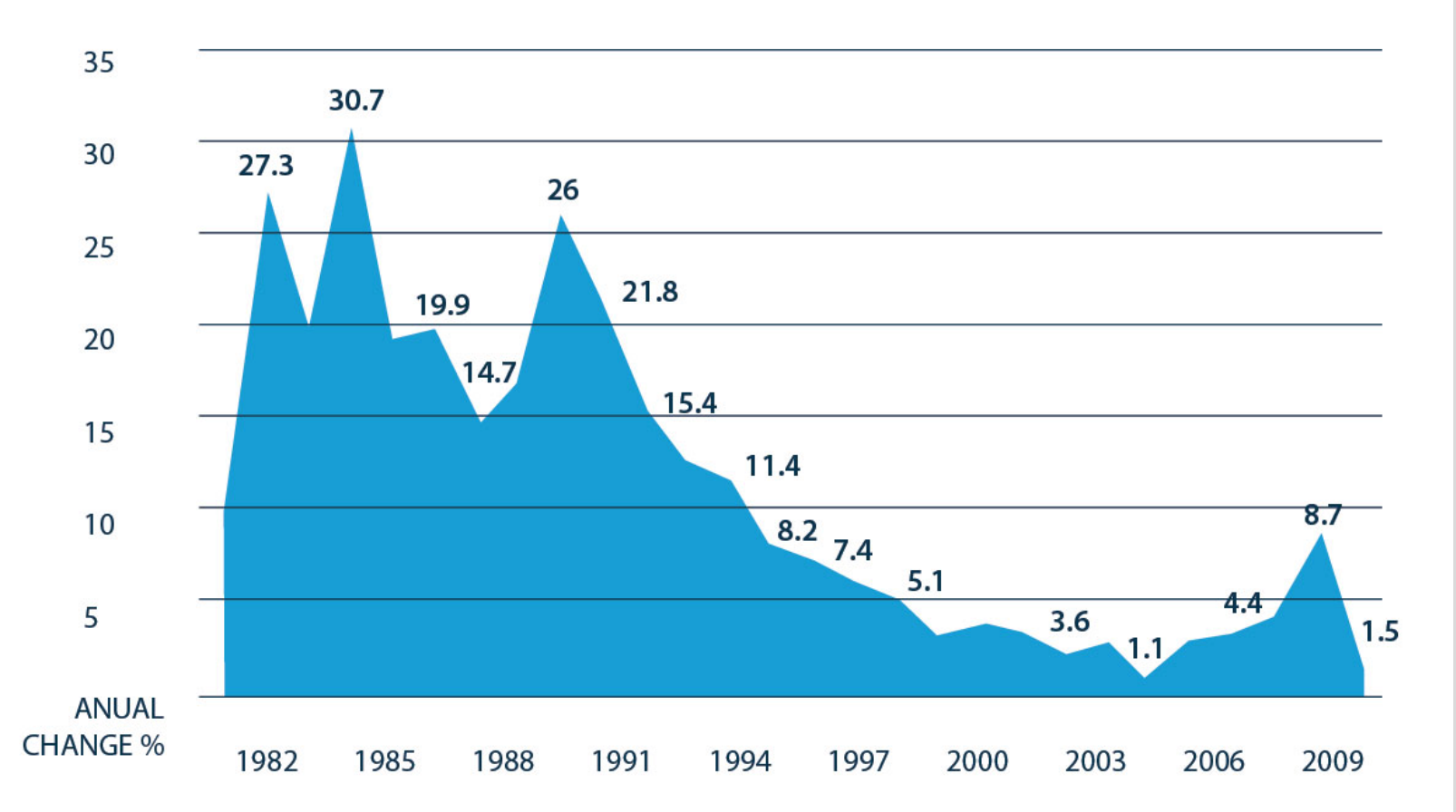
CHILE:
ECONOMIC AND INSTITUTIONAL FOUNDATIONS TO REACH DEVELOPMENT

Ministerio de Energía

Gobierno de Chile

STABLE ECONOMIC ENVIRONMENT

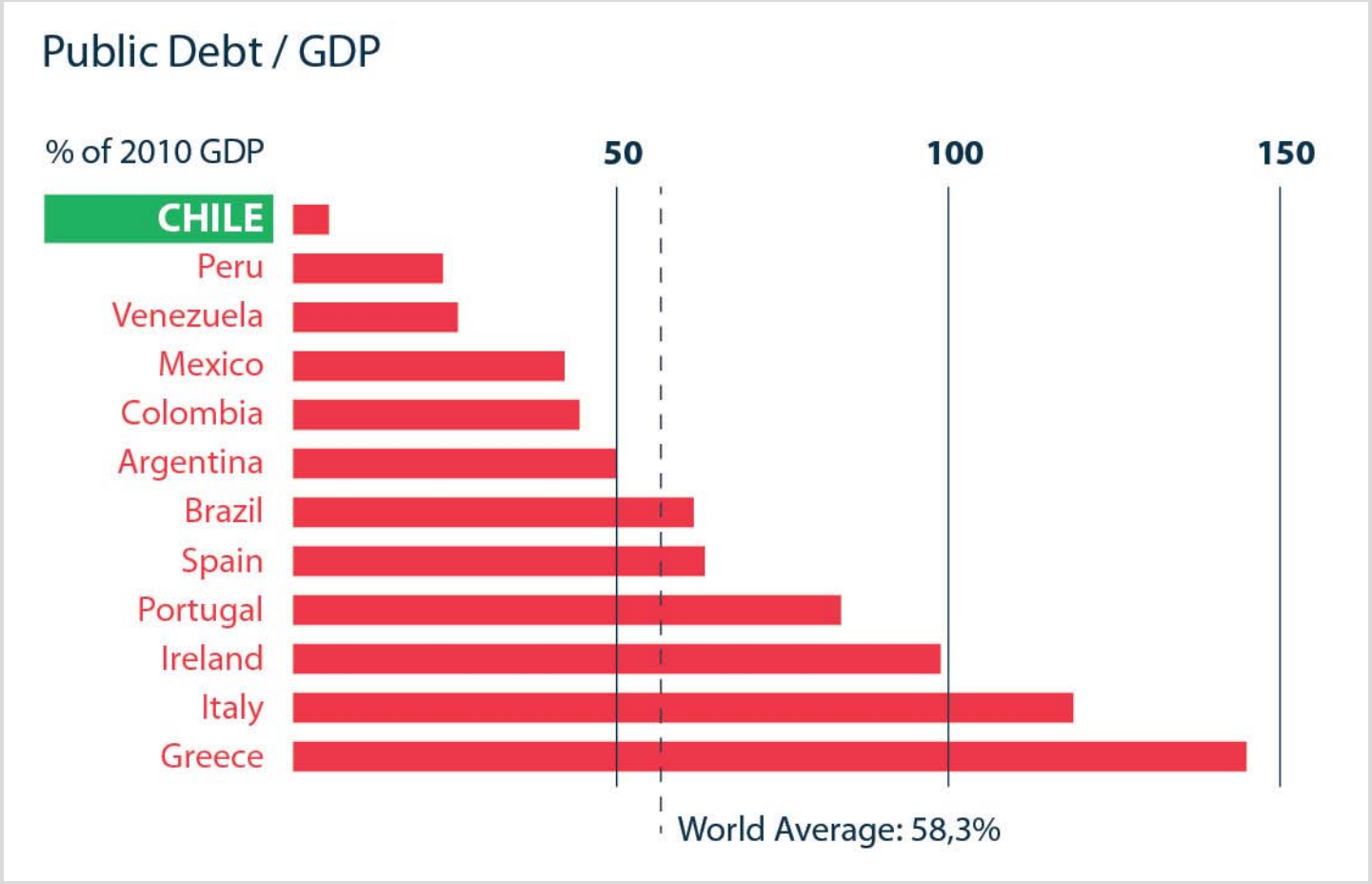
Inflation reduction



Source: Central Bank of Chile

RESPONSIBLE PUBLIC FINANCE

Low Public Debt as Percentage of GDP



Source: Cia World Factbook

POLITICAL STABILITY
Institutional index

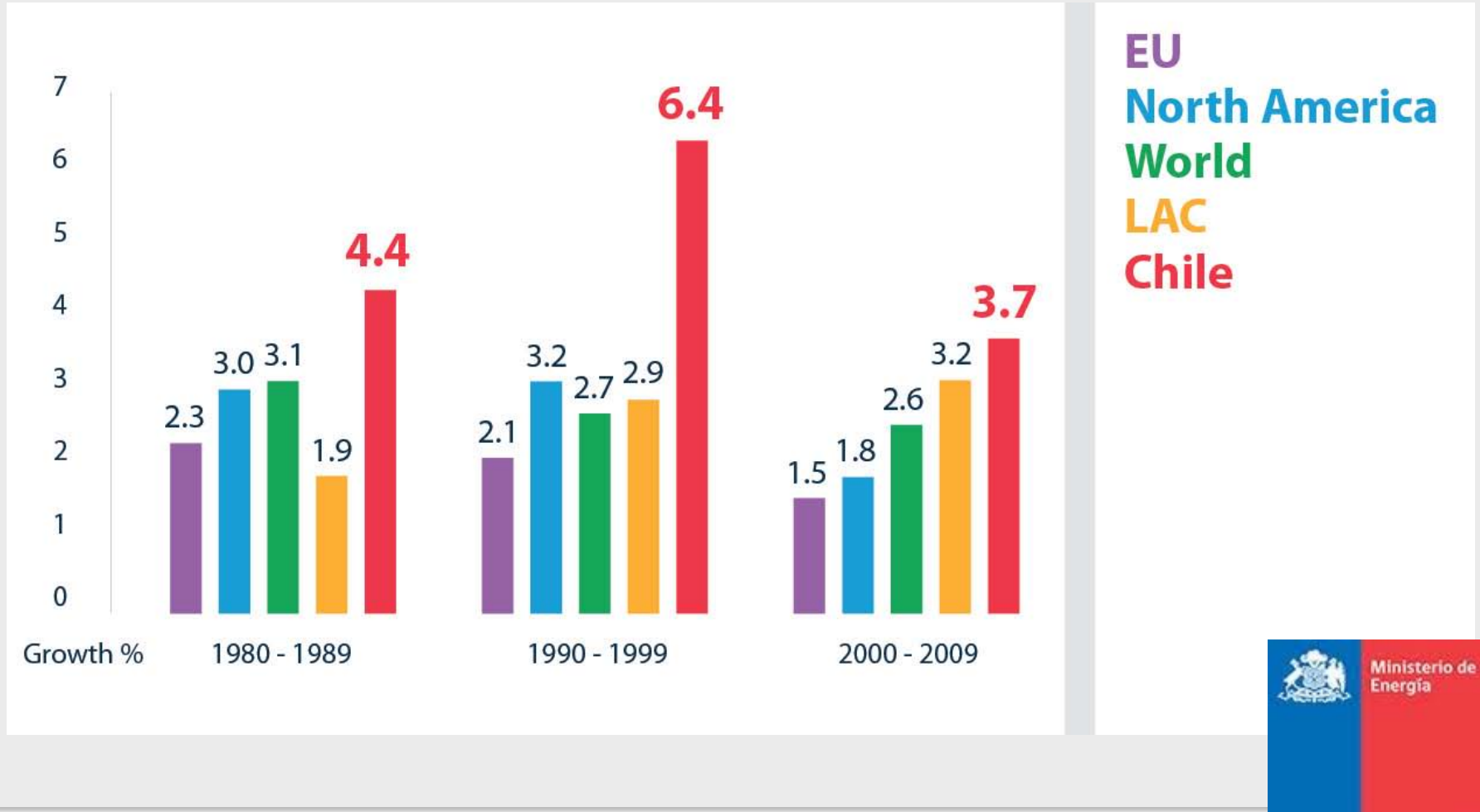
2009 INSTITUTIONAL QUALITY INDEX
Measures political and economic freedom

Country	Global Position (over 191 countries)
Denmark	1
Ireland	7
CHILE	**24**
Portugal	33
Spain	38
Italy	53
Greece	62
Mexico	79
Peru	83
Colombia	97
Brazil	98
Argentina	114
Venezuela	174

Best ranking in LA

Source: International Policy Network

SOLID GROWTH AND STABLE INSTITUTIONS



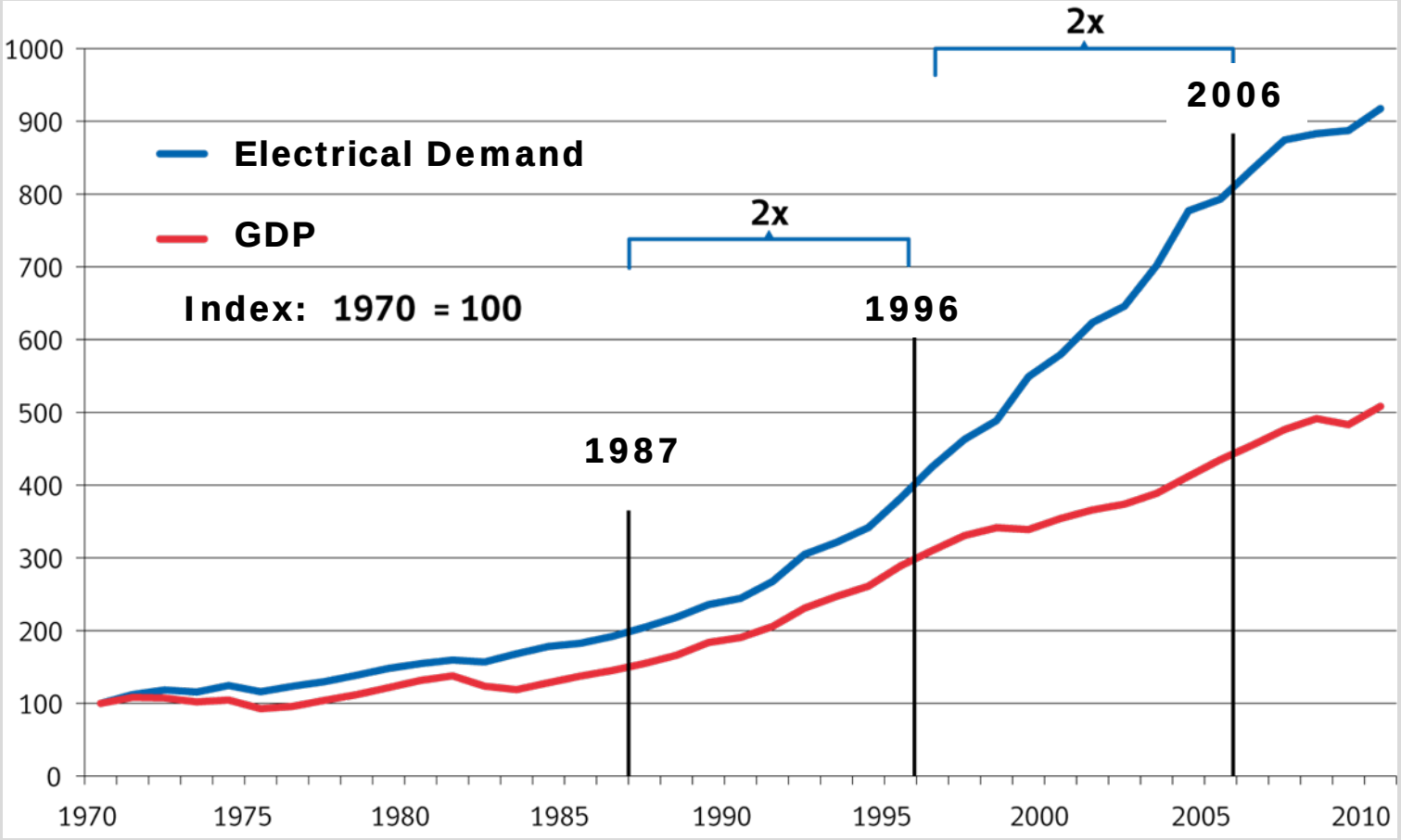
Source: World Bank

Ministerio de Energía

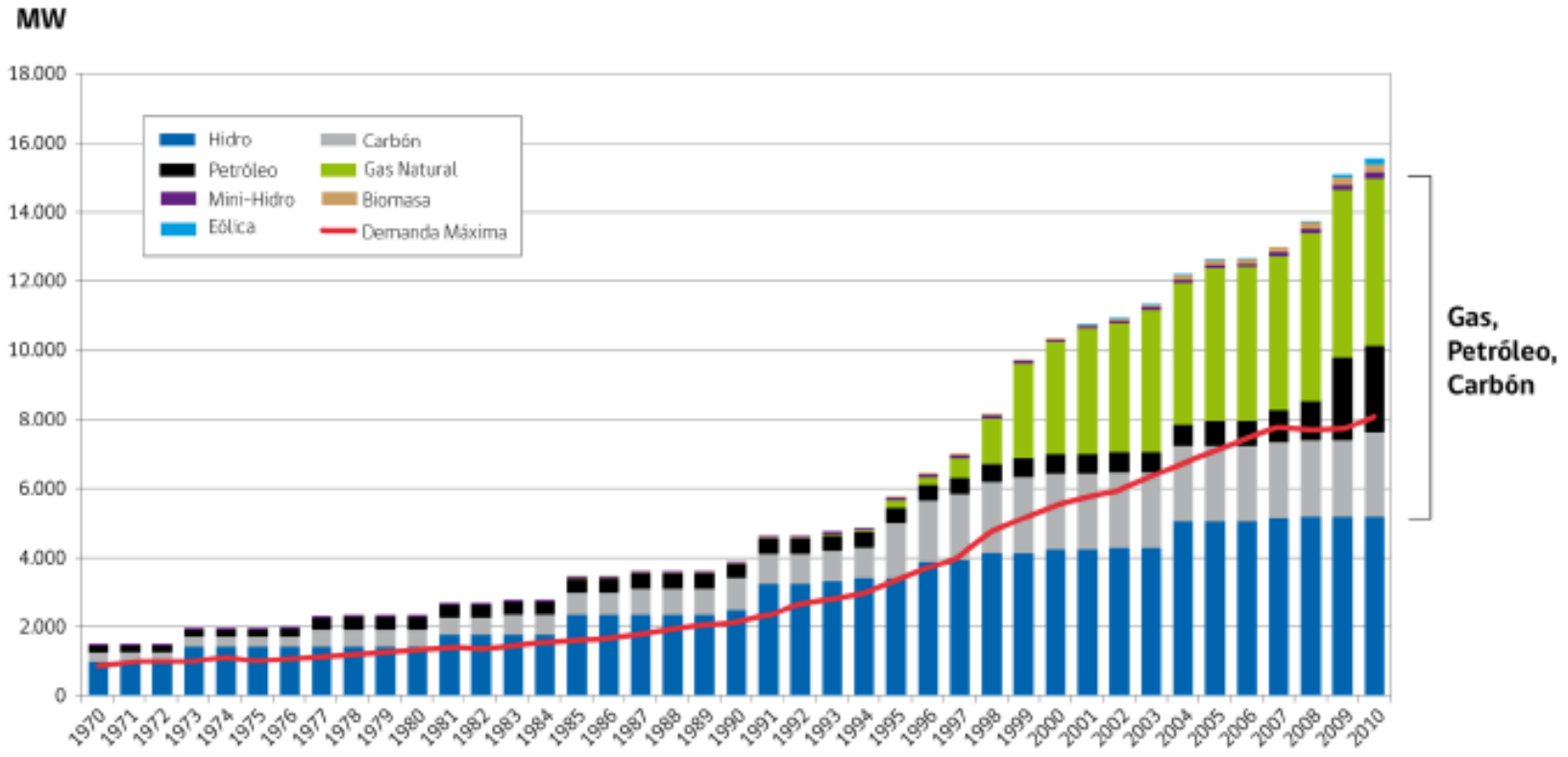
Gobierno de Chile

GROWTH = ELECTRIC DEMAND

Demand has doubled every decade

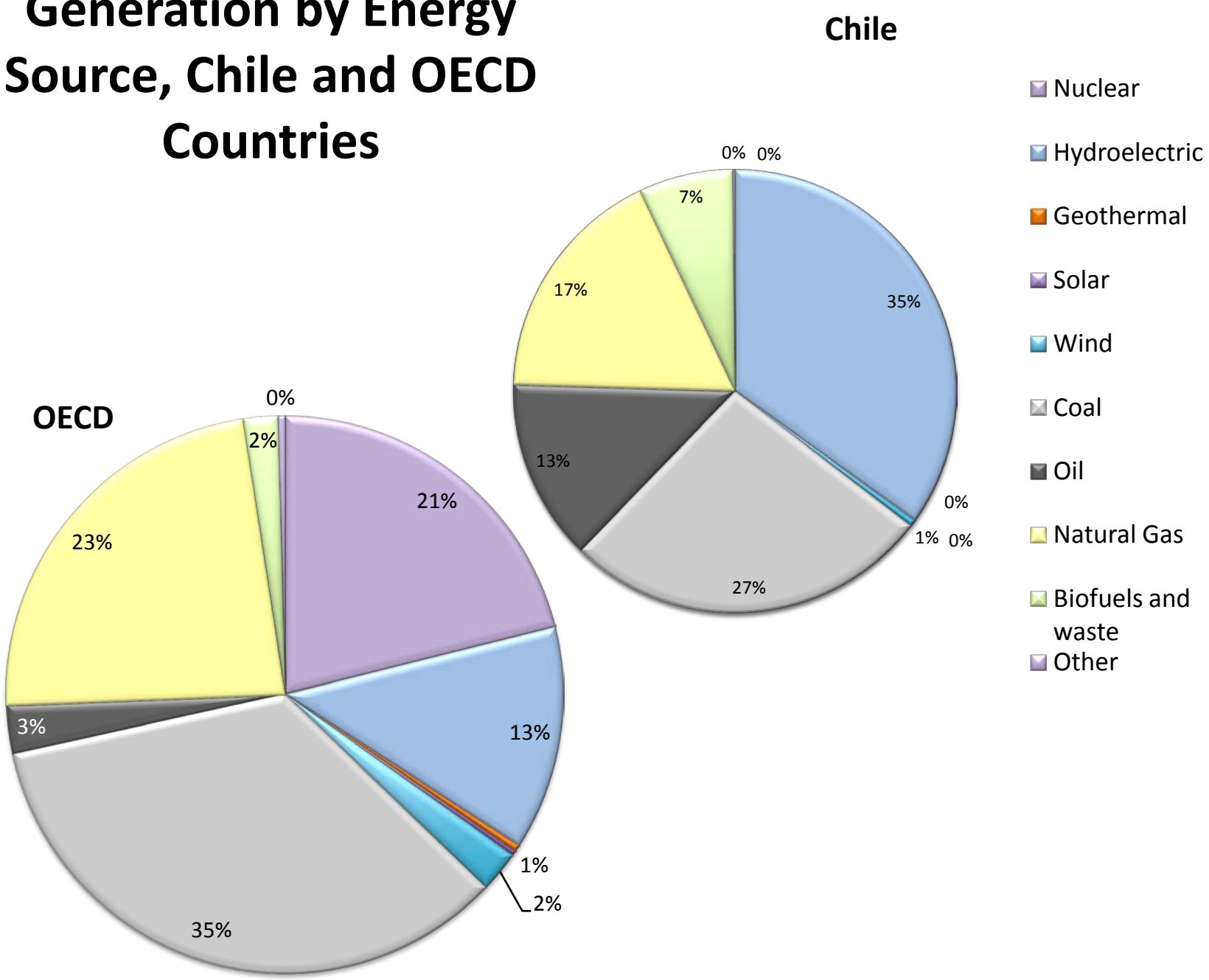


Installed Capacity (SING+SING)



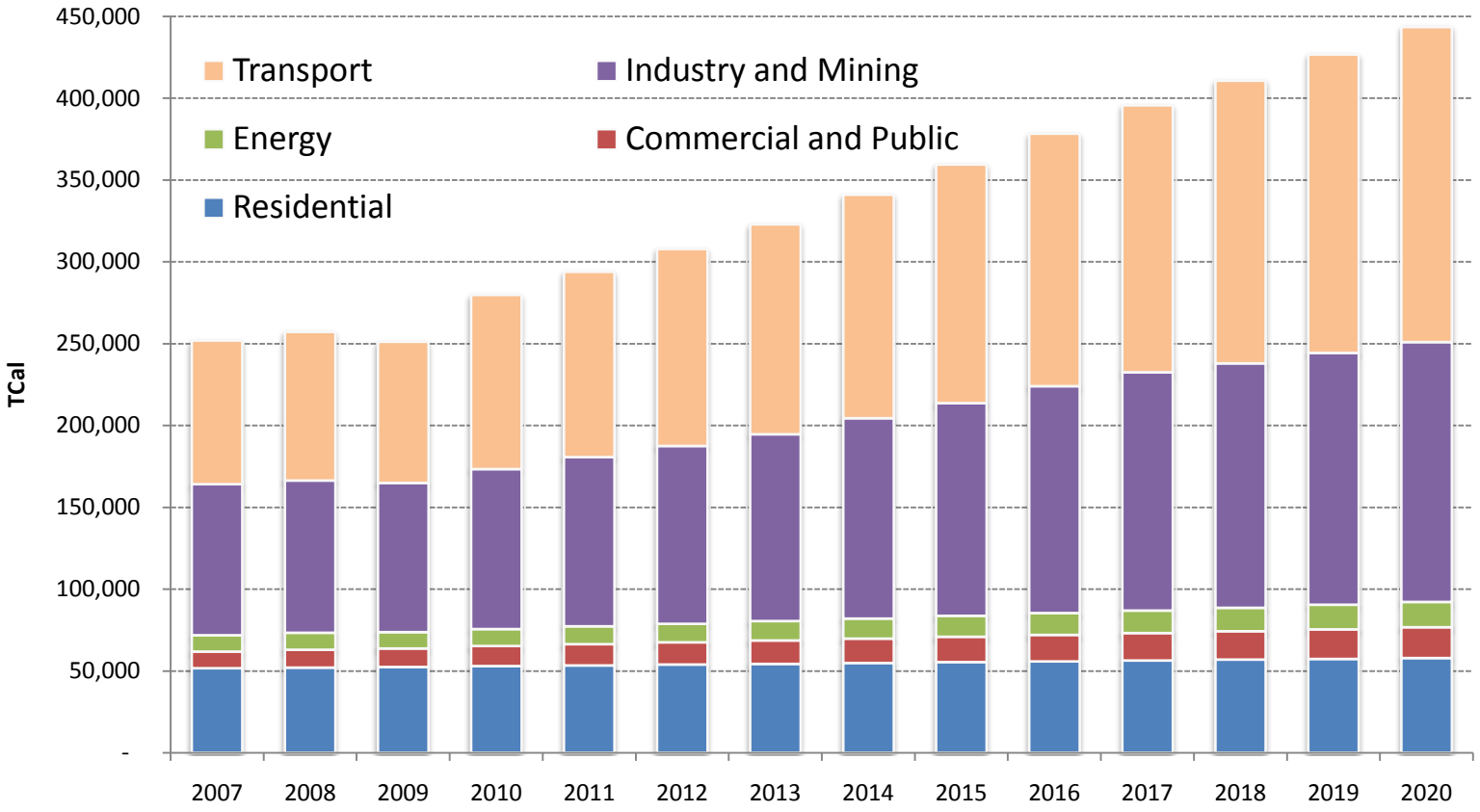
Fuente: Estadísticas Electricidad Comisión Nacional de Energía

Generation by Energy Source, Chile and OECD Countries



Source: IEA

Projection of total energy consumption by sector for the period 2007-2020



Source: PROGEA Study, commissioned by the Ministry of Energy

Fossil energy constitutes a large fraction of the energy matrix

- The country has very limited access to indigenous fossil fuels and a growing dependence of imports of coal and petroleum derivatives.

However Chile has a fossil intensive economy (almost 100% import)

- The carbon intensity of the economy is estimated at 600 tons per Million US$ of GDP PPP (about the same as upper income countries) while the per-capita emissions are estimated at 3.9 tons CO2 , or about twice the average in the region.

- In absolute terms, Chile's emissions of GHG are about 80 Million tons per year and are growing at a rate of 6-8% annually.

Chile's world quality renewable energy resources

TECNOLOGY	Theoric Potential (MW)
HIDRO	
Hidroeléctrico (1)	23.000
ERNC	
Geothermal (2)	16.000
Biomass (3)	470
Biogas (4)	400
Small Hydro (5)	1.400
Wind (6)	30.000
Solar (7)	228.000
Wave- Tidal (8)	240.000

Source: Ministry Of Energy

(1) (a) CNE/ (b) Estudio UTFSM 2008: Estimación de potenciales brutos al 2025, publicado por ACERA.

(2) (a) ENAP 2005/ (b) Estudio A Lahsen 1986

(3) (a)Estudio CNE-GTZ 2008 (Residuos de manejo forestal) / (b) Estudio UTFSM 2008: Estimación de potenciales brutos al 2025.

(4) (a) Estudio CNE-GTZ 2007

(5) (a) Estudio CNE, CNR y MEN 2007- 2010: Potencial teórico bruto en de obras de riego existentes entre Atacama y Araucanía. No considera derechos no consuntivos.

(6) (a) Elaboración Propia MINEN 2011 en base a explorador eólico solar aplicado sobre Región de Antofagasta (con 30 Ha/ MW)/ (b) Estudio UTFSM 2008: Estimación de potenciales brutos al 2025.

(7) (a) Estudio CNE 2009 Potencial en Regiones Arica y Parinacota, Tarapacá y Antofagasta, (con 2 Ha/ MW)/ (b) Estudio UTFSM 2008: Estimación de potenciales brutos al 2025.

(8) (a) Estudio Garrad Hassan 2009

Chile needs to use its world quality renewable energy resources

- These resources, if deployed have the potential to significantly change the emission path and carbon intensity of the economy, even potentially converting Chile in an exporter of zero carbon energy to the region.
- The use of this resources will provide energy security and will ensure Chile's exports competitiveness in the future.
- Chilean society demands great concern for sustainable development and Climate Change.
- Energy issues must be a State Policy.

ELECTRICITY GENERATION

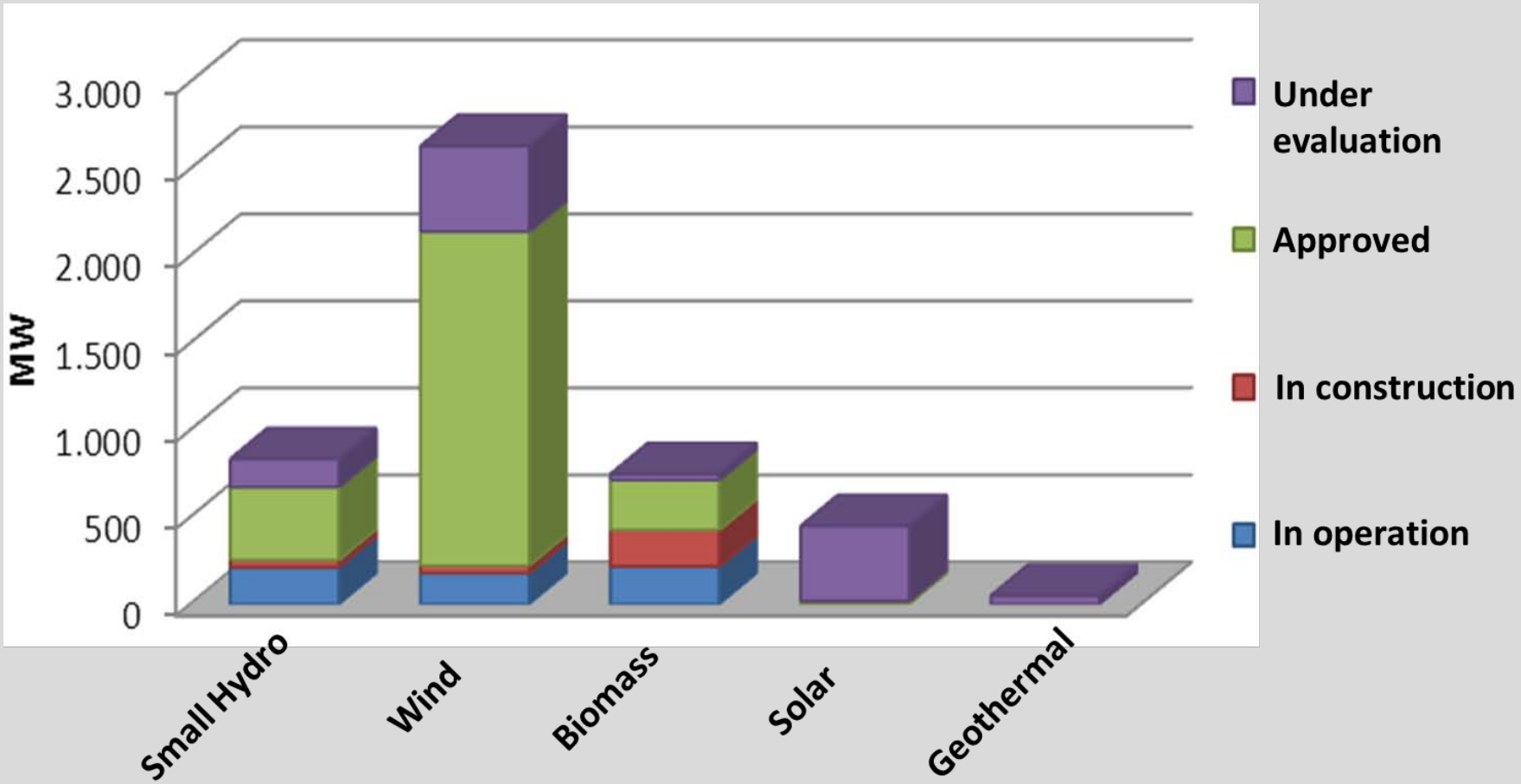
Renewable Energies Today

- Total renewable in operation: 612 MW.
  - Wind: 180 MW
  - Biomass: 219 MW
  - Small hydro: 213 MW

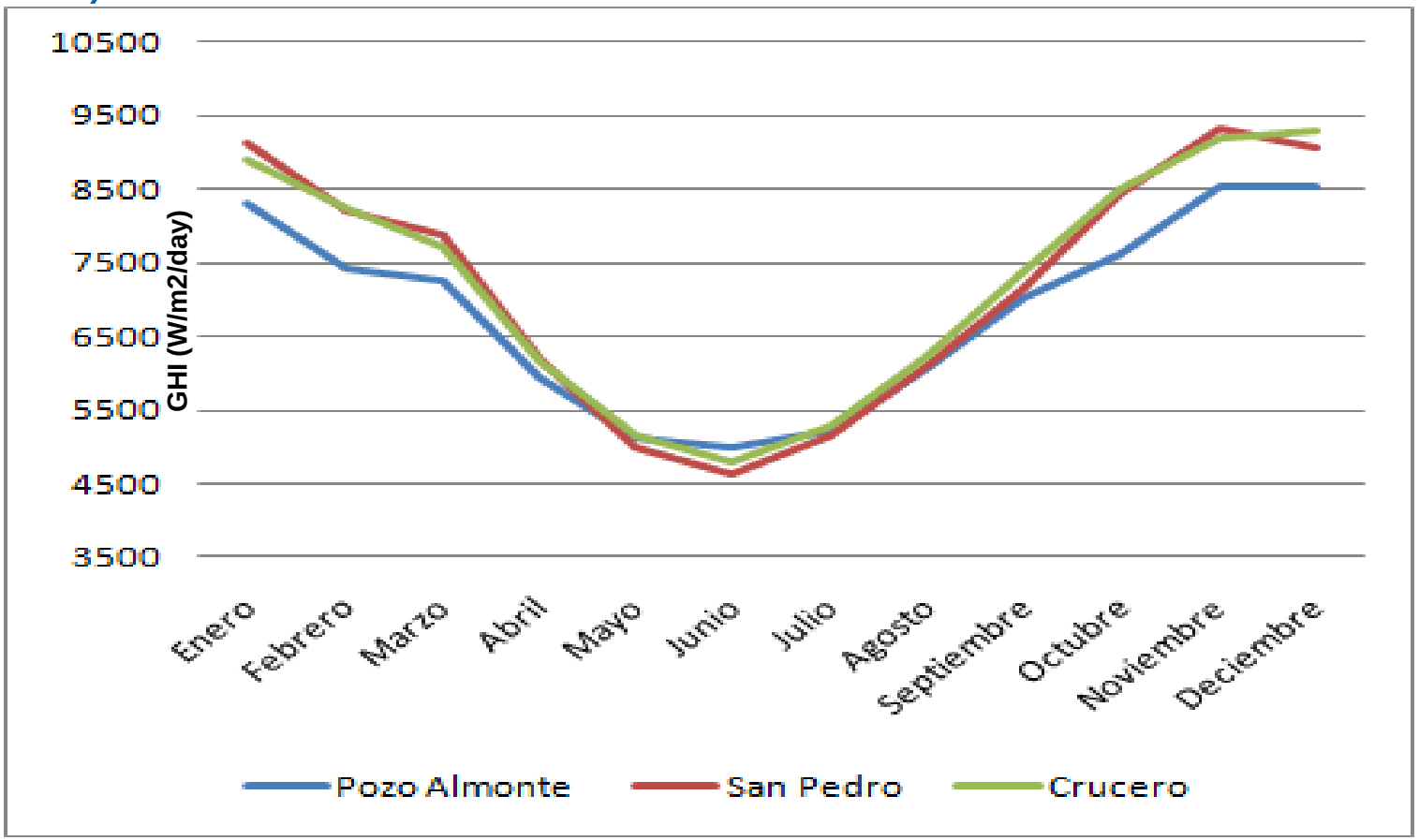
- There are also...
  - 2,641 MW in renewable projects (environmentally approved)
  - 1,171 MW under environmental evaluation.
  - 296 MW in construction.

ELECTRICITY GENERATION

Renewable Energies Today



Global Horizontal Radiation (GHI) in 3 representative stations (2010)



Measurement results indicate a high potential of solar radiation:

- > 2.800 kWh/m2/a (GHI)
- > 3.200 kWh/m2/a (DNI), post-processed data*
- Global Horizontal Radiation in Southern Spain: approx. 2.200 kWh/m2/year

*Fraunhofer ISE indicates that post-processed data have an uncertainty of up to 11,9 % (DNI) and approx. 4% (GHI)

ELECTRICITY GENERATION

Prospective measurements of solar energy

Región	GHI anual kWh/m²
Alemania	1.200
España	2.000
México	2.000
Etiopía	2.100
Desierto Sahara	2.500

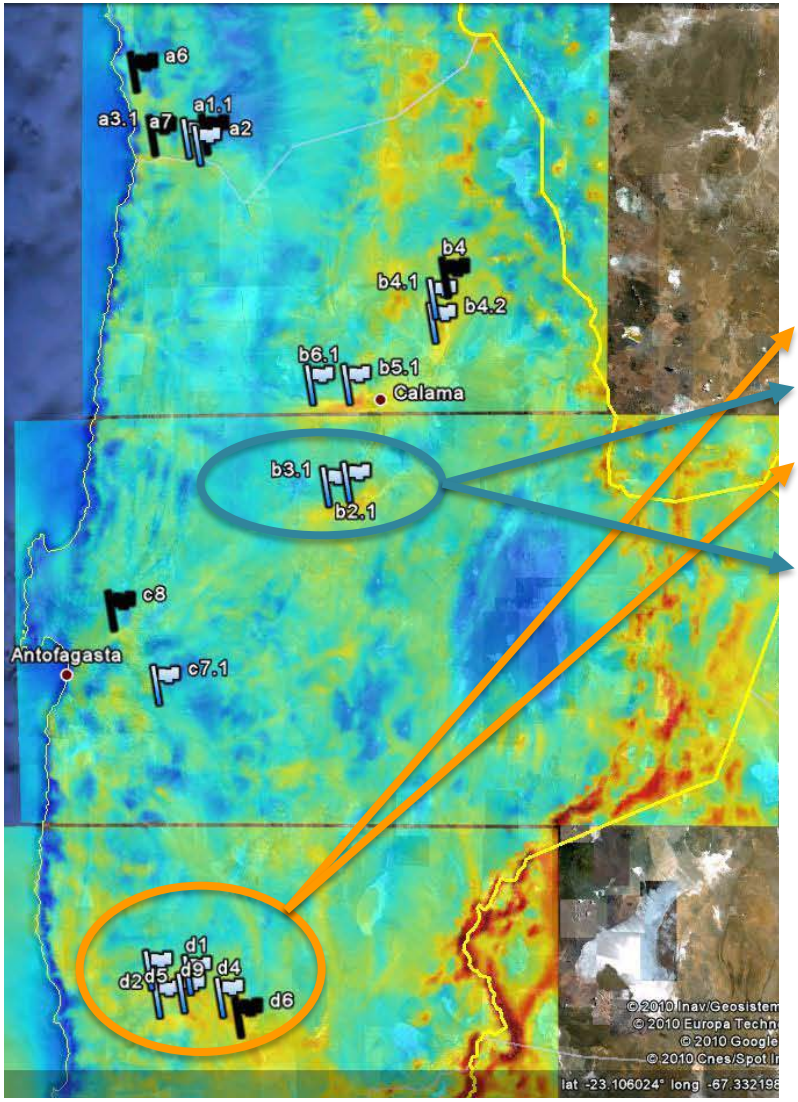
01.05.2010 – 30.04.2011

Estación	GHI anual kWh/m²
Pampa Camarones	2.490
Inca de Oro	2.572
Crucero	2.637

The best solar radiation in the world…

ELECTRICITY GENERATION

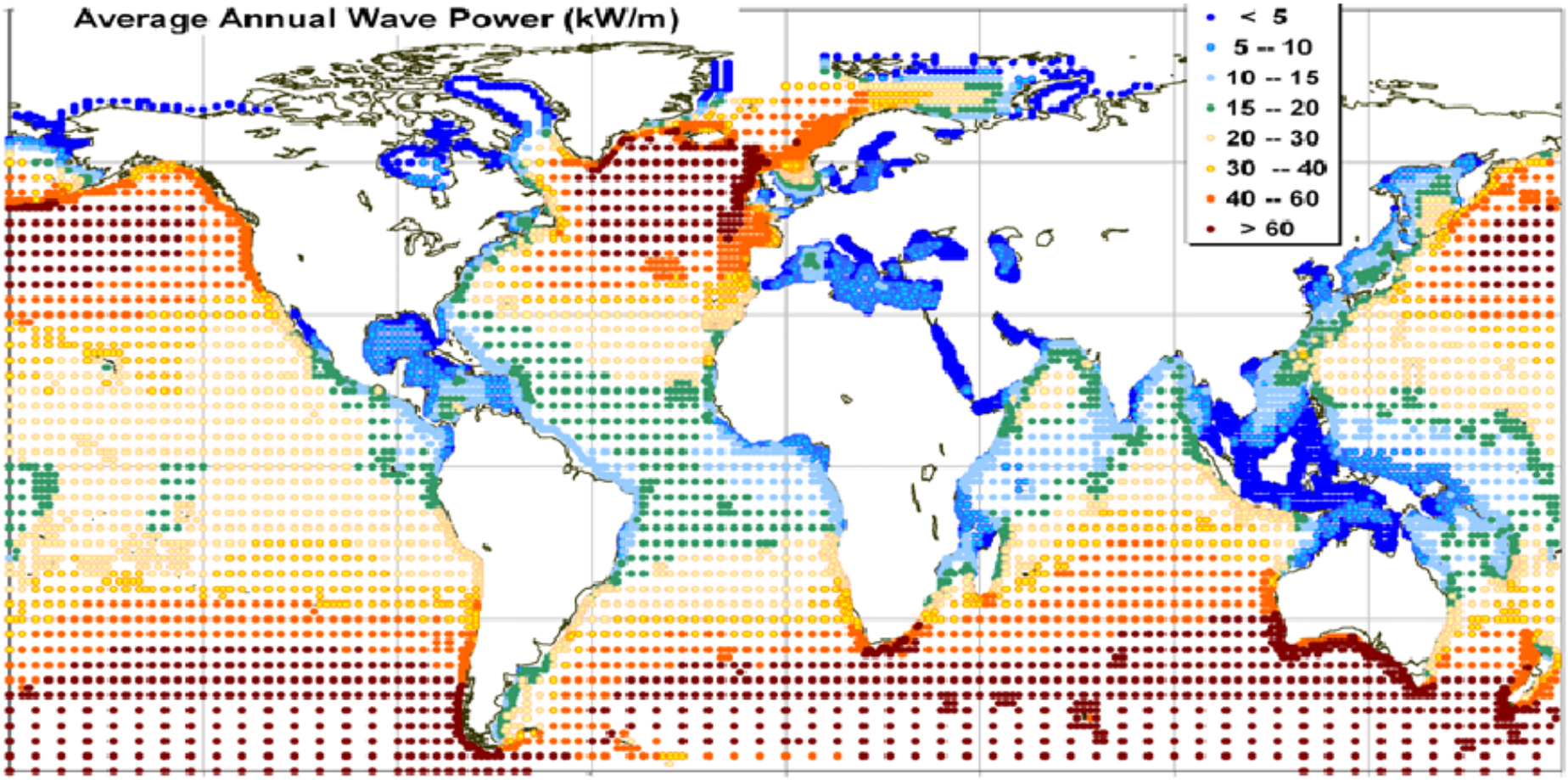
Prospective measurements of wind energy



Torre	V20 [m/s]	V10 [m/s]	Altura [m]	Factor de Planta
d5	9,0	8,5	2.176	37,8%
d1	8,9	8,5	2.269	37,9%
d4	8,7	7,9	2.550	34,7%
b2.1	8,6	7,9	2.282	35,9%
d9	8,2	7,8	2.103	33,5%
d2	8,2	7,8	1.963	34,5%
b5.1	7,9	7,0	2.104	30,6%
b3.1	7,8	7,2	2.080	30,8%
b4.2	7,8	7,0	2.694	29,9%
b4.1	7,4	6,8	2.847	25,9%
c7.1	6,6	5,9	647	28,4%
b6.1	6,3	5,5	1.716	18,7%
a7	6,1	5,6	826	24,4%
a2	6,0	5,5	888	24,3%

Good wind resources…

Great Potential in Tidal Energy



Source: Available in Nielsen and IEA, 2010.

Chile is a potential good partner to the CTF

- Chile offers a great opportunity as a special partner to the CTF in the fight of climate change.
- A country that wants to be a model among emerging economies.
- While these negotiations move slowly, strengthening partnerships between developed and developing countries nations will help us to move faster and to achieve more ambitious goals to de-carbonize our economies.

CTF can catalyze a transformation of the energy matrix in the country

- CTF resources could be used to address barriers that impede a faster and more comprehensive penetration of zero carbon options in its economy such as renewables.
- For example it could bridge the short term financial gap that would allow solar energy technologies to compete with coal and other fossil resources in the provision of energy to its manufacturing sector, including mining and agroindustry.
- CTF resources can also be used to eliminate information and technology barriers to permit market entry of other sources of energy such as marine energy.

Chile will prepare its investment Plan for the CTF Funds

- According to Chile's National Energy Strategy and Climate Change Action Plan
  - Focused mainly in Renewable Energy but considering Energy Efficiency.
- Focuses 100% in private sector operations, with Non Sovereign Guaranties
- Chilean government will host a Join Mission on November 16th to 18th to meet with
  - Other Government Institution
  - Private Sector
  - Civil Society
  - Other Donors
- We intend to submit investment plan by January with a request for US$ 200 million

Thank you

Gobierno de Chile

Ministerio de Energía

Gobierno de Chile