Synopsis of Chilean Renewable Energy Industry

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Attracting Foreign Direct Investment
The Chilean Government's Role Promoting Renewable Energy
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Abstract—The development and implementation of renewable energy power plants is important for Chile in order to increase energy security, supply remote mines with electricity, and eventually decrease energy costs. The Chilean government has promoted renewable energy and attracted Foreign Direct Investment (FDI) to develop large-scale renewable energy projects. However, the policies cannot sufficiently attract FDI in unproven renewable energies such as Concentrated Solar Power, though it is proven elsewhere. This paper examines the Chilean government’s renewable energy policies and investigates potential pitfalls of early to mid-stage capital for the renewable energy industry. Recommendations include linking the mining industry to the large-scale renewable energy industry in order to drive innovation and investment. A renewable energy technopole, or innovation center, should be established to link academia with private enterprise and government policy. Data for this research was acquired through in-person interviews with officials from CORFO (Economic Development Agency) and CER (Center for Renewable Energy) in Santiago, Chile, in June 2012.


Keywords- FDI; Chile; government policy; renewable energy investment; valley of death; early-stage financing; capital investment; Center for Renewable Energy; CORFO; renewable mining; technopole; energy innovation.

I. INTRODUCTION

Without substantial liquidity in Chile’s domestic banking sector, Foreign Direct Investment (FDI) has played a significant role in developing its infrastructure. This is no less evident than in the energy sector, which has received $13 billion FDI in the period from 1990-2008 (from 2008-2012, the sector garnered 43% of total country investments). However, much of this FDI is directed towards proven energy technologies, and sometimes fails to drive innovation in the renewable energy sector. Innovation in the renewable energy sector can only occur with a concerted triangulation between seed capital, government policy, and a skilled workers. In short, the Chilean government does well to attract FDI in the energy industry, but there remain some pivotal gaps to fill before the country can scale up renewable energy.

II. RENEWABLE ENERGY IN CHILE

A. Electricity Overview

Chile was among the first countries in the world to privatize electricity, which began on the utility scale in 1982 [1]. As a developing nation at the time, this was an audacious and provocative government policy decision. After being trained at the University of Chicago, Chilean graduates returned to Chile to embark on a systematic restructuring of government economic policy. This marked the beginning of Chilean government efforts to liberalize the Chilean economy in general, and began the slow transition to opening up Chile to Renewable Energy (Non-Conventional Renewable Energy-NCRE).

A small Latin American country with a population of around seventeen million people, Chile has strong commitments to climate change mitigation. This has created a palatable market for foreign investors. It ratified the UN Framework Convention on climate change and the Kyoto Protocol. In 2009 the president created an Inter-Ministerial Committee on climate change. Finally, in 2012, the government released its National Energy Strategy linking energy security with climate change [2]. There has been a tacit understanding of energy supply risks due to its heavy dependence on imported energy, (75% of fuels are imported), and the government has thus pushed forward renewable energy and energy efficiency legislation [3]. Lastly, Chile was a pioneer in employing renewable energy for industrial uses; in 1972 it installed a solar plant in the city of Antofagasta [4].

B. Key Aspects of Electricity Generation in Chile

- 37% of the countries’ electricity is consumed by the mining sector [5].
Industrial sector consumes 31% [6].

Commercial and public sectors consume 14% [7].

The rates for the use of the transmission system are set every four years by the Study of the trunk transmission [8].

Power plants smaller than 9 MW have the right to a price stabilization mechanism.

The domestic energy market is divided into four main sectors. The two Northern sectors, SIC (Central Interconnected System) and SING (Northern Interconnected System), are the most important because these make up nearly 16,000 MW combined. SING is powered almost exclusively by fossil fuel and, interestingly, is supplies nearly 90% of its electricity to mining and heavy industry (a point discussed later in this paper). SIC fires 51% of its energy through fossil fuel with the remaining created by large hydro (47%), wind energy (2%), and biomass (2%).

Meanwhile the two Southern systems, the Aysen System (SEA) and the Magallanes System (SEM), only account for about 150 MW combined, most of which is natural gas, diesel, or large hydro. This article deals specifically with SIC and SING large-scale utility energy.

III. NON-CONVENTIONAL RENEWABLE ENERGY (NCRE) LEGISLATION AND THE SPOT MARKET

Several pieces of legislation guide NCRE in Chile. Many of these laws recently entered into effect. For a country in South America, the Chilean RE policy can be considered quite progressive. In comparison to European countries, however, the legislation falls short and does not have the effect of attracting certain kinds of investment. Specifically, the NCRE legislation fails to attract enough seed capital or early to mid-stage financing (a common occurrence in developing countries). The key policies and government mandates for renewable energy are briefly outlined below:

- Law 19,940, March 2004
  - Modifies aspects of the electricity market affecting all generators by introducing elements especially applicable to NCRE [9].
  - Law 20,257, April 2008
    - Establishes a renewable portfolio standard (RPS). It creates the obligation for generators to incorporate 5% of NCRE electricity into their energy mix. This percentage will increase gradually to 10% by 2024. Companies who do not comply with this request have to pay a penalty” [10].
  - Law 20,365, August 2010
    - Creates a tax benefit that incentivizes the investment in solar thermal collectors for new constructions.
  - Law 19,940 (The Short Law)
    - Determination of nodal prices tends to stabilize values by diminishing the variation of the nodal price in relation to what is observed in the contract market with non-regulated customers”[11].

Figure: The theoretical operation of the Spot Market in Chile

Figure source: GTZ/CNE, 2009. Non-Conventional Renewable Energy in the Chilean Electricity Market

- Supreme Decree No. 244
  - “Creates provisions for companies whose generation capacity surplus is less than 9MW and/or operate with a non-conventional energy source less than 20MW. Exemption of payment for the use of main transmission systems” [12].

- Decree Law 600, The Statute on Foreign Investment
  - Since 1974, this law regulated the entry of foreign capital as foreign direct investment, using stable, transparent and simple rules. It applies to individuals or legal entities or Chileans who reside abroad and invest in Chile [13].
    - General Agreements and Actions
      - Ministry of Energy and Ministry of Environment created (2010-2011)
      - Climate Action Plant 2009-2012
      - Greenhouse Gas (GHG) emissions inventory
      - Second National Communication on Climate Change (2011)
      - Mitigation Options for Addressing Climate Change (MAPS)

A. Government Agencies Responsible for NCRE

Several different government agencies support the wide scale development of NCRE in Chile. These include CORFO (Economic Development Agency), CER (Center for Renewable Energy), CNE (National Energy Commission) and AchEE (Chilean Energy Efficiency Agency). CORFO is involved mostly in finance activities and fostering innovation. The CER is focused specifically on renewable energy and provides resources for developers and investors to ascertain available instruments (though the agency is still in its infancy stages). The CNE sets and monitors electricity prices, based on nodal price (“spot market”), updated every six months [14]. Finally the AchEE focuses specifically on energy efficiency. This paper is predominantly concerned with CER and CORFO, because these agencies deal with seed capital and the direct promotion of renewable energy investments. Eventually the CER will be responsible for supplying all relevant NCRE data, alleviating the burden on investors to acquire expensive data through other means. Below are two examples of data supplied by CER.
B. Investment in NCRE

- Total FDI investment in Chilean Energy system from 1990-2008 was $13,182 million (representing 20% of all FDI over that period) [15].
- Total investment in energy sector 2008-2012 estimated to be $24,459 million (equaling about 43% of total country investments) [16].
- Subsidies for preliminary studies for NCRE: Programs are eligible under the Clean Development Mechanism (Kyoto Protocol), with investments over $400,000 [17].
- Program for basic engineering studies: This subsidy covers up to 50% of engineering, electrical connection, or environmental impact studies up to $160,000 [18].
- “Parallel to the scheme included in the laws in this area, and with the goal of attracting investors interested in developing NCRE projects (CORFO: Innovation in Energies) open tenders will be carried out by NCRE block, in which the generators who participate could be awarded a State subsidy to improve the conditions of energy sales” [19].

C. Subordinated Debt Financing

A problem in the NCRE investment market cited by both the Chilean Government [20] and private analysts is the domestic finance sector’s lack of knowledge of differing clean energy technologies. The general lack of knowledge, or knowledge-capital, results in a sluggish investment environment for NCRE; ultimately this leads to higher interest rates, extra required guarantees, and an overall shortage of funding alternatives [21]. The Chilean Government should encourage the use of subordinated debt financing in large-scale NCRE projects because this would allow for a “reduction of the amount of equity required and therefore avoid the additional costs of equity” [22]. As opposed to senior debt, subordinated debt can better bridge knowledge gaps by scaling up at a faster rate.

IV. DISCUSSION: THE VALLEY OF DEATH OR CHILECON VALLEY?

The Chilean Renewable Energy industry has great potential to become a silicon valley for RE technology. By following the lead of Silicon Valley, which has unprecedented success conjoining university, government, and private capital to drive innovative industries, Santiago could be one day considered Chilecon Valley. Yet two crucial impediments exist (or three if government policy is considered inadequate). The first is knowledge capital, and the second is early stage financing. Without early stage financing (venture capital, seed capital), the Valley of Death looms over Chilecon Valley.

Picture Source: Ritchie et al. “Catalysing Early Stage Investment: Addressing the Lack of Early-Stage Capital for Low-Carbon Infrastructure in Developing Economies”.

A. Pre-Commercialization

“The Valley of Death” is a term that refers to new technologies unable to become marketable because they lack early stage financing, which is usually supplied by venture capitalists. The Valley of Death precludes innovative technologies from reaching development stages because projects cannot scale up and become marketable [23]. A project or company that falls into the Valley cannot be rescued without some other form of intervention in the market. Such projects have the characteristics of proven and demonstrable technology with low market demand. The perceived risk equates to an unmarketable early to mid-stage investment [24]. Innovative RE technologies, or even unproven technologies in a certain geographical area, may remain in the Valley of Death because investments are even too risky for venture capitalists.

The Chilean government can foster a Chilecon Valley by understanding its endogenous energy resources, such as Concentrated Solar Power and molten salt storage, and connecting its Universities to private enterprises exploring these specific renewable energies. It must be noted that the government has made strides in creating this type of environment, but it appears the policies are too broad and seek to incorporate too many technologies. The government cannot attempt to integrate all renewable energies into its knowledge-capital because this will create an abundance of moderately skilled workers (rather than experts), and will not lead to an innovative culture based around several very specific technologies. The government must make it a priority to incentivize innovation to allow focused learning in the renewable energy technology [26].

B. The Valley of Death and Spot Prices

Employing “spot” prices, which cannot distinguish between conventional energies and renewable energies, exacerbates the Valley of Death in Chile. Early stage financing is mostly unavailable for not yet tested renewable energy plants (though they may be proven in other countries). This causes investors to sink money into conventional energies instead. Therefore proven, conventional energies are more attractive.
This “technological neutrality” favors conventional energy and will not stimulate NCRE investment unless it is “reviewed periodically as the technology curve progresses [for NCRE]. The surcharge established is too low to act as an incentive to fulfill the quota” [27].

Although the CER offers assistance in large-scale projects near commercial development, it does not help burgeoning projects requiring early-stage financing (only .5% of early stage financing is sourced publicly, worldwide). Similarly, the CER offers some help with the prospecting (initial project phases) but not to extent that would result in proper levels of confidence to an early-stage private investor. Corfo does this to some degree, but it appears incapable of attracting large amounts of seed capital in the absence of international loaners. The amount of seed capital Corfo can leverage is rather small, and follows the trend of only investing in proven NCRE.

CORFO provides renewable energy prospecting data (National Energy Strategy 2012-2030), but it is not of sufficient quality for investors because it lacks “basic technical studies” which forces developers to “dedicate time and resources to carrying out their own individual studies” [28]. In other words, early-stage private investment must be used to pay for this technical data, which seed capitalists are not intent on paying for. It would be more prudent if the government provided adequate data. Clear data includes not only technical feasibility studies but also long-term access to the grid and public electricity demand forecasts.

C. Averting the Valley of Death

At the crux of RE promotion on the utility scale is government incentive for guaranteeing private investors that there will be a market—whether sustained through subsidy or not is of little importance. What is required is government policy to bridge the “Early-stage Financing Gap” and subsequently avert the Valley of Death. Whereas Silicon Valley doesn’t rely on private investment alone, (for example, Berkeley, San Francisco State, and UC Davis are all publicly funded Universities driving innovation), neither can RE in Chile rely on private investment alone. This might appear quixotic for the electricity sector which relied so heavily on private investment to build its infrastructure since 1982. Nonetheless the lack of early stage financing from both public and private sources, or some form of guarantees therein, presents:

- a critical market failure in most developing economies
- one that the private sector has been unable to resolve on its own [...] While public funders currently provide about $3.9 billion of financing for renewable energy power generation in developing countries (excl. China), most of this money is targeted at the late-stage construction phase once most of the project development risk is removed. Only 0.5% or about $18 million of this public funding targets the early-stage financing gap. (UNEP: “Catalyzing Early-stage Investment”)

Thus it is clear the Chilean government must focus on early stage investment, rather than late stage. Evidently, the Chilean government overestimates the degree of financing available for early stage because even in spite of CORFO instruments (early-stage financing for geothermal projects, for example) private financiers continue to be reluctant to invest unless another multinational, institutional investor such as the IFC is involved. Most of the large-scale investments in RE in Chile to date are only possible because large international loaners (such as the World Bank or IFC) provide a large percentage of project equity in addition to early-stage finance.

D. The Synthesis between Society, Innovation, and Implementation

On its own, RE policy cannot develop large-scale RE power plants. Neither can finance schemes for RE, or private investor’s aspirations. Developing and integrating RE technologies requires a certain innovation pathway consisting of: (1) R&D, (2) demonstration, (3) deployment, (4) diffusion, and (5) commercial maturity [29]. Human capital is an integral component of each of these five steps. Such capital is needed immediately in Chile. “There is a limited window of opportunity to capture the benefits of clean energy, which would include the development of a technopole and quality workforce, thus helping Chile to establish itself in the knowledge society—one of the country’s biggest challenges” [30]. A technopole will attract venture capital because knowledge-capital must be present before early-stage financiers are satisfied.

Chile has begun to take steps towards incubating this technopole. Programs such as Startup Chile, which promotes global entrepreneurship, finds seed capital for innovative companies after approval by Silicon Valley experts (Start-Up Chile is a program created by the Chilean Government that seeks to attract early stage, high-potential entrepreneurs). However, there is an apparent oversight in this program’s implementation. Several reasons were cited for the lack of efficacy of this program, the foremost of which is lack of venture capitalists and weak corporate connections (including no connection to the mining industry which imports nearly 100% of its technology); conflation of small business, startup, and corporate entrepreneurship (venture capital usually eyes startup, for example, and different regions require different businesses); talents needs to be attracted in targeted sectors (Chile must be clear about where it is focused). The lack of connection of Startup Chile to the mining industry is a severe pitfall in the government program. Such oversights continue to impede the growth of the Chilean technopole and consequently, RE innovation.

V. POLICY RECOMMENDATIONS TO ENCOURAGE LARGE-SCALE RE PROJECTS IN CHILE

The government should consider economies of scale while developing programs and legislation to promote NCRE in the future. By taking a step back and assessing the great resources Chile does have, it becomes easier to distinguish the gaps in policy. Clearly, there are gaps between the mining industry and renewable energy. Furthermore, it becomes evident that the country is on the brink of many technological breakthroughs if it can only realize the potential for cross-sectoral integration. Several points should be considered here.
A. General Observations

- The Chilean Mining industry (ranked first in the world for copper production, and fourth for conditions for mining investors), which makes up the majority of its GDP, will grind to a halt if the country’s energy needs are not soon addressed [29].
- Where a majority of mining operations are, in the North of the country within and around the Atacama Desert, solar irradiation is nearly the highest on the planet.
- The mining industry uses many of the same technologies as geothermal energy.
- Geothermal energy is also abundant in areas surrounding the main mines.
- Molten salt, a vital component of Concentrated Solar Power (CSP) which allows solar energy to be stored overnight, is abundant in the North of the country [30].
- Currently there are no Chilean CSP companies, and the government has not recognized this as a potential driver for innovation.
- Chile boasts one of the longest coastlines in the world, and therefore has a vast potential for offshore wind power.
- The government has done little to attract FDI into the offshore wind industry.

B. Specific Policy Recommendations

The Government should require the mining sector to source up to 20% NCRE by the year 2020 (increasing 1% annually), matching European country commitments and adding to investor confidence.

- Targeted innovation research in Concentrated Solar Power for Universities.
- Research in molten salt energy storage technologies.
- Substantially ease geothermal exploration regulation. Promote exploration and innovation through mining company’s expertise, capital, and know-how.
- Utilize international lenders for technology transfer and knowledge transfer.

VI. CONCLUSION

The Chilean government has done very well to encourage FDI in the energy industry. Yet the uptake in large-scale renewable energy projects continues to move slowly, despite the country’s promising geographical conditions for the incubation of renewable energy. Very specific national policies should focus on creating a Chilean technopole based on two RE technologies: Concentrated Solar Power and Molten Salt Storage. Since both technologies are bound together by virtue of their mutual dependence, the development of a technopole should be natural. The government can create policy to encourage the mining industry to work alongside this technopole so that all parties may enjoy the financial benefits of sustained energy through CSP in the future.

REFERENCES

[16] ibid.
[27] ibid: 15
