



SOLAR WATER HEATING MARKET EVALUATION

CASE STUDY OF CHILE

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Water Heating Initiative

UNITED NATIONS ENVIRONMENT PROGRAMME



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EXECUTIVE SUMMARY

The United Nations Environment Programme (UNEP) and the United Nations Development Programme (UNDP) launched a joint initiative entitled the "Global Solar Water Heating Transformation and Strengthening Initiative" (GSWH) with funding from the Global Environmental Facility (GEF) and the International Copper Association. The objective of the GSWH initiative was to develop, strengthen, and accelerate the growth of the residential solar water heating (SWH) sector.

The GSWH initiative began with five different project countries globally, including Chile. Prior to the GSWH initiative, Chile had approximately 6,000 m² of installed SWH capacity in 2006. From 2006 to 2013, the country experienced a constant increase of annual installed capacity between 35% and 50%. By 2011, the country had already surpassed the initiative's goal of reaching 35,700 m² of SWH installed capacity and by 2012, the country had a total installed collector area of 93,883 m². Of those numbers, the GSWH initiative facilitated the installation of 26,360 m² of SWH capacity leading up until June 2013.

This report analyzes the strengthening of Chile's SWH market and enabling environment over the course of the GSWH initiative. Specifically it examines the SWH market in Chile through two different approaches. First, the report provides a qualitative analysis of the development of the solar water heating market in Chile, studying the different stages of development that the market has experienced. The report describes the GSWH initiative's impact on the market in the following main subcomponent areas of the initiative:

- **Legal, regulatory, and institutional framework.** The report describes the impact of Law 20.365, which provided strong financial incentives for SWH installations, as well as the GSWH initiative's focus on strengthening enabling institutions in-country.
- **Public awareness raising, marketing support, and capacity building.** The GSWH initiative provided training resources and opportunities for SWH via manuals, in-person training sessions, and via pilot projects.
- **Financing mechanism and new delivery models.** Chile financed SWH projects in social housing in the country and offered a successful tax credit for installations.
- **Business skills barrier and product quality.** Chile introduced SWH certification and standards, and developed an industry association.

Second, this report employs a quantitative analysis using UNEP's SWH TechScope Market Readiness Assessment tool to compare Chile's TechScope scores for the SWH enabling environment across three time periods:

- **Pre-GSWH initiative.** The first stage is considered to be the period before the start of the GSWH initiative, which began during the last quarter of 2009;
- **Mid-Term of the GSWH initiative implementation.** The second stage coincides with the evaluation of the national GSWH initiative in Chile (2014).

- **Post-GSWH initiative.** The last stage of the scoring considers the achievements and impact of the GSWH initiative following its closure in 2014.

Using this baseline analysis, the report evaluates the extent to which the GSWH initiative had an impact on Chile's SWH market. This analysis considers seven areas of potential impact including SWH targets, financial incentives for system installation, SWH loan programs, building mandates, outreach campaigns, and product standards and certifications. **The results of this analysis conclude that the TechScope score for Chile has increased from 2.36 in the Pre-GSWH phase, to 3.11 in 2013 and to 3.17 in 2014.** National conditions, overall business climate, and financing stayed at a stable level over the last decade. From 2009 to 2014, at least 72,984 m² of new collector area was installed and an annual average sales of 13,619 m² (30%) were reached as of June 2014. This growth in the SWH market resulted in avoided greenhouse gas emissions of 25,211,208 kg CO₂ equivalent per year. According to projected growth targets for the SWH market, Chile's estimated avoided emissions will be 219,880,791 kg CO₂ equivalent per year by 2020.

The single biggest impact for the SWH market was Law 20.365 that was enacted by the federal government. Under the tax credit, the SWH market grew significantly from 2009 to 2013. According to the Ministry of Energy records, 55,266 m² of SWH was installed as of June 2014 under the tax benefit. With a favorable regulatory framework, the GSWH initiative supported SWH growth by spurring public information sharing, capacity building, trainings, and networking. In Chile, however, the GSWH initiative did not lead to the establishment of national SWH targets, lending programs for SWH, or building mandates, which are three parameters of influence the federal government could pursue in the future.

In summary, the GSWH initiative had mixed results impacting the SWH market in Chile. The GSWH initiative's greatest contribution was increasing public awareness and local capacity of installers and construction companies through installer trainings and other capacity building measures. However, the tax credit provided under Law 20.365 ended in 2013, halting the growth of the SWH market, and demonstrating the importance of financial mechanisms as part of a SWH market development program. As of 2015, there is a strong need for holistic, clear, and reliable regulatory policies and financial incentive programs to continue growth in Chile's SWH market.

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SECTION 1

BACKGROUND AND METHODOLOGY

1.1 BACKGROUND

The United Nations Environment Programme (UNEP) and the United Nations Development Programme (UNDP) launched a joint initiative entitled the “Global Solar Water Heating Transformation and Strengthening Initiative” (GSWH) with funding from the Global Environmental Facility (GEF) and the International Copper Association. The objective of the GSWH initiative was to develop, strengthen, and accelerate the growth of the residential solar water heating (SWH) sector. The GSWH initiative began with five different project countries globally, including Chile.

The SWH TechScope Market Readiness Assessment report and excel-based Analysis Tool (“the TechScope”) were developed to support the growth of the global SWH market by providing a replicable, high-level, and publicly available methodology to evaluate the residential SWH market in various countries.¹ The four parameters evaluated by the TechScope—SWH support framework, national conditions, financing, and business conditions—help provide an understanding of the opportunities and challenges faced by a country attempting to grow its SWH market. Policy makers can use the TechScope to benchmark current country achievements against specific objectives, compare achievements against other countries, and set future SWH market and policy goals.

The SWH TechScope Market Readiness Assessment report provides a detailed explanation of the assessment methodology, and serves as the instruction manual for the excel-based Market Readiness Analysis Tool. The associated tool allows users to input the relevant data for a specific country and receive a score that reflects the state of the country’s enabling environment for SWH.

This report profiles Chile and analyzes its experience in strengthening its SWH market over the course of the GSWH Initiative. This analysis assesses the progress Chile has made in fostering a stronger enabling environment for SWH under the GSWH initiative in part by comparing Chile’s TechScope scores across three time periods: before the GSWH initiative (pre-2009), during the GSWH initiative (2014, as discussed in the original TechScope report), and after the GSWH initiative (Fall 2015). This report also discusses the

¹ Note: This report may include examples of leadership in the commercial and industrial SWH sector, if relevant. The Report and excel-based Analysis Tools can be found at: <http://www.solarthermalworld.org/content/solar-water-heating-techscope-market-readiness-assessment-report-and-analysis-tool-2014>

impacts of the various initiatives undertaken by the Chilean government as part of its participation in the GSWH initiative, highlighting lessons learned.

1.2 ANALYSIS AND STRUCTURE OF THE STUDY

The purpose of this report is to analyze the SWH market in Chile, reviewing the context before, during and after the GSWH initiative to assess the impact of the initiative on the market. This report provides insights into the SWH market in Chile by using a replicable case study approach that offers lessons learned and best practices to other countries.

This report addresses the solar water heating market in Chile by offering two different approaches. First, the report provides a qualitative analysis of the development of the solar water heating market in Chile, studying the different stages of development that the market has experienced. Second, this report employs a more quantitative analysis using UNEP's SWH Techscope Market Readiness Assessment tool.

The report is structured as follows:

Section 2 of this report provides a narrative assessment of the SWH market in Chile, discussing the progress of Chile's SWH market as it relates to the main focus areas of the GSWH Initiative:

- Legal, regulatory, and institutional framework;
- Public awareness raising, marketing support, and capacity building;
- Financing mechanism and new delivery models;
- Business skills barrier and product quality.

Section 3 uses UNEP's TechScope Market Assessment Methodology and Tool to compare the relative state of Chile's SWH enabling environment at three different stages of the GSWH Initiative (Figure 1).

- **Pre-GSWH Initiative:** the first stage is considered to be the period before the start of the GSWH initiative, which began during the last quarter of 2009;
- **Mid-Term of the GSWH Initiative implementation:** the second stage coincides with the evaluation of the national GSWH Initiative in Chile (2014).
- **Post-GSWH Initiative:** the last stage of the scoring considers the achievements and impact of the GSWH Initiative following its closure in 2014.

In addition, a comparison of the scores at the three stages of implementation is presented in this section.

Figure 1. The three stages of the GSWH Initiative used for benchmarking the Chilean SWH market

Pre-GSWH Initiative Pre GSWH Initiative	Mid-Term GSWH Initiative MID Term Update	Post-GSWH Initiative Post GSWH
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Section 4 evaluates the extent to which the GSWH initiative had an impact on Chile's SWH market. This analysis is focused on seven primary areas of impact, including:

- SWH targets
- Financial incentives for system installation
- SWH loan programs
- Building mandates
- Outreach campaigns
- Product standards and certifications

Finally, the CO₂ savings are estimated based on targets established at the national level.

SECTION 2

DEVELOPMENT OF THE CHILEAN SWH MARKET

2.1 OVERVIEW OF THE SWH MARKET

2.1.1 THE GSWH INITIATIVE

Section 2 summarizes the development of the solar water heating market in Chile prior, during and following the GSWH Initiative implementation period. The first phase of the GSWH Initiative started in September 2009 and ended at September 2015. The Initiative received US\$1.5 million in funding through the UNDP and Global Environmental Facility (GEF). The GEF funds were matched by additional financing of US\$1,831,500 from the governments of Chile and institutions participating. The Initiative has supported the acceleration of SWH in Chile in partnership with the government and other stakeholders. The Initiative's goal was to accelerate and sustain a growth rate of 45% for the SWH market in Chile in order to achieve a target of 35,700 m² of installed SWH capacity, and to establish and sustain annual sales of 11,000 m². The Initiative envisioned the majority of this growth taking place in the residential sector, accounting for 80% of the total expansion of installed SWH capacity. It also set a long-term goal of growing the market to 1 million m² of total installed collector area by 2020. During the first quarter of 2015, authorities of the Renewables Energies Division of the Ministry of Energy and Environment and UNDP agreed and approved the extension of the solar program to September 2015.

2.1.2 OVERVIEW OF THE RESIDENTIAL ENERGY SECTOR

Chile's residential energy sector can be classified into four major areas: electricity, hot water, heating and cooking. In 2010, residential energy consumption was broken down as follows: 34.3% for electricity, 33.2% for hot water, 19.1% for heating and 13.4% for cooking (Ministry of Energy, 2010). In general, firewood is the primary residential heating fuel (57 to 58%). Heavy reliance on firewood has led to environmental and health impacts including increased deforestation and both indoor and outdoor air pollution. It has also caused increasing economic stress on households as prices for firewood continue to rise: from 2008 to 2014, prices per kWh have almost tripled from US\$0.26² to US\$0.63 (Ministry of Environment, 2015). This increase can be attributed to the introduction of a policy that promotes the use

² University of Chile

of dry wood and pellets and the establishment of a formal wood market. Thus, the demand for alternative heating technologies is increasing.

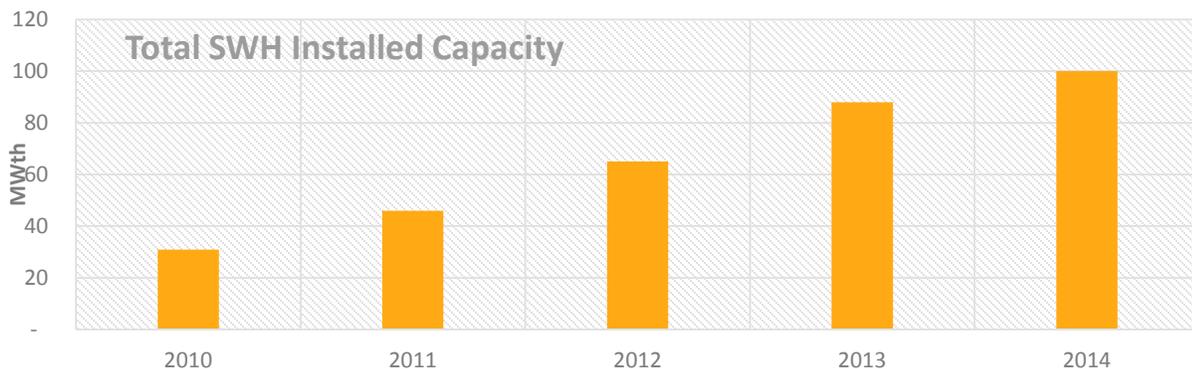
2.1.3 SWH MARKET IN CHILE

Prior to the GSWH Initiative, Chile had approximately 6,000 m² of installed SWH capacity in 2006. From 2006 to 2013, the country experienced year on year growth in annual installed capacity averaging between 35% to 50%. By 2011, the country had already surpassed the Initiative’s goal of reaching 35,700 m² of SWH installed capacity and by 2012, the country had a total installed collector area of 93,883 m². According to project documents, as of June 2013, the Initiative had facilitated the installation of 26,360 m² of installed SWH capacity as can be seen in Figure 2.

From 2009 to 2013, the SWH market was supported by the Law 20.365, which created a tax credit for solar thermal systems. However, the law expired on December 31, 2013 and in 2014, growth of installed capacity decreased to 13.6%. A key barrier to greater expansion is the high cost of SWH systems in the residential sector. The Ministry of Energy and GIZ estimate the cost of SWH for a household at an average price of 1,563,821 CLP or US\$2,300 and for a multi-family system (16 homes) 28,409,824 CLP or US\$40,900 (GIZ, 2015). The large majority (~90%) of SWH technologies are imported, mainly from China and to a lesser extend from Greece and Spain.

Looking at the GSWH Initiative’s impact in Chile from 2009 to 2014, at least 72,984 m² of new collector area was installed and an annual sales of 13,619 m² (30%) were reached as of June 2014. According to the Ministry of Energy records, a total of 55,266 m² of SWH capacity was installed in Chile as of June 2014 under the tax benefit established in Law 20.365. Furthermore, according to records of the Housing and Urbanism Ministry (MINVU), 8,859 subsidies have been delivered – equivalent to 17.718 m² of SWH – for SWH in existing social housing between 2011 and 2014.

Figure 2. Total SWH Installed Capacity in Chile (2010-2014)



2.2 LEGAL, REGULATORY, AND INSTITUTIONAL FRAMEWORK

One of the main objectives of the GSWH Initiative was to strengthen the enabling, institutional, legal, and regulatory framework to support SWH. As referenced in the previous section, from September 2009 to 2013, the SWH market was supported by Law 20.365, which created a tax credit for solar thermal systems and gave construction companies a chance to claim up to 100% of SHW costs through tax credits. The tax exemption significantly changed the financial context for the GSWH Initiative and already in the first year, from 2009 to 2010, SWH installations grew from 28,159 m² to 39,079 m². As a result, staff adjusted the GSWH Initiative's focus from assisting the government in developing a legal framework to supporting the implementation of the Law. Efforts included supporting relevant government agencies, supporting promotional activities, and developing training opportunities. As the law has been implemented, the Initiative has drawn attention to the law's limitations in design and implementation and prepared proposals to amend it. These included extending the period of time it was active, expanding coverage of the tax exemption to individuals and households, and incorporating some compulsory elements such as mandatory certification of installed solar thermal systems.

However, the law providing tax credits for SWH expired on December 31, 2013. The growth of installations decreased significantly from 35% to 50% in the previous years to only 13.6% in 2014. Thus, the GSWH program refocused its activities again to support the extension and adjustments of the Law. An international expert was hired to provide technical support for different activities required by the Ministry of Energy in preparation of an extension of Law 20.365 and a new legal framework, among other responsibilities.

In early 2014, the new government of President Michelle Bachelet included in its election agenda the approval and extension of the tax credit scheme (Epp, 2014). However, as of November 2015, Law 20.365 is still in the legislative process for extension to 2020. The current government energy strategy does provide a tax benefit for SWH installations included in new homes as well as in new social housing projects. For Chilean installers and construction companies, the tax breaks are the single most important financing incentive to continued investments in SWH.

2.3 RAISING PUBLIC AWARENESS

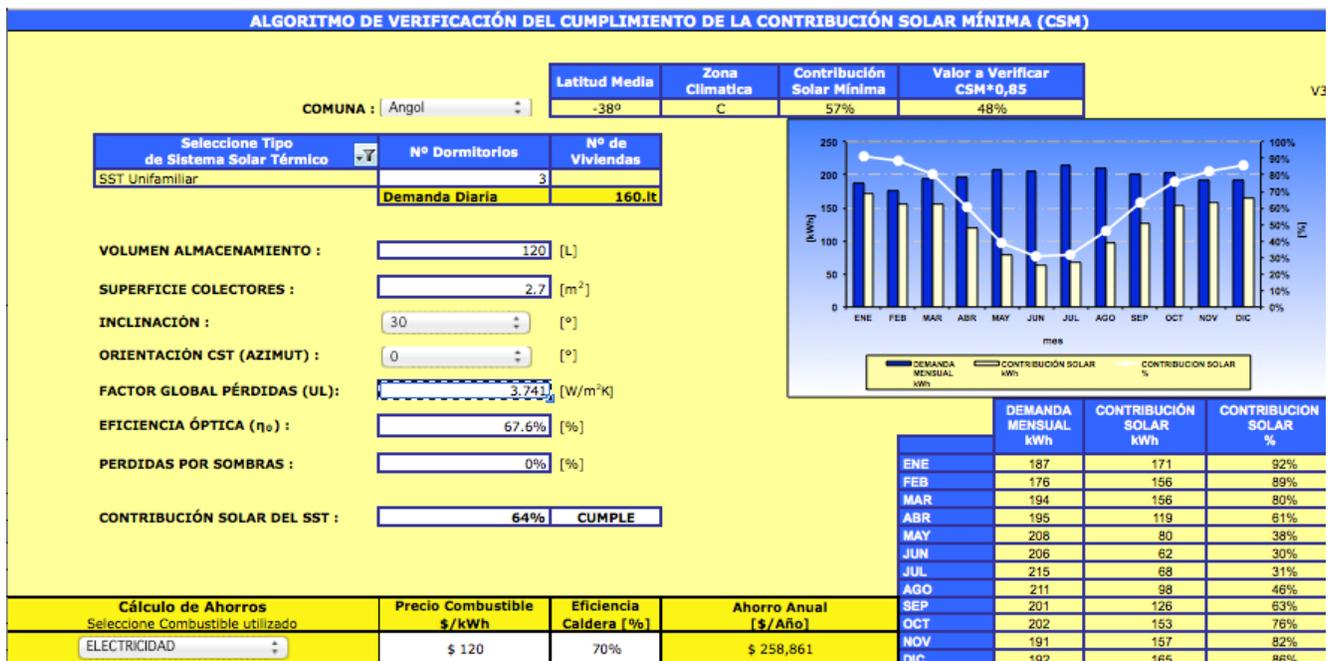
In the period from 2009 to 2013, the GSWH Initiative has focused most of its efforts on training, capacity building and developing knowledge products. With the start of the GSWH Initiative in 2009, an online information and outreach platform was put into place: www.programasolar.cl. After the conclusion of the Initiative, the website will still be maintained.

A major priority of the GSWH Initiative was also to improve SWH product quality and services provided by local SWH manufacturers. As such, the GSWH Initiative developed manuals and a series of capacity building trainings.

2.3.1 MANUALS

Design and installation guide were developed by MINERGI and the GSWH initiative in 2010 (Argomedo, 2015).³ In addition, three technical guides for the design and installation of centralized solar thermal systems, forced housing systems, and single family residences as can be seen in Figure 4. Design and Installation Guides for Hot Water Systems (MINENERGI, 2013). A Solar Specialist Technical Training manual was completed in 2013 (MINENERGI & UNDP Chile, 2010). Two technical manuals were developed for the Chilean Ministry of Housing and Urban Development and the Superintendence of Electricity and Fuel (SEC). Project staff was also developing technical tools that help builders incorporate SWH into the early stages of building design and construction and calculate the solar contribution of homes as evidence in Figure 3. Compliance Tool to verify the minimum solar contribution v3.0 (Programa Solar, 2015). The GSWH Initiative will integrate these tools into design programs, such as AutoCAD.

Figure 3. Compliance Tool to verify the minimum solar contribution v3.0 (Programa Solar, 2015)



³ Personal correspondence with Rosa Argomedo, Former Division Chief of Energy Access and Equity for MINENERGI.

Figure 4. Design and Installation Guides for Hot Water Systems (MINENERGIA, 2013)



Furthermore, the GSWH Initiative prepared materials describing the SWH experience of residents living in Chile's social housing units. As part of the Initiative, several social housing units received subsidized SWH systems provided by the Protection Program of Family Assets by the Ministry of Housing and Urban Development (MINVU). The GSWH Initiative invested in institutional support and capacity building at the Ministry of Energy and cooperated with partners such as the GIZ Project Solar Energy for Electricity and Heat Generation and MST members (Solar Thermal Committee): ACESOL A.G., ChC- CDT; ICA Chile (PROCOBRE) ANWO, CHILECTRA, the School of Architecture, MINENERGIA and SEC.⁴

The solar program successfully implemented a SWH Monitoring Study with the objective of developing a methodology and specifying a technology for monitoring and evaluating the technical aspects of solar thermal systems installed in Chile (Cambell Scientific, 2014).

Finally, the GSWH Initiative is currently preparing a manual that will provide support to the new legal framework and extension of Law 20.365.

2.3.2 CAPACITY BUILDING

One of the activities of the solar program was to run a series of capacity building trainings. Therefore, the program hired an international technical adviser to a) implement a training program in the public and private sectors; b) provide technical documentation for MINVU and SEC and c) provide technical support for the implementation of the SWH engineering pilots in collective social housing.⁵ The trainings were divided into theoretical and practical skills, allowing each institution to build capacity and skills for training technical specialists in solar installation and maintenance SWH (this program is currently under evaluation).

The following training content was conducted in each of the training sessions:

- Installation of prefabricated housing systems
- Design of solar thermal projects of any size, and

⁴ Acronyms: Chilean Association of Solar Energy (ACESOL), International Copper Association Chile (Procobre), ANWO (Chilean heating and cooling company), The Chilean Electric Company (CHILECTRA), Ministry of Energy (MINENERGIA), the Superintendency of Electricity and Fuels (SEC)

⁵ Acronyms: The Ministry of Housing and Urbanism (MINVU) and the Superintendency of Electricity and Fuels (SEC)

- Training of trainers

An initial training was conducted in the context of the "Teacher education and training in solar energy for domestic water heating for housing," project with the Catholic universities in the North (Antofagasta) of La Serena (La Serena) and Santiago (Santiago) as seen in Figure 5 and Figure 6.

Figure 5. Solar Thermal Training Course Presented by Juan Carlos Escribano (photos taken from website Programa Solar)



Figure 6. ARICA 1 Training Course (photos taken from website Programa Solar)



Figure 7. Advertisement for Practical course for solar technicians (photo provided by Rosa María Argomedo)



During 2015, the solar program has been working with a consultant to support programs that consider installing SWH in homes that are repaired and / or reconstructed in regions affected by natural disasters (Regions XV, I, III and V).

UNDP has signed several cooperation agreements with the following educational institutions: CFT Tarapacá (Arica), Universidad Arturo Prat (Iquique), Technological Institute of the University of Atacama (Copiapo) and Duoc Valparaiso. The objective is to provide theoretical and practical knowledge in solar thermal for teachers from each institution. A "train the trainers" curriculum will be delivered by teachers from the Department of Mechanical Engineering of the University of La Serena, and a solar thermal energy laboratory will be established. As a result, universities will by the end of 2015 have a permanent offer of technical training courses. Technicians certified through these courses will have acquired the skills to train technical specialists in solar installation and maintenance of SWH.

In total, 334 persons received trainings of a total of 210 hours throughout the country. Before the end of the GSWH in 2015, a publication of lessons learned will be prepared regarding trainings.

2.3.3 DEMONSTRATION SITES

The Ministry of Energy implemented SWH demonstration projects in nine rehabilitation centers, nursing and children's homes, 37 projects in educational centers such as kindergartens and schools, four in health facilities, and 300 projects in social housing, thereby targeting a population of more than 785,000 people with state investment of \$4.5 million from 2008 until today.

Figure 8. Solar Thermal Laboratory Inauguration at the University of La Serena in November 2014 (photos taken from website Programa Solar)



2.4 FINANCING MECHANISMS

2.4.1 FINANCING REQUIREMENTS OF THE GSWH INITIATIVE

In Chile, the installation cost of SWH systems is high relative to fossil fuels. Before 2009, few financing mechanisms were in place to incentivize the growth of a SWH market. The GSWH Initiative aimed to generate demand for SWH through the development of applicable consumer financing and financial support schemes. The Initiative aimed to add 29,000 m² of installed capacity amounting to a target of 35,700 m² of total installed SWH capacity in Chile by the end of the Initiative. In order to meet this target, the Initiative expected it would need to leverage \$US 15 to 20 million, including both bank lending and cash contributions.

2.4.2 PRE- GSWH INITIATIVE: EXISTING FINANCING MECHANISMS

Since 2007, Chile's Ministry of Housing and Urban Development (MINVU) has offered grants to repair or improve housing through its Family Homestead Project Program (Programa de Protección del Patrimonio Familiar or "PPPF"). Qualifying individuals must live in homes that are categorized as social housing or have a tax valuation under 650 Unidad de Fomento (UF) (US\$28,837.62) and belong to families with a maximum of 13,484 on their social protection card (Ficha de Protección Social) (Ministry for Social Development, 2015). As of 2011, 70.4% of Chile's housing stock qualified as social housing. The grants can be used to cover the cost of several types of home improvements, including energy efficiency. Beginning in 2011, grants were used to help pay for the cost of solar water heating systems.

Section 2.2 of Law No. 20.365 granted tax breaks for SWH systems in newly built houses for businesses and end-users. This meant that up to 100% of the costs of the SWH system were eligible for tax breaks. The law also included a five-year guarantee against system failures and a free inspection within the first year of operation. The Law focused on incentivizing construction companies to incorporate SWH systems in new housing.

2.4.3 DURING THE GSWH INITIATIVE

In the first phase, the GSWH Initiative attempted to establish a financial mechanism focused on the end user, specifically residential users. The mechanism would provide a financing line for the purchase, sale, and installation and after sales service of solar thermal systems. However, the idea garnered little interest and no bidders responded to the tender. During the second half of 2014, the GSWH Initiative cooperated with Ministry of Energy and Deutsche Gesellschaft für Internationale GIZ on a report, which analyzed the cost to implement SWH on individual and collective homes. The results included recommendations to extend Law 20.365.

Additionally, working with the MINVU, the GSWH Initiative developed a new internal regulation for the MINVU to monitor the increasing number of subsidies being provided to install SWH in existing social housing units, which totaled yearly:

- 609 subsidies in 2011
- 977 subsidies in 2012
- 2,395 subsidies in 2013
- 4,878 subsidies in 2014

Total subsidies between 2011 and 2014 amounted to 8,859. From June to October 2015, a pilot project is in place to install SWH in four existing social housing buildings. This pilot has a budget of US \$198,000, in order to purchase and install the SWH systems. Once the results of this pilot project are evaluated and determined successful, MINVU will proceed to install SWH systems in additional social housing units by providing a subsidy equivalent to US \$2,500 per household for 5,000 homes per year (CONOCER, 2013; MINENERGIA, 2014). MINVU expects to contribute of \$US 12.5 million per/year for SWH installation in social housing until 2016.

SECTION 3

APPLYING UNEP'S SWH TECHSCOPE ASSESSEMENT METHODOLOGY: PARAMETERS EVALUATION AND SCORE VARIATION IN 3 PHASES OF IMPLEMENTATION

3.1 INTRODUCTION AND SUMMARY OF SCORES

This section applies the TechScope SWH market readiness assessment methodology to analyze the market in Chile. The TechScope assessment methodology was designed based on in-depth research on international solar thermal markets and policy development, as well as a review of the experiences and outcomes of the five GSWH project countries.⁶

The methodology focuses on four interrelated parameters:

- I **SWH Support Framework (29% of score):** Government policies, regulations, and engagement programs have played an important role in scaling up many of the world's leading solar heating markets. For the purposes of developing the score, the support framework includes SWH targets, financial incentives, loan programs, building mandates, and outreach campaigns.
- II **National Conditions (30%):** The relevant national conditions include the incoming solar radiation (i.e. insolation), SWH penetration and market growth, energy demand trends, and the competitiveness of SWH compared to other heating fuels.
- III **Financing (20%):** Financing takes into account national macroeconomic conditions, as well as data on access to loans and the cost of financing.
- IV **Business Climate (21%):** The business climate is assessed by examining the ease of doing business, the existence of SWH quality standards, and the presence of associations that support

⁶ To access the entire Solar Water Heating Techscope Market Readiness Assessment, please refer to <http://solarthermalworld.org/content/solar-water-heating-swh-techscope-market-readiness-assessment-eight-caribbean-countries>.

SWH.

These four parameters are composed of 18 indicators that reflect different elements of the enabling environment for SWH in a given country.

Together, these indicators and their corresponding parameters can be used to construct a “snapshot” of a particular country’s SWH market. Based on this assessment, each country is provided an overall score on a scale of 0 to 5. A higher score reflects the fact that there is significant policy, financial, and industry infrastructure in place within the country to support and enable SWH deployment. A lower score reflects the fact that some of the “building blocks” for a robust solar heating market may not be in place. It is important to note that the score is static and does not capture progress that a country has made in strengthening its enabling environment.

The SWH TechScope Market Readiness Analysis Tool assigns the following broad labels for scores:

- **Score of 0-2:** SWH enabling environment is “emerging” and could likely benefit from additional support to accelerate SWH market growth.
- **Score of 2-3:** SWH enabling environment is “good” with the SWH market positioned for increased growth
- **Score of 3-4:** SWH enabling environments are considered to be “strong” and are likely ready to attract investment.
- **Score of 4-5:** SWH conditions are “very strong” – policy, market, financial, and business conditions are aligned to support SWH and market growth is likely to be rapid.

This report applies the TechScope Market Readiness Assessment for three different stages of Chile’s participation in the GSWH Initiative. The three stages analyzed are as follows:

- **Pre-GSWH Initiative (until 2009).** The first stage is considered to be the period before the initiation of the GSWH initiative and provides a baseline for analyzing its impacts.
- **Mid-Term of GSWH Initiative Implementation (2014).**⁷ The second stage coincides with the mid-term evaluation of the GSWH initiative in Chile.
- **Post-GSWH Initiative (2015).** The final stage takes into account all activities completed under the GSWH initiative following its closure in 2014.

Section 9 provides the scores for the three stages in detail. Figure 9 below provides a breakdown of TechScope indicators that (1) cannot be impacted by policy action, (2) indicators that are indirectly impacted by policy action (or would be directly impacted by policy action outside of the scope of the GSWH Initiative), and (3) indicators that are directly affected by policy action from the GSWH Initiative. As suggested by the scores in Table 1, some of the improvements in Chile’s TechScope score can be

⁷ While the year used for benchmarking the mid-term of the GSWH initiative is 2013, data used for indicators for this stage varies in years due to gaps in available data.

attributed to changes in indicators that would not be directly affected by policies enacted under the GSWH Initiative.

The summary of TechScope scores for each of the three stages are summarized in Table 1 below. As can be seen in the table, Chile’s TechScope score has increased steadily through all three stages of the GSWH Initiative. It is important to note that many of the TechScope parameters are either related to conditions specific to Chile itself (e.g. insolation) or outside of the scope of what could have been affected by the direct policy actions under the GSWH Initiative (e.g. country credit rating, heating fuel subsidies). As such, in assessing Chile’s progress under the GSWH Initiative it is valuable to focus analysis on improvements under the indicators that can be directly impacted by policy action from the government.

Figure 9. TechScope indicators and potential to be affected by policy action undertaken within the scope of the GSWH Initiative

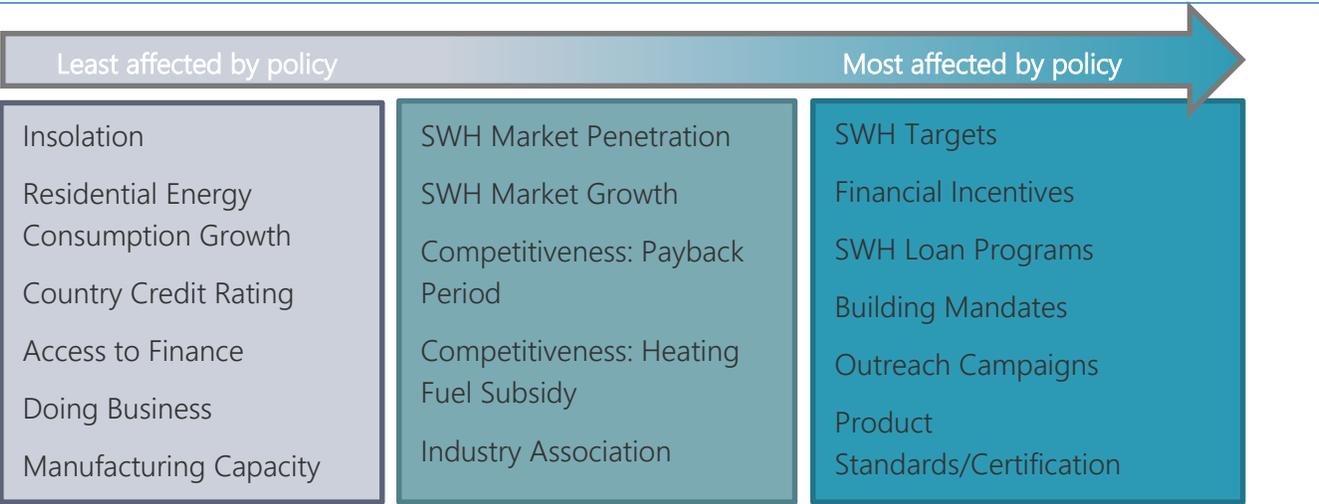


Table 1. Summary of TechScope scores for Chile across the three stages analyzed (weighted scores)

Parameter	Score	Indicator	Pre-GSWH		Mid-GSWH		Post-GSWH	
			Raw	Weighted	Raw	Weighted	Raw	Weighted
I. SWH Support Framework	29%	SWH Targets	0.0	0.00	0.0	0.00	0.0	0.00
		Financial Incentives for System Installation	0.0	0.00	5.0	0.40	5.0	0.40
		SWH Loan Programs	0.0	0.00	0.0	0.00	0.0	0.00
		Building Mandates	0.0	0.00	0.0	0.00	0.0	0.00
		Outreach Campaigns	5.0	0.20	5.0	0.20	5.0	0.20
		Subtotal		0.20		0.60		0.60
II. National Conditions	30%	Insolation	2.2	0.11	2.2	0.11	2.2	0.11
		SWH Market Penetration	0.0	0.00	0.0	0.00	0.01	0.00
		Residential Energy Consumption Growth	1.3	0.06	4.8	0.24	5.0	0.25
		SWH Market Growth	5.0	0.20	5.0	0.20	5.0	0.20
		Competitiveness: Payback Period	3.0	0.21	3.0	0.21	3.0	0.21
		Competitiveness: Heating Fuel Subsidy	5.0	0.25	5.0	0.25	5.0	0.25
		Subtotal		0.95		1.01		1.02
III. Financing	20%	Country Credit Rating	4.0	0.20	4.0	0.20	4.0	0.20
		Access to Finance	4.0	0.60	3.5	0.53	4.0	0.60
		Subtotal		0.85		0.73		0.80
IV. Business Climate	21%	Doing Business	4.0	0.20	5.0	0.25	4.0	0.20
		Manufacturing Capacity	4.0	0.12	4.0	0.12	3.0	0.09
		Product Standards and Certification	4.0	0.20	4.0	0.20	5.0	0.25
		Installer Certification	0.0	0.00	0.0	0.00	0.0	0.00
		Industry Association	0.0	0.00	5.0	0.20	5.0	0.20
		Subtotal		0.52		0.77		0.75
TOTAL	100%			2.36		3.11		3.17

3.2 PARAMETER I: SOLAR WATER HEATING SUPPORT FRAMEWORK

Table 2. Summary of Solar Water Heating Support Framework scores for Chile

Parameter	Score	Indicator	Pre-GSWH		Mid-GSWH		Post-GSWH	
			Raw	Weighted	Raw	Weighted	Raw	Weighted
I. SWH Support Framework	29%	SWH Targets	0.0	0.00	0.0	0.00	0.0	0.00
		Financial Incentives for System Installation	0.0	0.00	5.0	0.40	5.0	0.40
		SWH Loan Programs	0.0	0.00	0.0	0.00	0.0	0.00
		Building Mandates	0.0	0.00	0.0	0.00	0.0	0.00
		Outreach Campaigns	5.0	0.20	5.0	0.20	5.0	0.20
		Subtotal		0.20		0.60		0.60

3.2.1 SWH TARGETS

As of November 2015, the government Chile has never had a dedicated set of targets for SWH installations. Chile receives a score of 0 in this category.

Pre-GSWH Score	0	Mid-GSWH Score	0	Post-GSWH Score	0
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3.2.2 FINANCIAL INCENTIVES FOR SWH SYSTEMS INSTALLATION

Before 2009, no significant financial incentives for installing SWH systems were in place in country. Tax credits for companies that install SWH systems were introduced in 2009 with Law 20.365. However, the law expired at the end of 2013. In early 2014 the new government of President Michelle Bachelet included in its election agenda the approval and extension of the tax credit scheme (Epp, 2014). However, as of November 2015, Law 20.365 is still in a legislative process for this extension to 2020.

From 2009 to 2013, the GSWH Initiative was thus able to focus its efforts on outreach and capacity building while working with the MINVU on developing additional financial tools for social housing projects. Chile has developed a new financial mechanism to be administered by MINVU, providing subsidies to low-income families to install SWH with MINVU funds in existing social building, equivalent to US \$2,500 per household for 5,000 homes per year, resulting contributions of US\$12.5 million annually from 2016.

Due to the discontinuation of Law 20.365, Chile receives a score of 0.

Pre-GSWH Score	0	Mid-GSWH Score	5	Post-GSWH Score	0
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3.2.3 SWH LOAN PROGRAM

Chile has not had a dedicated loan program for supporting SWH in the last decade. However, a government program, Programa de Energización Rural y Social (PERYS), is in place for the development of public demonstration projects (MINENERGIA, 2015).

This gives Chile a score of 0.

Pre-GSWH Score	0	Mid-GSWH Score	0	Post-GSWH Score	0
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3.2.4 BUILDING MANDATES

Chile has not established SWH building mandates. As a result Chile receives a score of 0.

Pre-GSWH Score	0	Mid-GSWH Score	0	Post-GSWH Score	0
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3.2.5 OUTREACH PROGRAMS

The government has been supporting SWH outreach through trainings and capacity building programs for government agencies, including the Ministry of Housing and Urban Development and the Superintendence of Electricity and Fuel (SEC) since 2006. With the start of the solar program in 2009, an information and outreach platform was put into place www.programasolar.cl.

Due to the government's outreach efforts, Chile receives a score of 5.

Pre-GSWH Score	5	Mid-GSWH Score	5	Post-GSWH Score	5
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3.3 PARAMETER II: NATIONAL CONDITIONS

Table 3. Summary of National Condition scores for Chile

Parameter	Score	Indicator	Pre-GSWH		Mid-GSWH		Post-GSWH	
			Raw	Weighted	Raw	Weighted	Raw	Weighted
II. National	30%	Insolation	2.2	0.11	2.2	0.11	2.2	0.11

Conditions	SWH Market Penetration	0.0	0.00	0.0	0.00	0.01	0.00
	Residential Energy Consumption Growth	1.3	0.06	4.8	0.24	5.0	0.25
	SWH Market Growth	5.0	0.20	5.0	0.20	5.0	0.20
	Competitiveness: Payback Period	3.0	0.21	3.0	0.21	3.0	0.21
	Competitiveness: Heating Fuel Subsidy	5.0	0.25	5.0	0.25	5.0	0.25
Subtotal			0.84		1.01		1.02

3.3.1 INSOLATION

The average daily solar insolation levels range from 3.0 kWh/m²/day in the south to 6.0 kWh/m²/day in the north, with a daily average of 4.4 kWh/m²/day (Clean Energy Solutions Center (CESC), 2015). Based on the scoring methodology, Chile receives a score of 2.2.

Pre-GSWH Score	2.2	Mid-GSWH Score	2.2	Post-GSWH Score	2.2
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3.3.2 SWH MARKET PENETRATION

In 2013, Chile's SWH market penetration was 5.7 kWh_{th}/1000 people (Mauthner & Weiss, 2015). Thus, Chile's market penetration remains small, but notably, it is growing. The resulting score is 0.1.

Pre-GSWH Score	0.0	Mid-GSWH Score	0.0	Post-GSWH Score	0.1
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3.3.3 RESIDENTIAL ENERGY CONSUMPTION GROWTH

In the years 2003 to 2008, Chile has seen a small growth of 1% in residential energy consumption from 4,865 ktoe to 5,018. This increased continuously at a rate of 3% on average from 2008 to 2013 to a total consumption of 5,958 ktoe, providing potential for increased demand for SWH technologies.

This results in a score of 5.

Pre-GSWH Score	1.3	Mid-GSWH Score	4.8	Post-GSWH Score	5
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3.3.4 SWH MARKET GROWTH

Chile had a capacity of approximately 6,000 m² of installed collector area in 2006. Given the growth rates at the time, total installed capacity was expected to reach 11,000 m² by 2011. In the period from 2009 to 2014, however, Chile witnessed at least 72,984 m² of new installed collector area during implementation of the GSWH Initiative and an annual sale of 13,619 m² (30%) of collector area. Growth was expected to continue to reach the set target of 1 million m² of installed SWH capacity by 2020. According to the Ministry of Energy records, 55,266 m² of SWH have been installed by June 2014 under the tax benefit established in the Law 20.365. Furthermore, according to records of the Housing and Urbanism Ministry (MINVU) 8,859 subsidies have been delivered (equivalent to 17,718 m² of SWH) for solar water heating in existing social housing between 2011 and 2014 (Abdelhai, 2015).

Pre-GSWH Score	5	Mid-GSWH Score	5	Post-GSWH Score	5
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3.3.5 COMPETITIVENESS: PAYBACK PERIOD

SWH system costs. Glazed, flat plate collectors make up 100% of the residential SWH market in Chile (Mauthner & Weiss, 2015). The Ministry of Energy estimates the cost of SWH for a household at an average price of 1,563,821 CLP or US\$2,300.

Retail energy prices. In Chile, the majority of the residential sector meets its energy needs through firewood. The analysis assumes an average retail rate of US\$ 0.63/kWh for firewood based heating.

Based on RETscreen analysis, the payback period on a SWH system as compared to retail energy prices is 5.3 years and results in a score of 3.

Pre-GSWH Score	3	Mid-GSWH Score	3	Post-GSWH Score	3
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3.3.6 COMPETITIVENESS: HEAT FUEL SUBSIDY

This analysis assumes solar water heating is competing to some extent with electricity and oil products. Chile has no price capping or subsidies for fuels; however the government reduces price volatility for final consumers through two price stabilization funds – the Oil Price Stabilization Fund (Fondo de Estabilización de Precios del Petróleo or “FEPP”) and the Taxpayer Protection System for Changes in International Prices of Fuel (Sistema de Protección al Contribuyente ante las Variaciones en los Precios Internacionales de los Combustible or “SIPPCO”). The SIPPCO exclusively applies to transport fuels (diesel and gasoline) whereas the FEPP covers kerosene. Fuel oil, LPG (liquefied petroleum gas) and LNG (liquefied natural gas) are not covered by any fund or mechanism. The TechScope methodology does not consider a price stabilization fund as a formal subsidy and therefore Chile receives a score of 5.

Pre-GSWH Score	5	Mid-GSWH Score	5	Post-GSWH Score	5
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3.4 PARAMETER III: FINANCING

Table 4. Summary of financing scores for Chile

Parameter	Score	Indicator	Pre-GSWH		Mid-GSWH		Post-GSWH	
			Raw	Weighted	Raw	Weighted	Raw	Weighted
III. Financing	20%	Country Credit Rating	4.0	0.20	4.0	0.20	4.0	0.20
		Access to Finance	4.0	0.60	3.5	0.53	4.0	0.60
		Subtotal		0.80		0.73		0.80

3.4.1 COUNTRY CREDIT RATING

Chile has had stable country credit ratings of AA- from Standard & Poor's and AA3 from Moody's during the observed period. In 2012, Chile received an upgrading of its credit from A-plus to AA- citing the export dependent economy's solid performance and resilience during the global slowdown. Chile's credit rating makes it the highest rated country in Latin America and is at the same level as Japan, New Zealand, and Taiwan (Esposito, 2012).

These ratings give Chile a score of 4.0.

Pre-GSWH Score	4	Mid-GSWH Score	4	Post-GSWH Score	4
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3.4.2 ACCESS TO FINANCE

The access to finance score was determined through two measures of equal weight, real interest rates, which serve as a common proxy for the price of loans accounting for inflation, and the amount of domestic credit provided by the banking sector, which serves as a proxy for the availability of in-country finance. Chile's real interest rate has fluctuated between 13% in 2008 and 3% in 2014. Domestic credit from the financial sector has continuously increased at levels above 100%. These ratings give Chile a score of 4.

Pre-GSWH Score	4	Mid-GSWH Score	3.5	Post-GSWH Score	4
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3.5 PARAMETER IV: BUSINESS CLIMATE

Table 5. Summary of Business Climate scores for Chile

Parameter	Score	Indicator	Pre-GSWH		Mid-GSWH		Post-GSWH	
			Raw	Weighted	Raw	Weighted	Raw	Weighted
IV. Business Climate	21%	Doing Business	4.0	0.20	5.0	0.25	4.0	0.20
		Manufacturing Capacity	4.0	0.12	4.0	0.11	3.0	0.10
		Product Standards and Certification	4.0	0.20	4.0	0.20	5.0	0.25
		Installer Certification	0.0	0.00	0.0	0.00	0.0	0.00
		Industry Association	0.0	0.00	5.0	0.20	5.0	0.20
		Subtotal		0.52		0.77		0.75

3.5.1 DOING BUSINESS

In 2009, Chile ranked 40 out of 185 countries according to the International Finance Corporation and World Bank Doing Business Ranking . It improved the ease of doing business in the following years and ranked 37 in 2013. Chile has a high rank for certain indicators, such as starting a business and protecting investors, but a lower rank for indicators such as resolving insolvency and dealing with construction permits. However, in 2014 its performance decreased to rank 41 and in 2016 down to rank 48(World Bank, 2015). This results in a score of 4.



3.5.2 MANUFACTURING CAPACITY

The TechScope uses MVA as a proxy for how well positioned a country is for manufacturing. Chile’s MVA (as percentage of GDP) in 2012 was at 12 %, which was still low compared to both the global (~17%) and the average for developing countries (~21%). By June 2015 it has decreased to 11%. Chile continues to offer few incentives to improve manufacturing capacity and therefore there is a lack of SWH equipment and services. Most technical equipment is imported from China. Chile receives a score of 3.



3.5.3 PRODUCT STANDARDS AND CERTIFICATIONS

As of November 2015, Chile required product certifications for solar thermal systems and storage tanks. However, the National Standards Institute developed a set of quality standards for SWH systems and prepared a code of practice for SWH installers (Castañer, 2012). The Superintendencia de Electricidad and Fuel (Superintendencia de Electricidad y Combustibles or “SEC”) is responsible for overseeing the

approval, testing, and certification of solar collectors and storage tanks. Chile has a national standards body, solar thermal standards, testing facilities and national certification and labeling. In Chile, international standards are in use, specifically UNE EN 12.975 for Solar Thermal Collectors, UNE EN 12.976 for Precast Systems (integrated collector- storage tank systems, commonly radiators) and UNE 12.977 Deposits for accumulators. A solar thermal product national certification has been introduced in 2012.

The organizations that are authorized by SEC to give the certifications are:

- Servicios de Ingeniería y Calidad (SICAL)
- Centro de estudios, medición y certificación de calidad (CESMEC)
- Ivonne Loo Vasquez, Ingeniería y Certificación de Combustibles (ICOMNER)
- Sociedad de Ingeniería y Certificación de calidad (INGCER)s

The Instituto Nacional de Normalización (INN) is responsible for the harmonization of international norms. Based on its performance in this category, Chile receives a score of 5.



3.5.4 INSTALLER CERTIFICATION

As of November 2015, Chile had no national installer certification program. However, the GSWH Initiative and national universities have supported a number of capacity building trainings in order to increase skills of installers of SHW systems. Additionally, the SEC serves as the watchdog for proper installation of SWH systems that have obtained the franchise tax, but program is not active at the national level.

Chile has no national installer certification and receives a score of 0.



3.5.5 INDUSTRY ASSOCIATIONS

ACESOL is the Chilean Association for Solar Energy, and works to unite the public and private sectors in their promotion of solar power (ACESOL, 2015). Its primary goal is to build awareness about the market for renewable energy, particularly solar PV and solar thermal. In addition to promoting solar, ACESOL contributes to developing renewable energy policy, standards, and incentives. ACESOL is considered an active industry association focusing on solar thermal and receives a score of 5.



SECTION 4 NATIONAL SWH PROGRAM IMPACT ANALYSIS

This section assesses the impact of the GSWH Initiative on the SWH market in Chile. This assessment is focused on seven primary areas of impact as outlined in Figure 2 in Section 3.1:

- SWH Targets
- Financial Incentives for System Installations
- SWH Loan Program
- Building Mandates
- Outreach Campaigns
- Product Standards and Certification
- Installer Certification

The impact of the GSWH Initiative is defined in terms of high, medium, low or no impact as outlined in Table 6. Table 7 provides a summary of the impact of the GSWH Initiative in Chile. These assignments were determined qualitatively through the review of project documents and from conversations with national stakeholders (e.g. UNDP Mexico and Conuee).

Table 6. Levels of Impact and Associated Symbol

Level of Impact	Symbol
High Impact	
Medium Impact	
Low Impact	
No Impact	

Table 7. Summary of the Impact of the GSWH Initiative in Chile

Indicator	Pre-GSWH	Mid-GSWH	Post-GSWH	GSWH Initiative Impact
SWH Targets	0.00	0.00	0.00	
Financial Incentives for System Installation	0.00	5.00	5.00	
SWH Loan Programs	0.00	0.00	0.00	
Building Mandates	0.00	0.00	0.00	
Outreach Campaigns	0.00	5.00	5.00	
Product Standards and Certification	4.00	4.00	5.00	
Installer Certification	0.00	0.00	0.00	

4.1 SUMMARY

The Techscope score for Chile has increased from 2.36 in the Pre-GSWH phase, to 3.11 in 2013 and to 3.17 in 2014⁸. National conditions, overall business climate, and financing stayed at a stable level over the last decade. From 2009 to 2014, at least 72,984 m² of new collector area was installed and an annual average sales of 13,619 m² (30%) were reached as of June 2014. The single biggest impact for the SWH market was Law 20.365. Under the tax credit scheme for newly built houses from 2009 to 2013, the market grew significantly. According to the Ministry of Energy records, 55,266 m² of SWH was installed as of June 2014 under the tax benefit. In this phase with a favorable regulatory framework, the GSWH Initiative supported this growth by spurring public information sharing, capacity building, trainings, and networking as described in Section 2 of this report.

This growth in the SWH market resulted in avoided greenhouse gas emissions of 25,211,208 kg CO₂ equivalent per year by 2015 (Figure 10).

⁸ For a breakdown of all scores for the three stages, see section 9.

Figure 10. GHG Reductions (2015)



The Post-GSWH Initiative score remains higher despite the discontinuation of the tax credit scheme for two reasons:

(1) The Initiative provided technical expertise to the Ministry of Energy and worked with the MINVU on developing additional financial tools for social housing projects with significant results: according to records of the Housing and Urbanism Ministry (MINVU), a total number of 8,859 subsidies have been delivered (equivalent to 17,718 m² of SWH) for SWH in existing social housing between 2011 and 2014;

(2) The amendment and extension of Law 20.365 is currently in the regulatory process and the government has committed to a second phase up to 2020. Any improvement in Chile’s TechScope score over the next few years will depend on the development of SWH targets and building mandates, as well as the requirement of installer certifications.

4.2 SWH TARGETS

Indicator	Pre-GSWH	Mid-GSWH	Post-GSWH	GSWH Initiative Impact
SWH Targets	0.00	0.00	0.00	○

As of November 2015, Chile did not have a dedicated set of SWH targets. As such, the GSWH initiative did not have an impact on the development of binding SWH targets.

4.3 FINANCIAL INCENTIVES

Indicator	Pre-GSWH	Mid-GSWH	Post-GSWH	GSWH Initiative Impact

Financial Incentives for System Installation	0.00	5	5	
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The GSWH Initiative was highly influenced by the development of Law 20.365, which came into place in 2009, right before the Initiative was launched. From 2009 to 2013, the GSWH Initiative was thus able to focus its efforts on outreach and capacity building while working with the MINVU on developing additional financial tools for social housing projects. The GSWH initiative contributed to the development of a new financial mechanism to be administered by MINVU, providing subsidies to low-income families to install SWH with MINVU funds in existing social building, equivalent to US \$2,500 per household for 5,000 homes per year, resulting contributions of US\$12.5 million annually from 2016.

Since 2013, the GSWH Initiative has provided technical expertise on the amendment and extension of Law 20.365. The GSWH Initiative invested in institutional support and capacity building at the Ministry of Energy and cooperated with partners such as the GIZ Project Solar Energy for Electricity and Heat Generation and MST members (Solar Thermal Committee): ACESOL A.G., ChC- CDT; ICA Chile (PROCOBRE) ANWO, CHILECTRA, the School of Architecture, MINENERGIA and SEC (A. Abdelhai, personal communication, October 27, 2015).

As of November 2015, the Law is still in the regulatory process. The ending of the Law and the lengthy public discussion around the extension have led to an increasing distrust in the regulatory conditions for SWH destabilizing the market for local suppliers and distributors. This delay has also detracted from the progress the GSWH initiative made in increasing public awareness and consumer trust in SWH systems.

While the GSWH Initiative helped develop financial mechanisms and provided technical assistance to the Ministry of Energy, Law 20.365 has still not been extended. Without the extension of Law 20.365 the impact of the GSWH Initiative on financial incentives is considered moderate.

4.4 SWH LOAN PROGRAMS

Indicator	Pre-GSWH	Mid-GSWH	Post-GSWH	GSWH Initiative Impact
SWH Loan Programs	0.00	0.00	0.00	

Chile has not established a dedicated loan program for supporting SWH, but Law 20.365 provided tax exemptions for the installation of SWH systems in new homes prior to its expiration. The GSWH Initiative did not work on developing such a program although the tax exemption, the GSWH Initiative had a low impact in this area.

4.5 BUILDING MANDATES

Indicator	Pre-GSWH	Mid-GSWH	Post-GSWH	GSWH Initiative Impact
Building Mandates	0.00	0.00	0.00	

Chile has not established SWH building mandates and the GSWH Initiative did not work on developing building mandates. Therefore, the GSWH Initiative had no impact in this area.

4.6 OUTREACH CAMPAIGNS

Indicator	Pre-GSWH	Mid-GSWH	Post-GSWH	GSWH Initiative Impact
Outreach Campaigns	5.00	5.00	5.00	

Since 2006, the government has been supporting SWH outreach through trainings and capacity building programs for government agencies, including the Ministry of Housing and Urban Development and the Superintendence of Electricity and Fuel (SEC) since 2006. In 2009, the GSWH Initiative launched an information and outreach platform, www.programasolar.cl. Since the launch, this platform has been the central point for information exchange and updates in the Chilean SWH industry. With active information distribution, the development resources including handouts and manuals, and with cooperation with major stakeholders including the construction and installer industry, the Initiative had a high impact on public awareness and knowledge levels.

4.7 PRODUCT STANDARDS AND CERTIFICATION

Indicator	Pre-GSWH	Mid-GSWH	Post-GSWH	GSWH Initiative Impact
Product Standards and Certification	4.00	4.00	5.00	

As of November 2015, Chile did require product certifications for solar thermal systems. However, the National Standards Institute developed a set of quality standards for SWH systems and prepared a code

of practice for SWH installers. There are mandatory International Standards and National Institutions Certifications for solar collectors and water storage tanks. The GSWH Initiative provided support to improving product standards and certification through its capacity building and training efforts and therefore had a high impact on the market.

4.8 INSTALLER CERTIFICATION

Indicator	Pre-GSWH	Mid-GSWH	Post-GSWH	GSWH Initiative Impact
Installer Certification	0.00	0.00	0.00	

As of November 2015, Chile had no national installer certification program. However, the GSWH Initiative has been supporting a number of capacity building trainings. While there was no direct impact on mandatory certification programs, the GSWH Initiative has contributed to the increase in skills of installers of SHW systems.

4.9 LESSONS LEARNED AND THE PATH FORWARD

From 2006 to 2013, Chile experienced a constant increase of annual installed SWH capacity between 35% and 50%, beginning from a baseline of approximately 6,000 m² of SWH. By 2011, the country had already surpassed the GSWH initiative's goal of reaching 35,700 m² of SWH installed capacity and by 2012, the country had a total installed collector area of 93,883 m². Of those numbers, the GSWH initiative facilitated the installation of at least 26,360 m² SWH capacity leading up until June 2013. This growth in the SWH market resulted in avoided greenhouse gas emissions of 25,211,208 kg CO₂ equivalent per year in 2015 (Section 6.4). According to projected growth targets for the SWH market, Chile's estimated avoided emissions will be 219,880,791 kg CO₂ equivalent per year by 2020 (Section 6.5).

This report analyzed the extent to which the GSWH initiative had an impact on Chile's SWH market in seven areas of potential impact including SWH targets, financial incentives for system installation, SWH loan programs, building mandates, outreach campaigns, and product standards and certifications. **The results of this analysis conclude that the TechScope score for Chile has increased from 2.36 in the Pre-GSWH phase, to 3.11 in 2013 and to 3.17 in 2014.**

The single biggest impact for the SWH market was Law 20.365 that was enacted by the federal government. Under the tax credit, the SWH market grew significantly from 2009 to 2013. According to the Ministry of Energy records, 55,266 m² of SWH was installed as of June 2014 under the tax benefit. Within the context of the GSWH initiative and the Chilean government supported SWH growth in the following key areas:

- By providing a platform for public information sharing, www.progamasolar.cl. Since its launch in 2009, this platform has been the central point for information exchange and updates in the Chilean SWH industry, and a source for handouts and manuals.
- By providing capacity building, trainings, and networking opportunities for SWH installers and others in the industry.
- By providing support to improve product standards and certification through capacity building and training efforts.
- By providing technical expertise for the amendment and extension of Law 20.365.
- By developing pilot SWH projects in social housing and other facilities and contributing to the development a new financial mechanism to provide subsidies to low-income families to install SWH in existing social housing.

However, in three other enabling environment categories, the GSWH initiative did not have an impact in Chile's market. It did not lead to the establishment of national SWH targets, lending programs for SWH, or building mandates. These are three parameters of influence the federal government could pursue in the future.

In evaluating the GSWH initiative and progress in developing Chile's SWH market, several key lessons can be drawn:

Resource Coordination. The implementation SWH heating and other sustainable energy market development programs requires the coordination of existing staff, resources, and programs within government. The effort in Chile included an advisory group representing multiple institutions that provided coordination between the public and private sectors to help achieve development of legislation, regulation, and training programs according to the market's needs.

Strong Standards and Enforcement. It is important to provide regulatory bodies with the necessary powers to manage information regarding certified SWH equipment and the authority for certification bodies to perform audits of the implemented SWH projects. Similarly it is important to develop design guidelines and processes for the implementation of SWH, including certification programs and training.

Capacity Building. To ensure strong standards and enforcement, training for government officials and other professionals in the SWH field must also be provided to have professionals who are able to design, install, evaluate, and monitor the SWH market. The Chilean government must continue to deepen connections to educational institutions involved in this sector, both to ensure sufficient availability well-trained SWH installers, and to ensure capacity for monitoring and quality assurance from the government side.

Equity. The initiative provided significant savings on heating costs for low-income families. MINVU managed and implemented more than 8,800 grants for solar thermal collectors for social housing, providing significant savings for the most vulnerable families in Chile. Analyzing savings from programs like these as compared to fossil fuel heating alternatives can provide strong support for continuing incentive programs moving forward. The Chilean government could consider the mandatory installation of SWH systems in the design of new public infrastructure where the return on investment is highly profitable and continue installations in social housing, where families benefit the most from the cost savings on heating fuel.

Demonstration/Pilot Projects. The Ministry of Energy implemented a significant number of SWH demonstration projects. These projects have been monitored to count technical information solutions, review designs, and analyze return on investment, which will be important information to consider for new SWH initiatives and other renewable energy projects.

Program Stability and Holistic Implementation. To ensure growth in the SWH industry, incentive programs need to remain stable. The expiration of the tax credit for solar installations has severely impacted growth in the SWH market in Chile and made stakeholders in that market uncertain of the future. Steady growth in the industry will require consistent incentives and a holistic approach to developing a SWH market focusing on multiple parameters as outlined in this report. SWH market momentum required policy stability.

In summary, Chile has strong potential as an emerging market for SWH, but there is room to do more to enable a stronger SWH market building on the lessons learned described above. The tax credit provided under Law 20.365 ended in 2013, severely stalling the growth of the SWH market, and demonstrating the importance of financial mechanisms, stable incentives, and holistic program support as part of a SWH market development. To trigger further market growth, Chile needs clear and reliable regulatory policies and financial incentives that are stable and address multiple aspects of market development.

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SECTION 6 ANNEX OF SOLAR WATER HEATING TECHSCOPE MARKET READINESS ASSESSMENT TOOL AND GHG ANALYSIS

6.1 PRE-GSWH TECHSCOPE ANALYSIS

Techscope Report Solar Thermal Market Analysis

Country:

Chile PRE GSWH

SUMMARY OF RESULTS

Parameter	Parameter Weight	Indicator Weight	Indicator	Raw Score	Weighted Score
I. Solar Water Heating Support Framework	29%	5%	SWH Targets	0.0	0.00
		8%	Financial Incentives for System Installation	0.0	0.00
		7%	SWH Loan Programs	0.0	0.00
		5%	Building Mandates	0.0	0.00
		4%	Outreach Campaigns	5.0	0.20
II. National Conditions	30%	5%	Solar Insolation	2.2	0.11
		4%	SWH Market Penetration	0.0	0.00
		5%	Solar Thermal Growth: Residential Energy Consumption Growth	1.3	0.06
		4%	Solar Thermal Growth: SWH Growth	5.0	0.20
		7%	Competitiveness: Payback Period	3.0	0.21
III. Financing	20%	5%	Competitiveness: Heating Fuel Subsidy	5.0	0.25
		5%	Country Credit Rating	4.0	0.20
		15%	Access to and Cost of Financing	4.0	0.60
IV. Business Climate	21%	5%	Doing Business Index	4.0	0.20
		3%	Manufacturing Value Added (% GDP)	4.0	0.12
		5%	Product Standards and Certification	4.0	0.20
		4%	Installer Certification	0.0	0.00
		4%	Industry Association	0.0	0.00

Overall Score **2.36**

Assessment of Overall Strength of Market



Explanation of Scores

Score of 0 -2: SWH enabling environments are considered to be “emerging” and could likely benefit from significant additional national (or international) support if the objective is to accelerate market growth.

Score of 2-3: SWH enabling environments are considered to be “good” with a SWH market positioned for increased growth.

Score of 3-4: SWH enabling environments are considered to be “strong” and are likely to attract significant growth. Many of the world’s leading SWH markets will score between 3 and 4.

Score of 4-5: SWH conditions are “very strong” – policy, market, financial, business forces are closely aligned in support of SWH and market growth is likely to be rapid.

6.2 MID-TERM GSWH TECHSCOPE ANALYSIS

Techscope Report Solar Thermal Market Analysis

Country:

Chile MID GSWH

SUMMARY OF RESULTS

Parameter	Parameter Weight	Indicator Weight	Indicator	Raw Score	Weighted Score
I. Solar Water Heating Support Framework	29%	5%	SWH Targets	0.0	0.00
		8%	Financial Incentives for System Installation	5.0	0.40
		7%	SWH Loan Programs	0.0	0.00
		5%	Building Mandates	0.0	0.00
		4%	Outreach Campaigns	5.0	0.20
II. National Conditions	30%	5%	Insolation	2.2	0.11
		4%	SWH Market Penetration	0.0	0.00
		5%	Residential Energy Consumption Growth	4.8	0.24
		4%	SWH Market Growth	5.0	0.20
		7%	SWH Competitiveness: Payback Period	3.0	0.21
		5%	SWH Competitiveness: Heating Fuel Subsidy	5.0	0.25
III. Financing	20%	5%	Country Credit Rating	4.0	0.20
		15%	Access to Finance	3.5	0.53
IV. Business Climate	21%	5%	Doing Business Index	5.0	0.25
		3%	Manufacturing Capacity	4.0	0.12
		5%	Product Standards and Certification	4.0	0.20
		4%	Installer Certification	0.0	0.00
		4%	Industry Association	5.0	0.20

Overall Score **3.11**

Assessment of Overall Strength of Market



Explanation of Scores

Score of 0-2: SWH enabling environment is “emerging” and could likely benefit from additional support to accelerate SWH market growth.

Score of 2-3: SWH enabling environment is “good” with a SWH market positioned for increased growth.

Score of 3-4: SWH enabling environments are considered to be “strong” and are likely ready to attract investment.

Score of 4-5: SWH conditions are “very strong” – policy, market, financial, business conditions are aligned to support SWH and market growth is likely to be rapid.

6.3 FINAL GSWH TECHSCOPE ANALYSIS

Techscope Report Solar Thermal Market Analysis

Country: **Chile Post GSWH**

SUMMARY OF RESULTS

Parameter	Parameter Weight	Indicator Weight	Indicator	Raw Score	Weighted Score
I. Solar Water Heating Support Framework	29%	5%	SWH Targets	0.0	0.00
		8%	Financial Incentives for System Installation	5.0	0.40
		7%	SWH Loan Programs	0.0	0.00
		5%	Building Mandates	0.0	0.00
		4%	Outreach Campaigns	5.0	0.20
II. National Conditions	30%	5%	Solar Insolation	2.2	0.11
		4%	SWH Market Penetration	0.1	0.00
		5%	Solar Thermal Growth: Residential Energy Consumption Growth	5.0	0.25
		4%	Solar Thermal Growth: SWH Growth	5.0	0.20
		7%	Competitiveness: Payback Period	3.0	0.21
		5%	Competitiveness: Heating Fuel Subsidy	5.0	0.25
III. Financing	20%	5%	Country Credit Rating	4.0	0.20
		15%	Access to and Cost of Financing	4.0	0.60
IV. Business Climate	21%	5%	Doing Business Index	4.0	0.20
		3%	Manufacturing Value Added (% GDP)	3.0	0.09
		5%	Product Standards and Certification	5.0	0.25
		4%	Installer Certification	0.0	0.00
		4%	Industry Association	5.0	0.20

Overall Score **3.17**

Assessment of Overall Strength of Market



Explanation of Scores

- Score of 0 -2:** SWH enabling environments are considered to be “emerging” and could likely benefit from significant additional national (or international) support if the objective is to accelerate market growth.
- Score of 2-3:** SWH enabling environments are considered to be “good” with a SWH market positioned for increased growth.
- Score of 3-4:** SWH enabling environments are considered to be “strong” and are likely to attract significant growth. Many of the world’s leading SWH markets will score between 3 and 4.
- Score of 4-5:** SWH conditions are “very strong” – policy, market, financial, business forces are closely aligned in support of SWH and market growth is likely to be rapid.

6.4 GHG CALCULATION BASED ON ACHIEVED RESULTS (2015)

TechScope Report

Greenhouse Gas Calculator for Residential Solar Water Heating

Country:

Chile 2015

OUTPUT OF SOLAR WATER HEATING SYSTEMS INSTALLED

Solar Hot Water Systems Installed (m2)

	TOTAL	72,984
		0
		0

Energy Output (kWhth/yr)

46,758,085
46,758,085

TOTAL GREENHOUSE GAS REDUCTIONS

25,211,208
kg CO2e/yr

Equivalent to:



5,320
Passenger Vehicles on the Road



58,641
Barrels of Oil Burned

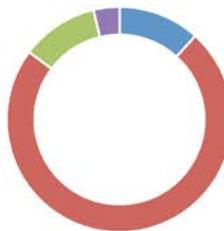


12,283
Tonnes of Coal Burned

GHG REDUCTIONS BY AVOIDED FOSSIL FUEL TYPE

AVOIDED EMISSIONS

	kg CO2e/yr
Residual Fuel Oil	2,951,094
Wood / Wood Waste	18,533,608
Electricity	2,790,517
Natural Gas	935,988
TOTAL	25,211,208



	Residual Fuel Oil
	Wood / Wood Waste
	Electricity
	Natural Gas

6.5 GHG CALCULATION BASED ON ESTIMATED RESULTS (2020)

TechScope Report

Greenhouse Gas Calculator for Residential Solar Water Heating

Country:

Chile 2020

OUTPUT OF SOLAR WATER HEATING SYSTEMS INSTALLED

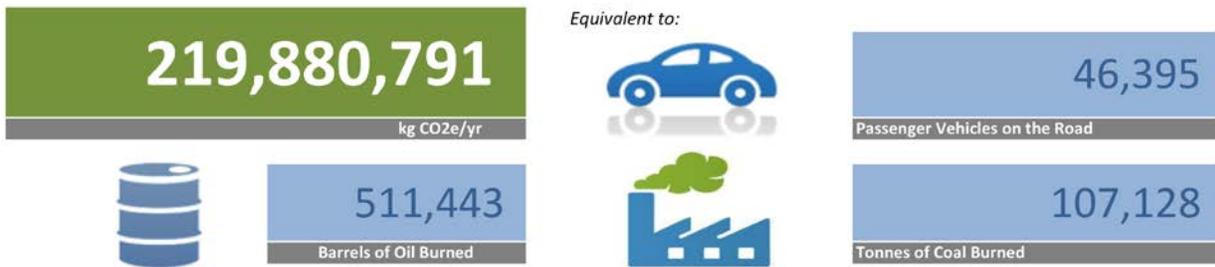
Solar Hot Water Systems Installed (m2)

	TOTAL	1,011,533
		0
		0

Energy Output (kWhth/yr)

392,095,420
392,095,420

TOTAL GREENHOUSE GAS REDUCTIONS



GHG REDUCTIONS BY AVOIDED FOSSIL FUEL TYPE



Energy Branch
Division of Technology, Industry and
Economics
United Nations Environment Programme
15, rue de Milan
F-75441 • Paris CEDEX 09
France
Tel.: +33 1 44 37 14 50
Fax: +33 1 44 37 14 74
Email: unep.tie@unep.org
www.unep.org/energy

www.unep.org

United Nations Environment Programme
P.O. Box 30552 Nairobi, Kenya
Tel.: ++254-(0)20-62 1234
Fax: ++254-(0)20-62 3927
E-mail: cpiinfo@unep.org



In 2009, the United Nations Environment Programme (UNEP) and the United Nations Development Programme (UNDP) jointly launched the Global Solar Water Heating (GSWH) Market Transformation and Strengthening Initiative (“the GSWH Initiative”) with funding from the Global Environmental Facility (GEF) and co-financing from the International Copper Association (ICA). The objective of the GSWH project is to develop, strengthen and accelerate the growth of the solar water heating (SWH) sector.

The GSWH Initiative supported SWH national market development in five countries including Chile. This report evaluates SWH market development in Mexico under the GSWH-supported national program using the Solar Water Heating TechScope Market Readiness Assessment Methodology and Analysis Tool to provide high-level assessments of the Mexican SWH market before, during, and after the GSWH Initiative. This report also provides a summary of lessons learned and best practices to encourage the implementation of national SWH initiatives in countries around the world.