

Technical Cooperation (TC) Document CH-X1007

I. Basic Information for TC

- Country/Region: Chile
- TC Name: Promotion and Development of Local Solar Technologies in Chile
- TC Number: CH-X1007
- Associated Loan/Guarantee Name: N/A
- Associated Loan/Guarantee Number: N/A
- Team Leader/Members: Christiaan Gischler, Project Team Leader (INE/ENE); Natacha Marzolf (INE/ENE); Paola Méndez (INE/ENE); Antonio Levy (INE/ENE); Virginia Snyder (INE/ENE); Angel Bohorquez Colombo (INE/ENE); Wesly Ureña (INE/CCS); Christoph Tagwerker (INE/CCS) and Andrés Consuegra (LEG/SGO) under the supervision of Leandro Alves (INE/ENE/CHF).
- Date of TC Abstract authorization: October 1st 2009
- Donors providing funding: Global Environment Facility (GEF)
- Beneficiary: Government of Chile (GoC)
- Executing Agency and contact name: Ministry of Energy (MINENERGIA)
- IDB Funding Requested: US\$2,727,273
- IDB Funding: US\$650,000
- Local counterpart funding, : US\$30,900,000
- Other funding: (ECLAC) US\$200,000
- Execution period: 48 months
- Disbursement period (which includes execution period): 54 months
- Required start date: Last quarter 2012
- Types of consultants (firm or individual consultants): firms and individual consultants
- Prepared by Unit: Energy Division (INE/ENE)
- Unit of Disbursement Responsibility : Country Office Chile (CCH)
- TC Included in Country Strategy (y/n); y TC included in CPD (y/n): y
- GCI-9 Sector Priority: Yes. Since it is closely aligned with the sector priority of protecting the environment, respond to climate change and promote renewable energy.

II. Description of the Associated Loan/Guarantee (estimated length: 1 page)

No loan or guarantee associated. Stand alone operation.

III. Objectives and Justification of the TC (estimated length: 1 page)

Objectives: The general objective of this project is to support the Government of Chile (GoC) and the Ministry of Energy (MINENERGIA) develop a solar industry, for solar water heating (SWH) and power generation in Chile (Photovoltaic (PV) panels and Concentrated Solar Power (CSP)). The specific objectives are to: (i) promote technology transfer, institutional strengthening and capacity building in solar technologies; (ii) develop pilot projects using solar technologies (SWH and power generation) and (iii) support the design of incentives, financial mechanisms and a public awareness campaign to promote solar projects with SWH and solar power generation technologies.

The current country strategy (CS) (GN-2642-1) for the period 2011-2014, was approved on December 8th 2011. This TC is aligned with the IDB Strategic Objective of (i) Supporting the implementation of the agenda for climate change adaptation and mitigation at the national level. Specifically this project will contribute to two of the pillar's indicators (i) Capacity for low carbon-content power generation and (ii) Generation capacity with NCRE. This TC is aligned with the CGI-9,

since its activities will focus on protecting the environment, responding to climate change and promoting renewable energy.

Justification¹. Between 1990 and 2008, the Chilean economy has been growing at an average annual rate of 5.5%, strongly driven by high copper prices reached in recent years. This economic growth, combined with a lack of attention paid to energy efficiency issues throughout the economic sectors, has resulted in an energy demand that has achieved growth rates higher than Gross Domestic Product (GDP) growth.

Electricity supply in Chile is characterized by a matrix where the main source of primary energy in terms of participation in the national installed capacity is hydro (38.2%) followed by natural gas (36.8%), coal (15.9%) and diesel (7.4%). This composition of the energy matrix makes the Northern Interconnected System (SING, acronym in Spanish) and Central Interconnected System (SIC, acronym in Spanish) highly vulnerable, due to their strong dependency on natural gas from Argentina and hydrological conditions, respectively².

To mitigate this vulnerability the market has reacted by introducing the most competitive energy source, namely coal, increasing the carbon composition of the electricity matrix. Nevertheless, Chile has an enormous potential on Renewable Energy (RE), ranging from the conventional wind to unconventional sources such as geothermal and solar³. Despite this huge potential, there is virtually no solar power generation in Chile.

In the last years, the increase of energy prices and the technological maturation of many Non-Conventional Renewable Energy (NCRE) technologies, along with the removal of barriers by the GoC, have fostered the development of NCRE projects in the country. Thus, the first projects in the SIC system that use wind power, biogas, small hydroelectric plants and biomass, have begun operating. The GoC has developed a series of initiatives to diversify the country's energy matrix and accelerate the introduction of NCRE in the energy sector. As part of these activities, the GoC will tender two pilot projects: (i) a grid connected PV farm to network of up to 0.5 MW of installed capacity (not part of this project) and (ii) a CSP of at least 5 MW. Both competitive processes will be administered by the Production Development Corporation of Chile (CORFO, acronym in Spanish), with the technical management of MINENERGIA.

Many different barriers contribute to hinder the introduction of solar power, namely:

- (i) **Legal and regulatory issues.** Although the net metering law, which allows the interconnection of PV systems to the grid, was sent to Parliament in 2011, no technical regulation regarding issues such as technical rules or tariffs has been defined. No decree addressing these matters was issued in 2011 since it would require a major negotiation with the sector stakeholders and more detailed information about cost and benefits of this technology.
- (ii) **Lack of quality control of solar equipment.** No quality control procedure for solar equipments, components or systems is provided and no voluntary norms or certification for the installation of SWH or PV applications is required. Mandatory standards for performance or installation of energy systems apply only to devices based on fuel and electricity, which are audited by the *Superintendencia de Electricidad y Combustibles* (SEC) in order to ensure quality and safety.

¹ For more information see detailed analysis in Full Size Document [IDBDOCS-#36829358-Full Doc CH-X1007 a CEO](#)

² For a complete analysis of this situation see FFLA (2009) "*Opciones para la matriz energética eléctrica – insumos para la discusión*".

³ MINENERGIA together with the German International Cooperation (GIZ acronym in German) assessed the potential in Northern regions of the country, particularly in the regions of Arica and Parinacota, Tarapacá and Antofagasta, with radiation levels of 3.000 kWh/m²/year or 8,0 kWh/m²/day, considered very high values by international standards.

- (iii) **Perception and awareness barriers.** An entry barrier to the promotion of solar technologies in Chile is the lack of knowledge and the mistrust of technology by potential customers as a result of poor experiences in the past. In view of this situation, there appears to be a consensus that the industry urgently needs to develop standards for the product.
- (iv) **Financial and market barriers.** There are limited sources or mechanisms for the promotion of solar technology in Chile. Most financial institutions and commercial banks are not very familiar with RE investments and cannot adequately evaluate the benefits and risks of entering into this market *niche*. Law 20.365 establishes tax exemption on SWH systems only for new dwellings⁴. Commercial and industrial enterprises do not receive public incentives to promote the installation of this technology. No incentives for CSP or DG with PV technologies have been developed. Given that there is no experience or knowledge regarding CSP in Latin America and the Caribbean (LAC), investors may not be able to take the risk under the current legal and regulatory framework, since it does not provide any guarantee of electricity prices in the long term.
- (v) **Professional and technical capacity barriers.** Overall, there is limited knowledge in Chile with respect to RE, including: characteristics, applications, benefits, operations, and environmental and sustainability advantages with respect to other self-generation alternatives (e.g., diesel-fueled electricity generators). There is a shortage of technical capabilities for the design, execution, monitoring and maintenance of Solar Projects. Engineers and technicians from the public and private sectors have virtually no experience with solar technologies⁵. Moreover, there is no formal training program, resulting in a lack of trained technicians able to develop new projects, operate the systems, and provide adequate technical service. Some initiatives have been carried out in this field, but most of them have been focused on providing simple solar solutions mainly at the household level.

This GEF project will focus on the promotion of solar technologies, namely SWH, CSP and Distributed Generation (DG) with PV applications and will support the design and installation of the CSP commercial plant in the northern part of Chile. These technologies can significantly contribute to reducing the dependency on energy from fossil fuels and increasing energy security, since solar irradiation is an indigenous resource.

IV. Description of activities/components and budget (estimated length: 1-2 pages)

This investment grant (IG) has three components:

Component I: Promote transfer of technology and capacity building in solar technology. The activities to be performed under this component include:

This subcomponent will (i) Assess the potential for development of solar thermal projects (CSP) and for PV for DG in SING and SIC; (ii) Assessment of economic, environmental and legal requirements for the implementation of PV and CSP plants in SIC and SING; (iii) draft of standards and guidelines for the designs and installation of PV systems; (iv) Definition of a PV-CSP energy pipeline project development; (v) development of a pre-investment study for the deployment of at least 5 MW of CSP or PV plant; and (vi) training activities for implementing PV and CSP projects through technical missions and local seminars.

⁴ The maximum potential benefit of the credit that considers the value of the new house and the land, is determined by the following scale: 100% of the cost for buildings valued below US \$75,000; 40% of the cost for buildings valued between US \$75,000 and US \$113,100; and 20% of the cost for buildings valued between US \$113,101 US\$ and US \$169,653.

⁵ The PDF B project "Training Program Plan for the Introduction of the Use of Renewable Energies in Rural Electrification in Chile" verified the lack of formal training programs in the field of renewable energies in all of the country. In particular, there are no polytechnic training programs or university level training. Of Chile's 50 universities, only three (6%) provide instruction on subjects related to renewable energies in mechanical, electrical and hydraulics engineering.

Component 2: Development of demonstration projects using solar technologies.

This subcomponent will (i) develop solar demonstrative projects: PV for DG for residential and small commercial applications using the know-how and upgraded skills funded through component 1 and a CSP plant in the northern part of Chile (ii) upgrade SWH manufactures in order to improve the increase the local product quality of SWH; (iii) carry out the monitoring and evaluation assessment of operational variables and ex-post results of the projects through the installation of monitoring systems to assess the ex-post benefits. This will allow to assess the quality of the ex ante and the requirements and costs of operation and maintenance. The information obtained from this assessment process will be used for information and dissemination purposes

For developing the CSP activities, MINENERGIA and IDB will work together with CORFO and the Economic Commission for Latin America and the Caribbean (ECLAC). CORFO and ECLAC will be participating to the financing of capacity building related activities.

Component 3: Design of incentives, financial mechanisms and public awareness campaign. The objective of this component is to replicate solar-based technology and ensure its long-term sustainability. This component will consist of:

(i) Identification, assessment of financial and other incentive mechanisms including credit schemes and tax incentives to promote solar technologies based on international experience (CSP, PV and SWH); (ii) Assessment of international experiences on rules and technical regulation for CSP and PV-DG; (iii) Design and implementation of a public awareness and education campaign to promote and replicate solar technology projects including information dissemination within the private and public sector.

Indicative Results Matrix

Impact Indicators	Base Level (2010)	Target Level (2016)
Increase on SWH installation	0	1.506 MWhth/yr
Solar PV installation increased nationwide	0	526 MWh/yr
Outcome Indicators	Base Level (2010)	Target Level (2015)
A CSP Plant installed (MW) (CSP)	0	5 MW
PV-DG installed (MW)	0	0.3 MW
Electricity generated with solar technologies (MWh/year)	0	13,665 MWh
Certified Solar Water Heating Systems are installed	0	100 m2 of SWH installed
Energy generated with Solar thermal energy	0	75 MWhth
Financial mechanisms & Incentives for solar technologies designed	0	Two new solar projects are financed by entities that received training and/ or made use of the incentives provided by the project
GHG emissions reductions achieved due to Solar projects (tCO2/year)	0	6.850

Output Indicators	Baseline 2011	2012	2013	2014	2015
Component 1. Promote transfer of technology and capacity building in solar technology					
Economic and technical assessment for CSP, SWH and PV potential, including site assessments carried out	0	1 study developed			
Definition of a PV-CSP energy pipeline project development	0		1 Pipeline Defined		
Support for a pre-investment study for the deployment of at least 5 MW of CSP or PV plant	0	1 Draft Report	1 final report developed	-	-
Definition of standards and monitoring protocols for solar panels	0		Draft for discussion available		Final protocols developed
Component 2: Development of demonstration projects using solar technologies					
Upgrade equipment for manufacturing installed	0		At least 1 firm upgraded with international standards		
Design and tender of a CSP Plant	0 MW				5 MW
Design and installation of demonstrative projects	0 PV 0 SWHS	0 m2 SWH 0 kW PV	50 m2 SWH 50 kW PV	80 m2 SWH 150 KW	100 m2 SWH 300 KW
Component 3: Design of incentives, financial mechanisms and public awareness campaign					
Incentives mechanism for the implementation of solar applications proposed and international experience assessed and share it with local partners	0 Study developed	0 Study developed	1 Study developed	1 Study developed	
Assessment of regulation for the integration of DG projects with solar technology carried out	0 Study developed	0 Study developed	0 Study developed	1 Study developed	
Design and implementation of a public awareness and education campaign.	0	0	0	1 Campaign designed 1 Workshop to present findings carried out	1 Campaign implemented 1 Workshop to present findings carried out

Indicative Budget

Component	GEF	IDB	CORFO	MINENERGIA ⁶	ECLAC	Total	
1	Promote transfer of technology and capacity building in solar technology	173,500	470,000	600,000	0	200,000	1,443,500
2	Development of pilot projects using solar technologies	2,217,813	20,000	0	30,000,000	0	32,237,813
3	Design of incentives, financial mechanisms and public awareness campaign	83,000	160,000	0	0	0	243,000
	Project Management	252,960	0	0	300,000	0	552,960
TOTAL		2,727,273	650,000	600,000	30,300,000	200,000	34,477,273

Monitoring and Evaluation: The outputs and outcomes defined in the Results Framework will be the base for the Monitoring and Evaluation (M&E) plan of this project. This M&E Plan will be prepared and executed by the Executing Agency (EA) and supervised by INE/ENE together with the Country Office in Chile. The Project Manager (PM) will be responsible for preparing Progress Reports (PR) based on the M&E plan every six (6) months. The PRs will have to be available to IDB and GEF upon demand. Additionally, the PM in collaboration with the IDB will annually prepare a Project Implementation Review (PIR) in accordance with GEF requirements. The costs for the monitoring plan will be assumed by the project.

A midterm evaluation report will be prepared by an independent consultant whenever 50% of the GEF resources have been disbursed, or 24 months following the effective date of the project contract, whichever comes first. A final evaluation will be prepared no later than 6 months after the project has disbursed 100% of the resources. All reports will include all technical and non-technical results, as well as a compendium of the main lessons learned. As MINENERGIA is a public institution, according to the Chilean Law, the *Contraloría General de la República* will be annually auditing the project. For more details see [M&E Plan CH-X1007](#).

(i) Executing agency and execution structure (estimated length: 1 page)

MINENERGIA will be the EA of this GEF project, as stated in the request letter of the GoC⁷. The EA will report to the IDB on the technical and administrative matters of the project, prepare and present progress reports, control and supervise the fund's administration, request disbursements, and maintain the communication channels with the IDB.

A Project Manager (PM) will be hired to provide technical oversight, coordination and supervision for the project. **As a condition prior to first disbursement, the PM will be selected and IDB will provide the non-objection accordingly.**

⁶ Per rules of the Government of Chile regarding public funding and private financing, the private sector must meet or exceed the amount provided by the government, i.e. 1:1 ratio. The private sector will provide the parallel financing once the Program's tender processes are awarded.

⁷ See request Letter [Solicitud de CT](#)

A Project Operational Guidelines (POG) will be defined between the IDB and MINENERGIA in order to establish responsibilities and obligations for the execution of the project, as well as for monitoring and evaluation activities.

Technical and basic responsibility for the project rests with MINENERGIA. CSC/CCH and INE/ENE will also conduct technical supervision and provide additional support, which includes supervision to procurement of studies commissioned with contribution resources, technical supervision of the Terms of Reference (TOR), and review of the technical quality of all studies financed under this project, regardless of the source of financing. **As a condition prior to second disbursement, the POG will be defined and agreed by MINENERGIA and IDB.**

(ii) Major issues (estimated length: 1 page)

In the following table the main risks identified and its mitigations measures are described:

Table 1: Risk Matrix

	Risks	Likelihood	Mitigation Measures
1	Lack of political commitment for development and implementation of solar projects	Low	The last administration had enacted several laws that promote NCRE, particular solar technology. All activities have been prioritized with the new authorities
2	Lack of national industry expertise to manufacture the components of the solar applications	Medium	Chile has a strong tradition is metal works and manufacturing in general, therefore given the correct incentives through this project, this risk can be mitigated. The tradition in metal works and manufacturing will be highly relevant to the installation of CSP and SWH systems, but solar power components will be imported
3	Lack of local expertise to design, construct, operate and maintain solar systems throughout its lifetime	Medium	Chile has highly trained technical and professional human resources capable of designing, building, operating and maintaining technology in general. Therefore providing the correct incentives and training through this project, this risk can be mitigated
4	Lack of interest from private sector to develop PV, CSP or SWH projects	Low	This risk can be mitigated given the financial incentives already in operation and the enacted laws, together with the awareness campaign provided by this project
5	Local financial market not willing to lend to NCRE using solar applications	Medium	This risk is addressed via the dissemination of CORFO's credit line for RE, EE and clean investments

	Risks	Likelihood	Mitigation Measures
6	Lack of raw materials to build solar applications	Low	Chile, as one the most important mining countries in the world, has important sources of mineral and raw material required for solar power, such as copper, lithium, silicon among others. This can represent an opportunity for Chile
7	Failure to identify or being able to secure optimal locations for CSP	Low	The North of Chile is the driest and one of the most isolated areas in the world, hence vast amounts of barren land is available. The 2008-2011 wind energy assessment project funded by GIZ carried out measurements to identify areas suitable for exploitation of wind and solar thermal energies. Furthermore, in 2010 the Ministry of National Assets (MINBIENES) and the Ministry of Energy (MINENERGIA) signed an agreement to promote the development of renewable energy projects on public lands suitable for implementation of renewable energies, specifically for wind and solar projects (Ministry of Energy resolution No. 033). Clause N°6 of the signed agreement between the Ministry of National Assets (MINBIENES) and the Ministry of Energy (MINENERGIA) states the promotion of the development of renewable energy projects on public lands and specifies the latitude and longitude coordinates of the public land assigned for CSP projects

(iii) Exceptions to Bank policy

No exceptions to Bank policy are foreseen. For procurement of goods and services and the selection and contracting of consultants the IDBs policies established in documents GN-2349-7 and GN-2350-7 will apply. Ex-ante review of procurement procedures will only apply to contracts whose costs exceed the ICB thresholds established by the IDB.

(iv) Environmental and Social Strategy

No environmental or social risk is foreseen. This TC is classified as C. For more information please see link to Environmental Filters - [Filtros Ambientales](#).

Annexes

Full Document: See [IDBDOCS-#36829475-CH-X1007 Full Size to CEO endorsement](#)

Risk Assessment: See [IDBDOCS-#36596018-CH-X1007 - Appendix I - Risk Assessment](#)

DEM: See [IDBDOCS-#36596047-DEM CH-X1007](#)

Procurement Plan: See [IDBDOCS-#36585536-Annex II - Procurement Plan - CH-X1007 a GEF](#)