PROGRAMME BARRIER REMOVAL FOR RURAL ELECTRIFICATION WITH RENEWABLE ENERGIES

(Programa Remoción de Barreras para la Electrificación Rural con Energías Renovables)

UNDP-GEF PROJECT (Project CHI/00/G32 (11799)

FINAL EXTERNAL EVALUATION

(AT THE END OF THE PERIOD OF IMPLEMENTATION)

FINAL REPORT
(Final Version 2.0)

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ACRONYMS

APR – PIR	Annual Progress Report of the project – Project Implementation Review
BIP	Integrated Projects Database, MIDEPLAN
CNE	National Energy Commission
CTA	Chief Technical Adviser of Project CHI/00/G32 (ATP)
CONAMA	National Environment Commission
CONAFE	National Electrical Force Company
COP	Conference of the Parties to the UNFCCC
CORE	Regional Council
CORFO	Production Development Corporation
DAEE	Energy Access and Equity Division
DIPRES	Directorate of Budget at the Ministry of Finance
EBI o IDI	Project datasheet of the National Investment System
FNDR	National Fund for Regional Development
FNDR-ER	National Fund for Regional Development for Rural Electrification
GEF	Global Environmental Facility (FMAM)
GHG	Greenhouse Effect Gases (GEI)
GDP	Gross Domestic Product (PIB)
GORE	Regional Government
HIB	Hybrid generation technology (NCRE) for rural electrification
IADB	Inter-American Development Bank (BID)
IDI	Investment datasheet of IPB, MIDEPLAN/MINISTRY OF FINANCE
INN	National Standards Institute
LAC-SURF	UNDP Regional Service Centre for Latin America and the Caribbean
MCH	Micro- hydro power plants
MIDEPLAN	Ministry of Planning and Cooperation
MDG	Millennium Development Goal (ODM)
MTE	Mid-Term Evaluation
NCRE	Non-Conventional Renewable Energies (ERNC)
NREL	National Renewable Energy Laboratory (USA)
PER	Rural Electrification Programme
PIR o APR	Project Implementation Review - Annual Progress Report
PRODOC	Project Document CHI/00/G32
PV	Photovoltaic power generation technology (PV)
SEC	Superintendence of Electricity and Fuels
SNI	National Investment System
SEREMI	Regional Secretariat
SERPLAC	Regional Secretariat for Planning and Coordination
SUBDERE	Regional and Administrative Development Undersecretary's Office
TPR	Tripartite Review
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change (CMNUCC)
US$	United States Dollar
UTER	Rural Electrification Technical Unit of the Regional Governments
Wp	Watt peak (Vatio pico)

CURRENCY

1 US$ = 485 $ Chilean pesos (as of January 2012)

UNITS

kWh	kilowatt/per hour
kW	kilowatt
MW	megawatt

0. ABSTRACTS

0.1 EXECUTIVE SUMMARY

The project ***Barrier Removal for Rural Electrification with Renewable Energies- UNDP-GEF (CHI/00/G32 Project (11799)*** has been implemented by the National Energy Commission (CNE) and subsequently, at the end of the implementation, by the Energy Access and Equity Division (DAEE) at the Ministry of Energy of Chile. The PRODOC was signed by all parties in September 2001 and the project began implementation in October of such year. The implementation period was initially 5 years and was extended, afterward, several times, until March 2012. The project has been implemented in the double initial time for reasons which will be explained below.

The project background related to the energy situation of rural population in Chile and the path traced by the country towards improving their lives through sustainable development indicate that *the project is relevant to the Chilean context, in line with GEF objectives*, and those guiding the country, both toward the fulfillment of the Millennium Development Goals and a low-emissions economy. Since the mid-nineties, Chile established a Rural Electrification Programme (PER) based on traditional grid extension and diesel and gasoline generators, for which operation and maintenance costs are very high when it comes to dispersed rural population in remote areas. Renewable energies accounted for an alternative supply, but had barriers to their use. To present, PER has accomplished its stated objectives and Chile has one of the highest electricity coverage rates of the continent (96.5% as of 2011) and the Barrier Removal project has contributed to establish Non-Conventional Renewable Energies (NCRE) as a valid option to continue to raise the coverage rate.

The *global environmental objective* of the project is to reduce carbon emissions caused by the use of electricity in Chile. The project is consistent with GEF Operational Programme 6, "Promoting the Adoption of Renewable Energies by Removing Barriers and Reducing Implementation Costs" and seeks to remove institutional and financial barriers with regards capacity and knowledge to the incorporation of NCRE in rural electrification in Chile, thus reducing emissions of Greenhouse Gases (GHGs).

The *programme objectives* aim to remove the barriers that prevent the use of NCRE in rural electrification in Chile, through the development of several activities that would reduce GHG emissions produced by energy sources in rural areas. To this end, the project shall conduct the following activities:

i. Promoting the removal of barriers to the successful use of renewable energies in the chilean rural electrification programme, generating within the existing institutional framework, conditions for the development of a NCRE market in Chile,
ii. Promoting public and private investments in terms of the development of rural electrification with non-conventional energies, and
iii. Promoting social equity and improvement of living conditions in rural communities.

The achievement of the objectives of the programme required the *removal of the following barriers* identified in the PRODOC in the elaboration of the project:

a) lack of rural electrification project portfolios with NCRE;
b) lack of regulations for renewable energy equipments;
c) lack of certification procedures for renewable energy systems and their installation;
d) lack of general knowledge with respect to NCRE;
e) lack of formal training programmes;
f) existence of high investment costs in projects with NCRE;
g) perception of associated risks with renewable energy technologies;
h) lack of technical expertise, equipment and analysis to perform wind resources measurements;
i) lack of NCRE commercial projects with economies of scale.

The *project cost* is U.S. $32,397,300 which includes a GEF contribution of U.S. $6,067,300 and a chilean co-financing of U.S. $26,330,000 (of which U.S. $755,000 were in kind). The project budget execution level as of December 2010 was 97%.

The *objective of the Final Term Evaluation* is to determine the relevance, performance and success of the project; look for signs of potential impact and sustainability of results, including the project's contribution to capacity building and the achievement of global environmental goals. It also attempts to identify and document lessons learned and shall include recommendations that can improve the design and implementation of other UNDP/GEF projects. The main results and findings[1] of the Final Term Evaluation are[2]:

Project Formulation

For the project implementation, 9 components were designed under a coherent logical framework to remove barriers towards the achievement of the objectives. Through this logical framework, the expected results for each component were also formulated, indicators and critical assumptions. These components are:

1. Generation of a Portfolio of Rural Electrification Projects using NCRE.
2. Elaboration of Technical Regulations for Electrification Systems with NCRE.
3. Elaboration of Certification Procedures for Electrical Systems with NCRE.
4. Implementation of a Promotional Campaign for NCRE.
5 Development of a Training Programme.
6. Design and Implementation of a Large-Scale Photovoltaic Demonstration Project
7. Developing a Financial Mechanism for NCRE Projects.
8. Reduction of the CO_2 Emissions by means of Hybridization Projects with Diesel-Fueled Systems Currently in Operation
9. Creation of Technical Capacity Building to Evaluate Wind Resources in Chile.

[1] The methodology included review of documents received from the parties, interviews with such groups, included other actors, field visits and submission of preliminary results to the parties.
[2] External evaluator is Humberto Rodríguez, selected following UNDP procedures.

The PRODOC contains the necessary elements for the implementation and execution; however, may not be fully appropriate to guide the replicability of the project. The project presents the following deficiencies in its formulation as regards estimation, design and programming:

- The magnitude of the project portfolios (component 1) and of the mass-scale photovoltaic project (component 6) was overestimated. Overestimation of component 6 (6,000 estimated systems instead of 3,064) had an impact in the project budget since contributions by GEF were overestimated with incremental costs and activities related to the project. The project's response was to extend the coverage of the project portfolio and the photovoltaic demonstration project from the IV Region across the country, adequate response because the land registry covered the country as well as photovoltaic projects.
- Objective 7 was poorly designed and 1/3 of the total budget of the GEF contribution to the project was committed to this component. Such component (Developing a Financial Mechanism for NCRE Projects) aimed to pursue the participation of private capital in rural electrification projects. In order to accomplish this objective, it was necessary to reduce the perception of risk arising from these projects through a financial mechanism. The reality is that rural electrification projects are funded by the national government, thus, the financial mechanism was not developed. Consequently, projects were implemented excluding the participation of private sector investments, thus, the component was reformulated in one related to productive use of energy reallocating and reassigning resources of $ 2 million to other components and to the productive use project.
- In relation to component 7, the mechanism suggested was not viable; therefore, a proposal to reformulate such component was suggested. Several alternatives were submitted. For instance, the Government of Chile proposed a new one, “Productive Use of NCRE in rural areas”. That said, at the end of the project, the large mobilization of government funds (U.S. $25,303,568) demonstrates their strong commitment to the project and the right approach of the decision taken.
- Due to the first two deficiencies, at some point in the implementation, 40% of the budget was stalled. The project’s response was to expand coverage of components 1 and 6, redefine a new objective for component 7 and reallocate these resources.
- The sequencing of activities in the timetable has not considered critical routes of the project implementation, as stated above.
- Another consequence of the deficiency in component 6 was the estimation of GHG reduction. Estimating 6,000 photovoltaic systems to be implemented instead of 3,064, consequently, the reduction of emission was double the amount esteemed.

Several of the indicators differ from the reality of the project implementation. The indicator of Immediate Objective 1, generation of the project portfolio, refers to the registration of 10 projects per year, when the identification, evaluation and registration in IPB was for the first two years and projects are registered in April for one or two years funding. It would have been more logical to have a total registration at the end of the project. Another indicator was the development of four regulations for each technology (component 2) and not the number that experts deemed necessary for that technology. Or in component 3, the indicator is the number of certified facilities, when the outcome is a procedure.

The expected period of implementation of 5 years is considered to be short, as too long has proved to be the implementation period of 10 years, due in part to the long process of redefining component 7.

On the other hand, the implementation mechanism – execution is simple and transparent. Monitoring mechanisms were those established by UNDP-GEF in these projects.

The evaluator considers that the *conceptualization design of the project is **Marginally Satisfactory (MS).***

Project Implementation

The project had a Mid Term Evaluation that identified the difficulty in implementing component 7 by the end of 2003 -two years after the project started-. The extension of the implementation deadline was due to several factors, among which are, first of all, the time it took to amend the design to introduce the project "Productive use of NCRE in rural areas". Secondly, the coordination required to manage the approval by GEF/UNDP. But besides these two, the investment projects require fundraising at regional level and there is strong competition at such level. This is the case of hybridization component 8, specifically, the Isla Desertores project that took several years to financially be closed.

The interrelationship between UNDP-GEF and CNE was swift and smooth, and the project, being first in CNE and then absorbed by the Ministry of Energy (established 2007), was always in the center of decisions related to the development of rural electrification projects. For the implementation, the project included the Chief Technical Adviser, UNDP Environment Officer and a Technical Officer, who took a strategic role to the project by assigning responsibilities according to the position of each member, facilitating and promoting the implementation and execution. This approach is one of the key factors to the success of the project.

The Logical Framework remained as the driving force during the implementation of the initiative and, as previously mentioned, amendment of component 7 was made. The Workplan included in the PRODOC was adjusted periodically to respond to the project implementation. These plans were presented to UNDP-GEF and approved by them. The programme made available, from the beginning, the ToR related to the contracts required for the implementation process. In connection with the work of consulting firms recruited, the evaluator considers that individuals or companies hired met the deliverable and deadlines in a satisfactory manner.

In general terms, bilateral communication channels between the parties were satisfactory, and there was no evidence to the contrary.

The evaluator considers *that the implementation approach is **Satisfactory (S).***

Monitoring and evaluation

After reviewing the information received, the evaluator has been able to infer compliance in the following monitoring mechanisms:

- Monitoring mechanisms established by UNDP have been used.
- CNE as Executing Agency managed daily tasks of the project using the Annual Work Plan.
- More specifically and related to monitoring mechanisms, nine PIRs were prepared for this project, the first being the PIR 2002 (1 July 2001 to June 30, 2002) and the last PIR in 2010 (1 July 2009-30 June 2010).

- Assessments of progress towards achieving the objectives by local coordination, UNDP Office in Chile and the UNDP/GEF Regional Adviser were satisfactory (S) as well as the assessments of the Project Implementation. With regards the PIR/APR in 2008 and 2009, the implementation of amended Component 7, Productive Uses, made little progress.
- Project Progress Reports. They consist of APR/PIRs. There are also final reports or outcomes of sub-contracts made by consultants and consulting firms.
- Tripartite meetings. The PRODOC established a tripartite meeting between the Government (Ministry of Foreign Affairs and Ministry Secretariat General of the Presidency, UNDP and the Executing Agency at least once a year, which was to be organized by UNDP. *No information was received from these meetings; however, they are registered* and their results are reflected in the PIRs.
- Project Closure Report. *A complete Final Project Report was developed* (*October 2011).*
- Meetings of the Coordinating Committee of the Project. Five Minutes of the Coordinating Committee were received which corresponds to meetings held at the end of the years 2001 to 2005. This includes presentations made with regards the project development, current status and a recommendation to redirect its course was made.
- Mid-Term Evaluation. The programme included a Mid-Term Evaluation, which was performed in December 2003 and considered the amendment of component 7 as shall be explained in subsequent sections.
- External Financial Audits. All financial management and relevant supporting documentation is handled by UNDP-Chile. UNDP hired financial audits/external accountants through specialized firms. The four external audits (2004, 2005, 2008 and 2010) are clean and without any qualifications. Include recommendations to be implemented, but none meant a risk to the project implementation.

The evaluator considers that there was systematic monitoring of progress of activities, and therefore considers that *the monitoring and follow-up of the project is* ***Satisfactory (S).***

Replicability

The project left an important legacy of regulations, certification procedures, learning materials for trainers and users of photovoltaic systems, biogas manuals and guidelines with regards the creation of cooperatives to promote and develop electrical projects and methodologies for NCRE project evaluation, among others. All this information is already in use by the Energy Access and Equity Division at the Ministry of Energy, and was also available to regional governments. This is *a very solid basis that shall be used to replicate NCRE projects* in other regions of Chile.

Cost-effectiveness of the project

The overall objective of the project was partially achieved as it managed to attain just over half the emissions reduction proposed in the PRODOC. But, in addition, only one third of the project portfolio was implemented, thus upon completion of the proposals, the reduction targets proposed shall be achieved. The project has produced outstanding results particularly in positioning NCRE within the Ministry of Energy and regional and municipal authorities, as a viable and sustainable alternative for energy supply in the rural sector and a source of productive use of energy. *In this sense, the project has been effective in achieving the results of several components with satisfactory and highly satisfactory performance.*

With regards the costs of reducing emissions, these has represented to GEF a cost of U.S. $246.85/t CO_2 against U.S. $110/t$CO_2$ budgeted, because the emissions reduction reached a 44.5 % of what was expected in the amended PRODOC. *Nevertheless, considering post-project emissions, the reduction of emissions from the entire portfolio reach 60.46 Gg (109.4% of what was expected in the amended PRODOC), hence, GEF cost comes down to U.S. $ 100.35*.

Sustainability

Four factors ensure sustainability of project results. The first one is capacity development. All the components of the project contributed to building capacity. Trainees were beneficiaries, staff from regional and local authorities, engineers, consultants, at different levels, among others. The material produced was widely disseminated through printed materials, videos, and placed on the project website.

The second factor that ensures sustainability of the project is ownership of NCRE technology. Without any doubt, this is *one of the outstanding results of this project*: institutions at central, regional and municipal levels have proven the sustainability of NCRE solutions and have become promoters in order to consider using NCRE in all projects due to its feasibility. This item relates to the third factor: Development of Institutional Capacity. The largest beneficiary was the Ministry of Energy. They have received the direct benefit of the project and the Energy Access and Equity Division has qualified personnel, information and methodologies developed by the project to ensure continuity in the use of NCRE.

Finally, the fourth factor is the broad acceptance of NCRE technology among the different institutional actors (Ministry of Energy, Ministry of Agriculture, among others) due to the proven results of the projects that have fostered acceptance of NCRE technology as an alternative for the development of rural areas.

Project results

Overall objective
Indicator: Reduction of 62.600 tons of CO_2 emissions after 20 years[3]
Achievements:

- The voided emissions through the systems implemented by the project and for the next 20 years of operation will be 24,580 tCO_2/per year[4], reaching 44.5% of the expected reduction proposal in the recalculated PRODOC of 55.28 Gg).
- Nevertheless, taking into account the post-project emissions, considering the emissions reduction from the entire portfolio, these reach 60.46 Gg (109.4% of what is expected in the amended PRODOC).

[3] When reviewing the sum of the figures in the PRODOC, page E4, the correct figure is 55 280 t.
[4] For this estimation, the methodology used is described in Annex E of the ProDoc. When reviewing the sum of the reductions of emissions, the target is 55.28 and not 62.61 tCO_2. But, in addition, considering that the number of photovoltaic systems to be installed was overestimated (6,000 instead of 3,064 resulting from the land registry), the reductions of emissions would be 42.596 Gg and not 62.610 Gg.

- Since the implemented projects correspond to 33% of households in the project portfolio, assuming the implementation of all projects, emissions reductions would be doubled and, thus, the expected emission reductions.
- *It is considered that the overall objective has been partially implemented in a **Satisfactory (S)** manner*.

Objective 1. Generation of a Portfolio of Rural Electrification Projects using NCRE.
Indicator: 10 new projects using NCRE are admitted in the Integrated Projects Database (BIP)
Achievements:

- The *project developed a portfolio of 100 NCRE projects*. (30 photovoltaic, 34 micro- hydro power plants and 36 hybrid systems), result considered to be ***outstanding*** (the indicator was 10 per year for 5 years of implementation). The project portfolio covers 11.070 households, with an estimated investment of U.S.$30,952,111.
- From this portfolio, 33 projects were implemented favoring 4,819 households with an estimated investment of U.S. $24,548,568, at an average value of U.S.$ 5,094 per solution.
- In addition to these projects, the amended component 7 brought 45 projects to the portfolio (42 solar pumping systems and 3 of biogas) favoring 45 households. The portfolio of these projects has an estimated investment of U.S. $932,319.
- A national land registry of households and rural services without electricity was held (12,400 households and rural facilities, surveyed and geo-referenced).
- The total amount of the project reached U.S. $33,334,379, of which the government contributed 75.9%, 4.6% from users, 3% from private partners and 18.2% from GEF.
- Considering the total amount of the implemented project and the value of the project to GEF, its *leverage level is 5.5, which is **Highly Satisfactory (HS)***.
- In this component, the project developed a methodology to evaluate projects considering NCRE which has been adopted by the Ministry. *This result is one of the factors that allow project sustainability.*
- Results of this component are considered ***Highly Satisfactory (HS).***

Objective 2: Elaboration of Technical Regulations for Electrification Systems with NCRE.
Indicator: 4 new regulations per technology are published: photovoltaic, wind energy, micro plants and biomass
Achievements:

- 44 technical regulations were developed: (15) photovoltaic technology, (7) wind energy, (4) hybrid systems and (18) micro- hydro power plants.
- Regulations are based on international standards and on the state of art of technologies, which is considered to be a major contribution to ensure technical sustainability of the systems.
- These are voluntary-type regulations in the country; however, the Chilean government adopts them to procure all NCRE equipment.
- Achievements of this component are considered ***Highly Satisfactory (HS).***

Objective 3: Elaboration of Certification Procedures for Electrical Systems with NCRE
Indicator: Number of certificates issued (depending on the number of projects actually implemented)
Achievements:

- Certification procedures for NCRE systems used in the project were developed.
- 3,064 photovoltaic systems from the Large-Scale Demonstration project of the IV region of Coquimbo were certified.

- The result of this component is ***Satisfactory (S).***

Objective 4: Implementation of a Promotional Campaign for NCRE
Indicator: Increased demand for NCRE-based rural electrification projects
Achievements:

- The promotional campaign consisted of direct work with regional governments, rural municipalities, local authorities and rural communities. Consultants also participated and prepared materials used in seminars, workshops and meetings.
- Posters, brochures and manuals (on photovoltaic systems, at trainers and users levels, wind energy, biogas and solar radiation) were developed and used
- Development of web-site ***www.renovables.rural.cl*** which operated between 2004 and 2007, and whose content has been transferred to the Ministry of Energy.
- Conducting seminars, workshops and dissemination meetings.
- Workshop on wind resource assessment. A CD which includes the presentations, list of participants and evaluation methodologies of the resource.
- Widespread dissemination of NCRE and, as a result, the number of NCRE projects admitted in BIP-MIDEPLAN reached 100.
- Achievements of this component are considered ***Satisfactory (S).***

Objective 5: Development of a Training Programme
Indicator: Number of courses implemented for the following levels: regional policy (project managers), engineers, technicians and users.
Achievements:

- Development of a training programme designed for those responsible for central and regional policies, regulatory agencies, inspectors, engineers, technicians and users.
- Organization of international events with CNE and project staff. In addition, the programme trained participants in the project through their attendance to the course.
- Conducting workshops regarding:
    - Field work techniques, interviews and data collection to generate NCRE portfolio projects, addressed to fieldwork staff.
    - Installation of wind measurement stations, and the handling and processing of data addressed to regional policy makers, professionals, engineers, technicians and CNE staff (2003 and 2004).
    - Evaluation of photovoltaic systems, in the VI Region, oriented to municipal officials, technicians and project staff.
    - Design of hybrid systems addressed to professionals in the government sector and consulting firms (2004).
    - Evaluation of NCRE projects oriented to professionals from the regional governments (I to IV region) (2004).
    - Training in micro- hydro power plants (2004 and 2005).
    - Training in ArcView, Geographic Information System, addressed to two CNE professionals (2005).
    - Training in solar photovoltaic systems, oriented to users, technicians and municipal authorities (3,800 participants in 2005).
- Up to 2009, there had been workshops and seminars in photovoltaic systems for approximately 3,500 end users, technicians, consultants, technology providers, local governments and municipalities.

- Achievements are considered ***Satisfactory (S)***; although, the evaluator has encountered that no long-term interagency agreements with universities and training institutions have been established to continue NCRE training.

Objective 6: Design and Implementation of a Large-Scale Photovoltaic Demonstration Project
Indicator: 1.000 photovoltaic systems shall be installed per year (.5.000 in total).
Achievements:

- The project identified needs of photovoltaic systems for:
  - 3,064 households in 15 municipalities.
  - 55 schools and rural health centers.
  - 1,500 households with PV installed in need of improvement.
  - Estimated investment for these projects was U.S. $6, 300,000.
- For the large-scale demonstration project, the Barrier Removal Programme:
  - prepared the technical engineering design of PV systems,
  - performed the technical-economic evaluation for the three previous projects,
  - prepared bidding documents (ToR and specifications) for the housing project,
  - managed, together with CNE, the creation of a special operating subsidy, which eventually led to the feasibility of the large-scale PV project operated by a private (essential step to make possible the large-scale project). This subsidy made viable new projects within NCRE at a later stage.
  - provided assistance to the Regional Government of Coquimbo in the formulation of regional projects and,
  - provided assistance to the bidding process: call for expressions of interest, invitation to tender and in the evaluation of bids to the international public tender.
- The bidding process of 3,064 photovoltaic systems for the IV Region was awarded to CONAFE for $5 million ($ Chilean pesos 2.925.845.225) for the installation, operation and maintenance of photovoltaic systems for a period of 10 years, renewable. The GEF provided approximately U.S. $120 per system as incremental cost.
- *After 5 years, this project continues operating successfully in a sustainable manner.*
- *An extremely valuable result* of the component is the ownership of the photovoltaic technology by the regional government, users and maintenance company; management system developed and to include the technology in supply energy proposals as a real, reliable and sustainable alternative, not only for the IV Region, but also for other regions.
- The evaluator considers ***Highly Satisfactory (HS***) the implementation of this component.

Objective 7a: Development of a Financial Mechanism for NCRE Projects
Indicator: Financial Mechanism designed, approved and operational, and at least one project implemented with each technology.
Achievements:

- *This component was not implemented* as the mechanism was not appropriate to mitigate the perception of risk of the private sector to participate in rural electrification projects. This objective was restructured.

Objective 7b: NCRE productive use in rural areas
Indicator: Generation of a portfolio of productive projects that incorporate the use of NCRE; and Engineering Design for 4 demonstration projects of solar water pumping in the IV Region.
Achievements:

- Development of a portfolio of productive use projects (see achievements of component 1)
- Development of methodologies for ex-post project evaluation and ex-post irrigation projects.
- Installation of demonstration systems for water pumping (4), biogas plants (2) and training of beneficiaries (including manuals and biogas video).
- The achievements are considered ***Satisfactory (S).***

Objective 8: Reduction of CO_2 Emissions by means of Hybridization Projects with Diesel-Fueled Systems Currently in Operation
Indicator: At least 2 hybridization projects in BIP.
Achievements:

- Portfolio of 36 projects admitted in BIP in 2007.
- Preparation of technical specifications and tender documents of 8 hybrid projects, to supply electricity to 2.000 households (6 winds -diesel and 2 solar-diesels).
- Assistance and GEF co-financing of U.S. $ 537,000 in Desertores Project.
- The evaluator considered ***Highly Satisfactory (HS)*** the achievements of this component.

Objective 9: Creation of Technical Capacity to Evaluate Wind Resources in Chile
Indicator: Measurements made in stations previously established.
Achievements:

- The Wind Energy Database (DVD), published in 2008, contains 33 stations in 10 regions of Chile, information on measurement location, duration, average wind speed, monthly averages, probability distributions, wind roses, type of data, logger used, daily profile of the wind and summary of the resource in pdf format.
- Training of many technicians, engineers and consultants were made, who subsequently participated in wind generation projects, connected to the grid, but not in rural projects.
- Achievement ***Satisfactory (S).***

STATE OF THE BARRIERS

The evaluator considers that, after the project, current state of the barriers is as follows:

BARRIER STATUS BEFORE THE PROJECT	BARRIER STATUS AFTER THE PROJECT
(a) lack of rural electrification project portfolios with NCRE;	• *Barrier removed.*
(b) lack of regulations for renewable energy equipments;	• *Barrier removed.*
(c) lack of certification procedures for renewable energy systems and their installation;	• *Barrier removed.*
(d) lack of general knowledge with respect to NCRE;	• *Barrier removed.*
(e) lack of formal training programmes;	*Barrier partially removed* as no evidence with regards the continuity of training programmes in institutions of

BARRIER STATUS BEFORE THE PROJECT	BARRIER STATUS AFTER THE PROJECT
	higher education was encountered; although, the Ministry includes training in their projects.
(f) existence of high investment costs in projects with NCRE;	• This barrier is considered *NOT removed* mainly due to the fact that, although, technology, for instance, photovoltaic, has decreased, the costs of installation and maintenance in remote and isolated areas, increases with distance and isolation. However, when considering the Life Cycle Cost (*Costo del Ciclo de Vida*) of NCRE projects, the government of Chile has encountered that these are technically, economically and environmentally feasible alternative to provide services in remote and isolated areas, and better than conventional energy systems. *Project designers* identified high investment costs as a barrier, but *did not consider the "life cycle cost" of energy supply as the variable to be taken into account.*
(g) perception of associated risks with renewable energy technologies;	• This perception is still valid for the private sector Who did NOT participate as investor in the projects. Hence, rural electrification will continue to be a task for the state.
(h) lack of technical expertise, equipment and analysis to perform wind resources measurements;	• *Barrier removed.*
(i) lack of NCRE commercial projects with economies of scale.	• *Barrier removed.* The project developed a scale project that has demonstrated to reach sustainable viability of Photovoltaic Systems.

But besides removing barriers, *this project has made significant contributions to the development of NCRE in Chile such as*:

- Strengthening the governance scheme in the institutional environment to address the challenges of energy supply for users in remote and isolated rural areas, challenges that must have governmental responses to the obligation of the state in providing a public service in an equitable manner.
- Development of a methodology to identify and evaluate rural electrification projects, where the project was able to place NCRE as technologies that are technically, economically and operationally viable and sustainable against conventional electrification schemes based on grid extension and diesel and gasoline generators.
- Ownership of NCRE technologies by central level government institutions (ministries, mainly of Energy and Agriculture), regional and municipal governments.
- Development of management patterns for NCRE projects and their validation in PV within the IV region of Coquimbo and the MCH in Llanada Grande, as well as three others developed in the X Region.

- Creation of a subsidy mechanism for the operation of PVS in the IV Region, which has been applied to other projects in the rural sector of the country.
- Development and validation of the "engineering management in government" for the implementation of the projects, applied to those of the Region IV and X.

CONCLUSIONS AND RECOMMENDATIONS

To the Ministry of Energy (DAEE)

- Consider *continuity* and *strengthening* of the achievements of the programme as it is an effort that responds to actual needs of the least advantaged rural population in the country.
- The use of NCRE in the rural sector is in line with the environmental policy of the country, with the goal towards a low-carbon development for the country, with the Millennium Development Goals and the real possibility of achieving 100% of rural electrification for the country. *Likewise, Chile could become an icon for Latin America by being the first Latin American country 100% electrified.*
- Continue the dissemination of existing information which was also available on the Barrier Removal Project website.
- Act in line with the reality with regards the need of political will for the implementation of the projects. The NCRE rural electrification projects implemented has shown that, where there was political will of local authorities and, particularly, political will, and support of regional and municipal authorities (as in the case of the Region of Coquimbo and a number of municipalities in different regions), projects could be implemented with the technical support and contribution of several activities from the Barrier Removal project.
- For households that are not likely to get connection to the electricity distribution grid, the NCRE electrification alternative has strengths from the technical, operational, environmental and economic point of view against fuel generators.
- For the sustainability of NCRE electrification systems in the long-term operation and maintenance for the rural sector requires ongoing support, both technically and financially, regardless whether management schemes are implemented by the private sector, municipalities or users. This support requires public investment, which has been endorsed through the Subsidy to Operation and Maintenance, created under the PV project of the Region of Coquimbo and has been included in the Budget Law.
- For the supply of electricity to rural population that lives more distant and dispersed, which in practice is the last to be considered in electrification projects, requires increasingly high investments, which implies the need to increase subsidies. The methodology of rural evaluation of the Ministry of Social Development has been modified; hence, subsidies to investments have increased.
- On the other hand, the needs of rural areas include not only electricity, but other sources of energy. In other words, the rural sector requires developing "energization" as a concept which implies the participation of new actors and a current vision that has been developed in the Ministry of Energy influenced by the Removal of Barriers Project. In order to accomplish this, new models for delivery of services and management shall be created. In the process of NCRE rural electrification, the vital importance of the State with regards to technical assistance, safety for investments and public expenditures, has been proved.

TO UNDP-GEF

- As a successful project, disseminate the acquired information and knowledge that this project has created, and the achievements.
- While projects are formulated for limited periods of time, this project has shown that by extending its implementation time, sustainability of electrification PVS projects, already with five years of successful operation and maintenance, as regards user-satisfaction, has been verified.
- Including gender perspective as part of the activities in this type of project would help analyzing the roles and responsibilities of women, both, as beneficiaries of electricity supply in their communities and their role as users of energy services either for domestic, productive or communal use. Schedule specific activities such as workshops or directed sessions allow the development of a process of awareness on gender issues, taking advantage of the technological outbreak, and expanding its benefits through social achievements. Determine the participation of women can also assess their role in the maintenance and use of equipment and possibly generate an active participation in greater productive use of electricity.

LESSONS LEARNED

- 5 years to implement a programme that intends to remove barriers nationwide as planned in the design, within a short period of time, especially considering that some of the results required the participation of several key actors.
- Allocation of resources in the budget should be within the scope of the indicator and the expected outcome. Specifically, in the case of the information campaign, neither resources nor staff required was provided to cover the scope described.
- Systematize achievements and disseminate acquired information, that may be of a public nature, would allow attaining a greater impact on the achievements of this project, for instance, by enhancing the development of case studies of beneficiary communities with photovoltaic solar energy would allow making even more visible this joint effort between UNDP-GEF and the Ministry of Energy.
- The effective participation of key actors at different stages of identification and development of NCRE rural electrification projects was essential to the success of the project. It is important to create, when starting the project, strategic alliances and consensus required for approval, funding and execution of the projects. Involve communities and direct beneficiaries of the projects are also essential to ensure the success of the projects.
- One of the essential aspects to the success of NCRE projects is designing and considering different management schemes leading to the sustainability of projects. This includes, not only economic resources, but also capacity building among technicians and users as well. The project considered this topic essential and strategic.
- The project success is also based on well-planned and executed pre-investment studies. Allocation of resources for these activities has a high return rate in the future. This leads to a careful study of actual needs of users and exploration of opportunities for income generation. The use of energy for productive purposes is a matter of great importance. This indicates that electrification projects with NCRE rural energy must come from actual needs of rural

population. Only through their participation, users shall "own" the project and generate the same success factors.

The Barrier Removal Project, as a whole, can be considered as a successful project developed with effectiveness and **Satisfactory (S)** with a **Highly Satisfactory (HS)** development of several components.

0.2 RESUMEN EJECUTIVO

El proyecto ***Programa Remoción de Barreras para la Electrificación Rural con Energías Renovables - UNDP-GEF (Proyecto CHI/00/G32 (11799)*** ha sido ejecutado por la Comisión Nacional de Energía (CNE) y posteriormente, al final de su ejecución, por la Dirección de Acceso y Equidad Energética (DAEE) del Ministerio de Energía de Chile. El PRODOC fue suscrito por todas las partes en Septiembre de 2001 y el proyecto comenzó su ejecución en Octubre del mismo año. El plazo de ejecución fue de 5 años inicialmente y posteriormente extendido en varias oportunidades hasta Marzo de 2012. El proyecto se ha ejecutado en el doble del tiempo inicial por razones que se explicarán más adelante.

Los antecedentes del proyecto derivados de la situación energética de la población rural de Chile y la ruta trazada por el país hacia el mejoramiento de las condiciones de vida de la población rural y el desarrollo sostenible indican que el *proyecto es pertinente a la situación de Chile*, está *en línea con las propósitos del GEF* y los que orientan al país tanto hacia el cumplimento de las Metas del Milenio y hacia una economía baja en emisiones. Desde mediados de los noventa, Chile estableció un Programa de Electrificación Rural (PER), fundamentado en la tradicional extensión de redes y grupos electrógenos a diesel y benzina, cuyos costos de inversión, y de operación y mantenimiento resultan muy elevados cuando se trata de población rural dispersa en zonas remotas. Las energías renovables representaban una alternativa de suministro pero presentaba barreras para su utilización. En la actualidad, el PER cumplió sus metas y Chile tiene uno de los más altos índices de cobertura de electricidad (96.5% a 2011) y el proyecto de Remoción de Barreras ha contribuido a establecer las Energías Renovables No Convencionales (NCRE) como una opción válida para continuar elevando el índice de cobertura.

El *objetivo medioambiental global* del proyecto es reducir las emisiones de carbono generadas por la utilización de la electricidad en Chile. El proyecto es consistente con el Programa Operacional 6 del GEF, "Promoción de la adopción de Energías Renovables por Remoción de Barreras y Reducción de Costos de Implementación", y busca eliminar las barreras institucionales y financieras, así como las de capacidad y conocimiento asociadas a la incorporación de las NCRE en la electrificación rural en Chile, reduciendo así emisiones de Gases de Efecto Invernadero (GEI).

Los *objetivos del programa* son remover las barreras que impiden el uso de NCRE en la electrificación rural en Chile, al desarrollar una serie de actividades que disminuirían las emisiones de GEI producidos por fuentes energéticas en áreas rurales. Con tal fin, el proyecto deberá llevar a cabo las siguientes actividades:

i. Promover la remoción de las barreras que impiden la utilización exitosa de las energías renovables en el programa de electrificación rural chileno, generando dentro del marco institucional existente las condiciones para el desarrollo en Chile de un mercado de NCRE,
ii. Promover las inversiones públicas y privadas en el ámbito del desarrollo de la electrificación rural con energías no convencionales, y
iii. Promover la igualdad social y el mejoramiento de las condiciones de vida en las comunidades rurales.

El logro de los objetivos del programa requería la *remoción de las siguientes barreras,* identificadas durante la preparación del proyecto en el PRODOC:

(a) falta de cartera de proyectos de electrificación rural con NCRE;
(b) falta de normas para los equipos de energías renovables;
(c) inexistencia de procedimientos de certificación para los sistemas de energías renovables y su instalación;
(d) desconocimiento de las NCRE;
(e) carencia de programas de capacitación formales;
(f) existencia de altos costos de inversión en proyectos con NCRE;
(g) percepción de riesgos asociados con las tecnologías de energías renovables;
(h) incapacidad técnica, de equipamiento y análisis para efectuar mediciones del recurso eólico;
(i) inexistencia de proyectos comerciales con NCRE que tengan economías de escala.

El *valor del proyecto* es de US$32.397.300 con una aportación del GEF de US$6.067.300 y un cofinanciamiento chileno de US$26.330.000 (de los cuales US$755.000 eran en especie). El nivel de ejecución presupuestal del proyecto a Diciembre de 2010 era de 97%.

El *objetivo de la Evaluación de Término Final* es determinar la importancia, el funcionamiento y el éxito del proyecto; buscar muestras del impacto potencial y la sostenibilidad de resultados, incluyendo la contribución del proyecto al desarrollo de capacidades y el logro de metas ambientales globales. También espera identificar y documentar las lecciones aprendidas y hará las recomendaciones que puedan mejorar el diseño y la puesta en práctica de otros proyectos de PNUD/GEF. Los principales resultados y hallazgos[5] de la Evaluación de Termino Final son los siguientes[6]:

Formulación del proyecto

Para la *ejecución del proyecto se diseñaron 9 componentes*, diseñados siguiendo un marco lógico coherente para remover las barreras y para alcanzar el logro de los objetivos. En este marco lógico también formularon los resultados esperados para cada componente, sus indicadores y suposiciones críticas. Estos componentes son:

1. Generación de una Cartera de Proyectos de Electrificación Rural con NCRE
2. Elaboración de Normas Técnicas para Sistemas de Electrificación con NCRE
3. Elaboración de Procedimientos de Certificación para Sistemas de Electrificación con NCRE
4. Implementación de una Campaña de Promoción para las NCRE
5. Desarrollo de un Programa de Capacitación
6. Diseño y Ejecución de un Proyecto Demostrativo Fotovoltaico de Gran Escala
7. Desarrollo de un Mecanismo Financiero para Proyectos con NCRE
8. Reducir las Emisiones de CO_2 a través de Hibridización de Proyectos con Sistemas Diesel Actualmente en Operación
9. Creación de la Capacidad Técnica para la Evaluación del Recurso Eólico en Chile.

[5] La metodología incluyó revisión de documentos recibidos de las partes, entrevistas a ellas y a otros actores, visitas de campo y presentación preliminar de resultados a las partes.
[6] El evaluador externo es Humberto Rodríguez, seleccionado siguiendo los procedimientos del PNUD.

El PRODOC contiene los elementos necesarios para la implementación y ejecución del mismo y no es completamente apropiado para orientar la replicabilidad del proyecto. El proyecto presenta en su formulación las siguientes deficiencias de estimación, diseño y programación:

- Se sobrestimaron las magnitudes de la cartera de proyectos (componente 1) y del proyecto masivo fotovoltaico (componente 6). La sobreestimación del componente 6 tuvo consecuencias presupuestales porque el proyecto estaba sobreestimando (6000 sistemas cuando fueron 3000) el monto de los aportes del GEF por costos incrementales y las actividades relacionadas con el proyecto. La respuesta del proyecto fue extender la cobertura de la cartera del proyecto y del proyecto demostrativo fotovoltaicos de la IV Región a todo el país, respuesta afortunada porque el catastro realizado cubre el país y los proyectos fotovoltaicos, también.
- El objetivo 7 resultó mal diseñado y en este componente estaba comprometido 1/3 del presupuesto total del aporte del GEF al proyecto. Este componente (Desarrollo de un Mecanismo financiero para Proyectos de NCRE) fue orientado a buscar la participación del capital privado en los proyectos de electrificación rural y se estimó que para logarlo había que disminuir la percepción de riesgo de estos proyectos mediante un mecanismo financiero mitigador de esta percepción. La realidad es que los proyectos de electrificación rural son financiados por el gobierno nacional y el establecimiento del mecanismo financiero no se desarrolló. Los proyectos se implementaron sin la participación del sector privado en la inversión y el componente se reformuló en uno de usos productivos, y sus recursos de Millones US$2 fueron reasignados a otras componentes y al de usos productivos.\
- En relación al componente 7, al no ser viable el mecanismo propuesto, se propuso reformularlo y se propusieron varias alternativas. El gobierno de Chile propuso uno nuevo, el "Usos productivos de la NCRE, en las zonas rurales". Ahora, al finalizar el proyecto, la gran movilización de fondos del gobierno (US$ 25.303.568) demuestra su gran compromiso con el proyecto y que el curso adoptado por el mismo fue el acertado.
- Como consecuencia de las dos primeras deficiencias, en algún momento de la ejecución el 40% del presupuesto se encontró paralizado. La respuesta fue ampliar la cobertura de los componentes 1 y 6, y redefinir un nuevo objetivo para el componente 7 y reasignar sus recursos.
- La secuencia de las actividades en el cronograma no consideró acertadamente las rutas críticas de su ejecución, como ya se consideró anteriormente.
- Otra consecuencia de la deficiencia en el componente 6 fue la estimación de la reducción de GEI. Al haberse estimado en 6000 el número de sistemas fotovoltaicos a implementar, no haberse encontrado sino 3064 e implementado igual número, entonces la reducción de emisiones fue estimada en el doble de lo que realmente era por este concepto.

Se considera que varios de los *indicadores distan de la realidad de la ejecución del proyecto.* El indicador del Objetivo Inmediato 1, generación de la cartera de proyecto, es el ingreso anualmente de 10 proyectos cuando la identificación, evaluación y registro en el BIP (Banco Integrado de Proyectos) estaba para los dos primero años y los proyectos se ingresan en abril para su financiación uno o dos años. Más lógico hubiera sido un número total al final del proyecto. Otro indicador era cuatro normas por tecnología (componente 2) y no el número que los especialistas consideraran necesarias por tecnología. O en el componente 3, el indicador es el número de instalaciones certificadas, cuando el producto es un procedimiento.

El tiempo de ejecución previsto de 5 años es demasiado corto, como demasiado largo ha resultado el tiempo de ejecución de 10 años, debido en parte al largo procesos de redefinición del componente 7.

Por otro lado el mecanismo de implementación – ejecución es simple y transparente. Los mecanismos de monitoreo fueron los establecidos por PNUD-GEF en estos proyectos.

En evaluador considera que la *conceptualización/diseño del proyecto es* ***Marginalmente Satisfactoria (MS).***

Implementación del proyecto

El proyecto en su ejecución tuvo una Evaluación de Mediano Término que identificó la dificultad en la ejecución del componente 7 a finales de 2003 (a los dos años de iniciado el proyecto. La ampliación de los plazos de ejecución se debió a varios factores, entre los cuales se destacan primero que todo, el tiempo que tomó cambiar el diseño para introducir el proyectos de "Usos productivos de las NCRE, en las zonas rurales". En segundo lugar, la gestión que fue necesario desarrollar para lograr su aprobación por parte del GEF/PNUD. Pero además de estas dos, los proyectos de inversión requieren de movilización de fondos a nivel regional y a este nivel ha fuerte competencia por ellos. Este es el caso del componente 8 de hibridización, específicamente el proyecto de la Isla Desertores que tomo varios años cerrar el proyecto financieramente.

La interrelación entre el PNUD-GEF y el CNE fue expedita y fluida, y el proyecto estando en el CNE y después absorbido por el Ministerio de Energía (creado en 2007), siempre estuvo en el entorno de las decisiones relacionadas con el desarrollo de proyectos de electrificación rural. Para la implementación del proyecto se integró un grupo compuesto por el Asesor Técnico Principal, el Oficial de Medio Ambiente del PNUD y un Funcionario Técnico que tuvo una aproximación estratégica al proyecto asignándose cada uno de ellos responsabilidades acordes con sus cargos que facilitaron y propiciaron la implementación y ejecución del mismo. Esta aproximación es uno de los factores de éxito del proyecto.

El Marco Lógico se mantuvo como eje conductor durante la implementación de la iniciativa y se introdujo la modificación del componente séptimo ya mencionada. El Plan de Trabajo presentado en el PRODOC fue ajustado periódicamente para responder a la ejecución del proyecto. Estos planes fueron presentados al PNUD-GEF y aprobados por ellos. El programa dispuso desde su comienzo de los TdR relacionados con las contrataciones requeridas para la implementación del mismo. En relación con el trabajo de las firmas consultoras contratadas, el evaluador encuentra que las personas o empresas contratadas cumplieron con los entregables y sus plazos de entrega, de manera satisfactoria

En términos generales los canales de comunicación bilaterales entre uno y otro interlocutor fueron satisfactorios, y no se encontró evidencia de lo contrario.

El evaluador considera que el *enfoque de la implementación es* ***Satisfactorio (S)***.

Monitoreo y evaluación

De la revisión de la información recibida, el evaluador ha podido inferir el cumplimiento de los siguientes mecanismos de monitoreo:

- Se han empleado los mecanismos de monitoreo establecidos por el PNUD.
- CNE como entidad ejecutora del proyecto se ocupó de las labores cotidianas del mismo empleando el Plan Anual de Trabajo.
- Más específicamente y relacionado con los mecanismos de monitoreo, en este proyecto se elaboraron nueve PIRs, siendo el primero el PIR 2002 (1 Julio 2001 a 30 Junio 2002) y el

último el PIR 2010 (1 Julio 2009 a 30 Junio 2010),

- Las evaluaciones del progreso hacia el logro de los objetivos por parte de la coordinación nacional, como de la oficina del PNUD Chile y el Asesor Regional del PNUD/GEF fueron satisfactorias (S) y las evaluaciones de la Implementación del Proyecto fueron de satisfactorias (S) con excepción de los PIR/APR de 2008 y 2009, cuando la ejecución del Componente 7 modificado, Usos Productivos, avanzó poco.
- Informes de Avance del proyecto. Consisten en los APR/PIRs. También existen informes finales o productos de los sub-contratos realizados por los consultores y firmas consultoras.
- Reuniones tripartitas. En el PRODOC se estableció la realización una reunión tripartita entre el Gobierno (Ministerio de Relaciones Exteriores y Ministerio Secretaría General de la Presidencia), PNUD y el Organismo de Ejecución al menos una vez al año, la que debía ser organizada por el PNUD. *No se recibió información de estas reuniones pero si se registra* en los PIRs la realización de las mismas y sus resultados se encuentran reflejados en ellos.
- Informe de Cierre del Proyecto. *Se elaboró un completísimo Informe Final de Proyecto (Octubre de 2011)*
- Reuniones del Comité Coordinador del Proyecto. Se recibieron cinco Actas del Comité Coordinador que corresponden a reuniones realizadas al final de los años 2001 a 2005 en las cuales se hace una presentación del desarrollo del proyecto y su estado actual, y se recomiendan acciones para redirigir su curso.
- Evaluación de Mediano Término. El programa consideraba una Evaluación de Mediano Termino. Esta se realizó en Diciembre del 2003 y consideró la modificación del componente 7 como se describirá más adelante.
- Auditorias Financieras Externas. Todo el manejo financiero y la documentación de respaldo respectivo, la maneja PNUD-Chile. El PNUD contrató auditorias financiero/contables externas con firmas especializadas. Las cuatro auditorías externas (años 2004, 2005, 2008 y 2010) son limpias y sin salvedades, con recomendaciones a implementar pero ninguna de ella era un riesgo para la ejecución del proyecto.

El evaluador considera que se le dio seguimiento sistemático al avance de las actividades, y considera por lo tanto que el monitoreo y seguimiento del proyecto es ***Satisfactorio (S).***

Replicabilidad

El proyecto ha dejado un legado muy importante de normas, procedimientos de certificación, material didáctico a nivel de capacitadores y de usuarios de sistemas fotovoltaicos, manuales de biogás y de creación cooperativas para el fomento y desarrollo de proyectos eléctricos, metodologías de evaluación de proyectos de NCRE, entre otros. Toda esta información se encuentra ya en uso por parte de la División de Acceso y Equidad Energética del Ministerio de Energía, y ha sido también accesible a los gobiernos regionales. Lo anterior forma una *base muy sólida que permitirá replicar proyectos* en otras regiones de Chile.

Costo-efectividad del proyecto

El objetivo global del proyecto fue alcanzado parcialmente ya que logró un poco más de la mitad de la reducción de emisiones propuestas en el PRODOC. Pero además, solamente fueron ejecutados la tercera parte de los proyectos de la cartera por lo que al completarse se alcanzarán las mestas de reducción propuestas. El proyecto ha producido unos resultados sobresalientes sobre todo en el posicionamiento en que la NCRE ha quedado en el Ministerio de Energía y en las autoridades

regionales y municipales, como una alternativa viable y sostenible para el suministro de energía en el sector rural y como fuente de usos productivos de la energía. *En este sentido, el proyecto ha sido efectivo en el logro de los resultados de varios componentes con desempeño satisfactorio y altamente satisfactorio.*

En cuanto a los costos de la reducción de emisiones, estas han significado para el GEF un *costo de US$246.85/t CO_2* evitada *versus US$110 /t$CO_2$* presupuestada, debido a que la reducción de emisiones alcanzó un 44.5% de lo esperado en el PRODOC corregido). Ahora bien, *si se considera las emisiones post-proyecto, al considerar la reducción de emisiones por toda la cartera*, estas alcanzan 60.46 Gg (109.4% de lo esperado en el PRODOC corregido) y el costo desciende para el GEF a US$100.35.

Sostenibilidad
Cuatro factores aseguran la sostenibilidad de los resultados del proyecto. El primero es el desarrollo de capacidad. Todos los componentes del proyecto contribuyeron a desarrollar capacidad. Los capacitados fueron beneficiarios, personal de autoridades regionales y nacionales, ingenieros, consultores, entre otros, y a diferentes niveles. El material elaborado fue ampliamente difundido mediante impresos, videos, y colocado en la web del proyecto.

El segundo factor que asegura la sostenibilidad del proyecto es la apropiación de la tecnología de NCRE. Sin lugar a dudas este es *uno de los resultados sobresalientes de este proyecto*: las instituciones a nivel central, regional y municipal han comprobado la sostenibilidad de las soluciones de NCRE y se han constituido en sus promotores al considerar en todos los proyectos la viabilidad de emplear NCRE. Este factor está ligado con el tercer factor: Desarrollo de capacidad institucional. El mayor beneficiario fue el Ministerio de Energía. Ellos han recibido el beneficio directo del proyecto y la División de Acceso y Equidad Energética tiene el personal calificado, la información y las metodologías desarrolladas por el proyecto para asegurar la continuidad de la utilización de las NCRE.

Finalmente, el cuarto factor es la amplia base de aceptación de la tecnología de NCRE entre los diferentes actores institucionales (Ministerio de Energía, Ministerio de Agricultura, entre otras) por los comprobados resultados de los proyectos que ha permitido la aceptación de la tecnología de las NCRE como alternativa para el desarrollo de las zonas rurales.

Resultados del proyecto

Objetivo global
Indicador: Reducción de 62.600 ton de emisiones de CO_2 después de 20 años[7]
Logros:

- Las emisiones evitadas por los sistemas instalados por el proyecto y por espacio de los próximos 20 años de operación serán de 24.580 tCO_2/año[8], alcanzando 44.5% de la reducción esperada propuesta en el PRODOC recalculada de 55.28 Gg).

[7] Al verificar la suma de las cifras en el PRODOC, pág. E4, la cifra correcta es 55.280 t.
[8] Para esta estimación se ha empleado la metodología descrita en el Anexo E del ProDoc. Al verificar la suma de las emisiones reducidas la meta son 55.28 y no 62.61 tCO2. Pero además, al considerar que se sobreestimó el número de sistemas fotovoltaicos a instalar (6000 versus 3064 determinados por el catastro), las emisiones reducidas serían 42.596 Gg en vez de 62.610 Gg.

- Ahora bien, si se considera las emisiones post-proyecto, al considerar la reducción de emisiones por toda la cartera, estas alcanzan 60.46 Gg (109.4% de lo esperado en el PRODOC corregido).
- Debido a que los proyectos ejecutados corresponden al 33% de las viviendas de la cartera de proyectos, suponiendo la ejecución de la totalidad de los proyectos, la reducción de emisiones se duplicaría y se tendría así la reducción de emisiones esperada.
- *Se considera que el objetivo global se ha cumplido parcialmente, de manera* ***Satisfactoria (S).***

Objetivo 1. Generación de una Cartera de Proyectos de Electrificación Rural con NCRE
Indicador: Cada año ingresan 10 nuevos proyectos con NCRE en el Banco Integrado de Proyectos (BIP)
Logros:

- El proyecto *desarrolló una cartera de 100 proyectos de NCRE*. (30 fotovoltaicos, 34 hidroeléctricos a pequeña escala y 36 sistemas híbridos), resultado considerado como ***sobresaliente*** (el indicador era 10 por año por espacio de 5 años de ejecución)**.** La cartera de proyectos cobija 11.070 viviendas, con una inversión estimada de US$30.952.111.
- De esta cartera, se ejecutaron 33 proyectos favoreciendo 4819 viviendas con una inversión estimada de US$24.548.568, con un valor medio de US$5.094 por solución.
- Además de estos proyectos, el componente 7 modificado aportó 45 proyectos a la cartera (42 con sistemas de bombeo solar y 3 de biogás) que favorecen a 45 viviendas. La cartera de estos proyectos tiene una inversión estimada de US$932.319.
- Se desarrolló un catastro a nivel nacional de viviendas y servicios rurales sin servicio de energía eléctrica (12400 viviendas y establecimientos rurales, encuestados y geo-referenciados).
- El monto total de todo el proyecto alcanzó la suma de US$33.334.379, de los cuales el gobierno aportó el 75.9%, los usuarios el 4.6%, los privados el 1.3% y el GEF, 18.2%.
- Considerando el monto total del proyecto ejecutado y el valor del proyecto para el GEF, el *nivel de apalancamiento para el GEF es de 5.5, lo que es* ***Altamente Satisfactorio (HS)****.*
- En esta componente se desarrolló una metodología de evaluación de proyectos considerando NCRE que ha sido adoptada por el Ministerio, resultado que constituye uno de los factores que permiten la sostenibilidad del proyecto.
- Los resultados de este componente se consideran ***Altamente Satisfactorios (HS)***

Objetivo 2: Elaboración de Normas Técnicas para Sistemas de Electrificación con NCRE
Indicador: Se publican 4 nuevas normas por tecnología: fotovoltaica, eólica, micro-centrales y biomasa
Logros:

- Se desarrollaron 44 normas técnicas para la tecnología fotovoltaica (15), eólica (7), sistemas híbridos (4) y Microcentrales hidroeléctricas (18).
- Las normas se fundamentas en normas internacionales y en el estado del arte de las tecnologías, y constituyen un aporte sobresaliente para asegurar la sostenibilidad técnica de los sistemas.
- Las normas son de tipo voluntario en el país pero el gobierno de Chile las adopta para todas las licitaciones de equipo de NCRE.
- Los logros de este componente se consideran ***Altamente Satisfactorio (HS)****.*

Objetivo 3: Elaboración de Procedimientos de Certificación para Sistemas de Electrificación con NCRE.

Indicador: Número de certificaciones realizadas (depende del número de proyectos efectivamente ejecutados)

Logros:

- Se desarrollaron los procedimientos de certificación para sistemas de NCRE utilizados en el proyecto.
- Se certificaron 3064 sistemas fotovoltaicos del proyecto Demostrativo Fotovoltaicos a Gran Escala de la IV región de Coquimbo.
- El resultado de este componente es ***Satisfactorio (S)***

Objetivo 4: Implementación de una Campaña de Promoción para las NCRE.

Indicador: Aumento de la demanda de proyectos de electrificación con NCRE por parte de las comunidades rurales

Logros:

- La campaña de promoción consistió en el trabajo directo del equipo coordinador del proyecto con los gobiernos regionales, municipalidades rurales, autoridades locales y comunidades rurales. Participaron también los consultores que redactaron los materiales empleados en los seminarios, talleres y reuniones.
- Se desarrollaron y emplearon afiches, folletos y manuales (sobre sistemas fotovoltaicos a nivel de capacitadores y usuarios, energía eólica, biogás y radiación solar).
- Desarrollo del web site www.renovables-rural.cl que funcionó entre 2004 y 2007, y cuyo contenido ha sido transferido al Ministerio de Energía.
- Realización de seminarios, talleres y reuniones de difusión.
- Taller de evaluación de recursos eólicos. Se elaboró CD con las presentaciones, participantes y metodologías de evaluación del recurso.
- El componente logró difundir ampliamente las NCRE y como resultado de ello, el número de proyectos ingresado al BIP-MIDELPALN que emplean NCRE alcanzó la cifra de 100.
- Los logros de este componente se consideran ***Satisfactorios (S)***.

Objetivo 5: Desarrollo de un Programa de Capacitación

Indicador: Número de cursos implementados para los siguientes niveles: político regional (gestores de proyectos), ingenieros y técnicos, usuarios

Logros:

- Desarrollo de un programa de capacitación orientado a los responsables de las políticas centrales y regionales, entidades reguladoras, inspectores, y a los ingenieros, técnicos y usuarios.
- Realización de eventos internacionales con el CNE y el personal del proyecto. Además, el programa capacitó a participantes del proyecto mediante su asistencia a curso.
- Realización de talleres sobre:
    - Técnicas de trabajo de campo, entrevistas y recopilación de datos, para la generación de una cartera de proyectos de NCRE, dirigido a personal de trabajo de campo.
    - Taller sobre instalación de estaciones de medición de vientos y el manejo y procesamiento de datos dirigido a responsables de la política regional,

profesionales, ingenieros y técnicos, personal de la CNE (2003 y 2004).
    - Evaluación de sistemas fotovoltaicos en la IV región para funcionarios municipales, técnicos y personal del proyecto.
    - Diseño de sistemas híbridos dirigido a profesionales del sector gobierno y empresas consultoras (2004).
    - Evaluación de proyectos de NCRE dirigido a profesionales de los gobiernos regionales (regiones I a IV) (2004).
    - Talleres sobre Pequeñas Centrales Hidroeléctricas (2004 y 2005).
    - Capacitación en el Sistema de Información Geográfico ArcView a dos profesionales de la CNE (2005).
    - Capacitación de sistemas solares fotovoltaicos orientado a los usuarios, técnicos y personal de autoridades municipales (3800 personas, en 2005).
- Hasta el 2009 se habían realizado talleres y seminarios para unos 3.500 usuarios finales, técnicos, empresas consultoras, proveedores de tecnologías, gobiernos locales y municipios, en sistemas fotovoltaicos.
- Los logros se consideran ***Satisfactorios (S)*** aunque el evaluador no ha encontrado que hayan quedado establecidos acuerdos inter-institucionales a largo plazo con universidades e instituciones capacitadoras para continuar la capacitación en NCRE.

Objetivo 6: Diseño y Ejecución de un Proyecto Demostrativo Fotovoltaico de Gran Escala
Indicador: Se instalarán anualmente 1.000 sistemas fotovoltaicos por año (5000 en total)
Logros:

- El proyecto identificó necesidades de sistemas fotovoltaicos para:
    - 3,064 viviendas en 15 municipios.
    - 55 escuelas y centros de salud rurales (postas).
    - 1,500 viviendas con sistemas PV instalados que necesitaban mejoramiento.
    - La inversión estimada para estos tres proyectos fue de US$6, 300,000.
- Para el proyecto demostrativo a gran escala, el programa de Remoción de Barreras:
    - preparó el diseño técnico de ingeniería de los sistemas PV,
    - realizó la evaluación técnico-económica de los tres proyectos anteriores,
    - preparó los documentos de licitación (TDR y especificaciones técnicas) para el proyecto de viviendas,
    - gestionó, junto con la CNE, la creación de un subsidio especial a la operación, el que finalmente dio viabilidad a la materialización del proyecto PV de gran escala operado por una empresa privada (paso fundamental para viabilizar el proyecto de gran escala). Este subsidio viabilizó posteriormente nuevos proyectos con NCRE.
    - asistió al Gobierno de Coquimbo en la formulación de los proyectos regionales.
    - asistió al Gobierno Regional en el proceso licitatorio en la convocatoria a expresión de interés, la convocatoria a la licitación y en la evaluación de las ofertas de la licitación pública internacional.
- La licitación de los 3,064 sistemas fotovoltaicos para la IV Región fue adjudicada CONAFE, por US$ 5 millones ($Chilenos 2.925.845.225), para la instalación, operación y mantenimiento de los sistemas fotovoltaicos por un período de 10 años, renovable. El GEF aportó como costo incremental aproximadamente US$120 por sistema.
- *Este proyecto continua después de 5 años operando exitosamente de manera sustentable*

- Un *resultado supremamente valioso* del componente es la apropiación de la tecnología fotovoltaica por parte del gobierno regional, los usuarios y la compañía de mantenimiento, del sistema de gestión desarrollado y de la inclusión de la tecnología en las propuestas de suministro de energía como una alternativa real, confiable y sustentable no solamente para la Región IV sino para otras regiones del país.
- El evaluador considera ***Altamente Satisfactoria (HS)*** la implementación de este componente.

Objetivo 7a: Desarrollo de un Mecanismo Financiero para Proyectos con NCRE
Indicador: Mecanismo Financiero diseñado, aprobado y operativo; y por lo menos un proyecto ejecutado con cada tipo de tecnología
Logros:

- *Componente no ejecutada* porque mecanismo no era apropiado para mitigar la percepción de riesgo del sector privado para participar en proyectos de electrificación rural. Reestructurado.

Objetivo 7b: Usos productivos de las NCRE, en las zonas rurales
Indicador: Generación de una cartera de proyectos productivos, que incorporen el uso de NCRE; y Diseño de ingeniería para 4 proyectos demostrativos de bombeo solar de agua en la IV Región.
Logros:

- Desarrollo de cartera de proyectos de usos productivos (ver logros de componente 1).
- Desarrollo de metodologías de evaluación expost de proyecto y evaluación expost de proyectos de riego.
- Instalación de sistemas demostrativos de bombeo (4), plantas de biogás (2) y entrenamiento y capacitación de beneficiarios (incluidos manuales y video de biogás).
- Se consideran ***Satisfactorios (S)*** los logros alcanzados.

Objetivo 8: Reducir las Emisiones de CO_2 a través de Hibridización de Proyectos con Sistemas Diesel Actualmente en Operación
Indicador: Al menos 2 proyectos de hibridación en el BIP.
Logros:

- Cartera de 36 proyectos ingresados en el BIP en 2007.
- Preparación de especificaciones técnicas y documentos de licitación de 8 proyectos híbridos, para suministrar electricidad a 2000 hogares (6 eólico-diesel y 2 solar-diesel).
- Asistencia y cofinanciación GEF por US$537.000 en el proyecto de Desertores.
- El evaluador considera ***Altamente Satisfactorios (HS)*** los logros de este componente.

Objetivo 9: Creación de la Capacidad Técnica para la Evaluación del Recurso Eólico en Chile.
Indicador: Mediciones realizadas en las estaciones establecidas
Logros:

- En el año 2008 se publicó la Base de Datos de Registros Eólicos (DVD) de 33 estaciones en 10 regiones de Chile (contiene información del lugar de medición, duración de la medición, velocidad promedio del viento, promedios mensuales, distribuciones de probabilidad, rosas de vientos, tipo de data logger empleado, perfil diario del viento y resumen del recurso en pdf).
- Capacitación a numerosos técnicos, ingenieros y consultores que posteriormente participaron en proyectos de generación eólica inyectada a la red pero no en proyectos rurales.
- Logro ***Satisfactorio (S)***.

ESTADO DE LAS BARRERAS

El evaluador considera que después del proyecto, el estado actual de las barreras es el siguiente:

ESTADO BARRERA ANTES DEL PROYECTO	ESTADO BARRERA DESPUÉS DEL PROYECTO
(e) falta de cartera de proyectos de electrificación rural con NCRE.	• *Barrera removida.*
(b) falta de normas para los equipos de energías renovables	• *Barrera removida*
(c) inexistencia de procedimientos de certificación para los sistemas de energías renovables y su instalación;	• *Barrera removida.*
(d) desconocimiento de las NCRE	• *Barrera removida*
(e) carencia de programas de capacitación formales;	• *Barrera removida parcialmente* porque no se encontró evidencia de la continuidad de programas de capacitación en instituciones de educación superior aunque el Ministerio si incluye capacitación en sus proyectos.
(f) existencia de altos costos de inversión en proyectos con NCRE;	• Esta barrera se considera *NO removida* .principalmente debido a que si bien la tecnología, por ejemplo, fotovoltaica ha disminuido, los costos de instalación y mantenimiento en las zonas remotas y aisladas, se incrementan con las distancias y el aislamiento. Pero al considerar el Costo del Ciclo de Vida (*Life Cycle Cost*) de los proyectos de NCRE, el gobierno de Chile ha encontrado que estos son una alternativa viable técnica, económica y ambientalmente para la prestación del servicio en zonas remotas y aisladas, y preferible a los sistemas de energía convencionales. *Los formuladores* de proyecto identificaron los altos costos de inversión como una barrera *pero no consideraron el "costo del ciclo de vida" del suministro de energía como la variable a ser tenida en cuenta*.
(g) percepción de riesgos asociados con las tecnologías de energías renovables;	• Esta percepción sigue siendo válida para el sector privado que NO participó como inversionista en los proyectos. La electrificación rural continuará siendo una tarea del estado.
(h) incapacidad técnica, de equipamiento y análisis para efectuar mediciones del recurso eólico;	• *Barrera removida*
(i) inexistencia de proyectos comerciales con NCRE que tengan	• *Barrera removida* El proyecto desarrolló un proyecto de escala que ha demostrado la viabilidad sostenible de los

ESTADO BARRERA ANTES DEL PROYECTO	ESTADO BARRERA DESPUÉS DEL PROYECTO
economías de escala.	Sistemas Fotovoltaicos.

Pero además de haber removido barreras, *este proyecto ha hecho importantes aportes al desarrollo de las NCRE en Chile como son*:

- El fortalecimiento del esquema de gobernanza en el entorno institucional para abordar el problema y los retos del suministro de energía para los usuarios de las zonas rurales remota y aislada, retos que deben tener respuestas gubernamentales frente a la obligación del estado de prestar un servicio público de manera equitativa.
- Desarrollo de una metodología para la identificación y evaluación de proyectos de electrificación rural, en donde el proyecto logró colocar las NCRE como tecnologías viables técnicamente, económicamente, operativamente y sostenibles frente a un entorno de esquemas de electrificación convencional mediante la extensión de redes y el uso de generadores a diesel o benzina.
- La apropiación de las NCRE por parte de las instituciones gubernamentales del nivel central (ministerios, principalmente de Energía y Agricultura), gobiernos regionales y municipales.
- Desarrollo de modelos de gestión para los proyectos de NCRE y su validación en los proyectos de SPV en la región IV Coquimbo y la MCH de Llanada Grande, así como otras tres desarrolladas en la X Región
- Creación del mecanismo de subsidio a la operación de los SPV en la IV Región, que se ha aplicado a otros proyectos en el sector rural en el país.
- Desarrollo y validación de la "ingeniería de la gestión gubernamental" para la ejecución de los proyectos, aplicada en los proyectos de la región IV y X.

CONCLUSIONES Y RECOMENDACIONES

Al Ministerio de Energía (DAEE)

- Considerar la *continuidad y fortalecimiento* de los logros alcanzados por el programa porque es un esfuerzo que responde a necesidades reales de los habitantes rurales y las poblaciones menos favorecidas del país.
- La utilización de las NCRE en el sector rural está en línea con la política ambiental del país, con la meta hacia un desarrollo bajo en emisiones para el país, con las Metas del Milenio y la posibilidad real de alcanzar 100% de electrificación rural del país. *También, Chile puede convertirse en un ícono para América Latina al ser la primera nación Latinoamericana 100% electrificada.*
- Continuar con la diseminación de la información existente y que estaba en la web del proyecto Remoción de Barreras.
- Actuar acorde con la realidad de la necesidad de voluntad política para la ejecución de los proyectos. Los proyectos de electrificación rural con NCRE ejecutados ha demostrado que en los lugares donde existió una voluntad política de parte de las autoridades nacionales y particularmente, la voluntad política y el apoyo de las autoridades regionales o municipales (como en el caso de la región de Coquimbo y una serie de municipios en distintas regiones), se pudieron ejecutar con el aporte técnico y la contribución de las distintas actividades del proyecto Remoción de Barreras.
- Para viviendas que no son factibles de conectar a la red de distribución de energía eléctrica, la alternativa de electrificación con NCRE tiene fortalezas desde el punto de vista técnico, operativo,

medio-ambiental y económico frente a los generadores a combustibles.

- Para la sustentabilidad de los sistemas de electrificación con NCRE en la operación y el mantenimiento a largo plazo para el sector rural, se requiere del apoyo permanente, tanto técnico como financiero, sin importar si los esquemas de gestión son ejecutados por el sector privado, por los municipios o por los propios usuarios. Este apoyo necesita de inversión pública, el que ha sido oficializado mediante el Subsidio a la Operación y Mantención creado en el marco del proyecto PV de la Región de Coquimbo y que ha sido incluido en la Ley de Presupuestos.
- Para el suministro de energía eléctrica a la población rural que vive más alejada y dispersa, que en la práctica es la última en ser considerada en proyectos de electrificación, se requiere de inversiones cada vez más elevadas, lo que implica la necesidad de aumentar los subsidios. La metodología de evaluación rural del Ministerio de Desarrollo Social se ha modificado y han aumentado los subsidios a la inversión.
- Por otro lado, las necesidades del mundo rural incluyen no solamente electricidad sino otras formas de energía. En otros términos, el sector rural requiere del desarrollo conceptual de la energización lo que implica la participación de nuevos actores y de una visión actual que se ha desarrollado en el Ministerio de Energía con influencia del proyecto Remoción de Barreras. Para ello, deberán crearse nuevos modelos de prestación de servicio y gestión. En el proceso de electrificación rural con NCRE ha quedado demostrada la vital importancia del Estado en la asistencia técnica y la seguridad de las inversiones y gasto público.

Al PNUD-GEF

- Difundir la información y el conocimiento generado en este proyecto, y los logros del mismo por tratarse de un proyecto exitoso.
- Si bien los proyectos se formulan para periodos de tiempo limitados, este proyecto ha mostrado que gracias a la extensión de su tiempo de ejecución se ha logrado verificar la sostenibilidad del proyecto de electrificación con SPV que lleva ya cinco años de exitosa operación y mantenimiento, a satisfacción de los usuarios.
- Incorporar la perspectiva de género como parte de las actividades en este tipo de proyectos permitiría analizar los roles y responsabilidades de las mujeres tanto como beneficiarias del suministro eléctrico en sus comunidades como en su rol de usuarias del servicio energético sea ésta para usos domésticos, productivos o usos comunales. Programar actividades específicas como talleres o sesiones dirigidas permite que se desarrolle un proceso de sensibilización en la temática de género aprovechando la incursión tecnológica y ampliando sus beneficios con alcances sociales. Determinar la participación de la mujer permite también valorar el papel de las mismas en el mantenimiento y uso de los equipos y posiblemente generar una participación activa en mayores usos productivos de la electricidad.

LECCIONES APRENDIDAS

- 5 años para ejecutar un programa que espera remover barreras a nivel nacional, como se tenía previsto en el diseño, es un tiempo corto, sobre todo teniendo en cuenta que algunos de los resultados requerían la participación de distintos actores clave.
- La asignación de los recursos en el presupuesto tiene que ir de la mano con el alcance del indicador y el producto esperado. Específicamente en el caso de la campaña divulgativa no se aprovisionaron ni los recursos ni el personal requeridos para cubrir el alcance descrito.
- Sistematizar los logros y diseminar la información obtenida, que pueda ser de carácter público,

permitiría obtener un mayor impacto en los logros de este proyecto, por ejemplo, elaborar estudios de caso de las comunidades beneficiarias con energía solar fotovoltaica permitiría aún hacer más visible este esfuerzo conjunto entre el PNUD- GEF y el Ministerio de Energía.

- Esencial para el éxito del proyecto fue la participación efectiva de los principales actores en las diferentes etapas de identificación y desarrollo de los proyectos de electrificación rural con NCRE. Es importante crear, en la etapa inicial del trabajo, las alianzas estratégicas y los consensos necesarios, para asegurar la aprobación, el financiamiento y la ejecución de los proyectos. Involucrar a las comunidades y beneficiarios directos de los proyectos, es también esencial para asegurar el éxito de los proyectos.
- Uno de los aspectos esenciales para el éxito de los proyectos de NCRE es diseñar y considerar diferentes esquemas de gestión que conduzcan a la sostenibilidad de los proyectos. Esto incluye no solamente los recursos económicos sino también el desarrollo de capacidad no solamente entre los técnicos sino también entre los usuarios. Este proyecto consideró esencial y estratégico este tema.
- El éxito de los proyectos también se fundamenta en bien planificados y ejecutados estudios de pre-inversión. La asignación de recursos para estas actividades resultan tener una alta retribución a futuro. Lo anterior conlleva a un estudio cuidadoso de las necesidades reales de los usuarios y de la exploración de sus oportunidades de generación de ingresos. El uso de la energía con fines productivos es un tema de la mayor importancia. Lo anterior indica que los proyectos de electrificación y de energización rural con NCRE deben surgir de las necesidades reales de la población rural. Solamente a través de su participación, los usuarios podrán "apropiarse" del proyecto y generar factores de éxito del mismo.

El proyecto Remoción de Barreras en su conjunto se puede considerar como un proyecto desarrollado con efectividad, exitoso y **Satisfactorio (S)** con el desarrollo **Altamente Satisfactorio (HS)** de varios componentes.

1. INTRODUCTION

The United Nations Programme for Development (UNDP), implementer of the ***project Barrier Removal for Rural Electrification with Renewable Energies - UNDP-GEF (Project CHI/00/G32 (11799)*** recruited Humberto Rodríguez (hereinafter, the evaluator) to undertake a Final External Evaluation at the end of the period of implementation of the Project. This external evaluation is provided in the Project Document (PRODOC).

The Final Evaluation which follows is intended to determine the relevance, quality, performance and success of the project. It seeks to identify the impact and sustainability of results, including the contribution to capacity development and the scope of global environmental goals. It seeks, likewise, to identify and document lessons learned and make recommendations that could improve the design and implementation of other UNDP/GEF (Global Environment Facility) projects.

With this evaluation, there is an opportunity to learn about the success or failure of the project, the sustainability of its results and benefit of lessons learned. It aims to achieve the following objectives:

- Analyze the implementation of the project;
- Review achievements of the project with regards compliance of the objectives and its expected results;
- Establish the relevance, performance and success of the project, including sustainability of results;
- Collect and analyze specific lessons and best practices with regards strategies used and implementation arrangements, which may be relevant to other projects in the Country and abroad.

The **evaluation methodology** consisted of:

- Reviewing documentation (prior to the visit to Santiago). This documentation was provided by UNDP Chile, the Project Coordinator and Ministry of Energy (MINEENERGIA).
- Interviews conducted in the country at the beginning of the mission. The evaluator met in Santiago with:
    - UNDP
        - UNDP Resident Representative
        - UNDP Energy and Environment Officer
        - Project Coordinator
        - Programme Assistant
    - In the Ministry of Energy
        - Head of the Sustainable Development Division
        - Head o the Energy Access and Equity Division, and Project Director
    - IV Region of Coquimbo
        - Head of Analysis and Control Division, Region, Regional Government of Coquimbo
        - Deputy Technical Regional Manager for the National Electrical Force Company (CONAFE)

- X Region of Los Lagos
  - Governor's Assistant
  - Mayor of Cochamó
  - President of the Cooperative

- Visits to the Ministry of Energy. The evaluator visited the Ministry of Energy, implementing agency of the project to obtain pertain information.
- Visit to projects. Joint visits of the Project Coordinator and Ministry staff were made to the IV Region (where photovoltaic systems – PVS - for both, domestic use and for water pumping have been installed) and in Llanada Grande, X Region, where micro- hydro power plants (MCH) were also installed. Visits not only included the equipment installed and work performed, but also conducting interviews to users in order to receive information about the project and the benefits resulting to them.
- Other interviews. The evaluator met in Santiago with staff consultants for further details on their participation in the project.
- Analysis of information.

Project Information. The information (reports and documents) was directly provided by the Project Coordinator. PIR (Project Implementation Report) from 2002 to 2011 and project activities plan from 2002 to 2008 were provided by UNDP as well. Reports of External Audits (2004, 2005, 2008 and 2010) and results of Tripartite meetings were also considered.

The listing of all the information provided, duly organized by dates, is provided in Section 6.6. In the electronic version of this report, all electronic files received are included. It is important to note that the *Final Report of the Project* was received in October 2011.

Upon completion of visits in Santiago, the evaluator proceeded analyzing the information provided. The evaluator requested additional information to both, UNDP and the Project Coordinator, having received *the latest information electronically on February 22, 2012 for the draft.*

Reviews to the Report. The evaluator has delivered the following versions:

- February 2012, Draft Version 1.0, to be reviewed by UNDP and the Ministry of Energy.
- March 28, 2012, Final Version 2.0, including comments from the Ministry of Energy and GEF /UNDP, Regional Office.

2. PROJECT CONTEXT

2.1 DESCRIPTION OF THE PROBLEM

This section is intended to describe the problems faced by the country in the area of rural electrification by 2000, the year around when the project was created as well as circumstances under which the project was formulated[9].

During the nineties, the Chilean economy experienced accelerated growth in the Gross Domestic Product (GDP) (6.73% average annual growth), an increasing demand for energy at rates similar to the GDP associated with power generation and a growth of CO_2 emissions. In order to allow the economy of the country to grow while not leading to increases in greenhouse gases (GHG), the Government of Chile began to search for policies and strategies that would enable a more efficient use of energy in the short term and, that in a long-term perspective shall change the composition of the country's energy matrix.

In order to carry on this change, sectoral authorities considered using the Rural Electrification Programme (PER), a successful project implemented since 1994. The convenience to use this programme is due to two reasons: it was considered a priority meeting the needs of rural population; likewise, it was a successful programme in execution, and the challenges to the use of Non-Conventional Renewable Energy (NCRE) could be better understood by the experiences of PER with conventional energy sources in rural areas as well. The conventional supply adopted by PER was the extension of electricity grids or the use of diesel or gasoline generators. However, the high costs of these conventional forms of electricity for rural population which were away from the grids, with access difficulties and dispersed in the territory, were a constraint to continue with these technologies; however, an opportunity for NCRE, moreover, when the country has high potential for solar energy in the north, wind energy in coastal and southern areas, and hydropower power and biomass in the south.

NCRE penetration in the country was poor and with unsatisfactory results in the light of very limited and uncompetitive markets, and in the reliability and sustainability of NCRE technologies. It was then necessary to identify the barriers that limit their development and suggest actions that would allow their use to a more massive scale to demonstrate technical, operational, and commercial feasibility. In this way, NCRE would become involved in changing the energy matrix

Population with no access to electricity in rural areas was 40% in the mid-nineties and by 2001, this had increased to 76% through the actions of PER[10][11]. The remaining 24% represents 136,669 households and of these, 74,000 were identified as potential market for NCRE.

Given these needs of the rural sector, the possibility of using NCRE and the challenges its use entailed, the Chilean government requested the United Nations Programme for Development (UNDP), to

[9] The evaluator was unable to obtain a copy of the PDF-B.
[10] As of year 2011, Chile has rural electrification coverage of 96.5% which, along with Argentina and Venezuela, are the countries with the highest rural electricity coverage in Latin America.
[11] National Energy Commission (2008). Achievements of the Rural Electrification Programme. *["Logros del Programa de Electrificación Rural"*] CNE. Santiago, Chile.

prepare a technical assistance project for the "Barrier Removal for Rural Electrification with Non-Conventional Renewable Energy" (Rebar) to be submitted to the Global Environment Facility (GEF), for approval and funding.

On the other hand, this problem afforded an opportunity to reduce emissions of Greenhouse Effect Gases (GHG) as rural households could aim to the use of petroleum-derived fuels generators, reduced significance of the Global Environment Facility (GEF for its acronym in English, FMAM: *Fondo para el Medio Ambiente Mundial*) and in line with environmental political guidance of the country, despite the fact that Chile was in 2001 a modest GHG emitter (3.6 t CO_2/ inhabitant/per year). Chile was a country also eligible for GEF projects. In accordance with its environmental policy, Chile ratified the United Nations Framework Convention on Climate Change on December 22, 1994. An additional feature that contributed to the formulation of the rural electrification programme was the pursuit of the Millennium Development Goals (MDGs), several of these promoted by the supply of energy in the rural sector and in particular, Objective No. 7, which is to integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources. Therefore, *at the time, there was a coalescence of factors that led to the formulation of the programme.*

2.2 PROJECT BACKGROUND

In late 1994, in response to the initiative of President Eduardo Frei of engaging all sectors of the population to economic development, an agreement was signed that launched the National Rural Electrification Programme (PER), developed at CNE, and whose purpose was to solve electricity shortages in rural areas, incorporating the concepts of equity, reduced migration, production development and decentralization of decisions. The target set in the programme was to provide electricity, in the first stage, to 75% of rural households in the country, within a period from 1994 to 2000. The rural electrification coverage that existed at the time, reached only 59%.

To achieve the goal, the State implemented a co-financing system for rural electrification projects, with the participation of private electricity distribution companies, beneficiaries of the projects and a state subsidy. PER is developed from a decentralized regional management, where each region develops, evaluates and funds its projects, according to regional needs and compliance of goals and objectives.

While the goal set for PER for the period 1995-1999 was successfully completed by 2000, there were still around 136,669 remaining households with no electricity, which affected approximately 600,000 rural inhabitants. This deficit is concentrated only in certain regions, which have less than 70% coverage while there are others with more than 85% coverage, nowadays, indicating an imbalance in regional developments.

The new PER of President Ricardo Lagos for the period 2000 - 2005 has proposed a 90% coverage for households and community centers (schools and health centers) both regionally and locally, with a total investment of 180 million dollars and the electrification of 98.244 households.

The government was also committed to:

- Improve human development indicators in the region and in the poorest communities in the country, coordinating efforts with other rural electrification programmes to eradicate poverty

in the areas of education, health and productive development, including areas with a high percentage of indigenous communities;
- Focus investments, conduct training and dissemination activities in regions with low energy coverage;
- Encourage the use of non-Conventional Renewable Energies by reducing existing barriers;
- Support the gradual replacement of energy systems based on diesel generators in order to reduce emissions of greenhouse gases.

The target of 90% coverage in rural electrification is based on concerted efforts targeting relatively rural areas, leaving aside approximately 65,000 households located in dispersed rural populations. The state policy with regards these households indicates that due to the dispersed nature of the population and the high cost of providing them with electricity, the cost-social benefit analysis to determine the subsidy amount for the provision of electric services needed to have a positive social evaluation.

The programming done by the State establishes that from 98,244 households to be provided with electricity in 2000-2005, 90% will be electrified through grid extension and the remaining 10% through diesel generators. However, there is a significant possibility that these households could be electrified using NCRE, if barriers that prevent the massive entrance of these technologies in rural electrification are removed.

Chile had important milestones with regards NCRE:

- Chile was one of the first countries in the world where solar energy was used for industrial purposes (the first solar industry was built in Antofagasta in 1972).
- As from the year 1961, a systematic measurement of solar resources (over 120 stations) was initiated. One of the world's highest resources was available among regions I and IV (around 4500 kcal/m^2/per day).
- Outstanding wind energy resources; although, its evaluation should be improved, covering further measuring stations, largest number of stations and greater measurement periods at appropriate heights.
- Significant availability of micro- hydro power resources in Regions VIII to XI for Micro-hydro power plants.

Despite isolated efforts made since 1994 to incorporate NCRE in the PER, at pilot projects level with different technologies (photovoltaic, wind energy, Micro- hydro power plants and forestry biomass gasification), *operating results were unreliable* and, in general terms, *both, the Government and private companies preferred providing electricity to isolated households with grid extensions and power generators*, since their results are known and trusted in terms of technology, and manageable in terms of operational and economic impacts.

Within the framework of PDF-B[12], around 29.355 households, which will never be electrified through grid extension or diesel systems due to the extreme condition of isolation and dispersion, were

[12] The evaluator was unable to obtain a copy of the study "Estimating Potential Application of Renewable Energy in Rural Electrification" [*Estimación del Potencial de Aplicación de Energías Renovables en la Electrificación Rural]*. Reference is made, indirectly, to the information of the study.

identified in 2000. These are part of the 64.735 households that will not be provided with electricity by the programme in accordance with the policy state defined to support for rural electrification. This, added to the total number of households, 9.824 that will be electrified by the programme through diesel systems within the next five years, reach an amount of 74.559 households as an estimate of the potential market for new rural electrification NCRE projects.

2.2.1. IDENTIFIED BARRIERS TO THE PROJECT

By 2000, the capacity related to NCRE in Chile, was limited in several aspects and levels. Apart from some small-scale trials, the experience was insufficient to address outreach programmes and coverage. There was also a significant lack of NCRE technologies by potential users, regional governments, project evaluators, project financing managers, etc. There were no NCRE project developers, and lack of knowledge in terms of technical and operational characteristics.

After a comprehensive analysis, the *identified barriers* in the PRODOC were:

(a) lack of rural electrification project portfolios with NCRE;
(b) lack of regulations for renewable energy equipments;
(c) lack of certification procedures for renewable energy systems and their installation;
(d) lack of general knowledge with respect to NCRE;
(e) lack of formal training programmes;
(f) existence of high investment costs in projects with NCRE;
(g) perception of associated risks with renewable energy technologies;
(h) lack of technical expertise, equipment and analysis to perform wind resources measurements;
(i) lack of NCRE commercial projects with economies of scale.

The *situation of the barriers at the end of the project* is that the barriers to be removed for the project implementation will cause an effect nationwide in terms of establishing a market for the development of NCRE in both, rural and urban areas. This will reduce emissions of greenhouse gases produced by the energy supply in rural areas.

2.2.2 PRODOC FORMULATION

Subsequently and based on PDF-B results, the Project Brief was developed whose final version (May 2001) includes the implementation of a Full size project with 9 components, to be developed in five years.

The project components are designed to remove the main barriers (Generation of a Portfolio of Rural Electrification Projects using NCRE, Development of Training Programme, Reducing CO_2 Emissions by means of Hybridization Projects with Diesel-Fueled Systems Currently in Operation) while the remaining six enhance the above. Of these components, special attention should be given to the component of Developing a Financial Mechanism for Projects using NCRE.

As result, barriers were well identified and the components to solve them, appropriately defined. The exception is the Financial Mechanism where the perception of risk to NCRE is an actual problem and constitutes a barrier; however, the cause was not well identified nor the proposed solution was suitable, as explained below.

The project value was U.S. $32,397,300, with a GEF contribution of U.S. $6,067,300 GEF and a chilean co-financing of U.S. $26,330,000 (of which U.S. $755,000 was in kind).

2.3 PROJECT APPROVAL BY GEF

Following UNDP-GEF procedures, the PRODOC (Project Document) was signed by the parties: National Energy Commission, Ministry of Foreign Affairs and the United Nations Programme for Development (UNDP) on September 16, 2001.

It should be noted that the programme meets the *Millennium Development Goals*, *Goal No. 7*: Ensure Environmental Sustainability and, consequently, with the Strategy for Poverty Reduction, and was in line with the environmental policy of the country.

2.4 STARTING DATE AND DURATION OF THE PROJECT

The project effectively started in October 2001, with an initial duration of five years (until 2006), the year from which has been successively extended until December 31, 2011.

The implementation period has been extended for five years in total, mainly due to delays caused by the interdependence of the components in the actual implementation of the project and were not properly considered in the formulation of the work plan (for instance, it is not possible to massively install systems without first having the equipment regulations) and delays that arose in approving the amendment of Objective 7 which was suggested by the Medium Term Evaluation conducted in 2004.

This project, therefore, *has been implemented in twice the time of its initial term.* The project is in Final Evaluation as of March 2012, thus complying with this GEF requirement. Table 2.1 shows the major milestones of the programme.

Table 2.1. Main events of the programme

Date	Activity
1-May-01	Prodoc version with proposed comments by GEF.
12-Sep-01	Prodoc Approval.
1-Oct-01	Beginning of the Project-Project executed by CNE within the Rural Electrification Area.
1-Jan-03	PER to be executed by the Regional and Administrative Development Undersecretary's Office (SUBDERE). The project remains in CNE for being technically responsible of the PER.
2003	A loan is being signed with IADB for the PER where SUBDERE is the executing agency and CNE is the co-executing agency of the Programme.
1-Dec-03	Mid-Term Evaluation.
1-Jul-09	Extension in Time.
3-Dec-10	Creation of the Ministry of Energy by National Law.
30-Jun-11	Ending of the Project.
30-Jun-11	New Extension in Time- Project Execution.
1-Dec-11	Final Evaluation.
31-Mar-12	Final Deadline for Project Execution.

Source: Prepared by the author.

2.5 OBJECTIVES OF THE PROJECT

The objectives of the project are of different nature as they must be in line with both, the objectives of the country and GEF.

The *global environmental objective* of the project is to reduce carbon emissions caused by the use of electricity in Chile. The project is consistent with GEF Operational Programme 6, "Promoting the Adoption of Renewable Energies by Removing Barriers and Reducing Implementation Costs" and seeks to remove institutional and financial barriers with regards capacity and knowledge to the incorporation of NCRE in rural electrification in Chile, thus reducing emissions of Greenhouse Gases (GHGs).

The programme objectives aim to remove the barriers that prevent the use of NCRE in rural electrification in Chile, through the development of several activities that would reduce GHG emissions produced by energy sources in rural areas. To this end, the project shall conduct the following activities:

(i) Promoting the removal of barriers to the successful use of renewable energies in the chilean rural electrification programme, generating within the existing institutional framework, conditions for the development of a NCRE market in Chile,
(ii) Promoting public and private investments in terms of the development of rural electrification with non-conventional energies, and

(ii) Promoting social equity and improvement of living conditions in rural communities.

Result or impact indicators:

- Reduction of 62.600 tons of CO2 emissions after 20 years[13].
- NCRE Percentage in the PER.
- 10 new projects using NCRE are admitted in the Integrated Projects Database (BIP).
- 4 new regulations per technology are published: photovoltaic, wind energy, micro plants and biomass.
- Number of certificates issued (depending on the number of projects actually implemented)
- Increased demand for NCRE-based rural electrification projects.
- Number of courses implemented at the following levels: regional political (project managers), engineers and technicians, users.
- 1.000 photovoltaic systems shall be installed per year (.5.000 in total).

To achieve the objective of the project, components were formulated and each one includes an immediate objective, specific outcomes and a number of activities designed to achieve the results required.

2.6 PROJECT COMPONENTS AND RESULTS

To remove the barriers identified and comprehensively analyze the formulation of the PRODOC, nine components were designed:

1. Generation of a Portfolio of Rural Electrification Projects using NCRE.
2. Elaboration of Technical Regulations for Electrification Systems with NCRE.
3. Elaboration of Certification Procedures for Electrical Systems with NCRE.
4. Implementation of a Promotional campaign for NCRE.
5. Development of a Training Programme.
6. Design and Implementation of a Large-Scale Demonstration Project.
7. Development of a Financial Mechanism for NCRE Projects.
8. Reduction of the CO2 Emissions by means of Hybridization Projects with Diesel-Fueled Systems currently in operation.
9. Creation of Technical Capacity to Evaluate Wind Resources in Chile.

Each component has expected results, proposed activities and budget for its implementation as follows:

- *Component 1: Generation of a Portfolio of Rural Electrification Projects using NCRE[14]*.

  Three results are expected for this component:
  - Overall potential use of NCRE in rural electrification in Chile at geographical level with regards renewable resources used and the number of households that may be assisted.

[13] When reviewing the sum of the figures in the PRODOC, page E4, the correct figure is 55 280 t.
[14] PRODOC, page 15 et. seq.

- Initial Portfolio of Rural Electrification projects with NCRE for a total of 12,500 households, intended to be admitted in the National Investment Systems[15] for application to state subsidy for rural electrification.
- Rural electrification projects with NCRE included in the National Investment System for application to state subsidy for rural electrification.

The total budget for this component is U.S. $536,875 [GEF: U.S. $300,000; Government: $200,000 (cash), U.S. $36.875 (In kind); Users $ 0; Private $0].

- *Component 2: Elaboration of Technical Regulations for Electrification Systems with NCRE.*

  Three results are expected for this component:

  - Regulatory framework for the implementation of technical regulations for electrical systems using NCRE.
  - Technical framework validated as a Chilean Official Regulation, by SEC, through a set of regulations for photovoltaic systems, micro- hydro power plants, wind and hybrid, and biomass gasification systems, which will facilitate the entrance of the private sector to the renewable energy market.
  - Wide knowledge of designated regulations by producers and importers of equipment and systems, such as professionals and technicians who have taken part in the development of these projects.

  The amount of resources budgeted for this component is U.S. $530,000 [GEF: U.S. $365,000; Government: U.S. $0 (cash), U.S. $165,000 (in kind); Users $ 0; Private $ 0].

- *Component 3: Elaboration of Certification Procedures for Electrical Systems with NCRE.*

  Two results are expected for this component:

  - Certification procedures of Electrical Generation Systems with NCRE to safeguard compliance of technical and quality regulations of equipment, inspection of facilities and control of installers using NCRE.
  - Development of a NCRE systems certification market in Chile to ensure sustainability of this activity beyond the end of this project, and the quality and sustainability of all projects with NCRE as well.

  The total budget for this component is U.S. $591,875 [GEF: U.S. $555,000; Government: U.S. $0 (cash), U.S. $36.875 (in kind); Users $ 0; Private $ 0]

- *Component 4: Implementation of a Promotional campaign for NCRE*

  For this component, two outcomes are expected

[15] System for managing state investments in infrastructure and social projects, within regulations set forth by the Ministry of Social Development.

- Promotional Campaign aimed to facilitate the development and management of NCRE-based rural electrification projects, reinforcing NCRE market and increasing knowledge of this technology.
- Project website to facilitate on-line communication with and among agents interested in the project.

The total budget for this component is U.S. $496,875 [GEF: U.S. $400,000; Government: U.S. $ 60,000 (cash), U.S.$ 36.875 (in kind); Users $ 0; Private $ 0]

- *Component 5: Development of a Training Programme*

For this component, the following result is expected:

- Generate sufficient training programmes aim to meet local demand for human resources training in NCRE-related fields, thus, the actors (users, electricity companies, technicians and installers, regulatory agency, administrators and inspectors) involved in the process of implementation of renewable energies acquire specific knowledge on NCRE as per their role.

The total budget for this component is U.S. $ 536,875 [GEF: U.S. $ 500,000; Government: U.S. $ 0 (cash), U.S. $ 36,875 (in kind); Users $ 0; Private $0].

- *Component 6: Design and Implementation of a Large-scale Photovoltaic Demonstration Project.*

For this component, the following result is expected:

- Install approximately 6,000 individual photovoltaic systems units in isolated areas of the IV Region of the country, thus, creating the replication of projects similar to those that supply energy through photovoltaic systems, and reach an estimated market of more than 20,000 households, including productive development projects with photovoltaic systems.

The resources allocated for this component are U.S. $10,111,525 [GEF: U.S. $794.900, Government: U.S. $5,814,000 (cash), U.S. $110,625 (in kind); Users U.S.$ 900,000 U.S. $2,492,000 Private].

- *Component 7: Development of a Financial Mechanism for Projects using NCRE.*

For this component, the result expected is as follows:

- Develop a non-grant Financial Mechanism or Fund that provides appropriate barrier removal in a manner that investors support/promote NCRE based systems over traditional approaches and, in turn, learn to manage and control possible risks involved in major investments for NCRE systems.

As shown below, this component was subsequently modified. The total budget assigned for this component is U.S. $18.259.62 [GEF: U.S. $2,070,000; Government: U.S. $10.385 million (cash), U.S. $110,625 (in kind); Users U.S. $558,000; Private U.S. $5.136.000].

- *Component 8: Reduction of CO_2 emissions through Hybridization Project with Diesel Systems currently in operation.*

  For this component, the expected result is:

  - Generate hybrid projects to be executed through Sate and private financing, and with the support of the Financial Mechanism referred to in the Activity.

  The total budget for this component is U.S. $310,625 [GEF: U.S. $200,000; Government: U.S. $0 (cash), U.S. $110,625 (in kind); Users $0; Private $0].

- *Component 9: Creation of Technical Capacity to Evaluate Wind Resources in Chile.*

  For this component, two results are expected:

  - Create internal capacities to allow adequate measurements and evaluations of the wind resources, at a level required for project design, for both the State and the private sector.
  - Having access to measurements in specific areas of the country, in line with the requirements for the preparation of projects of this nature.

  The total budget for this component is U.S.$ 410,625 [GEF: U.S.$ 300,000; Government: U.S. $0 (cash), U.S. $110,625 (in kind); Users $0; Private $0].

Guidance activities to achieve the intended outputs and their indicators and goals are given in detail in the PRODOC.

2.7 IMPLEMENTATION AND EXECUTION OF THE PROGRAMME

The executing and implementing agency are considered to be the agencies directly committed to the project. Here are their roles and responsibilities.

Implementing Agency: PNUD Chile

The GEF implementing agency for the programme is UNDP Chile. The programme will be managed in accordance with administrative regulations and procedures established by UNDP.

UNDP:

- shall manage and distribute programme funds on behalf of the GEF Secretariat,
- shall provide assistance in the procurement of equipment, if required, ensuring that the selection process of national and international consultants and subcontracts, as well, is carried out using competitive and transparent processes,

- shall provide assistance within GEF formal procedures regarding reporting, and
- shall be the formal channel through which correspondence between the programme and UNDP-GEF is handled, and
- shall be responsible for the continuous monitoring of programme progress.

Also:

- shall convene tripartite reviews at least once every 12 months, during the programme implementation,
- shall appoint a Programme Officer as the focal point for this programme,
- shall provide administrative support and financial and budgetary monitoring with regards the programme implementation,
- shall provide accounting, financial and budgetary records for the project,
- shall conduct the annual audit of the Programme following GEF procedures,
- may be entitled to charge a fee for the provision of services in accordance with UNDP corporate guidelines on Cost Recovery (Medium-High Cost Level in the Universal Price List).

Implementing Agency: CNE

The National Energy Commission was appointed as Implementing Agency of the project. The agency is responsible for the supervision of general aspects of the programme and shall be in charge of the design, management and monitoring of the project components, approval of each of its activities and specific terms of reference, of the recruitment of professionals, service personnel and equipment and report on the development of the project and payment orders.

CNE shall appoint one of its members as ***National Project Director***. Its role is to represent the project at national and international institutions related to the project. Specific responsibilities of this post will be directing the project, plan strategies and above all, implement the programme in an efficient manner according to the standards set in the PRODOC and its Annexes. Recruitment, payment and resource allocation must be approved by the National Project Director representing CNE/Ministry of Energy, and according to the formal mechanisms established together with UNDP to ensure transparency and efficiency in payments, contractual agreements and authorizations.[16]

Chief Technical Adviser

UNDP will select and hire a Chief Technical Advisor (CTA), according to the parameters established together with CNE. Its role is to manage the project under the direct supervision of the National Project Director.

Project Coordinating Committee

Furthermore, a *Project Coordinating Committee*, shall be created, whose purpose is to support the

[16] With the creation of the Ministry of Energy at the end of 2010, all CNE roles were assumed by the Energy Access and Equity Division at the Ministry of Energy.

implementation of the project, follow-up and monitor the execution of its activities and ensure that they are consistent with the objectives of the project and the National Strategy on Climate Change. The Committee is comprised of:

- CNE Executive Secretary of the Government of Chile, President,
- National Project Director,
- CONAMA Representative,
- UNDP Representative,
- Assistant Secretary for Regional Development,
- Chief Technical Adviser of the Project, Secretary.

Committee meetings will be at least twice a year and shall be convened by the President through the Secretary. These meetings will submit and analyze the progress of the project during the respective period. Its members will receive in advance documentation of the project implementation, results obtained, achievement of objectives, etc.

Likewise, representatives of regional governments, community members, and other organizations involved, and experts as well, will be invited to participate in the Committee, according to the nature of the topics addressed at the time.

The Committee will meet periodically, by summons of the President, through the Secretary. In any case, at least two sessions will be scheduled per year.

The programme set out the ToRs related to the contracts required for its implementation from the beginning of the project.

2.8 PROJECT TIMETABLE

The following timetable (Table 2.2) shows the schedule of activities.

Table 2-2. Timetable of project activities

WORK PLAN – PROJECT CHI00G32

PROJECT ACTIVITIES BY OBJECTIVE / PROJECT OPERATING YEAR

D1 Generation of a Portfolio of Rural Electrification Projects using NCRE

1.1 Update prospective studies with regards the potential use of NCRE in rural electrification through field studies.
1.2 Update land registries studies with regards using NCRE-based technologies in the country, and cross-reference this information provided in prospective studies on their potential use.
1.3 Develop a geographic information system to identify potential use of NCRE in rural electrification.
1.4 Identification of all best locations to develop pre-investment studies nationwide for the implementation of rural electrification projects using NCRE during 2001-2005. Potential for future energy needs would be of great importance when identifying locations to ensure that the NCRE chosen is appropriate and possible to expand, according to the needs within the frame of CNE's PER.
1.5 Identification of locations to develop pre-investment studies for NCRE projects and ToR preparation for its implementation.
1.6 Recruit and conduct pre-investment studies for NCRE projects oriented to the areas with the greatest potential for NCRE-based electrification and better coverage.
1.7 Develop geo-referenced databases of pre-evaluated rural electrification projects with NCRE, with estimated investment amounts, funding requirements, possible economies of scale, infrastructure needs, identification of households, evaluation of renewable resources, etc.
1.8 Conduct basic and detailed engineering studies for pre-investment projects that can be financed by the Financial Mechanism.
1.9 Information-collecting with regards social research of assessed communities for the implementation of rural electrification projects using NCRE.
1.10 Prepare documentation and incorporate projects to the National Investments System.
1.11 Prepare tender documents for the implementation of investment portfolios.
1.12 Develop institutional agreements with Regional Governments for bidding of NCRE-based rural electrification projects that have been identified and assessed.

D2 Elaboration of Technical Regulations for Electrification Systems with NCRE

2.1 Conduct a legal analysis with regards the application of technical regulations in systems with NCRE, considering the national regulatory and fiscal framework.
2.2 Develop and implement a regulatory framework proposal of technical regulations in NCRE systems.
2.3 Conduct a country-wide and international analysis on existing technical regulations for these technologies and, on the possible application of general regulations to these equipments.
2.4 Conduct a study aimed to identify technical aspects that require standardization to ensure a successful and sustainable operation of each of the technologies.

2.5 Analyze current systems and procedures for incorporation and approval of the regulations by INN and SEC and develop this process.
2.6 Conduct studies to define regulations and prepare the necessary documentation for its formalization through standardization procedures using INN and SEC.
2.7 Carry out standardization processes through INN and SEC.
2.8 Apply standing procedures for the regulations designed in Result D.2.1.
2.9 Carry out dissemination programmes of the regulations established to encourage the sharing of experience among promoters and implementers, the opening of new technology markets, and reliability in the technology of NCRE electrification projects.

D3 Elaboration of Certification Procedures for Electrical Systems with NCRE

3.1 Analyze the international experience in certification methodologies and procedures for NCRE equipment.
3.2 Define the most relevant certification issues of NCRE equipment and systems according to regulations developed in the immediate objective D.2.
3.3 Establish certification procedures to ensure compliance with chilean technical regulations.
3.4 Analyze national certification capacities and study overall demand for certification procedures.
3.5 Launch cooperation agreements with universities for training to set-up laboratories capable of conducting certification procedures.

D4 Implementation of a Promotional campaign for NCRE

4.1 Identify objectives and scope of the promotional campaign; this involves design a campaign in terms of coverage, targeting, means to be used and target market. The promotional campaign should include the promotion of training programmes for users.
4.2 Execute the campaign, according to the design guidelines.
4.3 Conduct an annual evaluation of the impact of the campaign in each of the components and status of the target market to which it points.
4.4 Establish institutional arrangements for implementation of the project website, including agreements with Internet service providers and other relevant local institutions as regards NCRE.
4.5 Implementation and maintenance of the project website.

D5 Development of a Training Programme

5.1 Search for national and international NCRE courses and training programmes.
5.2 Review and adjust training programmes designed within the framework of PDF B and define whether it will be implemented in Chile or abroad, according to the identified requirements.
5.3 Develop long-term institutional agreements with universities and training institutions.
5.4 Implement a training programme for several participants…
5.5 Follow--up monitoring and evaluation mechanisms on developed programmes aim to obtain feedback and, thus, reinforce and modify, if necessary, contents according to results.

D6 Design and Implementation of a Large-Scale Demonstration Project

6.1 Design the project and conduct an evaluation using the project evaluation for MIDEPLAN projects.
6.2 Submit and apply for State funding in order to obtain a subsidy through NCRE.
6.3 Award execution to grant the concession of electrical service (s) to a private company. Installation, operation and maintenance of the systems will be managed through one single company or separated into two contracts; one for installation and the other for operation and maintenance, as appropriate. Open bids will be called internationally once funding through state contributions, users, private companies and GEF is achieved.
6.4 Follow-up of the installation of PV systems and final evaluation of results considering aspects such as user-satisfaction…

D7 **Development of a Financial Mechanism for NCRE Projects**

7.1 Design a Financial Mechanism by UNDP Chile, UNDP GEF and CNE.
7.2 Develop specific evaluation methodology for selecting projects that could potentially benefit from the Financial Mechanism.
7.3 Develop and establish administrative regulations for the Financial Mechanism, which include the participation of UNDP, CNE, banks and potential beneficiaries, as well as all legal documentation required.
7.4 Submit and disseminate objectives and nature of the Financial Mechanism to all relevant actors.
7.5 Operation of the Financial Mechanism or Fund.
7.6 Monitoring and evaluation of the operation of the Financial Mechanism and dissemination of results.

D8 Reduction of the CO_2 Emissions by means of Hybridization Projects with Diesel-Fueled Systems currently in operation

8.1 Carry out an inventory of the communities that have diesel installations in Chile and its characteristics.
8.2 Develop engineering studies aim to determine technical and economic feasibility to develop these projects, on a case-by-case basis, taking into account the implementation of adequate measures of the resource in these locations.

D9 Creation of Technical Capacity to Evaluate Wind Resources in Chile

9.1 Define internal capabilities and prepare actors that will take part in the learning process.
9.2 Define areas where accurate measurements are taken place.
9.3 Data collection and information existing concerning the resource.
9.4 Process and analyze the data to be evaluated and characterize the resource.
9.5 Procure, install and provide training with regards the measuring stations.
9.6 Operate and maintain measuring stations.
9.7 Gather and back-up the data obtained from the measuring stations.
9.8 Provide training and conduct a final analysis of the data.
9.9 Dissemination of Results.

Source: Compiled from PRODOC, page 30

2.9 PROJECT BUDGET

The following table shows the total project budget of the programme that amounts to U.S. $32,397,300 for the 9 components. The evaluation, management and monitoring of the project of U.S. $82,400 and the preparation of the PDF B is included as well. Figure 2-1 shows the budget breakdown by component and source of funding (log scale).

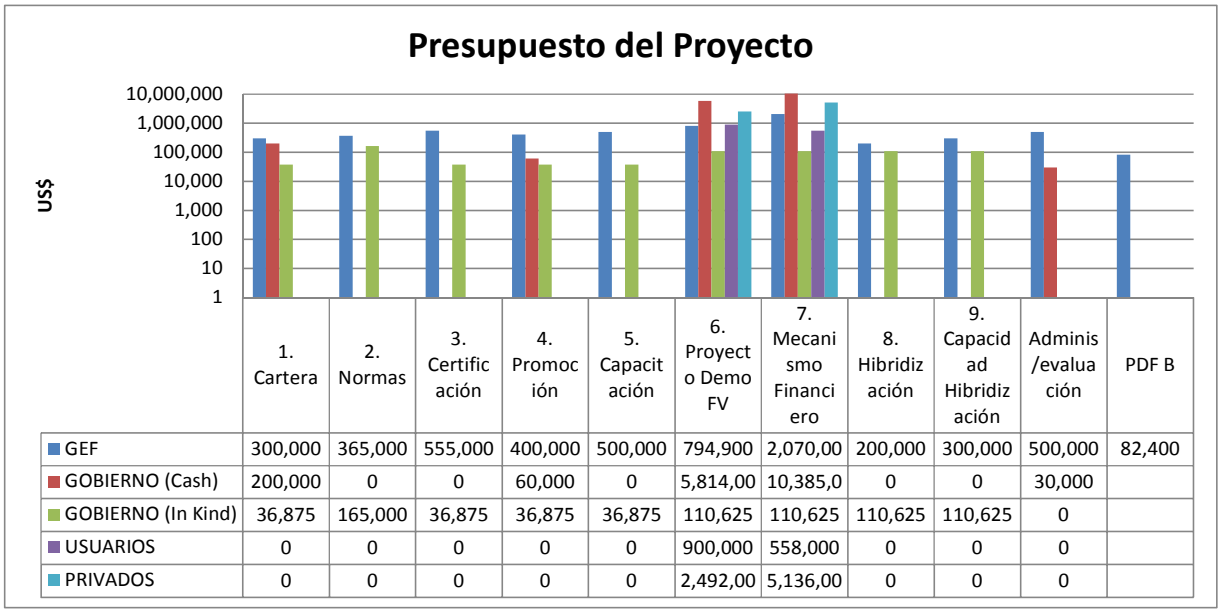
Of this budget, the largest donor is the Government (53%), with significant contributions from the private sector (24%) and GEF (19%) (See Figure 2-2). Most of the resources were allocated to the financial mechanism (component 7, 56%) and the demonstration project (component 6, 31%) (See Figure 2-3).

Table 2-3. Project Budget in 2001 (U.S.$)

COMPONENT	GEF	GOVERNMENT (Cash)	GOVERNMENT (In-Kind)	USERS	PRIVATE	SUBTOTAL	PARTICIPATION
D.1 Generation of a Portfolio of Rural Electrification Projects using NCRE	300,000	200,000	36,875	0	0	**536,875**	1.7%
D.2 Elaboration of Technical Regulations for Electrification Systems with NCRE	365,000	0	165,000	0	0	**530,000**	1.6%
D.3 Elaboration of Certification Procedures for Electrical Systems with NCRE	555,000	0	36,875	0	0	**591,875**	1.8%
D. 4 Implementation of a Promotional campaign for NCRE	400,000	60,000	36,875	0	0	**496,875**	1.5%
D. 5 Development of a Training Programme	500,000	0	36,875	900,000	900,000	**2,336,875**	1.7%
D.6 Design and Execution of a Large-Scale Demonstration Project	794,900	5,814,000	110,625	558,000	558,000	**7,835,525**	31.2%
D.7 Development of a Financial Mechanism for NCRE Projects	2,070,000	10,385,000	110,625	0	0	**12,565,625**	56.4%
D.8 Reduction of CO2 Emissions by means of Hybridization Projects with Diesel-Fueled Systems currently in operation	200,000	0	110,625	0	0	**310,625**	1.0%
D.9 Creation of Technical Capacity to Evaluate Wind Resources in Chile.	300,000	0	110,625	0	0	**410,625**	1.3%
Evaluation, administration, coordination and monitoring	500,000	30,000	0			**530,000**	1.6%
PDF B	82,400					**82,400**	0.3%
SUBTOTAL	**6,067,300**	**16,489,000**	**755,000**	**1,458,000**	**1,458,000**	**26,227,300**	**100%**

Source: CR PNUD-GEF – PRODOC, page 29.

Figure 2-1. Budget by components and funding sources (log scale)



	1. Cartera	2. Normas	3. Certificación	4. Promoción	5. Capacitación	6. Proyecto Demo FV	7. Mecanismo Financiero	8. Hibridización	9. Capacidad Hibridización	Adminis/evaluación	PDF B
GEF	300,000	365,000	555,000	400,000	500,000	794,900	2,070,00	200,000	300,000	500,000	82,400
GOBIERNO (Cash)	200,000	0	0	60,000	0	5,814,00	10,385,0	0	0	30,000	
GOBIERNO (In Kind)	36,875	165,000	36,875	36,875	36,875	110,625	110,625	110,625	110,625	0	
USUARIOS	0	0	0	0	0	900,000	558,000	0	0	0	
PRIVADOS	0	0	0	0	0	2,492,00	5,136,00	0	0	0	

Source: UNDP.-GEF PRODOC, information from page 29

Project Budget

1. Portfolio
2. Regulations
3. Certification
4. Promotion
5. Training
6. Demo PV Project
7. Financial Mechanism
8. Hybridization
9. Hybridization Capacity
10. Administration/evaluation
PDF B

gefg

GEF
GOVERNMENT (Cash)
GOVERNMENT (In-kind)
USERS
PRIVATE

Figure 2-2. Participation of concerned actors in the Budget Budget

GEF
GOVERNMENT (Cash)
GOVERNMENT (In-kind)
USERS
PRIVATE

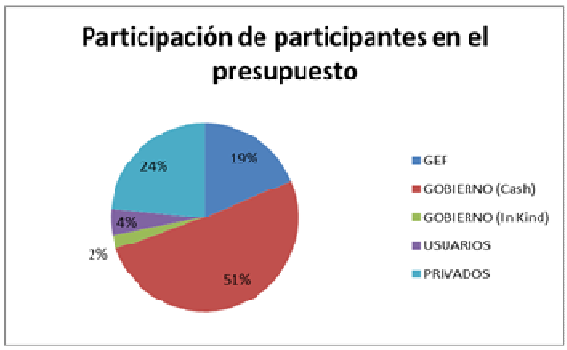
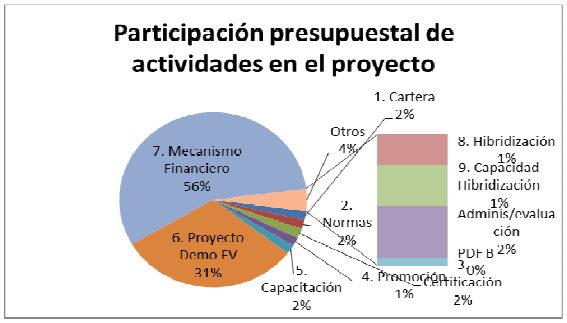


Figure 2-3. Participation of project activities in the Budget



1. Portfolio
2. Regulations
3. Certification
4. Promotion
5. Training
6. Demo PV Project
7. Financial Mechanism
8. Hybridization
9. Hybridization Capacity
   Others
   PDF B

Participation of the private sector was present in components 6 and 7, and in the implementation of the project; however, their contribution was very low and assumed by the government of Chile.

As discussed below, the component 7 was initially formulated following the Medium Term Evaluation. This component was canceled and resources were reallocated in 2006 to other components and then to the new component, *"7b: NCRE productive use in rural areas"* in 2007 approved by GEF. Table 2-4 shows these budgetary adjustments that resulted in substantial increases of several components as of these, No. 1, "Project Portfolios" has been crucial for the project.

Table 2-4. GEF Initial budget in 2001 and variations in years 2006 and 2007

	Year			Percentage
COMPONENT	**2001**	**2006**	**2007**	**Increase 2001-2007**
D.1 Generation of a Portfolio of Rural Electrification Projects using NCRE	300,000	600,000	600,000	100.0%
D.2 Elaboration of Technical Regulations for Electrification Systems with NCRE	365,000	365,000	365,000	0%
D.3 Elaboration of Certification Procedures for Electrical Systems with NCRE	555,000	555,000	555,000	0%
D. 4 Implementation of a Promotional campaign for NCRE	400,000	490,000	490,000	22.5%
D. 5 Development of a Training Programme	500,000	500,000	500,000	0%
D.6 Design and Execution of a Large-Scale Demonstration Project	794,900	794,900	794,900	0%
D.7a Development of a Financial Mechanism for NCRE Projects	2,070,000	1,140,000	140,000	-9.3%
D.7b NCRE productive uses, in rural areas	0	0	1,000,000	Nuevo
D.8 Reduction of CO2 Emissions by means of Hybridization Projects with Diesel-Fueled Systems currently in operation	200,000	520,000	520,000	160.0%
D.9 Creation of Technical Capacity to Evaluate Wind Resources in Chile.	300,000	300,000	300,000	0%
Evaluation, administration, coordination and monitoring	500,000	720,000	720,000	44.0%
PDF B	82,400	82,400	82,400	0%
SUBTOTAL	6,067,300	6,067,300	6,067,300	0%

Source: PRODOC, and PIRS 2006-2007

3. FINDINGS AND CONCLUSIONS

3.1 PROJECT FORMULATION

This section aims to describe and evaluate[17] how efficiently the concept and design of the project could face project issues, with an emphasis on consistency and logic of the strategy and logical framework of the project.

3.1.1 Conceptualization / project design

The *project is consistent* with GEF Operational Programme No. 6, "Promoting the Use of Renewable Energies by Removing Barriers and Reducing Implementation Costs"[18]. *The project is also in line with the environmental policy of the country.*

One of the priority programmes of the government of Chile was related to the Fight against Poverty, within which was the Rural Electrification Programme (PER) was inserted, responsible for the technical aspects of CNE, and later, of the Ministry of Energy. Coverage targets for rural electrification were ambitious and it was expected to achieve 90% coverage in 2006 at local and regional level. The problem of electricity supply in remote areas to dispersed users was the opportunity to use renewable energies as an alternative technically, economically and environmentally viable against the extension of grids or the use of petroleum-based fuels generators. These national policies and commitments on a path towards sustainable development and social equity are *conceptually well intertwined* in terms of conceptualizing the project.

The project proposal targets the removal of barriers identified (Generation of a Portfolio of Rural Electrification Projects using NCRE, Development of Training Programme, Reducing CO_2 Emissions by means of Hybridization Projects with Diesel-Fueled Systems Currently in Operation) while the remaining six enhance the rest). *Barriers were well identified as well as the mechanisms to remove them, except for component 7* "Financial Mechanism" aimed to mitigate the perception of risk with regards this technology for the private sector participation in the project, an actual barrier whose cause was not well identified and the mitigation mechanism was inappropriate. This situation led to redesign component 7 (recommendation resulted from the Mid-Term Evaluation[19]) allocating part of their

[17] All Findings and Conclusions sections marked with (E) in the ToR should be evaluated as Highly Satisfactory (HS), Satisfactory (S), Marginally Satisfactory (MS), Marginally Unsatisfactory (MU), Unsatisfactory (U) and Highly Unsatisfactory (HU).

[18] The objectives of this Operational Programme are: a) remove obstacles to the use of commercial or near-commercial renewable energy technologies, and b) reduce any additional implementing cost of the above technologies resulting from the lack of practical experience, low-volume emerging markets or due to the dispersed nature of the applications, with the aim to increase the technological deployment of renewable energy technologies through "win-win" and economically profitable transactions and activities. http://207.190.239.143/OP_6_Spanish.pdf

[19] UNDP-GEF-CNE (2004). Removing Barriers to Renewable Energy for Rural Electrification in Chile (REBAR) - Mid-Term Evaluation. [*"Remoción de Barreras para la Electrificación Rural con Energías Renovables en Chile (REBAR)-Evaluación de Medio Término"]*.UNDP-GEF-CNE. Santiago, Chile.

resources to reinforce the main components and making a new one to promote NCRE in productive projects in the rural sector.

The extension of deadlines was due to several factors, among which stand out, first of all, the time it took to change the design to introduce the "NCRE Productive Use in Rural Areas". Secondly, the coordination required to manage the approval by GEF/UNDP. But besides these two, the investment projects require fundraising at regional level and there is strong competition at such level. This is the case of hybridization component 8, specifically, the Isla Desertores project that took several years to financially be closed.

Both, the development *objectives* as well as the immediate objectives and their respective results formulated in the Logical Framework are *consistent with barriers to be removed (again, except for component 7). Objectives and results of the project are also in line with the initiatives of the government of Chile.*

The *implementation strategy* of the project *is considered to be accurate* since the participation of CNE and then, MINENERGIA, and their direct relationship with the PER were the appropriate institutional framework for its development. Following the signing of the agreement with the Inter-American Development Bank (IDB) for the development of rural electrification in 2003, the PER was implemented by Regional and Administrative Development Undersecretary's Office (SUBDERE); however, CNE remained co-executing through the Rural Electrification Area responsible for defining national goals and monitors its compliance. When constituting the Ministry of Energy in 2010, the Rural Electrification Area became the Energy Access and Equity Division (DAEE) of the Ministry, technically responsible for implementing the PER and where the project was finally placed. This indicates that, although, given the institutional changes in the energy sector in Chile, *the project always remained placed in a strategic position to encourage and promote NCRE in Chile.*

A *key factor in achieving the results* was the team that addressed the implementation strategy. This was organized to cover three specific areas: general coordination (provided by the Chief Technical Adviser of the Project, CTA), technical coordination (provided by a qualified technician) and strategic consulting support responsible for the political strategy at local and governmental level (provided by the National Project Director) and international strategic advice (provided by the Project Officer, UNDP Chile) under the direction and leadership of the National Project Director of CNE, and after, the creation of the Ministry of Energy, DAEE. This allocation of roles and responsibilities allowed maintaining a strategic path of the project, and a good project management, by coordinating and monitoring the activities that were recruited to companies and consultants.

As *risk factors,* the formulation of the project identified the related to the external conditions that could affect the national energy market and/or investments in rural electrification, both of which can affect the development of a NCRE market in Chile.

It was expected that NCRE projects were technically, economically and environmentally competitive against the traditional grid extension or generators using diesel or gasoline, as they effectively result for remote, dispersed and low energy-consumption users, but not attractive enough for private sector participation. Given the importance of the private sector, the project developed component 7 "Financial Mechanism" to decrease the actual perception of risk in NCRE projects and promote their participation in this sector. This mechanism, as a measure to mitigate the risk noticed by the private sector, did not

worked as rural electrification projects in Chile are primary funded by the government. Private sector participation in the project was limited to construction contracts (supply and installation of equipment) and in two particular cases, this sector participated in operating contracts, but never through investment contributions for NCRE projects.

Risk was also identified as a possible decline in fuel prices, a possibility that, at the beginning of the previous decade could be considered as valid, but that not occurred during the project implementation. There is always a risk related to the reallocation of resources for rural electrification as a result of economic crisis or disasters.

Another risk factor was the participation of communities and individuals beneficiaries of the project. The proposal to mitigate this risk was to raise awareness to the beneficiaries. In practice, all the relevant actors were involved in the process of interacting with beneficiaries (technicians, professionals, regional and municipal authorities, law enforcement authorities and agencies nationwide, even the beneficiaries themselves), *an effort that has been one of the determinants of success of the project.*

In addition to the above, there was another risk factor to the project related to the unsuccessful experiences of NCRE systems in the country in terms of sustainability due to the failure of several previous projects; for instance, solar photovoltaic systems which had not been sustainable solutions in time. Overcoming this real perception among beneficiaries and local and regional institutions became a major challenge for the project. The project faced the development of three management schemes: private (for PVS operation in Coquimbo), associated users (through electric cooperatives) and mixed between users and municipalities, which have their own characteristics, strengths and weaknesses. These schemes are at various stages of advancement and it is on them that sustainability of the implemented projects depends.

The project *components* and the activities proposed to achieve the objectives *are considered to be appropriate* and respond to institutional, legal and regulatory conditions of the programme. Timetables resulting from the activities and their interrelationship in time can hardly anticipate delays that can be incurred, but that is where the implementation of the project must be flexible and adapt to these situations in order to facilitate its implementation. This project faced delays caused by the need to start to design and develop the administrative engineering that allowed sustainability of the projects. And the second reason was the time spent in reallocating resources from component 7 and approval of its amendment as well, which took nearly two years.

Within this context, it is necessary to note that, *the initial timetable of activities for five years is very tight* when it comes to the project implementation; hence, the period of time should have been longer, at least three years. Although, the actual implementation time of the project, which is ten years, prove that only thanks to this length of time, a reinforcement of several activities with regards promotional processes, formulation of new NCRE projects, ex-post evaluations and verification of sustainability of projects, for instance, PVS large-scale project in Coquimbo (with five years of operation, already completed) were possible; however, this would have never been achieved, if the project has been implemented within the initial five-year term.

As for the timetable, the sequence of project activities did not respond to the logic of its implementation. For instance, the certification procedures of system was only possible if regulations

have been previously developed and the procedure has been tuned and used in the systems installed (See initial timetable, Section 2-8).

Indicators for the Development Objective of the Project, Project Purpose and each of the expected results for the nine components, were defined. Indicators are useful to guide the project implementation and to measure the achievements made; however, several indicators warrant some comments, namely:

- **Immediate Objective 1: Generation of a Portfolio of Rural Electrification Projects using NCRE**
  Result 1: NCRE Project Portfolio structured.
  Indicator 1: 10 new projects using NCRE are admitted in the Integrated Projects Database (BIP).
  Note: An appropriate indicator should have been the total number of projects admitted in BIP at the end of the project's duration as in one hand, the development process of the portfolio was only during the first two years and, on the other hand, projects are admitted in the BIP each year in April to be funded one or two years later.

- **Immediate Objective 2: Elaboration of Technical Regulations for Electrification Systems with NCRE**
  Result 2: Standard procedures for the application of technical regulations for electrical systems using NCRE.
  Indicator 2: 4 new regulations per technology are published: photovoltaic, wind energy, micro plants and biomass.
  Note: It makes no sense requiring four regulations per technology and not the number of regulations that specialists consider necessary.

- **Immediate Objective 3: Elaboration of Certification Procedures for Electrical Systems with NCRE**
  Result 3: Certification Procedures established for electrical systems using NCRE.
  Indicator 3: Number of certificates issued (depending on the number of projects actually implemented).
  Note: This indicator seems to be inappropriate as the result is a mechanism and the figure to be measured cannot be the number of certifications issued.

- **Immediate Objective 4: Implementation of a Promotional campaign for NCRE.**
  Result 4: Awareness and Promotional Campaign currently operational.
  Indicator 4: Increased demand for NCRE-based rural electrification projects.
  Note: Users are interested in the services provided by the energy rather than the technology itself. Project developers and institutions committed to the development of rural electrification are interested in the latter. The suggested indicator is the increased demand for electrification projects using NCRE for rural communities, but not by them.

- **Immediate Objective 6: Design and Implementation of a Large-scale Photovoltaic Demonstration Project.**
  Result 6: Commercial demonstration of photovoltaic systems.
  Indicator 6: 1.000 photovoltaic systems shall be installed per year.

Note: There would have been 6,000 households in the IV Region provided with electricity through PVS as per the PRODOC established. When developing component 1, it was established that the number of households were 3.084 instead. Consequently, the indicator exceeded the needs.

- **Immediate Objective 8. Reduction of CO_2 emissions through Hybridization Project with Diesel Systems currently in operation.**
  Outcome 8: Establishing a Hybrids Project Portfolio.
  Indicator: At least 2 hybridization projects in the BIP.
  Note: The actual fact is that projects must comply with the process of identification, evaluation and design up to the feasibility-level in order to be admitted in the BIP and, and thereafter subject to evaluation and financing. This does not mean that projects would finally be executed. In this sense, admitting projects in the BIP does not mean achieving the objective of emissions reduction.

The project presents the following deficiencies in its formulation in terms of estimation, design and programming:

- Magnitudes of the project portfolio (component 1) and the long-scale photovoltaic project (component 6) were overestimated. The overestimation of component 6 had budgetary implications as the project was overestimating (6.000 systems instead of 3.000) the amount of GEF contributions as per incremental costs and activities related to the project as well. The response of the project was extending coverage of the project portfolio and the photovoltaic demonstration project from the IV Region to the rest of the country, which was an appropriate response as land registry covered the country and photovoltaic projects as well.
- Objective 7 was poorly designed and in this component was committed one third of the total budget of GEF contribution to the project.
- As a consequence of the first two deficiencies, at some point during the execution, 40% of the budget was paralyzed. The response was extending coverage of components 1 and 6, redefine a new target for component 7 and reallocate its resources.
- Critical routes for its execution were not considered correct in the sequencing of activities listed in the timetable.
- Another consequence of the deficiency in component 6 was the estimation of GHG reduction. Estimating 6.000 photovoltaic systems to be implemented instead of 3.000, then the emissions reduction was estimated in the double of what it actually was and, nevertheless, was executed.

Therefore, the evaluator conceptualizes that the formulation of the Project is ***Marginally Satisfactory (MS).***

Relevance of the project for the country / Country ownership

Given the background of all national public policies of the PER, Poverty Reduction and Climate policy, the project *was relevant to the country* because encouraged the entrance of NCRE by providing technological options technically, financially and environmentally viable for the development of public policies.

In addition to *the high relevance of the project to the country, the project* has not only reached the achievements that are discussed later, *but has managed to position NCRE in the Ministry of Energy and other ministries (Ministry of Agriculture), in regional and municipal governments as a valid and sustainable option for rural electrification.* Such a situation was made clear during the joint missions carried out by the evaluator and authorities to the IV Region of Coquimbo and the X Region of Los Lagos as an indicator of *ownership of NCRE projects by these authorities.* In addition, other project actors, Ministry of Energy, Ministry of Social Development, Regional and Administrative Development Undersecretary's Office (SUBDERE), General Secretariat of the Presidency, Regional Governments, Rural Municipalities, Universities, consulting firms in the area of electrification and renewable energies, *have taken ownership of the knowledge of these technologies, project management, development of mechanisms for sustainability; therefore, these actors have verified the convenience of NCRE projects for the country.*

The extent of participation of actors reached during this process of ownership was high. The project interacted with all previous institutions to coordinate activities during the 10 years of implementation. To perform tasks, the project has led to the creation of support networks, consensus and awareness of NCRE; create technical conditions, and mainly policies for the implementation of the projects and to achieve compliance with immediate objectives.

3.1.2 Participation of the actors in the conceptualization/project design

The two institutions (CNE and UNDP-GEF) worked together at the design stage, as they had done before the signing of the preparatory phase (PDF-B).

No information is available (neither the PDF B nor recording information of this process was obtained) to evaluate the participation of the actors in the conceptualization and design of the project.

3.1.3 Other Aspects

For the implementation of projects, UNDP has the advantage over other institutions due to its enormous convening power over the state sector, unions and society in general. On the other hand, UNDP handles common social and governmental interest with the Government of Chile. Also, their recognized impartiality is favorable to act among multiple actors.

3.2 PROJECT IMPLEMENTATION

3.2.1 Implementation Approach

The implementation approach was simple and transparent. CNE, as Executing Agency was responsible for appointing staff, such as the National Project Director. UNDP recruited a Chief Technical Adviser (CTA). A Project Coordinating Committee was also created. All these posts with their roles are provided in Section 2-7.

The Logical Framework remained as the driving force during the implementation of the initiative and an amendment in the seventh component was made resulting in a reallocation of resources and a new component, Productive Use of Energy.

The Workplan that guided the implementation was also submitted in the PRODOC. This plan was adjusted periodically to respond to the project implementation. These plans prepared during the project implementation were requested by UNDP-GEF according to administrative procedures of both organizations with regards the approval of resources that would be executed each year.

During the project implementation, the use of information technologies such as electronic mail, enabled a better communication between CNE representative and UNDP.

In general terms, bilateral communication channels between the parties were satisfactory, and there was no evidence to the contrary.

Since the beginning of the programme, ToRs related to the contracts required for its implementation was available. Several consultants and consulting firms were recruited in order to implement the 9 project components. In connection with the work performed by consulting firms, the evaluator considers that individuals or companies contracted met the deliverables and deadlines in a satisfactory manner.

The PRODOC contains a logical framework in line with the overall and specific objectives of the project.

El evaluator considers that the implementation approach is **SATISFACTORY (S).**

3.2.2 Monitoring and Evaluation

3.2.2.1 Monitoring

The Project Brief established the following monitoring mechanisms for the implementation of the project:[20]

a. The programme will be monitored according to monitoring and evaluation procedures by UNDP and CNE, and both will be jointly responsible for the continuous monitoring of the progress of the project.
b. UNDP Chile shall monitor performance during the project execution.
c. The Project Coordinator will perform internal reviews and comment on the performance of the project in order to provide feedback and direct efforts in the desired direction.
d. Annual Tripartite Review Meetings will be held to evaluate the performance of the programme.
e. A mid-term evaluation of the project shall be performed. In addition to the financial aspects, compliance of results and activities in accordance with the objectives and work plan of the project will be also evaluated.

[20] UNDP-GEF (March 8, 2002). National Electrification Programme with Renewable Energy in Areas not Covered by the Grid. *[Programa de Electrificación Nacional con Energía Renovable en Áreas no Cubiertas por la Red]*, Project Brief. Page 42.

f. Similarly, the National Project Director, must submit a *Final Report* upon completion of the project according to the general guidelines and procedures established by UNDP for this purpose.
g. Another mechanism for monitoring and evaluation of the project is the one performed on a permanent basis by the Coordinating Committee, thereof, mentioned in detail in section B.4-3 of this document.
h. A Report of Completion of the Programme (Final Report) will be prepared for its consideration during the final tripartite review meeting.

The sample of documentation received with regards the Monitoring and Evaluation of the Project from 2001 to 2011 is enclosed.

After reviewing this information, the evaluator was able to infer the compliance of the following monitoring mechanisms:

- Monitoring mechanisms established by UNDP have been used.
- CNE as Executing Agency managed daily tasks of the project using the Annual Work Plan.
- More specifically and related to monitoring mechanisms, nine PIRs were prepared for this project, the first being the PIR 2002 (for the period 2001-2002) until July 2011. In the PIR/APR of 2003 and 2004, evaluation of component 8 towards achieving the development objectives has been assessed as unsatisfactory (U). This resulted in the reformulation of this objective. In the PIR/APR of 2005, the amended objective was assessed as satisfactory (S)[21] due to reconsideration and reformulation of this component.

Table 3-1. Monitoring and evaluation documentation (period 2001-2011)

Monitoring and Evaluation Activities
October 2001 - December 2011

Type of Activity	Detailed Activity	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Remarks
	Annual Report PIR		X	X	X	X	X	X	X	X	X		
1. Reports	Final Report of the Project											X	
	Tripartite Meetings	X	X	X	X	X	X	X	X	X	X		Results included in PIR/APR
2. Meetings	Minutes of Project Coordinating Team		X	X	X	X							
3. Workplans	Annual Workplans	X	X	X	X	X	X	X	X	X	X		
	External Financial Audits				X	X			X		X		
4. Evaluations and Audits	Final Evaluation											X	This Report

Source: Prepared by the author

[21] Classifications are HS (Highly Satisfactory), S (Satisfactory), MS (Marginally Satisfactory) and U (Unsatisfactory).

- Overall, project performance was described as satisfactory, with some components described as Highly Satisfactory (HS) and in few periods. Since the implementation of the project, in the PIR/APR of 2008, the programme is considered as Marginally Satisfactory (MS) also by UNDP/GEF Regional Adviser mainly due to the delay to implement component 7 and particularly due to component 8 (electrification of Isla Desertores) because of the long process that took to reformulate component 7. The project has been extended until 2011, more than other projects, but additional results achieved with this extension are significant and worth the effort made by all parties.
- The assessments of progress towards achieving the objectives were satisfactory (S). This process was performed by local coordination office, UNDP Chile and UNDP/GEF Regional Adviser. Evaluation of the Project Implementation was satisfactory (S) except for the PIR/APR of 2008 and 2009 as explained above (see Table 3-2).

Table 3-2. Evaluating scales for project implementation as per the PIR

Classification categories assigned to the progress towards the achievement of Project Objectives

Date APR/PIR	Period	Local Coordination	PNUD Office in Chile	Regional Adviser PNUD/GEF
julio-02	2001-2002	S		
julio-03	2002-2003	S		
julio-04	2003-2004	S		
julio-05	2004-2005	S	S	
julio-06	2005-2006	S	S	
julio-07	2006-2007	S	S	
julio-08	2007-2008	S	S	S
julio-09	2008-2009	S	S	S
julio-10	2009-2010	S	S	
julio-11	2010-2011	S	S	

Categories of classification assigned to the implementation of the Project

Date APR/PIR	Period	Local Coordination	PNUD Office in Chile	Regional Adviser PNUD/GEF
julio-02	2001-2002	S		
julio-03	2002-2003	S		
julio-04	2003-2004	S		
julio-05	2004-2005	S	S	
julio-06	2005-2006	S	S	
julio-07	2006-2007	S	S	
julio-08	2007-2008	MS	MS	MS
julio-09	2008-2009	S	S	MS
julio-10	2009-2010	S	S	S
julio-11	2010-2011	S	S	S

- Project Progress Reports. They consist of APR/PIRs. There are also final reports or outcomes of sub-contracts made by consultants and consulting firms.
- Tripartite meetings. The PRODOC established a tripartite meeting between the Government (Ministry of Foreign Affairs and Ministry Secretariat General of the Presidency, UNDP and the Executing Agency at least once a year, which was to be organized by UNDP. No information was received from these meetings; however, they are registered and their results are reflected in the PIRs.
- Project Closure Report. *A complete Final Project Report was developed (October 2011).*

- Meetings of the Coordinating Committee of the Project. Five Minutes of the Coordinating Committee were received which corresponds to meetings held at the end of the years 2001 to 2005. This includes presentations made with regards the project development, current status and a recommendation to redirect its course was made.

3.2.2.2 Mid-Term Evaluation

The programme included a Mid-Term Evaluation, which was performed in December 2003 and considered the amendment of component 7 as explained in Section 3.3.8.

3.2.2.3 External Financial Audits

All financial management and relevant supporting documentation is handled by UNDP-Chile. UNDP hired financial audits/external accountants through specialized firms. This includes reviewing the CDRs (Combined Delivered Report) of operating procedures used by the Project, according to what is established by UNDP and internal control environment.

According to the external audits of the programme, the implementation of the project was rated as Medium Risk as according to the Auditors, there were possibilities that many of the internal controls with regards payment process or others did not strictly comply with UNDP procedures. Four external audits (2004, 2005, 2008 and 2010) are clean and without any qualifications, including recommendations to be implemented, but none meant a risk to the project implementation.

The evaluator considers that there was systematic monitoring of work progress, and therefore considers that *the monitoring and follow-up of the project is* ***Satisfactory (S).***

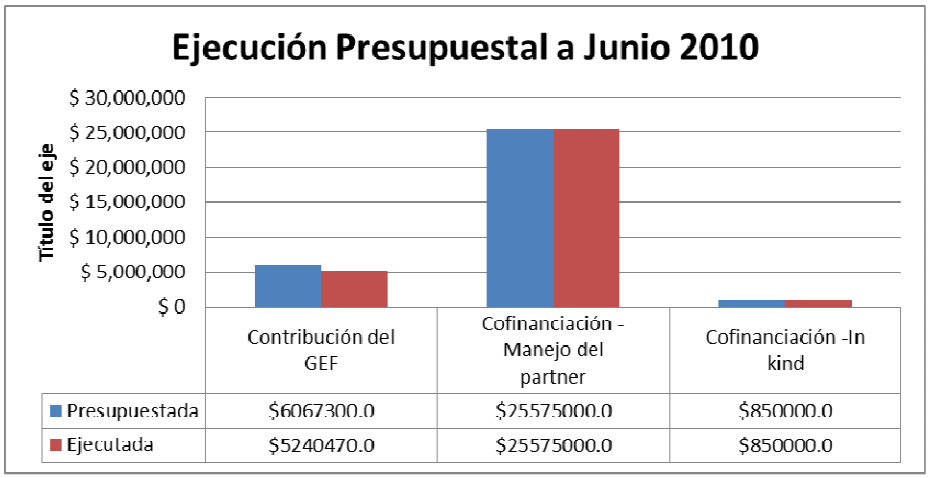
3.2.3 Financial Planning

The project was carried out according to the "partial national implementation" method, whereby transactions, contracts and disbursements required for project execution are authorized by the National Directorate of the Programme, but is subject to revision by UNDP, which is the agency directly responsible for payments and is in charge of the accounting record of transactions.

With regard to the co-financing and as per the PIR of June 30, 2010[22], co-financing managed by the government, including the in-kind contribution, had been executed in full, yet to be executed GEF contribution (Figure 3-1. Total execution of the project was already 97%).

Figure 3-1. Budget execution

[22] The most recent PIR of June 2011 does not contain any financial information about the project.



Source: PIR 2010

[Budget Execution as of June 2010
Title of the x-axis
Budgeted GEF Contribution Co-financing In-kind co-financing]
Executed Partner managing

Note: Execution by the government includes the figure of $3,726,000 for the hybrid project in Isla Desertores which, as of June 2010, had delays in its implementation.

The external audits made to the project (2004, 2005, 2008 and 2010), as mentioned above, are clean and without any qualifications. This indicates that there has been due diligence in the management of funds.

3.2.4 Replicability

The project left an important legacy of regulations, certification procedures, learning materials for trainers and users of photovoltaic systems, biogas manuals and guidelines with regards the creation of cooperatives to promote and develop electrical projects and methodologies for NCRE project evaluation, among others. All this information is already in use by the Energy Access and Equity Division at the Ministry of Energy, and was also available to regional governments.

The above constitutes *a very solid basis that shall be used to replicate NCRE projects* in other regions of Chile. In this regard, it is important to put all the information again and more fully in the website of the Ministry.

3.2.5. Cost-effectiveness of the project

The overall objective of the project was partially achieved as it managed to attain just over half the emissions reduction proposed in the PRODOC. *But, it is important to clarify that in the design of component 6, the number of photovoltaic systems to be installed in the IV Region of Coquimbo were overestimated as the land registry showed half the amount* (See Section 3.3.1). Nevertheless, the project managed to produce outstanding results particularly in positioning NCRE within the Ministry

of Energy and regional and municipal authorities, as a viable and sustainable alternative for energy supply in the rural sector and a source of productive use of energy. *In this sense, the project has been effective in achieving the results of several components with satisfactory and highly satisfactory performance.*

With regards the costs of reducing emissions, these has represented to GEF a cost of U.S. $246.85/t CO2 against U.S. $110/tCO2 budgeted, because the emissions reduction reached a 44.5 % of what was expected in the amended PRODOC. Nevertheless, considering post-project emissions, the reduction of emissions from the entire portfolio reach 60.46 Gg (109.4% of what was expected in the amended PRODOC), hence, GEF cost comes down to U.S. $ 100.35 (See Section 3.3.1).

It should be noted that the level of the incremental cost by PVS is based on a reduced PVS cost between U.S. $842 and U.S. $967 per photovoltaic system resulting in an incremental GEF cost between U.S. $49 and U.S. $240 per set of 100 Wp to the 5th and 1st year of the long-scale installation of these systems. It must be observed that, in reality, projects using photovoltaic systems far exceeded on average (U.S. $3.413, see Table 3-10) the cost of PVS assumed by GEF as high installations costs of these systems in remote and isolated locations were not considered in their analysis. This includes pre-investment costs and project development as well.

With regards the relationship between GEF contribution and the amount of resources mobilized, the project has had a high leverage factor of 5.5 which shows the efficiency of the project mobilizing resources (Section 3.3.2.3).

3.2.6. Sustainability

The objective of this section is to evaluate the extent to which project benefits will continue within or outside the project domains after it is completed.

3.2.6.1 Technical capacity building

As set forth in the ProDoc, the project developed several components that have left an important capacity in Generating project portfolios (component 1), Elaboration of Technical Regulations (component 2), Certification procedures using NCRE (component 3), Promotional campaign for NCRE (component 4), Specific training programmes (component 5), Developing a large-scale project on photovoltaic systems (component 6), Developing biogas and pumping projects (component 7), Hybridization (component 8) and Wind resource energy evaluation (component 9).

All the above items have a strong training component.

It is not at all clear how the agreements signed with training centers (component 5) will evolve in the future as these centers shall respond to the extent that developments take place to link trained staff.

3.2.6.2 Ownership of the NCRE Technology

This is, without any doubt, this is one of the outstanding results of this project: institutions at central, regional and municipal levels have proven the sustainability of NCRE solutions and have become promoters in order to consider using NCRE in all projects due to its feasibility.

3.2.6.3 Development of institutional capacity

The largest beneficiary was the Ministry of Energy. They have received the direct benefit of the project and the Energy Access and Equity Division has qualified personnel, information and methodologies developed by the project to ensure continuity in the use of NCRE.

In the other hand, academic institutions participating in the project are interested in pursuing the projects. This is the basis for further developments and promotion of more advanced knowledge among their students.

3.2.6.4. Broad-base acceptance of NCRE technology

There is, subsequently, institutions (Ministry of Energy, Ministry of Agriculture, among others) with a solid foundation and tested results of the project that has allowed the acceptance of NCRE technology as an alternative for the development of rural areas through electricity supply, and energy in general (energization).

3.2.7 Means of execution and implementation

The evaluation team believes that UNDP Chile:

- *effectively endorsed* the selection, recruitment, assignment of experts and consultants, and national counterparts in the definition of tasks and responsibilities,
- *jointly led with GEF Regional Office in Panama,* the consultation process to approve contracts,
- *provided the necessary efforts to timely made payments* in relation to fees and services that were hired.
- *with regards outcomes review resulting from consultancies, UNPD Chile did not expressed any considerations in relation to their qualities.*

In terms of effectively communicating procedures or responses to queries made to the Implementing Agency, UNDP proceeded by making the necessary arrangements, for instance, the reallocation of resources and amendment of objectives of component 7.

Meetings held, as indicated earlier in this Report, acknowledge that UNDP participation in connection with the quantity, quality and timeliness of inputs with regards their responsibilities for the implementation of the project, remained steadily.

Funds availability was in line with project requirements, in other words, the provision of resources for timely payments was "following the due process with regards requests for payment".

3.3 RESULTS

Below is a discussion of the achievements made in connection with the main objective, using as a criterion, the suggested indicators and the means for verification as described in the PRODOC.

3.3.1 Overall Objective

Table 3-3. Overall Objective. Indicator and compliance

Development Objective	Reduction of CO_2 emissions resulting from electricity generation in Chile.
Indicator	CO_2 emissions in the electricity sector drop down to 62.61 Gg.
Means for verification	National communications Official statistics
Assumptions	Develop PER Investment Plans.
Compliance to Indicator	The emissions reduced through direct benefits of the project were 24,580 tCO_2/per year, 44.5% of the expected reduction of 55.28 Gg. As a result of partial non-implementation of BIP project portfolios (only of 33% was executed), then, under the perspective of future development of the portfolio, emission reductions of 60.46 Gg shall be achieved. Consequently, the evaluator considers this result as ***Satisfactory (S)***.

The Project Development Objective was the reduction of CO_2 emissions resulting from the generation of electricity in a 20-year horizon to 62.610 t CO_2. To estimate the emission reductions by the project, the evaluator used the methodology and calculation factors used in the PRODOC. This indicator presents two difficulties. The first of these is that when verifying the sum of emissions in the PRODOC, the evaluator encountered that the correct figure is 55.280 t CO_2 instead of 62.610.

Table 3-4. Project estimated direct benefits in terms of reduced CO_2 emissions

Area	Gasoline	Households Year 0	Households Year 20	Volume Gasoline (20 years)	Emission Factor	Total Emissions 20 years (Gg)
Out of the programme	Candle (1)	6,000	6,000	8.640 ton.	3 kg/kg	25,92
Within the programme	Renewable	3,720	3,720	7.499,5 m^3	0,292 Gg/Tc	20,03
Electrification	Diesel	650	650	4.368 m^3	0,292 Gg/Tc	9,33
TOTAL						**62,61**

Source: PRODOC, Annex E, page 4 Correct figure (!) **55.28**

A second difficulty of the indicator is that the number of houses, 6.000, is overestimated for the IV Region as land registry reported 3.064. In this way, the direct benefits of the programme would be 42.6 Gg instead of 62.61.

In this table, "out of the programme" is understood as the emissions reductions by the project for which all households using candles for lighting move on to photovoltaic systems.

In the item "within the programme" the emissions reductions corresponding to the use of diesel, equal to 80% of the total, given that the transformation to hybrid systems and other renewable sources (except photovoltaic), is supposed to allow a saving of 80% in fuel consumption. Regarding those to be supplied by the grid extension, it is assumed that 10% of households will be electrified through non photovoltaic renewable energy projects.

In the item "electrification" it is assumed that the transformation to hybrid systems or other renewable (except photovoltaic) enables 80% savings in fuel consumption.

As *means for verification* of the achievements of the overall objective of the project, according to the PRODOC, national communications and official statistics should be considered. The evaluator has used the information given on the implemented projects provided in the Final Report. Applying the same methodology used in the PRODOC, the following Table 3-5 shows the emissions reductions by the implemented project: Removing Barriers[23].

Table 3-5. Direct Benefits of the Implemented Project in Terms of reductions of CO_2 emissions

Area	NCRE Technology	Displaced fuel	Households Year 0 and 20	Quantity Gasoline (20 years)		Emission Factor		Total Emissions 20 years (Gg)
Out of the programme	Photovoltaic	Candle	3,982	5.734.1	t	3 .00	kg/kg	17.20
Within the programme	Hybrids	Renewable	517	1042.3	m^3	0.292	Gg/Tc	2.78
Electrification	MCH	Diesel	320	2,150	m^3	0.292	Gg/Tc	4.59
TOTAL								**24.58**

The estimate of emissions reduced by the project is 24.580 t CO_2, which compared to the estimated indicator of 55.28 Gg, the project *would achieve 44.5% of emissions reductions.*

In the perspective for future development, because implemented projects reached only to 43% of households in the project portfolio admitted in the BIP, emissions reductions will reach 60.46 Gg which corresponds to 109% of estimated emissions (amended figure) from 55.28 Gg as direct benefit including post-project developments.

Table 3-6. Direct Benefits of the Project Portfolio in Terms of reductions of CO_2 emissions

Area	NCRE Technology	Displaced fuel	Households Year 0 and 20	Quantity Gasoline (20 years)		Emission Factor		Total Emissions 20 years (Gg)
Out of the programme	Photovoltaic	Candle	7,135	10274.4	t	3.00	kg/kg	30.82
Within the programme	Hybrids	Renewable	3,007	6062.1	m^3	0.282	Gg/Tc	16.19
Electrification	MCH	Diesel	937	6296.6	m^3	0.292	Gg/Tc	13.45
TOTAL								**60.46**

[23] The Barrier Removal Project has calculated the reductions of emissions by estimating the power generation of each type of system and assuming that renewable energy was generated with diesel, the programme has calculated the reductions of emissions in 25.950 t CO_2, a very similar figure to that estimated by the PRODOC methodology.

The evaluator considers that, given the results achieved and the prospect of future development, the achievement of the overall objective is ***Satisfactory (S).***

In GEF terms, these emissions reductions *cost U.S. $246.85/t CO_2* against *U.S. $110/t CO_2* budgeted because the emissions reductions reached 44.5% of what was expected in the amended PRODOC. Again, *once the entire portfolio is full developed, GEF cost shall be U.S. $100.35/t CO_2* (See Table 3-7).

Table 3-7. Emissions Reductions by the project and GEF cost

Emissions reduced by	Reduced emissions (Gg)	& Achieved (1)	& Achieved (2)	GEF (US$/t CO_2)
Project	24.58	39.3%	44.5%	$246.85
Portfolio	60.46	96.6%	109.4%	$100.35

Emissions reduction
1. As per PRODOC 62.61 Gg
2. Amended in PRODOC 55.28 Gg

3.3.2 Immediate Objective 1: Generation of a Portfolio of Rural Electrification Projects using NCRE.

Table 3-8. Component 1. Indicator and compliance

Development Objective	NCRE Project Portfolio structured.
Indicator	10 new projects using NCRE are admitted in the Integrated Projects Database (BIP).
Means for verification	BIP Database and National Investment System.
Assumptions	Renewable resources available for implementation.
Compliance to Indicator	Municipalities and regional governments involved in the project admitted 100 projects (30 photovoltaic, 34 micro- hydro power plants and 36 hybrid systems), the result considered to be ***Highly Satisfactory (HS).*** But beyond this result, • a design and progress in management required for the development of many of these projects is available. • commitment by the government to co-finance and execution of the projects has been made.

This component aims to create a project portfolio that will demonstrate real potential use of NCRE in rural electrification in Chile. The projects had to be admitted in the BIP of the National System of Investment for application to state subsidies.

The implementation strategy included awareness-raising and identification of opportunities with regional governments and rural municipalities with regards an extensive fieldwork to gather information required for the evaluation and design of the projects (identification and geo-referenced location of each beneficiary). Fieldwork began at the end of 2001 and was implemented by a team of five young electrical engineers, who received training to gather information on rural electrification projects portfolio using NCRE and were provided with the necessary technical equipment to perform the task and transportation as well.

Important results of this component are:

1. National land registry of households with no electricity in the country, a viable option to provide electricity through grid extension, due to their dispersed and remote nature. 12,400 households and farms were registered, which were geo-referenced and surveyed;
2. National survey of Electric Generator Units currently in operation and the communities and households provided by electricity by this means. 73 communities and 3.690 households with supply through electric generator units were identified.
3. Portfolio of 100 rural electrification projects using NCRE for the electricity supply of 11.049 rural households, which were also included in the computer database. The portfolio was valued at nearly $31 million.

This process started in the IV region of Coquimbo and *spread across the country*. The number of projects that were admitted in the BIP at the end of 2004 was 44. In parallel, the Government identified and conducted baseline evaluations with NCRE solutions to provide electricity to 35 islands of Chiloé and to improve electrical generation and distribution system in Robinson Crusoe island located in Archipiélago de Juan Fernandez. The number of projects was increasing year after year (67 in 2004, 76 in 2006 and 99 in 2007). Since 2008, projects began to increase as a result of the ones arose in the context of amended component 7 - productive use of energy - (solar pumping projects and biodigesters included).

In short, the number of households surveyed with no electricity feasible through grid extension was 12,400 nationwide. In addition, a total of 73 communities and 3,690 households using diesel generation systems were registered. This information was saved and managed through a database which is currently operated by the Ministry of Energy. Based on the result of this land and diesel units registry, 99 rural electrification projects with NCRE were identified, to provide electricity to around a total of 10,800 rural households. These projects were admitted in the BIP by Municipalities involved or by the respective regional governments.

In the project implementation, it is important to consider the situation that electrification projects using NCRE were facing against to those of grid extension. First of all, the project was framed within the PER mainly aimed to the electrification through grid extension or electric generator units, and NCRE technologies should demonstrate their technical economic and environmental sustainability. The Barrier Removal project also had to do with the assistance rather than with the implementation of the projects and this was due to government policies.

The PER did not give greater importance to the development of renewable technology projects to the point the IDB loan for rural electrification in 2003 only destined 10% to NCRE and the rest to grid extension. The Barrier Removal project was then requested to develop a methodology to identify and evaluate projects; this is a very important legacy, appropriate nowadays, for the Ministry of Energy.

However, in addition, the project conducted an extensive fieldwork, analysis of alternative technologies, renewable resource assessment, of projects and management models, providing the necessary documentation to the Regional Governments and Municipalities involved; therefore, projects were submitted to funding mechanisms by the relevant agencies at regional and communal level. In this sense, the project has achieved a project portfolio that has been identified and implemented, households that have benefited from the programme, technologies used, investment costs, among others aspects. *The project, then, has complied in a **Highly Satisfactory (HS**) manner its technical assistance role.*

3.3.2.1 Portfolio of electric power generation projects using NCRE

As a result of the Barrier Removal Project, NCRE project portfolio amounts to 100 projects, of three technologies PV (Photovoltaic), HIB (Hybrid) and MCH (micro-hydro). The projects benefit a total of 11.079 households, with an estimated investment of U.S. $2,794 average per household. The lower cost of technology investment is PV, but MCH that has a higher investment cost can deliver 5 times more energy average than PV (as discussed below) (See Table 3-9).

Table 3-9. Portfolio of electric power generation projects using NCRE as of 2011

TECHNOLOGY	PROJECTS		HOUSEHOLDS		ESTIMATED INVESTMENT *		UNITARY INVESTMENT
	Quantity	%	Quantity	%	(US$)	%	(US$/per Unit
PV	30	30%	7,135	64%	$17,353,498	56%	$2,432
HIB	36	36%	3,007	27%	$10,081,000	33%	$3,353
MCH	34	34%	937	8%	$3,517,613	11%	$3,754
TOTALS	**100**	**100%**	**11,079**	**100%**	**$30,952,111**	**100%**	**$2,794**

* Estimated investment at the time of identification and preparation of the project.
Source: PNUD-GEF-Ministry of Energy (2011) Final Report. Santiago, Chile.

From this project portfolio, 33 (33% of execution) projects have been implemented, mainly PV technology and at a unit cost per solution of U.S.$3,413 and for 3.982 households. Hybrid and MCH technology have the particularity to offer users more electricity, but at a higher cost per household as shown in the following table.

Table 3-10. Portfolio of electric power generation projects using NCRE implemented between 2001 and 2011.

TECHNOLOGY	PROJECTS		HOUSEHOLDS		ESTIMATED INVESTMENT		UNITARY INVESTMENT
	Quantity	%	Quantity	%	(US$)	%	(US$/per Unit
PV	16	48%	3,982	83%	$13,592,410	55%	$3,413
HIB	7	21%	517	11%	$7,390,532	30%	$14,295
MCH	10	30%	320	7%	$3,565,626	15%	$11,143
TOTALS	**33**	**100%**	**4,819**	**100%**	**$24,548,568**	**100%**	**$5,094**

The development of the electrical energy project portfolio and *implemented projects* are ***successful*** as they have shown that electricity supply, in addition to being sustainable to PV, HIB and MCH technologies, when projects were evaluated, their investment costs have proven to be lower that those based on traditional grid extension or diesel and gasoline generators in remote and isolated areas.

3.3.2.2 Productive use projects

Component 7 amended in 2007 called *Productive Use* used Photovoltaic Pumping (BPV) and biogas plants technologies. The total number of projects in the portfolio is 45, of which most are pumping systems, with an estimated investment per household (dewatering well for agricultural and domestic use) of US20.881 per solution, similar amount to the domestic biogas plants.

Table 3-11. Portfolio of projects on productive use of the energy

TECHNOLOGY	PROJECTS		HOUSEHOLDS		ESTIMATED INVESTMENT *		UNITARY INVESTMENT
	Quantity	%	Quantity	%	(US$)	%	(US$/per Unit
BPV	42	93.3%	42	93.3%	$877,000	94%	$20,881
BIOGAS	3	6.7%	3	6.7%	$55,319	6%	$18,440
TOTALS	**45**	**100%**	**45**	**100%**	**$932,319**	**100%**	

3.3.2.3 Investment amounts and GEF Leverage factor

The following table shows the amount of assumed contributions in the PRODOC in 2001 and those made by different actors. The amount of investments of implemented projects as of 2011 includes investments in the 33 executed projects (see Table 3-10) as the government's in-kind contribution estimated in the PRODOC, users investments estimations such as the cost of the electrical facilities inside their households ($150,000 chilean pesos per user), and the development of photovoltaic project by the private sector conducted during the project period.

Table 3-12. Expected contributions in 2001 PRODOC and executed in 2011

Investment Contributions	ProDoc 2001		Implemented 2011	
	Amount	%	Amount	%
GEF	$6,067,300	18.7%	$6,067,300	18.2%
GOVERNMENT (Cash)	$16,489,000	50.9%	$24,548,568	73.6%
GOVERNMENT (In-Kind)	$755,000	2.3%	$755,000	2.3%
USERS	$1,458,000	4.5%	$1,537,979	4.6%
PRIVATE SECTOR	$7,628,000	23.5%	$425,532	1.3%
TOTAL	**$32,397,300**	**100.0%**	**$33,334,379**	**100.0%**

As shown, the level of estimated investment in the PRODOC is similar to the one executed by the project in 2011. What is important to note is that participation of the private sector was not as expected for components 6 and 7, and was assumed by the state rising from 50.9% in the PRODOC to 73.6%.

The **level of leverage** achieved in the project is **5.5** for GEF, which the evaluator considers ***Highly Satisfactory (HS).***

In general, with regards the second component, the result is considered ***Highly Satisfactory (HS)*** as NCRE have gained much prominence as a solution for electricity supply in remote areas at regional and municipal level as well as at national level, as is shown through interviews with authorities of the IV and X regions, and with the authorities of the Energy Access and Equity Division at the Ministry of Energy.

3.3.3 Immediate Objective 2: Elaboration of Technical Regulations for Electrification Systems with NCRE

Table 3-13. Component 2. Indicator and compliance

Development Objective	Establish Technical Regulations
Indicator	44 technical regulations were published: photovoltaic technology, wind energy, micro- hydro and biomass.
Means for verification	Publication in Chilean Official Journals.
Assumptions	Effective implementation of the regulations developed.
Compliance to Indicator	44 technical regulations were published: (15) photovoltaic technology, (7) wind energy, (4) hybrid systems and (18) micro- hydro power plants. (15) for photovoltaic technology, (7) for wind energy, (4) for hybrid systems and (18) micro- hydro power plants approved by the Ministry of Economy and published in the Official Journal as Chilean regulations in compliance with the indicator in a ***Highly Satisfactory (HS)*** manner. No biomass regulations were developed as no projects were identified for this technology.

The project aims to the development of technical regulations necessary to ensure proper operation of the generating equipment, protection for property and users of the systems, preservation of the environment and establishment of quality standards of the service provided to users.

The implementation of the project involved conducting a preliminary study on international technical regulations (2003) and defining legal procedures to validate and standardize technical regulations that would be developed for Chile. To carry out the regulatory process [redacted] was established with the American National Standards Institute (INN).

The development and validation of the regulations was performed for technologies identified in the project bank and was developed from 2004 to 2006. A broad debate was coordinated by INN with the participation of CNE, Ministry and Academic representatives, companies and civil society. The approval process started in 2005 and in 2008, all 44 suggested regulations were approved by the Ministry of Economy and published as Official Regulations of Chile.

During 2008, the design and publication of four compendia, one for each technology was recruited. These compendia of regulations were widely distributed and disseminated to all institutions and actors

involved in rural electrification across the country (Ministries, Regional Governments and Governorates, Municipalities, Universities and companies linked to generation of projects using NCRE.

The nature of these regulations is *voluntary*, not mandatory to prevent them to become additional barriers for rural electrification projects using NCRE. However, CNE and the Ministry of Energy have been including these regulations on a *mandatory* basis as parte of the technical specifications and procurement of new rural electrification projects using NCRE.

The following figure shows the compendia of regulations and Annex 6-6 shows the list of regulations made.

Figure 3-2. Compendium of chilean NCRE regulations.

The evaluator examined regulations documents that were prepared for the four technologies: photovoltaic, wind, PCHs and hybrid systems. Photovoltaic Systems Regulation has been developed out of the official IEC approval 61386:1997 *Solar Photovoltaics Energy Systems* which corresponds to the most advanced international regulations concerning these systems. Regulation on wind energy is an amended translation of the international IEC regulation 61400-1: 1999 *Wind Turbine Generator Systems - Part 1: Safety Requirements.* The hybrid system regulation is based on IEC/PAS 62111:1999 *Specifications for the use of renewable energies in rural decentralized, electrification DRE Specifications - Part A: from Energy Requirements to electrification system,* however, this international regulation is not suitable for this system as when developing the regulation in Chile, the Committee conducted larger technical deviations and changes to the structure of the regulation. The compendium of regulations on four micro-hydro power plants has four IEC regulations namely: this version is identical to the one in English of the IEC / TR 61364:1999 *Nomenclature for hydroelectric power plant machinery,* an amendment to the Spanish version of IEC 60994: 1991*[Guía para la media en central de vibraciones y pulsaciones en máquinas hidráulicas],* identical to the Spanish version of the IEC 61366: *Hydraulic turbines, storage pumps and pump-turbines - Part I [Turbinas hidráulicas, bombas de acumulación y turbinas-bombas – Parte I],* is a modification of Spanish version of the IEC 60193:1999 *Hydraulic turbines, storage pumps and pump-turbines - Reception Test in model.*

Consequently, regulations are based on international standards and on the state of art of technologies, Staff who participated in the development of regulations included personnel from CNE, INN, and other

institutions, Universities, Industries, Private Consultants and others, recognized for their high professional skills

The evaluator considers achievements of this Component 2 ***HIGHLY SATISFATORY (HS)*** not only due to the number, the implementation experience and its participatory development process, but also because of the dissemination and quality of the work performed.

3.3.4 Immediate Objective 3: Elaboration of Certification Procedures for Electrical Systems with NCRE

Table 3-1. Component 3. Indicator and compliance

Development Objective	Certification Mechanism established.
Indicator	Number of certificates issued (depending on the number of projects actually implemented)
Means for verification	Superintendence of Electricity and Fuels (SEC).
Assumptions	Certification procedures developed are effectively applied.
Compliance to Indicator	3.064 photovoltaic systems from the Large-Scale Demonstration Project of Coquimbo were certified. The indicator is considered to be ***Satisfactorily (S)*** accomplished, although it was not applied to other projects and technologies.

This component aims to establish procedures for certification procedures of Electrical Generation Systems with NCRE to safeguard compliance of technical and quality regulations of equipment, inspection of facilities and control of installers using NCRE.

The project developed instruments (certification procedures) following international guidelines for each technology and implementation mechanism by means of agreements to conduct the certifications, thus leading to a certification market that will promote sustainable development of NCRE projects.

The certification process for NCRE systems should be performed once technical regulations were approved and, initially, it was estimated to be carried out in 2006. The project development led to a study to identify institutions with the capacity to perform certification services in Chile (2003), elaboration of the procedures to certify NCRE systems (2004-2006) and a ranking list with potential institutions capable to perform certifications for different renewable technologies (2007). Once the most appropriate institutions as per technology were selected among public and private institutions, the signing of the agreements went forward. These included the provision of additional equipment necessary for the effective development of certifications.

As of year 2008, 3.064 photovoltaic systems, associated to the large-scale demonstration Photovoltaic project of the IV Region f Coquimbo and 65 PV systems from the Petorca project in the V Region has been certified. In other technologies, such as the MCH in Llanada Grande delivered in white work in November 2010, certification processes could not be applied as they were not implemented in a timely manner.

The evaluator considers the result of component 3 as ***SATISFACTORY*** **(S),** although only the photovoltaic systems technology was applied.

3.3.5 Immediate Objective 4: Implementation of a Promotional campaign for NCRE

Table 3-15. Component 4. Indicator and compliance

Development Objective	Dissemination and Promotional Campaign currently Operating.
Indicator	Increased demand for NCRE-based rural electrification projects
Means for verification	Municipalities Reports.
Assumptions	Means available to implement the campaign in Chile.
Compliance to Indicator	An implementation strategy for the promotion of NCRE, which has resulted in numerous NCRE projects, has been executed. This strategy has been submitted by regional and municipal authorities, ***Satisfactorily (S)*** complying with the objectives of the component. No evaluation in the impact of promotional campaign was available.

This component aims to raise awareness among several local actors involved in rural electrification programmes with regards the economic, technical and environmental advantages of using NCRE technologies, through the increase of knowledge about them. Parallel to this, encourage the sharing of experience among promoters and implementers, the opening of new NCRE markets.

The project developed an entire promotional strategy that consisted of direct work with regional governments, rural municipalities, local authorities and rural communities. Consultants also participated and prepared materials used in seminars, workshops and meetings.

The project hast to design and develop media campaign and instruments to be used, as well as managing training programmes. Three mechanisms were designed and implemented: 1. Articles, brochures and manuals (see Figure 3-3 and Figure 3-4), 2. Website and 3. Seminars, workshops and dissemination meetings.

Although the project started at the beginning in 2001, with project dissemination activities and those with regards NCRE, specific outcomes were subsequently occurring. In 2003, a workshop on wind resource evaluation was held. A CD which includes the presentations, list of participants and methodologies of evaluation of the resource was prepared. This material was published in UNDP Chile documentation center and distributed to participants[24].

[24] Removal of Barriers for Rural Electrification with Renewable Energies (2005). CD: Wind energy records database. UNDP/GEF-CNE. Santiago, Chile.

Figure 3-3. Photovoltaic systems manuals (general, oriented to monitors and users)

The evaluator had the opportunity to review the two photovoltaic training manuals (See Figure 3-3) whose content is considered to be appropriate in terms of the thematic and the way in which it was developed and the language as well, thus, very much customer-oriented; for users of manuals, monitors of training programmes and end-users of photovoltaic systems of component 6.

A manual containing solar irradiance data throughout the country was also prepared as a valuable tool aim to properly design solar equipments.

Additionally, the project created its own web-site www.renovables rural.cl in 2004 aim to disseminate the objectives, activities, information and project results. In 2007, a national registry of electric generation facilities with NCRE was developed within the web site in 2007 using information from a geographic information system (GIS) produced in 2005 to keep track of NCRE projects to be used by CNE and other government institutions. The information contained in the web site has been transferred to CNE in 2007.

Furthermore, direct promotional activities were also carried forward to endorse NCRE in most regions of the country (I, II, III, IV, VII, VIII, X, XI and XII regions). In 2008, the objectives, goals, strategies, activities and results achieved by the project have been disseminated at international events.

The result of all these activities has been an increased in NCRE knowledge particularly between actors at regional and community level, not only on the technology itself, but also with regards financing alternatives and rural electrification management projects using NCRE. This was perceived by the evaluator during visits to regional authorities in the IV and X Region; at municipal level in the X Region; by beneficiaries in both regions visited, and by CONAFE that participates in the maintenance contract for solar systems in the IV Region of Coquimbo.

The project designed considered several activities with regards the promotional campaigns such as advertisement or advertising programs, promotion through workshops and events, specialized media, campaign implementation; and, on an annual basis, measuring and evaluating the impact of the campaign. Nevertheless, this approach and these activities involve recruiting expert consultants committed to these tasks and budget, as well, which would probably exceed what was assigned. In practice, the approach to actors was straight forward, through their participation in on-going activities; therefore, the implementation strategy, instead adopted by the project, was successful.

In relation to the indicator of success, it is best to consider the number of NCRE projects admitted in BIP-MIDEPLAN rather than municipal reports; that as mentioned in component 1, reached 100.

The evaluator considers that, although the impact of the activity of *component 4* has not been measured, there is a large number of projects in the portfolio of this component, as a result of direct interaction of the project with regional and local actors; hence, target objectives of the dissemination campaign have been achieved ***Satisfactorily (S).***

Figure 3-4. Solar radiation manual and PER report

3.3.6 Immediate Objective 5: Development of a Training Programme

Table 3-16. Component 5. Indicator and compliance

Development Objective	Training Programme currently Operating.
Indicator	Number of courses implemented for the following levels: • Regional policy (project managers). • Engineers and Technicians.
Means for verification	Project Reports and National Training and Employment Service (SENCE)
Assumptions	Available institutions to provide NCRE training.
Compliance to Indicator	A training programme has been implemented oriented to project beneficiaries; however, no long-term agreements with universities have been established in order to continue NCRE training. This component is considered as ***Satisfactory (S)***

This component seeks to develop a range of NCRE training programmes addressed to beneficiaries of sectors to which belonged the different actors of the project, approaching not only the technology, but also elements that would allow a successful implementation of the projects. This training programme was, thus, oriented to those responsible for central and regional policies, regulatory agencies, inspectors, engineers, technicians and users. The programme organized international events with CNE and project staff. In addition, the programme trained participants in the project through their attendance to the course and abroad visits to NCRE providers and facilities. The programme, also, envisioned the project internationally with the support of participants to international events.

Local workshops include the following topics:

- Field work techniques, interviews and data collection to generate NCRE portfolio projects, addressed to fieldwork staff.
- Installation of wind measurement stations, and the handling and processing of data addressed to regional policy makers, professionals, engineers, technicians and CNE staff (2003 and 2004).
- Wind energy aimed to professionals of the public and private sector.
- Evaluation of photovoltaic systems, in the VI Region, oriented to municipal officials, technicians and project staff, with the participation of 10 people. A technical manual was developed (2003). Another evaluation was conducted in 2004 addressed to technical staff from municipalities.
- Design of hybrid systems aimed to professionals in the government sector and consulting firms (2004).
- Evaluation of NCRE projects oriented to professionals from the regional governments (I to IV region) (2004).
- Training in Micro- hydro power plants (2004 and 2005).
- Training in ArcView, Geographic Information System, addressed to two CNE professionals (2005).

During the development of Component 6 (Design and Implementation of a Large-Scale Photovoltaic Demonstration Project), a training programme for solar photovoltaic systems oriented to users, technicians and municipal authorities staff was prepared in 2005 towards a target population of approximately 3,800.

Until 2009, workshops and seminars in photovoltaic systems have been held for approximately 3,500 end users, technicians, consulting firms, technology providers, local governments and municipalities.

The complete list of publications is given in Annex 6.6.

The evaluator has encountered that, when implementing the project, a variety of training activities were undertaken; and well-oriented to beneficiaries of the programme. It must be taken into account that, the approach to rural electrification using NCRE is not the same as the one applied to conventional technologies "especially in terms of establishing specific objectives and understand the technology,; that is, procedures, means and necessary mechanisms, actors involved, decision making and other aspects".[25] And this was acknowledged by the project.

Building a solid foundation for Training Programmes requires continued efforts from different institutions (local and regional government, universities and technical education centers) based on a long-term institutional capacity building leading to an expansion of the use of NCRE not only in the rural sector. While the project "supported the creation of specific courses and careers in technical schools, colleagues and universities focused on the development, implementation and maintenance of renewable technologies, being a particular and extra strength to what was expected from this component", the evaluator has encountered a guiding approach from the central government with regards the need for capacity development in the Rural Electrification Programme. Although these

[25]UNDP-GEF-Ministry of Energy (2011) Final Report. UNDP-GEF-Ministry of Energy. Santiago, Chile.

activities are essential to the success of the programme, equally important is the continuity of training activities in educational centers *(long-term institutional agreements with universities and institutions for NCRE training) of whose existence the evaluator has no information.*

El evaluator considers that component 5 has done a ***Satisfactory (S)*** performance because a training programme was successfully implemented geared toward the beneficiaries of the project; however, long-term interagency agreements with universities and training institutions in NCRE have not been encountered.

3.3.7 Immediate Objective 6: Design and Implementation of a Large-Scale Photovoltaic Demonstration Project

Table 3-17. Component 6. Indicator and compliance

Development Objective	Commercial Demonstration of photovoltaic systems.
Indicator	1.000 photovoltaic systems shall be installed per year (.5.000 in total).
Means for verification	Project reports and Databases.
Assumptions	Co-financing by the State-Private sector-Users is available.
Compliance to Indicator	The evaluator considers ***Highly Satisfactory (HS)*** the implementation of this component, even considering that the Barrier Removal Project was able to installed only over half of the proposed systems; however, the fact that systems are operational, users are satisfied and complying with tariff charges, thus, proving the sustainability of the project after 5 years of operation.

This component aimed to install 1,000 individuals PVS per year throughout the life of the project, which resulted in a total of 6,000 systems.

This component "Commercial Demonstration of Photovoltaic Systems" was grouped in the IV Region of Coquimbo for having one of the two worst rural electrification coverage, isolated and dispersed population and favorable solar potential. A field registry was conducted in 2002 and 2003 resulting in 4,600 isolated and dispersed households; 55 rural facilities, not being neither of them feasible for electrical supply by grid extension. 4 grouped-housing units' locations registered a total of 140 households and rural facilities (Los Morros, Almirante Latorre, Totoral and Caleta Talcaruca) were also identified.

As a result of the field registry of the entire region, the following needs were identified to be included as part of the large-scale photovoltaic project:

- 3,064 households in 15 municipalities.
- 55 schools and rural health centers (would integrate a PVS project for health centers and schools in the region), and
- 1,500 households with PV systems installed in need of improvement, particularly because of failures and damages due to the lack of maintenance (these systems were part of the project to improve regional PVS systems).

- Four hybrid projects were also generated for coastal locations in the IV Region.

During 2004, the Regional Government of Coquimbo submitted to BIP the three regional projects:

- large-scale demonstration project of the IV Region for 3.064 photovoltaic systems,
- regional PV project for 55 rural facilities and,
- regional improvement project of 1,500 PV systems.

Estimated investment for these projects was U.S.$6, 300,000 and the number of beneficiaries was 4.564 households and 55 rural facilities (health centers and rural schools).

In the large-scale demonstration project, FNDR financing was approximately $5 million. In May 2004, the tender was obtained and scheduled for the end of the year while the implementation was coordinated for 2005 and 2006.

The Barrier Removal Project performed the following tasks:

- prepared technical engineering design of PV systems,
- performed technical-economic evaluation for the three projects,
- prepared bidding documents (ToR and technical specifications) for the housing project,
- managed, together with CNE, the creation of a special operating subsidy, which eventually led to the feasibility of the large-scale PV project operated by a private (essential step to make possible the large-scale project). This subsidy made viable new projects within NCRE at a later stage,
- provided assistance to the Regional Government of Coquimbo in the formulation of regional projects and,
- provided assistance to the bidding process: call for expressions of interest, invitation to tender and in the evaluation of bids to the international public tender.

The bidding process for 3,064 photovoltaic systems for the IV Region was awarded to CONAFE for $5 million ($ Chilean pesos 2.925.845.225) for the installation, operation and maintenance of photovoltaic systems for a period of 10 years, renewable.

The evaluator was able to observed, during a visit to two photovoltaic systems in rural households, a module of 125 Wp capacity, from an internationally recognized firm, outdoor pole-mounted to the household and internal electrical facilities piped well-made; charging regulator protected in a metal case with glass window to observe the state of charge of the battery; battery contained in a plastic case without user access; and polarized outlets (see Section 6-5). These systems had also been certified by SEC, thus, maintenance record approved by CONAFE. *The evaluator considers these as well designed and installed PV systems and currently in operation. And well maintain after five years later (CONAFE had recently changed the battery).*

When the evaluator visited CONAFE (See Section 6.5.3), the existence of a division committed to the project came to particular express through the following:

PVS Advantages:

- PVS solved a problem: people came to the world,
- Low maintenance requirements,
- Project has shown sustainability of the framework proposed;
- Technology is reliable and ensures good service,
- Solved the power supply situation of dispersed users, in an economically viable way, since the cost for grid extension is high in these areas.

In addition to the three above PV systems in the Region of Coquimbo, this component generated another 26 PV projects for other regions. Field registries were conducted while PV system design and preparation for the terms of the tendering procedures were held. All PV projects identified were admitted in BIP for evaluation, financing and implementation by respective municipalities. These projects were designed to deliver PV electricity to about 2,300 households and rural facilities, with a total estimated investment of U.S. $3,200,000.

Until 2009, a total of 29 PV projects had been prepared and submitted to BIP for evaluation, financing and implementation. Once executed, the projects would provide electricity to more than 7,000 beneficiaries, including homes, schools, rural health centers, churches and social centers.

In addition to these results, it is noteworthy that the project solved, when implemented, a number of difficulties related to the organizational model of the project. This has to do with the lack of interest of the private sector in participating in these projects. Operational structures considered were (a) privately operated projects, (b) projects whose operation and maintenance remained in the hands of the municipalities, (c) projects whose operational responsibility rested with actual users, or (d) mixed management structures. The role of the state was proven in ensuring sustainability of the projects, hence, selected private companies to procure equipment and its installation under the condition to maintain systems for 10 years, extendable. In order to properly implement the project, it was necessary to develop “administrative engineering” in all state institutions at a central and regional government level, to be proactive to the project execution. Particularly important was the discussion held in the Congress with the regards the creation of a specific subsidy for operation and maintenance of NCRE systems.

When finalizing the registry, the 6.000 PVS projects initially proposed did not matched reality; however, the project directly installed 3,064 photovoltaic systems and has admitted 29 PVS projects to BIP until 2009. The project was evaluated using the evaluation methodology of MIDEPLAN. The project effectively achieved subsidies through FNDR, used GEF resources for co-financing the project (partially, because they were not 6.000 PVS), supported the regional government throughout the international competitive bidding (ICB) and continued working with the regional government in overseeing the project. Moreover, an extremely valuable result of the component is the ownership of the photovoltaic technology by the regional government, users and maintenance company; management system developed and to include the technology in supply energy proposals as a real, reliable and sustainable alternative. From being a regional project has transformed in a national initiative, which has led to evaluate different operating models and increases the project portfolio.

The evaluator considers ***Highly Satisfactory (HS)*** the implementation of this component.

3.3.8 Immediate Objective 7a. Development of a Financial Mechanism for NCRE Projects

Table 3-2. Component 7. Indicator and compliance

Development Objective	Establishing a Financial Mechanism of Risk Mitigation
Indicator	7.1 Financial Mechanism designed, approved and operational. 7.2 At least one project implemented with each technology.
Means for verification	7.1 Written procedures, standards, guidelines and signed agreements, written approval of the Financial Mechanism designed by local UNDP office, GEF-UNDP, and CNE. 7.2 Semiannual Reports.
Assumptions	Institutions assuming administration of the projects are available.
Compliance to Indicator	This component WAS NOT executed as it was restructured and its resources reallocated to other components.

The Objective of this component was to design a financial mechanism to mitigate financial risk and facilitate access to finance additional investments required by rural electrification projects using NCRE. The component aimed to mitigate the perception of risk with regards this technology for the private sector participation in the project and hybridization of diesel systems in operation.

In 2002, a study for the design of a financial mechanism was tendered to bid and hired. This study was conducted from July 2002 and, in July 2003, the proposal was submitted to UNDP-GEF; however, not approved by the Regional Office.

The Mid-Term Evaluation in 2004 encountered that the Immediate Objective No. 7 had been ill conceived as the creation of a financial mechanism was not feasible due to the fact that in the PER framework, all rural electrification projects were funded by the State through FNDR. *The Mid-Term Evaluation recommended to redesign Immediate Objective No. 7 and rescheduling $2 million allocated to this component.*

The implementation of this component as originally conceived and after its amendment, had frozen third part of GEF resources (U.S. $2M) for several years and after determining to reassign them, the process was slow, which led the extension of the term of the project implementation.

3.3.9 Immediate Objective 7b. NCRE productive use in rural areas

Table 3-19. Component 7b. Indicator and compliance

Development Objective	NCRE productive use in rural areas
Indicator	1. Generation of a portfolio of productive projects that incorporate the use of NCRE. 2. Engineering design for 4 demonstration projects of solar water pumping in Region IV.
Means for verification	1. Geo-referenced Database which includes productive projects using NCRE. 2. Training NCRE Manual to be used in productive systems.

	3. Implementation Report of the 4 projects (Construction and tender, ex-post evaluation).
Assumptions	Renewable resources available for its implementation. There is interest from regional governments to finance and implement productive NCRE projects.
Compliance to Indicator	The component has been executed ***Satisfactorily (S).***

In relation to component 7, the MTE showed the feasibility of the mechanism suggested as investments in the energy sector for rural areas are carried out using resources from the chilean government. As the mechanism suggested was not viable, a proposal to reformulate such component was suggested. Several alternatives were submitted. For instance, the Government of Chile proposed a new one, "Productive Use of NCRE in rural areas". That said, at the end of the project, the large mobilization of government funds (U.S. $25,303,568) demonstrates their strong commitment to the project and the right approach of the decision taken.

In 2005, an agreement was reached with UNDP-GEF to redesign Immediate Objective No. 7, accepting to reprogramme resources originally allocated to this component. A first reallocation of $ 1 million was approved to strengthen activities in other components. During the tripartite meeting in April of 2007 (Government, UNDP - GEF Project) a proposal was submitted to reallocate resources not assigned yet from the original budget ($ 1 million) to develop over a period of 24 months and under the GEF Operational Programme No. 6, a set of measures to promote and support the use of NCRE for productive use in rural areas of Chile. The proposal received preliminary approval from GEF-UNDP, with a detailed work plan and related budget.

Objective of component 7b, "Productive Use" was formulated to demonstrate feasibility of NCRE for productive use, thereby displacing the use of generators and water pumps operated on gasoline or diesel, contributing to the reduction of CO_2 emissions and to better manage water resources.

New activities of component No.7 were developed during from 2007 to 2010 with regards achievements to develop field registries in regions I, II, IV, VII, VIII and IX aimed to identify projects for productive NCRE use in the rural sector, development of demonstration projects, training and promotional activities. In order to develop productive use, agreements were made during 2008 with regional governments of Coquimbo (IV Region) and of Maule (VII Region) to prepare project portfolios and provide technical training.

At the close of business of the component in 2010, 681 households were registered and a portfolio of 338 irrigation projects with solar pumping (221 in the IV Region and 117 projects in the VII Region). Five demonstration projects were implemented (4 in the IV Region and one in the VII Region). For the IV region, an engineering design for 32 irrigation projects, to be tendered by the Regional Government of Coquimbo, were prepared. Other results of this component are:

- Ex-post evaluation of 5 irrigation demonstration projects (2011);
- Training programmes for farmers in the IV region and for the Municipality of Empedrado in the II Region.

Besides the use of photovoltaic systems for irrigation, the project developed activities to demonstrate the use of biodigesters in rural areas, designed as an alternative to provide electricity to the sector. Other results are:

- A practical demonstrative workshop of construction and operation of domestic biodigesters (theory and practice) in the Municipality of Empedrado, VII region was conducted. The workshop was held in May 2008 and started with the construction of a 10 m^3 biodigester to produce gas for domestic use (refrigeration and kitchen). A training programme also was conducted for rural residents, municipal employees and officials of the central and regional government;
- Manuals for construction, operation, biogas theory and audiovisual materials were also developed.

Demonstrative activities led CNE/Ministry of Energy to initiatives of their own, who organized a workshop on productive use which included domestic biodigesters in Coltauco (VI Region of Libertador Bernardo O'Higgins) and a number of irrigation projects with solar pumping (Municipality of Pozo Al Monte, I Region, Tarapacá). The support provided by the project to this first initiative was through the preparation of audiovisual material for the training and biodigesters. On the other hand, beneficiaries of the projects have learned how to build biodigesters, leading to new entrepreneurs committed to the business of building domestic biodigesters.

A very important result of these activities has been the project's support to the preparation of a National Programme on Rural and Social Energy (PERYS) by the Ministry of Energy that includes elements of productive use of energy in the rural sector.

The evaluator considers that results of reprogramming activities and reallocating resources with regards the productive use has been ***Satisfactory*** (S).

3.3.10 Immediate Objective 8. Reduction of CO_2 Emissions by means of Hybridization Projects with Diesel-Fueled Systems currently in operation

3.3.11 Table 3-20. Component 8. Indicator and compliance

Development Objective	Establish a Project Portfolio on Hybridization Systems.
Indicator	At least 2 hybridization projects in BIP.
Means for verification	Official Statistics.
Assumptions	Wind resource is available. Institutions assuming administration of the projects are available.
Compliance to Indicator	Over 34 projects were admitted in BIP far exceeding the indicator. In addition, the project Desertores is currently being executed for which GEF has invested U.S.$537,000 to the project. Support has been provided to the GORE of Los Lagos with regards the preparation and development of activities related to the bidding process and technical assistance. Compliance of the indicator is ***Highly Satisfactory (HS).***

The objective of this component is to develop technical and economic feasibility studies and detail engineering of hybridization projects of generation systems using diesel oil or other fossil fuels. It was expected that these projects could use the Financial Mechanism (Component N°7) for their implementation. The indicator was to admit at least two hybridization projects to the BIP and implement one during the life of the project.

The total number of hybridization projects included in the BIP is 36 which were admitted as follows:

- 4 hybrid projects admitted in the BIP in 2003 for the communities of Camar, Pan de Azúcar, Santa Maria Island and Rio Verde.
- 20 hybrid projects were admitted in the BIP in 2004, which were designed to provide electricity to 2,077 rural households. 16 of the projects correspond to diesel systems currently in operation.
- 34 hybrids projects had been admitted in the BIP in 2005 for 2,633 rural households, from which 2 hybrid projects would be executed in the communities of Cupo (wind-diesel) and Camar (solar-diesel) located in the II Region. Additionally, engineering designs of 12 wind-diesel systems for Chiloé islands were prepared.
- 36 projects have been admitted in the BIP in 2007. That year, technical specifications and tender documents for 8 hybrid projects to provided electricity to 2,000 homes (6 wind-diesels and 2 solar-diesels) were prepared.

In 2010, the construction of two projects in Chiloé, Quenu Island and Tabón was planned and financed by FNDR and for regional execution. The Barrier Removal project developed technical studies and recruited detailed engineering together with the development of necessary documents for bidding of the project. Full documentation was given to the regional and municipal authorities. To date, *these two projects have been tendered three times, are actually contracted and will begin construction soon.*

During 2008, technical documentation was prepared for bidding with regards the construction and operation of 8 wind-diesel systems in seven islands of Grupo Desertores and Llanchid Island located in the X Region. During 2009 – 2010, the project was redesigned and reevaluated, in preparation of technical documents (technical specifications and terms of reference) and bidding procedures. The project includes the supply and construction of 8 wind/diesel or gas systems and 5 dispersed households with isolated wind systems in the islands and the operation and maintenance of the systems for a period of 10 years. To ensure the project's economic viability, a subsidy system for the operation was designed and implemented. In 2009, UNDP Chile and the GOC proposed using U.S. $537,000 from the Barrier Removal project as direct contribution to the investment of Desertores project; in addition to the support to the Regional Government of Los Lagos in bidding procedures. Given the expectation of a rapid implementation of the project, the period of the Barrier Removal Project was extended until June 2011.

Desertores project has had delays which do not depend on the Barrier Removal Project. The project was finally tendered in April 2011.It The project was awarded to a local company and, currently, the Barrier Removal Project is providing technical assistance to the GORE through an international expert.

Chiloé Islands were indeed notable projects. For this reason, from 2003 to 2007, these projects conducted a campaign on wind measurement in 32 islands of Chiloé in order to generate a portfolio of

hybrid wind/diesel projects for these islands (land registry were made, surveys, analysis of alternatives, wind analysis, etc., and in some cases, detail engineering studies were also developed). Unfortunately, these projects have not been implemented and, in much of these islands, the *GORE of Los Lagos has decided to provide electricity through diesel systems.*

The evaluator believes that the project succeeded in enrolling 34 projects in the BIP (much more than 2), developed a project portfolio for Chiloé (land registry was made, surveys, analysis of alternatives, wind analysis, etc., and in some cases, detail engineering studies were also developed), and Desertores Project is currently being developed using GEF funds for direct investment and the GORE is being provided of technical assistance for the project. Consequently, the evaluator considers that the implementation of this component has been ***Highly Satisfactory (HS)***.

3.3.12 Immediate Objective 9. Creation of Technical Capacity to Evaluate Wind Resources in Chile.

Table 3-21. Componente 9. Indicator and compliance

Development Objective	Building technical and practical knowledge to carry on diagnoses in wind energy.
Indicator	Measurements made in stations previously established.
Means for verification	Project Reports
Assumptions	Institutions available to develop measurements,
Compliance to Indicator	Building capacity was developed and measurements and evaluations of wind potential in 33 localities (10 regions of Chile) as well. The indicator has been ***Satisfactorily (S)*** fulfilled.

The PRODOC well established that wind potential was attractive for the generation of electricity and should be determined, primarily, oriented towards small-and medium-scale generation for the rural sector. The objective of this component was to build national capacities to properly develop measurements and assessments of wind resource to the level necessary to design rural electrification projects.

For being Chiloé Islands an emblematic electrification project in 2002, the project Barrier Removal was requested to prioritize the development of pre-investment activities for the preparation of NCRE projects for the islands. The project Barrier Removal installed, since May 2002, wind stations on four islands to generate information for the entire group of 37 islands. By rotating the stations to the other islands, wind data collected and analyzed for the generation of electricity in Chiloé was already provided in 2004.

By 2005, the project had identified 31 locations for wind development, from which 15 had been evaluated (7 were in Chiloé) and measurements came forward for 12 months in 16 locations.

The Wind Database (DVD), published in 2008, contains 33 stations in 10 regions of Chile, information on measurement location, duration, average wind speed, monthly averages, probability distributions, wind roses, type of data logger used, daily profile of the wind and summary of the resource in pdf format. This information was widely disseminated and is accessible to users.

The Barrier Removal project developed capacity to promote and train key actors through two workshops in wind resources. The first one on the installation and operation of wind monitoring stations, and the other, focused on the evaluation and preparation of projects using hybrid systems, which included registration and evaluation of wind and solar resources for power generation purposes.

The Barrier Removal Project provided assistance and training to CNE with regards the installation of 6 wind measurements stations to develop potential wind projects connected to the grid. But also, within the context of the project, private consultants and entrepreneurs, who have made wind resource evaluations for commercial purposes, not linked to rural electrification, were trained.

The project has also raised interest in the use of wind resources for productive purposes among other government institutions (Ministry of Agriculture) and the installation of wind-diesel hybrid systems in border areas.

The evaluator conceived that objectives of this component have been met ***Satisfactorily (S)***; however, is worth mentioning that, although the training did not had an impact on wind projects for rural areas, the training itself impacted the development of wind projects linked to the national network.

3.3.12 Sustainability

The objective of this section is to assess the extent to which project benefits will continue within or outside the project domain after it is completed.

3.3.12.1.1 Technical capacity building

As set forth in the PRODOC, the project placed particular emphasis on the development of technical capacity through component 5. In practice, all components provided technical capacity as staff was trained on the development of project portfolio. For instance, component 2 left approved technical regulations adapted by Chilean experts of the highest level, the mechanism of certification (component 3) developed capacities in universities, the commercial demonstration for PVS (component 6) has allowed proper maintenance of PV systems through the private sector, sustainable operation of the systems and the development of productive applications (component ____) has allowed training to staff in water pumping and biodigesters, the component related to hybridization (component 8) has developed capacities in the design and installation of hybrid systems and, finally, component 9 has allowed staff training who later worked on the development of wind resource in Chile through systems connected to the grid.

The project has then left an important legacy of qualified staff to different levels and in different institutions and companies.

3.3.12.2 Economic and Sociopolitical Sustainability of the Rural Electrification Programme

Component 6, commercial demonstration of photovoltaic systems, is currently in operation for over five years. Users surveyed are satisfied with the systems. The company performs resource-related

billing, collection and provides maintenance services to systems. Management mechanism developed by the project has proven to be functional.

Similarly, in the Llanada Grande project (MCH), the electrification cooperative operates the plant, provides maintenance, charge services and collect payments. The cooperative is, after a year and a half of service, an organization that plans to expand services because the plant capacity currently exceeds the demand.

The above facts allow the evaluator to observe that developments are sustainable in the short and medium term.

3.3.12.3 Other aspects of the Programme sustainability

In this project, according to the findings of the consultant, technical, operational and environmental sustainability have been proven when using the PVS and MCH for rural electrification, irrigation projects with solar pumping and biodigesters, under the conditions of rural sectors identified by the project. These technologies involve no major environmental risks, except for improper disposal of batteries of PVS and managing water basins inappropriately. To handle batteries, CONAFE has contracted an environmental management service.

Technical, operational and environmental sustainability of the programme is considered high due to the quality of the acquired equipment and regular maintenance of PVS provided by CONAFE.

3.4 CURRENT STATUS OF BARRIERS

The project evaluator considers that, after the project, the current status of the barriers is as follows:

Table 3-22. Project impact on technical barriers

BARRIER STATUS BEFORE THE PROJECT	BARRIER STATUS AFTER THE PROJECT
(f) lack of rural electrification project portfolios with NCRE;	• *Barrier removed.*
(g) lack of regulations for renewable energy equipments;	• *Barrier removed.*
(h) lack of certification procedures for renewable energy systems and their installation;	• *Barrier removed.*
(i) lack of general knowledge with respect to NCRE;	• *Barrier removed.*
(e) lack of formal training programmes;	*Barrier partially removed* as no evidence with regards the continuity of training programmes in institutions of higher education was encountered; although, the

BARRIER STATUS BEFORE THE PROJECT	BARRIER STATUS AFTER THE PROJECT
	Ministry includes training in their projects.
(f) existence of high investment costs in projects with NCRE;	• This barrier is considered *NOT removed* mainly due to the fact that, although, technology, for instance, photovoltaic, has decreased, the costs of installation and maintenance in remote and isolated areas, increases with distance and isolation. However, when considering the Life Cycle Cost (*Costo del Ciclo de Vida*) of NCRE projects, the government of Chile has encountered that these are technically, economically and environmentally feasible alternative to provide services in remote and isolated areas, and better than conventional energy systems. *Project designers* identified high investment costs as a barrier, but *did not consider the "life cycle cost" of energy supply as the variable to be taken into account.*
(g) perception of associated risks with renewable energy technologies;	• This perception is still valid for the private sector Who did NOT participate as investor in the projects. Hence, rural electrification will continue to be a task for the state.
(h) lack of technical expertise, equipment and analysis to perform wind resources measurements;	• *Barrier removed.*
(i) lack of NCRE commercial projects with economies of scale.	• *Barrier removed.* The project developed a scale project that has demonstrated to reach sustainable viability of Photovoltaic Systems.

But, in addition to barriers removal, this project has made significant contributions to the development of NCRE in Chile such as:

- Strengthening the governance scheme in the institutional environment to address the challenges of energy supply for users in remote and isolated rural areas, challenges that must have governmental responses to the obligation of the state in providing a public service in an equitable manner.
- Development of a methodology to identify and evaluate rural electrification projects, where the project was able to place NCRE as technologies that are technically, economically and operationally viable and sustainable against conventional electrification schemes based on grid extension and diesel and gasoline generators.
- Ownership of NCRE technologies by central level government institutions (ministries, mainly of Energy and Agriculture), regional and municipal governments.
- Development of management patterns for NCRE projects and their validation in PV within the IV region of Coquimbo and the MCH in Llanada Grande, as well as three others developed in the X Region.
- Creation of a subsidy mechanism for the operation of PVS in the IV Region, which has been applied to other projects in the rural sector of the country.

- Development and validation of the "engineering management in government" for the implementation of the projects, applied to those of the Region IV and X.

The Barrier Removal Project, as a whole, can be seen as a successful project, developed with effectiveness and **SATISFACTORILY (S)** achieving the implementation of several components in a **HIGHLY SATISFACTORY (HS)** manner.

4. CONCLUSIONS AND RECOMMENDATIONS

To the Ministry of Energy (DAEE)

- Consider continuity and strengthening of the achievements of the programme as it is an effort that responds to actual needs of the least advantaged rural population in the country.

- The use of NCRE in the rural sector is in line with the environmental policy of the country, with the goal towards a low-carbon development for the country, with the Millennium Development Goals and the real possibility of achieving 100% of rural electrification for the country. Likewise, Chile could become an icon for Latin America by being the first Latin American country 100% electrified.

- Continue the dissemination of existing information which was also available on the Barrier Removal Project website together with UNDP-GEF.

- Act in line with the reality with regards the need of political will for the implementation of the projects. The NCRE rural electrification projects implemented has shown that, where there was political will of local authorities and, particularly, political will, and support of regional and municipal authorities (as in the case of the Region of Coquimbo and a number of municipalities in different regions), projects could be implemented with the technical support and contribution of several activities from the Barrier Removal project.

- For households that are not likely to get connection to the electricity distribution grid, the NCRE electrification alternative has strengths from the technical, operational, environmental and economic point of view against fuel generators.

- For the sustainability of NCRE electrification systems in the long-term operation and maintenance for the rural sector requires ongoing support, both technically and financially, regardless whether management schemes are implemented by the private sector, municipalities or users. This support requires public investment, which has been endorsed through the Subsidy to Operation and Maintenance, created under the PV project of the Region of Coquimbo and has been included in the Budget Law.

- For the supply of electricity to rural population that lives more distant and dispersed, which in practice is the last to be considered in electrification projects, requires increasingly high investments, which implies the need to increase subsidies. The methodology of rural evaluation of the Ministry of Social Development has been modified; hence, subsidies to investments have increased.

- On the other hand, the needs of rural areas include not only electricity, but other sources of energy. In other words, the rural sector requires developing “energization” as a concept which implies the participation of new actors and a current vision that has been developed in the Ministry of Energy influenced by the Removal of Barriers Project. In order to accomplish this, new models for delivery of services and management shall be created. In the process of NCRE rural electrification, the vital importance of the State with regards to technical assistance, safety for investments and public expenditures, has been proved.

TO UNDP-GEF

- As a successful project, disseminate the acquired information and knowledge that this project has created, and the achievements.

- While projects are formulated for limited periods of time, this project has shown that by extending its implementation time, sustainability of electrification PVS projects, already with five years of successful operation and maintenance, as regards user-satisfaction, has been verified.

- Including gender perspective as part of the activities in this type of project would help analyzing the roles and responsibilities of women, both, as beneficiaries of electricity supply in their communities and their role as users of energy services either for domestic, productive or communal use. Schedule specific activities such as workshops or directed sessions allow the development of a process of awareness on gender issues, taking advantage of the technological outbreak, and expanding its benefits through social achievements. Determine the participation of women can also assess their role in the maintenance and use of equipment and possibly generate an active participation in greater productive use of electricity.

5. LESSONS LEARNED

- 5 years to implement a programme that intends to remove barriers nationwide as planned in the design, within a short period of time, especially considering that some of the results required the participation of several key actors.

- Allocation of resources in the budget should be within the scope of the indicator and the expected outcome. Specifically, in the case of the information campaign, neither resources nor staff required was provided to cover the scope described.

- Systematize achievements and disseminate acquired information, that may be of a public nature, would allow attaining a greater impact on the achievements of this project, for instance, by enhancing the development of case studies of beneficiary communities with photovoltaic solar energy would allow making even more visible this joint effort between UNDP-GEF and the Ministry of Energy.

- The effective participation of key actors at different stages of identification and development of NCRE rural electrification projects was essential to the success of the project. It is important to create, when starting the project, strategic alliances and consensus required for approval, funding and execution of the projects. Involve communities and direct beneficiaries of the projects are also essential to ensure the success of the projects.

- One of the essential aspects to the success of NCRE projects is designing and considering different management schemes leading to the sustainability of projects. This includes, not only economic resources, but also capacity building among technicians and users as well. The project considered this topic essential and strategic.

- The project success is also based on well-planned and executed pre-investment studies. Allocation of resources for these activities has a high return rate in the future. This leads to a careful study of actual needs of users and exploration of opportunities for income generation. The use of energy for productive purposes is a matter of great importance. This indicates that electrification projects with NCRE rural energy must come from actual needs of rural population. Only through their participation, users shall "own" the project and generate the same success factors.

6. ANNEXES

6.1 TERMS OF REFERENCE

Final Project Evaluation

PROJECT N ° 11799
"BARRIERS REMOVAL FOR RURAL ELECTRIFICATION WITH RENEWABLE ENERGIES"

1. GENERAL INFORMATION

In 2001, the Chilean government requested the United Nations Programme for Development (UNDP) assistance and support in the preparation of a technical assistance project to promote the use of non-conventional renewable energy (NCRE) under the Rural Electrification Programme (PER), that the Government was executing since 1994.

As background to the national context, the Chilean economy has experienced accelerated growth from 1990 to 1999, with a Gross Domestic Product (GDP) at a rate of 6.73% per year. Meanwhile, the average annual energy consumption of the country has also grown at rates similar or even superior to the GDP, in areas such as the energy sector, with an increasing trend of CO_2 emissions associated with the energy sector and its future projections.

This situation has encouraged government authorities to seek corrective strategies that would allow the economy of the country to grow while not leading to increases in greenhouse gases (GHG). In this sense, it was clear that policies to promote a more efficient use of energy could have significant impacts on the short term, but on the other hand, they had to work in a long-term perspective for bringing about significant change in the composition of the country's energy matrix.

To this end, the Government undertook to make a concerted effort to remove as soon as possible major barriers to the installation of competitive markets for these unconventional energy sources technologies in the country.

To carry on this important change, the national authority decided to undertake the beginning of this task by means of using the Rural Electrification Programme (PER), a successful project implemented by the Chilean state since 1994 across the country. The reasons for such choice were of two types. On the one hand, this programme was considered to be of priority to meet the needs of rural population, with successful results and had the advantage of being a fully-operational. On the other hand, based on previous experience with conventional energy sources, the challenges presented by the implementation of NCRE were better understood.

- With the conviction that Non-Conventional Renewable Energy (NCRE) were an excellent alternative for decentralized systems and for remote and dispersed households, the Government of Chile requested the United Nations Programme for Development (UNDP), to prepare a technical assistance project for the "Removal for Rural Electrification with Non-

Conventional Renewable Energy" to be submitted to the Global Environment Facility (GEF), of the Climate Change Convention for approval and funding.

- The project document was approved by GEF and signed in Chile in September 2001 by the Ministry of Foreign Affairs, the National Energy Commission (CNE) and the United Nations Programme for Development (UNDP).
- Approval of the Project Document considered a non-refundable GEF financing of U.S. $6,067,300 and a committed co-financing by the State of Chile for U.S. $26,330,000. This includes a State contribution of $16,489,000 (plus an in kind contribution of U.S.$ 755,000), a contribution of U.S. $7,628,000 from the private sector and a contribution of U.S. $1.458 million from the users.
- The project was designed within a five-year period. However, the project had successive extensions, being the last one adopted in 2009, extending the duration until June 31, 2011.
- Once this step has been followed, a final project evaluation needs to be performed, according to the regulations established for GEF funded projects.
- Due to the above, it is necessary to hire a professional who can independently evaluate the agencies and institutions involved in the implementation of the project.

1.1. Project Development Objective

- The project document CHI/00G32 aims to remove the existing barriers to include Non-Conventional Renewable Energy (NCRE) in the rural electrification in Chile, through the development of a set of activities to allow the reduction of greenhouse gas emissions produced by the generation of electricity in the rural sector. The project also seeks to generate, within the rural electrification area, market conditions that would allow developing direct actions to reduce current emissions of greenhouse gases caused by the use of diesel power generation systems. The project also sought to produce an effect, at national level, and to establish and develop a NCRE market as well.
- In order to achieve the Millennium Development Goal, the project will carry out the following activities:
- Promote the barrier removal to the use of NCRE in rural electrification in Chile, generating within the existing institutional framework, conditions to develop a NCRE market in Chile.
- Promote public and private investment in the field of development of rural electrification using NCRE.
- Promote social equity and improve the living conditions of rural communities.

During the preparation phase of the project, a comprehensive analysis of existing barriers to the introduction of NCRE in rural electrification was performed, identifying the following:
(a) lack of rural electrification project portfolios with NCRE; (b) lack of regulations for renewable energy equipments; (c) lack of certification procedures for renewable energy systems and their installation; (d) lack of general knowledge with respect to NCRE; (e) lack of formal training programmes; (f) existence of high investment costs in projects with NCRE; (g) perception of associated risks with renewable energy technologies; (h) lack of technical expertise, equipment and analysis to perform wind resources measurements; (i) lack of NCRE commercial projects with economies of scale.

1.2. Immediate Objectives of the Project

Based on the identified barriers to the introduction of NCRE in rural electrification, nine Immediate Objectives were designed, the expected results and related activities, designed to remove these barriers:

1.2.1. Immediate Objective 1: Generation of a Portfolio of Rural Electrification Projects using NCRE

- *Result: (a) Overall potential use of NCRE in rural electrification in Chile at geographical level with regards renewable resources used and the number of households that may be assisted. (b) Initial Portfolio of Rural Electrification projects with NCRE for a total of 12,500 households, intended to be admitted in the National Investment Systems for application to state subsidy for rural electrification. (c) Rural electrification projects with NCRE included in the National Investment System for application to state subsidy for rural electrification.*

1.2.2. Immediate Objective 2: Elaboration of Technical Regulations for Electrification Systems with NCRE

Result: (a) Regulatory framework for the implementation of technical regulations for electrical systems using NCRE. (b) Technical framework validated as a Chilean Official Regulation, by SEC, through a set of regulations for photovoltaic systems, micro- hydro power plants, wind and hybrid, and biomass gasification systems, which will facilitate the entrance of the private sector to the renewable energy market. (c) Wide knowledge of designated regulations by producers and importers of equipment and systems, such as professionals and technicians who have taken part in the development of these projects.

1.2.3. Immediate Objective 3: Elaboration of Certification Procedures for Electrical Systems with NCRE

- *Result: (a) Certification procedures of Electrical Generation Systems with NCRE to safeguard compliance of technical and quality regulations of equipment, inspection of facilities and control of installers using NCRE. (b) Development of a NCRE systems certification market in Chile to ensure sustainability of this activity beyond the end of this project, and the quality and sustainability of all projects with NCRE as well.*

1.2.4. Immediate Objective 4: Implementation of a Promotional campaign for NCRE

Result: (a) Promotional Campaign aimed to facilitate the development and management of NCRE-based rural electrification projects, reinforcing NCRE market and increasing knowledge of this technology. (b) Project website to facilitate on-line communication with and among agents interested in the project.

1.2.5. Immediate Objective 5: Development of a Training Programme

- *Result: Generate sufficient training programmes aim to meet local demand for human resources training in NCRE-related fields.*

1.2.6. Immediate Objective 6: Design and Implementation of a Large-Scale Demonstration Project

- *Result: Install approximately 6,000 individual photovoltaic systems units in isolated areas of the IV Region of the country, thus, creating the replication of projects similar to those that supply energy through photovoltaic systems, and reach an estimated market of more than 20,000 households, including productive development projects with photovoltaic systems.*

1.2.7. Immediate Objective 7: Development of a Financial Mechanism for NCRE Projects

- *Result: Develop a non-grant Financial Mechanism or Fund that provides appropriate barrier removal in a manner that investors support/promote NCRE based systems over traditional approaches and, in turn, learn to manage and control possible risks involved in major investments for NCRE systems.*

1.2.8. Immediate Objective 8. Reduction of the CO_2 Emissions by means of Hybridization Projects with Diesel-Fueled Systems currently in operation

- *Result: Generate hybrid projects to be executed through Sate and private financing, and with the support of the Financial Mechanism referred to in the Activity.*

1.2.9. Immediate Objective 9. Creation of Technical Capacity to Evaluate Wind Resources in Chile.

- *Result: (a) Create internal capacities to allow adequate measurements and evaluations of the wind resources, at a level required for project design, for both the State and the private sector. (b) Having access to measurements in specific areas of the country, in line with the requirements for the preparation of projects of this nature.*

2. OBJECTIVES OF THE EVALUATION

Final evaluations are intended to determine the relevance, performance and success of the project, looking for signs of potential impact and sustainability of results, including the project's contribution to capacity development and the achievement of global environmental goals. These evaluations also seek to identify and document lessons learned and make recommendations that might improve design and implementation of other UNDP/GEF projects.

The final evaluation of the project has been organized in accordance with UNDP/GEF policies and procedures. Its main objective is to analyze and document results obtained with the implementation of project CHI/00/G32.

2.1. UNDP/GEF Policy Monitoring and Evaluation (M & E)

UNDP/GEF policy monitoring and evaluation (M & E) has four objectives:

- Monitor and evaluate results and impacts;
- Provide inputs for decision-making and make necessary amendments and improvements;
- Promote a responsible utilization of resources, and
- Document, provide feedback and disseminate lessons learned.

To ensure effectiveness of M & E of projects, a set of tools continuously applied during the life of the project is utilized, for instance, periodic monitoring of indicators, mid-term reviews, audit reports and final evaluations.

2.2. Overall objective of Final Evaluation.

The Overall objective of the final evaluation of the project "Barrier Removal for Rural Electrification with Non-conventional Renewable Energies", during its implementation, from October 2001 to June 2011 is:

- Analyze project implementation;
- Review the progress of the project in relation to the fulfillment of the project objective and expected results;
- Establish the relevance, performance and success of the project, including sustainability of results;
- Collect and analyze specific lessons learned and best practices on strategies used and implementation arrangements, which may be relevant to other projects in the Country and abroad.

2.3 The main actors of this evaluation are:

- Project Coordination CHI/00/G32;
- Technical support team of UNDP Country Office;
- Authorities form the Ministry of Energy, Energy Access and Equity Division and local authorities (regional governments and municipalities).

2.4. The evaluation will focus specifically on:

a) Evaluate and describe achievement of objectives, results/ impacts, and outcomes of the project (Changes made over time regarding the project logical framework in terms of objectives, expected results and execution mode should be considered and evaluated).
b) Evaluate achievements of the project according to the Criteria for Evaluation of GEF Projects, including the evaluation for the first time since it entered into operation, ownership of local environmental authorities and regional actors, participation of actors, sustainability, replicability, financial planning, cost/effectiveness (profitability), monitoring and evaluation. These criteria are:

    - **Relevance.** The extent to which the activity is appropriate to develop priorities and national and local organizational policies, including changes over time.
    - **Effectiveness.** The extent to which an objective has been achieved or is likely to do so.
    - **Efficiency**. The extent to which results have been delivered, in an economically viable way, also called cost effectiveness or efficacy.
    - **Results**. Positive and negative, foreseen and unforeseen, changes, and effects produced by a development intervention. In GEF terms, results include direct project outcomes, short and medium term outputs and longer-term impact including global

environmental benefits, replicability and other local effects.

- **Sustainability.** The likely ability of an intervention to continue to deliver benefits for an extended period of time after completion. Projects need to be environmentally, financially and socially sustainable.

c) Identify problems or circumstances that may have affected project implementation and impact achievement;
d) Recommend measures to ensure viability and sustainability of the project and its results in order to guide the development of other long-term intervention phases, including the ones from new donors;
e) Identify key lessons learned that can be disseminated between relevant GEF projects, authorities and actors.
f) Account for the investments made by GEF funded project CHI/00G32.

2.5. Specific aspects of the project to be considered for the evaluation:

a) Evaluate impacts and consequences of the duration of the project, which was longer than what was initially established in the Project Document.
b) Evaluate impacts and consequences of amendment in Immediate Objective No. 7 "Development of a Financial Mechanism for NCRE Projects" and the reallocation of funds originally assigned to this component.
c) Evaluate the embodiment of co-financing established in the Project Document, changes and additional funds as well, generated during the course of the project.

3. SCOPE OF THE EVALUATION

Final evaluation must submit a comprehensive report regarding:

- Performance of a completed project, evaluating the project design.
- Implementation process.
- Achievement of results and objectives, including changes in the objective and results during implementation.
- Language: An original version of the report in Spanish and a copy in English should be submitted.

4. EXPECTED OUTCOMES OF THE EVALUATION

The following products are expected to be delivered by the evaluator:

4.1 Oral presentation with main findings of the evaluation: This presentation should be held at UNDP Country Office before the evaluation mission has been concluded; this will allow verifying, validating and clarifying the findings of the evaluation.

4.2 Evaluation Report: This report must be sent electronically to the Project Coordinator and UNDP Country Office (CO), UNDP-GEF Regional Coordination Office, within a period of no more than 20 days counted from the award date (as detailed in section 7.1). Parties shall review the document and submit comments to the evaluator within a period of no more than 14 days after the report has

been delivered. The evaluator shall consider these comments to be included in a final report to be delivered in an electronic version (one original and two copies) within a period of no more than three days after comments have been delivered. In the event that there are any discrepancies between impressions and findings of the evaluation team and the parties above mentioned, an annex at the end of the document should be included in order to explain these discrepancies. UNDP-GEF and UNDP CO Chile shall sign a final approval document that will be attached to the final report.

4.3 General considerations of the report:

- Times New Roman - 11, single-spaced; automated table of contents, page numbers (centered below). The use of graphics and photographs, where relevant, is recommended,
- Length: Up to 50 pages in total, excluding annexes.
- Language: an original version in Spanish and a copy in English.

The report of the evaluation must be based on UNDP-GEF guidelines and regulations for final evaluations and follow the structure as it is described in Annex 2 of the Guidelines for GEF Project Evaluations (Appendix ____).

5. METHODOLOGY

The methodology for evaluation to be applied must follow the guidelines as defined in the Guidelines for Evaluations (Appendix ...). It is recommended that the evaluation team submit the proposed methodology to conduct the evaluation of the programme in execution, which shall be discussed in advance with UNDP-Chile and the Ministry of Energy, as well as, with the Project Coordinating Unit, in order to create balance between written information, interviews and field visits.

6. EVALUATOR

The evaluator shall be selected through a competitive process by common agreement between UNDP-Chile, the Ministry of Energy and the Project Coordination Unit. The evaluator must be skilled in disciplines related to sustainable development with an emphasis on Non-Conventional Renewable Energies and its use in rural electrification, as well as in policies and institutional development

The evaluator must be experienced in project evaluation and management and basic knowledge of UNDP and GEF policies and procedures. Moreover, considering the main actors of the evaluation, the evaluator must have experience working with multiple actors and knowledge of participatory evaluation methods. The profile and responsibilities of the evaluator are described below.

Evaluation Consultant

As described in the ToR and in line with GEF Guidelines for Project Evaluations, the consultant shall be responsible for:

- Evaluate the design of the project and its progress towards the objectives established.
- Evaluate sustainability issues, ownership, monitoring and evaluation and efficiency.
- Evaluate the project strategy and obtained impacts.

- Evaluate how the various bodies or actors relate to each other, while maintaining a clear definition of their specific roles.
- Evaluate financial aspects (including co-financing funds).
- Compile and edit data and prepare the final report.

Required profile

- Extensive international experience in monitoring and evaluation of energy projects.
- Previous experience in project evaluations that promote the use of Non-Conventional Renewable Energies (NCRE) in rural electrification and sustainable development.
- Preference will be given to consultants with knowledge of monitoring and following-up, as well as, of evaluation of projects implemented by GEF and/or UNDP.
- Experienced managing the logical framework methodology and have knowledge of governmental, private and non-governmental organizations related.

Skills

- Possess proven experience in development, management and dissemination of documents.
- Demonstrate resources (human and technical) required to develop the consultancy.
- Aptitude for teamwork.
- Willingness to adapt to sudden changes during the consultancy.

7. ARRANGEMENTS FOR IMPLEMENTING THE EVALUATION

UNDP-Chile Office will be operation focal point for this evaluation. This Office, together with the project team, shall be responsible for organizing field visits for evaluators and setting-up interviews with the project team and governmental and nongovernmental actors (individual and/or group interviews).

Evaluation was requested by UNDP, led by UNDP Office in Chile, as Implementing Agency. UNDP Office in Chile has overall responsibility for the coordination and logistical arrangements to conduct the evaluation, and also provides the necessary support to the evaluation team (travel, accommodation, work space, communications, etc.) along with the timely delivery of per diem contract payments. UNDP Country Office shall organize the mission to sites (travel arrangements, meetings with key actors and beneficiaries, interviews and field visits). The evaluation team shall receive a brief oral summary of the Country Office and the RCU through a teleconference, at the beginning of his mission. It is expected that the team shall also provide an oral summary of preliminary findings and conclusions of the evaluation mission to the CO and RCU. Further discussions with the CO and RCU concerning the mission and the project can be coordinated while the evaluation is conducted.

These terms of reference and agenda of the mission are based on UNDP-GEF policies and procedures. UNDP-CO, UNDP-GEF-RCU and the project team were all agreed. Final report must have been accepted and approved by UNDP before being used publicly. For this, UNDP-CO and UNDP-GEF-RCU must formally approve the report (see Appendix 5).

7.1. Main activities and deadlines

Total duration of the evaluation shall be **60** days, of which **30 of them are working days**, and the remaining 30 days are reserved to receive feedback on the report.

Preparation for fieldwork: (10 days, including travel time).

- Submit the implementation programme to be approved by UNDP-Chile, the Ministry of Energy and the Project Coordination Unit.
- Obtain project documentation and other material that may have relevant information of the project (PIRs, TPR reports, mid-term evaluation and other assessments, etc.).
- Become familiar with the overall situation of the country (by reviewing the CCA, UNDAF and other country reports).
- Prepare the mission in detail, including methodology, in cooperation with UNDP-CO and the project team.
- Prepare a teleconference with UNDP-GEF Regional Adviser.

Mission: (10 days)

- Meeting with UNDP-CO team;
- Meetings with relevant local actors;
- Joint review of all the available material of the project, with a focus on results and outcomes;
- Visit the project site:
  - Monitoring and reviewing of accomplished and ongoing activities (capacity building, awareness/education, demonstration activities on sustainable use, community development, etc.).
  - Interviews with beneficiaries and key actors, including representatives of local authority, local environmental authority, communities, etc.

Draft Report (10 days):

- Final Interviews /validation with UNDP-CO, UNDP-GEF-RCU and project team.
- Draft project in the appropriate format.
- Review of final conclusions by phone with UNDP-CO and the RCU Regional Technical Adviser.
- Complete and submit final report for further comments.

Review of draft report by counterparts (25 days)

- The counterpart, UNDP-CO and UNDP-GEF-RCU shall have a maximum of 14 days for review, observation and comments on the document.

Final Report (5 days)

- Final submission of evaluation report

8. FEES AND PAYMENT

This consultancy is for 60 days of work with a 30-day window, during which feedback on the report will be received.

Payment arrangements and specifications: The evaluator shall be hired and financed by project funds. The payment method will be:

- 20% at the beginning of the consultancy, upon receipt and approval of an execution programme.
- 40% following 20 days of the consultancy, upon receipt and approval of report (Evaluation Report) prior to the oral presentation.
- The remaining 40% shall be paid once the final report has been completed and approved by UNDP-CO and UNDP-GEF-RCU. The quality of the final report shall be evaluated by UNDP-CO and UNDP-GEF-RCU. If the quality does not meet the UNDP-GEF standards or requirements, the evaluator shall be asked to rewrite or review (as necessary to) the document before payment of the last installment.

ANNEXES

Annex 1: List of documents to be reviewed by the evaluators
Annex 2. Explanation of GEF terminologies
Annex 3: Financial Planning - Co-Financing
Annex 4: Response Managing Table
Annex 5. Review and Approval Form
Annex 6. Code of Conduct (to be signed within the contract)
Annex 7. Guidelines for GEF Project Evaluations (Evaluation Teams Version)
Tracking Tools??

Annex 1. List of documents to be reviewed by the evaluators

Documents:
1. Project Document
2. Logical Framework
3. Substantive Review
4. Final report/Mid-Term Evaluation including the Response Managing Table
5. ?
6. Annual reports (PIR)
7. Quarterly Reports (QPR)

UNDAF / CPAP
Minutes of meetings of the Steering Committee

Annex 2. Explanation of GEF terminologies

Implementation Approach includes an analysis of the project's logical framework, adapt to changing conditions (adaptive management), partnerships in the planning of implementation, changes in project design and the handling/management/administration of the project in general.

Some elements of an effective implementation approach may include:

- The use of the Logical Framework, during the implementation, as a management and Monitoring and Evaluation (M & E) tool.
- Effective partnerships established with relevant actors involved in the country/region for the implementation of the project.
- Lessons learned from other relevant projects (e.g. same focal area) as part of the project implementation.
- Feedback from M & E activities used for adaptive management.

National Ownership is the relevance of the project to development and environmental agendas of the country, commitments of the recipient country and regional and international agreements (when applicable).

Some elements of effective ownership may include:

- The project concept arises from sector and development plans of the country.
- Results (or potential results) of the project have been included in the sector and development plans of the country.
- Relevant Representatives of the country (e.g. government officials, civil society, etc.) are actively involved in identifying, planning and/ implementing the project.
- The recipient government maintains a financial commitment to the project
- The government has approved policies and/or amended regulatory frameworks in line with the objectives of the project.

For those projects whose main focus and actors are in the private sector more than in the public sector (e.g. IFC projects), elements of effective ownership that prove interest and compromise from local private sector towards the project may include:

- Number of companies participating in the project: receiving technical assistance, applying for financing, attending dissemination events, adopting environmental regulations promoted by the project, etc.
- Contributions provided by participating companies to achieve environmental benefits driven by the project, including: equity investments, guarantees provided, co-funding of project activities, in-kind contributions, project collaboration with industry associations, etc.

Key actors participation

It consists of three processes that are related, and usually overlapping. These are: dissemination of information, consultation and participation of "key actors". Key actors can be individuals, groups, institutions and other organizations with an interest or a role in final results of the project financed by GEF. The terminology also includes those who may be adversely affected by a project.

Examples of effective public intervention include:

<u>Dissemination of information</u>

- Properly implement awareness- raising campaign.
- Consultation and participation of actors.
- Consulting and using skills, experiences and NGOs knowledge, local communities and groups, private and public sector and academic institutions in the design and evaluation of the activities of the project.

Key actors participation

- Institutional networks of the project well-placed in all national or community organizational structures. For instance, promoting structures of community decision-making by including local knowledge and transferring management responsibilities to national or community organizations as the project is coming to its closure.
- Building partnerships between different actors of the project
- Compliance with commitments toward key local actors. They consider being adequately involved.

Sustainability

It measures the continuity level of benefits, within or outside the scope of a particular project, once GEF external assistance has come to an end. Relevant factors to improve sustainability of results of the project are:

- Development and implementation of a sustainability strategy.
- Establish tools and financial and economic mechanisms to ensure a continuous flow of benefits once GEF assistance ends (from public and private sectors, income-generating activities, and market transformations to promote the objectives of the project).
- Development of appropriate institutional arrangements by the public and/ or private sector.
- Development of policy and regulatory frameworks that promote the objectives of the project.
- Include environmental and ecological factors affecting future flow of benefits.
- Appropriate development of institutional capacity (systems, structures, staff, experts, etc.)
- Identification and participation of advocacy groups (e.g. individuals in the government and civil society who can promote sustainability of project output).
- Achieving social sustainability, for instance, that project activities are integrated or incorporated (mainstreaming) into the economy or production activities of the community.
- Reaching consensus among key actors on the course of actions on project activities.

Replicability

In the context of GEF projects, replicability is defined as lessons learned and experiences arising from the project, which are being replicated or expanded in the design and implementation of other projects. Replication can be described as: adequate replication (lessons leaned and experiences that were replicated in different geographic areas) or extended replication (lessons learned and experiences were replicated within the same geographic area, but funded by other sources). Examples of replication approaches include:

- Knowledge transfer (e.g. dissemination of lessons learned through documents on the results of the project, training workshops, exchange of experiences, national and regional forums, etc.)

- Expansion of demonstration projects.
- Capacity building and training of individuals and institutions to expand the scope of the project in the country or other regions.
- Place individuals, institutions or companies trained by the project in service to replicate results of the project in other regions.

Financial Planning

Includes current project costs by activity, financial management (including disbursement issues), and co-financing (see Annex 2 for further discussion of co-financing). If there has been a financial audit, the most important findings should be presented in the TE.

Adequate financial plans include:

- Rigorous financial controls, including reporting and planning, which would allow the administration of the project, take informed decisions on the budget, at any time, enabling a timely flow of funds for adequate payments of tangible outcomes of the project.
- Diligence managing funds and financial audits.

Cost-effectiveness

Evaluate the scope of environmental and development objectives of the project, as well as of the outcomes, in relation to the effort, costs and implementation time. It also examines the project's compliance with the application of the concept incremental cost. Cost-effectiveness factors include:

- Compliance with incremental cost criteria (e.g. GEF funds are used to finance a project component that would not have been possible without this funding) and ensure co-financing and an associated financing.
- The project completed planned activities and met or exceeded the expected results in terms of the scope of the Environmental and Development Objectives according to the timetable and is cost-effective, as initially planned.
- The project used a benchmark or comparative approach (did not exceeded the costs level of projects developed within a similar context). A benchmark approach in Climate Change and Ozone Projects measures the cost-effectiveness using an accepted threshold such as $10 tons of carbon equivalent reduced and thresholds for gradual elimination of specific ozone-depleting substances (ODS) measured in terms dollars spent per kg. ($/kg.) of each type of reduced ODS.

Monitoring and Evaluation.

Monitoring is the periodic oversight of a process or implementation of an activity that seeks to establish whether the contributions, work plans, other required actions and outcomes are progressing as planned, in order to take timely actions to correct identified deficiencies. Evaluation is the process by which programme inputs, activities and results are analyzed and judged explicitly against standards or baseline conditions using performance indicators. This will allow project managers and planners to make decisions based on evidence from the information on the level of project implementation, performance indicators, funding availability level, etc., based on the logical framework of the project.

Monitoring and Evaluation include activities to measure the scope of the project such as the identification of performance indicators, procedure to measure and determine the base line. Projects

need to implement monitoring and evaluation plans with adequate funding and appropriate staff and include activities such as data collection methods, description of sources, collecting baseline data and participation of key actors. Given the long term nature of many GEF projects, projects are encouraged to include plans for long-term monitoring that are sustainable once the project is over.

6.2 ITINERARY

Table 6-1. Air and land itineraries - H. Rodríguez.

Date	Day	Time	Air transportation	Land transportation
8-Jan-12	Sunday	10:05	Bogotá-Santiago, Chile	
11-Jan-12	Wednesday	7:00		Santiago - La Serena
12-Jan-12	Thursday	14:00		La Serena - Santiago
16-Jan-12	Monday	7:45	Santiago - Puerto Montt	
17-Jan-12	Tuesday	13:00		Puerto Montt - Llanada Grande
18-Jan-12	Wednesday	8:00		Llanada Grande Region
19-Jan-12	Thursday	8:00		Llanada Grande - Puerto Montt
19-Jan-12	Thursday	19:15	Puerto Montt - Santiago	
20-Jan-12	Friday	9:30	Santiago - Bogotá	

6.3 LIST OF INSTITUTIONS/INDIVIDUALS VISITED

Date	Time	Place	Name	Title	City	Country code	Phone number	E-mail
Monday, January 09, 2012	10:00	PNUD	Raúl O' Ryan	Director of Energy and Environment	Santiago	56-2	6541012	raul.oryan@undp.org
			Paloma Toranzos	Programme Assistant	Santiago	56-2	6541057	paloma.toranzos@undp.org
			Carlos Canales	Project Coordinator	Santiago	56-2	3656854	ccanales@minenergia.cl
	16:00	MIN/DAEE	Rosa María Argomedo	Chief, Energy Access and Equity Division	Santiago	56-2	3656854	ragom_edo@minenergia.cl
Tuesday, January 10, 2012	9:30	PNUD	Benigno Rodríguez	UNDP Resident Representative	Santiago	56-2	6541000	benigno.rodriguez@undp.org
			Raúl O' Ryan	Director of Energy and Environment	Santiago	56-2	6541012	raul.oryan@undp.org
			Paloma Toranzos	Programme Assistant	Santiago	56-2	6541057	paloma.toranzos@undp.org
			Carlos Canales	Project Coordinator	Santiago	56-2	3656854	ccanales@minenergia.cl
	15:00	POCH	Luis Costa	Director of Sustainability Services	Santiago	56-2	2070154	luis.costa@poch.cl
	16:00	New Horizons Centre	Reinhold Schmidt	Director of Sustainability Services	Arica	56-58	584681	reinhold.schmidt@gmx.net
Thursday, January 12, 2012	10:30	GORE	Luis Henríquez	Head of Analysis and Control Division, Region IV, Coquimbo	La Serena	56-51	207230	lhenriquez@gorecoquimbo.cl
	12:00	CONAFE	Segundo López	Deputy Technical Regional Manager	Coquimbo	56-51	201401	slopezu@conafe.cl
Monday, January 16, 2012	11:30	Mayor Regional Government, Los Lagos	Cristóbal García	Representative of the Mayor	Puerto Montt	56-65	283191	cgarcia@goreloslagos.cl
			René Cárcamo	Productive Development Unit	Puerto Montt	56-65	283160	rcarcamo@gmail.com
	17:00	Río Puelo	Carlos Soto Sotomayor	Mayor of Cochamó	Cochamó	56-65	99493993	gabinetecochamo@gmail.com
Tuesday, January 17, 2012	12:00	Llanada Grande	Pedro Furranca Vera	MCH Operator, Llanada Grande	Llanada Grande			
	14:00	Llanada Grande	Henry Argel Soto	Manager, Electricity Cooperative	Llanada Grande			henryargel@hotmail.cl
Thursday, January 19, 2012	15:00	PNUD	Benigno Rodríguez	UNDP Resident Representative	Santiago	56-2	6541000	benigno.rodriguez@undp.org
			Raúl O' Ryan	Director of Energy and Environment	Santiago	56-2	6541012	raul.oryan@undp.org
			Paloma Toranzos	Programme Assistant	Santiago	56-2	6541057	paloma.toranzos@undp.org
			Carlos Canales	Project Coordinator	Santiago	56-2	3656854	ccanales@minenergia.cl

6.4 SUMMARY OF INTERVIEWS

Place: Santiago, Chile
Consultants : Humberto Rodríguez
Project: Barrier Removal for Rural Electrification with Renewable Energies
Mission Dates: 9 –19 January 2012
Objective:
1. Obtain first-hand key information.
2. Dismiss uncertainties about the documentary review previously done.

Date	Meeting and Main Considerations
Monday January 9, 2012	**1. 9:00 to 10:00. Coordination meeting with Carlos Canales, CTA of the Project** This was, essentially, the initial coordination meeting where the schedule of meetings and technical visits to the IV and X Region was reviewed and adjusted. **2. 10:00 to 12:00 Meeting with UNDP/GEF Environment and Energy team. Raul O'Ryan (Programme Officer), Paloma Torranzos (Programme Assistant)** Exchange of Information with regards the External Evaluation Mission and administrative matters with UNDP. **3. 16:00 to 17:00 Meeting with Rosamaría Argomedo, Chief, Energy Access and Equity Division** Exchange of information with regards the Evaluation Mission and the project. In this meeting, it was highlighted the relevance of the project to the Ministry of Energy in terms of impact and benefits.
Tuesday January 10, 2012	**4. 9:30 to 10:15 Benigno Rodriguez, UNDP Resident Representative, Raul O'Ryan (Programme Officer), Paloma Torranzos (Programme Assistant), Carlos Canales (CTA).** Greeting protocol. Agenda for visits was presented. The project has a long history. There have been many changes in CNE, in the Ministry of Energy, etc. The closure of this project is considered important. UNDP is becoming an Organization of knowledge, hence, the evaluation will be useful to document lessons learned. **5. 15:00 Luis Costa, Director, Sustainability Services, POCH (former UNDP Environment Officer UNDP).** A recount of the project was made until approximately 2005, date on which Luis left UNDP. Emphasis was placed on all the initial work performed and consolidating the strategy that could ensure sustainability of the project. **6. 16:00 Reinhold Schmidt, New Horizons Centre. Director, Sustainability Services.** The consultant made a presentation of his participation as a trainer of trainers in photovoltaic systems, of the development of these systems guide for trainers and beneficiaries. He also explained his participation in photovoltaic pumping

	systems. **7. 10:30 Luis Henríquez, Head of Analysis and Control Division, IV Region, Coquimbo** Mr. Henriquez was concentrated on showing the benefits of the PVS for rural users and clearly stated the ownership of the technology by authorities of the IV Region, to the point that, it is always considered in energy supply plans as an alternative technically, economically and environmentally viable.
Thursday January 12, 2012	**8. 12:00 Segundo López, Deputy Technical Regional Manager, CONAFE, Coquimbo** (See Section 6.5.3)
Monday January 16, 2012	**9. Cristóbal García, Mayor Representative, X Region, Los Lagos; Reneé Carcamo, Productive Development Unit** Mr. Garcia expressed the regional government's interest in using NCRE for power supply of the islands too. **10. Carlos Soto Sotomayor, Mayor of Cochamó** The Mayor expressed his willingness to continue the MSCHs development in the region as key projects for the municipality. At present, this Office has developed 4 MCHs (Llanada Grande, Segundo Corral, Valle El Frío y Paso El León).
Tuesday January 17, 2012	**11. Henry Argel Soto, Manager, Electricity Cooperative, Llanada Grande** (See Section 6.5.4)
Thursday January 19, 2012	**12. 15:00 Benigno Rodriguez, UNDP Resident Representative, Raúl O'Ryan (Programme Officer), Paloma Torranzos (Programme Assistant), Carlos Canales (CTA).** Presentation of first findings in UNDP (see power point presentation and attendance list in the Annexes section).

6.5 SUMMARY OF FIELD VISITS

6.5.1 User 1. IV Region of Coquimbo

The consultant visited two users in the rural area of the IV Region in Coquimbo.

Configuration of Standard System for household

- Solar generator. It consists of a module of 125 Wp of crystalline silicon Total Energy.
- 230Ah Battery, initially Sonnenschein. At present, after five years, batteries have been replaced by Sun Xtender ®, which are sealed lead-acid batteries, VR-AGM type (Valve Regulated-Absorbent Glass Mat) http://www.sunxtender.com/
- Charge controller Phocos.
- Users were provided with 2 sockets and 4 compact fluorescent lights (CFL).

It is worth noting that the quality of components is good; in addition, provided systems were provided of a generous capacity:

- Solar power capacity is good (125 Wp), as in many countries, panels between 70 and 100 Wp are usually installed.
- Battery capacity is good (230 Ah) against what is installed in other countries for use in households (100 Ah). It is a maintenance-free sealed gel battery.
- Charge regulator capacity is also good (10 A).
- Components in the panel are well-mounted on the closed panel preventing user access to the regulator.
- Battery box is robust and avoids user contact.
- Systems are installed properly.

Figure 6-1 shows the system visited.

A visit to the solar pumping system was also made. This system consists of 6 Isofoton modules (6x75 Wp = 450 Wp0 and a Grundfoss submersible pump directly coupled to the system via a Grundfoss regulator.

The system had pumped 1800 m^3 in 3 years, giving a pumping of 1.7 m^3/per day, which against municipal supply via tanker of 1 m^3/per month, represents a very important solution to meet the needs of private consumption and keep the crops, which can be seen through the following photos.

Figure 6-1. SFV household type – ILLAPEL– ILTA sector

USERS: Mr. Manuel Carvajal Esquivel and Mrs. Visitación Marin -
Day of Visit: February 11, 2011
User frame: S31o 38 '56.5 "W71 ° 17'54 .7
Cell phone: 94230270

Beneficiaries of the systems and family. Solar module of 125 Wp.

Box with charge regulator (Phocus) (right center) and breaker (left center). Sticker of system review by CONAFE. 150 Ah wet-cell deep-cycle batteries, base-mounted metal.

Battery box. Keep watch to prevent user access to the battery

Detail installation with wiring in electrical PVC pipe

Luminaire installed at 12 VDC

Polarized outlet (+ / -)

Cell Phone Charger

Radio / CD player

Black and white TV of 14 " at 12 VDC

[MAINTENANCE RECORD YEAR 5

DATE: 15/12/11

TECHNICIAN: Ilegible Logo CONAFE

NATIONAL ELECTRICAL FORCE COMPANY, S.A.

The seals must not be broken, the accidental breakage of a seal must immediately be reported to CONAFE. Customer Service Telephone: 600 500 50 50 / Ilegible]

Figure 6-2. SFV water pumping type– ILLAPEL– ILTA sector
USERS: Mr. Manuel Carvajal Esquivel and Mrs. Visitación Marin -
Day of Visit: February 11, 2011
User frame: S31o 38 '56.5 "W71 ° 17'54 .7
Cell phone 94230270

Generator which consists of 6x75 Wp (= 450 Wp) ISOFOTON modules IS-15S/12

Water pumped meter (accumulative of 1888 m^3, average 1.7 m^3/per day for 3 years)

GRUNDFOSS pump system regulator

Storage tank of 7 m^3

View of farmed area by drip irrigation system. Area 1000 m^2 (20 m x 50 m)

View of the surrounding area (without irrigation)

Growing of vegetables and onions. Corn can be observed in the background. Note the drip irrigation system.

Corn and fruit farming.

6.5.2 User 2. Coquimbo Region

Configuration of standard PV system for household is identical to the previous user.

Figure 6-3 shows the visited system.

A visit to the solar pumping system was also made.. This system consists of 6 Isofoton modules (6x75 Wp = 450 Wp0 and a Grundfoss submersible pump directly coupled to the system via a Grundfoss regulator.

The system had pumped 861 m3 in 3 years, giving a pumping of 0.79 m3/per day, which against municipal supply via tanker of 1 m3/per month, represents a very important solution to meet the needs of private consumption and keep the crops, which can be seen through the following photos.

Figure 6-3. SFV household type – ILLAPEL– CABRA_CORA sector
USERS: Mr. Pedro Sanchez Osorio and Mrs. Helena Huertas
Day of Visit: February 11, 2011
User frame: S31o 33 '44.3 "W71 ° 21'37 .7
Cell phone 93655561

Solar Module of 125 Wp.

Box with charge regulator (Phocus) (right center) and breaker (left center). Sticker of system review by CONAFE. Maintenance Maintenance Record year 5 (inspection dated December 12, 2011.
CONAFE: Customer Service Phone: 6005005050

Battery box. Keep watch to prevent user access to the battery

Figure 6-4. SFV water pumping type – ILLAPEL– CABRA_CORA sector
USERS: Mr. Pedro Sanchez Osorio and Mrs. Helena Huertas
Day of Visit: February 11, 2011
User frame: S31o 33 '44.3 "W71 ° 21'37 .7
Cell phone 93655561

Generator which consists of 6x75 Wp (= 450 Wp) ISOFOTON modules IS-15S/12

Water pumped meter (accumulative of 861 m^3, 0.79 m^3/per day average for 3 years)

GRUNDFOSS pump system regulator

Storage tanks of 10 m^3 (m^3 2x5)

General view of the well and pipeline

Growing of vegetables

Farmed Area - garden (drip irrigation system).
Area 1000 m^2 (20 m x 50 m)

Crop Corn

6.5.3 CONAFE- Segundo López

Location: Management Office, CONAFE, Coquimbo
12/01/2012 11:00
Participants: Segundo López, Technical Assistant Manager, Rosamaría Argomedo CNE; Carlos Canales, CTA, H. Rodriguez, external evaluator

Large-scale Demonstration Project

- In 2002, a land registry was made to more than 3,500 households without electricity (EE).
- In 2004, an international tender was made and awarded. The installation/construction began in 2005 and ended in 2007.

Main problems in the implementation

- The 1st survey of beneficiaries WAS NOT in line to reality in 2005, due to migration, for instance, of users.
- Secondly, the assigning of beneficiaries would not define who would get the installation, but the municipal authorities did.
- For suppliers, the standard of luminaries was too demanding. Phocos of Bolivia (Ronald Cavero) developed a unit that was not on the market, meeting the specifications; however, has not lasted long enough.
- 3,064 systems were installed (2,968 households and 94 rural facilities). The first ones with DC power supply; the second ones with a 220V /500 W inverter.

Configuration of Standard System for household

- Solar generator. It consists of a module of 115 Wp of crystalline silicon Total Energy.
- Users were provided with 2 sockets and 4 compact fluorescent lights (CFL).
- 230Ah Battery, initially Sonnenschein. At present, after five years, batteries have been replaced by Sun Xtender ®, which are sealed lead-acid batteries, VR-AGM type (Valve Regulated-Absorbent Glass Mat) http://www.sunxtender.com/
- The project recycles batteries throughout a commercial agreement with Tencnorec (leader in the recovery of lead in Chile, http://www.tecnorec.cl/index.html)
- Internal installation is not from the company and has been paid by the user.

Operation of the systems

- After 5 years, SPV work well. New equipment has arrived, such as cell phones and satellite TV; therefore, demand has increased. An upgrading of the systems is expected and required.

Tariff

- Tariff is fixed rate of $12,326 chileans pesos/per month. There is a subsidy of $9,326 chileans pesos provided by the regional government. The difference of $3,000 chilean pesos is paid by the user. (See Figure 6-5).
- Late payments in rural areas is 10% (urban is between 3-4%). The service remains, even if it is not paid as is more expensive to go disconnect.

- A negotiation with regional authorities with regards a readjustment in the rate - about 30% - is currently taken place. Since household economies are very low, authorities won't be able to charge more than the actual rate as that would increase the difference to pay by the users with respect the subsidy.

Training to users

- Training was provided to users through 300 meetings on best ways to handle the systems.

Customer Service

- Inspections once time a year. In case of failure, there are 72 hours to respond to the complaint.
- Due to the economy of scale and CONAFE comprehensive coverage in the region, a Prompt Payment (users can pay bills in many places) to customers is provided, thus, attention via Call Center as well.
- CONAFE has a special unit: SER (Alvaro Izquierdo oversees this contract), aim to manage this business. It has fleet of vehicles, staff (5), four 4x4 vehicles, bike delivery of bills (MyV is in charge of maintenance).

New projects in the region:

- Reinstallation of g systems (150 systems have been reinstalled due to user mobility).
- Reinstallation of other systems.
- Repowering of systems.
- There is a new project in progress: 34 schools (hybrid with PVS) implemented by Tecnored.

Advantages of SPV

- PVS solved a problem: people came to the world,
- Low maintenance requirements,
- Project has shown sustainability of the framework proposed;
- Technology is reliable and ensures good service,
- Solved the power supply situation of dispersed users, in an economically viable way, since the cost for grid extension is high in these areas (US$30.000/per km).

- Figure 6-5. Photovoltaic rural user invoice – IV Region, Coquimbo

[Illegible - to be translated]

6.5.4 South Region

Micro-hydro power in Llanada Grande
February 13 and 14, 2011

MCH in Llanada Grande has a generating capacity of 145 kW, a layout distribution of 40 km, a public lighting system of 70 luminaries; currently, serving 105 beneficiaries.

The following may be stated, as conclusion of this visit:

User- satisfaction

- Users are satisfied with the energy delivered by the plant. Current tariff is charged as follows:
  - Fixed rate: $1,693 ($2,014.67 VAT included)
  - Variable rate: $100.80/kWh ($142.74 / kWh VAT included)
  - VAT: 19%

- As stated by user (Ramon Alvarado), nowadays, monthly cost is about $13,000/per month against $90,000 spent for 7 daily hours of a gasoline plant operation of 2.5 kW. Service is available from August 2010. The user has a TV, radio, cell phone, machine, tools, among others. Mr. Alvarado conferred his ancestral right on water use and handed it over to the municipality for MCH development.

Day of the Visit: January 17 and 18, 2012

Figure 6-6. MCH in Llanada Grande

Engine Room and substation

Penstock, valve and regulator

Turbine, gearbox and generator

Power demand at 12:05 (42.25 kW)

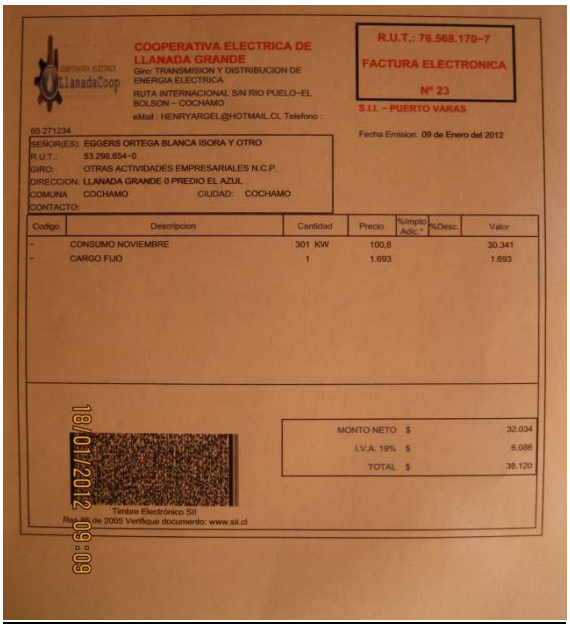
Energy generated by MCH from the start of operation

Penstock and waterfall in the background

Desander

Water uptake system (intake)

Plant logbook



COOPERATIVA ELECTRICA DE LLANADA GRANDE
Giro: TRANSMISION Y DISTRIBUCION DE ENERGIA ELECTRICA
RUTA INTERNACIONAL S/N RIO PUELO–EL BOLSON – COCHAMO
eMail : HENRYARGEL@HOTMAIL.CL Telefono :

R.U.T.: 76.568.170-7
FACTURA ELECTRONICA
Nº 23
S.I.I. – PUERTO VARAS

65.271234
Fecha Emision: 09 de Enero del 2012

SEÑOR(ES): EGGERS ORTEGA BLANCA ISORA Y OTRO
R.U.T.: 53.298.654-0
GIRO: OTRAS ACTIVIDADES EMPRESARIALES N.C.P.
DIRECCION: LLANADA GRANDE 0 PREDIO EL AZUL
COMUNA COCHAMO CIUDAD: COCHAMO
CONTACTO:

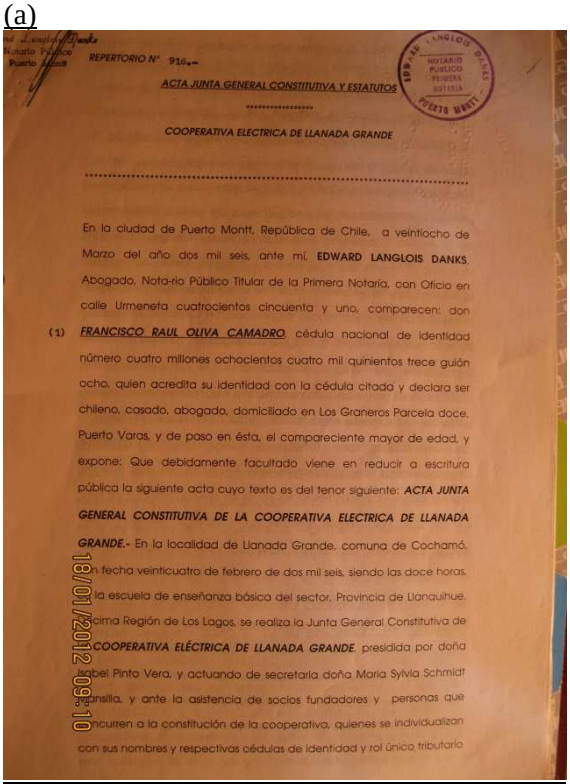
Codigo	Descripcion	Cantidad	Precio	%Impto Adic.*	%Desc.	Valor
-	CONSUMO NOVIEMBRE	301 KW	100,8			30.341
-	CARGO FIJO	1	1.693			1.693

MONTO NETO	$	32.034
I.V.A. 19%	$	6.086
TOTAL	$	38.120

18/01/2012 09:09

Timbre Electrónico SII
Res. 80 de 2005 Verifique documento: www.sii.cl

Invoice Model to customer of the Cooperative (a)



REPERTORIO N° 916.-

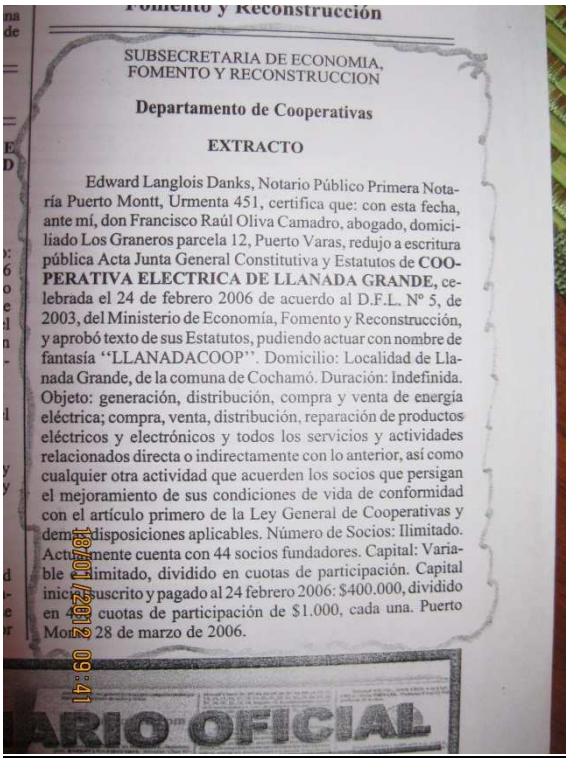
ACTA JUNTA GENERAL CONSTITUTIVA Y ESTATUTOS

COOPERATIVA ELECTRICA DE LLANADA GRANDE

En la ciudad de Puerto Montt, República de Chile, a veintiocho de Marzo del año dos mil seis, ante mí, **EDWARD LANGLOIS DANKS**, Abogado, Nota-rio Público Titular de la Primera Notaría, con Oficio en calle Urmeneta cuatrocientos cincuenta y uno, comparecen: don (1) ***FRANCISCO RAUL OLIVA CAMADRO***, cédula nacional de identidad número cuatro millones ochocientos cuatro mil quinientos trece guión ocho, quien acredita su identidad con la cédula citada y declara ser chileno, casado, abogado, domiciliado en Los Graneros Parcela doce, Puerto Varas, y de paso en ésta, el compareciente mayor de edad, y expone: Que debidamente facultado viene en reducir a escritura pública la siguiente acta cuyo texto es del tenor siguiente: ***ACTA JUNTA GENERAL CONSTITUTIVA DE LA COOPERATIVA ELECTRICA DE LLANADA GRANDE.-*** En la localidad de Llanada Grande, comuna de Cochamó, a fecha veinticuatro de febrero de dos mil seis, siendo las doce horas, en la escuela de enseñanza básica del sector, Provincia de Llanquihue, décima Región de Los Lagos, se realiza la Junta General Constitutiva de la ***COOPERATIVA ELÉCTRICA DE LLANADA GRANDE***, presidida por doña Isabel Pinto Vera, y actuando de secretaria doña Maria Sylvia Schmidt Sanhueza, y ante la asistencia de socios fundadores y personas que concurren a la constitución de la cooperativa, quienes se individualizan con sus nombres y respectivas cédulas de identidad y rol único tributario

18/01/2012 09:10

General Constitutive Act - Electric Cooperative in Llanada Grande (b)



Fomento y Reconstrucción

SUBSECRETARIA DE ECONOMIA, FOMENTO Y RECONSTRUCCION

Departamento de Cooperativas

EXTRACTO

Edward Langlois Danks, Notario Público Primera Notaría Puerto Montt, Urmenta 451, certifica que: con esta fecha, ante mí, don Francisco Raúl Oliva Camadro, abogado, domiciliado Los Graneros parcela 12, Puerto Varas, redujo a escritura pública Acta Junta General Constitutiva y Estatutos de **COOPERATIVA ELECTRICA DE LLANADA GRANDE,** celebrada el 24 de febrero 2006 de acuerdo al D.F.L. Nº 5, de 2003, del Ministerio de Economía, Fomento y Reconstrucción, y aprobó texto de sus Estatutos, pudiendo actuar con nombre de fantasía ''LLANADACOOP''. Domicilio: Localidad de Llanada Grande, de la comuna de Cochamó. Duración: Indefinida. Objeto: generación, distribución, compra y venta de energía eléctrica; compra, venta, distribución, reparación de productos eléctricos y electrónicos y todos los servicios y actividades relacionados directa o indirectamente con lo anterior, así como cualquier otra actividad que acuerden los socios que persigan el mejoramiento de sus condiciones de vida de conformidad con el artículo primero de la Ley General de Cooperativas y demás disposiciones aplicables. Número de Socios: Ilimitado. Actualmente cuenta con 44 socios fundadores. Capital: Variable e ilimitado, dividido en cuotas de participación. Capital inicial suscrito y pagado al 24 febrero 2006: $400.000, dividido en 400 cuotas de participación de $1.000, cada una. Puerto Montt, 28 de marzo de 2006.

18/01/2012 09:41

ARIO OFICIAL

Publication of an extract of the Electric Cooperative in Llanada Grande "Llanadacoop" (Official Journal, March 28, 2006) (c)

(a) Invoice Model to customer of the Cooperative

[LOGO	ELECTRIC COOPERATIVE OF LLANADA GRANDE Money order: TRANSMISIION Y DISTRIBUCION DE ENERGIA ELECTRICA RUTA INTERNACIONAL S/N RIO PUELO-EL BOLSON – COCHAMO E-mail: henryargel@hotmail.cl Phone number: 65 271234	R.U.T. 76.568.170-7 ELECTRONIC INVOICE N°23 S.I.I. – PUERTO VARAS Date of issue: January 09, 2012

MR. (MESSRS):	**EGGERS ORTEGA BLANCA ISORA Y OTRO**
RUT:	53.298.654-0
MONEY ORDER:	OTRAS ACTIVIDADES EMPRESARIALES N.C.P.
ADDRESS:	LLANADA GRANDE 0 PREDIO EL AZUL
COMMUNE:	COCHAMO
CITY:	COCHAMO
CONTACT:	

Code	Description	Quantity	Price	% additional Tax *	% Discount	Value
-	ENERGY SERVICE NOVEMBER	301 KW	100.8			30.341
-	FIXED FEE	1	1.693			1.693

Electronic Stamp SII
Decree ___ dated 2005. Check document: www.sii.cl

NET VALUE	$	32.034
VAT	$	6.086
TOTAL	$	38.120]

b) General Constitutive Act - Electric Cooperative of Llanada Grande

[Illegible stamp and signature — Illegible stamp

CASE BOOK N° 916

ACT GENERAL ASSEMBLY MEETING AND BYLAWS

ELECTRIC COOPERATIVE OF LLANADA GRANDE

In the city of Puerto Montt, Republic of Chile, on the twenty-eighth of March, two thousand and six, before me, **EDWARD DANKS LANGLOIS**, Lawyer, Notary Public, Holder of the First Notary, Office in street Urmeneta four hundred fifty-one, appears: **(1) FRANCISCO RAUL OLIVA**, national identity card four millionth eight hundred and four thousand five hundred and thirteen dash eight, who

proves his identity national card to be cited and declares chilean, married, lawyer, temporary residing at Los Graneros Parcel twelve, Puerto Varas, of legal age, and states: as duly authorized comes to reduce in public deed the following act whose text reads as follows: ***ACT GENERAL ASSEMBLY MEETING OF THE ELECTRIC COOPERATIVE OF LLANADA GRANDE.-*** In the city of Llanada Grande, commune of Cochamó, dated February twenty-four, two thousand and six, being the twelve hours in the primary education school of the area, province of Llanquihue, X Region of Los Lagos, the General Assembly Meeting of the Electric Cooperative of Llanada Grande takes place chaired by Isabel Pinto, and acting secretary, Maria Sylvia Schmidt Mansilla, and the assistance of founding partners and people attending the General Assembly Meeting of the cooperative, who are individualized to their respective names and identity national cards and unique tax number…]

c) Publication of an extract of the Electric Cooperative of Llanada Grande "Llanadacoop" (Official Journal, March 28, 2006).

[Undersecretary of Economy, Development and Reconstruction

Cooperatives Department

EXTRACT

Edward Langlois Danks, Public Notary, First Notary, Puerto Montt, Urrmenta 451, certify that: on this date, before me, Francisco Raúl Oliva Camadro, lawyer, residing at Los Graneros, Parcel 12, Puerto Varas, reduce in public deed: Act General Assembly Meeting of **the ELECTRIC COOPERATIVE OF LLANADA GRANDE.-** on February 24, 2006, according to D.F.L. N° 5, 2003, of the Ministry of Economy, Development and Reconstruction, and approved text of its bylaws, may act as "LLANADACOOP" as fictitious name. Address: Locality of Llanada Grande, in the commune of Cochamó. Duration: Indefinite. Objective: generation, distribution, purchase and sale of electricity; purchase, sale, distribution, repair of electrical and electronic products and all services and activities directly or indirectly related to the above, and any other activity that the partners agree to pursue that would improve their living conditions in accordance with Article I of the General Law of Cooperatives and other applicable provisions. Number of Partners: Unlimited. At present, there are 44 founding members. Capital: Variable and unlimited, divided into shares of participation…]

6.6 LIST OF DOCUMENTS PRODUCED BY THE PROJECT

(List taken from Final Project Report, page 113).

Promotional materials, technical manuals, documents and audiovisual materials prepared by the project within in the framework of Component No. 4 and 5.

Brochures

- Pamphlet Rural Electrification using NCRE, Region II
- Pamphlet Rural Electrification using NCRE, Region IV
- Basic Maintenance Chart PV Systems
- Security Chart and Consumption of PV Systems
- Registration of NCRE Facilities.
- Brochure Bio-Gas Practical Workshop
- Brochure Photovoltaic Project, Region IV
- PER Social Impact and Future Projections 2008
- Brochure Irrigation PV Projects, Coquimbo Region
- Brochure "Registration of electricity generation facilities based on NCRE"

Manuals and Technical Publications

- Users Manual for Photovoltaic Systems
- Trainers Manual for Photovoltaic Systems
- Bio-Gas Manual as source of Energy
- Operating Bio-Gas Manual
- Bio-Gas Construction Manual
- Manual to create Rural Electrification Cooperatives
- Bio-Gas Manual (jointly with FAO)
- Photovoltaic Technology Handbook
- Compendium Solarimetric Registration
- Compendium Chilean Regulations - PV Systems
- Compendium Chilean Regulations - Aerogenerators
- Compendium Chilean Regulations - Hybrid Systems
- Compendium Chilean Standards - Micro-hydro power
- Technical Manual on Photovoltaic Solar Energy
- Users Training Booklet for PV systems

Project documents and most relevant Technical Reports

- Project document, design and technical specifications for 25 individual solar projects in different regions of the country (2004).
- Project document, design and technical specifications for a hydroelectric plant for the city of Melinka, Region XI (2006).
- Project document, design and technical specifications for a wind-diesel plant for the islands of Quenu and Tabón, X Region (2008).
- Project document, design and technical specifications for two wind-diesel systems for the localities of Renovales and Tehuelches, Magallanes, Region XII (2006).

- Project document, design and technical specifications for a hybrid generation wind-diesel plant for the localities of Melinka and Repollal, Region XI (2007).
- Project document, design and technical specifications for a hydroelectric plant for the locality of Llanada Grande, X Region (2008).
- Ex-post evaluation of micro-hydro power in El Melado, Region VII (2007).
- Ex-post evaluation of micro-hydro in Río Grande, San Pedro de Atacama, Region II.
- NCRE Certification Report in Chile (2005).
- Design and technical specifications for 32 solar pumping systems for irrigation in Coquimbo Region (2008).
- Design and technical specifications for construction and operation of domestic biogas plants (2007).
- Project document, design and technical specifications for seven wind-diesel systems for Desertores islands, X Region (2009).
- Evaluation Report of the training campaign on photovoltaic systems for Region IV (2009).
- Design and technical specifications for a wind-diesel system for the border post in Puesto Viejo, Region XI (2005).
- Design and technical specifications for a wind-diesel system for the locality of Cupo, Region II (2007).
- Design and technical specifications for a micro-hydro power for the locality of Toconce, II Region, Antofagasta (2011).
- Design and technical specifications for hydraulic generation system for Puerto Gaviota, Region XI, Aysén (2006).
- Demand calculation and design of a wind-diesel power generation plant for the locality of Chaca, Region XV (2007).
- APR/PIR Annual Progress Reports submitted to GEF – UNDP.
- Report on existing local gaps for the development of NCRE projects (2011).
- Databases by region with local land registries of households without electricity, not viable for power supply through grid extension.

Digital material, audiovisual and graphic

- Film on DVD format of the constructions workshop to build a bio-gas plant in Empedrado, photovoltaic irrigation, Region VII.
- Wind database of 44 wind measurement stations installed by the project. Interactive CD.
- Audiovisual materials with the testimony of fieldwork performed for pre-investment in the islands of Chiloé, X Region.
- CD with material of the Installation and Monitoring of Wind Measurement Stations.
- Audiovisual material of the workshop and building of domestic bio-digesters in the Commune of Coltauco, VI Region, O'Higgins.
- Computational geo-referenced database which includes local land registries of households without power supply.
- Computational geo-referenced database of rural electrification projects using NCRE and of self-generating diesel systems in operation.

Most relevant summary of activities and training workshops carried out by the project

- Preparation and implementation of a training programme for users of photovoltaic systems in the IV Region: 3,064 families.
- Training workshops on NCRE technologies: (a) photovoltaic systems: 275 people, (b) Micro-hydro power: 60 people, (c) hybrid systems with wind technology: 300 people.
- Organization of 19 technical workshops and training seminars and courses with regards NCRE systems in the regions, addressed to users, installers, consultants, technology providers, government and municipal officials and professionals.
- Technical guidance to field team of professionals of the Barrier Removal project on conducting surveys and creating a project portfolio of rural electrification projects using NCRE.
- Creation of electric cooperatives for NCRE projects and training workshops to its members in managing and operating cooperatives and in uses of renewable power generation systems.
- Bio-Gas practical workshop for the population of the Municipality of Empedrado; municipal, staff, regional government and state institutions officials.
- International Workshop for the design of hybrid systems for power generation in rural electrification, ECLAC, June 15 to 17, 2004.
- Workshop on wind resource monitoring and installation and management of wind measuring stations and solar radiation.

6.7 LIST OF REVISED DOCUMENTS

Table 6-2. Project documentation

File	Name of the Document	Date	Author 1	Document type
1	Otros\Comentarios_CHI99G41.doc	Jun-99		
2	Otros\documentosdurantelaejecucionpdf_b.zip	Jun-00		
3	1_Chile_RE_Spanish_ProDoc27_Jun_01.doc	Jul-01	GEF	ProDoc
4	PIR - APR	Jan-02	Project	PIR
5	Plan Actividades	Jan-02	Project	Plan
6	PIR - APR.rar	Jan-04	Project	Files
7	Reporte_Feb_04final.doc	Jan-04	Ramirez and Rodriguez	MT Evaluation
8	Reporte_Feb04final.pdf	Jan-04	Ramirez and Rodriguez	MT Evaluation
9	Auditorias\2004\-12FinalCHI-00-G32(2004).ppt	Dec-04	Ernst & Young	Audit
8	Contrato GORE-CONAFE	Jun-05	Conafe	Contract
10	Contrato GORE - CONAFE\Contrato Instalaciones PV GORE CONAFE.PDF	Jun-05		
11	Certificacion ERNC	Jun-05	Project	Report
12	Sistemas Fotovoltaicos de Electrificación para Viviendas Rurales - Manual de Usuario	Jul-05	Project	Book
13	Sistemas Fotovoltaicos de Electrificación para Viviendas Rurales - Guía para Monitores	Jul-05	Project	Book
14	Auditorias\2005\PNUD Elect.Rural CHI 00-G32 (11799) 2005.ppt	Dec-05		Audit
15	Auditorias\2005\Recomendaciones.ppt	Dec-05	Grant Thomton	Audit
16	Manual Constitución y Funcionamiento de Cooperativas Eléctricas y Modelo de Estatuto	Jan-06	Project	Book
17	Normas Energías Renovables ProyectoCHI00G32\NormasFotovoltaicos.pf	Jan-06	Project	Regulation
18	Normas Energías Renovables Proyecto CHI00G32\Normas Hidraulicas	Jan-06	Project	Regulation
19	Componente 7	Jan-07	Project	Proposal
20	Contrato Instalaciones PV GORE CONAFE.PDF	Jul-07	Conafe	Contract
21	Normas Energías Renovables Proyecto	Jan-08	Project	Regulation
22	CHI00G32\NormasSistemasHibridos.pdf	Jan-08	Project	Regulation
23	Logros del Programa de Electrificación Rural	Aug-08	CNE	Book/DVD
24	Auditorías\2008\Informe CNE(11799).ppt	Dec-08	Grant Thomton	Audit
25	Auditorias\2010	Dec-10	ACG	Audit
26	Manual de Biogas	Jan-11	FAO Project	Book
27	Minuta proyecto GEF-PNUD.pdf	Apr-11	Project	Evaluation
28	Proyecto CHI-00-G32.pdf	Jun-11	Project	Summary
29	Programa_de_Electrificacion_Rural_la_experiencia_de_Chile.pdf	Jun-11	Ministry of Energy	Report
30	BID Informe PER 2010.pdf	Jun-11	Ministry of Energy	Report
31	Informe Final	Oct-11	Project	Report
32	Informe Final Proyecto CHI.00.G32-11799 Borrador V.3 20.9.pdf	Oct-11	Project	Evaluation
33	Minuta visita Region Coquimbo Evaluación proyecto GEF PNUD.doc	Dec-11	Project	Evaluation
34	Minuta visita Region Los Lagos Evaluación proyecto GEF PNUD.doc	Dec-11	Project	Evaluation

43	Cobertura electrificación a Dic. 2011.xls	**Dec-11**	**Ministry of Energy**	**Report**
35	Otros\Personal proyecto.xlsx	**Feb-12**		
36	CDR\CDR with encumbrance 2007.pdf	**Feb-12**	**Project**	**Report**
37	CDR\CDR with encumbrance 2006.pdf	**Feb-12**	**Project**	**Report**
38	CDR\CDR with encumbrance 2009.pdf	**Feb-12**	**Project**	**Report**
39	CDR\CDR ER 2011.pdf	**Feb-12**	**Project**	**Report**
40	**Base de datos de registros eólicos**	**Feb-12**	**Project**	**DVD**
41	**Olor a gas**	**Feb-12**	**Project**	**DVD**
42	Otros\rsolicituddeinformacin2.zip	**Feb-12**		**Report**

6.8 COMMENTS FROM THE MINISTRY OF ENERGY AND RESPONSES

The period during which comments were received was from February 13, 2012 to March 28, 2012.

6.8.1 Comments from the Ministry of Energy and responses.

On behalf of the MME and the CTA of the project, observations directly made on the document in Word version were received. The comments contained, herein, have been excised from this document (Word version) and responses are immediately provided.

Comment 1. Page 2.1

There are more current reports to the year 2010 - 2011 (Government and IDB) referred to the Rural Electrification Index. These reports will be sent by e-mail.

Response 1. The footer has been modified because according to the PER, index as of 2011 is 96.5%. However, the text describes the situation before the project.

Comment 2. Page 2-3. With regards state policy

"We disagree with this point, what happens is that, at that time, there was an evaluation methodology for rural electrification projects where calculations were made on private and social evaluation to determine the subsidy amount that was delivered, only if there was a positive social evaluation and not by the fact there are other needs".

Response 2. State policy with regards these households indicates that due to the high level of geographical dispersion and costs to provide them with electricity, cost-benefit analysis of social impact to determine the subsidy amount for electricity service provision should have a positive social evaluation.

Comment 3. Page 3-2.

It is essential to consider what has been done by the Government of Chile; with regards the work performed by the Project Manager.

Response 3. Recognition was made "under the direction and leadership of the National Project Director of CNE and after the creation of the Ministry of Energy, of DAEE as well.

Comment 4. Page 3-12.

It would be good to mention that, when defining the project, twice the amount of households was determined for the Coquimbo PV project, directly affecting the reductions of emission.

Response 4. Clarification was made on this matter. The reader is being referred to a further explanation in the section indicated below.

Comment 5. Table 3-5. Page 3-16.

In displaced fuel, "renewable" does not seem right.

Response 5. To prepare this table, the PRODOC methodology was used.

Comment 6. Page 3-16.

Part one. The final report of the coordinator clearly indicated that 25,947 tons of voided CO_2 correspond to projects **actually implemented.** It also indicates that evaluation of the project portfolio generated means the reduction of a total of 72 Gg of CO_2 after 20 years (page 49). This is the figure that matters. The project is not being evaluated for implemented NCRE projects, but for the portfolio raised and admitted in the BIP! In this sense, the work performed or results of the project within the project portfolio component means the reduction of 72Gg of CO^2 after 20 years. In my opinion, this result is satisfactory. In any case, the project can be evaluated by the number of implemented projects. That is outside the scope of the project.

Part two. It must be taken into consideration that both, the amount initially calculated in the project of greatest impact, as well as, ongoing projects which are now being executed, and the project portfolio, and the future to continue Hybridization of existing diesel systems using NCRE by the Government, shall mean, in the medium term, a quite important figure for the Country.

Response 6. It is important to note that, in the PRODOC, emissions reductions are on direct benefits of the programme and not on the admitted projects in the BIP.
GEF/UNDP Regional Office also agrees that are only those which have been executed, but has suggested calculating the reduction in post-project emissions.

Comment 7. - Page 3-26. Referred to the component evaluation

Considering the portfolio and activities that were held and the job still performed by the Government, I believe that the achievement made is greater.

Response 7. I agree with this comment, it is valid for component 1 and has been expressed as such; however, I consider that this component has been properly evaluated.

Comment 8. Page 3-28. With regards the appreciation of the evaluator on the lack of medium and long-term training programmes

The Government, when defining one of the components of the Rural and Social Electrification Programme of the Ministry of Energy, small-scale trainings and NCRE dissemination, continuous work of this programme in which training workshops on NCRE in the Regions of the country have been conducted. Study of Gaps has also been developed, as starting point for new challenges and GEF Projects. Due to this explanation, I disagree with the comments of the evaluator.

Response 7. The evaluator has reformulated his observation as follows:

"the evaluator has encountered a guiding approach from the central government with regards the need for capacity development in the Rural Electrification Programme. Although these activities are essential to the success of the programme, equally important is the continuity of training activities in

educational centers *(long-term institutional agreements with universities and institutions for NCRE training) of whose existence the evaluator has no information"*

Comment 9. Page 3-33. Referred to the component evaluation

Everything that meant the development of this issue and reallocation of funds as well was a coordinated effort from the Government and CTA in order to conduct and approve all the necessary activities. From my perspective, it was a great achievement from the CTA and the Project in every sense.

Response 9. I agree with the comment and that is why I considered this component satisfactory.

Comment 10. Page 3-36. Referred to the component evaluation

Projects are now being implemented in Desertores, Quenu and Tabón islands as well as in health centers and rural schools; therefore, I believe there is a significant impact in what has been made by the project and its execution. The grid-connected projects are carried out by private sectors to a different scale from the project, and with capital and international experts, who endorse measurements.

Response 10. The evaluator is familiar with projects in Desertores, Quenu and Tabón islands, as well as, with large-scale wind energy projects connected to the grid. Therefore, considers results of this component SATISFACTORY.

Comment 11. Page 3-38. Regarding the following comment:

- Identify the lack of a governance scheme in the institutional environment to address the challenges of energy supply for users in remote and isolated rural areas, challenges that must have governmental responses to the obligation of the state in providing a public service in an equitable manner.

The following comment was made:

"I disagree with the comment. The Government, at Central Level, designed a new social and rural electrification programme within the Ministry of Energy. A different electrification programme within SUBDERE was also developed. These two programmes include the methodologies and financing to develop NCRE projects for isolated users, and for Hybridization of isolated diesel systems, a portion was set aside for equitable payment and work is currently being done with regards regulatory improvements to the electricity law as for isolated systems with less than 1.5 MW"

Response 11. The situation is that the project contributed to strengthening the governance for rural electrification. The comment was reformulated as follows:

- Strengthening the governance scheme in the institutional environment to address the issue and challenges of energy supply for users in remote and isolated rural areas, challenges that are having positive responses against the state's obligation to provide a public service in an equitable manner.

Comment 12. Page 4.1. With regards conclusions/recommendations:

- For the supply of electricity to rural population that lives more distant and dispersed, which in practice is the last to be considered in electrification projects, requires increasingly high investments, which implies the need to increase subsidies.

The following comment was made:

> Methodology for rural evaluation of the Ministry of Social Development was amended and subsidies for investments increased.

Response 12. Above comment was completed with the following text:

Methodology for rural evaluation f the Ministry of Social Development has been amended and subsidies for investments have increased.

6.8.2 Comments from the Climate Change Mitigation, Regional Office – Regional Adviser and responses

The following comments from Mr. Oliver Page were received on March 28, 2012:

Comment # 1.

I suggest carrying out a retrospective analysis with regards the decision to cancel the initial Immediate Objective 7 and reallocate funds to other activities and/or components. Mid-term evaluation recommended this cancellation and UNDP, together with the Government, made the decision on reassigning these funds. At the end of the project, we shall all evaluate the consequences of this decision to see if this was the right direction to follow.

Response 1. In relation to component 7, in the mid-term evaluation it is clearly recognized that the mechanism suggested was not viable; therefore, a proposal for its reformulation was presented and several alternatives were presented. The Government of Chile proposed a new one, "Productive Use of NCRE in rural areas." That said, at the end of the project, the large mobilization of government funds (U.S. $25,303,568) demonstrates their strong commitment to the project and the right approach of the decision taken.

This response has been included in the executive summary (English version, page 0-3), in the Spanish version (page 0-16) and in the main text (page 3-32).

Comment # 2.

I suggest a more in-depth analysis with regards the duration of the project. The report states that the original period of 5 years was too short; however, keeping an unclosed project for over 10 years was not viable for UNDP. Also, although the approval of amendments to the project certainly caused delays, these are not the only reason why the project was extended for a longer period. It shall be important for UNDP (and GEF) to learn from this experience, on how to formulate ambitious objectives within a project, particularly of this nature, compatible with demanding implementation deadlines which are required by UNDP and donors.

Response 2. The extension of the implementation deadline was due to several factors, among which are, first of all, the time it took to amend the design to introduce the project "Productive use of NCRE in rural areas". Secondly, the coordination required to manage the approval by GEF/UNDP. But besides these two, the investment projects require fundraising at regional level and there is strong competition at such level. This is the case of hybridization component 8, specifically, the Isla Desertores project that took several years to financially be closed.

This response has been included in the executive summary (English version, page 0-4), in the Spanish version (page 0-18) and in the main text (page 3-1).

Comment # 3 (Barrier not removed - Costs)

In the barriers analysis, it is mentioned that those with "high investments costs" were not removed. I agree that the project had no significant influence on the cost of the equipment. However, there is recognition that renewable energies are the most cost effective solution in some isolated sites. This is evidenced in the state's commitment to fund, in advance, these solutions, even though there are "more expensive". Likewise, even though the risk perceived by the private sector in investing in isolated renewable energy did not decrease, the Project did succeed in incorporating the private sector within management models, with positive results.

Response 3. Investment costs of the project remain high. In this sense, the barrier has not been removed. But, if the Life Cycle Cost ("Costo del Ciclo de Vida") for NCRE projects is considered, the government of Chile has encountered that these are technically, economically and environmentally sustainable to provide services in remote and isolated areas, and better than conventional energy systems. The evaluator considers that project designers identified high investment costs as a barrier, without considering the "life cycle cost" of energy supply as the variable to be taken into account. The evaluator shall consider this observation in the report.

This response has been included in the executive summary (English version, page 0-11), the Spanish version (page 0-26) and in the main text (page 3-39).

Comment # 4

I agree with the evaluator that direct emissions reductions that are attributable to the project are only those resulting from the ones actually implemented. I suggest that calculation of the total potential for the emissions reduction that would result from executing the entire project portfolio, is accounted as post project emissions reductions and clearly include both figures (with the corresponding CO_2 cost per ton).

Response 4. The evaluator shall include post project emissions reductions and CO_2 costs in the body of the report.

This response post has been included in the executive summary (English version, page 0-5 and 6), Spanish version (page 0-19 and 20) and in the main text (pages 3-13 and 17).

6.8.3 DVD INCLUDING FULL REPORT

It contains all reports and project information.

This DVD will accompany the final printed version.

LAST PAGE OF THIS REPORT