REQUEST FOR CEO ENDORSEMENT

PROJECT TYPE: Medium-sized Project
TYPE OF TRUST FUND:GEF Trust Fund

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PART I: PROJECT INFORMATION

Project Title: Promoting the Development of Biogas Energy Amongst Select Small - and Medium-Sized Agro-Industries			
Country(ies):	Chile	GEF Project ID:[1]	5335
GEF Agency(ies):	UNIDO	GEF Agency Project ID:	100181
Other Executing Partner(s):	CER - Renewable Energy Centre	Submission Date: Resubmission Date:	06-20-2014 07-29-2014
GEF Focal Area (s):	Climate Change	Project Duration(Months)	36 months
Name of Parent Program (if applicable): ➢ For SFM/REDD+ ☐ ➢ For SGP ☐ ➢ For PPP ☐	n/a	Project Agency Fee ($):	162,939

A. FOCAL AREA STRATEGY FRAMEWORK[2]

Focal Area Objectives	Expected FA Outcomes	Expected FA Outputs	Trust Fund	Grant Amount ($)	Cofinancing ($)
CCM-3	Favorable policy and regulatory environment created for renewable energy investments	3.1 Renewable energy policy and regulation in place	GEF TF	945,532	1,185,523
CCM-3	Investment in renewable energy technologies increased	3.2 Renewable energy capacity installed 3.3 Electricity and heat produced from renewable resources	GEF TF	769,619	15,258,977
		Total project costs		1,715,151	16,444,500

B. PROJECT FRAMEWORK

Project Objective: To reduce GHG emissions by promoting investment and market development of biogas energy technologies in select agro-industries in Chile.

Project Component	Grant Type	Expected Outcomes	Expected Outputs	Trust Fund	Grant Amount ($)	Confirmed Cofinancing ($)
1. Policy and information.	TA	1. Policies and information targeting the development of biogas-based electricity and heat generation in agro-industries have been strengthened.	1.1 Preparation and supporting adoption of secondary regulation supportive of biogas energy plants in agro-industries. 1.2 Collection and consolidation of technical, financial	GEF TF	100,000	210,000

[1] Project ID number will be assigned by GEFSEC.
[2] Refer to the Focal Area Results Framework and LDCF/SCCF Framework when completing Table A.

			and economic parameters for biogas energy projects in small- and medium-sized agro-industries.			
2. Technical capacities and delivery skills.	TA	2. Adequate design, installation and operation practices for biogas energy plants in the agro-industrial sector have been adopted due to improved capacities of developers, suppliers and technicians.	2.1 Scoping and design of a training and certification programme for project developers, suppliers, installers and operators of biogas energy systems in agro-industries. 2.2 Training and certification of prospective project developers, suppliers, installation companies, and operators of biogas-based energy plants.	GEF TF	230,000	280,000
3. Investment and project portfolio.	TA	3. Biogas energy has been adopted by select agro-industries.	3.1 Technical assistance to small- and medium-sized agro-industries for the development of biogas energy projects. 3.2 Promotion and dissemination of information and best practices regarding biogas energy technology for small- and medium-sized agro-industries in Chile.	GEF TF	450,000	600,000
	INV		3.3 Establishment of a portfolio of biogas energy projects in the dairy sector to qualify for external financing and implementation initiated for selected biogas energy projects (750kW) under a public tender mechanism. 3.4 Creation of an enabling environment		700,000	15,074,500

			for financial instruments facilitating access to investment in biogas energy plants for small- and medium-sized agro-industries.			
4. Monitoring and Evaluation.	TA	4. A monitoring plan has been prepared and implemented in coordination with UNIDO.	4.1 A monitoring plan has been designed and agreed upon during the Project's inception phase. 4.2 Project progress on defined indicators and compliance with UNIDO guidelines (including gender) is being monitored. 4.3 A mid-term review and terminal evaluation have been conducted.	GEF TF	80,000	80,000
Subtotal					1,560,000	16,244,500
Project management Cost (PMC)[3]				GF TF	155,151	200,000
Total project costs					**1,715,151**	**16,444,500**

C. SOURCES OF CONFIRMED COFINANCING FOR THE PROJECT BY SOURCE AND BY NAME ($)

Please include letters confirming cofinancing for the project with this form

Sources of Co-financing	Name of Co-financier (source)	Type of Cofinancing	Cofinancing Amount ($)
National Government	Renewable Energy Centre (CER)	In-kind	600,000
National Government	NAMA Facility via Renewable Energy Centre (CER)	In-kind	670,000
National Government	Ministry of Energy	Cash	3,700,000
Private Sector	Fundo Playa Venado	Cash	159,000
Private Sector	Fundo Playa Venado	In-kind	15,500
Private Sector	Schwager Biogás	Investment	11,200,000
GEF Agency	UNIDO	Cash	60,000
GEF Agency	UNIDO	In-kind[4]	40,000
Total Co-financing			16,444,500

D. TRUST FUND RESOURCES REQUESTED BY AGENCY, FOCAL AREA AND COUNTRY[1]

GEF Agency	Type of Trust Fund	Focal Area	Country Name/ Global	(in $)		
				Grant	Agency Fee	Total

[3] PMC should be charged proportionately to focal areas based on focal area project grant amount in Table D below.

[4] UNIDO in-kind support will be provided primarily by the UNIDO Regional Office in Uruguay to assure that synergies between the UNIDO/GEF -5 project in Uruguay and this Project are fully utilized.

				Amount (a)	(b)[2]	c=a+b
(select)	(select)	(select)				0
(select)	(select)	(select)				0
Total Grant Resources				0	0	0

[1] In case of a single focal area, single country, single GEF Agency project, and single trust fund project, no need to provide information for this table. PMC amount from Table B should be included proportionately to the focal area amount in this table.

[2] Indicate fees related to this project.

F. CONSULTANTS WORKING FOR TECHNICAL ASSISTANCE COMPONENTS:

Component	Grant Amount ($)	Cofinancing ($)	Project Total ($)
International Consultants	232,500	62,500	295,000
National/Local Consultants	95,500	177,500	273,00

G. DOES THE PROJECT INCLUDE A "NON-GRANT" INSTRUMENT?

(If non-grant instruments are used, provide in Annex D an indicative calendar of expected reflows to your Agency and to the GEF/LDCF/SCCF/NPIF Trust Fund).

The project does not foresee the establishment of non-grant instrument with funds from the GEF Trust Fund. However, the Government of Chile (GoC) has received support from the NAMA Facility[5] for its "Self-Supply Renewable Energy in Chile (SSRE)" NAMA (please see Annex H for further information on the NAMA itself). As the NAMA foresees financing for pre-investment studies as well as investments in renewable energy technologies, it was decided not to create an additional, financial instrument with GEF funding in parallel. Instead it is envisaged that the GoC will successfully make available the necessary financial resources that will support the development and up-scaling of new biogas projects that will result from Project Component #3.

PART II: PROJECT JUSTIFICATION

A. DESCRIBE ANY CHANGES IN ALIGNMENT WITH THE PROJECT DESIGN OF THE ORIGINAL PIF[6]

A.1 National strategies and plans or reports and assessments under relevant conventions, if applicable, i.e. NAPAS, NAP national communications, TNAs, NCSA, NIPs, PRSPs, NPFE, Biennial Update Reports, etc.

The proposed UNIDO/GEF initiative primarily builds upon the following national policy documents:

(i) First and Second National Communications[7];

(ii) Energy Policy: New Guidelines[8];

(iii) The National Energy Strategy 2012-2030[9].

The First National Communication from 2000 mentions that the role of Non-Conventional Renewable Energy (NCRE) in the overall energy mix is small. However, within the NCRE sector methane recuperation plays an important role, mainly in sanitary landfills and waste water treatment plants. Chile's Second National Communication on climate

[5] The NAMA Facility was jointly established by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) and the Department of Energy and Climate Change (DECC) of the United Kingdom to contribute an initial €70 million of funding to support developing countries and emerging economies that show leadership on tackling climate change and that want to implement ambitious climate protection measures (NAMAs).

[6] For questions A.1 –A.7 in Part II, if there are no changes since PIF and if not specifically requested in the review sheet at PIF stage, then no need to respond, please enter "NA" after the respective question.

[7] Chile's First National Communication to the United Nations Framework Convention on Climate Change, Comisión Nacional del Medio Ambiente - CONAMA (2000) and . Chile.; and Second National Communication, Ministerio del Medio Ambiente/Comisión Nacional del Medio Ambiente (2011)

[8] Política Energética: Nuevos Lineamientos. Transformando la Crisis Energética en una Oportunidad Política, Comisión Nacional de Energía - CNE (2008).

[9] Estrategia Nacional de Energía 2012-2030. Energía para el futuro, Ministerio de Energía (2012).

change, released in 2011, mentions Chile's large potential for renewable energy and sets an indicative target of 20% NCREs for 2020[10]. In 2008, the Government published its Energy Policy: New Guidelines, which manifests the importance of clean energy. In addition, a Technology Needs Assessment exercise done by the Economic Development Agency (CORFO) during 2009 and included in the Second National Communication highlights the potential uses for anaerobic digestion in waste management and renewable energy supply. In February 2012, the Ministry of Energy published the National Energy Strategy 2012-2030, which considers the need to increasingly incorporate NCREs into the Chilean electricity grid as one of its fundamental pillars, while recognizing that some improvements upon current legislation are necessary. The Strategy also indicates that the State will hold open tender processes to promote NCRE technologies that are currently not competitive enough to develop.

The Project further takes benefit from a study providing inputs and recommendations for a National Bioenergy Strategy, which covers biogas production for energy purposes[11]. This study identifies the opportunities and challenges for biogas and biomass energy generation in Chile, and identifies and prioritizes lines of action to remove the existing barriers.

The Project is closely aligned with Chile´s agenda to combat global greenhouse gas emissions. Chile has been highly proactive by developing Nationally Appropriate Mitigation Actions. The Renewable Energy Centre (CER) has prepared a NAMA supporting the implementation of Non-Conventional Renewable Energy (NCRE) projects for energy self-supply. The present Project builds forth on this initiative, while intensifying support for biogas technology. A second NAMA is prepared by the Ministry of Environment, targeting emissions caused by organic waste and effluents. This NAMA is particularly relevant for the agriculture and livestock sector, which is the target beneficiary of this Project.

A.2. GEF focal area and/or fund(s) strategies, eligibility criteria and priorities.

The Project is consistent with the CCM-3 objective (Promote investment in renewable energy technologies) of the GEF-5 Results Framework. This objective is pursued by the Project as follows: (i) strengthening the policy framework and establishing appropriate incentives for energy generation from agro-industry wastes, specifically in the dairy sector; (ii) mobilizing capital resources for direct and indirect investment in waste-to-energy technologies, specifically anaerobic digestion technology for biogas production to generate electricity and heat. Important GHG mitigation effects are expected compared to the baseline situation

The Project will directly contribute to the core outcomes of the GEF-5 Results Framework "Investment in renewable energy technologies increased" and "GHG emissions avoided". The Project will also introduce amendments to the existing regulatory framework for energy generation from agricultural and agro-industry waste and as such, contribute to CCM-3 Outcome "Favorable policy and regulatory environment created for renewable energy investments".

A.3 The GEF Agency’s comparative advantage:

Since its establishment, UNIDO has built up a long track record assisting countries to implement programmes that support inclusive and sustainable industrial development. UNIDO’s Energy and Climate Change Branch pursues the integration of low-carbon objectives into industrial development policies and activities, especially with respect to small- and medium-sized industries. In particular, UNIDO helps its clients solve two fundamental problems: (i) de-linking intensity of energy and material use from economic growth, and (ii) reducing the environmental damage that occurs with energy and material use. The GEF Council document GEF/C.31/5 highlights UNIDO's comparative advantage in capacity building and technical assistance, specifically with respect to its involvement of the industrial / private sector in projects. This is also the case in this Project, where the focus will be on facilitating a low carbon development pathway for selected agro-industries in Chile.

UNIDO is well-positioned to implement the Project because of its experience and expertise in renewable energy projects in a variety of technologies (including small-scale hydro, solar, wind, biomass, and biogas) – especially with respect to their application for productive uses, it long history of cooperation with key stakeholders, and its high

[10] The Second National Communication for Chile defines NRCE as wind energy, small scale hydro power (plants up to 20MW), biomass, biogas, geothermal energy, solar and tidal energy.

[11] Final Report "Recomendaciones para la elaboración de una Estrategia Nacional de Bioenergía", prepared for the Ministry of Energy by the Unidad de Desarrollo Tecnológica, Universidad de Concepción, 11 July 2013.

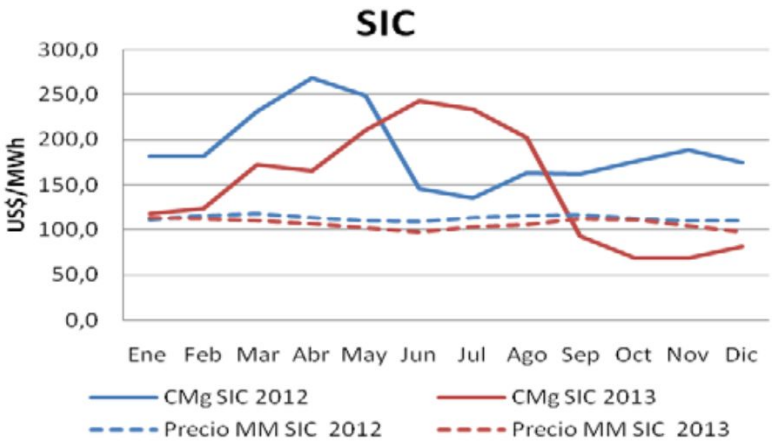
standards of fiduciary responsibility. Moreover, UNIDO has a broad network of experts and experiences in the region; e.g. UNIDO is cooperating with Brazil's first biogas laboratory, which was launched at Itaipu-Brazil in mid-2012. The present GEF Project will also benefit from the sharing of experiences and networking opportunities with other UNIDO projects focusing on biogas applications and waste valorization in agro-industries such as in Uruguay and Pakistan. UNIDO has a regional office in Uruguay that also covers Chile, Argentina, Paraguay and Brazil, with 6 staff: 2 professional staff with extensive project management experience; 4 general service staff, three of whom have extensive experience in administering projects.

A.4. The baseline project and the problem that it seeks to address:

Context:

While Chile only accounts for 0.2% of global GHG emissions, these have increased by more than 230% between 1990 and 2006, totalling 59 million tonnes of $CO2_{eq}$ in 2006[12]. The energy sector, representing 34% of national GHG emissions, is the main source, thereby offering opportunities for mitigation actions to achieve substantial impact and introduce a more low-carbon development path by incorporating renewable energy systems. Chile has taken a proactive role in mitigating its impacts on global climate change and made a formal commitment to the Copenhagen Agreement in 2010 aimed at a 20% deviation by 2020 compared to the business-as-usual scenario. The main focus of Chile's mitigation actions are energy efficiency (EE), renewable energy (RE), land use and land use change and forestry (LULUCF).

Electricity costs in Chile are among the highest in the LAC region[13]. The following figure presents the variation of marginal generating costs in Chile's main grid system, the Sistema Interconectado Central (SIC). The energy prices in this system vary significantly during the year due to the seasonal availability of hydroelectricity (ranging from 243 USD/MWh in June to 69.3 USD/MWh in November, resulting in an average value of 148 USD/MWh over 2013.



The Government of Chile launched the National Energy Strategy 2012-2030 in March 2012, based on the following overarching objectives: economic efficiency, energy security, and sustainability. This document recognizes the role of non-conventional renewable energy (NCRE) sources to develop the sector by: (i) an explicit commitment to the development of clean energy sources, including large hydropower and NCREs; (ii) issuing Government-led tenders to buy blocks of NCRE-based electricity, thereby creating favourable conditions for project developers and investors; (iii) implementing strategies for the promotion of new technologies; and (iv) pursuing improvements to current legislation to stimulate the development of NCREs in the country. On 15 May 2014, the GoC released the new energy agenda for 2014-2018, which forms the basis for the national energy policy. The agenda has seven pillars, amongst which there is a

[12] Government of Chile (2011). Segunda Comunicación Nacional de Chile ante la Convención Marco de las Naciones Unidas sobre Cambio Climático, Santiago. Available at: http://www.mma.gob.cl/1304/articles-50880_docomunicadoCambioClimatico.pdf.

[13] OLADE. Energy Economic Information System. Energy Statistics, 2012 (http://www.olade.org/sites/default/files/publicaciones/PLEGABLE2012-SEC.pdf).

commitment to develop the country's own energy resources by addressing concrete obstacles to renewable energies as well as by reducing the prices of electricity to consumers.

Until recently, renewable energy policies were only focused on promoting on-grid electricity generation systems; there was virtually no policy support for distributed power systems and renewable energy for self-supply. The largest market for renewable energy systems for self-supply is found in industries that combine substantial energy demand with the availability of energy resources. This is typically the case in large agro-industries, which can take benefit of the existence of biomass waste streams, and biogas systems based on anaerobic digestion of manure, organic residues, municipal waste and wastewater. Larger installations may sell their surplus energy to third parties[14]. Since 2009, the market for biomass and biogas is steadily growing in Chile.

The main drivers for renewable energy for self-supply projects are the following: (i) high energy costs in Chile compared to the regional level, and the expectation that prices will increase further; (ii) promotion of diversification of energy sources to increase national energy security and reduce dependence on energy imports; (iii) synergy with social and environmental demand for appropriate management of organic waste, including municipal waste, wastewater, and liquid industrial residues[15]; (iv) increased competitiveness by taking benefit of the economic value of resources presently treated as waste, which fits into cleaner production strategies; and (v) reduction of carbon emission footprints of domestic products in line with national, voluntary commitments, thereby improving the environmental performance of Chilean companies.

The Law 20.257 (2008)[16] requires the electricity companies operating within Chile's main grid systems SIC and SING to certify that 10% of the contracted energy is derived from NCREs. This obligation is introduced gradually, originally striving for a 10% share in 2024. In October 2013, Law 20.698[17] was approved which raised this goal to a 20% share of NCREs by 2025. Furthermore, it obliges electricity generation companies with a demand larger than 200MW to annually inject a renewable energy volume equivalent to 20% of the volume bought from the grid. The regulation for the Net Billing Law is to enter into force in 2014. Another major step forward is the envisaged interconnection of both grid systems as authorized under the Law 20.726. For a detailed description of the Chilean electricity sector and the position of NCREs, please refer to the document published by the Ministry of Energy and GIZ in 2012[18].

As a result of progressive legislation, by March 2014 the total capacity of NCREs connected to the national grid systems has grown to 1,352 MW; predominantly wind, biomass and small hydro. Large-scale photovoltaic took off in 2013 and is also expected to increase quickly, with a large portfolio of wind and solar projects having passed the environmental qualification procedure[19]. At the end of 2014, a total NCRE capacity between 1,500 and 1,800 MW is expected to be online. The present status of grid-connected NCREs is shown in the next table.

TABLE 1: NCRE INSTALLED CAPACITY AND PROJECT PORTFOLIO IN CHILE (MARCH 2014)[20]

STATUS			SEIA	
	IN OPERATION	UNDER CONSTRUCTION	EIA APPROVED	EIA BEING QUALIFIED
	(MW)	*(MW)*	*(MW)*	*(MW)*
Bioenergy	444	32	85	67

[14] In Chile electricity generators with a maximum interconnected capacity of 9 MW are recognized in the Electricity Law as PMGD (Small Distributed Generating Medium). Also the figure (MGNC) Non-conventional Generating Medium exists for installations with a maximum capacity of 20 MW. Other options include sales of upgraded biogas for injection into the natural gas network; which is done by wastewater plant La Farfana in the Santiago Metropolitan Area.

[15] The so-called "RILes" (Resíduos Industriales Líquidos).

[16] Ley 20.257 "Modificaciones a la Ley General de Servicios Eléctricos Respecto de la Generación de Energía Eléctrica con Fuentes de Energías Renovables no Convencionales", Ministry of Energy.

[17] Ley 20.698 "Propicia la ampliación de la matriz energética, mediante fuentes renovables no convencionales".

[18] The report "Documento Complementario al Libro; Las Energías Renovables No-convencionales en el Mercado Eléctrico Chileno", published by the Strategic Project for the Expansion of Renewable Energies in the Interconnected Electric Systems (Ministry of Energy/GIZ), ISBN 978-956-8066-13-0, Santiago de Chile, May 2012.

[19] Under the national SEIA system.

[20] Reporte CER March 2014. Available at: http://cer.gob.cl/mailing/2014/marzo/ReporteCER_marzo2014_dise%f1o.pdf.

Wind energy	421	585	4,359	1,624
Small hydro	338	85	270	202
Solar	149.8	225	5,951	3,953
Geothermal	0	0	120	0
TOTAL	**1,352**	**926**	**10,785**	**5,846**

With respect to small-scale renewable energy projects, the Renewable Energy Centre (CER), together with the Economic Development Agency (CORFO) and the Ministry of Energy, has set up tender a tender system to foster the renewable energy system for self-supply market in Chile, in line with the National Energy Strategy 2012-2030. The first call for proposals under the INNOVA Programme closed in April 2013 and 10 projects were selected for a total support of USD$3.5 million. CORFO further manages a range of financing instruments fostering small enterprises, investment and energy efficiency, which are promoting SSRE development (see Annex I).

Furthermore, the NAMA "Self-Supply Renewable Energy in Chile (SSRE)", combining technical assistance and grant financing was approved through the NAMA Facility, and will be executed by CER and CORFO on behalf of the Ministry of Energy. This programme is expected to induce transformational changes in the residential, commercial and industry sectors of the Chilean economy by promoting the use of SSRE for electricity as well as heat supply. Through addressing the barriers faced by current small-scale renewable energy investors in Chile, the NAMA will produce synergies to contribute to the long-term development of the renewable energy sector in Chile.

Biogas

Biogas is a combustible gas that is generated by the action of micro-organisms in the absence of oxygen (anaerobic digestion). It is a NCRE source that has been successfully utilised in several countries worldwide and can be economical in Chile. It can be produced using various organic materials as substrate, such as animal manure, agro-industrial waste and wastewater. Biogas can be used to replace fossil fuels and firewood for heat production (in stoves, boilers and furnaces). The methane fraction of biogas can be used, after certain treatment, to generate electricity or combined heat and power (co-generation). Upgraded biogas can also be used as a biofuel, and for injection in natural gas networks. In Chile the main sources of feedstock are animal manure (poultry, pigs, cattle, etc.), organic waste and wastewater from agro-industries (e.g., wine, beer, dairy and slaughterhouses), municipal waste, sewage and sludge. Many of the agro-industries that generate biogas are small- or medium-sized enterprises[21].

The technical energy potential of biogas obtained through the anaerobic digestion of non-woody biomass resources has been estimated at 9,750 GWh per year[22]. The following table presents the contribution of the main sources: liquid manure, agro-industrial residues, organic municipal solid waste (landfill), and wastewater.

TABLE 2: TECHNICAL ENERGY POTENTIAL OF BIOGAS IN CHILE (GWH)				
Landfill	**Liquid manure**	**Wastewater treatment**	**Agro-industrial residues**	**Other**
972 (10%)	4,056 (42%)	1,611 (17%)	2,389 (25%)	722 (6%)
TOTAL: 9,750				

Over 20 biogas energy project are presently operational in the country. Biogas was initially collected and flared at landfill sites, including as Clean Development Mechanism (CDM) projects. Triggered by Law 20.257 and the persistently high energy prices in Chile, landfill gas is now increasingly used for electricity production to feed into the national grid, and existing sites are upgraded to enable energy production. The largest grid-connected plants (2MW or larger) are based on landfill or wastewater and located in the Santiago Metropolitan Area. One wastewater site (La Farfana) produces upgraded biogas to be used as household gas. Two large biogas projects (Agro Ancalí and Los

[21]Please note that in Chile companies with sales of less than 4.3 million USD are considered small- and medium-sized.
[22] Source: Bioenergy strategy, p.15, based on Chamy et al.

Angeles) are based on manure, with co-generation capacities of around 2 MW[23]. For a recent overview of installed biogas projects, please refer to Annex J of this document.

Dairy sector

The Chilean dairy sector ranks 39th in the list of milk producing countries in the world. At the national level, the dairy sector accounts for 31% of the livestock sector´s contribution to the GDP, and 0.7% of the total GDP[24]. The dairy sector is defined as the dairy farmers (primary production) and the dairy factories (milk processing). According the last Census (VII, 2007) there are 18,774 dairy farms in Chile[25,26], employing a total of 61,470 people. The total number of producing milk cows is 488,383. Over 95% of the national dairy production is concentrated in the following zones:

	Central Zone (34,838 animals): the regions Valparaíso (V), Metropolitana (RM), and O´Higgins (VI)
	South-Central Zone (52,570 animals): the regions Maule (VII) and Biobío (VIII)
	South Zone (400,975 animals): the regions La Araucanía (IX), Los Ríos (XIV) and Los Lagos (X).

The sector is heavily concentrated in the Los Lagos region due to its favorable conditions for cattle farming.

There is a very large group of smallholders with less than 20 cows (over 15,000) and few farms with more than 500 animals (less than 100). There are great differences with respect to productivity, competitiveness, and access to information and external financing. The following table provides an overview of these differences, based on information prepared for the national sector association Consorcio Lechero. This demonstrates the differences in opportunities to take benefit from biogas energy technology across the sector. A more detailed analysis of the dairy sector in this region is given in Annex K.

[23] The Agro Ancalí project was approved under CDM. Los Angeles combines a dairy farming with agricultural activity. Besides selling surplus electricity to the grid under the PMGD modality, the Los Angeles plant uses biogas-based thermal energy to warm greenhouses where its tomatoes are grown (2 ha).

[24] Source: http://www.cuerovacachile.com/web/?cat=8

[25] VII Censo Agroindustrial – INE (2007) www.censoagropecuario.cl

[26] For a detailed socio-economic characterization of the dairy producers, consult: "Informe Estudio Caracterización de los Productores Lecheros, usando Base de Datos Disponibles", by Agrosur GESTA, for Consorcio Lechero, October 2012. Available at: http://consorciolechero.cl/chile/pags/informes-finales.php.

TABLE 3: DAIRY SECTOR IN CHILE - FARM SIZE AND PRODUCTIVITY				
Farm size (# cows)	**Description**	**# Farmers**	**# Animals**	**Estimated milk production**
1-19	Small cattleholders with few opportunities to become commercially efficient. Micro-enterprises.	15,241	80,970	1,300 l/yr[27]; 500 l/ha-yr
20-49	Small cattleholders, predominantly supported by INDAP. Part of this group has the potential to progress and become competitive.	1,684	48,358	2,800 l/yr; 1,650 l/ha-yr
50-99	Small and medium producers, of which many are incorporated in INDAP. This group counts producers with potential, but they need training and dissemination of information and best practices.	672	45,923	4,250 l/yr; 3,200 l/ha-yr
100-299	Small to medium producers, some of them still incorporated in INDAP. This group is characterized by increased use of technology and a larger milk production, but still lack access to better technologies and knowledge of best practices due to constraints to access information.	870	150,127	5,500 l/yr; 4,850 l/ha-yr
300-499	This is the group of good dairy producers, including excellent examples but also some farmers who would need training and better practices.	211	78,643	6,500 l/yr; 6,300 l/ha-yr
500 - more	This is the most advanced group in terms of technology and practices, and with access to up to date information.	96	84,362	8,500 l/yr; 11,000 l/ha-yr
TOTAL		**18,774**	**488,383**	

The following data were collected during the PPG phase (please see Annex K for further details) to estimate the biogas yield based on cow manure and the generated heat (thermal energy) and electricity, assuming that 38% of the manure can be collected to feed the anaerobic digester, and 35% of thermal energy is transformed into electricity by the gas engine-generator set.

TABLE 4: ENERGY PRODUCTION AT DAIRY FARM.					
Animals	**Liquid manure production**	**Methane volume**	**Primary energy biogas**	**Thermal energy biogas**	**Electric energy biogas**
-	(Kg / animal-yr)	(Nm^3CH_4 / yr)	(kWh/yr)	(kWh/yr)	(kWh/yr)
1	20,090	554.5	5,157	1,960	686

To calculate the total energy production for each farm size interval, the average nominal capacity is taken as an approximate value. This yields the following result:

TABLE 5: DAIRY SECTOR IN CHILE - TOTAL ELECTRICITY PRODUCTION						
Farm size (# cows)	**# Farmers**	**Average nominal capacity**	**Average electricity production**	**Total installed capacity**	**Total electricity production**	**Share**
	(units)	**kW**	**kWh/yr**	**MW**	**MWh/yr**	**(%)**
1-19	15,241	0.4	3,310	6.4	50,500	13%
20-49	1,684	1.5	11,400	2.4	19,300	5%

[27]Per cow per nursing.

TABLE 5: DAIRY SECTOR IN CHILE - TOTAL ELECTRICITY PRODUCTION						
Farm size (# cows)	**# Farmers**	**Average nominal capacity**	**Average electricity production**	**Total installed capacity**	**Total electricity production**	**Share**
	(units)	**kW**	**kWh/yr**	**MW**	**MWh/yr**	**(%)**
50-99	672	4.8	37,500	3.2	25,200	7%
100-299	870	13	100,000	11.1	87,400	23%
300-499	211	30	238,000	6.4	50,300	13%
500 - more	96	200[28]	1,580,000	19.2	151,500	39%
TOTAL	**18,774**			**48.7**	**384,000**	**100%**

Based on the data and analyses presented above, and in Annex K, and the present status of biogas in Chile, the following considerations are made:

- The farmers with below 50 animals have little capacity to be commercially efficient and very limited potential to grow. This seriously affects creditworthiness.
- Farmers with below 50 animals have rarely used bank funding; about 1/3 receive (small) credits from and the Institute for Agriculture and Livestock Development (INDAP); very few (1-2%) have been involved in CORFO (Economic Development Agency) and FIA (Foundation of Agricultural Innovation) programs. By consequence, it is most unlikely that this group can attract bank loans to invest in biogas energy systems and pass a business-as-usual due diligence procedure. The cost of a tailored project pre-investment phase would be prohibitive in most cases.
- The total group of farmers with below 50 animals makes up about 18% of the total market share for biogas.
- The total market share of the farmers with between 50 and 499 animals is 43%, involving a total of 1,753 dairy farms. The group holding 100 to 499 animals is generally competitive and has access to information and finance. This group, counting 1,081 farms, makes up 36% of the market.
- It is further understood that presently, biogas energy technology is commercially introduced in some of the larger biogas farms (> 500 animals).
- With decreasing farm sizes, the following aspects become increasingly relevant: (i) limited access to finance; (ii) limited access to information, technology and best practices; (iii) relatively high project preparation costs; and (iv) increasing project risks for the farmer (investment costs compared to annual turnover). While biogas may be technically and economically feasible for farms with less than 500 animals, identified barriers progressively hamper penetration of biogas technology downward the market pyramid.

The following biogas project types (concrete, covered, lagoon, and plastic) are applicable to the different farm sizes in the dairy sector, as outlined in the following table.

TABLE 6: DAIRY SECTOR IN CHILE - TYPICAL GENERATING CAPACITIES				
Farm size (# cows)	**Average nominal capacity**	**Average electricity production**		**Applicable project type**
	kW	**kWh/yr**	**kWh/yr**	
100-299	6.4 - 19	50,400	151,000	plastic - lagoon
300-499	23 - 38	179,000	298,000	lagoon - covered
500 - more	59 - 590	464,000	4,640,000	covered - concrete

The reported investments costs are in the range 4 - 12 USD/watt. The annual costs for operation and maintenance (O&M) in Chile are estimated at 13% of the capital costs, which is substantially higher than indicated by foreign

[28] This figure represents an estimated guess since no detailed information about the larger dairy farmers was retrieved during the PPG phase. The largest farm identified holds over 7,000 animals.

sources (USDA, IRENA), providing figures in the range of 4-12%. The economic performance of a concrete type (274 kW), covered-type (74 kW), and lagoon-type (36 kW) biogas electricity plant is evaluated as follows. Further information can be found in Annex L.

DAIRY SECTOR IN CHILE - ECONOMIC PERFORMANCE OF BIOGAS PROJECTS				
Project type	**Capacity**	**Investment**	**IRR**	**NPV (@10%)**
Case1: Concrete	274 kW	USD 1,045,000	14.0%	USD 169,505
Case 2: Covered	74 kW	USD 305,000	10.7%	USD 8,538
Case 3: Lagoon	36 kW	USD 148,000	10.8%	USD 4,772

As a general appreciation, the projects are marginally economical but likely not attractive for private investors, who will seek higher returns. The PPG phase also made clear that there is a need for consolidated data as input for more reliable calculations of economic feasibility and profitability, and opportunities to reduce costs. During the PPG phase a quantified indication of the financial IRR required by the beneficiary of a renewable-energy power system was not obtained. There is also no information concerning the opportunity cost of capital for a dairy farmer.

The Foundation of Agricultural Innovation (FIA) and the Agricultural Research Institute (INIA), both operate under responsibility of the Ministry of Agriculture. INIA Remehue, in the Los Lagos region, has recently installed two pilot anaerobic digestion systems (80 m^3) in a milk factory for demonstration purposes with financial support from FIA, producing about 24 m^3 biogas per day based on liquid manure. The site is used to promote biogas in the region, for example through local Technology Transfer Groups (GTTs) set up by INIA and the cooperative Colun[29]. FIA, relying on engineering firm Kaiser Energía, is also developing an associative project in the Biobío region. One of the objectives of the associative projects is to develop business models and generate best practices. The selection of the participating farmers is done by INDAP, which has large experience with farmer's associations. FIA has further initiated the construction of four other pilot plants in the Coquimbo and Maule regions[30]. INDAP also has a credit line for investment in small NCREs that may reduce the cost of water supply for irrigation by smallholders[31].

Baseline project:

The baseline project consists of the activities, policies and financing instruments pursued by the Government of Chile to promote investment in non-conventional renewable energy technologies (including biogas) for energy self-supply and sales of electricity to the grid. In addition, a number of activities in the field of regulation and technology demonstration are being pursued by Government agencies. Specifically, the baseline is composed of the following:

(1) National Energy Strategy 2012-2030 by Ministry of Energy. The promotion of renewable energy is one of the six pillars of the National Energy Strategy. The Laws 20.257 (2008) and 20.698 (2013) set minimum NCRE shares for electricity generation companies with a target of 20% by 2025. In response, investment in grid-connected renewable energy technologies in Chile has sharply increased during the last years. Investment in biogas is taking off but remains limited to landfill and wastewater treatment plants and a few large early adopters in the agro-industrial sector, some of which are using pig and cow manure.

(2) Preparation of secondary regulation supportive of renewable energy for self-supply and biogas projects. One activity concerns the design of regulation governing the safety, construction, operation, and environmental aspects of biogas installations. This activity is led by the Superintendent for Electricity and

[29] For more information, please consult: http://www.inia.cl/blog/2013/09/30/productoras-de-leche-de-colun-estan-interesadas-en-energias-renovables-no-convencionales.

[30] The pilot anaerobic digester systems ordered by FIA produce in the range of 7 to 13 m^3 of biomethane per day. For more information, please refer to: http://www.fia.cl/ListadoNoticias/Noticias/tabid/139/ArticleID/433/FIA-cofinanciar%C3%A1-la-instalaci%C3%B3n-de-plantas-pilotos-de-biog%C3%A1s-para-la-agricultura.aspx.

[31] INDAP's Associative Irrigation Programme (PRA) can finance up to 90% of the investment in equipment and civil works to a maximum of around USD 80,000 (200 UF) per project and USD 8,000 (UF 200) per beneficiary. For more information, please refer to: www. http://www.indap.gob.cl/programas/riego-asociativo.

Fuels (SEC) and based on the outcomes of a field survey carried out in the first half of 2013. A second activity concerns the quality of digestate produced by anaerobic digesters, including sanitary aspects and innocuousness. Presently, digestate cannot be transported outside the farm where it is produced, which limits the scope for associative business models and impedes sales of digestate as an organic fertilizer to generate additional revenues from biogas. The options available to regulate digestate are being discussed between the Ministry of Environment (MMA) and the National Normalization Institute (INN).

(3) Since 2009, the Ministry of Energy, the Renewable Energy Centre (CER) and the Economic Development Agency (CORFO) have supported renewable energies through an intervention strategy that is based on three areas of activity: (i) market creation through capacity and awareness building and knowledge management (ii) development of a bankable project pipeline e.g. through co-financing of pre-feasibility studies and iii) the provision of appropriate financing instruments. With respect to small-scale renewable energy projects, a tender system has been established to foster the renewable energy for self-supply market in line with the National Energy Strategy 2012-2030. A first call for proposals under the INNOVA Programme closed in April 2013 and 10 projects were selected for a total support of USD$3.5 million. In the period 2011-2013, the Ministry of Energy financed the execution of several studies in the field of biogas energy technology as input for a 'National Bioenergy Strategy' (under preparation).

(4) The "Self-Supply Renewable Energy in Chile (SSRE)" NAMA, combining technical assistance and grant financing through the NAMA Facility, which is executed by CER and CORFO on behalf of the Ministry of Energy (EUR 14.9 million). Additional national funding is made available by the Ministries of Energy and Agriculture and CORFO (USD 14.5M). Of the combined amount, it is estimated that USD$ 4-5 million will be invested in biogas technology. Additional CORFO funds relevant for investment in renewable energies by agro-industrial SMEs are: (i) Development and Growth Fund, (ii) Seed Fund, (iii) Technological Investment Support Program, and (iv) Investment Support Program in Opportunity Zones.

(5) The Foundation of Agricultural Innovation (FIA) and the Institute for Agriculture and Livestock Development (INDAP) have financing windows open for investment in small-scale renewable energy technologies. FIA is presently implementing a demonstration pilot of small biogas plants to create field experiences, generate best practices and promote energy innovation by the dairy sector. Two of these pilots are implemented at the Agricultural Research Institute (INIA) in Remehue in the Los Lagos region. These are receiving visits from interested farmers and are used for initial training and promotion. The Chilean dairy sector association Consorcio Lechero has highlighted technological innovation and biogas technology as an opportunity to increase economic competitiveness.

(6) The Government has further launched the Clean Technology Fund Investment Plan for Chile in April 2012, which aims to tap US$200 million from the Clean Technology Fund (CTF) providing concessional financing and technical assistance for renewable energies and energy efficiency[32]. The original Investment Plan (IP) included three components 1: a concentrated solar power project (CSPP), 2: a large-scale grid-connected solar PV program (LSPVP) and 3: a renewable energy self-supply and energy efficiency program (RESSEE). So far, USD 118M of CTF resources have been approved by the CTF Trust Fund Committee (TFC): USD 67M for the CSPP[33], USD 50M for the LSPVP, and USD 1M for the RESSEE preparation grant. With respect to the RESSEE program, the Preparation Grant is currently being executed by IDB and IFC. This is expected to be finalised by August 2014 with the subsequent programme expected to be starting in January 2015. The programme will promote capital market financing to small and medium-sized companies that are currently unable to implement sustainable energy measures due to lack of information, transaction costs, and lack of financing.

[32] For more information, please refer to: https://www.climateinvestmentfunds.org/cifnet/country/chile.

[33] As in the initial IP USD 100M were requested for the CSPP project (of which only the USD 67M were approved so far), the Government of Chile has proposed to reallocate the USD 33M of unused CTF resources to a Geothermal Risk Mitigation Program (MiRiG). This request was approved in October 2013.

Problem statement:

The overarching development problem identified is the present vulnerability of Chile´s energy sector, which is strongly dependent on imported fossil fuels. This imposes a challenge to sustained economic growth and causes high average energy costs undermining competitiveness of the national economy. As noted previously, the average marginal costs of the Central Interconnected System (SIC) in 2013 were 148 USD/MWh and are among the highest in the LAC region. Thermal-based electricity generation is also a major source of greenhouse gas emissions in Chile. In response, the Government of Chile has prioritized the incorporation of non-conventional renewable energy (NCRE) technologies into the national energy sector, as outlined in the Ministry of Energy´s National Energy Strategy 2012-2030. With respect to biogas, the Ministry of Energy has drafted a preparatory study analyzing the barriers and market potential for bioenergy in Chile, which contains detailed recommendations for policy development.

The baseline project specifically addresses the presently low penetration rate of biogas and other non-conventional renewable energy technologies in Chile´s agriculture and livestock sector. It is recognized that the energy potential of biomass and biogas feedstock in agro-industries, including the dairy sector, is hardly exploited, which translates into a lost opportunity to add value to the production chain and to address environmental issues related to agro-industrial residues and effluents. The baseline project provides technical support and financing opportunities to eligible NCREs. However, the introduction of biogas energy technologies into small- and medium-sized agro-industries is hampered by a range of specific barriers, which are not well addressed under the baseline project. This provides a rationale for GEF involvement. These barriers identified for biogas technology for energy generation are described in detail in the next paragraphs:

Barriers:

Policy barrier: One of the policy barriers identified concerns the lack of regulation governing the quality of the digestate, including compliance with sanitary criteria and innocuousness. Proper regulation of this aspect would open the scope for commercialization of the digestate as organic fertilizer to generate additional revenues that are critical for economic viability. Under the current legislation, the digestate, if transported outside a generator's premises, would be considered industrial waste, to be deposited at designated landfill sites. The possibility to regulate digestate is being discussed between the Ministry of Environment (MMA) and the National Normalization Institute (INN). Regulation may be done through a separate standard, or by appending digestate to the existing standard for compost (NCh 2880, Of. 2004)[34].

Under the Electricity Law, small distributed electricity generators, smaller than 9MW (PMGD), are authorized to connect to the grid. In practice however, they often operate in a void as requests for connection and sales contracts are not processed swiftly, a circumstance which adds to the risk profile of a potential investment. Moreover, the focus in Chile has been on large-scale generation. Grid studies and grid connection have a decisive impact on the overall project costs of small NCRE projects. Consultancy firms also have focused on large scale projects, rendering costs for such studies high for smaller generators interested in connecting to the distribution grid. As long as grid access for PMGDs is not prioritized, project developers expect that the Net-Billing Law (Law 20.571, introducing net metering and billing for generator capacities below 100 kW) will have little effect to trigger the market. It is noted that the SSRE NAMA intends to address this barrier at a project level, by providing technical and legal assistance to proponents in order to speed up the process.

Technology barrier: Commercial biogas energy systems in Chile are predominantly based on foreign technology. This technology is costly for Chilean standards, and therefore only feasible for large installations. Recently, international suppliers for biogas projects have begun training of national firms to execute civil works and assembly of equipment, enabling some reduction of the investment costs. At least one Chilean company offers smaller anaerobic digesters at lower costs based on national technology, which is not fully mature yet. Suppliers of biogas equipment in Chile are in the process of fine-tuning the technology and cost level to the local market conditions. Among other aspects, studies undertaken during the PPG phase pointed out the necessity to quantify the costs of operation and maintenance of biogas technology in Chile. Validation of technology through demonstration pilots followed by a certain level of

[34] National regulation will presumably draw upon standards from European countries, including Germany (RAL GZ 251, GZ 256, GZ 245, GZ 246, GZ 258); United Kingdom (BSI PAS110), and Switzerland (ASCP guideline 2001).

standardization is necessary steps to serve smaller agro-industries such as dairy farmers and create customer confidence in biogas technology. While proven, foreign technology can be feasible for cattle farms above 500 animals, locally-made biogas systems can serve farmers with less than 150 cattle.

Technology constraints further arise due to the lack of skilled human resources. Given the incipient market for biogas technology in Chile, there are few professionals and technicians with expertise to design, build and implement biogas energy projects. Moreover, operators of existing biogas systems are generally not duly prepared to assume their role in a professional manner. This particularly holds true for the small- and medium-sized agro-industries.

Delivery skills and business models: Information obtained during the PPG phase provided strong indications that small- and medium-sized agro-industries will generally not endeavour into energy generation due to a lack of knowledge, investment capital, and attitude; unless there is a pressing shortage of high-quality energy, which may be the case in remote areas. Exploiting feedstock produced in the sector, such as manure from dairy cattle farming, for energy production will therefore largely rely on project developers, who will need to enter into agreements with local farmers defining ownership of installations, remuneration for feedstock supplied, destination of digestate, roles and responsibilities of parties, etcetera. In the current market, the few project developers operating in Chile[35] focus on the "low-hanging fruits" such as large cattle and pig farms. Smaller projects are less attractive because of proportionally lower revenues, higher project risks and opportunity costs. No detailed information from these companies with respect to the business model followed could be retrieved during the PPG phase but the main financial drivers presumably include payment for feedstock, revenues from energy (electricity) sales, and possibly a premium paid by the technology supplier.

The value chain of biogas technology exhibits flaws including weak support and after-sales services; inadequate maintenance routines and services; incipient technology development and innovation by domestic companies and research institutes; insufficient supply of training services and consultancy; and a general lack of professionals with expertise to analyse and implement energy projects embedded in agro-industrial production processes. Moreover, foreign equipment suppliers have no technical services deployed in Chile, affecting the technical availability of installations and causing elevated commercial losses[36]. Chile further lacks duly prepared laboratories for feedstock analysis and determination of the methane production potential. These barriers are typical for incipient renewable energy markets. The envisaged SSRE NAMA aims strengthen the resource base of national professionals trained to design and implement renewable energy projects for self-supply. Targeted beneficiaries include project developers, national industries, energy professionals, financial experts and public officers. The NAMA does not specifically address biogas technology, however.

For the dairy sector, a business model based on project developers may take time to develop as farmers do not easily adopt new technologies. There is also an obvious information unbalance between feedstock owners (farmers) and project developers. The segment of small dairy farmers adds complexity due to the large number of actors involved and the geographical distribution. The introduction of centralized biogas systems, as applied in Germany, would face a number of barriers, including the traditional low level of association between individual farmers, limited road infrastructure, the costs of transportation of feedstock to the digester and of digestate back to the fields, financing, retribution of benefits among the participating farmers, and the creation of local ownership. In the absence of consolidated data to assess the validity of proposed business models, small farmers are reluctant to accept biogas as a viable option[37]. There is a general lack of tested ownership, business and organizational models for biogas energy projects for small and medium size dairy farmers. In this respect, Chile may benefit from experiences in the region, including Brazil and Uruguay.

Information barrier: As yet, there is limited insight in the commercial potential for biogas energy technology in the agro-industrial sector. Studies carried out so far[38] are primarily based on census data yielding a theoretical potential. For

[35] Four (4) companies were identified during the PPG phase.

[36] The lack of adequate technical services not only causes long down-periods in case of mechanical failure, but also affects proper adjustment of process parameters and control systems during the start-up phase of the biogas plant.

[37] (i) The use of manure as feedstock has an opportunity cost, which is understood by the farmer as the cost of alternative fertilizer. Proper information and demonstration of the suitability of digestate as a fertilizer, may help correcting this perception. (ii) Co-digestion of fodder, such as maize or ballica, is not easily accepted as this affects milk production, which is core business for the farmer.

[38] See for example, Bidart, C (2013).. A similar approach was followed by Moraga, A., during the PPG phase (2014).

small- and medium-sized agro-industries, these estimates should be matched with information including a farmer's energy demand, energy costs, organizational set-up of substrate collection, project costs, and financing capabilities. From a business perspective, interest only arises if a potential project is feasible and financially attractive. The absence of clear regulation and of business and financing models based on consolidated key data, are an impediment to inform feedstock owners duly and provide complete, concise and transparent information. As a result, farmers remain with unanswered questions and misinterpretations, will be reluctant to embark on biogas technology and may lose confidence in project developers. This also applies to the small and medium size dairy farmers, who are not used to work with debt capital and are generally unaware of the tenders and other financing windows offered by CORFO and others. Consolidated financial data are also required to assess the economy and profitability of biogas projects within acceptable uncertainty margins. It is therefore important to have successful projects in place to demonstrate the use of biogas technology in a specific sector, such as dairy farmers. During the PPG phase, the installations of INIA in Remehue were identified as a potential site for demonstration and training. Outreach activities are also covered by the SSRE NAMA.

Financial barrier: Financial barriers are in place at several points in the value chain. Firstly, most biogas projects need a price incentive in order be financially viable. In Chile this is presently addressed by offering tax exemptions and subsidies, thereby lowering investment costs. Accelerated depreciation provides an additional incentive but mostly favours companies that generate taxable profits, which is usually not the case for project developers and farmers just starting (who typically have large turnovers but small profit margins). Pre-investment costs are a limiting factor for project developers, unless they are backed up by larger companies or provide other services to maintain a positive cash flow. The dispersed geographical distribution of the dairy sector and the large distances in Chile further add to the cost profile of biogas projects. Small farmers have a poor financial track record and are usually not liable for credit from commercial banks[39]. CORFO offers a range of financing instruments targeting NCREs and agro-industries. Ultimately, these instruments are expected to bring down capital costs for investors, reduce project development and O&M costs due to learning effects, and reduce the presently high risk profile of biogas projects as perceived by credit suppliers. The envisaged SSRE NAMA aims to leverage concessional loans for investment in NCREs to complement grant funds made available through the financing obtained from the NAMA Facility.

A. 5. Incremental /Additional cost reasoning: describe the incremental (GEF Trust Fund/NPIF) or additional (LDCF/SCCF) activities requested for GEF/LDCF/SCCF/NPIF financing and the associated global environmental benefits (GEF Trust Fund) or associated adaptation benefits (LDCF/SCCF) to be delivered by the project:

In response to the findings of the PPG phase, the Strategic Results Framework for the Project "Promoting the Development of Biogas Energy Amongst Select Small – and Medium Sized Agro-Industries" has been revised. The development objective is: "To reduce GHG emissions by promoting investment and market development of biogas energy technologies in select small- and medium-sized agro-industries in Chile." That is, the Project no longer intends to concentrate its efforts on only one region of Chile due to the reasons outlined below. However, it does continue to target only one sector, namely the dairy sector, to assure optimal use of available resources[40].

Compared to the PIF concept, the Project strategy has been adjusted to reflect the advances under the baseline situation concerning: (i) regulation promoting the introduction of NCRE sources into the national energy matrix; (ii) implementation of pilot biogas systems in small- and medium-sized agro-industries, including the dairy sector; and (iii) the approval of a sector NAMA facilitating investment in biogas technology for energy self-supply, alongside other financing instruments offered by the Ministry of Energy and CER-CORFO. The PPG phase enhanced the understanding of the barriers for biogas energy faced by the dairy sector. It was shown that the commercial market for biogas energy systems consists of farms holding more than 100 animals. Smaller farmers would need to implement innovative organizational models, possibly combined with simplifications of the technology. Small farmers are generally not served by project developers and lending institutes[41], while they lack the specific knowledge needed for biogas development. Moreover, they rarely qualify for bank credits and do not have a tradition to work with debt capital.

[39] See Annex I for the use of external financing by the dairy sector.
[40] It is expected that the approaches developed during this Project shall be expanded to other agro-industrial sectors in Chile in the future, pending available funding.
[41] With the exception of INDAP.

Notwithstanding, the Government of Chile, as well as sector institutions, have started to reduce these barriers and unleash the potential of biogas energy – and other NCREs – in small- and medium-sized agro-industries.

In response, the present GEF Project will take a broader approach to the biogas market in Chile by (i) facilitating investment in market segments which are ready to take off; (ii) expanding professional capacities and skills for scaling-up; and (iii) providing technical assistance and disseminating best practices, thereby reducing project costs and accelerating penetration of biogas technology downward the market pyramid. This approach is justified given the presence of a strong baseline project, including financing facilities for direct investment and replication. GEF funding will be used to provide specific support for biogas energy technology in the field of policy, capacity and project development, which is not covered under the baseline project. This use of GEF funding is fully incremental.

In comparison to the PIF, the logical framework has been adjusted to reflect the changes in approach followed by the Project. The Project will consist of the following four components:

1. Policy and information.
2. Technical capacities and delivery skills.
3. Investment and project portfolio.
4. Monitoring and Evaluation

The following paragraphs provide a description of the purpose of the anticipated project outputs and their contribution to the defined outcomes.

Component 1. Policy and information.

Outcome #1. Policies targeting the development of biogas-based electricity and heat generation in agro-industries have been strengthened.

The objective of this Project component is to strengthen the regulatory framework for biogas-based energy generation in agro-industries, with a focus on the dairy sector. This component will contribute to: (i) regulation in the fields of safety and operation of biogas installations, and transport and innocuousness of feedstock and digestate; and (ii) enabling conditions for project development, grid connection and sales of biogas and heat. It will further analyse economic aspects of business ventures into biogas generation and consolidate economic, technical and financial data relevant for project evaluation, thereby addressing present information barriers. This information will assist in shaping financial support instruments and incentives for biogas investments.

Output 1.1 Preparation and supporting adoption of secondary regulation supportive of biogas energy plants in agro-industries.

This project output encompasses supporting the on-going preparation, consultation and submission for approval of regulation concerning the design, installation and operation of agro-industrial biogas installations in Chile to assure that the needs of small-and medium-sized farmers are also considered. The SEC is preparing a policy project targeting integrity and operational safety of installations, including the following aspects: (i) responsibilities of owners, designers, builders, and operators; (ii) best practices and risk mitigation measures in plant designs; (iii) mandatory use of safety and control devices; (iv) compliance of design, components and materials with applicable technical standards and certificates; (v) specifications of biogas (H_2S limit); (vi) operation, maintenance, prevention, and inspection; (vii) operation and safety manuals; and (viii) registration and communication protocols. This output further pursues the preparation of adequate regulation allowing the transport of agro-industrial feedstock and digestate while safeguarding sanitary and innocuousness requirements. Presently, transport of organic material outside a farm is generally not allowed, which is a major impediment for developing larger, centralized biogas plants based on cooperative or associative business models. This output will further contribute to ongoing amendments to energy sector regulation to interconnect small biogas energy systems to the electricity grid, and to sell biogas or heat to third parties. This output builds forth on regulation developed in alignment with Chile's National Energy Strategy aimed at widening the market opportunities for NCRE generators.

Output 1.2 Collection and consolidation of technical, financial and economic parameters for biogas energy projects in small- and medium-sized agro-industries. As identified during the PPG phase, the market opportunities for biogas energy systems in Chile are large co-generation systems, which benefit from economies of scale; and small and medium size systems for self-supply of heat and electricity. The economic viability of smaller systems is marginal if based on energy generation alone. However, reliable technical, economic and financial input data are lacking to assess the economy, profitability and financial robustness of biogas projects within acceptable uncertainty margins. There is also scope to benefit from additional potential revenue streams, such as commercialization of digestate and environmental services. Moreover, there is a need to devise cost-effective strategies to perform operation and maintenance, and financial engineering to minimize capital costs. This information will feed into the design of business and ownership models, such as operational lease. The present project output aims to collect and consolidate specific data for a range of applicable biogas technologies and project sizes in Chile, with a focus on the dairy sector. This will provide valuable input information for the design and evaluation of business proposals, as well as the design of financial incentives for biogas energy technology by the Government of Chile. It is thus expected that both the targeted beneficiaries i.e. stakeholders in the dairy industry interested in biogas technologies as well as the government agencies offering support to these groups such as CER, CORFO, FIA and INDAP will benefit from the information gathered and lessons learned. CER envisages developing a web-based knowledge management platform for this purpose. This bioenergy platform is to consolidate existing knowledge from different sources, systematize it and make it readily available to all sectors that have a vested interest, in a format that is easily accessible by the particular sector. In addition, the development of a user-friendly calculator/estimator available for farmers/project developers shall be considered.

Component 2. Technical capacities and delivery skills.

Outcome #2. Adequate design, installation and operation practices for biogas energy plants in the agro-industrial sector have been adopted due to improved capacities of developers, suppliers and technicians. The objective of this project component is to establish adequate professional skills and business models to develop, implement and successfully operate biogas-based energy generation systems in agro-industrial businesses with a focus on the dairy sector. Presently, the market for biogas energy systems in Chile is still incipient and by consequence, (i) plant designs and installations do commonly not attain necessary quality and safety standards; (ii) there are few players on the market who target the top segment of the market; (iii) there is little experience with business models enabling the use of smaller biogas systems; and (iv) there is a general lack of qualified engineers, technicians and operators in the sector. This component aims to address these barriers, using GEF resources to complement baseline activities implemented under coordination of CER, specifically the Technical Component of the NAMA Initiative "Self-Supply Renewable Energy in Chile (SSRE)". The activities proposed under this component will be designed and implemented in close coordination with the biogas sector and the dairy sector in Chile, to whom it is specifically targeted[42]. Strong ownership and sector involvement are a prerequisite for the successful implementation of this component.

Output 2.1 Scoping and design of a training and certification programme for project developers, suppliers, installers and operators of biogas energy systems in agro-industries. This project output will finance consultancies and expert support to: (i) identify specific capacity and training needs of biogas sector agents; (ii) design a detailed, differentiated training programme for sector agents, as well as for prospective plant operators of biogas systems in agro-industries; (iii) propose an organizational set-up for the training programme to reach the target group in an efficient, cost-effective and equitable manner; and (iv) provide recommendations with respect to financial sustainability of capacity building activities. The training programme will be based on applicable regulation and standards, and draw upon available guidelines, manuals and best practices in Chile and abroad. In order to assure that the programme meets actual needs, a so-called "test round" shall be included. That is, the training programme will be evaluated and improvements introduced after year 1 to ensure that the required competences are actually created.

Output 2.2 Training and certification of prospective project developers, suppliers, installation companies, and operators of biogas-based energy plants. This output will provide training on the safe and effective operation of biogas-based renewable energy systems for heat and electricity generation to ensure that prospective operators understand their

[42] It is envisaged that the training and certification programme will be piloted in the dairy industry and can later be expanded to other sectors interested in utilizing biogas technologies.

responsibility with respect to safety aspects, operational procedures and compliance with applicable regulation, guidelines and manuals. It is envisaged to set up a voluntary certification system for professionals and companies who have successfully passed the training programme. Such a system would be would be administered by a body with oversight function in charge of issuing and retracting certification. Potential candidates for certification would be those stakeholders involved with the envisaged 5 to 10 biogas projects that are to be built under Component 3.3. The appropriateness of such a certification scheme will be discussed with the sector, the Government of Chile and UNIDO during the Project[43]. In addition, funds will be made available to explore possible arrangements for the continued support of such a certification scheme beyond the project's lifetime.

Component 3. Investment and project portfolio.

Outcome # 3. Biogas energy has been adopted by select agro-industries.

The objective of this project component is to provide technical assistance to small- and medium-sized agro-industries, specifically those active in the dairy sector, to facilitate their engagement with biogas technologies. Since energy generation is normally not the core business of such industries, targeted support will be provided. Close cooperation with the technical component of the SSRE NAMA is envisaged. In addition, the GEF funding will be used to actively build a viable portfolio of biogas energy projects in the dairy sector, which is able to benefit from the available public sector financing such as from the Ministry of Energy, CORFO and the NAMA. As all public sector financing in Chile normally requires co-investment from the private sector – either via the beneficiaries of the project or through project developers – the co-financing leveraged by the Project will primarily target the outputs proposed under this project component. This component will thus facilitate the development and up-scaling of biogas technology in the dairy industry in all relevant regions of Chile.

Output 3.1 Technical assistance to small- and medium-sized agro-industries for the development of biogas energy projects. This output will support CER in its coordinating and supervising role to provide technical support to developers of NCRE project is Chile. Baseline funding for technical assistance and a help desk is available through the NAMA Technical Component but is intended primarily to support the application process for the financial instruments available under the NAMA. Moreover, the development of biogas energy projects in small- and medium-sized agro-industries, particularly in the dairy sector, requires specialist's knowledge and expertise, which is scarce in Chile. GEF funding under this output will be used to hire such expertise (national and international experts) and mitigate the costs for effectively following up on biogas project initiatives. GEF support will be incremental to the baseline technical assistance, provided under the NAMA TC. This output is expected to contribute to the establishment of a permanent support facility (technical help desk) within CER, thereby expanding the project portfolio as developed under Output 3.3.

Output 3.2 Promotion and dissemination of information and best practices regarding biogas energy technology for small- and medium-sized agro-industries in Chile. This output will complement baseline activities to promote biogas energy technology in Chile, targeting the small- and medium-sized agro-industries with a focus on the dairy sector. Promotion and outreach activities under the baseline project include regular activities by CER, CORFO and the Ministry of Energy. Dissemination and outreach are also included in the NAMA Technical Component. With a view to the dairy sector, government institutions including FIA and INDAP as well as sector associations such as Consorcio Lechero are involved in innovation programmes covering promotional and outreach activities. Specifically in the dairy sector, it was found that biogas projects in small- and medium-sized farms do not take off since: (i) the sector has insufficient knowledge about biogas technology and the organization thereof; (ii) smaller systems cannot exploit economies of scale; (iii) legal issues limit the exchange of feedstock and digestate; (iv) there is a lack of information about project costs; (v) interconnection costs are prohibitive for small projects; and (vi) there is a lack of tradition among small farmers to collaborate in associative business models. This output aims to collect best practices from pilot plants and commercial projects, as well as information about biogas technology and project organization. GEF funding will be used to support the development of promotional material specifically for the dairy sector and to increase the

[43]A comparable certification mechanism is managed by the Chilean Energy Efficiency Agency (AChEE), which sets forth certification as a requisite for funding eligibility.

visibility of biogas at national events and business fairs. The regional network of CER will be actively utilized in the dissemination of information and best practices.

Output 3.3 Establishment of a portfolio of biogas energy projects in the dairy sector to qualify for external financing and implementation initiated for selected biogas energy projects (750kW) under a public tender mechanism. The purpose of this project output is to support the development of biogas energy initiatives in small- and medium-sized agro-industries and establish a project portfolio ready for submission to interested financiers[44]. GEF resources will be used to co-fund pre-investment costs (i.e. primarily feasibility studies, as well as technical design studies, cost of permitting procedures and social and environmental studies[45]) up to a maximum of 50%, as and if required. It is the intention to streamline this component with the pre-investment financial mechanism set up under the NAMA Financial Component, which applies similar funding criteria. This mechanism is supervised by CER, which reviews and approves submitted proposals according to established criteria including, amongst others, the benefits in terms of GHG emissions avoided, the quality and techno-economic feasibility of the proposal, the contribution of own financing, the creation of capacities and technology transfer, the economic efficiency as well as economic and social-co-benefits such as job creation and rural electrification. If deemed appropriate, UNIDO and CER can establish additional criteria to ensure a balanced and representative project portfolio benefiting the interests of the dairy sector. The proposed arrangement avoids the establishment of a parallel pre-investment financing mechanism within CER and contributes to the effective use of staff and monetary resources. The delivered, biogas project proposals can be submitted for financing under the NAMA facility and other available loan instruments. For a more detailed description about the institutional set-up and the structure of the NAMA Financial Component, please refer to Annex H.

In addition, this output encompasses the selection, procurement and successful operation of a first batch of biogas projects under the upcoming Government (CORFO) tenders[46]. Funding for these tenders has been allocated and committed to the Project by the Ministry of Energy[47]. It is expected that about 750 kW biogas projects will be installed in dairy farms under the Project´s time horizon, with an estimated investment cost of USD 4,000,000. Public funding (USD 800,000) will complement private sector investment (equity and debt) to the amount of USD 3,200,000. This is in line with the ratio for allocation of funds practiced in Chilean public tenders i.e. 20% public funds need to be matched by 80% of private sector finance. The tender will focus on the generation of electricity and heat in the farm ranges 100-500 animals. The presentation of a solid business plan and arrangements for operation and maintenance will be a requisite to ensure sustainability. The number of biogas projects built under this output is expectedly 5 to 10.

Output 3.4 Creation of an enabling environment for financial instruments facilitating access to investment in biogas energy plants for small- and medium-sized agro-industries. This output encompasses the creation of an enabling environment for financing mechanisms that facilitate access to investment capital in biogas energy technology for eligible projects. This mechanism will be established under the baseline project and expectedly consist of the NAMA "Self-Supply Renewable Energy in Chile (SSRE)" which has been approved by the NAMA Facility Board[48]. Biogas is one of the eligible technologies under this NAMA. The Ministry of Energy has committed public funding to an amount of USD 2,900,000. The GEF Project will increase the share of biogas projects eligible for financing under the NAMA by: (i) enhancing the quality of submitted proposals by technical assistance (Outputs 3.1 and 3.3); and (ii) by ensuring the quality of project designs, installation, and operation (Output 2.2). As a result, it is expected that, compared to the baseline scenario, more proposals for biogas energy projects in small- and medium-sized agro-industries will successfully pass the NAMA due diligence process. Besides private sector financing, which has already been secured from the project developer Schwager Biogás, the NAMA Financial Component can provide investment grants up to a maximum of 20% of the project sum. It is noted that, alongside the NAMA, CORFO provides a range of financial

[44] If and where appropriate COMFAR (Computer Model for Feasibility Analysis and Reporting) shall be used to aid the establishment of a project portfolio.
[45] These studies shall also include energy and technology audits at potential project sites in order to assure processes are optimized prior to the installation of any new equipment.
[46] Please note that public tender mechanisms in Chile take the form of grant instruments like the 'Innovation in ERNC'. See also: http://www.corfo.cl/programas-y-concursos/programas/concurso-de-innovacion-en-energias-renovables
[47] Please refer to the Ministry´s co-finance letter (06 February, 2014).
[48] For further info, please see: http://nama-facility.org/projects/projects-selected.html

instruments to support business development and investment projects for the sector, which may be accessed by project proponents.

Component 4. Monitoring and evaluation

Outcome # 4. A monitoring plan has been prepared and implemented in coordination with UNIDO. Monitoring of project progress is essential for the adequate and timely delivery of results. This project component covers project monitoring and oversight by UNIDO in close coordination with CER and the project partners, as well as mid-term review and terminal evaluation of the Project.

Output 4.1 A monitoring plan has been designed and agreed upon during the Project's inception phase. This output covers the organization of an inception workshop, the definition of progress and impact indicators and the design of a detailed monitoring plan and methodology. Gender aspects will be paid particular attention to and it is anticipated that a gender analysis will be carried out during the inception phase to facilitate gender mainstreaming throughout project implementation. The following activities will be implemented using GEF and UNIDO cash resources: (i) subcontract for hosting of inception workshop; and (ii) subcontract for design of monitoring plan and tools for data collection and recording; and (iii) subcontract for M&E specialist to provide backstopping. It is expected that the M&E specialist is also able to carry out the proposed gender analysis. If not, additional resources will need to be contracted.

Output 4.2 Project progress on defined indicators and compliance with UNIDO guidelines (including gender) is being monitored. This output covers backstopping to review project progress and compliance with UNIDO guidelines and best practices concerning social, economic, environmental, and human development. Special attention will be given to opportunities to strengthen the position of women. Relevant project activities, specifically related to training, communication with civil society groups, and biogas usage involving smallholder farms, will be reviewed on gender-specific issues and opportunities. The activity implemented will be: (i) national consultancy in gender issues and human development; and (ii) regular monitoring site visits by PM and PMU.

Output 4.3 A mid-term review and terminal evaluation have been conducted. This project output consists of the mid-term review and the GEF terminal evaluation, to be carried out by independent international consultants. The mid-term review will be carried out by UNIDO and CER after 15-18 months of project implementation, using UNIDO co-finance. The GEF terminal evaluation will be held in the last month before project termination. The activities to be implemented are: (i) national consultancy for support with mid-term review; and (ii) independent international consultancy for GEF terminal evaluation.

In addition, it should be noted that the co-financing ratio of the project management cost was reduced from 1:3 in the PIF to 1:1.3 due to the fact that the Project is expected to benefit from the approval of the NAMA, reducing overhead management and costs. At the time of the approval of the PIF concept, the NAMA had not obtained financing from the NAMA Facility and hence such support could not be counted upon. In order to avoid replication and minimize project management overhead, the thus released co-financing funds have ben reallocated to project activities in order for these to be executed as comprehensively as possible, counting on all available co-financing support.

Global GHG Benefits

The global environmental benefits of the Project are associated with (i) the implementation of on-grid renewable energy (biomass-based electricity generation); and (ii) market development of renewable energy based electricity generating capacity. The following table (based on the GEF Manual[49], page 3) summarizes the methodology used:

[49] GEF/C.33/Inf.18, April 16, 2008

Type of GHG emission reduction	Direct (A)	Indirect (B, C)	
Component of GEF intervention that can cause this type of GHG emission reduction	Direct implementation of RE technologies	The Project does not establish a direct replication mechanism. GHG benefits obtained from leveraged investments are considered as effects of market transformation.	Market transformation
Logframe (SRF) level	Outputs 3.1-3.5	n/a	Medium-term impact after project termination (10 years)
Quantification method	Direct evaluation of environmental benefits over lifetime (verification of installed RE capacity and baseline assumptions)	n/a	Top-bottom approach based on expected market development of biogas technologies for electricity generation in Chile.
Quality of Assessment	Based on expected performance of 750 kW biogas systems in Chile. Error range is estimated at +/-50%.	n/a	Based on: (i) assumption that 10-12 MW biogas-based energy capacity is being added annually (for self-supply and/ or decentralized power generation); (ii) baseline shifts are included in the applied GEF causality factors; (iii) CO2-intensity of electricity generation sector in Chile is 0.52 tCO_2 per MWh). The error range in the assessment is expected to be -50% to +50%.

Direct benefits

The Project aims to mobilize US$ 4 million for direct investment in biogas installations. By assuming an approximate specific investment cost of US$ 5.3 million per MW, a total electric capacity of 750 kW would be installed under the Project (distributed over various smaller projects). The expected annual energy production is 5,920 MWh/yr. Over a 10-year economic lifetime of the investment, the total electricity production would be: 10 yr * 5,920 MWh/yr = 59,200 MWh. Based on the indicated CO_2-intensity of the power system[50], the direct GHG emission reductions are: 59,200 MWh * 0.5219 tons CO_2eq/MWh = 30,900 tons CO_2eq.

Indirect benefits

The market potential that can be developed in small- and medium-sized dairy farms is estimated at 17.5 MW, with associated GHG emission reductions of 71,800 tons CO_2eq per year[51]. Assuming a market penetration rate of 10% (1.75 MW) per year, after 10 years a total of 17.5 MW biogas-based electricity generation would be operational. The indirect emission benefits are based on the expected economic lifetime of the investments that take place in the 10-year time horizon after project completion. Ignoring reinvestments during this period, the total generating capacity accounted is equal to 17.5 MW. The overall electricity production would then be: 1,377,000 MWh. The associated emission reductions are: 10 yr * 71,800 ton CO2eq/yr = 718,000 ton CO2eq/yr. By applying a 60% GEF causality factor, the total (indirect) GHG benefits that can be ascribed to the Project are estimated at: 431 kton CO_2eq.

While the GEF project may also have a (minor) impact on the market development of biogas beyond the dairy sector, including bovine meat production, and pig and chicken farms, through outreach activities and demonstration of the

[50] Based on the combined marginal emission factor of the Central Interconnected System in Chile (0.5219 ton CO2eq/MWh, according to IGES database).
[51] See Annex M.

viability of biogas based energy production, these potential indirect GHG emission reductions have not been taken into consideration in order to assure conservativeness. The total emission reductions attributable to the GEF project are thus estimated at: 431 + 30.9 = 461.9 kton CO_2eq.

A.6 Risks, including climate change, potential social and environmental risks that might prevent the project objectives from being achieved, and measures that address these risks:

Risks	Likelihood	Impact	Remedial actions
1. Delay to implement improvements to the policy and institutional framework would affect biogas market development.	Low	Low	The Government of the Chile, through the Renewable Energy Centre, is strongly committed to the project. It is considered a key element to develop a biogas market as well as to reduce GHG emissions from the agro-industrial sector. Hence, a delay with respect to the improvement of the policy and institutional framework is not expected. Moreover, important advances have been made since the PIF stage. By consequence, the Project will be mainly focused on the enhancement of technical regulation to provide a clear legal framework for biogas projects.
2. Lack of trust or interest among beneficiaries would reduce the pace of market introduction of biogas technology.	Low	Medium	The progressive implementation of biogas projects under Project Component 3 will demonstrate the feasibility of the biogas technologies in the dairy sector. The Project can thereby build upon recent advances in other economic sectors with respect to the usage of NCREs, including initial biogas experiences. There are strong Government policies in place fostering investment in NCREs. As such, renewable energies and biogas are increasingly well received by the private sector. However, the dairy sector is traditionally very hesitant to accept new technologies; moreover, biogas energy production is not a core business, hence farmer's capital will not easily be applied for energy technology. Project developers and ESCOs are mostly focused on attractive projects ("low-hanging fruits") rather than providing adequate information and services to the small- and medium-sized dairy sector. The Project will provide technical assistance and outreach activities to accelerate the penetration of biogas technology downward the market pyramid.
3. Lack of adequate technology support would affect the success of biogas energy projects.	Medium	High	Biogas technology demands a certain level of active management and control of the anaerobic process. Therefore, capacity gaps will be addressed under Project Component 2, by strengthening of the delivery skills and business models to provide technological support, including after-sales services and the organization of operator activities. Experiences with demonstration pilots and initial projects will enable the design of efficient business and management models including the roles and responsibilities of supplier, owner and operator.
4. Lack of financial incentives would affect biogas market development after Project termination.	Medium	Low	The Project aims to prepare project developers and business owners, specifically dairy farmers, to have access to adequate knowledge and technical support to assess the viability of biogas initiatives and be able to submit project proposals for financing, including access to incentives provided by CER/CORFO. Present grants to mitigate investment costs, such as provided under the SSRE NAMA and the CORFO INNOVA programme, are expected to be required only during market take-off, after which projects should be financially sustainable. Incentives to facilitate project development and investment will likely remain in place as part of a broader package of Government instruments to foster economic development,

Risks	Likelihood	Impact	Remedial actions
			including of small- and medium enterprises. GEF support will expectedly result in an accelerated learning curve, thereby lowering project preparation and investment costs, improving economic and financial performance, and reducing project risks as perceived by the providers of debt capital.
5. The outcomes of the Project would be affected by climate change	Low	Low	Adverse impacts due to climate change are not expected. Planned investments are not likely to be located in zones that are vulnerable to sea level changes nor are the waste streams to be utilized expected to vary significantly with climatic changes. Furthermore, as the project aims to actively mitigate GHG emissions, it is expected that climate change implications, from e.g. methane that escapes and is not captured, are negligible.

A.7. Coordination with other relevant GEF financed initiatives

The project will build on the experience with a number of initiatives that CNE has implemented in the past, notably the UNDP/GEF/CNE project "Removal of barriers to Rural Electrification with Renewable Energy" (2001-2011) and CNE's program on "Rural and Social Energization" (PERYS), and in particular build on their experiences with bio-methanisation. Specifically, the UNDP/GEF/CNE-funded project targeted the removal of barriers to rural electrification with renewable energy. Amongst the outputs achieved was capacity building for non-conventional renewable energy, the elaboration of 44 technical norms for systems based on clean technologies, the establishment of procedures for the certification of clean energy projects as well as the conduct of workshops covering biogas for productive uses. The PERYS program targeted the use of non-conventional renewable energy in vulnerable, isolated, and public facilities with the goal of helping to improve the quality of life. Several workshop and pilot projects have been implemented. Moreover, several biogas-related studies have been undertaken in Chile more recently, including the *Manual de biogás* (Varnero, 2012), and *Modelos de negocio que rentabilicen aplicaciones de biogás en Chile y su fomento* (Gamma Ingenieros, 2011), the results of which will also be taken into consideration. It should be noted though that at this point in time, there exists no conclusive information regarding the range of energy output considered financially worthwhile for SMEs in the select agro-industries. The Project aims to generate this type of information in a transparent and standardized fashion.

The project will in particular draw on synergies from the UNIDO GEF-5 project "Towards a green economy in Uruguay: stimulating sustainable production practices and low- emission technologies in prioritized sectors", which aims to transform the different kinds of waste generated in agriculture and agro-industry production chains in Uruguay into various types of energy and/or other by-products, aiming at the development of a low carbon sustainable production model, supported by an adequate technology development and transfer. As far as feasible, joint activities between these projects will be promoted. Synergies with other UNIDO branches such as Agro-Business Development and Environmental Management will also be explored.

B. ADDITIONAL INFORMATION NOT ADDRESSED AT PIF STAGE:

B.1 Describe how the stakeholders will be engaged in project implementation.

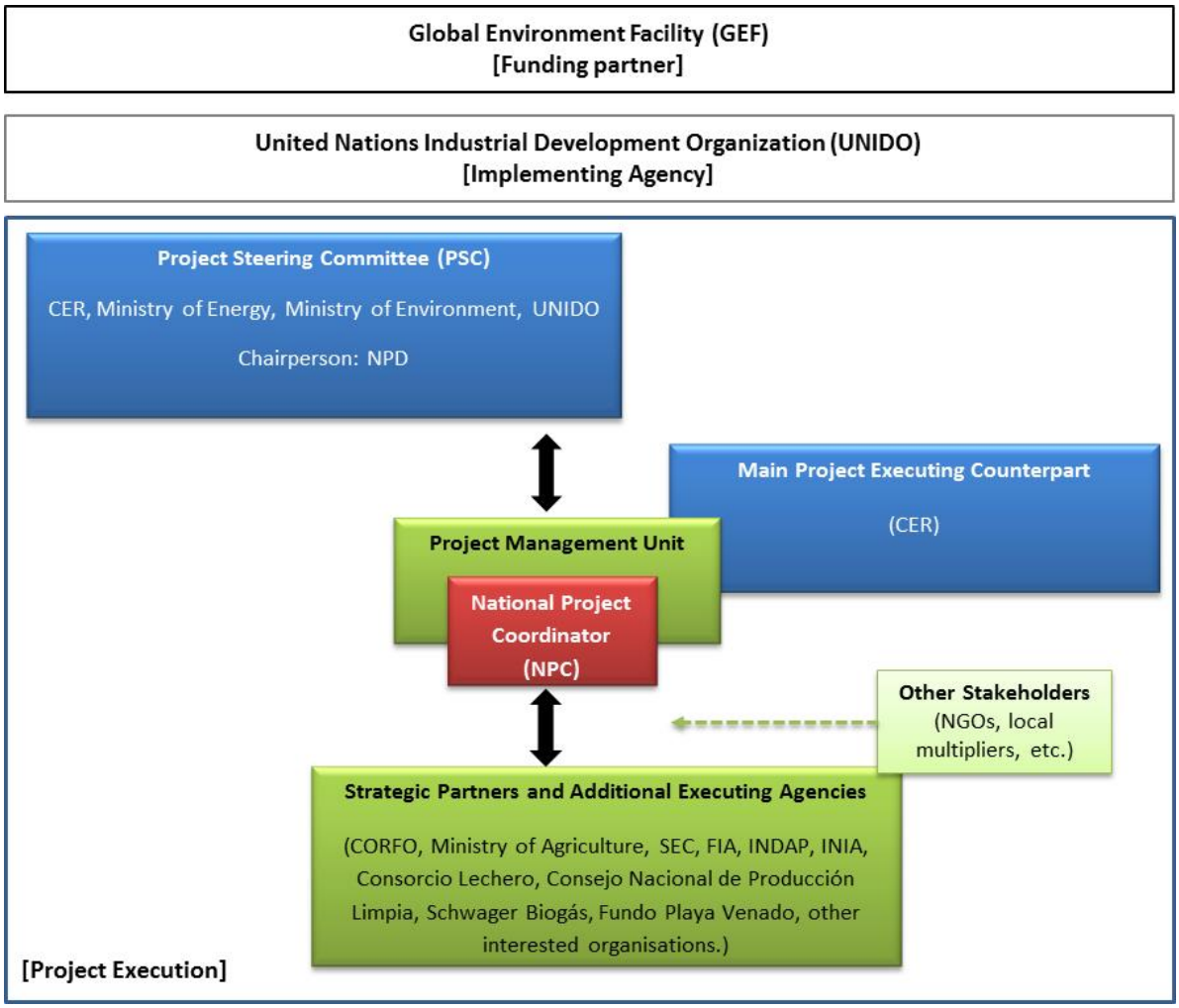
The GEF Implementing Agency for the Project will be UNIDO. The executing counterpart will be the Renewable Energy Centre (Centro de Energías Renovables - CER) of the Government of Chile. CER is an Agency of the Ministry of Energy set up in 2009 as a CORFO committee with a board of directors including representatives from the Ministry of Energy, Environment, Agriculture, Economy and CORFO. CER contributes to policy formulation and is responsible for the implementation of financial support instruments targeting NCREs. The Centre operates in coordination with CORFO and the National Energy Commission (CNE) and serves as an information and guidance centre for government bodies, investors, project developers and academic researchers.

Management arrangements

The Project will be implemented directly by UNIDO. The responsibility for the Project's execution lies with CER.

CER will designate a person who will act as the National Project Director (NPD) and who will be based in CER in Santiago. The NPD will be responsible for assuring that the Project is represented on the national level and that all communications are channeled correctly between the relevant (governmental) actors. As CER does not have full legal capacity to subscribe international agreements, they are not able to receive funds directly and hence expect some of the project execution to be undertaken by other national agencies such as INIA, the Agricultural Research Institute, which operates under responsibility of the Ministry of Agriculture.

The following figure shows schematically how the counterparts and stakeholders relate with each other:



The specific responsibilities of each involved party are described as follows:

Project Steering Committee:

The Project will establish a Steering Committee (PSC) as the highest decision-making authority, the preliminary composition of which is as follows:

- Representative of UNIDO;
- Representative of CER;
- Representative of Ministry of Energy;
- Representative of Ministry of Environment (GEF Operational Focal Point).
- National Project Coordinator.

The Steering Committee will be chaired by the NPD and convoked on a biannual basis. If considered necessary,

UNIDO and CER can request extraordinary meetings of the Steering Committee.

This project document shall guide the overall work of the Project Steering Committee, in particular, the budgeted work plan as per Annexes E and F.

The responsibilities of the Steering Committee include, amongst others:

i. review and approval for annual work plans;
ii. review and approval of annual GEF reporting (PIRs);
iii. review and approval of annual budgets;
iv. monitoring of Project progress; and
v. guidance on strategic issues and activities.

The PSC will conduct its activities fully in line with the GEF and UNIDO rules and regulations (particularly GEF Council Documents C.39.09 and C.39.03/Inf.3).

Specific roles to be undertaken by each of the stakeholders that are part of the PSC:

Renewable Energy Centre (CER): apart from being member of the Project Steering Committee, CER will be the executing counterpart for the Project. It shall coordinate and supervise some Project components and activities. Specifically, CER will be responsible for evaluating proposals for commercial and demonstration biogas plants under the Project and decide upon allocation of funding in consultation with UNIDO. Moreover, the in-kind support consists of hosting the project management unit (PMU), coordination with government partners, the provision of office space and technical inputs by CER staff.

Ministry of Energy: apart from being member of the Project Steering Committee, the Ministry of Energy is responsible for formulating the energy policy and industry regulations, including the validation and implementation of the institutional and regulatory framework regarding NCREs. Relevant experiences and resources will be drawn upon when analyzing the policy/regulatory framework during project implementation. Moreover, the Ministry is responsible for providing US$ 3.7 million in co-financing through a public tender mechanism for the implementation of biogas projects.

Ministry of Environment: apart from being a member of the Project Steering Committee, the Ministry of Environment is responsible for implementing and coordinating the National Climate Change Action Plan, comprising mitigation actions at national and local level, which include the incorporation of NCREs into the national energy matrix. The GEF Operational Focal Point in Chile belongs to this Ministry.

UNIDO: it will oversee the implementation of the Project. It will be represented by a designated UNIDO staff member in the Steering Committee.

Project Management Unit:

For daily management and coordination of project activities, a project management unit (PMU) will be set up. The PMU will be responsible for the project at local level and will be the main point of contact for government institutions and stakeholders. The PMU will also be responsible for elaborating the annual work plans. The PMU will include as a minimum the National Project Coordinator (NPC). PMU members will either be national consultants (Chile) or seconded from the national counterparts (CER, Ministries of Energy, Economy, or CORFO), unless otherwise agreed, and will be based in the offices of CER in Santiago de Chile. The National Project Coordinator will be responsible for the day-to-day management and supervision of the project, including overall technical aspects of the project, the coordination of contracting (consultants, sub-contracts) and monitoring activities. S/he will be supported by a Project Assistant (PA) as well as technical staff. All staff shall satisfy the selection criteria described in the Terms of Reference (TOR) to be developed and be hired using the Project's GEF and co-financing resources (CER). CER will provide in-kind support (office, communication, transport, local staff). The PMU will be responsible for coordinating the communication and dissemination of the project results, lessons learned and success stories that are important for the sustainable and future development of the involved market sectors in Chile.

Strategic Partners:

Several organisations will be engaged at different stages of project execution in order to provide and/or share specific experiences and knowledge and to participate in the project's activities.

An overview of the roles of each of the envisioned partners, which may be engaged in the execution of the Project, is given in the following table.

PARTNER	ROLE
Economic Development Agency (CORFO)	CORFO, founded in 1939, is the public agency in charge of promoting economic development, focusing on the national production of goods and services. CORFO has executed financial instruments targeting entrepreneurs for many years. In 2012 alone, it supported 167,188 beneficiaries with grants and non-grant instruments. CORFO is responsible for detailing and implementing financial support instruments for NCREs, including biogas under the baseline project (see Annex I). As such, it will also coordinate and implement the financial component of the envisaged SSRE NAMA and execute the funds made available for pre-investment studies under the GEF Project, under the responsibility of CER. CORFO, alongside sector organizations, will also support CER in the coordination and execution of the envisaged capacity building activities.
Ministry of Agriculture	Responsible for formulating the policy and industry regulations in the agriculture sector, including the promotion of the use of non-conventional renewable energies (NCREs) within relevant sub-sectors. Relevant experiences and resources will be drawn upon when analyzing the policy/regulatory framework during project implementation..
Superintendent for Electricity and Fuels (SEC)	The SEC, established in 1904, is the main public agency in charge of supervising the electricity and fuel markets. Among its competences is the establishment and enforcement of quality and safety standards for electrical and fuel-related installations. As such, the SEC has a primary role ensure safety of biogas installations.
Consorcio Lechero	The Consorcio Lechero is the main sector association for the dairy sector, including producers, dairy industry, cooperatives, service providers, and academic institutions. Its main objective is to facilitate the creation of value throughout the production chain and support its members to be competitive and prepared to operate in a globalizing market. Energy security and energy costs are among its priorities, as well as reducing the environmental footprint.
Consejo Nacional de Producción Limpia	The Clean Production Council belongs to the Ministry of Economy, Promotion and Tourism. Among other activities, it pursues the establishment of Clean Production Agreements (APLs) with a large variety of businesses, including the agriculture and livestock sector[52]. Although biogas-based energy production is not part of the sector APL, important synergies exist related to effluent control and the management of residues.
Foundation for Agricultural Innovation (FIA)	The Foundation for Agricultural Innovation is a public entity belonging to the Ministry of Agriculture, with the aim to support technological innovation and dissemination thereof in the agricultural sector. FIA presently provides financing for NRECs in the agricultural sector, and is implementing a biogas pilot programme in the dairy sector.
Institute for Agricultural and Livestock Development (INDAP)	INDAP is a public entity belonging to the Ministry of Agriculture. Its function is to promote and support the production and sustainable development of smallholder farms as part of Chile's agricultural sector. Through its programmes and services, INDAP aims to promote technological development in this sector and improve its commercial, entrepreneurial and organizational performance. (http://www.indap.gob.cl/que-es-indap)
Agricultural Research Institute (INIA)	INIA is the main institution in Chile in the field of agricultural research. It is a private corporate, non-profit entity dependent on the Ministry of Agriculture. It

[52] Please refer to the following link for an updated list of APLs: http://www.cpl.cl/Acuerdos%28APL%29/?sector=1

	started in 1964, when it was created by the Agricultural Development Institute, the Chilean Economic Development Agency (CORFO) and the universities: Universidad de Chile, Pontificia Universidad Católica de Chile and the Universidad de Concepción. INIA has national geographic coverage made up of 10 regional research centers located in the Coquimbo, Valparaíso, Metropolitan, Libertador Bernardo O'Higgins, Maule, Bío Bío, Araucanía, Lagos, Aysén and Magallanes regions. INIA has 983 employees and more than 17,500 hectares to carry out research, transfer and extension projects, and has appropriate laboratories, libraries and facilities for such tasks. It is funded by public and private funds, research projects and the sale of technological supplies. It has recently installed a biogas demonstration plant in the Osorno, Lagos Region (INIA Remehue) with technical and financial support from FIA. (http://www.inia.cl/acerca-de-inia/?lang=en)
Private companies	These form the main beneficiaries of the project, including SMEs in select agro-industries (such as dairy) as well as engineering companies that supply biogas technology and consultancy services. Both Fundo Playa Venado and Schwager Biogás have committed co-financing to the pilot projects to be established under the Project. Through the public funding made available by the Ministry of Energy, through the NAMA Financial Component as well as CORFO and others, additional private sector companies will be involved with the Project.

B.2 Describe the socioeconomic benefits to be delivered by the Project at the national and local levels, including consideration of gender dimensions, and how these will support the achievement of global environment benefits (GEF Trust Fund/NPIF) or adaptation benefits (LDCF/SCCF):

The proposed Project fits into national strategies to promote cleaner production technologies, enhance sector productivity and competitiveness, preserve natural resources, protect the local and global environment and diversify the energy mix by increasing the share of renewable energies. The Project is expected to deliver tangible socio-economic benefits for Chile in the targeted sectors as a whole and as individual businesses, as well as for the men, women and their families involved.

The socio-economic benefits at national level (country) are achieved as a result of the expected economic growth in the targeted sectors. With the inclusion of biogas technologies and the accompanying better effluent management and treatment technologies, environmental impacts derived from business activities would be reduced, thus increasing their competitiveness in the market, which may be translated into growth. This particularly applies to the Chilean dairy sector, which is increasingly export-oriented. Additionally, the Project will contribute to reduce economic dependence on fossil fuel imports through strengthening the energy diversification strategy by increasing the use of renewable energy.

The Project will provide direct technical assistance to identified subsectors (dairy farmers) that can contribute to the reduction of GHG emissions. These will benefit from the Project by acquiring technological know-how to reduce the environmental impact of effluents, increase the use of renewable energy sources (specifically biogas) and reduce sector methane emissions. This technological capital will create opportunities to: (i) add value to the product chain and become more successful on the international markets for dairy (commodity) products; (ii) reduce the present burden on the environment of the dairy sector in Chile; (iii) assist producers in the primary sector and industries to become more competitive; and (iv) strengthen the supply of energy in rural area in Chile through self-supply and/or distributed generation of heat and electricity.

Through the transfer of state-of-the-art technological concepts and project designs, the Project contributes to the development of a professional sector able to design, implement and operated biogas technology systems and equipment, including the provision of adequate after-sales services. This entails high-quality jobs in the field of engineering, agronomy, consultancy and project development with increased value creation, thereby offering opportunities for local professionals to attain higher incomes and sustain the creation human capital resources in the country. With regard to the group of small dairy farmers, the Project will contribute to improving their economic position by demonstrating the applicability of biogas technology and providing them with a reliable source of energy to replace more costly fossil fuels and electricity. Government and sector organizations consider this impact as highly relevant for this group of farmers and their families.

As mentioned in the description of Outputs 4.1 and 4.2 (on pages 20 and 21) as well as indicated in the logframe (Annex A on pages 32-34), gender will be mainstreamed throughout project implementation. It is expected that social and economic benefits from the implementation of biogas-based energy supply and low-carbon technologies will be shared equally by male and female workers in the respective sectors. Direct creation of jobs is an important opportunity that could benefit both men and women. Women often have a predominant role to sustain smallholder economies and therefore the Project may benefit those women in this kind of situation.

B.3. Explain how cost-effectiveness is reflected in the project design:

Bearing in mind that the GEF allocation of resources for this project is US$ 1,715,151, the cost-effectiveness is estimated at US$ 56 / ton CO_2eq, considering only the direct GHG benefits over the initiative's lifetime (30,900 tons CO_2eq). If the indirect GHG benefits (total 461,900 tons CO_2eq, bottom-up approach) are included, the cost-effectiveness improves to approximately US$ 3.71 / ton CO_2eq.

C. DESCRIBE THE BUDGETED M &E PLAN:

Project monitoring and evaluation (M&E) will be conducted in accordance with established UNIDO and GEF procedures. The M&E activities are defined by Project component #4 and the activities for M&E are specified and budgeted in the M&E plan (please refer to the table below). Monitoring will be based on the indicators defined in the Strategic Results Framework (which indicates the means of verification) and the Annual Work Plans. M&E will make use of the GEF Tracking Tool, which will be submitted to the GEF Secretariat three times during the implementation of the Project (at CEO Endorsement, as part of the Mid-term Review and upon submission of the Terminal Evaluation.

UNIDO, as the GEF Implementing Agency, will involve the GEF Operational Focal Point and project stakeholders at all stages of project monitoring and evaluation activities in order to ensure usage of their results to guide further planning and implementation.

It is further noted that CER has an MRV platform in place to track the energy production and emission reductions delivered by the renewable energy projects that will materialized under the NAMA. This platform will facilitate impact monitoring of the present Project.

MONITORING AND EVALUATION PLAN AND BUDGET (INDICATIVE)

Type of M&E activity	Responsible Parties	Budget USD*			Time frame
		GEF	UNIDO	Gov't (in-kind)	
Inception Workshop (IW) and inception report	UNIDO Project Manager (PM); Project Management Unit (PMU)	0	5,000	10,000	Within first months of project start up
Backstopping by M&E specialist	UNIDO Project Manager (PM); Project Management Unit (PMU); expert consultancy	10,000	0	0	As needed
Periodic progress reports and monitoring of project impact indicators (as per LogFrame)	UNIDO Project Manager (PM); Project Management Unit (PMU); Project Steering Committee (PSC); expert consultancy	10,000	40,000	2,000	Semi-annually
Measurement GEF Tracking Tool specific indicators	UNIDO Project Manager (PM); Project Management Unit (PMU); Project Steering Committee (PSC); expert consultancy	5,000	0	3,000	Mid of project and at project completion
Mid-term review	UNIDO Project Manager (PM); Project Management Unit (PMU); expert consultancy	20,000	5,000	5,000	Mid of project

Type of M&E activity	Responsible Parties	Budget USD*			Time frame
		GEF	UNIDO	Gov't (in-kind)	
Independent terminal project evaluation	Independent evaluator managed by UNIDO ODG/EVA.	35,000	10,000	0	Project completion (at least one month prior to the end of the project and no later than six months after project completion)
TOTAL indicative cost		80,000	60,000	20,000	

According to the Monitoring and Evaluation policy of the GEF and UNIDO, follow-up studies like Country Portfolio Evaluations and Thematic Evaluations can be initiated and conducted. All project partners and contractors are obliged to: (i) make available studies, reports and other documentation related to the Project; and (ii) facilitate interviews with staff involved in the project activities.

Legal Context:

The present project is governed by the provisions of the Standard Basic Cooperation Agreement between the Government of the Republic of Chile and UNIDO, signed on 26 April 1988.

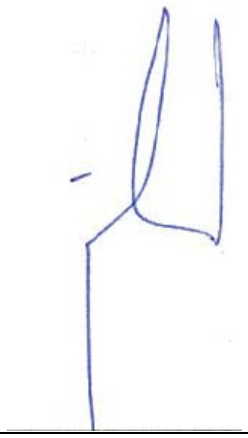
PART III: APPROVAL/ENDORSEMENT BY GEF OPERATIONAL FOCAL POINT(S) AND GEF AGENCY(IES)

A. RECORD OF ENDORSEMENT OF GEF OPERATIONAL FOCAL POINT(S) ON BEHALF OF THE GOVERNMENT(S):): (Please attach the Operational Focal Point endorsement letter(s) with this form. For SGP, use this OFP endorsement letter).

NAME	POSITION	MINISTRY	DATE *(MM/dd/yyyy)*
Mrs. Ximena George-Nascimento	GEF Operational Focal Point	**MINISTRY OF ENVIRONMENT**	**02/01/2013**

B. GEF AGENCY(IES) CERTIFICATION

This request has been prepared in accordance with GEF/LDCF/SCCF/NPIF policies and procedures and meets the GEF/LDCF/SCCF/NPIF criteria for CEO endorsement/approval of project.

Agency Coordinator, Agency Name	Signature	Date *(Month, day, year)*	Project Contact Person	Telephone	Email Address
Philippe R. Scholtès Managing Director Programme Development and Technical Cooperation Division (PTC) UNIDO GEF Focal Point		29/07/2014	Nina Zetsche, Industrial Development Officer, PTC/ECC/RRE, UNIDO 	+43 (1) 26026 3569	n.zetsche@unido.org

ANNEX A: PROJECT RESULTS FRAMEWORK (either copy and paste here the framework from the Agency document, or provide reference to the page in the project document where the framework could be found).

UNIDO/GEF Project: CHILE - Promoting the Development of Biogas Energy Amongst Select Small – and Medium Sized Agro-Industries.					
Applicable GEF Strategic Objective and Program: CCM Objective 3 "Promote investment in renewable energy technologies"					
Applicable GEF Expected Outcomes: CCM-3 "Favorable policy and regulatory environment created for renewable energy investments"; "Investment in renewable energy technologies increased"					
Applicable GEF Outcome Indicators: CCM-3 "RE policy and regulation in place"; "Electricity and heat produced from renewable resources"					
	Indicator	**Baseline**	**Targets (End of Project)**	**Means of verification**	**Assumptions**
Project Objective	**To reduce GHG emissions by promoting investment and market development of biogas energy technologies in small- and medium-sized agro-industries.**				
Component 1	**Policy and information.**				
Outcome 1. Policies targeting the development of biogas-based electricity and heat generation in agro-industries have been strengthened.	**Extent to which RE policies and regulations are adopted and enforced (score of 0 to 5)** [53] **% of policies and regulations in which women associations have been consulted**	**no regulation in place; level (1)** **no women's associations have been specifically consulted (0)**	**level 4 (regulation adopted but not enforced)** **women's associations have been specifically consulted (1)**	**official publications; final evaluation; meeting reports**	**(1) Sustained government commitment to strengthen regulatory framework; (2) approval of the proposed regulation by National Congress; (3) demonstrated economic, social and environmental benefits of decentralized (biogas) power generation compared to baseline situation; (4) interest by women's associations to be consulted.**
Output 1.1 Preparation and supporting adoption of secondary regulation supportive for biogas energy plants in agro-industries.	regulation for: (a) digestate quality and transport, and (b) safety of biogas installations.	no regulation in place (0)	regulation discussed, submitted for approval and adopted (level 4)	project records; official publications	(1) Sustained government commitment to strengthen policy framework; (2)) approval of the proposed regulation by National Congress; (3) adequate coordination between involved authorities (CER, SEC, Min Agriculture, Min Environment) and sector stakeholders.
Output 1.2 Collection and consolidation of technical, financial and economic parameters for biogas energy projects in small- and medium-size agro-industries.	Detailed set of consolidated parameters for biogas in Chile.	No consolidated data set available for biogas in Chile (0)	Consolidated data set (1)	project publications	(1) Sector stakeholders are willing to share information; (2) installed biogas systems yield realistic data on project design, costs, and performance.

[53] Level rating as defined in the GEF CC Tracking Tool.

Component 2	**Technical capacities and delivery skills.**				
Outcome 2. Adequate design, installation and operation practices for biogas energy plants in the agro-industrial sector have been adopted due to improved capacities of developers, suppliers and technicians.	**Number of biogas professionals trained**	**No. biogas professionals trained.**	**Biogas professionals trained (75)**	**Project documents; field visits**	**(1) Sector stakeholders have sustained interest in training on biogas technology; (2) Project activities are implemented as planned.**
Output 2.1 Scoping and design of a training and certification programme for project developers, suppliers, installers and operators of biogas energy systems in agro-industries.	Report with training programme, which considers specific incentives and facilities for female participants	No training programme designed (0)	Training programme designed (1)	project documents	(1) Sector stakeholders have sustained interest in training on biogas technology; (2) Project activities are implemented as planned.
Output 2.2 Training and certification of prospective project developers, suppliers, installation companies, and operators of biogas-based energy plants.	(a) Number of biogas professionals trained; (b) certified.	(a) No. biogas professionals trained (0); (b) certified (0).	(a) biogas professionals trained (75 of which at least 10% shall be women); (b) certified (50).	project documents; certificates issued; field visits	(1) Sector stakeholders have sustained interest in training on biogas technology; (2) Project activities are implemented as planned.
Component 3	**Investment and project portfolio.**				
Outcome 3. Biogas energy has been adopted by select agro-industries.	**Biogas projects started operations;** **Jobs (including temporary) created;** **Private investment capital leveraged (USD).**	**No biogas projects started operations (0);** **No biogas related jobs created (0);** **USD 0.**	**A total of 750 kW projects started operations;** **At least 10 biogas related jobs (including temporary) created;** **USD 11 million;**	**Project documents and publications; field visits; project evaluations.**	**(1) Sector stakeholders have sustained interest in training on biogas technology; (2) Proposed projects are able to attract adequate financing.**
Output 3.1 Technical assistance to small- and medium-sized agro-industries for the development of biogas energy projects.	(a) Permanent help desk (or task force) on biogas within CER; (b) Number of biogas projects assisted during pre-investment phase.	(a) Generic support on NCREs by CER; (b) Project portfolio under tenders until 2013.	(a) Helpdesk (or task force) on biogas established complementing baseline situation[54]; (b) At least twenty projects supported (20).	project documents, official publications CER;	(1) Sector stakeholders have sustained interest in training on biogas technology; (2) Baseline activities provide a solid institutional context; (3) Calls for proposals on biogas proceed as expected.
Output 3.2 Promotion and	(a) Gender	(a) No specific	(a) Gender	project	(1) Sector stakeholders have sustained interest in

[54] Including generic support by CER and the activities (helpdesk and technical assistance) envisaged under the SSRE NAMA.

dissemination of information and best practices regarding biogas energy technology for small and medium agro-industries in Chile.	mainstreamed publication on biogas in dairy sector with best practices and key parameter[55]s; (b) Gender mainstreamed promotional material (brochures, website) available; (c) Presence of Project on business fairs and events.	publication (0); (b) No material developed (0); (c) Isolated activities by sector stakeholders (0).	mainstreamed publication on biogas with best practices and key parameters (1); (b) Gender mainstreamed promotional material developed and distributed (1); (c) Presence of Project in at least three events (3).	documents and publications; field visits; project evaluations	training on biogas technology; (2) Baseline activities provide a solid institutional context; (3) Project activities are implemented as planned.
Output 3.3 Establishment of a portfolio of biogas energy projects in the dairy sector to qualify for external financing and implementation initiated for selected biogas energy projects (750kW) under a public tender mechanism.	(a) Number of projects with feasibility and technical studies; (b) Number of projects legally structured and with permits in place; (c) Biogas projects approved under CER tender; (d) Biogas projects started operations.	(a) No studies (0); (b) No projects legally structured, and no permits obtained (0); (c) Nonviable proposals received under earlier tenders (0); (d) No biogas projects started operations (0).	(a) Twenty projects with feasibility and technical studies completed (20); (b) Twenty projects legally structured and with permits in place (20). (c) A total of 750 kW biogas projects approved under CER tender; (d) A total of 750 kW projects started operations.	project documents and publications; technical reports; field visits project evaluations	(1) Sector stakeholders have sustained interest in training on biogas technology; (2) Sufficient expert support is available; (3) Proposed projects are able to attract adequate financing.
Output 3.4 Creation of an enabling environment for financial instruments facilitating access to investment in biogas energy plants for small- and medium-sized agro-industries.	(a) Number of biogas energy projects in small- and medium-sized enterprises accessing existing technology specific financial instruments. (b) Private investment capital leveraged.	(a) No biogas projects accessing technology specific subsidies and financing windows (0); (b) None (USD 0).	(a) Five projects have submitted business plans to access existing technology specific financial instruments; (b) At least USD 11 million.	Project documents and publications; field visits.	(1) Sustained Government interest in biogas market development; (2) Agreements between Government in Chile, NAMA Facility and lending institutions; (3) Establishment of technology specific financial instruments.

N.B. Output 3.4 solely depends on co-financing.

[55] As an example may serve the German publication for the agricultural sector by KTBL Darmstadt (Germany) "Faustzahlen Biogas, Erscheinungsjahr 2013, ISBN 978-3-941583-85-6" (in German). See: www.ktbl.de.

ANNEX B: RESPONSES TO PROJECT REVIEWS (from GEF Secretariat and GEF Agencies, and Responses to Comments from Council at work program inclusion and the Convention Secretariat and STAP at PIF).

Comments	Response	Reference in documents
Comments from the GEF Council		
None received.		
Comments from the GEF Secretariat		
12. Is the project consistent and properly coordinated with other related initiatives in the country or in the region? By CEO Approval, please provide concrete institutional arrangements to ensure that there are linkages between the proposed GEF project and the CTF-funded initiatives.	The Project is embedded in a national policy context pursuing the accelerated implementation of non-conventional renewable energy (NCRE) technologies, including biogas, in Chile. Government-led initiatives include specific regulation for biogas (digestate, safety of installations, grid connection), access to finance (financing instruments by CORFO, FIA and INDAP targeting SMEs in agriculture and livestock sector, generic as well as specific for NCREs). Recently, the "Self-Supply Renewable Energy" NAMA instruments has been approved, which provides a strong policy and institutional context for the GEF project to build upon. In a regional context, it is mentioned that UNIDO has developed a GEF-funded biogas project in Uruguay, which will exchange experiences and knowledge with the present project in Chile. The Clean Technology Fund (CTF) remains relevant as a source of capital for investment in NCREs, including biogas. However, CTF funds are primarily focused on large-scale projects, including PV. The SSRE NAMA however, is closely aligned with the present Project, in terms of technology, project scale and beneficiaries. Therefore, the NAMA has been taken as point of departure to formulate the baseline project. The linkages between the NAMA and the GEF project are described in section A.1 and in the Annex H "Description of the NAMA Mechanism".	See section A.3 (p.5). See section A.1 (p.5) and Annex H.
25. Items to consider at CEO endorsement/approval. (a) Confirmation and detailed analysis of GHG emission reduction figures. (b) Modalities for management and administration of the non-grant instrument. (c) Concrete institutional arrangements to ensure that there are linkages between the	(a) The direct and indirect GHG emission reductions have been evaluated (see Annex M "Incremental action of GEF intervention and GHG benefits"). Please note that additional assumptions would be needed to assess the GHG emission reductions of individual biogas projects with a better accuracy. Including: type of energy produced and replaced (LPG, electricity, diesel), type of technology, project efficiency, transport emissions, other project parameters. These parameters will vary according to the scale and type of project. With respect to biogas-based electricity production, the CO2-intensity of grid electricity may be subject to a baseline shift. Please note that avoided methane emissions from the decomposition of organic material (manure) are not claimed by this Project under CCM-3. (b) Please note that a GEF-funded, non-grant instrument is no longer foreseen in the Project design given the existence of a similar facility under the SSRE NAMA. This facility will be operated by CER and CORFO and is expected to attract additional capital. The management and administration modalities hereof are described in the Annex H "Description of the NAMA Mechanism", p.5.	See section A.5, p.21-22 See Annex H. See Annex H.

proposed GEF project and the CTF-funded initiatives	(c) Please refer to the answer under (b).	
(d) Details on whether future calls for proposals are planned beyond 2014 by the government of Chile	(d) This is included in the baseline programme. The national counterparts expect that renewable energy for self-supply will continue to be promoted by the Government of Chile, however , no formal declaration in this regard has been made by the new government yet.	
(e) Details on who will take care of the adjustments of the proposed model to other regions of Chile (adjustments for regional differences) and how this will be ensured.	(e) The support model (i.e. business support by CER/CORFO, with financial inputs from the SSRE NAMA and other international funding sources, combined with technical assistance to project developers, SME and investors) is valid in the whole territory. With a view on small- and medium-sized agricultural enterprises, including the dairy sector, sector agencies such as FIA, INDAP, and INIA have national coverage. However, agricultural activity is bound to specific regions, mainly bound to latitude. (For example, the dairy sector is concentrated in the central-southern part of the country.) Another aspect that may vary according to region is farm size, which is largely a result of local socio-economic and demographic conditions. Regional differences will therefore translate into variations in terms of the scale, type, and financing of biogas projects. While CER/CORFO, and its partners will provide assistance to support project development, the private sector will be responsible for shaping biogas projects in a way that best suits its needs. The GEF project is expected to provide valuable inputs and lessons to this purpose.	
(f) Clarification on the baseline use of the biomass and whether this baseline currently leads to anaerobic fermentation (and methane) or only aerobic fermentation (and therefore mainly CO2).	(f) The present use of biomass (manure) in the dairy sector is as a fertilizer, by spreading it on the fields, where it is degraded primarily by aerobic fermentation. Please note that the Project does not claim any emission reductions related to avoided methane releases.	See Annex H.
(g) Detailed information clarifying the respective roles of CORFO and CER in the management and funding of the non-grant instrument.	(g) Please refer to the answer under (b).	
h) A budgeted M&E Plan that monitors and measures results with indicators and targets.	(h) A budgeted M&E plan is foreseen under Component 4 of the Project (see Table M&E Plan, page 29). The indicators and targets proposed in the Strategic Results Framework (SRF) will be reviewed and agreed upon during the inception phase of the Project.	See section C, p.29
i) Provide quantifiable SMART indicators for the logframe.	(i) SMART indicators have been provided in the SRF (logframe), Annex A.	See Annex A

ANNEX C: STATUS OF IMPLEMENTATION OF PROJECT PREPARATION ACTIVITIES AND THE USE OF FUNDS[56]

A. PROVIDE DETAILED FUNDING AMOUNT OF THE PPG ACTIVITIES FINANCING STATUS IN THE TABLE BELOW:

PPG Grant Approved at PIF: **USD50,000**			
Project Preparation Activities Implemented	***GEF/LDCF/SCCF/NPIF Amount ($)***		
	Budgeted Amount	***Amount Spent To date***	***Amount Committed***
1. Analysis of policy & regulatory framework*	N/A	--	--
2. Analysis of financial barriers	11,500	5,801	5,699
3. Analysis of technical & commercial framework**	1,500	0	1,500
4. Analysis of potential for biogas energy development in the select agro-industries*	N/A	--	--
5. CEO Endorsement Request	37,000	23,689	13,311
Total	50,000	29,490	20,510

*Fully covered by UNIDO co-financing.
**Additionally covered by UNIDO co-financing.

[56] If at CEO Endorsement, the PPG activities have not been completed and there is a balance of unspent fund, Agencies can continue undertake the activities up to one year of project start. No later than one year from start of project implementation, Agencies should report this table to the GEF Secretariat on the completion of PPG activities and the amount spent for the activities.

ANNEX D: CALENDAR OF EXPECTED REFLOWS (if non-grant instrument is used**)**

Provide a calendar of expected reflows to the GEF/LDCF/SCCF/NPIF Trust Fund or to your Agency (and/or revolving fund that will be set up)

No reflows to the GEF Trust Fund are foreseen under this Project

Not applicable.

ANNEX E: BUDGET ALLOCATION

BUDGET ALLOCATION (INDICATIVE)							
COMPONENTS & ACTIVITIES							
		GEF	UNIDO	GoC		UNIDO Budget lines	
			cash	in-kind	cash	code	description
		(US$)	(US$)	(US$)	(US$)		
COMPONENT 1. POLICY AND INFORMATION.							
1.1	(i) two national experts hired to prepare regulation, associated to CER	35,500	0	150,000	0	17-00	national experts
	(ii) international biogas expert hired for backstopping and advisory tasks	24,500	0	0	0	11-00	international experts
1.2	(i) subcontracted company to collect and consolidate biogas project parameters	40,000	0	60,000	0	21-00	subcontracts
	Subtotal	100,000	0	210,000	0		
COMPONENT 2. Technical capacities and delivery skills.							
2.1	(i) subcontract to national institute/company for design of training and certification programme	30,000	0	30,000	0	21-00	subcontracts
2.2	(i) one or more international experts for training activities and technical advice incl. exploration of potential mechanisms for long-term sustainability of the proposed scheme	58,000	0	0	0	11-00	international experts
	(ii) one or more subcontracts for hosting of training events in several places in Chile	17,000	0	50,000	0	21-00	subcontracts
	(iii) one or more subcontracts to national institute / company for organization and execution of training programme	125,000	0	200,000	0	21-00	subcontracts
	Subtotal	**230,000**	**0**	**280,000**	**0**		
COMPONENT 3. Investment and project portfolio.							
3.1	(i) one or more international biogas experts hired for technical and legal advisory tasks, including project reviews	100,000	0	50,000	0	11-00	international experts

	(ii) subcontract to national institute to provide long-term technical assistance on biogas energy project development in the targeted sector	250,000	0	450,000	0	21-00	subcontracts
3.2	(i) one or more subcontracts to national institutes/ companies to execute promotional and dissemination activities	70,000	0	50,000	0	21-00	subcontracts
	(ii) one or two national experts hired to implement and coordinate promotional activities	30,000	0	10,000	0	17-00	national experts
3.3	(i) subcontract for co-funding pre-investment costs of biogas projects submitted to CER/CORFO	700,000	0	0	0	21-00	subcontracts
	(i) CER/CORFO co-funding of 750 kW biogas projects under local contract agreements	0	0	0	800,000	21-00	subcontracts
3.4	(i) CER/CORFO public funding of SSRE NAMA Financial Component	0	0	0	2,900,000	21-00	subcontracts
	Subtotal	**1,150,000**	**0**	**560,000**	**3,700,000**		
COMPONENT 4. MONITORING & EVALUATION							
4.1	(i) subcontract for hosting of inception workshop	0	5,000	10,000	0	21-00	subcontracts
	(ii) subcontract for design of monitoring plan and tools	5,000	0	0	0	17-00	national experts
	(iii) international M&E specialist to provide backstopping	5,000	0	0	0	11-00	international experts
4.2	(i) international expert on progress monitoring	10,000	5,000	0	0	11-00	international experts
	(ii) national consultancy in gender issues and human development	5,000	0	5,000	0	17-00	national experts
	(iii) UNIDO PM support for project monitoring	0	35,000	0	0	16-00	staff travel
4.3	(i) international / national consultancy for mid-term review	20,000	5,000	5,000	0	11-00 / 17-00	international / national experts
	(ii) international / national consultancy for GEF terminal evaluation	35,000	10,000	0	0	11-00 / 17-00	international / national experts
	Subtotal	**80,000**	**60,000**	**20,000**	**0**		
TOTAL (COMPONENT 1-4)							
	TOTAL	**1,560,000**	**60,000**	**1,070,000**	**3,700,000**		

N.B. UNIDO in-kind support will mainly contribute to activities undertaken under output 3.2.

SUMMARY KEY BUDGET LINES (COMPONENT 1-4)				
UNIDO Allotment line	**Funding Source (in USD)**			
	GEF	**UNIDO (cash)**	**GoC (in-kind)**	**GoC (cash)**
international experts (11-00)	232,500	12,500	50,000	0
national experts (17-00)	95,500	7,500	170,000	0
subcontracts (21-00)	1,232,000	5,000	850,000	3,700,000

PROJECT MANAGEMENT BUDGET ALLOCATION AND PROCUREMENT					
COMPONENTS & ACTIVITIES	**BUDGET ALLOCATION**				
	Funding Source		**Procurement**		
	GEF	**COF (in-kind)**	**UNIDO Allotment line**		**responsible entity**
	(US$)	**(US$)**	**code**	**description**	
PROJECT MANAGEMENT					
Project Coordinator (3 yrs.) – Santiago de Chile	**140,151**	**0**	17-00	national experts	UNIDO
Administrator (3 yrs. part-time) - Santiago de Chile	**0**	**60,000**			CER
Communication	**0**	**30,000**			CER
Office space (Santiago de Chile)	**0**	**40,000**			CER
Transport	**0**	**30,000**			CER
Travel	**15,000**	**0**	21-00	subcontracts	UNIDO
Supervision CER	**0**	**40,000**			CER
TOTAL PROJECT MANAGEMENT COSTS					
TOTAL	**155,151**	**200,000**			

ANNEX F: ANNUAL BUDGET

				PLANNING		
				YEAR 1	YEAR 2	YEAR 3
	GEF	Co-Financing		GEF	GEF	GEF
		in-kind	cash			
	(US$)	(US$)	(US$)			
COMPONENT 1. POLICY AND INFORMATION.						
1.1 Preparation and supporting adoption of secondary regulation supportive of biogas energy plants in agro-industries.	**60,000**	150,000	0	34,000	15,500	10,500
1.2 Collection and consolidation of technical, financial and economic parameters for biogas energy projects in small- and medium-sized agro-industries.	**40,000**	60,000	0	0	25,000	15,000
Sub-total 1	**100,000**	**210,000**	**0**	**34,000**	**40,500**	**25,500**
COMPONENT 2. TECHNICAL CAPACITIES AND DELIVERY SKILLS.						
2.1 Scoping and design of a training and certification programme for project developers, suppliers, installers and operators of biogas energy systems in agro-industries	**30,000**	30,000	**0**	30,000	0	0
2.2 Training and certification of prospective project developers, suppliers, installation companies, and operators of biogas-based energy plants.	**200,000**	250,000	**0**	70,000	70,000	60,000
Sub-total 2	**230,000**	**280,000**	**0**	**100,000**	**70,000**	**60,000**
COMPONENT 3. INVESTMENT AND PROJECT PORTFOLIO.						
3.1 Technical assistance to small- and medium-sized agro-industries for the development of biogas energy projects.	**350,000**	500,000	0	115,000	125,000	110,000
3.2 Promotion and dissemination of information and best practices regarding biogas energy technology for small- and medium-sized agro-industries in Chile.	**100,000**	100,000	0	35,000	55,000	10,000
3.3 Establishment of a portfolio of biogas energy projects in the dairy sector to qualify for external financing and implementation initiated for selected biogas energy projects (750 kW) under a public tender mechanism.	**700,000**	15,500	4,700,000	100,000	300,000	300,000
3.4 Creation of an enabling environment for financial instruments facilitating access to investment in biogas energy plants for small- and medium-sized agro-industries.	**0**	0	10,359,000	0	0	0
Sub-total 3	**1,150,000**	**615,500**	**15,059,000**	**250,000**	**480,000**	**420,000**
COMPONENT 4. MONITORING AND EVALUATION.						

4.1 A monitoring plan has been designed and agreed upon during the Project's inception phase.	**10,000**	10,000	5,000	10,000	0	0
4.2 Project progress on defined indicators and compliance with UNIDO guidelines (including gender) is being monitored.	**15,000**	5,000	40,000	3,000	6,000	6,000
4.3 A mid-term review and terminal evaluation have been conducted.	**55,000**	5,000	15,000	0	20,000	35,000
Sub-total 4	**80,000**	**20,000**	**60,000**	**13,000**	**26,000**	**41,000**
SUBTOTAL	**1,560,000**	**1,125,500**	**15,119,000**	**397,000**	**616,500**	**546,500**
PROJECT MANAGEMENT	**155,151**	**200,000**		**48,151**	**54,000**	**53,000**
TOTAL PROJECT COSTS	**1,715,151**	**1,325,500**	**15,119,000**	**445,151**	**670,500**	**599,500**

ANNEX G: TRACKING TOOL FOR CLIMATE CHANGE MITIGATION PROJECTS

Separate file with file name “Annex G_GEF CC Mitigation Tracking Tool.xls”

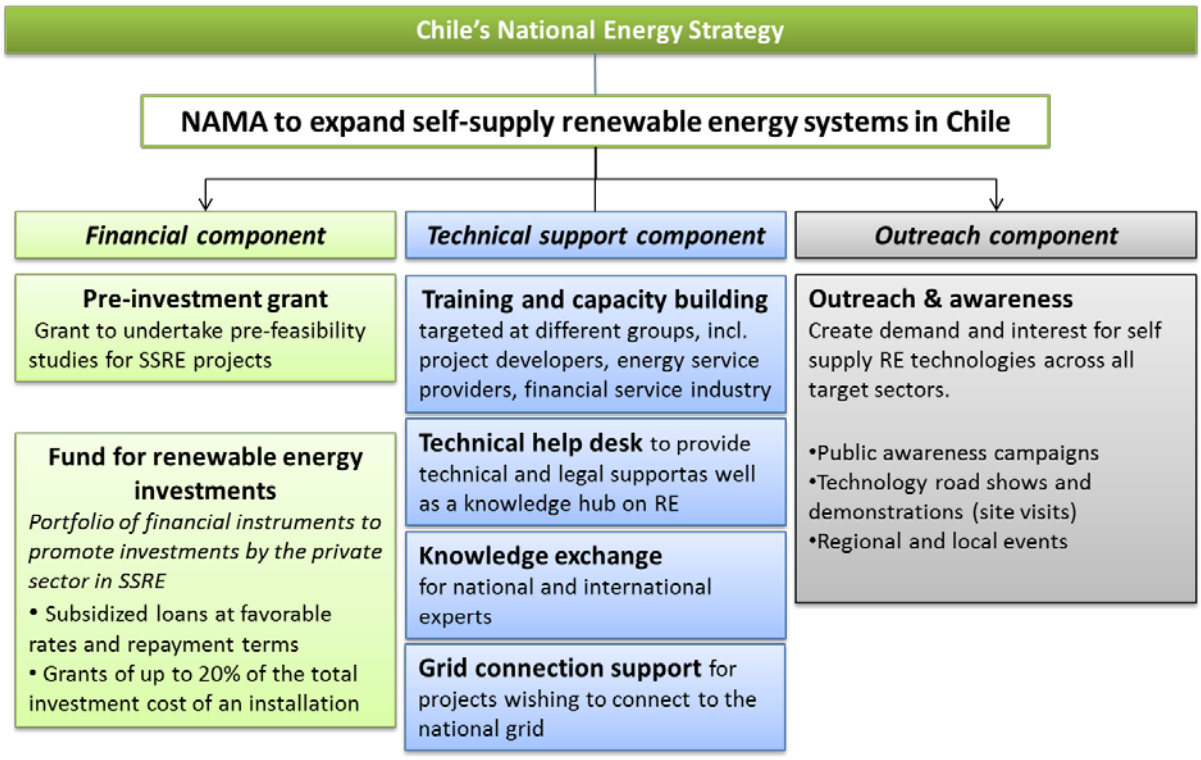
ANNEX H: DESCRIPTION OF NAMA MECHANISM[57]

Objective:

The overarching objective of the NAMA is to promote the incorporation of Renewable Energy systems for Self-Supply in Chile by creating adequate financial and technical conditions for the early stages of development of this emerging industry.

This NAMA aims to foster SSRE project development in Chile by strengthening a market that is almost inexistent today. It will do so through: (i) a Financial Component to remove financial barriers and incentivize SSRE investments; and (ii) a Technical Component to develop the complementary SSRE industry and specialized market segment.

The structure and components of the SSRE NAMA are outlined in the next figure and will be described in the next paragraphs.



Financial component:

The specific objective of the financial component of the NAMA is to leverage around USD 100 million in investment. This is achieved through an appropriate mix of financial instruments. The long-term financial ambition of the NAMA is to leverage investments and financing for SSRE projects and create a stable investment and financing environment. The expected GHG reduction associated to this portfolio is 2 million ton of $CO2_{eq}$ (over the project lifetime of 20-25 years), considering the emission factors officially used for the grids and the following distribution of technologies:

[57] This Annex is based on documents (1) "Template for NAMA Support Project Outlines for the project Self-Supply Renewable Energy in Chile (SSRE)" submitted by the Ministry of Energy of Chile to the International NAMA Facility; and (2) "NAMA Proposal Self-supply renewable energy (SSRE) in Chile" prepared by Ecofys and Fundación Chile on behalf of CER, with support from the German Federal Ministry of Environment, Nature Conservation and Nuclear Safety.

Renewable Energy Technology	Expected share
PV	35%
Biomass	33%
Biogas	16%
Solar water heating	9%
Mini hydro	4%
Wind	3%

The financial component aims to facilitate the entry of project developers and financial institutions into this new business area. It will offer the following support instruments to overcome the identified financial barriers:

(i) Co-financing for pre-feasibility studies;
(ii) Tailor-made investment grant scheme for project promoters;
(iii) Partial credit guarantee scheme for local financial institutions; and
(iv) Advisory services for financial sector institutions.

CER together with CORFO will be responsible for the implementation of the project components. Hereby they can build upon their experience in the RE financing sector. The implementation and adequate use of a mix of financial instruments will be backed by training of financing institutions. All SSRE technologies are eligible provided that they meet certain criteria. The most relevant technologies include:

- Photovoltaic panels;
- Solar water heaters;
- Waste-to-energy biogas;
- Waste-to-energy biomass;
- Mini-hydro power;
- Geothermal heat pumps; amd
- Small scale wind energy.

The financial component seeks to develop and foster local financial capacities and mobilise investment and financing for SSRE projects. The four activities of this component are:

A. Development of a bankable project pipeline: A bankable project pipeline is Chile is lacking due to the fact that either project promoters are not willing to bear the high up-front cost of (pre-) feasibility studies given the uncertain availability of funds to realize the projects or due to the fact that existing studies do not meet the information requirements of commercial banks to make their financing decisions. The programme will provide co-financing to undertake necessary (pre)-feasibility studies of at least 250 SSRE projects at a total cost of EUR 1.5 million. (Pre)-feasibility studies that will be eligible for co-financing will need to meet the required quality and information requirements of potential financiers. These study grants will be provided in the early stage of the programme to help build a pipeline of quality projects. The majority of the funds available for the grant would presumably be disbursed in the first three years of operation of the programme. The need for pre-investment grants should

diminish once the market becomes more familiar with the technologies and the industry is better established.

B. Training and advisory services for financial sector institutions: This instrument aims at strengthening relevant staff of financial institutions interested in financing SSRE projects. A total amount of EUR 400,000 will be needed for this component. Training and advisory activities will focus among other things on the following aspects: (i) Assessment of bankable SSRE business models in the local market; (ii) Development of standardized financing proposals for eligible projects; (iii) Training of staff for efficient screening and assessment of project proposals; (iv) Screening and filtering of (pre-) feasibility studies and promotion of suitable identified projects to local financial institutions.
C. Investment grants: At the investment stage, the financial component will provide financial incentives to project promoters in the form of investment grants to cover part of investment costs and therefore incentivize the investment decision of the promoter. A total amount of EUR 3.5 million will be considered as investment grants. EUR 2 million will be financed with resources from the NAMA facility and EUR 1.5 million with own resources from the Chilean government. These facilities aim at subsidizing up to 20% of the total installed capacity cost, including technology, installation costs, grid connection, and permitting, engineering and other required expenses. The expected leverage ratio of this financial instrument is approximately 1:4.
D. Guarantee fund: A EUR 8 million fund for partial credit guarantees will be established in order to raise a larger pool of capital from financial institutions for project loans. This scheme aims to facilitate financing from local commercial banks through sharing or bearing the anticipated losses of SSRE projects. The cost efficient structuring of the credit guarantee fund will be determined in an in-depth study during the appraisal phase of the project. The expected leverage ratio of this financial instrument is approximately 1:6-7.

The Chilean Economic Development Agency CORFO will be the executing entity of the fund. CORFO has a long-standing experience in financing grid connected RE projects. Furthermore, CORFO is already operating several successful guarantee funds for SME financing of local financial institutions.

There will be two investment support instruments available: a subsidized loan and an investment grant. Applicants may apply for funding for either instrument or for both. Selection will be through a competitive process that considers funding requested vs. impact generated. Subsidized loans will be given preference over grants as these carry a lower cost to the programme. There will also be secondary criteria that assess risks of the project and additional benefits that go beyond GHG emissions reductions. The decision process should be transparent, efficient and non-discriminatory. The programme will also simplify, to the highest extent possible, the application process to avoid placing additional burdens and barriers on applicants.

Loan Instrument	Terms
Subsidized loan	Subsidized loans will be made available to finance up to 80% of the total cost of a renewable energy installation so the applicant must provide at least 20% own equity.
Investment grant	Investment grants will be made available for up to 20% of the total installed cost, subject to certain conditions. This includes technology, installation costs, connections to the grid, permitting, engineering and other required expenses.

Technical component:

The objective of the technical component is to build up knowledge on development and operation of RE systems for self-supply to generate demand for these technologies and ultimately achieve the objectives of the NAMA. The activities under the outreach component will disseminate the benefits of SSRE systems to a large number of stakeholders. The creation of momentum is fundamental to get the programme moving. The target group for these activities will be mainly companies, business associations, ESCOs, technology providers. However, wider stakeholder groups including government, researchers and civil society will also be considered.

The technical component seeks to develop and foster local technical capacities to design, implement and maintain SSRE projects and make their benefits widely known. This component considers the development of the following activities:

A. Training and Capacity Building: Through workshops and trainings, stakeholders from the private and public sector (excluding the financial sector, which is covered by the financial component) will be trained in the following areas: SSRE feasibility analysis, project development and management, introduction to RE technologies, MRV, etc.
B. Technical Help Desk: that provides technical and legal support to project developers on questions related to technologies, project development and regulatory and legal matters. The technical help desk will be the main entry point for project developers and other stakeholders.
C. Knowledge Exchange: Fund and carry out an ex-change programme with national and international experts to share experiences and expertise.
D. Grid-Connection Support: Fund specialized advisory services for projects that plan to connect to the electric grid. Resources will be allocated in order to support and accompany companies and entrepreneurs developing SSRE projects.
E. Outreach and Awareness: The NAMA will help raise awareness on options for utilizing SSRE in Chile´s industry. Technology road shows and site visits sponsored by the NAMA will bring potential investors in contact with the technologies and with current users.
F. Monitoring Reporting Verification (MRV): Development of a GHG inventory in the small scale energy sector and design of a MRV-system for the SSRE NAMA. Design of templates and formats for re-porting, data aggregation and processes for the verification of this NAMA.

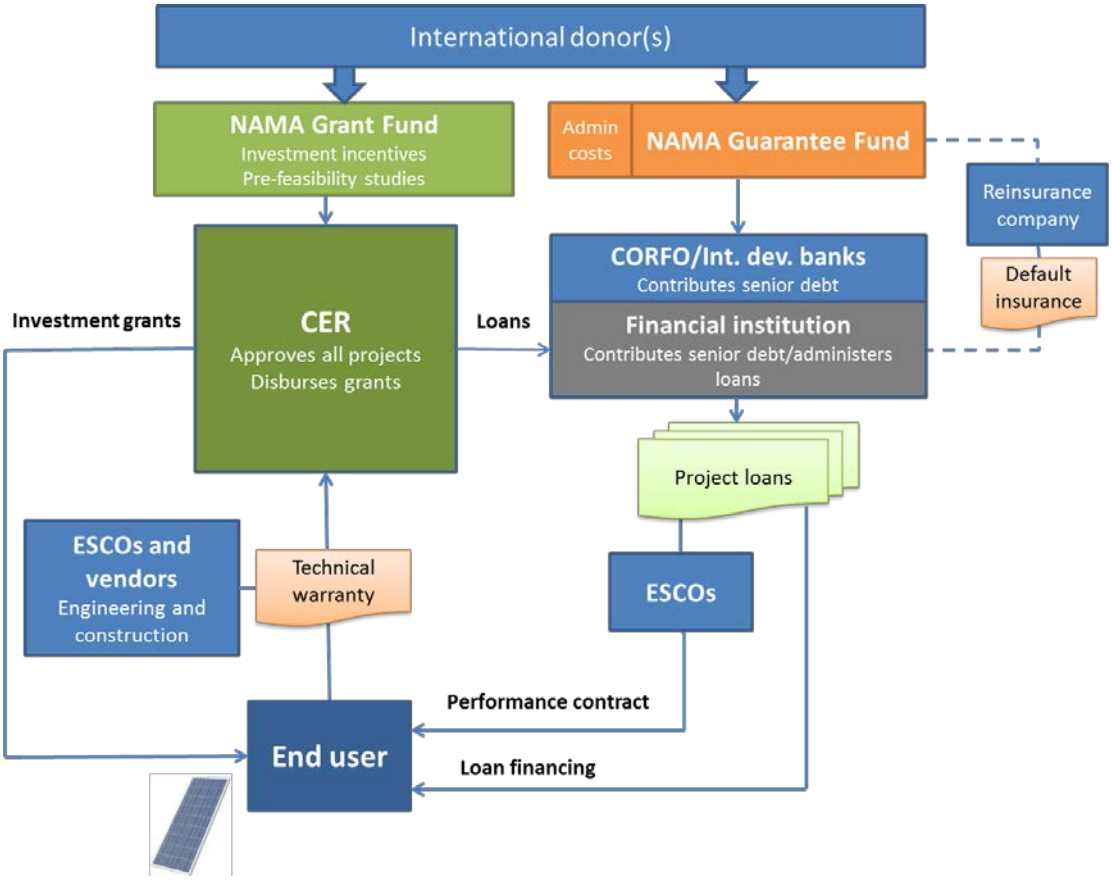
Implementation Framework:

The following implementation framework is envisaged:

- **International Financing** would be directed to one of two Funds: a Grant Fund and a NAMA Guarantee Fund. Multiple donors, with different objectives, can contribute to this structure. Not all funding would have to be committed at once, there is a possibility to start with seed funding and increase funding as the programme matures.
- The **NAMA Grant Fund** would be used exclusively for pre-feasibility studies and for providing investment grants to projects. The donor and CER can agree on the share of funds for each instrument. These funds would be managed exclusively by the CER and granted on a case-by-case basis.
- The **NAMA Guarantee Fund** contains funds that are also granted to the programme but they are used as a credit guarantee to raise a larger pool of capital for project loans. The fund would be structured as a "first-loss tranche", assuming a majority share of the default risk of the loan programme. This risk can be assumed directly or through a third party that would provide re-insurance to cover some or all of the default risk. If this is the case, the NAMA would pay for the premiums.
- Senior debt will be raised from Chile's **Economic Development Agency (CORFO) and international development banks** at preferential rates to capitalize a majority of the loan programme. These creditors will have the most senior claim on funds.

- The administration of the loan programme will be tendered to **private commercial banks**. To participate, banks will be expected to contribute capital and assume some of the risk of the loans. Their risk exposure should be sufficient to attract and motivate commercial banks within their existent risk profiles and horizons but at the same time minimize moral hazard and ensure good loan origination. A tender process should ensure a competitive package.
- Commercial banks would disburse and administer loans to **ESCOs and end-users**. The aim is to provide loans with a 3-4 annual percentage rate (APR) with maturities of up to 20 years. Private banks would receive a spread that would depend on the level of risk they are taking and the share of capital being contributed.

The set-up of the Financial Component, including the roles of CORFO and CER, is shown in the next figure.



Funding:

The funding requirements and planned financing of the NAMA instrument are presented in the following tables.

Funding Requirements (EUR)

	FC-Component	TC-Component
Personnel	400,000	900,000
External Services		1,500,000
Investments	11,500,000	400,000
Other		200,000
Total	**11,900,000**	**3,000,000**

Planned financing (EUR)

	FC-Component	TC-Component
NAMA Facility funding volume	12,000,000	3,000,000
Funds provided by submitter (national government or delivery organisation) and other implementing partners	14,500,000[58]	100,000
Third party contributions (e.g. third party grants/concessional loans)	2,000,000 (GEF for SSRE using biogas)	
Total	**29,500,000**	**3,100,000**

[58] This figure considers USD 10 million INNOVA CORFO investment grants for SSRE, USD 3.5 million from the ministry of agriculture and USD 1 million from regional governments for the same purpose.

ANNEX I: LIST OF FINANCING INSTRUMENTS FOR NCRES IN CHILE

1. Innova CORFO – US$10 million Renewable Energy Innovation Fund

US$10 million fund to finance capital costs of self-supply renewable energy projects under the ESCO model. The fund subsidises up to 50% of capital costs with a US$1 million cap per project. This support instrument also finances technology and business models dissemination activities, capacity building, and guided plant visits. The call for proposals closed in April 2013. The results of these will further inform activities under the NAMA.

2. CER – Pre feasibility co-financing

In association with the German Development Bank KfW, this instrument developed by the Chilean Renewable Energy Centre (CER) seeks to finance up to 40% of renewable energies feasibility studies, with a USD 45,000 cap per project. Projects must connect to the grid (North or Central systems) to be eligible. Specific types of studies that are financed include:

- Pre-feasibility and feasibility studies;
- Prospect studies;
- Basic engineering studies;
- Environmental impact studies.

3. CNR – Renewable Energies for Irrigation

The National Commission for Irrigation (CNR), a Government agency dependant of the Ministry of Agriculture, destines funds to incentivise the investment in irrigation-related RE projects.

- In 2012, CNR launched its first tender (US$ 3.3 million approximately) for supporting projects that use renewables in irrigation activities
- Also in 2012 CNR received, as part of a cooperation agreement with the Ministry of Energy, over US 200.000 for co-financing pre-feasibility studies for RE project for irrigation
- In 2013, a second public tender will be launched in 2 stages in June and September. Funds will exceed US$ 3.2 million to co-finance irrigation-related renewable energy projects

4. Clean Technology Fund

The Clean Technology Fund (CTF) looks to support the financing of non-conventional renewable energy projects, and reduce costs, risks, and liquidity and capacity barriers associated with these types of projects. The following are the components of the CTF efforts in Chile:

- Concentrated Solar Power Project (CSPP) in the North of Chile (US$ 100 million)
- Large scale Photovoltaic Program (LSPVP) (US$ 50 million)
- Scale-up Renewable Energy Self Supply and Energy Efficiency (RESSEE) for individual energy end-users (US$ 49 million)
- RESSEE prep grant (US$ 1 million)

5. CORFO Guarantee Funds

- FOGAPE - Guarantee Fund for Small Entrepreneurs. This is not specific for NCREs. Eligible beneficiaries are limited to a maximum turnover of UF 25,000 (approx. USD 1,000,000)[59]. In case of an association, 66% of the de los participants must need this maximum.

[59] For the actualized conversion rate of UF to CLP, please refer to: www.valoruf.cl.

- FOGAIN - Investment Guarantee Fund. This is not specific for NCREs. Eligible beneficiaries are limited to a maximum turnover of UF 100.000 (approx. USD 4,000,000).
- FOGAEE - Energy Efficiency Guarantee Fund. For EE investments only.

6. CORFO Venture Capital Lines

- F3. This is not specific for NCREs. For beneficiaries with capital value up to UF 100,000 (approx. USD 4,000,000).
- K1. This is not specific for NCREs. For beneficiaries with a turnover up to UF 400,000 (approx. USD 16,000,000)

ANNEX J: LIST OF INSTALLED BIOGAS PROJECTS IN CHILE

(The presented list tentatively presents the present biogas projects in Chile. Elaboration based on Reports by Sustentank, Information from CER, and Presentations Biogas Seminar 2012).

Name	Type	Biogas Production	Capacity	Usage	Year
		(x1,000 m3/yr)	(MW)		
Agrícola Ancalí	Cow Manure		1.9	Electricity	
Proyecto Lechería Rupanco (50 cows)	Cow Manure	12		Electricity	
Proyecto Lechería X Región (80 cows)	Cow Manure	15		Electricity	
Planta Biogás HBS Los Angeles	Cow Manure		2.2	Cogeneration	2011
Tamm (Fundo Rinconada)	Cow Manure	29	0.2	Electricity	2013
Agrícola Super	Pig Manure	20,780		Flaring and heating of biodigestor	
Las Pampas	Pig Manure		1.0	Electricity	2013
CCU Temuco	Agro-industry	569		Heat for self-supply	
Mafrisur	Agro-industry	260		Flaring	
Orati	Agro-industry			Heat for self-supply	
Viña Francisco de Aguirre	Agro-industry	31		Flaring	
Viña Concha y Toro	Agro-industry			Flaring	
Inducom	Agro-industry	1,350		Flaring	
Coltauco	Wastewater			Cooking	
Empedrado	Wastewater			Cooking and refrigetion	
La Farfana	Wastewater	24,000		Sales of biogas	
Concepción	Wastewater	2,500		Flaring	
Trebal Mapocho	Wastewater		5.0	Cogeneration	2012
Consorcio Santa Marta	Landfill	43,800	14.0	Flaring	2013
El Molle	Landfill	13,000		Flaring	
Cohihues-La Yesca	Landfill	10,000		Flaring	
Copielemu	Landfill	5,500		Flaring	
Loma Los Colorados	Landfill		22.0	Electricity	2009-13
El Empalme	Landfill	2,500		Flaring	
Coronel	Landfill	7,500		Flaring	
El Panul	Landfill	5,000		Flaring	
Total			**46.3**		

ANNEX K: MARKET PENETRATION OF BIOGAS ENERGY IN THE DAIRY SECTOR

The present annex aims to assess the potential of biogas energy generation in the dairy sector in the regions V, RM, VI, VII, VIII, IX, X, and XIV in Chile. The analysis if focused on electricity production. Individual farms may opt for heat production or co-generation, depending on the internal energy demand and the business context.

A. Characterization of the dairy sector

The Chilean dairy sector ranks 39th in the list of milk producing countries in the World. At the national level, the dairy sector accounts for 31% of the livestock sector´s contribution to the GDP, and 0.7% of the total GDP[60]. The dairy sector is defined as the dairy farmers (primary production) and the dairy factories (milk processing). According the last Census (VII, 2007) there are 18,774 dairy farms in Chile[61,62], employing a total of 61,470 people. The total number of producing milk cows is 488,383. The sector is heavily concentrated in the Los Lagos Region due to its favorable conditions for cattle farming. Over 95% of the national dairy production is concentrated in the following zones:

- Central Zone (34,838 animals): the Regions Valparaíso (V), Metropolitana (RM), and O´Higgins (VI);
- South-Central Zone (52,570 animals): the Regions Maule (VII) and Biobío (VIII); and
- South Zone (400,975 animals): the Regions La Araucanía (IX), Los Ríos (XIV) and Los Lagos (X).

There is a very large group of smallholders with less than 20 cows (over 15,000) and few farms with more than 500 animals (less than 100). There are great differences with respect to productivity, competitiveness, and access to information and external financing. The following tables provide an overview of these differences, based on information prepared for the national sector association Consorcio Lechero[63]. This demonstrates the differences in opportunities to take benefit from biogas energy technology across the sector.

I. Dairy farmers - Size and Productivity

I. DAIRY SECTOR IN CHILE - FARM SIZE AND PRODUCTIVITY				
Farm size (# cows)	**Description**	**# Farmers**	**# Animals**	**Estimated milk production**
1-19	Small cattleholders with few opportunities to become commercially efficient. Micro-enterprises.	15,241	80,970	1,300 l/yr[64]; 500 l/ha-yr
20-49	Small cattleholders, predominantly supported	1,684	48,358	2,800 l/yr;

[60] Source: http://www.cuerovacachile.com/web/?cat=8

[61] VII Censo Agroindustrial – INE (2007) www.censoagropecuario.cl

[62] For a detailed socio-economic characterization of the dairy producers, consult: "Informe Estudio Caracterización de los Productores Lecheros, usando Base de Datos Disponibles", by Agrosur GESTA, for Consorcio Lechero, October 2012. Available at: http://consorciolechero.cl/chile/pags/informes-finales.php.

[63] See footnote 26. The study provides additional information with respect to the type of equipment for milking, irrigation and land operations used per segment. Refrigerating is common for farmers above 50 milk cows.

[64] Per cow per nursing.

I. DAIRY SECTOR IN CHILE - FARM SIZE AND PRODUCTIVITY				
Farm size (# cows)	**Description**	**# Farmers**	**# Animals**	**Estimated milk production**
	by INDAP. Part of this group has the potential to progress and become competitive.			1,650 l/ha-yr
50-99	Small and medium producers, of which many are incorporated in INDAP. This group counts producers with potential, but they need training and dissemination of information and best practices.	672	45,923	4,250 l/yr; 3,200 l/ha-yr
100-299	Small to medium producers, some of them still incorporated in INDAP. This group is characterized by increased use of technology and a larger milk production, but still lack access to better technologies and knowledge of best practices due to constraints to access information.	870	150,127	5,500 l/yr; 4,850 l/ha-yr
300-499	This is the group of good dairy producers, including excellent examples but also some farmers who would need training and better practices.	211	78,643	6,500 l/yr; 6,300 l/ha-yr
500 - more	This is the most advanced group in terms of technology and practices, and with access to up to date information.	96	84,362	8,500 l/yr; 11,000 l/ha-yr
TOTAL		**18,774**	**488,383**	

II. Dairy farmers - Social and Economic Indicators

II. DAIRY SECTOR IN CHILE - SOCIAL AND ECONOMIC INDICATORS							
Farm size (# cows)	**# Farmers**	**Value annual production (USD/yr)[65]**		**Commercial production**		**Member of association**	**Internet access**
				Contract	Sales		
1-19	15,241	503	9,554	4.95%	18.34%	2.10%	2.48%
20-49	1,684	21,660	53,068	17.03%	55.97%	5.55%	10.14%
50-99	672	82,193	162,743	26.44%	68.67%	15.08%	37.20%
100-299	870	212,736	636,080	34.02%	79.76%	28.21%	54.12%
300-499	211	754,245	1,254,561	41.83%	86.14%	38.62%	75.78%
500 - more	96	1,643,868	more	27.50%	71.38%	37.21%	83.73%
TOTAL	**18,774**			**7.06%**	**25.59%**	**4.34%**	**8.04%**

[65] The economic value of the annual production is based on the typical productivity per animal as indicated in Table , and the milk price offered early 2014 (CLP 205 per liter, equivalent to USD 0.39 per liter. Source: Report M. Vargas, p. 24; 8 February 2014).

III. Dairy farmers - Access to Finance and Technical Assistance

III. DAIRY SECTOR IN CHILE - ACCESS TO EXTERNAL FINANCING AND ASSISTANCE						
Farm size (# cows)	**# Farmers**	**Credit INDAP**	**Credit State Bank**	**Credit Other Banks**	**CORFO**	**FIA**
1-19	15,241	29.2%	5.6%	3.8%	0.4%	0.1%
20-49	1,684	32.8%	14.9%	12.5%	1.6%	1.1%
50-99	672	8.5%	17.2%	29.2%	9.5%	0.8%
100-299	870	1.7%	12.2%	34.2%	17.2%	1.3%
300-499	211	0.5%	9.3%	51.1%	38.3%	1.2%
500 - more	96	3.7%	9.5%	49.2%	16.7%	0.8%
TOTAL	**18,774**	**27.6%**	**6.7%**	**6.8%**	**1.7%**	**0.2%**

It must be noted that the indicated figures date back to 2007 and one may assume that at least internet coverage, and farmers that have received support through CORFO and FIA, have increased. Notwithstanding, the figures demonstrate a strong stratification and a low use of external financing by the sector, even in the largest establishments (49.2%).

IV. Typical energy costs

IV. DAIRY SECTOR IN CHILE - TYPICAL ENERGY COSTS		
Unit energy price (firewood)	*12*	CLP /kWh_{th}
Unit energy price (LPG)	*88*	CLP /kWh_{th}
Electricity tariff BT2	*106*	CLP /kWh

B. Biogas generation potential in dairy farms

During the PPG phase, the following data were collected to estimate the biogas yield based on cow manure.

V. KEY FIGURES BIOGAS YIELD IN DAIRY FARM		
Parameter	**Value**	**Unit**
Liquid manure production	*20,090*	Kg/ animal-yr
Mass ratio (volatile solids: liquid manure)	*0,12*	kg_{sv}/kg
Biomethane yield	*0,23*	Nm^3/ kg_{sv}
Manure usage rate	*38%*	%
Digestate production rate	*3*	%
Lower caloric value biomethane	*9,30*	kWh/Nm^3CH_4
Conversion rate biogas - electricity	*35%*	%
Technical availability	*90%*	%

VI. ENERGY PRODUCTION IN DAIRY FARM			
Animals	**Liquid manure production**	**Biomethane volume**	**Primary energy biogas**

VI. ENERGY PRODUCTION IN DAIRY FARM			
Animals	**Liquid manure production**	**Biomethane volume**	**Primary energy biogas**
-	(Kg / animal-yr)	(Nm^3CH_4 / yr)	(kWh/yr)
1	20,090	554.5	5,157

The energy that can effectively be used depends on the collection (usage) rate of the manure produced. This factor is estimated at 38% per head (equivalent to 45% for 1.2 unit-animal). This factor is depends on the number of stabulation hours and the effectiveness of liquid manure collection. The small farmers use at least 2-3 times more pasture area than the large ones, which makes manure collection less practical. In the following, a manure usage rate of 25% is estimated for small farms, increasing to 70% for the largest ones. In addition, highly productive animals produce more manure.

The chemical energy contained in the biogas can, in principle, be 100% transformed into useful heat. If used to produce electricity, it is fed into an engine which drives an electric generator. It is estimated that the conversion efficiency (from chemical energy to useful electricity) is 35%. In practice, it will be lower for a small system and somewhat higher for a very large system. If the heat is also used (co-generation), total system efficiencies of 90% can be reached.

VII. ELECTRICITY AND HEAT PRODUCTION IN DAIRY FARM				
Animals	**Primary energy biogas**	**Manure usage rate**	**Thermal energy biogas**	**Electric energy biogas**
-	(kWh/yr)	(%)	(kWh/yr)	(kWh/yr)
1	5,365	38%	1,960	686
				Nominal capacity: 70 Watt

Assuming a technical availability of the generator of 90% (equivalent to approx. 8,000 annual operating hours) the installed nominal generating capacity would be around 70 W per animal.

VIII. DAIRY SECTOR IN CHILE - NOMINAL CAPACITY AND ELECTRICITY PRODUCTION							
Farm size (# cows)	**# Farmers**	**Manure usage rate**	**Nominal capacity range**		**Electricity production range**		**Relative value[66]**
	(units)	**(%)**	**kW**	**kW**	**kWh/yr**	**kWh/yr**	**(%)**
1-19	15,241	25%	0.05	0.8	331	6,300	13.2%
20-49	1,684	25%	0.8	2.1	6,630	16,240	6.1%
50-99	672	38%	3.2	6.3	25,200	49,900	6.1%
100-299	870	38%	6.4	19	50,400	151,000	4.7%
300-499	211	45%	23	38	179,000	298,000	4.7%
500 - more	96	70%	59	more	464,000	more	5.6%
TOTAL	**18,774**						

To calculate the total energy production for each farm size interval, the average nominal capacity is taken as an approximate value. This yields the following result:

[66] This is the economic value of the annual electricity volume (at the present price per kWh of CLP 106, eq. USD 0.20), compared to typical annual sales of dairy products by the farm).

IX. DAIRY SECTOR IN CHILE - TOTAL ELECTRICITY PRODUCTION						
Farm size (# cows)	**# Farmers**	**Average nominal capacity**	**Average electricity production**	**Total installed capacity**	**Total electricity production**	**Share**
	(units)	**kW**	**kWh/yr**	**MW**	**MWh/yr**	**(%)**
1-19	15,241	0.4	3,310	6.4	50,500	13%
20-49	1,684	1.5	11,400	2.4	19,300	5%
50-99	672	4.8	37,500	3.2	25,200	7%
100-299	870	13	100,000	11.1	87,400	23%
300-499	211	30	238,000	6.4	50,300	13%
500 - more	96	200[67]	1,580,000	19.2	151,500	39%
TOTAL	**18,774**			**48.7**	**384,000**	**100%**

C. Market penetration of biogas in the dairy sector

Based on the data and analyses presented in the Tables I-II, VIII and IX, and the present status of biogas in Chile, the following considerations are made:

- The farmers below 50 animals is characterized as weak, with limited potential to grow stronger. This seriously affects creditworthiness.
- Farmers below 50 animals have rarely use bank funding; about 1/3 receive (small) credits from INDAP; very few (1-2%) have been involved in CORFO and FIA programs. By consequence, it is most unlikely that this group can attract bank loans to invest in biogas energy systems and pass a business-as-usual due diligence procedure. The cost of a tailored project pre-investment phase would be prohibitive in most cases.
- The total group of farmers below 50 animals makes up about 18% of the total market share for biogas.
- The total market share of the farmers between 50 and 499 animals is 43%, involving a total of 1,753 dairy farms. The group holding 100 to 499 animals is generally competitive and has access to information and finance. This group, counting 1,081 farms, makes up 36% of the market.
- It is further understood that presently, biogas energy technology is commercially introduced in some of the larger biogas farms (> 500 animals).
- With decreasing farm sizes, the following aspects become increasingly relevant: (i) limited access to finance; (ii) limited access to information, technology and best practices; (iii) relatively high project preparation costs; and (iv) increasing project risks for the farmer (investment costs compared to annual turnover). While biogas may be technically and economically feasible for farms with less than 500 animals, identified barriers progressively hamper penetration of biogas technology downward the market pyramid.

[67] This figure is a "good guess" since no detailed information about the larger dairy farmers was retrieved under the PPG. The largest farm identified holds over 7,000 animals.

ANNEX L: PRELIMINARY ECONOMIC ASSESSMENT OF BIOGAS PROJECTS IN THE DAIRY SECTOR

The present Annex aims to assess the economic and financial feasibility of biogas energy generation projects in the dairy sector.

A. Typical energy costs

I. DAIRY SECTOR IN CHILE - TYPICAL ENERGY COSTS FOR END-USERS[68]		
Unit energy price (firewood)	12 CLP / kWh_{th}	0.023 USD / kWh_{th}
Unit energy price (LPG)	88 CLP /kWh_{th}	0.167 USD / kWh_{th}
Electricity tariff BT2	106 CLP / kWh	0.020 USD / kWh

The cost of electricity for regulated clients (in this case governed by the BT2 tariff) is substantially higher than the marginal cost of the Central Interconnected System (SIC), which according to CER was 137,6 US$/MWh during February 2014 at the 220 kV bar in Quillota[69]. It is therefore reasonable to assume that the BT2 tariff covers all economic costs incurred to deliver the electricity service.

The value of the digestate produced in a biodigestor is estimated at 2000 CLP/kg (3.77 USD/kg), equivalent to the market price of 1 kg of ureum fertilizer. It is assumed that the feedstock (liquid manure) is available at no cost.

B. Electricity generation in dairy farms

The following table presents key figures for estimating electric energy production based on biogas production in the dairy sector.

II. ELECTRICITY AND HEAT PRODUCTION IN DAIRY FARM				
Animals	**Primary energy biogas**	**Manure usage rate**	**Thermal energy biogas**	**Electric energy biogas**
-	(kWh/yr)	(%)	(kWh/yr)	(kWh/yr)
1	5,365	38%	1,960	686
				Nominal capacity: 70 Watt

C. Capital costs of biogas project for electricity generation in the dairy sector

Estimated capital costs of biogas plants in Chile are provided by project developers[70].Foreign sources of information are in the same range or lower, while the assessment by A. Moraga under the PPG phase yielded substantially higher costs[71].

[68] Exchange rate: 1 USD = 530 CLP.
[69] CER Report March 2014.
[70] Presented by Kaiser Energy at FIA Seminar, Santiago de Chile, 7 November 2012
[71] Report "Promoción del Desarrollo de Energía a partir de Biogás, en una Selección de Pequeñas y Medianas Agroindustrias", prepared for CER/UNIDO, by Andrea Moraga, 14 January 2014

III. ESTIMATED INVESTMENT COST FOR BIOGAS PROJECTS IN SME DAIRY SECTOR					
Description	***Unit***	**Type**			
		Concrete	**Covered**	**Lagoon**	**Plastic**
Volume	*(m^3)*	3,500	1,000	500	40
Feedstock Rate	*(m^3/d)*	117	33	17	1
Biogas production	*(m^3/d)*	2,621	739	381	22
Methane production	*(m^3/d)*	1,441	407	209	12
Energy production	*(m^3/d)*	14,357	4,049	2,086	123
Electricity production	*(kWh/d)*	6,030	1,620	793	43
Electric capacity	*(kW)*	274	74	36	2
Load hours	*(h)*	22	22	22	22
Description	***Unit***	**Investment**			
Digestor	*(USD)*	420,000	50,000	100,000	25,000
Equipment	*(USD)*	350,000	135,000	38,000	0
Gas engine with generator	*(USD)*	275,000	120,000	10,000	500
TOTAL	*(USD)*	1,045,000	305,000	148,000	25,500
Specific project cost	*(USD/kW)*	3,813	4,143	4,108	13,062

The described project types (concrete, covered, lagoon, and plastic) are applicable to the different farm sizes in the dairy sector, as outlined in the following table.

IV. DAIRY SECTOR IN CHILE - TYPICAL GENERATING CAPACITIES				
Farm size (# cows)	**Average nominal capacity**	**Average electricity production**		**Applicable project type**
	kW	**kWh/yr**	**kWh/yr**	
100-299	6.4 - 19	50,400	151,000	plastic - lagoon
300-499	23 - 38	179,000	298,000	lagoon - covered
500 - more	59 - 590	464,000	4,640,000	covered - concrete

D. Operating costs of biogas electricity projects

The annual costs for operation and maintenance (O&M) are estimated by Moraga and Bidart[72] at 13% of the capital costs.This is substantially higher than foreign sources (USDA, IRENA), which provide figures in the range of 4-12%.

E. Revenues from biogas electricity projects

The economic performance of a concrete type (274 kW), covered-type (74 kW), and lagoon-type (36 kW) biogas electricity plant is evaluated on the following pages.

[72]Bidart, C., "A Techno-economic Assessment of the Generation and Usage of Biogenic Gases in Chile as a Substitute of Natural Gas", Ph.D. Thesis, Karlsruhe Technology Institute, 2013, Germany

V. DAIRY SECTOR IN CHILE - ECONOMIC PERFORMANCE OF BIOGAS PROJECTS				
Project type	**Capacity**	**Investment**	**IRR**	**NPV (@10%)**
Case1: Concrete	274 kW	USD 1,045,000	14.0%	USD 169,505
Case 2: Covered	74 kW	USD 305,000	10.7%	USD 8,538
Case 3: Lagoon	36 kW	USD 148,000	10.8%	USD 4,772

As a general appreciation, the projects are marginally economical but likely not attractive for private investors, who will seek higher returns. The PPG did not obtain a quantified indication of the financial IRR required by the exploitant of a renewable-energy power system. There is also no information concerning the opportunity cost of capital for a dairy farmer.

The economic performance is sensitive with respect to the specific investment (USD/kW) and the O&M costs, moreover since O&M costs are proportional to the investment. Assuming a fixed investment, the sensitivity for variations in O&M costs is shown in the next table.

SENSITIVITY ANALYSIS COVERED TYPE (O&M)		
O&M costs (US)	**IRR**	**NPV (@10%)**
5.0%	21.1%	144,835
6.0%	19.9%	127,798
7.0%	18.7%	110,761
8.0%	17.4%	93,724
9.0%	16.1%	76,687
10.0%	14.8%	60,316
11.0%	13.5%	42,612
12.0%	12.1%	25,575
13.0%	**10.7%**	**8,538**
14.0%	9.3%	-8,500
15.0%	7.8%	-25,537

It is seen that, by controlling O&M costs, the economic performance of biogas investments would increase sharply, attaining IRR values above 20% which suggest commercial viability.

Case 1. Economic analysis covered-type biodigestor (74kW)

INVESTMENT COSTS		
electric capacity	**0.274**	MW
specific investment	**3,813,869**	USD/MW
biodigestor	420,000	USD
equipment	350,000	USD
gas engine + gen	275,000	USD
project investment	**1,045,000**	USD

Grant NAMA	0.00%	0
Grant CORFO	0.00%	0
Reduced project cost		**1,045,000**

depreciation	10.0%	(%)
economic lifetime	10	years
residual value	0%	

REVENUES		
availability	**70%**	
electricity production	1,681	MWh/yr
	138,096	kWh/month
energy price	**200**	USD/MWh
	106.0	*CLP/kWh*
variation	0.00%	
energy sales	**336,264**	USD/yr
digestate	0	USD/yr
annual income	**336,264**	USD/yr

OPERATING COSTS		
operating costs	**13.0%**	(% of investment)
	135,850	USD
price indexation	0.0%	%
nett result	200,414	USD

NPV (@)	10.0%	169,505	USD
IRR		14.0%	%
levelized costs (LCE)		131.32	USD/MWh
		69.6	*CLP/kWh*

year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
		1.00	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Net present electricity production (MWh)	*14,314*	*1,681*	*1,681*	*1,681*	*1,681*	*1,681*	*1,681*	*1,681*	*1,681*	*1,681*	*1,681*
Total annual benefits (USD)	**2,066,195**	**336,264**	**336,264**	**336,264**	**336,264**	**336,264**	**336,264**	**336,264**	**336,264**	**336,264**	**336,264**
replaced electricity (USD)	2,066,195	336,264	336,264	336,264	336,264	336,264	336,264	336,264	336,264	336,264	336,264
Total annual costs (USD)	**(834,739)**	**(135,850)**	**(135,850)**	**(135,850)**	**(135,850)**	**(135,850)**	**(135,850)**	**(135,850)**	**(135,850)**	**(135,850)**	**(135,850)**
O&M costs (US)		(135,850)	(135,850)	(135,850)	(135,850)	(135,850)	(135,850)	(135,850)	(135,850)	(135,850)	(135,850)
Result before taxes (USD)	**(1,045,000)**	**200,414**	**200,414**	**200,414**	**200,414**	**200,414**	**200,414**	**200,414**	**200,414**	**200,414**	**200,414**
NPV (USD)	**169,505**										

Case 2. Economic analysis lagoon-type biodigestor (36kW)

INVESTMENT COSTS			
electric capacity		**0.036**	MW
specific investment		**4,111,111**	USD/MW
biodigestor		100,000	USD
equipment		38,000	USD
gas engine + gen		10,000	USD
project investment		**148,000**	USD

Grant NAMA	0.00%	0
Grant CORFO	0.00%	0
Reduced project cost		**148,000**

depreciation	10.0%	(%)
economic lifetime	10	years
residual value	0%	

REVENUES			
availability		**70%**	
electricity production		221	MWh/yr
		18,144	kWh/month
energy price		**200**	USD/MWh
		106.0	*CLP/kWh*
variation	0.00%		
energy sales		**44,181**	USD/yr
digestate		0	USD/yr
annual income		**44,181**	USD/yr

OPERATING COSTS			
operating costs		**13.0%**	(% of investment)
		19,240	USD
price indexation		0.0%	%
nett result		24,941	USD

NPV (@)	10.0%	4,772	USD
IRR		10.8%	%
levelized costs (LCE)		141.56	USD/MWh
		75.0	*CLP/kWh*

year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
		1.00	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Net present electricity production (MWh)	*1,881*	*221*	*221*	*221*	*221*	*221*	*221*	*221*	*221*	*221*	*221*
Total annual benefits (USD)	**271,471**	**44,181**	**44,181**	**44,181**	**44,181**	**44,181**	**44,181**	**44,181**	**44,181**	**44,181**	**44,181**
replaced electricity (USD)	271,471	44,181	44,181	44,181	44,181	44,181	44,181	44,181	44,181	44,181	44,181
Total annual costs (USD)	**(118,221)**	**(19,240)**	**(19,240)**	**(19,240)**	**(19,240)**	**(19,240)**	**(19,240)**	**(19,240)**	**(19,240)**	**(19,240)**	**(19,240)**
O&M costs (US)		(19,240)	(19,240)	(19,240)	(19,240)	(19,240)	(19,240)	(19,240)	(19,240)	(19,240)	(19,240)
Result before taxes (USD)	**(148,000)**	**24,941**	**24,941**	**24,941**	**24,941**	**24,941**	**24,941**	**24,941**	**24,941**	**24,941**	**24,941**
NPV (USD)	**4,772**										

Case 3. Economic analysis concrete-type biodigestor (274kW)

INVESTMENT COSTS		
electric capacity	**0.074**	MW
specific investment	**4,121,622**	USD/MW
biodigestor	50,000	USD
equipment	135,000	USD
gas engine + gen	120,000	USD
project investment	**305,000**	USD

Grant NAMA	0.00%	0
Grant CORFO	0.00%	0
Reduced project cost		**305,000**

depreciation	10.0%	(%)
economic lifetime	10	years
residual value	0%	

REVENUES		
availability	**70%**	
electricity production	454	MWh/yr
	37,296	kWh/month
energy price	**200**	USD/MWh
	106.0	*CLP/kWh*
variation	0.00%	
energy sales	**90,816**	USD/yr
digestate	0	USD/yr
annual income	**90,816**	USD/yr

OPERATING COSTS		
operating costs	**13.0%**	(% of investment)
	39,650	USD
price indexation	0.0%	%
nett result	51,166	USD

NPV (@)	10.0%	8,538	USD
IRR		10.7%	%
levelized costs (LCE)		141.92	USD/MWh
		75.2	*CLP/kWh*

year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
		1.00	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Net present electricity production (MWh)	*3,866*	*454*	*454*	*454*	*454*	*454*	*454*	*454*	*454*	*454*	*454*
Total annual benefits (USD)	**558,024**	**90,816**	**90,816**	**90,816**	**90,816**	**90,816**	**90,816**	**90,816**	**90,816**	**90,816**	**90,816**
replaced electricity (USD)	558,024	90,816	90,816	90,816	90,816	90,816	90,816	90,816	90,816	90,816	90,816
Total annual costs (USD)	**(243,632)**	**(39,650)**	**(39,650)**	**(39,650)**	**(39,650)**	**(39,650)**	**(39,650)**	**(39,650)**	**(39,650)**	**(39,650)**	**(39,650)**
O&M costs (US)		(39,650)	(39,650)	(39,650)	(39,650)	(39,650)	(39,650)	(39,650)	(39,650)	(39,650)	(39,650)
Result before taxes (USD)	**(305,000)**	**51,166**	**51,166**	**51,166**	**51,166**	**51,166**	**51,166**	**51,166**	**51,166**	**51,166**	**51,166**
NPV (USD)	**8,538**										

Based on the considerations concerning the market segments in the dairy sector in Chile,[73] the market development strategy devised for the GEF Project is to address the identified barriers, thereby enabling the adoption of biogas technology by the market segment 100-499 animals. Simplifying matter, the baseline situation may be characterized by the market segment above 500 animals adopting biogas in the near to medium term, without GEF incremental action.

The following table clarifies the baseline, scope, and incremental action of the GEF Project targeting the dairy sector in Chile's main regions.

I. DAIRY SECTOR IN CHILE - GEF INCREMENTAL ACTION AND GHG BENEFITS				
Farm size (# cows)	**Action GEF Project**	**Total installed capacity**	**Total electricity production**	**Associated GHG emission reductions[74]**
		MW	**MWh/yr**	**Ton CO2eq/yr**
1-19	Out of scope	-	-	-
20-49	Out of scope	-	-	-
50-99	Out of scope	-	-	-
100-299	Incremental Action	11.1	87,400	45,600
300-499	Incremental Action	6.4	50,300	26,200
500 - more	Baseline (including baseline shift)	Baseline	Baseline	Baseline
TOTAL		**17.5**	**137,700**	**71,800**

Assuming a market penetration rate of 10% (1.75 MW) per year, after 10 years a total of 17.5 MW biogas-based electricity generation would be operational. The indirect emission benefits are based on the expected economic lifetime of the investments that take place in the 10-year time horizon after project completion. Ignoring reinvestments during this period, the total generating capacity accounted is equal to 17.5 MW. The overall electricity production over lifetime would be:

Total electricity production = 10 yr * 137,700 MWh/yr = 1,377,000 MWh.

The associated emission reductions are: 10 yr * 71,800 ton CO2eq/yr = 718,000 ton CO2eq/yr.

By applying a 60% GEF causality factor, the total (indirect) GHG benefits that can be ascribed to the Project are:

Total indirect benefits = 60% * 718,000 ton CO2eq/yr = 431 kton CO2eq.

Direct emission reductions

The Project aims to mobilize USD 4 M for direct investment in biogas installations. By assuming an approximate specific investment cost of USD 5.3M per MW, a total electric capacity of 750 kW would be installed under the Project (distributed over various smaller projects).

[73] See Annex K Market Penetration of Biogas Energy in the Dairy Sector, section C.

[74] Based on the combined marginal emission factor of the Central Interconnected System in Chile (0.5219 ton CO2eq/MWh, according to IGES database).

The expected annual energy production is:

= 0.75 MW * 8766h/yr * 90% = 5,920 MWh/yr.

Over a 10-year economic lifetime of the investment, the total electricity production would be:

= 10 yr * 5,920 MWh/yr = 59,200 MWh.

Based on the indicated CO2-intensity of the power system, the direct GHG emission reductions are:

= 59,200 MWh * 0.5219 ton CO2eq/MWh = 30,900 ton CO2eq.

Other market effects

The thermal energy potential for liquid manure (beyond the dairy industry) has been estimated at 4,056 GWh per year (Chamy, 2007). Bidart (2013) provides a figure of 2,083 GWh for the electricity potential, considering an average manure usage rate. Applications outside the dairy sector include bovine meat production, and pig and chicken farms. It is assumed that the GEF project will have a minor impact on the market development of biogas in these sectors, by outreach activities and demonstrating its successful application in dairy farms. The GEF project is also directly supportive to the SSRE NAMA, which targets all types of manure producers in the primary sector.

It is assumed that, over a 10-year period after Project termination, about 1/3 of the market potential will be developed. Hence, in year 10, the annual electricity delivered by manure-based biogas installations is about 700 GWh/yr. Assuming this volume is developed linearly, 70 GWh is added yearly (equivalent to 8-10 MW electric capacity). Over the 10-year period, the total electricity volume produced is:

= 55% * 10 yr * 70 GWh/yr = 385 GWh = 385,000 MWh.

The associated GHG emission reductions are:

= 385,000 MWh * 0.5219 ton CO2eq/MWh = 201,000 ton CO2eq.

Applying a conservative GEF causality factor of 20%, the indirect GHG emission reductions as a result of manure market transformation would be around:

= 20% * 201,000 ton CO2eq = 40,200 ton CO2eq.

Pleas note that other market effects have been elaborated here only for demonstration purposes. Since such effects have a high uncertainty, they shall not be included in the total emission reductions calculation for the GEF project.

Total emission reductions

The combined, total emission reductions attributable to the GEF project (not considering other market effects) are estimated at:

= 431 + 30.9 = 461.9 kton CO2eq.

ANNEX N: DOCUMENTS CONSULTED

- VALGESTA ENERGÍA S.A., "Análisis de Incentivos Tributarios para Proyectos de Generación de Energía Renovable No Convencional ERNC", prepared for the Subsecretary of Energy, December 2011.

- GAMMA Ingenieros S.A., "MODELOS DE NEGOCIO QUE RENTABILICEN APLICACIONES DE BIOGÁS EN CHILE Y SU FOMENTO", Report No. 584105-8-LE10, for Ministry of Energy, Santiago, 29 April 2011

- Manual de Biogás, autor María Teresa Varnero, 2012

- "Diseño de un Instrumento de Fomento para Proyectos de Biogás - Biomasa que Apunten a la Asociatividad de Tenedores del Recurso Biomásico - Informe Final", prepared for the Ministry of Energy, by Sustentank, 20 March 2012

- Report "Promoción del Desarrollo de Energía a partir de Biogás, en una selección de Pequeñas y Medianas Agroindustrias - Marco Financiero e Instrumento", prepared for CER/UNIDO, by Mariana Vargas, 8 February 2014.[75]

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- Bidart, C., "A Techno-economic Assessment of the Generation and Usage of Biogenic Gases in Chile as a Substitute of Natural Gas", Ph.D. Thesis, Karlsruhe Technology Institute, 2013, Germany.

- Chamy C, Vivanco E., "Identification and Classification of different kind of Biomass available in Chile for Biogas Generation", National Commission of Energy of Chile (CNE) and German Agency for International Cooperation (GTZ), Santiago, Chile, 2007.

- "Propuesta de Perfeccionamiento de Entorno a Proyectos de Aprovechamiento Energético de Lodos y Residuos Sólidos Urbanos", Gamma Ingenieros (2012)

- "Estudio de Pre-evaluación del aprovechamiento energético de los residuos sólidos urbanos", Ingeniería Alemana, February 2012.

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[75] Compiled during the PPG phase.
[76] Compiled during the PPG phase.