

PROJECT: Sustainable business models for biogas production from organic municipal solid waste.

COUNTRY: Argentina

Midterm Review

Final Report of the Consultant

UNDP # PIMS5345

GEF ID # 5734

The Mid Term Review was carried on from August 26 to October 12, 2019.
This Final report was issued on October 31, 2019.

GEF Operational Focal Area/Strategic Program:
Climate Change

Executing Agency:
UNDP

Implementing Partner:
Secretaria de Ambiente y Desarrollo Sustentable, Government of Argentina.

MTR team members:
Enrique Riegelhaupt, Ing. Agr.

Acknowledgements:
Lic. Santiago Solda
Ing. Alejandro Villani

Table of CONTENTS

1. Executive Summary	4
2. Introduction	9
3. Project Description and Background Context	10
4. Findings	16
4.1 Project Strategy	16
4.2 Progress Towards Results	18
4.3 Remaining barriers to achieving the project objective	19
4.4 Project Implementation and Adaptive Management	21
4.5 Sustainability	24
4.6 Ratings	26
5. Conclusions and recommendations	28
5.1 Conclusions	29
5.2 Recommendations	30
6. Annexes	
ANNEX 1. MTR TOR	
ANNEX 2. MTR EVALUATIVE MATRIX	
ANNEX 3. RATINGS SCALES	
ANNEX 4. ITINERARY OF THE MTR MISSION	
ANNEX 6. LIST OF PERSONS INTERVIEWED	
ANNEX 7. LIST OF DOCUMENTS REVIEWED	
ANNEX 8. CO-FINANCING TABLE	
ANNEX 9. SIGNED UNEG CODE OF CONDUCT FORM	
ANNEX 10. SIGNED MTR FINAL REPORT CLEARANCE FORM	
Annexed in a separate file: Audit trail of received comments on draft MTR	

i. List of Acronyms

CAMMESA	Compañía Administradora del Mercado Mayorista de Electricidad, S.A.
CE	Cooperativa Eléctrica de Olavarria
DNCC	Dirección Nacional de Cambio Climático
DNGIR	Dirección Nacional de Gestión Integral de Residuos (de la SayDS)
ENGIRSU	Estrategia Nacional de Gestión de Residuos Sólidos Urbanos
FAO	Food and Agriculture Organization of the United Nations
GHG	Green House Gases
GEF / FMAM	Global Environmental Facility / Fondo para el Medio Ambiente Mundial
GIRSU	Gestión Integral de Residuos Sólidos Urbanos
IDSR	Instituto de Desarrollo Sustentable de Rafaela
INTI	Instituto Nacional de Tecnología Industrial
INTA	Instituto Nacional de Tecnología Agropecuaria
kWe	Kilo Watt of electric power
SAyDS / MAyDS	Secretaría de Ambiente y Desarrollo Sostenible (before, Ministerio de Ambiente y Desarrollo Sustentable)
SAGyP/ MAGyP	Secretaría de Agricultura, Ganadería y Pesca, (before, Ministerio de Agricultura, Ganadería y Pesca
MEM	Ministerio de Energía y Minería
MTR	Mid Term Review
M&E	Monitoring and Evaluation
MSW	Municipal Solid Waste
MWe	Mega Watt of electric power
PIR	Project Implementation Report
PROBIOMASA	Programa para la Promoción de la Energía de la Biomasa – Ministerio de Agricultura / Secretaria de Agricultura.
PRODOC	Project Document
RENOVAR	Programa de Energía Renovable, del Ministerio de Energía y Minería
UNCE	Universidad Nacional del Centro de la Provincia de Buenos Aires
UNCC	United Nations Convention on Climate Change
UNDP	United Nations Development Program
UNL	Universidad Nacional del Litoral

List of Tables

Table 1. MTR Ratings & Achievement Summary Table

Table 2. Recommendation Summary Table

Table 3. Implementation Plan and related Milestones

Table 4. Remaining barriers to achieving the project

Table 5. Execution of GEF funds, in USD

Table 6 Rate of disbursement and total budget execution

Table 7. Data from six feasibility studies on the generation of energy from landfill gas and one bio digester.

Table 8. MTR Ratings & Achievement Summary

Table 9. MTR Assessments of the Progress towards achievement of Results

1. Executive Summary

Project Information	
UNDP PIMS ID	5345
GEF ID	5734
Title	Sustainable Business Models for Biogas Production from Organic Municipal Solid Waste
Country(ies)	Argentina, Argentina
UNDP-GEF Technical Team	Energy, Infrastructure, Transport and Technology
Project Implementing Partner	Government
Joint Agencies	Not applicable
Project Type	Full Size
PIF approval Date	May 1, 2014
CEO endorsement date	Jul 26, 2016
Prodoc signature date	Jan 23, 2017
Atlas IDs	100597
Planned closing date	31 december, 2020
GEF financing	USD 2.779.849
UNDP contribution (if any)	USD 150.000
Government co-financing,	USD 10 135 000 (in cash)
Total Co-financing	USD 12 595 000 (in cash + in kind)
Total Funding	USD 15 524 849

Project Description
<p>The Project envisages demonstrating the potential of biogas (including landfill gas) for energy generation from organic municipal solid waste at medium-sized urban centers in Argentina. The project will develop and optimize effective business models for energy production as part of integrated waste management under the national GIRSU program. Three to four small-scale biogas energy systems will be procured and demonstrated in selected municipalities. The Project is focused on electricity generation for self-supply with sales of surplus energy to the grid, but also envisages demonstrating biogas production for heat (including cogeneration) and biomethane production. The Project will deliver electricity from renewable energy sources (biogas) for approx. 21,000 people, thereby avoiding a total emission of 575 kton CO_{2eq} over lifetime of the pilot projects.</p>

Project Progress Summary
<p>After a delayed implementation process, team members were selected and contracted in August 2017. The activities formally started on 25th October 2017, with the Technical Committee first meeting; priority pilots were selected (Rafaela, Olavarria, Las Heras, Tapalqué); several technical and financial assessments were recommended; Cerrito site was put as an example; detailed technic and financial prefeasibility analysis were urged to ensure that biogas and landfill gas use is sustainable, and a strong recommendation was made to open single biddings for feasibility, design, building and commissioning of the pilots.</p>

Since early 2018, activities were delayed by new regulations on personnel contracting adopted by the Federal Government. Little progress was achieved, as reflected in PIR 2018. In 2019, after previous limitations were overcome, two consultancies were contracted: Rafaela bio digestion feasibility study (by UNL) was finished, as well as 5 of the 13 studies on landfill gas utilization (by INTI).

Some progress was made by the Project regarding formulation of specific policies and regulations. However, these were not formally adopted or implemented by the Federal Government. The GIRSU Program has incorporated the separation and treatment of organic fractions in the projected landfills, but is not presently financing actions for landfill gas use in existing or new landfills. At Municipal level, the supporting declarations of local administrations are not yet matched to effective actions / contributions made by them to implement the pilot projects.

Delivery rates of GEF funds were repeatedly very low: about 5% in 2017, 5% in 2018, and 5.63% in 2019 (first 7 months).

The overall progress towards project's objective and outcomes is very little in general; and nil in some relevant aspects as: enabling regulations, specific policies opening the market for biogas power below 0.5 MWe, technical standards for biomethane, working demonstrative projects, development of viable business models for energy production from MSW. Some efforts were made in these directions, with no achievements at the present.

Table 1. MTR Ratings & Achievement Summary Table

Measure			
Project Strategy	N/A	Achievement description	MTR Rating
Progress Towards Results	Objective Achievement	To introduce biogas technologies for energy generation as part of the National Strategy for integrated municipal solid waste management	2
	Outcome 1 MSW-based biogas energy technologies are incorporated in the national GIRSU programme for deployment in municipal and regional waste plant	(1a) Number of municipalities with MSW-based biogas energy projects covered by the GIRSU programme (1b) Number of national programmes and policies adopting MSW-based biogas energy as a relevant option 1c) Number of policy and regulatory proposals developed and adopted	1
	Outcome 2 Demonstration biogas energy technologies using MSW feedstock are procured and fully operational	(2a) Installed electricity generating capacity of MSW- based biogas pilot projects (MW); 2b) Annual volume of electric energy produced by biogas pilots (MWh/yr) (2c) Financing mobilized for investment in MSW-based biogas energy systems (US\$) (2d) Number of people trained and employed for MSW-based biogas energy generation (m/f).;	1
	Outcome 3 The Monitoring & Evaluation plan for the Project has been implemented	3a) Mid-term review and follow-up on recommendations to enhance project effectiveness and sustainability	3
Project Implementation and Adaptive Management			2
Sustainability			1

The scale of ratings applied is:

Rating	MTR Assessment	Description
6	Highly satisfactory (HS)	It is expected that the objective / outcome achieves or surpass all the End- of-the-Project goals without significant deficiencies. The progress toward achievement of the objective/outcome can be considered as a “good practice”.
5	Satisfactory (S)	It is expected that the objective / outcome achieves most of the End- of-the-Project goals with only minor deficiencies.
4	Moderately Satisfactory (MS)	It is expected that the objective / outcome achieves a majority of the End- of-the-Project goals, but with important deficiencies.
3	Moderately Unsatisfactory (MU)	It is expected that the objective / outcome achieves a majority of the End- of-the-Project goals, with great deficiencies..
2	Unsatisfactory (U)	It is expected that the objective / outcome does not achieve a majority of the End- of-the-Project goals.
1	Highly Unsatisfactory (HU)	The objective / outcome has not achieved his intermediate goals and it is not expected to reach the End- of-the-Project goals.

Summary of conclusions

1. Financial delivery, starting from 6% in September 2019, will probably not reach more than 10% by the end of this year. The project will start year 2020 with 90% of its budget not executed, and only 25% of its time life remaining. The main danger is that there will be no time left to achieve most of the outcomes. Two adaptive measures may be considered:

- a) to speed-up the execution of planned activities, trying to execute as much as possible in 2020; and / or
- b) to extend the project duration for one year, until December 2021.

2. If only option a) is chosen, there is a low probability (according to Consultant's estimations) to achieve a substantial increase of financial delivery and to obtain related outcomes, since several corrective actions needed may not be implemented in time, such as :

- i. *to define a critical path to implement the pilot projects*, setting the necessary technical and economic pre-conditions, identifying milestones and deadlines, and adopting clear rules of decision (of the "GO / NO GO" type);
- ii. *to find an alternative fast-track for decision making*, since only two sessions of the Directive Board are probable during 2020, and future financial commitments will have to be approved at this level -, and
- iii. *to contract "packages of activities"*, comprising all that may be needed to implement each pilot project, with a technically capable organization, able to proceed at a much faster pace.

3. The policies and regulations needed to shape an enabling environment for the future adoption / dissemination / multiplication of the new business models to be developed by the Project are not yet in place; and the business models themselves are not fully developed and tested. Since a new administration will take some time to consider and take decisions. Also, the associated investment costs are not yet clear.

4. Too high expectations were deposited on the viability of small-scale biogas-to-power systems, grid-connected, selling electricity to CAMMESA in the context of RENOVAR Program, by means of a special agreement or a waiver to the currently applying rules. This goal -related to **Outcome 1 (MSW-based biogas energy technologies incorporated in the national GIRSU programme for deployment in municipal and regional waste plants) and Outcome 2 (Demonstration biogas energy technologies using MSW feedstock are procured and fully operational)** -seems to be still quite far away. It is advisable to give more attention to alternatives that may generate power for self-consumption in towns below 500,000 residents which are the focus of the Project.

5. The monitoring and evaluation system gave clear and early warnings about the increasing arrears in the financial execution and the late -or failed- delivery of products /outcomes. However, arrears and delays kept occurring in 2017, 2018, and 2019. The causes of these delays -mostly of administrative nature- were discussed in the second Directive Board session (July 2019); but it is not clear whether effective corrective actions were taken by the national implementing agency.

6. No environmental benefits have resulted to date from Project's activities, since no reduction of GHG emissions was achieved, and the installations for burning or using landfill gas are not yet part of the projects financed by GIRSU.

7. On other side, several benefits in the institutional side are evident, such as:

- the participation of the Project team in various policy formulation bodies dealing with climate change, renewable energy, waste management;
- the interest declared by several municipalities towards the use of the organic fraction of solid waste for energy generation;
- a good level of communication and cooperation established with three National Programs (GIRSU, RENOVAR and PROBIOMASA).

8. To reinforce and consolidate the progress made in these fields, the national policies need now to be formally adopted, the pilot projects implemented, and executive decisions should be made by GIRSU to adopt biogas-for-energy from SWM as a functional component of their strategies and actions.

9. To achieve higher financial sustainability, biogas-to-energy business models need to generate other revenues besides energy. A reduction of the flow of organic waste to landfills may provide them, through a lower fee paid to the landfill contractor for a lower overall flow of waste to the landfill. It is not clear if this savings will cover the additional expenses incurred when sorting and processing the organic fraction in bio digesters. This is a major issue regarding sustainability, and deserves strong research efforts, not yet undertaken by the project.

10. If bio digestion is selected as a technical alternative to process the organic fraction of MSW, environmentally and economically appropriated solutions must be found to ensure the safe final disposition of liquid and solid effluents, that are more than 50% of the inflow of organic matter. This is a major sustainability issue, not focused upon by the Project.

Table 2. Recommendation Summary Table

<i>Corrective actions for the design, implementation, monitoring and evaluation</i>	1. Generation of electricity for the national grid should not be the main goal of the project, since the capacity attainable in most sites does not allow for grid connection. The project should focus more on options for off-grid power generation and thermal utilization of biogas / landfill gas, testing and demonstrating these options.
	2. Some ways to contract the execution of “packages of activities” with agile and flexible organizations must be found, to achieve faster advances of project activities. Implementation of some activities by third parties may help to achieve fastest execution.
	3. Monitoring, evaluation and reporting should follow a detailed “critical path” of activities, with clearly marked and well defined milestones, allowing for decisions to be made by the Project team according to the progress made /not made, and achievements attained / not attained.
<i>Proposals for future directions underlining main objectives</i>	4. It is necessary to define a critical path to implement the pilot projects, setting the technical and economic pre-conditions, identifying milestones and deadlines, and adopting clear rules of decision (of the “GO / NO GO” type).
	5. To start talks with the Government in order to agree on, and then to prepare, a proposal for a major revision, aiming to extend the Project duration until the end of year 2021 and also redefining its outcomes, outputs and budget.

2. Introduction

Purpose of the MTR and objectives

The main purpose of the MTR is to assess progress towards the achievement of objectives and outcomes as specified in the Project Document and to find early signs of project success or failure. The goal is to identify the necessary changes to be made in order to set the project on-track to achieve its intended results. A review of the project's strategy and risks to sustainability is also an objective.

Scope and Methodology:

The review relates to the lapse from January 2017 to August 2019, covering 32 of the 48 months of the foreseen project life (75%), for which financial and other data are available.

The methodology started by collecting and analyzing data from several sources:

- a) project documents
- b) interviews with government officials, local partners and other key stakeholders
- c) visits to sites where semi-structured interviews were made to operators and local authorities
- d) inspection of financial reports and PIRs provided by UNDP.

Having collected as much relevant info as possible, a comparison was made between project achievements and its original goals, focusing on six aspects:

- i. the technical performance of the waste-to-energy systems;
- ii. the actual, measurable impacts on the environment;
- iii. the amount of renewable energy produced and used;
- iv. the financial viability / sustainability of the technologies and arrangements developed;
- v. the level of adoption and ownership by municipalities (and/or other implementing agencies);
- vi. the main barriers found, and those that the Project did overcome by its adaptive management.

The comparison between expected and achieved results is the backbone of the recommendations. A brief assessment of the financial delivery rate is also done.

The main limitations of this MTR were:

1. No information was made available on national co-financing.
2. No technical documents or technical proposals produced by the Project Team could be reviewed by the Consultant; if this type of documents do exist, the Project has not a document repository or central filing system to which the MTR could have access.
3. The interviews with partners and stakeholders were brief, and not supported by documents or other written data (except in the case of RENOVAR Program).
4. In the written information delivered to MTR, it was not clear which activities were performed by the GIRSU Program with active participation of the Project -or using Project resources- to plan or build new waste management systems in mid or small towns.

Structure of the MTR report

The structure of this reports follows the guidelines for MTR Reports. It begins with an Executive Summary, Table of Ratings and Summary of Conclusions. Then, it makes an Introduction to the purpose of the MTR, Objectives, Methodology and Limitations. Section 4 details MTR findings, and is the basis for Conclusions and Recommendations. Separate files contain the Annexes 1-10 and. A special Annex for Audit Trail summarizes the comments received to the Draft Report and the actions taken by the Consultant.

3. Project Description and Background Context

Development context: environmental, socio-economic, institutional, and policy factors relevant to the project objective and scope.

The Project objective is to demonstrate the potential of biogas obtained from the organic fraction of urban waste in small and medium towns to generate renewable energy as power and heat, including this option as a part of the National Strategy for the Integrated Management of Urban Solid Residues (ENGIRSU). In its original conception (at 2005), ENGIRSU defined its main end as “to improve the health of the population, in the widest sense”, and waste management strategies should reduce threats to public health.

The project is aligned with the National Climate Change Strategy, Lines of Action 7 "To promote energy production and its rational and efficient use", and 8 "To promote and expand the integration of clean, and technically, economically, environmental and socially acceptable, energy sources in the national energy matrix".

Acting at the intersection of three mayor axis of development policies i.e. public health, environment and renewable energy, the Project must find alternatives that conform to a wide set of goals.

Argentina is the second largest country in South America, and more than 90% of its population lives in towns; almost 50% in five major agglomerations: Buenos Aires, Rosario, Cordoba, Mendoza, La Plata. GDP “per capita” is around 14,000 USD/person/year. In average, it is a mid-income country, but about 30% of the population stands below the poverty line.

The country is a net importer of energy in the form of crude oil, diesel oil and natural gas. Renewable sources are increasing their share in the national energy matrix, manly as a result of two active policies: a) the mandatory admixture of bioethanol and biodiesel in gasoline and diesel oil, and b) a public bidding system opening the electricity market for over 4,500 MWe of renewable sources of electricity that will be grid-connected by 2020.

Urban waste management falls into the jurisdiction of local governments (Municipios), while the Provinces share some subsidiary responsibilities. To make direct interventions in this field, the Federal Government must arrive to specific agreements with local governments, in a case-by-case basis. Federal funding has been concentrated in financing the infrastructure, and providing other capital goods needed, such as heavy equipment, lorries, etc. But the operational costs of waste collection and treatment must be paid by the municipalities, which cannot fully recover these expenses with specific fees or other tax incomes, and depend on other sources of federal funding, borrowing, etc., to keep the systems running.

Reducing the amount of organic waste flowing into landfills has been declared as a priority in the GIRSU Strategy, and the use of the biogas generated by this flow is seen as an opportunity to recover economic value as thermal energy or electricity. However, it is not to yet proven that this alternative is technically and financially possible in small and medium towns, by means or viable business models.

The Third National Communication to the UNCCC indicates the priority mitigation measures according to town sizes, as follows:

Population	GHG emission reduction measures
Over 200,000	Refuse separation; landfill gas capture in existing landfills, power & heat
100,000 to 200,000	Refuse separation; building new landfills, landfill gas capture, power & heat
50,000 to 100,000	Refuse separation; building new landfills, landfill gas capture, power & heat
20,000 to 50,000	Refuse separation; composting of organic fraction, landfill establishing

The potential of biogas capture was also identified in Argentina’s Second National Communication to the UNFCCC. The 2017 Biennial Update Report estimates that “Waste” was the source of 4% of all national GHG emissions in 2014, of which 2% came from Municipal Solid Waste.

Problems that the project sought to address, threats and barriers targeted

The problem addressed by the Project is that the organic fraction of the municipal waste streams is currently sent to landfills, because the institutional capacities and the business models to convert this fraction in energy and to generate economic value are lacking. This situation creates negative external effects in the spheres of local sanitation, economy, society, and environment, and global environmental impacts by increased emissions of methane.

Several barriers to be overcome were identified in the PRODOC.

- a) *Defective political framework for small-scale renewable energy projects*: plants below 500 kWe are not allowed to sell power to the wholesale market run by CAMMESA or to be in other ways connected to the national grid; there are no incentives or specific regulation for heat generation.
- b) *Present vacuums in the secondary regulation* referring to grid access, net power measurement, security, transportation and end-use of digested biomass.
- c) *Inadequate coordination* between authorities and stakeholders.
- d) *Limited knowledge* of the biogas-to-energy technologies in the waste treatment sector: landfill design is not commonly optimized for the capture of biogas and re-injection of lixiviates; other design characteristics usually impede or curtail biogas extraction.
- e) *Lack of viable business models* for energy generation from MSW-based biogas: as concluded in five case-studies by INTI (Table 7 of this report) the wholesale price of electricity is about 60 USD/MWh, but the price paid for surplus energy sold by self-producers to the grid is below 30 USD/kWh, making impossible to recover the operational expenses. A special niche opened by RENOVAR at 128 USD/kWh applies only for plants above 0.5 MW that may supply power for 15 years or more.
- f) *Lack of practical experience* about biogas from MSW in Argentina: for example, biodigesters require a stable flow of biomass, of known composition, free of bactericides and heavy metals, regulated moisture and pH; any deviation of the appropriate conditions reduces or entirely stops their biogas generation.

The main present threats to achieve the Project goals are two: a) the technical performance and financial viability of the available technologies for energy recovery from biogas in small-scale systems; b) the little time left until project ends.

Defective or unreliable technical performance of biogas-to-energy systems may sharply reduce the interest of public and private operators of municipal waste systems, whom logically tend to prefer the old, fool-proof and problem-free alternatives that they can manage with their own manpower and local resources, i.e. burning the biogas in torches. Also, since the separate treatment of organic waste demands more investment and increases the operational costs of already existing or future waste management systems, their owners or operators want to be sure that the new revenues -or the savings- obtained from energy generation will compensate for the additional expenditures, and will be both financially sound and free of risk. This is not a proven case for small-scale systems.

Favorable policies and adequate regulations may reduce other threats and diminish the risk perception from the owners, but defective performance and /or negative cash flows are non-acceptable risks, both for the municipal administrations and the private operators of MSW systems. This is the main threat to be addressed by the Project, by developing and testing viable business models.

At the time of this MTR, less than 15 months are left until Project's end: this lapse is too short to achieve most of the project's results and outcomes.

Project Description and Strategy: objective, outcomes and expected results, description of field sites.

The Project intends to support the inclusion of energy generation systems using biogas sourced from urban waste treatment systems in the context of the GIRSU Program, making use of its institutional, organizational and capital-attracting capabilities, as well as its ability to concentrate available know-how.¹

The Product, outcomes and results as stated in the PRODOC are:

	Indicators	Baseline	Mid-term goal	End of the project goal
Product: to include biogas technologies for energy generation into the National Strategy of Integral Management of Urban Waste.	(A) Reduction of direct GHG emissions achieved by pilot plants producing energy from biogas, and by their replication	0 ton CO _{2eq} /year	2.200 ton CO _{2eq} /year	13.400 ton CO _{2eq} /year
	(B) A framework of regulations and policies designed for energy generation from biogas of MSW	2	3	5
	(C) Number of public-private partnerships established to make use of biogas from MSW	1	1	3
	(D) People supplied by electricity produced in pilot plants producing energy from biogas, and by their replication	0	2.275 people;	21.000 people;
Outcome 1: Technologies of energy generation from USM biogas incorporated to the GIRSU program , to be installed in local and regional MSW treatment plants	(1a) Number of municipalities with projects of energy generation from biogas of MSW covered by GIRSU program	0	1	4
	(1b) Number of programs and policies including energy generation from MSW- biogas as a relevant option	0	2	4
	(1c) Number of proposals for regulations and policies developed and adopted	0	3	5
Outcome 2: Tecnologies that demonstrate energy production from MSW- biogas are acquired and fully operational	(2a) MW of installed capacity for power generation in pilot projects using biogas from MSW	0 MW	0,2 MW	0,54 MW
	(2b) Annual electricity production by pilot projects from biogas	0 MWh/año	1.300 MWh/yr	4.010MWh/yr
	(2c) Amount of financing mobilized for investment in energy generation systems from MSW biogas	0	USD 3 million	USD 10 million
	(2d) Number of people trained in gender issues and employed for energy generation from MSW biogas RSU (men/women)	0h; 0m	20h; 20m	40h; 40m
Outcome 3.: Monitoring & Evaluation Plan is implemented.	(3a) Mid Term Review (1); following of recommendations to enhance efficacy and sustainability of the Project	(4a) (0)	(4a) MTR completed	(4a) Following of recommendations is completed

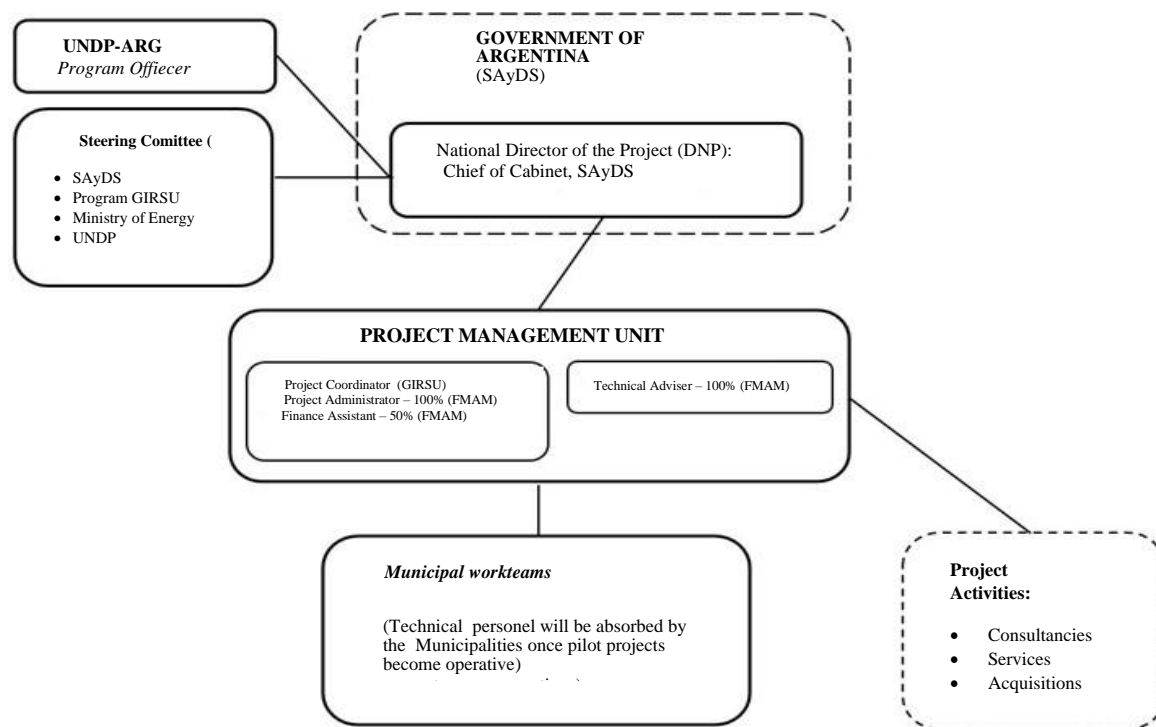
¹ PRODOC, Objetivo de Desarrollo: “Introducir tecnologías de biogás para la generación de energía como parte del programa nacional de gestión integral de residuos sólidos urbanos.”

Four field sites were selected by the Steering Committee, as of 2017: Rafaela (120,000 p, 950 mm/year), Olavarria (112,000 p, 600mm/year), Las Heras (950,000 p, 300 mm/year), Tapalqué (7,500 p, 850 mm/year). All these sites are located in the subtropical climate zone, with mildly cold winters, hot summers and moderate to low rainfall.

Las Heras landfill collects waste from more than one million residents, and is thus beyond the scope of the Project. A small cell was built there to study the effects of the re-injection of lixiviates, an option that may be replicable in smaller towns. In Rafaela a small bio digestion unit (110 m3) was built, that might process up to 200 kg of organic matter per day, i.e. the daily generation of organic waste from one or two thousand people. Tapalqué is still considered as a possible site for demonstration purposes. Olavarria is a landfill site, with one cell currently ending biogas production and another cell almost filled, that might be closed in 2020.

Project Implementation Arrangements: short description of the Project Board, key implementing partner arrangements.

The implementing national body is the Ministry of Environment and Sustainable Development (MAyDS, currently SAyDS), through “Dirección Nacional de Gestión Integral de Residuos” (DNGIR) also executing all actions and programs regarding MSW. The Directive Board (“Junta Directiva”) is formed by representatives of “Secretaría de Ambiente y Desarrollo Sostenible” (SAyDS); “Programa GIRSU”; “Ministerio de Energía y Minería (MEM)”; DNCC, Chancellery and UNDP. The sketch below illustrates these arrangements, as stated in the PRODOC.



Other key stakeholders and initiatives are: the RENOVAR Program (MEM) and “Ministerio de Agroindustria”, which executes the PROBIOMASA program with FAO, INTA and INTI. INTI gives technical assistance to RENOVAR, assessing and monitoring the biogas-to-energy projects to be included in it.

Other partnerships were advanced with

- Programa Provincial de Incentivos a la Generación de Energía Distribuída; it could support Olavarria landfill development
- Red Argentina de Municipios frente al Cambio Climático; to enhance public communication
- Mesa de Infraestructura de propuestas de Cambio Climático; to develop proposals for UNCCC - COP
- Agencia de Cooperación Internacional de Alemania (GTZ); to design a new program on Circular Economy

- Comisión Interministerial de proyectos para el Fondo Verde; drafting projects for Korean Green Fund.

An Inception Workshop was held in Aug 9th, 2017. At this meeting, a national inventory presented by PROBIOMASA counted 106 bio digestion units as of 2016, of which 28% were fed with MSW, 40% had proper treatment and final disposition of solid and liquid effluents, and 43% made some use of biogas, but only 4% for energy generation. It was stated that additional investments for biogas capture and use should be undertaken by GIRSU; but these were not actually being made. It was agreed with “Dirección Nacional de Cambio Climático” that one of the first studies to be performed would be a diagnostic of the existing 50 landfills, to assess their methane emissions, the feasibility of biogas capture and use for energy, and investment costs.

A Technical Committee was formed, and held a first session in oct 25th, 2017, with participation of MAGyP, MEM, PROBIOMASA, INTI, UNICE, the Administrative Coordinator and Technical Advisor of GEF ARG16/23 (Santiago Solda, Andrea Afranchi). No evidence of further sessions of the Technical Committee was given to this MTR.

A budget of USD 100,000 was available for Monitoring & Evaluation, and a detailed plan was included in the PRODOC and in the Implementation Plan to this effect.

The institutional arrangements agreed are summarized in the following sketch

Project timing and milestones

An overall plan of Project Activities was not made available for Consultant’s inspection. Milestones are summarized in Table 3:

Table 3. Implementation Plan and related Milestones

PIF Approval Date	May 1, 2014
PPG	April 1,2014
CEO Endorsement submitted to GEF	February 27th, 2014
CEO Endorsement of Project approved	Jul 26, 2016
1st meeting of TPC (PAC)	December 14th, 2016
Project Document Signature Date (project start date):	Jan 23, 2017
Date of Inception Workshop	Aug 9, 2017
1st Tripartite meeting	November 2nd, 2018
Technical Committee inauguration	Oct 25, 2017]
Expected Date of Mid-term Review	July, 2019
Actual Date of Mid-term Review	September, 2019
Expected Date of Terminal Evaluation	Three months before Project Closure
Original Planned Closing Date	December 31st, 2020
Revised Planned Closing Date	To be discussed with authorities before GEF consultation

Main stakeholders: summary list

The following list identifies the main stakeholders identified in the Inception Workshop.

Federal Level	Secretaria de Ambiente y Desarrollo Sostenible (SAyDS); DNGIRS GIRSU Program; Ministerio de Energía y Minería (MEM); RENOVAR Program PROBIOMASA Program
Municipal level	Municipalities of: Olavarría Tapalqué Rafaela (through IDSR) Las Heras, Cerrito.
Technical bodies	INTI INTA UNCE UNL
Private Enterprises	Transportes Malvinas Cooperativa Eléctrica de Olavarría

4. Findings

4.1 Project Strategy

Project Design

The problem addressed by the project is key to reduce the GHG emissions generated by the current national strategy for MSW, as implemented by GIRSU program. Otherwise, the construction of more landfills without landfill gas collection and burning systems will lead to higher methane emissions from MSW management.

It looks that an incorrect assumption was made regarding the economic viability of landfill gas capture and/or biogas generation for energy in small-medium towns, because electricity generation in these sites shows currently negative NPV (net present value). Even after assuming very high prices for electricity, above 120 USD/MWH, these plants might recover the cost of their operational expenses, but not their capital expenditure. By focusing on this option, the relevance of project strategy might be compromised if other, more effective, ways to achieve the intended results are not found.

The effective country ownership of the Project can be assessed by two indicators: a) the normative and financial commitments made by the Federal Government, and b) the actual involvement of the main direct beneficiaries, i.e. the Municipal administrations. In both aspects, positive declarations of support were and are plentiful, but concrete facts -such as co-financing the pilot projects, contracting personnel for the pilots, etc. have been scarce.

In the decision-making processes leading to PRODOC formulation, consultations were made with direct beneficiaries and other stakeholders, taking into account their needs and opinions. No relevant gender issues were identified at that stage, and since the consultancy on gender issues was not yet implemented as of September 2019, no further data or considerations on the subject were available for this MTR.

From the Consultant's viewpoint, the major areas of concern, as regards project strategy are:

- a) the still pending demonstration of economic & financial viability of small-scale energy generation technologies integrated to MSW systems;
- b) the low level of expertise of the few commercial providers of these technologies in Argentina;
- c) the lack of safe and cost-efficient solutions for the final disposition of the solid and liquid effluents from the bio digestion of MSW ².

The midterm targets, in general, meet the SMART criteria and could have been attained in the 30 months of execution accumulated at September, 2019. However, an unexpected 8-month delay occurred in 2017 affecting the process of selection and contracting the Project Team, and a further 3-month delay occurred in the beginning of 2018, when the Federal Government effected a radical change in the regulations concerning personnel contracts. These delays, added to the lack of a Technical Adviser for 11 months after the resignation of the first one contracted, and the cumbersome procedures applied for contracting third-parties services, have led to the presently very low level of execution of the Project's activities.

The progress so far achieved is insufficient to evaluate whether any beneficial development effects such as income generation, gender equality and women's empowerment, improved governance, etc. were or might be attained in the future.

² In sites where composting facilities are operational, the solid effluents from bio digestors might be added to the composting beds, with small additional cost. Liquid effluents can be reinjected to landfill cells, provided that adequate installations and equipment are present.

4.2 Progress Towards Results

Progress towards objective and outcomes

Table 3. Progress Towards Results Matrix: achievement of outcomes against end-of-project targets

	Objective and Outcome Indicators	Base-line	Mid-term Target	End of Project Target	Mid term Level Asses-ment	Achieve-ment Rating (1 to 6)	Justification for Rating
Project Objective: To introduce biogas technologies for energy as part of the National Strategy for Integrated Municipal waste management	(A) Achieved direct GHG emission reductions by pilot biogas energy plants and replication	0 ton CO _{2eq} /yr;	2,200 ton CO _{2eq} /yr	13,400 ton CO _{2eq} /yr	0 ton CO _{2eq} /yr	I	Direct reduction of emissions achieved by project activities is zero
	(B) Policy and regulatory framework for MSW-based biogas energy supported	2	3	5	2		Several initiatives supported (technical norm for biogas, ban on landfills without gas burning) but only one was issued (on the use of MSW-derived compost)
	(C) Number of public-private partnerships exploiting MSW based biogas established;	1	1	3	1		No partnerships are established
	(D) Number of people served by electricity produced by pilot biogas energy plants and replication	0	2,275	21,000 people	0		Electricity production has not yet started in Project's pilots
Outcome 1: MSW-based biogas energy technologies are incorporated in the national GIRSU programme for deployment in municipal and regional waste plants.	(1a) Number of municipalities with MSW-based biogas energy projects covered by the GIRSU program	0	1	4	1	I	Four energy projects in landfills are currently operating, but these did not result from Project activities
	(1b) Number of national programs and policies adopting MSW-based biogas energy as a relevant option	0	2	4	0		RENOVAR did not adopt biogas based power below 0.5 MW (the power limit feasible for medium towns)
	(1c) Number of policy and regulatory proposals developed and adopted	0	3	5	0		Some proposals are being developed. One was adopted by SAYDS.
Outcome 2: Demonstration biogas energy technologies using MSW feedstock are procured and fully operational.	(2a) Installed electricity generating capacity of MSW- based biogas pilots	0 MW	0.2 MW	0.54 MW	0	I	No pilot projects are in operation or near to operate.
	(2b) Electricity produced by biogas pilots	0 MWh/yr	1,300 MWh/yr	4,010 MWh/yr	0		Zero electricity is produced in biogas pilot power plants .
	(2c) Financing mobilized for investment in MSW-based biogas energy systems	0	US\$ 3M	US\$ 10M	0		No new investment in MSW-based biogas energy supported by or connected to the Project
	(2d) Number of people trained and employed for MSW-based biogas energy generation (0m; 0f	20m; 20f	40m; 40f	4m; 6f		
Outcome 3: The Monitoring & Evaluation plan for the Project has been implemented	(3a) Mid-term review and follow-up of recommendations to enhance project effectivity / sustainability		(3a) Mid-term Review completed		1	3	MTR in execution, near to be completed.
	(3b) Terminal Evaluation document				NA		NA

4.3 Remaining barriers to achieving the project objective

A summary of the present state of the barriers is made in Table 4.

Table 4. Remaining barriers to achieve the project objective

Barriers identified in PRODOC	Present State
<i>1. Defective political framework</i> for small-scale renewable energy projects	Plants below 500 kWe are not allowed to sell power to the wholesale market (MME) run by CAMMESA; there are no incentives or specific regulation for heat generation.
<i>2. Present vacuums in the secondary regulation</i> referring to grid access, net power measurement, security, transportation and end-use of digested biomass.	Barrier still standing. The use of bio digested solid and liquid effluents from MSW is not allowed by SENASA. Grid access is not permitted for plants below 500 KW. Net power measurement is accepted by some power distribution companies. The use of digested MSW (both solid & liquid) in agriculture is forbidden by SENASA.
<i>3. Inadequated coordination</i> between authorities and stakeholders.	Some Municipalities have contracted their MSW management operations.
<i>4. Limited knowledge</i> of the biogas-to-energy technologies in the waste treatment sector:	Barrier still standing. Landfill design is not regularly optimized for the capture of biogas. Defective re-injection of lixiviates and other design characteristics limit the biogas extraction. A few MSW bio digestors are in regular, continuous operation.
<i>5. Lack of viable business models</i> for energy generation from MSW-based biogas	Barrier still standing. No viable business models have been designed and tested. Feasibility studies by INTI in five landfills -plus the UNL study in Rafaela biodigestion unit found clearly positive business cases (IRR above 20%) only in two sites, both serving more than 770 000 people and assuming energy may be sold at 129 USD/MWH to future RENOVAR public bids. However, in the same sites, at current prices from 60 to 87 USD/MWH, IRR is below 9 %. At 60 USD/MWH, two cases had very low or negative IRR.
<i>6. Lack of practical experience</i> about biogas from MSW in Argentina	Two out of four bio digestion units with energy production evaluated by the Project did operate with good results in the last four years (Cerrito, El Jote); but two could not start operation (Huinca Renancó, Rafaela). Big landfills operators generate power, at least in two cases (CEAMSE, Rosario)
Barriers not identified in PRODOC	Present State
<i>7. Lack of funding</i> for small scale energy projects	Big projects for energy recovery from landfill can make profits and have access to private funding or bank loans. Small projects, with negative Net Present Value, are not bankable, and need subsidies to be implemented.
<i>8. Lack of reliable commercial providers of technology</i> for small scale bio digestion	Technology providers for small-scale biogas production are in the R&D&TT sector, do not operate as commercial firms, and do not give guaranties and post-sale services.

4.4 Project Implementation and Adaptive Management

Management Arrangements

The project is executed under the National Implementation concept. A Directive Board (Junta Directiva) was formed, with a representative each, of: “Secretaría de Coordinación y Cooperación Internacional (SECIN) del Ministerio de Relaciones Exteriores y Culto”; “Secretaria de Ambiente y Desarrollo Sustentable (SAyDS) and UNDP.

The Directive Board is responsible for the approval of the Pluriannual workplan, monitoring its development, approval or budgetary annual and substantive revisions, approval of financial and technical reports. It should hold at least one annual meeting. Two meetings of the Directive Board took place (October 25th, 2017 and July 19th, 2019).

A Technical Committee was established as of October 25th, 2017 with participation of seven institutions, and the general objective of opening a channel for technical consultations on the pilot projects and other activities. It held one meeting.

Work planning

A Project implementation Plan was structured for the period 2017-2020. It is summarized by the consultant in Table 1. The planned activities and corresponding budget were revised and updated twice in the following years, as indicated in the PIRs 2018 and 2019.

Because of the recurrent delays in the implementation process, some activities were repeatedly planned to be executed in 2017, 2018 and 2019. For example, in the report to the Directive Board meeting of July 2019, it was stated that the belated replacement of the Technical Adviser meant that the Project Team was left without his technical hand for more than nine months, and that the administrative support -while being still paid by the Project- was not more available.

Finance and co-finance

The GEF-financed activities progressed at a very slow pace, as summarized in Table 5.

Table 5. Execution of GEF funds, in USD

YEAR	Executed	Budgeted (approximate figures)	%
End of 2017	37 065	800 000	5%
End of 2018	110 348	2 300 000	5%
2019 (8 months)	156 632	2 600 000	6%
TOTAL	156 632	2 800 000	5%

About 73% of the total expenditure until July 2019 (\$113 698 out of \$152 622) was made to pay for the salaries of the Project Team; and 27% to Consultants, Travel and Audits. No information was available to the MTR Consultant about co-finance from the Argentine Government.

Project-level monitoring and evaluation systems

The Project Document allotted a budget for Monitoring & Evaluation of USD 100,000 from GEF funds, and additional finance of USD 35,000 from the Government and UNDP. However, in the financial statement provided by the UNDP office, covering the period January 2017 - August 2019, there is no register of expenses specifically made for the monitoring and evaluation activities.

The PIRs 2018 and 2019 were duly prepared by the Project Coordinator following the UNDP format. Two sessions of the Directive Board were held, one at the start of project’s activities (October 25th, 2017) and the second in July 19th, 2019.

The overall ratings, as assessed in the PIRs were

	2018	2019
Overall DO Rating	Moderately Unsatisfactory	Moderately Unsatisfactory
Overall IP Rating	Moderately Unsatisfactory	n.a.
Overall Risk Rating	High	High

It is worthwhile to compare the assertions made in the Cumulative Progress sections of the PIRs 2018 and 2019. In 2018, it was stated that:

“ ... it is expected that energy will start to be generated when Rafaela’s pilot and others pilot projects start working”;
 “It is also expected that, as a result of the conversations initiated with RenovAR’s team Program, the minimum power required to projects can be reduced”
 “... a Normative proposal for digestate management was developed and presented to Ministry of Environment, but has not been adopted yet”;³
 “Even though the project didn’t manage to elaborate new regulatory framework, it is planned to develop during 2018 a technical standard for the composition of biomethane for home use in bottle tanks.”
 “Municipality of Rafaela, one of the pilot projects, developed a bio digester and generated biogas. The project forecasts to add value to this project by transforming the biogas in biomethane.”

In 2019, the level of achievement was described as follows:

“As a result of the study of methane development study generated in 13 sanitary landfills it is expected that new projects could participate in RenovAR Program, to reduce emissions form Sanitary Landfills as well”
 “. . . a proposal for including projects from the study of energy generation from methane of 13 sanitary landfills in Argentina will be send in July”
 “. . . as a result of the conversations initiated with RenovAR’s team Program, the minimum power required to projects can be reduced”
 “. . . 591 ton CO₂eq/yr” (referring to emissions reductions as cumulative progress since project start)
 “. . . started two TORs for a normative proposal for the inclusion of biomethane in the Biofuels Law and a technical standard for composition of MSW biogas”
 “Energy will start to be generated Rafaela’s pilot in October, after finishing viability study”.
 “Energy produced in Rafaela will be 69 MWh/yr”
 “Pre-Viability study from Olavarría indicates that energy capacity will be 0,25 MW. Projects Works will be started at the end of 2019”.

These assertions could not be verified by the MTR Consultant. In the visit to Rafaela, he could observe that the bio digester was built two years before the Project started, it is in disrepair, never produced biogas, and its moto-generator is not connected to a grid. In Olavarría, the new landfill cell is not yet closed, and it is not possible to start the works for landfill gas capture, because the detailed engineering is not ready and the financing arrangements, business models and tenders are not drafted.

In the “Cummulative Progress since Project Start” section, where the advances made by the Project were reported, in the item “Financing mobilized for investment...” the PIR 2019 informs that:

“USD 7 M from Ensenada (Buenos Aires) electricity generation plant from landfill gas. It is a Ceamse + Secco RenovAR Program. USD 6 M from González Catán (Buenos Aires) electricity generation plant from landfill gas. It is a Ceamse + Secco RenovAR Program. USD 5 M from Ricardone, (Santa Fe) electricity generation plant from landfill gas. It is a Global Green RenovAR Program. USD 2 M from Huinca Renancó (Córdoba) Biodigester.”

³ It was adopted by a Resolution of SAYDS in the following year.

In fact, these investments did not result from Project’s activities; most of them were well advanced or fully developed before Project’s inception. Moreover, having executed only 50 K USD in consultancies and zero investments, these developments could not have been an outcome of the project; to include them in this section of the PIR does not seem to be justified.

The lack of concordance between some of the advances reported in the PIRs, those informed to the Directive Boarding in the meeting of July 19th, and the real situation -as verified by the MTR Consultant- may be due to an overoptimistic viewpoint of the Project Team, taking promises of future support or future actions as near-to-be facts. This is clearly the case in three examples:

- a) the declared commitment of Rafaela Municipality and IDSR to complete the commissioning of the experimental bio digestion and power generation units during 2018, and again in 2019, that had not yet become a fact in September 2019;
- b) the report on the imminent start of the Olavarria landfill collection and energy utilization system, for which there was not even a conceptual engineering ready in September 2019, and;
- c) the imminent special waiver to allow biogas power generation units below 500 kW to be connected as a cluster to the grid, that was considered but never issued by MEM authorities.

It is difficult do devise corrective actions to avoid this type of bias in M&R. To have a clear list of milestones and deadlines may help to check achievements, but this checklist was not included in the Action Plan.

In essence, the monitoring and evaluation system implemented by the Project gave early warnings about the mounting arrears in the budget execution, and the correspondingly belated or failed implementation of crucial project activities. This was very clear in the financial data reported by UNDP in the 2018 and 2019 PIRs, summarized in Figure 1 and Table 6. below.:

Figure 1. Projected and executed disbursements

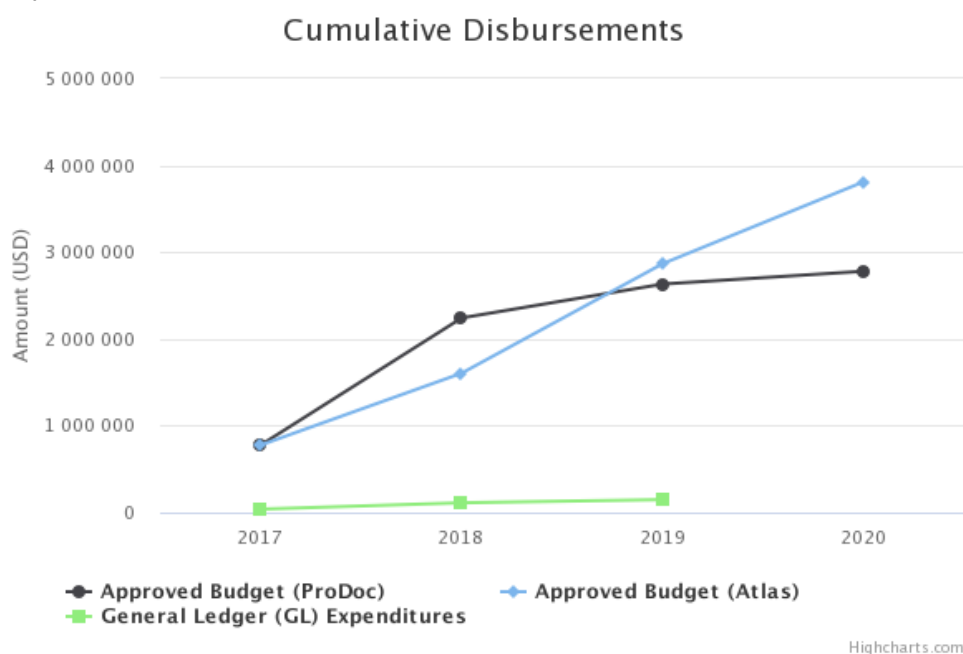


Table 6 . Rate of disbursement and total budget execution

Cumulative GL delivery against total approved amount (in prodoc):	5.33%
Cumulative GL delivery against expected delivery as of this year:	5.63%
Cumulative disbursement as of 30 June, in USD (amount to be updated in late August):	148,124

Source: UNDP, 2019 PIR.

One external audit was made by an independent accounting firm, covering the expenses made by the Project between June 01 and November 30, 2018. No relevant observations were made by the auditing firm.

Stakeholder engagement

Many stakeholders were identified, participated in the Inception Workshop, and made contributions in the form of recommendations for Project implementation at this event. The most directly and strongly interested stakeholders are four Municipalities where the pilot projects would be implemented.

The Consultant could have direct contact with only two of these Municipalities (Rafaela and Olavarría), in brief interviews. In view of the sayings and data provided by interviewed persons, the Consultant's concludes that, at least in these two cases, the Municipalities see the Project as a source of subsidies to develop experimental actions aiming to improve and/or to keep in operation some of the MSW management systems that they already have in place.

In the case of Rafaela, this would help to solve the present problem of a plant for bio digestion of the organic fraction of MSW, acquired with subsidies from several sources that is unfinished and unable to work. The Municipality itself does not possess nor operates this installation; it is located in a site managed by IDSR, a non-profit organization created and supported by the municipal government.

In Olavarría, one of the three existing cells in the landfill is near to be filled; there are facilities for the incineration for hazardous waste (presently not operating). The Municipality expects the Project may provide funds for a new landfill gas capture system, that apparently would not be funded by GRSU. In this case, there is no direct interest from the Municipality in electricity generation, since the town's water and public lighting systems are operated by a Cooperative. The Cooperative already operates a donated photovoltaic system in a sub-grid and could be interested in assuming a similar operation with landfill gas, if the capital expenditure is covered with some subsidy.

Other stakeholders such as INTI and UNL are or were contracted as services providers for technical consultancies. These two institutions made substantial contribution to the progress towards achievement of project objectives, on the technical side.

The local governments supported the project objectives through participation in project meetings, and also signed letters of agreement aimed to implement future activities. In the case of Rafaela, an engineer was contracted to handle the relations between IDSR and the project team in the process of overhauling and commissioning the experimental bio digester and power plant -that has not yet started-.

Reporting

The reporting provisions made in in the PRODOC have been fulfilled by the Project. The changes needed in the management were reported once to the Directive Board, in the meeting of July 19th, 2019; only 30 months after the Project formally started operations.

The Project team addressed two PIRs rated as Moderately Unsatisfactory with an optimistic view, assuming that the delays in implementation and the un-fulfilled commitments of the stakeholders would be overcome in the near future.

One example of this view is the issue of the authorization for grid connection of power plants below 500 kW: since this is not allowed by standing regulations, the project asked for an exception to the rule to be considered by MEM. Such a waiver was promised, but never issued; and in the meantime, other options for power generation not connected to the grid were not studied or tested.

Communications

The communication with stakeholders is good. The Project team has been in frequent contact with personnel of the Municipalities, RENOVAR, PROBIOMASA and GIRSU. The Consultant cannot assess whether this fluid communication has made significant contributions towards the achievement of project's outcomes or to further investments from these stakeholders enhancing Project's sustainability.

About the project communication to the public, little information was supplied by the Project team. The Project has not a web page of its own, and its presence in the MAYDS website is limited to a sheet (with twelve paragraphs). The Project has not yet undertaken a public campaign to make its activities known by the general public. In the towns where pilot projects are being considered, the communication efforts have focused on the authorities and the technicians of the waste management sector.

Very little can be assessed about the project's progress towards results in terms of sustainable development benefits or global environmental benefits, since the pilot projects are not in operation, and biogas from MSW is not being used in small towns for energy purposes (with two exceptions). In Cerrito, this has been happening for more than six years, clearly not as an outcome of Project's activities.

4.5 Sustainability

As already stated in PIRs 2018 and 2019, the overall risk for the Project Sustainability are high, as summarized in Table 7 and detailed below.

Table 7. Risks to sustainability

TYPE of RISK	In PRODOC assessment	in MTR assessment	Difference due to
Financial	LOW	HIGH	There is no current market for CERs Only big operators qualify for RenovAR Negative NPV if electricity price is below 120 USD/MWH
Socio Political	MID	HIGH	Political commitment to invest in landfill gas capture and management does not exist in the Federal Government Municipalities will not adopt MSW management systems that may not recover their operational costs
Institutional Framework	MID	HIGH	Inadequate government structure, low local capacities, weak political support prevail.
Environmental	VERY LOW	MID / HIGH	No practical and safe options for the final disposition of wastewater and digestate are available.
Other	NONE	HIGH	Commercial firms providing technical services, building, operation of MSW bio digestors are few and unexperienced. Research institutions cannot build and operate them.

Financial risks to sustainability

The GIRSU Program would finance the landfill gas (or biogas) capture and burning in MSW systems. This is not currently happening, since Project BID 3245 has not within its goals to finance the burning of landfill gas. It is the opinion of the Consultant that this fact poses a major risk for the sustainability and replicability of the demonstrative projects to be implemented by the Project, because even if these pilots could prove that biogas capture and its use for energy are viable options, the national program that concentrates the financial resources for investment in urban waste management will not provide the funds needed for biogas utilization.

Moreover, after the prices in the CERs market went down, the private operators are not interested in the capture and burning of landfill gas in torches, unless they are paid a plus for this operation; and so, the installations have been abandoned in most landfills, as explained in the interviews.

In a few big landfills, and thanks to a specific market niche opened by MEM offering a base price of 160 USD / MWH for biogas-sourced electricity with 15-year contracts, five projects for power generation (in the range of 4 to 14 MWe) were signed, with a total investment of 20 Million USD. Four of these are actually operating: however, these sites correspond to MSW systems serving more than one million people each, and are out of the scope of the project.

There is a high risk to not leverage financing for power generation projects below 0.5 MWe, which have negative NPV if electricity is valued at 120 USD/MWH or less (see Table 7).

Socio-economic risks to sustainability

There is also a high risk that one of the technological options proposed by the project -i.e. to separate the organic fraction of MSW in order to recover energy from biogas- may be not sustainable in economic terms, in the case of small and medium municipalities. For example, in the only case with a more comprehensive study (Rafaela pilot biodigester and power plant) the NPV of the projected cash flow is negative, unless electricity is sold above 120 USD/MWH and the initial investment is not repaid.

The conclusions of the feasibility studies performed by INTI in five landfills -plus the UNL study in Rafaela) are summarized in Table 7 and commented below. Clearly positive business cases, with IRR above 20%, were found only in two sites serving more than 770 thousand people, assuming that energy may be sold at 129 USD/MWH to future RENOVAR public bids. In the same sites, with prices from 60 to 87 USD/MWH, the calculated IRR values are below 9 %. And, at 60 USD/MWH, two cases had very low or negative IRR.

It looks clear that only the projects with capacity above 0.5 MW that can be sustained for 15 years ⁴ may be profitable, by selling electricity at 129 USD/MWH in the special “market niche” created by RENOVAR.

It is highly doubtful that the Municipalities will build energy generation systems with expected negative cash flows, only to reduce the flow of organic waste to the landfills. Moreover, if the energy recovery from landfill gas is not profitable, the owner or operator may be forced to burn it in a torch if new regulations command it, but not compelled to build and operate a costly energy generation system, only to incur in financial losses.

It is very understandable that the people in charge of MSW management in the Municipalities –who are involved in a daily struggle to keep working a public service whose costs cannot be recovered from taxes- tend to look at this type of proposals with apprehension. The interest to reduce the flow of organic matter entering the landfill may exist, but if the actions needed have bigger costs than returns, the decision will be negative.

A similar reasoning applies to the use of landfill gas for energy production: if the new operational expenses cannot be paid with the income -or the savings- obtained from the generation of electricity, the Municipality will not be in a better financial position.

Table 8. Data from six feasibility studies on the generation of energy from landfill gas and one bio digester.

Source & date	Capacity			Technical Feasibility	USD / MWH	Internal Rate of Return	Emission Reductions			(Thou sands people)	Processed Waste		Per capita generation	May start	Site
	Max	Mid	End				Direct	Indirect	Total		kg/h/d	kg/h/y			
	MW	MW	MW				KtCO _{2e} in 20 years				kw / person				
INTI 09/09	1.40	1.00	0.27	NEGATIVE Lixiviate not drainable	129	29.1%	839	65	904	717	0.575	210	0.002	¿?¿?	MISIONES
					60	7.6%									
INTI 25/02	3.000	1.00	1.00	POSITIVE	129	22.1%			278	1,200	1.182	431	0.003	2021	MENDOZA
					84	7.9%								2021	
INTI 19/09	2.00		1.00	POSITIVE	60	9.1%	2174	145	2,319	1,699	1.189	434	0.001	2022	CORDOBA
INTI 05/09	0.234	0.12	0.08	POSITIVE	105	5.8%	149	13	163	240	0.821	300	0.001	2020	CATAMARCA
					60	-8.60%									
INTI 11/09	0.390	0.30	0.19	POSITIVE	87	7.6%			253	274	0.480	175	0.001	2021	TRELEW
					60	2.2%									
UNL 22/08		0.02		DUDOSA	120	negative			n.s.	2			0.010	2021	RAFAELA

Source: INTI and UNL reports, prepared for GEF ARG16G23, 2019

Institutional framework and governance risks to sustainability

Since the Municipalities are the local governments having most of the responsibilities on municipal waste management, they are the main institutions that must take the decisions on the options opened to collect and use the landfill gas, or to give separate treatment to the organic fraction of waste streams in bio digestors to use it for energy generation. In any case, sizable additional investments must be undertaken,

⁴ This is not always the case, and depends on the time since the landfill was closed: the landfill gas production curve peaks and then decreases sharply in the first five years after closure.

more personnel must be hired by the Municipality or the contractor that operates the local system, and new operational expenses and risks must be taken.

The governance of small and medium towns depend on the ability of its administrations to provide the essential communal services while paying all bills and wages. Any new financial burden that may imbalance this delicate equilibrium is perceived as a potential risk to the institution’s sustainability.

Environmental risks to sustainability

Two main environmental risks of the ENGIRSU became evident in the last years:

- a) the difficulties found to collect and find adequate final disposition for the lixiviates from landfills and the liquid effluent from bio digesters, in regions where rainfall is near to or higher than evaporation (as in Misiones); and
- b) the very few alternatives available for the final disposition of solid effluents from biodigesters.

If innovative solutions are not devised soon to solve these problems, the separation and treatment of the organic fraction of MSW may be hindered to environmental regulations. The plants that cannot dispose of residual liquids and solids in safe and innocuous ways may be closed.

4.6 Ratings

Table 9. MTR Ratings & Achievement Summary

Measure	MTR Rating	Achievement Description
Project Strategy	The Project envisages demonstrating the potential of biogas (including landfill gas) for energy generation from organic municipal solid waste for medium-sized urban centers in Argentina. It will develop and optimize effective business models for energy production as part of integrated waste management under the national GIRSU programme. Three to four small-scale biogas energy systems will be procured and demonstrated in selected municipalities	As of the MTR mission, demonstration of biogas for energy generation by means of pilot plants was not achieved. Pilot plants are not operational, neither near to be implemented. Business models for energy production from MSW management systems in small-scale biogas energy systems are not developed.
Progress Towards Results	Outcome 1 MSW-based biogas energy technologies are incorporated in the national GIRSU program for deployment in municipal and regional waste plants. Achievement Rating: 1	GIRSU Program has considered to include MSW biogas technologies. However, there are not cases of actual deployment in small-medium towns with GIRSU funding.
	Outcome 2 Demonstration biogas energy technologies using MSW feedstock are procured and fully operational. Achievement Rating: 1	Biogas energy technologies are not yet procured, nor operational. The basic studies needed to deploy these technologies in MSW management systems are still in progress.
	Outcome 3: The Monitoring & Evaluation plan for the Project has been implemented Achievement Rating: 3	Internal M&E plan has been partially implemented.

The ratings of Table 9. were assigned by the MTR Consultant, according to Table 10.

Table 10. MTR Assessments of the Progress towards achievement of Results

Rating	MTR Assessment	Description
6	Highly satisfactory (HS)	It is expected that the objective / outcome achieves or surpass all the End- of-the-Project goals without significant deficiencies. The progress toward achievement of the objective/outcome can be considered as a “good practice”.
5	Satisfactory (S)	It is expected that the objective / outcome achieves most of the End- of-the-Project goals with only minor deficiencies.
4	Moderately Satisfactory (MS)	It is expected that the objective / outcome achieves a majority of the End- of-the-Project goals, but with important deficiencies.
3	Moderately Unsatisfactory (MU)	It is expected that the objective / outcome achieves a majority of the End- of-the-Project goals, with great deficiencies..
2	Unsatisfactory (U)	It is expected that the objective / outcome does not achieve a majority of the End- of-the-Project goals.
1	Highly Unsatisfactory (HU)	The objective / outcome has not achieved his intermediate goals and it is not expected to reach the End- of-the-Project goals.

5. Conclusions and recommendations

5.1 Conclusions

Corrective actions for the design, implementation, monitoring and evaluation of the project

At the end of September 2019, the Project stands 15 months before its end. Any corrective action that may be now decided will start its effective implementation at the fourth quarter of 2019, for a total duration of 14 months, and will probably face more delays because of the foreseeable institutional changes with a new federal administration will be inaugurated.

The Project's financial delivery achieved 5.63% in Aug 2019 and will probably not exceed 10% by the end of this year. Thus, the project will begin 2020 with 90% of its budget not executed, and only 25% of its duration remaining. The main danger is there will be no time left to achieve most of the outcomes.

To avoid an overall under-performing status at the end of the Project, two alternatives may be considered:

a) to speed-up the execution of the planned activities, trying to execute as much as possible in 2019/2020; and/or b) to extend the project for one year, until December 2021.

If option a) is chosen, there is a low probability (according to Consultant's estimations) to achieve a substantial increase of financial delivery and related outcomes. Three main corrective actions should have to be taken:

- *to define a critical path to implement the pilot projects*, setting the necessary technical and economic pre-conditions, identifying milestones and deadlines, and adopting clear rules of decision (of the "GO / NO GO" type);
- *to find an alternative fast-track for decision making*, since only two sessions of the Directive Board are probable during 2020, and the financial commitments must be approved at this level
- *to contract "packages of activities"*, comprising all that is needed to implement each pilot project, with an organization able to proceed at a faster pace.

The basic steps in the critical path for the pilot projects should include (as duly foresaw the Implementation Plan in 2017):

- i) to finish pre-feasibility and feasibility studies at the sites (of which, three or more should result positive and sound business cases);
- ii) to sign contracts with stakeholders (municipalities, private operators, power takers);
- iii) to prepare the tenders and technical specifications for the bidding process;
- iv) to complete the bidding process;
- v) to ensure purchasing, building and commissioning of the systems;
- vi) to train local operators.

It must be noted that during 2018/19, it took from 3 to 9 months after the contracts for the feasibility studies were signed to start delivering results. It would be absolutely necessary to find much faster ways to complete all the steps and attain full development of three pilot projects within 2020. Unfortunately, this seems improbable, because under the National Execution Agreement, the Project must follow the procedures and regulations of the federal government for bidding, contracting, under UNDP guidelines for NIM projects. It may be useful to review the National Execution Agreement or request direct services in which UNDP could undertake some of those tasks. Another option is to engage CSOs/NGO as Responsible Parties

In the case of INTI, direct contracting was authorized because this institution provides technical services to RENOVAR. But any other type of contract involving purchasing, building, commissioning, and the like, should complete a cumbersome and long administrative process.

Besides, the policies and regulations needed to shape an enabling environment for the future adoption / dissemination / multiplication of the new business models are not yet in place; and the business models themselves are not fully developed and tested. It is also probable that a new administration will take some time to consider and make a decision about the Project's proposals in this regard. And, since the associated investment costs are not yet clear, the adoption of these business models and the correlated investments as a base for the national policies on SWM management will need some sort of approval at higher levels of decision.

Apparently, the monitoring and evaluation system of this Project did give clear and early warnings about the increasing arrears in the financial execution and the belated or failed delivery of products. However, arrears and delays kept occurring in 2017, 2018, and 2019. Every activity was clearly described in the Project Document, and all were included in the first annual implementation plan, issued in December 30th, 2016. IN spite of this, the pace of execution and the consequent delivery rate were very slow, and in 2018 and 2019 activities scheduled for previous years were planned again, or reported as "near to be finished".

The causes of these delays -mostly of administrative nature- were discussed in the second Directive Board session (July 19, 2019) but it is not clear whether the corrective actions were taken by the national implementing agency.

Actions to follow up or reinforce initial benefits from the project

No initial environmental benefits have resulted to date from Project's activities, since no reduction of GHG emissions has been achieved, and the installations for burning or using landfill gas are not yet part of the projects financed by GIRSU.

On the other side, several benefits in the institutional side are evident, such as:

- the participation of the Project team in various policy formulation bodies dealing with climate change, renewable energy, waste management;
- the interest declared by several municipalities towards the use of the organic fraction of solid waste for energy generation;
- a good level of communication and cooperation established with three National Programs (GIRSU, RENOVAR and PROBIOMASA).

To reinforce and consolidate the progress made in these fields, the national policies need now to be formally adopted, the pilot projects implemented, and executive decisions should be made by the abovementioned programs in order to adopt biogas-for-energy from MSW as a functional component of their strategies and actions.

Proposals for future directions underlining main objectives

Considering that accomplishing the main objectives is not possible in the remaining time before Project's end – since no more than 13 months are left until December 2020- the Consultant's deems that a revision is needed, foreseeing an extension until December 2021. Also, because of the imminent change in the national Administration in December 2019, some delay in the policy making and implementation process is probable.

It is advisable to put less expectations in the possibility of biogas-based power plants below 0.5 MW to be grid-connected and to sell electricity to CAMMESA, since the efforts made in this direction during three years were fruitless. As an alternative, more emphasis should be given to explore, assess and test the options to produce electricity for self-consumption in Cooperatives and Municipalities.

To achieve financial sustainability, the biogas-to-energy business models will need other sources of revenues besides energy. The reduction of the flow of organic waste to landfills may provide them, in the form of a

lower fee paid to the contractor by the Municipality, corresponding to a lower overall waste flow to the landfill. However, it is not clear if this income -or saving- will cover the additional expenses incurred by sorting and processing the organic fraction in bio digesters. This is a major issue regarding sustainability, that needs special research efforts, not yet undertaken by the project.

If bio digestion is selected as a technical alternative to recover energy from the organic fraction of MSW, an environmentally and economically appropriated solution must be found, to ensure a safe final-disposition of their liquid and solid effluents, that may represent more than 50% of the initial inflow of organic matter. Again, this is a major sustainability issue, not focused by the Project.

5.2 Recommendations

As per PRODOC “the Project envisages demonstrating the potential of biogas (including landfill gas) for energy generation from organic municipal solid waste for medium-sized urban centers in Argentina. The project will develop and optimize effective business models for energy production as part of integrated waste management under the national GIRSU program. Three to four small-scale biogas energy systems will be procured and demonstrated in selected municipalities. The Project is focused on electricity generation for self-supply with sales of surplus energy to the grid, but also envisages demonstrating biogas production for heat (including cogeneration) and biomethane production. The Project will deliver electricity from renewable energy sources (biogas) for approx. 21,000 people, thereby avoiding a total of 575 kton CO₂eq over lifetime of the pilots projects”.

Corrective actions for the design, implementation, monitoring and evaluation of the project

1. The generation of electricity for the national grid should not be the main goal of the project, because the capacity attainable in most small-medium towns does not allow for grid connection. Instead, the alternatives for off-grid generation and thermal utilization of biogas and landfill gas should be explored and tested as first options.
2. The implementation of every activity through the normal channels of the Federal Administration has proven to be very slow and cumbersome. Some ways to contract the execution of packages of activities with more agile and flexible third parties must be found, to achieve faster advancement of project activities. It may be useful to review the National Execution Agreement, to request direct services in which UNDP could undertake some of those tasks and/or to engage CSOs/NGO as Responsible implementing Parties
3. Monitoring, evaluation and reporting should follow a detailed critical path of activities and outputs, with clearly marked, well defined milestones, allowing for decisions to be made by the Project team according to the progress made and achievements attained.
4. No actions can be recommended to reinforce the initial environmental benefits from the Project, since none has taken place.
5. It is necessary to define a critical path to implement the pilot projects, setting the technical and economic pre-conditions, identifying milestones and deadlines, and adopting clear rules of decision (of the “GO / NO GO” type).
6. It is highly commendable to start negotiations with the Government in order to agree on, and to prepare a proposal for an extension of the Project until the end of year 2021 .