INDEPENDENT EVALUATION UNIT
OFFICE OF EVALUATION AND INTERNAL OVERSIGHT

INDEPENDENT TERMINAL EVALUATION

DOMINICAN REPUBLIC

STIMULATING INDUSTRIAL COMPETITIVENESS THROUGH BIOMASS-BASED, GRID-CONNECTED ELECTRICITY GENERATION

UNIDO project ID: 100288
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Table of Contents

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Evaluation Team:

Dr. Alfredo Curbelo Alonso

ABBREVIATIONS AND ACRONYMS

Abbreviation	Meaning
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Greenhouse-gas
GWh	Giga Watt hour
IPVEM (PIVEM)	Industrial Park Víctor Espaillat Mera (Parque Industrial Víctor Espaillat Mera)
LAC	Latin America and the Caribbean
LPG	Liquid Petroleum Gas
M&E	Monitoring and Evaluation
MEM (MEM)	Ministry of Energy and Mines (Ministerio de Energía y Minas)
MENARE (MIMARENA)	Ministry of Environment and Natural Resources (Ministerio de Medio Ambiente y Recursos Naturales)
MTR	Medium-term Review
MW	Mega Watt
NCEFZ (CNZFE)	National Council of Export Free Zones (Consejo Nacional de Zonas Francas de Exportación)
NEC (CNE)	National Energy Commission (Comisión Nacional de Energía)
NFZIP (PIZFN)	Navarrete Free Zone Industrial Park (Parque Industrial Zona Franca Navarrete)
NPC	National Project Coordinator
NPIS	National Power Interconnected System
PA	Project Assistance
PC	Project component
PD	Project Director
PIF	Project information form
PIR	Project Information Report
PM	Project Manager
PMA	Project Manager Assistant
PMU	Project Management UNIT
PSC	Project Steering Committee
RET	Renewable energy technology.
SFZC (CZFIS)	Santiago Free Zone Corporation (Corporación Zona Franca de Santiago)
SFZIP (PIZFS)	Santiago Free Zone Industrial Park (Parque Industrial Zona Franca de Santiago)
TE	Terminal Evaluation
TOR	Terms of Reference
TPC	Technical Project Committee
UNIDO	United Nation Industrial Development Organization

GLOSSARY OF EVALUATION-RELATED TERMS

Term	Definition
Baseline	The situation, prior to an intervention, against which progress can be assessed.
Effect	Intended or unintended change due directly or indirectly to an intervention.
Effectiveness	The extent to which the development intervention's objectives were achieved, or are expected to be achieved.
Efficiency	A measure of how economically resources/inputs (funds, expertise, time, etc.) are converted to results.
Impact	Positive and negative, intended and non-intended, directly and indirectly, long term effects produced by a development intervention.
Indicator	Quantitative or qualitative factors that provide a means to measure the changes caused by an intervention.
Lessons learned	Generalizations based on evaluation experiences that abstract from the specific circumstances to broader situations.
Logframe (logical framework approach)	Management tool used to facilitate the planning, implementation and evaluation of an intervention. It involves identifying strategic elements (activities, outputs, outcome, impact) and their causal relationships, indicators, and assumptions that may affect success or failure. Based on RBM (results based management) principles.
Outcome	The likely or achieved (short-term and/or medium-term) effects of an intervention's outputs.
Outputs	The products, capital goods and services which result from an intervention; may also include changes resulting from the intervention which are relevant to the achievement of outcomes.
Relevance	The extent to which the objectives of an intervention are consistent with beneficiaries' requirements, country needs, global priorities and partners' and donor's policies.
Risks	Factors, normally outside the scope of an intervention, which may affect the achievement of an intervention's objectives.
Sustainability	The continuation of benefits from an intervention, after the development assistance has been completed.
Target groups	The specific individuals or organizations for whose benefit an intervention is undertaken.

EXECUTIVE SUMMARY

The project "Stimulating industrial competitiveness through biomass-based, grid-connected electricity generation cycle" is a full-size GEF project implemented by UNIDO in the Dominican Republic and hosted by the National Energy Commission.

The project started in January 2014 with an expected duration of 48 months. Its completion was finally extended to December 2020.

This independent terminal evaluation assessed the entire intervention. Overall performance was reviewed against the standard evaluation criteria of relevance, efficiency, effectiveness, progress to impact and sustainability. In addition to assessing overall results, the evaluation also aimed to identify recommendations to inform and strengthen UNIDO's future interventions.

The project objective is to promote the implementation of decentralized, biomass-based energy production in industrial free zones in the Dominican Republic with the aim of reducing GHG emissions while contributing to their competitiveness within Free Trade Zones.

The project set out to achieve objectives relevant to the socio-economic development of the Dominican Republic. The expected results could also be a reference in the region in terms of the use of biomass energy. However, its objectives and results were ambitious and difficult to achieve within the framework of a project. Despite not achieving the expected results, modest progress was made in the direction indicated by the project objective.

The development problem addressed by the project is highly relevant to the Dominican Republic. The project beneficiaries and participating national authorities actively supported the project activities. They showed a great commitment to the project's progress.

The limited results obtained do not correspond to the relatively high degree of budget execution. This performance was influenced by failures of the project design and lengthy processes related to project management that avoided achieving planned results in the anticipated timeframes.

The results obtained in the component related to policies for the promotion of biomass use are too general. No specific proposals for modifications or additions to the existing regulatory framework were made. The installation and start-up of the biomass power generation plant by a private company, which was the central expected outcome of the project, was not achieved. As an alternative, the project supported the successful demonstration of biomass gasification opportunities through an innovative demonstration project developed by a local company.

Sustainability of project contributions constitutes a challenge in the current circumstances.

Based on detailed feedback from project stakeholders and the evaluation's own findings, the following recommendations are made in order of priority, with a view to informing the design and strengthening of future UNIDO initiatives.

Recommendation 1

UNIDO's specialized departments should support of the establishment of national action plans for the promotion of a formal sustainable biomass-to-energy market and the broad deployment of technological solutions for the energy use of biomass. At the same time, promote partnerships with other UNS specialized agencies and development cooperation.

Recommendation 2

The design of projects aimed at promoting the use of biomass for heat and electricity production should:

- Include activities aimed not only at the identification of biomass potential, but also at the design of the biomass supply chain, its technical-economic evaluation, and capacity building of project stakeholders from this sector. Special attention should be given to supporting the establishment and consolidation of the biomass-to-energy market. To this end, the involvement of biomass sector stakeholders should be encouraged.
- Include detailed planning of investment activities according to the practice of the investment cycle of industrial projects. In particular, pay attention to aspects such as engineering design, and identification of the most suitable technology supplier, including the schedule of the construction and assembly activities, start-up, and commissioning of the plant. The above activities are time- and resource-consuming tasks. Consider local experience and the maturity of the market, and make a conservative estimate of the deadlines.
- Formulate the project results chain in such a way that the necessary synergies of the different project components do not interfere with the relative independence of the realization of each project result.

Recommendation 3

Facilitate the performance of the Director PMU by:

- Provide training and coaching to the members of the PMU in the fulfillment of their responsibilities.
- Ensure that the PMU director receives direct technical support from a PMU staff member or technical advisor.
- Promote the planning and monitoring of project activities through detailed annual work plans.
- Provide direct and systematic support from UNIDO headquarters by the PM or a designated PMA.

1. Introduction

1.1. Evaluation objectives and scope.

The purpose of the evaluation is to assess independently the project and advise the United Nations Industrial Development Organization (UNIDO) improve the performance and results of ongoing and future programs and projects. The terminal evaluation (TE) will cover the entire duration of the project from its starting date on 27 January 2014 to its operational completion on 31 December 2021.

The evaluation has two specific objectives:

i. Assess the project performance in terms of relevance, effectiveness, efficiency, sustainability, and progress to impact; and
ii. Develop a series of findings, lessons learnt, and recommendations for enhancing the design of new and implementation of ongoing projects by UNIDO.

The Terminal Evaluation was conducted following the UNIDO Evaluation Policy[1] and the UNIDO Guidelines for the Technical Cooperation Project and Project Cycle[2]. In addition, the Global Environmental Facility (GEF) Guidelines for GEF Agencies in Conducting Terminal Evaluations, the GEF Monitoring, and Evaluation Policy, and the GEF Minimum Fiduciary Standards for GEF Implementing and Executing Agencies will be applied.

The evaluation is carried out as an independent in-depth evaluation using a participatory approach, whereby all key parties associated with the project will be informed and consulted throughout the evaluation.

The evaluation will use a theory of change approach and mixed methods to collect data and information from a range of sources and informants. It will pay attention to triangulating the data and information collected before forming its assessment. This is essential to ensure an evidence-based and credible evaluation, with robust analytical underpinning.

The theory of change will identify causal and transformational pathways from the project outputs to outcomes and longer-term impacts, and drivers as well as barriers to achieving them. The learning from this analysis will be useful to feed into the design of future projects so that the management team can effectively manage them based on results.

1.2. Overview of the Project Context

The Dominican Republic has enjoyed strong economic growth in recent years prior to the beginning of the pandemic, growing at an average of 3.57% per year between 2011 and 2013, just prior to the start of the project. The pace accelerated to an average of 6.22 % per year during the project implementation period (2014-2019), driven by robust domestic demand. It was one of the fastest growing economies in LAC during those five years.

The energy sector is characterized by a strong dependence on imported fossil fuels and energy consumption is among the highest energy costs for industrial end-users in the region. Consumption of fuel oil not used for power generation, the main industrial fuel, increased by 178% from 2009 to 2013. Starting in 2014, the annual consumption of these fuels began to decrease. Thus, consumption in 2018 was 5% lower than in 2014. The price of fuel oil experienced a period of growth of 79% from 2009 to 2013, followed by a period of a 14% decrease from 2014 to 2018.

[1] UNIDO. (2021). Director General's Bulletin: Evaluation Policy (UNIDO/DGB/2021/11).

[2] UNIDO. (2006). Director-General's Administrative Instruction No. 17/Rev.1: Guidelines for the Technical Cooperation Program and Project
Cycle (DGAI.17/Rev.1, 24 August 2006).

Total power generation grew by 41% during the period 2009 to 2013, but this growth rate decreased during the following 5 years (2014 - 2018) to 14.3%. The share of non-conventional renewables (PV, wind and modern biomass) for power generation has been increasing since 2011. The share of PV and wind generation increased from 1.6% to 3.9% between 2014 and 2018. In addition, the contribution of biomass power generation to renewable energy generation increased to 5% in this same period. Consequently, the share of renewable energy generation by non-conventional sources was 53% wind, 25% solar and 22% biomass in 2018.

The Government of the Dominican Republic has demonstrated its commitment to diversifying the national energy mix. There are two main government institutions leading this effort: the National Energy Commission created in 2007 with the decree of Law 57-07 on incentives for the development of renewable energy sources and their special regimes; and by the Ministry of Energy and Mines (MEM) established in 2013 with Law 100-13. These efforts include promoting investments in renewable energy technologies. One of the instruments developed that contributed to this purpose was Law 57-07 (2007), which establishes financial benefits and tax exemptions. Also, the NEC approved in June 2011 a regulation allowing net metering. This regulation opened new opportunities for small generators to participate in the power market.

The energy situation in the Dominican Republic during the project preparation period (2011-2013) was characterized by energy shortages, high energy prices and uncertainty about electricity supply. These problems affected the manufacturing industry, and in particular the network of companies in the Free Trade Zones. This economic sector focuses on export activities. It is made up of 75 parks and 695 operating companies, 77.8% of which belong to the industrial sector. The sector's contribution to the Gross Domestic Product (GDP) of the Dominican Republic was 3.4% in 2013 and 3.2% in 2019.

1.3. Overview of the Project.

Table 1. Project fact sheet	
Project title	Stimulating industrial competitiveness through biomass-based, grid-connected electricity generation
UNIDO ID	100288
GEF Project ID	4747
Region	LAC
Country(ies)	Dominican Republic
Project donor(s)	GEF
Project implementation start date	27 January 2014
Expected duration	48 months
Expected implementation end date	31 December 2020
GEF Focal Areas and Operational Project	CCM – 3
Implementing agency(ies)	UNIDO
Executing Partners	National Energy Commission (NEC), National Council of Export Free Zones (NCEFZ), Santiago Free Trade Zone Corporation (SFZC)
UNIDO contribution (USD)	USD 60,000
Donor funding	USD 1,300,000
Project GEF CEO endorsement/approval date	19 December 2013
Co-financing at CEO Endorsement, as	USD 7,620,000

applicable	
Total project cost (USD), excluding support costs and PPG	USD 8,920,000
Planned terminal evaluation date	January-April 2021

In this context, the National Energy Commission (NEC) and the National Council of Export Free Zones (NCEFZ)[3] agreed to work together to promote the implementation of decentralized, biomass-based energy production in industrial free zones in the Dominican Republic with the aim of reducing GHG emissions, while contributing to their competitiveness within Free Trade Zones[4].

The selected free zone for the implementation of the project demonstration activities was the Industrial Park Víctor Espaillat Mera (IPVEM). It is the largest free zone park of the country and is owned and administered by the Santiago Free Zone Corporation (SFZC)[5]. IPVEM is located in Santiago de los Caballeros city, capital of the Cibao Province.

To achieve the project's objective, the following barriers were identified:

- Policy:
  Despite the National Energy Plan 2004-2015 and the Law 57-07, which provides a high-level policy framework to promote decentralized power generation and renewable energy technologies in the country, there is still the need to strengthen the policy and regulatory frameworks (e.g., concession regimes, tax exemptions, net metering (to net billing), fiscal stimulus, etc.), to support developers of small-scale, decentralized renewable energy systems. In addition, renewable energies (specifically biomass-based power plants) may benefit from more specific regulations concerning nuisance and environmental impact, including particle emissions and water usage.
- Technology:
  Related to the lack of experience with the design and operation and maintenance of decentralized energy systems in the Dominican Republic and biomass technology for electricity generation in particular.
- Business skills and delivery model:
  Identified lack (potential) of consensus between SFZC and the hosted companies as a barrier for developing the demonstration plant and proposed guidance to establish a dialogue between all stakeholders. Substantial investment was made in a new substation, which was recovered through the internal electricity tariff (where the price would be set by SFZC). Moreover, expertise on biomass energy technology in the Dominican Republic is not commonly available. The few professionals working in this field are generally linked to technology suppliers, hence independent technical advice is difficult to find.

[3] The National Council of Export Free Zones is a governmental body created by Law 8-90 and made up of representatives from public and private sectors. The main function is to outline a comprehensive policy for the promotion and development of the free zone sector. In addition to regulating and applying Law 8-90 on the sector in the Dominican Republic.

[4] The baseline of the project focused on an efficient, decentralized power plant that could supply electric energy at a cost level comparable to the cost of grid electricity.

5 The Santiago Free Zone Corporation is a public – private organization that is the owner and administrator of the Victor Espaillat Mera Free Economic Zone (IPVEM).

- Information:
  Even though awareness among industries and industrial free zones about the cost of electricity has increased since the PIF design phase in 2011 (especially in free zones such as Santiago, which are directly affected by the supply deficit on the wholesale market), there is still a general lack of knowledge about the opportunities for introducing RETs in industry.
- Finance:
  The financial risks associated with new electricity generating plants are considered high; by consequence, new power plants do not materialize to match the increasing demand. For biomass plants, the lack of acquaintance with the technology (cogeneration – i.e., electricity generation), the lack of a tracking record, and perceived concerns about the sustainability of the biomass supply add to this risk profile.

To overcome these barriers, the project includes four different components (PCs) and outcomes (Figure 1)

PC 1: Policy support for decentralized, biomass-based energy generation.

Outcome 1: ***The policy and regulatory environment conducive to decentralized, biomass-based power and heat generation has been strengthened.***

- **Output 1.1**: Regulation for decentralized biomass-based power generation (environmental impact, nuisance, and water use) has been reviewed, amended and streamlined;
- **Output 1.2:** Proposals for financial incentives to stimulate decentralized, renewable energy technologies have been prepared and submitted to the Government for approval;
- **Output 1.3**: Existing information sources on the biomass potential in the national territory have been validated and integrated;
- **Output 1.4**: Sustainable biomass sourcing strategies have been developed in coordination with rural development programmes in the Santiago region.

PC 2: Demonstration of proven biomass technology for electricity generation.

Outcome 2: ***A biomass-based electric power plant (envisaged capacity 3 MW) has been adopted by the Santiago Industrial Free Zone.***

- **Output 2.1:** A detailed feasibility study for the development of an envisaged 3 MW decentralized, biomass-based electricity plant at the Santiago Free Zone has been carried out;
- **Output 2.2:** Supportive studies and technical designs have been prepared, and permits and concessions obtained;
- **Output 2.3:** Staff from Santiago and other industrial free zones have received training on technical and managerial aspects of small-scale biomass plants;
- **Output 2.4:** The envisaged 3 MW biomass-based electric power plant has been procured and made operational under an appropriate business model.

PC 3: Supportive activities for training, promotion and dissemination

Outcome 3: ***Awareness for the concept and benefits of biomass power generation has been raised among relevant stakeholders.***

- **Output 3.1:** A communication plan has been prepared to interact with civil society organizations and the general public on the topic of sustainable biomass sourcing;
- **Output 3.2:** Operational experience and best practices from the Santiago demonstration plant have been compiled;
- **Output 3.3:** Promotional activities including technical seminars, dissemination events, and drafting of technical manuals and guidelines, have been carried out.

PC 4: Monitoring & Evaluation.

Outcome 4: ***A monitoring plan has been prepared and implemented in coordination with UNIDO.***

- **Output 4.1:** A monitoring plan (that also covers monitoring of competing uses of biomass) has been designed and agreed upon during the Project's inception phase;
- **Output 4.2:** Project progress on defined indicators and compliance with UNIDO guidelines (including gender) is being monitored;
- **Output 4.3**: A mid-term review and terminal evaluation have been conducted.

Figure 1. Project Components.

1.4. Theory of Change

The long-term change expected from the project is that the decentralized, biomass-based energy production is widely used in the Dominican Republic

The project aimed to contribute to this long-term change by achieving medium-term changes resulting from the creation of the conditions conducive to a wide deployment of biomass-based energy production in the industrial sector.

Specifically, the project expected to promote the implementation of decentralized, biomass-based energy production in industrial free zones in the Dominican Republic.

The project's promotion of biomass-based energy production is intended to be the result of changes caused by the project's results in the regulatory and policy environment, in the awareness of relevant stakeholders, and in national technological capacity. (Figure 2)

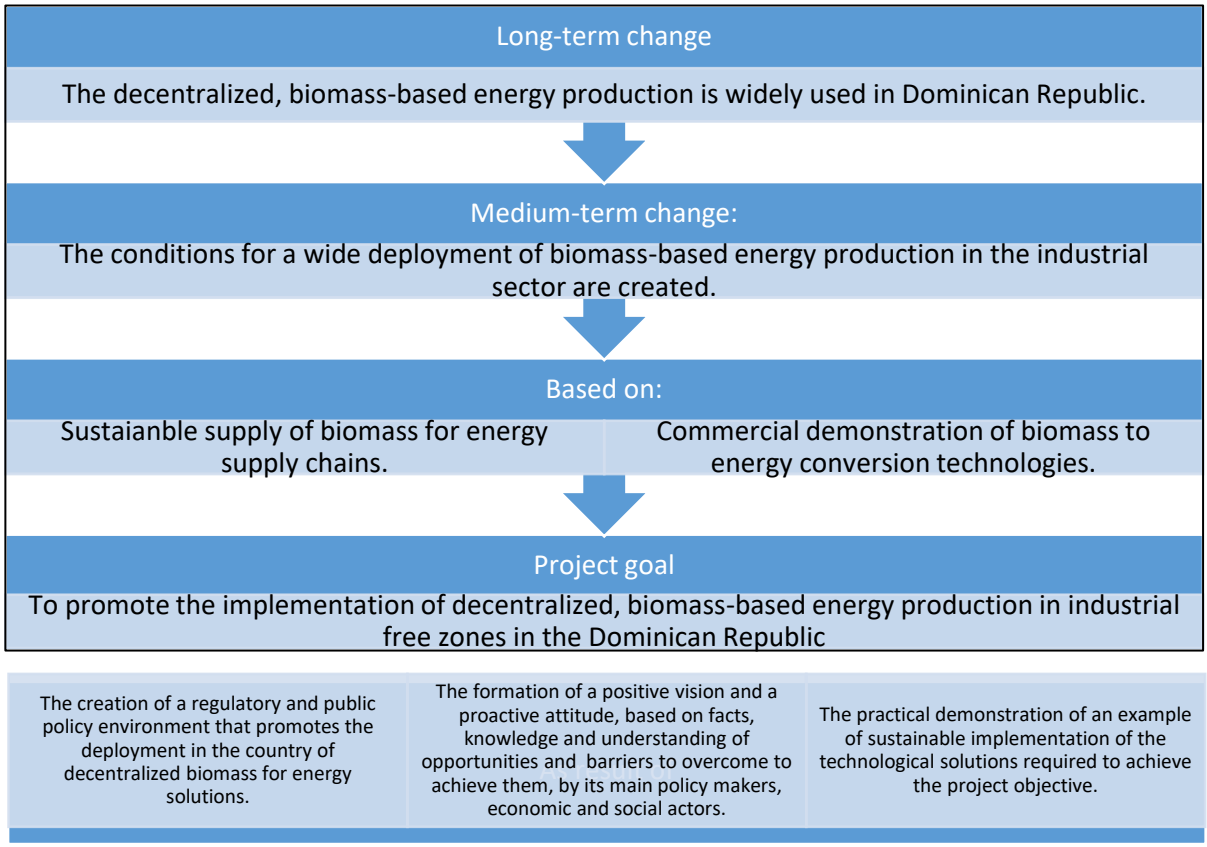

Figure 2Theory of change

Specifically, the expected short- medium-term changes to be produced by project activities are associated to:

- The creation of a regulatory and public policy environment promoting the deployment in the country of decentralized generation of electricity from biomass.
- The formation of a positive vision and a proactive attitude, based on facts, knowledge, and understanding of opportunities and barriers to overcome, by the main economic and social project stakeholders.
- The practical demonstration of the possibility of the sustainable implementation of the technological solutions required to achieve the project objective.

One relevant point of analysis is that contribution of the result-chain to attain above-described

changes for the promotion of biomass energy production depends of to two essentially different, but connected business activities:

- The biomass supply chain.
- The biomass-based energy facility.

To achieve the medium-long term changes associated with each outcome, a set of outputs were defined:

In the case of the accomplishment of the outcome of component 1, it is addressed through four products:

- Outputs 1.1 and 1.2 focus on the area of electricity generation activity.
- Output 1.3 is focused on a better knowledge of the existing biomass potential in the country and
- Output 1.4 is aimed at developing biomass supply strategies specifically to the foreseen biomass power plant in the SFZIP. However, it does not contribute directly to the achievement of this outcome. Due its expected result, this output would correspond to outcome 2.

The results associated with component 2 are addressed through four products, all focused on the implementation of the biomass plant, but none is focused on the supply chain of biomass as fuel.

In the case of component 3, the three outputs contributes to the expected result.

While the outcomes and outputs of the project contribute to achieve expected short medium-term changes in the topic of power generation, they failed to promote such changes in the area of the biomass supply chain.

1.5. Evaluation Methodology

The evaluation methodology is based on indications from the TORs (Annex 1)
The most significant particularity of the implemented methodology is that the stakeholder's consultations were done using online technology due to travel limitations imposed by the COVID 19 pandemic.

Despite the extended duration of the project, the evaluator had access to good quality information on the project implementation. This information was comprised of different project reports: project information reports; project progress reports; minutes of meetings of the Project Steering Committee (PSC) and the Technical Project Committee (TPC), deliverables of consultancies contracted by the project, etc. (annex 2).

A comprehensive and representative set of interviews was organized (annex 3)

1.6. Limitations of the Evaluation

The main limitation of this evaluation process is directly related to travel limitations imposed by the COVID 19 pandemic.

For this reason, the evaluator did all the typical field activities of the evaluation process using online communication services. Nevertheless, the gathered information qualifies as appropriate for the formation of an objective and data-based idea about relevant issues of the evaluation process.

2. Evaluation

2.1. Progress towards impact.

The project aimed to promote the changes necessary to achieve widespread use of biomass as an energy source in the Dominican Republic.

These changes were expected in three directions, corresponding to each project outcome:

a. Recommend adjustments in the regulatory and policy framework for the effective promotion of the use of biomass as a renewable energy source.

In this direction, the project could not support a substantial improvement of the regulatory framework but some progress was achieved:

- The convenience and possibility of facilitating the access of small and medium electricity generators to the benefits of some existing rules in the current regulatory framework was demonstrated.
- The basis for promoting the biomass market in the regulatory framework of the forestry sector was created.
- Improved understanding of the potential of biomass and the main barriers to its commercial use.

b. Demonstration of the technical and economic feasibility of technological solutions for biomass electricity production.

Although no progress was made in the demonstration of a 3 MW biomass electricity production plant, progress was made in:

- The identification of the main barriers for the promotion of investment in the biomass to energy business by the national private sector.
- Relevant actors in the free trade zone sector and the rice sector in the country were sensitized on the opportunities and limitations of actions aimed at using biomass and agro-industrial waste to generate electricity.
- National capacity was strengthened to develop innovative biomass gasification systems and expand their use in industrial enterprises for heat production.

c. Increased awareness and training of stakeholders to expand the use of biomass as an energy source.

Although it was not possible to provide technicians, specialists and decision-makers with specialized information on the use of biomass for electricity generation through guides and manuals and to facilitate access to experiences in the development and operation of a commercial biomass power plant, progress was made in the following areas:

- The creation of a space for interaction between relevant agents and the promotion of new ideas, business and collaboration opportunities that creates the basis for the consolidation of the biomass sector as an energy source. This is the result of the creation of the Biomass Network, which brings together professionals from very diverse sectors such as biomass producers, representatives of the industrial sector, consultants and academics, and public policy makers.

– The use of digital media and social networks for the dissemination of experiences, knowledge and the facilitation of contacts between actors who play an important role in promoting the use of biomass for energy.

An important step towards a comprehensive approach to the issue of biomass for energy by the Government of the Dominican Republic, facilitated by the project, was the increased communication, interaction and understanding of the responsibilities and synergies of the ministries and agencies in charge of the energy sector and the environment and natural resources sector.

Considering that the progress achieved by the project results is well below expectations, progress to impact is considered **moderately satisfactory.**

2.2. Project Design

Overall design

The project aimed to promoting biomass for energy use. This objective contributes to some of the socioeconomic development priorities of the Dominican Republic such as the reduction of the country's dependence on imported fuels and mitigating climate change. In addition, promoting the progress of rural areas based on local development and fostering the circular economy, while reducing energy costs in the industrial sector.

The problem addressed by the project is complex and multi-sectorial. Progress towards its achievement requires completing major changes on both the biomass supply side and the industrial end-user side. Among the factors complicating progress towards the goal is the fact that the biomass-to-energy market was incipient and not based on formal standards. Industrial sector experience in using biomass for energy on a commercial basis was scarce and concentrated in a few cases for the production of heat rather than electricity.

The overall design concept of the project is adequate. It recognizes the government institution leading the country's energy development as a stakeholder in the design and implementation of the project. The project beneficiaries are strong institutions representing the free trade zone sector. NCEFZ and SFZC were actively involved during project design. Both institutions committed to act as executing partners.

UNIDO, on the other hand, has long experience and capacity to promote biomass for energy use and to support investment activities.

The overall project design lacks a more direct approach to the issue of biomass supply and biomass for energy market promotion. The involvement of stakeholders from the biomass policy and production sectors, according to the project design, is not sufficiently direct and specific to enhance their contribution to the achievement of the project objectives.

Project result framework

The project objective is well formulated and corresponds to the development problem addressed.

The design of the project results chain is the typical three-component design. One component for improving the policy and regulatory environment, a second for technology demonstration, and the last for stakeholder awareness, information dissemination, and communication.

The most relevant issues on the design of the project's results chain are:
- Outcome 1: Strengthening the regulatory and policy framework for the promotion of the use of biomass energy for heat and power. Special attention was given towards small-scale facilities using biomass for energy.

The outputs of Outcome 1 focused mainly on power generation. Issues related to the regulation of biomass supply and the establishment of a robust biomass-to-energy market are not addressed.

Two outcomes are devoted to biomass-related aspects:

Output 1.3 "Existing sources of information on biomass potential in the national territory are validated and integrated". The formulation of this output makes sense as a contribution to the assessment of the magnitude of the biomass supply potential for a biomass market.

However, this approach does not directly contribute to the goal of the outcome: strengthening the regulatory and policy framework for the promotion of the use of biomass for energy.

Output 1.4 "Sustainable biomass sourcing strategies have been developed in coordination with rural development programs in the Santiago region".

Addressing the issue of sustainable biomass sourcing as a contribution to the establishment of sustainable biomass market would be a contribution to the achievement of this outcome. To this end, this output should have focused on strengthening the policy and regulatory framework that supports the establishment of a biomass market. However, the current formulation of this output was more appropriate to be included in Outcome 2. Especially considering that the expected biomass sourcing strategy is part of the business model to be established for the supply of biomass to the power plant envisaged being implemented by the above-mentioned outcome.

The design of this outcome lacks the necessary focus on contributing to the strengthening of the regulatory and policy framework that supports the establishment of the biomass-to-energy market.

- Outcome 2 is dedicated to the demonstration of proven biomass technology for electricity generation.

- Outcome 2 is dedicated to the demonstration of proven biomass technology for electricity generation.

The main expected result of this component is that SFZC would acquire and operate a biomass power plant, with an envisaged electrical capacity of 3 MW. SFZC would receive financial, technical, and advisory support from the project.

This evaluation of the design of this outcome is provided based on the concept of the industrial project investment cycle. This cycle comprises three phases: pre-investment, investment, and operational (Figure 3).

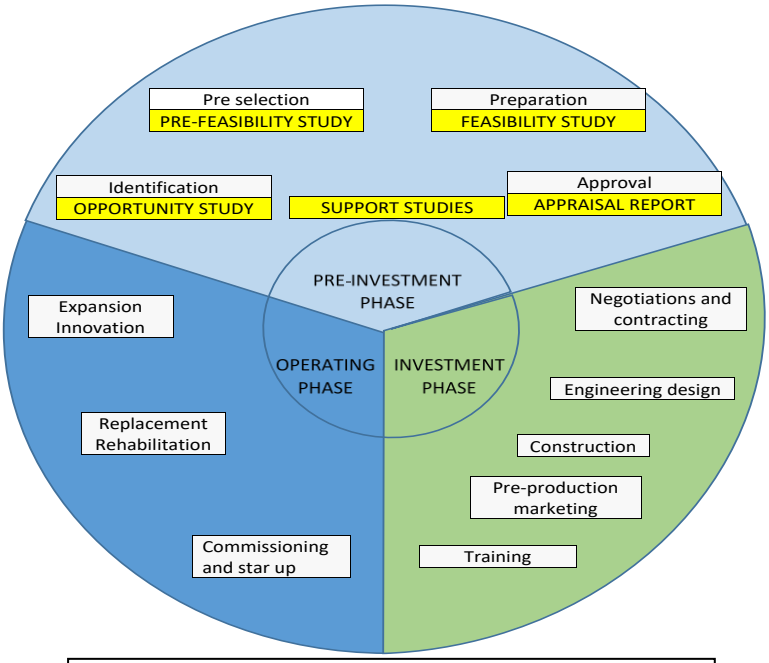

Figure 3 Project Investment cycle
Source: Manual for the preparation of industrial feasibility studies.
W.Bejrens, P.M. Hawranek. UNIDO. 1991

Outcome 2 of the project was planned to cover the first two phases.

During the pre-investment phase, it is strongly recommended to complete the sequence of opportunity, pre-feasibility, and feasibility studies. These studies usually require some complementary studies. The final product of this phase is the appraisal report. This report is used by the investor to approve the investment proposal.

The project design undertakes this phase by implementing output 2.1 dedicated to the feasibility study and output 2.2 dedicated to supporting studies and obtaining the necessary permits and concessions.

This design of outcome 2, assumes that the pre-feasibility studies were completed during the project preparation phase.

However, the conclusions of the three technical studies included as Annex I[6], J[7], and K[8] of the project document indicate the need for the completion of pre-feasibility study phase before initiating the feasibility studies.

Conclusions and recommendations of these reports identified some issues that needed to be solved as inputs for the feasibility study.

Some if these issues are:

- The selection of the technological solution to be implemented was no concluded:
    - While the studies carried out coincided to recommend the implementation of a 3MW biomass power plant (Rijs, Bermudez), the selection of the technology to be used remained incomplete:
        - One study concluded: "Recognizing the preliminary nature of this analysis, the generation project "A"[9], directed exclusively to the production of power, shows the most favorable economic indicators." (Rijs)
        - The other study concluded: "The financial-economic evaluation shows that the three scenarios[10] show adequate profitability indicators. The selection of one or the other scenario will depend on the feasibility analysis where the prices of plants of this type in the market are included and on a comprehensive analysis of the economic and technological feasibility." (Bermudez)
- The selection of the plant location site from two possible options remained pending. For the selection of the specific site, it was necessary to:
    - Characterize the water sources available for the plant's cooling system. (Rijs).
    - Determine the requirements of the area needed for the installation of the power plant. It needed a floor plan scheme considering, in addition to the technological area of electricity generation, the biomass storage and handling areas, the power grid connection facility, and the area for water treatment and cooling. (Rijs).

[6] Humberto Checo H. "Determination of Biomass Availability in the Surroundings of Santiago, Dominican Republic and General Frameworks for its Transformation into Energy". UNIDO/CNE/CZFIS Project: "Stimulating Industrial Competitiveness Through Biomass Based, Grid-Connected Electricity Generation" (GF/DOM/12/001 & TEDOM12002). Final report. Santiago of the Knights. Dominican Republic November 2, 2012.

[7] R. Rijs. "Energy transformation of biomass for electricity generation in the Industrial Free Zone of Santiago" 3 MW biomass plant - Pre-feasibility study. UNIDO/CNE/GEF Project: "Stimulating Industrial Competitiveness Through Biomass-Based, Grid-Connected Electricity Generation" (UNIDO/100285/4034). Dominican Republic. April 12, 2013

[8] Dr Raul Perez Bermudez. "Determination of biomass energy transformation scenarios for electricity generation in the CZFIS". Project: "Stimulating Industrial Competitiveness Through Biomass-Based, Grid-Connected Electricity Generation" (GF/DOM/12/001 & TEDOM12002). Santiago of the Knights. Dominican Republic. 2012.

[9] using the Rankine Steam Cycle

[10] Scenario A: Biomass combustion plant (Rankine cycle) for the production of electricity, Scenario B: Biomass combustion plant (CHP) for the production of electricity and thermal energy, Scenario C: Biomass gasification plant producing a gas fuel with medium specific heat of combustion.

    - Conduct "a detailed study to assess the impact of weather conditions on the emission of particles, gases, noise, etc., and take the appropriate mitigation measures". (Rijs).
- Conduct a detailed study of the biomass supply chain to:
    - Design an effective and low-cost solution for biomass transportation. (Rijs)
    - Design and execute a business model with biomass producers, which guarantees exclusivity in the stable and safe purchase of biomass resources over time and avoids commercial speculation of biomass, and guarantees the sustainability of the project over time. (Bermudez).
    - Carry out "simulated purchase" operations of biomass from the sources with the greatest potential identified, as a way of better recognizing the existing difficulties in incorporating significant volumes of them into the project. (Humberto).

In the case of the issue related to ensuring a sustainable supply of biomass at reasonable prices for the biomass power plant was not adequately addressed in the component results.

Although output 1.4 addressed the problem of sustainable biomass supply strategies and one of the results of output 2.4 focused on the design of the biomass supply business model, it was insufficient to support the design of the biomass supply chain and its establishment.

The project design should have addressed these issues through specific project activities before launching the feasibility study.

The first two years of the project implementation period were planned to complete the pre-investment phase. This period was insufficient to complete this investment phase because:

- Part of the first one-year period was used to set up the project management structures.
- Conducting the studies and evaluating their results to decide the next step took additional time.
- The design of the biomass supply chain is a complex and time-consuming task due to the limited experience, institutional capacity, and the scarce number of market players in this field in the country.

The investment phase comprises negotiation and contracting, engineering design, construction, and assembly, and ends with plant commissioning. This phase starts right after an investment decision is made.

It is foreseen that the activities described above would be carried out through outputs 2.2 and 2.4.

In the case of output 2.2, activities from both phases of the investment cycle are mixed. The preparation of supporting studies corresponds to the pre-investment phase, while

the preparation of technical designs and obtaining permits and concessions correspond to the investment phase. This fact affects the identification of a clear breakpoint that decides the approval of the investment during the implementation of Outcome 2.

The narrative of this output does not describe the scope of the technical studies. A more detailed description was needed, including the need for engineering design. It could have influenced the period and budget dedicated to this output in the project design.

Outcome 2.4 "The planned 3 MW biomass power plant has been procured and commissioned with a suitable business model" intended to address the procurement, installation and transfer to the power plant owner. However, the description of deliverables provided by the project document does not include any specific investment phase activities related to technology transfer considerations, construction and erection tasks and commissioning of the power plant.

Consideration of the duration of this output shows an underestimation of the actual extent of activities planned and required.

According to the annual budget, it was planned to start purchasing the equipment during the second year of the project period. However, prior to the purchase, it was necessary to complete the engineering design, the bidding process, and the signing of the supply contracts. Therefore, the purchase of equipment could not start until at least one year after the approval of the investment by the investor. This means that this specific process could start no earlier than the third year of the project period.

The installation of the equipment could start only after its arrival in the Dominican Republic. This could take six to twelve months after contracting. Only after completion of the assembly work is it possible to start the commissioning and start-up process.

This phase also includes the selection and training of personnel. According to the project design, this activity is executed through deliverable 2.3.

Some of the limitations of the investment phase design are:

- The description of outputs 2.2 and 2.4 do not include some critical activities. This is the case, for example, of engineering designs, equipment procurement, civil works and assembly activities, and plant commissioning. These activities are time and resource-consuming.
- The planned timeframe was insufficient to achieve the expected results. This was because the actual sequence and duration of the planned and missing activities were not taken into account when planning the output. (Table 2).

  A more realistic and effective design of this outcome would redistribute activities per output and increase the total duration.

  A more specific description of this redesign of outcome 2 would be:

Output 2.1 focused on closing the pending issues of the pre-feasibility study phase. It would include a detailed study of the biomass supply logistic. The main result of this output would be the selection of the most appropriate technical economic solution for installing the biomass power plant.

Output 2.2 is dedicated to the feasibility study of the selected proposal. It would include studies aimed at the technical design of the plant and the environmental impact. Needed permit and authorizations would be received. Preliminary agreements for the supply of biomass and its price would be achieved. The main result of this output would be an investment proposal (an appraisal report), with a detailed business plan ready to be considered for approval by the board of directors of ZFIS.

Output 2.4 would include a more detailed description of its activity. For example, the detail engineering studies, equipment procurement process, construction and erection activities as well as commissioning.

The total duration of the outcome would be in the order of five years. (Table 2)

Table 2. Investment Cycle schedule

Phase	Activity during the phase	According to	Project output	Schedule (year)				
				1st	2nd	3rd	4th	5th
Pre-investment	Opportunity Study	PD	PPP					
		EA	PPP					
	Prefeasibility Study	PD	PPP					
		EA	Output 1.1 (RD)					
	Feasibility Study	PD	Output 2.1					
		EA	Output 2.2 (RD)					
	Complementary studies/ Closing of the pre-feasibility study phase.	PD	Output 2.2					
		EA	Outputs 2.1/2.2 (RD)					
	Appraisal Report	PD						
		EA						
Investment Phase	Negotiations and contracting	PD	Output 2.4					
		EA						

	Engineering design	PD	Output 2.4					
		EA						
	Civil works and	PD	Output 2.4					
		EA						
	Equipment supply		Output 2.4					
	Equipment installation		Output 2.4					
	Training	PD	Output 2.3					
		EA						
	Pre-commissioning and start-up	PD	Output 2.4					
		EA						
Note:		PPP	Project Preparation Phase					
		PD	Project design					
		EA	Evaluation Assessment					
		PPP	Project Preparatory Phase					

Another issue to highlight is the choice of the case for the demonstration of the tested biomass energy technology. The selection as a demonstration case of a 3 MW biomass power plant funded by SFZC was not the most appropriate.

This is due, at least, to the fact that:

- ✓ The capacity of the selected biomass power plant makes it difficult to find a proven and economically attractive technological solution for the investor.

  The reason is that, for steam power plant technology, the selected power capacity is small and the unit cost (USD per MW of power capacity) is too high. On the other hand, for biomass gasification technology, the selected power capacity is too large to be considered a proven technology.

- ✓ Achieving a secure, stable and sustainable supply of the amount of biomass estimated to be needed was highly uncertain. This conclusion is based on the following facts:
  - The market for biomass for energy was not formal;
  - There was no previous experience in the country to provide a daily supply of biomass in the order of 100 tons per day or 30,000 tons per year of acacia mangium chips.

- The logistics for transporting this biomass over a distance of 60-120 km did not exist.

✓ The selection of SFZC as the project investor adds some specific risks to achieve investment approval:
- Biomass power generation is a long-term specialized business activity.
- SFZC needed to develop business expertise to manage this new activity.
- SFZC's motivation for investing in the biomass power plant was driven by circumstantial reasons related to the economic impact of the poor quality of electricity supply that existed at the time the project was designed.
- It is very likely that the SFZC board would approve the investment in this business only if it turns out to be a low-risk investment. However, this rating is very rare for this type of pioneering biomass power generation project.

Outcome number three focuses on rising stakeholder awareness on the technological solution and on the benefits of biomass power generation.

The design of the outputs, in this case, is appropriate. They address issues related to communication, collection of experiences and best practices, and promotion of project results, as well as dissemination of associated know-how.

In the case of output 3.1: “A communication plan has been prepared to interact with civil society organizations and the general public on the topic of sustainable biomass sourcing”. It was designed “As part of the due diligence process during preparation and implementation of the biomass pilot plant”. For this reason, it was not possible to advance in the implementation of the product until the location of the pilot plant was defined.
This communication plan could have been aimed at raising awareness of the Dominican society in general to avoid unnecessary negative perceptions about the project objective "to develop the use of biomass for decentralized electricity generation" and the pilot plant implementation process in particular. In this case, the implementation of the product could have been done from the first year and would have contributed more effectively to the achievement of the project objective.

In the case of Outcome 3.2: "Operational experience and best practices from the Santiago demonstration plant have been compiled", it could only be executed once the Santiago plant was operational. However, the output could have been designed to facilitate the access of local experts, specialists, and decision makers to the operational and best practices of biomass plants similar to the envisaged Santiago plant. Once the Santiago biomass power plant was operational, its experience could also have been compiled.

Finally, two aspects of the project design require specific consideration:

A Does the project focus on the promotion of biomass for heat and electricity production or only for decentralized biomass electricity production?

This issue makes no difference for the promotion of the market of biomass for energy. Nevertheless, the technology complexity, the regulatory environment, and the need for incentives could be substantially different for both kinds of final biomass use.

The project design is ambiguous in this regard. While the statement of some critical components of the resulting chain of the project (the project objective and outcome 1) lead to a focus on heat and power, its narrative focuses on energy production (Table 3).

Table 3. The focus of elements of the project result chain	
Project result chain component	Focused on promotion of

	Heat & Power	Power
The objective	The statement	The description
Outcome 1 (Policy)	The statement	The description
Output 1.1 (incentive and regulations)		The statement & the description
Output 1.2 (financial incentive)	The statement & the description	
Outcome 2 & its outputs (Technology demonstration)		The statement & the description
Outcome 3 & its outputs (Raising awareness)		The statement & the description

B. Is the project design oriented to the promotion of decentralized biomass for energy use at the national level or is it oriented to support the implementation of the demonstration case in the SFZIP?

This question is aimed to conclude whether the project is designed in such a way that if the implementation of component 2 has problems, the rest of the project components are also compromised.

Although the outcome statement is focused on the national level, two outputs (3.1, 3.2) were closely related to the progress of outcome 2. Consequently, the delay in the implementation of outcome 2 could affect the opportunity to achieve the expected outcomes of outcome 3. It could have been avoided if those outputs would be designed considering the national experience gained from the project's demonstration activities would have been just one additional valuable example.

Methodologically, the design of the results logical framework is adequate. The formulation of the objective, results and outputs is correct. They anticipate medium-long-term, medium-term and short-term changes respectively. The outcome indicators are SMART and the baseline values and targets are well formulated.

The main methodological observations on the design of the resulting framework are:

- The formulation of outcome indicator no. 3 ¨Number of people who have engaged with the concept and benefits of biomass energy generation¨ is difficult to measure.
- The formulation of outcome 3.1 "A communication plan has been prepared to interact with civil society organizations and the general public in Santiago" does not pursue any change. The implementation of the communication plan is not considered by the wording of the output.
- The formulation of output 3.1 does not match the text used in the narrative of component 3 by including the phrase "in Santiago".

In conclusion, the design of the project's results framework has flaws that affect the achievement of the project's objectives and results.

- Issues related to biomass supply and promotion of the biomass-to-energy market are underestimated.
- The design of Output 2 fails to guide the implementation of the project investment cycle aimed at demonstrating proven technology for decentralized biomass power generation. The period required to accomplish this task is underestimated.
- The fact that most of the outputs of Outcome 3 are focused on the foreseen Santiago biomass power plant makes that the design of Outcome 3 limits the opportunities for contribution to

achieving the project objective during its implementation.

The project design is rated as **moderately unsatisfactory.**

2.3. Project performance

2.3.1 Relevance

The project is conceived to respond to the priorities of development strategies of the Dominican Republic. Specifically, it aims to increase energy independence, contribute to climate change mitigation and contribute to the development of rural communities in areas with biomass production and commercialization potential.

In particular, the project provides alternatives for energy sustainability using renewable energy sources. The beneficiary is a relevant economic sector of the country, the Industrial Free Zone sector. The economic viability of this sector is highly sensitive to production costs due to their close connection with the import-export activity. For this reason, the contribution of the project to demonstrate the technical-economic viability of an energy solution based on national resources, sustainable and friendly to the environment was welcomed by this sector.

The participation of the NCEFZ and the SFZC in the project under the category of "other executing partners" is an expression of this support. The Corporation also made a co-financing commitment amounting to 6,475,000 USD via cash and loans.

It should be noted that the exit of the SFZC from the project did not affect its relevance. The SFZC decision was because the improvement of the power supply by the national interconnected power system reduced its motivation for investing in such novel and risky business projects. The NCEFZ maintained its commitment to the project after the withdrawal of FSCZ. Actively supported the search of new demonstration sites among the different Free Zones in the country. The systematic support to project activities by relevant national authorities was also an expression of its relevance.

The government agencies involved in the PSC appointed high-level officials as their representatives. Throughout the project period, these officials attended in person almost most of the twelve Steering Committee meetings. They were the Executive Secretary of CNE, a Deputy Minister of MENARE, the Director of Biomass of MEM, the Executive Director of NCEFZ, and the President of SFZC.

The aforementioned government agencies also effectively supported the PTC. Senior managers, designated as members of the CTP, actively and systematically attended most of the 34 meetings of this committee.

MENARE's ownership of the project also reflects the relevance of the project for the national authorities. The role of this Ministry in the project was primarily conceived as a regulatory authority. However, it turned out to be one of the relevant actors in the project. In particular, it promoted and actively participated in the strengthening of the regulatory framework for the production and commercialization of biomass for energy purposes.

The project relevance is rated as **highly satisfactory**.

2.3.2 Effectiveness[11].

Assessment of project effectiveness is based on the analysis of the progress attained by project outcomes and outputs.

Project Outcome 1: "The policy and regulatory environment conducive to decentralized, biomass-based power and heat generation have been strengthened".

This project component is aimed at strengthening the existing regulatory framework for small-scale, decentralized power plants.

It was expected to:

- Fine-tuning existing regulations and incentives to make investments in energy generation attractive for these market players.
- Propose additional regulation that may prove beneficial to address specific concerns about biomass plants, such as nuisance and particle emissions.

This outcome intended to:

a. Review, amend and streamline national and municipal regulation for decentralized biomass-based power generation (environmental impact, nuisance, and water use). (Output 1.1)

The baseline of this output was that procedures to obtain concessions for electricity generation and environmental permissions are not geared to biomass technology, small capacities, and the self-supply operation modality. In addition, specific aspects of biomass technology, such as water usage, particulate emissions, and other nuisance, might require guidelines and regulations more detailed to mitigate environmental and social concerns.

This output envisaged to review existing regulation and permitting procedures and propose amendments for its improvement and simplification.

The implemented activities were the following studies:

✓ Study on Regulation and Incentives[12].

This study was focused on proposing improvements to the current regulatory framework related to decentralized biomass power generation.

The results of this study are characterized by the general nature of its recommendations. However, it identifies some opportunities for improvement of the regulatory framework that is of interest to the results committed in this output.

Examples of these opportunities are the introduction of tax incentives to the forestry sector to stimulate biomass production for energy. Also, to facilitate to small and medium-size power producer's access to the power grid and to promote the implementation of the Electric Cooperatives recognized by Law 57-08.

✓ Technical Guide for the management of forestry biomass[13].

This guide was requested by MENARE and its preparation was supported by an international project expert.

[11]Rating system for outputs/ outcomes progress: Total progress, Partial progress, Limited progress and No progress. (E, B, R, M),

[12]Prepared by Ing. Francisco Ortega. The deliverables were delivered between November 2016 and June 2018.

[13] Prepared by Dr. José Antonio La Cal and was delivered in December 2020.

The guide is focused on the provision of technical recommendations related to forestry biomass production for energy use. This product is based on the experiences and best practices of the European forestry sector.

The MENARE accepted this Guide as a technical document to be used as a reference by interested stakeholders.

- ✓ Proposal of a thematic regulation on the energy use of forest biomass[14].

This proposal is produced by a consultancy providing support to the Commission for the Preparation of the General Regulation of the Forest Sector Law of the Dominican Republic, No. 57-18.

This document regulates the use of forest biomass, whether it comes from "energy plantations", remnants of forest exploitation, or other silviculture operations in the forestry, for energy production purposes, be it for thermal use, electricity generation, or production of bio-fuel or bio-fuel.

MENARE recognized the contribution of this study to the elaboration and socialization of the Decree 627-21 "Regulation of the Sectorial Forestry Act No. 57-18" from October 8, 2021,

- ✓ Request for Power Expansion by a self-producer of electrical energy from residual biomass[15].

This consultancy is carried out to support the NEC in the preparation of the regulations provided for in Article # 95 of the Regulation of the Incentive Law for the development of Renewable Energies and its Special Regimes (Law No. 57-07). This article establishes the possibility that self-producers of electricity request to expand their installed power capacity above the limit of 1.5 MW.

The developed product makes easier the application for this limit expansion to self-producers using biomass residues or biomass by-products as a primary energy source. At the same time, it allows the NEC to speed up the assessment and verification of compliance with the regulation of the request to extend the generation capacity limit.

The results of this study were accepted by the NEC.

- ✓ "Study of current and potential biomass production in the Dominican Republic and its planned use for power generation"[16].

This study covered, at the national level, the current and potential biomass production in the Dominican Republic and its planned use for power generation.

The conclusions and recommendations of the study concerning the regulatory and policy framework for decentralized biomass-based energy production highlight aspects such as:

- o The need to increase the support of the financial sector to biomass producers.
- o Promote the formal supply of biomass while limiting the informal one as a mechanism to promote fair prices.
- o Existing barriers related to logistics, costs, and high uncertainty in the reliability of biomass transportation agreements and contracts.
- o The convenience of extending the benefits of the incentives of Law No. 57-07 and its modifications to the production of energy from biomass, biomass producers, and

[14] Prepared by Ing. Humberto Checo and Dr. José Antonio La Cal. It was delivered in December 2019.

[15] Prepared by CORPOEMA (corpoema@corpoema.net). Delivered April 2021.

[16] Prepared by Ing Humberto Checo. Consulting Company "Proyectos y Estructuras AJ, SRL" delivered in April 2018. It is part of the MEM co-financing actions for the project.

intermediaries, in particular about the tax exemption of equipment, machinery, and accessories necessary to transform the raw material for sale.

- ✓ Evaluation of the results and opportunities for improvement of the "Law of Incentive to the Development of Renewable Energy Sources and its Special Regimes" (Law 57-07)[17].

This evaluation was aimed at performing a quantitative analysis of the application of Law 57-07 and the Net Metering Program.

Concerning the regulatory incentive regime and its institutional design, the study identifies the following key challenges and setbacks with recommendations for their improvement:

- the discretionary application of the regime of feeding rates (feed-in tariff);
- the net metering program is considered misaligned with the requirements of the electrical system despite being effective in supporting project development;
- the actual concession regime is qualified as inappropriate deterring the development of projects and behaving as a barrier to entry.
- the institutional design is assessed as unclear in the assignment of functions and responsibilities, hindering the effectiveness and transparency of the decision-making processes.

In addition, it recognizes the insufficiency of direct incentives associated with investments to promote biomass cogeneration. The promotion of long-term supply contracts to biomass projects is recommended. It would stabilize project incomes and facilitate the financing of investments.

In correspondence with the scope of this study, these recommendations are mainly focused on the promotion of large-scale electricity generation with renewable energy sources. Its impact on strengthening the regulatory framework for the promotion of decentralized energy generation using biomass is indirect.

- ✓ Develop and implement a computer tool based on a robust methodology that allows determining the operating parameters of hybrid power generation plants for the correct application of Law 57-07 by the National Energy Commission (NEC)[18].

The Incentive Law for the Development of Renewable Energy Sources and their Special Regimes (57-07) recognizes that renewable energy producers could hybridize their generation systems and still fully benefit from the law incentives. The benefits they receive under this law depend on the participation rate of these renewable sources in total energy production.

This consultancy developed an advanced computer tool that makes it easier for the producer to comply with the requirements of the law and carry out a self-evaluation of their performance. At the same time, it makes it easier for the NEC to audit compliance with the requirements and systematically evaluate the behavior and benefits of the application of the corresponding article of Law 57 08.

This tool was accepted by the NEC.

The obtained output results mainly contribute to facilitating the implementation of aspects of Law 57-07 and Law 57-18 related to biomass energy use. However, the expected results to strengthen the regulatory framework for the decentralized generation of energy from biomass are restricted to a few general recommendations.

The progress of the output **is limited** in relation to what was expected according to the project narrative.

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[17] Prepared by MULTICONSULT Y CIA. LTDA.www.multiconsultorias.com. Delivered in August 2020.

[18]Prepared by Xtudia. Delivered in July 2021.

b. Prepare and submit to the Government for approval proposal for financial incentives to stimulate decentralized, renewable energy technologies. (Output 1.2)

This output is aimed to enhance existing financial incentives under Law 57-07. In addition, facilitate access to these incentives by other stakeholders, such as project developers and intermediaries. As well, proposals for new incentives specifically targeted at decentralized electricity and heat generation were expected.

The PSC agreed to incorporate the expected results of this output to the "Study on Regulations and Incentives" implemented by output 1.1

The project could not formulate and propose any proposal for financial incentives that encourages the decentralized generation of energy based on biomass. The main reason is that a process aimed at reforming the Dominican Republic's electricity sector, known as Pacto Eléctrico, was initiated in 2015. In this context, it was considered that it was not necessary for the project to work in this direction.

This output is rated as **no progress**.

c. Validate and integrate existing information sources on the biomass potential in the national territory. (Output 1.3).

The present output was aimed at validating and integrating existing sources on the biomass potential and possibly creating a database covering relevant parts of the national territory.

The activities implemented by the project were:

✓ The study on the "Availability of Biomass for Power Generation in the Dominican Republic: An Analysis of Existing Information"[19].

The objective of this study was to identify and record all existing information sources in the Dominican Republic on the production and use of biomass of agricultural and forestry origin for energy production.

The study, although it did not meet the expectations, reached a group of results of interest such as, for example:

- The existing information on the potential and availability of biomass for energy in the Dominican Republic is scarce. Therefore, it recommends continuing to detail and strengthen the knowledge about the potential of biomass as an energy source. In addition, recommends strengthening the national systems of records and statistics corresponding to the production and consumption of biomass.
- The report established the existence of a potential to produce 1.6 million tons of biomass per year (tons/year) and a consumption of 585,218 tons/year by consumer companies. It specifies that the highest biomass consumption is concentrated in eight companies.

✓ "Study of current and potential biomass production in the Dominican Republic and the assessment of it use for power generation"[20].

This study covered the current and potential biomass production at the national level in the Dominican Republic and the assessment of using it for power generation.

The contribution of this study to the knowledge of the biomass production potential for energy is focused on determining the development potential of the areas dedicated to the establishment of

[19] Prepared by Eng. Mamerto Valerio and delivered in September 2015.

[20] Prepared by Ing Humberto Checo. Consulting Company "Proyectos y Estructuras AJ, SRL" delivered in April 2018. It is part of the MEM co-financing actions for the project.

forest and grass plantations for energy purposes. It is done considering the edapho-climatic and geographical conditions of the country and the requirements of the species considered.

Main results:

- It identifies a total area of 476,071 hectares of high quality for the production of grasses and 449,248 hectares suitable for the promotion of forest species, mainly Acacia mangium.
- The production potential of suitable areas for the promotion of Acacia mangium is provided for high/medium yield scenarios. Is estimated the potential to produce 12.6/8.0 million tons of biomass per year. This biomass production would make it possible to generate 8524/5485 GWh/year and install 1,076/693 MW power capacity at 25% electrical efficiency per scenario.
- In the case of the low yield scenario at short/medium-term, average annual production of between 159 and 296 thousand tons of forest biomass per year is estimated. This biomass production would allow a power generation between 54 to 201 GWh/year. Also, to install a power capacity between 7 to 25 MW, at a 25% electrical efficiency.

✓ The consultancy "Programming services for the integration of biomass statistics and inclusion of new functionalities"[21].

The purpose of this consultancy was to carry out a series of updates and improvements in the statistical data collection system related to the production of forest biomass and the allocation of authorizations for the exploitation of forest resources used by the Ministry of Environment and Resources Natural The objective was to obtain more up-to-date, reliable and complete biomass statistics.

This consultancy performed two specific actions aimed to strengthen the national capacity to access and analyze the information required to promote the energy use of biomass:

a. The creation of a geographic information system of zones and biomass production potential for the industrial generation of heat and electrical energy.

This system was developed to determine the country's biomass potential for the production of forage species and fast-growing trees through a geo-referencing analysis at the national level.

A database, that exclusively indicates the sites with a high possibility of industrial-based promotion of tree plantations and tropical grasses for the production of biomass for energy purposes, was created. Using it, maps of the potential for the production of grasses and Acacia mangium were generated.

This database is the first of its kind in the country. It allows the development of programs and strategies to promote biomass plantations for energy purposes.

b. Updating of the statistical data collection system related to the production of forest biomass and the allocation of authorizations for the exploitation of forest resources used by the MENARE.

The modifications introduced allow accounting for the production of biomass-based on the request of authorization of forestry management plans. In addition, it makes possible the creation of maps with the geographical distribution of the biomass potential production and the estimation of biomass potential of selected areas.

[21] Prepared by Richard Mendoza and delivered in July 2017.

Because of the actions carried out, it is considered that the purpose of this output integrating and evaluating the scant and dispersed information available on the potential for biomass production for energy existing in the country was achieved. The collection and analysis capacity was strengthened through databases of data from the MENARE statistical system and the application of a geographic information system.

This output is rated as fully achieved.

c. Develop sustainable biomass sourcing strategies in coordination with rural development programs in the Santiago region. (Output 1.4).

According to the project document this output should address two very important issues related to the sustainability of the biomass-based decentralized energy production plants:

– The synergy between the development programs to improve quality of life and income levels among the rural population and the deployment of the chain of value associated with biomass for energy projects.

– The sourcing strategy of the biomass-plant operator to secure the biomass supply. This strategy should not only minimize the risks related to biomass supply but also should assure the sustainability of the supply chain.

No activity has been performed on this output.

The output is rated as No Progress

In summary, the expected results of this outcome for strengthening the regulatory and policy framework have been achieved to a limited extent. No specific proposal for adjustments or additions to the existing regulations to be approved by the competent authorities was made.

Some progress was reached increasing the knowledge of the potential of biomass production for energy and the barriers to using it. The outcome contributed to increasing institutional capacity to improve the quality and availability of information about this potential.

Based on this assessment and that the 2 outputs of 4 show no progress, this outcome is rated with **limited progress**

Project Outcome 2: A biomass-based electric power plant (envisaged capacity 3 MW) has been adopted by the Santiago Industrial Free Zone.

This project component envisaged creating a successful showcase of the application of biomass technology for electricity generation at an industrial free zone in the Dominican Republic. The project development and realization process is expected to generate a wealth of experiences regarding the appropriateness of existing regulation and permitting, environmental issues, biomass logistics, cost-effectiveness, and interaction with civil society, as well as useful lessons for replication.

This outcome intended to:

- Carry out a detailed feasibility study for the development of an envisaged 3 MW decentralized, biomass-based electricity plant at the ZFZIP. (Output 2.1).

Output 2.1 “A detailed feasibility study for the development of an envisaged 3 MW decentralized, biomass-based electricity plant at the Santiago Free Zone has been carried out.”

This output should provide SFZI with the necessary information to decide on the investment in the 3 MW biomass power plant.

The description of this product envisaged achieving this result by commissioning a feasibility study. Completion of this study was scheduled for one year.

Instead of commissioning a feasibility study, as it was required by the project design, a pre-feasibility study was commissioned almost 18 months after project initiation.

This study was the "Site Evaluation and Study of Pre-feasibility for a Biomass Plant in the Dominican Republic"[22].

The results of the study were provided under the next premises:

- The biomass plant will supply the base electricity consumption of SFZIP, without contributing surpluses to the grid.
- Consider cogeneration / tri-generation and hybridization options with solar photovoltaic installations.
- Evaluate the location of the plant inside and outside the SFZIP site, taking into account biomass availability, economic and environmental criteria.

The final report of the study, presented in January 2016, concludes that the most viable option is:

The installation of a 4MW power generation plant using the Rankine steam cycle technology that would generate between 40% - 44% of the electricity previously consumed by the SFZIP in 2016. It would be located in the Cibao area and would use rice husk as fuel, which makes it advisable to collaborate with rice producers in the area to supply this residue as fuel

The financial-economic indicators that the pre-feasibility study yielded were an investment cost of 13.2 million USD, a generation cost of 73.1 USD / MWh, an IRR of 16.3%, and a payback period of 6.2 years.

After considering the results of this study and the country's energy situation, the Board of Directors of the SFZC withdraws the established commitment to investing in the biomass plant as co-financier of the approved project[23].

In their communication, they conclude that for Corporation to commit irrevocably to carry out the project carries to take a considerable risk. The Corporation argues the high cost, estimated between 12 and 14 million dollars; the long period, between 4 to 6 years, that is required to make operational the plant.

These risks were also associated with uncertainty regarding:

- The unpredictable future changes of the international price of fossil fuels. At that moment already was observed caused a fall in oil prices to unforeseen levels.
- Price of the energy tariff in the country due to the changes expected in the near future in terms of the supply of generation associated with the entry into operation in the immediate future of new electricity generation plants.

Faced with this situation, the NCEFZ and the NEC make a call for expression of interest among the industrial free zones of the country for the identification of a new site for the installation of the demonstration plant. As a result, the Navarrete Free Zone Industrial Park (NFZIP) is identified as a possible new beneficiary for the implementation of the project's demonstration plant. That is approved at the meeting of the Project Steering Committee of December 2016[24].

The NFZIP is located in the extreme north of the urban area of the Navarrete municipality,

[22]Prepared by Gas Natural Fenosa, Engineering. Delivered in January 2016.

[23] Letter to the Project Management Committee signed by Mr. Miguel A. Lama Rodríguez, president of the Board of Directors of the Corporación Zona Franca Industrial Santiago dated April 22, 2016.

[24] Minutes of the Meeting of the Project Steering Committee held on December 5, 2016.

Santiago province, of the Dominican Republic.

The NFZIP includes ten manufacturing plants specialized mainly in the textile sector, which have an average of 2,200 employees.

To determine the scope and opportunities of the intervention for the energy use of forest biomass in the NFZIP, the:

"Feasibility study and design of the layout of the plant for the expansion of a cogeneration plant of thermal and electrical energy from biomass in the Dominican Republic (Case NFZIP)"[25]

The study was aimed at evaluating the technical, economic, and financial aspects related to the expansion of the biomass generation plant in the free zone, including the evaluation of the equipment and the operational efficiency of the existing plant, and the identification of additional equipment to be purchased for expansion purposes.

This case was of interest since in the industrial park there is a biomass plant with two boilers and a 100kVA turbo-generator, which supplies steam to seven companies in the free zone. These companies supply themselves with electricity from two LPG motor-generators or the biomass plant. This last option was not operational at the time of the study due to technical problems.

This biomass plant is estimated to consume 2,600 tons per year whose origin is locally acquired processed residual biomass at a price in the order of 15 USD / ton

The remaining three companies produce steam with conventional fuel-fired boilers and electricity through a contract with the local distribution company.

The results obtained are based on estimates since the NFZIP lacks process diagrams, mass/energy balances, or operation and maintenance manuals for the existing biomass plant. This is operated manually (without a distributed control system) and all the instruments in the plant only show instantaneous indication and no historical data are recorded. The humidity of the biomass used is not controlled nor is it possible to determine its hourly consumption.

The study carried out on the supply of biomass concludes that:

- ✓ Two biomass sourcing options are recommended:
  - Strengthen and expand the current strategy for the acquisition of biomass from local sources in the Navarrete area and its periphery. In this region, there are two important agro-industries: rice and tobacco, which generate abundant waste that is not being commercialized in a business manner.
  - Use the Acacia mangium plantations in the Bonao, Villa Altagracia, and Nagua areas, estimating an average cost of US$ 55 / ton at the NFZIP gate when suppliers are more than 100 km away.
- ✓ The main current risks for biomass supply are associated with speculation, environmentalism, and other group interests, which can be managed by the project;
- ✓ Current and future scenarios for the supply of biomass are favorable for the project.

As a result, the study recommends as the most viable option for all NFZIP companies:

- Produce steam through current biomass boilers and electricity supply by connection to the National Power Interconnected System (NPIS), taking advantage of the figure of Unregulated User. This option is the one that offers the lowest costs for the production of steam and electricity of all the variants considered.

[25]Made by Naturgy. Delivered December 2018.

– Supply biomass from an expansion of current local sources, strengthening contractual relationships with them. As an alternative, access Acacia mangium chip producers established about 100 km away from the plant.

However, although a cost-benefit analysis is performed, the report with the results of the analysis is not sufficiently detailed to facilitate decision making by the NFZIP. For example, the report does not describe the cost of the investment or the expected savings that are critical issue.

The absence of this information makes it difficult for the investor to make decisions about the continuity of the project.

The NFZIP positively accepted the results of the study and initially gave its willingness to continue with the implementation of the proposed option. The project team with the support of the TPC worked during the first semester of 2019 to formalize the required technical support. Finally, in July of the same year, it became clear that the NFZIP was not going to continue with the project.

In parallel to this study, the project evaluates the option of the implementation of the demonstration plant in the rice sector. This is based on the interest shown by this rice sector in the framework of the call for possible beneficiaries of the project carried out by the NCEFZ and the results of the pre-feasibility study carried out for the biomass plant in the SFZIP, the project decides to evaluate the biomass plant development opportunities in this sector.

For this evaluation was signed the consultancy:

"Pre-feasibility study of biomass thermal and electrical energy cogeneration plants of at least 350 kW in rice mills in the Dominican Republic."[26]

This study is focused on the generation of electricity and heat from biomass in rice mills and the identification of business models and technologies that are best suited to biomass plants in the rice mill sector.

The main results obtained:

- It was not possible to establish a solid baseline that would make it possible to characterize the sector from an energy point of view. This is because, in the absence of systematized information, a survey of 212 producers was used as the source of information. However, these were only answered by 5.6% of the respondents (12 producers).
- The preliminary study to estimate economic viability based on the comparison between the Levelized Cost of Electricity (LCOE)and the cost of purchasing electricity from NPIS, it is concluded that:

  The two models[27] considered for implementing a power plant using rice husks as fuel are few viable. Small 300 kW plants have power generation costs that are above the market prices. While the larger 2.2 MW power plants have generation costs that are close to those of the market. However, the logistical problems of this low-density biomass are an important risk to implementing this option.
- No special interest was detected on the part of rice factories and associations in taking advantage of rice husks as biofuel to obtain energy in their factories. Among the causes of this lack of interest, the report mentions: the existence of a market for this residue and the context of commercial instability due to possible imports of rice from foreign markets at a lower price, which does not facilitate investment planning.

[26]Prepared by CENER. Delivered December 2018.

[27] 300 kW electric power plant with an EPC cost of 8.8 million USD / MW, 10% plant energy yield and consumption between 5,000 and 6,000 tons of rice husks.
2.2 MW plant of electrical power with an EPC cost of 4.0 million USD / MW, 10% plant energy yield and consumption in the order of 20,000 tons per year of rice husks supplied from 4 or 5 factories.

In view of these preliminary findings, the study was terminated.

In summary, three pre-feasibility studies were carried out in this output. However, for different reasons, none of the beneficiaries of these studies decided to proceed with the projects. Nevertheless, these studies showed some of the existing opportunities and constraints for the development of decentralized power generation projects using biomass as fuel.

This result is rated as partial progress in accordance to the expected results.

- Prepare supportive studies and technical designs and obtain permits and concessions. (Output 2.2).

No progress because it was not possible to implement a commercial biomass plant.

- Train staff from Santiago and other industrial-free zones on technical and managerial aspects of small-scale biomass plants. (Output 2.3).

No progress.

- Procure and make operational, under an appropriate business model, the envisaged 3 MW biomass-based electric power plant has been. (Output 2.4).

Because the results of output 2.1, the project management concluded that this output would not be possible to implement as planned. That is, to make operational a decentralized biomass power plant on a commercial basis.

In order to identify new opportunities for the demonstration of decentralized energy solutions based on the use of biomass, the project called, through the Biomass Network, for applications to support innovative projects in this field.

These project proposals had to contribute to the practical demonstration of the sort of technological solutions promoted by the Industrial Bioelectricity Project. The support that the proposals would receive would be in the form of co-financing, so the economic contribution of the application would be an aspect to be valued. As a source of co-funding, the budget line dedicated to the acquisition of equipment for technology demonstration in this output was used. This budget was intended primarily for the purchase of auxiliary equipment that would contribute to the reduction of the environmental impact of the demonstrative Biomass Power Plant.

Of the three applications received, the "ST Gasification Project", presented by the local company LatAm BioEnergy, was selected. This project promotes the use of biomass in an industrial plant of the agri-food sector. It is aimed at the modernization of a biomass gasification plant for thermal purposes in operation in a plant of the company Agrifeed sited in Santo Domingo city. This system is intended for steam production and is intended to replace up to 88% of current LPG consumption with gas produced from biomass. The intervention has a total equipment budget of US$724,314, of which the bioenergy project is to contribute US$150,000 and LATAM Bioenergy co-financed the rest.

The project was successfully executed in 204 days. This timeframe is very reasonable considering the complexity of the actions carried out and the limitations imposed by the COVID 9 pandemic, both for the implementation of imports and for securing local labor. At the time of closing of this evaluation, the testing and commissioning process has been completed and is in the process of delivery to the client. Expectations for replacing LPG as a fuel with biomass in steam production were exceeded, reaching 95% of the planned 88%. It is the result of the replacement of 158,000 gallons of LP Gas with Syngas.

The results of this demonstration action are important for the objective of promoting the use of biomass as an energy source in the country:

- It is based on a nationally developed gasification plant design that facilitates sustainability and technological development.
- It has an innovative character both in the design of the basic equipment (filters and feeding system) and in the use of automatic control solutions integrated with artificial intelligence elements.
- It achieves a significant improvement in the performance indicators of this type of plant. A cold energy efficiency of the gasification process of 85.17% is reported.
- It is implemented as a demonstration case in the commercial operation of a commercial plant. This increases the value of the results obtained in terms of robustness, reliability and technical and economic feasibility.

In addition, in line with the original purpose of output 2.4 to fund technical "add-ons" to the biomass power plant to ensure technical sustainability and compliance with social, environmental, and safety standards were acquired some measuring equipment for the determination of air and water environmental quality parameters. This purchase was approved in 2019 and completed in 2021. The delay in completing the acquisition and installation of the equipment was related to COVID pandemic. The equipment is operated by MENARE Environmental Quality Directorate. Some devices were installed permanently in the MENARE laboratory (currently being upgraded) while other measuring devices are portable and handheld. The equipment enhances MENARE´s capacity to carry out compliance verification measurements at stationary power sources and comparable industrial activities

This output is rated as **partial results.**

In summary, the central purpose of this outcome is not achieved, which was the demonstration under commercial conditions of a decentralized plant for the production of electricity based on biomass with power capacity in the order of 3 MW.

However, progress has been made in understanding in more detail the existing opportunities and limitations for the development of this type of investment based on the results of the technical-economic studies carried out by the project. In addition, it is successfully possible to develop a "showcase" of the use of biomass as an energy source in the agri-food industry based on national technology according to international standards.

It is concluded that this result achieved **a partial progress** in the achievement of the expected results.

<u>Project Outcome 3: Awareness of the concept and benefits of biomass power generation has been raised among relevant stakeholders.</u>

This outcome is focused to address barriers related to information, technical and business skills, particularly those that may affect the deployment of biomass power generation in the country, as well as the commissioning of the planned demonstration power plant.

Especially the environmentally and socially sensitive approach towards securing biomass supply that the project promotes should facilitate widespread uptake. All outputs under this component will pay particular attention to gender aspects to assure that both men and women will benefit

equally.

This outcome intended to:

- Prepare a communication plan to interact with civil society organizations and the public on the topic of sustainable biomass sourcing. (Output 3.1).

According to the project document, as part of the due diligence process during the preparation and implementation of the biomass pilot plant, a communication plan will be designed to structure and organize the dialogue with stakeholders from civil society.

The purpose of this activity – when the 3MW plant was planned in Santiago – was to avoid unnecessary negative perceptions by society that might affect the implementation process and the good name of the proponents, but also to collect viewpoints and information as a basis for defining mitigation measures, as and if appropriate.

This output will develop a communication plan and lead the communication process until successful project termination.

To respond to this output, the project's Communication Plan was drawn up and implemented and the Biomass Network was established.

The project communication plan was prepared in 2017, along with an action plan for its implementation. The same set as objectives:

- Help producers, industries, and associations to improve their energy production system from the use of biomass.
- Keep the members of the Biomass Network informed of all the activities and events carried out by the project.
- Offer information to the target audience about the initiatives developed by the project, the potential, and advantage of its implementation.

The communication channels identified in the plan were the use of training materials, such as brochures, pamphlets, newsletters, press releases; interaction with local media (television, radio, press); the generation of content for social networks and the website, and the preparation of monthly reports and an annual event to promote the program.

The Biomass Network is created to become a platform that brings together stakeholders who interact or wish to interact with the biomass sector, including producers, consumers, intermediaries, technologists, experts, and institutions.

The network is associated with an online platform, hosted on the website of the Industrial Bioelectricity project (https://www.bioelectricidad.org/). In this platform, it is possible to access relevant information on the registered stakeholders in the biomass sector, the availability of biomass and its potential, as well as the projects that are being carried out.

This network is considered as a step in the formal recognition of the existence of the sector and a contribution to the consolidation of an incipient market of biomass for energy in the Dominican Republic.

Because of the implementation of the communication plan, the following results were obtained:

A. The Biomass Network is made up of 74[28] members representing a wide range of stakeholders linked to the energy use of biomes
B. The Industrial Bioelectricity website was created https://www.bioelectricidad.org.

[28] Taken from: https://www.bioelectricidad.org/listado/members on August 21, 2021.

This site has three main sections:

I. Biomass Network.

This section is designed to manage the members of the biomass network and to facilitate interaction between them, to enable access to maps and information on projects. At the time of the review, it was possible to access geo-referenced information Acacia mangium of the year 2016, and information from five projects with biomass boilers was registered.

II. Library:
The library has the following components:

a. Digital library:
The digital library allows access to a group of digitized documents grouped into the following categories:

- Presentations: Being dedicated to facilitating access to the presentations made by the project in different events, it only contains those related to two events held at the end of 2016.
- Laws and regulations: although it intends to facilitate access to legal regulations of interest to the different players in the incipient market of biomass for energy, it is limited to facilitating access to four of them.
- Reports: It is expected that this category will present reports that allow interested parties to access studies and analyzes that facilitate decision-making on the use of biomass for energy purposes. Contains access to seven reports29 all of them made in 2015 and 2016.
- Documents: It is the repository of the published numbers of the bulletin (Industrial Bioelectricity), except those of January - November 2019, and all the editions of the magazine (Dominican Bioenergy Magazine. The magazine of the Industrial BioElectricity Project) of the project.

b. Online courses: This contains the links of five courses with calls between July and September 2017.

c. Types of biomass (Forestry, municipal waste, and agricultural waste). It contains a short explanatory text and a link that allows the reader to access more detailed information

d. Types of technologies (physical-chemical, biochemical and thermochemical methods). It contains a short explanatory text and a link that allows the reader to access more detailed information.

e. Legal framework: a brief description of the institutions that apply the main legal instruments included in the digital library.

III. What's new:

This section is intended to provide access to information on:

- News. At the time of the review, it was possible to access news published from March 2020.
- Job bank. At the time of the review, it does not contain offers.

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29 Energy Panorama of the Dominican Republic, National Renewable Energy Laboratory (NREL), 2015.
Roadmap to a Sustainable Energy System: Harnessing the Dominican Republic's Sustainable Energy Resources. World Watch Institute. 2015.
Roadmap for a Sustainable Energy System: Use of the Sustainable Energy Resources of the Dominican Republic. World Watch Institute. 2015.
IRENA REmap: Renewable Energy Outlook. International Renewable Energy Agency (IRENA)in English. 2016.
IRENA REmap: Renewable Energy Prospects. International Renewable Energy Agency (IRENA)in Spanish. 2016.
ClimaScopio: Energy Profile 2015. ClimaScopio 2015. 2015.
2015 - National Inventory of Greenhouse Gases of the DR. National Council for Climate Change and the CDM (CNCCMDL). 2015.

- Events. At the time of the review, it does not contain advertisements.
- Photo gallery. It contains a collection of photos and videos of six activities carried out by the project all before 2018.

C. The "Industrial Bioelectricity" Bulletin was published.

These newsletters are a short, easy-to-read material with 4 - 5 pages, containing as sections: Main article, Latest news (summary and link), online courses and an update of the new members of the biomass network, and a link to the content of the web page of the network. Monthly newsletters published 28 numbers between May 2016 and December 2019.

D. The magazine was published: "Dominican Bioenergy Magazine. The magazine of the Industrial BioElectricity Project".

It is aimed at an audience interested in bioenergy issues and has the following sections: Activities, News, Articles, News, Specials on activities and results of the project, and national and international issues of interest to the magazine's target audience. Five issues were published between March 2018 and May 2019.

E. The content was published in the mainstream media.
F. Accounts were kept up to date on the social network:

Updated information has been published in them promoting project activities such as invitations to webinars and conferences, reporting activities, and providing news of interest in the field of biomass for energy.

- On Facebook, the account is Project BioElectricidad Industrial was created in November 2016, at the time of the review it has 243 followers. It shows an abundant activity that reflects the activity of the project and shows information of interest to its followers related to the topic of biomass for energy. The photos section contains three albums referring to project activities.
- The link on Twitter is @ProyectoBioElec and was created in November 2016. At the time of revision[30] reports with 219 tweets, 615 following, and 339 followers. The promoted content is relevant to the objectives of the project's communication plan
- The LinkedIn account is Bioelectricidad, it has 13 followers and it is reported that it was created in 2017. No activity has been identified in this network by the project.

To achieve the planned results of this output, an extensive activity was carried out, which even surpassed the initial design with the creation of the Biomass Network. However, its main limitations are the late start of the communication plan (practically three years after the start of the project) and the lack of systematic updating and completion of some of the IT products developed.

For this reason, this output is qualified as partial progress.

- Compile the operational experience and best practices from the Santiago demonstration plant. (Output 3.2).

The project document describes that the demonstration plant is expected to generate a host of lessons and experiences concerning project development, biomass sourcing, technical performance and reliability, operation and maintenance, costs, nuisance, impact on the environment, and perception by other, potential Project developers and free zones.

The expected results of this output were:

[30] August 21, 2021.

– a report and multimedia material for dissemination produced using the collected operational experiences and best practices from the Santiago biomass plant
– The review of international experiences in coordination with NEC, NCEFZ, and SFZC.

None of these results were obtained, because they depended on the progress of the demonstration plant.

No progress.

- Carry out promotional activities including technical seminars, dissemination events, and drafting of technical manuals and guidelines. (Output 3.3)

Because the project pursues triggering a market for biomass-based electricity generation by industrial zones, it was expected that his output would:

– Share specific technical information with peer organizations of SFZC under the leadership of the NCEFZ.
– Deliver promotional events and seminars were organized together with NEC, UNIDO, and other stakeholders,
– Produce an assessment would be carried out to establish to what extent scaling-up and replication are likely to be achieved based on the ongoing and planned activities.
– Formulate recommendations for additional support (as needed) would be made to assure the sustainability of the project beyond its conclusion.

The main results obtained in this output are related to:

– An active exchange of technical information among the main stakeholders of the project that took place in the framework of the systematic meetings of the project's Technical Operational Committee, the analysis, and discussion of the reports of the consultancies carried out and, in the workshops, organized by the project.

These exchanges fostered as a relevant element the consensus among the different stakeholders on the priority of attention to the development of the incipient market of biomass for energy in the Dominican Republic, the need to advance in its regulation, and greater inter-institutional synergy between the MEM, the NEC, and MENARE.

Other relevant stakeholders such as the NCEFZ, the SFZIP, the NFZIP, and various biomass producers and consumers also benefited from this exchange.

– An adequate activity was deployed to promote the Project.
This was carried out first through the publication of the Project's Bulletin and Magazine and its presence in the social networks already described in the analysis of output 3.1.

In addition, visits and meetings were made with stakeholders who carry out relevant activities for the Project, such as those carried out at Alcoholes Finos Dominicanos, the Briquette Factory, the San Pedro Bioenergy Power Plant, the biomass facilities of the NFZIP, etc.

The Project organized some events. Among organized events is the workshop aimed at presenting the results of the "Study for the production of briquettes from biomass available on the border of the Dominican Republic" carried out by the Ministry of Energy and Mines, the first National Seminar on Potential, Current Uses and uses of biomass in

the Dominican Republic. In 2020, 4 webinars were organized focused on issues related to the use of biomass as an energy source.

Project activities were promoted at significant events such as the Energy Forum in Vienna in 2017 and the IV Sustainable Energy Forum in 2020.

In summary, during the execution of this output, a group of activities was carried out that positively contributed to its achievement, however, its scope and impact were limited, starting only at the end of the third project execution.

It is considered that this output obtained partial progress in the achievement of its purposes.

Within the framework of this outcome, progress is being made in raising awareness and knowledge of relevant stakeholders about the opportunities and limitations for the deployment of the use of biomass as an energy source in the Dominican Republic. Mechanisms are established that promote the interaction of stakeholders in the incipient biomass market for energy and means are established for communication with the specialized public and with a general interest in the matter.

This result has achieved **limited progress.**

Concerning the effectiveness of the project (table 4), it is concluded that:

- All the three project components achieved limited progress and of eleven outputs, six of them show no progress or limited progress and only one total progress (Table 4). Besides, the result indicator of the project objective expressed in terms of emission reduction is partially achieved.
- The absence of a deep and detailed study of the specific regulatory and policy barriers that limit the safe, reliable and sustainable supply of biomass and its commercial use for the production of heat and electricity, as a starting point for the studies carried out to improve the regulatory framework, contributed significantly to these not obtaining the expected results.
- The lack of a rigorous observance of established steps of the cycle of industrial investment projects contributed to the absence of progress implementing the planned demonstration case. In addition, the decision-making process for implementing this cycle, not always was dynamic and executive enough as expected by the private sector.
- Progress was shown raising awareness and facilitating the integration of relevant stakeholders, while developing synergies among them, to promote the use of biomass for energy purposes. The effective use of a set of online digital communication media was a factor of the success in achieving this progress.

However, most of the results that were not achieved are associated with limitations in the project design that seriously hindered its achievement. For this reason, the qualitative rather than quantitative analysis is used as a reference in rating this indicator.

The project's effectiveness is rated **as moderately satisfactory**.

Table 4. Summary of the achievement of the expected results of the project		
Outcome / Output	Progress	Comments
Outcome 1. The policy and regulatory environment conducive to decentralized, biomass-based power and heat generation have been strengthened.	Limited Progress	The expected results to strengthen the regulatory and policy framework have been achieved to a limited extent. In relation to regulations for small biomass electricity producers, adjustments were made to facilitate their access to the benefits of existing regulations, but no progress was made in promoting their participation in the market or in creating financial incentives. However, some progress was made in strengthening the regulatory bases for the future development of the biomass market. Progress was made in better understanding the potential of biomass production for energy and increased institutional capacity to improve the quality and availability of related information. Of the 4 outputs, no progress has been made in 2.
Output 1.1 Regulation for decentralized biomass-based power generation (environmental impact, nuisance, and water use) has been reviewed, adjusted, and streamlined.	Partial progress	The results of this product contribute mainly to facilitate the implementation of aspects of Law 57-07 and Law 57-18 related to the use of biomass energy. However, the expected results to strengthen the regulatory framework for the decentralized generation of energy from biomass are limited to proposals for general recommendations for both the detail of its formulation and its adjustment to the project objectives.
Output 1.2 Proposals for financial incentives to stimulate decentralized, renewable energy technologies have been prepared and submitted to the Government for approval.	No progress	No proposal for financial incentives to stimulate decentralized biomass-based energy generation is formulated or proposed.
Output 1.3 Existing information sources on the biomass potential in the national territory have been validated and integrated.	Total Progress	The purpose of integrating and evaluating the scarce and dispersed information available on the potential of biomass production for energy in the country was achieved. The capacity to collect and analyze biomass data was strengthened through the MENARE statistical system databases and the

Table 4. Summary of the achievement of the expected results of the project		
Outcome / Output	Progress	Comments
		application of a geographic information system.
Output 1.4 Sustainable biomass sourcing strategies have been developed in coordination with rural development programs in the Santiago region.	No progress	No activities were developed in this output. The reason was that it was aimed at developing biomass supply strategies in the areas that would supply biomass to the project's demonstration biomass plant, which was not implemented.
Outcome 2. A biomass-based electric power plant (envisaged capacity 3 MW) has been adopted by the Santiago Industrial Free Zone.	Limited Progress	The main objective of this result, which was the demonstration under commercial conditions of a decentralized biomass-based electricity production plant with a power of about 3 MW, was not achieved. However, progress was made in a more detailed understanding of the existing opportunities and limitations for the development of this type of investment based on the results of the technical-economic studies carried out by the project. In addition, a "showcase" of the use of biomass as an energy source in the agri-food industry has been developed based on national technological developments with innovative solutions at international level.
Output 2.1 A detailed feasibility study for the development of an envisaged 3 MW decentralized, biomass-based electricity plant at the Santiago Free Zone has been carried out.	Partial Progress	Three pre-feasibility studies were conducted, including the one foreseen in the project design. Although none of the beneficiaries of these studies, for different reasons, decided to move forward with the feasibility studies, they showed the opportunities and limitations for the development of decentralized power generation projects using biomass as fuel.
Output 2.2 Supportive studies and technical designs have been prepared, and permits and concessions obtained.	No progress	It was not possible to implement a commercial biomass power plant
Output 2.3 Staff from Santiago and other industrial free zones have received training on technical and	No progress	No activities were carried out as a commercial biomass plant was not implemented.

Table 4. Summary of the achievement of the expected results of the project		
Outcome / Output	Progress	Comments
managerial aspects of small-scale biomass plants		
Output 2.4 The envisaged 3 MW biomass-based electric power plant has been procured and made operational under an appropriate business model.	Partial progress	Given the fact that it was not possible to implement the 3 MW biomass power plant, an alternative intervention was launched to demonstrate viable technologies for the use of biomass as an energy source. A successful intervention co-funded by the project was achieved for the expansion and modernization of an existing biomass gasification plant for thermal applications in the country with technologies from a local company.
Outcome 3. Awareness for the concept and benefits of biomass power generation has been raised among relevant stakeholders.	Limited Progress	Little progress has been made in the awareness and knowledge of the relevant actors about the opportunities and limitations for the deployment of biomass as an energy source in the Dominican Republic. Mechanisms are established to promote the interaction of the actors of the incipient biomass for energy market and means of communication are established with the specialized public and with a general interest in the subject. However, it was not possible to disseminate the experience of a demonstration plant in commercial operation since it was not implemented.
Output 3.1 A communication plan has been prepared to interact with civil society organizations and the public in Santiago.	Partial Progress	An extensive communication activity was carried out based mainly on social networks and the regular publication of informative materials. The Biomass Network was established as a mechanism to meet with stakeholders, which was not foreseen in the project design. However, its main limitations are the late implementation of the communication plan (almost three years after the start of the project) and the lack of systematic updating and finalization of some of the online products developed.
Output 3.2 Operational experience and best practices from the Santiago	No progress	No biomass power generation plant was installed, whose experiences could be disseminated.

Table 4. Summary of the achievement of the expected results of the project		
Outcome / Output	Progress	Comments
demonstration plant have been compiled.		
Output 3.3 Promotional activities including technical seminars, dissemination events, and drafting of technical manuals and guidelines, have been carried out.	Partial Progress	A number of promotional activities were carried out, however, their scope and impact were limited. They were initiated only at the end of the third year of project implementation. *

2.3.3 Efficiency

The Project budget was 1,300,000 USD provided by the GEF plus a national co-financing of 7,620,000 USD. The SFZC committed, as part of the national co-financing, to contribute 6,565,215 USD. These funds were intended to cover the expenses related to the acquisition and commissioning of the 3 MW Biomass Plant to be installed in the SFZIP.

The project budget was concentrated in three budget lines related to national and international staff and consultants and the contracting of services (figure 1). The budget for these three lines represents 64.3% of the total budget, which together with the equipment line budget covers 89.4% of the total.

The execution of the Project budget reached 75.6% according to the available information[31]. The budget lines for staff and national consultants have a very high execution, higher than 92%.

Of interest for the analysis of budget execution are the levels reached of the budget line of "contractual services" with an acceptable 79.4% and the budget line "equipment" that only reaches 49.3% (Figure 4). The achieved budget execution in both cases is outlined by the no implementation of the envisaged power plant. The project had budgeted the acquisition of equipment and facilities for the biomass plant that would guarantee a socially and

[31] Project delivery report. 100288 - Stimulating industrial competitiveness through biomass-based, grid connected electricity generation. 27.01.2014 - 30.06.2020.

environmentally responsible design and operation.

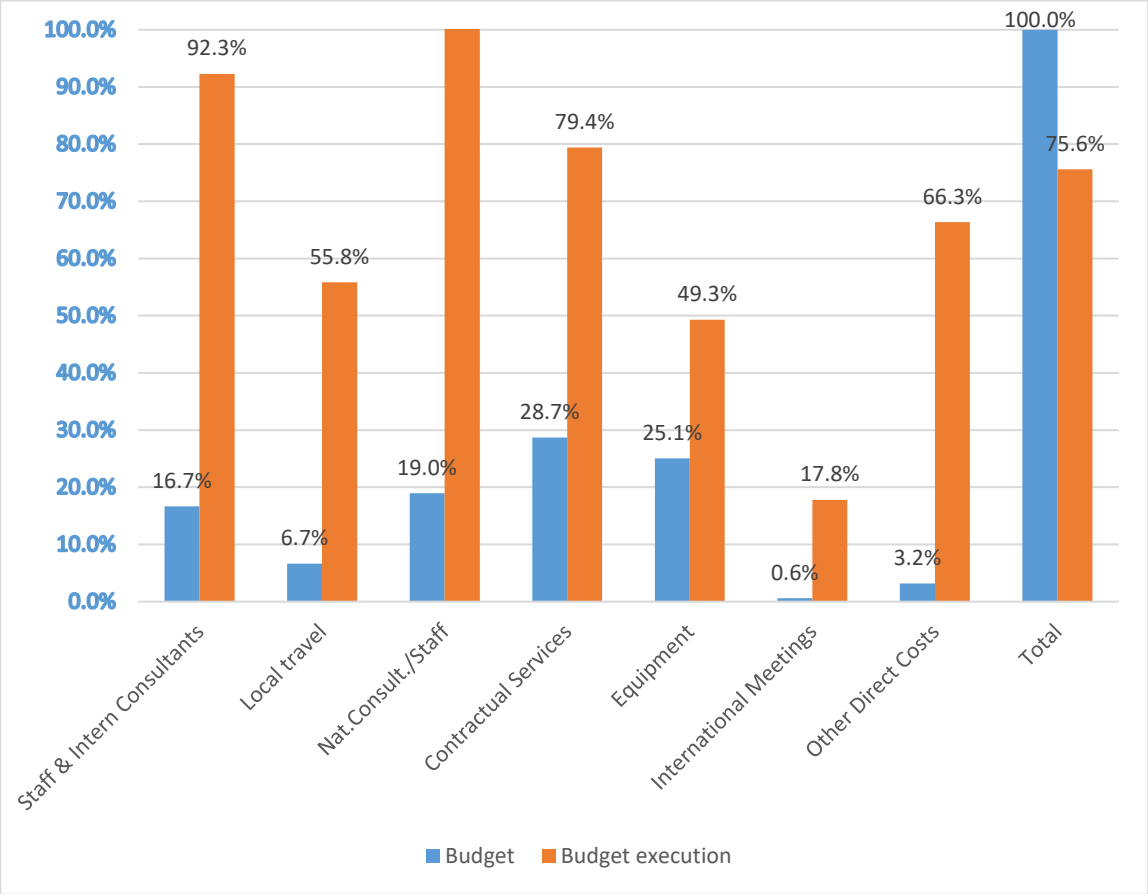

Figure 4 Total budget distribution and execution

Consulting services are the item with the highest allocation of the project budget.

Under this budget line, twelve consulting services were signed up, using both ISA and Service contract types. One of the characteristics of the procurement of these services was the follow-up of the due process. This led to processes, sometimes lengthy, that included the acceptance by the Technical Operational Committee of the ToR as a step before the procurement activity from the UNIDO Headquarter.

The fact that the signed consulting services are provided by experts or consultant companies from four different countries shows the coverage of these bidding processes. Experts from the Dominican Republic execute five studies; participate jointly with international consultants in carrying out three studies and international consultants conducted the remaining four. (Table 5)

The operational technical committee maintained a systematic follow-up work on the delivery of the contracted products. In this way, the monitoring and evaluation of the correspondence, in content and quality, of the results delivered with the assumed commitments were carried out. It can be affirmed that an important part of the delivered results was characterized by technical quality, the timeliness of the methods used, and their practical approach. However, the results of the three consultancies were not accepted, fully or partially, for technical reasons.

Table 5. Technical Consulting Services				
Title	**Consultant**	**Country**	**Category of the consultant.**	**Remarks**
1. Availability of Biomass for Power Generation in the Dominican Republic: An Analysis of Existing Information	Eng. Mamerto Valerio	DR	N	The PSC did not approve the report because it considers that the results obtained are not of the required quality and do not correspond to what was agreed in the terms of reference[32].
2. Regulations and incentives	Francisco Ortega	DR	N	It was not a successful report. The main points made by the CTO members were related to the fact that the proposals and recommendations are of a general nature and are not ready for practical implementation, as required by the TORs[33].
3. Site Evaluation and Pre-feasibility Study for a Biomass Plant in the Dominican Republic (Pre-feasibility Study for the installation of a biomass plant that supplies energy to the Industrial Free Zone of Santiago)	Union Gas Fenosa. Mariano Chaubert	Spain / DR	I/N	
4. Pre-feasibility study of biomass plant expansion in NFZIP	Gas Natural Fenosa Engineering (GNFE) / Naturgy Mariano Chaubert	Spain / DR	I / N	
5. Pre-feasibility study of biomass thermal and	National Center for	Spain / DR	I / N	This consultancy ended without

[32] Minutes of the meeting of the PSC held on September 30th, 2015

[33] Minutes of the meeting of the PSC held on September 20th,2018.

Table 5. Technical Consulting Services				
Title	**Consultant**	**Country**	**Category of the consultant.**	**Remarks**
electrical energy cogeneration plants of at least 350 kW in rice mills in the Dominican Republic	Renewable Energies of Spain (CENER) with Management Consulting Group (MCG)			delivering all the agreed products. The results of the pre-feasibility study were not attractive to the companies in the sector. Therefore, it was not considered necessary to prepare the last deliverable: the terms of reference for a feasibility study.[34]
6. Programming services for the integration of biomass statistics and inclusion of new functionalities.	Richard Mendoza	Spain	I	
7. Biomass Network Maintenance	Ramses Bermúdez	Nicaragua	I	
8. Technical guide on sustainable use of biomass of forest origin in the Dominican Republic.	Jose La Cal	Spain	I	
9. Support to the Commission for the Preparation of General Regulation Law 57-18	Humberto Checo	DR	N	
10. Regulations for self-producers of electricity through biomass waste and biofuel by-products	CORPOEMA	Colombia	I	
11. Supervision of the Hybridization processes authorized by the NEC	Xtudia	DR	N	
12. Results and improvements of law 57 07	Multiconsult	DR	N	
Note:			**N: National I:**	

[34] Minutes of the meeting of the CTO on March 7th, 2019

Table 5. Technical Consulting Services				
Title	**Consultant**	**Country**	**Category of the consultant.**	**Remarks**
			International	

Some aspects that limit the effectiveness of the use of the resources released from the budget are:

✓ The significant extension of the project duration.

The project is approved by the GEF to be executed with a duration of four years in December 2013[35] and actually, its activities are officially closed in December 2020, 3 years after schedule.

During execution, two extensions of the project were requested:

- The first was requested in July 2017. To extend the duration of the project by 2 years, passing the completion date to December 2019.
  This request is motivated because substantial progress is not made in the main results of the project.
- The second request was made in December 2019 for an extension of one year until December 2020.
  This extension is aimed at concluding a group of processes that contributed to strengthening regulatory capacities for the promotion of projects based on the use of biomass.

✓ Late start of some outputs (in August 2015, almost 40% of the time available for project execution had already elapsed):
- Output 1.1. The expert is hired to enhance the incentives and regulations studies in late 2015.
- Output 1.2. The corresponding studies were integrated with Output 1.1 consulting.
- Output 2.1. The pre-feasibility study on the installation of the biomass plant associated with the SFZIP was contracted in August 2015.
- Component 3. Its execution is delayed as it is designed based on the progress of component 2.

✓ Dilated decision-making processes:
- The SFZC announces its intention to exit the project in April 2016, the pre-feasibility study of the possible demonstration action to be executed in Component 2 instead of in the SFZIP begins only in December 2017, 20 months later.
- The excessive duration of the processes to put in place the consulting services. This includes the approval of the calls for proposals and later for hiring the consultancies.

✓ Excessive duration of consultancies in relation to the available time frames of the project:
Most of the consultancies took more than 6 months from the hiring to the delivery of the final report.

[35] https://www.thegef.org/project/stimulating-industrial-competitiveness-through-biomass-based-grid-connected-electricity. Reviewed: August 26, 2021.

The next table (table 6) shows the main project milestones.

Table 6. Relevant milestones in the execution of the project		
Dates	**Event**	**Observations**
July 2014	Formal establishment of the Project Steering Committee and start of its activities.	It is carried out six months after the start of the project.
September 2015	Report of the biomass availability based on existing information study is delivered	It is estimated that it started in September 2014
January 2016	The final report of the pre-feasibility study for the installation of a biomass plant that supplies energy to the Industrial Free Zone of Santiago is delivered.	2 years after the project started
April 2016	The SFZC announces its withdrawal of support to co-finance the Biomass Plant.	In the end, it leads to the exit of the project of one of its "other executing partners"
May 2016	The search for another site for the execution of the demonstration project begins in conjunction with the NCEFZ.	
October 2016	The ToRs are approved for the study on regulations and incentives based on products 1.1 and 1.2	The final report is delivered in November 2017.
November 2016	The biomass platform is launched	Bulletin: March 2016 Facebook and Twitter; Nov 2016. Project assistant hiring to attend communication: March 2017 Communication plan: May 2017 Magazine: March 2018
February 2017	The NFZIP is identified as a possible beneficiary of the project to implement the demonstration project	In April 2017, the agreement with the NFZIP as a beneficiary of the project was formalized.
June 2017	Extension of project completion is requested until December 2019.	
August 2017	The ToRs for the pre-feasibility study for the expansion of the NFZIP biomass plant is published	In December 2017, the contract was signed with the company selected to carry out the study.
October 2018	The final report of the pre-feasibility study is delivered.	Based on the non-formal expression of interest of the NFZIP, the project works to give continuity to the study
May 2019	The TPC concluded that NFZIP is not interested in continuing with the project	The conclusion of the relations with the NFZIP is made official in the PSC of July 2019.
Dec 2019	Extension of the project is requested until December 2020	

As previously analyzed, the execution of the Project budget is 75%. This figure is influenced by the non-acquisition of the equipment associated with output 2.4. If the amount allocated in the budget for these expenses is excluded, the level of execution rises to 84%.

However, the results obtained compared to those expected are meager. None of the three outcomes achieved significant results according to the project's results framework. In the case of outputs, of the ten planned, only one achieved all expected results, five achieved only partial results, and the rest are in the range of limited or no progress.

The limited results obtained do not correspond to the relatively high level of budget execution. This behavior was influenced by failures of the project design and lengthy processes related to project management that avoided achieving planned results in the anticipated timeframes.

The efficiency of the project is rated **moderately unsatisfactory.**

2.3.4. Sustainability

Sustainability analysis focuses on considering to what extent its results and benefits will be sustained over time after the project ends.
Among the results and benefits that should be considered in this analysis, the following stand out:

- Tools were developed that, based on information technologies, facilitate the implementation of regulations associated with Law 57 07, which favor small energy producers based on renewable sources.
  Although the foreseeable impact of these tools constitutes a motivating factor for the NEC to continue with this line of work, there is no evidence that once the project support is concluded, financial resources are available to continue systematically with this activity, expanding the scope of it.

- Relevant institutional actors recognized the importance of the biomass market as a condition for the development of biomass energy use. Progress was made in characterizing this incipient market and some factors limiting its development were identified.

- The project contributed to the strengthening of new regulatory tools and technical support instruments that support the energy use of biomass within the framework of the Forestry Law 57 18. In addition, the Biomass Network was established as a meeting place for stakeholders.

  However, the absence of an active link with the project by relevant actors in the forestry sector, such as the Dominican Chamber of Forestry, the National Association of Forestry Companies or the National Association of Forestry Professionals, hinders the sustainability of the results obtained.

- Limitations and opportunities to develop biomass energy projects were identified in specific cases based on the results of the pre-feasibility and biomass availability studies carried out.

  A thorough analysis of these results is needed as an input to develop a roadmap of the actions required to create a regulatory and public policy environment that will

effectively take advantage of the identified opportunities and overcome existing constraints.

Effective spaces were created to promote the use of biomass as an energy source to the specialized public, stakeholders, and the public.

The agreements reached with the CNE to provide continuity to these project products during the post-project period augur well for their sustainability.

- The project contributed to the strengthening of interconnection, cooperative work, and the understanding of the complementary roles of relevant institutional stakeholders in the processes associated with the sustainable and competitive use of biomass as an energy source.

Sustainability of project contributions creating a better understanding and raising awareness of relevant institutional and economic stakeholders about using biomass for energy constitutes a challenge in the current circumstances.

Continuing the work started by the project requires a political will that gives it the priority it has for the socio-economic development of the country. A medium-long and inter-institutional approach is required that goes beyond sectoral and technocratic analyzes.

The sustainability of the results and benefits of the project is considered **moderately probable.**

2.4. Performance of cross-cutting criteria

2.4.1 Monitoring & evaluation.

The project document describes a monitoring and evaluation system. A description of the expected activities is also provided.

Monitoring and evaluation activities conceived by the project design were:

- The design of a detailed monitoring plan and methodology.
- Review project progress based on the annual progress reports and monitoring of project impact indicators
- Review of project activities on gender-specific issues.
- The mid-term review and the GEF terminal evaluation.

The assessment of implemented Monitoring and Evaluation (M&E) planned activities shows that:

- A detailed monitoring and evaluation plan and methodology were designed.

According to the project document, a detailed M&E plan was designed by an international expert. This plan was discussed during the project inception workshop, but there is no evidence of its formal approval.

This plan is a comprehensive document for guiding the M&E activity of the project. It was fully implemented, except that the periodicity with which the meetings of the CTO and the PSC were held was not always as foreseen by the monitoring and evaluation plan.

This plan, based on an agreement of the PSC, introduced an additional committee: the Technical Project Committee (TPC)

The frequency of TPC and PSC meetings was planned monthly and biannually. However, the actual period of these meetings was lower than planned (Table 7)

Table 7. TPC and PSC meetings.							
	2014	2015	2016	2017	2018	2019	2020
TPC	2	1	5	12	8	5	1
PSC	1	3	2	2	1	1	1
	July	August, September, November	April, December	April, June	July, September	July	January

- The monitoring of the project progress was accomplished:

– Annual project reports.
These reports were produced every year during the project lifespan. The quality of the reports is adequate and clearly describes the achieved progress, difficulties, and undertaken and planned actions.

– Monthly project report. ´
This report details the activities done during the period. The activities are described by each project component. The reports also enumerate planned activities for the next month.

- The monitoring function of the TPC and the PSC was partially accomplished:

– The TPC was focused on monitoring, coordination, and guidance of project activities at the operational level. The relevant stakeholders of the project were represented in the TPC membership. The institutional position of nominated members of the TPC gave significant authority to this committee. The annual number of the TPC meetings was significantly lower than planned. It was especially relevant during the period 2014 – 2016. This fact affected the operational decision-making process and contributed to the delay in the implementation process during this period of the project. The role and activity of this committee became much more relevant during the 2017 – 2019 period. The number of meetings increased and they were held essentially in full composition. The fact that only on two occasions the PSC meetings were held at the end of the year (2015, 2016). Many of the considered subjects during the meetings were relevant to the monitoring function of the project.

– The Project Steering Committee membership was according to project document indications. The PSC meets practically in full composition ten times during the project period. The PSC activity based on the number of hold meetings was high during the 2014 – 2017 period. This activity decreased during the next 2018 – 2020 period.

– Of the six PSC meetings that were to be held at the end or beginning of the year, only two were held during these periods. As a result, decisions such as the approval of annual work plans, project budgets and project information reports (PIRs) were made when the period for which they were to be approved had already advanced in time. In addition, this reduced the ability of the PSC to provide guidance on strategic issues and activities for the next annual plan based on an assessment of previous annual performance of the project.

This affected the capacity of this committee to fulfill its responsibilities.

The selection of the topics of the meeting agenda was according to the most relevant issues related to the progress of the project during the period. The conclusions and agreements of the meeting contributed to improving the project performance.

- The review of project activities on gender-specific issues by an expert on gender issues planned in the M&E plan was not undertaken.

- The mid-term review was completed as planned.

The review is provided during the April and May months of the year 2016. It is done by two national consultants. However, the M&E system of the project indicated that the leading evaluator should be an international expert.

The conclusion of the Medium-term Review (MTR) includes some recommendations focused to improve the project performance. For example[36]:

- Monitor compliance with gender integration in the re-approach of the project.

- Promote the streamlining of biomass studies carried out in the Ministry and the definition of Incentive policies for renewable energies, to contribute to obtaining on time the results (products) planned by the project.

- Facilitate support for exchanges of experience on the use of biomass, as well as develop synergies with other initiatives

There is no evidence that the PSC has considered these appropriate recommendations. Subsequent to the mid-term review a PSC meeting was held on December 5, 2016. In the minutes of this meeting, the analysis of the results of this review does not appear on the agenda.
.
The design and budget of the M&E system were correct. However, during the implementation, some deviation of the M&E plan affected its effectiveness. These deviations are focused on the frequency and opportunity of the date of the TPC and PSC meetings.

The monitoring and evaluation system is rated as **Moderately Satisfactory.**

[36] Quotes of the MTR document

2.4.2 Results-Based Management

Project management represented a challenge for the project team and the project manager.
The mere fact that the project was aimed at the promotion of relatively new production and commercial activity was challenging. Activity without any significant practical experience nor adequate market conditions already made the task more complex. Under these conditions, the identification, sensitization, and coordination of stakeholders were tasks that required an additional effort. For these same reasons, the management of activities aimed at improving the regulatory framework for the promotion of biomass as a source of energy required special efforts and additional technical capacities.

The management of this project included the task of managing the investment cycle of a biomass power plant to be commissioned in a very short time frame. This is a complex and specialized task that was not adequately addressed. This activity was further hampered by design flaws in the relevant component of the project.

The duration of the project implementation requires a specific assessment.

This project was extended 3 years in addition to the four years originally approved.

The first extension request was made at the end of the approved period (2017). The reason was the lack of progress for the realization of the biomass power plant during the planned period. The extension was requested for two more years. The objective of this extension was to identify a new opportunity for the completion of the demonstrative case as per outcome 2. Also for closing some delayed outputs of outcome 1. Besides, to make progress in the implementation of outcome 3 that was delayed while waiting for progress of the demonstrative case.

The second extension request was made ending the year 2019. The requested extension was one more year. It was expected to use it for finishing some project activities running during this period.

Both extension requests were approved by the PSC at the appropriate time. Later on, they were shortly approved by the UNIDO headquarters.

The management project capacity was in place soon after the project started. In particular, the project team was in full composition since the same beginning of the project implementation.

A significant aspect that affected the management capacity of the project team was the frequent changes in its composition (table 8):

- The Project Manager (PM), nominated by UNIDO, changed four times during the project period. However, the first PM filled the position during almost the complete original period of the project.
- The Project Director (PD) position corresponded to be beheld by the President of the NEC. The person that filled this last position changed four times during the project period.
- The National Project Coordinator (NPC) position was filled by three different persons during the original project period. A fourth NPC was nominated during the extension period.
- The Position of Project Assistance (PA) was filled by three different persons during the project period. Nevertheless, it was the most stable one because the last PA held the position during six of the seven years of the project.

The PMU, in charge of daily management and coordination of project activities, consisted of a National Project Coordinator (NPC) supported by a Project Assistant (PA). The NPC was responsible for the day-to-day management and supervision of the project, including technical aspects of the project and the coordination of contracting (national consultants, sub-contracts) and monitoring activities.

The PMU, in this composition, lacked its technical capacity about issues related to biomass for energy use. This capacity was needed for advising and supporting the day-to-day decision-making process of the project team and the TPC. Because the national institutions supporting the project also had limited experience and training in this field this gap was reinforced.

During the extension period, a Project Technical Assistant and a Project Technical Expert were hired to compensate for this gap. Their proven contribution to improving the performance of the project confirms the convenience of this decision.

Table 8. Composition of the project management team[37].

	Original period				Extension period		
	2014	2015	2016	2017	2018	2019	2020
Project Manager	PM1	PM1	PM1	PM1/ PM2 (July)	PM2/ PM1 (April)	PM3/ PM4	PM4
Project Associate					PMA1	PMA1	PMA1
Project Director	PD1	PD1	PD2	PD2	PD3	PD3	PD4
National Project Coordinator	NPC1	NPC2/ NPC3	NPC 3	NPC3	NPC3/ NPC4	NPC4	NPC4
Project Assistant	PA1	PA2/ PA3	PA3	PA3	PA3	PA3	PA3
Technical Assistant					TA1	TA1	
Technical Expert						TE1	TE1

The efficiency of the management activity of the project was also affected by the absence of annual work plans. The evaluator does not have any evidence that annual operational plans were elaborated and implemented.

The lack of annual work plans led to some improvisation of the planning of some project activities. The review of the minutes of TPC and PSC meetings guides the conclusion that the operational approach of the decision-making process prevailed over the planned one.

The before mentioned failures, and long processes for the approval of consultancies and technical services, lead to a slow rate of progress project outputs and finally to project delays.

The main challenge faced by the project management was the impossibility of establishing and commissioning a 3 MW biomass power plant at SFZIP. This became a reality when SFZC confirmed the decision to withdraw the commitment to co-finance the biomass power plant in April 2017. This triggered the withdrawal of SFZC from the project, creating a critical situation.

Given this situation, the PSC decided to request the extension of the project in June 2017. At that time, it was imperative that the PSC, under the guidance of the UNIDO PM, had decided to revise

[37] PM1: Nina Zetche, PM2: Mark Draeck, PM3: Susumu Takahasi, PM4: Martin Lugmayr.
PA1: Liliana Morales.
PD1: Enrique Ramírez, PD2: Juan Rodriguez, PD3: Ángel Canó, PD4: Edward Veras.
NPC1: Jehová Peña, NPC2: Ramsés Bermúdez, NPC3: María Zubiaga, NPC 4: Claudia Adames.
PA1: Ramsés Bermúdez, PA2: María Zubiaga, PA3: Milagros Minervino.
TA1: Remi Rijs
TE1: José La Cal.

the project results framework. Furthermore, to decide whether this revision would lead to a major amendment[38] of the project. However, such a revision was not made.

In any case, minor amendments to the project result framework were needed. In particular, the modification of those outputs, which progress, was linked to the location of the demonstrative biomass power plant in Santiago. It is the case of output 1.4 and most of the outputs of outcome 2 (2.1, 2.2, and 2.4) and outcome 3 (3.1 and 3.2). This revision, in particular, would allow a better performance of outcome 3. The approval of a minor revision corresponds to UNIDO[39].

The principal piece of the revision of the project result framework would be the amendment of outcome 2. In this case, the expected amendment would be focused on the selection of the technology demonstration case. The essence of the change would be to give up the proposal to make operational a costly biomass power plant. The reasons for that change would be:

– The executing project partner committed to financing the demonstration biomass power plant quit the project.
– Finding a new project beneficiary in a short period was unlikely because:

- The decision of the SFZC to abandon the support of the 3 MW power plant investment, could guide other potential project partners to the conclusion that this kind of investment is a costly and risky business.

- National and international energy circumstances had changed after the project starts. The improvement of the stability of power supply in the Dominican Republic and the reduction of the international fuel prices could have decreased the interest of companies in the industrial free zones for this kind of project.

– The period available, including a possible project extension, was insufficient for covering a full investment cycle to achieve, from a fresh start the original goal of the outcome.

The needed modification of the outcome result framework was about the selection of technology demonstrative cases. A modification to put in place a small heat or/and power biomass facility would increase the opportunities for success.

In this case, the project could have played a direct co-financer role using the budget for equipment allocated to output 2.4. As a result, the investment risk for the private sector project owner would be reduced. In addition, the opportunities to find the right beneficiary of this project outcome would increase.

This modification of the scale of the expected technology demonstration case of outcome 2, supported by a comprehensive argumentation, could have been proposed as a minor amendment. In any case, the chances to be approved as a major amendment were reasonably high.

There was also a need to consider some minor reformulations of the project results framework, within the scope of a possible amendment, which would facilitate improved performance of Outcome 3.

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[38] RULES, PROCEDURES, AND OBJECTIVE CRITERIA FOR PROJECT SELECTION, PIPELINE MANAGEMENT, APPROVAL OF SUBPROJECTS, AND CANCELLATION. GEF/C.30/3, December 2006 and POLICY GUIDELINES ON THE PROJECT AND PROGRAM CYCLE POLICY. GEF/C.52/Inf.06. April 18, 2017.
This last document establish that:
Major amendment means a change in project design or implementation that has a significant impact on the project's objectives or scope, or an increase of the GEF project financing of more than 5%.
Minor amendments are changes to the project design or implementation that do not have significant impact on the project objectives or scope, or an increase of the GEF project financing up to 5%.

[39] The before referred document, while describe the procedures for minor amendment for FSPs, stated: "If the changes occur after the CEO endorsement, and do not include a change in the GEF project financing, the Agencies act on the amendment at their discretion".

It is a fact that the project management made adaptive management decisions. These decisions were mostly related to dealing with outcome 2 implementation difficulties. These were discussed and accepted by the PSC.

Using a more aggressive and deeper adaptive approach of the result-based management was needed to facilitate accomplishing a better project performance.

Frequent changes in personnel responsible for different project management responsibilities and the lack of expertise of the project team to deal with issues related to the use of biomass for energy during the original project period affected the efficiency of project management. During the project's extension period, this expertise was provided by international experts hired for this purpose.

The result-based management activity is rated as moderately satisfactory.

2.4.3 Gender mainstreaming

The project design adequately addressed the gender issue through activities related to:

- The development of biomass sourcing strategies by smallholder farmers under sustainable management plans,
- The development of guidelines, best practices and analytical tools.
- Training and
- Communication with civil society groups.

However, the lack of progress on most of the project outputs where gender was planned to be addressed affected the project results in this regard. These were outputs 1.4 (procurement strategies), 2.3 (training), 3.2 (best practices) and 3.3 (development of technical material and guidelines).

In the implementation of the project, the role of women in project management was relevant.

On average, 50% of the members of the Project Steering Committee were women. Of the four national coordinators, two were women, as was the project assistant. Both positions were held for 6 of the 7 years of the project. The project director was a woman for 4 of the 7 years of the project, as was the deputy project director.

Gender mainstreaming is rated **satisfactory.**

3. Stakeholder's performance.

3.1. UNIDO.

This project is a result of the joint effort of the NEC and the Free Zone Sector of the Dominican Republic, with the active support of UNIDO.

The technical fundament of the project design is based on reports produced by experts mobilized by UNIDO. The technical preparation of the project considerer both power production and biomass supply considerations. However, there is no evidence of the participation of stakeholders directly involved in the market of biomass for energy during the preparation of the project. A similar situation is founded with the participation of the MENARE. The role recognized for this ministry in the project document is just as an environmental regulatory entity.

Nevertheless, it was not considered as the governmental institution responsible for the application of State policies for promotion, protection, and sustainable management of forestry[40].

Had UNIDO promoted a more direct involvement of MENARE in project preparation, the shortcomings of the project design related to biomass supply would probably have been avoided.

The design of the M&E system was adequate. The governance of the project was guided by clear rules for the functioning of the PSC, the TPC, and the PMU. These rules were described by the Project Monitoring Plan.

Nevertheless, it should be pointed out, that the composition of the PMU, should have included a position for a technical expert. A specialized technical expertise on biomass for energy issues was needed for the day-by-day project management activity of the project. It would help to improve the design and monitoring of the technical services and consultancies, to identify priorities and focus efforts to achieve planned results, and to maintain a more fluent communication with national technical counterparts.

The lack of specialized technical capacity on biomass for energy issues of the PMU and of local experts was compensated by the hiring of a technical expert and technical assistance during the project extension period.

The guidance of the adaptive management activity was mainly at an operational level. It is the case of the search for alternatives to the failure of accomplishing the expected 3 MW biomass power plant in Santiago. Besides, there is no evidence that the recommendations of the MTR were considered for improving the performance of the project.

The confirmation of the impossibility to achieve one of the main project results stated in its outcome: "A biomass-based electric power plant (planned capacity of 3 MW) has been adopted by the Santiago Industrial Free Zone" due to the exit of the SFZC project in 2017, created a situation that could have been used to adapt the project results framework to the new scenario.

UNIDO missed this opportunity to promote the amendment of the project result framework. It would have created better conditions to improve the performance the project under the conditions existing at that time.

The impacts of the multiple changes of the project manager during the 2018 – 2020 period on project activities were reduced by the recruitment of one project associate at headquarters. This

[40] https://ambiente.gob.do/viceministerio-recursos-forestales-2/ visited September 9, 2021

position was held by the same person during the entire period. The active role of the Project Associate in having constant communication with the technical experts, stakeholders (MARENA; MINEM) consulting firms, National Project Coordinator made decision making processes (in terms of project implementation) less lengthy and consequently activities progressed in a faster manner.

UNIDO project managers kept a systematic contact with the PMU and National Authorities. They attended all the PSC meetings. Nevertheless, the field visits of the PM were not carried out as systematically as was needed (table 9). This situation was critical during the period 2016 – 2018. However, visits were conducted by the Project Associate, in coordination with the Technical Assistant (once) and the National Project Coordinator (twice). During these visits, meetings with project's stakeholders were held, workplans were approved and critical project decisions were taken.

Table 9. Visits of the project manager/ project management assistant to the Dominican Republic

	2014	2015	2016	2017	2018	2019	2020
PM	2	3	0	1	0	1	
PA						1	1

UNIDO actively contributed to the integration of relevant stakeholders both during the project preparation and implementation stages. Nevertheless, more direct and active involvement of relevant stakeholders of the biomass production, supply, and policy sector would have helped to a better design and performance of the project. The participation and support to project activities of UNIDO specialized departments in investment processes and policy design would also have helped to improve the project design and the effectiveness of its implementation.

The management capacity of the project was affected by frequent changes of people holding leading project management positions. This capacity affected low number of field visits by the project manager during significant periods.

Project management was results-oriented, but failed to develop the activities within the available time periods. An adaptive management approach was used at the operational level to deal with difficulties and changes in the project environment. However, adaptive management did not take the opportunity to request the amendment of the project results framework. This amendment would have significantly improved the chances of achieving a better project performance.

3.2. National counterparts

The national counterparts of the project were the NEC, NCEFZ, and the SFZC. All these organizations played an active role during the project preparation. The NEC contributed to aligning the project to the priorities of the Sustainable National Energy Development, and the NCEFZ was representing the beneficiary sector of the project. The role of the SFZC was essential for the project. The SFZC committed to financing a multi-million USD biomass power plant.

All these organizations actively engaged both in the project preparation and in implementation. They were represented in PSC by their highest authorities that attended in person most of the meetings held by the Committee. The TPC also received active and effective support from these organizations.

The NEC facilitated the participation of its technical staff in project activities and financed the position of PA.

The NCEFZ support to facing the exit from the project of the CSFIS was significant.
The CSFIS actively participated in project activities and demonstrated an active and constructive attitude. Its decision to exit from the project was based on reasonable business-oriented criteria.

Other government bodies, besides the NEC, demonstrated a high commitment to the project. It was the case of the MENARE. This ministry, besides the responsibility as National GEF focal point and national environmental authority, played a leading role during the project implementation supporting the inclusion of activities focused on the biomass supply and market.

The MEM was not initially included as a project stakeholder because it was created while the project was in the approval process. Nevertheless, this ministry was actively involved in project activities and showed a strong commitment to the project as a member of the PSC and the TPC.

The fact that the government agencies most relevant to supporting the project objective were involved as national counterparts reflects the importance and relevance of the project in responding to national priorities.

This active participation of these national leading institutions, representing both the energy sector and the environment and natural resources, promotes the strengthening of cooperation and development of synergies among them. It is an additional benefit produced by the project. In addition, it facilitated to these organizations achieve and share a better understanding of the complexity and multi-sectorial character of the development of the use of biomass for energy.

Supported by UNIDO, the National counterparts led by the NEC designed a set of activities for the continuity of some project activities and results. It is the case of the biomass network, the tools for facilitating the access to benefits of Law 57 – 07 by small power producers, and the guidance for the use of forestry biomass for energy.

Nevertheless, project activity has created the conditions for the promotion of the approval and implementation of a comprehensive, multi-sectoral national action plan for the promotion of the use of biomass for energy.

This plan would create opportunities to progress achieving project impacts. In particular, this plan could be aimed to support the establishment consolidation of the market of biomass for energy, to improve the regulatory framework, increase the awareness of relevant stakeholders and the public, and the promotion of business opportunities.

It would be also an opportunity to strengthen the keep the created by the project momentum t of cooperation among different governmental institutions and to engage the private sector and business associations and civil society.

3.3. Donor.

The donor has fulfilled adequately its obligations.

4. General Evaluation.

The Project addresses a problem relevant to the Dominican Republic and countries in the region. Project design flaws significantly limited the opportunities to achieve outstanding performance. However, project management did not take the opportunity to overcome some of these design flaws by requesting adjustments to the results framework at the end of the original project period. During implementation, results were achieved that contribute to the project objective albeit in a limited way, primarily due to the project design constraints already mentioned. This resulted in little progress towards impact. A high execution of the approved budget was obtained, which does not correspond to the limited results achieved.

The findings of the evaluation lead the evaluator to conclude that the overall assessment of the project (table 10) is moderately satisfactory.

Table 10 General Evaluation			
#	Evaluation	Findings	Evaluator
A	Progress to impact	**Finding 1**. Despite the limited results obtained by the project, some progress towards impact was achieved: – Improved knowledge of biomass potential and a better understanding of the challenges to comprehensively address biomass-to-energy market issues. – Strengthening the regulatory basis for the commercial use of biomass for energy in the natural resource management environment. – The consolidation of a demonstrative reference case of national capacities for the development of advanced technologies for biomass energy utilization. – Moving key national institutions, such as MEM, MINAREN and NEC, towards a better understanding of the complexities, requirements and synergies needed to address the promotion of biomass energy use.	**Moderately satisfactory.**
B	Program Design	Moderately unsatisfactory	
1	General Design	**Finding 2**. The general design of the project is adequate. The project responds to the national development priorities of the Dominican Republic. The selection of UNIDO as implementing agency corresponds with its proven technical capacity and long experience supporting activities for the promotion of biomass for energy use. Relevant national stakeholders were actively involved in project preparation and committed to supporting project implementation. However, a more specific and detailed approach to the issue of biomass supply and biomass-to-energy market promotion was necessary to achieve the project objective. A more direct involvement during project preparation of stakeholders from the policy making and biomass production sectors would have helped to improve the project design in this regard.	Satisfactory

2	Logframe	**Finding 3.** The design of the results chain of the Project's Results Framework had limitations that directly affected the efficiency and effectiveness of its implementation. In particular, the lack of results and activities aimed at specifically addressing the issue of biomass supply and the promotion of the biomass-to-energy market, in line with the complexity and relevance of this issue. The design of the outcome aimed at demonstrating a proven technology for decentralized biomass power generation through private commercial investment was insufficient. First and foremost, because it was not formulated as an industrial investment cycle to build and operate a biomass power plant. One of the consequences was that it underestimated the period of time needed to fulfill the investment cycle of a biomass power plant. The design of the outcome focused on awareness and capacity building meant that the progress in achieving its outputs depended on the progress made in the technology demonstration outcome. This fact limited its direct contribution to the achievement of the project objective. **Finding 4.** The logical framework is methodologically adequate. The major shortcoming is the absence of a definition of project impacts.	Moderately unsatisfactory
C	Program Performance	Moderately unsatisfactory	
1	Relevance	**Finding 5.** The development problem addressed by the project is highly relevant to the Dominican Republic. The project beneficiaries and participating national authorities actively supported the project activities. They showed a great commitment to the project's progress.	Highly Satisfactory
2	Effectiveness	**Finding 6.** The absence of a thorough and detailed study of the specific regulatory and policy barriers that limit the safe, reliable and sustainable supply of biomass and its commercial use for heat and power production contributed significantly to the failure of studies conducted to improve the regulatory framework for this purpose to achieve the expected results. **Finding 7.** The decision-making process for the implementation of the industrial investment project cycle of the expected biomass power plant was not always sufficiently dynamic and executive as expected by the private sector. **Finding 8.** Progress was shown raising awareness and facilitating the integration of relevant stakeholders, while developing synergies among them, to promote the use of biomass for energy purposes. The effective use of a set of online digital communication media was a factor of the success in achieving this progress.	Moderately satisfactory
3	Efficiency	**Finding 9**. The limited results obtained do not correspond to the relatively high degree of budget execution. This performance was influenced by failures of the project design and lengthy processes related to project management that avoided achieving planned results in the anticipated timeframes. Mobilized resources were used for intended purposes.	Moderately unsatisfactory
4	Sustainability of	**Finding 10.** Sustainability of project contributions creating a better understanding and raising awareness of relevant institutional and economic stakeholders about using biomass for energy constitutes a challenge in the current circumstances.	Moderately Likely
D	Cross-Cutting Issues	Moderately Satisfactory	

1	Monitoring and Evaluation	**Finding 11.** The design of the M&E system and the allocated budget for its implementation were appropriated. All reports were produced timely and with good quality. However, during the implementation, some deviation of the M&E plan affected its effectiveness.	Moderately satisfactory
2	Results-Based Management (RBM)	**Finding 12.** The project management approach was mainly guided by an operational style. The management team reacted in a timely manner to new situations. However, the decision-making process and implementation of activities sometimes took too long. **Finding 13**. A more aggressive and deeper adaptive approach was needed. The status of project implementation, at the end of the originally planned period, presented an opportunity to request a modification of the project results framework. Approval of this modification would have facilitated the achievement of improved project performance. However, no such request was made. **Finding 14.** Frequent changes in project team members affected the effectiveness of project management. In addition, project management was constrained by the lack of technical capacity of the project team to deal with biomass-to-energy issues during the original project period.	Moderately satisfactory
3	Gender Mainstreaming	**Finding 15.** The project design envisaged addressing the gender issue through activities associated with some outputs. However, the lack of progress on most of the project outputs where this issue was planned to be addressed affected the project outcomes in this regard. The role of women in project management activities was relevant.	Satisfactory
E	Partners' Performance		Moderately Satisfactory
1	UNIDO	**Finding 16.** UNIDO actively contributed to the integration of relevant stakeholders in both the preparation and implementation phases of the project. However, a more direct and active involvement of stakeholders from the biomass production, supply and policy sector would have contributed to improved project design and implementation. Involvement and support to project activities by UNIDO departments specialized in investment processes and policy development would have contributed to improve the design and effectiveness of project implementation. **Finding 17.** UNIDO's ability to perform project management was affected by frequent changes of project manager and the low number of field visits by the project manager during significant periods prior to the COVID pandemic. **Finding 18.** UNIDO's management of the project was results-oriented. The adaptive approach to project management was adequately used at the operational level to cope with difficulties and changes in the environment during project implementation. However, the organization did not consider modifying the project results framework when appropriate, which would have been a significant and necessary adaptive initiative in project management.	Moderately Satisfactory

2	National Counterparts	**Finding 19.** The project had as national counterparts relevant institutions for its implementation and sustainability. Among them are MEM, NEC, MENARE, NCEFZ and SFZC. All of them actively participated in its preparation and/or execution. Among these institutions was the MEM, which was created just as the project was in the approval process. The NEC, which kept all the commitments made during the preparatory phase, including co-financing. The role of MENARE, which was initially foreseen only as an environmental regulatory institution and GEF focal point, grew during the project implementation period. This ministry actively contributed to increasing the project's focus on the biomass sector. National counterparts representing the free zone sector fulfilled their commitments. Although the exit of SFZC from the project, justified for business reasons, seriously affected the project results.	Satisfactory
3	Donors	**Finding 20.** The donor adequately fulfilled its obligations to the project	Satisfactory
F	General Evaluation	Moderately satisfactory	

5. Conclusions, recommendations, and lessons learned

The project set out to achieve objectives relevant to the socio-economic development of the Dominican Republic. The expected results could also be a reference in the region in terms of the use of biomass energy. However, its objectives and results were ambitious and difficult to achieve within the framework of a project. For this reason, the project management and their national counterparts faced an arduous task. However, despite not achieving the expected results, modest progress was made in the direction indicated by the project objective. The experience accumulated in the design and implementation of the project has enabled the formulation of a set of recommendations and lessons learned that can be used by project stakeholders.

5.1. Conclusions

The relevance of this project is very high not only for the Dominican Republic but for the entire LAC region. The project addresses the problem of the scarce use of forest biomass and agro-industrial biomass residues available for use as a renewable energy source. This relevance is related to the opportunities it opens up for making progress in addressing climate change, improving energy security, and the national foreign exchange balance. It is also relevant for the contribution that the achievement of its objectives can make to rural development and the advancement of local communities, and to the creation and consolidation of small and medium-sized enterprises in the industrial, technological, and service sectors.

The specific problem addressed by the project is the use of biomass for decentralized heat and power generation. This renewable energy solution is recognized by the Dominican Republic's energy development policy. However, the progress made in this field in the country is based on solar and wind technologies, without significant advances in the use of biomass.

Some project results show that advancing in this field would benefit multiple economic actors.

These actors include rural producers, companies involved in supply chain logistics and the transformation of biomass into solid biofuels. In addition, agro-industrial and industrial producers could benefit from a circular economy and technological innovation scheme. Finally, companies working in the consulting, engineering, equipment supply and maintenance sectors are economic agents that could benefit from developments in this area.

The experience of the implementation of this project ratifies that the achievement of the proposed objectives constitutes a complex development problem. Progress in this area requires a comprehensive government-led approach focused not only on the techno-economic aspect of power generation.

In particular, it is required to promote a wider range of biomass energy end uses that substitute the use of conventional fuels in boilers, furnaces, and dryers in addition to cogeneration and power generation. In this context, the consolidation of a formal biomass-to-energy market connected to rural development is essential.

The project objective has been partially achieved. The achievement of the expected results is limited. The results obtained in the component related to policies for the promotion of biomass use are too general. No specific proposals for modifications or additions to the existing regulatory framework were made. The installation and start-up of the biomass power generation plant by a private company, which was the central expected outcome of the project, was not achieved. As an alternative, the project supported the successful demonstration of biomass gasification opportunities through an innovative demonstration project developed by

a local company.

In addition to design flaws, a contributing factor to these limited results was the complexity of the local situation for this type of investment. This complexity is due to, among other factors, the lack of experience of local stakeholders, the immaturity of the biomass-to-energy market, and the instability of the energy situation. Under these conditions, the pace of project implementation was not sufficiently executive and efficient to achieve the realization of an investment project within reasonable time frames and with acceptable risks for the private investor.

The project contributed to raising public awareness of the opportunities and limitations of the use of biomass as an energy source. However, it was not to the extent envisaged. Nevertheless, the groundwork was laid to expand the use of digital communication products and social media to raise awareness of biomass energy use.

The main progress towards project impact focuses on a better understanding of the biomass energy potential in the country and the opportunities and challenges for its use. In addition, the active participation of national institutions in project activities has contributed to increasing their capacity to successfully address these challenges.

Sustainability of the limited project results is a challenging goal. It requires a comprehensive approach and sustained commitment by key national institutions to design and implement a roadmap for the promotion of biomass use for energy.

The overall project design was appropriate. It was a three-component project aimed at improving the regulatory framework, demonstrating a proven technology, and conducting awareness-raising activities. The involvement of energy sector stakeholders and energy end-users in the project was well designed. However, the involvement of stakeholders from the biomass and natural resources sector was not. The design of the project results framework had flaws that directly affected the efficiency and effectiveness of its implementation. These shortcomings are summarized below. Insufficient attention to the biomass supply chain and promotion of the biomass-to-energy market. Poor compliance with the requirements for a successful industrial investment cycle and planning for too short a period of time to complete it. And the unfortunate design of the awareness-raising activities, which linked their progress to that of the implementation of the demonstration case, reducing the chances of achieving the expected impact in this area.

The level of project budget execution was acceptable, but this level of financial execution is not commensurate with the limited results achieved. However, this level of financial execution is not commensurate with the limited results achieved. Factors contributing to this limited effectiveness were: weaknesses in the design of the project's results framework, delays in initiating implementation of some outputs, and a decision-making process that sometimes took longer than necessary.

The operational management of the project was highly adaptive to the difficult situations created by changes in the project environment and to the results of its activities. The project management enjoyed the committed support of UNIDO and the national counterparts represented by the designated senior staff. However, the project management capacity was affected by several factors. These included frequent changes of the project director, project manager and PMU manager. Also, the PMU's own technical capacity in the field of biomass energy use was not sufficient to support an executive and dynamic decision-making process during the original implementation period. Finally, the lack of systematic and timely PSC and TPC activity during some periods also affected the project management capacity.

The selection of the national counterpart was very appropriate and adequate for the project. It was composed of the national government institutions in charge of the energy sector (NEC and MEM) and the environment and natural resources management (MINAREN). It also included organizations representing the Free Trade Zone sector. All national counterparts actively participated and contributed to the implementation of the project.

UNIDO adequately fulfilled its responsibility as executing agency. However, in the case of project management it would have been more effective if:

- UNIDO's specialized departments in investment processes and policy development had supported the design and implementation of the project.
- The incumbent of the project manager position would have been more stable.
- The project results framework would have been requested to be amended as a result of a deeper and more aggressive adaptive project management approach.

5.2. Recommendations

Recommendation 1

UNIDO's specialized departments should support of the establishment of national action plans for the promotion of a formal sustainable biomass-to-energy market and the broad deployment of technological solutions for the energy use of biomass. At the same time, promote partnerships with other UNS specialized agencies and development cooperation.

Recommendation 2

The design of projects aimed at promoting the use of biomass for heat and electricity production should:

- Include activities aimed not only at the identification of biomass potential, but also at the design of the biomass supply chain, its technical-economic evaluation, and capacity building of project stakeholders from this sector. Special attention should be given to supporting the establishment and consolidation of the biomass-to-energy market. To this end, the involvement of biomass sector stakeholders should be encouraged.
- Include detailed planning of investment activities according to the practice of the investment cycle of industrial projects. In particular, pay attention to aspects such as engineering design, and identification of the most suitable technology supplier, including the schedule of the construction and assembly activities, start-up, and commissioning of the plant. The above activities are time- and resource-consuming tasks. Consider local experience and the maturity of the market, and make a conservative estimate of the deadlines.
- Formulate the project results chain in such a way that the necessary synergies of the different project components do not interfere with the relative independence of the realization of each project result.

Recommendation 3

Facilitate the performance of the Director PMU by:

- Provide training and coaching to the members of the PMU in the fulfillment of their responsibilities.

- Ensure that the PMU director receives direct technical support from a PMU staff member or technical advisor.
- Promote the planning and monitoring of project activities through detailed annual work plans.
- Provide direct and systematic support from UNIDO headquarters by the PM or a designated PMA.

5.3. Lessons learned

A. Progress in the use of biomass for energy purposes, using sustainable schemes and efficient technologies, is still insufficient at the international level. It is, therefore, to be hoped that international projects to promote this activity will continue to be supported. The experience of this project shows the convenience of considering some key aspects in its design and implementation to increase the chances of success.

1. The project design must be specific, detailed, and comprehensive in addressing the biomass issue.

   One of the most important risks for investors in these projects is the guarantee of the sustainability of the supply of biomass as fuel on agreed terms, at stable prices, and over the long term. To reduce this risk, project design should consider the inclusion of outcomes and outputs aimed at:
   - Achieving the participation and support of relevant stakeholders in this sector. These stakeholders include participants in the biomass-to-energy market chain and policymakers who develop regulations and public policies in the forestry and environmental sectors.
   - Strengthen the technical and institutional capacity of the economic agents involved in the biomass supply chain.
   - Contribute to the consolidation of the biomass-to-energy market by improving the regulatory and policy framework where necessary.
   - The elaboration of a detailed design of the biomass supply chain during the investment preparation period. Estimating the additional investment cost of securing biomass supply, and the price of biomass at the point of delivery.

2. The design of the technology demonstration component of these projects aimed at demonstrating the feasibility of using biomass for energy purposes is a major challenge.

The main output of this component is usually a specific technological intervention, often associated with a business model. As a general rule, the private sector is expected to participate in this intervention by assuming financial and economic commitments. This is because this participation is interpreted as a sign of the business viability of the selected case. It also facilitates the promotion of the experience to other entrepreneurs. In addition, the participation of private enterprises contributes significantly to co-financing, facilitating compliance with GEF standards in this area.

These technological interventions have in themselves a set of associated risks that constitute barriers to entry for private sector participation in their implementation. These barriers are what justify the need to carry out demonstration actions with the support of a non-reimbursable funding source.

The objective of this type of component is to help reduce the risk assumed by the private sector in these interventions, which facilitates its support for the same. The project actions are then focused on carrying out actions aimed at sharing these risks and demonstrating a set of good practices as a tool to reduce and control these risks.

In deciding the demonstration case, the assessment of the opportunities that exist to manage existing barriers should be a determining criterion in its selection. The decision to involve the private sector ultimately depends on the technical-economic feasibility demonstrated by the feasibility studies, the level of risk appreciated by the private company, and the correspondence with its predominant commercial interests.

The following factors should be considered in the selection of a demonstration case

a. What is the intended end use of the biomass energy to be implemented? The most common options are biomass boilers for steam or hot water production, cogeneration or power generation for self-supply with or without delivery to the grid, and the independent power producer case.
All of these options help to demonstrate how to manage the barriers associated with, for example, biomass supply and access to finance.

However, the magnitude and complexity of the barriers associated with the technologies, the value of the investment costs, the regulatory complexities, and the opportunities for economic benefits differ for each of these options.

Similarly, the potential for replication of the demonstration case is different for each option.

b. To what extent does the involvement of the project as co-financier of the technology intervention reduce the financial risks assumed by the private company?

The project usually covers the investment preparation costs, while the company covers those associated with equipment, construction and assembly, and start-up. The investment preparation costs are not usually strongly dependent on the size capacity of the facility.

For these reasons, in smaller projects, the share of co-financing by the private company is smaller. Therefore, these projects have a lower financial risk for these companies.

c. What is the scope of the technological intervention?
It may be a technological improvement or an expansion of the capacity of an existing facility. In the latter case, the company already has some technological expertise. This reduces many risks.

Or it can be a new installation. In this case, the private company involved may or may not already have experience in this energy activity, or even be outside its main line of business. The risk situations are greater in the latter case, which can occur with independent power producers or self-power producers with delivery to the grid.

3. The selection of the demonstration case of the technical-economic viability of the use of

biomass for energy purposes should minimize the risks assumed by the project.

This means that the selection of the demonstration case among the available options must be based on the detailed consideration of a set of aspects including not only technical and economic risks. For example:

- the existence of an appropriate minimum regulatory framework to ensure the commercial exploitation of the facility
- The availability of a minimum set of information, regulations, experiences, and tools allows establishing a sustainable biomass supply chain in the specific conditions of the project in question.
- The possibility of designing a technological solution that includes both the supply of biomass and its energy use demonstrates technical-economic viability and a level of risks acceptable to the private investor.
- The existence of the technical and managerial capacity to execute the complete investment cycle within the time frame available for these projects, a maximum of 4 or 5 years. In particular, identify commercial suppliers of proven technological solutions, carry out basic and detailed engineering studies that ensure minimizing technological errors, the constructive capacity to carry out the works in the chosen place in the required terms, legal actions for the purchase of land, supply contracts, price agreements, etc.

This type of project cannot afford the luxe of leaving the response to these elements to the project implementation stage. In that case, the odds that a complex situation could arise during project implementation are high. This could lead to weak project performance.

B. The project management unit must have in-house technical capacity to support the operational work.

The PMU of such complex projects constantly makes decisions that require technical considerations. The cycle of a consultancy is an example. The preparation of terms of reference, the selection of potential bidders and successful bidders, and the monitoring and evaluation of intermediate and final results are activities that require technical input.

The PMU's interaction with technical, business, academic or government counterparts to establish priorities, purposes and define tasks, while maintaining an appropriate balance between the interests of the project, as expressed in the committed objectives and results, and those of each of these counterparts, also requires significant technical capacity.

Finally, the interpretation and analysis of complex situations that arise during the project implementation period often require adequate technical capacity on the part of the PMU. In addition, this capacity is necessary to formulate appropriate recommendations to help improve project performance under such circumstances.

Options for assigning the necessary technical capacity to the PMU are the appointment of a member to fulfill this role or the hiring of external experts for this purpose. It is not sufficient to provide in the project document the option of hiring these experts. These experts must be hired at the right time and with specific tasks. Lack of this technical capacity can result, for example, in a slow decision-making process, in project management losing focus on project results, and in some stakeholders not committing to the project or taking ownership

of it as they should.

ANNEXES.

Annex 1. Terms of reference (UNIDO weblink).

https://www.unido.org/sites/default/files/files/2020-01/GFDOM-100288_TOR_TE-2019.pdf

Annex 2. List of documents reviewed.

Reports reviewed	
Title	**Author**
Disponibilidad de Biomasa para la Generación de Energía en la República Dominicana: Un Análisis Sobre de la Información Existente	Ing. Mamerto Valerio
Regulaciones e incentivos	Francisco Ortega
Evaluación de Emplazamientos y Estudio de Pre factibilidad para una Planta de Biomasa en República Dominicana (Estudio de Pre factibilidad para la instalación de una planta de biomasa que abastezca de energía a la Zona Franca Industrial de Santiago)	Union Gas Fenosa.
Estudio de factibilidad y diseño de la disposición de la planta para la expansión de una planta de cogeneración de energía térmica y eléctrica a partir de biomasa en la República Dominicana	Naturgy Energy Group, S. A
Estudio de pre factibilidad de plantas de cogeneración de energía térmica y eléctrica de biomasa de al menos 350 kW en molinos de arroz en la República Dominicana	Centro Nacional de Energías Renovables de España (CENER) y Managment Consulting Group (MCG)
Servicios de programación para la integración de estadísticas de biomasa e inclusión de nuevas funcionalidades.	Richard Mendoza
Creation of a Biomass Network for the Dominican Republic and technical support services	Ramses Bermudez
Reglamento de biomasa	La Cal, H Checo
Guía técnica sobre aprovechamiento sostenible de biomasa de origen forestal en república dominicana	José La Cal
Normativa para los auto productores de electricidad a través residuos de biomasa y subproductos de biocombustibles	CORPOEMA
Producción actual y potencial de biomasa en República Dominicana y su plan de aprovechamiento para la generación de energía	Proyectos Estructuras AJ
Fiscalización de los procesos de Hibridación autorizados por la CNE	Xtudia. Software Constructors.
Resultados y mejoras de la ley 57 07	MULTICONSULT Y CIA. LTDA. ENERGÍA Y MEDIO AMBIENTE

Project documents and reports referred to:
1. Project document and annexes.
2. Medium Term Evaluation Report
3. Monitoring Reports
4. Project Steering Committee. Meeting minutes
5. Technical Operational Committee. Meeting Minutes
6. Progress Information Reports
7. Project Delivery Reports

Annex 3. List of persons interviewed.

List of interviewed people (online)	
Name	Organization
Milagros de Camps/ Rosa Otero/ Sarah Díaz de Defrank/ Ramón Díaz/ Eduardo Cipion	MENARE
Edward Veras/ Yeulis Rivas/ Francisco Gómez/ Ezequiel González y Jonas Ortiz	NEC
Alfonso Rodriguez/ Charlie de la Rosa/ Ernesto Acevedo	MEM
Miguel Lama	Director. CSFZ
Martin Rivas	Director. NFZ
Patricia Abreu Fernández	Ex Vice minister. MENARE
Luisa Fernández	Ex Director. NCFZE
Ebell de Castro	Staff member. CSFZ
Daniel Liranzo/ Angie Perez/Hector Santos	Staff members. NCFZE
José La Cal	International consultant.
Remi Rijs	Ex Project Technical Assistant
María Zubiaga	Ex National Project Coordinator
Mariano Chabert	Consultant

Annex 4. Project results framework

UNIDO / GEF Project:	Stimulating Industrial Competitiveness Through Biomass-based, Grid-connected Electricity Generation.
Applicable GEF Strategic Objective and Program:	CCM Objective 3 "Promote Investment in Renewable Energy Technologies"
Applicable GEF Expected Outcomes:	CCM-3 "Favorable Policy Framework Created for Renewable Energy (RE) Investments in Industrial and Commercial Applications"; "Investment in RE Technologies Increased"
Applicable GEF Outcome Indicators:	CCM-3 "RE Policy and Regulation in Place"; "Electricity and Heat Produced from Renewable Resources"

Objective / Output	**Indicator**	**Baseline**	**Targets (end of the project)**	**Means of verification**	**Assumptions**
Project Objective					
To promote the implementation of decentralized, biomass-based energy production in industrial free zones in the Dominican Republic to reduce GHG emissions, while contributing to their competitiveness.	CO2eq emissions	Lifetime tons of CO2eq emissions avoided (0)	Lifetime tons of CO2eq emissions avoided (244,800 tCO2eq)	GEF climate change mitigation tracking tool	(1) Project is implemented as planned; (2) Data to calculate CO2eq emission reductions is available
Component 1	**Policy Support for Decentralized, Biomass-based Energy Generation.**				
Outcome 1. The policy and regulatory environment conducive to decentralized, biomass-based power and heat generation has been strengthened.	Extent to which RE policies, regulations and strategies have been proposed.	No specific support for decentralized RE in place: level 1 GEF Tracking Tool.	Various policy measures and strategies have been proposed: level 3 GEF Tracking Tool.	Official publications; final evaluation.	1 Sustained government commitment to strengthen policy framework; (2) Demonstrated economic, social and environmental benefits of decentralized (biomass) power generation compared to baseline situation.

Objective / Output	Indicator	Baseline	Targets (end of the project)	Means of verification	Assumptions
Output 1.1 Regulation for decentralized biomass-based power generation (environmental impact, nuisance, and water use) has been reviewed, adjusted and streamlined.	**Draft regulation and / or guidelines for:** (a) Generating concession, (b) Environmental impact, (c) Nuisance, and (d) Water use.	No special regulation or guidelines on 4 issues are in place (0; 0; 0; 0).	Specific regulation or guidelines proposed on 4 issues (1; 1; 1; 1).	Project records; official publications.	1 Sustained government commitment to policy framework 2 Adequate coordination with MIMAREMA, Santiago Municipality and other relevant authorities.
Output 1.2 Proposals for financial incentives to stimulate decentralized, renewable energy technologies have been prepared and submitted to the Government for approval.	**Proposal for financial incentives for small biomass power plants**	Law 57-07 in place; not effective to stimulate small-decentralized biomass energy plants (0).	Proposal submitted (1).	Project records; official publications.	(1) Sustained government commitment to strengthen policy framework; (2) Economic benefits of decentralized RETs exist vs. baseline scenario and are acknowledged.
Output 1.3 Existing information sources on the biomass potential in the national territory have been validated and integrated.	**Biomass resource database**	Resource data fragmented and not validated; no database (0).	Updated database created (1).	Project records, field visits.	(1) Stakeholders are willing to share information and setup a national information point (database).
Output 1.4 Sustainable biomass sourcing strategies have been developed in coordination with rural development programs in the Santiago region.	**Sustainable sourcing strategies documented and endorsed by local stakeholders**	Initial business proposals by SFZC; some programs targeting forestry in place in the region (Plan Sierra).	Strategies supported by local stakeholders (1).	Project documentation; possible MoU's with local CSOs (including smallholder groups).	(1) Viable biomass sourcing schemes can be devised; (2) local CSOs, smallholders and other stakeholders are interested to consider biomass supply as a source of income generation and land management.

Objective / Output	Indicator	Baseline	Targets (end of the project)	Means of verification	Assumptions
Component 2 Demonstration of Proven Biomass Technology for Electricity Generation.					
Outcome 2. A biomass-based electric power plant (envisaged capacity 3 MW) has been adopted by the Santiago Industrial Free Zone.	Installed capacity (MW); amount invested (US$).	(0 MW; US$ 0).	(3 MW33; US$ 6.5 million).	Project records, field visits; final evaluation.	1 Project designs are technically, social, environmentally and economically feasible; Project financed by project developer; (3) Equipment providers and contract stakeholders deliver promptly.
Output 2.1 A detailed feasibility study for the development of an envisaged 3 MW decentralized, biomass-based electricity plant at the Santiago Free Zone has been carried out.	**Feasibility study.**	No full study (0).	Feasibility study completed (1).	Project documentation; appraisals by counterparts.	(1) Prefeasibility studies are positive; (2) Positive decision by SFZC and other stakeholders to start the biomass project.
Output 2.2 Supportive studies and technical designs have been prepared, and permits and concessions obtained.	**Supportive studies; permits and concessions.**	No studies (0); no permits and concessions (0).	Studies completed (1); all permits and concessions obtained (1).	Project documentation; appraisals by counterparts.	(1) Input data for technical studies all available; (2) Adequate site selected and acquired; (3) Adequate access to water use, water discharge, and road infrastructure.
Output 2.3 Staff from Santiago and other industrial free zones have received training on technical and managerial aspects of small-scale biomass plants	**Trained people (number of persons).**	No persons specifically trained (0).	Male staff (10) and female staff (10) trained (1).	Project documentation; appraisal by counterparts and beneficiaries.	(1) Demonstration plant (Output 2.4) in place; Key personnel has been assigned by the project operator (SFZC);
Output 2.4 The envisaged 3 MW biomass-based electric power plant has been procured and made operational under an appropriate business model.	Business model for: (a) Power plant; (b) Biomass sourcing; Biomass power plant.	No conceptual models in place (0; 0); No power plant (0).	Business models detailed and implemented (1; 1); Power plant operational (1).	Field visits; plant commissioning reports; bill of lading; appraisals by	(1) Final project designs are technically, social, environmentally and economically feasible (Outputs 2.1 and 2.2 in place); (2) Project can be financed by project developer; (3) Equipment providers and contract

Objective / Output	Indicator	Baseline	Targets (end of the project)	Means of verification	Assumptions
				counterparts, final evaluation.	stakeholders deliver promptly.
Component 3 Supportive Activities for Training, Promotion and Dissemination.					
Outcome 3. Awareness for the concept and benefits of biomass power generation has been raised among relevant stakeholders.	Number of people that have been engaged with the concept and benefits of biomass power generation.	No people engaged with (0).	Women (50) and men (50) engaged with (1).	Project documentation, publications and proceedings.	(1) Demonstration plant procured and operational; (2) Sustained interest in biomass generation by industrial free zones.
Output 3.1 A communication plan has been prepared to interact with civil society organizations and the public in Santiago.	**Communication plan.**	No communication plan (0).	Communication plan (1).	Project documentation, publications; meeting minutes with CSOs.	(1) SFZC and CZNFE are committed to engage with local stakeholders; (2) CSOs are willing to interact with the Project.
Output 3.2 Operational experience and best practices from the Santiago demonstration plant have been compiled.	**Best practices, especially with respect to environmental and financial performance.**	Only experience with biomass-based steam generation (0).	Best practices compiled (1).	Project documentation and publications.	(1) Demonstration plant procured and operational (Outputs 2.1-2.4 completed).
Output 3.3 Promotional activities including technical seminars, dissemination events, and drafting of technical manuals and guidelines, have been carried out.	**Promotional activities; Manuals and guidelines.**	No promotional activities (0); No manuals and guidelines (0).	Promotional activities implemented (1); Manuals and guidelines compiled (1).	Publications, seminar proceedings; Technical reports.	(1) Demonstration plant procured and operational; (2) Sustained interest in biomass generation by industrial free zones.