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IMPLEMENTATION COMPLETION AND RESULTS REPORT

ON A LOAN (7652-MX)

IN THE AMOUNT OF US$50 MILLION

AND

GRANT FROM THE GLOBAL ENVIRONMENT FACILITY (TF93134)

IN THE AMOUNT OF US$10.5 MILLION

AND

AN ADDITIONAL FINANCING LOAN (8216-MX)

IN THE AMOUNT OF US$50 MILLION

TO THE

UNITED MEXICAN STATES

FOR THE

MEXICO SUSTAINABLE RURAL DEVELOPMENT PROJECT

December 14, 2018

Agriculture Global Practice

Latin America and Caribbean Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective June 29, 2018)

Currency Unit	=	US Dollar
MXN 19.655	=	USD 1.00
US$ 0.051	=	MXN 1.00

FISCAL YEAR
July 1 – June 30

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ABBREVIATIONS AND ACRONYMS

AF	Additional Financing
BCR	Borrower Completion Report
BP	Business Plan
CC	Climate Change
CDM	Clean Development Mechanism
CFE	Federal Electricity Commission
CPS	Country Partnership Strategy
EE	Energy Efficiency
E-IRR	Economic Internal Rate of Return
FIRA	Agricultural Shared Risk Trust
FIRCO	Shared Risk Trust
FND	Rural Financial Development Agency
FOMAGRO	Shared Risk Fund for Agribusiness Development
FOTEASE	Fund for Energy Transition
GEF	Global Environment Facility
GEO	Global Environmental Objective
GHG	Greenhouse Gas
GIZ	German Society for International Cooperation
GoM	Government of Mexico
IBRD	International Bank for Reconstruction and Development
ICR	Implementation Completion and Results Report
MIS	Management Information System
M&E	Monitoring and Evaluation
MOP	Manual of Operations
MTR	Mid-term Review
NAFIN	National Financial Agent
NPV	Net Present Value
OR	Operating Rules
PAD	Project Appraisal Document
PDRS	Sustainable Rural Development Project
PDO	Project Development Objective
PECC	President's Special Program for Climate Change
PERA	Renewable Energy for Agriculture Project
RE	Renewable Energy
RF	Results Framework
SAGARPA	Ministry of Agriculture, Livestock and Fisheries
SEMARNAT	Ministry of Environment and Natural Resources
SENER	Ministry of Energy
SHCP	Ministry of Finance and Public Credit
SP	Special Program
TA	Technical Assistance
TIF	Federally Inspected Type Plants
UNFCCC	United Nations Framework Convention on Climate Change
USD	US Dollar

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DATA SHEET

BASIC INFORMATION

Product Information

Project ID	Project Name
P106261	MX Sustainable Rural Development
Country	**Financing Instrument**
Mexico	Investment Project Financing
Original EA Category	**Revised EA Category**
Partial Assessment (B)	Partial Assessment (B)

Related Projects

Relationship	Project	Approval	Product Line
Supplement	P108766-Sustainable Rural Development	24-Feb-2009	Global Environment Project
Additional Financing	P130623-Sustainable Rural Development Additional Financing	20-Nov-2012	IBRD/IDA

Organizations

Borrower	Implementing Agency
Government of Mexico, Secretaria de Hacienda y Credito Publico, Unidad de Asuntos Internacionales	Fideicomiso de Riesgo Compartido (FIRCO)

Project Development Objective (PDO)

Original PDO

The project development objective is to promote the adoption of environmentally sustainable technologies in agri-businesses.

FINANCING

	Original Amount (US$)	Revised Amount (US$)	Actual Disbursed (US$)
World Bank Financing			
P106261 IBRD-76520	50,000,000	46,800,513	46,800,513
P106261 IBRD-82160	50,000,000	40,000,000	32,251,246
P108766 TF-93134	10,500,000	10,500,000	9,264,007
Total	**110,500,000**	**97,300,513**	**88,315,766**
Non-World Bank Financing			
Borrower	27,740,000	54,760,000	54,760,000
Local Communities	80,110,000	215,140,000	215,140,000
Total	**107,850,000**	**269,900,000**	**269,900,000**
Total Project Cost	**218,350,000**	**367,200,513**	**358,215,766**

KEY DATES

Project	Approval	Effectiveness	MTR Review	Original Closing	Actual Closing
P106261	24-Feb-2009	29-Jan-2010	11-Jun-2012	31-Dec-2013	29-Jun-2018
P108766	24-Feb-2009	08-Feb-2010	11-Jun-2012	31-Dec-2013	29-Jun-2018

RESTRUCTURING AND/OR ADDITIONAL FINANCING

Date(s)	Amount Disbursed (US$M)	Key Revisions
20-Nov-2012	25.31	Additional Financing Change in Results Framework Change in Loan Closing Date(s) Reallocation between Disbursement Categories Other Change(s)
01-Apr-2015	52.23	Change in Procurement
01-Dec-2016	72.36	Change in Loan Closing Date(s)
02-Mar-2018	77.64	Cancellation of Financing Reallocation between Disbursement Categories

KEY RATINGS

Outcome	Bank Performance	M&E Quality
Satisfactory	Moderately Satisfactory	Modest

RATINGS OF PROJECT PERFORMANCE IN ISRs

No.	Date ISR Archived	DO Rating	IP Rating	Actual Disbursements (US$M)
01	17-Apr-2009	Satisfactory	Satisfactory	.50
02	26-Oct-2009	Satisfactory	Satisfactory	.50
03	11-Feb-2010	Satisfactory	Satisfactory	.50
04	30-Jun-2010	Satisfactory	Moderately Unsatisfactory	.50
05	09-Jan-2011	Satisfactory	Moderately Unsatisfactory	.50
06	29-Jun-2011	Satisfactory	Moderately Satisfactory	5.89
07	28-Dec-2011	Satisfactory	Moderately Satisfactory	12.66
08	01-Jul-2012	Satisfactory	Satisfactory	25.81
09	28-Dec-2012	Satisfactory	Satisfactory	30.54
10	22-Jun-2013	Moderately Satisfactory	Moderately Satisfactory	37.45
11	07-Jan-2014	Satisfactory	Moderately Satisfactory	37.45
12	09-Aug-2014	Moderately Satisfactory	Moderately Satisfactory	47.18
13	11-Feb-2015	Moderately Satisfactory	Moderately Satisfactory	52.73
14	15-Sep-2015	Moderately Satisfactory	Moderately Unsatisfactory	57.15
15	04-Apr-2016	Moderately Satisfactory	Moderately Unsatisfactory	64.48
16	25-Oct-2016	Moderately Satisfactory	Moderately Satisfactory	72.87
17	08-May-2017	Moderately Satisfactory	Moderately Satisfactory	74.73
18	06-Jul-2017	Moderately Satisfactory	Moderately Satisfactory	75.23
19	27-Dec-2017	Moderately Satisfactory	Moderately Satisfactory	76.91
20	28-Jun-2018	Moderately Satisfactory	Moderately Satisfactory	78.79

SECTORS AND THEMES

Sectors

Major Sector/Sector	(%)
Agriculture, Fishing and Forestry	**26**
Fisheries	13
Livestock	13
Energy and Extractives	**25**
Other Energy and Extractives	25
Industry, Trade and Services	**49**
Agricultural markets, commercialization and agri-business	49

Themes

Major Theme/ Theme (Level 2)/ Theme (Level 3)	(%)
Urban and Rural Development	**0**
Rural Development	17
Land Administration and Management	17
Environment and Natural Resource Management	**0**
Climate change	50
Mitigation	50
Renewable Natural Resources Asset Management	34
Biodiversity	17
Landscape Management	17

ADM STAFF

Role	At Approval	At ICR
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I. PROJECT CONTEXT AND DEVELOPMENT OBJECTIVES

A. CONTEXT AT APPRAISAL

1. When the Mexico Sustainable Rural Development Project (SRDP) was appraised in 2008, agriculture remained a comparatively weak sector of the economy despite 15 years of liberalizing reforms which had shifted the rural economy towards markets and the private sector, and five years of balanced, broad-based economic expansion marked by a dramatic increase in exports. Around 25.5 million people (24.3% of total population) still lived in rural areas. The Government of Mexico (GoM) recognized the need to diversify agricultural production to meet the requirements of more integrated and competitive global markets where productivity, reduced costs and high-quality standards were paramount. Studies acknowledged for example, the Mexican livestock sector's contribution to environmental contamination and global warming: the cattle industry alone represented 13.4% of Mexico's greenhouse gas (GHG) emissions in 2007.

2. Competitiveness, the sustainability of agriculture and agri-business in the context of Climate Change (CC) mitigation and energy efficiency had become core tenets of Mexico's national development priorities. Mexico aspired to lead the developing world on renewable energy and climate change and was the first emerging economy to submit its Climate Change commitment to the United Nations Framework Convention on Climate Change (UNFCCC). From 2008 on, changes were made in the regulatory framework and norms governing support for renewable energy (RE) and energy efficiency (EE) but constraints were evident including the lack of domestic technologies or suppliers to meet the demand stimulated, or the technical experience, expertise and capacity to support agribusinesses seeking to adopt these innovations.

3. Government passed laws mandating support for solar and other RE sources and promoted technical and financial incentives to improve productivity, market access, and the development of RE sources and EE practices. In this effort, the Fideicomiso de Riesgo Compartido (Shared Risk Trust, FIRCO), a decentralized unit of the Ministry of Agriculture, Livestock and Fisheries (SAGARPA), played an increasingly prominent role in rural areas. Government's mechanisms and incentives had been tested in the Bank-supported PERA pilot project[1] which supported government's compliance with its Kyoto Protocol commitments and implementation of its CC policies/programs. PERA's success prompted further Bank/GEF financing to boost the environmental sustainability and increased EE of small and medium-scale agri-businesses, and to address climate change in agriculture.

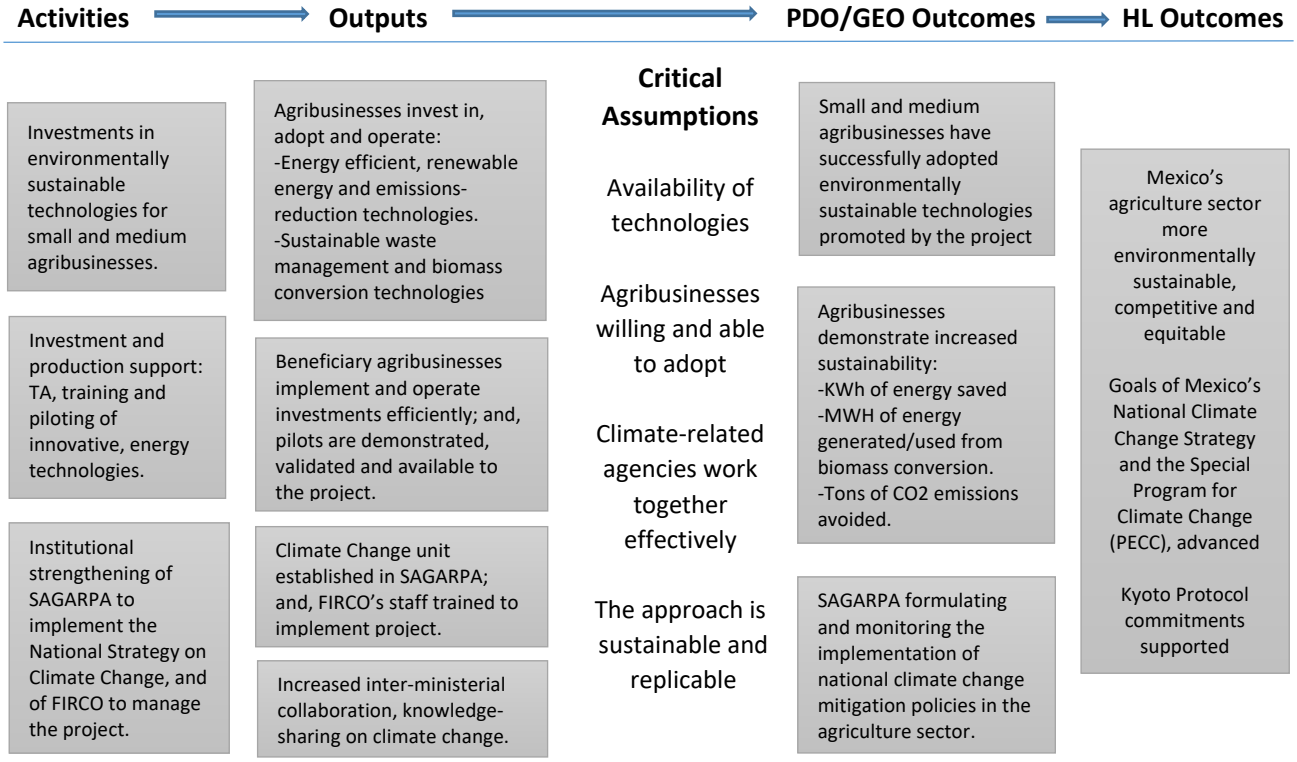
4. Rationale for Bank support: The Bank's ability to crowd in global expertise on the topic, direct experience in Mexico and long-term dialogue with the GoM and stakeholders on CC adaptation, policy-making and mitigation, justified its support for this operation. Direct experience included 25 diverse, climate change-related projects financed by Bank loans, GEF grants, carbon finance agreements, grants for carbon finance capacity-building and for economic and sector work. The US$501.25 million Climate Change Development Policy (Project Appraisal Document (PAD), Section A2), and the PERA pilot, were crucial interventions. The Bank's technical knowledge, and access to complementary financing such as GEF grants to promote global environmental sustainability, further boosted the rationale for supporting this project. The project pioneered RE and EE investment in the Mexican agricultural sector.

5. Higher-level objectives: The project responded directly to the country's higher-level objectives anchored in the

[1] SAGARPA/FIRCO implemented the pilot US$21.7 million Renewable Energy for Agriculture Project (PERA) from 2000-2006, supported by a Global Environment Facility (GEF) grant of US$8.9 million. Key technical knowledge and lessons were captured.

Country Partnership Strategy (CPS) FY2008-2013 (No. 42846-MX), including: a more Sustainable and Equitable Mexico, reducing economic and environmental limitations on small and medium-scale producers; and; a more Competitive Mexico, fostering value-added and energy efficient practices. It also aligned with the Mexican National Development Plan (NDP) 2007-2012 through its "economic competitiveness" and "environmental sustainability" pillars; and, helped SAGARPA prepare/implement the agriculture sector's action plan under the Mexican President's Special Program for Climate Change (PECC). The National Agricultural Sector Program (2007-2012) defined climate change as a strategic national and international issue demanding immediate attention. The project addressed the GoM's established activities for climate change mitigation through its "capture and use of methane for productive purposes and to reduce overall GHG emissions". The project – an IBRD-GEF blend - was consistent with GEF Climate Change Focal Areas, specifically GEF-4 SP2 "Promoting Energy Efficiency in the Industrial Sector", and SP4 "Promoting Sustainable Energy Production from Biomass".

Theory of Change (Results Chain)



Project Development Objective and Global Environment Objective (PDO/GEO)

6. The Project Development Objective (PDO) was "to promote the adoption of environmentally sustainable technologies in agri-businesses[2]".

7. The Global Environment Objective was "to contribute to the goals of the National Strategy on Climate Change

[2] Technologies: bio-digesters, solar panels, solar thermal for water heating, turbines, solar water pumps, motor-generators and energy efficiency works (like solar chillers for milk.)

by reducing GHG (CO2) emission through the adoption of emission-reduction technologies and support to the implementation of the President's Special Program for Climate Change (PECC), with special reference to the improved environmental sustainability of small and medium-scale agri-business".

Key Expected Outcomes and Outcome Indicators

8. The Outcome Indicators (PAD) were: (i) Increased number of small and medium-sized agri-businesses adopting environmentally sustainable technologies (RE sources, EE technologies and/or sustainable waste management and biomass conversion); (ii) Tons of CO2 equivalent avoided through project activities; and, (iii) SAGARPA successfully formulating climate change mitigation and adaptation policies in the agricultural sector and monitoring their implementation. Project objectives were expected to be achieved through demonstration models subsequently disseminated and expanded throughout Mexico.

9. Targeted beneficiaries: The project was not a poverty reduction operation, but a vehicle for climate-smart technology adoption. The project was of national scope, but more investments were expected in states with a higher concentration of agricultural activity. Targeted adopters would be agri-businesses operating within agricultural production chains - mainly fruits, vegetables and intensive livestock (dairy, beef or pork) - and required some scale and assets. Agribusiness' incomes would be improved by reducing production costs and improving competitiveness: social impacts would be monitored as "good social practices in agri-business". The PAD specified support to small and medium agri-businesses but did not define their characteristics. The Operational Manual subsequently defined agribusiness size by applying Ministry of Economy (ME) parameters, based mainly on number of permanent employees. [3] See Table 1.

Table 1: Size of Agribusiness by Number of Employees

Size	Number of Employees
Micro Agribusiness	0-10
Small Agribusiness	11-50
Medium Agribusiness	51-250
Large Agribusiness	Over 250

Components

10. Component 1: Investments in Environmentally Sustainable Technologies in Agri-businesses (estimated total cost US$151.04 million of which Bank US$46.58 m (31%), GEF US$4.79 m (3%), Borrower US$24.20 m (16%) and Beneficiaries US$75.47 m (50%)). FIRCO matching grants would subsidize up to 50% of total investment cost not to exceed US$200,000. Sub-components: (i) enterprise modernization via energy consumption efficiency and/or use of RE, benefiting 929 agribusinesses; (ii) RE subprojects (solar thermal and photovoltaic systems, on-grid); (iii) EE subprojects; and, (iv) energy production from biomass: sustainable waste management, and biomass conversion for energy usage through bio-digesters, with/without motor-generators. GEF resources would also be used in the matching grant facility and sought the removal of technological barriers to energy efficiency.

[3] Source: *Ley de Competitividad de la Micro, Pequena y Mediana Empresa: Secretaria de Economia*, 2002. SAGARPA classifications covered agricultural producers and could not be generalized across types of farming activities. The ME option applied across sectors, was explicitly agribusiness-related and was aligned with classifications used by the National Institute of Statistics and Informatics (INEGI).

11. Component 2: Investment and Production Support Services (estimated total cost US$10.91 million of which Bank US$3.30 m (30%), GEF US$ 1.73 m (16%), Borrower (US$1.28 m (12%) and Beneficiaries US$4.60 m (42%). Sub-components: (i) partial reimbursement of Business Plan (BP) preparation costs including energy diagnostics; (ii) technical assistance (TA) for BP implementation, and training to integrate promoted technologies on farms/agri-businesses; (iii) four pilots to demonstrate/validate environmentally sustainable and innovative technologies which the project could promote under Component 1 or replicate post-project; and, (iv) mid-term and final knowledge-sharing assessments of systems (technical, environmental and social).

12. Component 3: Institutional Strengthening (estimated total cost US$3.59 million of which Borrower US$0.66 m (18%) and GEF US$2.93 m (82%). Sub-components: (i) institutional strengthening of SAGARPA including policy development assistance to address climate change and the environmental impact of sub-projects; (ii) implementation of climate change initiatives, TA and training to support implementation of the PECC and National Strategy on Climate Change; (iii) inter-ministerial workshops to promote climate change knowledge sharing and collaboration within the project; and, (iv) institutional strengthening of FIRCO's capacity - centrally and regionally - to promote the project to potential beneficiaries, implement the project, and coordinate/execute carbon credit programs.

13. Component 4: Project Management, Monitoring and Evaluation (estimated total cost US$2.45 million of which GEF US$0.95 m (39%) and Borrower US$1.5 m (61%)) would finance: (i) project management activities within FIRCO; and (ii) development and operation of a project monitoring and evaluation (M&E) system.

B. SIGNIFICANT CHANGES DURING IMPLEMENTATION

Revised PDOs and Outcome Targets

14. The PDO was not revised either under the original project or the Additional Financing (AF, discussed below). Outcome targets were adjusted to account for the three years of the AF. Notably (see also Section IVA), AF-specific targets for the PDO Indicators and Component 1 Intermediate Results Indicators were higher in most cases than the original project, even though the loan amount was the same and the engagement period shorter. This is because key foundational systems were already established or evolving, including proven technologies, installed hardware, markets for appliances and expertise, institutional capacity and experience with the incentive mechanism. It was assumed the project could move ahead, processing more investments, faster.

Revised PDO Indicators

15. Neither the PDO nor GEO Indicators were revised, but one Intermediate Results Indicator was dropped by the AF: "Number of energy efficient and/or renewable energy subprojects prepared". It was considered redundant given other indicators, and SAGARPA required beneficiaries to prepare their own subprojects.

Revised Components

16. Components were not revised under the original project or the Additional Financing (see below).

Other Changes

17. Additional Financing (AF): An AF Loan of US$50.0 million for three years was approved on November 20, 2012, The AF funds were allocated 100% to scaling up Component 1 agribusiness investments to enhance the coverage and impact of a project rated Satisfactory for progress toward Development Objective and Implementation Progress. No changes were made to project objectives, components or essential design, but the emphasis shifted, and scope was expanded, as follows:

- **Intensive promotion of the project's more successful technologies** (bio-digesters, solar heating and photo-voltaic systems connected to the grid) to other productive chains and activities (post-harvest treatment of agricultural products, new applications for bio-digesters, solar-heated climate control in greenhouses) and greater focus on motor-generators for biogas use;
- **Promotion of alternative uses for biomass and solar energy** (solar parks, clustering of producers/processors, alliances with food processors to disseminate energy efficiency practices, and studies/ pilot activities); and,
- **Shifting the model from one relying on demonstration effects to dissemination:** Under the AF, technologies proven under the original credit were scaled down to include smaller producers.

18. Complementary modifications to the original project: (i) a three-year extension of the GEF closing date (from December 31, 2013 to December 31, 2016) for consistency and to support the implementation of the AF[4]; (ii) revised final targets for PDO Results Indicators to reflect the impacts of scaling-up; and, (iii) reallocation of funds from disbursement Category 1 to Category 2 given high demand for agri-business sub-projects at the time and the need to channel resources into those investments.

19. Changes in the subsidy element: Due to economies of scale for energy efficient technologies – demonstrated by a Bank study in 2014 which analyzed markets (costs and suppliers of technology) for four project-financed technologies - [5] as well as new Operational Rules introduced in 2013 which changed the subsidy eligibility ceiling for SAGARPA's Special Programs, the subsidy limit (matching grant) was increased.[6] The Bank provided No Objection in 2016 to align the project subsidy eligibility ceiling with those programs, increasing it from US$200,000 per investment to US$1,000,000.

20. UN Clean Development Mechanism: The PAD outlined a scheme in Component 1(b) (Sustainable waste management and potential biomass conversion with use as energy) for linking small and medium-sized dairy and pig agribusinesses to the UN Clean Development Mechanism (CDM) to sell Emission Reduction Carbon Credits. The CDM was attractive at the peak of the carbon market in 2008 (the year of project appraisal) when prices reached US$36 per ton, but lost relevance due to: (i) its cumbersome access requirements; (ii) complex monitoring, reporting and verification accounting for mitigation impact; and, (iii) sharp decline in the carbon price to around 28 cents by 2011. Lack of access to the CDM had no influence on project investments or technology uptake. The GoM retained Climate Change as a key piece of its agenda and refocused dialogue on meeting international agreements (e.g., commitments under the UNFCCC and the 2016 Paris Agreement.)

21. Restructuring: The project underwent three Level 2 restructurings, the rationale for which is explained below.

[4] The project's operational costs were wholly paid from GEF resources and thus loan extension needed extension of the GEF.
[5] *Estudio de Mercado de Equipos y Proveedores de Energias Renovables en el Sector Agropecuario en Mexico,* World Bank, July 2014. The study examined the cost structure, price variation, technical specifications and market options for photo-voltaic systems, bio-digesters, solar heating systems and motor-generators to support the project's technical and procurement decisions including the rationale for introducing "Commercial Practices" procurement modality, and for increasing the subsidy eligibility ceiling from US$200,000 to US$1.0 M.
[6] The PAD mentioned but did not define, SAGARPA's Special Programs. The term was used in FIRCO's operational manual. FIRCO would use resources from "joint agreements under the scheme of the Special Programs of SAGARPA", interpreted to mean that all SAGARPA or SENER programs from which FIRCO obtained operating resources were Special Programs.

- **April 1, 2015:** Amended the AF Loan Agreement to specify "Commercial Practices" as an acceptable procurement method for "goods, works and non-consulting services" and "consulting services";[7]
- **December 1, 2016:** Extended the closing date of the Additional Financing and the GEF Grant by 18 months from December 31, 2016 to June 29, 2018;[8] and,
- **March 5, 2018:** Cancelled US$10.0 million of AF Loan funds.

Rationale for Changes and their Implication for the Original Theory of Change

22. The rationale for the main changes, none of which affected the Theory of Change, was as follows:

- **Expanded opportunity:** The AF broadened the project scope in alignment with the existing PDO and components and with the proven model, enabling FIRCO to focus intensively on the growing demand for subproject investments.
- **Alignment with market realities:** This project exemplified the World Bank's need to adopt "Commercial Practices" as a procurement method. It reflected the market context/reality for RE and EE technologies in Mexico and their procurement by many agri-businesses whose financial contribution exceeded government's. See Section IV B.
- **Extension was essential:** The 18-month extension of the AF Loan was prompted by budget shortages under government's fiscal austerity and the Peso's declining value, not institutional or operational capacity issues. The extension bought time for the project to respond to demand, considering the pipeline of interested agri-businesses. Further extension of the GEF Grant was required because grant resources were financing the project management team, while infrastructure investments were covered by the loan.
- **Impact of budget constraints and decision to cancel:** As of November 2017, US$20 m remained undisbursed from the loan. SAGARPA earmarked US$10 m from its November 2017 budget allocation for FIRCO activities (mainly small-scale solar with short execution periods). Given that securing the additional US$10.0 million would be impossible in the six months remaining, FIRCO, in agreement with the National Financial Agent (NAFIN) and Ministry of Finance and Public Credit (SHCP), opted to cancel this amount. Subsequently, the earmarked US$10 m went to another unit within SAGARPA, and FIRCO was unable to execute even those. The World Bank team persuaded SAGARPA to reallocate these resources to FIRCO, but it was too late to execute them. [9] After the project closed, FIRCO used these national resources to continue investments, supporting over 100 additional sub-projects, most of which were still under completion at ICR delivery and could not be counted.

II. OUTCOME

A. RELEVANCE OF PDOs

Assessment of Relevance of PDOs and Rating

[7] Bank Procurement Regulations on "Commercial Practices" (para 6.46) state: "Commercial Practices refers to the use of well-established procurement arrangements used by the private sector (normally entities not subject to the Borrower's public procurement law) for the procurement of Goods, Works and Non-Consulting Services. Commercial Practices may also be used for a program of imports undertaken by private sector entities. The Bank's Core Procurement Principles are the standard for determining the acceptability of Commercial Practices".
[8] First extension for the Loan and second for the GEF Grant. Cumulative extensions were 4.5 years, needing the Regional Vice-President's approval.
[9] The BCR (FIRCO 2018) states that this reduced achievement for PDO Indicator "Number of agribusinesses which have adopted environmentally sustainable technologies" and the Intermediate Outcome Indicator "MWh produced by biomass subprojects"

23. The project PDO maintained **High** relevance to Bank CPS objectives and Mexico's key economic and sector strategies, throughout execution. While some adaptive changes occurred - especially under the AF - in how the project was implemented and the scope of planned technology investments, these did not affect PDO relevance. This rating is justified as follows:

- **The PDO remains consistent with the World Bank Group's Mexico Country Partnership Strategy** (CPS, 2014-2019, No. 80800-MX), especially its pillar "Unleashing Productivity" by increasing private sector innovation and upgrading infrastructure to decrease costs and promote competitiveness. It is also aligned with the CPS' "Green Growth" goal, reducing growth's footprint and using natural resources more optimally.
- **Government policies and strategies have consistently supported the original PDO**: The Mexican National Development Plan (2013-2018) focuses on national prosperity and productivity, inter alia, by investing in sustainable development and clean energy in the agriculture sector, focusing on small and medium-sized businesses. Mexico's current National Climate Change Strategy would reduce energy intensity through efficiency and responsible consumption, and seeks long-term growth through, inter alia, adoption of clean technologies. The 2015 Law for the Use of Renewable Energy and Energy Transition Financing sets maximum targets for fossil fuel generation[10], strengthening the enabling environment for RE. Policies to promote clean rural growth are also supported by Mexico's commitment to the Nationally Determined Contributions, and the National Climate Change Law which regulates/reduces GHG emissions across sectors.
- **Mexico is now a global leader in RE and EE in agriculture, using demand-driven, incentives-based investments.** High pent-up demand in rural Mexico based on effective and rapid dissemination of project successes, shows that agribusinesses believe that adopting these technologies promotes production cost savings and competitive benefits. Mexico now has significant experience investing in clean energy technology for agribusiness and FIRCO has visited many countries (including China, Uruguay, Uzbekistan, Haiti and Romania) to discuss/promote the project model. Staff of the US Department of Agriculture visited the project twice, interested in replicating the model in the US.

B. ACHIEVEMENT OF PDOs (EFFICACY)

Assessment of Achievement of Each Objective/Outcome

24. Project efficacy is rated **Substantial**. The project was innovative, demand-driven and national in scope, an important operation in the Bank's agriculture-energy nexus, and a global example. The project made a unique and attributable contribution to Mexican development through: (i) its direct contributions to the nation's GHG accounting (where public resources are used as an incentive for private investment in green technology); (ii) its role in the country's changing energy matrix (with agri-businesses transforming into energy supply units in rural areas); and, (iii) its influence in helping to develop a local market/suppliers of good quality energy technology equipment and infrastructure for agro-industrial use, along with national technical and advisory capacity. The project also had significant co-impacts which inter alia, positioned beneficiary agribusinesses to compete in national and international markets, and improved their environmental and productive sustainability.

25. The overriding objective was to promote behavior change within agribusinesses by demonstrating RE and EE technologies, disseminating the results through nationwide, multi-media campaigns, and providing financial incentives, TA and training to agribusinesses to foster adoption. The evidence of achievements rests on strong results for individual outcome indicators (aggregating the original and AF projects) while factoring in evidence

[10] These are: 65% fossil fuel generation by 2024, 60% by 2035 and 50% by 2050.

from studies of the co-impacts (including social) of project-financed technologies and other, directly-related outcomes. It does not include formal impact data or final evaluation findings, for reasons explained in Section IV.

PDO: "Promote the adoption of environmentally sustainable technologies in agri-businesses"

26. Objective Outcome 1: *Number of small and medium agribusinesses adopting environmentally sustainable technologies (renewable energy, energy efficient technologies, sustainable waste management or biomass conversion).*

- **1,842 agribusinesses (85% of target) adopted 2,286 technologies (105.4% of target).**[11] The project reached 200% of the original PAD target for numbers of beneficiary agribusinesses, at lower than expected cost. Two basic factors account for this result: careful targeting of the investments as determined by the Special Programs through which project funds were channeled and, effective demand from the agribusinesses community (BCR/FIRCO, 2018). Micro, small and medium agribusinesses represented respectively, 95% of subprojects and 92.5% of total investment financing. Large agribusinesses made up 5% and 7.5% of numbers and financing, respectively. (See Section II E and Annex 7, Diagram #1 showing technologies).
- **Previous beneficiaries and new proponents perceived the environmental and economic impacts of investing in and adopting an integrated bundle of technologies.** This largely accounts for the number of technologies (subprojects) financed exceeding the number of beneficiaries, reflecting: successful promotion, as agribusinesses were clearly willing to contribute up to 50% (and considerably more in specific cases) of subproject cost for each of several technologies; and, FIRCO's decision, based on studies and field evidence, to accept the economic rationale for intensifying investment beyond the equity of one enterprise, one investment, to increase impact and sustainability. Some 263 returning and new beneficiaries saw value in the integrated "packages" of performance and sustainability-enhancing technologies.[12]
- **FIRCO promoted the technologies and the benefits of adoption starting well before effectiveness.** The benefits – environmental and economic – of clean, efficient energy in the sector, project objectives, the incentives scheme and the types of technologies available, were widely disseminated.[13] Promotion followed two streams: (i) demonstration days on the production units of large and medium-sized beneficiary agribusinesses where candidates could inspect the technologies in operation and discuss their features with owners and FIRCO technicians; and, (ii) FIRCO's dissemination campaigns via print, audio-visual and direct encounters with the agribusiness sector, federal and state agencies, academia and research institutions, as well as through the project website: <www.proyectodeenergiarenovable.com>.

27. Objective Outcome 2: *Tons of CO2 equivalent reduced.*

28. This indicator is linked directly to the GEF GEO and far exceeded its target.

- **GHG emissions of CO2e were reduced by 6.02 million tons (303% of target) over the course of the project.** When the project was prepared (2007/08), there was no clear idea of how to design and measure the proposed

[11] An additional 101 subprojects (representing several technologies) were approved before closing, still under execution and not counted here. Of these, 27 % are more than 50% complete and are financed with FIRCO's own funds.

[12] Technical studies showed the need to integrate several investments to maximize outcomes. A "typical" integrated package under the AF included a bio-digester, motor-generator and grid connection works.

[13] In its publication "*Prospectiva de Energias Renovables 2015-2029*" the Ministry of Energy (SENER) estimated - in regard to the work of SAGARPA/FIRCO in RE – that in 2014, FIRCO investments in photovoltaic energy enabled the following: installation of 14.2% of total installed capacity in Mexico (17 of 120 MW) and 19.4% of energy generated nationally (20 of 103 GWh); and, FIRCO's support for biogas use in cogeneration represented 24.0% of capacity installed (12 of 50 MW) and generated 25.2% of national energy production (38 of 151 GWh).

innovative elements, most notably CO2e reductions for individual technologies. This was especially so for bio-digestion systems (which delivered the largest emissions reductions). Estimates/targets were simple with little understanding for example, of the cumulative impact of reductions over time as additional technologies were financed and came on line.

- **FIRCO, SENER, SEMARNAT and the Bank collaborated on parameters to calculate GHG emissions**, resulting in a document "Methodology for the Quantification of Impacts", utilized from 2014 on to calculate CO2e reductions, cross-referencing "Guidelines for National GHG Inventories" of the Inter-Governmental Panel on Climate Change. Re-calculation of emissions reductions based on these sources resulted in numbers significantly higher than those in the PAD Results Framework.[14]
- **FIRCO pioneered RE in the sector and accurate measurement of CO2 emissions by technology**, as a direct result of its collaboration with the Bank under this project. The FIRCO program was the only government program keeping actual, accurate CO2e measurements from the field, results which were updated every six months and reported to the SAGARPA CC Directorate (see next PDO Indicator). See also Annex 7, Section B for basic methodology used in the field from 2014 on, to calculate CO2 emissions reductions by technology.

29. **Objective Outcome 3:** *SAGARPA is successfully formulating climate change mitigation and adaptation policies and programs in the agricultural sector and monitoring their implementation.*

- **Fully-achieved:** SAGARPA established, as required by the project, a General Directorate for Addressing Climate Change in the Agro-Livestock Sector, and in collaboration with SENER and SEMARNAT, became the key sector player in formulating, promoting and monitoring climate mitigation and adaptation instruments and measurements.
- **Each subsector represented in the Directorate has its own programs aligned with national CC strategies.** The Directorate: (i) monitors climate-related agricultural risk in the cattle and cropping industries; (ii) establishes cross-sector synergies on CC; (ii) reports GHG emission reductions resulting from SAGARPA's programs (as measured by FIRCO) to SEMARNAT (national lead on climate mitigation policies and programs) and SENER; (iii) represents the sector at national and international climate forums; and, (iv) shares oversight of key, climate-related programs under SAGARPA which demonstrate strong mitigation contributions.
- **SAGARPA, influenced by the Bank/FIRCO dialogue on RE, created the *Bioeconomia* Program which injected 1.0 M Pesos into SENER's Energy Transition Fund (FOTEASE)** to finance/influence agricultural RE initiatives on a multi-year basis, while fostering inter-agency RE coordination.[15] Some 50% of this allocation was operationalized through FIRCO from 2010-2018 for project RE activities.
- **SAGARPA influenced policy-making and execution,** e.g., through FIRCO's capacity-building seminars for development banks including the Agricultural Shared Risk Trust (FIRA) and the Mexican Rural Financial Development Agency (FND) following which, both institutions markedly increased investments in agricultural RE programs and projects.

30. Other strong results (Intermediate Outcomes):
Number of KWh of energy saved from adoption of energy efficient technologies and corresponding tons of avoided CO2e emissions.

- **382.14 million KWh of energy were saved (124.0% of target)** from the application of energy use efficiency practices through 495 Loan-financed subprojects and another 205 GEF-financed investments; and,

[14] Up till 2014, the project measured CO2e only for the year of technology installation. From 2014 on, the project measured cumulative CO2e, from the year of installation and adding each subsequent year of reduction up to the reporting period. See Annex 7.
[15] Government ministries can allocate resources to FOTEASE, earmarking them for use over time, independent of the annual budget.

- **205,721 Tons of CO2e emissions were avoided (270.0% of target)**, stemming from reduced direct consumption of fossil fuels and lower demand for electricity whose generation in Mexico is primarily fossil-fuel based. See Table 2, Annex 7.

Number of MWh of energy produced by biomass and corresponding tons of CO2e emissions avoided.

- **221,624 MWh of energy were produced from biomass (98.5% of target).** Accelerated deterioration of the motor-generators caused by quality/supplier issues reduced profitability of using biomass for electricity generation, and hence agribusiness' interest in co-generation activities faded. A 2014 Bank study of markets and providers of bio-digesters and motor-generators,[16] a GEF-financed project pilot on biogas filtration (a key factor in motor-generator operation), and FIRCO's decision to permit investment in integrated packages of technologies (most commonly an improved motor-generator with bio-digester and grid connection equipment), reinvigorated interest in biomass use and demand for bio-digesters.
- **5.78 million Tons of CO2e emissions were avoided (377.8% of target)**, importantly due to the surge in bio-digester investments with upgraded motor-generator and associated equipment and a more accurate CO2 accounting methodology.

Other supporting achievements:

31. Competitiveness: Agribusiness competitiveness – actual and potential – was improved by the following: [17]

- **Beneficiaries of 738 photovoltaic systems and 419 bio-digesters were well-positioned to increase the economic viability of their technology and enterprise under the new 2015 Law of Energy Transition.** Private power producers (including project agribusinesses) can optimize energy costs by selling their excess energy production into the grid (not just exchange it for energy credits towards their energy bill, as before).
- **Savings accrued from reduced use of fossil fuels and from the generation of electricity via motor-generators**. Estimated reductions, above all in energy use, ranged from 10% to 40% for solar heating systems, and 30% to 60% for bio-digestion systems with motor-generator. Other savings included using effluents from bio-digesters for irrigation and the sludge for organic fertilizer. Potential gains include reinvestment of those savings to generate incremental income, and reduced energy expenses for pumping water for agricultural purposes. See Annex 7, Table 2.
- **Scaling-up of systems multiplied agribusinesses in contact with these cost-saving technologies.** The number of direct experiences rose, and skepticism was reduced; use of efficient and simple to use equipment for productive processes increased; and, project technologies were introduced in isolated rural areas.
- **Development of a solar market:** Prior to the project the solar market in Mexico was nascent. Through demonstration effects and beneficiary demand, the growth of a domestic market for EE and RE technologies was accelerated and prices, especially for solar panels, decreased.
- **Better processing of on-farm waste improved farm conditions.** Bio-digesters permitted the processing of manure and slaughterhouse waste, improving overall farm conditions and enabling the production of bio-fertilizers, an additional source of income for farmers.
- **Development of a suppliers register reduced infrastructure costs and promoted supplier development.** Technical guidelines by technology can be applied to any country with minor adaptations to meet local laws.
- **Development of a Commercial Practices guideline for Mexico,** a well-balanced application of a public tender process in private practice and, including a website and safeguards.

[16] *Estudio de Mercado de Equipos y Proveedores de Energias Renovables en el Sector Agropecuario en Mexico*, World Bank, 2014
[17] *Informacion para Evaluacion de Coimpactos Derivados del Proyecto de Desarollo Rural Sustentable-Mexico*, Kobeh, March 2012.

- **Of paramount importance - and best practice - the Bank's support enabled FIRCO to measure actual CO2 reductions in the field.** The GoM is now able to measure - by sub-sector and technology - emissions reductions, emissions avoided, fossil-fuel displacement and critical related variables. All are essential to promoting RE and EE adoption by the agribusiness sector, meeting international standards/agreements, and formulating climate change, energy and environmental policies using data-driven approaches.

C. EFFICIENCY

Assessment of Efficiency and Rating

32. The assessment of efficiency focused on: (i) a cost effectiveness assessment of project investments; (ii) an economic and financial analysis; (iii) the project's implementation efficiency; and, (iv) sustainability. Baseline information on key performance variables was available for the universe of subprojects (technologies) supported by the project. The baseline was supplemented with information from the project's Management Information System (MIS) as well as the Borrower Completion Report (BCR/FIRCO, 2018) and financial reports from the National Financial Agent (final report of NAFIN, October 2018). See Annex 4 for the full assessment.

33. Cost Efficiency Analysis. The project supported 2,286 subprojects, each corresponding to a specific technology. As expected, most technologies show economies of scale in terms of capacity (the largest capacities tend to show the highest energy savings and GHG emissions' reduction per dollar invested by the project). There are clear economies of scale for the unit cost of tons of CO2 equivalent avoided but this is less evident when considering unit cost of energy produced/saved. The solar thermal systems have lower costs for the smallest and largest capacities. In general, the lower unit cost corresponds to bio-digesters implemented on pig farms, cattle farms and TIF (Federally Inspected Type) plants, as well as heat recovery systems, high efficiency boilers and efficient water pumps. All have unit costs for tons of CO2 equivalent below US$20 dollars. Comparisons of cost efficiency confirm that the project operated within sector-specific norms.

34. Economic and Financial Analysis. The ex-ante cost-benefit analysis included a financial analysis of investment subproject models for selected technologies in the FOMAGRO Program (2002-2007) database, but it did not include economic analysis, alluding to the complexity of subsidies in the energy sector. [18] The omission of economic analysis is important given that the project's stream of benefits is substantially undervalued if it is estimated using market prices or omitting services that have no actual access to current markets. To measure the project's economic worth from society's perspective, an ex-post economic cost-benefit analysis was performed. The economic value of the net CO2 equivalent emissions reduced through the project's interventions is valued at shadow prices and included in the economic analysis based on the latest World Bank guidelines. Three scenarios have been estimated which include a Baseline as well as a 'Low price' and a 'High Price' valuation of the potential GHG net emissions' reduction, generated through project interventions. See Table 2 below.

Table 2: Economic Analysis

[18] FOMAGRO (*Fondo de Riesgo Compartido para el Fomento a los Agronegocios)* was government's first attempt to develop mechanisms to promote environmentally friendly technologies in rural areas, through private sector cost-sharing and use of RE (including from biomass).

Economic Analysis	E-IRR (%)	NPV (US$)	Switching value for costs	Swtiching value for revenues
Baseline	17%	95,946,570	31%	24%
Low price scenario	33%	274,134,051	88%	47%
High price scenario	65%	571,113,187	184%	65%

35. Sensitivity: The robustness of these results to changes in the projected costs and benefits streams was tested and confirmed through sensitivity analysis. For this, switching values with respect to cost increases and reductions of economic benefits were estimated. In the case of a 'Baseline' scenario, the switching value for cost increments was estimated at 31%, while that for reduction in benefits was approximately 24%. This means that the project would remain economically feasible (i.e., an attractive investment for society in general), even if project costs were to increase by as much 31% or projected benefits were to decrease by 24%.

36. Sustainability: An assessment of the sustainability of subprojects from a financial perspective is highly relevant, so financial cost benefit analysis was performed for the different categories of subprojects implemented. All subproject categories proved financially feasible with financial internal rates of return (F-IRR) higher than the assumed discount rate of 10% and financial Net Present Value (NPV) higher than zero. The ex-post financial indicators are at least (if not above) the projected results in the ex-ante evaluation. See Table 3.

Table 3. Financial Indicators of Subprojects by Category

Number of technologies	Financial Analysis by category	IRR	NPV	Average NPV
162	Thermal Systems	46%	11,735,826	72,443
419	Biodigesters	38%	134,503,507	321,011
188	Motogenerators	56%	29,168,999	155,154
26	Turbines	53%	8,013,150	308,198
738	Photovoltaic Systems	12%	3,930,156	5,325
314	Energy Efficiency	42%	31,621,667	100,706
386	Energy Efficiency Irrigation Pumping	71%	30,992,592	80,292
5	Biomass energy systems	30%	3,084,567	616,913
2238	All categories*	36%	242,997,533	108,578

NOTE: Does not consider the 48 subprojects under "complementary investments" for electricity grid connection.

37. Even if the benefit stream of GHG net emissions' reductions from investment sub-projects is omitted from the analysis, the financial rate of return and the net present value of the RE and EE technologies supported indicate that these are viable, sustainable private investments (full GHG considerations included in Annex 4). It is expected that the energy reform program underway in Mexico and further efforts to establish a carbon trading system and other carbon offset incentives, would make it even more viable for agribusiness to invest in all the categories of technologies supported by the project. These improvements will attract more technology providers and generate a dynamic market.

38. Implementation efficiency: The project faced significant challenges during implementation from budgetary and administrative restrictions imposed by national regulations, exchange rate fluctuations, market distortions and other barriers to the adoption of RE and EE technologies. Regardless, the project delivered – except for beneficiary numbers - results on or above the final targets in the RF.[19] These results were also achieved with fewer

[19] "Number of small and medium agribusinesses adopting environmentally sustainable technologies" (explained in para. 27) and "Number

resources than originally planned (Annex 3). Further, extension of the closing date enhanced project efficiency by permitting the completion of additional technology investments, even though the underlying reasons were fiscal austerity and FIRCO's efforts to disburse the Loan in face of significant devaluation of the Peso. Weighing these challenges against project results/outcomes, implementation efficiency is assessed as Substantial.

39. Efficiency rating. Efficiency is rated as **Substantial** based on the positive economic and financial results and actions taken to ensure the sustainability of project interventions, despite the difficult challenges faced by the implementing agency. The main challenges faced by the project cannot be attributed to the implementing agency, and they were properly addressed to the extent possible.

D. JUSTIFICATION OF OVERALL OUTCOME RATING

40. Overall outcome is rated **Satisfactory** based on minor shortcomings in the project's achievement of its PDO.

- **High** ongoing relevance of the PDO based on its initial and sustained alignment with Bank strategy documents for Mexico and with country policies and strategies supporting RE, EE and climate change mitigation in agriculture.
- **Substantial** rating for Efficacy, given the following: strong - and in some cases exceptional - results across all critical indicators, beneficiaries' demand for multiple investments to boost the economic and environmental benefits of adoption, their willingness to cost-share well beyond expectations, and generally positive sustainability outlook.
- **Substantial** rating for Efficiency, based on positive economic and financial outcomes, strong sustainability outlook and the project's ability to overcome/ride out major challenges and implement successfully.

E. OTHER OUTCOMES AND IMPACTS (IF ANY)

Gender

41. While SAGARPA had a gender policy linked to its programs since 2010, essentially giving women financing priority, gender participation was not an explicit project goal. The BCR (FIRCO, 2018) states that investment proposals received from women (or indigenous groups) were attended under general guidelines established for SAGARPA's Special Programs (SP).[20] This does not mean that women-managed agribusinesses were not financed, but there was no project plan to foster this, and the RF did not include gender indicators. The BCR estimates that 20 percent of project investments went to women-managed enterprises, but this was not verified.

Institutional Strengthening

42. Institutional capacity was promoted through targeted training and direct project implementation, as follows:

- **Capacity of SAGARPA and FIRCO personnel was strengthened** through training on climate change, energy technology and innovation, environmental policy issues in the agriculture sector, and the technical and operational aspects of implementing the project technologies in the field.

of MWh of energy produced from biomass" which achieved 98.5%.

[20] The BCR (FIRCO, 2018) states that several Special Programs explicitly guarantee women equal access with men and, in some years of the project, a points system for financing approval assigned added weight to proposals from marginal municipalities/groups.

- **Some 386 FIRCO employees were trained** (138% of target) on Bank operational rules and standards and on the simplified investment processing agenda agreed with the Bank. Training was continuous, with annual training events for management, technical specialists and staff, including decentralized/regional.
- **FIRCO conducted 17 inter-ministerial workshops** (283%) promoting collaboration on project CC activities.
- **The project's institutional arrangements evolved during implementation**. Government turnover in 2012 saw SAGARPA's structure and inter-institutional relationships change. FIRCO developed skills in: identifying strategic partners and defining joint activities; donor coordination; maintaining stronger links to Mexico's state power utility (*Comision Federal de Electricidad*, CFE); collaboration with local partners and technicians; and, to interacting/engaging more with SAGARPA, especially on CC and normative areas, and to leverage financing.
- **Procurement training was provided by the Bank** at least once a year, to FIRCO and its decentralized staff.
- **FIRCO leaders and personnel participated in technical study exchanges and international events.** Foreign technical delegations visited the project including from the US Department of Agriculture. FIRCO representatives travelled abroad to discuss the project, including to China. FIRCO personnel (12) were trained in clean development in Japan, and FIRCO technicians (40) were trained in RE at the National University of Mexico.
- **Events were held convening FIRCO, other institutions/agencies, research bodies and academia** to discuss developments in RE technologies, project operating regulations and new support schemes.
- **FIRCO gained a stronger understanding of the importance of measurement, analysis and the evaluation of results**, even though its overall performance was disappointing on the latter. See Section IV, M&E.

Mobilizing Private Sector Financing

43. The project mobilized US$215.14 million of private, beneficiary financing, around 143% of the estimated aggregate target and 60% of total project cost. Estimates of beneficiaries' behavior including their willingness to co-finance, were indicative. Under project rules, FIRCO would provide a subsidy of between 20% and 50% of total investment cost, to a maximum of US$200,000; these rules changed during implementation, with the Bank agreeing to increase the ceiling to US$1,000,000 to reflect market realities including integrated packages of technologies and higher prices for certain types of complex RE infrastructure, on a case by case basis. Beneficiary agribusinesses were expected to contribute the difference and did, including 263 who either returned for additional, complementary investments, or financed several technologies in one subproject to optimize profitability and sustainability.

Poverty Reduction and Shared Prosperity

44. While the project did not focus on poverty, "equity" was a higher-level objective under the 2008-2013 CPS (see PAD). Implicitly, the project sought to bring small and medium agribusinesses lacking the financial means to innovate, up to par environmentally by strengthening sustainability, mitigating climate change and improving competitiveness. That said, most of the initial investments were in bio-digesters where scale is an issue, the lesson being to effectively invest and have the level of adoption which can demonstrate impact quickly and be widely disseminated.

45. In practice, project beneficiaries fit a wider spectrum than envisaged because the project was demand-driven, and the approach was comparatively flexible – larger agribusinesses were not explicitly excluded – implying a trade-off between equity and impact. Even so, larger participants were few and mainly in the initial period: they preferred to seek higher volumes of financing from commercial sources/other programs. FIRCO shifted its

targeting focus markedly to smaller agribusinesses once demonstration models were available for dissemination. Data covering 100% of project technology investments across all types from 2008-2017[21] show that small and micro-enterprises captured 83% of total technology investments with medium and large agribusinesses at 17%. See Annex 7, Diagram #3 showing share by agribusiness size and type of technology.

46. **Other social aspects:** An early project-financed Social Survey (2011) sampled 42 agribusinesses (22.4% of total at that time) in 14 States and interviewed 42 agribusinesses owners/technology recipients and 54 workers, providing some insights into the project's social impacts. Employees of the agribusinesses surveyed were about two-thirds male and one-third female. Of the 42 agribusinesses surveyed, eight had indigenous workers who reported benefiting from having formal employment and stable incomes. However, none of the agribusinesses financed were indigenous-owned/run (and this did not change). At the time of the study, some 607 new, temporary jobs had been created to implement the technology investments of the sampled group. Some 76% of the workers interviewed had received project-related training averaging two courses per worker.

Other Unintended Outcomes and Impacts

N/A

III. KEY FACTORS THAT AFFECTED IMPLEMENTATION AND OUTCOME

A. KEY FACTORS DURING PREPARATION

47. **The project's objectives were clear, and its technical and operational logic were well-described in the PAD and linked to the lessons of related operations.** The project was demand-driven, and thus certain aspects of design were indicative and flexible. The M&E agenda and deliverables were clear and realistic. The Results Framework aligned with operational objectives, but indicators could have been broader and richer (see Section IV, M&E). Baselines were to be developed post-effectiveness, based on agribusiness entry profiles. Targets were generally appropriate. In the case of CO2 emissions, targets reflected the lack of accurate, technology-specific estimation methodologies at appraisal (Section II). Targeted beneficiaries were specified in the PDO but not described/defined in the PAD. The risk analysis was adequate but did not mention additionality (see below), whose potential effects on Bank projects in Mexico were known. The mitigation measures suggested for potential budget problems lacked substance. In terms of readiness to implement, both the Bank and FIRCO teams knew that much of the framework and instruments for successful implementation would have to be established by the project, and thus "readiness" was a relative term in this case.

48. **At the time of preparation, there was little/no established institutional, technical or commercial precedent.** The market for energy technology was certainly developing but slowly, with few providers and scant experience attending the agro-livestock sector. Commercial transaction standards were lacking, as well as technical/quality specifications for the targeted technologies, or appropriate guidelines for the review and analysis of subproject proposals. FIRCO's decentralized Management Units lacked the operational capacity to work with the project subsidy mechanism and needed training and experience on the job. Finally, GEF projects are inherently demanding, designed to remove barriers for which technical and institutional capacity may not pre-exist, the bar is high to secure GEF approval and the vision is longer-term. There are also implicit time lags in promoting and disseminating the results of demonstrated innovations and fostering their adoption, which needs "champions"

[21] *Proyecto de Desarollo Rural Sustentable: 2202 Acciones Tecnologicas* - 2008-2017, FIRCO, September 2017.

and incentives.

B. KEY FACTORS DURING IMPLEMENTATION

Factors subject to government and/or implementing entities' control:

49. **Budget sufficiency and certainty were the most serious issues facing the project throughout.** While the lack of additionality in lending projects in Mexico can be an issue – all loan resources are incorporated into the national budget and there is no designated project account - this only partly explains the project's budget difficulties. The real limitation in this case was SAGARPA's failure to allocate to FIRCO adequate resources from its annual budget envelope under the national budget law. Even though FIRCO had a packed pipeline of investment proposals and agribusinesses demanding access, it was perpetually short of money and unable to plan with confidence. FIRCO, as result of its annual budget difficulties, sought resources from SAGARPA's Special Programs (SP, footnote 6), but the requirements of many SPs were inconsistent in key respects with those needed to get Bank approval. SAGARPA's requirements also changed annually/repeatedly based on internal negotiations. Since FIRCO was not the designated Responsible Unit for most of these SPs, it had little control over this situation. Further, government's fiscal austerity program (2014-2016) caused SAGARPA to further tighten budget and re-design its programs. As a result, FIRCO's resource position worsened, and its professional staff was eroded at all levels, affecting its operational capacity. Collaboration with regional coordinators and local technical personnel to maintain active supervision and project-sponsored training of local staff/teams, mitigated this situation. SAGARPA's declining budget saw FIRCO and the Bank seeking ways to accelerate loan disbursement, including through increased investment in photovoltaic and solar heating systems with short execution cycles. This situation created pressure to seek partial cancelation to avoid transaction costs on undisbursed funds.

50. **Implementation of the GEF Grant was problematic.** Post-effectiveness changes in Mexican norms/rules by the Ministry of Finance and Public Credit prevented NAFIN from disbursing grant resources directly to private beneficiaries. Alternative mechanisms were needed to sustain the additionality of the GEF Grant funds and enable their direct use for planned activities, while aligning with Bank and country fiduciary norms. Procurement of a "funds administrator" for the Grant was delayed several years by complicated contracting and protracted public bidding processes. Bureaucratic constraints also limited the transfer of GEF resources to that funds administrator, affecting training, field supervision and payments to the Implementation Team. Further delays were incurred while a "Seed Capital" revolving fund was established to allow up-front payments by FIRCO to be later reimbursed by GEF. Despite all such efforts by the Bank and FIRCO, the US$10.5 million GEF Grant was only 33% disbursed by the time of the 2016 restructuring. The GEF was used mainly to pay project management and supervision costs in the extension period; by closing, GEF disbursements had reached 88%.

51. **The FIRCO/NAFIN relationship was especially productive**. NAFIN played a fundamental role in developing processes for documenting subprojects and in supporting the disbursement process. NAFIN's shared experience shortened response times in situations affecting project performance, and it efficiently facilitated issues involving the Bank. SAGARPA, on the other hand, played a limited role in helping resolve FIRCO's budget problems and in adjusting the norms of its SP to those of the Bank to permit FIRCO's access to adequate resources. Further, changes in budget priorities under a new government in 2012 saw the policy context for annual budget allocations change along with the rules for accessing project support, which the project could neither control nor resolve (BCR/FIRCO, 2018).

52. **Flexible targeting in the initial phase benefited an innovative project.** Medium-large agribusinesses became the initial focus of project investments to demonstrate earmarked technologies, and the reasons are clear. As noted by the BCR (FIRCO, 2018), an agribusiness with 5,000 head of cattle sees better GHG emissions reductions, has greater liquidity to embrace innovation and withstand risk, and landed status is likely to be regular. Second, project funds were competitive and demand-driven, which needed a certain organizational capacity associated with size to mobilize rapidly and launch investment. The initial focus on larger firms galvanized the development of a renewable energy market which had existed in nascent form pre-project. Further, while the larger, more seasoned agribusinesses appreciated the project's concessional resources, they also had access to larger amounts of financing through commercial sources and their participation consequently dropped off. With demonstration models tested/available, FIRCO's targeting shifted more intensively to micro/small and medium agribusinesses (see Table, Annex 7).

Factors subject to World Bank control:

53. **Bank authorization of "commercial practices" for procurement facilitated successful project execution.** Because of the project's complex fiduciary arrangements required frequent revisions were needed of operational procedures and many adjustments were made to align project activities with country norms and Bank rules. These adjustments occurred in the context of the project's strong technical performance where early adoption created high demand among Mexican agribusinesses for EE and RE technologies. Although "commercial practices" was a recognized procurement method (for goods, works and consultant services) under both the original Loan and the GEF Grant, its operational application remained unclear. Negotiation of the AF Loan saw "commercial practices" removed, although it remained under the GEF Grant, creating a misalignment in the implementation of blended Bank instruments. Clarification and re-insertion proved critical for successful project execution and the dialogue on procurement with the client. See para 69.

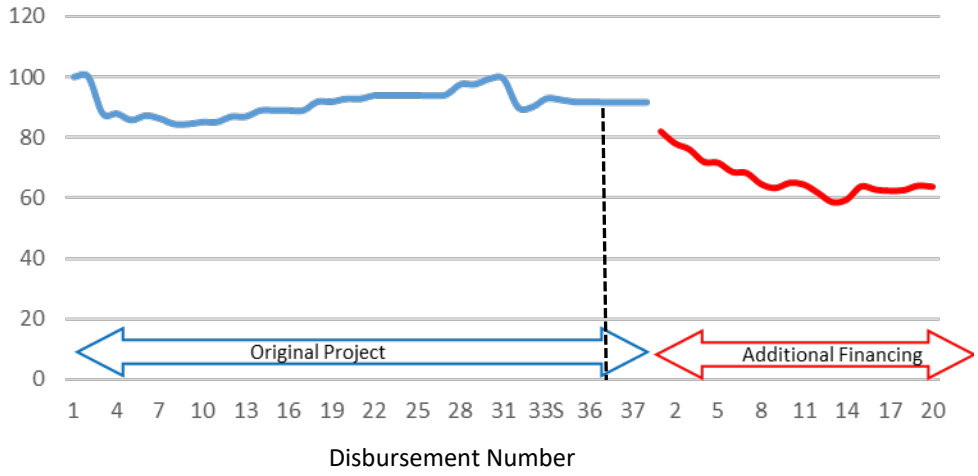
54. **Mid-Term Review (MTR) found that the PDO remained robust and relevant.** The project was key to preparing industry for "green growth" via timely development of the technology market and introduction of clean energy practices in industrial processes. Physical implementation was rated Satisfactory, with important results evident, despite delays. While some operational adjustments were needed, progress had created opportunities to further expand project impact. Certain activities needed intensification including: long-term maintenance of installed systems; development of national technical capacity/standards for the operational stage of all key project technologies; and, cost-benefit analysis, results dissemination and communication. An Additional Financing (AF) loan was recommended. Its justification rested primarily on reaching more beneficiaries, given high demand, but the disbursement trajectory and the likelihood that budget difficulties would continue, were evidently not factored into this decision.

Factors outside the control of the Government:

55. **Continued decline of the Peso against the US Dollar had both negative and positive effects.** It was a determining factor in the AF's low and declining level of disbursement. Independent of the increased scale of the technology investments over time, the conversion of the subsidy element at the then-current rate of exchange, continued to decrease. The exchange rate used for the project's first disbursement in 2011 was 11.94 Pesos/USD whereas the rate used for the last disbursement in 2018 was 18.73 Pesos/USD, representing an increase of 57% in the relative value of the US Dollar. Comparing the lowest rate registered with the highest observed in December 2016 (20.35 Pesos/USD), represented an increase in the relative value of the US Dollar of 70.5%. Ultimately

however, this meant that the project was able to buy more pesos with fewer dollars, requiring fewer loan resources to achieve the same (and higher) targets and resulting in substantial savings. See below.

Exchange Rate Index: Peso vs USD (1st Disbursement = 100)[22]



IV. BANK PERFORMANCE, COMPLIANCE ISSUES, AND RISK TO DEVELOPMENT OUTCOME

A. QUALITY OF MONITORING AND EVALUATION (M&E)

M&E Design

56. Key features of M&E design were as follows:

- **The PDO was clearly stated.** The intent of the GEO was consistent with that of the PDO but it went further by explicitly linking the objectives to the National Strategy on Climate Change and the PECC.[23]
- **The PAD spelled out the M&E arrangements, along with specific, timed evaluative/analytical deliverables.** A standard framework of baseline, beneficiary assessment and impact evaluation studies would be contracted with FIRCO coordination and technical supervision. A final stakeholder workshop was to review results and develop a post-project sustainability plan.
- **The Theory of Change was clear and the RF was adequate, with some caveats:** Baselines were to be developed after effectiveness using agribusiness entry profiles, a common approach in demand-driven projects. The RF had no social indicators, and some indicators were pro-forma: the Intermediate Outcome target for TA is identical to targeted technologies and to proposals prepared; many Intermediate Outcomes are outputs; and, the internally complex PDO Indicator on SAGARPA (Annex 1), shows a simple yes/no target. Finally, the RF focused on environment and climate change, not considering the project's potential economic/other benefits even at an intermediate level.

M&E Implementation

[22] Source: FIRCO 2018
[23] It could be argued that as worded, the PDO sought promotion and adoption per se, as it did not specify impacts on targeted agribusinesses.

57. Key aspects of M&E implementation were the following:

- **FIRCO prepared and disseminated important data sets, produced quality semester reports demonstrating project results, and coordinated a series of targeted studies.** FIRCO also produced a strong Borrower Completion Report (FIRCO, October 2018) and conducted a closing event presenting the project results, using own funds. Data and studies provided valuable inputs to the ICR and FIRCO responded efficiently to Bank requests for information.
- **FIRCO's capacity to accurately measure actual CO2 emissions by technology was a major break-through,** without precedent in other Mexican ministries or agencies and a best practice achievement of high value to stakeholders.
- **The Bank gave M&E high/continuous priority from pre-effectiveness, but evaluation outputs fell short.** The Bank team and the United Nations Food and Agriculture Organization (FAO) repeatedly urged FIRCO to conduct a project baseline evaluation, and at the MTR offered financing and methodological mentoring. Bank resources financed the creation of tools, and all agribusinesses had an entry profile/baseline, but they were never formalized or analyzed with FIRCO citing, inter alia, lengthy institutional processes likely to inhibit procurement.
- **The planned final impact evaluation was not conducted.** After protracted discussions, the late discovery that there was no viable control group - and other baseline issues - derailed attempts to contract an impact evaluation. An evaluation study using simple before/after comparisons was agreed but not contracted until August 2018, and thus even preliminary inputs for the ICR were unavailable. [24]
- **Opportunities to revise/enhance the RF were missed.** While the RF was generally adequate, restructurings and/or the AF could have enhanced the RF by adding, for example: core indicators; co-benefits, including social (since there were underlying equity goals); sustainability (O&M practices/arrangements, given that most investments were for equipment, systems and infrastructure); and/or energy cost reductions (as a component of competitiveness). Also, the AF had increased the target for CO2e by 158%. Further revision of the target by the 2016 restructuring – based on calculations using the new methodology - was inadvertently missed by the Bank team. This was due, inter alia, to the pressures of reinstating the Commercial Practices procurement modality, and to negotiating and processing separate extensions of the closing dates for both the loan and the GEF, the latter requiring the Regional Vice-President's approval.
- **M&E problems reflected a generalized lack of data-driven decision-making in the public sector**. SAGARPA had no expectations of evaluation, nor a methodology, and saw evaluation as more of a risk than an opportunity. Thus, in parallel with efforts to launch an evaluation framework, the Bank team worked to identify the project's co-benefits.

M&E Utilization

58. Key features of M&E utilization were:

- **Institutional stakeholders relied heavily on FIRCO's management of project databases including FM and Procurement,** including SAGARPA, FIRCO's State Management Units, NAFIN, SENER and the Bank.
- **FIRCO's semester reports were well-presented** in a consistent, comprehensive format and kept the Bank informed, usually coinciding with supervision missions.
- **Project data were a valued input into key activities** including: the ICR, which made extensive use of its products; FIRCO's training programs, results dissemination and energy technology promotion campaigns;

[24] Treatment and control group candidates were to be agribusinesses whose proposals were approved/not approved. FIRCO's state field offices collected this information and it was finally agreed in 2014 (Aide Memoire) that FIRCO would construct two databases. When the time came for final impact evaluation, FIRCO claimed to not have access to either database.

SAGARPA/FIRCO representation at national and international energy forums; delegations visiting Mexico from countries interested in the FIRCO model; and, for SAGARPA's Special Programs and the activities of its Climate Change Directorate.

- **FIRCO-coordinated studies were an important resource for the ICR,** and for important project decision-making.
- **FIRCO's access to timely, accurate CO2e data strengthened government's capacity for data-driven policy-making**, strategy formulation, and official representation on climate change both nationally and internationally.

Justification of Overall Rating of Quality of M&E

59. Performance on M&E is rated Modest for the following reasons:

- **Minor weaknesses in the Results Framework indicators did not constrain assessment of the PDO.** Databases were comprehensive, well-designed and informative, and the body of special studies was a valuable input to understanding and quantifying project results.
- **The lack of baselines and a control group to support formal impact evaluation, and lack of an evaluation study per se, are weaknesses.** They deprived this unique project of an important, additional source of evidence and validation. While FIRCO bears much of the responsibility for this situation, the Bank team could have exerted additional pressure by making closing date extension and related "concessions" requiring management approval contingent upon rapid action by FIRCO to resolve specific M&E constraints.

B. ENVIRONMENTAL, SOCIAL, AND FIDUCIARY COMPLIANCE

60. The project triggered Environmental Assessment (OP 4.01) and Indigenous Peoples (OP/BP 4.10). Subprojects would be screened to ensure compliance with local laws and Bank safeguards including – without triggering – Natural Habitats, Physical Cultural Property and Pest Management. Significant environmental impacts were not expected due to the project's components/activities being focused on minimizing the environmental footprint of agribusinesses through reduced GHG emissions and energy consumption, and transitioning agribusinesses to renewable energy and more efficient energy use. Performance is discussed below.

Environmental:

61. Environmental compliance was as follows:

- **Project compliance was satisfactory throughout,** due to FIRCO's commitment and to agribusinesses' acceptance of the environmental model, as well as the benefit of having the same Bank environmental specialist from project preparation through closing.
- **FIRCO worked hard to ensure that the subprojects it approved would not have negative environmental impacts**, and it trained beneficiary agribusinesses in complying with applicable permits and licenses, and in applying preventive, mitigation and corrective measures aligned to Bank rules while minimizing compliance costs. This was complicated by the multiplicity of agencies involved in the environment and lack of clarity in federal, state and municipal environmental regulations (BCR/FIRCO, 2018).
- **Supervision visits found few problems of compliance with firms' Environmental Management Plans.** The investments themselves, regardless of type, demonstrated effective solutions to environmental issues (e.g., contamination, health and sanitation, odors) as well as reducing GHG emissions and the use of fossil fuels.

- **The final Bank mission sustained the ratings of Low Risk and Satisfactory** for overall implementation of environmental safeguards.

62. **Environmental benefits and co-benefits of the project were substantial** (based on a survey of 100 project beneficiaries across a wide spectrum of agribusiness activities)[25], and included: (i) **massive reductions in GHG emissions** and in fossil-fuel energy consumption; (ii) **efficient treatment of solids** from pig and cattle properties; (iii) **reduced water contamination** due to improved manure and waste/residue management; (iv) **by-products of the technology systems** including organic fertilizers and compost, and cleaned waste water conveyed organic fertilizer for irrigation via closed systems; (v) **reduced use of commercial fertilizers**; (vi) **compliance** with national environmental laws; and, (vii) **better quality of life** for neighboring communities, improved quality of habitat surroundings, and improved working conditions for laborers due to reduced odors and environmental contaminants.

63. **Social**: Compliance with the Indigenous Peoples safeguard was satisfactory. None of the agribusinesses financed were indigenous-owned or managed. Indigenous participation through the agribusiness labor force was low. No information was reported on indigenous participation since the 2011 Social Survey. Reported co-impacts from that survey and from field interviews with agribusiness managers/workers included: (i) **improved/safer working conditions** from reduced odors, cleaner physical environment, modernized installations and equipment, reduced gas intoxication risk, and, appropriate spaces for chemical storage and management; (ii) **workers reported improved health** (44%), all of these in pig operations where bio-digesters had reduced direct contact with excreta and improved air quality; (iii) **increased staff numbers and/or salaries** from implementing alternative energy technologies which increased profits; and, (iv) **training of direct and indirect beneficiaries** (e.g. contracted workers) to manage alternative energy technologies.

Financial Management:

64. The ratings for financial management (FM) performance ranged from Moderately Satisfactory to Moderately Unsatisfactory over the course of the project. Delays affected GEF grant-financed project activities because the funds flow mechanism could not function as designed due to changes in national budget policy (see Section III). Alternative mechanisms had to be devised. FM training for FIRCO staff (state/local) was delayed. FIRCO's human resource limitations at that time required an administrative consulting firm to manage funds for operational costs – including training - but significant delays affected the firm's contracting. FM performance improved over time with alternative mechanisms adopted, including a revolving fund to ensure the additionality of GEF Grant resources to the FIRCO budget - devised to accelerate disbursement - and an administrative agency was contracted to manage consultants and training events. Government sought a partial cancellation of US$10.0 million, processed in November 2017. SAGARPA confirmed sufficient budget allocation for FIRCO to fully disburse the Loan by closing but a series of issues limited efforts to use it. By closing, undisbursed balances were US$7.75 million (AF) and US$1.2 million (GEF).

65. **Audit:** External audit reports for the loans and GEF grant were prepared under terms of reference acceptable to the Bank. Project unaudited interim financial reports (IFR) and audit reports were generally submitted on time with some delays, mostly in the early stages. Audits presented unmodified (clean) opinions. All audit reports were considered acceptable to the Bank.

[25] *Informacion para Evaluacion de Co-Impactos Derivados del Proyecto de Desarollo Rural Sustentable*, FIRCO, 2015

66. **Project Cost and Financing:** Actual costs exceeded projections under both stages, as did Borrower and beneficiary counterpart contributions. Total cost of the original project was US$224.62 million (133.42% of estimated) and of the AF, US$133.58 million (111.63% of estimated), including the GEF Grant. Total aggregate cost was US$358.20 million, 124% of the aggregated estimates. Government contributed US$33.12 million (119.4%) to the original project and US$21.64 million to the AF (17.14%), although the AF did not estimate a further contribution from government. Beneficiaries contributed an aggregate US$ 215.14 million, about 143% of the aggregate expected contribution under both operations and 60% of total project cost. Some US$10.0 million were cancelled from the AF. The GEF disbursed US$9.25 million (88%).26 See Annex 3 cost tables.

67. **Technology costs:** Technology costs varied over the project period due to: increased supply as the number of providers increased; cost reductions, especially for solar panels; and, increasing costs of some imported equipment due to the US Dollar/Peso exchange rate. Market evolution was accelerated by FIRCO/project support. Importantly, even though price stabilization by type of energy system or by size was not possible, by providing support within the parameters of the Operational Rules, FIRCO negotiated with providers to keep prices within reasonable limits. See unit cost discussion Section III and Annex 3.

68. **Procurement:** The Bank's procurement oversight was continuous, comprehensive and benefited from having a single Bank Procurement Specialist for the duration. The procurement function was especially challenging due to the need to adjust procurement modalities, processes and documentation over time as markets for the technologies developed and evolved. Markets were thin early on, and Bank procurement rules were not well-understood, especially at FIRCO's decentralized levels. The Bank provided mentoring and training to FIRCO, improving procurement efficiency over time including the scope of local procurement supervision. Important, independent studies were financed to support: (i) review of project procurement practices (Garcia, 2012); (ii) the quality and prices of key, project-financed technologies (GIZ 2014); and, (iii) the Mexican market for technology equipment and providers (World Bank, 2014). The latter study of 700 registered providers enabled the Bank and FIRCO to review and validate project procurement instruments and helped the Bank team make a case for re-introducing "Commercial Practices" (see below).

69. Procurement documentation adopted, with Bank support, the "*Expediente Simplificado*" (ES) which required considerable effort to ensure compliance. FIRCO also prepared and updated master lists of reliable suppliers, providing agribusinesses with options when selecting a provider, including whether firms offered O&M services and guidance. The formal move to use "Commercial Practices" (instead of Price Comparison or "shopping", a process whose costs proved to be deterring agribusiness participation), where an agribusiness could review quotes and services before deciding, was an important innovation designed to keep costs down, promote competition and transparency, and support agribusiness decision-making (see Section III). The project's procurement challenges and their resolution contributed to the World Bank's procurement reform, an important, positive institutional "spillover effect".

C. BANK PERFORMANCE

[26] While the AF Loan was not full-executed by closing, FIRCO was legally entitled under Mexican law to access US$7.27 million of project resources allocated under the 2018 budget which could be disbursed up to the end of October 2018 (end of grace period). The Bank agreed that 106 contracted subprojects remained eligible for completion and disbursement, including access to the project subsidy.

Quality at Entry

70. Key elements of project quality at entry are as follows:

- **Quality at entry is rated Moderately Satisfactory**. The project had high strategic relevance and its objectives were clear. The Bank identified, facilitated and prepared a timely, complex, ground-breaking operation with important medium- and long-term implications – the first of its kind in Mexico. The technical strategy was innovative and sound, backed by FIRCO's well-conceived and managed incentives program to promote demand, dissemination and adoption based on the evidence of other projects/programs.
- **The project was complex, and its engagement period was short,** especially in view of GEF involvement. Expectations were ambitious, given that institutional structures, financial arrangements, technical and operational capacity, markets and agribusiness buy-in, all needed development. The Bank believed that the potential rewards justified the risks, the policy/strategic context was supportive, and the investments were timely.
- **The project was a climate smart, technology adoption operation with equity as an underlying theme.** Intentionally, there were no explicit poverty reduction goals, but the Indigenous Peoples safeguard was triggered.
- **Environmental conservation was a fundamental project goal**. Environmental safeguards were diagnosed appropriately, and the required analyses conducted.
- **Fiduciary aspects were well-designed** (although they required adjustments due to policy changes over which the project had no control). The additionality issue did not arise in project documents, and thus the fiduciary/implementation arrangements did not discuss mitigation options.
- **The project risk analysis under-rated certain factors.** The Bank could not have predicted policy and regulatory changes after effectiveness, nor the fiscal implications of a change in government. However, the PAD risk analysis bypassed additionality, potential budget shortfalls were rated as moderate risk and, budget was to be "ensured through consultations with the client".
- **Implementation arrangements were explained succinctly in the PAD.** The institutional framework and responsibilities, as well as the subproject selection process and cycle were well-described, but no details were provided on the characteristics of targeted agribusinesses. The Bank's prior, longstanding relationship with FIRCO promoted confidence in its capacity to coordinate the operation.
- **M&E arrangements were standard, with some shortcomings.** They called for a Management Information System (MIS), baseline, mid-term knowledge assessment, a final evaluation and a beneficiary assessment. The RF was adequate but could have been improved to capture more of the project's potential outcomes/benefits.

Quality of Supervision

71. Key features of supervision quality are as follows:

- **Supervision focused on development impact.** The MTR diagnosed the critical issues affecting progress, and the benefits flowing from the project model and followed up both systematically. The AF, a direct outcome, not only expanded coverage, but sought to deepen impact through integrated packages of investments, and new approaches such as energy "clusters".
- **Regularly scheduled supervision missions routinely included appropriate specialists.** These included fiduciary, safeguards, agribusiness and energy specialists. FAO specialists provided M&E and agribusiness expertise. Bank fiduciary staff were crucial in brokering solutions to FM and procurement constraints, with FIRCO and NAFIN.
- **Performance reporting was high quality,** candid, comprehensive and a valuable input to the ICR.

- **Transition arrangements received focused attention.** The final year included consultation on specific aspects of the transition to normal operations. Government was continuing to invest with own funds in the same technologies and types of subprojects without World Bank support. The demonstrated benefits and co-impacts of this project, and beneficiaries' investment of US$215.4 million of own resources, increase the likelihood of an effective transition to regular operations.
- **Bank efforts to ensure quality M&E had mixed results.** The Bank exerted a consistent effort, starting in the pre-effectiveness period, to launch and mainstream M&E, inculcate good practices, and ensure that FIRCO captured adequate data to prove the project's case. This included important Bank/FIRCO-coordinated studies not contemplated explicitly in the M&E framework at appraisal (see Section IVA and Annex 6). Efforts with FIRCO to organize an impact evaluation were unsuccessful. At ICR finalization the agreed evaluation was still in progress.

Justification of Overall Rating of Bank Performance

72. On balance, accounting for both the strengths and flaws of the preparation phase as they affected quality at entry, along with a generally strong supervision performance with some weaknesses, Bank performance overall is rated **Moderately Satisfactory**.

D. RISK TO DEVELOPMENT OUTCOME

73. The risk to development outcome is assessed as **Low**, for the following reasons:

- **The legal and policy environment in Mexico for renewable energy, energy efficiency and climate change mitigation remains favorable.** The new government has expressed commitment to providing incentives to agriculture/agribusiness to invest privately in energy innovation and move to self-sufficiency (renewables). Government turnover however, inevitably creates uncertainty about whether this supportive environment will continue, as ministries establish priorities and the expected government down-sizing gains momentum.
- **All beneficiary agribusinesses received O&M training specific to their investment, mandated under their Business Plans.** Further, a high proportion of beneficiary agribusinesses have formal maintenance contracts with the supplier, as did the five visited by the ICR mission (chickens, pigs and balanced feed production).
- **An estimated 85-90% of the technology subprojects financed remain operational,** based on direct evidence from FIRCO's state offices and field observations over a 10-year period. The cost-reducing attributes of the project's energy technology systems, as well as their co-impacts, are strong incentives to keep them working.
- **Technologies with low maintenance requirements have a higher likelihood of sustainability:** These include photo-voltaic and solar heating systems, and energy efficient practices. Agribusiness size and financial capacity to maintain the investment are important factors. Beneficiaries' investment of US$215.4 million of own funds, far exceeding estimates, suggests a strong incentive to maintain the investment.
- **Bio-digester systems without co-generation equipment (motor generators) show maintenance issues due to modest profitability.** Importantly, a major portion of FIRCO funds in 2016 were used to maintain/modernize earlier bio-digester investments and, the AF increased financing for bio-digesters with integrated investments in motor-generators and related equipment.
- **The project promoted demand for rural energy technologies, helping to grow the domestic market for quality energy systems and specialized technical services.** The project introduced clean energy practices into industrial processes. FIRCO also collaborated with the National University of Mexico, GIZ and other institutions to develop quality standards and technical specifications, which accelerated the evolution of suppliers in the RE and EE market and helped to improve the availability of replacement parts.

- **FIRCO formulated a list of verified providers by technology, assuring investment quality.** FIRCO coordinated with provider associations, specialists and higher learning institutions to design the basic requirements for certification by the National Certification Association (ANCE). Agribusinesses accessing Procedures for Commercial Practices could check a provider's attributes and make an informed decision.
- **Replication of and demand for the promoted technologies beyond the project, is evident.** No formal studies are available, but FIRCO reports that technology providers are supplying new private investments based on the project model. Medium and large-scale pig producers are expanding their project-financed installations using own funds and moving into other production units of the same agribusiness in the State of Jalisco**.** In Sonora State, pig farms with project-financed motor-generators have financed new equipment to expand their capacity to produce electricity.
- **A German Society for International Cooperation (GIZ) study in 2014[27] analyzed the quality, user perception and profitability of 70 completed project-financed solar heating and photovoltaic systems in 12 states.** The study's findings were generally positive. Beneficiary satisfaction was exceptionally high across all elements including functionality, economic support received, systems installation, collaboration and the three-way relationship with FIRCO and providers. Most of the subprojects visited were functioning well. Profitability was generally satisfactory: some 83% of beneficiaries showed energy savings ranging from 88% to 96%, although the study found that the sales price for 30% of solar heating and 87% of photovoltaic systems was too high.

V. LESSONS AND RECOMMENDATIONS

74. Issues of budget sufficiency and certainty in Mexico need upstream analysis, consultation with key project authorities and planning. The issue is how to ensure regular and adequate budget for the project duration, a constraint affecting the entire Bank portfolio in Mexico, magnified in times of fiscal austerity. Options in the Mexican energy sector might include using FOTEASE, a SENER trust fund which permits multi-year budgeting and earmarked funding for RE and EE efficiency interventions, although the FOTEASE budget must still be approved by the Ministry of Finance. To strengthen their case, teams need to undertake detailed economic analysis to demonstrate project cost savings to relevant ministries and key institutional/other stakeholders.

75. The use of public sector financing, and incentives/subsidies to leverage private financing for energy technology adoption in agriculture is justified. Given the magnitude of the agriculture and agribusiness sectors in Mexico, adoption of RE and EE technologies can have a massive impact on the environment, on national targets for renewable energy and on climate change mitigation. They also impact on national and global competitiveness through energy cost-savings and self-sufficiency, compliance with global standards and ultimately, a reduction in government subsidies. Innovation takes time, needs "champions" and can benefit from a focus on larger agribusinesses initially to launch technology adoption, and build national markets and technical expertise. Beneficiary co-financing remains a sine qua non, but levels need tailoring to agribusiness size and access to finance.

76. Energy technology innovation projects in the agriculture sector need to factor in both demand and supply. Promoting agribusiness buy-in and adoption is just one side of an equation involving multiple, parallel development streams. Similar projects should factor in: market development, including of appropriate technologies, reliable, competitive local providers, and of specialized advisory and maintenance services;

[27] Estudio de Calidad sobre los Sistemas de Calentamiento de Agua Solar y Fotovoltaicos y sus Instalaciones en el marco del Proyecto de Desarollo Rural Sustentable de FIRCO: Resultado de Estudio, GIZ/Ministry of Economic Cooperation and Development/Cooperacion Alemana.

supportive, flexible project procurement which can help to establish technical, price and quality standards; TA and training – public and/or private - focused on the installation, operation and long-term sustainability of systems; dissemination of the economic, environmental and social results of technology adoption; a parallel R&D agenda to resolve emerging challenges, develop databases and make the case for supporting the model; and, ensuring that the characteristics and needs of targeted beneficiaries are well-understood.

77. Innovative projects requiring behavior change can benefit from flexible targeting. A comprehensive, upstream analysis is recommended of the scale, activities, typology and motivation of potential beneficiaries to participate. Technically, interventions in RE and EE are equally viable for small or large agribusinesses, but economies of scale matter. Larger bio-digester technologies are more cost-effective and efficient, while solar has a greater potential to be modular. Incentives also matter. While the incentive driving a large dairy operation to participate is likely a substantial increase in profitability, for a micro/small agribusiness, pumped water for cattle driven by a photovoltaic system might represent the difference between viability and failure and thus the social impacts are also important. Energy innovation initiatives could benefit from a clear distinction in the mechanisms for selection, support/incentives and expected cost-share depending on size, production volume and technology.

78. Building a culture of M&E in key institutions is as important as executing the designed agenda. This is especially true of impact evaluation, which has an uneven track record in Mexican public institutions and needs concerted attention in projects. Direct support and mentoring from the Bank's Development Impact Evaluation unit (DIME) and other specialists from the earliest stage of a project can build understanding of the objectives and methodologies of impact evaluation starting with baseline and control group formulation. The Bank can help public authorities commit to M&E (including by financing it with loan funds, not grant resources) and understand the benefits - social, political, technical and economic - of data-driven assessment and formulation of public policy, strategy, plans and programs. The client needs to understand that evaluation is designed to improve performance and outcomes, not undermine coordinating authorities. .

ANNEX 1. RESULTS FRAMEWORK AND KEY OUTPUTS

A. RESULTS INDICATORS

A.1 PDO Indicators

Objective/Outcome: Project Development Objective: Promote the adoption of environmentally sustainable technologies in agribusinesses

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Number of small and medium-sized agri-businesses adopting environmentally sustainable technologies (renewable energy, energy efficient technologies, sustainable waste management or biomass conversion)	Text	0 19-Jan-2009	919 31-Dec-2013	2168 29-Jun-2018	1,842 29-Jun-2018

Comments (achievements against targets): Substantial achievement: 85% The PDO sought to promote behavior change within agribusinesses and the PDO indicator was designed to capture the extent to which this had happened. No baseline was established. This objective implies a relationship between the number of agribusinesses adopting project technologies, as well as the technologies adopted by each agribusiness. The adoption of multiple technologies by a single agribusiness speaks to the project's success in fostering adoption. The project's RF measures both the number of technologies adopted (in terms of number of subprojects financed/executed), and the number of agribusinesses supported. Note that the Additional Financing increased both targets. At project design, these numbers were assumed to be equal, i.e. each agribusiness would adopt one technology. During implementation however, many agribusinesses wanted multiple types of technology, i.e. a more integrated systems approach to maximize benefits, resulting in the number of technologies exceeding the number of unique agribusinesses. This high demand led to over-achievement on technologies adopted and under-achievement on the numbers of adopters. Also, government committed to completion of remaining, unfinished technology subprojects with own counterpart resources, after closing.

The precise value for number of agribusinesses is 1,842 (85% of target) and the number of technologies adopted (subprojects financed) is 2,286.

Objective/Outcome: Global Environment Objective: Contribute to the goals of the National Strategy on Climate Change by reducing GHG (CO2) emissions and improving the environmental sustainability of small and medium-scal

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Tons of CO2 equivalent reduced	Number	0.00	770000.00	1987500.00	6021967.00
		19-Jan-2009	31-Dec-2013	29-Jun-2018	29-Jun-2018

Comments (achievements against targets): Target exceeded: 303% Over-achievement of the GEO is in part due to the types of technologies supported by the project and adopted. Because the project was demand-driven, the original targets were determined based on assumptions around the types of technologies expected/likely to be supported. Ultimately, project demand focused on bio-digesters, a technology with much larger emissions reductions than other types of subprojects (such as energy-efficient chillers) and photovoltaic systems (solar panels). See ICR Annex 7. However, a key reason for the larger than projected CO2e reductions was the collaborative effort of the Bank, FIRCO, SENER and SEMARNAT to devise a more accurate, technology-specific CO2e calculation methodology based on real-time field monitoring and using reliable databases. Emissions reductions were thus much higher than expected by closing of the Additional Financing (which had significantly increased the target). Of critical importance, up till 2014, the project measured CO2e only for the year of technology installation. From 2014 on, the project measured cumulative CO2e, from the year of installation and adding each subsequent year of reduction up to the reporting period. See Annex 7B. The Bank team had increased the CO2e target by 158% at the time of the AF, but inclusion in the RF of a revised target for this indicator following the recalculation of CO2e using the new methodology, was inadvertently missed. The team was fully occupied, inter alia, negotiating and processing reinstatement of the Commercial Practices procurement modality, as well as extension of the closing dates for both the loan and the GEF Grant, the latter requiring RVP approval. Thus, the achievement is measured against the AF target.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion

SAGARPA is successfully formulating climate change mitigation and adaptation policies and programs in the agricultural sector and monitoring their implementation	Yes/No	N 19-Jan-2009	Y 31-Dec-2013		Y 29-Jun-2018

Comments (achievements against targets): Achieved: 100% The project required that SAGARPA establish a Climate Change (CC) unit able to successfully formulate and adapt policies and programs for the agriculture sector and monitor their implementation. SAGARPA established, as required by the project, a General Directorate to Address Climate Change in the Agro-Livestock Sector, in the project's initial period and, in collaboration with SENER FIRCO and SEMARNAT, became the key sector player in formulating, promoting and monitoring climate change/mitigation and adaptation instruments. Each agricultural sub-sector represented in the Directorate has its own programs aligned to national CC strategies. The Directorate: (i) monitors climate-related agricultural risk in the cattle and cropping industries; (ii) establishes cross-sector synergies on CC; (iii) reports GHG emissions reductions resulting from SAGARPA's programs (as measured by FIRCO) to SEMARNAT (national lead on climate mitigation policies and programs) and SENER; (iv) represents the sector at national and international climate forums; and (v) shares oversight of key, climate-related programs under SAGARPA which demonstrate strong mitigation contributions. SAGARPA, influenced by the Bank/FIRCO dialogue on RE, created the Bioeconomia Program which injected 1.0 M Pesos into SENER's Energy Transition Trust Fund (FOTEASE) to finance/influence agricultural RE initiatives on a multi-year basis, while fostering inter-agency RE coordination. Some 50% of this allocation was operationalized through FIRCO from 2010 to 2018 for project RE activities. SAGARPA also influenced policy-making and execution, e.g., through FIRCO's capacity-building seminars for development banks including FIRA (Agricultural Shared Risk Trust) and the Mexican Rural Financial Development Agency (FND), following which, both institutions markedly increased their investments in agricultural RE programs and projects. This indicator's target might have been improved by reporting its internal elements, rather than a Yes/No format.

A.2 Intermediate Results Indicators

Component: 1. Investments in Environmentally Sustainable Technologies in Agriculture

Indicator Name	Unit of	Baseline	Original Target	Formally Revised	Actual Achieved at

	Measure			Target	Completion
Number of agri-businesses having adopted low carbon intensity technologies	Text	0 19-Jan-2009	919 31-Dec-2013	2,168 29-Jun-2018	1,842 29-Jun-2018

Comments (achievements against targets): Substantial achievement: 85.0% Refer to comments under first PDO Indicator above. The PAD shows an aggregate target of 879 agri-businesses based on estimated demand, but FIRCO always monitored a target of 919, equal to that of the PDO Indicator #1. The AF increased the target by an identical amount, to 2,168. No baseline was established. See discussion of achievement in Comments Section of the PDO Indicator.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Number of KWh of energy saved from adoption of energy efficient technologies and corresponding tons of avoided CO2 e emissions	Text	0 19-Jan-2009	9.29 M KWh & 11,268 Ton CO2e 31-Dec-2013	143.45 million KWh & 76,172 Ton CO2e 29-Jun-2018	382.14 M KWh and 205.72 M Ton CO2e 29-Jun-2018

Comments (achievements against targets): Exceeded: 266.4% (KWh of energy) and 270% (Tons of avoided CO2 e emissions). Target was increased by the Additional Financing. A baseline was to have been collected prior to subproject approval in each case, but was not available to the ICR. FIRCO's strong promotion of energy efficient practices (Loan and GEF-financed) resulted in some 700 such subprojects, enabling energy savings far exceeding project targets. Efficient use of electricity showed stronger demand than systems based in fossil fuels. In the latter case, its achievement combines reduced direct consumption of fossil fuels with reduced demand for electricity whose generation in Mexico is based importantly on the burning of petroleum-derived fuels.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion

Number of MWH energy is produced by biomass and corresponding tons of CO2 e emissions avoided	Text	0 19-Jan-2009	33,937 KWh & 248,835 Tons CO2e 31-Dec-2013	224,908 MWh and 1.53 million tons CO2e 29-Jun-2018	221,624 MWh and 5.78 million tons CO2e 29-Jun-2018

Comments (achievements against targets): Substantial/Exceeded: 98.5% and 377.8% of targets, respectively. Target was formally revised by the Additional Financing. The incentive to use biogas for electricity generation met problems in the early years due to the accelerated wear on and deterioration of the motor-generators used, due to biogas filtration issues (damage from sulphuric acid and humidity), which significantly reduced the profitability of their operation and became a limiting factor on investments of this type, and on co-generation per se. However, based on the early results of the GEF-financed pilot/study on biogas filtration, agribusinesses with project-financed bio-digesters were financed by FIRCO to acquire a type of equipment which eliminated this constraint in new motor-generators. New bio-digester subprojects financed were integrated with this more efficient and durable motor-generator. In the future, this is expected to facilitate much greater use of biogas and co-generation.

Component: 2. Investment and Production Support Services

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Number of agri-business employees/processors has participated in training events organized by the project	Text	0 19-Jan-2009	300 31-Dec-2013	930 29-Jun-2018	994 29-Jun-2018

Comments (achievements against targets): Exceeded: 107% Target was formally revised by the Additional Financing. Training programs focused on sustained support for all aspects of technology specifications, operation, utilization and maintenance which differed depending on the type and size of the investment, and the type of agribusiness activity.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Number of energy efficiency and /or renewable energy sub-projects received technical assistance on energy efficiency and/or renewable energy technologies during implementation	Text	0 19-Jan-2009	919 31-Dec-2013	2,168 29-Jun-2018	2,286 29-Jun-2018

Comments (achievements against targets): Exceeded: 105.4% See explanation of numbers (technologies vs agribusinesses) under PDO Indicator #1. Target was formally revised by the Additional Financing. This indicator is a proxy for and equivalent to "# of technology subprojects financed", the goal being to ensure that TA on energy efficiency and/or renewable energy technologies covered all technology subprojects financed. Technical assistance was mandated through the Business Plan, accompanied its installation, and focused on integrating the technology into the productive side, understanding its technical attributes and potential, and inculcating strong operation and maintenance practices in beneficiary agribusinesses.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Number of pilot projects carried out to demonstrate and validate other technological innovations that could be proposed under the project	Text	0 19-Jan-2009	4 31-Dec-2013		4 11-Jun-2018

Comments (achievements against targets): Achieved: 100% The GEF financed 4 studies to support development of pilot technologies: (i) Development of Technology for Biogas Filters which Improve Sulfur-Hydroxide Retention Efficiency. Works were concluded at end-2017 to

develop the infrastructure and mountings for equipment for the filtration system, which will also include a telemetric system to monitor in real time the efficiency at different stages of the filtration process to establish the level of maintenance to ensure best results. Some problems were encountered, limiting system use and retrieving of results but this was resolved with the supplier and the study was completed; (iii) Evaluation of the Climatization of Greenhouses through Photo-voltaic Systems and their Comparison in Financial Efficiency with Solar Heating Systems; (iii) Diagnosis of the Situation of Effluents Generated by Bio-Digestion Systems developed in Mexico under the FIRCO-World Bank Support Scheme. The study was developed in 2016, based on a sample of solid and liquid effluents in 52 (of the 333) bio-digestion systems installed, in 4 states; and, (iv) Evaluation of Pyrolisis as a Method for Sustainable Use of Pollinaza to generate Electricity

Component: 3. Institutional Strengthening

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
A unit within SAGARPA is established to support and/or to formulate, implement and monitor Climate Change mitigation and adaptationpolicies and programs in agriculture sector	Text	No Unit 19-Jan-2009	Unit established and functioning 31-Dec-2013	The unit is established and functioning 29-Jun-2018	The unit is established and functioning 29-Jun-2018

Comments (achievements against targets): Achieved: 100% This unit, the General Directorate for Addressing Climate Change in the Agro-Livestock Sector within SAGARPA, has enabled SAGARPA to play a prominent role in promoting sustainable productive systems and in providing incentives to stakeholders to participate/engage in Climate Change mitigation. Further, this unit monitors and supervises the activities of sub-sector CC programs, forges links to other, similar public programs in other sectors to find synergies and improve results/outcomes, and is responsible for reporting to federal authorities on activities developed to mitigate and accurately measure GHG emissions as part of the national CC strategy. See PDO Indicator #3 above for details.

Indicator Name	Unit of	Baseline	Original Target	Formally Revised	Actual Achieved at

	Measure			Target	Completion
Number of Inter-ministerial workshops promoting collaboration and knowledge sharing on climate change activities related to the project carried out	Text	0 19-Jan-2009	6 31-Dec-2013		17 29-Jun-2018

Comments (achievements against targets): Exceeded: 283% See ICR Main Text Section II E.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Number of SAGARPA/FIRCO staff that participated in training events organized by the project	Text	0 19-Jan-2009	156 31-Dec-2013	280 29-Jun-2018	386 29-Jun-2018

Comments (achievements against targets): Exceeded: 138% Institutional development training events were an important project activity over time, involving SAGARPA and FIRCO (including its decentralized offices) along with other agencies involved in renewable energy activities: e.g., Federal Electricity Commission (FEC); Electric Energy Shared Risk Trust (FIDA); and, Agricultural Shared Risk Trust (FIRA). Training addressed key themes: the technology and methodology for evaluating proposals technically and economically; project administration processes; Bank rules; Project dissemination and documentation. Training was limited in the early years by GEF flow-of-funds issues but recouped and exceeded the target.

Component: 4. Project Management, Monitoring and Evaluation

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised	Actual Achieved at Completion

				Target	
Quarterly physical and financial status reports prepared and submitted to the Bank	Text	Reports submitted to the Bank 19-Jan-2009	Quarterly 31-Dec-2013	Reports submitted to the Bank 29-Jun-2018	Reports submitted to the Bank 29-Jun-2018

Comments (achievements against targets): Achieved: 100% Quarterly physical and financial status reports were submitted to schedule throughout.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Semi-annual documents on lessons learned and policy implications are prepared. To coincide with supervision missions	Text	Reports submitted to the Bank 19-Jan-2009	Semi-annual 31-Dec-2013	Reports submitted to the Bank 29-Jun-2018	Reports submitted to the Bank 29-Jun-2018

Comments (achievements against targets): Achieved: 100% Documents were prepared in advance of supervision missions and discussed with missions.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Planning process followed as defined in the Operations Manual describing when and how Annual Implementation Plans (AIP) and quarterly and	Text	AIP prepared and submitted to the Bank 19-Jan-2009	AIP prepared and submitted to the Bank 31-Dec-2013	AIP prepared and submitted to the Bank 29-Jun-2018	AIP prepared and submitted to the Bank 29-Jun-2018

monthly plans prepared based on Project Implementation Plan					

Comments (achievements against targets): Achieved: 100%

B. KEY OUTPUTS BY COMPONENT

Objective/Outcome 1 (PDO): **Promote the adoption of environmentally sustainable technologies in agri-business (PDO)** **Objective/Outcome 1 (GEO): Promote the adoption of GHG (CO2) emission-reduction technologies by agri-businesses, thus contributing to the goals of the National Strategy on Climate Change (GEO)**	
Outcome Indicators	**PDO:** Number of small and medium-sized agri-businesses adopting sustainable technologies (renewable energy sources, energy efficient technologies and/or sustainable waste management and biomass conversion) 1,842 **agribusinesses (85.0% of target)/2,286 technologies (105.4% of target)** **GEO:** Tons of CO2 equivalent reduced **[6,021,967 Ton CO2 e (303.0%)]** SAGARPA successfully formulating climate change adaptation and mitigation policies and programs in the agro-livestock sector and monitoring their implementation. **[Yes (100%)]**
Intermediate Results Indicators	**Component 1: Investments in Environmentally Sustainable Technologies in Agribusinesses** **PDO/GEO:** Number of agri-businesses having adopted low carbon intensity technologies [**1,842 agribusinesses (85.0%)]** **PDO/GEO:**

	Number of KWh of energy saved from adoption of energy efficient technologies (and corresponding tons of avoided CO2e emissions) [**382,140 kWh (124.0%) and 205,721 Ton CO2e (270.1%)]** Number of MWH energy is produced by biomass (and corresponding tons of CO2e emissions avoided) **[221,624 MWh (98.5%) and 5.78 million Ton CO2e (377.8%)]** **Component 2: Investment and Production Support Services** **PDO/GEO:** Number of energy-efficient and/or renewable energy subprojects prepared (Dropped by AF but still monitored by FIRCO) [**2,286 (105.4%)]** Number of agribusiness employees/representatives who participated in training events organized by the project [**994 (107.0%)]** Number of energy-efficiency and/or renewable energy subprojects that received technical assistance for the preparation of business plans for energy efficiency and/or renewable energy technologies. [**2,286 (105.4%)]** Number of energy-efficiency and/or renewable energy subprojects that received technical assistance on energy efficiency and/or renewable energy technologies during implementation. **[2,286 (105.4%)]** 4 pilot projects carried out to demonstrate and validate other technological innovations that could be proposed under the project. **[4 (100%)]**

	Component 3: Institutional Strengthening **PDO/GEO:** Number of SAGARPA/FIRCO staff that participated in training events organized by the project. **[386 (137.9%)]** **GEO:** Number of Inter-Ministerial workshops promoting collaboration and knowledge sharing on climate change activities related to the project, carried out. **[17 (283.3%)]** A unit within SAGARPA is established to support and/or to formulate, implement and monitor Climate Change mitigation and adaptation policies and programs in the agriculture sector. See Annex 1. **[Yes (100%)]** **Component 4: Project Management, Monitoring and Evaluation** **PDO/GEO:** SAGARPA/FIRCO project staff, including regional staff, in place and functioning at all times during the project with sufficient capacity to carry out all project activities. **[278 – no target]** Quarterly physical and financial status reports prepared and submitted to the Bank. **(20 (100%)]** Semi-annual documents on lessons learned and policy implications are prepared coinciding with supervision missions. **[17/no target for AF, 200% achieved under original project]**

	Planning process to be followed as defined in the Operations Manual describing when and how Annual Implementation Plans (AIP) and quarterly and monthly plans will be prepared based on Project Implementation Plan (PIP). **[No target/Operational Manual (MOP) Planning processes followed/100%]**
Key Outputs by Component (linked to the achievement of the Objective/Outcome 1)	**Component 1: Investments in Environmentally Sustainable Technologies in Agribusinesses** # Mexican States with project investments (Target 30): [**30 (100%)]** # Promotional events: **[130 (106%)]** # Subprojects by beneficiary agribusiness size: Micro (**1,058**), Small (**789**) Medium (**300**) and Large (**67**)[28] # Agribusinesses with more than one subproject: **[Est. 250 (No Target)]** # Bio-digesters financed: **[419 (110.6%)]** # Photovoltaic systems financed: **[738 (394.7%)]** # Solar heating systems financed: **[162 (37.0%)]** # Motor-generators financed: [**214 (125.1%)]** # High efficiency pumps financed: **[700 (106%)]** # Agribusinesses with O&M arrangements with suppliers (%): **[Est. 50% (No target)]** **Component 2: Investment and Production Support Services** # Studies financed by the project**: [4 (100%)]** # Final project evaluation prepared and reviewed by Bank: **[Zero (Target 1)]** **Component 3: Institutional Strengthening**

[28] No targets due to demand-driven nature of the project, and results are based on shares of a total 2,214 total technology subprojects (best information at the time).

	# Training courses to SAGARPA, FIRCO and other agencies in renewable energy (works, equipment and specifications): **[30 (no target)]** # Training courses to SAGARPA, FIRCO and other agencies in administrative processes and Bank rules: **[13 (no target)]** # Training events for FIRCO including its state units, in Bank procurement: **[3 (no target)]** # FIRCO technicians receiving foreign/external training: **[66 (no target)]** # Demonstration days to promote technology adoption: **[154 (no target)]** # Promotional materials developed and disseminated: **[257,050 copies of fliers, brochures, magazines, manuals (no target)]** **Component 4: Project Management, M&E** Preparation by FIRCO of a budget for the Implementation Team: **100%** Development of a project portal: **100%**

ANNEX 2. BANK LENDING AND IMPLEMENTATION SUPPORT/SUPERVISION

A. TASK TEAM MEMBERS

Name	Role
Preparation	
Michael Carroll	CoTTL
Marie-Helene Collion	TTL
Roberto Aiello	
Gabriella Elizondo Azuela	
Lasse Ringius	
Gabriel Penalosa	Procurement Specialist
Victor Ordonez Conde	
Juan Carlos Alvarez	
Alberto Yanosky	Environmental Safeguards Specialist/Cons
Julie Godin	
Supervision/ICR	
Marie-Helene Collion	Task Team Leader
Michael Carroll	Co-Task Team Leader
Svetlana Edmeades	Task Team Leader
Katie Kennedy Freeman	Task Team Leader
Gabriel Penaloza	Senior Procurement Specialist
Luis Barajas Gonzalez	Financial Management Specialist
Alberto Yanosky	Environmental Safeguards Specialist/Cons
Guillermo Hernandez Gonzalez	Senior Energy Specialist
Arelia Jacive Lopez Castaneda	Social Safeguards Specialist/Cons
Erika Felix	Agricultural Economist/FAO
Yerania Sanchez	Agricultural Economist/FAO
Anna Roumani	ICR Author/Consultant

B. STAFF TIME AND COST

Stage of Project Cycle	Staff Time and Cost	
	No. of staff weeks	US$ (including travel and consultant costs)
Preparation		
FY07	2.300	27,268.55
FY08	40.736	207,152.86
FY09	26.161	120,470.85
Total	**69.20**	**354,892.26**
Supervision/ICR		
FY09	5.170	8,022.39
FY10	16.702	76,138.50
FY11	12.860	79,709.06
FY12	20.477	113,743.30
FY13	10.820	65,227.42
FY14	14.900	134,059.80
FY15	21.071	103,900.61
FY16	24.025	128,481.13
FY17	15.365	89,336.32
FY18	14.665	88,391.87
FY19	10.275	79,413.98
Total	**166.33**	**966,424.38**

ANNEX 3. PROJECT COST BY COMPONENT

Original Project (7652 MX)

Components	Amount at Approval (US$M)	Actual at Project Closing (US$M)	Percentage of Approval (US$M)
1. **Investments in environmentally sustainable technologies in agri-business**	151.04	224.08	148.36
2. Investment and Production Support Services	10.91	0.03	0.27
3. Institutional Strengthening	3.59	0.24	6.69
4. Project Management, Monitoring and Evaluation	2.45	0.27	11.02
Contingencies	0.37	0.00	0.00
Total	**168.35**	**224.62**	**133.42**

Additional Financing (8216 MX)

Components	Amount at Approval (US$M)	Actual at Project Closing (US$M)	Percentage of Approval (US$M)
1. **Investments in environmentally sustainable technologies in agri-business**	120.75	129.27	107.06
2. Investment and Production Support Services	---	0.15	0.00
3. Institutional Strengthening	---	1.89	0.00
4. Project Management, Monitoring and Evaluation	---	2.27	0.00
Contingencies	0.00	0.00	0.00
Total	**120.75**	**133.58**	**110.63**

Project Financing

Sources of Funds	Original Project			Additional Financing		
	Amount at Approval (US$M)	Actual at Closing (US$ M)	%	Amount at Approval (US$ M)	Actual at Closing (US$ M)	%
IBRD	50.00	46.80	93.60	50.00	32.25	64.50
GEF	10.50	1.36	13.05	--	7.89	75.14
Borrower	27.74	33.12	119.40	--	21.64	--
Beneficiaries	80.11	143.34	179.92	70.75	71.80	101.50
Total:	**168.35**	**224.62**	**133.42**	**120.75**	**133.58**	**111.62**

Source: NAFIN/FIRCO 2018

ANNEX 4. EFFICIENCY ANALYSIS

1. **Scope of Analysis.** The efficiency analysis of the Mexico Sustainable Rural Development Project focuses on four areas: i) cost effectiveness assessment of project investments; ii) economic and financial analysis; iii) project's implementation efficiency; and, iv) sustainability.

2. **Sources of data**. Baseline information on key performance variables was available for the universe of technologies supported by the project. Given the project development objective, some of the most relevant variables tracked by the project are: renewable energy produced/energy saved, GHG emissions avoided (in tons of CO2eq) and investments (sorted by source). The baseline was supplemented with information from the Monitoring and Evaluation System of the project as well as the Borrower Completion Report (first draft prepared by FIRCO in October 2018) and financial reports from the Fiduciary Agent (last report prepared by NAFIN in October 2018).

3. The categories of renewable energy and energy efficiency technologies, with the number of technologies, supported by each category and other relevant information, are summarized in Table 1.

Table 1. Investment in technologies supported by Mexico Sustainable Rural Development Project to promote the adoption of renewable energy and energy efficiency technologies.

TECHNOLOGIES BY CATEGORY					AVERAGE		
Number of technologies	Category: Thermal Systems - Capacity (m3)	Fuel savings lt/year	Tons of CO2eq avoided/year	Investment (US$)	Fuel savings lt/year	Tons of CO2eq avoided/year	Investment (US$)
82	0 a 4	688,387	1,036	1,774,352	8,395	13	21,638
34	5	448,212	955	1,562,313	13,183	28	45,950
25	6 a 10	495,371	1,012	1,550,307	19,815	40	62,012
21	11 a 50	883,164	2,016	1,914,472	42,055	96	91,165
162	Total	2,515,134	5,019	6,801,444	15,526	31	41,984
TECHNOLOGIES BY CATEGORY					AVERAGE		
Number of technologies	Category: Biodigester - Type of Units	Biogas production m3/year	Tons of CO2eq avoided/year	Investment (US$)	Biogas production m3/year	Tons of CO2eq avoided/year	Investment (US$)
9	Agroindustry	1,294,033	6,224	1,358,770	143,781	692	150,974
18	TIF	5,220,796	24,935	4,270,461	290,044	1,385	237,248
121	Cattle Farm	65,393,404	206,840	20,974,349	540,441	1,709	173,342
1	Poultry Farm	7,500	550	62,228	7,500	550	62,228
270	Pig Farm	139,553,561	962,598	42,268,312	516,865	3,565	156,549
419	Total	211,469,294	1,201,147	68,934,121	504,700	2,867	164,521
TECHNOLOGIES BY CATEGORY					AVERAGE		
Number of technologies	Category: Motogenerators - Nominal Capacity (Kw)	Energy savings Kwh/year	Tons of CO2eq avoided/year	Investment (US$)	Energy savings Kwh/year	Tons of CO2eq avoided/year	Investment (US$)
128	30-60	13,112,344	6,506	5,371,268	102,440	51	41,963
60	65-160	13,488,046	6,667	5,033,406	224,801	111	83,890
188	Total	26,600,390	13,173	10,404,674	141,491	70	55,344
TECHNOLOGIES BY CATEGORY					AVERAGE		
Number of subprojects	Category: Turbines - Output power (Kw)	Energy savings Kwh/year	Tons of CO2eq avoided/year	Investment (US$)	Energy savings Kwh/year	Tons of CO2eq avoided/year	Investment (US$)
8	30	1,178,001	597	757,308	147,250	75	94,663
18	60-200	5,483,067	2,770	2,140,628	304,615	154	118,924
26	Total	6,661,068	3,367	2,897,935	256,195	129	111,459

TECHNOLOGIES BY CATEGORY					AVERAGE		
Number of technologies	Category: Photovoltaic Systems - Output Power (kwp)	Energy savings Kwh/year	Tons of CO2eq avoided/year	Investment (US$)	Energy savings Kwh/year	Tons of CO2eq avoided/year	Investment (US$)
417	0-39	13,213,631	6,405	25,846,325	31,687	15	61,982
199	40-59	16,845,336	8,098	27,097,491	84,650	41	136,168
122	60-125	13,988,589	6,487	16,841,816	114,661	53	138,048
738	Total	44,047,556	20,990	69,785,632	59,685	28	94,560
TECHNOLOGIES BY CATEGORY					**AVERAGE**		
Number of technologies	Category: Energy Efficiency - Type of Equipment	Energy savings Kwh/year	Tons of CO2eq avoided/year	Investment (US$)	Energy savings Kwh/year	Tons of CO2eq avoided/year	Investment (US$)
19	High efficiency boiler	14,415,174	3,944	1,539,974	758,693	208	81,051
63	Cold storage	9,349,609	4,662	7,371,523	148,406	74	117,008
25	Ligthing	1,792,976	881	1,028,997	71,719	35	41,160
26	Efficient motors	1,314,159	644	1,074,703	50,545	25	41,335
1	Heat recovery	691,233	157	46,630	691,233	157	46,630
93	Efficient water pumps	13,394,848	6,563	2,577,061	144,031	71	27,710
87	High efficiency chilling system	7,559,339	3,285	6,984,411	86,889	38	80,281
314	Total	48,517,338	20,137	20,623,300	154,514	64	65,679
TECHNOLOGIES BY CATEGORY					**AVERAGE**		
Number of technologies	Category: Energy Efficiency Irrigation Pumping - Water lifted (m3)	Energy savings Kwh/year	Tons of CO2eq avoided/year	Investment (US$)	Energy savings Kwh/year	Tons of CO2eq avoided/year	Investment (US$)
214	0 < 20k	12,543,457	6,044	5,379,915	58,614	28	25,140
75	20k to 300k	6,910,980	3,329	2,075,537	92,146	44	27,674
62	>300k to 500k	5,764,071	2,864	1,927,598	92,969	46	31,090
35	>500k	5,601,698	2,625	1,156,178	160,049	75	33,034
386	Total	30,820,205	14,862	10,539,228	79,845	39	27,304
TECHNOLOGIES BY CATEGORY					**AVERAGE**		
Numebr of technologies	Category: Biomass energy systems	Fuel savings in litres/year	Tons of CO2eq avoided/year	Investment (US$)	Fuel savings lt/year	Tons of CO2eq avoided/year	Investment (US$)
5	All typologies	1,754,655	5,558	1,884,980	350,931	1,112	376,996
TECHNOLOGIES BY CATEGORY					**AVERAGE**		
Number of technologies	Auxiliary investment	Investment (US$)			Investment (US$)		
48	Electricity grid interconnection	23,860,849			497,101.02		
ALL TECHNOLOGIES AND CATEGORIES					**AVERAGE**		
TOTAL - All categories	All categories		Tons of CO2eq avoided/year	Investment (US$)		Tons of CO2eq avoided/year	Investment (US$)
2,286	**All technologies**		**1,284,252**	**191,871,315**		**562**	**83,933**

Source: own calculations based on information from the project's Monitoring and Evaluation System, FIRCO and NAFIN.

Note on tons of CO2eq avoided when considering all technologies: The tons of CO2eq avoided by all technologies per year implies that the corresponding technologies are fully operative in a given year. The technologies were implemented in different years along the project implementation period.

Note on investment (US$): The information on investment corresponds to the amount invested in that specific technology, with financing from IBRD, GEF and/or Government (through national programs) and a contribution from agribusinesses. The economic analysis considers all project costs (of the four project components).

Cost Efficiency Analysis

4. **Renewable energy and energy efficiency**. The Mexico Sustainable Rural Development Project invested in renewable energy and energy efficient technologies for micro, small and medium-sized agribusinesses in Mexico. To support the adoption, adequate operation and sustainability of these technologies, the project also invested in institutional strengthening, technical assistance and pilots for new technologies as well as studies to assess various likely co-benefits (environmental, social and economic additional benefits) generated by the project interventions. A total of 2,286 technologies were supported by the project; each technology corresponded to one renewable energy or energy efficient technology among the categories financed by the project.

5. For every dollar invested in renewable energy and energy efficient technologies, diverse levels of energy production/savings and of GHG emissions' reduction (expressed in tons of CO2eq) were achieved. As expected, in terms of capacity, most technologies show economies of scale: in every category of technology, the largest capacities tend to reach the highest energy savings and GHG emissions' reduction per dollar invested by the project. This tendency also applies to the tons of CO2eq abated per each unit of clean energy produced or energy saved through project interventions. Regarding the bio-digesters, the best results – in terms of biogas production and GHG emissions' reduction – per every dollar invested come from the pig farms and cattle farms. For the energy efficient technologies, the best performers per every dollar invested are the heat recovery systems, followed by the efficient water pumps.

6. In terms of unit costs of renewable energy produced / energy saved and GHG emissions' reduction, there are clear economies of scale for the unit cost of tons of CO2eq avoided but it is less evident when considering unit cost of energy produced/energy saved – except for photovoltaic systems. The solar thermal systems have lower unit costs for the smallest and largest capacities. In general, the lower unit costs correspond to bio digesters implemented in pig farms, cattle farms and TIF Plants as well as heat recovery systems, high efficiency boilers and efficient water pumps (under the category of energy efficient technologies); all of them have unit costs for tons of CO2eq below US$20 dollars. Table 2 summarizes the information on unit costs for the categories of technologies supported by the project. It was elaborated considering information from the universe of technologies supported by the project.

7. Comparisons to appraisal stage cost estimates (ex-ante cost-benefit analysis based on FOMAGRO Program, 2002-2007) are complicated by the rapid change in the cost of technologies. Global benchmarks for unit costs are influenced by the site-specific nature of installation of technologies. Furthermore, comparisons to international examples would require attention to variables such as technical specificities, years of reference as well as applicable discount and exchange rates. Nonetheless, comparing tons of CO2 abated per unit of renewable energy produced or per unit of fossil fuel displaced is a more indicative approach. There is some analysis that provide useful

orientations in the case of Mexico[29]. For instance, a reference for tons of CO2eq emissions avoided per Kwh by a photovoltaic system is 0.0003 which is lower than the average proportion attained by the project (0.00048 tonCO2eq/Kwh) in this particular category of technologies.

8. It is important to notice that, in the context of the Mexican agriculture sector, the project has been a key initiative to facilitate the business environment for these types of investments. It provided the basic conditions for an initial demand and for the development of local technology providers.

Table 2. Cost Efficiency Analysis of technologies supported by the project.

Category: Thermal Systems - Capacity (m3)						
Number of technologies	Category: Thermal Systems - Capacity (m3)	Fuel savings in litres/US$	TonCO2eq/US$	TonCO2eq/Fuel lt	Cost US$/Fuel lt	Cost US$/TonCO2eq
82	0 a 4	7.76	0.0117	0.0015	0.129	85.64
34	5	5.74	0.0122	0.0021	0.174	81.82
25	6 a 10	6.39	0.0131	0.0020	0.156	76.57
21	11 a 50	9.23	0.0211	0.0023	0.108	47.48
162	Total	7.40	0.0148	0.0020	0.135	67.76
Category: Biodigester - Type of Units						
Number of technologies	Category: Biodigester - Type of Units	Biogas m3/US$	TonCO2eq/US$	TonCO2eq/Biogas m3	Cost US$/Biogas m3	Cost US$/Biogas m3
9	Agroindustry	19.05	0.0168	0.0009	0.053	59.65
18	TIF	24.45	0.0687	0.0028	0.041	14.55
121	Cattle Farm	62.36	0.1484	0.0024	0.016	6.74
1	Poultry Farm	2.41	0.0434	0.0180	0.415	23.05
270	Pig Farm	66.03	0.3480	0.0053	0.015	2.87
419	Total	61.35	0.2631	0.0043	0.016	3.80
Category: Motogenerators - Nominal Capacity (Kw)						
Number of technologies	Category: Motogenerators - Nominal Capacity (Kw)	Kwh/US$	TonCO2eq/US$	TonCO2eq/Khw	Cost US$/Kwh	Cost US$/tonCO2eq
128	30-60	48.82	0.0242	0.0005	0.020	41.28
60	65-160	53.59	0.0265	0.0005	0.019	37.75
188	Total	51.13	0.0253	0.0005	0.020	39.49
Category: Turbines - Output power (Kw)						
Number of technologies	Category: Turbines - Output power (Kw)	Kwh/US$	TonCO2eq/US$	TonCO2eq/Kwh	Cost US$/Kwh	Cost US$/TonCO2eq
8	30	31.11	0.0158	0.0005	0.032	63.46
18	60-200	51.23	0.0259	0.0005	0.020	38.64
26	Total	45.97	0.0232	0.0005	0.022	43.04
Category: Photovoltaic Systems - Output Power (kwp)						
Number of technologies	Category: Photovoltaic Systems - Output Power (kwp)	Kwh/US$	TonCO2eq/US$	TonCO2eq/Kwh	Cost US$/Kwh	Cost US$/TonCO2eq
417	0-39	10.22	0.0050	0.0005	0.098	201.77
199	40-59	12.43	0.0060	0.0005	0.080	167.30
122	60-125	16.61	0.0077	0.0005	0.060	129.81
738	Total	12.62	0.0060	0.0005	0.079	166.23
Category: Energy Efficiency - Type of Equipment						
Number of technologies	Category: Energy Efficiency - Type of Equipment	Kwh/US$	TonCO2eq/US$	TonCO2eq/Kwh	Cost US$/Kwh	Cost US$/TonCO2eq
19	High efficiency boiler	187.21	0.0512	0.0003	0.005	19.52
63	Cold storage	25.37	0.0126	0.0005	0.039	79.06
25	Ligthing	34.85	0.0171	0.0005	0.029	58.42
26	Efficient motors	24.46	0.0120	0.0005	0.041	83.43
1	Heat recovery	296.47	0.0673	0.0002	0.003	14.86
93	Efficient water pumps	103.95	0.0509	0.0005	0.010	19.63
87	High efficiency chilling system	21.65	0.0094	0.0004	0.046	106.30
314	Total	47.05	0.0195	0.0004	0.021	51.21
Category: Energy Efficiency Irrigation Pumping - Water lifted (m3)						
Number of technologies	Category: Energy Efficiency Irrigation Pumping - Water lifted (m3)	Kwh/US$	TonCO2eq/US$	TonCO2eq/Kwh	Cost US$/Kwh	Cost US$/TonCO2eq
214	0 < 20k	46.63	0.0225	0.0005	0.021	44.51
75	20k to 300k	66.59	0.0321	0.0005	0.015	31.17
62	>300k to 500k	59.81	0.0297	0.0005	0.017	33.65
35	>500k	96.90	0.0454	0.0005	0.010	22.03
386	Total	58.49	0.0282	0.0005	0.017	35.46
Category: Biomass energy systems						
Numebr of technologies	Category: Biomass energy systems	Fuel savings in litres/US$	TonCO2eq/US$	TonCO2eq/Fuel lt	Cost US$/Fuel lt	Cost US$/TonCO2eq
5	All typologies	18.62	0.0590	0.0032	0.054	16.96

[29] José Miguel González Santaló, 2016. Los costos de reducir emisiones de CO2. *https://www.energiaadebate.com/los-costos-de-reducir-emisiones-de-co2/*

Source: own calculations based on information from the project's Monitoring and Evaluation System, FIRCO and NAFIN.
Note: in line with the financial analysis, the stream of energy produced/energy saved and GHG emissions' reduction is calculated based on a twenty-year period.

i) Economic and Financial Analysis

9. **The Economic and Financial Analysis at appraisal stage**. Given the demand-driven nature of activities implemented by the project, the exact composition of investments in renewable energy and energy efficient technologies was not established a priori. Therefore, the ex-ante cost-benefit analysis of the project was based on investment models (for selected technologies), derived from the FOMAGRO Program (2002-2007) database. The technologies are classified in two categories: (i) investments in renewable energy sources (mainly solar panels, bio digesters with generators, and photovoltaic systems connected to the grid); and, (ii) investments to improve energy efficiency (i.e. investments in efficient engines, efficient cooling/heating systems, etc.). Average technical references and average investment size was taken from the database and applied to the models. The models were used to calculate financial indicators for the selected technologies. However, the economic evaluation to calculate economic rates of return was not carried out, the main reason being the complexity of the system of energy subsidies. The Project Appraisal Document indicates that the economic rate of return would be considerably higher than the financial rate of return as the levels of subsidies is quite high.

10. **The Ex-post Economic and Financial Analysis**, presented in this section, provides economic and financial indicators for the universe of technologies that received support from the Mexico Sustainable Rural Development Project. The only point of comparison between the ex-ante and ex-post evaluations is the financial analysis of technologies (given that the ex-ante evaluation did not integrate the economic analysis). An economic analysis is of outmost importance given that the stream of benefits coming from this project is substantially undervalued if using market prices or omitting services that have no actual access to current markets.

11. **Economic Analysis**. To measure the economic worth of the project from the perspective of society, a standard ex-post economic cost-benefit analysis was performed. The economic value of the net CO2eq emissions reduced through the project's interventions is valued at shadow prices and included in the economic analysis on the basis of the latest World Bank guidelines.[30] Three scenarios have been estimated which include a Baseline as well as a 'Low price' and a 'High Price' valuation of the potential GHG net emissions' reduction, generated through project interventions. For the 'Baseline' scenario, excluding the GHG net emissions' reduction economic valuation, this analysis yielded an Economic Internal Rate of Return (E-IRR) of 17 percent, and a Net Present Value (NPV) of USD 95.9 million.[31] For the 'Low Price' scenario, this analysis yielded an Economic Internal Rate of Return (E-IRR) of 33 percent, and a Net Present Value (NPV) of USD 274.1 million. For the 'High Price' scenario, the analysis yielded an Economic Internal Rate of Return (E-IRR) of 65 percent, and the Net Present Value (NPV) of USD 571.1 million.

[30] Guidance note on shadow price of carbon in economic analysis. World Bank, September, 2017.
[31] Applying a discount rate of 10%, as per SHCP- Investment Unit, Circular No.400.1.410.14.009, January13, 2017.

12. The robustness of these results to changes in the projected costs and benefits streams was tested and confirmed through a sensitivity analysis. For this, switching values[32] with respect to cost increases and reductions of economic benefits were estimated. In the case of a 'Baseline' scenario, the switching value for cost increments was estimated at 31%, while that for reduction in benefits was approximately 24%. This means that the Project would remain economically feasible, or in other words, a good investment for society in general, even if projects costs were to increase by as much 31% or projected benefits were to decrease by 24%. Table 3 summarizes the results of the economic analysis.

Table 3. Economic Analysis

Economic Analysis	E-IRR (%)	NPV (US$)	Switching value for costs	Swtiching value for revenues
Baseline	17%	95,946,570	31%	24%
Low price scenario	33%	274,134,051	88%	47%
High price scenario	65%	571,113,187	184%	65%

13. Based on the above results it can be concluded that the Project is a sound investment from the society's perspective. All the same when accounting for the robustness of the indicators tested with significant levels of variability to estimated costs and benefits.

14. **Project Costs.** The stream of costs considered in the Project's cost-benefit analysis comprises the Project's yearly implementation costs for all components, including co-financing by private sector (agribusinesses) and; the expected incremental recurrent expenses (operation and maintenance expenses) of equipment financed by the Project (under Component 1) through the whole period of analysis. The period of analysis used in the economic analysis was 25 years. It was established taking into account the likely useful life of the technology promoted by the Project (20 years). The operation and maintenance costs assumptions for the different technologies are detailed at the end of this section, together with all other relevant assumptions.

15. **Project Economic Benefits.** Project economic benefits accounted for in the analysis are all derived from Component 1. They come in the way of net reductions to energy costs and of GHG emissions arising from the displacement of currently used higher-cost/high-carbon energy generated from fossil fuels, by renewable and lower cost/low-carbon sources, such as solar energy (through photovoltaic systems, solar thermal systems), biogas (through moto-generators and turbines), etc. Other benefits accounted for in the analysis stem from energy reduction costs accrued through the adoption of a high energy-efficient technology (e.g. cold storage, milk-chilling equipment).

16. The reduction of energy expenses with respect to the counterfactual (i.e. the without-project scenario), result from the use of lower-cost energy sources (by reducing the unit cost for energy) and the adoption of highly energy-efficient technology (by reducing energy consumption). In cases where no energy is being displaced, and beneficiaries are off the grid, the economic benefit is the value of the clean energy produced with the new technology.

17. The value of the energy to be produced and displaced was based on historical series of prices of

[32] The switching value reflects the maximum increased in costs or decrease in revenues, expressed in percentage terms, which would turn the incremental net present value of the stream of net revenues from a particular investment to zero. In other words, it is the maximum increase in costs or decrease in revenue that an investment could withstand before turning 'unfeasible'.

electricity and relevant fuels. For the economic analysis, the price structure was analyzed, based on official information (mainly official decrees), to assess net transfers and the value added tax was excluded (i.v.a.). Due to the complexity of properly incorporating government taxes and cross-subsidies for the various energy sources and fuels, the social price estimates could be unprecise nut these are considered useful and valid for the purposes of this analysis.

18. The Project contributes to climate change mitigation through an estimated net reduction in GHG emissions. The project surpassed its target for GHG emissions' reduction (cumulative measure in tons of CO2eq) during the period of project implementation and reached a net reduction of 6.0 million tons of CO2eq. Considering the 25 year economic analysis, the project will contribute to mitigate over 21.7 million tons of CO2eq. Table 4 presents the estimated CO2eq emissions reduction by renewable energy and energy efficient technologies supported during the project implementation period as well as projections of C02eq emissions reduced for the whole period of analysis set for the economic evaluation. The Tons of CO2eq net reduction are presented in Table 4.

Table 4. Tons of CO2eq emissions' net reduction along the period of analysis

Energy produced/saved	Total reduction in tCO2eq achieved over project life	Projected average annual reductions beyond 2018 in tCO2eq	Projected 25 year total emissions reductions in tCO2eq
Eenergy produced by biomass*	5,780,000	931,231	20,446,126
Energy saved by energy efficient technologies and renevable energy technologies**	241,967	64,374	1,240,772
Total	6,021,967	995,605	21,686,898
NPV Low price scenario			198,796,715
NPV High price scenario			530,124,572

**Biomass energy systems and Biodigesters, including motogenerators to produce energy.*
**Thermal Systems, Turbines, Photovoltaic and Energy Efficiency Technologies.*

19. **Financial Analysis.** A financial cost-benefit analysis for the Project as a whole would not be relevant, as project design did not contemplate that the financial return from public investment ought to cover the corresponding financial costs. However, it is pertinent to assess the sustainability of technologies from a financial perspective, and thus a financial cost benefit analysis was performed for the different categories of technologies implemented by the project. The data used to estimate the stream of net incremental revenue per category of technologies came from the databases of the project. The financial cost-benefit analysis used much of the same general assumptions applied to the economic analysis with a few differences: the period of analysis is 20 years and market prices include i.v.a and subsidies.

20. All categories of technologies proved financially feasible with financial internal rates of return (F-IRR) higher than the assumed discount rate of 10% and financial NPV higher than cero. The results of the financial analysis are presented in Table 5.

Table 5. Financial Indicators of technologies by category

Number of technologies	Financial Analysis by category	IRR	NPV	Average NPV
162	Thermal Systems	46%	11,735,826	72,443
419	Biodigesters	38%	134,503,507	321,011
188	Motogenerators	56%	29,168,999	155,154
26	Turbines	53%	8,013,150	308,198
738	Photovoltaic Systems	12%	3,930,156	5,325
314	Energy Efficiency	42%	31,621,667	100,706
386	Energy Efficiency Irrigation Pumping	71%	30,992,592	80,292
5	Biomass energy systems	30%	3,084,567	616,913
2238	All categories*	36%	242,997,533	108,578

Note: the category of auxiliary investments to support electricity grid interconnection (48 investments) was not considered for the financial analysis.

21. **Comparison with ex-ante financial indicators**. According to the ex-ante financial analysis, for the category of investments in solar thermal systems, the IRR varies between 17% in the case of activated charcoal and 37% for cheese factories. The photovoltaic systems, are less financially attractive with IRR between 3.5% and 7.7%, especially given the fact that energy tariffs were highly subsidized in Mexico (at the time of the ex-ante evaluation). As for the returns to investments in energy efficiency technologies, the indicators range from and IRR of 14% in the case of a meat-packing facilities to 41% in the case of abattoirs. In addition, it is likely that these financial benefits would increase in the future as the price of energy is subsidized but tendency of the government policy is to gradually reduce these transfers. Finally, the financial benefits from investing in photovoltaic systems are likely to improve not only because of the reduction in energy subsidies but also due to the decreasing prices of equipment, which is expected to continue in medium-long term.

22. The ex-post financial indicators for the categories of thermal, photovoltaic and energy efficient technologies are at least (if not above) the projected results in the ex-ante evaluation.

23. The **main assumptions** used in the cost-benefit analysis are listed in Table 6.

Table 6. Main Assumptions used in the Cost-Benefit Analysis

Period of Economic Analysis	25 years
Period of Financial Analysis	20 years
Assumed useful life of equipment	20 years
Social Discount Rate / Financial Discount Rate	10%
Assumed annual operation and maintenance costs (as percentage of initial investment):	
Photovoltaic systems	1%
Thermal systems	2%
Bio digesters	5%
Moto generators	2%
Turbines	2%
High Efficiency Equipment	2%
High Efficiency water pumps	3%
Assumed shadow exchange rate	1
Social 'Low price' of CO2 equiv. US$/ton	30
Social 'High price' of CO2 equiv. US$/ton	80
The time series of exchange rates were taken from Mexico's Central Bank. Adjusted time series were used to calculate prices of energy in USD. It was necessary given recent spike in the exchange rate for the Mexican Peso (MXN) against the US Dollar (USD). When converting MXN prices to USD prices, without adjusting the exchange rate, the actual growing tendency of prices was reverted and decreasing steadely (which contradicts not only the current policy reforms but the projected tendency over time).	
Electricity tariffs (2 for commercial use and 9 for irrigation) are taken from CFE and historical series were also consulted from SENER and CRE.	
Prices of Fuel oil, Diesel, G.L.P., and Natural Gas are taken from PEMEX and historical series were also consulted from SENER and CRE.	

ii) Project Implementation Efficiency

24. The project faced significant challenges during implementation in relation to: a) budgetary and administrative restrictions imposed by national regulations; b) exchange rate fluctuations; and, c) market distortions and other barriers to the adoption of renewable energy and energy efficient technologies.

25. **Budgetary and administrative restrictions**. The operation scheme of external credits received by the Federal Government was a key restriction in the use of financial resources from the project. In Mexico, the implementing agencies do not access the funds directly. The funding levels depend on the budgets that are annually proposed by the Federal Executive and finally authorized by the Legislative Power (Chambers of Deputies and Senators), through the agreement of the National Budget (PEF) – which does not necessarily consider the credit commitments already made by the Mexican Government. This regulatory condition ultimately impacted the achievement of the goals agreed in the credit 7652-MX and conducted to the project extension requested through the additional financing 8216-MX.

26. The change in FIRCO functions was an additional constraint for project implementation. At the beginning of project implementation, FIRCO had the mandate to promote new technologies, where the financial risk was shared with the producers. During implementation, FIRCO's functions were transformed from promoter of agribusinesses to a mere operating support agency of SAGARPA. These changes implied that FIRCO was not able to take an active part in the planning and submission of budgets to the SHCP. It resulted in the designation of budgets that did not always responded to the investment needs of the project and that were allocated to SAGARPA units, other than FIRCO. In fact, all the resources that FIRCO implemented, with regard to the commitments of the project, proceeded indistinctly from diverse units/programs of SAGARPA and SENER. As SAGARPA and SENER established the operation rules of the programs under their mandate, these did not coincide with the project specific requirements. It all resulted in extensive lobbying and administrative burdens.

27. In some fiscal years, the measures imposed by the SHCP in terms of fiscal discipline aggravated the situation. It led to the reduction and even cancellation of budgets.

28. Of the total resources dedicated to this project, based on IBRD loans, 30% of the costs were covered by the Bioenergy program (SAGARPA), 37% by the Bio economy program (SENER) and the remaining 33% from other investment support programs, which were not specific for renewable energies or energy efficiency. These other programs encompassed additional difficulties for the tagging of eligible investments within the frame of the national operation rules and the project criteria.

29. **Exchange rate fluctuations**. The continuous depreciation of the Mexican peso against the US dollar was one of the most determining factors for the low disbursement of resources from the additional financing. Regardless of the increase in the value of technologies, the conversion of the contribution from the Federal Government made in pesos to dollars for reimbursement purposes was ever decreasing. During the implementation of the additional financing, the peso lost its value against the dollar in almost 40%.

30. **Market distortions and other barriers to the adoption of renewable energy and energy efficient technologies**. The project included investments for institutional strengthening and technical assistance that certainly improved the business environment for the adoption of renewable energy and energy efficient technologies in the agriculture sector. Some examples are: technical references for the design and operation of technologies, considering local conditions; identification and support of technology providers; and, extensive efforts to create and strengthen the demand for renewable energy and energy efficient technologies in a complex sector and country context. The energy and agriculture sector are substantially subsidized. In recent years there have been relevant actions from the Federal Government of Mexico to transit from highly distorting subsidies to less distorting and even 'greener' transfers. As energy prices are less subsidized and environmental values – such as the value of GHG emissions – are considered for policy design, the market for renewable energies and energy efficient technologies will certainly develop more rapidly.

31. It is worthy to notice that, despite the challenges, the project delivered results on or above the final targets established in the results framework. Table 7 summarizes the number of technologies targeted and completed during project implementation, sorted by their corresponding financing source - original loan, additional financing and GEF Trust Fund (disbursed mainly during the implementation

of the additional financing, except for the US$1.5 million revolving fund created to support cash flow at the very start of project implementation given the many budget and administrative constrains).

Table 7. Technologies implementation targets and achievements

Technologies	Targets				Achievements				% of Target Achieved
	7652MX	8216MX	TF093134	Total	7652MX	8216MX	TF093134	Total	
Solar Thermal Systems	329	109	0	438	138	24	0	162	37
Biodigesters	300	79	0	379	333	86	0	419	111
Motogenerators and Turbines	0	131	40	171	122	37	55	214	125
Photovoltaic Systems connected to the Grid	109	78	0	187	248	490	0	738	395
Energy Efficient Technologies (including for irrigation)	0	520	141	661	217	278	205	700	106
Other: Biomass Energy Systems	0	152	0	152	0	3	2	5	3
Complementary/Auxiliary Works	0	180	0	180	26	22	0	48	27
Total	**1,084**	**940**	**262**	**2,168**	**1,084**	**940**	**262**	**2,238**	**105**

iii) Sustainability

32. The ex-post economic and financial analysis provides useful insights on the sustainability of project interventions. Even if the benefit stream of GHG net emissions' reduction is deducted from the analysis, the financial rate of return and the net present value of the renewable energy and energy efficient technologies supported by the project indicate that these are viable investments from the private perspective. It is expected that the energy reform underway and further efforts on the establishment of a carbon trading system and other carbon offset incentives, would make it even more viable for agribusiness to invest in all the categories of technologies supported by the project. These improvements will attract more technology providers and further generate a more dynamic market.

33. There are other co-benefits produced by the project, which contribute to sustainability: incremental income generation by agribusinesses, through the reinvestment of savings from reduced energy expenses; support to local employment and local economic dynamics; reduction in energy expenses for pumping water for agricultural purposes (and even reduction in water lifting if water concessions were to be better enforced with the installation of water meters); reduction in environmental pollution of air, soil and water resources, due to improvements in the management of solid and liquid waste (which gain greater relevance for agribusiness as environmental laws are enforced); and, further energy cost optimization through the implementation of cogeneration and grid interconnection.

ANNEX 5. BORROWER COMMENTS

A. Executive Summary of Borrower Completion Report (FIRCO, 2018)

A. Presentation

1. This document responds to the commitments established with the World Bank through the Project Appraisal Document (PAD) and in point 5.08 of the General Conditions for Loans, to present a Final Report that would permit evaluation of project results and development of a post-project sustainability plan.

B. PDRS background

2. The *Fideicomiso de Riesgo Compartido* (FIRCO) (Shared Risk Trust Fund), has supported validation processes and renewable energy systems since 1994 as a driving agent of new technologies, with such activities being translated into programs such as the Renewable Energy Project for Agriculture (Spanish acronym PERA), partially-financed by the World Bank and the Global Environment Facility (GEF).

3. Based on these experiences and the need to boost the use of renewable energies in agricultural productive processes, fishing, aquaculture and agribusiness to reduce their carbon footprint as well as to stimulate greater productivity, FIRCO managed resources with the World Bank under a first Loan, 7652 MX for US$50 million and a GEF Grant for US$10.5 million USD (TF 093134) whose agreements were signed in 2009 and became effective in 2010. These resources supported the "Sustainable Rural Development Project for the Promotion of Alternative Energy Sources in Agribusinesses, and to Promote Energy Efficiency in the Agricultural Sector" (PDRS).

4. Due to the results achieved by this operation and facing growing demand from the country's agribusinesses, a second loan was processed, 8216-MX for US$50 million (and the GEF Grant was extended), which became effective in 2013 and had an original closing date of December 2016, subsequently extended to conclude in June 2018.

5. The main objective of the PDRS was to "Contribute to the reduction of greenhouse gases (Spanish acronym GEI) to mitigate the impacts of climate change through the adoption of renewable energy and energy efficiency practices in productive processes of agribusinesses, to promote energy savings and reduce production costs, thus increasing companies' profitability.

C. Components of the PDRS

6. The operation of the PDRS is structured under four main components:

- Investment in Sustainable Environmental Technologies for Agribusiness
- Investments in Services to Support Production
- Institutional Strengthening
- Project Management, Monitoring and Evaluation

C.1 Component for Investment in Sustainable Environmental Technologies in Agribusinesses

7. Financing in the framework of this component, both for renewable energy systems and the practices for efficient use of energy, was conducted through Consensus Agreements under the scheme of the Special Projects of the Secretariat of Agriculture, Livestock, Rural Development, Fishery and Food (SAGARPA) and the Secretariat of Energy (SENER), through which this subsidiary support was given once to the beneficiaries for the amount specified in each case and according to what was established in the Operational Regulations of each Special Program. Under this scheme, FIRCO acted as the Executing Agent for the support while the different areas of SAGARPA and SENER acted as the Responsible Units with the authority to determine coverage, support amounts and requirements of the Special Programs.

8. In the components, two types of projects are considered: those focused on establishing production systems and use of renewable energy and systems focused on application of practices for the efficient use of energy. The indicative targets during the period of validity of the PDRS were based both on the goals and indicators of the original 7652-MX loan and the GEF Grant TF-93134 and revised versions for the additional loan 8216-MX (Arrangement for Results' Monitoring), as well as those used to measure the impact and monitoring indicators of the PDRS. The general target for the number of promoted subprojects was surpassed by 5 percentage points, reaching 2,286 subprojects.

9. While this number of subprojects is relevant, the benefits derived from them are greater, since throughout the period of PDRS validity, GHG emissions were reduced by a volume exceeding 6 million tons of CO_2, twice what was predicted and agreed; the demand for electric energy diminished by 382,140 KWh due to the adoption of efficient energy use practices; and, 221,600 MWh were produced by using biomass and photovoltaic systems inter-connected to the grid.

10. Regardless of the fact that the promotion of the different renewable energy systems was the same, factors such as the timing of system installation, the availability of biomass for use and the type of energy required, influenced the demand for support resulting in certain technologies like solar thermal and the use of other biomass (different from those derived from pigs and cattle) had low demand, while other systems were in high demand and absorbed most of the assistance, e.g., photovoltaic systems inter-connected to the grid, bio-digesters for generation of biogas and motor-generation equipment to use the biogas.

11. With regards to subprojects for energy efficiency, that goal was surpassed as well. Coverage of these activities was in pumping systems for high efficiency wells, Chiller-type cooling systems, cold chamber rehabilitation, substitution of boilers and heat recovery units. In this case, subprojects were partly covered by GEF Grant resources.

C.2. Investment in Production Support Services

C.2.1. Subcomponent for the Formulation of Business Plans

11. The application of resources in this case was practically zero, since, under the ROs of SAGARPA's Special Programs, the formulation of these Plans was found to be outside the program's support; therefore, it was decided that this investment should be performed by the proponents to encourage their interest, ensure their participation and the seriousness of the proposals embodied in their subprojects, and attainment of the corresponding support. Aside from this, technical staff of FIRCO's State Management and the PDRS Implementation Team (EDI) provided guidance and advice to adjust the

Business Plans at the request of solicitants. This change was notified to the World Bank and was the object of an agreement to transfer the resources available to other components.

C.2.2 Training and Technical Consultancy Subcomponent

12. An important part of the process of adoption of renewable clean energy and efficient use of energy was through training of producers and private technicians, for which the target of 930 trainees was surpassed by 7.0% with 994 trained by means of specific courses for each technology. The technical assistance services were provided by the staff of FIRCO's State Management and the External Consultants from the EDI located in the entities of the different countries. The number of subprojects covered by this service was 2,286.

C.2.3 Energy Diagnostic Subcomponent

13. The difficulties faced in the first phase of the PDRS to execute the GEF resources constrained progress in applying energy diagnostic instruments, which is why the subprojects were saved in data sheets and calculation reports that took into account the main technical characteristics of the systems as well as their energy savings and the environmental benefits estimated from their implementation. This mechanism that has shown the potential for using these types of instruments to expedite the technical and economic feasibility paperwork of the subprojects being supported, a scheme that also obtained the No Objection of the World Bank.

C.2.4 Technology Development Studies Subcomponent

14. The four agreed pilot projects were developed to evaluate the new renewable energy technologies financially, technically and environmentally to broaden the spectrum of usable systems in the sector.

15. The first of these corresponded to the "Development of Filters for Biogas" to reduce their hydrogen sulfide (H_2S) and humidity content that cause rapid wear of the motor-generators which was limiting the use of biogas for electricity generation. The prototype developed was tested at a dairy operation with good results, decreasing these two elements to levels that do not damage the motor-generation equipment, reducing the need to perform frequent maintenance services and adjustment of the motor-generator. In addition, the design is simple, affordable, easy to handle and safe for operators.

16. The second project was the "Evaluation of climatization of greenhouses through photovoltaic systems and comparison of their financial efficiency with solar thermal systems" which sought an alternative to the increasing areas exploited by greenhouses and the need to ensure operational temperature conditions to obtain better and greater production without the need for fossil fuels. This study was done only at the desk level because even though the technical evaluation projected that the use of photovoltaic systems to supply electricity to heat water or for heat pumps was feasible, the results of the financial analysis for both options determined they had zero economic feasibility compared to solar thermal.

17. The third pilot corresponded to the "Evaluation of pyrolysis as a method to sustainably use poultry manure to generate electric energy" which proposed answering the question regarding the appropriate disposition of this waste that implies high risk of environmental pollution, and to public and animal health.

This proposal was backed by positive experiences obtained in other countries and by its adaptation to the conditions of Mexican productive units and the boost this would give to national technology development by manufacturing the equipment in Mexico.

18. Aside from the infrastructure developed and the equipment installed, the technology could not be evaluated because of troubles with the central pyrolysis equipment, which could not be resolved before the PDRS concluded. FIRCO is committed to following up until the system is operational and the results are disseminated.

19. The last study corresponded to the "Diagnosis of the current situation of effluents generated from the bio-digestion systems developed in Mexico under the FIRCO-World Bank support scheme," which did not imply a pilot project but did allow to evaluate the degree of water pollution and mud coming from the bio-digesters, as well as the compliance with environmental norms and based on this it was proposed to be used in the applications allowed by the norms. Based in the results achieved the Manual for "Good Practices for the harnessing of Bio-digestion Effluents Systems" was prepared.

C.2.5. Final Evaluation Subcomponent

19. Due to problems with the hiring process for the Final and Impact Evaluation of PDRS under the mode of Selection Based on Quality and Cost with resources from the GEF Grant, the recruitment was done with FIRCO's own resources under Public Bidding in August 2018. The execution period contemplated in the contract is four months and results will be available in the first half of December 2018. Under an agreement with the World Bank, the study will only be a Final Evaluation and "impacts" will not be covered. Over 320 questionnaires will be applied to beneficiaries of the project.

C.3. Institutional Strengthening Component

20. This component, designed to develop the capacity of official staff involved in promoting investment in the systems supported by the PDRS, faced problems of achievement in the first phase of the PDRS due to limitations in accessing GEF resources, a problem which was resolved by the end of 2010 and with which the activities envisaged were developed starting in 2011.

C.3.1. Training Subcomponent

21. From 2011, a training program was put into action based on seminars in which staff from FIRCO and other dependencies such as SAGARPA and SENER, the Federal Commission for Electricity (Spanish acronym CFE) and the Electric Energy Savings Trust Fund (FIDE) participated, among others.

22. The objective of the courses and seminars was to establish the basis for FIRCO's technical staff to increase their knowledge and successfully perform the technical and economic evaluation/analysis of subprojects as well as to break down the barriers of ignorance of these technologies in other dependencies. The goal of 280 trained technical officials was surpassed and 386 technicians were trained.

C.3.2. Update Forums Subcomponent

23. This subcomponent financed exchange trips between FIRCO and EDI staff to work with personnel of the Governments of Uruguay and Romania; to participate in technical forums organized by international institutions in Brazil, China, Chile and Italy; and to exchange experiences regarding practical results obtained in different areas of the promotion of renewable energies and operational schemes for such support.

C.4. PDRS Management Component

24. This component implemented activities for the direction and management of the PDRS, as well as the monitoring and management of its technical aspects.

25. Development of this Component faced problems of access to the resources from the GEF Grant, based in Mexican fiscal norms and the norms of the World Bank. Resolution of this problem led to the authorization for contracting a private agent to administer the resources for management of the PDRS. This caused the delayed launching of training and technical assistance and the intermittent nature of these services as well as the monitoring and oversight of approved subprojects.

26. Through resources from this Component, the PDRS web site was developed, which was a valuable tool for the dissemination of information and within which were accessible the project's technical documents, manuals and specifications which needed to be observed in the preparation of technical subprojects and the lists of verified or certified firms which could participate as suppliers to the subprojects. Additionally, the web site housed the Procurement System through which subproject proponents could select the supplier for their subproject.

C.5. Operative Characteristics of the Project (Financing Sources and Operational Mechanics)

27. The activities developed under the PDRS were divided into two large groups: direct support to induce investment in renewable energies and energy efficient practices (in the first stage of the PDRS) which were funded with resources from the World Bank's two credits, along with the support granted by the Special Programs in SAGARPA and SENER and the contributions from beneficiaries.

28. The Operational Mechanism applied for these consisted in easing the procedures for and compliance with the requirements defined in the Operational Rules of each of the ten or more different Special Projects for which FIRCO acted as the Executor. Once the investments were made and the envisaged works were concluded for each subproject, they proceeded to review compliance with the requirements and verifications of the World Bank as well as integration of the agreed Simplified File for subsequent disbursement requests via the Financial Agent.

29. In this group, also included was assistance to the investment in energy efficiency practices and measures under the second stage of the PDRS, paid for by the GEF Grant. The Operation Mechanism applied to this support was similar to the one set out for the disbursement of the credits, but in this case, the beneficiary had to provide a financing contribution of 100% and once the required documentation was provided, the beneficiary was reimbursed 50% of the investment, with prior authorization of the World Bank.

30. In the second group, were activities developed under the components for: Production Support Services, Institutional Strengthening and Project Administration which were financed with GEF Grant resources through their administration by a management entity following the procedures that were agreed with the World Bank in the Operational Manual.

31. The amount of the resources from the two credits was US$100 million from which US$46.7 million were from Loan 7652-MX and US$32.1 million from Loan 8216-MX with an accumulated disbursement of US$78.8 million which, in the current exchange rate, represented assistance of 1,166.0 million Pesos.

32. Usage of the resources from both credits was 78.8%. This situation was motivated by the low availability of budget under the Special Programs for their application and subsequent disbursement, which was complicated by the greater availability of resources from the credits in Pesos due to the declining peso/dollar exchange rate.

33. In September 2018, the expenditures under the GEF Grant were processed for US$9.26 million which represented a usage of 88.2% of the total amount of the Grant resources. Specific procedures for the expenditure of the credits and the grant were established under diverse instruments, from which the Operational Manual stands out.

D. Institutional transversal activities

34. The principal national public policies for the adaptation and mitigation of climate change are defined in government's program which is also defined by each administration and which address and are detailed in different sector and special programs in such a way that the PDRS addressed what was established in the National Development Plan 2007-2012 and in the 2013-2018 Plan, as well as the Agricultural, Fishing and Food Development Sector Program 2007 and 2012 and in 2013-2018.

35. Since the main policies in this field are defined by the Secretariat of the Environment and National Resources (SEMARNAT) and SENER and specifically, by SAGARPA for the agricultural sector, FIRCO had to interact with them and within which can be found the activities developed to support the Special Climate Change Program, and through which over 2,286 subprojects were supported, enabling the reduction of GHG by over 6 million tons of $CO_{2;}$ the interaction with CFE which made it possible to use Interconnection Contracts for Renewable Energy Sources or Cogeneration Systems of Small and Medium Scale, to cover the subprojects supported by the PDRS; the collaboration with SEMARNAT which enables the availability of important technical documents such as the Technical Specifications for the Design and Construction of Bio-digesters in Mexico; and, the proposal for the Establishment of a Certification Process for Companies related to Bio-digestion Systems and the Good Practices Manual for the implementation of Bio-digestion Systems.

36. On the other hand, an important collaboration process was developed with the German Cooperation Technical Agency (GIZ), with whose support Technical Specifications for Water Heating Systems with Thermal Solar Energy, the Manual for the Evaluation of Technical-Economic Offers for Solar Thermal Systems and the Solar Thermal System Principles Manual.

E. PDRS' monitoring and follow up actions

37. In this regard, several indicators related to environmental, energy and social impacts were developed, as well as methodologies agreed with the World Bank which can be found in the "Guidance Manual for Control and Follow up of the Projects Implemented by FIRCO". Due to the breadth of FIRCO's activities and limitations on FIRCO in keeping these subprojects under its control, a system for calculating a baseline and emissions reductions was developed for each subproject, a system which was maintained through surveys of information on selected agribusinesses.

F. Safeguards

38. By signing the Loan Agreements, FIRCO committed to fulfilling a series of Safeguards defined by the World Bank, which are applied generally to any loan approved by this financial institution. Upon Reviewing these Safeguards, topics relate to: environmental assessment, natural habitats, forests and Indigenous Peoples. An analysis was done of the applicability, defined jointly with the World Bank, and in which one can document their compliance, linked as well to the type of system being supported. An applicability analysis was performed and defined along with the World Bank. In it, compliance had to be documented and linked with the kind of system that was being backed. The documents that ensured compliance were in the Simplified Files.

G. Social evaluation and impacts

39. The general objective of this evaluation was to establish parameters that would allow the monitoring and analysis of benefits at the social level, generated by the support channeled through the PDRS, and to identify and analyze the diverse direct or indirect co-benefits of a qualitative and quantitative kind perceived by the beneficiaries, workers in these agribusinesses, and the adjacent community, derived from the implementation of these technologies.

40. The methodology for the social evaluation was defined jointly with the World Bank and with assistance from FAO and was a sample study. Throughout the period of the PDRS, an evaluation was prepared which covered the first stage of the Loan and for which information was surveyed on 22.5% of all agribusinesses that were benefited with project resources during 2008-2011. These were located in 14 directorships (13 states and Comarca Lagunera). The results obtained made it possible to evaluate positively the social impacts derived from the PDRS's incentives. It is worth mentioning that because of administrative issues, the social evaluation for Loan 8216-MX was not developed, a situation that was agreed upon with the World Bank.

H. Lessons learned

41. Regardless of the accumulated experience that FIRCO had available from implementing project resources for renewable energy subprojects (some coming from the GEF Grant), throughout the PDRS period challenges arose from changes in FIRCO's budgetary situation, the RO's attention to the Special Programs and a market for renewable energy systems and energy efficiency practices that was experiencing rapid growth and a lack of rules/norms that would give assurance to the agribusinesses that invested in them. These challenges were resolved, and they allowed for a regulatory framework that seeks to give certainty to investors in these technologies, as well as a verification and enterprise certification scheme whose use could be updated and used in future fiscal years when the Mexican Government

allocates budget for renewable energy.

42. In the technical sphere, new technologies were tested, then adjusted and adapted to exploit country conditions. This created a new investment field for agribusinesses, in such a way that there is a broad catalogue of applications for the technologies to agribusinesses, thereby giving interested firms options to select the one that best suits its needs.

A. Borrower's comments on the Bank's Draft ICR

1. The Bank team sent the advanced draft ICR to the Borrower on November 9, 2018. On November 20, the Borrower's comments on the draft ICR were discussed with the Bank team via video-conference attended by FIRCO, NAFIN and other stakeholders. The Borrower incorporated its formal comments directly into the draft ICR (see NAFIN's email below). The Bank's final ICR incorporates those comments.

From: Maria de Lourdes Gonzalez Carmona <lgonzalezc@nafin.gob.mx>
Sent: Friday, November 23, 2018 8:27 PM
To: Katie Kennedy Freeman; Guillermo Hernandez Gonzalez
Cc: octaviomontufar@prodigy.net.mx; octavio.montufar@firco.sagarpa.gob.mx; Oscar Alonso Ramirez Herrera; Luis Villamar; Erika.Felix@fao.org; Yerania.Sanchez@fao.org; Anna F. Roumani; lvelazquez@nafin.gob.mx; Veronica Gabriela Alcaraz Contreras
Subject: RV: Borrador del ICR - Sustainable Rural Development Project (FIRCO)
Attachments: FINAL VERSION.-Implementation completion and results report ICR (FIRCO y NF).docx

[External]
Estimada Katie:

Con el gusto de saludarte y en alcance a los acuerdos sostenidos durante la VC del pasado martes 20 de noviembre, me permito adjuntar al presente los comentarios consolidados del Gobierno Mexicano al borrador del ICR que amablemente nos compartieron.

Cabe señalar, que las observaciones de FIRCO que fueron remitidas a ese organismo internacional el pasado viernes 16, ya se encuentran integradas a este documento.

Quedamos a sus órdenes por cualquier comentario adicional.

Saludos.

Lourdes González Carmona
Gerente de Agente Financiero
NACIONAL FINANCIERA, S.N.C.
lgonzalezc@nafin.gob.mx
Tel. +52 55 5325-6487

ANNEX 6. SUPPORTING DOCUMENTS (IF ANY)

Project Appraisal Document (44860-MX)
Loan Agreement
GEF Grant documents
Project Paper: Additional Financing
Restructuring Papers
Implementation Supervision Reports (ISR)
Supervision Aide Memoires
Technical Supervision Reports
Quarterly Reports
Semester Progress Reports
Procurement Post-Reviews
Financial Management Supervision Reports
Audit Reports

Studies/Reports

1. Evaluacion de los Impactos Sociales: Proyecto de Desarollo Rural Sustentable, Miriam Macias Solis, FIRCO-DEAA, May 2011
2. Proyecto de Desarollo Rural Sustentable para el Fomento de las Fuentes Alternas de Energia en los Agronegocios, que promuevan la Eficiencia Energetica en el Sector Agropecuario: Revision de Medio Termo, FIRCO/SAGARPA, 2012
3. Estudio de Mercado de Equipos y Proveedores de Energias Renovables en el sector Agropecuario en Mexico, World Bank, July 2014
4. Paper: Introducing Photovoltaics to New Markets through Government Development Programs: The FIRCO Example in Mexico, Hanley, Montufar, Rovero, Foster and Ellis (New Mexico University), undated. (*https://www.researchgate.net/publication/237491295_Introducing_Photovoltaics_to_New_Markets_Through_Government_Development_Programs_The_FIRCO_Example_in_Mexico*)
5. Estudio de Calidad sobre los Sistemas de Calentamiento de Agua Solar y Fotovoltaicos y sus Instalaciones en el Marco del Proyecto de Desarollo Rural Sustentable de FIRCO – Resultados de Estudio, GIZ/Cooperacion Aleman/Ministerio Federal de Cooperacion Economica y Desarollo, September 2014 (*https://energypedia.info/images/b/b1/GIZ_Estudio_calidad_CSA_y_SF_2014.pdf*)
6. Informacion para Evaluacion de Coimpactos Derivados del Proyecto de Desarollo Rural Sustentable, FIRCO/Banco Mundial, 2014
7. Informe de la Revision Independiente de Adquisiciones: Proyecto de Desarollo Rural Sustentable - Mexico, Dora Gracia Kobeh, March 2012
8. Guia de Orientacion para el Control y Seguimiento de los Proyectos Implementados por el FIRCO, en el Marco de Apoyos Otorgados por Banco Mundial y el Fondo Mundial para el Medio Ambiente (GEF).
9. Informe de Conclusion del Prestatario (Borrower Completion Report), FIRCO, October 2018
10. Proyecto de Desarollo Rural Sustentable: 2202 Acciones Technologicas, FIRCO, September 2017
11. Prospectiva de Energias Renovables 2015-2029, SENER, 2015 *https://www.gob.mx/sener/documentos/prospectivas-del-sector-energetico*

ANNEX 7: PROJECT-RELATED SUPPORTING INFORMATION AND DATA

A: Box: The FIRCO Subproject Process, Matching Grant Mechanism and Commercial Practices

The Project/FIRCO financed RE and EE technology subprojects using a matching grant incentive mechanism tested under the PERA pilot. The process is summarized below, along with changes made during implementation and the commercial practices modality for procurement.

- **The objectives, access criteria and types of technologies tested, demonstrated and available were disseminated widely** by FIRCO through multi-media instruments and direct contact with relevant institutions, agribusiness groups, academia and the research community.
- **Potential beneficiaries were invited to submit subprojects to FIRCO** for initial screening by technical staff in FIRCO's Regional Offices nationwide to ensure their compliance with beneficiary and sub-project eligibility criteria as defined in the Project Operational Manual. Subprojects meeting those criteria were forwarded to FIRCO's central office where the proposal was evaluated by the Regulatory and Monitoring Commission.
- **Eligibility criteria included economic, technical and environmental feasibility**; the subproject's likely impact at the national, regional, and local levels; the potential to generate increased income (through decreased unit production costs); and, amount of energy saved, or emissions avoided.
- **Entry profile data/information was collected from potential beneficiaries**, e.g., enterprise characteristics and activities, energy use, income and number of employees, and was intended to underpin a subsequent project baseline.
- **Eligible subprojects were financed in the order they were received.** Once the available budget was allocated, remaining eligible proposals would be financed with priority the following year.
- **Agribusinesses with approved subprojects signed a contract with FIRCO**, specifying the implementation plan and financing. The project provided a Matching Grant of up to 50% of total subproject cost to a maximum of US$200,000 (without defining differentiated levels of support by agribusiness size or type of technology), expected to build ownership, cost-effectiveness and sustainability. This amount was also intended to partially reimburse costs of preparing the Business Plan (BP) including the required "energy diagnostic", a practice discontinued under the AF as SAGARPA decided that agribusinesses should fund their own BP.
- **FIRCO's Regional/State Offices provided beneficiaries with TA and training** to integrate the financed technologies in their farms and agribusinesses and inculcate good O&M practices. Since implementation support frameworks needed to be built, FIRCO technicians (including fiduciary and procurement) at all levels received extensive training, running concurrently with project implementation.

Matching Grant Mechanism

- **After intensive study and dialogue with counterparts, the Bank agreed in 2016 to increase the ceiling on total project cost under the subsidy mechanism from US$200,000 to US$1.0 million,** to bring the project into line with programs involving FIRCO, most relevantly, the Special Programs through whose resources FIRCO supported the project.

- **Many of these programs financed RE as part of a broader (and higher cost) set of integrated investments** demanded for the creation, modernization or expansion of agribusinesses, whereby a "subproject" as defined by SAGARPA might include greenhouses, a tractor and photovoltaic system, or a slaughterhouse with solar thermal system. The project financed just the RE portion.
- **FIRCO would pay up to 50% of the whole package, which might involve the Bank project paying 100% of the RE portion** (i.e., the photovoltaic system) - likely to exceed US$200,000. This also implied that in certain cases, beneficiary agribusinesses cost-shared well above 50%. The cost-sharing amounts depended on the individual technology being financed.
- **Further, under the AF, the types of investments financed expanded to include more expensive systems** such as fruit boilers, milk chillers and solar parks, financed by FIRCO on a case by case basis. There were also cases where a cluster of micro/small agribusinesses would seek a large RE/EE investment for joint use, where the US$200,000 ceiling was far too low. Further, even though an agribusiness was classified – based on the number of permanent employees – as "small", it could have an economically large productive operation requiring the installation of much larger RE/EE systems at higher cost.
- The actual level of subsidy support for each subproject was determined by the Operational Rules of the Special Program accessed by FIRCO to secure budget for the project but could not/did not exceed 50% (of the subproject).

Commercial Practices

- **The Bank's agreement to reinstate "Commercial Practices" (CP) as a procurement modality** was also to an important degree driven by the larger size and higher cost of some subprojects, but also by agribusiness' aversion to going through complex public bidding processes driven by Bank procurement requirements but not required under Mexican law. The project sought to avoid burdening beneficiaries with additional requirements: CP complied with Bank rules without being burdensome.
- **There is no formal definition of CP other than that used by the private sector**, explaining why it is different for each project where the method is used. Bank procurement Guidelines para. 3.13) state: "When the loan provides funds to a financial intermediary institution or entity (or its designated agency) such as an agricultural credit institution, a development finance company or an infrastructure development fund, to be on-lent to beneficiaries such as individuals, private sector enterprises, small and medium enterprises or autonomous commercial enterprises of the public sector for the partial financing of subprojects, the procurement of goods, works, and non-consulting services is usually undertaken by the respective beneficiaries in accordance with well-established private sector procurement methods or commercial practices that shall be acceptable to the Bank."
- **The project exemplified the Bank's need to adopt CP as a procurement method.** It reflected the market context/reality for RE and EE technologies in Mexico and their procurement by many agri-businesses whose financial contribution to their subproject exceeded that of the Government. The formal move to use CP instead of price comparison (3 quotes) or "shopping" – a process whose costs were deterring agribusiness participation - was an important innovation designed to keep costs down, promote competition and transparency, and support agri-business decision-making.

B: Table: Methodologies used to Calculate CO2 Emissions, by Technology

Table 1: Basic Methodologies supporting Measurement of CO2 Emissions, by Technology

1. Solar Thermal System		
Parameter to be Obtained	**Method**	**Procedure**
Unit of fossil fuel displaced (in liters, m3, kg per unit of time)	Direct	Readings of temperature meters for the entry and exit of fluid (0 C) and measurement of the entry and exit flow (liters/month) of STS. Obtain the usable energy delivered by the system and with this data and data on the efficiency of a conventional system, calculate the amount of fossil fuel displaced through application of a thermo-dynamic analysis.
	Indirect	From the technical document provided to the purchaser/user by the supplier, STS capacity (in liters) is determined. Also required, is the temperature of the feedstock entering the system and temperature of the fluid requiring processing (in C) to determine the system's usable energy. Also, it is also necessary to consider the efficiency of the conventional system, so that with this data and the usable energy, the quantity of fossil fuel displaced through the application of a thermo-dynamic analysis can be calculated.
2. Bio-Digester with Oxidation Pool		
m3/month of biogas broken down	Direct	Take monthly readings of the biogas meter of the flow going to the Heater (m3/month)
	Indirect	Collect data on the monthly average of the number of heads of animals and use the Methodology for Bio-digesters with Oxidation Pool Approved by the FIRCO Central Office.
3. Motor-Generator		
kWh/month Generated	Direct	Take monthly readings of the energy meter (kilowattmeter) on the Motor-Generator (kWh/month.
	Indirect	Utilize data on the potential of the Motor-Generator obtained from the technical document provided by the manufacturer and multiply it by the hours of operation per month.
4. Photovoltaic System connected to the Grid (SFVCR)		
kWh/month generated	Direct	Monthly readings of the energy meter (kilowattmeter) of the SFVCR (kWh/month)
	Indirect	Review the technical document provided by the supplier to the purchaser/user, installed capacity (in kW) of the SFVCR and with information on the number of hours of sun in the location, calculate the electric energy generated per day. This value, multiplied by the days of the month, permits measurement of the energy generated monthly.

Table 2: Field Guidelines for Measurement of Energy Efficient Practices

Parameter to be Obtained	Procedures to Measure Electric Energy Efficiency	Parameter to be Obtained	Procedures to Measure Electric Energy Efficiency
kWh/month Saved	To understand the energy history, reconstruct the electricity consumption history of the agribusiness, obtained from CFE receipts for at least one year before application of the energy efficiency measurement. Once this practice is implemented, collect data on energy consumption (kWh) from key sources: readings of the meter corresponding to what the charges are connected to and monthly receipts obtained from the CFE. The difference between previous consumption and installation of the meter and actual consumption, corresponds to the savings obtained from these practices. It is important to link production (product, good or service delivered) and the quantity of energy used to obtain the Energy Index. This is obtained before and after application of the energy measurement because the difference between the two is the saving obtained for each product.	Unit of Fossil Fuel saved (liters, m3, kg per unit of time)	To understand the energy history, reconstruct the fossil fuel consumption history of the agribusiness, obtained from receipts and notices of the administrating firm, for at least one year before application of the energy efficiency measurement. Once this practice is implemented, collect data on consumption of fossil fuel (liters, m3, kg). The difference between previous consumption and installation of the meter and actual consumption corresponds to the savings obtained from these practices. It is important to link production (product, good, service delivered) and the quantity of energy used to obtain the Energy Index. The index is obtained before and after application of the energy meter; the difference between the two is the saving obtained from each product.

C: Diagrams, Tables and Charts supporting the ICR

Diagram 1: Distribution of Total Investments by Type of Technology

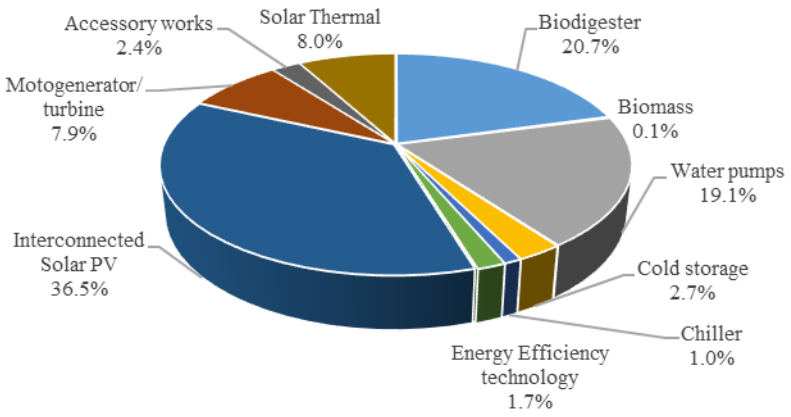


Diagram 2: Greenhouse Gas Emissions by Technology (Tons CO2e/year)

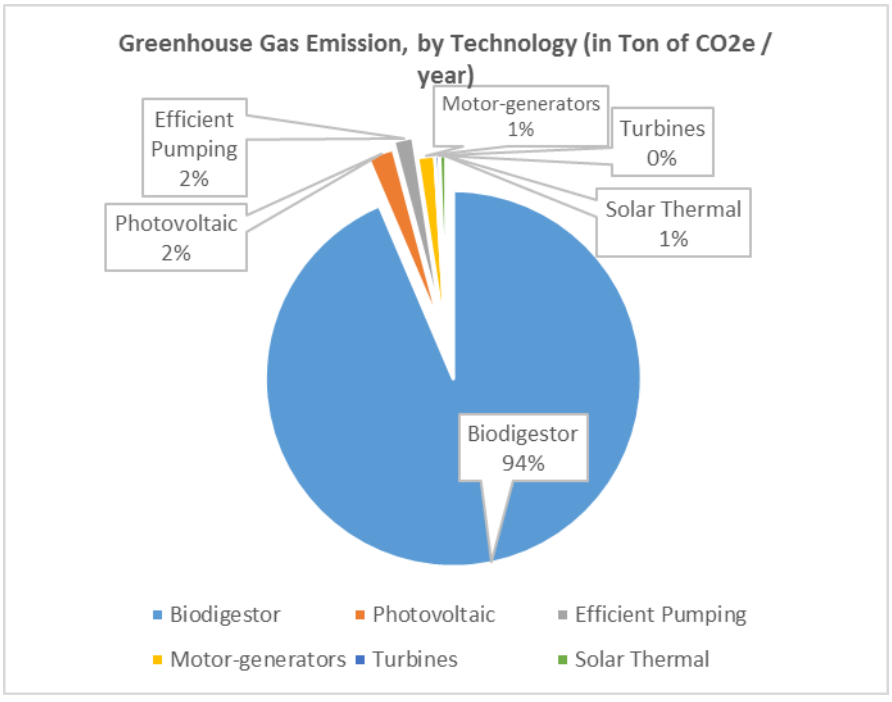


Table 1: Special Programs providing Resources to the Project (Original Project and AF)

Special Program (SP)	Financing (US$ M)	# Invest.	Types of Technology Investments
7652-MX			
Program to Sustain Natural Resources: Component for Bio-energy and Alternative Energy Sources	13.04	324	Construction of Bio-Digesters Photovoltaic Systems, grid-connected Solar Heating Systems Refrigeration Chambers/Chillers
Bio-Economia	14.68	366	Construction of Bio-Digesters Photovoltaic Systems, grid-connected Solar Heating Systems
Slaughterhouses (Federal Inspection Type)	4.69	121	Solar Wáter Heating Systems
Project supporting Added Value for Agribusiness via Shared Risk Trusts (PROVAR)	14.10	268	Construction of Bio-Digesters Motor-Generators and Solar Heating Systems
Others:	0.16	5	Solar Heating Systems and packages of Energy Efficiency Investments
TOTAL:	**46.68**	**1,084**	
8216-MX			
Bio-Economia	7.83	232	Solar Heating Systems Bio-Digesters
Component for Bio-energy and Sustainability	14.55	464	Photovoltaic Systems, grid-connected
Component for Livestock Sustainability	1.73	37	Bio-Digester Systems
Agro-Food Productivity Program	6.31	177	Refrigeration Chambers Bio-Digester Systems Solar Heating Systems Photovoltaic Systems, grid-connected Motor-Generators
Slaughterhouses (Federal Inspection Type)	0.65	12	Modernization of Refrigeration Chambers Solar Heating Systems
Project to support Value Added of Agribusiness through Schemes for Shared Risk (PROVAR)	1.18	18	Refrigeration Chambers
TOTAL:	**32.25**	**940**	

Source: FIRCO MIS 2018

Table 2: Reduced Emissions, Energy Consumption and Energy Costs – Selected Technologies[33]

Technology	Energy Consumption vs Production (kWh/pa)		GHG Emissions (Tons CO2/year)		Energy Cost/Savings (P$ kWh/pa)	
	Inefficient	Efficient	Inefficient	Efficient	Inefficient	Efficient
Biodigester with Motor Generator						
- Pig Production (average 5 units)	154,259 Consumed	122,897 Produced	2,918	2,093 Reduction (1st 2 yr.)	P$265,413	P$213,715 (Savings/80% coverage)
- Dairy Production (average 5 units)	579,418 Consumed	325,627 Produced	307.6	174.2 Reduction	P$752,579	P$421,797 (Savings/56% coverage)
Photovoltaic Systems connected to Grid						
- Agro-Industries (average 4 units)	277,907	66,243 Produced	147	35 Reduction	P$459,480	P$124,071
- Dairy and Fattening (average 3 units)	209,466	62,546 Produced	111	33 Reduction	P$405,362	P$136,706 (Savings/30% coverage)
- Chicken and Fish Farming (average 3 units)	121,327	87,215 Produced	64	26 Reduction	P$218,896	P$87,215 (Savings/40% coverage)
High Efficiency Agricultural Pumps (average, 5 units)	776,267	411,598 (Consumption using better equipment)	412.1	218.95 Reduction of 193.15	P$61,901	P$14,628 (Cost reduction pa of P$47,273)

Source: Co-Impacts Study (FIRCO, 2014)

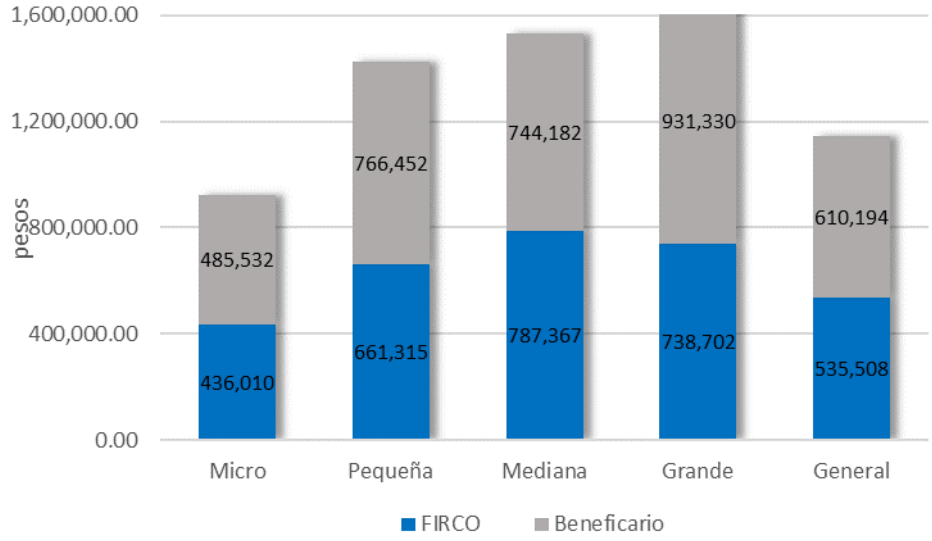
Table 3: Average support by Subproject and Agribusiness Size (Pesos)

Type	FIRCO	Beneficiary	Total*
Micro	436,009.7	485,531.6	921,541.3
Small	661,315.2	766,452.3	1,427,767.5
Medium	787,367.3	744,181.8	1,531,549.1
Large	738,701.6	931,329.6	1,670,031.2
General	535,507.77	610,193.98	1,197,193.14

* Source: FIRCO 2018 The sum of FIRCO and Beneficiary support does not coincide with the total, because in all cases it comes from averages in the data base.

[33] Data sourced from co-impacts study (FIRCO 2014).

Chart 1: Average Support by Source of Financing, Beneficiary Agribusinesses



Source: FIRCO Database of 2,214 subprojects with subsidies, supported between 2008-2017

Chart 2: Greenhouse Gas Emissions, with and without the Project (not including Bio-Digesters)

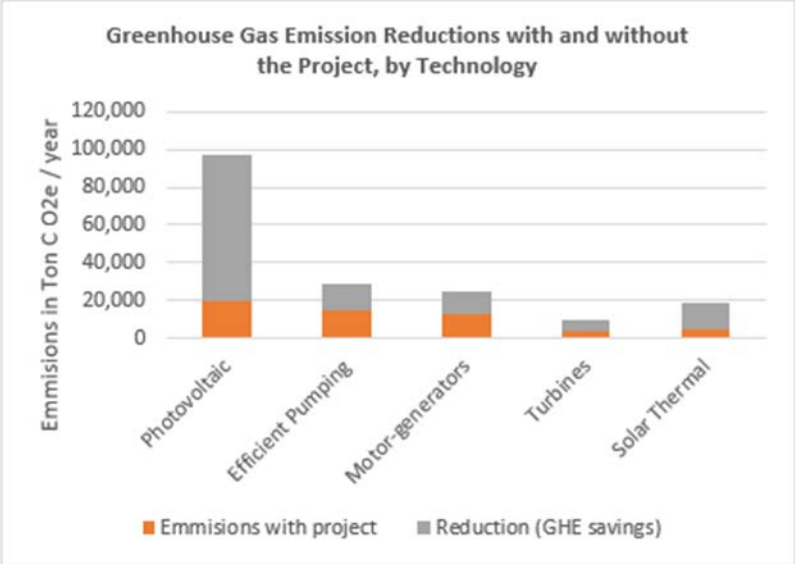


Table 4: Total average Investments – Minimum, Maximum and Average by Agribusiness Size
(Pesos)

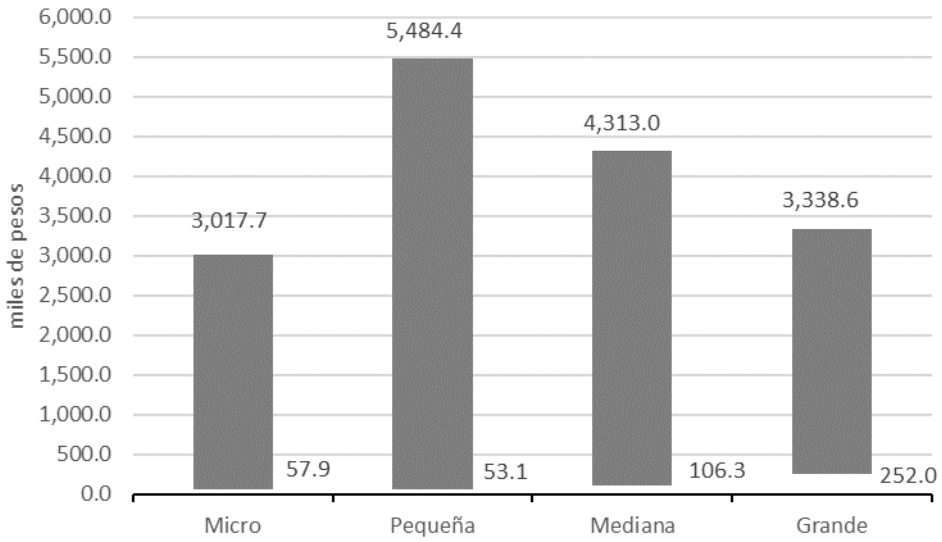
Size	Minimum	Maximum	Average
Micro	57,886	3,017,693	815,233
Small	53,057	5,484,412	1,399,627
Medium	106,310	4,312,977	1,590,580
Large	252,019	3,338,631	1,372,787

Source: FIRCO 2018

Note:

The minimum and maximum investments correspond to an average of 10 subprojects with lower or higher investment by type of agribusiness. The average corresponds to the average of all investments registered, by size of the agribusiness.

Total average Investments – Minimum, Maximum and Average – by Subproject and Agribusiness Size
('000 pesos)



Source: FIRCO, Database of 2,214 subprojects with subsidies, supported from 2008 to 2017 (best available information)

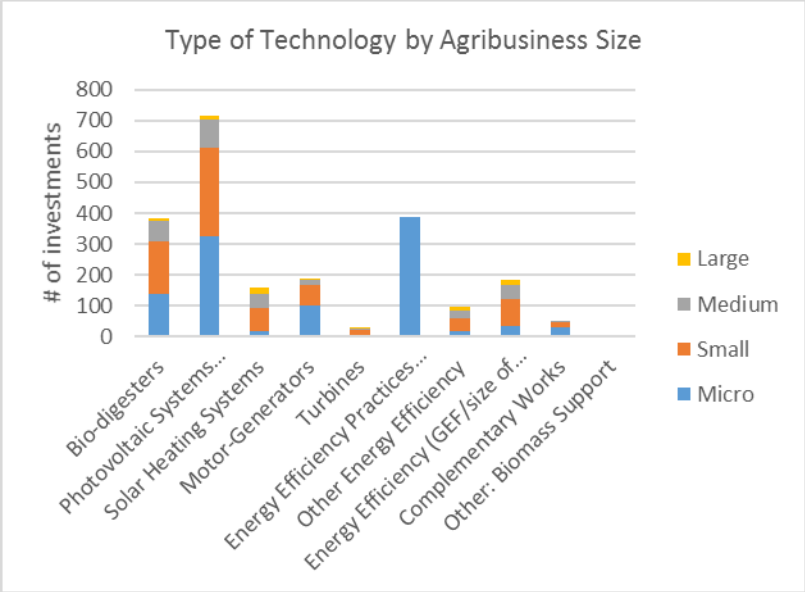
Table 5: Total Number of Subprojects, Amount disbursed by State and Percentage Distribution

State	Loans 7652-MX and 8216-MX and GEF Grant/TF-93134			Percentage Distribution		
	No. of Subprojects	Disbursements		No. of Subprojects	Disbursement in Pesos	Disbursement in USD
		(Pesos M)	(USD M)			
Aguascalientes	94	49.33	3.40	4.11	3.95	4.08
Baja California	31	19.71	1.26	1.36	1.58	1.51
Baja California Sur	7	4.17	0.29	0.31	0.33	0.35
Campeche	13	7.52	0.52	0.57	0.60	0.62
Chiapas	7	5.61	0.36	0.31	0.45	0.43
Chihuahua	133	64.29	4.05	5.82	5.15	4.86
Coahuila	32	15.45	1.00	1.40	1.24	1.20
Colima	47	19.11	1.34	2.06	1.53	1.61
Comarca Lagunera	252	191.27	13.22	11.02	15.33	15.86
Durango	44	12.53	0.82	1.92	1.00	0.98
Guanajuato	268	122.79	8.14	11.72	9.84	9.77
Guerrero	1	0.83	0.04	0.04	0.07	0.05
Hidalgo	12	14.92	0.86	0.52	1.20	1.03
Jalisco	321	141.98	9.31	14.04	11.38	11.17
México	19	18.03	1.10	0.83	1.44	1.32
Michoacán	118	60.94	3.77	5.16	4.88	4.52
Morelos	17	14.14	0.98	0.74	1.13	1.18
Nayarit	33	34.09	2.01	1.44	2.73	2.41
Nuevo León	153	81.69	5.63	6.69	6.55	6.76
Oaxaca	23	13.46	0.75	1.01	1.08	0.90
Puebla	85	39.42	2.67	3.72	3.16	3.20
Querétaro	45	27.93	1.93	1.97	2.24	2.32
Quintana Roo	2	1.00	0.05	0.09	0.08	0.06
San Luis Potosí	31	11.15	0.76	1.36	0.89	0.91
Sinaloa	102	66.74	4.34	4.46	5.35	5.21
Sonora	100	71.80	4.90	4.37	5.75	5.88
Tamaulipas	2	3.16	0.26	0.09	0.25	0.31
Tlaxcala	2	1.19	0.09	0.09	0.10	0.11
Veracruz	11	6.59	0.40	0.48	0.53	0.48
Yucatán	130	76.88	5.85	5.69	6.16	7.02
Zacatecas	151	50.37	3.23	6.61	4.04	3.88
Total	**2,286**	**1,248.09**	**83.33**	**100.00**	**100.00**	**100.00**

Source: FIRCO 2018

Note: (i) The monetary totals might not coincide with totals of the data bases due to rounding effects; (ii) States with over 100 investments are highlighted.

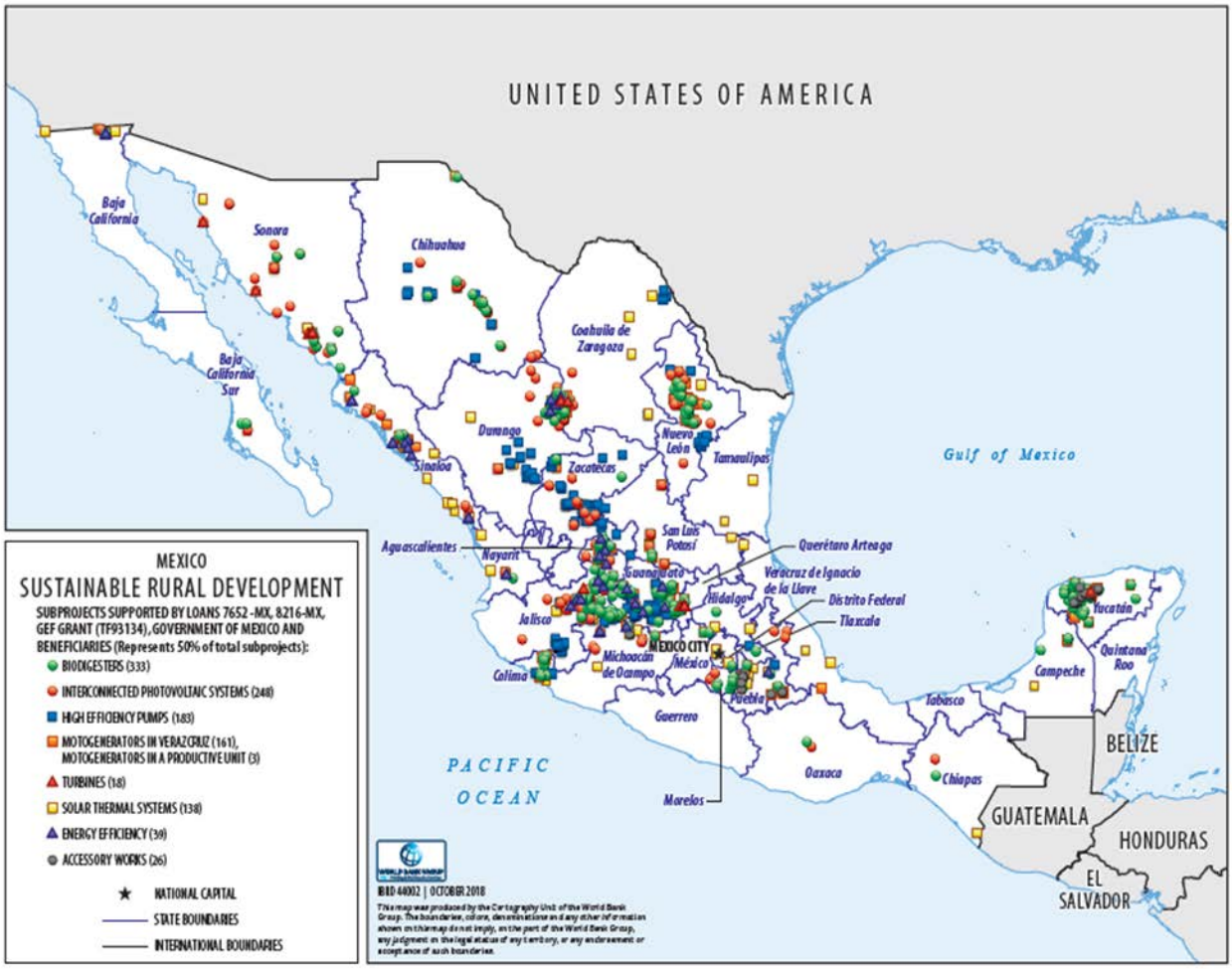
Chart 4: Types of Technology Investments and Share by Agribusiness Size



Source: FIRCO: 2018

ANNEX 8: MAPS

A. Google Map: Type of Investment and Distribution[34]



[34] Map represents all investments at the time its preparation, and about 50% of total investments financed by end-of-project.

B. Map of Mexico