



PILOT PROJECT GRACO: "Green Autonomous Communities"

Report

UNDERSECRETARY OF ENERGY

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Index

Introduction	3
Goal	3
Background	3
Justification	3
Project description	7
Activities	7
Houses information	8
Deliverables	10
Evidence of PVAS installation	11
Workshops Evidence	24
Training system	24
Climate change awareness	26
References	29
Schedule 1	30
Schedule 2	32
Schedule 3	33

Introduction

In the State of Yucatan, each day appears more houses without electricity service. The lack of this basic housing service sharpens poverty by diminishing the productive capacity of people. According to the National Institute of Statistics and Geography (INEGI-*for its abbreviation in Spanish*), in 2015 approximately 5 590 houses lacked electricity of any kind in Yucatan. Nowadays, this number has risen to 5 961 houses (0.91% houses in the State).

The current project it has aimed to be a pilot, by implementing in a local community of 11 houses without the electricity service. While the long-term goal is to be able to scale the project to every house in Yucatan that lacks the electricity service, through the installation of an affordable, clean, and autonomous energy source (solar photovoltaic modules).

Goal

Reduce the energy inequality in Yucatan, starting with 11 houses in a small rural community, by providing the electricity service installing an affordable, clean, and autonomous energy source (solar photovoltaic modules).

Background

1. UK-Pact Ilumexico SEFOET

UK-Pact is an alliance for the sustainable growth of Mexico and United Kingdom. Through this alliance, Ilumexico has been working with the Secretariat of Economic Promotion and Labor of Yucatan (SEFOET-*for its abbreviation in Spanish*) and the Secretariat of Sustainable Development (SDS-*for its abbreviation in Spanish*) in developing a sustainable model to achieve universal electricity service coverage. Currently, the project is under development, and it consists of four main activities:

1. Diagnostic
2. Co-creation workshops
3. Design Manual to implement universal coverage public policy
4. Funding search

Justification

Therefore, the present project with FutureFund is aligned with another current projects that are being implemented in the Yucatan. In addition, it is lined up with 9 SDG (Sustainable Development Goals), part of the 2030 Agenda, ratified in 2017 by Mexico (Gobierno de México, 2017). The 9 SDG are showed in **Figure 1**.



Figure 1. Sustainable development goals aligned to Project GRACO.

As well as with 21 lines of action from the State Development Plan (Gobierno de Yucatán, 2019). These lines of action are described as follow in Table 1.

Table 1. Lines of action aligned with GRACO project.

Axis: 4 Green and Sustainable Yucatan	
Policy: 4.5 Affordable and Clean Energy	
Objective: 4.5.1 Increase clean energy generation in Yucatan	
Strategy: 4.5.1.1 Promote technological development of clean energies	
Line of action	Description
4.5.1.1.2	Link different sectors for the joint implementation of energy efficiency and clean energy projects
Strategy: 4.5.1.2 Promote energy generation from renewable sources and energy efficiency compatible with the social and environmental settings.	
4.5.1.2.1	Promote renewable energy projects on the industrial and residential scopes.

4.5.1.2.4	Promote generation and management of distributed and autonomous energy through renewable sources.
Objective: 4.5.2 Improve access to clean energy in Yucatan	
Strategy: 4.5.2.1 Promote generation of clean energy	
Line of action	Description
4.5.2.1.1	Promote the use of devices compatible with clean energy to the population.
Transverse Axis: 5 Gender Equality	
Policy: 5.1 Gender Equality	
Objective: 5.1.2 Reduce gender gaps in education	
Strategy: 5.1.2.1 Reduce desertion, abandonment, and educational backwardness of women	
Line of action	Description
5.1.2.1.1	Promote collaboration agreements and foster coordination with the public, private, social, and academic sectors to strengthen inclusive education, with special attention to remote communities.
5.1.2.1.16	Provide support and incentives to strengthen the school permanence of girls and women, with emphasis on areas at high risk of school dropout.
Objective: 5.2.1 Increase equal opportunities for groups in vulnerable situations	
Strategy: 5.2.1.1 Promote equal opportunities for the rights of people in vulnerable situations	
Line of action	Description
5.2.1.1.1	Stimulate technical and operational skills and knowledge for the work of young people in vulnerable situations
Strategy: 5.2.1.2 Promote equal opportunities for the social welfare of people in vulnerable situations	
Line of action	Description
5.2.1.2.1	Facilitate the access and permanence of people with a disability to a comprehensive and quality education.
5.2.1.2.3	Encourage organizations that develop community development projects or actions, combat social inequalities and inclusive access.
5.2.1.2.7	Promote support programs for people in vulnerable situations that facilitate access to housing and basic services.
Strategy: 5.2.1.3 Promote opportunities for a dignified life for people in vulnerable situations	
Line of action	Description
5.2.1.3.1	Strengthen the infrastructure, equipment and assisted technology for the population in vulnerable situations, with an emphasis on people with disabilities
Transverse Axis: 9 Sustainable Communities	
Policy: 9.4 Territorial Organization	
Objective: 9.4.1 Improve territorial planning with a sustainable focus in the state	
Strategy: 9.4.1.1 Promote a territorial ordering scheme for human settlements that favors the sustainable development of cities and communities	
Line of action	Description

9.4.1.1.1	Design land use planning programs in adequate conditions of physical and patrimonial security.
9.4.1.1.2	Carry out interventions that reduce the vulnerability and risk of human settlements in the most marginalized communities.
Strategy: 9.4.1.3 Promote the development of local ecological zoning plans	
Line of action	Description
9.4.1.3.4	Identify areas of opportunity that promote the generation of investments in clean energy.
Strategy: 9.4.1.4 Structure infrastructure projects through conscious and rational planning based on economic and social profitability	
Line of action	Description
9.4.1.4.1	Promote that infrastructure projects adhere to sustainable planning with financial profitability and socioeconomic impact.
9.4.1.4.2	Incorporate the approach of sustainability and sustainable urban development in the provision of public services.
9.4.1.4.3	Adequately plan the development of the areas destined for the economic progress of the state in coordination with the public, private, social, and academic sectors.
9.4.1.4.4	Promote actions to replace the use of firewood and charcoal inside homes.
9.4.1.4.5	Promote affordable housing financing schemes for state workers and groups in vulnerable situations.
Axis: 10 Regional Development	
Objective: 10.1 Reduce territorial inequality in access to economic, social, cultural and environmental rights among the regions that make up the state of Yucatán	
Strategy: 10.1.4 Promote good sustainability practices that guarantee the reduction of impacts on the environment	
Line of action	Description
10.1.4.4	Establish conservation and promotion mechanisms for the sustainable use of natural resources.
10.1.4.5	Enhance the geographic capabilities of the state for the development of renewable energies.

Project description

The projects consists on the Installation of 11 Photovoltaic Autonomous Systems (PVAS) in the municipality of Tecoh, Yucatan, followed by workshops and awareness on climate change and sustainability, as well as trainings on the maintenance and caring of their solar systems.

The installation of PVAS and workshops were executed in the period comprehended from August 23th, to August 28th

Activities

The project consists of the activities showed in the diagram of **Figure 2**.

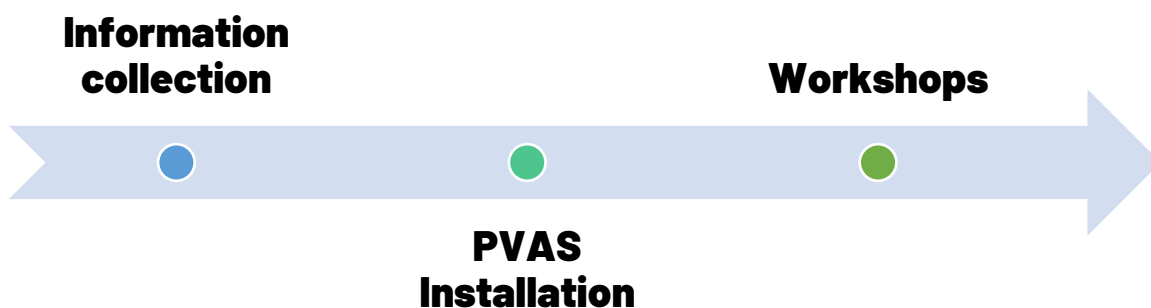


Figure 2. Main activities of GRACO project.

The description of the main activities is described as follow:

1. Site Visit

- First, SEFOET visited Tecoh and their villages to make sure that the implementations site and houses were far from an electricity line and therefore hard to get access to the electricity service any time soon. In addition, the visit serves to make a small survey on the householders and their needs and interests.

2. Recollection of Information

- It was necessary to collect the information from the houses and population beneficiary from the project. In this regards, Annex 2 shows the summary of the information collected. In detail, the information collected from the beneficiaries were owner name and age, gender, contact details, number of house inhabitants by gender, and number of native mayan speakers.

3. Systems Installation

- Installation of the 11 PVAS according to specifications in Annex 1. The PVAS comprise two main systems: 1) Photovoltaic systems, including the photovoltaic module, inverter, charge controller and battery, and 2) Electrical installation, including wiring, 4 lights and 2 electrical outlets.

4. Workshops

- There were 2 workshops: 1) Training about the maintenance of the PVAS and the procedure to plug in electrical devices into the system, and 2) Awareness workshop on environmental care and climate change.

In this regard, the workshop on the PVAS maintenance was responsibility of Yucatan government and municipality, while our implementing partner, Ilumexico, carried out activities 2 and 3.

Houses information

In **Figure 3** is showed a map of the 11 houses where the PVAS were installed. Also, in **Table 2** and **Table 3** are shown the geographical coordinates, owner names and photos of the houses respectively.

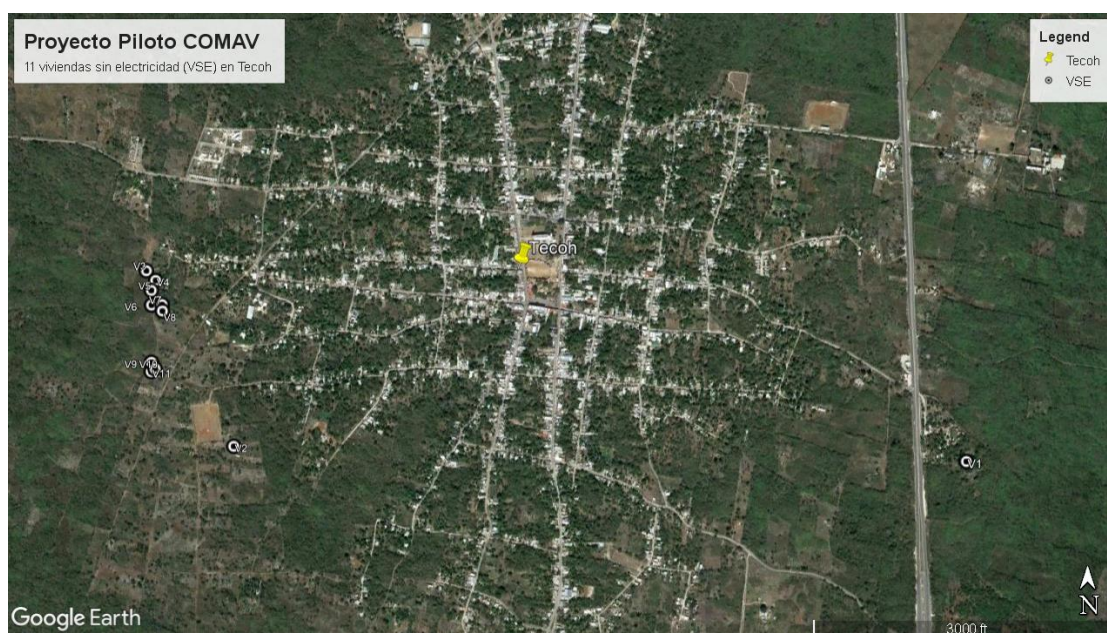


Figure 3. Map of houses locations without electricity service in Tecoh, Yucatán.

Note: The map only shows 9 houses due to view settings.

Table 2. Geographical locations and owner name of houses without electricity service (HWES).

ID	Latitude (°)	Longitude (°)	Owner Name
HWES 1	20.741791	-89.484997	Pablo Alvarado Hernández
HWES 2	20.738069	-89.482883	Mercedes de Rosario Chan Aké
HWES 3	20.754574	-89.472916	Raúl Ezequiel Guzmán Aké
HWES 4	20.742518	-89.485121	Gilberto Medina López
HWES 5	20.573862	-89.468193	Góngora Chuc Gregorio

HWES 6	20.741858	-89.485237	Leydi Beatriz Ucán Cal
HWES 7	20.74187	-89.484932	Clemente Xool Tamayo
HWES 8	20.741699	-89.484923	Gloría María Dzul Uc
HWES 9	20.740322	-89.485235	María Eugenia García Pech
HWES 10	20.740149	-89.485131	María de los Ángeles Tuyub Canul
HWES 11	20.572414	-89.474434	Rodrigo Adiel Puch Góngora

Table 3. Houses before PVAS installation.



Deliverables

The project includes the following deliverables

5. 11 PVAS according to specifications in **iError! No se encuentra el origen de la referencia..**
6. Training workshop about preventive maintenance of the PVAS, which main topics are:
 - Photovoltaic Modules Cleaning
 - Battery maintenance
 - Electrical system maintenance
 - PVAS and electrical devices use
7. Awareness workshop for adults and children about the environmental care and climate change.

A diagram of the photovoltaic system is observed in **Figure 4**.

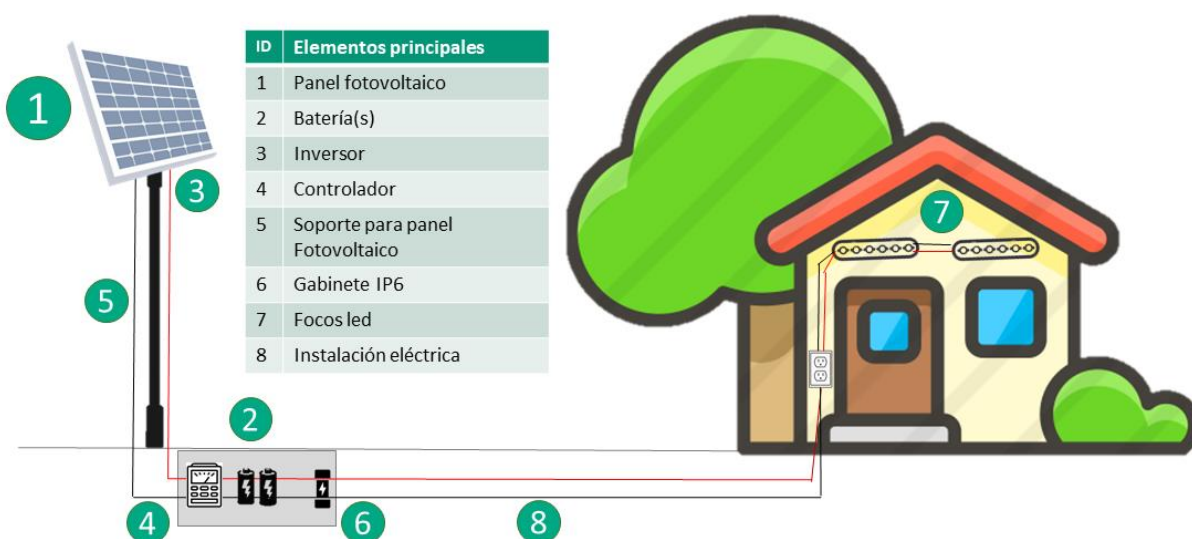


Figure 4. Diagram of main elements in the Photovoltaic Autonomous System.

Evidence of PVAS installation



HWSE 1





HWSE 2



HWSE 3



HWSE 4



HWSE 5





HWSE 6



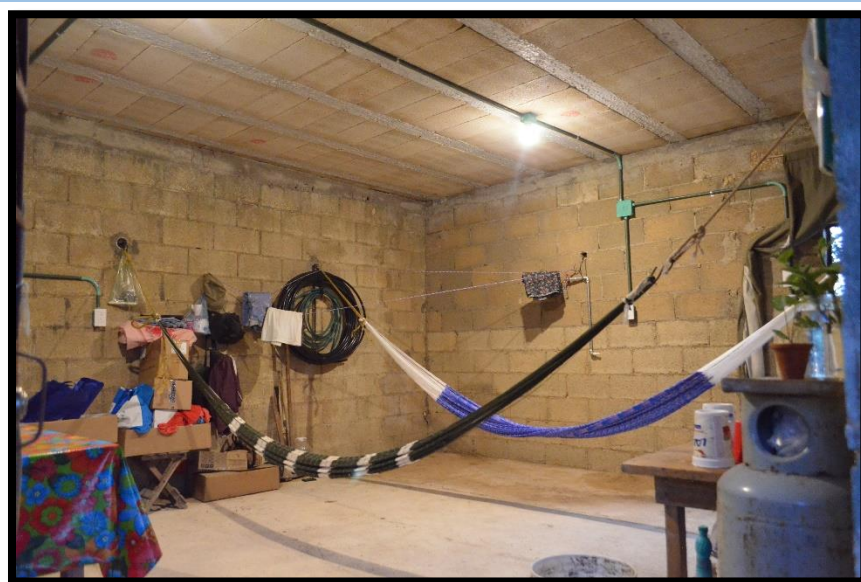


HWSE 7





HWSE 8



HWSE 9



HWSE 10



HWSE 11

Workshops Evidence

Training system

The training workshop consists on the following topics:

- Description and show of the system
- Cleaning of the solar module
- Care of the electrical system
- Procedure to plug-in electrical devices
 - The users must call Iluméxico for the electrical devices they want to plug-in. The system only supports 800 W of electrical charge.
- Description of the power meter
 - The power meter shows the time remaining of power according to the electrical charge plug-in.





Climate change awareness

The workshop about climate change awareness consists on the following activities:

- It was showed a video about the climate change and its global effects.
 - The video described the importance of the sun.
 - After the video, there were questions asked to the group to they get aware about the impacts of climate change in its community.
- There was a manual activity in which they built the house they wanted and put a sun because its importance given the new energy system they had.
- After all participants, grown-up and kids, finished they houses. They made group activities to increase awareness of the importance on all the members of the community,







References

- Gobierno de México. (2017). *El Cumplimiento de la Agenda 2030 y los Objetivos de Desarrollo Sostenible en México*. Ciudad de México: Oficina de Presidencia. Retrieved julio 22, 2021, from <https://www.gob.mx/agenda2030/documentos/el-cumplimiento-de-la-agenda-2030-y-los-objetivos-de-desarrollo-sostenible-en-mexico>
- Gobierno de Yucatán. (2019). *Plan Estatal de Desarrollo del Gobierno del Estado de Yucatán 2018-2024*. Mérida, Yucatán: Diario Oficial del Gobierno del Estado de Yucatán. Retrieved julio 22, 2021, from https://www.yucatan.gob.mx/docs/transparencia/ped/2018_2024/2019-03-30_2.pdf

Schedule 1

Table 4. Technical Specifications for the Photovoltaic Autonomous Systems.

Elements	Technical Specifications	Warranties	Certificates
Photovoltaic module	330 - 410Wp 72 cells or 144 semi-cells polycrystalline Efficiency: > 15%	20 years with power > 80% 10 years with power > 90%	FIDE Stamp ¹ IEC 61730 IEC 61215
Charge controller	Maximum current 20A MPPT Voltage 12/24 V	2 years minimum, including all protections	IEC62109
Voltage Inverter	Pure Sine Wave, 1,000W- minimum In: 12 - 24Vcd Out: 110 - 120 Vca Efficiency: > 90%	2 years minimum, including all protections	IEC 62109-2 o UL1741
Battery	Lithium System Battery, minimum capacity of 1,200 Wh Voltage 12/24 V in series (if applicable) More than 3,000 cycles	3 years	-
Power meter	Voltage in: 12/24 V Energy consumption measurable in kWh Including memory and port for data acquisition Energy consumption visualization in screen	3 years	-
Structure Support	Pole of at least 2 meters of height with solar module structure support, and grounded, or solar module structure support simple to install solar modules in the roof. In both cases, structures should have anticorrosive protection.	3 years	-

¹ FIDE is a Mexico institution who certificate energy efficiency and photovoltaic products.

Cabinet	Cabinet to house the battery system, inverter, charge controller and wires. The element should have anticorrosive protection, and vandalism protection.	-	-
Accessories	Photovoltaic wire (PV), XLPE, in Conduit tubes	-	1) NOM-001-SEDE 2) NOM- 063-SCFI NMX-J-508-ANCE
Lighting, and electrical elements	4 LED lights of at least 7 Wp with luminous flux >800 lm, 2 plug-in, 4 switches.	-	-
Electrical installation	The electrical installation must comply with the provisions of the current NOM-001-SEDE and the necessary elements must be installed so that the objective of bringing electricity to users without access to electricity is met. The locations to install the outlets and the lamp holder bases will be chosen in agreement with the user, with all the accessories necessary for the proper functioning of the electrical installation, such as, among others: gutters, plates, conduit tube and switches. The conduit will be thick-walled metallic and for interiors it may be PVC or thin-walled metallic approved for that use. The Installation must have adequate grounding in the components that require it.	-	NOM-001-SEDE

Schedule 2

Table 5. Data of the project GRACO beneficiaries

ID	Owner Name	Age	Gender	Male inhabitants	Female inhabitants	Maya Speakers
HWSE 1	PABLO ALVARADO HERNANDEZ	37	Male	2	2	1
HWSE 2	MERCEDES DE ROSARIO CHAN AKE	29	Female	2	1	2
HWSE 3	RAUL EZEQUIEL GUZMAN AKE	21	Male	2	2	2
HWSE 4	GILBERTO MEDINA LOPEZ	68	Male	1	0	0
HWSE 5	GONGORA CHUC GREGORIO	71	Male	1	1	2
HWSE 6	LEYDI BEATRIZ UCAN CAL	31	Female	1	3	2
HWSE 7	CLEMENTE XOOL TAMAYO	65	Male	1	1	1
HWSE 8	GLORIA MARIA DZUL UC	45	Female	1	0	1
HWSE 9	MARIA EUGENIA GARCIA PECH	62	Female	0	2	0
HWSE 10	MARIA DE LOS ANGELES TUYUB CANUL	50	Female	2	4	0
HWSE 11	RODRIGO ADIEL PUCH GONGORA	45	Male	1	0	0

Schedule 3

Table 6. Detail of costs for the Photovoltaic Autonomous Systems

Section 1: Local Currency Expenditure						
Num	Country that costs expended in:	Name of Supplier/Service Provider / Consultants (if not known at Budget, state TBC.	Detail of service or goods being purchased	Cost Type [Mandatory]	Local Currency :	US \$
					MXN	19.81
LC01	México	ERES Energia Renovable SAPI de CV	Acquisition of 11 solar photovoltaic modules, 330 W	Miscellaneous	\$44,660	\$2,255
LC02	México	ERES Energia Renovable SAPI de CV	Acquisition of 11 power inverters for photovoltaic systems, 1000 W	Miscellaneous	\$37,653	\$1,901
LC03	México	ERES Energia Renovable SAPI de CV	Acquisition of 11 lithium batteries, 1200 Wh	Miscellaneous	\$182,468	\$9,213
LC04	México	ERES Energia Renovable SAPI de CV	Acquisition of 11 charge controllers	Miscellaneous	\$124,282	\$6,275
LC05	México	ERES Energia Renovable SAPI de CV	Acquisiton of 11 support systems for photovoltaic modules, pole or other	Miscellaneous	\$25,147	\$1,270
LC06	México	ERES Energia Renovable SAPI de CV	Installation service of 11 photovoltaic systems, including 2 led lights of 9W and 2 power plugs	Miscellaneous	\$64,358	\$3,249
LC07	México	TBC	digital material of communication 3 infographics, 3 newsletters	Publications	\$16,588	\$838
				Total costs	495,157	\$25,000