الجمعية اللبنانية للطاقة الشمسية
The Lebanese Solar Energy Society

Abstract

The Lebanese Solar Energy Society, LSES, was founded as a nonprofit organization in 1980. The group's members include experts in solar energy, university professors, as well as chemical, mechanical, and electrical engineers. However, due to the Lebanon War, activities were temporarily interrupted and relaunched in 2002.

The main objective of LSES, is to offer a platform for individuals and professionals for developing RE sources and have signed a training collaboration agreement with some Lebanese universities for students in engineering schools.

LSES is actively involved in many events promoting renewable energy through lectures, projects and events with various National and International organizations mainly the Order of Engineers and Architects in Lebanon, Industrial Research Institute IRI and other NGOs. In addition, LSES has inaugurated in 2012 an important Renewable Energy education tool called **ECOTRUCK.**

The Ecotruck, an initiative jointly developed with Industrial Research Institute, is aiming to educate students in private and public schools and the public at large, the local communities through the municipalities, about Renewable Energy practices as sustainable energy sources reducing the pollution and protecting the environment.

Introduction

1.1 Donor's Statement:

"Small Portable Solar Power Packs (SPSPP) for providing sustainable clean energy", implemented by LSES, is a project awarded by GEF SGP Lebanon in 2021 that started in November 2022 in the aim of alleviating the financial burden caused by the power outage crisis, this project succeeded, based on very defined criteria, in providing alternative clean energy to the pollution caused by the electricity generators by installing 26 solar power packs for low-income families in Beirut affected by the explosion at the Beirut Port and trained them on their use and necessary maintenance through conducting follow-up visits to these families .

LSES also conducted trainings for technicians and experts on installation and maintenance of Solar power packs within this context.

Adnan Melki
GEF SGP National coordinator in Lebanon

1.2 LSES Statement:

This project as described in this booklet and implemented during the year 2023 gave LSES in general and me particularly, as President, an unforgotten and great moral satisfaction. Through this grant and action, we have helped few families in needs, reduce their poverty and familiarize them as much as possible to use a sustainable energy from solar source in addition reduce the pollution.

This aspect will in a way give a small light in their lives thanks to all who contributed in making this project a reality mainly:

GEF/Small Grant Program Lebanon, LSES board members, who were always of a great assistance for important decisions regarding the progress of works, the Secretary General Youssef Ghantous who helped in preparing the call for proposal and the selection of students engineers for the assessment, the trainees, the treasurer Jean Paul Sfeir for his continuous assistance, member Ziad Doumit, member Wissam Daou who participated in the Solar PV training courses as well as Dr. Bechara Nehme, Head of Electrical Engineering School – USEK and Ecosys management in general and Mr. Georges Geha in particular who granted the DC/PV cables for free.

A special thanks to Industrial Research Institute IRI and its Director General Dr. Bassam Frenn for the continuous support mainly in the training aspects and to the subcontractor company Projection sarl and its MD Engineer Firas Hajj who implemented successfully all the works despites all constraints and difficulties.

At the end we wish to thank the Order of Engineers and Architects in Beirut who gave us the opportunity to expose this work in its premises the House of Engineers through a ceremony on 29th November 2023.

Walid El Baba
LSES President

Table of Contents

Call for proposal launched in 2021 by Global Environment Facility (GEF) Small Grants Programme (SGP) Lebanon & Implemented by UNDP

The project, with a very simple idea and approach without sophisticated technical innovation aspect, consists in providing the supply and proper operation of 26 portable solar power packs of capacity 1000 Watts with Battery for partial sustainable energy alternative solution using clean energy source (PV solar) to meet urgent local needs of low income families houses, half of the units to be delivered to apartments affected by the explosion of Beirut port, the other half to apartments in Beirut suburbs mainly in marginalized areas.

The project aims to reduce social and energy poverty by reducing electric bills of beneficiaries and familiarize those families to use sustainable energy source and be aware of solar applications and climate change effects. It aims to limit the effects of the energy starvation on the most vulnerable families which would affect the education of their children, the domestic day to day use of the families including lighting, internet, and refrigerators.

The Solar Power pack will remain the possession of LSES under a “Free Leasing “contract, allowing to control its traceability, proper operation as well as the good use and durable maintenance.

The beneficiaries have been selected according to a specific questionnaire as per *(Annex A).*

In addition to the above, the project contributed in engaging the community through following actions:

- **A training session for 8 technicians** to be familiarized with the solar PV systems in general, components and types of installations

-**A workshop for disseminating** the information among selected organizations of civil society.

The duration of the project was of 11 months.

During 4 to 5 months of operation regular technical visits were planned for data collections in order to establish an evaluation document for the future.

This project has also served as a demonstration tool for encouraging the replication of this type of portable packs, with various capacities, at a larger scale within residential buildings all over Lebanon

By implementing such demonstration project in those selected apartments, the use of sustainable solar energy through the energy pack will be:

-Generate more interest and awareness in using clean energy systems at private and individual level

-Make citizens aware of reducing percentage of greenhouses gases emissions

-Create a balance between a clean environment and the well-being and human needs.

After receiving the green light for the grant in 2022 the contract was signed mid-January 2023 between **LSES** and **Global Environment Facility (GEF) Small Grants Program (SGP) Lebanon/ UNDP**.

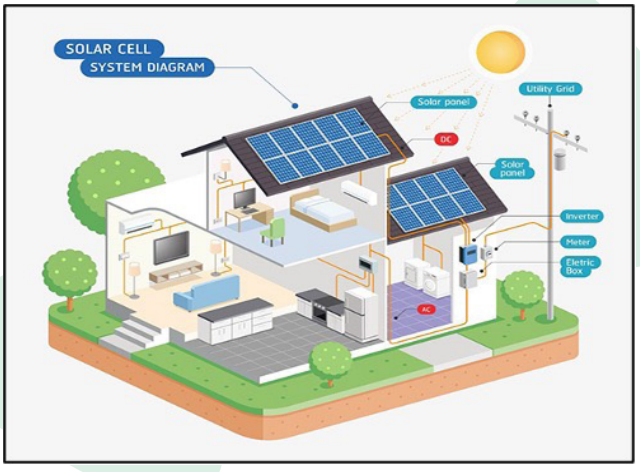
Works were launched under the supervision of Mr. Adnan Melki as national coordinator from GEF/Small Grant Program Lebanon for all day-to-day matters, and LSES Engineer Ziad Doumit as LSES project manager.

SPSPP Technical Specifications And Technical Layout

What are On-grid, Off-grid, and Hybrid solar systems?

On-grid, Off-grid, and Hybrid solar systems represent three distinct approaches to harnessing clean, renewable solar energy that plays a pivot role in reducing carbon emissions.

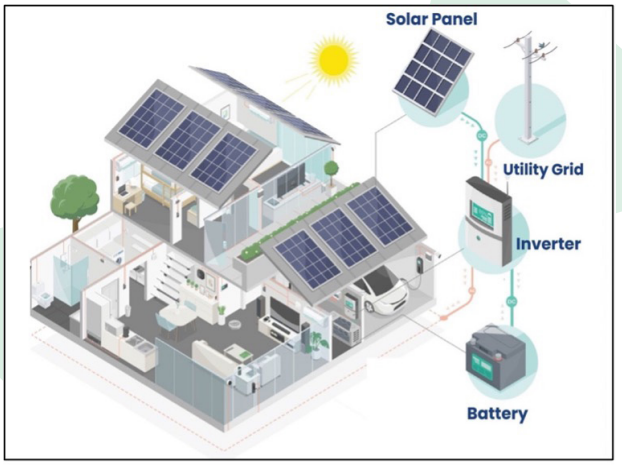
The On-grid solar system, also known as a grid-tied, Utility-interactive, Grid Inter-tie and Grid Back feeding system, is interconnected with the conventional electrical grid. It generates electricity from solar panels and feeds any surplus energy back into the grid, effectively allowing the owner to offset their energy consumption costs and, in some cases, earn credits.



Conversely, Off-grid solar systems operate independently of the grid, relying on batteries to store excess energy generated during the day for use at night or during cloudy periods.

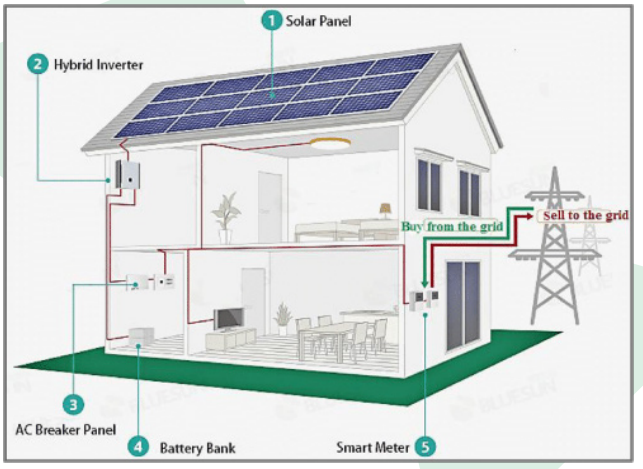
These systems are typically installed in remote areas where grid connectivity is either economically unfeasible or unavailable. Off-grid

systems offer energy self-sufficiency but require careful planning to ensure continuous power supply.



Hybrid solar systems combine the best approaches of both on-grid and off-grid systems. They are designed to store excess energy in batteries while still being connected to the grid. This allows users to have backup power during grid outages while taking advantage of the cost-saving benefits of on-grid systems. Hybrid systems offer increased energy reliability and can be tailored to suit a variety of needs, making them an increasingly popular choice for residential and commercial applications.

The project's engineers have opted to use the off-grid method.



Preparation Process

LSES assigned Mrs. Lina Bassil as the project coordinator, and trainees Miss Celine Jreig and Mr. Roudy Aoun (both genders should be equal according to the contract) to visit the families in needs and conduct the survey for about 50 families taking into consideration the following criteria:

- Sick individuals who require a continuous electrical backup (such as respirators).

-The number of occupants in the household, especially the number of kids, in order to facilitate future online learning.

However, because of unforeseen circumstances, the trainees had to be substituted multiple times. Ultimately, recently graduated engineer Nourhan Waked and engineering student Christian Tawk performed admirably throughout the entire process.

As for the supply of equipment and installation works:

Renewable Med Energies Company supplied the Power packs at a special cost, thanks to LSES member MD. Ziad Doumit.

Mrs. Yamak Co provided the solar PV panels

Solarnet (LSES Board Member Jean Paul Sfeir), provided the necessary accessories with part of them as a grant while the PV DC cables were offered with thanks free of charge by Ecosys.

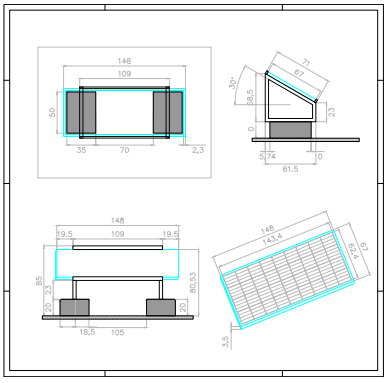
LSES subcontracted “Projection” sarl Company who provided the best bid, for the supply of the supporting metallic frame as well the whole execution works and commissioning.

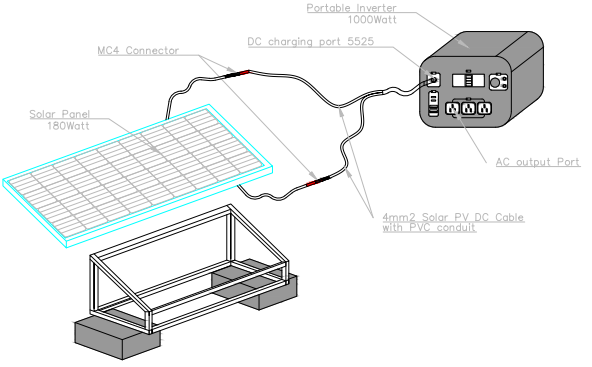
Finally, a total of 26 families were chosen based on predetermined criteria following the long list of visits with 2 families leaving outside Beirut one in Akkar in the North and one in Aramoun area after receiving the donor approval.

The chosen homeowners were required to sign an advance agreement stating that LSES has no responsibility for any unrelated electrical harm. The signed document restricted also any modifications or additions to the installation.*(Annex B).*

Installation & Follow Up

The installation was successfully implemented and commissioned by Eng. Habib Hammoud (Projection sarl) in coordination with Mrs. Bassil, working under the supervision of Eng. Ziad Doumit, and Eng. Walid El Baba, the director.





Since most of the chosen beneficiaries are renters, LSES found difficulties to define the proper location of the solar panel; part of those panels was installed on the balcony, where it is effective as much as possible without shading and facing preferably South while another part was installed on roof without affecting the roof since the supporting frame will be mounted on concrete blocks that weight 50 kgs per block (With the exception of one person who experienced harm by the Beirut port blast on both physical and mental level, LSES agreed exceptionally to offer the power pack while the solar panel will be placed later on when situation will allow that).

Furthermore, the majority of buildings lack elevators, or if existing are not continuously in operation, consequently, the team working on-site had to lift each and every piece of equipment up to roof at high floor levels.

A full explanation for a sustainable and safe operation of the solar power pack was given to all the families with a guidance on what to do or not to do. An installation document was signed by families attesting to their knowledge of how to operate the powerpack and its regular operation. *(Annex C).*

There were normal difficulties throughout the post-installation period. In addition to the tens of phone calls and texts inquiring about any unexpected signal shown on the screen, the team has visited the families up to four times in the last four months, in order to follow up and inquire about any issues.

Technical Report on the Installation of -180Watt Solar Panels and Alpha ESS Portable Power Station AP1000 - (SPSPP)

After the four follow up visits we can state below the following achieved results

6.1 Implementation:

The installation project aimed to demonstrate the practicality and benefits of solar energy utilization, particularly in remote or off-grid locations. The chosen equipment included 180-watt solar panels and the Alpha ESS Portable Power Station AP1000 *(Annex D)*. The installation process can be summarized as follows:

1.The sites demonstrate divergences in spatial layout and construction methodology, thereby requiring the development of a versatile metallic base for the panels capable of accommodating diverse environments. The selection of an appropriate location was informed by considerations such as solar irradiance, accessibility, and alignment with the sun's path to ensure optimal energy capture.

2.Solar Panel Installation: The 180-watt solar panels have been securely affixed to a support structure, meticulously positioned to optimize tilt and orientation for the maximal absorption of solar energy. However, it should be noted that a subset of panels may deviate from the optimal tilt and orientation due to construction methodology, anti-theft considerations, shading caused by adjacent structures, and other factors.

3.Alpha ESS Power Station Integration: The Alpha ESS Portable Power Station AP1000 was positioned in close proximity to the users. It was connected to the solar panels using a PV cable connected to the DC charging port 5525, enabling energy conversion, storage, and distribution.

4.Wiring and Connection: Wiring was carefully routed from the solar panels using MC4 cables to the Alpha ESS Portable Power Station. The connections were made following industry-standard practices to ensure safety and efficiency.

5.System Testing: After the installation was completed, thorough testing of the entire system was conducted to verify the functionality of the solar panels, the power station, and their integrated operation.

6.Throughout the installation process, the team encountered the need to manually transport all products up a staircase in the absence of an electric elevator. Additionally, challenges arose during site transitions, specifically in locating suitable parking spaces.

6.2 Inspection:

Four comprehensive inspections (one each month) *(Annex E)* were carried out to assess the effectiveness of the installation and the overall performance of the solar energy system. Each inspection covered various aspects, including:

1.Energy Output: The amount of energy generated by the solar panels and stored in the Alpha ESS Power Station was measured over a specified period, it reached 80 watts to 100 watts at peak. This data was compared with expected energy production to evaluate efficiency.

2.Battery Performance: The storage capacity and discharge capabilities of the Alpha ESS Power Station were tested to ensure its reliability in providing continuous power, even during periods of low solar irradiance.

3.System Integration: The interaction between the solar panels and the power station was examined to identify any compatibility issues or communication errors.

4.Safety Measures: The installation's adherence to safety standards and the proper functioning of protection mechanisms, such as overcurrent and overvoltage safeguards, were reviewed.

5.Limited Space: The available installation space posed constraints on the positioning and alignment of the solar panels, affecting their optimal energy capture.

6.Charging Input Defect: In some cases, we encountered the presence of defect in the charging DC input port 5525 of the Alpha ESS Portable Power Station AP1000, and this issue was solved and maintained properly.

7.Thermal Challenge: A technical concern emerged regarding the thermal performance of the Alpha ESS Portable Power Station AP1000, necessitating a resolution through the repositioning of the powerpack.

6.3 Final Technical Statement:

The deployment of 180-watt solar panels and the Alpha ESS Portable Power Station AP1000, orchestrated by the LSES, shows the potential of solar energy adoption in Lebanon. While challenges were encountered, the successful installation and inspection demonstrate the viability of solar energy as a sustainable power source, along with the need of careful planning and technical expertise.

The project will strengthen the increased solar energy integration and will emphasize the importance of addressing challenges to ensure reliable and efficient renewable energy systems. It will also help reduce pollution for a clean environment.

Furthermore, the LSES has assumed responsibility for the comprehensive maintenance of the system until end of June 2024, further demonstrating their commitment to the longevity and optimal performance of this renewable energy infrastructure