Joun Development Projects Series

Proposal for Solar Energy for the Town of Joun

2025 - 2030

Community Solar Projects are a powerful way to democratize access to clean energy and promote sustainability within communities

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SOLAR ENERGY FOR THE TOWN OF JOUN

A Handbook

Abstract

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Prepared by Antoine J. Burkush, PhD

Joun, Al Chouf

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Acknowledgments

This collection of proposals is the result of a shared vision and a collaborative journey, guided by the input, dedication, and insights of countless individuals who hold Joun close to their hearts. It would not have been possible without the unwavering support and contributions of community members, experts, stakeholders, and local leaders, each of whom brought their unique perspectives to the table.

First and foremost, I extend my heartfelt gratitude to the residents of Joun, whose voices, ideas, and aspirations have been the foundation of this work. Your willingness to share your thoughts and dreams for our town has been invaluable in shaping proposals that truly reflect our community's spirit and goals. Your participation in discussions, surveys, and community gatherings has been a testament to your **commitment** to Joun's future.

Special thanks to all whose contributions were instrumental in refining our vision.

To the local leaders and stakeholders who championed this project, your support has been a vital source of encouragement. Your leadership and understanding of Joun's unique challenges and opportunities have given depth to these proposals, grounding them in both our town's history and its potential for growth.

Finally, I would like to thank everyone who worked behind the scenes—whether gathering data, conducting research, or organizing meetings—your efforts have been crucial in bringing this work to life.

Together, we have created a roadmap for Joun's future that honors our heritage and inspires a brighter tomorrow. I am truly grateful to each of you for your contributions, enthusiasm, and dedication to this endeavor.

With sincere appreciation,

Dr Antoine J. Burkush, PhD

الشكر والتقدير

هذه المجموعة من المقترحات هي نتيجة رؤية مشتركة ورحلة تعاونية ، تسترشد بمدخلات وتفاني ورؤى عدد لا يحصى من الأفراد الذين يحملون جون قريبا من قلوبهم. لم يكن ذلك ممكنا بدون الدعم والمساهمات الثابتة من أعضاء المجتمع والخبراء وأصحاب المصلحة والقادة المحليين ، الذين قدم كل منهم وجهات نظره الفريدة إلى الطاولة.

أولا وقبل كل شيء، أعرب عن خالص امتناني لسكان جون، الذين كانت أصواتهم وأفكارهم وتطلعاتهم أساس هذا العمل. لقد كان استعدادك لمشاركة أفكارك وأحلامك لمدينتنا لا يقدر بثمن في تشكيل المقترحات التي تعكس حقا روح مجتمعنا وأهدافه. كانت مشاركتك في المناقشات والاستطلاعات والتجمعات المجتمعية شهادة على التزامك بمستقبل جون.

شكر خاص للذين كانت مساهماتهم مفيدة في صقل رؤيتنا.

إلى القادة المحليين وأصحاب المصلحة الذين دافعوا عن هذا المشروع ، كان دعمكم مصدرا حيويا للتشجيع. لقد أعطت قيادتك وفهمك لتحديات وفرص جون الفريدة عمقا لهذه المقترحات ، مما جعلها راسخة في كل من تاريخ مدينتنا وإمكاناتها للنمو.

أخيرا ، أود أن أشكر كل من عمل وراء الكواليس - سواء في جمع البيانات أو إجراء البحوث أو تنظيم الاجتماعات - كانت جهودك حاسمة في إحياء هذا العمل.

معا ، أنشأنا خارطة طريق لمستقبل جون تكرم تراثنا وتلهم غدا أكثر إشراقا. أنا ممتن حقا لكل واحد منكم على مساهماتكم وحماسكم وتفانيكم في هذا المسعى.

مع خالص التقدير،

د. انطوان جان البرخش

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مشاريع

مبادرات شخصية

"من أجل الصالح العام"

Joun Development Projects

"Pro Bono Publico"

Dr Antoine J. Burkush, PhD

رؤية واحدة، هوية واحدة، مجتمع واحد

Preface

In a world where rapid change is the new normal, the importance of strategic, sustainable, and community-centered development is paramount. Joun, with its rich cultural heritage, natural beauty, and resilient community, stands at a crossroads—one that presents both challenges and extraordinary opportunities. As we look toward Joun's future, it is essential that our plans honor the town's heritage, respond to today's needs, and set a course for future generations to thrive.

This series of proposals is the result of a deeply collaborative effort to envision Joun's path forward. Each plan reflects input from residents, local stakeholders, and community leaders, resulting in a shared vision that is both ambitious and respectful of our town's unique identity. These proposals encompass a comprehensive range of initiatives, from infrastructure and economic development to cultural preservation and environmental stewardship, with each component tailored to address Joun's specific strengths, challenges, and aspirations.

Our proposals emphasize a commitment to public infrastructure improvements, economic empowerment, environmental sustainability, and cultural continuity. From plans to enhance recreational facilities and community services to initiatives for sustainable tourism and green energy, each proposal aims to make Joun a model of progressive yet grounded development. The ultimate goal is to create a vibrant, inclusive, and resilient community—one that embodies the values, dreams, and talents of its people.

I extend my heartfelt gratitude to everyone who has contributed to this vision. Your dedication, ideas, and insight have been invaluable, illuminating the pathway to a future that aligns with Joun's core values while embracing growth and innovation. These proposals are an invitation to all residents of Joun to imagine, participate, and help build a community that harmonizes tradition with the possibilities of tomorrow.

As you review this collection, I encourage you to see not just plans, but a vision for what Joun can become. Let us move forward together, translating these ideas into action, and creating a brighter, thriving, and unified future for Joun.

With deep respect and optimism,

Dr Antoine J. Burkush, PhD

مقدمة

في عالم حيث التغيير السريع هو الوضع الطبيعي الجديد ، فإن أهمية التنمية الاستراتيجية والمستدامة التي تركز على المجتمع أمر بالغ الأهمية. تقف جون ، بتراثها الثقافي الغني وجمالها الطبيعي ومجتمعها المرن ، على مفترق طرق - مفترق طرق يمثل تحديات وفرصا غير عادية. بينما نتطلع إلى مستقبل جون ، من الضروري أن تكرم خططنا تراث المدينة ، وتستجيب لاحتياجات اليوم ، وتضع مسارا للأجيال القادمة لتزدهر.

هذه السلسلة من المقترحات هي نتيجة جهد تعاوني عميق لتصور مسار جون إلى الأمام. تعكس كل خطة مدخلات من السكان وأصحاب المصلحة المحليين وقادة المجتمع ، مما يؤدي إلى رؤية مشتركة طموحة وتحترم الهوية الفريدة لمدينتنا. تشمل هذه المقترحات مجموعة شاملة من المبادرات ، من البنية التحتية والتنمية الاقتصادية إلى الحفاظ على الثقافة والإشراف البيئي ، مع تصميم كل مكون لمعالجة نقاط القوة والتحديات والتطلعات المحددة لجون.

تؤكد مقترحاتنا على الالتزام بتحسين البنية التحتية العامة ، والتمكين الاقتصادي ، والاستدامة البيئية ، والاستمرارية الثقافية. من خطط تعزيز المرافق الترفيهية والخدمات المجتمعية إلى مبادرات السياحة المستدامة والطاقة الخضراء ، يهدف كل اقتراح إلى جعل جون نموذجا للتنمية التقدمية والمرتكزة. الهدف النهائي هو إنشاء مجتمع نابض بالحياة وشامل ومرن - مجتمع يجسد قيم وأحلام ومواهب شعبه.

وأعرب عن خالص امتناني لكل من ساهم في هذه الرؤية. لقد كان تفانيك وأفكارك ورؤيتك لا تقدر بثمن ، مما يضيء الطريق إلى مستقبل يتماشى مع القيم الأساسية لجون مع احتضان النمو والابتكار. هذه المقترحات هي دعوة لجميع سكان جون للتخيل والمشاركة والمساعدة في بناء مجتمع ينسق التقاليد مع إمكانيات الغد.

أثناء مراجعتك لهذه المجموعة ، أشجعك على رؤية ليس فقط الخطط ، ولكن رؤية لما يمكن أن يصبح عليه جون. دعونا نمضي قدما معا، ونترجم هذه الأفكار إلى أفعال، ونخلق مستقبلا أكثر إشراقا وازدهارا وموحدا لجون.

مع الاحترام العميق والتفاؤل،

د. انطوان جان البرخش

SOLAR ENERGY FOR THE TOWN OF JOUN

EXECUTIVE SUMMARY

The Proposal provides strategies for implementing solar power in a community. Community solar projects are gaining popularity as a sustainable and cost-effective way to provide renewable energy to communities. These projects involve a group of individuals or organizations coming together to collectively invest in and benefit from a solar energy system. By sharing the costs and benefits of solar power generation, community solar projects can make renewable energy more accessible to a wider range of people, including renters, low-income households, and those with limited roof space or unsuitable roofs for solar panels.

The background section explains what a community solar project is and its benefits. It highlights several key benefits of community solar projects. Firstly, they can help to reduce energy costs for participants by providing access to clean, renewable energy at a lower cost than traditional utility rates. This can help to improve energy affordability and reduce energy burden, particularly for low-income households. Community solar projects also allow participants to support local renewable energy development and reduce greenhouse gas emissions, contributing to a more sustainable future.

Incorporating solar power into a community project involves careful planning and coordination to ensure the project's success. Some strategies for successful implementation include engaging stakeholders early in the planning process, conducting thorough site assessments to determine the feasibility of solar installations, securing financing through a combination of grants, loans, and incentives, and developing a clear project timeline and budget. Additionally, it is important to establish clear communication channels and decision-making processes to ensure that all stakeholders are informed and involved throughout the project.

Before launching a community solar project, it is essential to consider a set of project readiness questions to assess the project's feasibility and potential for success. These questions may include: Is there sufficient community interest and support for the project? Are there suitable sites for solar installations available? What financing options are available, and what are the projected costs and benefits of the project? By carefully considering these questions and conducting thorough due diligence, project organizers can ensure that their community solar project is well-planned and sustainable.

In Lebanon, the solar energy scene is rapidly developing, with increasing interest and investment in renewable energy projects. Lebanese municipalities play a crucial role in promoting solar energy adoption by providing incentives, streamlining permitting processes, and supporting community solar initiatives. The United Nations Development Programme (UNDP) has been actively involved in promoting solar energy projects in Lebanon, working to increase access to clean and sustainable energy for communities across the country.

To meet the energy needs of the 7500 inhabitants of Joun, a comprehensive solar power system would be required. This would involve careful site selection, taking into account factors such as sun exposure, available land area, and proximity to existing infrastructure. Challenges and obstacles to implementing solar energy projects in Lebanon may include regulatory barriers, lack of technical expertise, and limited financial resources. However, by developing innovative financing strategies, engaging schools and educational institutions in solar initiatives, and carefully evaluating potential sites, these challenges can be overcome.

Administrative Overview of the V24 Initiative provides an outline of the administrative process for setting up the Village 24 Initiative, including steps such as consultation with residents, establishing an Energy Committee, and conducting a detailed study and procurement of the renewable energy system.

The Village 24 (V24) Initiative, part of the CEDRO IV Project, aims to provide sustainable energy solutions to Lebanese villages and communities. The initiative involves a technical overview of solar energy systems, as well as an administrative framework for setting up and managing the project. By creating a summary checklist to guide project implementation and addressing future concerns and options, the V24 Initiative seeks to promote the development of renewable energy projects at the community level.

The technical Overview of the Village 24 Initiative describes the technical aspects of the Village 24 Initiative, including the hybrid microgrid concept.

In conclusion, community solar projects such as the one proposed for Joun offer a promising opportunity to promote renewable energy adoption, reduce energy costs, and support sustainable development in Lebanon and beyond. By leveraging the expertise and resources of local municipalities, international organizations such as the UNDP, and community stakeholders, solar energy projects can play a critical role in advancing energy access and environmental sustainability. As the solar energy landscape continues to evolve in Lebanon, it is essential to consider the unique challenges and opportunities presented by each community and develop tailored strategies to promote solar energy adoption and support a more sustainable future.

PART ONE

The Fundamentals

BACKGROUND

What Is a Community Solar Project?

A **community solar project** is a collaborative effort that allows multiple customers—such as individuals, businesses, nonprofits, and other groups—to benefit from solar energy. Here are the key points about community solar:

1. **Definition**:
   - Community solar is any **solar project or purchasing program** within a specific geographic area.
   - In community solar, the benefits flow to **multiple customers**, rather than being limited to individual homeowners or businesses.
   - Customers typically benefit from energy generated by solar panels at an **off-site array**.
2. **How It Works**:
   - Community solar projects generate electricity from sunlight, and the electricity flows through a meter to the utility grid.
   - **Subscribers** (households, businesses, or any other electricity customer) pay for a share of the electricity generated by the community solar project.
   - This payment is typically in the form of a **monthly subscription fee**.
   - The local utility pays the community solar provider (can be the municipality) for the energy generated, and each subscriber receives a portion of the dollar value generated by their community solar subscription as a **credit**.
   - This credit is applied directly to a subscriber's monthly electric bill, helping to **reduce customers' electricity costs**.
3. **Benefits of Community Solar**:
   - **Equitable Access**: Community solar allows all households and businesses to access the benefits of solar energy, regardless of whether they can install panels on their own roofs.
   - **Cost Savings**: In areas where solar power is less expensive than fossil-generated electricity (which is the case in most places), consumers can **save money** on their monthly bills.
   - **Resilience**: Community solar provides resilience during blackouts or weather events.
   - **Local Job Creation**: Community solar projects create local jobs in installation, maintenance, and management.
4. **Consumer Protections**:

- Community solar programs should incorporate **key consumer protections** to ensure subscribers receive strong benefits.

In summary, community solar is a powerful way to democratize access to clean energy and promote sustainability within communities.

Benefits of Community Solar Projects

Installing solar panels on a building or household can come with a variety of issues.[5] For homeowners, these limitations include roof shape/size constraints, shading, grid capacity, and zoning regulations. Non-homeowners cannot make building modifications like solar installations.

Community solar functions similarly to conventional grid-supply energy insofar as it provides energy remotely, requiring no installation or maintenance on the part of the consumer.[5] Because of community solar projects' remote nature, the physical limitations of solar installation for consumers disappear. Also, due to its subscription/opt-in functionality, community solar can increase access to solar energy for low-income households. These projects benefit initial investors too. As consumer rates for solar energy become lower through distributed generation of community solar, initial investors in community solar projects experience higher returns in the long run.[5]

Centralizing the location of solar systems can thereby create advantages over residential installations:[5]

- Avoiding trees, roof size and/or configuration limitations, adjacent buildings, the immediate microclimate and/or other factors which may reduce power output at the residential location;[7][8]
- Avoiding building codes, zoning restrictions, homeowner association rules and aesthetic concerns;[9]
- Reduced maintenance requirements;[7]
- Reduced installation costs;[5]
- Return-on-investment.[10]

There are also a number of social/community benefits of community solar:[5]

- Expanding participation to include renters and others who are not residential property owners.[3]
- Increased solar access for low-income residents;[5]
- Community solar's ability to generate jobs and educational resources.[5][11]

Strategies of Incorporating solar power into a community project

Incorporating **solar power** into a community project can have numerous benefits, from reducing energy costs to promoting sustainability. Here are some strategies to consider:

1. **Community Solar Projects**:
   - **Community solar** allows multiple customers to buy electricity from a shared solar project. These projects can be installed near where the community members live.
   - Consider building community solar arrays on **public buildings**, **private lands**, or even the **roofs of apartment buildings**. This approach ensures that everyone in the community can benefit from solar energy without installing panels individually[1].
2. **Meaningful Benefits of Community Solar**:
   - Focus on providing **meaningful benefits** to community members. These benefits can include:
     - **Greater Household Savings**: Prioritize projects that offer substantial electricity bill savings for subscribers.
     - **Low- to Moderate-Income Household Access**: Reserve capacity for low- and moderate-income households, ensuring equitable access to clean energy.
3. **Stakeholder Engagement**:
   - Involve community members, local government officials, and stakeholders from the outset.
   - Host community meetings, workshops, and focus groups to gather ideas and ensure buy-in.
4. **Educational Initiatives**:
   - Use community solar projects as educational tools. Organize workshops, tours, and informational sessions to raise awareness about solar energy.
   - Teach community members about the environmental and economic benefits of solar power.
5. **Collaborate with Local Governments**:
   - Work closely with local government agencies to streamline permitting processes and regulatory approvals.
   - Leverage local resources and expertise to ensure successful project implementation.
6. **Public-Private Partnerships**:
   - Explore partnerships with private companies, nonprofits, and community organizations.
   - Jointly fund and manage community solar projects to maximize impact.

7. **Community Engagement Events**:
    - Host events related to solar energy, such as **solar fairs**, **workshops**, or **solar-powered festivals**.
    - Use these events to engage community members, showcase solar technologies, and encourage participation.
8. **Financing Models**:
    - Investigate financing options, including grants, loans, and crowdfunding.
    - Consider creating a community solar cooperative or subscription model.

Remember that community solar projects are about more than just generating clean energy—they strengthen community bonds, promote environmental stewardship, and empower residents to take control of their energy future.

Project Readiness Questions

1. What are the steps in the development process?
2. How do you build a project development timeline, including key milestones?
3. Which are the key contracts required in the solar development process?
4. Who are the members of your development team?

Development Roles:

Developers hire many expert consultants and vendors to guide the process, but **developers** must lead the following roles:

1. **Financing and Capital Raising.** Developers' primary role is to lead the financing of a project, which includes accurately predicting expenses and revenues, building

financial models, secure financing, and ensuring benchmarks are being met to release financing. Community solar developers may work with financing entities to raise the necessary capital to fund projects. This could include seeking investment from private equity firms, banks, and other investors who are interested in supporting renewable energy projects.

2. **Vendor Evaluation.** After financing, developers' second most important role is vetting, hiring, and managing a team to get the job done, which includes Requests for Proposals (RFPs) for services, vetting bids, creating task lists, and contract negotiations.

3. **Project Management.** After vendor evaluation, developers' third most important role is managing and coordinating all of the vendors to ensure that the project gets done on time and as expected, which includes scheduling and facilitating regular team meetings, taking notes and ensuring follow-up, problem solving, and mediation between vendors.

4. **Site Identification and Acquisition.** A developer must be an expert in identifying and acquiring suitable sites for community solar projects. By saying "acquiring," we mean securing site control. Acquiring sites is one of the most important roles of a developer.

5. **Creative Financing Strategies.** Community solar developers who specialize in bringing creative financing sources into projects are the best at providing deep benefits to the Solar Project Communities.

6. **Partnerships.** Developers should be experts at pulling together a coalition of consultants, funders, and community members to get a project approved, financed, built, and into operation. They are the leaders of the team.

7. **Community Engagement.** This role can be hired out but having the developer play the community engagement role helps build trust with the community and ensures success of the project. Community engagement is delicate and is tied to permit approvals. Therefore, it is highly advisable to at least participate at some level in this role.

8. **Subscription Management.** Subscriber management requires dedicated staff and sophisticated software tools to track customer interactions. Some developers choose to handle this effort in house, but because of the expertise and capacity required, many hire out.

9. **Marketing and Sales.** Subscription management will include marketing and selling community solar subscriptions to customers. This work could be led by a Subscription Management vendor, but developers should participate in efforts to

build relationships with community organizations and local businesses to promote participation.

10. **Project Design and Engineering.** Even though many people have the skills to design solar projects, in order to submit for permits, project designs must be stamped by a professional engineer. Most developers hire vendors for engineering services.

11. **Permitting and Regulatory Compliance.** Developers are responsible for securing the necessary permits and approvals for community solar projects. Professional engineers, electrical contractors, and legal counsel should be hired to ensure that projects comply with government regulations and utility requirements.

12. **Construction Management.** Once a community solar project has received permitting and funding approvals, developers are responsible for overseeing the installation. This oversight includes coordinating with contractors, overseeing the installation of solar panels and other equipment, and ensuring that the project is completed on time and within budget. Some developers hire outside construction management but most do not.

13. **Asset Management.** Asset Management involves overseeing the daily operations of the project, which includes managing the maintenance team, paying bills, and accounting.

14. **Operations and Maintenance.** After a community solar project is completed, the project owner will be responsible for its ongoing operation and maintenance. This can include monitoring system performance, conducting routine maintenance and repairs, and ensuring that the project is running efficiently.

Solar Energy Scene in Lebanon

Solar energy projects are making a positive impact in Lebanon, benefiting both residents and the environment. Here are some notable initiatives:

1. USAID's Solar-Powered Water Pumping Projects:
   - Administrator Samantha Power recently announced $8.5 million in funding for Lebanon. This support will facilitate 22 new solar-powered water pumping projects across the country. These projects aim to serve over 150 towns and villages, benefiting more than half a million Lebanese citizens and refugees.
   - The solar-powered water pumping stations not only provide much-needed electricity but also refurbish chlorination equipment.

2. Previous Solar Energy Projects:
   - USAID has already supported 41 solar energy projects, benefiting 460,000

residents in 70 Lebanese towns and villages. These projects contribute to sustainable energy solutions and strengthen local economies[2].

These efforts demonstrate the commitment to sustainable development and community well-being in Lebanon.

The Role of Lebanese Municipalities in Solar Energy

At a time when Lebanon is going through a double electricity crisis caused by generator owners launching a rationing program due to diesel shortage, and later the lifting of subsidies, there has been much talk of solar energy as an eco-friendly alternative. A number of Lebanese municipalities have several experiences in this regard, whereas some have solar power lights, others have a sustainable municipal building with solar panels that provide electricity, and others have resorted to securing clean energy to the entire village or town houses. Today, this alternative is being put forward as providing solar energy without the need to secure a hard currency to buy fuel oil, as sunlight is available for free.
This resolution, which recently made headlines on the social media, comes after Electricité du Liban (EDL) was unable to provide more than 800 megawatts of energy due to the fact that its funds are in Lebanese pounds and it can only buy fuel in US dollars. EDL is a public institution and can only purchase dollars from the Banque Du Liban (BDL) on the basis of the official exchange rate, in order to secure maintenance parts, chemicals and fuel. As for the generators, their supply hours have dropped because they were previously affected by the diesel shortage, while their owners now fear that customers will be unable to pay the subscription fees. Against this backdrop, the **demand for solar panels increased, and attention has turned to local authorities** that have already started a solar energy project within their scope, as has the private sector.

In talking about independent experiences in alternative energy, we found that the central regulatory element is absent, therefore we will be facing a new state of energy waste in multiple forms. And given the chaos in the electricity sector since the generators entered the field with the interests of fuel and oil importers, the solar energy experience would also be chaotic, but nevertheless it has produced guiding models for the government to draw up an electricity plan based on its experiences.

Municipalities in Lebanon have broad powers, and one of the most important roles entrusted to them is local development. And while the State has monopolized the electricity sector with the possibility of some granted exceptions such as" Zahle Electricity", the need for an alternative to "EDL" during rationing hours has produced generators and solar power in the form of generators, which indicates that this sector is not regulated to date, and is a product of need.

Within this framework, the experience of the municipality of Kfarmishki in the Rashaya district has become a "cited example" among the Lebanese. In this Bekaa town, about 100 homes receive 5 amperes, and electricity is distributed for about 5 hours, according to a member of its municipality, Tony Ayoub who noted that "the preparation for the solar energy project began about 4 years ago, and it was actually launched in October 2019. The project costed 200 thousand US dollars, and several associations contributed to its financing, including USAID and Caritas." He pointed out that "solar energy accounts for 30 percent of the electricity used by households." This shows that **some Lebanese municipalities rely on themselves** and on their access to donor assistance in order to provide basic services to the population. And while the roots of this project date back to the pre-economic collapse in Lebanon, the "**rush**" of municipalities and private institutions towards alternative solutions will deepen the need for decentralized solutions to the electricity crisis, in the absence of a broad and comprehensive change in the way the electricity facility is managed.

"When the State moves towards administrative decentralization and finances municipalities, the latter will be able to develop their scope responsibly and constructively," Saïbi added.

Municipal experiences do not stop there. Another experience is the solar water heating project in the municipality of Choueir. However, the municipality stated that it "has submitted a solar energy project and is waiting to receive approval in order to install 60 amps of solar panels on the roof of the municipal building, meaning that it would be a large network."

The municipality pointed out that "the solar water heating project (within its scope) started with Minister Elias Bou Saab when he was president of the municipality of Choueir. The project was launched in cooperation with a Lebanese bank that provided financing facilities, in order to encourage individuals to participate in this project, in which about 100 houses have participated
Regarding the new solar energy project in Choueir, the municipality stated that "its goal is to supply the municipal building and nearby squares with electricity in order to have street lighting at night," explaining that "in the event of an electricity cut in the town, the municipality will provide power to the institutions threatened by power outages, and then it will be able to supply them with power."

These initiatives came to address the citizen's need for electricity amid the darkness of the economic crisis in Lebanon, but they remain individual and do not fall within the framework of a comprehensive electricity plan that will pull the country out of the cycle of rationing and the danger of disruption of services and basic needs, such as the internet, water and others. However, similar initiatives that help the population are fine, especially since they do not cause toxic emissions in the form of those that come out from private generators. But the “dismissal” of a comprehensive and centralized plan for electricity based on alternative energy leads to wasting a large amount of energy and loses the solution.

On the other hand, the need for generators for all municipalities has not ceased due to the non-purchase of batteries for energy storage. However, this experience made it necessary for the municipality to distribute the electricity of generators and solar power itself to homes, which led to some kind of stability in villages and towns.

The conclusion we reached after questioning the municipalities presidents is that, in addition to the fact that the bill dropped significantly after switching to solar power, the population got rid of the problem of frequent power outages, and they were able to work remotely and learn from home without any problems.

Township initiatives are numerous and cannot be counted in this report, and the same is true for private sector initiatives. After reaching the red line for the diesel crisis, which threatened all sectors, including chicken farms, the solution was found in a chicken farm in Mtein, owned by the father of agricultural engineer Roland Sarkis. This farm has 80,000 chickens and 160 solar panels. Sarkis confirmed that "the cost of the project is about $80,000, but it does not include batteries, which makes us resort to a generator.”

The savings made by the farm, only in terms of diesel, are $900 per month compared to their other farm, which does not have a solar power project.

As for "Arcenciel" in Deir Taanayel, one of its managers, Elia Ghorra, stated that "solar power generation projects in Deir Taanayel started in 2014, the last project being completed in 2018, and their total cost reached about 170 thousand US dollars,” pointing out that “the project contains 600 panels, but without batteries, which makes us resort to generators.”

"Last year, the project produced 203 megawatts," he added, noting that “the project was financed by several parties, including the UNDP and the United Nations, through loans.”

Most of these experiences have shown that the batteries necessary to conserve the produced solar energy are not available to be used when the sun is absent, which inevitably leads to the need to resort to a special generator to benefit from solar energy.

UNDP Solar Activities in Lebanon

UNDP Lebanon works within four focus areas: Social and Local development, Conflict Prevention and Peacebuilding, Democratic Governance and Institutional Development, and Environmental Governance. Along with its partners, UNDP is working in line with the new UNDP strategic plan 2022-2025, based on the six signature solutions (Poverty & inequality, governance, resilience, environment, energy and gender equality) and the three enablers (Digitalization, Strategic innovation, Development financing) towards delivering what is required to implement the 2030 agenda and to achieve our SDGs.

The **United Nations Development Programme (UNDP)** has been actively involved in solar projects in Lebanon. Here are some notable initiatives:

1. **Solar Photovoltaic Systems for Residential Homeowners**:
    - UNDP provides a guide for selecting solar PV systems with battery storage for residential use. These systems offer sustainable electricity generation, rely on sunlight, and require minimal maintenance. While the upfront costs are relatively high, they significantly reduce electricity bills over 20+ years[1].
2. **Empowering Nabay Municipality with Solar**:
    - In February 2024, UNDP, in partnership with the European Union, inaugurated a solar initiative and business center in Nabay Municipality, Matn region. This project aims to support a greener Lebanon[2].
3. **Bids for Solar Installation in Lebanon**:
    - UNDP recently called for bids to provide, deliver, install, and commission a photovoltaic (PV) system in Lebanon. This step contributes to embracing renewable energy solutions and creating a more sustainable future[3].

These efforts demonstrate UNDP's commitment to promoting solar energy and addressing

Solar Power Required to Meet the Energy Needs of the 7500 Inhabitants of Joun

The amount of **solar power** required to meet the energy needs of **7500 inhabitants** depends on several factors, including their electricity consumption, available sun exposure, and the efficiency of solar panels. Let's break it down:

1. **Electricity Consumption**:
    - The first step is to determine the **average daily electricity consumption** for the entire population. This figure varies based on location, lifestyle, and other factors.

- For example, if we assume an average daily electricity usage of **30 kilowatt-hours (kWh)** per household (based on national averages), then for 7500 inhabitants, the total daily consumption would be:

  Total daily consumption = 7500 inhabitants times 30 kWh /inhabitant = 225,000 \ kWh/day

2. **Sun Exposure**:
   - The amount of **sunlight** your location receives affects the efficiency of solar panels. Areas with more sun exposure generate more energy.
   - You'll need to find the **peak sun hours** for your specific location. These are the hours when sunlight intensity is highest.
   - Let's assume an average of **5 peak sun hours** per day for our calculation.
3. **Solar Panel Power Rating**:
   - Solar panels have different power ratings, typically measured in **watts (W)**. Common residential panels range from **250 W to 400 W**.
   - Let's use an average panel rating of **300 W** for our example.
4. **Calculating the Number of Panels**:
   - We can use the following equation to estimate the number of solar panels needed:

     Number of panels} = Total daily consumption divided by Panel wattage times Peak sun hours

   - Plugging in the values:

     Number of panels = 225,000 kWh/day divided by 300 W/panel times 5 hours/day = 1500 panels.

Therefore, to fully offset the electricity needs of 7500 inhabitants, you would need approximately **1500 solar panels** (assuming the specified average values). Keep in mind that this is a simplified estimate, and actual requirements may vary based on location, panel efficiency, and other factors[12].

Calculating the Number of Panels:

- We can use the following equation to estimate the number of solar panel: needed:

$$\text{Number of panels} = \frac{\text{Total daily consumption}}{\text{Panel wattage} \times \text{Peak sun hours}}$$

- Plugging in the values:

$$\text{Number of panels} = \frac{225,000 \text{ kWh/day}}{300 \text{ W/panel} \times 5 \text{ hours/day}} = 1500 \text{ panels}$$

Site Selection

SOURCE: Report written by Captis Ltd – author Cora Plant.
Peer Review and other professional input provided by Plan Energy Ltd – www.planenergy.co.uk.

Solar Farm components:

Ground mounted Solar Farms, when appropriately sited, can blend well with surrounding landscapes and can be largely screened from nearby neighbors. They are made up of relatively few components with limited civil works required. Solar Farm components include, inter alia:

- Solar panels and associated mounting systems and foundations,
- Inverters – to convert the electricity generated from DC to AC
- Transformers – to transfer the electrical energy
- On site customer and network operation substation
- Security arrangements – fencing and CCTV
- Access tracks
- Landscaping.

Criteria to Be Considered

When undertaking a project feasibility and carrying out an initial assessment of a site in the context of its suitability to accommodate a commercial Solar Farm a number of criteria need to be considered including:

- **the scale of the land available,**
- **the number of landowners associated with the proposed site**
- **proximity to the grid,**
- **site topography and ground conditions and**
- **key planning and environmental considerations**.
- **Proximity to the Grid and available capacity**

A critical governing factor in relation to the viability of a solar farm is its proximity to the nearest Grid – and the available capacity at that node to accept the generation.

Generally speaking, and as can be confirmed by financial modelling, a sub 5MW Solar Farm would need to be located within 1km of the substation and require no upgrade to the substation/network in order to be viable.

- **Site topography and ground conditions.**

Another key governing factor in relation to a site suitability is the site topography and the ground conditions. In relation to the **site topography South/ South West facing slopes are required** in order to maximize the solar gains and therefore energy yield of your installed plant. Also, it is preferably that the site would be broken up with few natural boundaries and hedgerow. This enables the length of Solar arrays to be maximized and provides a site that is more efficient in terms of achieving the installed capacity. However, it should be noted that some natural boundaries and hedgerows can be important to break up sites and provide screening where there is potential for impacts from a landscape and visual perspective. This can be considered further at a more detailed pre-screening stage.

- **Planning and Environmental Considerations**

Important elements from a planning an environmental perspective to consider at early feasibility/ planning screening stage include the following:

- Land zoning
- Existing and historical planning applications in the vicinity.
- Proximity to archaeological and cultural heritage features.
- Proximity to flood zones.
- Scenic Views.
- Landscape character.
- Potential for Glint and Glare impacts.
- Traffic and transport considerations.

Conclusion

In theory Community led Solar Farms are viable (subject to a number of criteria) and if designed and installed correctly can provide a steady return to investors. In the financial model prepared as part of this study return is in the region of 6%. In addition to this there would also be an annual payment for community related projects. There is also the potential for community employment opportunities in the form of Asset management and Operation and Maintenance of the Community led Solar Farm – where financial liabilities associated with the Farm become community opportunities.

Challenges and Obstacles

Community solar development comes with its own set of challenges. Here are some common obstacles that developers may encounter:

1. **Navigating Regulatory and Policy Landscape**:
    - **Local and state regulations** can significantly impact community solar projects. Developers must understand zoning laws, permitting requirements, and interconnection rules.
    - **Navigating complex policies** related to incentives, net metering, and tax credits can be challenging.

2. **Securing Financing**:
    - **Raising capital** for community solar projects can be difficult. Developers need to explore financing options, secure loans, and attract investors.
3. **Land Acquisition and Site Selection**:
    - Finding suitable land or rooftops for solar arrays can be a challenge. Factors include land availability, sun exposure, and proximity to the community.
    - **Negotiating land leases** and addressing landowner concerns are essential.
4. **Community Engagement and Buy-In**:
    - **Gaining community support** is critical. Developers must engage residents, address concerns, and build trust.
    - **Educating stakeholders** about the benefits of community solar is an ongoing effort.
5. **Utility Interconnection Delays**:
    - **Grid interconnection** can be time-consuming due to utility processes, paperwork, and technical requirements.
6. **Consumer Protections and Equity**:
    - Ensuring **equitable access** to community solar is essential. Projects should prioritize low- to moderate-income households and provide strong consumer protections.
7. **Technical Challenges**:
    - **Solar design and engineering** require expertise. Proper panel orientation, shading analysis, and system sizing are critical.
    - **Maintenance and monitoring** of solar arrays are ongoing tasks.
8. **Marketing and Subscriber Recruitment**:
    - Attracting subscribers to community solar programs can be challenging. Developers need effective marketing strategies.
    - **Educating potential subscribers** about the benefits and dispelling myths is crucial.
9. **Project Viability and Long-Term Sustainability**:
    - Ensuring that community solar projects remain financially viable over the long term is essential.
    - **Managing risks**, including changes in regulations or market dynamics, is part of project sustainability.
10. **Collaboration and Partnerships**:
    - Building relationships with local governments, utilities, and other stakeholders is vital.
    - **Public-private partnerships** can enhance project success.

Community solar development requires persistence, collaboration, and adaptability to overcome these challenges and create meaningful benefits for the community.

Financing

Engaging **local businesses** in supporting your community solar project is essential for its success. Here are some strategies to foster collaboration and gain their support:

1. **Business Partnerships and Sponsorships**:
   - **Reach out to local businesses**: Identify companies that align with your community solar goals. Consider those with sustainability initiatives or a commitment to clean energy.
   - **Propose partnerships**: Offer sponsorship opportunities. Businesses can contribute financially or provide in-kind support (e.g., materials, labor, marketing).
2. **Educational Workshops and Events**:
   - **Host workshops**: Invite local business owners to educational sessions about community solar. Explain the benefits, cost savings, and environmental impact.
   - **Showcase success stories**: Share case studies of businesses that have adopted solar energy. Highlight their positive experiences.
3. **Joint Marketing Campaigns**:
   - **Collaborate on marketing**: Create joint campaigns that promote both the community solar project and the supporting businesses.
   - **Feature businesses**: Highlight businesses as solar champions in your project materials and communications.
4. **Employee Engagement**:
   - **Involve employees**: Encourage businesses to engage their employees. Offer special subscription rates for employees to participate in the community solar program.
   - **Employee education**: Conduct sessions within businesses to educate employees about community solar and how they can get involved.
5. **Local Procurement and Supply Chain**:
   - **Local sourcing**: If businesses have procurement needs (e.g., construction materials), encourage them to source locally. Highlight the positive impact on the community.
   - **Supply chain sustainability**: Discuss how community solar aligns with sustainable supply chain practices.
6. **Shared Benefits and Branding**:
   - **Emphasize shared benefits**: Explain how community solar contributes to the local economy, job creation, and environmental stewardship.
   - **Co-branding**: Explore co-branding opportunities. Businesses can be recognized as community solar supporters.
7. **Networking and Business Associations**:

- **Attend local business events**: Participate in networking events, chamber of commerce meetings, and industry gatherings. Connect with business owners.
- **Leverage business associations**: Partner with local business associations to promote community solar. They can help spread the word.

8. **Customized Solutions**:
    - **Tailor benefits**: Understand each business's unique needs. Customize the benefits of supporting community solar based on their priorities (e.g., cost savings, sustainability, community impact).

Remember that local businesses play a vital role in community solar projects. By emphasizing shared benefits and building strong relationships, you can create a win-win situation for both the project and the business community.

Strategies to Engage Schools in Solar Initiatives

Involving local schools in a **solar energy project** can be a rewarding endeavor that benefits both the educational community and the environment. Here are some strategies to engage schools in solar initiatives:

1. **Educational Workshops and Seminars**:
    - **Host workshops** and **seminars** on solar energy directly within schools. Invite experts, engineers, or local solar installers to educate students, teachers, and parents.
    - Cover topics such as how solar panels work, the environmental impact of solar energy, and career opportunities in the renewable energy field.
2. **Solar Curriculum Integration**:
    - Work with teachers to **integrate solar topics** into the curriculum. Incorporate solar energy concepts into science, technology, engineering, and mathematics (STEM) classes.
    - Encourage students to explore solar-related projects, research, and experiments.
3. **Hands-On Solar Projects**:
    - **Install solar panels** on school rooftops or in visible areas. Use these installations as **educational tools** for students.
    - Involve students in the installation process (under supervision) to provide practical experience.
4. **Student Competitions and Challenges**:
    - Organize **solar design competitions** or **energy-saving challenges** within schools.

   - Encourage students to propose innovative solar solutions for their campus or community.
5. **Community Role Models**:
   - Schools with solar panels can become **community role models**. Showcase your solar project to inspire local businesses and households to consider renewable energy options.
   - Host open houses or tours to demonstrate the benefits of solar energy.
6. **Collaborate with Local Businesses**:
   - Partner with local solar companies or energy providers. They can offer expertise, sponsor educational events, or even donate solar equipment.
   - Create a win-win situation where businesses gain positive exposure while supporting educational initiatives.
7. **Solar-Powered STEM Labs**:
   - Establish **solar-powered STEM labs** within schools. Equip them with solar panels, batteries, and monitoring systems.
   - Students can learn about energy production, storage, and efficiency through hands-on experiments.
8. **Community Awareness Campaigns**:
   - Involve students in **raising awareness** about solar energy. Create posters, videos, or social media campaigns.
   - Highlight the environmental benefits and cost savings associated with solar power.
9. **Solar Art and Creativity**:
   - Encourage students to express their understanding of solar energy through **art projects**.
   - Consider murals, sculptures, or other creative installations related to solar themes.
10. **Solar-Powered Events**:
   - Host **solar-powered events** at schools. Use solar-generated electricity for lighting, sound systems, and food stalls during fairs, concerts, or outdoor activities.

Remember that involving schools in solar projects not only promotes clean energy but also empowers the next generation with knowledge and skills for a sustainable future.

Evaluating the Site

The first step in the design of a photovoltaic system is determining if the site you are considering has good solar potential.

Some questions you should ask are:

- Is the installation site free from shading by nearby trees, buildings or other obstructions?
- Can the PV system be oriented for good performance?
- Does the roof or property have enough area to accommodate the solar array?
- If the array will be roof-mounted, what kind of roof is it and what is its condition?

Mounting Location: Solar modules are usually mounted on roofs. If roof area is not available, PV modules can be pole-mounted, ground-mounted, wall-mounted or installed as part of a shade.

Shading: Photovoltaic arrays are adversely affected by shading. A well-designed PV system needs clear and unobstructed access to the sun's rays from about 9 a.m. to 3 p.m., throughout the year. Even small shadows, such as the shadow of a single branch of a leafless tree can significantly reduce the power output of a solar module. Keep in mind that an area may be unshaded during one part of the day, but shaded at another part of the day. Also, a site that is unshaded in the summer may be shaded in the winter due to longer winter shadows.

Orientation: In northern latitudes, by conventional wisdom PV modules are ideally oriented towards true south.

Tilt: An increased tilt favors power output in the winter and a decreased tilt favors output in the summer. Nevertheless, it is recommended that modules be installed at the same pitch as a sloping roof, whatever that slope is, primarily for aesthetic reasons, but also because the tilt is very forgiving.

Required Area: Residential and small commercial systems require as little as 50 square feet for a small system up to as much as 1,000 square feet.
Keep in mind that access space around the modules can add up to 20 percent to the required area.

Possible Next Steps:

- Secure landowner agreement to develop a community led solar farm in an agreed upon location.
- Review next stage grants to progress the project.
- Confirm available capacity at the substations.
- Undertake the detailed assessments recommended as part of this study.
- Update financial model with site specific details and confirm the business case.
- Assess the potential to build a community co-op. This will ensure economies of scale at procurement stage for community solar farms.
- Appoint consultants to apply for a planning application for the community solar farm.

BUSINESS PLAN FOR ESTABLISHING A COMMUNITY SOLAR PROJECT IN JOUN

Here's a detailed business plan for establishing a community solar project in Joun. This project will harness local renewable energy resources to reduce electricity costs, promote sustainability, and create energy independence for Joun residents.

Business Plan for Joun Community Solar Project

Executive Summary

The Joun Community Solar Project (JCSP) aims to install a shared solar energy system that will provide affordable, renewable electricity to Joun's residents, businesses, and public facilities. This project intends to reduce reliance on traditional power sources, lower electricity costs, and promote environmental stewardship within the community. The community solar model allows individuals and organizations to benefit from clean energy production without needing to install solar panels on their own property, fostering broad access and participation.

Mission Statement

To provide sustainable, affordable, and locally sourced solar energy to the residents of Joun, reducing environmental impact and fostering community resilience.

Objectives

1. Reduce Community Energy Costs: Lower electricity bills for residents, businesses, and public institutions by providing access to shared solar energy.
2. Promote Environmental Sustainability: Contribute to Joun's environmental goals by reducing the town's carbon footprint.
3. Increase Community Energy Independence: Build resilience through locally generated energy, reducing reliance on external energy sources.
4. Engage Community Participation: Develop a model that allows broad community participation in solar energy, including options for residents who can't install solar panels on their property.

Project Overview

Site Selection

- Location: Identifying a suitable site within or near Joun, ideally a large, open area with ample sunlight exposure. Public land or community-owned property will be prioritized to reduce acquisition costs.
- Size Requirement: Approximately 1-2 acres, depending on energy production goals and available land.

Energy Production Goals

- Annual Production: Aim to generate enough power to supply 100-150 households and small businesses.
- Capacity: A solar array with a capacity of 500-750 kW, which would produce an estimated 750,000 to 1 million kWh annually, based on local solar irradiance.

Market Analysis

Target Market

- Local Residents: Households interested in accessing renewable energy, especially those unable to install their own solar systems.
- Small Businesses: Businesses in Joun looking to reduce operational costs through lower electricity bills.
- Public and Community Buildings: Schools, municipal buildings, and community centers seeking sustainable energy options.

Market Need

- Rising electricity prices and frequent power outages underscore the need for reliable and affordable renewable energy solutions. Joun's residents are increasingly interested in sustainable living practices but face challenges due to high upfront costs for solar installations. A community solar project offers a cost-effective way to benefit from renewable energy without the need for individual installation.

Services and Benefits

1. **Solar Power Subscription Program**

- Residential Subscription: Monthly subscriptions allowing households to receive solar power credits directly on their utility bills.
- Business Subscription: Flexible plans for small businesses to reduce energy costs through renewable energy credits.

• Low-Income Access: Reduced-cost subscription plans for low-income households to ensure broad community participation.

2. Environmental and Community Impact

• Reduced Carbon Footprint: By replacing a portion of conventional energy with solar power, JCSP will help lower greenhouse gas emissions.

• Community Ownership Model: By offering ownership shares, the project will empower community members to invest in and take ownership of local clean energy.

3. Educational and Engagement Programs

• Workshops on Renewable Energy: Free workshops and informational sessions to educate the community about renewable energy and sustainability.

• Youth Engagement Programs: Partnering with local schools to involve students in learning about renewable energy and environmental stewardship.

Facility Design and Layout

1. Solar Array: A ground-mounted solar panel array located on a centrally accessible plot of land. Panels will be positioned to maximize sunlight exposure and optimize energy output.
2. Battery Storage: Optional installation of battery storage units to store excess energy for use during peak times or in case of grid outages.
3. Community Education Center: Small facility or information kiosk onsite to provide information about the project, showcase energy data, and host occasional educational events.
4. Monitoring and Control Systems: Real-time monitoring technology for efficient management and transparent sharing of energy production data with subscribers.

Financial Plan

Startup Costs

Category	Estimated Cost (USD)	Description
Land Acquisition/Preparation	$50,000 - $100,000	Site preparation, fencing, and access
Solar Panels and Equipment	$600,000 - $800,000	Solar modules, inverters, racking
Battery Storage (Optional)	$100,000 - $200,000	For energy storage during peak times
Installation Costs	$150,000	Labor, installation, and grid connection
Permitting and Licensing	$20,000	Local permits and grid connection fees
Education and Outreach Setup	$10,000	Community engagement materials and events

Total Startup Costs: $930,000 - $1,280,000

Monthly Operating Costs

Category	Monthly Cost (USD)	Annual Cost (USD)
Maintenance and Monitoring	$2,000	$24,000
Insurance	$1,000	$12,000
Staffing and Administration	$3,000	$36,000
Marketing and Outreach	$500	$6,000
Miscellaneous	$500	$6,000

Total Monthly Operating Costs: $7,000
Total Annual Operating Costs: $84,000

Revenue Streams

1. Monthly Subscription Fees
   - Residential Subscribers: 100 households at $25/month = $2,500/month
   - Business Subscribers: 20 businesses at $50/month = $1,000/month

Total Monthly Subscription Revenue = $3,500

2. Energy Credits and Incentives
   - Renewable energy incentives or tax credits (e.g., the Investment Tax Credit) can provide additional annual revenue of approximately $50,000 in the first five years.
3. Green Energy Certificates: Revenue from selling Renewable Energy Certificates (RECs) = $10,000 annually

Total Monthly Revenue = $4,166
Total Annual Revenue (with incentives) = $110,000

Projected Annual Profit/Loss = $26,000 (approximately)

Marketing Strategy

1. Community Outreach and Education: Hold town meetings and workshops to explain the benefits of the solar project, emphasizing cost savings and environmental impact.
2. Digital Campaigns: Use social media and local websites to spread awareness about subscription options, open house events, and the environmental benefits.
3. Local Partnerships: Collaborate with local businesses, schools, and environmental organizations to reach a wider audience and encourage community support.
4. Subscription Incentives: Offer a discount for early sign-ups and a referral program for current subscribers to encourage community growth.

Management and Staffing

1. Project Manager: Oversees overall operations, finance, and partnership development.
2. Technical Staff: Responsible for system maintenance, monitoring, and troubleshooting.
3. Community Outreach Coordinator: Manages subscriber relations, community education, and marketing.
4. Administrative Support: Handles customer service, billing, and general office management.

Funding Sources

1. Government Grants and Incentives: Apply for grants supporting renewable energy projects, such as government-level solar incentives or rural development funds.
2. Private Investments: Engage local and regional investors interested in sustainable energy initiatives.
3. Crowdfunding and Community Contributions: Encourage residents and businesses to contribute through crowdfunding platforms, offering tiered membership benefits for contributors.
4. Green Banks and Clean Energy Loans: Apply for low-interest loans specifically available for renewable energy projects.
5. Tax Credits and Rebates: Use available tax credits to offset installation costs.

Sustainability and Community Impact

1. Environmental Impact: By offsetting traditional energy sources with renewable energy, JCSP will reduce the community's carbon footprint, supporting local and regional environmental goals.
2. Economic Benefits: The project will create local jobs during installation and ongoing operation, providing economic growth for the community.
3. Energy Independence and Resilience: With a local solar power source, Joun can reduce its dependence on the national grid, providing greater energy reliability and resilience during power outages or crises.
4. Community Engagement: Educational programs, workshops, and ongoing communications will foster awareness and understanding of renewable energy within the community.

Conclusion

The Joun Community Solar Project offers a sustainable and inclusive approach to renewable energy, providing affordable access to solar power for residents, businesses, and public facilities. By creating a community-driven renewable energy source, JCSP will not only lower electricity costs and reduce environmental impact but also strengthen Joun's resilience and independence in energy resources. Through effective funding strategies, sustainable management, and robust community engagement, JCSP aims to become a long-term asset and a model for renewable energy transition in rural communities.

PART TWO

SUSTAINABLE ENERGY FOR LEBANESE VILLAGES AND COMMUNITIES: THE VILLAGE 24 INITIATIVE

Source of this Part:

BOOKLET: SUSTAINABLE ENERGY FOR LEBANESE VILLAGES AND COMMUNITIES: THE VILLAGE 24 INITIATIVE: Copyright © UNDP / CEDRO – 2018

Introduction: The CEDRO IV Project

One of the main objectives of the European Union (EU) funded and United Nations Development Program (UNDP) implemented CEDRO IV project, is to find innovative, cost- effective, and environmentally beneficial pathways to transform our power system.

In partnership with the Ministry of Energy and Water (MEW), the Lebanese National Power Utility (EDL), and the Lebanese Center for Energy Conservation (LCEC), **this booklet presents all the required information necessary**, based on lessons learned and newly established protocols, in implementing a community and/or village led renewable energy system, including all the requirements and caveats that need to be taken into account **when establishing such a system by a municipality** and respective community.

It is hoped that a community led renewable energy system, whether based on solar power (as done in Kabrikha, South Lebanon), wind power, bioenergy, and/or any other means of sustainable power generation, will have the **advantages** of:

• **Economies of scale**: meaning that the costs of renewable energy provision will be significantly reduced from combining households and institutions together instead of each institution and/ or household doing it alone
• **Community cooperation**: a community led sustainable energy initiative will empower the sense of community cooperation and spirit, and will indirectly lead to more sustainable offshoot initiatives
• **Environmental benefits**: a community led sustainable energy initiative can enhance the local environmental performance of villages and/or communities, especially in relation to local air pollution and greenhouse gas (GHG) emissions
• **Energy security**: a community led sustainable energy initiative, if replicable in a sufficient number of villages and towns, has the ability to assist Lebanon in reducing its reliance on expensive imported oil, enhancing energy security.

This booklet **presents a recommended solution to initiate, construct, and connect a renewable energy system for a Lebanese village**. This solution (as implemented in Kabrikha) will be closely monitored and evaluated (in terms of impact to and from the grid) by the National Utility, EDL, for a maximum period of up to 12 months, before which EDL will allow out similar initiatives to take hold.

The main premises of the agreed upon process highlighted in this booklet – and any future versions / upgrades – is that the process must be:

• Agreeable and manageable to EDL
• In line with any existing rules and regulations targeting the electricity sector

• Has the potential to evolve and be subject to modifications that will make it easier and more replicable

These premises – imperative to the success and acceptance of such a project - may not render the process that is established herewith best or ideal, however, it is a workable starting point that would be subjected to a lot of lessons and experiences learned from the current and any future implementations which will lead, hopefully, to its gradual enhancement – in line with the electricity situation in Lebanon - to make it more successful, replicable, and anchored as one of Lebanon's main distributed sustainable electricity options or pathways.

The process/scheme will be termed 'Village 24 Initiative' (V24 Initiative).

Technical Overview of the Village 24 Initiative

The Village 24 Initiative aims to install a renewable energy (RE) system for any given village. The initiative is constructed taking into account the below parameters and/or assumptions:

1. The Lebanese power system, especially in rural areas, is subjected to long hours of blackouts that are expected to continue, at least in the short-term

2. In the medium to long term, national power provision is expected to improve up to the provision of 24-hour electricity from the national grid

3. Many Lebanese villages have adapted to the above reality by establishing their own power generation (based on diesel gensets) and distribution network and/or centralizing the management (including often the ownership) of the diesel gensets and distribution network (including control of billing of power) officially under the municipality

4. Every institution and household in Lebanon can install, independently, a renewable energy system on their respective roof and/or premises and apply to a net metering scheme. The net metering scheme has been approved by EDL through Decision No. 318-32 / 2011. The Village 24 initiative takes into account this Decision as the platform and foundation of the provided village-scale solution

5. Installing a community renewable energy system will have to,

therefore, be compatible with the short-term electricity situation and adaptable enough to be viable under the longer- term power situation

The technical description of the Village 24 Initiative, which can be considered a hybrid (dually operated on the local genset with the associated network and the utility grid) microgrid, is outlined in Figure 1a (national utility power is not present in the village) and 1b (national utility power is present in the village).

UTILITY POWER ON

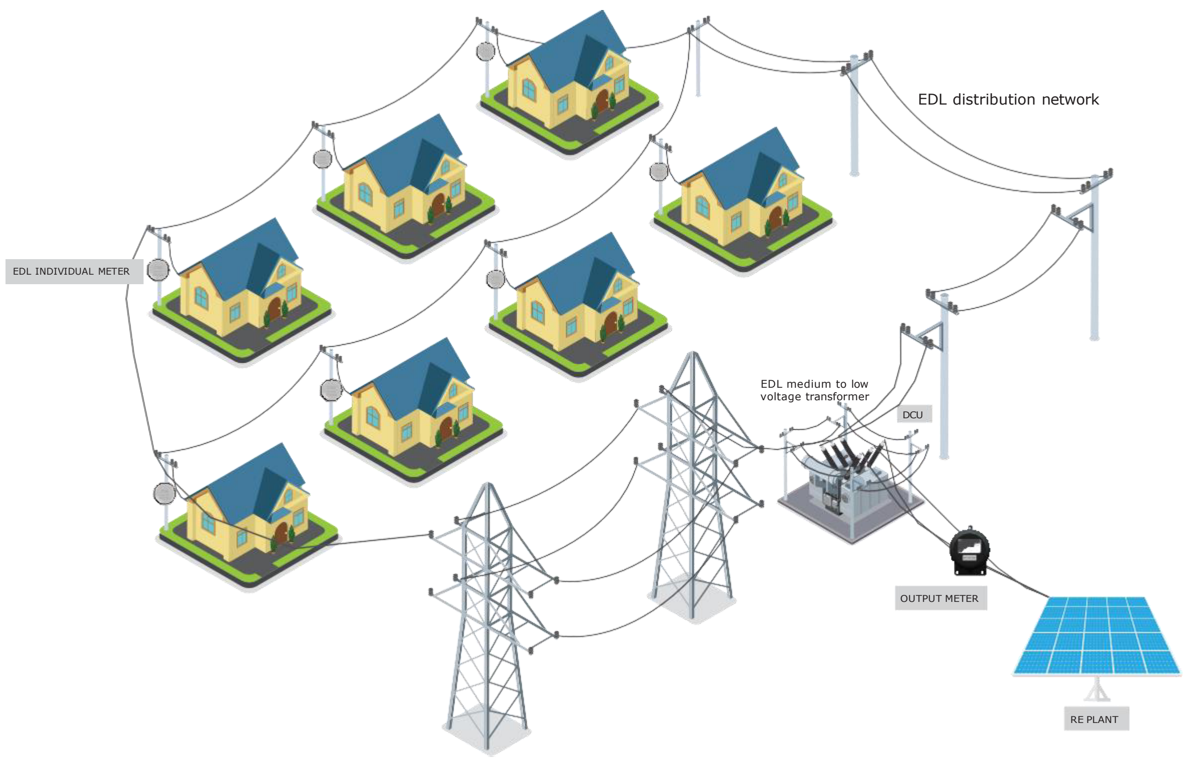


Figure 1a. Utility power not available

UTILITY POWER OFF

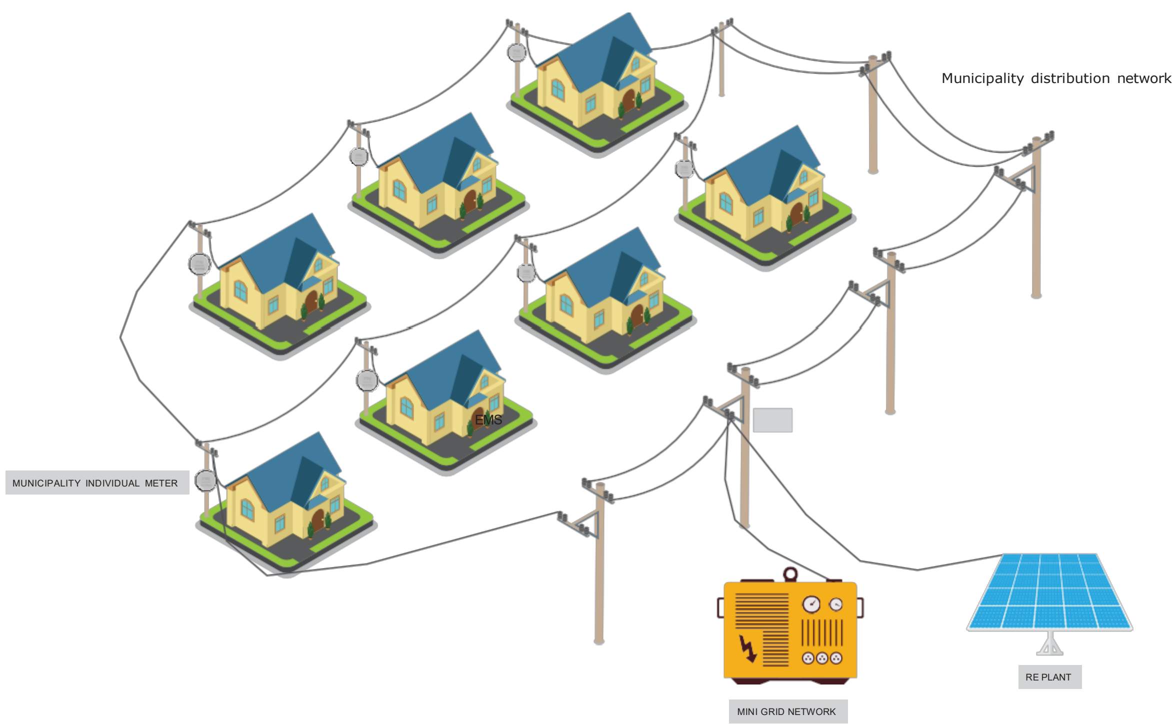


Figure 1b. Utility Power is Available

Figure 1: The Village 24 initiative: a hybrid (Genset & Utility) microgrid concept

When national utility power is not present, the municipality is feeding the renewable energy power into its own independent distribution network, in synchronization with its diesel generators. Injecting the RE power into the municipal grid, if the RE power is well sized and implemented (see Annex 1 on sizing a solar photovoltaic system to hybridize with the municipal diesel genset and utility network), will have the dual benefits of enabling the municipality to:

(1) Operate a smaller generator; and
(2) Reduce the fuel consumption and costs for its diesel generators.

Including a central battery storage at the moment is costly, however this may change in the near future and thus merits future assessment (see section 5.3).

The conditions required to launch the Village 24 scheme are:

- The municipality has its own network and that network is well constructed to deliver power at the voltage and frequency levels required for all the village institutions and households that may aim to be part of the V24 scheme (see Annex 2 on important distribution network caveats and required conditions)

- The municipality bills the institutions and households, within its jurisdiction, on power consumed (i.e., on each kWh consumed) as opposed to power capacity rented (i.e., as opposed to having lump-sum payments for each kW or Ampere rented out)

- The municipality has land and/or roof space to install the required RE system

When utility power is present (Figure 1b), an automatic transfer switch (ATS) will immediately divert and transmit the RE power into the national grid, connected to a low to medium voltage transformer (kindly see Chapter 2 for the administrative requirement of the Village 24 scheme). An advanced smart meter, that has to be approved by EDL (see Annex 3 on general technical specifications – Annex 3 Section 3.4.2), is connected at the point of injection of the RE power into the national grid. This is considered the total power output of all the households and/or institutions that are part of the Village 24 Initiative in any respective village (see Chapter 2). In turn, all the households and/or institutions that sign up to the Village 24 Initiative will have to install a smart meter, also approved by EDL, which will record and transmit data on each institution/household's electricity consumption (input power). The smart meters will transmit the data on electricity consumption in 2 ways that have to be both catered for in the scheme, either:

(1) Via power line communication (PLC), through installed data concentrator units (DCUs) and from there to the server of EDL (and backed up in a server at the municipality), and;

(2) Via infrared optical reading where the EDL and/or designated service provider personnel will obtain the electricity consumption data semi-manually from each facility and/or household independently

EDL will then implement the protocols of decision No. 318-32 / 2011, whereby EDL will bill each household and/or institution for the net electricity consumed, per billing period. This cycle occurs from January to December, where in each billing period (expected to be every two months) each institution or household will be billed the net amount of power, calculated by EDL (See Annex 4 for an overview on single net metering and the V24 Initiative).

If the amount exported by the household or institution (which is equivalent to the share of that household or institution's ownership in the RE plant's power output for that same period
- as outlined in the Energy Committee – See Annex 4 on single net metering and the V24 Initiative) is greater than the power consumed, the surplus is rolled over to the next billing period. This will be the case until the end of the year where any surplus (i.e., net exported power from the household or institution to the national utility EDL) will be considered as granted without compensation to the utility, EDL. This clause may be subject to change in the future upon the discretion of the national utility EDL.

Furthermore, EDL has the discretion, as per the existing EDL net metering Decision 318-32 / 2011, to cancel the household and/or institution's billing subscription fee if the renewable energy power exported to the national grid, estimated per household and/or institution, is at least 75% of the power imported from the national grid.

Administrative Overview of the V24 Initiative: Setting up the Scheme

The administrative process to develop a Village 24 initiative has been established herein based on the experiences learned from the 250 kWp Kabrikha community solar photovoltaic (PV) plant (see figure 2), implemented by the EU funded UNDP CEDRO 4 project, in coordination with the Ministry of Energy and Water, EDL, and the LCEC.

Figure 2: 250 kWp system implemented at Kabrikha, South Lebanon

Figure 3 illustrates the detailed process of the Village 24 Initiative, while the following sub-sections explain each of these steps independently.

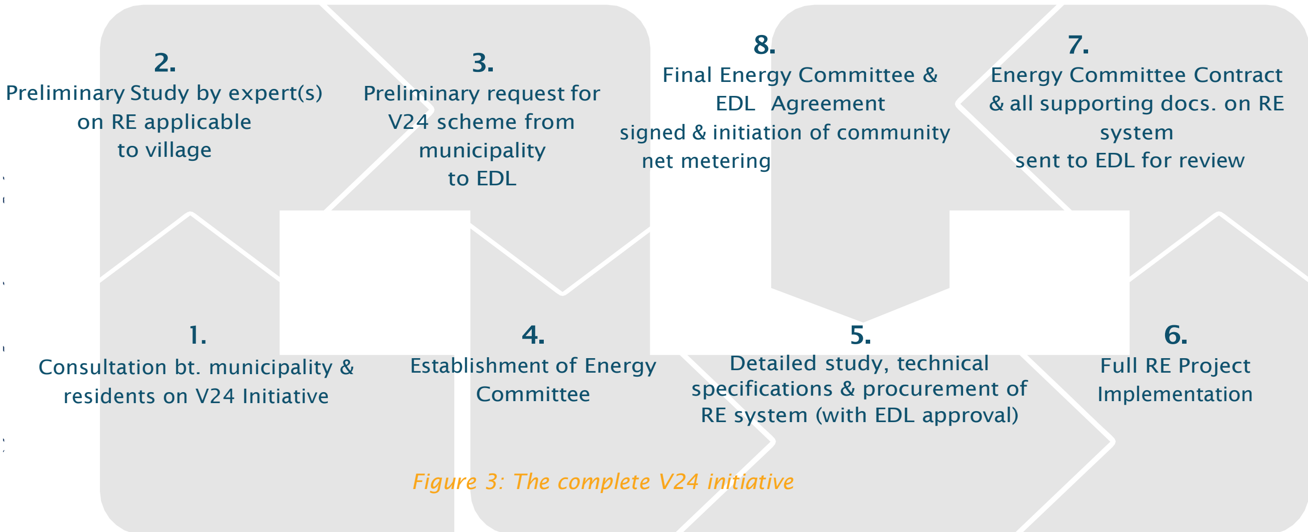
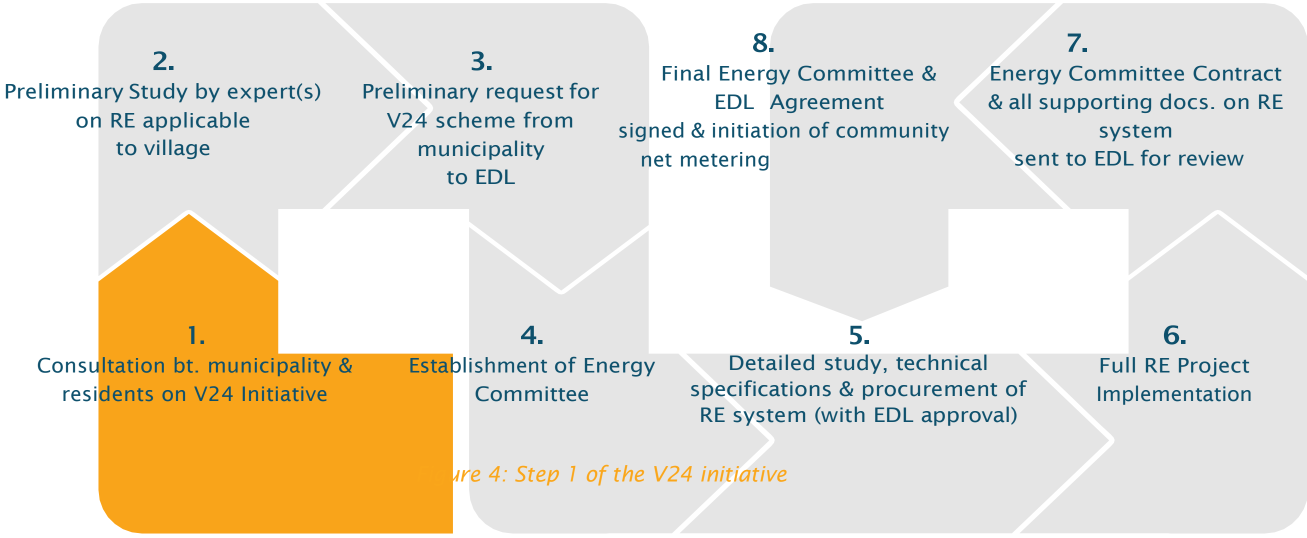


Figure 3: The complete V24 initiative

A summary check-list of all the necessary steps that the municipality and champion residents have to take can be furthermore found in Chapter 4.

Step 1.

Consultation between municipality and respective residents on V24 initiative



ure 4: Step 1 of the V24 initiative

The first step of the Village 24 Initiative is to launch an expression of interest in establishing a community renewable energy system for the residents and institutions of the community itself.

Step 1 has to be led by the municipality and should be done through an official public hearing and/or consultation. Any concerned member of the community, or non-governmental organization or local group, and/or any private sector entrepreneur(s) that wish to work towards implementing such a scheme will have to go first through the municipality channels and/or be endorsed by the municipality. This is particularly the case given that it must be assumed that the municipality has already its own distribution network and diesel gensets and/or is willing to construct/expand one.

It is beneficial that the municipality sends out leaflets on the public hearing meeting objective and its intentions (to set up a renewable energy system for the community) before at least 1 week from the set date of the hearing/meeting.

In the official public meeting, the municipality will discuss with the residents and institutions within its legal vicinity its intention on implementing a RE system and the expected costs and benefits (see Annex 5 for an overview of the benefits of community scale renewable energy systems). It will then illicit the preliminary interest of its citizens, listing all those who have expressed this interest.

The municipality, if the majority of households and/or institutions agree to investigate this opportunity, will then move to step 2 of the process.

Step 2.
Preliminary study on RE system and applicability

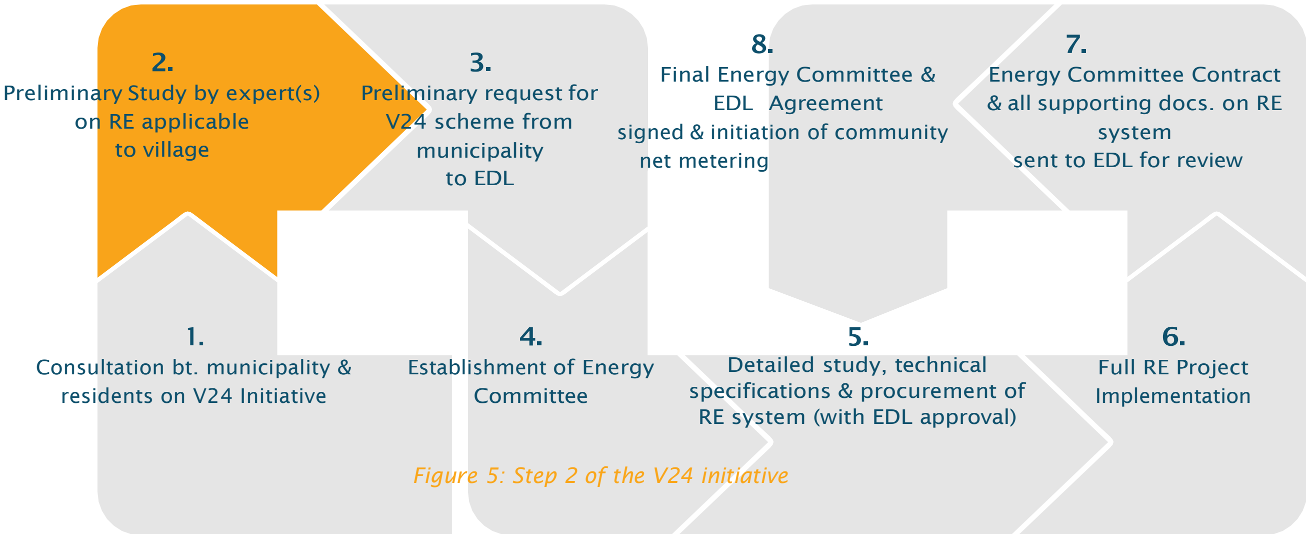


Figure 5: Step 2 of the V24 initiative

Step 2 requires the expertise of a renewable energy and/energy generation expert to determine the most suitable applicable option(s) for the municipality.

The preliminary study should gather/include the following information:

- Electricity consumption information about the households and/or institutions that have expressed willingness to be part of the Village 24 Initiative in their respective village (based on consultations in Step 1)

- Gather expectations from the households and/or institutions about their appetite (and ability and willingness) to invest, capacity and power desired from the RE system, and when they need the power mostly (their approximate electricity load profile)

- Check the availability of meters (i.e., legal connection) in the households and/or institutions that want to take part of the Village 24 Initiative and their sound legal status with the utility company; this is a pre-requisite for connection

- Assess the availability of the current generation system of the municipality, i.e., the genset(s) present, their ability to cater for the village, their ability to synchronize with the RE system suggested or alternatively present a rough estimate of the required investment to set up the required conventional generating units

- Assess the possibility(ies) of location, availability of land/roof space, resource, and connection point of any suggested RE system

- Assess the quality and capacity of the distribution network set up by the municipality to cater for a new RE source or alternatively present a rough estimate of the investment required to set up/or expand this network.

- Assess the possible connection points of the RE plant to the EDL distribution network and the diesel genset network, and provide a preliminary network proposal to ensure quality power delivery (See Annex 2 for important network considerations)

- Other data depending on renewable energy choice and location specificities

Upon gathering of the above information, the consultant(s) will decide, in coordination with the municipality, what is the required and optimal RE system, the possible capacity, and all the approximate associated costs of undertaking this project. It is also advisable to inflate the assumed costs by a margin of 20%, in order to ensure that any future contingency will be sustainably dealt with. If this additional 20% margin on the budget is not used, it can be refunded to the respective households and institutions or be kept for maintenance reserve.

Furthermore, it is advisable for the RE consultant(s)/experts(s) and the municipality to share the outputs of this study again with the residents to get their feedback and reassess their willingness to continue with the Village 24 Initiative.

If enough residents and/or institutions are interested still after the preliminary study results are communicated, then the municipality moves to Step 3.

Step 3.
First communication between municipality and EDL

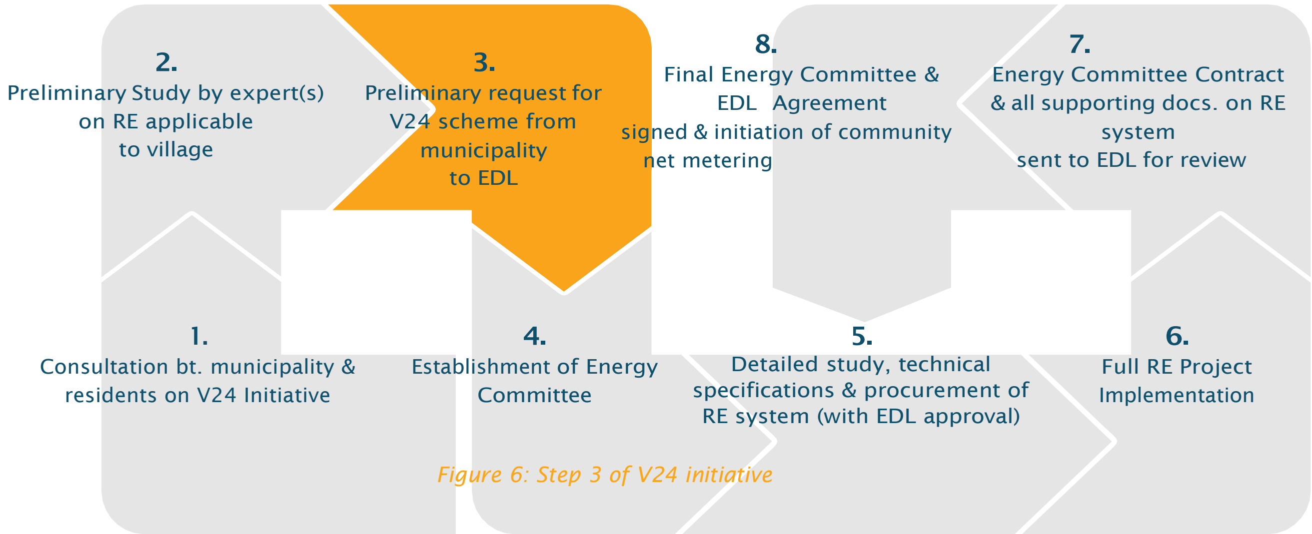


Figure 6: Step 3 of V24 initiative

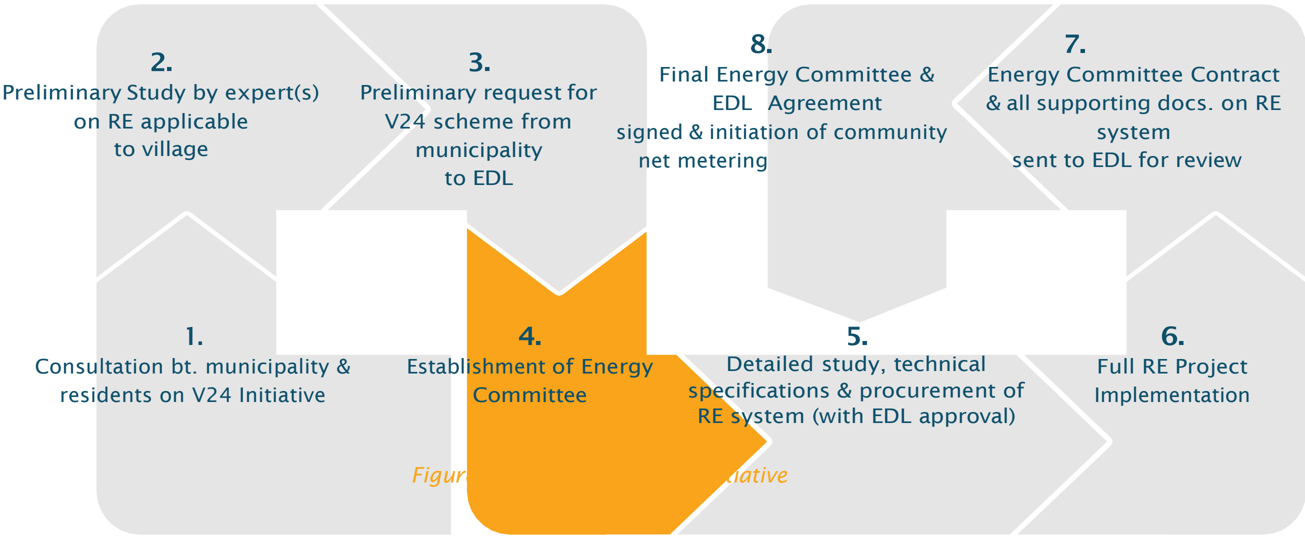
Upon successful completion of Step 2, the municipality should seek official approval from EDL in an official letter, presenting the following minimum information:

- The name and location of the municipality
- The number of residents and institutions that will likely enter the Village 24 Initiative
- The type, capacity and power output expected from the RE system
- The possible points/options of connection of the RE system to the national grid

The municipal council has to agree officially and address this letter to EDL, expressing the above elements, and request an approval to move forward with the process of generating clean and renewable energy (See Annex 6 for a template letter based on a Municipal Decision Document to be sent to EDL).

Only upon the official and positive written response of EDL that the municipality can move ahead with the Village 24 Initiative, can the municipality and residents move to Step 4.

Step 4.
Establishment of the Energy Committee



The next step is to establish the Energy Committee that will be the Committee responsible for the ownership and management of the Village 24 Initiative*.

Upon the preliminary and positive response of EDL to the municipality's official letter/ communication to establish an RE system, the Municipal Council should proceed to establish the Energy Committee. All the management and authority of the Village 24 Initiative will be now under the ownership and the responsibility of the Energy Committee.

First, the Municipal Council must meet and identify the shareholders and shares. The shares are calculated based on the amount of money to be paid per participant, in line with the indicated power expectations that that particular participant indicated in Step 2. This will be validated in step 5. Annex 7 gives an example of the expected costs of such a scheme using a hypothetical 100 kWp solar PV system.

Second, the Municipal Council shall proceed to set up the Energy Committee; annex 8 indicates the Committee Contract and by-laws form that must be approved and signed by the founders (the board) and all of those who have enlisted to be part of the Village 24 (and who will put up their share of the capital and installation costs). This established ordinance should be ratified by the public notary and saved in the municipality. The contract is renewed every year allowing participants to opt in or out of the scheme.

After which, a bank account is set up with the committee's president and secretary being the two signatory parties. The households and/or institutions that are signatories to the Village 24 Initiative must eventually dispense their dues, in accordance with their respective shares – as listed in the Energy Committee contract attachment - of the RE power plant and the RE power plant's supply and installation costs (that will be known in Step 5) into this bank account directly (they will be given the account number by the Energy Committee signatory representatives).

It is worthwhile to note the presence of various micro-finance facilities that may assist certain households and/or institutions in obtaining their required capital costs through soft loans (see Annex 9 for a brief on existing micro-finance institutions).

** The Energy Committee manages all assets that it has directly paid for; whereas the municipality would be still responsible for the already existing assets of its local network.*

Step 5.
Detailed study, technical specifications & procurement of RE system

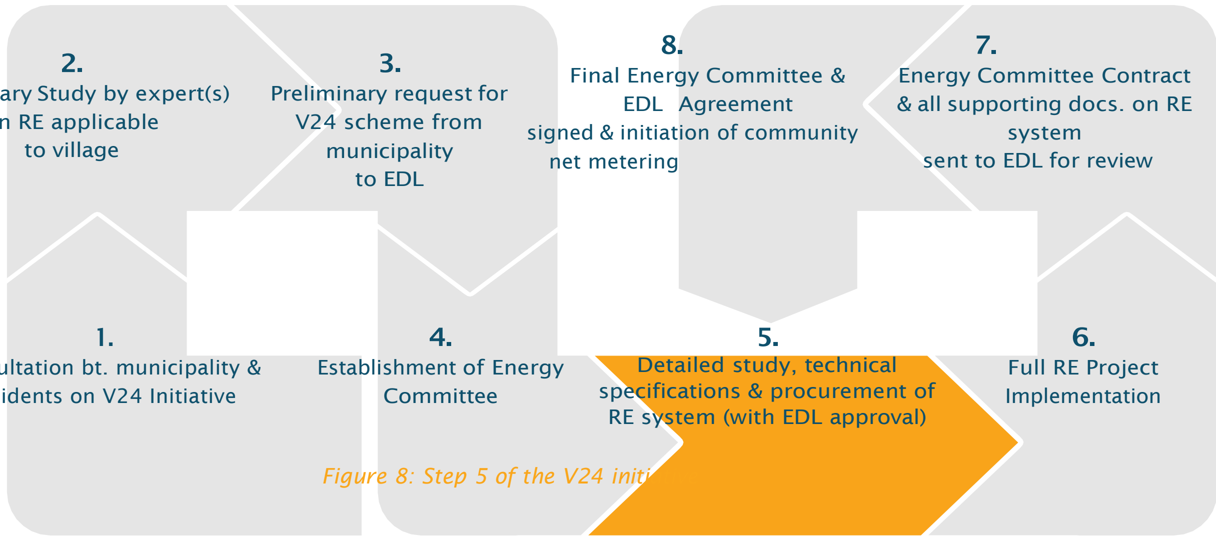


Figure 8: Step 5 of the V24 initi

Upon the official original positive response of EDL and the establishment of the Energy Committee, the Energy Committee can move forward in undertaking the detailed study with the related bill of quantities (BOQ) and procurement process.

The study will focus on the technical specifications for the system that best fits the community's specificities and those residents and/or institutions that have expressed their willingness to join and have signed up to the Energy Committee. This requires the consultant(s) to revisit, in coordination with the municipality officials, all the households and/or institutions and to record their demand for RE power, including their willingness to pay (as a one-time upfront payment) for the RE power capacity that they think they need (and/or that they are advised to acquire by the consultant(s)). A template questionnaire can be found in Annex 10 that can be used to illicit this information.

As an example, if there were 100 homes and each home expressed the need for 1 kW of capacity to cover 30 – 50% of their total electricity needs, and if there is space available (in general a solar PV needs 10 m2/kW) where a solar PV plant can be easily installed and relatively easily connected to both the municipality gensets and to a low to medium voltage transformer of the national utility grid (EDL grid), then the study will incorporate the complete technical specifications of the 100 kWp solar PV system, related smart meters (using EDL specifications – See Annex 3 for the specifications), and related municipality network reinforcement (if needed), as well as all the administrative and legal requirements for contractors, including the required guarantees. It is important that the municipality indicates that all prices of bidding contractors be valid for a period of at least 6 months. It is also advisable in order to expedite the process, time-wise, that each bidder submits one hard copy and two soft copies (on CD) of the submission files. Annex 3 indicates the general technical specifications of components that can be used for the community solar project, including specifications for solar panels, inverters, and other balance of system components. Annex 11 indicates administrative issues to consider and the guarantees required. Furthermore, it is advisable for the municipality to consult the Ministry of Energy and Water and the Lebanese Center for Energy Conservation (LCEC) for a short-list of qualified contractors and any advice in the tendering phase.

It is advisable that at least 3weeks are given for prospective tenders and that the tender is well communicated via social media and other means.

Figure 9 indicates a recommended evaluation pathway that the municipality should take to ensure a successful implementation of the RE project.

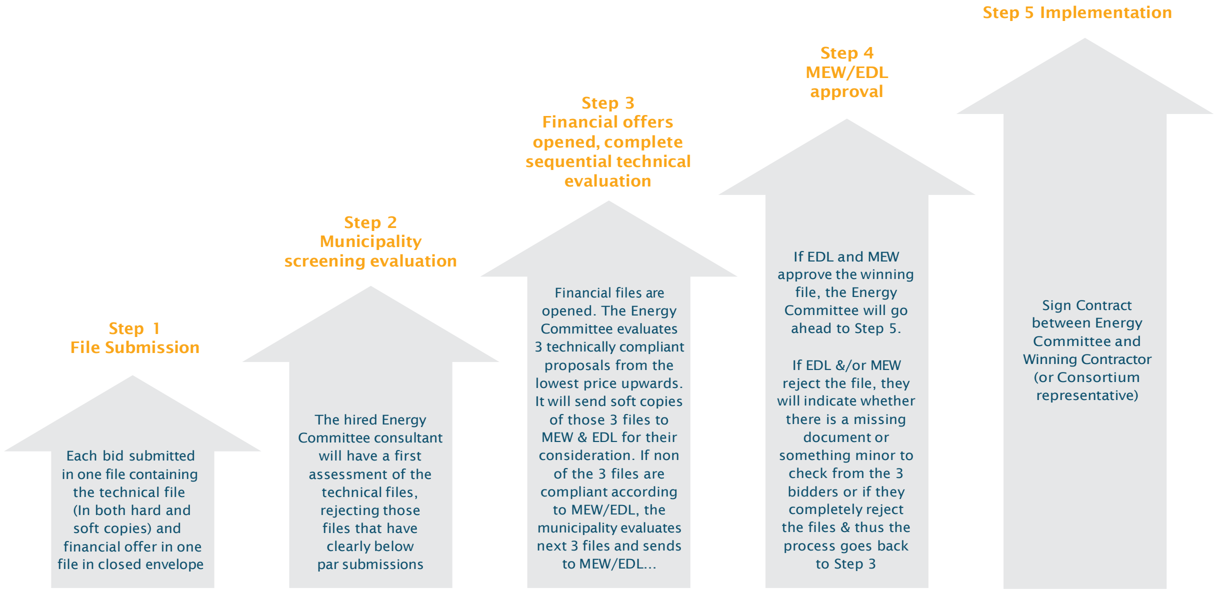


Figure 9: Recommended procurement and evaluation process

In Step 1 of the procurement and evaluation process, the Energy Committee will receive the submissions in both hard and soft copies as to render the process more flexible for the reviewing stakeholders (the consultant(s) / expert(s), EDL and MEW). The technical consultant(s) of the Energy Committee will filter the technical submissions in Step 2 (of the procurement process outlined in Figure 9), leaving those that meet all the pre-requisite evaluation criteria. Annex 11 indicates a sample of technical criteria that may be used. The Energy Committee may ask any bidder for missing documentation or clarifications if needs be. Once the technically compliant files are selected, the Energy Committee opens the financial files. In order to ensure transparency of the process and technical quality / compatibility of the system as per MEW and EDL's rules and regulations; Step 3 requires that the municipality then send the first three technically compliant (according to the municipality hired expert) and lowest price bidders' technical file to the (1) Ministry of Energy and Water and the LCEC and (2) to the EDL Net Metering Committee. The Ministry of Energy and Water (MEW) / LCEC will review the submissions from a technical perspective to ensure all products meet the required specifications, and EDL reviews in particular the smart meters and data concentrator units that will be installed. If MEW and/or EDL reject any file, the municipality must then send the second batch of three offerors in accordance with their prices (if available), and so forth, until one winner is selected.

As soon as the procurement process is done, i.e., as soon as the award (based on the recommended process detailed above) is issued, the municipality should undertake another public hearing for only those that have indicated that they would like to enlist in the Village 24 Initiative.

Once the final and complete price is known (the Energy Committee can add the fees of the consultant(s) herein too that assisted in the above procurement process), this price can be communicated to the participants (it is advisable to keep a 20% margin on the submitted price to spend if any contingency occurs that was not foreseen during the time of the bid proposal and bidding – and if this contingency amount was not used during the construction and commissioning of the RE plant it can be immediately reimbursed). At this point, the Energy Committee demands that the participants transfer their required share of the cost to the Bank Account of the Energy Committee within a deadline of 4 – 6 weeks.

Step 6.
Full RE Project Implementation

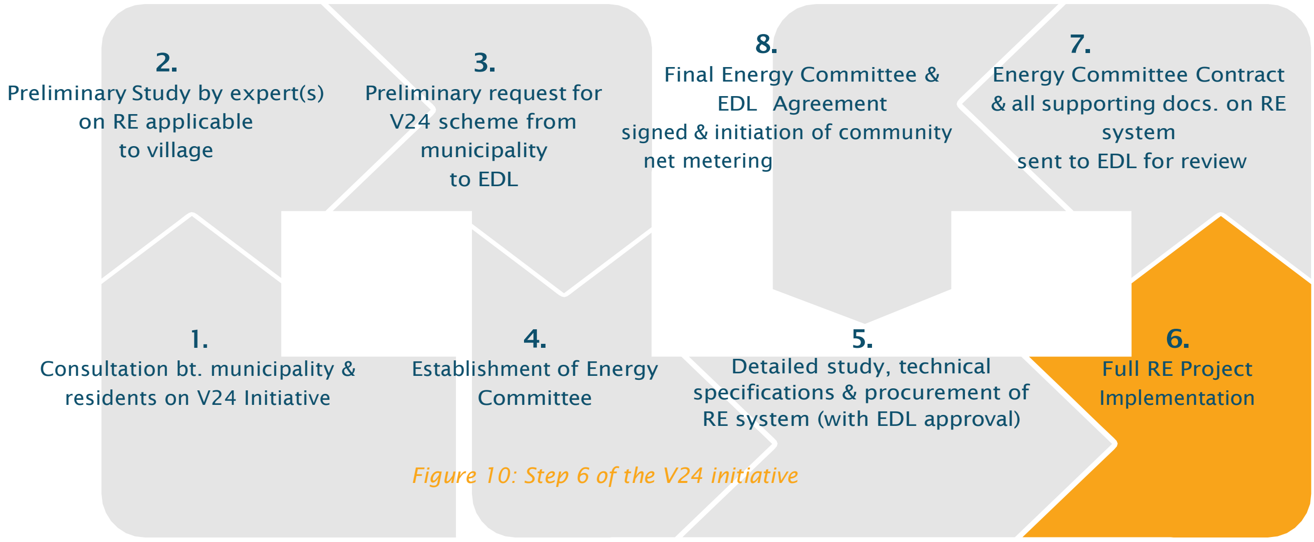


Figure 10: Step 6 of the V24 initiative

Once all the required budget is in the Energy Committee's Bank Account (along with the recommended 20% margin), the Energy Committee can sign the contract with the winning contractor. It may be necessary to obtain a letter from the Bank that will ascertain the availability of these funds, backed up by a commitment letter from the Energy Committee that these funds will solely be used for the RE project. This would give the winning contractor the guarantees that he/she may require.

Implementation of works should be expected to happen over a period of 5 – 8 months, depending on the complexity of the selected system and the required civil and electrical works.

During and in parallel to the implementation phase of the RE system, the contractor must purchase the meters and deliver them to EDL and/or whoever EDL contracts for their installation. The Energy Committee must stay in constant communication with EDL in regards to this issue until all smart meters and related communication systems and data transfer protocols are set up. This will also require a computer to be designated or bought and installed by (and in) the municipality for data storage and transfer, as well as an internet subscription for both the public network to enable the file transfer protocol of the data.

Step 7.
Full Documentation Transferred to EDL

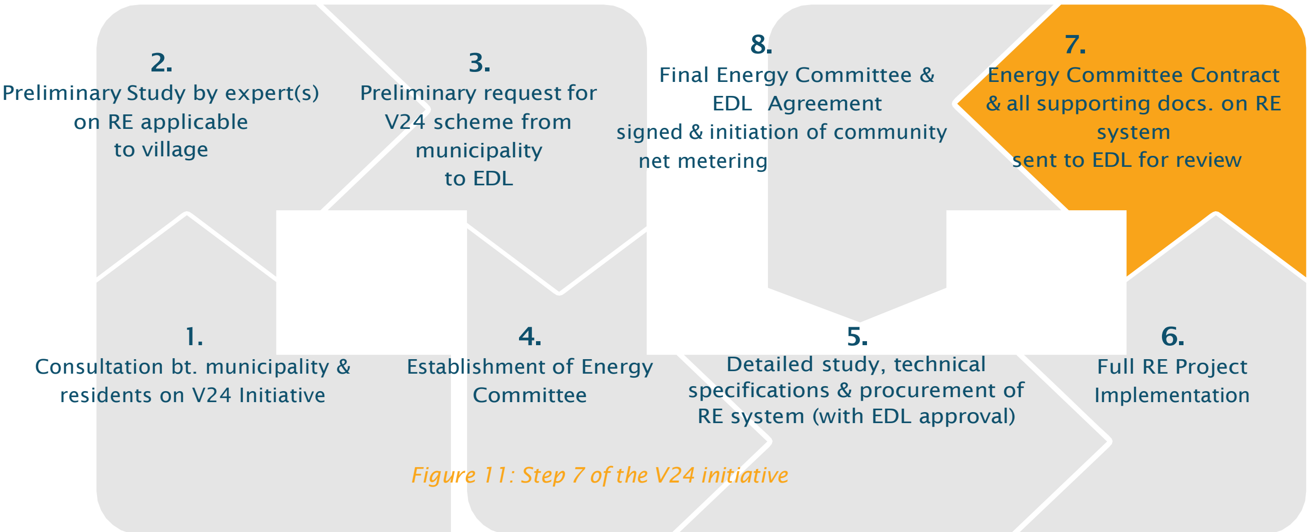


Figure 11: Step 7 of the V24 initiative

Once the project is fully implemented and configured, including any municipality network reinforcement and smart meters (including the DCUs and the servers) for each Village 24 participant – where applicable, the Energy Committee will send EDL the following documentations:

The Energy Committee Contract, including:

a. A full list of the shareholders complete with the meter ID (the existing one – whether electromechanical or digital / smart)

b. The newly installed smart meter ID (in cases where the existing meter is electromechanical or requires replacement as per EDL's recommendations)

c. The old index (last read index before replacement of the meter)

d. Subscription number, branch number, and subscription capacity

e. The full details (study) of the RE implementation undertaken, including:
- Plant's detailed electrical and mechanical technical drawings
- Performance simulation
- Single Line Diagrams
- Data sheets for all installed components complete with the relevant compliance with international standards and testing reports.
- Operation methodology and expected yearly profile (with hourly resolution) of the energy back-fed into the utility network including any reactive power compensation

f. A request for validation w.r.t the connection point to the EDL network

EDL will review the files and may send out a team to inspect the RE power plant and the connection point.

Step 8.
Final Contract Agreement (EDL & Energy Committee) Signature

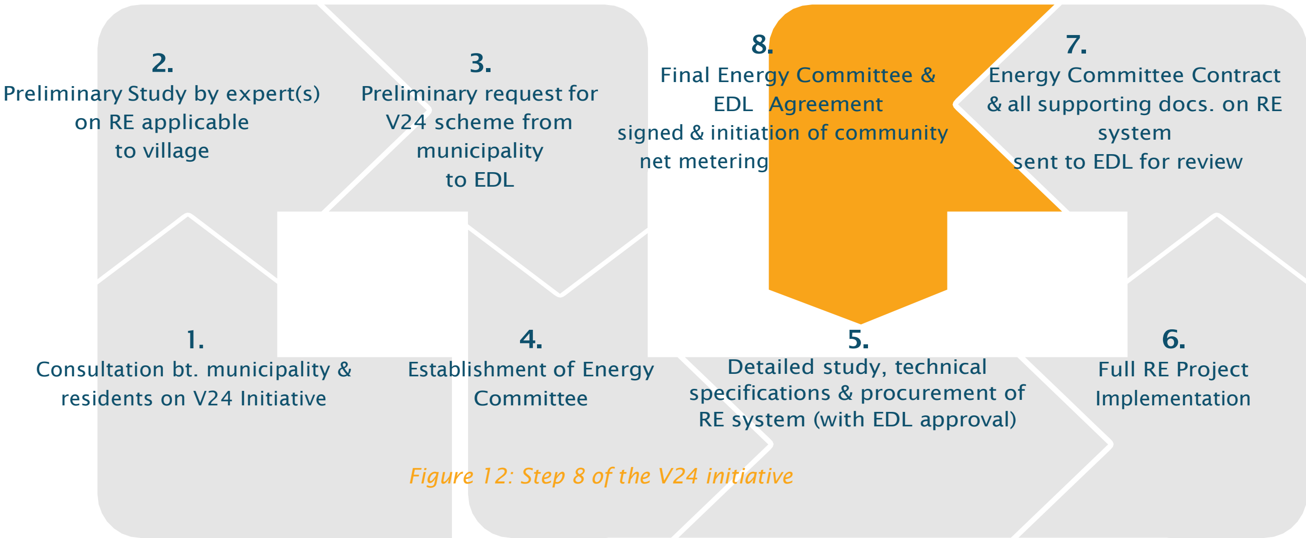


Figure 12: Step 8 of the V24 initiative

Once EDL has reviewed the file and if all is agreeable to EDL and approved by its Board, a final contract agreement between EDL and the Energy Committee is signed.

A draft template of this Agreement Contract between EDL and the Energy Committee can be found in Annex 12.

Once this is signed, EDL will ensure that the project is then able to connect to its low-to- medium voltage (or other) transformer or the transformer connection point, and will begin the community net metering initiative from the next opening window, which is effectively from January 1st of every year. A copy of this contract is filed at EDL and the second copy is kept at the municipal building for reference.

The contract is renewed every calendar year allowing participants to remain part of or leave the Energy Committee and thus the Village 24 Scheme, as well as allowing other participants to join. Participants have until the end of October of every year to express their intentions, after which it would not be possible to update the participants' list. This is because when new participants enter or leave the Scheme, the shareholder distribution will have to be re-inputted into the EDL software. Leaving and entering the Village 24 scheme, with all the transactions required between the incumbent and new participants (e.g. selling of shares of incumbent subscriber to new participant), is left to the discretion of the participants themselves and the Energy Committee. What is important to note is that any new participant that wishes to enter the Village 24 Scheme must be allowed to do so if:

(1) The Energy Committee can increase the capacity of the renewable energy system in accordance with the new participant(s) required demand for power and willingness to pay, or;

(2) Through having the payment of the new participant be divided to all existing participants pro-rata, given that their respective shares will now be slightly diluted. This must have the agreement of all the members, or, alternatively, the money paid by the new participant(s) will be given only to those members who are willing to sell a part of their shares to the entering participant(s), in accordance with their requested capacity.

Summary Check-List

Below is a summary check-list to be followed by a municipality and eventually the Energy Committee.

Table 1: Check list

Action	Check
1. Call for a town meeting to consult on the implementation of an RE plant	☐
2. Present the benefits of the system's implementation as opposed to more traditional implementations	☐
3. In coordination with a hired expert, conduct the survey and collect the latest EDL bills for interested residents to come up with preliminary vision of the RE plant required (including location of plant and connection options)	☐
4. Submit the preliminary letter requesting the implementation of the V24 scheme to EDL & receive EDL response	☐
5. Establish the Energy Committee; Sign the contract by the board members. Compile the list of interested members along with the required information Create a bank account for the Energy Committee	☐
6. Hire the consultant(s) and acquire detailed consumption data for the interested members	☐
7. Coordinate information sharing with the consultant(s) (possible members, available network complete with the components, quality of the grid, etc…)	☐
8. Validate the detailed study, and launch the bidding process	☐
9. Conduct in coordination with the consultant(s) and potential bidders a site visit. And provide clarification when and if needed	☐
10. Evaluate received technical and financial offers; evaluate until there are three lowest price technically responsive files	☐
11. Share the three files with MEW / LCEC and EDL for recommendations. Share three files at a time, until the lowest (financially) three technical offers are approved by the stakeholders.	☐
12. Sign the contract with the winning bidder	☐
13. Announce the details of the approved implementation, the winning bidder along with the price to the committee members	☐
14. Collect the money in accordance with shares into Energy Committee Bank Account	☐
15. Sign contract & start implementation complete with all its components (plant, network upgrade – if needed -, meters, DCUs, servers, etc…)	☐
16. Finalize the contract complete with all members' signatures and supporting documents; Get it approved by the notary	☐
17. Send out to EDL for final approval complete with all final (as – built) documents	☐
18. Launch the 'virtual net metering'	☐

Future Concerns and Future Options

In this chapter variations to the detailed Village 24 Initiative are presented in the form of 'concepts' that would require further refinement both from a technical / architectural design and the legal / administrative perspectives. It is highly recommended that the municipal board, in the first steps of the Village 24 Initiative, and the Energy Committee board, once established, refer to an expert for the detailed design of the renewable energy plant itself and the sub-sequent financial / business models required to make the entire scheme financially attractive to the independent households and/or institutions investors/participants.

Large villages and towns

The Village 24 scheme is based on a single centralized system installed in one plot and connected to the dual available networks of the national utility grid and the local grid through one connection point, respectively. For this architecture, the village must have one network, which in the case of large villages with irregular geographical boundaries and construction development concentration, might not be feasible.

In this case, future amendments to the Village 24 Initiative need to be taken into account. These amendments could be that each village and/or town be allowed to submit more than one Village 24 initiative. Each submitted application will have its own separate renewable energy power station connecting to a separate point to the EDL network (i.e. to another low to medium voltage electricity transformer), separate houses and/or institutions that fall within its vicinity, and separate data storage and communication hardware.

Further detailed investigation as to the connection points with particular focus on the effects – if any – on the utility grid, namely in terms of harmonics and grid (distribution) readiness / capacity to take on any additional variable generation, would be required.

The distributed systems could be connected together through a fiber optic information and communication technology (ICT) network should the municipality wish to have a consolidated reading of their production and hence performance. However, in no way does connecting the systems result in it being viewed by the utility network as one complete system and hence does not reduce the components needed to initiate the V24 Initiative separately (in other words the DCUs, the PV meters, and the individual meters).

A public-private partnership

Public-private partnerships (PPPs) may be defined as a long-term contract between a private party and a government agency, for providing a public asset or service, in which the private party bears significant risk and management responsibility. PPPs have been used extensively worldwide for their ability to leverage private capital and competencies in supporting and successfully implementing sustainable development projects in infrastructure (energy, water, transport, and ICT). In the case of renewable energy, many countries including Lebanon are trying to adopt energy policies and laws to encourage green energy sources. They are also trying to find legal and financing frameworks which facilitate the employment of public private partnerships (PPPs) in this sector, as the case of independent power producers (IPPs) where the design, construction, financing, operation and maintenance of the renewable energy projects are mostly performed by private partners selling their power to the national utility through power purchasing agreements (PPAs).

The Government of Lebanon (GoL) has recently established Law 48, dated 07/09/2017, establishing the regulations that will dictate public-private partnerships. Within this Law, it is indicated that the 'High Council for Privatization and Partnership', along with the concerned Ministry (in this case Ministry of Energy and Water) and the Ministry of Finance, can administer public-private proposals and partnerships.

The provisions of this law shall govern all PPP Projects undertaken by the State and public institutions and all moral persons of public law, with the exception of municipalities and unions of municipalities, which may choose to subject their PPP Projects to the provisions of this law.

In 2002 the Lebanese parliament ratified law 462 which regulates the Electricity sector, and creates an authority body called "The Electricity Regulatory Authority (ERA)" to organize and control electricity affairs, having the ability to issue licenses effective through public tenders or offerings for the purpose of producing and distributing electricity. This law unfortunately has not come into force and to date the ERA hasn't been established. The 462 Law, especially article 7 of it, was subject to several amendments through different laws (lately by laws 288 in 2014 which states that temporarily, for a period of two years, and until the appointment of members of the Authority and giving them their tasks, the production permissions and licenses will be granted by a decision of the Council of Ministers upon a proposal of the Ministers of Energy and Water, and Finance. Law 54/2015 extended the application of Law 288/2014 until 30/4/2018).

Applying in one way or another any of the above laws, with certain required amendments, to the Village 24 Initiative has the possibility of radically transforming the way the initiative is designed and administrated. For example, it could be possible that the Government of Lebanon issue a feed-in tariff for Village 24 Initiatives of a certain value ($c/kWh) that is set depending on the technology location, choice, design, and scale, over a certain number of years (e.g. 20 years). Therefore, when electricity is not present from the national utility grid, the renewable energy system feeds into the local network as the originally described Village 24 Initiative, and will be managed by the Energy Committee. However, when the utility power is present, the renewable energy system 'sells' its power to the national utility at an agreed upon connection point. When the national utility and/or other guaranteeing public agency pays for the power sold, the money will be transferred to the Energy Committee (or perhaps in this case a company established or any other legal structure more in tune with PPP arrangements) and distributed to the individual owners according to their shares. However, the legality of this and the implementing decrees need to be established.

Electricity Storage prospects

The Village 24 Initiative, as described, is based on the solar PV technology which produces clean electricity during the day. Pushing the boundaries of the system a step further through the installation of a battery storage bank could further alleviate the dependence on the diesel generators. This is especially the case during night-time blackout hours where the demand becomes lower and thus can be possibly catered for more cost-effectively by battery storage.

However, including battery storage in the current market prices would considerably increase the upfront investment cost. In Lebanon, considering the technology maturity to date, it is more common to find low maintenance lead-acid batteries which would cost on average 150-180$/kWh, while lithium ion batteries – a promising alternative – costs between 200 -250 $/kWh. As for the balance of system costs, including inverters, wiring, switches, battery bank, charge controller, etc., prices can vary between 1,000 and 1,200 $/kW.

Including a battery bank requires re-designing the system in terms of capacity in order to account for the batteries' capacity – autonomy dependent – and introduces new parameters to the system as it is an additional source of electricity. When doing so, it is highly recommended to have an expert on board and complete a detailed study with accurate data collection. The system would require additional space for the centralized battery storage, the additional dual mode inverters for the battery bank and most importantly an advanced monitoring system that would be able to communicate between the utility grid, the diesel generators, the battery system and the demand and manage priority feeding at all times.

Storage decentralization

Under the Village 24 Initiative, end users could opt to install storage systems in their residences to which part or all of the household could be connected. Going the decentralized route would also require a slight revision of the renewable energy system's sizing in order to accommodate for the batteries. However, with this set-up, an additional parameter is taken into account which is space availability in the households. Therefore, the battery size /capacity is not only accounted for in terms of the needed / requested load and autonomy but also in terms of the available space. The latter is far more restrictive than with the centralized storage system, as including battery storage in existing houses may entail taking up space from other commodities / utilities. In parallel, the additional parameters will have to be accounted for in the management system.

Island mode

Lebanon's electrification rate is approximately 100%; which translates into the physical utility network being available on all Lebanese land. However, the quality of electricity in rural areas, in terms of the voltage and frequency levels, is far from ideal when available. To this end, residents can opt to invest in a renewable energy system that would cater for their peak consumption under an 'island mode' architecture until the utility network's quality is improved. This system storage capacity would not just cater for the evening operation but also for time slots throughout the day in order to perform regular O&M tasks on the generators.

The here presented system will include: the renewable energy source (solar PV, Wind turbine, Biogas, etc…), the diesel generators and the battery storage. System sizing is done to meet the maximum peak demand and the needed hours of battery autonomy, however when sizing the battery bank, critical or selected loads should be used as to keep the required space and eventual cost reasonable.

Energy Co-operatives

Energy Co-operatives run the largest number of shared solar projects worldwide. The cooperatives law in Lebanon was established in 1964 under decree law 17199. The Cooperatives General Directorate under the Ministry of Agriculture, oversees and regulates cooperatives in Lebanon. For this reason, existing cooperatives are mostly confined to agricultural cooperatives. Recent efforts have been made to kick start the process of introducing energy cooperatives and setting up the required legal framework and rules and regulations. Relevant articles of the law are summarized below:

- Article 1: states that the cooperative does not seek profit but seeks improving the social and economic livelihood of its members.
- Article 4: states that the cooperative needs to operate within a strict geographical area and cannot establish branches outside the area.
- Article 5: states that the two cooperatives serving the same purpose cannot operate in the same geographic area.
- Article 7: The cooperative is a legal entity that can own property, open bank accounts, receive grants and apply for loans
- Article 21: the one person one vote principle applies to all cooperatives, voting weights does not change in respect to share ownership.
- Article 24: payment of the shares can be paid in small installments over a period stated in cooperative bylaws; the ownership of the shares cannot be transferred without the approval of the board.
- Article 25: One member cannot own more than 20% of the shares.

The bylaws stated above give the members of the cooperatives a clear legal framework to comply with this decrease contract risks. The energy cooperatives protect members' rights with clear regulations aimed at organizing the financial obligation of its members in a democratic organizational structure. Furthermore, cooperatives can apply to subsidized energy loans where cash flow are in most cases positive throughout the duration of the project.

Investigating the initiation of Energy Cooperatives in Lebanon is recommended.

Peer to peer energy trading

The future electric grid is characterized by increased energy sharing between prosumers (i.e. both producers and consumers), consumers and electric utilities. Optimizing energy resources, optimizing the usage of infrastructure and system assets and ensuring that accurate and secure records of all energy related transactions are kept, many companies and utilities are opting to use block chain-based distributed ledger technologies as an enabling backbone for operation. Blockchain technology can allow decentralized prosumers to safely buy and sell electricity between each other at negligible marginal costs. Accounting becomes decentralized and shared by everyone on the network. In this context, decentralized energy storage systems will play a vital role thanks to their high flexibility and the fact that they could respond quickly to dynamic price signals. This opens a variety of business models and use cases where these systems can be applied.

Peer-to-peer energy trading has significant importance in optimizing the synchronization of energy production/consumption by exploiting electric storage and demand-side management, thus, stacking the benefits of battery storage and increasing its financial returns. Members of the community could increase self-consumption of their solar energy resource, support with frequency regulation and ancillary services to the distribution network and allow users to exchange solar energy, stored in a battery bank or produced and directly fed to the distribution network, when resource and demand mismatch between consumers is present. Consumers can also purchase energy from neighboring prosumers, the utility company or community diesel generators.

In Lebanon, rural areas host a highly versatile pool of residents, some of which are expatriates that only use their said residences during summer and extended holidays, while others spend their weekdays in the city and their weekends and extended vacation days in their home- town. Optimizing demand and supply becomes a more complex challenge in this context, and the blockchain platform could offer forecasting potential for the local energy system and integrate various sources of energy supply (shared PV-diesel micro-grids, rooftop solar, decentralized storage systems like batteries and electric vehicles).

For this 'scheme' to function, further investigation into the business model under which the scheme could be monitored and operated is needed, including the required technical infrastructure related to information and communication technology. Furthermore, a detailed legal study must be performed to fully understand the implementation of this de-regulation model in Lebanon.

Other technologies

Community scale renewable energy is not only limited to solar energy. Other types of renewable power generation can play a vital role in the transition towards sustainable energy. Wind turbines are being implemented through shared community schemes all over the world, bioenergy plants are also very suitable for municipal scale power generation. These types of developments are still lacking in Lebanon and there is still huge untapped potential in expanding the solar model to other technologies.

This is particularly important to wind energy in terms of social acceptance; recent studies have shown that local attitudes about wind energy concerns such as intermittency and visual impacts can become more positive if wind turbines were owned by local communities.

Furthermore, community scale biogas can benefit from the community scale virtual net- metering scheme in the sense that it can combine different waste streams and respond to both heat and power demands.

The Role of the National Control Center

With the increased adoption of distributed and centralized commercial and utility scale variable renewable energy generation systems and the expansion of the business models and architectural schemes under which they are implemented, it is important to highlight and bring forth the need of intervention of the local National Control Center in monitoring and controlling the distributed systems all over the country. This is quintessential for the effective integration of variable generation into the utility grid as imposed by the nature of such variable technologies that solicits the requirement of a central control authority to ensure proper operation when it comes to reactive power compensation, primary control, ancillary services and meeting unit commitments and spinning reserve or inertia requirements.

It is recommended that the National Control Center intervenes at an early stage and adopts a strategy to implement the needed ICT infrastructure and operate the geographically and technically diverse systems to ensure reliability of the national electrical system.

Conclusion

This present booklet detailed the steps of the implementation of the innovative solution entitled V24 Initiative developed and implemented in close collaboration with EDL and MEW. The draft process is subject to updates based on lessons learnt, experienced gained, and/or upgrades /changes to occur on the electricity production and distribution networks.

The report provides the steps of the implementations from both the technical – complete with the caveats to consider along the way - and administrative / legal – complete with template documentation perspectives.

From a technical perspective, the process builds on:

- The interest / willingness of the residents to pursue such an implementation
- The availability of renewable energy potential in the village
- An existing / dynamic and efficient parallel low – voltage network, owned and operated by the municipality
- A properly sized system to meet the average needs of the subscribers / shareholders

From a legal perspective, the process builds on:

- The preliminary approval of EDL to implement the V24 Scheme

- The establishment of the Energy Committee to legally represent the village vis-à-vis EDL matters

From a financial perspective, the process builds on:

- The economies of scale rendering the initial investment acceptable by all parties
- The available micro-financing options that could alleviate the payments (both initial / down payment and instalments)

Annex 1.

Sizing a Solar Photovoltaic System to Hybridize with the Municipal Diesel Genset and the National Utility Network

Sizing of solar PV systems in a microgrid such as that discussed for the Village 24 Initiative is a task that must be undertaken by an energy engineer and/or expert. However this section gives the general considerations that need to be taken into account, so that the municipality and/or other concerned entities can take note of them.

The solar PV system under the V24 initiative scheme operates in two modes:

1. Net metering mode with the EDL network allowing the subscribers to reduce their monthly utility bills.

2. Fuel reduction mode with the local network allowing the municipality and subsequently the residents to reduce the diesel consumption and O&M costs on the backup generators. These two operation modes dictate certain constraints to be considered while sizing the system:

- EDL net metering constraints: The currently available net metering scheme implemented in Lebanon allows the subscriber to reduce his/her monthly bills through 'net consumption' payments which are rolled over to the next billing cycle – in case of surplus – until the end of the fiscal / calendar year. In which case, any surplus is not financially remunerated, but is considered as a contribution to EDL's electricity production. Therefore, sizing the system larger than the maximum yearly energy consumption would increase its upfront / investment cost while not increasing its financial benefits and returns to the correlated extent. This will result in an increased payback period as the return on investment is fixed (the yearly consumption). If and when EDL modifies its net metering scheme to allow a payment at retail rate for the excess of renewable energy power at the end of a given year, the above constraint can be readdressed.

- The available diesel generators with which the system will synchronize and operate in fuel reduction mode. The latter mode ensures that the generators do not cycle below 30% of their rated power capacity in order to preserve the integrity of the generator's mechanical components. Any excess PV production that will risk the generator going below 30% will thus have to be curtailed through the energy management system. Therefore, the rated capacity of the diesel generators and acceptable curtailment percentage of the total theoretical PV energy produced are constraints to be adopted in system design and sizing. It is important to note that the higher the PV energy curtailment, the larger the PV plant capacity and the lower the relative consumption of PV energy. Thus an increased upfront / investment cost of the system and its payback period is witnessed.

• Data collection: the sizing of the solar PV system is done based on the number of residents that will be part of the Village 24 Initiative and their actual electrical loads while adding the above constraints as limiting factors. It is highly recommended that the municipality installs meters in at least a sample of the interested subscribers' households in order to collect accurate consumption data with higher resolution. In the absence of such data, the PV sizing is done based on the total subscribers' average load over a year or a survey-based estimate demand profile, which in theory should be close to the smaller generator size (refer to Annex 2 on important distribution network caveats and required conditions in section 1 for more details). Next step is optimizing the system capacity based on the maximum curtailment constraint to keep it within economic carrying capacity limits.

• Spatial availability: solar PV requires considerable roof and/or marginal land space. For each 1 kWp capacity, an approximate surface area of 10 m2 is required. However, this value needs to be validated by the consultant given its sensitivity to other variables like land inclination and solar PV design (e.g. Inclination, single-axis tracking, etc.).

• It should be noted that in times of intermittence (during off-grid operation), the synchronization system along with the system's controller will ensure that the optimal generator(s) is(are) dispatched so that to match supply and demand while incorporating spinning reserve requirements and minimizing the need for solar PV energy curtailment.

Having in mind the process flow of implementing a Village 24 Initiative presented in Chapter 3, it would be optimal and a better practice if the sizing and optimization process of the solar PV system is divided into two sequential steps:

1. During step 2 (preliminary study) of the process flow, an optimization process is undertaken so that to obtain a preliminary maximum feasible PV system capacity based on the maximum allowable curtailment percentage (usually less than 15%), the spatial availability, the available generator capacity (or the generator that will/may be purchased) and the total yearly load demand. A sample optimization sheet is available on CD with this present booklet where the user inputs the constraint parameters, the hourly load profile for a typical year and the hourly generation profile for a PV system at the specific location for a typical year. The sheet takes into account 12 hours of daily power cut-off under the alternating on and off scheme over a 48 hours period. This will be 6 hours on – 4 hours off – 4 hours on – 4 hours off – 6 hours on – 6 hours off - 4 hours on – 4 hours off – 4 hours on – 6 hours off. The optimization procedure can be described by the below formula:

Maximize ($\sum_{0*}^{\$\%\&'} YYYY$) by varying the PV capacity

Subject to: $\sum_{0*}^{\$\%\&'} CCYY \leq$ Curtailment limit

$\sum_{0*}^{\$\%\&'} YYYY \leq$ Yearly demand

Space required $\leq$ Spatial availability in m^2

Where "Yi" is the solar PV energy produced in hour 'i' and is calculated by multiplying the mapped hourly specific yield by the PV capacity. Ci is the curtailed energy in hour 'i' during off-grid operation and is calculated as the excess solar PV energy in hour 'i' considering the minimum loading ratio of 30% on the diesel generator.

Since this is an early stage sizing model, and due to the possibility of unavailability of the needed hourly generation and consumption data, the user has the option to input the yearly average load and the PV system's specific yield at the set geographical location to output a typical hourly profile for the load and PV production (information can be found online on website such as http://globalsolaratlas.info) by mapping the inputted data to a typical consumption and generation profile in Lebanon. The model then outputs the maximum PV capacity while respecting the constraints which then can be used as the capacity top boundary for steps 3, 4 and 5 in the process flow.

Individual shares to subscribers can then be distributed under the conditions that **(1)** the share size does not yield energy greater than the annual energy consumption of that subscriber, and **(2)** the sum of all the shares is less than or equal to the maximum PV capacity calculated in the optimization model.

2. During step 5 of the process flow (detailed study), the renewable energy consultant(s) and system designer(s) should have accurate data in regards to the number of subscribers, their consumption profile and hence the maximum feasible PV system capacity. In this step, it is highly recommended that the consultant(s) simulate the system using an integrated energy system modelling software that provides the tools for the optimization of PV-diesel hybrid systems in order to verify the sizing calculations, the optimal operation and the financial and technical feasibility of the designed system. It is worth noting that obtaining an accurate load profile at this stage and running accurate simulations will reduce the risk of over-designing the PV system that has a 25-year lifetime. In other words, reducing the risk of having excessive curtailment (above the designed for limit) and/or not meeting the yearly financial returns.

Annex 2.

Important Distribution Network Caveats and Required Conditions

One of the assumed existing parameters for the Village 24 Initiative listed in Chapter 2 is the existence of a unified low voltage network to which the renewable energy plant would connect during utility blackouts. On the one hand, this initiative falls under the legal responsibility of the Energy Committee that will enter into contract with the National Utility Company (EDL), and is thus responsible for managing, operating and maintaining the local backup generation network. On the other hand, the renewable energy system synchronizes with the locally installed LV network during EDL blackouts through a fuel reduction device / energy management system. The energy management system monitors the instantaneous demand, the generator(s) load and the instantaneous PV production and manages and controls the solar PV penetration into the generation mix while ensuring a minimum loading ratio of 30% on the diesel generators and catering for the set spinning reserve.

The section below lists important parameters to address when considering the installation of a renewable energy system for a community.

A2.1 LV network design

Villages that have a distributed backup service network will have to consolidate this network under the auspices of the municipality. Hence the network will consist of:

- Diesel generators; in order for the network to be dynamic and efficient, at least two generators must be installed
  1- The first generator is sized based on the maximum village demand. This value could be provided from EDL bills or based on the EDL circuit breaker installed per household / institution
  2- The second generator is sized based on the average village demand

- Power cables; cables need to be properly selected and sized as to provide the required current carrying capacity within the respected voltage drop limits

- Synchronization panel; to synchronize the operation of the diesel generators

- Individual meters; meters are installed at the households / institutions providing the kWh consumption reading per subscriber

During peak hours and seasons, the former coinciding typically in early mornings, and early afternoons to early evening where most of the family members are active in the households, while the latter being the result of an increase in the village residents or individual demands notably during the summer, the larger generator is operated. During off-peak hours, typically during the day, the smaller generator is operated. The switching between both generators depending on the demand and its safety operation has to be supervised and managed through synchronization.

An optimal scenario would be if three diesel generators are installed and operated under a synchronization system. This would allow sizing one of the generators to operate with the solar system during daytime, sizing a small generator to meet the load during night time when it is at its minimum and sizing one generator to operate in synchronization with one of the other two in order to meet the demand during peak load hours.

A2.2. LV network Caveats

- **Existing grid quality**

Some villages in Lebanon have taken on the initiative of centralizing their backup generations through the installation of a parallel Low Voltage (LV) network supplied by diesel generators to cater for the village's power demand during utility cut-off times. These networks including the generators are usually owned, operated and maintained by the local municipality that bills the residents based on a tariff of 300 LL / kWh ($c20/kWh). A new decree (number 135/1/A.T) dated 28 July 2017 requires backup system providers (diesel operated generators) to charge the user based on his/her kWh consumption as opposed to billing based on the permissible peak power (circuit breaker capacity). To this end, all backup system providers have to install digital energy meters for the subscribers and will have to follow the Ministry of Energy and Water's pricing for billing the customers connected to the diesel operated generators.

As a first step, when collecting information about the electricity demand and current available models, both in terms of business models and backup solutions, the existing established network should be looked into thoroughly. The main elements to investigate include:

a. The distribution network

Village geography plays a major role when setting up the LV network; optimally, the generators would have to be installed equidistantly from the available households/consumers as to avoid oversizing cables in order to keep the voltage drop within acceptable limits (up to 8%).

Branches emanating from the generators' network should be balanced in terms of connections. In other words, dense neighborhoods should have more than one branch supplying the residences with electricity. This would also eliminate the need for oversized cables and a poor power quality in certain neighborhoods. Now that the new decree imposes the backup generators' sector to charge the customers as per their consumption and not by trenches, the limit on peak power supplied is alleviated, rendering a possible increase in demand or even decrease in some cases on the diesel generator's network and branches. Therefore sizing cannot take a limited power consumption but has to account for the maximum the household / institution might consume which is limited by their EDL subscription capacity. Therefore, a critical aspect to consider when installing the network or investigating it later is cable type and size; for the same voltage drop (a factor of cable length), aluminum cables have a higher cross sectional area than copper ones, as shown in table A2.1 below.

Table A2.1: Equivalent standardized cross sectional area at equal voltage drop

Copper (mm^2)	Aluminium (mm^2)
6	10
10	16
16	25
25	35
35	50
50	70
70	95
95	150
120	185
150	240
185	300

b. Grounding system and protection

In most Lebanese areas, when acquiring a backup connection from the neighborhood diesel generator, the provider usually uses one (1) phase of the three (3) phases to connect one or several households in a way as to keep the balance between the phases. Grounding and earthing are usually absent or sometimes connected haphazardly, by connecting to the national utility ground or neutral, rendering no provision of safety measures. By doing so, whenever any fault occurs on the phase in question, there is no safe path to discharge any fault currents which may cause damage to appliances or components and possibly result in electrocution.

When integrating the renewable energy source into the mix, system protection from the available networks both EDL and the LV diesel network should be taken into account. Any faults resulting from the 'common practices' would cause the system to keep disconnecting and not properly synchronize with either network thus resulting in a decrease in system performance and solar energy yield.

c. Reservations for future expansion

Some neighborhoods might experience an increase in demand, whether through the available households that have additional residents, more activity requiring increased electricity consumption, or through newly built households. Cables used in the network should be oversized by a minimum factor of 1.2 as a safety margin and a contingency for future expansion.

In dynamic villages, where construction and residents' occupancy are changing, network design / distribution needs to be constantly checked so to make sure the quality of the electricity does not fall below the recommended level.

- **Current Switching methods (between different diesel generators)**

An efficient micro-grid / local grid should have a generator sized to provide the village peak demand when needed – namely during evenings, holidays, summer seasons – and another generator to cater for the average demand.

Ideally, generators would be synchronized and connected to an automatic transfer switch rendering the network fully automated. The system would switch between generators to cover the instantaneous village consumption while making sure that the optimal generator is running under a high efficiency loading ratio to reduce unnecessary diesel and possible O&M costs. The available network should be designed for dynamic usage and hence has a flexible supply capacity to meet the somewhat flexible or changing demand based on seasons and time of day. In such a case, switching between the two available sources of electricity would be done automatically through a smart synchronization system that would be able to sense the demand and turn on the right generator (size).

Should the switching be done manually, in which case the generators are not synchronized, synchronizing the generators and connecting them to a Programmable Logic Controller is required. The Programmable Logic Controller would be capable of monitoring the instantaneous demand, the renewable energy plant production and then control the operation of the generator in order to ensure the optimal performance of the whole system.

Annex 3.

General Technical Specifications of the Solar PV system Complete with Metering Components

A3.1 PV modules

PV modules must be crystalline silicon PV modules that comply with the norm IEC 61215 edition 2 and shall be qualified to and be classified by Class according to IEC 61730. PV modules shall also comply with the requirements of IEC 62716 (Ammonia Corrosion test).

The modules shall also be tested through at least one of the following quality and durability programs:

- Fraunhofer's PV Durability Initiative (PVDI) testing
- Atlas 25+ PV durability testing program
- PVEL's vendor qualification test program
- NREL's Qualification Plus for PV module reliability
- VDE Durability Testing Program
- TUV Sud Thresher or equivalent

A3.2 Inverter

For grid-connected operation, inverters are multi-string inverters. The inverters control the current into the grid to meet the requirements for connection functionality. These standards include a voltage and frequency range and requirement for "anti-islanding" to ensure that the inverter disconnects from the utility grid if the latter is not within the specified conditions.

It is recommended that each PV generator with similar physical and radiation characteristics (tilt, temperature, radiation, etc.) are connected to one single MPPT.

The grid-dependent inverter requirements shall also include the following:

- Dynamic compensation of Reactive Power
- Inverter automatic reconnection conditions
- Linear output power control from a third device (read and write capabilities)
- Utility-Interactive Photovoltaic inverter system

They should also have the following certification:

- Harmonic Current (IEC 61000-3-2 and / or IEC61000-3-4), IEC 62109-1/2
- With anti-islanding protection as per VDE 0126-1-1 or similar

A3.3 PV Plant controller

The PV plant controller unit shall be a fuel-reduction device, tested with successful experience of at least 1 year in operation in similar conditions and shall be compatible with the Genset Control Unit and communicate with the inverters to guarantee the proper operation of the existing and / or new gensets (genset efficiency, minimum part load, spinning reserve, reverse current protection, etc.).

If the available genset does not include an embedded Genset Control Unit, then the Contractor shall supply and install a third party meter on the genset power lines to read the genset's operational parameters.

The PV plant controller unit should integrate communication protocols compatible with:

1. Reading capabilities: current and voltage sensors and Genset Control Unit
2. Writing capabilities: Inverters

The controller should be able to communicate with the system's components through RS485, Ethernet and/or RS232 (compatible with grid-connected inverter, existing Genset Control Unit, environmental sensor and electrical meters)

A3.3.1 Monitoring sub-system and data logger

It is recommended to have a complete monitoring sub-system that would have the following equipment:

- Irradiance Sensor: Reference PV solar cell with voltage output.

- DC Current and Voltage Transducers: Internal or external DC current transducers to measure: Electrical energy from PV generator, electrical energy to inverter.

- AC Meters: Digital three phase meters with output pulse signal (open collector 1,000 p/kWh); class II; 230V-50Hz; input: current (depending on rated power), Dimension 1-DIN module, compatible with monitor system.

- Temperature Gauge: External ambient and PV modules temperature sensor (IP65).

- Communication and Signal Interface: Device for real time visualization and download of stored data. A communication protocol compatible with external sensors, meters, inverters and Genset Control Unit should be used. A data logger can be a separate device or it can be included in the PV plant controller unit and should store current and historical data while having a data logging capacity that computes averages or integrates at least the following hourly values: Month, day, hour, irradiation, PV energy generation, inverter energy output to loads, AC consumed by the building, AC delivered to the grid, average voltage. Additionally, the logger shall allow remote monitoring and shall have at least the capacity to store two years of data.

- Energy Display Unit: Energy management computing with display at least of: power values of PV generator, power in/out from the inverter (W); temperature (ºC) and voltage (V); irradiance (W/m2); ambient temperature (ºC); installation reference number.

• Evaluation software: Software PC compatible to perform monthly evaluation reports with at least the following indicators: year, month, energy values (kWh), in plane average daily reference yield, average daily PV generator normalized yield, average daily final normalized yield, performance ratio (%), solar fraction (%), AC energy consumed from the grid, and AC energy delivered to the grid.

The software shall enable alarm configuration.

A3.4 Smart Meters and Data Concentrator Units

A3.4.1 Household / Institution Smart Meters

General Specifications

Description	Value
Current Reference Value (Iref)	5A
Starting Current (Ist)	20mA
Minimum Current (Imin)	0.25A
Maximum Current (Imax)	80A
Current Surge Withstand Capability	100A (continuously) | 2,400A (during 0.01s)
Power absorbed by the current circuit (at Iref)	< 0.3 VA
Voltage Rated Value (Un)	127 – 230V
Voltage Operating Limit (Un)	± 20%
Voltage Thermal Capability	400V
Voltage Circuit Load	< 4.5 VA (without PLC transmission)
Active Energy Measuring Accuracy	Class B (EN 50470-3)
Reactive Energy Measuring Accuracy	Class 2 (IEC 62053-23)
Test Constant Measuring Accuracy	1,000 pulses / kWh (kvarh)
Temperature and Humidity	25˚C to 70˚C
Operating and Sorting Range	25˚C to 85˚C
Humidity Limit	95% (non – condensing)

Power – free Output (optional)

Description	Value
Maximum Switching Voltage	280 Vac (DC switching not possible)
Current (continuously)	0.5 AacMax

Switching elements

Description	Value
Maximum Operating Voltage	250 Vac
Nominal Load	60A
Switching capacity	20,000 VA
Operating time	< 30ms
Number of Operations	10^5

Communication Link

Description	Value
Optical Port	According to EN62056-21
Used signals	RX/TX
Implemented Communications protocol	EN 65056-46
Speed	9,600 bauds

PLC port

- PLC modem within the A band according to CENELEC EN 50065 – PRIME
- RS 485 port (2 wires)
- 2 identical RJ11 connectors internally united; used signals:
    1. GND
    2. UP (a)
    3. UN (b)
    4. UN (b)
    5. UP (a)
    6. GND

A3.4.2 PV Plant Export Smart Meter

Description	Value
Current Reference Value (Iref)	5A
Starting Current (Ist)	40mA
Minimum Current (Imin)	0.5A
Maximum Current (Imax)	80A
Current Surge Withstand Capability	100A (continuously) | 2400A (during 0.01s)
Power absorbed by the current circuit (at Iref)	< 0.1 VA
Voltage Rated Value (Un)	127 – 230V
Voltage Operating Limit (Un)	± 20%
Voltage Thermal Capability	400V
Voltage Circuit Load	< 5 VA (Phase A & B) < 16 VA (Phase C)*
Active Energy Measuring Accuracy	Class B (EN 50470-3)
Reactive Energy Measuring Accuracy	Class 2 (IEC 62053-23)
Test Constant Measuring Accuracy	1,000 pulses / kWh (kvarh)
Temperature and Humidity Opertaing Range	- 25˚C to 70˚C
Operating and Sorting Limit Range	-25˚C to 85˚C
Humidity Limit	95% (non – condensing)

* Multifunction meter, consumption requirements per EN 62053-61

Power – free Output (optional)

Description	Value
Maximum Switching Voltage	280 Vac (DC switching not possible)
Current (continuously)	0.5 Aac Max

Switching elements

Description	Value
Maximum Operating Voltage	250 Vac
Nominal Load	60A
Switching capacity	20,000 VA
Operating time	< 30ms
Number of Operations	10^5

Communication Link

Description	Value
Optical Port	According to EN62056-21
Used signals	RX/TX
Implemented Communications protocol	EN 65056-46
Speed	9,600 bauds

PLC port

- PLC modem within the A band according to CENELEC EN 50065 – PRIME
- RS 485 port (2 wires)
- 2 identical RJ11 connectors internally united; used signals:
    1. GND
    2. UP (a)
    3. UN (b)
    4. UN (b)
    5. UP (a)
    6. GND

Complete with Resin encapsulated Cable Passing Measuring Current Transformers

Description	Value
Operating frequency	50/60 Hz
Resin encapsulating	synthetic thermosetting
Insulation reference voltage	0.72 kV
Test voltage	3 kV x 50 Hz (per phase)
Continuous overcurrent	1.2 In
Rated short thermal current (I th)	80 In
Rated dynamic current	2.5 x Ith
Safety factor	N ≤ 5
Maximum Power Dissipation (max range value)	≤ 8W
Short Circuit Current	35 kA x 1 sec.
Operating temperature	-25 + 50˚C
Storage temperature	-40 + 80˚C
Manufactured according to	IEC / EN 60044-1, VDE, BS, UTE

A3.4.3 Data concentrator units

Power Supply

Description	Value
Rated Voltage	Vn = 3x230 / 400 Vac
Operating range	0.4 to 1.1 Un
Maximum Power Consumption (normal conditions)	7W total / 37 VA per phase
Maximum Power Consumption (forced conditions)	12W total / 37 VA per phase
Insulation	10KV / 1 min between Ethernet and the other circuits 2KV / 1min between the other circuits

Meter Parameters

Description	Value
Nominal Voltage	3x127 – 230 / 400 Vac
Current	3x5 (10) A
Frequency	50 Hz
Accuracy	- Active: Class B or 1 (EN 50470-3 or IEC 62053-21) - Reactive: Class 2 (EN 62053-23)

Communications

- 3 Low Voltage PLC Communication Lines
- Connectors:
  - 1 V.A – 1V.N
  - 1V.B – 1V.N
  - 1V.C – 1V.N
- Characteristics: PRIME signal according to version 1.3.6. – 3 independent channels in Tx and Rx – 1 Vrms signal over an impedance of 2 Ohms – Dynamic range 65dB
- Ethernet port: TCP / IP Protocol - Ethernet (standard) 10Mb / 100Mb – Auto MDI – X (crossover) – Insulation: 10KV / 1 sec
- 3G / GPRS module: PH8: Five band, 800/850/AWS1/1900/2100MHz – Double SIM
- Serial Port RS485/RS232 SRV

Measurement characteristics

Description	Value
Current	3x5(10)A
Reference Voltage	3x127 – 230 /400 Vac
Frequency	50 or 60Hz (according to model)
Energy Accuracy	Class B active (EN 50470-3) Class 1 reactive (EN 62053 – 23)

Battery

- When disconnected: 500 days
- When connected and supercap charged, interruptions of 1hour are possible without using the battery

Environmental characteristics

Description	Value
Operating range	-25˚C to 60˚C (outside the cabinet)
Storage range	-25˚C to 70˚C
Humidity	< 95% (non – condensing)

Built-in antenna

- Built-in omnidirectional antenna or built-in directive antenna, including a fixing accessorize to guarantee the insulation of 10KV.

IP / IK classification

- IP 65 / IK 09

Cover Protection

- Class II and double isolation

A 3.5 Private internet connection for remote reading

A3.5.1 M2M Alfa SIM cards

Machine 2 Machine (M2M) Alfa SIM cards will be installed on the existing public and on the servers (typically the EDL department in charge of the meter reading in the area and the municipality) creating a secure data transfer connection.

A3.5.2 4G Alfa Dongle

A 150 Mbps dongle to be installed on servers (typically the EDL department in charge of the meter reading in the area and the municipality); the dongles should have the following features:

- Compatible with LTE, EDGE, GPRS and GSM networks
- Compatible with Windows XP, Windows Vista, Windows 7 and MAC operating systems

Annex 4.

Single Net Metering and the Village 24 Initiative

A4.1 Single Net Metering

Net metering is a billing technique based on EDL decision No. 318-32 / 2011 that allows residential, commercial, and industrial entities to produce electricity using renewable energy, and send the additional production not used on the site itself back into the grid. Over any given accounting year (starting from January 1st to December 31st), installers of renewable energy systems would be allowed to export their respective electricity production at times when these are not used locally. At the end of each billing period (commonly: 2 months), the installer of the renewable energy system will be charged only for the net amount of power consumed from the grid, i.e., the import minus the export of power. If there is excess power injected to the grid, over and on top of those imported, then this excess power is rolled over to the next billing period. At each billing period, whenever exports are greater than 75% of the import the customer's connection fees are cancelled. This goes on until the end of the year, where if electricity exported is more than imported, EDL will zero the meter. This will entail no financial transfers from EDL to the subscriber.

A4.2 Village 24 Initiative or the Community Net Metering

Community net metering uses the concept of the single net metering policy mentioned above and based on the same decree. With community net metering, households / institutions can get together and install a renewable energy farm in one area and the output of this farm can be divided into the number of subscribers that invested in installing it. Each investor / subscriber would import power from the grid and therefore will have the same import characteristics as before (single meter at the households / institutions), however the subscriber's exported renewable energy power from the renewable energy farm is measured through a dedicated meter - based on EDL recommendations and - installed at the point of connection with the utility network (refer to Annex 3). The export value will be calculated based on the percentage share of ownership for that subscriber in the solar power plant. It is a virtual net metering process.

To this end, a dedicated billing tool has been developed for the billing department at EDL, hosted at the collection department under whose jurisdiction the Village 24 implementation falls; in the case of Kabrikha, it is the collection department of Jouwaya in the South of Lebanon.

The tool aims at providing the billing team with indexes for bi-monthly individual imports (consumption from EDL) and exports (power fed back to EDL) for each subscriber.

Therefore once the system capacity and technical details are known and subscriptions (shares from the system's total investment cost) have been paid, the Energy Committee would input the subscribers' details (names, meter ID, branch ID, etc…) along with their shares of the system's output into excel which can then be uploaded into the billing software by EDL. This enables the tool to read the PV output production at the end of the 2-months cycle and calculate the individual power export per subscriber using their percent share (of the total exported renewable energy power). EDL will then have its import and export indexes per subscriber to issue their respective bills. The software will automatically estimate, save and rollover any excess power of individual subscribers per billing period to the next billing period.

Annex 5.

Benefits of Community Scale Renewable Energy Systems

To date, in Lebanon, distributed installations are the most common implementation set up available, given their cost and relatively smooth power production profile. Installing a distributed solar PV system would currently cost in the range of 1 -1 .5 $/kWp depending on complexity and on the connection (network) required. It would also require 10 m2 per kWp.

Community solar power provides several benefits, of which:

1. Lower Cost

Going the community scale route provides nearly 40 - 60% reduction on the investment cost normally attributed to the 'economies of scale' i.e. the development process in quantities and the specific (large capacity attributed to community level consumers) systems designs.

2. New market segments

The specific designs and larger scales create a new pool of end users / customers. In particular the available sizes (capacities) and its modularity renders the systems uniquely appropriate to meet a community level demand.

3. Alignment with local interest

The investment in such technology at the local level not only meets the local demand but also creates job opportunities for the local residents and allows the village to reduce health risks from polluting energy sources through the reduction of dependence on diesel generators.

4. Flexible system arrangement

As opposed to the distributed system, the community scale system provides additional flexible arrangements, namely when it comes the system's operation over its lifetime in cases where the user decides to move or is unable of continuing the payments, etc… The share ownership allows the user to simply sell his shares as opposed to having to remove a system and sell it.

5. Professional management

It is more likely that the community system will be operated and maintained by individuals nominated by the Energy Committee. Any need for maintenance, whether preventive or corrective, falls under this individual's responsibility and job description, hence reducing the performance risk.

6. Reduced roof space

Finally, distributed systems require localized space that could be used for other 'services' such as water tanks, solar water heaters, antennas and technical rooms. In some areas, the needed roof space might not be available or might be public owned which would require permits and agreements to install a solar PV system. The community scale set up potentially solves the space issue.

Annex 6.

Template Letter of Preliminary Approval

Template available on the CD provided with this booklet

الجمهورية اللبنانية
محافظة:________________________
قضاء:__________________________
بلدية:__________________________

قرار رقم:________________________

الموضوع: الموافقة المبدئية على تلزيم تركيب مشروع الطاقة المتجددة بقدرة_________ كيلو/واط على العقار رقم__________ من منطقة __________ العقارية.

إن مجلس بلدية______________________،
بناً ء على محضر جلسة المجلس البلدي تاريخ_____________________,
بناءٍ على المرسوم الإشتراعي رقم 118/1977)قانون البلديات وتعديالته(, بناً ء على الموافقة المبدئية على تلزيم تنفيذ مشروع توليد طاقة نظيفة ومتجددة وهو كناية عن
_________________)مزرعة شمسية أو مزرعة هوائية(، إلى آخره بقوة__________ كيلو/واط،
وبانتظار موافقة مؤسسة كهرباء لبنان على تركيب هذه المزرعة، وتشكيل لجنة الدارة هذه المنشأة مرفقة اسمائهم ربطا.

يقرر ما يأتي:

المادة ألولى: الموافقة المبدئية على انشاءمشروع توليد طاقة نظيفة ومتجددة على العقار____________ من منطقة________ العقارية بقدرة انتاج وقدرها________ كيلو/واط. المادة الثانية: احالة هذا القرار الى مؤسسة كهرباء لبنان الخذ الموافقة النهائية على تركيب هذه المنشأة وتوقيع اتفاقية مع المؤسسة بهذا الخصوص.
المادة الثالثة: انشاء لجنة الدارة هذه المنشأة مؤلفة من المشتركين المحتملين المرفقة اسمائهم ربطا.
المادة الرابعة: ينشر ويب ّلغ هذا القرار حيث تدعو الحاجة.

في________________________

ألعضاء　　　　نائب الرئيس　　　　رئيس البلدية

Annex 7.

Theoretical Financial Appraisal of a 100 kWp Solar PV System

A 100 kWp system is herewith presented as an example for ease of demonstration; it is highly recommended that this example be presented during the meetings, as to provide as concrete information as possible at the decision making steps.

Assumption for this financial appraisal are as follows:

- A 100 kWp system, together with its network, communication system (smart meters, data concentrator units, laptops, internet…) may cost up to 150,000 USD, all inclusive.

- We assume that each subscriber in the Village 24 initiative has 1% of the power output of the 100 kWp system and therefore owe a maximum of 1,500 USD for their respective share of the system.

- Annual operation and maintenance cost is assumed to be $3,000 (approximately 2% of capital costs), meaning that each subscriber has to pay $30 each year for the solar PV (or app. $2.5 per month).

- The net capacity factor is 17% (taking into account maximum curtailment of the solar PV of 15%), meaning that each subscriber will benefit from 1,500 kWh per year (this is a rough estimate and depends also on the geographic location in Lebanon).

- The average cost of electricity (combining EDL current rate with the possible diesel generator electricity prices that are varied between $c16 - $c26/kWh – depending on oil prices), is assumed to range from $c13 - $c18/kWh.

- Three discount rate scenarios are taken:
  - A discount rate of 13% with 5 years repayment period (similar to current rates of micro-finance loans – refer to Annex 9 for the available micro-finance institutions)
  - A discount rate of 5%, assuming all the money is put up by the subscriber without a loan (therefore it is foregone interest – assumed at 5% - of this money)
  - A discount rate of 2.6% (assuming the NEEREA soft loans are extended to the Village 24 Initiative).

The net present value (NPV) and the payback period of the above scenarios (combining low oil prices and high oil prices with the three discount rate assumptions) will yield the below dynamic payback periods listed in table A7.1:

Table A7.1: Dynamic payback periods for the present case scenarios

Discount	2.6% (NEEREA)		5% (equity)		13% (micro-finance)	
Oil Price	Low	High	Low	High	Low	High
NPV ($)	3,055	5,603	2,021	3,970	561	1,590
Simple PBP (years)	4.2	3	4.2	3	4.2	3
Dynamic PBP (years)	Positive cashflow	Positive cashflow	5.94	4.13	7.79	Positive cashflow

All scenarios are positive with the exception of obtaining a micro-financed loan to pay for the required capital costs, coupled with low oil prices. Therefore it is highly recommended for the Ministry of Energy and Water, the Lebanese Central Bank and the Lebanese Center for Energy Conservation to assist the Village 24 subscribers to tap into the NEEREA loan. The best case scenario will lead to a payback period of 6 years and a net present value of over $2,200, i.e. almost a return of 1.5 times the capital investment.

Annex 8.

Energy Committee by-laws and Internal Contract

نظام ادارة مزرعة شمسية

مقدمة

بعد أن تـمّ تركيب مزرعة طاقة متجددة بقدرة____كيلو/واط وذلك وفقا للمعايير الدولية وبعد ان تم توقيع اتفاقية مع مؤسسة كهرباء لبنان)مرفقة ربطا(قرر الموقعين ادناه تشكيل لجنة فيما بينهم،الغاية منها تحديد حقوق وموجبات المستفيدين من هذه المزرعة)الشمسية أو الهوائية،...(والمنشأة في بلدة __________ الواقعة في محافظة __________ قضاء __________ ، وتنظيم ادارتها من أجل حسن استعمالها وصيانتها والمحافظة عليها. ويعتبر هذا النظام الزاميًا لكل مستفيد من هذه المنشاة سواء كان مالكا او مستاجرا عقارا في البلدة ولديه ساعة كهربائية الكترونية باسمه، ولكل صاحب حق من الحقوق المتفرّعة عن حق الملكيّة.

اولًا - الهيئة العامة للمنشاة: تتألف

الهيئة العامة للجنة من اهالي وسكان بلدة__________ الذين يرغبون باالستفادة من المنشأة والذين إطلعوا على نظامها ووافقوا على اإلتفاقيات الموقعة من قبلها.

ثانياً - شروط االنضمام الى المنشاة:

- ان يتمكن المشترك من الستفادة تقنيا وعمليا من المنشاة.
- ان يملك اشتراكا رسميا مع مؤسسة كهرباء لبنان وان يملك ساعة كهرباء الكترونية.
- ان يدفع فواتير مؤسسة كهرباء لبنان المستحقة على ما يملك بانتظام، واال يسقط حقه حكمًا وفورا من االستفادة من المنشأة.
- ان يدفع الفاتورة المتضمنة فرق المقطوعيات التي سجلها العداد حسب التعرفات المرعية االجراء وذلك في موقع تسليم الطاقة ولدى تقديم اإليصال المعتمد من قبل كهرباء لبنان او الشركات المخولة من قبلها.
- ان يقوم بدفع ما يتوجب عليه من اعمال الصيانة.
- ان يلتزم بنظام اللجنة والتعديالت التي قد تطرأ عليه.
- ان يشارك باجتماعات الهيئة العامة التي يدعا اليها.

ثالثا - مركز اللجنة:

- يكون مركز اللجنة في مقّر المجلس البلدي.

رابعا - الهيئة االدارية:

- تتألف الهيئة االدارية من رئيس ونائب رئيس و أمين سر وأمين صندوق.

يتولى رئيس البلدية حكما رئاسة اللجنة .

انّ الرئيس هو الذي يمّثل اللجنة أمام القضاء والهيئات الرسمّية والخاصة وتجاه الغير.

يقوم رئيس اللجنة بتوجيه الدعوات من أجل حضور جلسات الجمعّيات ويترأسها ويديرها.

يتولى نائب رئيس البلدية حكما مهام نيابة الرئاسة.

يتولى__________ مهام امانة السر.

)عبر التعيين او االنتخاب حسب ما تقرره الهيئة العامة في اول اجتماع تعقده(

على الرئيس وامين السر ان يمسكا:

1. الئحة بأسماء اعضاء الهيئة العامة يبّين فيها األقسام التي يملكونها أو يملكون فيها وهويتهم ومحل اقامتهم ووضعيتهم القانونّية والمالّية تجاه اللجنة.
2. ملفات اللجنة والسجالت ومجمل المستندات المتعّلقة بها, وان يحتفظا بنسخ عن جميع االتفاقات والعقود واألوراق الرسمّية والتصاميم وكّل ما هو متعّلق بادارة المنشأة.
3. السجالت التي تحتوي على محاضر االجتماعات واألوراق والقيود المتعّلقة بها.
4. تحفظ جميع هذه الدفاتر والمستندات في مركز اللجنة.

يتولى________ مهام امانة الصندوق.)عبر التعيين او االنتخاب حسب ما تقرره الهيئة العامة في اول اجتماع تعقده(

على الرئيس وامين الصندوق ان يمسكا وينظمان:

1. دفاتر وملفات محاسبة اللجنة بجميع عالقاتها مع الغير وخاصة مع الدولة واالدارات الرسمّية.
2. ينّظمان ميزانّية المصاريف المرتقبة عن كّل سنة قادمة.
3. ينظمان اوراق ومستندات صندوق الصيانة.
4. تحفظ جميع هذه الدفاتر والمستندات والملفات في مركز اللجنة.

- كما يمكن للهيئة االدارية أن تشكل لجان استشارية أو تقنية من أعضاء اللجنة ويمكن االستعانة بتقنيين وإختصاصيين من خارج اعضائها.
- انّ مهمة اعضاء الهيئة هي مّجانّية.
- من الممكن ان تقبل الهيئة االدارية الهبات المادية والمالية على ان يتم عرضها على الهيئة العامة في اول اجتماع تعقده.
- تسجل الهبات فور قبولها في سجالت اللجنة .
- توضع االموال التي تزيد قيمتها عن__________ في احد المصارف المعترف فيها في حساب خاص باسم اللجنة على ان يكون حق التوقيع عليه منوطا بالرئيس وامين الصندوق باالتحاد.

خامساً - اجتماعات الهيئة االدارية:

- تعقد الهيئة االدارية إجتماعاتها الدورية كل شهر بدعوة من الرئيس كما لها ان تعقد اجتماعات استثنائية في حال طلب ذلك 10% من أعضاء الهيئة العامة.

سادساً - حقوق وواجبات اعضاء الهيئة العامة:

- يعفى جميع اعضاء اللجنة من رسوم االشتراك الواردة على الفاتورة في حال كانت الطاقة الموردة من المنشأة على شبكات كهرباء لبنان اقله بحدود 75% من الطاقة المستهلكة منه.
- يتم احتساب الطاقة المستهلكة من كل من اعضاء اللجنة.
- إن أعمال الصيانة هي على عاتق اعضاء اللجنة لذلك يتم انشاء صندوق تجري تغذيته من بدل اشتراك شهري على الشكل التالي:

= تدفع اشتراكات الصيانة وفقا لمقدار حصص كل مشترك في المنشأة. = ان الحد االدنى لكلفة تشغيل وصيانة المنشأة يقدر سنويا بحوالي 3,5 بالمائة من قيمة مجمل استثمار المنشأة.

= يتم لحظ في الموازنة السنوية للمنشاة باب خاص لالعطال الطارئة التي قد تتعرض لها المنشأة.

- كل عضو في اللجنة محددة حصته في هذه المنشأة وفقا لما هو مبين في الجدول)رقم______(ويعتبر مشتركا بمنظومة التعداد الصافي.
- يعتبر حكما مستقيال من عضوية اللجنة كل عضو يفقد شرطا من شروط االنتساب المذكورة في البند الرابع أو باع منزله أو لم يعد يرغب بتجديد إشتراكه في اللجنة.
- على أنه ال يحق للمشترك ان يترك اللجنة اال بعد انتهاء السنة التعاقدية التي تمتد من / / الى / / شرط اعالم الهيئة االدارية للجنة خطيا نيته هذه قبل شهرين من انتهاء السنة التعاقدية.
- ال يمكن ادخال اي عضو جديد الى اللجنة خالل السنة التعاقدية والتي تمتد من / / الى / / شرط اعالم الهيئة االدارية للجنة خطيا نيته بان يصبح عضوا فيها قبل شهرين من بدء السنة التعاقدية.
- اذا كان للقسم او للمنزل الواحد عدة مالكين)حالة الشيوع في ملك ّية القسم أو توزيع الملك ّية بين مالك الرقبة وصاحب حق االنتفاع(, يعتبر جميع هؤالء المالكين مسؤولين بالتكافل والتضامن فيما بينهم عن نصيب القسم او المنزل في مصاريف اعمال الصيانة ويعتبر تبليغ أحدهم بمثابة تبليغ اآلخرين.
- تشمل نفقات الصيانة من دون حصر جميع مصاريف التصليحات المتوجبة على المنشاة.

سابع ًا - اجتماعات الهيئة العامة:

- تعقد الهيئة العامة إجتماعاتها كل ستة أشهر ولها ان تعقد اجتماعات استثنائية اذا طلبت ذلك الهيئة اإلدارية.
- تبلغ الدعوات قبل اسبوع من موعد الجمعية اما مباشرة بواسطة موظف من المجلس البلدي او لصقا على باب القسم.
- ال يعتبر االجتماع قانوني ا ّال بحضور األكثر ّية المطلقة من األعضاء على األقل في الجلسة األولى, ويكون قانوني ًا بمن حضر في الجلسة الالحقة،وتتخذ الهيئة قراراتها باألكثر ّية الحاضرة.
- ال يجوز أن تناقش في الجلسة ا ّال المواضيع المحددة لها, ما لم يوافق الرئيس على بحث المواضيع التي تطرح مباشرة.
- ا ّن القرارات القانونية التي تتخذها الجمعيات تلزم الغائبين والمخالفين والممتنعين عن التصويت.

ثامناً - اعمال صيانة المنشأة:

- تتعاقد الهيئة االدارية مع شركة مختصة الجراء عملية الصيانة الضرورية للمنشأة.
- يبقى للشركة التي تولت تركيب المنشأة االفضلية من اجل القيام بمهام اعمال الصيانة.

تاسعاً - تعديل النظام: يجوز

اللهيئة العامة تعديل هذا النظام بأكثرية ثلثي أعضائها بناء على إقتراح الهيئة اإلدارية شرط أن ال يتعارض هذا التعديل مع اإلتفاقية الموقعة مع مؤسسة كهرباء لبنان.

عاشراً - حل اللجنة:

- تعتبر اللجنة محلولة حكمًا في حال فسخت مؤسسة كهرباء لبنان العقد الموقع معها، او اصبحت المنشأة من دون منفعة تقنية على ان تعود أموالها وممتلكاتها في حال وجدت للبلدية، دون أن يعود ألي من أعضائها بأي حق أو مطلب أو تعويض ناتج عن هذا الحل.

حادي عشر - حل الخالفات: كل

خالف يتعلق بتفسير هذا النظام أو تنفيذه بين أعضاء اللجنة أو بينهم وبين الهيئة االدارية يحل حبيا وفي حال تعذر االمر يتم حل اللجنة شرط اعالم مؤسسة كهرباء لبنان فورا بهذا الجراء.

Annex 9.

Existing Micro-Finance Institutions in Lebanon

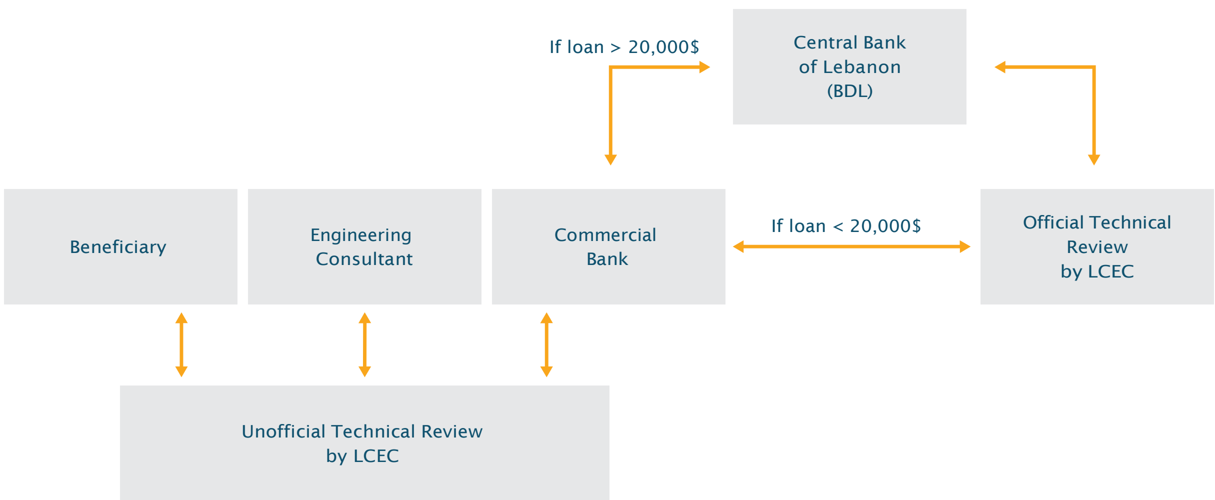
After setting up the Energy Committee and during the detailed study phase, individuals are highly encouraged to consider available options for acquiring the money for their respective shares. Hereafter are available institutions that offer financing options for a committee or for individuals.

A9.1 Energy Committee Financing Options:

A9.1.1 NEEREA

The National Energy Efficiency and Renewable Energy Action (NEEREA), launched in 2010 by the Central Bank of Lebanon, provides commercial banks with incentives to grant loans to finance an Energy Saving or Renewable Energy Project. The loan size can go up to $10M with a repayment period of 14 years. The loan has an effective interest rate of 2.6% with a grace period of up to 4 years. Figure A9.1 here below shows the comprehensive application process.

Figure A9.1 NEEREA application process



Technical Review of NEEREA Loan – LCEC

A 9.1.2 Kafalat Energy

The Kafalat Energy Program extends loan guarantees of 75% to small and medium enterprises to finance renewable energy and energy efficiency projects. The loan is provided by the Lebanese Commercial Banks, the loans can go up to $333k with a repayment period of 15 years. Interest is at a rate of 2.75% on USD currencies and 3.84% on LBP currencies with a 1.5% guarantee fee and a grace period of up to 2 years. Table A9.1 hereafter provides additional information on the available programs.

Table A9.1: Kafalat Energy Program

Name of Programs	Program A - Energy Efficiency	Program B - Renewable Energy generation for internal use	Program C - Renewable Energy generation for sale to third parties
Investment type	To finance the adoption of or conversion to sustainable energy consumption, i.e. to optimize an energy system to consume less	To install a renewable power generation system, and consume the produced electricity for internal use, to replace fossil fuel based electricity	To install a renewable power generation system, with the aim of selling all or part of the produced electricity to others, including the public grid
Maximum loan amount	LBP 500 Million or equivalent in USD	LBP 500 Million or equivalent in USD	LBP 1,320 Million or equivalent in USD
Loan Duration	or equivalent to in USD	Up to 15 years	Up to 15 years
Guarantee	75%	75%	75%
Interest Rate (%)	3%	3%	3%
Grace Period	Between 6 months and 1 year	Between 6 months and 2 years	Between 6 months and 3 years

Eligible applicants are SMEs (Individual, Sole Proprietorship, Simple Partnership, limited liability company (SARL), joint stock company (SAL), Cooperative, NGO) with less than 40 registered employees operating in one of the five subsidized sectors: Industry, Tourism, Agriculture, High Technology and Crafts.

Non Eligible Types of SMEs

In addition to the activities not supported by any of Kafalat's guarantees, SMEs which are not eligible for Kafalat Energy in particular, are:

- Energy Consultants
- Energy Service Companies (ESCO)
- Energy Contractors

These companies are engineering companies specialized in energy, and prepare packages of energy efficiency measures or renewable energy installations for their clients.
They are not eligible for Kafalat Energy themselves, but their clients might be, should they meet the eligibility criteria. Thus the application should be made in the name of the final beneficiary of the loan i.e. their client.

Technical Eligibility

In order to ensure the fund will be used by the most energy beneficial projects, energy savings (Programme A) or renewable energy generation (Programmes B & C) relative to the initial investment will be compared to a benchmark in each technology.

Programmes B & C - Renewable Energy

When submitting to the above programs, the requesting file should include the following information:

1. Current Energy Situation: The report should detail the current sources of energy generation, costs and problems. Supportive documents such as EDL bills and generator/diesel bills must be provided. In addition, the resources of the proposed renewable energy solution must be presented along with all the site constraints.

2. System Design Considerations: The design must be coherent such that equipment sizing, selection and specifications are optimal. All losses must be accounted for, and all electrical connections compliant to applicable standards. This is to ensure a fault free operation, and reduce operation costs.

3. Energy Yield Calculation: The energy yield calculations must be accurately performed with a computer-based calculation tool, and take into consideration all the previously mentioned parameters. If available, commercial or proprietary software should be used. If not available, the calculation steps will be explained and justified in detail. In any case the calculation must include a comparison to a business as usual scenario.

Indicators for files evaluation

1. Key Energy Indicators: The results should emphasize the energy benefits of the project. They could be presented as follows:

- Total energy yield in kWh/year
- Specific energy yield in kWh/kWinstalled
- Performance Ratio (PR) in %
- Overall System Conversion Efficiency in %
- Nominal output current in A
- Nominal output power in kW
- Avoided CO_2 emissions in tons of CO_2. This information is mandatory.

2. Key Financial Indicators: They should be justified by pro-forma invoices, previous energy bills of the facility, and take into account the time value of money.

- Capital cost of all components
- Engineering and Installation costs
- Operation and Maintenance costs
- Savings-to-Investment ratio (SIR)
- Levelised Cost of Energy
- Net Present Value of project

A9.1.3 Kafalat Basic

Kafalat Basic is a loan guarantee program of 75% provided to Lebanese SMEs to finance fixed assets and working capital needs. It is provided by the Lebanese Commercial Banks with a loan size of up to $200k and a repayment period of 7 years. The interest rates that apply to this loan are 3.75% on USD currencies and 3.85% on LPB currencies and a guarantee fee of 2.125%. This loan includes a grace period of 6 month to 1 year.

A 9.1.4 LEEREFF –Lebanon Energy Efficiency & Renewable Energy Finance Facility

The LEEREEF is a EUR 80Million loan provided by the European Investment Bank (Eur 50Million) and Agence Française de Développement (EUR 30Million) supporting small-scale investment in energy efficiency (EE) and renewable energy (RE). LEEREFF aims to finance projects ranging from a minimum of $54,000 of investment to a maximum of $60Million of investment. The total interest rate on a LEEREFF loan will be computed on the basis of the weighted average of the interest rates charged by EIB and AFD plus a margin of 3.75% for the local commercial banks, plus a commission of 0.5 percent for BDL. Then a percentage equivalent to 1.5 times the interest rate on one-year treasury bills in liras will be subtracted from the total interest rate and as a result the final interest paid by the borrower will be close to zero. The local banks will pay the interest to EIB and AFD, while BDL will provide liquidity in liras to the banks equivalent to one and a half times the amount of the loan.

A9.2 Individual Financing Options (micro-finance)

A9.2.1 Emkan

Emkan is a Lebanese financial institution licensed by the Central bank of Lebanon and established by Bank Med in June 2011. Emkan provides micro enterprises, small enterprises and employees with loans starting from LBP 500,000 to LBP 15,000,000. The interest rate ranges from 10% to 13% depending on the value and purpose of the requested loan. Emkan only provides individual loans. For employees the value of the loan cannot exceed 35% of his/her monthly income. Loan terms range from 4 to 48 months based on Emkan's conditions for borrowers and the ability of the borrower to repay the amount approved.

A9.2.2 Vitas

Vitas is a Lebanese microfinance institution licensed and supervised by BDL since 2007. Vitas provides financial products to both business and individuals ranging between $300 and $30,000. The interest rates range from 13-16% depending on the value and the purpose of the requested loan. The repayment period varies from 4 months to 24 months for personal loans and up to 5 years for home improvement loans.

Annex 10.

Template Questionnaire for collection of detailed individual load profile

The sample questionnaire presented herewith allows the energy consultant (s) to collect detailed information in regards to the potential subscribers' load profile for the detailed study (step 5 of the process).

It is recommended that the consultant (s) and / or champion resident (s) complete the survey themselves in the form of the households / institutions visits to facilitate the data collection process, make sure all information are provided and get as accurate information as required (refer to Annex 1 for importance of data collection accuracy).

PERSONAL

1. Which seasons do you use your home?

☐ Fall ☐ Winter ☐ Spring ☐ Summer ☐ All year round

2. How many people are active in the house during?

Fall – Weekdays

__________Early Day (6am – 10am) __________Midday (10am – 2pm)
__________Afternoon (2pm – 6pm) __________Early Night (6pm – 12am)
__________Late Night (12am – 6am)

Holidays

__________Early Day (6am – 10am) __________Midday (10am – 2pm)
__________Afternoon (2pm – 6pm) __________Early Night (6pm – 12am)
__________Late Night (12am – 6am)

Winter – Weekdays

__________Early Day (6am – 10am) __________Midday (10am – 2pm)
__________Afternoon (2pm – 6pm) __________Early Night (6pm – 12am)
__________Late Night (12am – 6am)

Holidays

__________Early Day (6am – 10am) __________Midday (10am – 2pm)
__________Afternoon (2pm – 6pm) __________Early Night (6pm – 12am)
__________Late Night (12am – 6am)

Spring – Weekdays

___________Early Day (6am – 10am) ___________Midday (10am – 2pm)

___________Afternoon (2pm – 6pm) ___________Early Night (6pm – 12am)

___________Late Night (12am – 6am)

Holidays

___________Early Day (6am – 10am) ___________Midday (10am – 2pm)

___________Afternoon (2pm – 6pm) ___________Early Night (6pm – 12am)

___________Late Night (12am – 6am)

Summer – Weekdays

___________Early Day (6am – 10am) ___________Midday (10am – 2pm)

___________Afternoon (2pm – 6pm) ___________Early Night (6pm – 12am)

___________Late Night (12am – 6am)

Holidays

___________Early Day (6am – 10am) ___________Midday (10am – 2pm)

___________Afternoon (2pm – 6pm) ___________Early Night (6pm – 12am)

___________Late Night (12am – 6am)

3. What is the status of your home?

☐ Owned ☐ Rented

4. What do you do in case of blackouts?

☐ Owned Generator ☐ Subscribed to Generator ☐ UPS ☐ APS ☐ Nothing

Other (please specify) ___________

5. Do you have any renewable energy equipment installed in your home? If yes please mention its size.

☐ PV solar panels ___________ ☐ Solar water heating ___________

☐ Wind Turbine ___________ Other (please specify) ___________

6. On average, how much is your electricity bill per month? ___________

7. On average, how much is your generator bill per month? ___________

8. On average, how many hours of electricity black outs do you experience per day ? ___________

9. On average, how many hours is the generator operated per day? ___________

10. What is the total salary income salary for all employed members in the house per year?

☐ < 6,000$ ☐ 6,000 - 12,000$ ☐ 12,000 – 18,000$

☐ 18,000 - 24,000$ ☐ 24,000 – 30,000$ ☐ 30,000 – 36,000$

☐ 36,000 – 42,000$ ☐ 42,000 – 48,000$ ☐ 48,000 – 54,000$

☐ 54,000 – 60,000$ ☐ Prefer not to say

BUILDING

11. What year was your house built?

12. What type of construction is your home?

☐ Wood ☐ Rock/Brick ☐ Stucco Other (please specify) __________

13. Is your home insulated?

☐ Yes ☐ No ☐ I don't know

If Yes: ☐ Walls ☐ Floors ☐ Ceilings

14. What is the total living area of your home (including basement)?__________ m^2

15. How many floors? __________

16. How many windows or glass doors do you have on each side of your home?

__________North __________South __________East __________West

17. How many windows are single pane, double pane or tinted?

__________Single __________Double __________Tinted

18. How would you describe you home in terms of air leakage?

☐ Very Leaky ☐ Average ☐ Very Tight

LIGHTING

19. How many lamps do you use for each type and wattage (indoor and outdoor)?

__________Incandescent (40-75W) __________Incandescent (75-90W)

__________Incandescent (>100W) __________Fluorescent

__________LED (9-14W) __________LED (>14W)

__________Energy Saving Compact Fluorescent Lamp (CFL) (11-18W)

__________CFL (19-26W) __________Incandescent

__________Fluorescent __________LED

__________Energy Saving Compact Fluorescent Lamp (CFL)

SPACE HEATING

20. What type of heating system is installed? Mention how many rooms it heats.

☐ Electric Furnace __________ ☐ Wood Stove __________

☐ Electric Heat Pump __________ ☐ Chimney __________

☐ Electric Baseboard __________ ☐ Oil Furnace __________

☐ Gas Furnace (forced air) __________ ☐ Geothermal Heat Pump __________

☐ Gas Space Heater __________ ☐ Other __________ ☐ None

21. When was the heating system installed? __________

22. **How many days or months do you use your heating system per year?** ___________

23. **At what temperature do you normally set your thermostat for heating?** ___________

WATER HEATING

24. **What is the type of your water heaters? Mention how many units there are next to each type.**

☐ Electric Furnace ______ ☐ Gas ______ ☐ Propane ______
☐ Fuel Oil ______ ☐ Heat Recovery ______ ☐ Solar ______
☐ Other ______ ☐ None

25. **What is the tank size of the water heater?**

☐ Small (<30 gallons or <114 Liters) ☐ Medium (30 - 49 gallons or 115 – 186 Liters)
☐ Large (50 - 69 gallons or 187 – 261 Liters) ☐ X-Large (>70 gallons or >262Liters)

26. **When was it installed?** ________________

27. **What is the thermostat setting of the water heater?**

☐ Warm (<55 C˚) ☐ Hot (55 – 65 C˚) ☐ Very Hot (>65 C˚)

28. **Approximately, how many showers are taken per week in your home?** ___________

29. **On average, what is the length (minutes) of each shower?** ___________

COOLING

30. **What type of cooling system is installed? Mention how many rooms it cools.**

☐ Packaged Central Electric AC _______ ☐ Geothermal Heat Pump _______
☐ Split System Electric AC _______ ☐ Other _______
☐ Packaged Window Unit ______ ☐ None ______ ☐ Fan ______

31. **When the cooling system was installed?** ___________

32. **How many days/months do you use your cooling system per year?** ___________

33. **At what temperature do you normally set your thermostat for cooling?** ___________

APPLIANCES

34. **How many refrigerators and freezers do you have at home? Please mention the power consumption (in Watts) for each unit.** ________________________________

35. **Please fill in the table below for non-constant use appliances**

Appliances	Usage Frequency	Power	For each time, how many minutes used during					Operated on EDL or Generator or both
	Weekly	Watt	Early day	Midday	Afternoon	Early Night	Late Night	
Dishwasher								
Elect. Oven								
Washing Machine								
Dryer								
Microwave								
Pump								
Hair Dryer								
Ceiling Fan								
Coffee maker								
Iron								
TV								
Computer								
Radio								
Video game								
Humidifier								
Blender								
Vacuum cleaner								
Other:								

AWARENESS

36. **Have you considered decreasing your electricity and generator bills?**

☐ Yes ☐ No

37. **Have you ever taken any actions to reduce your energy consumption or utility bills?**

☐ Yes. What ______________________________ ☐ No

38. **Are you aware that using PV would decrease CO2 emissions (pollution) and electricity and/or generator bills?**

☐ Yes ☐ No

39. **Are you willing to pay an upfront costs (#$) to benefit from a PV power plant implemented in your village?**

☐ Yes ☐ No

Any other comments the respondents would like to add?

Annex 11.

General Legal and Administrative Bidding Recommendation and Evaluation Criteria

Data	Specific Instructions / Requirements
Title of Goods/Services/Work Required:	Supply and Installation of a _________ Power Plant consisting of _________ (ex: PV generator and different mounting structures, inverters, hybrid PV controller (fuel reduction device)), data logger, and auxiliary equipment and the provision of training and documentation on the operation and maintenance of the installed systems, in _______ in Lebanon as follows: Site: Village, Kaza
Language of the Bid	English
Site Visits	Interested bidders for site visit should confirm their attendance including the name of one representative only by email on or before ___________(two weeks after invitation to bid publishing) to the following email address: E-mail: ____ *(consultant's email and committee's president's email)*
Period of Bid Validity commencing on the submission date	Minimum 6 months
Advanced Payment upon signing of contract	Not allowed
Performance Security	Required Amount: 10% of Contract Value (actual quoted value) Form: See Enclosed Section 1- Form for Performance Security
Preferred Currency of Bid	United States Dollars (US$)
Deadline for submitting requests for clarifications/ questions	Five (5) working days before the submission date.
Contact Details for submitting clarifications/questions	Focal Person: Consultant Address: Committee's headquarters Fax No.: +961 ______________ E-mail address dedicated for this purpose: ____ *(consultant's email and committee's president's email)*
Bid submission address	Municipality [Address] ____
Bid submission method	hard and soft copies
Deadline of Bid Submission	Date and Time: ______________(one month after ITB's publishing) Beirut Local Time

Evaluation method to be used in selecting the most responsive Bid	• Non-Discretionary "Pass/Fail" Criteria on the Technical Requirements, and • Lowest price offer of technically qualified/responsive Bid
Required Documents that must be Submitted to Establish Qualification of Bidders (In "Certified True Copy" form only)	• Company Profile, which should not exceed fifteen (15) pages, including printed brochures and product catalogues relevant to the goods/services being procured • Members of the Governing Board and their Designations duly certified by the Corporate Secretary, or its equivalent document if Bidder is not a corporation • Tax Registration/Payment Certificate issued by the Internal Revenue Authority evidencing that the Bidder is updated with its tax payment obligations, or Certificate of Tax exemption, if any such privilege is enjoyed by the Bidder • Certificate of Registration of the business, including Articles of Incorporation, or equivalent document if Bidder is not a corporation • Trade name registration papers, if applicable • Local Government permit to locate and operate in the current location of office or factory • Official Letter of Appointment as local representative, if Bidder is submitting a Bid in behalf of an entity located outside the country • Quality Certificate (e.g., ISO, etc.) and/or other similar certificates, accreditations, awards and citations received by the Bidder, if any • Environmental Compliance Certificates, Accreditations, Markings/Labels, and other evidences of the Bidder's practices which contributes to the ecological sustainability and reduction of adverse environmental impact (e.g., use of non-toxic substances, recycled raw materials, energy-efficient equipment, reduced carbon emission, etc.), either in its business practices or in the goods it manufactures, if any • Plan and details of manufacturing capacity, if Bidder is a manufacturer of the goods to be supplied • Certification or authorization to act as Agent in behalf of the Manufacturer, or Power of Attorney, if bidder is not a manufacturer • Latest Audited Financial Statement (Income Statement and Balance Sheet) including Auditor's Report for the past Two (2) years • Statement of Satisfactory Performance from the Top Five (5) Clients in terms of Contract Value the past Three (3) years. • All information regarding any past and current litigation during the last three (3) years, in which the bidder is involved, indicating the parties concerned, the subject of the litigation, the amounts involved, and the final resolution if already concluded.
Other documents that must be Submitted to Establish Eligibility	• VAT Registration Certificate (if applicable) • Statement of warranty • Power of Attorney for Joint Venture/ Consortium (See enclosed section 2 – Joint Venture Partner information form) • Detailed method statement for implementation with the requested timeframe and a detailed work plan that reflects a clear strategy for works implementation • Preliminary schedule based on the duration set in the work plan indicating clearly the main activities duration, resources, with clear allocations of labor, material and equipment resources versus the quantities of works to be executed in accordance with the programme of works • Organogram reflecting the structure of the team (including number of staff) who will be implementing and monitoring the required works and services as well as CVs of the team leader, key personnel, engineers, field staff, technicians, etc… • Proven track record with details, specifications and pictures of completed renewable energy projects in Lebanon of a minimum of one 100 kWp Hybrid PV systems for PV installations implemented in the past 2 years • Minimum of 3 years of experience in similar contracts within the renewable energy field (mainly solar photovoltaic systems, other than solar-powered street lighting, wind systems, waste treatment systems, etc…), for the implementing local entity.
Latest Expected date for commencement of Contract	Upon Contract Signature

Maximum Expected duration of contract	The overall term of execution is spread over Five (5) to Eight (8) months, effective from contract signature date.
The contract will be awarded to	One (1) Bidder, depending on the following factors: • Lowest price offer of technically qualified/responsive Bid, and • A result of Pass on all the Non-Discretionary "Pass/Fail" Criteria on the Technical Requirements
Criteria for the Award and Evaluation of Bid	Award Criteria • Non-discretionary "Pass" or "Fail" rating on the detailed contents of the Schedule of Requirements and Technical Specifications • Compliance on the following qualification requirements: Bid Evaluation Criteria • Demonstrated ability to honour important responsibilities and liabilities allocated to Supplier in this bid (e.g. financial, performance guarantees, warranties, or insurance coverage, etc…) • The time schedule for design, supply, transportation, installation, commissioning, documents and training complies with the deadlines set in the bid. • Similar Projects reference list showing experience of the Offeror; Minimum of 3 years of experience in similar contracts within the renewable energy field (mainly solar photovoltaic systems, other than solar-powered street lighting) for the implementing local entity. • Proof of the successful operation in similar environmental and climatic conditions for at least 3 years for the main system's components (at least 1 year for the fuel reduction device for the PV systems). • Proof of successful implementation of a minimum of one Hybrid Solar PV/ Diesel project undertaken over the past 2 years of a minimum capacity of 100 kWp (in one project at least), completed in Lebanon, for the implementing local entity. • Proof of after-sales service capacity and appropriateness, experience and capability of local service and technical support available. • The Organization and Methodology approach proposed for this Contract has the necessary general management skills and team composition of the organizational units for a project of this kind. • The CVs of the Key Staff (specialized engineers -renewable energy engineers- are required, technicians and/or skilled workers proposed for the main tasks have the qualifications and experience in the installation of hybrid photovoltaic power plants; the Offeror's local implementing team should comprise at least 1 senior engineer with minimum 3 years of experience in the design and implementation of solar PV systems (other than solar-powered street lighting) with at least 1 year in Hybrid PV design, and at least 1 junior engineer with minimum 1 years of experience in PV systems, as well as technicians with proven record in PV systems' implementation. • The technical description of equipment and preliminary design comply with the requirements of design, performance and size of the bid. • Datasheets, Catalogues and Certificates of conformity of the main components (PV modules, wind turbines, mounting structures, inverters, fuel reduction device, and other components) meet or exceed the requirements of this bid and relevant international performance standards. • Authorization by the main goods' manufacturers of all components to Bidder offering to supply the goods in the country of final destination. Not required for the goods which the Bidder manufactures. • The statement of warranty of defects in materials and workmanship and operation and performance guarantee backed by the manufacturers' guarantee on all the main components and the entire system, meets or exceeds the required periods.

Section 1: FORM FOR PERFORMANCE SECURITY

Template available on the CD provided with this booklet

(This must be finalized using the official letterhead of the Issuing Bank. Except for indicated fields, no changes may be made in this template.)

To: *Municipality* ______________________________

[Insert contact information of Committee president]

WHEREAS *[name and address of Contractor]* ___________________________(hereinafter called "the Contractor") has undertaken, in pursuance of Contract No.___________________ dated ______________, to deliver the goods and execute related services ______________ (hereinafter called "the Contract"):

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with his obligations in accordance with the Contract:

AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee:

NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you, on behalf of the Contractor, up to a total of *[amount of guarantee] [in words and numbers]* ______________________________, such sum being payable in the types and proportions of currencies in which the Contract Price is payable, and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of *[amount of guarantee as aforesaid]* __________without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

This guarantee shall be valid until a date 30 days from the expiry of the system's performance guarantee provided by the Contractor (2 years after commissioning).

SIGNATURE AND SEAL OF THE GUARANTOR BANK

Date ______________________________________

Name of Bank ________________________________

Address _____________________________________

Joint Venture Partner Information Form *(if Registered)*

Template available on CD provided with this booklet

Date: ________________ *(as day, month and year) of Bid Submission*

1. Bidder's Legal Name: ______________________________
2. JV's Party legal name: ______________________________
3. JV's Party Country of Registration: ____________________
4. Year of Registration: ______________________________
5. Countries of Operation ______________________________
6. No. of staff in each Country ________________________
7. Years of Operation in each Country ___________________
8. Legal Address/es in Country/ies of Registration/Operation:
9. Value and Description of Top three (3) Biggest Contract for the past five (5) years
10. Latest Credit Rating (if any): ______________________
11. Brief description of litigation history (disputes, arbitration, claims, etc.), indicating current status and outcomes, if already resolved.

____

____

____

12. JV's Party Authorized Representative Information

Name: ______________________________

[insert name of JV's Party authorized representative]

Address: ______________________________

[insert address of JV's Party authorized representative]

Telephone/Fax numbers: ______________________________

[insert telephone/fax numbers of JV's Party authorized representative]

Email Address: ______________________________

[insert email address of JV's Party authorized representative]

Attached are copies of original documents of:

[check the box(es) of the attached original documents]

☐ All eligibility document requirements listed in the Data Sheet

☐ Articles of Incorporation or Registration of firm named in 2.

☐ In case of government owned entity, documents establishing legal and financial autonomy and compliance with commercial law.

Annex 12.

Agreement Contract between EDL and the Energy Committee

Template available on the CD provided with this booklet

اتفاقية خاصة بمشتركي ومنتجي الطاقة المتجددة عبر اشتراك التعداد الصافي الجماعي

الفريق األول: مؤسسة كهرباء لبنان – ممثلة بشخص رئيس مجلس االدارة – المدير العام المهندس كمال الحايك.

الفريق الثاني: مجموع المشتركين لدى مؤسسة كهرباء لبنان والوارد اسماؤهم وارقام اشتراكاتهم وشعبهم وعناوينهم في الجداول المرفقة بهذه االتفاقية الممثلين باللجنة المصادق عليها لدى كاتب العدل ___________ والتي يرأسها ____________________ السيد ____________________.

لما كان الفريق االول - مؤسسة كهرباء لبنان – لها الحق الحصري بإنتاج ونقل وتوزيع التيار الكهربائي وفقاً للقوانين واألنظمة السارية المفعول،

وباعتبار ان القوانين واألنظمة النافذة تجيز للمواطنين إنتاج الطاقة الكهربائية الستهالكهم الخاص، واستناداً الى قرار مجلس االدارة

رقم 318-32/2011 تاريخ 4/7/2011 المصادق عليه من وزارة الطاقة والمياه بكتابها رقم 1706/7ص تاريخ 16/8/2011 وموافقة وزارة المالية على القرار بكتابها رقم 854/ 16ص تاريخ 9/11/2011 لمدة سنة واحدة قابلة للتجديد بعد الحصول على المصادقات المطلوبة،

وبما ان وزارة المالية بكتابها رقم 116/ص16 تاريخ 26/2/2016 قد وافقت على تجديد العمل بمنظومة التعداد الصافي لمدة سنة واحدة على أن يتم اعداد دراسة بنتائج المشروع والجدوى التي تحققت منه لناحية الطاقة الكهربائي التي ستوضع على الشبكة،

وسنداً لقرار مجلس ادارة مؤسسة كهرباء لبنان رقم 345-25/2016 تاريخ 26/5/2016 القاضي في البندين «أولاً» و«ثانياً» منه ما يلي:

أولاً الموافقة على معاملة المشتركين الذين يرغبون باالستفادة من المنشأة)مزرعة الطاقة المتجددة(اسوة بمشتركي التعداد الصافي ووفق ذات اآللية المتبعة والمنصوص عنها في قرار مجلس االدارة رقم 318-32/2011 تاريخ 4/7/2011.

ثانيا: عرض البند – أولً- على مصادقة وزارة الطاقة والمياه وموافقة وزارة المالية.

وبعدما صادقت وزارة الطاقة والمياه على البند »أولً« من قرار مجلس االدارة رقم 345-25/2016 تاريخ 26/5/2016 بموجب كتابها رقم 1772/7ص تاريخ 23/6/2016،

وبما أن المهلة القانونية للمصادقة على البند »اولً« من قرار مجلس االدارة المنوه عنه اعاله من قبل وزارة المالية والمنصوص عنها في المادة 29 من المرسوم رقم 4517 تاريخ 13/12/1972 المحددة بشهر من تاريخ التبليغ الحاصل____________ ب 11/6/2016 قد انقضت عند نهاية الدوام الرسمي بتاريخ
12/7/2016 دون ورود أي جواب من هذه الوزارة،

وحيث انه سنداً ألحكام المادة 29 من المرسوم رقم 4517 تاريخ 13/12/1972، يعتبر البند اولً من قرار مجلس االدارة رقم 345-25/2016 تاريخ 26/5/2016 مصدقاً حكماً من قبل وزارة المالية،

بناء على ما تقدم، وبما

ان الفريق الثاني يستفيد من مزرعة الطاقة المتجددة المتجددة)الطاقة الشمسية وطاقة الرياح والنفايات ...(المنوي انشاؤها في بلدة____________ الواقعة في محافظة____________ قضاء__________ ، بحيث ان كل مشترك محددة حصته في هذه المنشأة)المزرعة(وفقاً لما هو مبين في الجدول رقم__________ ، ويرغب في االشتراك بمنظومة التعداد الصافي
)NET METERING(،

وبما ان انتاج المزرعة من الطاقة الكهربائية سوف يقسم على مجموع المشتركين وفق الحصة المحددة لكل واحد منهم وعلى ان تعتبر هذه الحصة بمثابة الطاقة الموردة منهم على شبكة المؤسسة،

وبما أن الفريق الثاني سيقوم بشراء وتركيب العدادات االلكترونية المناسبة على نفقته الخاصة لكل مشترك بحيث يتم ربطها بآلة الكترونية تقوم بقراءة تأشيرات الطاقة المستهلكة لكل مشترك على حدة والطاقة المصدرة الى الشبكة من العداد الدقيق، وسيتم توزيع الطاقة المصدرة لكل مشترك على حدة بواسطة
برنامج ووفق النسب المخصصة لكل مشترك،

وباعتبار ان الفريق األول قد اجاز للفريق الثاني ربط تجهيزاته المتعلقة بانتاج التيار الكهربائي عبر الطاقات المتجددة من مصادر الهواء أو الشمس او النفايات... بشبكاته،

لذلك، تم االتفاق بالرضى الكامل بين الفريقين على ما يلي:

أولً يتكفل الفريق الثاني بتركيب عدادات تسجل كامل الكميات المستهلكة من قبله وتلك التي يجري ضخها على شبكات المؤسسة، وتصدر الفواتير بفرق المقطوعية كل شهرين وفقاً لألآلية المنصوص عليها في قرار مجلس االدارة 318-32/2011 تاريخ 4/7/2011.

- ان االنشاءات والتجهيزات االلزمة لالشتراكات العائدة لمشتركي منظومة التعداد الصافي)NET METER-ING( )الفريق الثاني(بما فيها العدادات االلكترونية التي سيتكفل بتركيبها تصبح ملكاً للفريق الول نهائياً اعتباراً من تاريخ تركيبها باستثناء مزرعة الطاقة المتجددة)المنشأة(المنوي انشاؤها.

- يقتضي على الفريق الثاني تزويد الفريق االول بعً ينة من العدادات االلكترونية التي سيجري تركيبها وذلك
لإجراء الفحوصات الالازمة عليها والتأكد من مدى مطابقتها للمواصفات الفنية المعتمدة لدى الفريق االول.

ثانيًا: يعفى الفريق الثاني من رسوم االشتراك الواردة على الفاتورة في حال كانت الطاقة الموردة منه على
شبكات الفريق االول اقله بحدود 75% من الطاقة المستهلكة منه.

ثالثًا: يتم احتساب كل من الطاقة المستهلكة من الفريق الثاني والطاقة الموردة منه وفق تعرفات مبيع
الطاقة المعمول بها لدى الفريق االول أي:
1- تعرفات الشطور لمشتركي التوتر المنخفض.
2- تعرفات وفق اوقات االستهالك لمشتركي المحطات الخاصة.

رابعًا: في حال زادت كميات الطاقة المنتجة من قبل الفريق الثاني عن تلك المستهلكة منه يتم تدوير الرصيد الى الفاتورة التالية على أن
يُصفى الفائض في نهاية كل سنة ميالدية ويسجل هذا الفائض في
السجالت الحسابية كهبة، وبالتالي ال يمكن للفريق الثاني االستفادة من هذا الفائض في السنة التالية.

خامسًا: يبقى للفريق االول الحق بتحديد وتعديل الشروط والمواصفات الفنية والتقنية للتجهيزات المطلوبة من الفريق الثاني تأمينها وذلك فيما
يتعلق بطريقة الربط والتعداد والتعرفة. على ان يتولى الفريق االول
اخطار الفريق الثاني بذلك قبل شهر واحد.

سادسًا: يخضع الفريق الثاني لألنظمة السارية في المؤسسة والتي لها منفردة الحق بتعديلها.

سابعًا: عند تشغيل المنشأة وربطها بالشبكة العامة ال يمكن بأية حال من االحوال حذف أو إضافة أي مشترك ضمن هذه المنظومة خالل السنة المالية التي تبدأ في أول كانون الثاني وتنتهي في 31 كانون االول. على أنه يتوجب على اللجنة التي تمثل مجموع المشتركين بمنظومة التعداد الصافي ايداع الفريق االول جدولًا جديدًا في كل عام وذلك قبل شهرين من انتهاء السنة المالية المحددة اعاله يتضمن اسماء المشتركين الذين يرغبون باالستفادة من هذه المنظومة المذكورة، وعلى أن يتم االشارة فيه الى اسماء
المشتركين الذين يمت اضافتهم او حذفهم.

ثامنًا: يجوز للفريق االول وبإرادته المنفردة ان يفسح العقد الموقع مع الفريق الثاني في حال عدم القيام بتشغيل المنشأة)مزرعة الطاقة المتجددة(المنوي انشاؤها، دون أن يعود للفريق الثاني المطالبة بأي حق أو مطلب أو تعويض بهذا الخصوص على أن يسبق هذا االجراء
انذار يوجه من الفريق االول للفريق الثاني
تحدد مدته بثالثين يومًا تمكينًا له من معالجة الموضوع.

تاسعًا: تقع اعمال الصيانة على عاتق الفريق الثاني، وبالتالي ال يتحمل الفريق االول أية مسؤولية تجاه
االعطال التي قد تطرأ على المنشأة أو أية اضرار قد تحدث والتي من شأنها التأثير على السالمة العامة، ويبقى للفريق االول الحق في
إجراء الكشوفات الدورية للتأكد من أن أعمال الصيانة تتم وفقًا لألصول
السيما في ما يتعلق منها بصيانة اجهزة التعداد.

عاشرًا: يتوجب على الفريق الثاني تركيب اجهزة حماية كافية وملائمة لتجهيزاته وأماكن اشتراكه لدرء االخطار التي يمكن ان تحدث من جراء هذا الربط، وان المؤسسة في حل من اي مسؤولية او مطالبة بأي عطل أو ضرر.

حادي عشرة: يعود للفريق االول حصريًا االستفادة من عائدات بيع الكاربون الناتج عن تخفيض انبعاثات غازات الدفيئة المتولدة عن تنفيذ مشاريع الطاقة المتجددة.

ثاني عشرة: يجيز الفريق الثاني للفريق االول مراقبة االجهزة المركبة في أي وقت يشاء ويقتضي عليه الحفاظ عليها من أي ضرر او تلف.

ثالث عشرة: يتعهد الفريق الثاني بأن يدفع الفاتورة المتضمنة فرق المقطوعيات التي سجلها العداد حسب التعرفات المرعية اإلجراء وذلك في موقع تسليم الطاقة ولدى تقديم اإليصال المعتمد من قبل مستخدمي الفريق االول.

رابع عشرة: اذا تمنع احد المشتركين بمنظومة التعداد الصافي عن تسديد الفاتورة التي تقدم اليه، يحق للفريق االول اللجوء الى كافة الوسائل القانونية والنظامية الستيفاء المبالغ المرتبة له دون ان يؤثر ذلك على عمل ونشاط المنشأة، كما يحق للفريق االول شطب هذا المشترك المتخلف عن الدفع من الجداول المرفقة وبالتالي عدم تمكينه من االستفادة من منظومة التعداد الصافي.

خامس عشرة: يحق للفريق الثاني التقدم بطلب لتعديل هذه االتفاقية، على أنه يعود بالمقابل للفريق االول النظر بهذا الطلب وتقرير المناسب بشأنه بما ال يتعارض مع أنظمته والقرارات الصادرة المتعلقة بهذه االتفاقية ذات الصلة.

سادس عشرة: حررت هذه االتفاقية على نسختين اصليتين بيد كل طرف نسخة منها للعمل بموجبها ووقع من قبل الفريقين.

الفريق االول: ______________ الفريق الثاني: ______________

مؤسسة كهرباء لبنان رئيس
مجلس االدارة –
المدير العام
المهندس كمال الحايك

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PART TWO

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