# BLOCKCHAIN-ENABLED SOLUTIONS FOR THE UPTAKE OF RENEWABLES ENERGY IN LEBANON

*- January 2020 -*

This report builds on the existing and prior reports written up within and in cooperation with UNDP-Lebanon and in the context of the Lebanese market and social-cultural environment, (2014, 2016, 2018) and with the objective to increase the dissemination of Renewable Energy technologies across Lebanon and to a further extent in the Middle East region. This report also builds on the technical developments in the Blockchain space and specifically Blockchain-energy applications and is a non-exhaustive review of existing applications in the energy sector. It covers inter alia incentives, P2P energy trading, Microgrid applications and how to deploying these in the context of Lebanon. The intent is to theoretically validate the currently existing and deployed applications in the Blockchain energy space and which would be of use in the context of the Lebanese energy market and to a further extent allowing for rapid upscaling of renewables in Lebanon and the region. It should serve as a guide for policy and regulation to Governments interested in the deployment of such technologies in the region.


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# 1. INTRODUCTION

## 1.1 BLOCKCHAIN-ENABLED SOLUTIONS FOR RENEWABLE ENERGY IN LEBANON

The situation of Lebanese Electricity sector is alarming and placing a heavy burden on the national economy due to its inefficiencies. With electricity tariffs heavily subsidized, these expenses substantially contribute to the country's national debt through the financial deficit of the state-owned power utility Electricité Du Liban (EDL). This situation has been exacerbated with the continuous influx of refugees in the wake of the Syrian crisis. Since EDL is still unable to provide 24/7 electricity supply, citizens and companies are forced to use pollutive and expensive private generator to cope with 3 to 12 hours of downtime each day.

While the necessary reform of electricity sector is yet to be implemented, the Government of Lebanon (GoL) has tackled renewable energy by establishing the national financial mechanism called NEEREA (the National Energy Efficiency and Renewable Energy Action) and subsequently opening up the energy market to net-metering, resulting in the significant growth of private investment in the renewable energy sector. The GoL targets over 12% Renewable Energy by 2020 and 30% by 2030 (National Energy Efficiency Action Plan (NEEAP))[1]. However, as of the end of 2018, aggregated solar PV installation represents only 56MWp, delivering 80 GWh a year in a grid running at 15 TWh annually[2]. Renewable Energies (<4%), and Solar (<1%) represent therefore just a fraction of total energy consumption in a country where energy dependency is high. With over 95% of electricity needs derived from imports of oil derivatives (fuel oil, diesel oil…), this leaves Lebanon prone to external factors, a barrier to economic development. The lagging behind the national target clearly indicates more needs in promoting renewables.

In the context of Lebanon, distributed renewable energy has significant economic, environmental, and social benefits, specifically:

- Allowing for the reduction of Lebanon's dependence on fuel imports;

- Promoting money circulation within the country and inducing an immediate and long-lasting annual net benefit on national economy with a multiplier effect on GDP growth;

- Creating employment opportunities along renewable energy value chain[3].

Considering these multi-fold benefits, the UNDP has undertaken system-wide value chain assessment of renewable energy to identify necessary interventions to strengthen renewable energy value chain and to capture the employment opportunities[4]. Among its recommendations, promotion of research and development in the sector along with pilot projects has been identified as a key bottom-up and actionable intervention. In addition, the promotion of companies that

[1] Ministry of Energy and Water & LCEC (2016), The National Renewable Energy Action Plan for the Republic of Lebanon 2016-2020
[2] UNDP (2018), 2017 Solar PV Status Report for Lebanon
[3] UNDP (2018). Renewable Energy Sector in Lebanon – Value Chain Assessment and Analysis
[4] Interview - Hesse, Ewald, CEO GSy and Cofounder Energy Web Foundation (EWF), Berlin, 02.09.2019 and 03.09.2019

work on hybrid renewable energy systems was also recommended because Lebanon may even be well positioned to play a role on an international level in the unique area of hybrid renewable system.

In light of these recommendations, UNDP has initiated the exploration of blockchain-based solutions for the renewable energy sector in Lebanon. Blockchain technology has been globally discussed in all matters of circles and is well documented with today all sectors of industry tackling the digital transformation of their business activities. It is now overall recognized that **blockchain** also known as Distributed Ledger Technology (DLT) **is a tool for tackling governance issues, tamperproof recording of events, contracts and other digital material, and traceability and ownership of assets as well as trust free peer to peer transactions** among other benefits.

The value proposition of blockchain-based solution is based on its decentralized, immutable, transparent and verifiable nature. As opposed to centralized or cloud-based solutions, blockchain technology brings significant advantages on bridging and solving:

1) **Data security:** because the data is recorded and available to multiple peers, the larger the network the less "hackable" the data and its blockchain become (i.e. data security is inherent to blockchain technology),

2) **Traceability & Transparency:** all transactions are available to the network so that the Ledger is kept as a transparent record and can be viewable under a blockchain explorer. It is immutable and resilient,

3) **Cost:** recording data on newer blockchains (POS, POA and newer algorithms etc.) will give blockchain technology an interesting cost-perspective.

As of late 2019, up to **200 blockchain-based business models**[5] have been identified in the energy sector, among which the most compelling use cases of blockchain in the energy sector evolve around:

**- Grid-connected and island microgrid applications,**

**- Peer to peer energy trading (P2P),**

**- Grid balancing and load optimization and battery storage,**

**- Data collection at the grid-edge level,**

**- Digital currencies & incentives**[6]**.**

Aiming at the quick development in Lebanon, rather than theoretical research, the study has first identified real-world applications and development of commercial-size blockchain-based energy business models through online reaches, interviews and the collection of working use-cases from the fast evolving blockchain space. Taking into the specific context of Lebanon, the study has identified suitable blockchain-enable solutions for the uptake of renewable energy in relatively short-term as well as the set of recommendations for deployment. To practically serve for business developer, energy-related companies and policy-makers that might be interested in the blockchain-enabled applications, **Deploying Blockchain-Enabled Energy Solutions** will be the focus of this report, which aims to map a clear procedure in the context of Lebanon.

[5] Interview - Hesse, Ewald, CEO GSy and Cofounder Energy Web Foundation (EWF), Berlin, 02.09.2019 and 03.09.2019
[6] UN Environment Enquiry, "Digital Finance and Citizen Action", ANNEX II: Examples of Distributed Energy Markets, Including P2P Trading, Carbon Product Trading, Microgrids and Virtual Plants, Page 44, February 2019 and Event Horizon Report,Energy Web Foundation, 2019

## 1.2 METHODOLOGY

For the identification of suitable blockchain-enabled solutions for the uptake of renewables, it was taken account the local context of Lebanon such as the legislative framework, the monopoly of electricity generation, transmission and distribution by the state-owned utility company EDL as well as its financial and technical capacity. The focus of the recommended solutions is naturally articulated around the most scalable and impactful projects available for deployment in limited timeframe.

This report provides an in-depth roadmap for applying the most consumer-oriented blockchain energy-applications as well as those projects that would facilitate grid operation and specifically focuses on blockchain technology as a means to unlock the investment in renewable energy by providing the following specific values:

- Prosumer inclusion and market participation,

- Financial innovation and private-public partnership (co-operatives) participation,

- Grid operability, balancing and energy storage solutions,

- Increasing renewable energy access, including to remote communities.

In this context, the report outlines procedures for implementing:

- SolarCoin digital asset with solar power producers **(Project A)**

- SunExchange business model through Public-Private Partnership **(Project B)**,

- Energy blockchain solutions provided by platforms such as LO3 Energy, Grid Singularity and PowerLedger applied to grid connected/island microgrids and-or a neighborhood using Smart-Meter data collection **(Project C)**,

- tLiquidStare batteries on the Go for powering remote communities **(Project D)**

For each project, the advantages and benefits of the proposed solutions are also described.

# 2.
# APPLYING BLOCKCHAIN-ENABLED ENERGY SOLUTIONS IN THE CONTEXT OF LEBANON

## 2.1. DIGITAL CURRENCIES: PROSUMER INCLUSION (PROJECT A)

In the context of Prosumer incentivization and market participation, cryptocurrencies such as Solar Coin are focused on community and financial inclusion. The coin can be considered a **"Digital Asset"** (a cryptocurrency) which goal it is to create positive externalities in rewarding solar energy producers throughout the world for their participation in producing solar energy and build a network of participants of this currency. Hence, instead of having a Gold-backed or Debt-backed currency (USD, EUR), or Server/POWmining-backed currency (BTC, ETH...), SolarCoin pegs its mechanism of currency distribution to the MWh of solar power produced. By distribution digital coins to solar power producers in Lebanon and creating nodes, the social and economic utility of this new currency can build up and create transactional value for the community using it. Coins are given for free and have the advantage that it can be easily deployed with online, desktop and smartphone application in matter of minutes. Any solar participant can apply by following the procedure on how to file a claim for Solar Coins.

### PROCESS FOR CLAIMING SOLAR COINS – STEPS

**1.** Downloading the SolarCoin Wallet at www.solarcoin.org under three formats:

**a.** Plug and play digital solutions:

**i.** Desktop Solar Coin Wallet available under Windows and Apple formats: similar to an online bank account interface, the wallet stakes at a 2% compile yearly interest rate and allows to participate in the Solar Coin Network and validate the transactions in the Blockchain,

**ii.** Smartphone app: Both Google and Android and Apple users can doenload the lightweight wallet available on the app store.

Additionally, solar monitoring platforms such as the World´s number 1 SMA Sunny Portal can embed the open-source Solar Coin API to their monitoring dashboard and requires little IT infrastructure for maintenance and operation. Solar Coin has also been introduced to the main Solar Industry Monitoring and Inverter companies and any Solar Asset Manager or solar IPP such as ACWAPOWER in the Middle-East can participate in the project and claim their Solar Coins.

**b.** Offline solution:
i. Paper wallet (for offline/un-hackable security features) – note: useability and interaction with the Network is low as the Waalet Address would have to be transferred to an online account in order to transfer any Solar Coin amount,

**2.** Manual claiming
Any solar power producer may file a claim directly at claims.solarcoin.org by providing ID and paper/scanned documentation validating the ownership and grid connection status of the solar installation. The required documents and process are explained in detail hereafter:

**Step 1: Creating a Solar Coin Account**
Process for onboarding of monitoring platform, solar installer or individual solar owner:

**Step 2: Registering a solar facility**
Registering the solar installation facility by providing grid connection documentation and-or third-party (private or public entity) certified installation documentation, address of the installation.

## ADVANTAGES & BENEFITS OF THE PROPOSED SOLUTION

The entire process is a **5 minute setup with immediate scalable impact** and is available to anyone with an internet connection. This will give an easy chance to Lebanese participants to trial and test existing Blockchain solutions and obtain their first digital asset. In the long run, while **SolarCoin could become a defacto currency,** it could also become a **Universal Basic Income for solar power producers** simply by "mining" SolarCoin from their Solar Installations in Lebanon as SolarCoin is distributed for each MWh of solar power produced, for as long as the solar installation is operating.

This business model allows for:

- SolarPower producers can get a higher IRR for their solar investment,

- SolarCoin is a Digital Currency, like Bitcoin it can be used to pay for/purchase goods and services,

- A key challenge in scaling SolarCoin and its value resides in Network Growth and market awareness inside and outside the solar industry. Regulators and Policy Advocates in the Solar Industry should embrace a favorable context for Digital Assets and Digital Currencies

## 2.2. FINANCIAL INNOVATION: NEW BUSINESS MODELS (PROJECT B)

Innovative crowd-funding through Bitcoin and other digital assets that effectively allows "anyone in the world to co-finance and/or co-won a solar installation itself operating anywhere in the world"[7].

The platform allows market participation in the operation and co-ownership of a fraction of a solar installation and reap the benefits for the energy produced by the facility. The business model of SunExchange one of the leading platforms that facilitate these transactions and operating from South Africa respect local development and regulations and administrative requirements for the installation and the long-term operation of the plant. The procedure of running the SunExchange Alternative financing platform in the Lebanese context is explained in details hereafter:

At its core, the SunExchange Business Model is similar to that of a Solar Developer/ EPC contractor.

### PROCESS FOR SETTING UP A CROWD-FUNDING SOLAR PROJECT

- Locating a suitable site/rooftop for deploying the solar installation,

- Establishing a local entity (ie company/SPV) for running the solar project,

- Obtaining a lease agreement for the rooftop/land,

- Establishing a PPA with in this case EDL in Lebanon for off-taking the solar electricity produced from the installation,

- Financing the solar installation,

- Building, operating and owning (BOO) the solar installation during the term of the PPA.

What differs in the financing mechanism of such renewable energy installations is that the Investment Vehicle are effectively Bitcoin and other digital assets accepted by SunExchange (Ethereum...). Any participant regardless of jurisdiction may participate in the financing of the solar installation *"down to the size of a solar cell"* [8] Abraham Cambridge, CEO SunExchange. The financing process is straightforward:

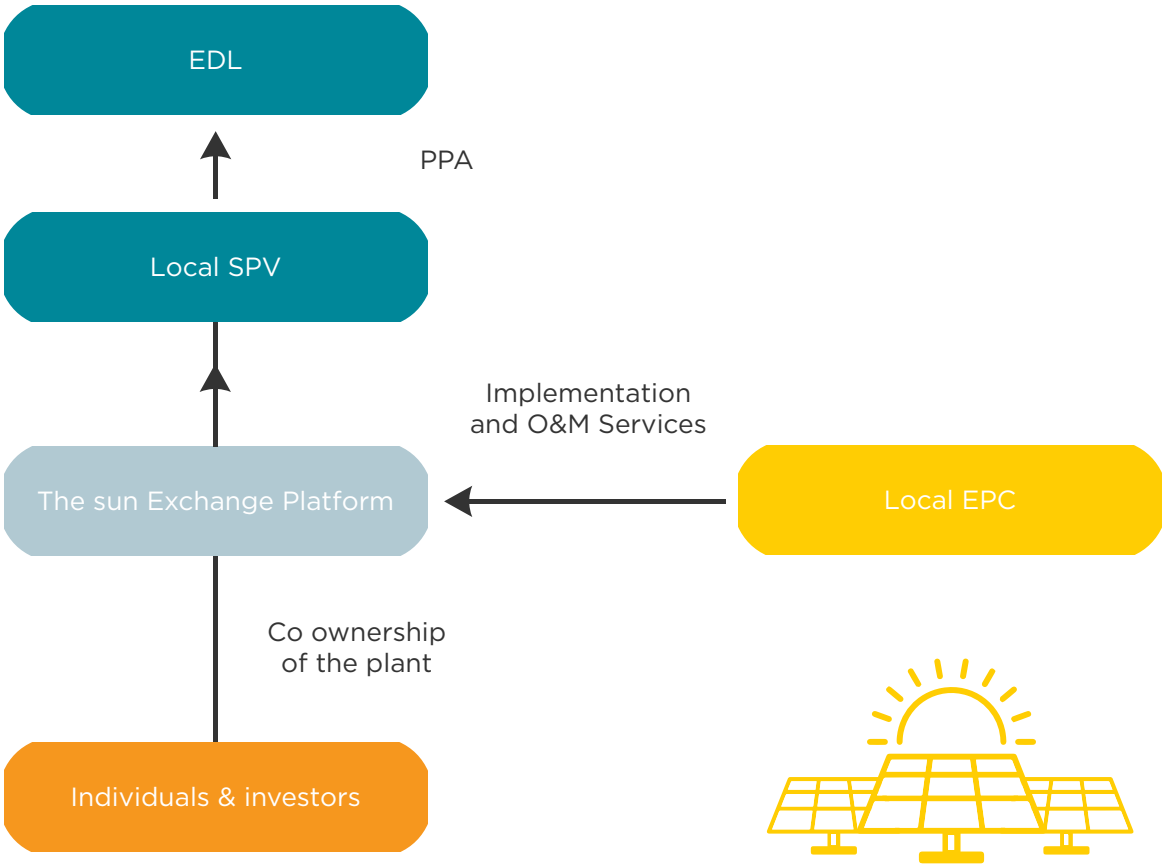
- Registering on the SunExchange platform with User ID

- Sending funds in Bitcoin (BTC) or other accepted digital assets, to be held under custodianship of the SunExchange platform,

- The digital assets allocated to the solar installations give a right to co-ownership of the solar install, very much like a crowdfunding investment mechanism,

- The co-owners receive a payback based on their contribution to the overall financing of the solar install during the entire lifetime of the power plant, with a "return on investment" generally calculated around 10% annually.

[7] Wallace, John, SunExchange Business Developer, UNDP "Innovative Finance" project in Moldova, 2018-2019
[8] Cambridge, Abraham, SunExchange CEO, UNDP "Innovative Finance" project in Moldova, 2018-2019




## ADVANTAGES & BENEFITS OF THE PROPOSED SOLUTION

**The Sun Exchange value resides in its Investment Vehicle and its impact in behavioral finance:** it opens up manageable pico-investments to International Investment-grade Investors (ie: Solar Asset Managers, IPP´s,...) as well as anyone around the world looking to divest their portfolio of assets. In the context of the deployment of Microgrids in Lebanon, this business model could allow for the participation of Lebanese families with means to co-finance such solar installation as well as the setup of co-operatives managing a single-asset. This business model allows for:

- The solar installation operates under the Standards established by the local market (Lebanon) under Netmetering and-or PPA,

- Co-operatives can run and operate a solar installation under similar financing means,

- Noted challenges are that such business model should be “accepted” at regulatory level whereby investors are allowed to own and use digital assets for the financing of solar installations in Lebanon.

## KEY RECOMMENDATIONS AND CHALLENGES

**The GoL should recognize Bitcoin and other Digital Assets as an Investment Vehicle** at least in the context of this specific energy use-case. This will allow international as well as local Lebanese residents to participate in the local funding of a network of solar installations based on a PPA (Power-Purchase Agreement model). The GoL should focus on:

- **Enacting legislation on innovative finance** and crypto-crowdfunding with digital assets in the context of renewable energies and solar in particular, whereby these are regarded as an investment vehicle. The adoption of existing legislative frameworks in other countries such as Switzerland[9] can serve as reference for the legislative requirements that need to be enacted in Lebanon,

- **Setting up of a Framework for PPA´s in the context of solar energy delivered by an independent entity** such as a solar field/installation and/or co-operative delivering to or through the grid, with obligation from the incumbent entities (EDL effectively) to recognize and enforce such an agreement.

## 2.3. GRID & MICROGRID BLOCKCHAIN SOLUTION (PROJECT C)

In the context of deploying smart-grid blockchain technology functionalities in Lebanon, these will allow an individual household and to a further extent a local Microgrid to participate in delivering electricity to the grid, helping balance the grid and providing flexibility in real-time.

The actual energy is separated from the traded energy-data as the applications links to the Blockchain, thereby keeping a record of any energy traded. The entire process is done “virtually”, allowing the Grid Operator EDL to tackle:

- Grid Flexibility and Balancing,

- Peer to Peer energy trading,

- Billing & Accounting of the energy at hyperlocal level,

- Grid/connected Microgrid and storage solutions

Given the interoperability of solutions between Microgrid and Grid solutions and time/cost constraints, the suggestion is to focus on a Grid-implemented solution with the Grid Operator EDL at the Smart-Meter level in order to rapidly scale up (if the project is proven successful). While any of the companies such as PowerLedger, LO3 Energy and GridSingularity may offer such solution, we refer to these companies as “Technology Provider” in the below process for implementing the Project.

[9] https://www.newsd.admin.ch/newsd/message/attachments/55153.pdf

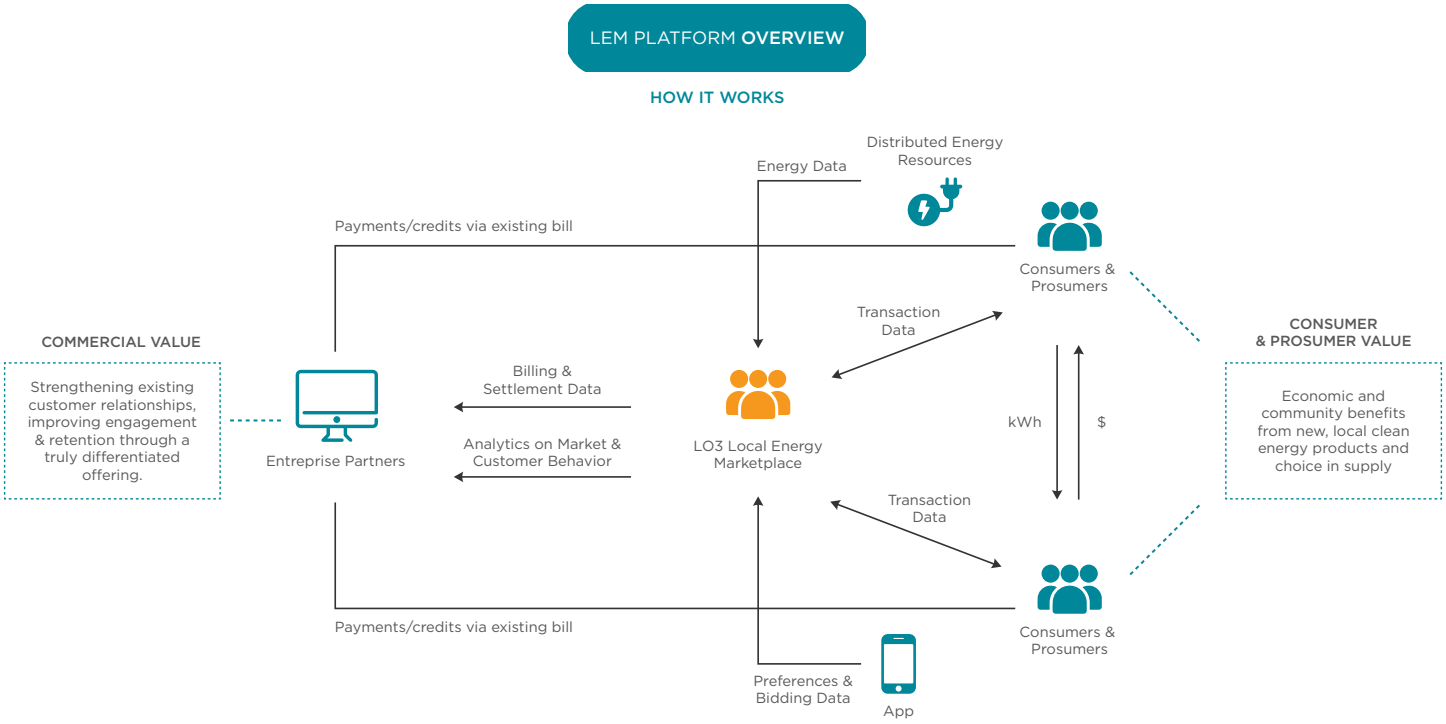
## PROCESS FOR RUNNING GRID-CONNECTED APPLICATIONS IN THE LEBANON CONTEXT

Choosing between available applications is a matter of identifying the operator with most experience on the market. The common denominator between each application is that of Blockchain smart-contracts that allow for the trades to take place on a digital platform.

In the context of Lebanon, a suitable technology provider would need to be selected in order to assist in the deployment of the chosen technology solution and run it alongside the incumbent electricity provider (EDL) and testing under "test-net" infrastructure and resources. **The platform is integrated at the Grid Operator or Microgrid level, allowing for later implementations in deploying smart-meters at the Grid-edge.**

While the technology is **readily available through a smart app to the end-user,** it is more a matter of funding requirements of the relevant pilot/concept as well as staffing the project IT-wise during a period of time which would allow for a relevant appraisal. These projects require coordination between the technology provider and the IT teams at the Utility/Grid Operator. A later integration of hardware (smart-meters) can be extended at Prosumer level. Peer to Peer trades are reconciled and billed with matching on the platform and according to the "tempo" of the data provided.

In this context, **EDL can play the role of Aggregator of individual customer billing** and subsequently compensate each customer according to their monthly peer-to-peer trades.




**Notice:** *All the Technology Provider applications currently perform the transactive layer only. While these can be integrated into DERM software (control layer) for grid balancing, the effective results of blockchain technology on grid balancing will be available at a future stage.*

### KEY RECOMMENDATION

GoL should recognize blockchain in the energy sector as a technological "tour de force" for electricity access and allow for trial-testing of relevant applications in the field of energy. In particular, Government is invited to tackle:

- **Setting up of a legal framework and measures in favor of Blockchain solutions to a general extent (energy sector, digital assets…)** and possibly through setting up of a technological sandbox where projects such as PowerLedgers xGrid[10] and LO3s Pando[11] could be deployed and tested with a select number of users or existing initiatives such as the Village24 Microgrid,

- Allowing Electricite du Liban (EDL) in Lebanon to participate as a member and affiliate to the Energy Web Foundation alongside other world class utilities and act in the Middle-East region as a test-case to deploying Grid Singularity's D3A (automated P2P energy trading platform for localized marketplaces)[12] and EWF's Origin (asset origination and carbon certificates tracking)[13]. A utility like EDL in Lebanon could deploy D3A for immediate appraisal of consumer load capacity in Lebanon. A test net with a select number of "plugged-in" household (users) would allow the study of real-time electricity provided, thereby studying demand-response and grid flexibility. **While the entire process is done "virtually",** the demand-response quality depends also on the quality and availability of data.

- At a future stage, **enacting reforms and regulation towards electricity marketplace** could be done in order for households to participate in the energy grid with automatic bids. Such regulation would have to identify at best the costs associated to wheeling the energy to the grid and under which agreement (PPA-based or spot prices) the market participants would be authorized to enter the marketplace.

## 2.4. BEYOND THE GRID – POWERING REMOTE COMMUNITIES (PROJECT D)

The applications presented in this section all provide batteries on the go for beyond the grid applications albeit with different approaches. These solutions effectively allow for deployment of physical solutions to power Communities in rural areas such as refugee camps, isolated villages or "mobile communities" **as long as an internet connection is available for reconciliation of the market trades.**

Some applications such as the LiquidStar[14] business model provides blockchain enabled "smart" battery software through an app that runs decentralized connected batteries. On the one hand it articulates its solution around SDG7 by empowering communities in rural areas in deploying these smart batteries and on the other hand it solves the "recycling" problem of lithium by providing a solution in naturally using the existing battery packs of electric vehicles. The LiquidStar technology is most versatile in that it builds on existing and tested personal and device ID recognition using Blockchain technology included in the now widely used Blockpass[15] mobile application. Blockpass is currently being deployed across the banking industry and online exchanges to enhance KYC and AML checks.

In effect, this gives a Blockchain burnt-in ID to the battery device, the user and the charging point, allowing for digital tracking "on the Blockchain" of any of the entities involved in the use of the battery system.

[10] https://www.powerledger.io/product/xgrid/
[11] https://lo3energy.com/pando/
[12] https://www.d3a.io/
[13] https://energyweb.org/portfolio/origin-ptt/
[14] https://www.liquidstar.io/
[15] https://www.blockpass.org/

Running Microgrids that are non-grid connected is the focus of PowerLedger´s[16] MuGrid[17] initiative and this is probably the most compelling solution in the context of Lebanon´s rural communities. Building up on the locally deployed hybrid solar-diesel community microgrid initiative, the MuGrid interface can allow users to participate in a closed-grid infrastructure.

MuGrid facilitates an accelerated return on investment on distributed generation and storage assets and can empower consumers to become prosumers through providing a market mechanism to participate in the network, no matter how small the generation asset is. Similarly, to PowerLedger´s xGrid and LO3´s Pando platform at the Community level, MuGrid is integrated through an **app** for users to actively or automatically place a trade on their electricity, making use of the Microgrids battery system to both store energy and/or regulate supply/demand on their behalf. **While the app links to the Blockchain, thereby keeping a record of the trade and the energy settled, the entire process is done "virtually".** This process is done in the background of the software, based on data available and at the "tempo" of the data provided.

BBOXX[18] makes use of a tested business model of inter-connected SHS systems deployed with a common denominator (the Blockchain) to build up a Microgrid format. BBOXX focuses on the deployment of SHS (solar home systems) for individual residential use and the Microgrid is a natural extension to its business model. By deploying Community-Solar Microgrid applications, P2P energy trading can take place and residents/tenants within buildings such as apartment complexes, local shopping centers, offices and rural locations can trade the energy that they produce within this same Microgrid.

### PROCESS FOR DEPLOYING LIQUIDSTAR, MuGRID AND BBOXX MICROGRID SOLUTIONS

While BBOXX and MuGrid require "boots on the ground" to train local staff and participants and effectively deploy a network of interconnected SHS and-or building a solar install acting as a Microgrid, LiquidStar presents the advantage that the Battery kits can be shipped in and deployed independently and in total versatility by the Community itself with little, if any, tech experience other than running an app on a mobile phone.

The deployment of the battery charging points can be done remotely and with minimal online support from LiquidStar team. The charging itself is performed by effectively running an app connected to both the device and the charging station, allowing for flexibility in the source of energy used in charging the station.

Requirements for deploying LiquidStar mobile batteries other than that of having an internet connection are that:

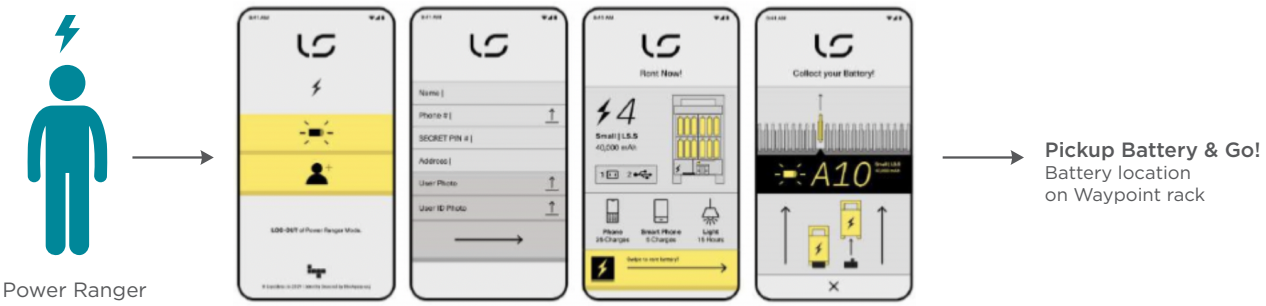
- in order to deploy LiquidStar batteries, a charging point needs be identified and "plugged" to the Blockchain Application as a Source-Provider,

- Power-Rangers then distribute the Batteries in the communities where the electricity is needed, and act as Managers of the Waypoint and/or a set of batteries,

[16] UN Environment Enquiry, "Digital Finance and Citizen Action", ibidem, Page 45, February 2019
[17] https://www.powerledger.io/product/ugrid/
[18] https://www.bboxx.co.uk/

- The batteries are so designed that they can deliver based on the energy needs of the local communities where the devices are being deployed.

At its core, the LiquidStar Business Model is similar to that of a remote Software provider (ie: the app provides billing, energy tracking and waypoint management) thereby allowing different hardware/battery standards to use LiquidStar´s common protocol.




## ADVANTAGES & BENEFITS OF THE PROPOSED SOLUTION

In the context of existing Microgrid infrastructure and/or the deploying of new rural Microgrid infrastructure, **PowerLedgers MuGrid software can be combined to the physical installation and deployment of the hardware elements constituting the Microgrid itself.** The MuGrid interface keeps track via internet of each individual consumer in order to assess the amount of electricity used.

Likewise, in the case of BBOXX, a Microgrid is deployed from within the Community either by establishing a "central" fully autonomous solar installation and-or diesel-hybrid installation that assesses each individual point of consumption (households). BBOXX´s software automatically logs through its interface the relevant amount of energy used within the network, with a dashboard available to participants for viewing of their daily/ weekly/monthly use of electricity. Going further and where energy access is most critical, LiquidStar offers a solution for communities "on the go" and the most remote villages by delivering "mobile batteries". **This business model allows for:**

**- Local Off the Grid "island" Microgrid solutions,**

**- Powering rural villages and mobile communities**

**- Increasing Renewable Energy throughout developing nations**

## KEY RECOMMENDATION

**GoL should recognize Microgrids as an inherent technological leap for powering rural communities and actively promote the deployment of such Microgrid solutions.** In particular, Government should focus on:

- Enacting legislation to promote such Microgrid solutions independent from the Grid and EDL,

- Setting up of a Framework for testing such Microgrid applications in select locations such as the Village 24 initiative in order to assess the technology and physical requirements for deploying these solutions.

# 3. CONCLUSION

In the context of this report to provide blockchain solutions which are consumer-oriented and deployable at grid/national level, the Author has concentrated on scalable and impactful POC´s that can be deployed with minimal budget and time constraints. **This multi-faceted solution where different business models are applied to the Energy Grid in Lebanon, together will help increase market penetration of Renewables at the National level.**

**While the Projects and Proof of Concepts described in this document require project management on the ground as well as IT and hardware integration, applying these solutions, will demonstrate:**

- Immediate value in the rapid deployment of grid-connected Blockchain solutions such as LO3/PowerLedger or GSy/d3a interface (or similar application) for the use at Grid-level with Lebanon´s Grid operator and Utility company Electricite du Liban (EDL) through its smart meters,

- Going beyond the grid, implementing scalable solutions such as LiquidStar to allow energy access to regions where communities are "on the go",

- Deploying Prosumer-oriented interfaces such as Digital Assets and Financial Innovation Business models investment platform for co-operatives.

Further, in order to assess these solutions, the following table demonstrates project timeline and budget constraints:

| | Digital Assets For Prosumer Inclusion (Project A) | Financial Innovation (Project B) | Peer To Peer Energy Trading And Grid Optimization (Project B) | Mobile Batteries (Project D) |
|---|---|---|---|---|
| Company | SolarCoin Foundation under the ElectriCChain Affiliate | Local EPC construction, SunExchange for financing | Lo3Energy, PowerLedger or GridSingularity/ D3A.io | LiquidStar, BBOXX, PowerLedger |
| Project Deliveries | Filing for 56 MWp of solar installations | Financing and building a 500 kWp solar installation | Testing smart-meter/server integration with 12 households running a solar installation (p2p/grid balancing) | Testing 4 mobile batteries (grid/ microgrid connected) in replacement of Diesel Generators |

| | | | | |
|---|---|---|---|---|
| **Budget Requirements** | Total 5,000 USD to Project Manager. Project to be finance by a private donor | Total of circa 500,000 USD (project finance). Project to be entirely financed by the Sun Exchange co-owners | Total of 15,000 USD (Phase1-1month). Proect to be financed by the Grid Operator or "Private Donor" | Total of 20,000 USD. Project to be financed by "private donor" |
| **Time To Deploy And Time Required To Running Tests (Timeline)** | 1-month from the moment the data on the solar installs is available and participating installs have been located | Permitting process under 3months, PPA negotiation under 3months (in parallel), financing in 3months, building in 3months. Total: 9-months | 1/2months from the moment the data on the solar installs and smart meters is available and participating smart-meters have been located | 3-months from the moment the batteries have been deployed |
| **Regulatory Requirements** | Regulation to be implemented for allowing for Digital Assets to circulate | SandBox/Pilot project for allowing PPA; Sand-Box/Pilot for allowing Digital Assets to finance a solar install | SandBox/Pilot project for allowing p2p trading in place of netmetering | SandBox/Pilot project for allowing b2c energy trading from batteries replacing diesel generators |
| **Direct Beneficiaries (Solar Owners, Installers...)** | Solar Power producers, the solar industry and to a larger extent the Economy. Increases Renewable Energy | Private Public Partnerships (Cooperatives) running this financing model. Increases Renewable Energy | The grid Operator and households benefit most from the solution as it allows for better grid balancing and electricity reliability | Households (ie: using lithium batteries instead of large diesel generators) |
| **Impact (Short Vs Lt, Small/ Big)** | Medium Term impact will develop as the Network of participants grows | Short Term impact as the business model can be applied to financed multiple solar projects | Medium Term impact will develop as the number of smart meters and solar installs grows | Short Term impact as the batteries can be deployed at scale |

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## REFERENCES OF FIGURES

Fig1. LO3 Energy Pando Platform taken from: LO3 – Energy: Company Overview Presentation, “Reshaping our Energy Future”, August 2019

Fig2. LiquidStar” Batteries on the go” App. LiquidStar: Company Overview Presentation, August 2019

## ABOUT THE AUTHOR:

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