“We will make electricity so cheap that only the rich will burn candles” Thomas Edison

PREAMBLE

This document provides information on the Bitlumens project, its core conceptual idea, business model, competitive advantages, the team, ICO details and roadmap towards the first MVP. A more technical description of the core architecture and APIs will follow soon after. This whitepaper has been published in November 2017. We recommend following updates on our website and other media channels periodically, for new information and updates. Also, more detailed papers will be released in the future, specifically on the consensus and governance mechanisms. However, it should be noted that our architecture is holistic, all components tie together and synergize in a modular way.

Bitlumens brings electricity and water from renewable sources using Internet of Things and the Blockchain to women in rural villages in Latin America. Thanks to solar energy and our technology, people can use electricity, charge their electrical appliances and even water their crops! Women acquire our hardware with tokens through a microloan which they amortize in monthly installments. This allows them to build a credit score leading to financial inclusion and poverty alleviation. In addition, family members can buy tokens to send a remittance which could cover the expenses for the machine, meaning water and electricity bills can be covered. We also quantify carbon mitigation and particulate matter reduction in each household to allow women to become carbon credit issuers.

Mission

Our mission is to offer a peer to peer platform where users adopt off grid Solar systems to reduce carbon emissions and get access to lighting and water in places where there is no power grid. Our platform allows the payment of the hardware to be done through installments using Bitlumens Tokens (BLS). The project focus on women farmers who will own their own data and can sell it to the government or development banks using BLS token. The system also allows crowdfunding through digital currencies while using the blockchain. Our goal is to create both financial return and positive measurable social and environmental impact.

We provide solar energy to remote villages and in consequence reduce CO_2 and health hazards, displacing kerosene lamps, plastic, biomass and bio-fuels as lighting source, increase customer savings, proliferating financial inclusion and in some cases providing employment. Our digital platform aims at offering distributed, managed by consensus and off grid smart energy solutions in low resource households. Our platform contributes to the UN SDGs, in particular with;

Affordable and Clean Energy, Sustainable Cities and Communities, Good Health and Well-being, Gender Equality and Climate Action. Bitlumens GmbH is registered and incorporated in Zug, Switzerland.

Introduction

Bitlumens wants to electrify rural areas in poor communities, help bring down CO2 emissions, foster gender equality and promote financial inclusion through its platform. 1.1 billion women remain locked out of the financial system, not least due to the lack of proper identification documents. Identity does not have to remain a barrier for financial inclusion and economic empowerment. In addition, according to the World Energy Outlook, 1.2 billion people don't have access to electricity while 2.7 billion don't have access to clean cooking. In some cases, such as Ethiopia and Zambia only a small portion of rural inhabitants have access to electrification [see Table 1]. Most of them depend on inefficient and hazardous fuels, such as biomass, kerosene, plastic, battery torches and candles. Fuels and its combustion process contribute to the release of greenhouse gases into the atmosphere. Among those fuels, kerosene is a source of CO_2 and black carbon. Black carbon or soot, a particulate matter (PM) resides only a few days or weeks until a natural phenomenon called coagulation happens, where cloud droplets and aerosol particles attract each other. This phenomenon helps to clean the atmosphere by flushing out aerosol particles. Hence, replacing all kerosene lamps worldwide with solar lights could serve as short-term action to reduce global warming. A single kerosene lamp emits over 100 kg of CO_2 per year when used four hours a day.

Globally, burning kerosene for lighting generated 240 million tons of CO_2 equivalent a year, around 0.5% of global emissions. In fact, just kerosene lamps replaced in Africa and Asia with solar panels saved 1.4 million tons of CO_2 equivalent in 2014 alone. Moreover, on a general basis burning 20 kg wood during one day emits about 200 grams of PM2.5, this equals smoking 10,000 cigarettes. The energy sector in Latin America and many other developing regions present major challenges to meet energy requirements. In fact, some of these countries rely on fossil fuels to meet energy demand. Price volatility, fossil fuel shortages, governmental regulations on fossil fuel prices, geopolitical settings, power outages and climate change mitigation are major key variables that need to be considered to address energy security. However, the Latin America presents a vast amount of non-conventional-renewable-energy sources such as wind and solar which can be exploited to address power reliability and energy security.

Table 1 illustrates the megatrends driving the development on solar off grid projects. Large number of people without electricity, increasingly cheaper solar panels, growing mobile phone penetration (SIM cards) and high energy spending on inefficient fuel sources are some of the variables we take into account to model off grid energy solutions. In addition, we focus on the intersection of high cell phone availability, low rate of electrification, high number of adults unbanked and high adoption rate of kerosene or other inefficient fuels used for cooking or electricity.

	Population without Electricity	Rural Electrification Rate	CO_2 (metric tones per capita) 2013	Mobile Penetration	Residential Electricity Price
	Millions	**%**	**tones**	**%**	**¢/kWh**
Haiti	7.5	17.2	0.23	55	33
Nicaragua	1.4	57.1	0.77	78	21
Trinidad and Tobago	0	99.4	34.52	140	32
Ethiopia	73	12.2	0.11	18	9
Zambia	11	3.8	0.25	40	15
Peru	3	74.5	1.87	66	9
Guatemala	1.7	74.8	0.87	51	18
Brazil	0.8	97.8	2.49	57	10
Honduras	0.9	76.3	1.05	66	17
Panama	0.3	65.65	2.7	81	16
Ecuador	0.5	97.05	2.78	55	8

Table 1:Potential Markets

Displacing kerosene and biomass

In many developing countries kerosene (paraffin) is widely used as fuel for light and cooking. The use of kerosene as lighting fuel is an important source of black carbon (BC) and carbon dioxide. Especially in rural areas and in regions such as Asia and Africa where most families use dim kerosene lamps to light their homes at night. The combustion originated from burning fuel indoors pollutes the air with harmful particles, which can irritate the eyes and lungs, and can also cause accidents. According to different studies 3.5 million premature deaths occur each year are linked to smoky indoor environments. Off grid energy services supplied from renewable sources can not only displace kerosene usage with efficient Light Emitting Diodes (LEDs), but also reduce the dangerous side effects produced by combustion.

Other sources of fuel are pine kindling, used in Latin America as a source of light. Like kerosene, pine kindling often causes health issues, such as long-term neurological and kidney damage.

Kerosene and biomass powered wick lamps are far less efficient than solar powered LED lanterns. As stated by kerosene is a dangerous and inefficient fuel used in wick lamps which provides less useful light compared to solar lanterns. Kerosene wick lamps provide 1 to 6 lumens per square meter. LED has higher efficiency - measured in lumens per watts- quality and quantity of lighting when compared to kerosene lamps. The use of LED lanterns entails reductions on greenhouse emissions and operating costs. A kerosene lamp producing 37 lumens during a period of four hours per day will consume about three liters of kerosene per month at an average cost of USD 0.35 per liter in India.

Most off-grid customers live in rural areas and on less than $2 a day. Therefore, energy accounts for a significant amount of their spending. However, distributed energy companies (DESCO) are bringing new forms of financing to the homes of people living in rural areas. As an example, for an initial down payment of 3,500 Kenyan shillings ($34) and daily installments of Ks 50 during a year, Kenyan villagers can get access to electricity.

By generating renewable power from the sun, DESCO aim at offering reliable energy services and reducing greenhouse gas emissions in a cost competitive manner. Some of these companies use "pay as you go systems" to provide access to credit for people who do not have access to cash. This solution provides ownership of the technology once all installments had been paid. Bitlumens provides a solution to support villagers gaining access to IDs, micro-credits, electricity by using solar panels and the blockchain. Combining clean tech, fintech, the blockchain and cloud computing, Bitlumens offers a software as a service (SaaS) where women living in rural villages and in need of power can get access to Sun Home Systems (SHS). The latter are user-friendly, eco-friendly, and smart internet of things (IoT) devices that bring power to the unbanked in places without power grid. In short, our platform gives kerosene or plastic-dependent households immediate access to cleaner, safer, and affordable energy in Latin America.

Initial Markets

	Lat	Lon
Guaramal Panama	8.337543	-82.551045
Valle Departament Honduras	13.422095	-87.547689
Chinandega Nicaragua	12.896268	-87.537753
Escuintla, Guatemala	14.3009	-90.7882

Table 2: Locations to install the first minimum viable product

2. The Solar System

Ideally, our Solar Kit will initially use a 15/20/50W solar panel and Lithium Ferro Phosphate battery. We will sell 3 systems coming with different appliances, i.e. two USB charging ports; integrated dimmable LED lights; LED Backlit LCD TV; Radio and TV.

	USB	LED Bulbs	LED Bulbs	Radio	TV 15.6'	Battery	PV panel
		200 lumens	400 lumens			Amp/h	Volts peak
First Configuration	2	2 used for 6 hours	-	1	-	3	15
Second Configuration	2	2 used for 4 hours			1 TV for 6 hours	4.5	20
Third Configuration	4		3 used 6 hours	-	1 TV for 6 hours	10.5	50

	GHI	PSH	PR	Y_e	E_v
	kWh/m²/a	[h/a]	[-]	[kWh/kWp/a]	[USD cents/kWh]
Ecuador	1641	1641	0.80	1313	11
Honduras	2230	2230	0.80	1784	30
Nicaragua	1909	1909	0.80	1527	32
Panama	2000	2000	0.80	1500	24
Guatemala	2200	2200	0.80	1760	31

Table 3: irradiance values, peak hours and the performance ratio.

The solar kit is connected to a smart meter and to the user's cell phone. We use programmable logic controllers (PLC) that allow the current to be measured. The code should measure the current and voltage each 5 seconds. With these values it calculates the power produced and consumed. The smart meter works with a memory card allowing our agents to add the load profile of each user to a centralized panel whenever they have internet connectivity. The latter will provide the data in the form of text messages, such as, available credit, battery availability, electricity consumed, lighting duration, daily cost and energy output.

Off Chain: The digital IDs are not part of the blockchain but are going to be centralized. Each user will be able to have their own ID and credit history. This information can be shared to third parties who offer microlending solutions, governments and development banks. Users can get access to microcredits by paying a specific interest rate based on personal and behavioral variables.

On chain: The idea is that our investors know when the transactions by our users are done. After the transaction is entered in the system by our agents, Bitlumens will pay these agents a commission denominated in tokens. In addition, carbon credits are credited to final users and denominated in BLS tokens.

To be able to provide financial inclusion two important pieces of information are provided, IDs and KYC. Bitlumens gives access to a platform that connects microcredit solutions to users who are not powered to the grid, offering SHS. We will provide cooperative banks with key pieces of information they require to open an account or facilitate financial services given the proof of valid microcredit. Each user will be able to have their own ID and credit history. This information can be shared to third parties who offer microlending solutions, governments and development banks. Users can get access to microcredits by paying a specific interest rate based on personal and behavioral variables.

The system will be comprised (at minimum) of the following components:

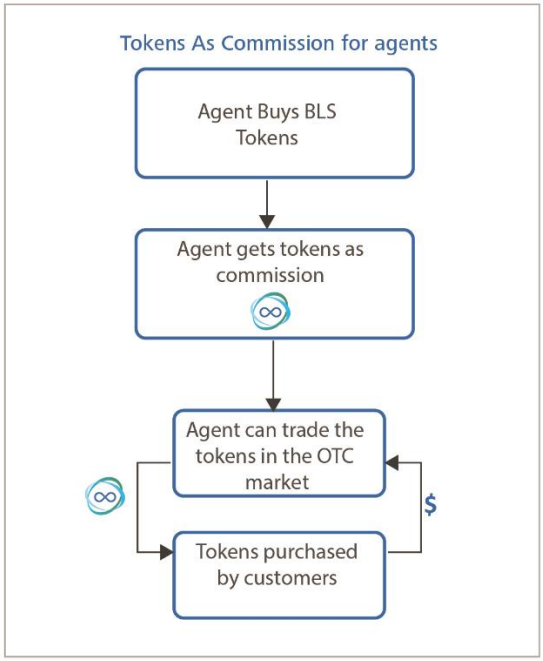
(i) A token creation smart contract (Ethereum)

(ii) A utility billing system contract (Ethereum)

(iii) IPFS (hash-based decentralized file storage)

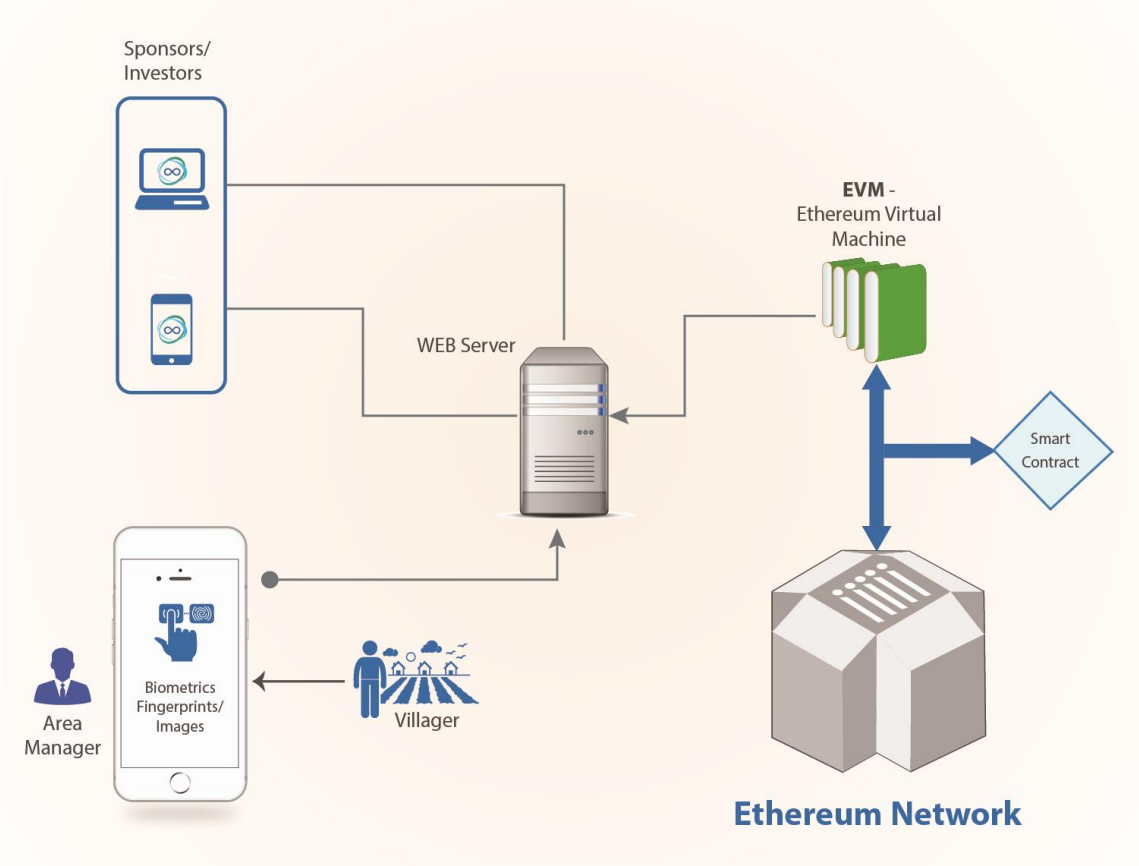
(iv) A centralized server to hold fingerprint data and notarize identity requests (approve/refuse)

Bitlumens team will own the private key to add and remove agents. Agents have the power to add utility bills for clients. The workflow is the following: the agent goes to the client's home, collects the money and buys a token in the OTC market for the client to use (so she can use the hardware). In addition, agents get a commission in tokens as explained in the following graph:



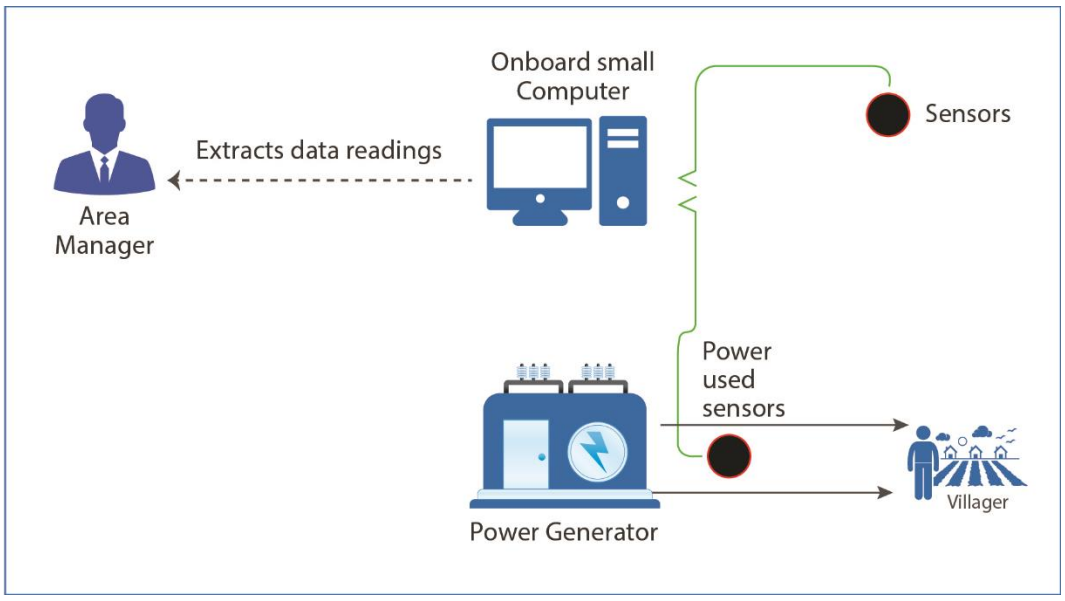
Then, the agent makes a blockchain transaction that contains the utility bill data of the client. The agent uploads the detailed information to IPFS. We use IPFS files to store the information on the file itself. More specifically, the transaction contains the following information: the token value information, potentially some of the energy consumption (but only a few, as storage on Ethereum is very costly) and a IPFS hash to the file containing the detailed energy consumption. Each client is assigned a user number, which identifies them uniquely. For KYC purposes, it suffices for the bank to ask a server (iv) that their client's number matches the correct fingerprint. Once they can trust the user number, they can look at the blockchain (ii) smart contract to estimate the credit rating of the client and participate on a microcredit. It is also possible to add a credit rating functionality, where a credit rating agency would associate client numbers with credit rating, thereby making the process easier for banks.

The area manager, the agent and the investor interact through our web and mobile app. On and off chain data communicates using oracles. The tokens can be exchanged on a public blockchain through Ethereum. An additional layer of smart contracts is added to execute instructions based on predefined conditions.

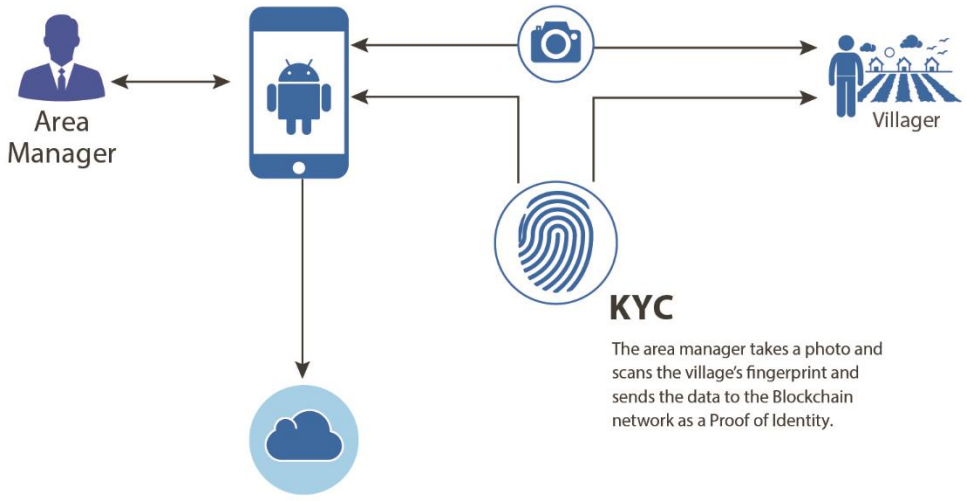


Sensor Data Flow

Our clients own their own data. These data can be sold to the government or to development banks. The data runs in a private blockchain and is connected to our sensors.

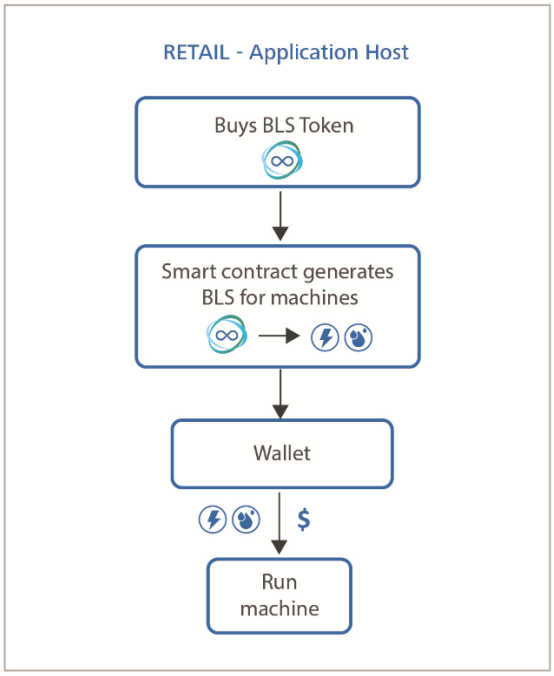


Operation in a Village and Identity of Villagers



Each machine has a serial number and is linked to a user which is identified using their fingerprint. The MVP aims to support usage of Ether and is built on the Ethereum network, as it is currently the most mature blockchain to implement smart contracts.

The following graph shows the flow of BLS tokens needed for women farmers to run their machines. These women buy tokens to run their machines which are used to produce power for electricity or water.



Our mission is to include women living in rural villages into the financial system by providing microcredit and pay as you go solutions. Therefore, Bitlumens aims at licensing the platform and operate with cooperative banking services in a global scale to improve the lives of villagers while contributing to carbon mitigation strategies related to the Paris Climate Agreement of December 2015.

In addition, family members can buy BLS tokens through our app and send a remittance to one of our final users (machine owners) destined to pay for water and electricity bills.

Use Cases

Bitlumens Tokens/General Overview					
ERC20/ BLS ICO	OTC market	Exchange and Smart Contract layer	Oracles and IoT	Data is Tokenized	Carbon Credits Tokenized

Bitlumens Tokens/Data Ownership					
Data is Tokenized using IoT and oracles	Client owns Data	Pools of Data	Client trades data for tokens by consensus	Data is sent to acquirer + Smart contract layer	Tokens can be used to get discounts on additional devices

Bitlumens Tokens/Remittances					
Remitter creates profile	Buys tokens in OTC market	Wallet Address	Sends tokens to new wallet address	Smart Contract layer	New user runs machine using tokens

Bitlumens Tokens/Carbon Credits					
Agent creates KYC of user	Model carbon mitigation	Client runs machine for 1 year	Model calculates carbon mitigation	Smart Contract layer	Tokens used to get a max. 10% discount on the purchase of new machines

License the Software to a Microlending Entity

Bitlumens software can be licensed to banks (SaaS) in exchange for fees or revenue share. Bitlumens helps the Cooperative Credit Banks originate new sustainable loans, then it syndicates or sells these loans to 3rd party investors where each microcredit has a piece of hardware as collateral. This process allows for the legal creation of the loan and transfer of funds to the borrowers based on an existing banking license. On the payment side, the depository is a collaborating Cooperative Credit Bank and all members who borrow on the platform will be onboarded as a bank member with full AML/KYC and associated accounts.

Before originating a loan, agents will perform the due diligence on each interested villager, including behavioral variables. The platform will evaluate credit metrics and derive a credit score based on the collected information and on the regulatory framework adopted in each country.

Allow Certified Emission Reduction (CER)

Bitlumens fulfills the requirements based on the clean development mechanism (CDM) under the article 12 in Kyoto's protocol and earn sealable certified emission reduction (CER) credits. The emission reductions occur when villagers don't use biomass or kerosene as lighting source. This information is included in the measurement, verification and reporting (MVR) framework under the Paris Agreement. The methodology for measurement is taken from the intergovernmental panel on climate change (IPCC). Reporting is done through the actions taken to mitigate GHG and on adaptability measures that are considered relevant to the achievement of the climate change objectives. In addition, data verification is done through national MRV and through ICA. The idea is to license the platform to governments to visualize the emission reductions in different areas of the country based on sensors, IoT and the blockchain. This will allow clear auditability and the possibility to enter into Carbon Credit markets.

Tokenizing the machines allowing Peer to Peer Lending

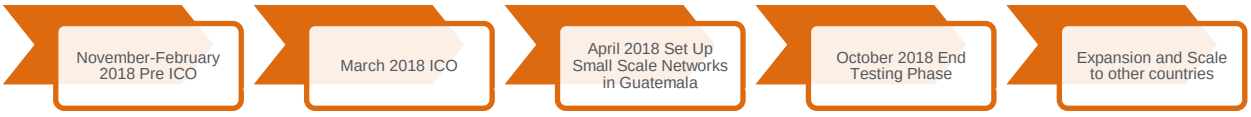
Our manufacturer sends the machines to the port. The quantity ordered by Bitlumens will be stored in the blockchain so later agents can collect the machines and verify that the number of machines arriving at the port is equal to the number of machines Bitlumens paid. The machine serial number is stored in the blockchain. Crowdfunders can then buy one these machines and get an appreciation of the token value. Therefore, the token is collateralized by the machine. The latter is transported to the end users who pay the tokens to purchase the machine. Part of the tokens is given in commissions to our agents and part is sent to the local bank. Agents must input the amount into Bitlumens mobile app along with the KYC and biometric information of each user. The agents sell tokens for the machine to operate. Once the machine operates we can show the load profile of each user. This will increase transparency among crowdfunders to show a real person is using the device. Investors will be matched to villagers based on a first come first serve logic. The token will flow to the account of a villager and matched to the serial number of one of the hardware. Villagers will pay the hardware by installments denominated in BLS.

3. Project timeline

Customer defaults rates are expected to vary in each region, but for simplicity reasons our model takes 10% average rate. However, these cases need to be assessed regularly. Our model quantifies the amount of default of each customer over a time horizon. The agent working in the field will collect the system back and then sell it second hand.

Our system gives the option to add a digital ID for each user, collecting credit data, creating credit scores and giving access to financial services. In India, for instance, the Aadhaar system is now accessible to more than 1.1 billion people. Users can open accounts by presenting the Aadhaar numbers. We plan to deploy a similar scheme in Latin America, where agents collect the fingerprints of our users and save these in centralized servers supporting encryption. In addition, agents will upload the KYC, load profile while the system will calculate the credit score based on the user's credit history. We expect to have one project manager per 100 users, installing between

60-100 systems each month. Microlending institutions are providing technical assistance while working closely with their women's project. Hence, our goal is to train women and make them part of our team as agents. Their wages will depend on the region and are based on commissions. During the third trimester, we expect to have a regional manager to support us on scaling the project in the country.



The following table shows the breakdown of how we expect to invest the funds over a period of 3 years:

Hardware	35%
Legal	2%
Wages	35%
ICO Expenses	2%
Software development	20%
Marketing and PR	6%
Total	100%

We started the development of an API. Our web api will communicate with oraclize. Communications between Pay as you go systems front-end dashboard, loggers, and mobile app and Bitlumens back-end's HTTPS server are via RestAPI/JSON. Bitlumens back-end system uses a PostgresSQL database to store the actual data points and IDs. It runs a full ethereum node, and is used for data retrieval and analysis. In addition, we will use Solc compiler, IBM Hyperledger, Ethereum, Java, HTML, IPFS, Native iOS/Android, PHP, Node, Golang and Haskell.

The role of the blockchain within Bitlumens operation is to record each user's KYC information and the already predefined smart contract to preserve verifiable records of the contract's conditions during purchases.

On Bitlumens, the only state update that can be settled on the blockchain is a transfer of tokens. The platform allows for fiat payments in exchange of tokens. The storage and verification of data are placed on a private chain where only investors can access. However, women are the sole owners of the data and Bitlumens can only access it to optimize our processes.

We expect to have the smart meter ready in the second trimester as we plan to create a peer to peer network for power exchange without the need of having a power grid. The smart meter will inform the user how much power has been produced, consumed and stored into the battery which can be traded in exchange for tokens. In addition, during the second trimester a sensor will be added to the battery allowing rentals. These rentals will allow users to generate revenue. The users in the

network should have bought tokens in advance held in custody in the digital wallet. These tokens are sold by crowdfunders (investors) who had purchased the token in the ICO.

Bitlumens will be working with a solar manufacturer who can ship 100 units together with the pay as you go system within a two-week period. In addition, Bitlumens had already started a pilot project in Guatemala.

Roadmap

Description	Concept	Proof of Concept	Prototype	Live	Growth
Developer Claims					
	✓ Website ✓ Whitepaper	✓ Product Prototype ✓ Licenses	✓ Pilot Studies Beta Users ✓ Hardware	○ Clients ○ Software Prototype	Scalability Additional Features

4. Token Specification and ICO rules

Our token is an ERC20 utility token, and aims to provide social and environmental transformation, where all proceeds will support the development of the software and MVPs currently placed in Guatemala. Bitlumens token can also seen as a loyalty token allowing investors to show their affiliation and level of support in the project. It does not represent equity.

The utility tokens are initially distributed in a presale (pre ICO) which starts on April 26 and lasts until April 30 at midnight CET. A maximum of 10 million BLS tokens are offered during a 72 hour pre ICO at a price of 1000 BLS /ETH. Only payments in ETH are accepted. Bitlumens assists parties preferring to participate in the pre ICO in fiat currency. If all 10 million BLS were sold in the pre ICO about USD 11 million would be raised (assuming a ETH/USD rate of 1100).

The duration of the ICO is 28 days. It starts on May 1 at midnight CET and is divided into 4 periods (see Table 4). On the first day of the ICO BLS tokens are offered at a price of 700 BLS /ETH. Between the 2nd and the 7th day, the price is 650 BLS/ETH and between the 8th and the 14th day the price increases to 600 BLS /ETH. Finally, during the last 14 days of the ICO the price is 550 BLS/ETH.

	BLS /ETH
Pre ICO	**1000**
ICO Day 1	**700**
ICO Day 2-7	**650**
ICO Day 8-14	**600**
ICO Day 15-28	**550**

Table 4: ICO Price Schedule

The ICO will terminate early, if an equivalent USD 25 million have been raised. This amount corresponds to the projected funding and investment needs for a period of 3 years.
The total supply of tokens is capped to 50,000,000, with the smallest available denomination being 0.0001. The detailed allocation of BLS among the various stakeholders is shown in Table 4.

Allocation	Number of tokens (in million)	in %
Total	**50**	**100**
Pre ICO	**10**	**20**
ICO	**20**	**40**
Bitlumens	**9**	**18**
Team and Advisors	**10**	**2**
Bounty	**1**	**20**

Table 5: Token issuance

KYC/AML
AML/KYC for the ICO phase is currently handled by the best industry practice in Switzerland.

Team

Veronica Garcia: CEO/Founder, Veronica Garcia has been an investment consultant at Credit Suisse and UBS. After finishing her graduate studies at the ETH in Zurich she joined the IBM Research Lab in Zurich. She had worked as a consultant for the World Bank, IADB and Castalia.

Daniel Heller: CIO, Daniel Heller has been associated with the Peterson Institute for International Economics since January 2017 as a visiting fellow. Before joining the Institute, he was head of financial stability at the Swiss National Bank, head of the Secretariat of the Committee on Payment and Settlement Systems at the Bank for International Settlements, and executive director for Switzerland, Poland, Serbia, Azerbaijan, and four Central Asian republics at the International Monetary Fund. He received his PhD from the University of Bern and was a research fellow at Stanford University. His academic publications are on optimal design of bond auctions, demand for central bank money, and collateral requirements for over-the-counter (OTC) derivatives clearing. His current research focuses on the impact of emerging digital technologies such as blockchain on the financial sector, financial stability, and central banking.

Ali Askar: CTO, Ali used to be a cloud solutions consultant and network security architect at Akron Telecoms. Ali possesses sound expertise in designing, deploying, and administering cloud services to support our platform product as well as custom applications.

Stefano Battiston: Advisor, is SNF Professor at the Department of Banking and Finance of the University of Zurich. His work applies the complex networks approach both to the empirical analysis of large economic networks and the modelling of their dynamics. Since several years, his main interests have been financial contagion, default cascades, and propagation of financial distress, where he combines the insights from the statistical mechanics of networks with the analysis of economic incentives.

Thomas Kansy: Advisor, Thomas is an experienced quantitative modeler and designs and carries out complex research on the relationship of asset values and regulation. Thomas has worked with a broad portfolio of public and private clients, including multinational energy companies, multi-lateral organisations such as the OECD and World Bank, governments across the world, and the European Commission.

Herbert Sterchi Advisor, Herbert has been the Lead Finance at Thomson Reuters Global Resources. He specialized in accounting processes, SAP implementation and audits based on IFRS. He had pioneered controls and procedures, bringing increased accountability to technology and content development and reducing overall spend while increasing product functions and features and reducing time to go to market.

Rekha Jain, Developer, Rekha is a senior Java/J2EE developer of working at Cygnet Infotech, having rich experience developing cloud ready scalable applications. She is an analytical thinker that resolves on going issues or defects, often called upon to consult on problem that have eluded resolutions by others.

Priya, Designer, Priya is a senior graphics designer working at Cygnet Infotech, having rich experience in user interfaces and user experience. She is a creative designer & feels a creative release when dots connect, things fall into place for better visuals.

Nirav: Java Architect, Nirav is a Java architect working at Cygnet Infotech, who is known for innovative ideas and transforming concepts to realities. He is passionate about innovation, communication, and teamwork to ensure quality, timely project completion.

David Morton: Advisor, Originally a computational physicist, he developed and tested new algorithms for the first European robo advisory, the Swissquote's e-private banking platform. In 2013, David published his doctoral dissertation on robo advisory focusing on portfolio optimization, behavioral aspects of investment and optimal risk forecasting. David is currently the lead engineer at Credit Suisse for the development and implementation of the bank's new goal-based investment process.