



# CandelaCoin

## WHITE PAPER

*Decentralized solar energy and software that utilizes blockchain technology for peer-to-peer energy transfer and the democratization of energy.*

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# ABSTRACT

Ditch the grid with Candela Coin! Candela Coin is a token that allows holders to take part in the groundfloor phase of decentralized solar energy and a blockchain based peer-to-peer energy transfer platform. People across the globe will be able to transfer solar energy to others in their communities using candela coin as a medium of exchange. Blockchain-based peer-to-peer transfer allows users to buy, sell, or store solar power allowing energy to be more accessible and sustainable for the world. Our vision is to decentralize and democratize the consumption, transfer, and production of solar energy. With Candela coin, we remove the need for large monopolies and power companies that control the price and supply of the power we rely on, putting the power back in the hands of we the people.

The age of transactive energy in the sharing economy is upon us, and its wide spread adoption depends on a secure and robust means for rewarding participation. Digitization is coming to the energy industry as many key network, sensor, computing and communication technologies make it possible to drive decentralization of the electric grid and energy market. Tokenization will play a vital role in securely exchanging grid edge data between users and devices, safely opening up the electric power market to broad participation. Peer-to-peer exchange of energy is upon us!

# INTRODUCTION

All across the world the new energy consumer wants comfort, security, a more engaging relationship, and a promising future for energy production. A democratized energy marketplace is the only way to achieve this promise, and the Candela Coin team has developed a key piece of this paradigm shift. With Candela Coin, we are reimagining the customer's role in, and access to, increasingly open and competitive solar electricity markets. The energy market is currently facing challenges with its centralized conventional power stations and grid that require high costs to maintain. This means higher costs for the consumer. The existing electricity and power model will not be able to keep up with the increasing electricity demand with its centralized grid and infrastructure. Costs will rise dramatically. Consumption is expected to more than double by 2050. A paradigm shift is necessary. A shift to decentralized solar powered microgrids made up of people is what we are building. We want communities to create their own decentralized solar energy.

Blockchain technology can benefit and accelerate the shift to solar energy. It fits perfectly into the renewable energy sector because it allows direct peer-to-peer transactions between users, and offers transparency and local energy self-sustainability. This project aims to create truly decentralized solar energy across the globe made up of we the people, instead of the power companies or middlemen. This will allow peer to peer production and transfer of solar energy. Utilizing blockchain technology allows us to create seamless production and peer to peer transfer of solar energy. We share many things with those in our community. There is constant exchange and interaction with those around us. The one thing we haven't been able to share is the very thing needed to make any of it happen: Energy.

This will reduce disruptions caused by incidents hundreds of miles away such as hurricanes and leave you unaffected. While the rest of the city may lose power, your family and community will be okay. Energy decentralization and democratization has come. Embrace it. In this paper, we link the technical value domains to the services that consumers, prosumers and third parties can provide to one another and to the electric power system.

# THE CANDELA COIN DIFFERENCE

The concept of utilizing blockchain to decentralize power and energy is a new but not novel concept. However, there have only been a handful of attempts in the past to even begin to take the depth of the challenge presented to us with the goal of democratization and decentralization of energy for all. So what makes Candela coin different? Candela coin's goal is to create a seamless single point of transaction for easy buying, selling, and storing energy. Past attempts have been unable to bridge the gap with some offering secondary markets, lack of liquidity, multi-token systems, or even inviting large corporate entities to invade the technology.

Candela coin's goal is to truly democratize and decentralize energy for all so that the world is no longer dependant on large monopolies and corporations for their energy. We aim to do this by removing the current infrastructure that keeps our nations tied to these corporations and entities. We are offering innovative IoT hardware that enables users to receive and store energy, while at the same time giving them a single point of seamless transaction to buy and sell energy. We are truly aiming to empower the people.

Candela's open-source ecosystem allows users to participate in every way possible. Everybody is a contributor. Candela coin is unique in that it allows users who aren't prosumers to add liquidity to the energy market. By doing this we believe that we can truly democratize and decentralize energy.

# THE PROBLEM

The energy market is currently facing challenges with its centralized conventional power stations and grid that require high costs to maintain. This means higher costs for the consumer. The existing electricity and power model will not be able to keep up with the increasing electricity demand with its centralized grid infrastructure. Costs will rise dramatically. Consumption is expected to more than double by 2050. Many problems we face also include power company monopolies and duopolies, poor service or non-functional service during times of crisis, inclement weather, or in developing areas. There are also the issues that stem from government regulations. With the power companies if you don't pay for monthly service your power is shut off. With candle you use what you buy. It's like going to the grocery store. Get power without a power company.

If a prosumer wants to sell their excess solar energy back to the grid, they are given cents on the dollar. Our solution would allow them to get more money for their excess solar energy as well as reduce the costs for the consumer. Our economies run on energy, but the current energy system is costly and inefficient. Creating useful energy is one of the dirtiest and most wasteful things we do, from mining, refining and burning fuel, to transporting electricity across long transmission and distribution lines. In the US, some estimates show an 86 percent inefficiency in converting and transporting energy into the useful product that powers modern lifestyles and economic productivity. This creates unintended and costly health and environmental challenges, from asthma to climate change, and a significant loss of economic value. It turns out that the U.S. economy is not especially energy efficient. Of the total high-quality energy consumed to support economic activity in 2010, only 14 percent was converted into useful work. In other words, the American economy wasted 86 percent of all the energy used that year in the production of goods and services. One can easily imagine that waste of this magnitude creates an array of costs that weakens the nation's economic and social well-being. This problem has emerged because in the current power sector business models, utilities use outdated constructs of its consumers as rate payers; missing the opportunity and value only a customer can provide. Companies earn revenue based on producing energy at the center of the utility grid, in large power plants, and pushing it to the grid edge where it "serves the load" as it is consumed. Companies generating and distributing power are accustomed to roughly 10 percent returns on their capital investment. This model locks in profitability for regulated electricity companies, but discourages innovation and saddles consumers with decades of legacy costs.

In newly-electrifying countries, a centralized grid is too costly and sluggish for the needs of the one billion people without energy access today. As demand grows, it also becomes more distributed. It is harder and more costly to predict and balance supply and demand while lacking visibility into millions of new consumer devices and distributed energy resources popping up at the grid edge. These trends are tearing apart existing utility business models and spooking shareholders and analysts alike.

## PROBLEMS IN THE MARKET TODAY



Centralized model



Locks in models of energy waste



Lack of consumer choice



Electricity networks in need of expensive upgrades



Financial models are locked in

Laitner, Skip. Linking energy efficiency to economic productivity: recommendations for improving the robustness of the U.S. economy, WIREs Energy Environ 2015, 4:235–252.

doi:10.1002/wene.1352 See for instance California Public Utilities Commission:

[http://www.cpuc.ca.gov/uploadedFiles/CPUC\\_Public\\_Website/Content/About\\_Us/Organization/Divisions/Policy\\_and\\_Planning/PPD\\_Work/PPD\\_Work\\_Products\\_\(2014\\_forward\)/PPD-An-Introduction-to-Utility-Cost-of-Capital.pdf5](http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/About_Us/Organization/Divisions/Policy_and_Planning/PPD_Work/PPD_Work_Products_(2014_forward)/PPD-An-Introduction-to-Utility-Cost-of-Capital.pdf5)

Though examples abound in countries facing higher penetration of renewables, see for instance how PJM market operators push back with even further subsidies that drive up costs for consumers.

<https://www.utilitydive.com/news/pjm-price-formation-proposal-would-dramatically-change-how-prices-are-set-i/511053/>

# THE OPPORTUNITY

We are providing the infrastructure to allow users to have open access to decentralized and democratized energy for all. Blockchain technology can benefit and accelerate the shift to solar energy. It fits perfectly into the renewable energy sector because it allows direct peer-to-peer transactions between users, and offers transparency and local energy self-sustainability. This project aims to create truly decentralized solar energy across the globe made up of we the people, instead of the power companies or middlemen. This will allow peer to peer production and transfer of solar energy. Utilizing blockchain technology allows us to create seamless production and peer to peer transfer of solar energy.

This opportunity is not only about technology, it's about the way the technology is adopted by consumers, not by regulated companies. Consumers will continue to buy and use smart phones, smart appliances, and distributed renewable energy, because they think it improves their lives. Our vision is that people, communities and energy consumers everywhere can show their demand for decentralized solar energy—not wasted energy—in our global system by resetting the rules of the marketplace.

Decentralized solar power will change the way we think about community and how we can interact with our neighbors. Using solar panels owned by local prosumers (individuals who produce solar electricity with their solar panels), it allows for additional power generation, storage, and energy transactions between households. Neighbors can harness excess energy and sell it to other tenants in their building or neighbors across the street or in the community, utilizing blockchain technology. This exchange of energy will be made possible with Candela coins, IoT devices and peer to peer exchange/marketplace software. It enables the transfer of energy between prosumers and consumers. It also provides real-time analysis and marketplace data. It allows you to put a human face to your energy provider. Not just any face, your community members.

Today's Market Assumptions	The New Reality
Consumers have no frame of reference for a kWh —it is a metric with no intrinsic value, only relative value.	New expectations for local or green products, convenience or resiliency.
Our entire focus is on managing from the center, and the supply side.	Grid problems almost always come from the edge, not the center, making them very hard and expensive to resolve.
Infrastructure capital costs are repaid by consumers through broad, not specific, pricing mechanisms.	Traditional energy generation struggles to compete and recover costs due to ever- cheaper renewables.
Building more generation and grid infrastructure is the only way to manage distributed energy resources.	Better smart utilization of the grid reduces costs for customers and increases security.
Time and location of production and consumption are not fully valued.	Time and location—along with other attributes —matter a lot and will have significant value.
Few centralized nodes and limited data.	Big data and millions of new devices exist at the grid edge.

Table 1 Why the market is changing

<https://www2.deloitte.com/us/en/pages/energy-and-resources/articles/the-math-series-solving-for-disruption-in-US-electric-power-industry.html>

<https://microgridknowledge.com/microgrid-2017-com-ed/>

## THE TIME IS NOW

The new reality for the energy industry is one in which the technology to achieve these goals is available to us. Innovators have already begun to create solutions to decentralize energy consumption. However, these solutions have fallen short of truly decentralizing and democratizing energy production and consumption. Some may require multiple steps and complicated secondary markets, or rely on existing solar panels and grid infrastructure. Some even focus specifically on allowing corporate entities to work into their system, effectively transferring the current power paradigm to the blockchain. All of which still fall short of Candela coin's true goal of open access, democratization, and decentralization of energy for all.

The only way forward is to reimagine how we value, transact and consume energy. This is 'transactive energy,' This will transform energy markets and reward consumers with better energy services than what would come from utilizing the existing grid. In order for this model to function, a transactive energy platform is urgently needed. With Candela's open source model, we don't have the same restrictive costs, infrastructure, and regulations that the utility monopolies have. By removing these barriers we could reduce the price of electricity and improve the service. It's important to do this now because in the future the power monopolies may attempt to lobby for regulations to prohibit a decentralized system such as ours.

# THE SOLUTION

Get power without a power company. We propose that the answer to these mounting concerns is Candela, a blockchain based system that functions across connected hardware (IoT devices), a token system for transactive energy (Candela Coin), and a foundation that advances market design and technology in tandem.

We want communities across the world to create their own decentralized solar energy. Individuals in the community will own their solar panels and can sell their excess energy to others in the community. We envision that people with solar panels, small and large, will all be able to contribute electricity to the Candela system. If a user wants to sell their solar energy back to the grid, they are given cents on the dollar. Our solution would allow them to get more money for their solar energy as well as reduce the costs for the purchaser.

Candela uses an IoT metering device that runs blockchain technology, giving it capabilities not currently available in many energy markets. First, it shows solar panel owners how much energy they're producing, rather than having them trust the local utility to calculate the amount. The blockchain also enables the direct transfer of energy between users and dramatically reduces the costs of such transactions. The community marketplace solution offers a compelling way for users in a community to buy and sell solar energy. Users can easily make an offer, create a budget, or even sell their own power on the marketplace.

Candela can manage the flow of electricity and the exchange of energy within electric power systems through the formation and delivery of pricing signals, use of predictive analytics and automation of activities, which reflect true cost of local service. This can all happen behind the scenes, at the machine-to-machine level. The system unlocks value to be assembled in new ways and priced appropriately. Transactive energy, properly implemented, represents the fairest allocation of risk and reward enabling new business models that provide services to participants. By rewarding efficiency and flexibility, the system has the potential to activate value for customers and create new ways to manage and invest in the responsive grid of the future, which is beneficial in developed economies, and it can be transformative in newly electrifying ones. Candela can provide a wide range of benefits throughout the electricity market and ecosystem. In addition to clear value for market participants (described in detail further below), Key outcomes include:

1. Efficient and adaptive market pricing
2. Improved system reliability and flexibility
3. Pathway for technological innovation
4. Improved balance of risk and reward for asset owners
5. A rich, interactive future for an energy industry serving informed communities

Blockchain technology is an innovative method of storing and validating data that permits direct transactions between energy prosumers and consumers. Transactions are trackable and tamper-proof on distributed systems without the need for centralized monitoring. Thanks to the blockchain, the possibility of manipulation is virtually eliminated. In addition, authentication processes guarantee the confidentiality of user data. The combination of a decentralized solar energy solution and blockchain technology will make it possible for a person who owns photovoltaic systems to sell solar energy and receive payment from other users.

## MARKET SIZE

Global electricity markets are enormous. In 2016 alone, \$718 billion was invested in the electricity sector worldwide, and investor-owned utilities in the US collectively generated \$350 billion in revenue. <sup>10</sup> According to the International Energy Agency, the world will need to invest \$44 trillion in global energy supply and another \$23 trillion in energy efficiency to meet current climate policy goals and forecasted growth in energy demand through 2040. We have calculated that a mere one percent savings in energy investment will be worth \$670 billion by 2040. As industry trends accelerate, we believe that the value of decentralized assets and services can be more fully captured in a transactive energy system. The market is much larger than simply extrapolating energy generation and consumption metrics, it includes the wealth of value associated with new data availability and flexible grid services. And value accrues to a wide range of market participants: consumers, generators, and other technology vendors. In the short term, conservatively estimating market value based on near-term use cases with today's compensation mechanisms, there exists a \$90 billion total addressable market for Candela. By 2025, reasonable forecasts show this growing to \$200 billion, with an estimated annual value of \$25 billion passing through the Candela system.

## THE PRODUCT

Candela creates the ability to buy and sell solar energy between users. We use the ethereum blockchain to secure and manage the data needed to create marketplace transactions. The Candela Coin provides the incentive for energy prosumers and consumers to contribute and participate in an energy marketplace. Candela is based on a market model called transactive energy, which refers to economic and control techniques that enable broad participation in the new multi-party energy system, and designed to provide all market participants more opportunities to connect.

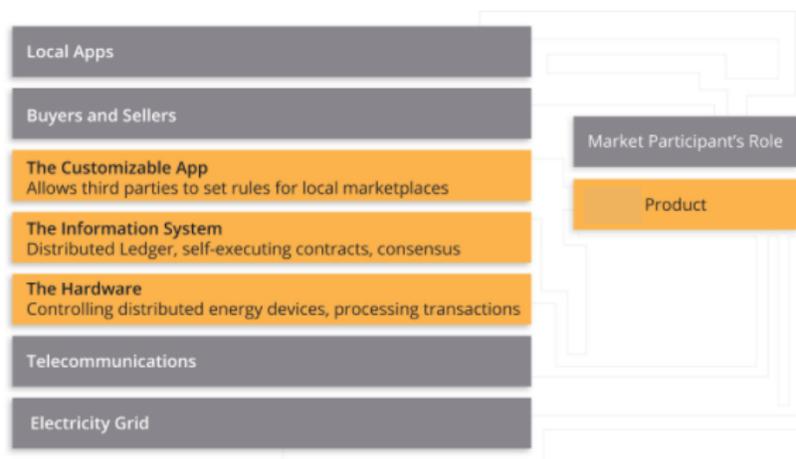


Figure 1. Transactive Energy Stack

EEI, Annual Financial Review, 2016. Accessed at:  
[http://www.eei.org/resourcesandmedia/industrydataanalysis/industryfinancialanalysis/finreview/Documents/FinancialReview\\_2016\\_02\\_IndustryFinPerf.pdf](http://www.eei.org/resourcesandmedia/industrydataanalysis/industryfinancialanalysis/finreview/Documents/FinancialReview_2016_02_IndustryFinPerf.pdf)  
<https://about.bnef.com/blog/market-digitalization-energy-sector-grow-64bn-2025/>

## MARKETPLACE/TRADING SOFTWARE

Candela marketplace enables prosumers, consumers, and commercial producers to introduce a unique energy marketplace so all members of the community can trade energy in order to achieve both personal and community energy goals. This is a marketplace designed to directly connect prosumers, commercial producers and consumers to their community.

**Flexible Trading:** Configure your marketplace to trade energy and enable your consumers to source renewables from their local community.

**Powerful Metrics:** Analyze the market with customer and trade analytics, trading dynamics, offer subscriptions, and other configurable analytics from prosumers and consumers in an easy-to-use portal.

**Personal Energy Management:** Lead prosumers and consumers on a new energy journey, starting with valuable energy tools on a branded mobile application, to learn about their energy profile and renewable engagement opportunities.

**Highly Extensible:** Securely integrate to third-party software and energy devices to power your marketplace and streamline your customer's experience.

**Simple Deployment:** Launch a marketplace in 90 days with a team of experts who partner with you through every implementation stage from design collaboration, to test and turn up, and ongoing support.

**Secure and Scalable:** Purpose built using Blockchain technology to ensure personal and system data security from day one and as trading transactions scale.

# CUSTOMIZABLE APP

Candela offers participants the ability to engage in the transactive energy marketplace on their own behalf. Communities will be able to use the system to set the rules of their decentralized solar energy or other applications, utilizing the token to incentivize the recruitment of new prosumers. We have described the token interactions within the use cases below. As discussed, network participants need only the use of a smartphone app and Candela Coins to be engaged in the Candela marketplace. We are developing a mobile app soon to be available globally to third parties who can use it to set up decentralized solar power and access the services of the Candela platform, including establishing market participants and marketplace rules.

# HARDWARE

We are in the process of developing a Candela-enabled IoT hardware device that functions as a distributed computing node and an asset control switch. This device provides the control layer to translate economic signals from Candela's transactive energy layer into physical device control algorithms to enable functionalities in local generation, storage, and smart device operation desired by the market. This device permits the designation of certain kWh units of locally produced energy to be marked and offered for consumption by adjacent local participants using the same component. The transaction is "cleared" within this system between the meters through machine-to-machine management of distributed ledger entries.

This IoT metering device runs blockchain technology, giving it capabilities not currently available in most energy markets. First, it shows solar panel owners how much energy they're producing, rather than having them trust the local utility to calculate the amount. The blockchain also enables the direct trading of energy between households and dramatically reduces the costs of such transactions. Rather than tie the Candela system exclusively to Candela devices, other 3rd party Candela-compliant hardware can be brought into the network through a light client-and-partnership approach (described further below). Incentivizing and enabling interoperability of a wide range of devices will allow other technology vendors to accrue value from Candela while accelerating network growth through their own contributions. In being device-agnostic, device control algorithms have been developed to be compatible with the vast majority of commercial communications protocols.

Prosumers and consumers are able to use solar panels both stationary and personal, they are not restricted to just rooftop solar panels.

# CANDELA FOUNDATION

The Candela Foundation exists as an agency interested in advancing policy and technology of the Transactive Energy system. The Foundation is chartered to advance market participation inline with token distribution, monitoring adoption and ensuring that the benefits of the Candela system are being realized fully in the real world. The Foundation is set to invest in installation and integration of distributed energy resources including IoT hardware, electricity storage, generation assets, and smart appliances. In most markets, while there may be pilot financing for new solutions and customer trials, there are very real market barriers to turning these into ongoing commercial operations. In other markets, off-grid for instance, the ability for participants to access credit, and therefore basic debt financing, may stand in the way of initial deployments. By directing funding toward third party developers that can build on the Candela marketplace where participants hold the Candela Coins (CLA tokens), the Foundation has the capacity to provide an early market structure within which to grow and integrate—along with the combined efforts of 3rd party developers and network partners—toward utility scale impact. In a decade, we anticipate that Candela will be a new normal; a standard protocol stack advanced by a commercial network of market participants that benefit from predictability in a functioning marketplace that allows them to invest in the capital costs required to deliver value added services. Candela is poised to be one of many commercial actors developing services on the platform. Support for projects can be distributed in ways similar to how they flow today but with much more transparency and assurance that they reach the right market participants for the right reason and result.

A number of solutions for managing distributed energy resources exist without operating on blockchain technology. At least in the near term, a number of technical approaches will coexist, and in some cases may be complementary. We envision the advent of transactive energy operating on blockchain technology unleashing the power of consumers to achieve some of the same optimization benefits, but with greater potential to scale at lowest cost in the future. Blockchain improves our system by allowing us to give untrusted third parties control over smartcontract marketplaces and data value-added processes, and allowing them to settle transactions within the network.

<b>Candela Is</b>	<b>Candela Is Not</b>
A decentralized solar energy peer to peer exchange platform	Strictly a settlement platform (settlement is just one of the functions it can provide)
Global in scope and highly scalable in design	Limited geographically or to specific market designs
Creating new value-added services (such as local energy) and valuing grid services	Focused only on electricity sales of today
Designed to operate with or without underlying grid infrastructure	Focused narrowly on financial transaction settlement

# USE CASES

## Use Case 1: Peer-to-Peer Energy

Electricity retailers and distribution utilities generate revenue by selling electricity to customers and ensuring a reliable power supply. Last year, Europe’s 260 million electricity customers paid more than €115 billion for their electricity. Across the US, EU and Australia, customers paid \$185 billion. As DERs continue to proliferate, so too will the ability to transact locally with other network participants. As the Candela network grows, we envision that an increasing amount of this power will be sold not between utilities and customers, but between customers themselves, peer-to-peer, on the Candela platform.

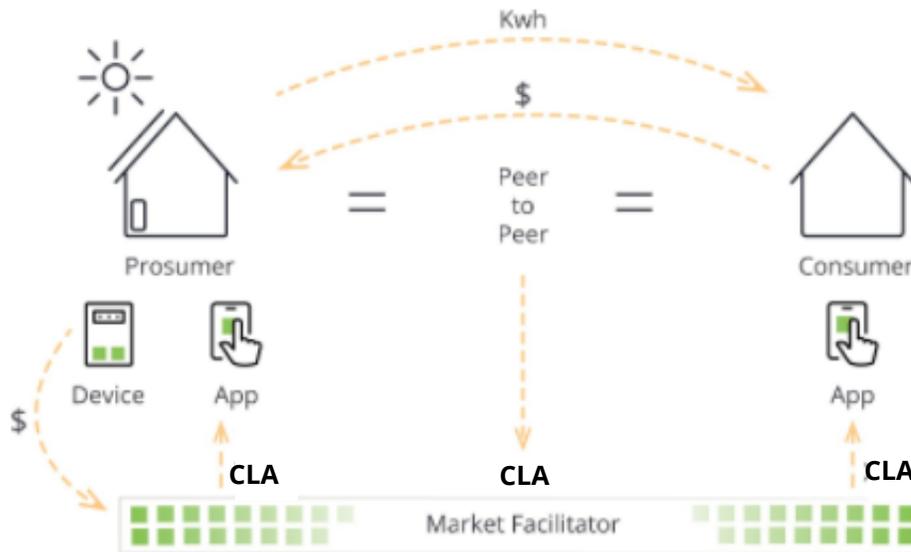


Figure 2 Peer-to-peer (P2P) energy use case

**Step 1:** John is a ‘prosumer’ with solar panels on his roof. He buys a Candela compliant metering device.

**Step 2:** John downloads the mobile app that lets him join his local community solar energy exchange. The app is enabled by his own CLA token, or by one provided for that purpose by an interested third party.

**Step 3:** John uses CLA tokens and his metering device to join the local marketplace.

**Step 4:** John earns CLA tokens for selling his power to his neighbors on the local market.

**Step 5:** His neighbor also downloads the app because she wants to buy power from John. She sets her budget for local renewable energy in the app and pays with CLA tokens.

Participant	CLA usage	Exchange	Incentive
Prosumer (selling services)	Uses CLA with a compliant hardware device in order to claim the profits from an asset in the marketplace.	Pay for a meter, Pay for electricity, Withdraw revenue	Prosumers are able to sell services—including local energy—into the marketplace
Consumer	Uses CLA with an account in the app to participate in the marketplace. No compatible hardware device is required.	Pay for electricity.	Consumers are able to buy a new product, local energy, and reduce network charges.

## **Use Case 2: Decentralized Solar Energy Matrix**

We plan to help communities across the world develop their own decentralized solar energy matrices. This will allow peer to peer energy trading between prosumers and consumers in the community. Matrices today encompass a range of integrated grid-edge hardware and software technologies to operationalize closed, efficient, clean-energy systems ranging in size from a hospital or campus to a military installation or entire island nation. These resilient systems can be tied to existing grid infrastructure or deployed as a standalone entity—vital to the effort to bring electricity to the 1.2 billion people still without power around the world. The market is set to nearly double in value to \$23 billion by 2021. Solar energy matrices represent the decentralized infrastructure model of the future, and Candela can be the enabling functionality to accelerate deployment around the world. Solar energy matrix project developers, operators and other hardware vendors all see additional value by earning and holding CLA tokens. Candela can improve system-wide operational efficiency by responsive load management, thus improving return on investment (ROI) and economics for developers and operators. It will allow monitoring of excess capacity and potential to sell to other consumers in other matrices as long as they are connected, or otherwise find value for the storage and other services available from your matrix. Data transparency and uniformity across project portfolios will further support the ecosystem.

## **Use Case 3: Connectivity Event**

Our role is evolving as more activity is required to ensure real and reactive power requirements are met in a world of distributed energy resources. At some point there could be the possibility of a connectivity event. All the matrices could transfer electricity/energy between each other. According to the International Energy Agency, smart demand response alone could save \$270 billion globally in investment in new energy infrastructure that would otherwise have been required by 2040. Already the Demand Response Auction Mechanism in California is showing that up to \$27 million may be spent annually to deliver demand shaving. The data is worth more or less depending on the location and timing.

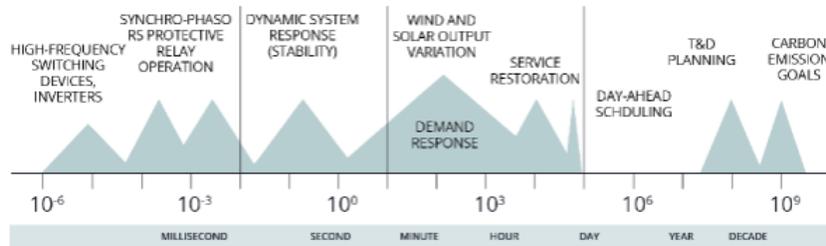


Figure 3 Demand Response by Source

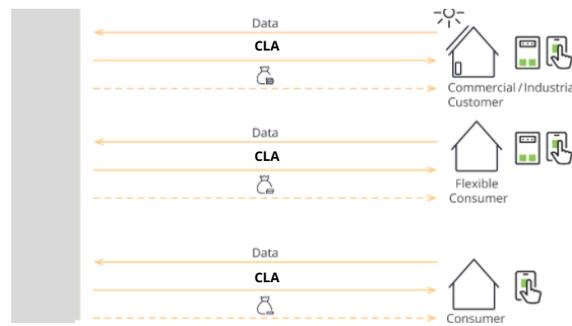


Figure 4 DSO use case

<https://www.greentechmedia.com/articles/read/californias-dram-tops-200mw-as-utilities-pick-winners-for-distributed-energy#:~:text=California's%20DRAM%20Tops%20200MW%2C%20as%20Utilities%20Pick%20Winners%20for%20Distributed,solar%2C%20storage%20and%20demand%20response.>

### Use Case 4: Electric Vehicle smart charging

Electric vehicle adoption is accelerating rapidly. In 2016 the total number of electric vehicles topped 1 million for the first time; today there are already more than 2 million. By 2025, 40 to 70 million are forecasted. At ~3 MWh of power consumption per year per vehicle, these new cars will consume the output of one hundred new 400 MW combined cycle natural gas power plants every year. Where, when, and how drivers charge their EVs will be an increasingly important challenge—and opportunity—for managing the grid. Today, in the US alone, that market is \$250 million. Globally, by 2025, it will reach \$25 billion.

# USE CASE PIPELINE

Other use cases are being explored and will be piloted via forthcoming projects announced soon. These include managing transactions for grid services, wholesale electricity market trading and settlement, and enabling monitoring and verification for demand response programs. These use cases carry clear market values for services necessary to manage changes in power market dynamics already underway. The advanced energy sector is estimated to be a \$1.4 trillion global market. Looking forward, Candela will enable an entirely new set of market mechanisms and services.

## SCALING TO MEET FUTURE DEMAND

Our dedicated team is committed to rapidly scaling and opening up the information and marketplace app and solar energy matrix devices to create global impact. The Candela Foundation opens up the broader network of global participants that we know are actively developing and influencing markets today. With the CLA token, everyone can own, participate in, and profit from this new system to access cleaner and better energy services, creating the most productive economies possible with the mechanisms to scale ongoing investment and improvement over time.

## GO TO MARKET STRATEGIES

Candela is designed to bring the power of markets to individuals and communities. We see overwhelming value potential in the Candela system, and realizing Candela's full network effects will require commercial strategies to reflect consumer demand, management of commercial partnerships, optimal token distribution, sound governance and incentives to promote growth and adoption. This includes allowing third party device manufacturers to build Candela compatible devices for microgrids.

These strategies will be pursued in the interest of increasing our market access:

1. Establish partnerships to maintain focus on data access and control and network development.

Cost and timelines for the commercialization of hardware have been central challenges in clean energy markets for the past decade. The Candela team deeply understands production scale-up challenges, commercial financing gaps and the economics of production—and believes Candela's value increases the more hardware manufacturing partners we work with. For the production of Candela-enabled devices as well as other components, we will lean on our strategic partners to deliver physical assets into markets to meet global demand as the Candela network expands. We have begun discussions with leading device manufacturers to enable third party hardware components as clients in the Candela system. These relationships will provide diversified production and accelerated deployment of the hardware necessary to fully animate the Candela system in commercial power markets. Candela is looking to do a number of global projects with partners at varying stages of development.

Projects will range in size from a few participants to hundreds; it's anticipated that average project size will steadily increase as more technology comes online. The majority of the prospective projects are located in North America, Europe and Asia in developed markets. These projects include market participants in various cities and communities. This range of participation can tell us a lot: it signals that these market players are keen to be part of the ongoing value shift and define new roles for themselves as the marketplace evolves. Other use cases where data is the new fuel need to be rapidly tested. Unleashing token interactions is part of the way we do this.

## 2. Incentivized Token distribution

We see early network growth as a key enabler of scale. The goals of distribution are to ensure the rapid adoption of CLA tokens (candela coins) into real-world projects. An app will be available initially for third parties to develop their own solar energy matrix rapidly in on-and off-grid markets. Through the app, CLA tokens will be available to use with devices for participation in the marketplaces in a local area. For commercial service providers, benefits include the value of the data itself and optimizing key business processes such as access to new customers and avoiding acquisition and settlement costs, increased retention, operating at smaller market closing or settlement periods, access to services that allow network operators to avoid or defer expensive network upgrades and improve efficiency, and the ability to aggregate and manage customer load and behavior in new ways. Consumers and prosumers are incentivized to participate to access a new service they may not have been able to obtain before such as verified green energy, local energy, or the ability to engage their electric vehicle as a grid asset. Economic compensation for valuable market behavior is further expected to incent participation. Solar energy Prosumers will be compensated on a monthly basis just for producing solar electricity. They will be compensated in CLA tokens based on the amount of solar electricity they produce each month. We want to do our part to ensure a clean, green future.

# TOKEN MECHANICS

The future decentralized solar energy will be optimally organized in geographic clusters. Interconnected at multiple levels, clustering allows for locally structured markets and balancing areas. Such network design enables efficient operation and a range of valuable services at the grid edge. Increases in grid efficiency and new service offerings can allow economies to become more productive by reducing waste from the outset. The Candela System is designed to promote the most efficient, secure, generation and consumption of energy.

Today, expensive cloud-based infrastructure is necessary for top-down management by distribution utilities and ISOs. Current command and control architectures become impractical, insecure and cost-prohibitive as grid edge nodes – smart assets and distributed energy resources (DERs) – continue to proliferate. The grid architecture of today also locks up data more optimally available to support new incentive structures, behavior and markets. The blockchain is necessary to enable and manage the new communication and marketplace layers underpinning the electricity network of the 21st century. Candela utilizes the ethereum blockchain to unlock this valuable data and enable these new markets.

The blockchain is necessary to enable and manage the new communication and marketplace layers underpinning the electricity network of the 21st century. Candela will use the ethereum blockchain to establish and manage a global network of energy market participants. It will also establish location, security and proof of ownership. The Candela coin (CLA token) is an ERC20-compliant medium of exchange and will be used to attract consumers, prosumers and communities to the marketplace by requiring and incentivizing them to acquire and hold tokens. Prosumers and consumers will be rewarded for participating in local energy markets. Other market participants such as generators, aggregators and service providers can also acquire and hold tokens. Commercial agents can acquire and hold tokens both for themselves and on behalf of (and with the consent of) consumers and prosumers as they see value in the data at the edge of the grid that they would not have access to without significant investment. CLA tokens will be redeemable for hardware and candela IoT devices. They will also be used by consumers to purchase energy from prosumers and possible commercial energy suppliers as well. Prosumers will be compensated on a monthly basis just for producing solar electricity. They will be compensated in CLA tokens based on the amount of solar electricity they produce each month. We want to do our part to ensure a clean, green future. A fixed global supply of CLA will be minted, once, upon the Candela Coin launch event. CLA will be used to access and use mobile accounts and Candela-compliant hardware devices of market participants to enable them to participate in the network. CLA tokens will not be mined.

# TOKEN UTILITY

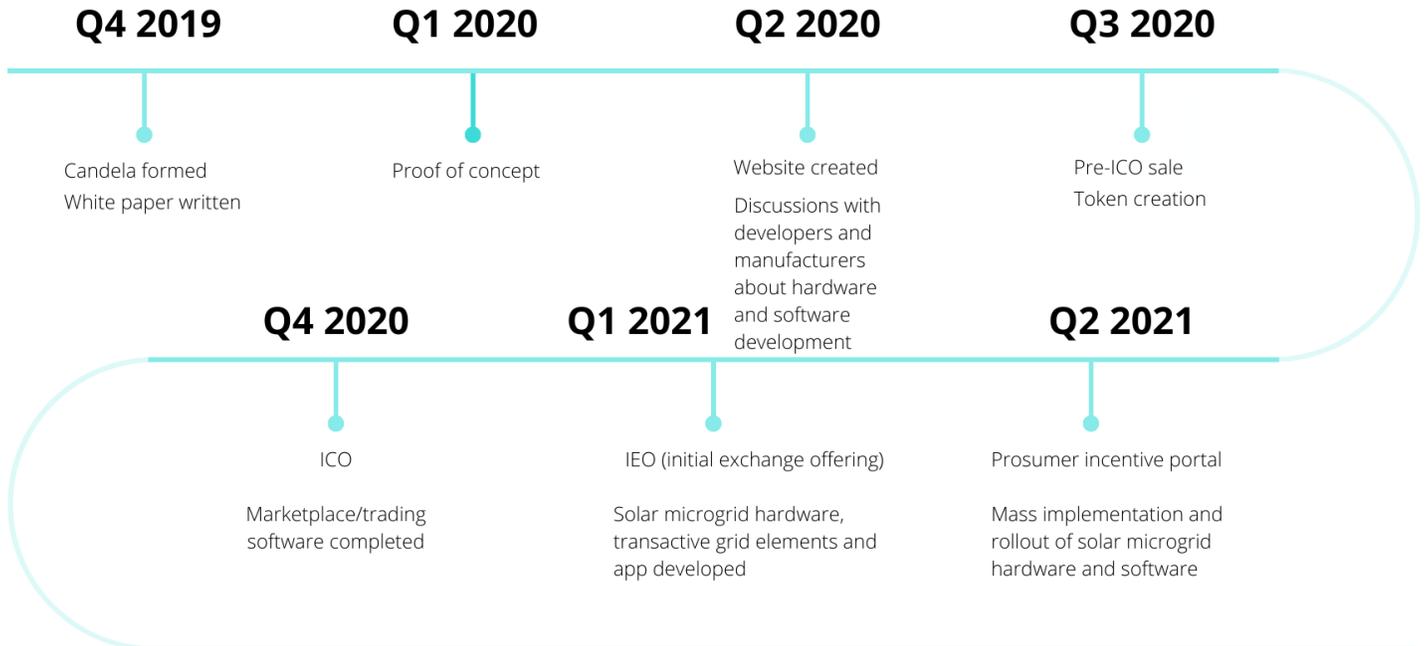
Unlike any other solution currently in existence, Candela coin offers a single coin and a single point of entry for buying and selling energy. We do this by aggregating the average price of a buyer's bid and the average price of a seller's ask to create a seamless transaction experience. Not only are we able to provide the most streamlined transaction experience, but we are also able to ensure liquidity and continuity of power.

To incentivize users who currently have solar panels, we have set aside a reward pool of 5 million tokens. They will be given a certain amount of Candela coins (CLA tokens) per kWh produced. This will go to early prosumers who want to take advantage of our system and platform. Candela users will be able to store energy that was purchased and they can use it or resell it when they choose. Prosumers will also receive candela coins as payment from users who buy their energy.

# THE REVOLUTION

Candela is building confidence in transactive energy solutions and proving the essential role they will play in the future world of energy. Prosumer and consumer energy interactions will be tracked and recorded on the blockchain. Users can set preferences and monitor real-time energy transactions through the Candela mobile app and cloud-based web interface. With a detailed proof-of-concept, and groundbreaking conversations happening around the world, Candela is poised to disrupt the global energy economy and rewrite the rules for how energy can be generated, transferred, and put to use.

# ROADMAP



## TEAM

Candela's core team brings a diversity of skillsets, ranging from hardware development to utility design, technical standards setting, marketing strategy and policy advocacy, financial product design, and complex trading in derivatives markets, distributed energy computing, peer-to-peer consensus networks, cryptography, and cybersecurity, among other disciplines. The team has a unique knowledge base of integrating blockchain and transactive energy elements with physical energy generation and control assets in a regulated environment.

Leadership:

Avi Shane Verdugo - CEO  
Sam Rosenberg - COO  
Aoutman Amenzouy - CTO

# BOUNTY PROGRAM

6,250,000 tokens are to be divided according to the stakes accumulated amongst selected participants:

- signature campaigns on Bitcointalk.org, reddit and other crypto forums
- following and promoting Candela coin social media accounts i.e. twitter, reddit, etc
- publishing and posting candela coin on blogs
- translating content

## ICO DETAILS

By participating in the token sale you will receive CLA tokens. The ICO hard cap will be three million dollars. We will issue 95,000,000 CLA tokens in the ICO. The total token supply is 125 million. 25 million tokens will be given to the team of developers, advisors, escrows, and bounties. 5 million tokens will be set aside for solar prosumers to be used as incentives/rewards. No new tokens will be created.

## CONCLUSION

With blockchain technology becoming ubiquitous, we see its integration into the energy sector as the logical next step. Candela coins are a digital currency and a medium of exchange in solar energy transactions in decentralized solar energy matrices. We will decentralize the energy industry. Decentralized solar power in communities across the globe will lead to lower costs, higher compensation for solar energy prosumers, a reward for solar energy producers, and accelerate the global clean energy transition. Global aspirations of societies today are to create energy resiliency, security, access, decarbonization and democratization at the lowest cost. The trends toward renewable generation and increased electrification to provide for global energy needs also increases complexity within the centralized grid architecture and market arrangements, and the disruption coming to this industry is not in doubt. As these global aspirations are born out at local level, a number of transition issues arise: who pays for the electricity grid as those who can invest in renewables become more self-reliant? How do we avoid outages as we plug in distributed loads such as EVs? How can we most rapidly provide energy access to millions in rural, urban or natural disaster areas without waiting for a centralized grid? How do we ensure renewables are not inadvertently increasing carbon emissions because intermittency requires fossil fuel backup under today's market designs? A more efficient, resilient, and participative electric power ecosystem has never been more needed as our world transitions into a more dynamic and uncertain political, technological and

environmental era dealing with transition to a low carbon and highly automated future. Nor has this type of ecosystem ever been more possible than now, with the rapid advances in affordable DER, edge and cloud computing power, high speed telecom network, IoT, AI, and blockchain.

The work ahead lies in creating a decentralized, efficient way to manage new prosumers and billions of devices coming to electric power ecosystems. The concept described here is the first step for transactive energy application development, highlighting the attributes, their value to the electric power system, and the ways that they can be combined in specific use cases to facilitate the optimal coupling of local electric generation to parties that can value, procure, store and utilize this generation most efficiently. The attributes include information on the load type and proximity as well, and may support users draw from intelligent IoT based controllers that can begin to expose and incorporate the full value streams of smart load management from facility EMS and EV charging.

The concepts described in this paper are intended to frame the potential application of an energy services token system to enable a more decentralized energy paradigm. We are just beginning to see the potential for consumers to optimize electricity systems and the economic utility of them. With Candela, we create the path for participation to enable this new transactive energy marketplace. We can finally share energy. Decentralized solar power will change the way we think about energy. By using solar panels owned and by local community members, it allows for additional power generation, storage, and energy transactions between users. This exchange of energy will be made possible with Candela coins, IoT devices and peer-to-peer exchange/marketplace software. It enables the transfer of energy between prosumers and consumers. It also provides real-time analysis and marketplace data. Decentralized solar energy will reduce disruptions caused by incidents hundreds of miles away such as hurricanes and leave you unaffected. While the rest of the city may lose power, your family and community will be okay. Energy decentralization and democratization has come.