WEC
World Energy Consortium

Executive
Light Paper
2021

WEC Transactive Energy Blockchain

www.worldenergyconsortium.com

Highlights

The World Energy Consortium (WEC) is a provider of a Transactive Energy (TE) ERC-20 Ethereum token-based blockchain global framework that provides energy consumer transactions, energy generation access, and participation in decentralized and wholesale energy markets. WEC's TE framework consists of multiple permissioned TE sidechains as part of the global Ethereum WEC network. WEC's TE framework has just started to be built into a live, multi-faceted, and worldwide platform with the plan to serve an ecosystem potentially encompassing all major energy use cases and sectors for "operational energy," energy events where financial transactions are involved.

The first federation of sidechains and smart contract settlements of the WEC Token provides a unique energy loyalty and reward to energy participants who participate in energy savings, demand response (DR) energy curtailment, energy settlements, micro-renewables, and other energy programs. The initial smart contract settlements for launch will be for capacity and energy programs for curtailment DR, one of the largest sub-sectors in green energy and the one best suited for energy rewards as of today.

WEC's TE framework is being built for the 21st-century grid, characterized by the active "prosumer" (both producer and consumer of energy) participation in energy markets, bidirectional power flows (e.g., net metering of Behind-The-Meter (BTM) resources), and sophisticated financial transactions between prosumers, utilities, and third-party service providers. TE transactions BTM and In Front of the Meter (IFOM) are already on a hockey-stick shape of growth as they are now merging with the increased adoption of smart Internet of Things (IoT) devices, such as connected thermostats and other newly-networked Distributed Energy Resources (DERs) such as renewable energy sources, Electric Vehicles (EV), and Electric Storage Resources at the edge of the grid.

One compelling application for the Token is Virtual Power Plants (VPPs), the start of which is embodied in the adoption of distributed solar generation and the separation of distribution from traditional generation. For the last decade, there has been the ability to aggregate edge grid capacity enabling the creation of Virtual Power Plants (VPPs), and now after years of regulation evolution these VPPs (and the individual end-consumers) can participate in energy markets and can profit as they engage in energy trading between market participants.

This new grid ecosystem will only accelerate growth with the viable introduction of a trusted, energy standards-focused, and all digitized payment and settlement system and Token, and this is the mission of WEC.

WEC's implementations for energy sidechains are projected to be one of the most energy-efficient, encrypted blockchain platforms in the market today, 10x more energy-efficient than any other energy blockchain project we know of. A worldwide platform for encrypted energy transactions that support the transition to renewable generation must also comport to energy efficient operations. Bitcoin uses more energy than the entire nation of the Netherlands, for example. Often, current crypto-driven energy usage is powered by non-renewable power plants. The WEC permissioned sidechain TE architecture will make energy consumption for blockchain processing a non-factor.

The WEC TE Energy framework and platform are designed to accelerate grid evolution and enable the transition to a clean energy generation system and a decentralized and decarbonized economy while supporting equitable settlements for participants in today's wholesale energy markets.

WEC Blockchain Transactive Energy Platform
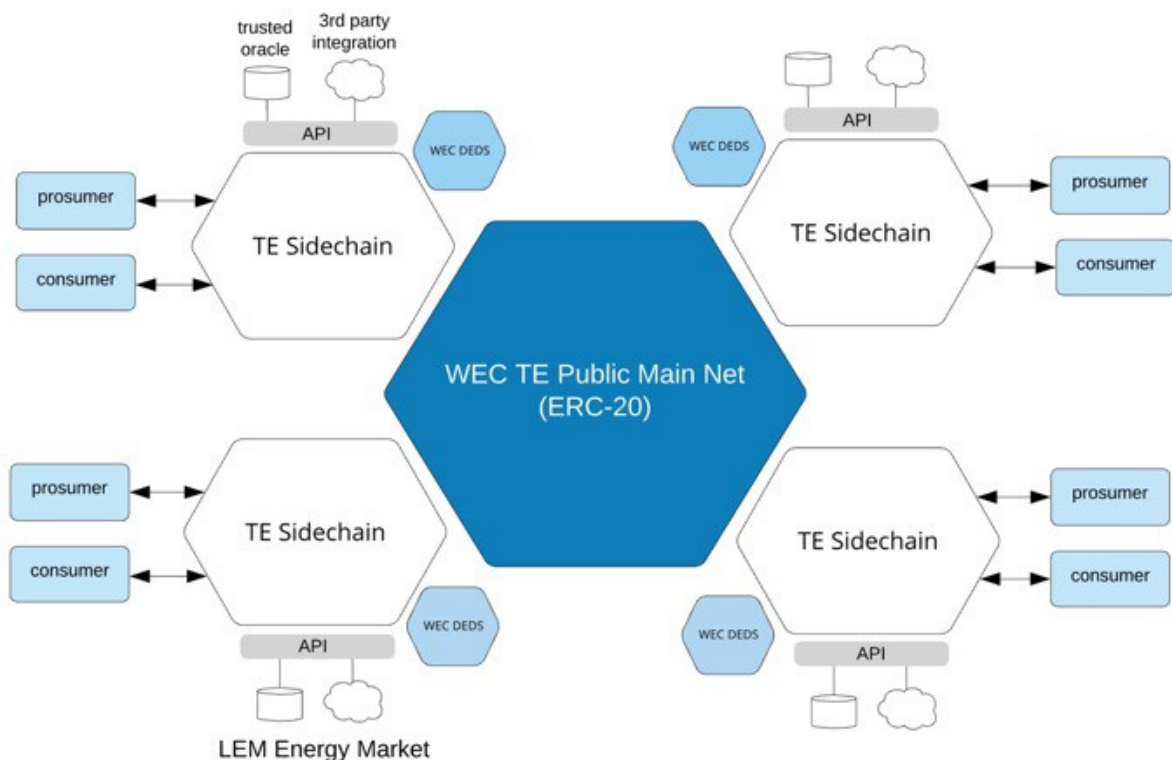
The WEC-TE main reference framework is based on multiple local/regional TE permissioned sidechain blockchain systems that encrypts and records transactions for energy in Local Energy Markets (LEMs) through a secure international ERC-20 Token and settlement standard. WEC TE sidechains are ready to deploy in worldwide regional markets and can scale modularly as more participants and authorities are added to the platform. TE sidechains have a hierarchical design, addressing country-specific energy markets first, followed by a more granular local/ISO and state-specific market designs. Each TE sidechain can be transacted in a local or regional energy market where participants are located. By controlling a WEC digital wallet, they can participate in energy loyalty and reward token program incentives. Collectively these regional sidechains are linked to a universal Transactive Energy Public Main Net, which creates a scalable, locally relevant, and truly global WEC TE Network.

The service guarantees participants will get rewarded and paid for every energy event they support. The building blocks and key elements of the WEC architecture are described below, they are:

WEC TE Core Platform
WEC TE Sidechains
WEC DEDS (Distributed Energy Data Store)
WEC Digital Wallets

Both WEC TE core and sidechains are based on an Ethereum ERC-20 compliant architecture. The smart contracts in the sidechains are specific to the energy token settlements.
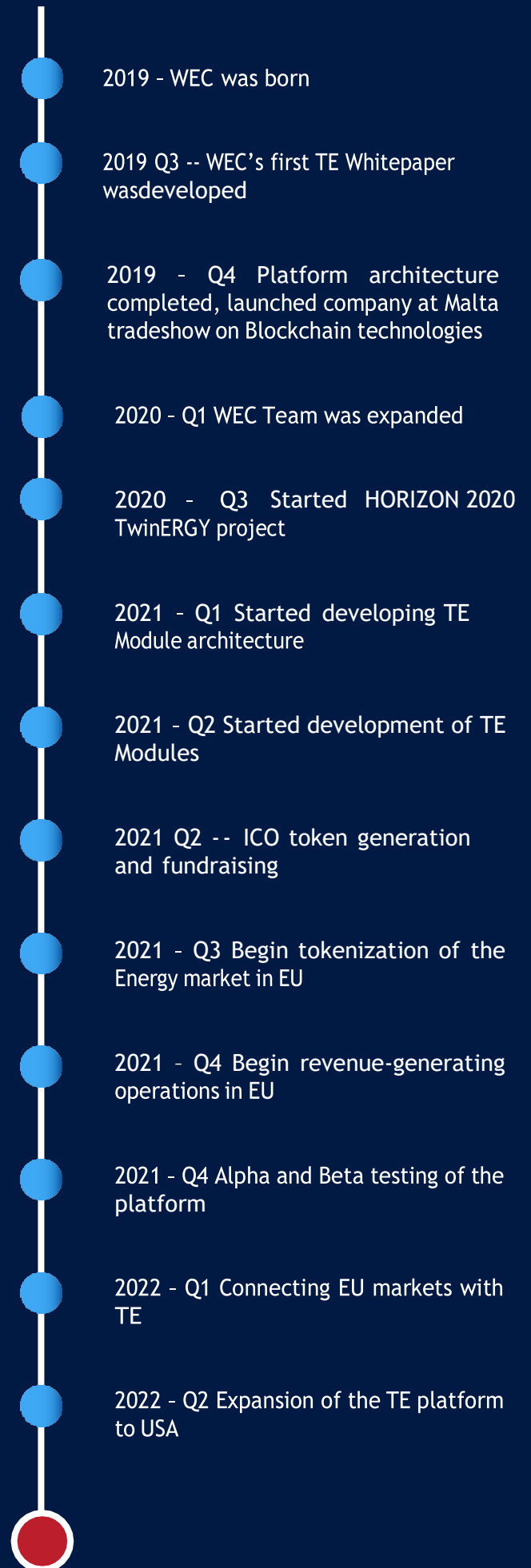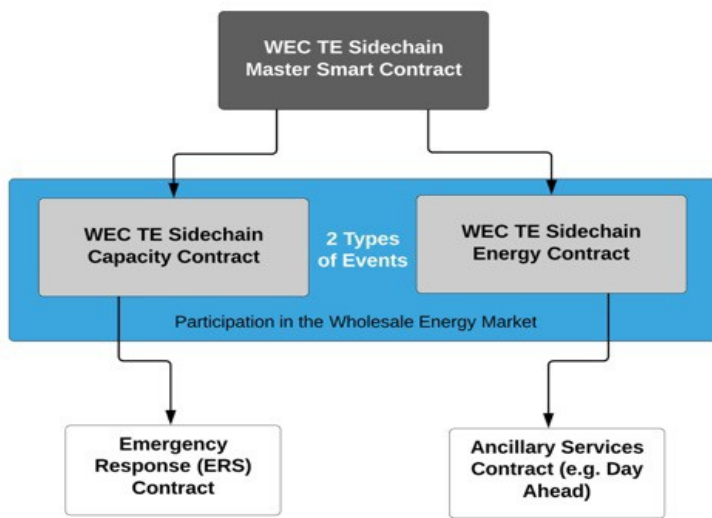
WEC TE Core Platform

The WEC TE platform is an Ethereum ERC-20 compatible public permissionless core global blockchain network that handles all WEC ERC-20 tokens. The WEC TE platform also interfaces with fiat and other cryptocurrencies via cryptocurrency exchange gateways. It provides loyalty rewards to all local WEC permissioned blockchain sidechain TE LEM platforms via WEC Ethereum wallets. This is where the energy market is opened to speculative investment participants through the energy tokens and for individuals commanding energy consumption and/or distributed renewable generation capacity.

The WEC TE Platform is fully compliant with the IEEE's Blockchain Energy Standards and will be the most robust IEEE-compliant Blockchain platform in existence. As detailed in the IEEE paper entitled"DLT / Blockchain in Transactive Energy Use Cases Segmentation and Standardization Framework," by Cali, Lima, Li, and Ogushi, the IEEE P2418.5 Blockchain in Energy Standards provides an open, common, and interoperable reference frameworkmodel for blockchain in the energy sector.

WEC members sit on the IEEE P2418.5 Energy Standards committees and that will provide confidence and trust to the energy community and beyond to rally around the WEC platform solution. It will also ensure technology stability, vendor interoperability, and build-to standards that ease innovation adoption and accelerates mass adoption of energy crypto-settlements.

Our Timeline

2019 – WEC was born

2019 Q3 -- WEC's first TE Whitepaper wasdeveloped

2019 – Q4 Platform architecture completed, launched company at Malta tradeshow on Blockchain technologies

2020 – Q1 WEC Team was expanded

2020 – Q3 Started HORIZON 2020 TwinERGY project

2021 – Q1 Started developing TE Module architecture

2021 – Q2 Started development of TE Modules

2021 Q2 -- ICO token generation and fundraising

2021 – Q3 Begin tokenization of the Energy market in EU

2021 – Q4 Begin revenue-generating operations in EU

2021 – Q4 Alpha and Beta testing of the platform

2022 – Q1 Connecting EU markets with TE

2022 – Q2 Expansion of the TE platform to USA

WEC TE Sidechain Master Smart Contract

WEC TE Sidechain Capacity Contract — 2 Types of Events — **WEC TE Sidechain Energy Contract**

Participation in the Wholesale Energy Market

Emergency Response (ERS) Contract

Ancillary Services Contract (e.g. Day Ahead)

The WEC TE sidechain platform design allows for multiple types of energy contracts to be created in an ongoing manner as more services are added to the WEC platform. This allows for a natural yet structured way for new smart contracts needed for new technology, new products, and new programs to be added into the overall TE settlement system among smart contracts. This modular and scalable smart contract evolution allows new sources of energy market revenue to be harnessed as the energy markets evolve towards a decarbonized economy system. The number and type of smart contracts vary per region and concession zones, by applications and use cases, and by vendor requirements and restrictions.

WEC Capacity Contract

This type of smart contract is used to enroll, transact, dispatch, and process the payment settlement between the parties involved. Typical transactions using this type of capacity market (in kW or MW) smart contract involves DER Aggregators, DSO, and ISO/TSO, including the end-user market participants (e.g., residential buildings/condominiums). A specific settlement protocol for this contract will be maintained and followed for all those nodes subscribing to the contract terms.

WEC Energy Contract

This type of contract is used to enroll, transact, dispatch and process the payment settlement between the parties involved. Typical transactions using this type of wholesale and retail energy market (in kWh or MWh) smart contract involve the same participants above, but it handles ancillary and grid services, voltage, and black start services, network reconfiguration services, day-ahead, and real-time energy, energy arbitrage, etc. A specific settlement protocol for this contract will be maintained and followed for all those nodes subscribing to the contract terms.

Pricing Options

Transactions between parties on the WEC network can be carried out on a Peer-to-Peer (P2P) basis using available WEC network price feeds, depending on the needs of the participants, transaction type, and feeds available

Smart Contract Settlement Protocol

WEC TE smart contract transactions between buyer and seller go through a set of stages to complete the full lifecycle, which includes participant ID validation, transaction bidding, transaction validation, market auction, additional pre-settlement resolutions among sidechain contracts, and finally, overall transaction settlement. This final stage is where the energy service is delivered to the buyer(s), and the seller(s) are rewarded with the payment for their services.

WEC Smart Contracts Summary

The WEC blockchain platform will launch with two fully-scoped-out types of smart contracts designed to address the wholesale and retail energy market services.
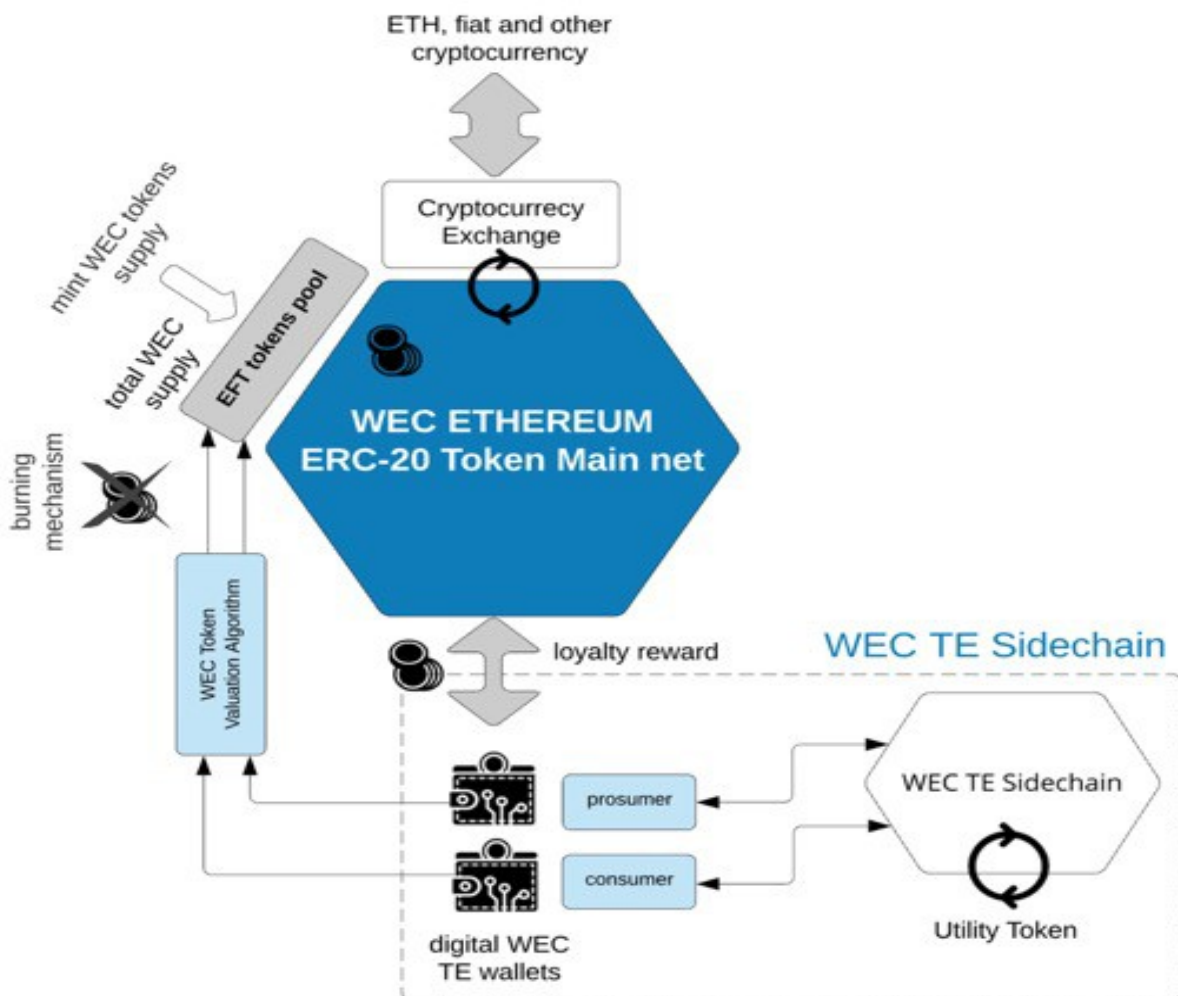
WEC Tokenization Framework

WEC Ethereum Main Net - this is a permissionless public main net Ethereum network component, where a WEC ERC-20 compatible tokens are released. Here is where the WEC global blockchain administers the WEC public token pool, which is also connected to and registered in cryptocurrency exchanges.

WEC TE sidechains – this component is a permissioned Ethereum compatible private sidechain federated network that works with local and regional energy markets, compliant with the IEEE Blockchain Energy Standard P2418.5. This component connects to permissioned and authorized energy participants. We expect to have hundreds of WEC TE sidechains in operation, allocated to LEM/DSO and ISO/TSO energy markets around the world as the WEC TE platform becomes mature
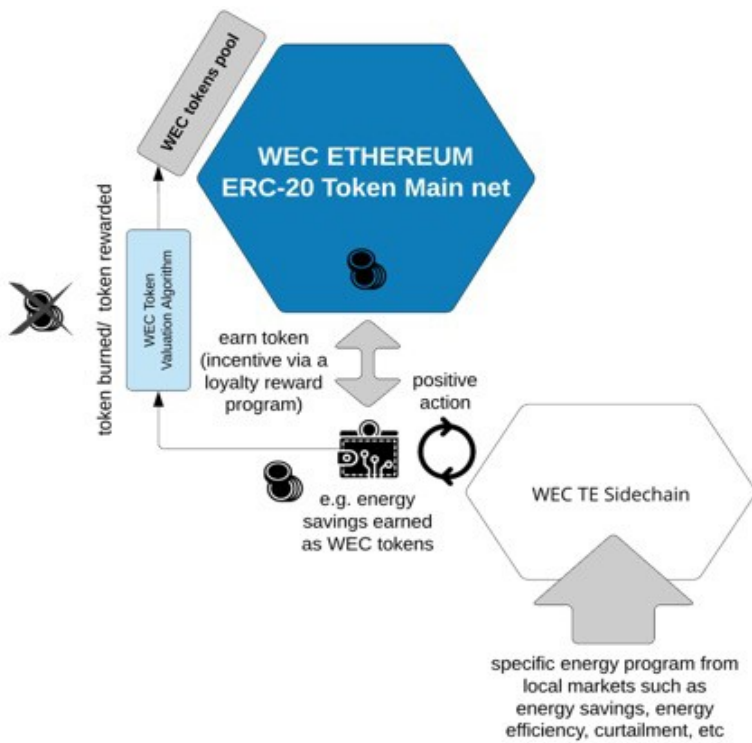
The WEC ERC-20 Token

The WEC ERC-20 compatible tokens, or the "WEC tokens," will be minted with one Billion (1,000,000,000) tokens initially to address the gigawatt global energy market defined throughout this paper. The initial token generation, containing the genesis WEC blockchain block, will be created by a WEC token smart contract. The initial token balance will be allocated into specific token pools, which will be described in the next sections. The WEC token will be a tradeable token in public market exchanges so that anyone will be able to buy, sell, or trade it in public Ethereum cryptocurrency networks.

The WEC TE sidechain token is a utility token and has no crypto or fiat value, per se. It is used only to account for the energy transactions in local LEM sidechain marketplaces. These utility tokens serve only to maintain the WEC platform transaction accountability and can also work as an ERC-20 compatible token with a permissioned, authorized sidechain. Although this sidechain utility token is described here, it is not implemented in the first stages of the WEC TE platform since it requires further technology and market design validation in the next deployment phases.

WEC ETHEREUM ERC-20 Token Main net

WEC tokens pool

token burned/ token rewarded

WEC Token Valuation Algorithm

earn token (incentive via a loyalty reward program)

positive action

e.g. energy savings earned as WEC tokens

WEC TE Sidechain

specific energy program from local markets such as energy savings, energy efficiency, curtailment, etc

WEC Token Econometrics and Algorithms

Discount utility: The first and foremost utility is that of a discount token where WEC can be used for paying for services from qualified WEC network service provider participants.

Reward utility: Its second use case is as a reward token for qualified WEC devices where device owners are incentivized to connect to the WEC network to earn reward tokens from qualifying events, such as demand response, which are recorded on the WEC blockchain.

Deflationary utility: Finally, the WEC token is designed with mechanisms in place to support its value through the process of periodic "token burning" by permanently removing a portion of tokens from the total circulation supply of WEC to counterbalance inflation depending on the growth rate of the WEC network.

WEC Token Valuation Mechanism

The fundamental principle WEC has adopted to preserve and support the WEC ERC-20 compatible token valuation is to tighten the token reward mechanism with a "token burning factor" algorithm. The preliminary assumption is that as more WEC tokens are rewarded, the more positive actions (e.g., energy-saving habits, demand response programs, participation in wholesale and retail markets, etc.) are implemented in the WEC sidechain energy systems, creating a positive impact on society, environment, and the economy. These positive actions stimulate the WEC token in circulation to increase, resulting from the rewarding mechanism, which is proportional to the WEC burning schedules. In summary, the WEC TE platform participants' positive actions contribute to more rewards tokens to be earned, and therefore more tokens to be burnt in proportion to these rewards, which in the end preserves the WEC token value.

The ratio between tokens "earned" (aka, "rewarded" or "awarded") and "token burned" to preserve token value is calculated by the proprietary WEC token valuation algorithm, which dynamically allocates this ratio based on a schedule and the current market conditions

This dynamic mechanism is necessary to support the tokens value and incentivize market adoption of WEC tokens. Anyone can buy WEC tokens via the WEC main website or via any public cryptocurrency exchange that the WEC TE platform is registered with. Users can transfer WEC ERC-20 compatible tokens to their crypto wallets and keep them for future value increases, sell them, or use them to buy or transact with qualified energy services or related equipment or labor.

Fundamentally from the supply-demand perspective, as more rewards are given, less WEC token becomes available in the market, thus creating scarcity and therefore, all else being equal, increasing the WEC Token value
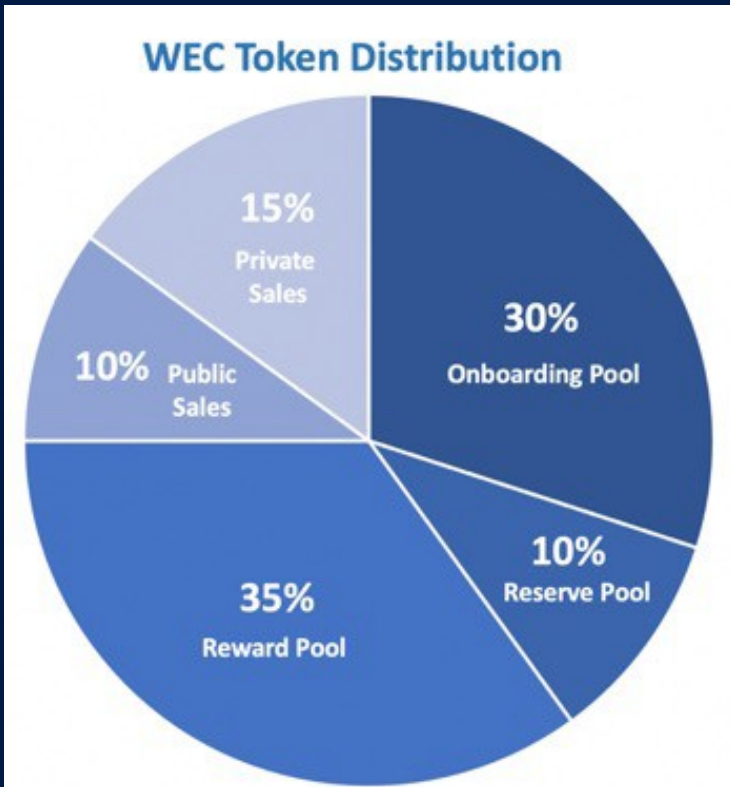
WEC Token Distribution and Use of Proceeds Plan