

Energy Web Origin: An open-source, state-ofthe-art toolkit for renewable energy and carbon markets across the globe

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EWF is accelerating the development of the most valuable blockchain-based energy sector dApps

EWF's ecosystem has prioritized these five application domains:



EWF has shared v1 of EW Origin with the public and showcased several pilots—with more currently in development



These examples involved real companies with real physical assets and actual, real-time generation and consumption data, but no financial transfer

EW Origin is an end-to-end, open-source, blockchain-based toolkit for REC, GO, I-REC trading, tracking, and reporting



| Key benefits of EW Origin | | | | | | | | |
|----------------------------------------------------|---------------------------------------|------------------------------------|--|--|--|--|--|--|
| Hourly kWh data uploads | Disintermediated and consistent UX | Greater automation | | | | | | |
| Interoperability with EVs, batteries | Plug-and-play adaptability | Aggregation and other new features | | | | | | |
| Avoided marginal CO ₂ emissions info | Lower transaction costs | Reduced barriers to entry | | | | | | |

EW Origin enhances transparency, modernizes user experience, and increases access for renewables markets



12.4.2018.13.15.00 - Cel461139ad87ba097eaa0254a213b/98-bib622225ee-000m/982255d83cae

Certificate Created - Initially owned by Microsoft Corporation

12.4.2018.13.15.00 - 0x27ba3923c448135aa896986bhtea721b646daarhaac2161a875c55ha90d7b28

Initial Logging - Logging by Asset #0

EW Origin will support advanced deals like PPAs and enable aggregation for smaller market participants

| General | | | | |
|----------------------|-------|--|--------------------------|--|
| Start Date: | | | Pick a date | |
| End Date: | | | Pick a date | |
| Buyers output share: | | | | |
| Location | | | | |
| Country: | All | | | |
| Region: | All | | | |
| Туре | | | | |
| Asset Type: | All | | Choose Asset Type | |
| Arbitrage rules | | | | |
| Target asset type: | | | Choose Target asset type | |
| Asset ratio: | Range | | | |
| Country: | All | | | |
| Region: | All | | | |
| | | | | |

CREATE PPA

EWF is developing an open-source reference implementation of the EW Origin toolkit for PJM GATS in collaboration with PJM EIS

EW Origin "Market Toolkit"

Framework and tools providing various features for a marketplace for trading RECs, GOs, and I-RECs

EW Origin "Issuer Toolkit"

Framework for issuing and tracking ownership for RECs, GOs, and I-RECs at the kilowatt-hour (kWh) level

EW "Asset Registry"

The global EWF asset registry where all assets, devices, and users are documented and where the provenance of renewable production information at the kWh level are documented

EW Origin Full Reference Implementation

Combines the Market Toolkit, Issuer Toolkit, and Registry in a single reference implementation in one market that ultimately any issuing body or registry can reference, modify, and adopt

EWF released v1 of EW Origin in April 2018

Current EW Origin Capabilities

1. Onboard renewable generation and energy consumption assets

2. Onboard generators and buyers

3. Onboard renewable energy demands

4. Upload kWh generation data ("tags")

5. Transfer ownership of available tags by matching with onboarded demands

6. Claim (and retire) tags

7. Generate certificate from claimed tags

8. Send reports containing certificate(s)

| General | | | | |
|--------------------------|--|---------------|-------------------|--|
| Cap per Timeframe (kWh): | | | | |
| | | | Choose Timeframe | |
| Start Date: | | | Pick a date | |
| | | | Pick a date | |
| | | | | |
| | | | | |
| Criteria | | | | |
| | | | | |
| | | | | |
| Location | | | | |
| | | | | |
| | | | | |
| Туре | | | | |
| | | | | |
| | | | Choose Compliance | |
| Туре | | | | |
| | | | | |
| | | | Choose Compliance | |
| Consumption | | | | |
| | | | | |
| | | | | |
| | | CREATE DEMAND | | |



EWF developed reference implementations for different device connection scenarios



The EW Origin Bond Code takes energy data at kWh level and puts persistent data on light client



-> A sequencer with a modular energy data interface

Q

EWF is using the Artik 710 device as a powerful SoM to securely host the EW Origin bond code and EWF light client

| Processor | | | | | | |
|-----------------------------------------------------|--|--|--|--|--|--|
| 8x ARM [®] Cortex [®] -A53@1.4GHz | | | | | | |
| 3D graphics accelerator | | | | | | |
| 1edia | | | | | | |
| 4-Lane MIPI CSI | | | | | | |
| 4-Lane MIPI DSI up to | | | | | | |
| FHD@24bpp | | | | | | |
| l ² S audio interface | | | | | | |
| emory | | | | | | |
| 1GB DDR3 @ 800MHz | | | | | | |
| 4GB eMMC | | | | | | |
| curity | | | | | | |
| Secure point to point | | | | | | |
| authentication and data | | | | | | |
| transfer | | | | | | |
| Trustwara | | | | | | |
| ITustware | | | | | | |
| adio | | | | | | |
| IEEE 802.11a/b/g/n/ac | | | | | | |
| 4.1 (Classic+BLE) | | | | | | |
| ZigBee/Thread | | | | | | |
| Power Management | | | | | | |
| Provides all power of the ARTIK | | | | | | |
| 710 Module using on board | | | | | | |
| bucks and LDOs | | | | | | |
| Interfaces | | | | | | |
| GPIO, I ² C, SPI, UART, SDIO, USB | | | | | | |
| 2.0, JTAG, Analog Input | | | | | | |
| | | | | | | |



EWF is using ResinOS to support EW Origin bond code, EWF light client, and "watchdog"



More details on ResinOS and Resin.Io

OS focused on IoT security and secure fleet management

- **ResinOS:** Open source Linux based on Yocto
- Resin.io: Secure tool chain from *git push* to device provisioning
- Trusted CI/CD to the fleet via VPN manager
- Supports Artik platform



The Resin.io dashboard



| Applications > Implications > | 🌀 resin.ie | D 将 Ge | etting Started | 🖹 Docs 🔹 Status | i | | | | | | | _ |
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Onboarding via Origin REST API



| [□] <u>energywebfoundation</u> / bond | ♥ Watch 5 ★ Star 2 % Fork 2 | | | |
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| ♦ Code ③ Issues 0 ⋒ Pull requests 0 	 Projects 0 	 III Insights | Sv | wagger.io: a | api_contract.yaml | |
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| 1 # This is an example. Please use it as such. Fo 2 # Please mind that the generators for servers a | Please use it as such. For more info read swagger documentation and wikipedia artic is://en.wikipedia.org/wiki/Representational_state_transfer generators for servers and clients can be outdated and are open source contribuito | ns. Energy Prod | ucer | ~ |
| 3 4 Don't change swagger: "2.0". 4 # Don't change swagger: "2.0". 5 swagger: '2.0". | | GET /produ | ced Produced energy | <u> </u> |
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| 7 title: Energy Measurement API 9 # Always change the v Also keep the previ 10 # I.E. Client version | version of the API endpoints and contracts, keeping compatibility in the major vers ous versions available for retro compatibility. s 1.** are able to access the /v1/* endpoints without changing any code. Minor | ion. Parameters | | Try it out |
| versions only fix t ones. 11 # When version 2.0.0 12 yersion: "100" | | Name | Description | |
| 13 # the domain of the ser .your_company.com for 14 bost_ad_vuccompany. | <pre>vice, site can be added like api.site_name.your_company.com, keeping site_name dashboards or any other webapp based on api.site_name.your_company.com.</pre> | limit | How many items to return at one time (max 10) | |
| 14 HOST appropriate of the second sec | that your API supports with authentication enabled. | (query) | Default value : 5 | |
| 17 # Litner use http only 18- schemes: 19 - https | with no authentication Ok https + auth. | start | Date in RFC 3339 format. ie. 2018-03-14T17:11:19+00:00 | |

Create your server stub and integrate your production/consumption data with Origin easily https://github.com/energywebfoundation/bond/blob/master/core/ref/api_contract.yaml, https://editor.swagger.io/#!/



EWF has cultivated strong interest in **EW** Origin pilots among Affiliates and others

