

GAIA-X and the Web3 Sustainability Loop

Trent McConaghy
GAIA-X, Aug 30, 2021
Slides: <http://trent.st/content/gaiax-wsloop.pdf>

@trentmc0 @oceanprotocol



GAIA-X is getting built. 👍

Now, how can GAIA-X
be self-sustaining over the decades?



GAIA-X Sustainability Goals

Here's the challenge.

Find a design to enable...

- GAIA-X ecosystem *sustainable and growing*, towards *ubiquity*
- Funding goes to teams writing code, doing outreach, over the long term (decades)
- GAIA-X funding grows as usage of network grows

Including:

- Basic design is simple to understand and communicate
- Can be implemented in a pragmatic fashion, over time
- Get people to do “work”
- Encourage skin-in-the-game by users

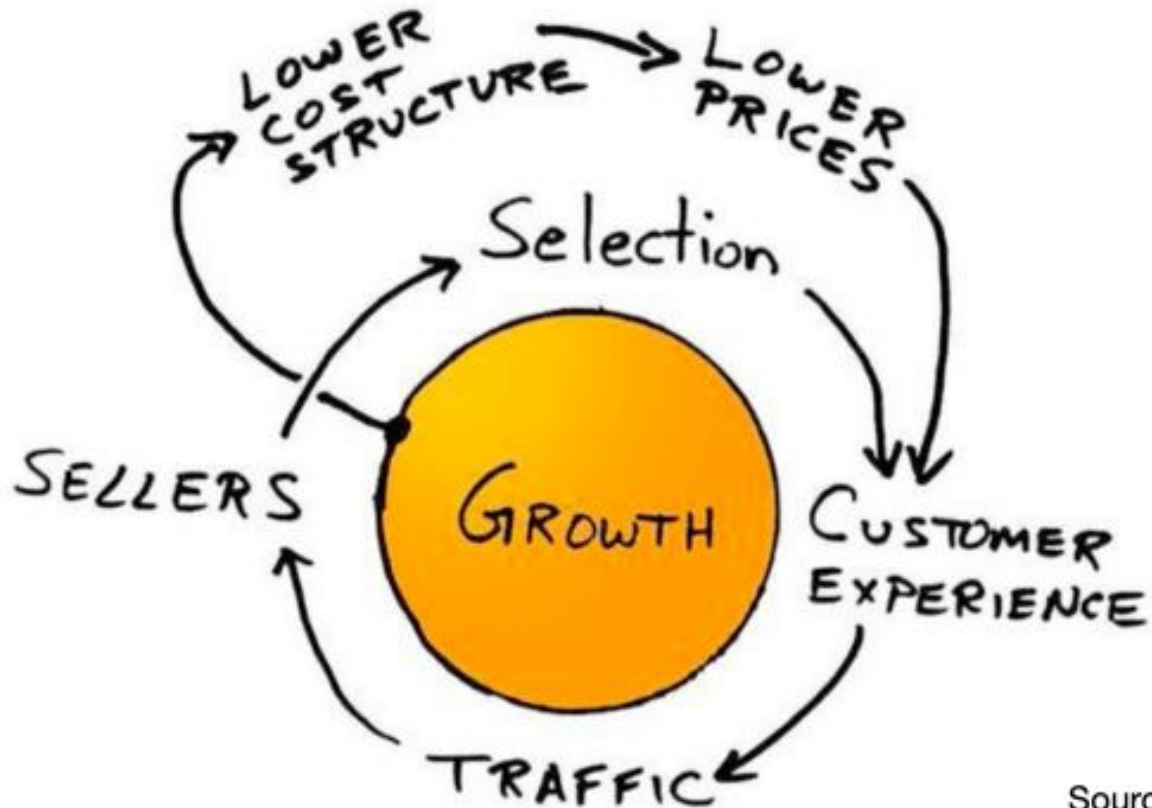
A choice of system-level design will lead to goals of sub-blocks in the system.



From Amazon to Web3 Sustainability



How does Amazon work?

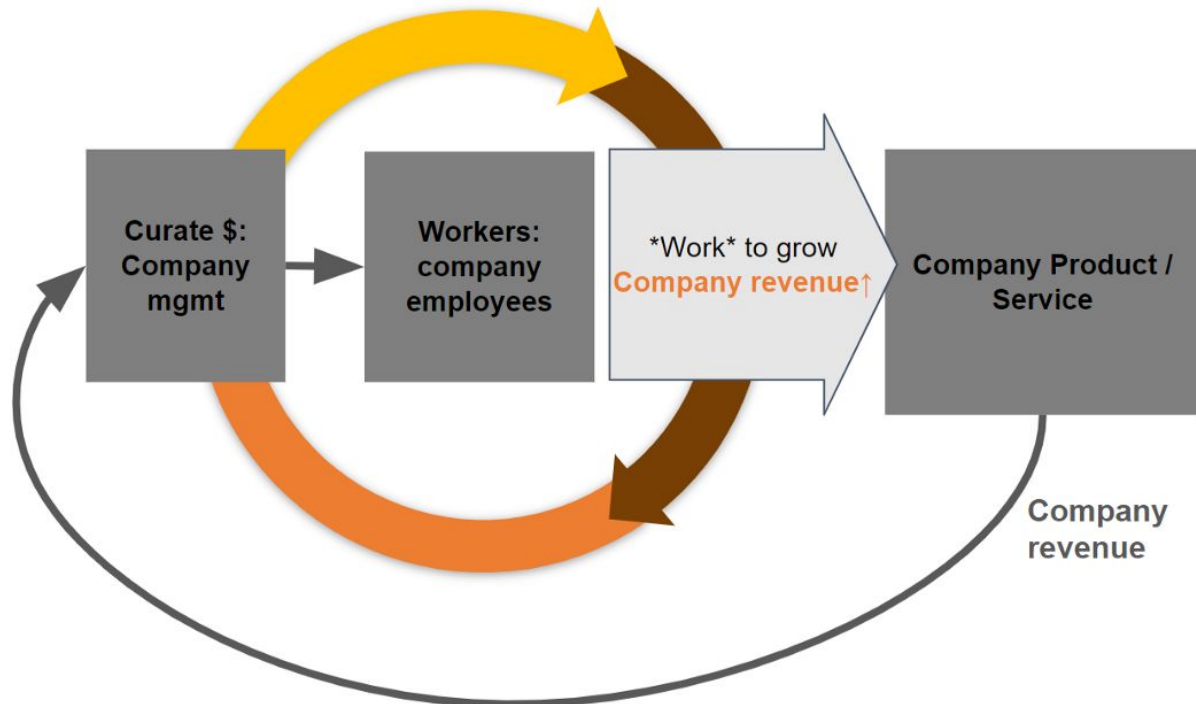


Source: Amazon



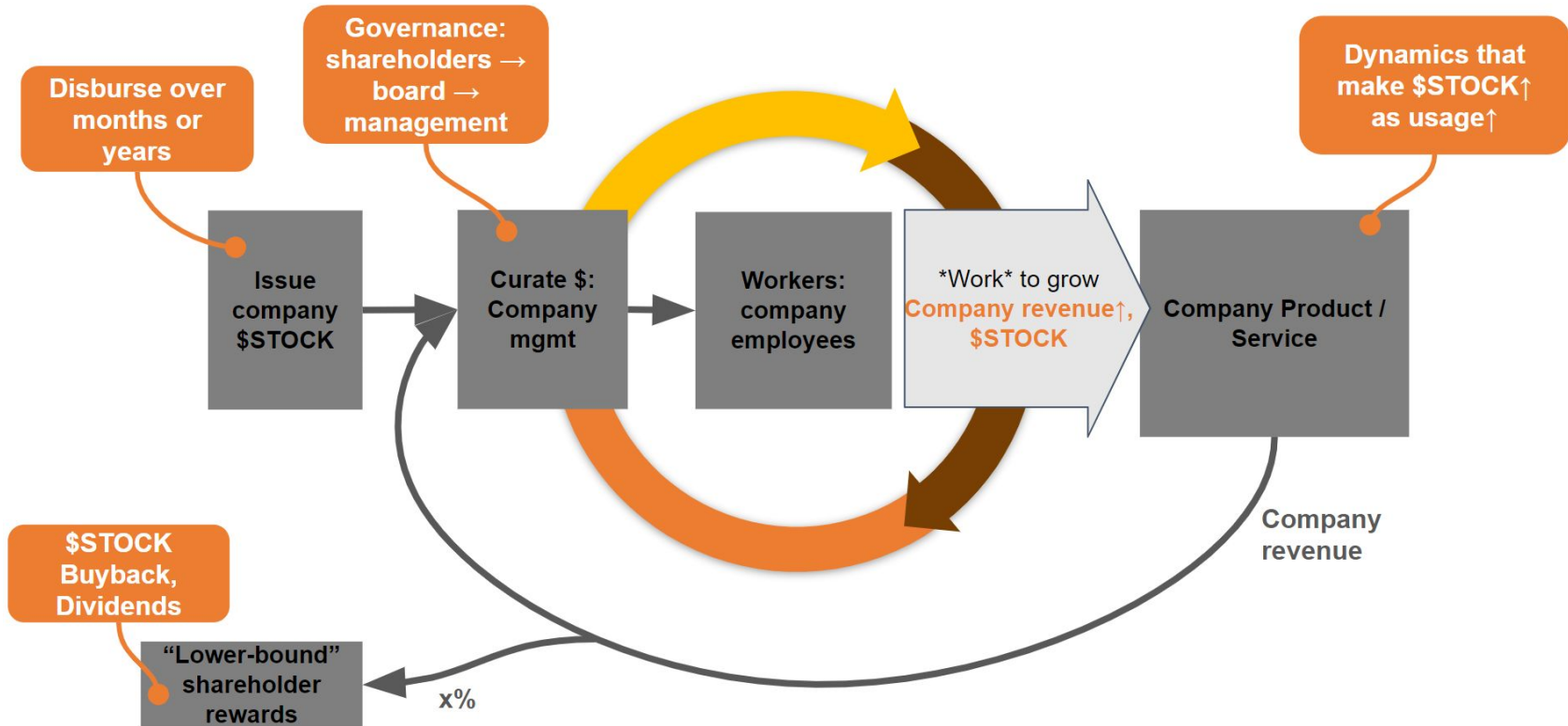
Company business model with a focus on revenue

Challenges: how to kickstart the company, how to grow fast enough to beat the competition



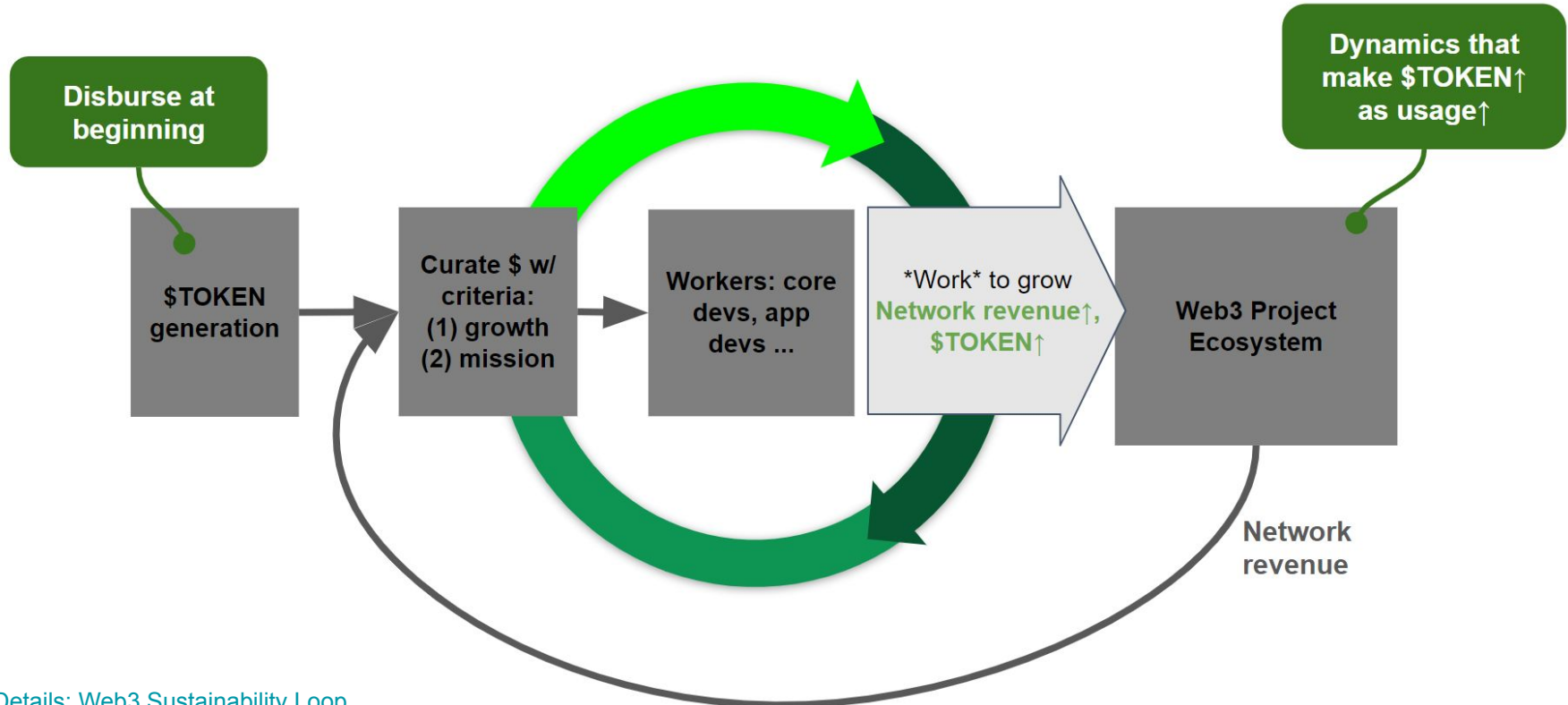
Company business model - full picture

Has an “outer wrapper” that uses stock as a tool, in addition to revenue.



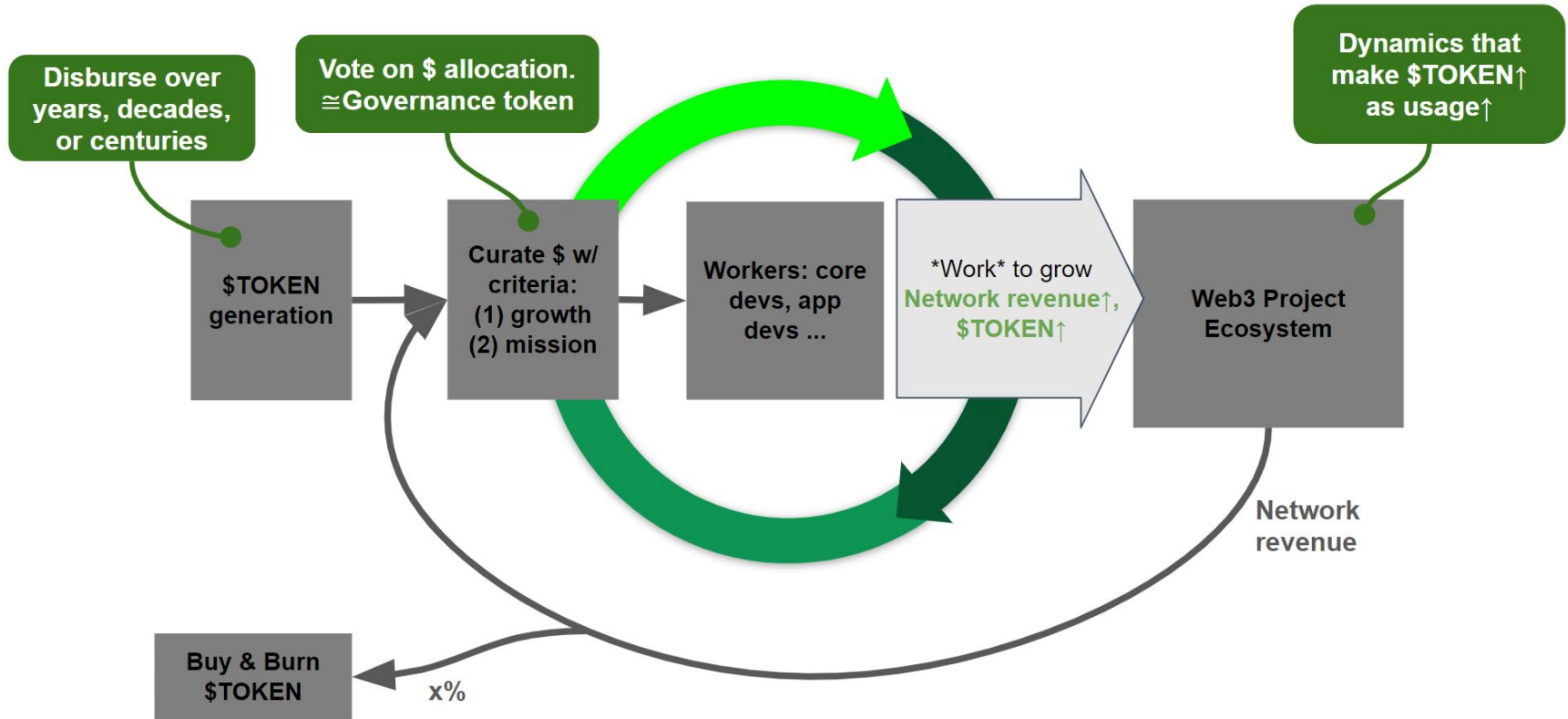
Web3 Model with a focus on revenue

But, challenges: how to kickstart the project, how to catalyze growth



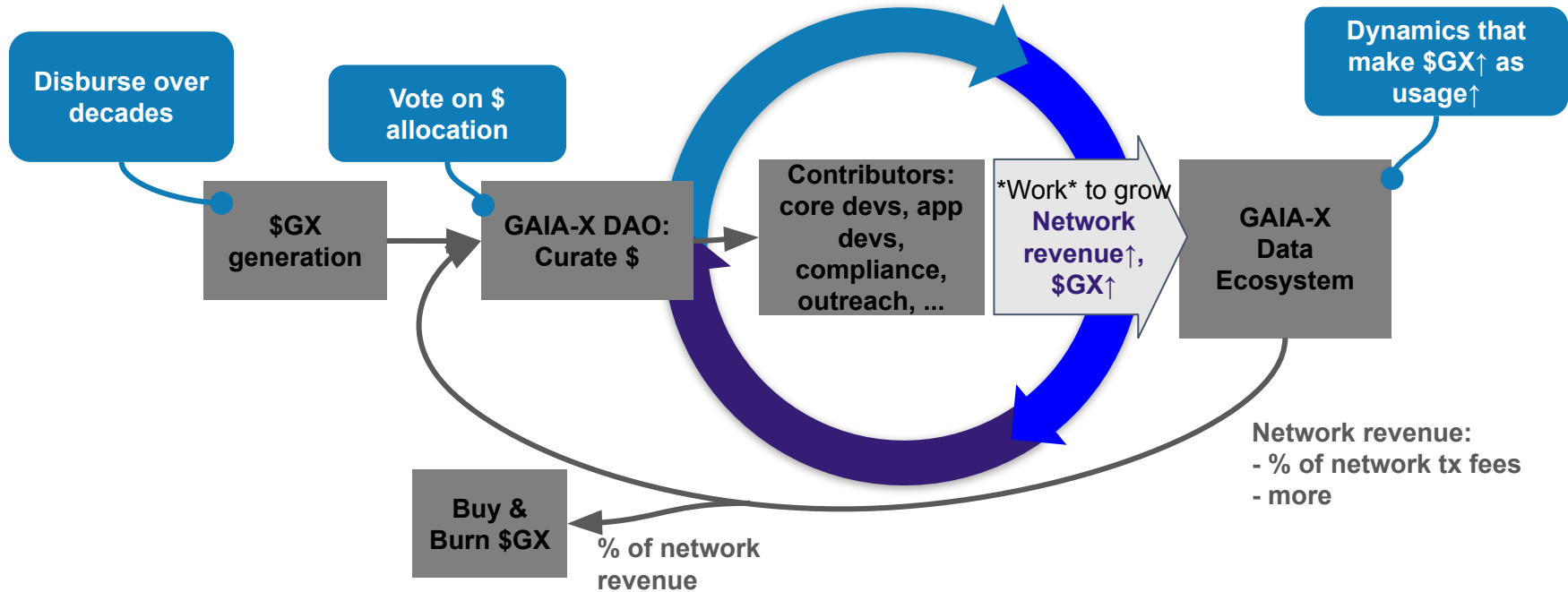
The Web3 Sustainability Loop

Has an “outer wrapper” that uses tokens as a tool, in addition to revenue



GAIA-X Sustainability Loop

Revenue for long-term sustainability, GX token to catalyze it



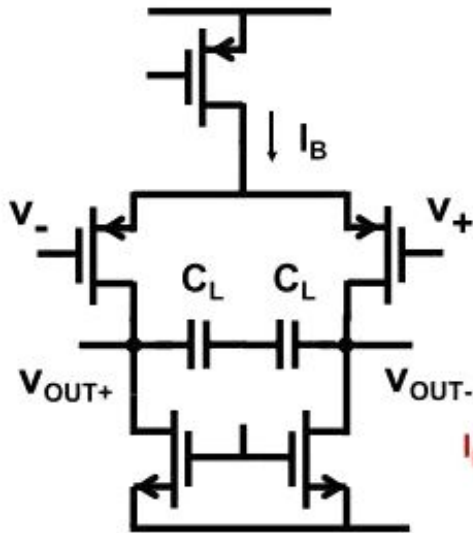
Will it work?
How do we verify the design?



Verification in Electrical Engineering



Pure Manual Analog Circuit Design



$$GBW = \frac{g_{m1}}{2\pi C_L} \quad g_{m1} = \frac{I_B}{V_{GS1} - V_T}$$

$$GBW_{max} = \frac{I_B}{V_{GS1} - V_T} \frac{1}{2\pi C_L}$$

0.2 V

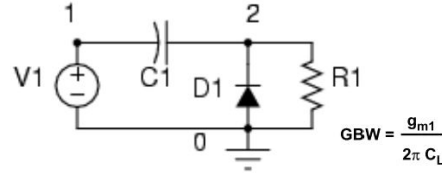
$$I_B = 10 \mu\text{A} \quad C_L = 1 \text{ pF} \quad GBW_{max} \approx 10 \text{ MHz} \quad [8]$$

$$FOM = \frac{GBW \cdot C_L}{I_B} = 1000 \text{ MHzpF/mA} \quad [800]$$



SPICE workflow

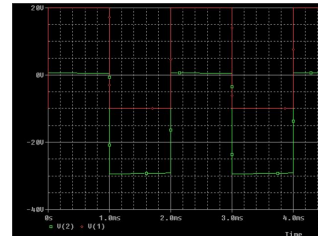
Manual design



Enter netlist
(schematic editor, or write)

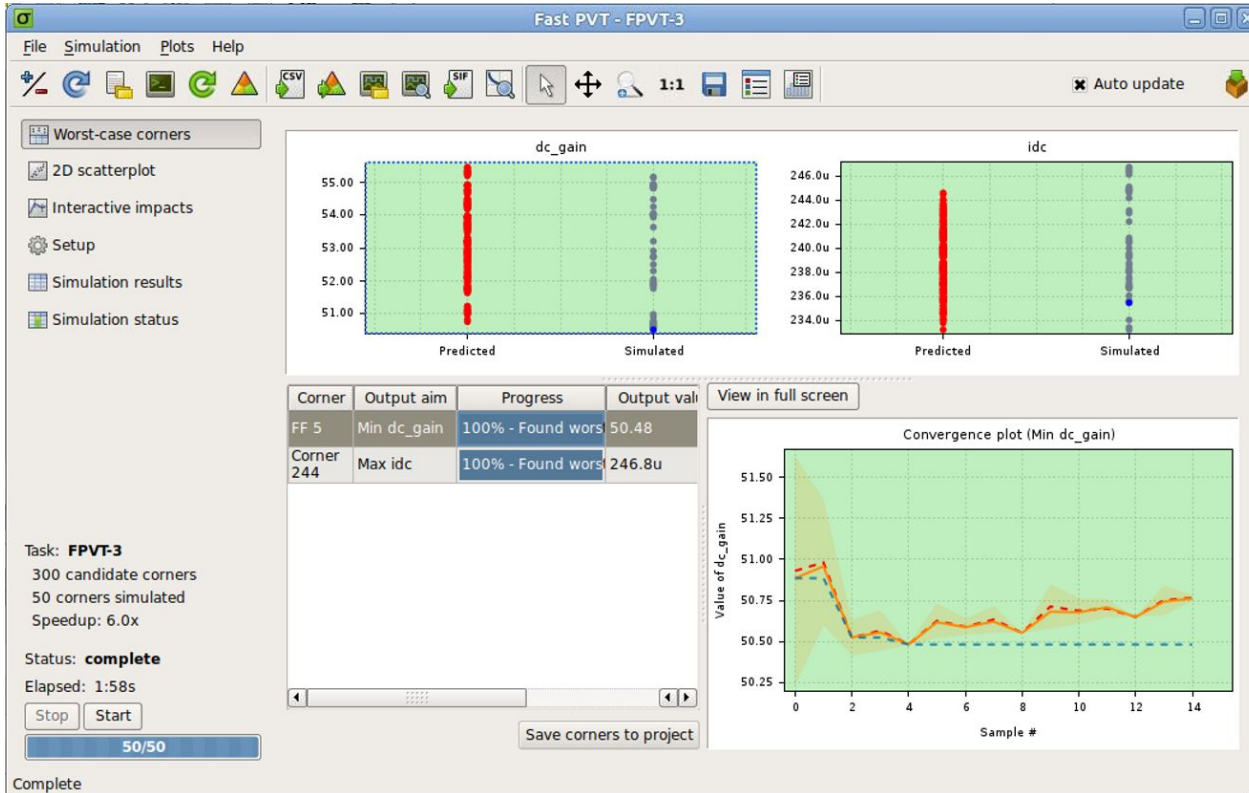
```
SPICE sample circuit - diode clamp
*Component settings shown with DC value, AC value, and
*transient signal wave: <DC> <AC> <SP> <wave>, with the period
*of 1.0 ns if not 0 (note: 0.0 is 0 (zero) level)
*Capacitor for clamping
C1 1 2 1nF
*Diode for clamp - model name is diode
D1 2 0 diode
*DC analysis - large enough that AC is 0 on
*model for diode
.MODEL diode D1N
*AC transfer function generated for this circuit
DC 10 10 0 1
*AC frequency sweep - assume circuit is biased with V1 =
```

Run SPICE



Example: Verification with SPICE

Solido Fast PVT: Worst-case analysis via global optimization



Verification in Token Engineering



How To Verify

It's pragmatic to do verification in **phases** of increasing fidelity:

1. **Humans.** Subjective discussions, with increasing # people. 1 → 2 → key stakeholders
2. **Software modeling**, with increasing fidelity. Spreadsheet → **simulation**
3. **Economic (live).** Can ratchet value-at-risk over time. People can choose risk/reward tradeoff. Phased approach.

Let's focus on simulation here...



TokenSPICE

<https://github.com/tokenspice/tokenspice>



TokenSPICE: EVM Agent-Based Token Simulator

TokenSPICE can be used to help design, tune, and verify tokenized ecosystems in an overall Token Engineering (TE) flow.

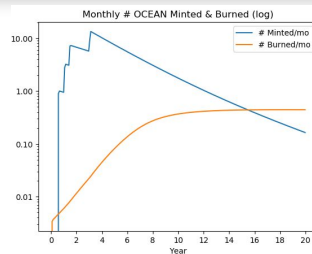
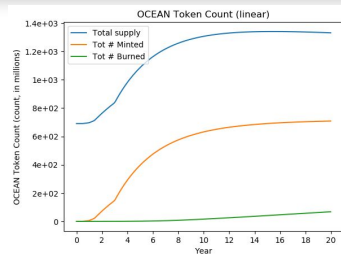
TokenSPICE simulates tokenized ecosystems using an agent-based approach.

Each "agent" is a class. Has a wallet, and does work to earn \$. One models the system by wiring up agents, and tracking metrics (kpis). Agents may be written in pure Python, or with an EVM-based backend. (The [original version](#) was pure Python. This repo supersedes the original.)

It's currently tuned to model [Ocean Market](#). The original version was tuned for the [Web3 Sustainability Loop](#). However you can rewire the "netlist" of "agents" to simulate whatever you like. Simply fork it and get going.

TokenSPICE was meant to be simple. It definitely makes no claims on "best" for anything. Maybe you'll find it useful.

[Documentation](#).



TokenSPICE workflow

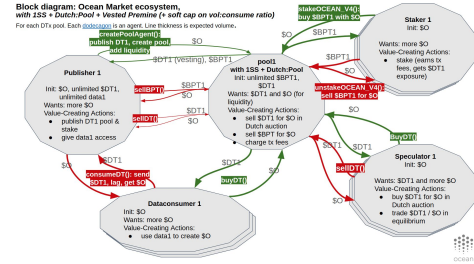
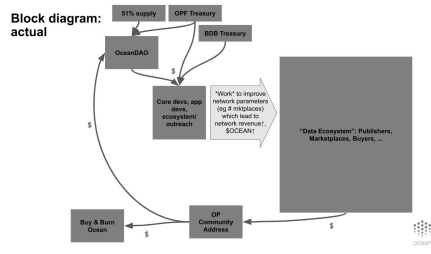
Manual design



Enter netlist
(schematic editor, or write)



Run
TokenSPICE



Python + Solidity (EVM)

```

__init__(self, OceanDAO, BobTreasury, CoreDevs, GPCommunity, BuyBurnOcean):
    self.OceanDAO = OceanDAO
    self.BobTreasury = BobTreasury
    self.CoreDevs = CoreDevs
    self.GPCommunity = GPCommunity
    self.BuyBurnOcean = BuyBurnOcean

    # Work to improve network parameters (eg 8 mBlocksize)
    # which will be done by network community (OceanDAO)

    # Buy & Burn Ocean
    self.BuyBurnOcean = BuyBurnOcean

    # GP Community Address
    self.GPCommunity = GPCommunity

    # Data Ecosystem: Publishers, Marketplaces, Buyers, ...
    self.DataEcosystem = DataEcosystem
    
```

```

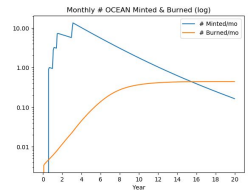
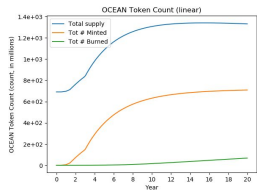
__init__(self, OceanDAO, BobTreasury, CoreDevs, GPCommunity, BuyBurnOcean):
    self.OceanDAO = OceanDAO
    self.BobTreasury = BobTreasury
    self.CoreDevs = CoreDevs
    self.GPCommunity = GPCommunity
    self.BuyBurnOcean = BuyBurnOcean

    # Work to improve network parameters (eg 8 mBlocksize)
    # which will be done by network community (OceanDAO)

    # Buy & Burn Ocean
    self.BuyBurnOcean = BuyBurnOcean

    # GP Community Address
    self.GPCommunity = GPCommunity

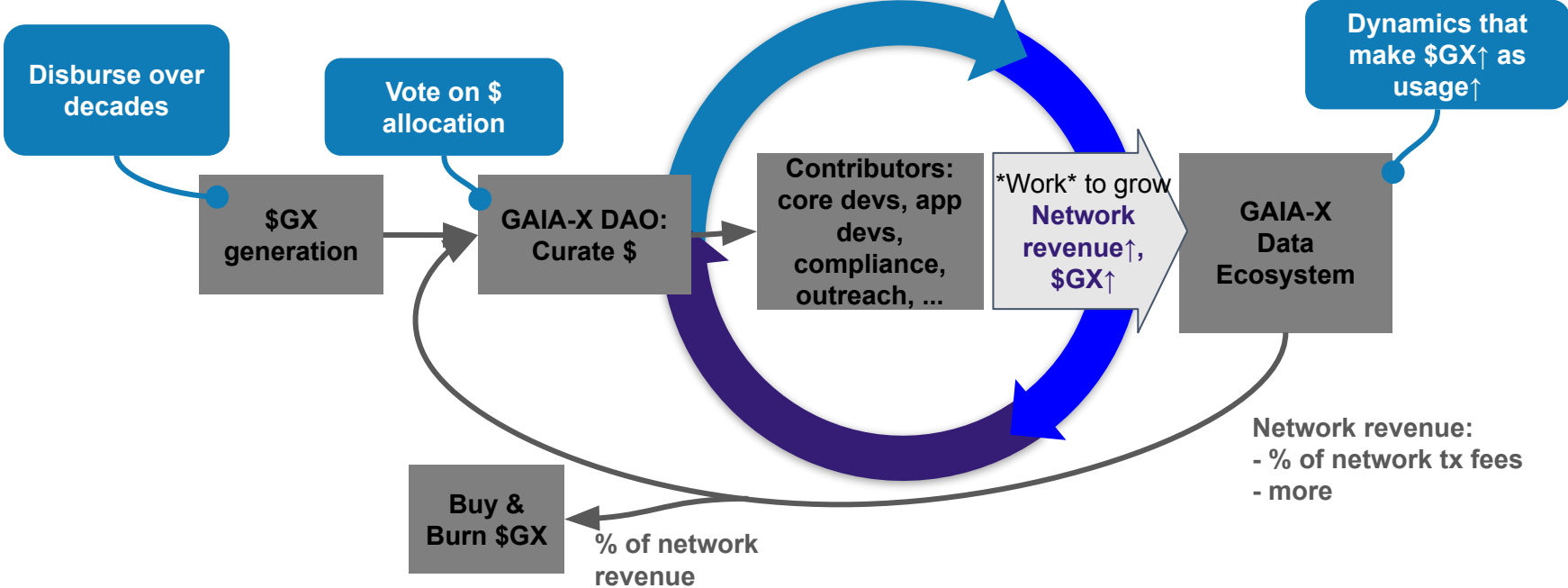
    # Data Ecosystem: Publishers, Marketplaces, Buyers, ...
    self.DataEcosystem = DataEcosystem
    
```



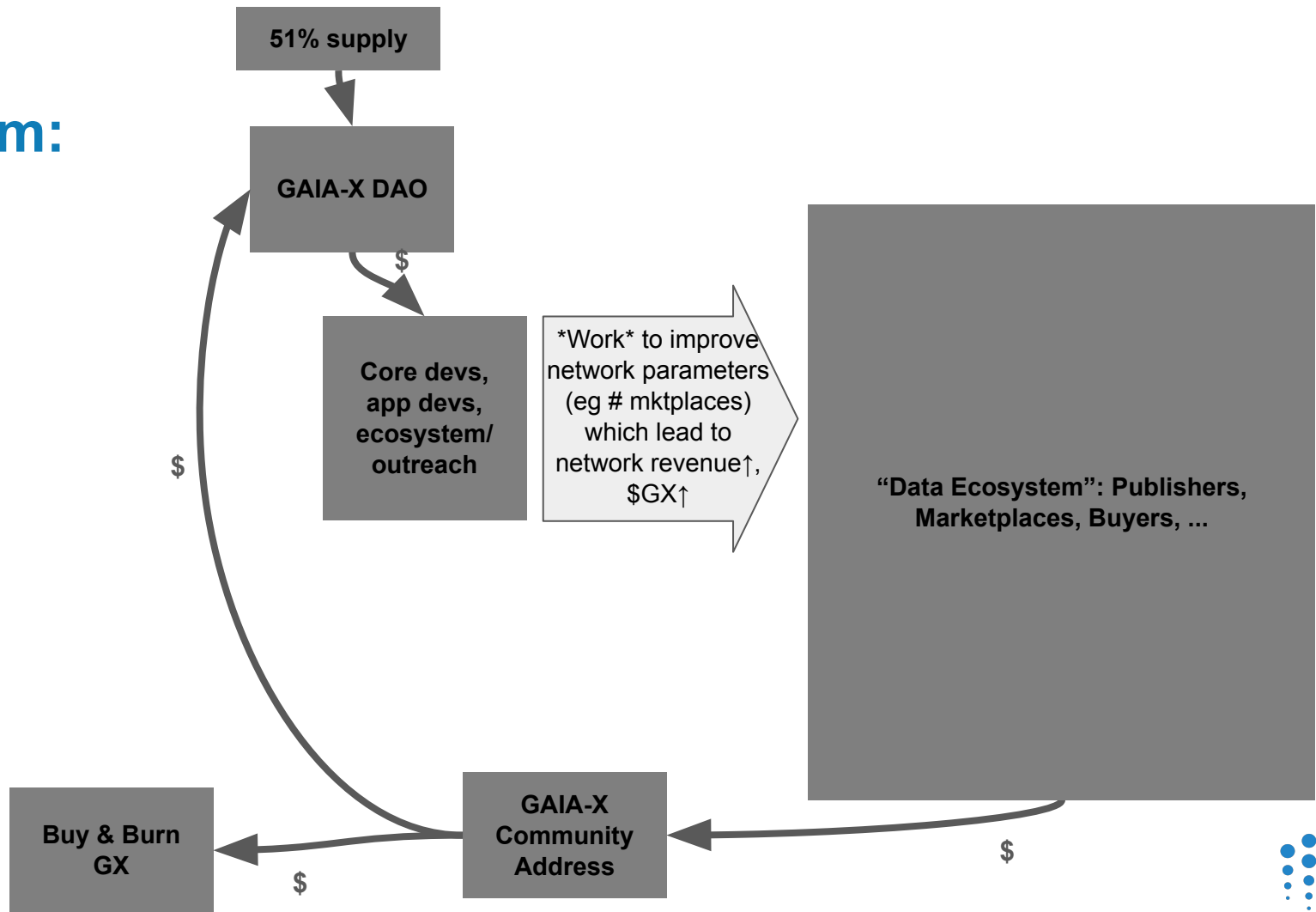
Agent-Based Simulation to Verify GAIA-X Ecosystem Sustainability



GAIA-X Ecosystem block diagram - simplified version

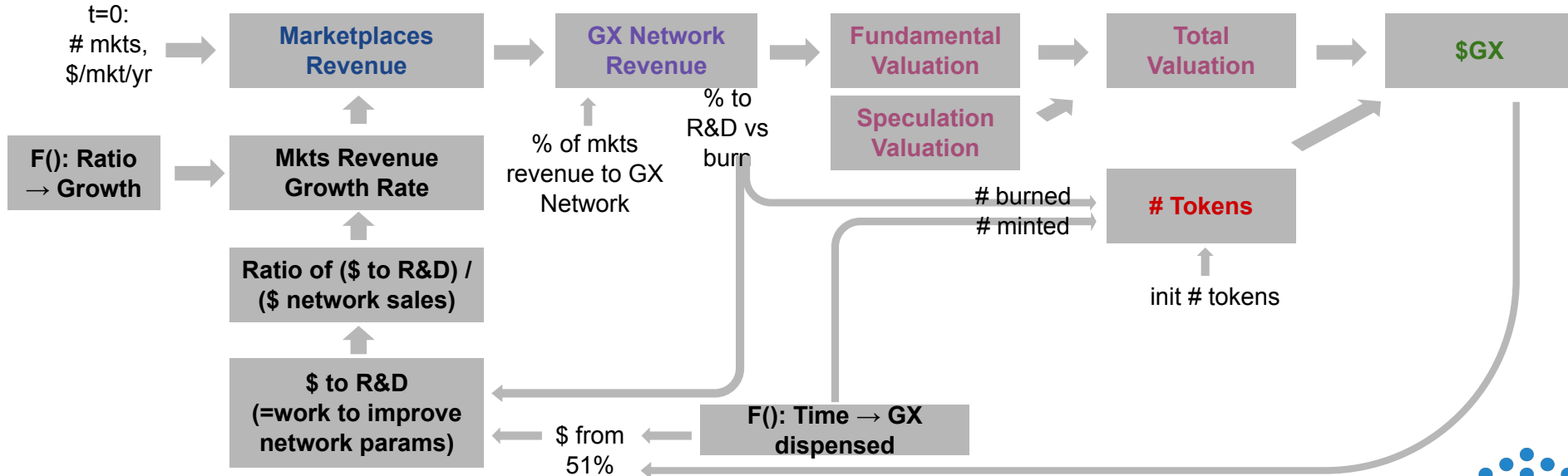


Block diagram: actual



Key variables being modeled

- We can model GAIA-X revenue and \$GX over time. This helps our decision-making.
 - We can model **marketplaces' revenue**. Depends on initial parameters, and \$ growth rates.
 - From that, we can model **GAIA-X network revenue**. Depends on % mkts revenue to GAIA-X network.
 - From that, we can model fundamental **valuation** of GAIA-X network (e.g. P/S). Can compare this to speculation-based component too.
 - We can also model **# tokens**, including effects of minting and burning
 - From valuation of GAIA-X network, and # tokens, we can model **\$GX**



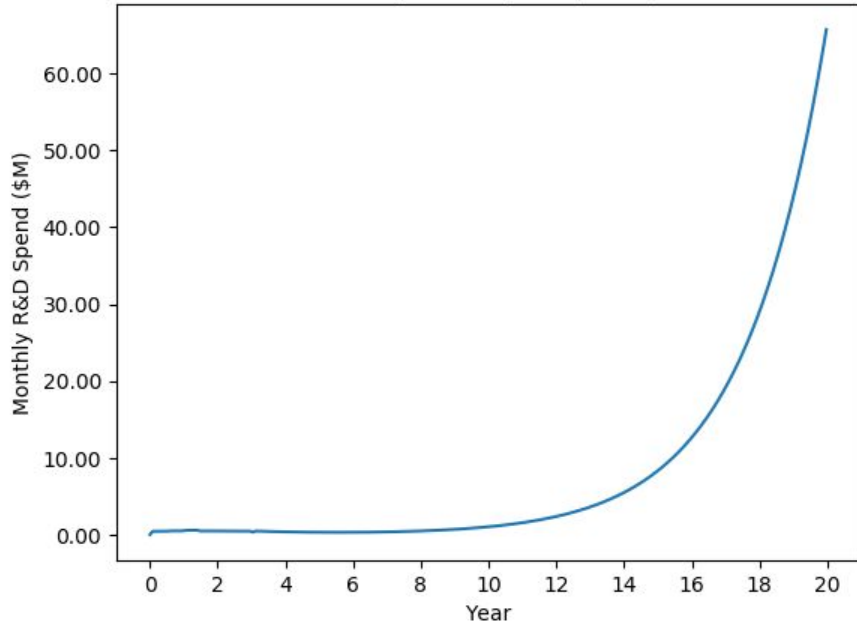
TokenSPICE Parameter Settings

- Simulation time 20 years
- Growth rate info:
 - `growth_rate_if_0_sales` = -11.8% (for total = -25%)
 - `max_growth_rate` = 41.5% (for total = 100%)
 - `tau` = 0.6 (ie ratio needs to be 0.6 just for half the total range. MUCH higher than before)
 - `$ R&D` = `grantTakersMonthlyRevenueNow()`; `$ sales` = `gaiaXMonthlyRevenueNow()`
- GAIA-X toll from marketplaces revenue: 5%
- Speculation valuation at t=0: \$20M
- Growth rate of speculation valuation: 10% / year
- Fundamentals valuation approach: P/S = 30x
- % of revenue to burn directly: 10%
- Ramped exponential minting: like right side of 20200505: H=4.0, T0=0.5, T1=1.0, T2=1.4, T3=3.0, M1=0.10, M2=0.25, M3=0.50. Stop after 34 halvings (about 125 years)
- DAO is funded by: minting over time, some pre-mine

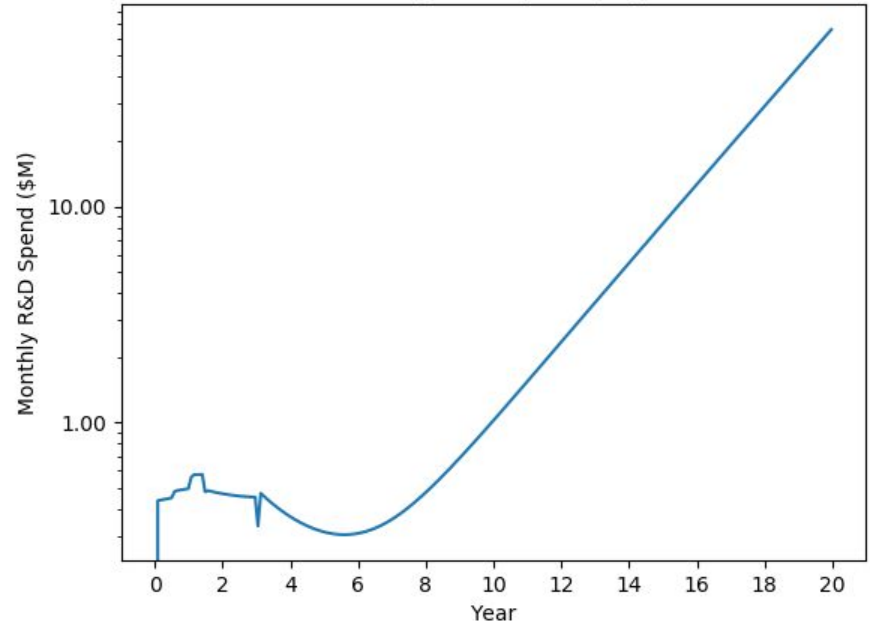


Monthly R&D Spend

Monthly R&D Spend (linear)

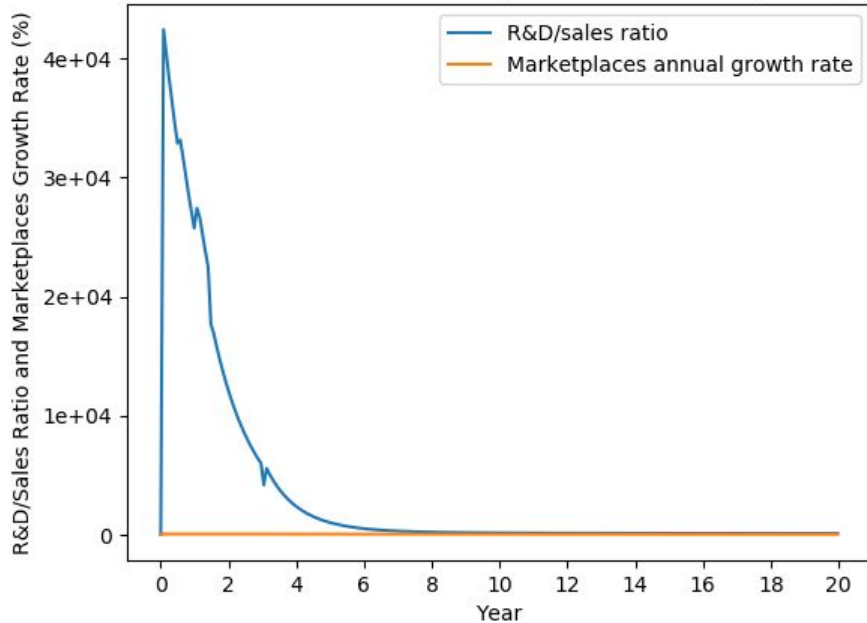


Monthly R&D Spend (log)

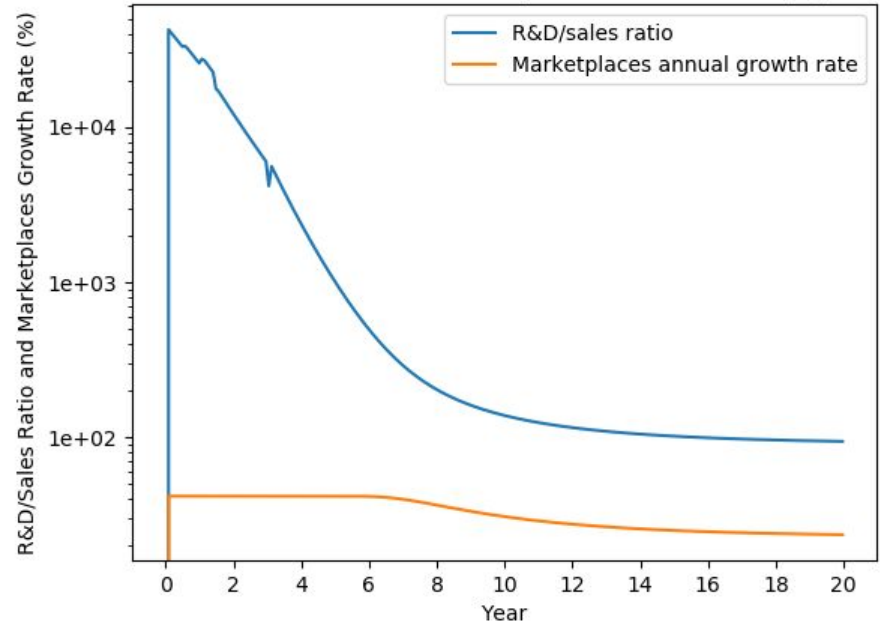


R&D/Sales Ratio, Marketplaces Growth Rate

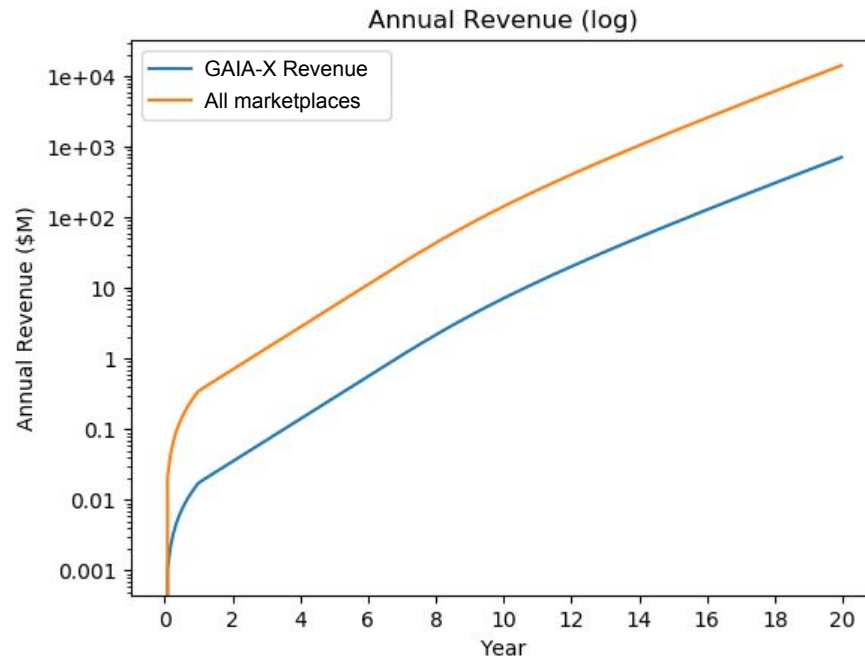
R&D/Sales Ratio and Marketplaces Growth Rate (linear)



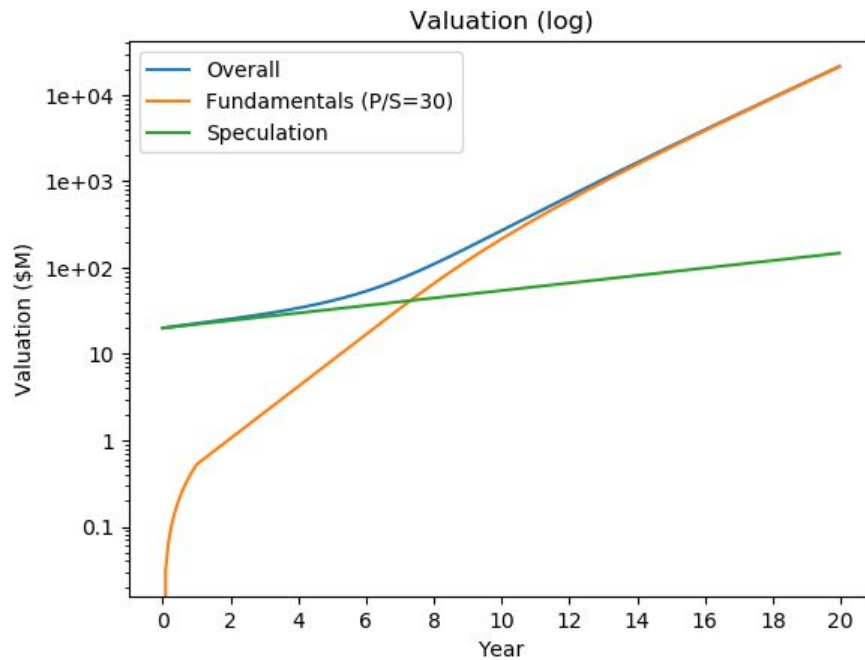
R&D/Sales Ratio and Marketplaces Growth Rate (log)



Revenue

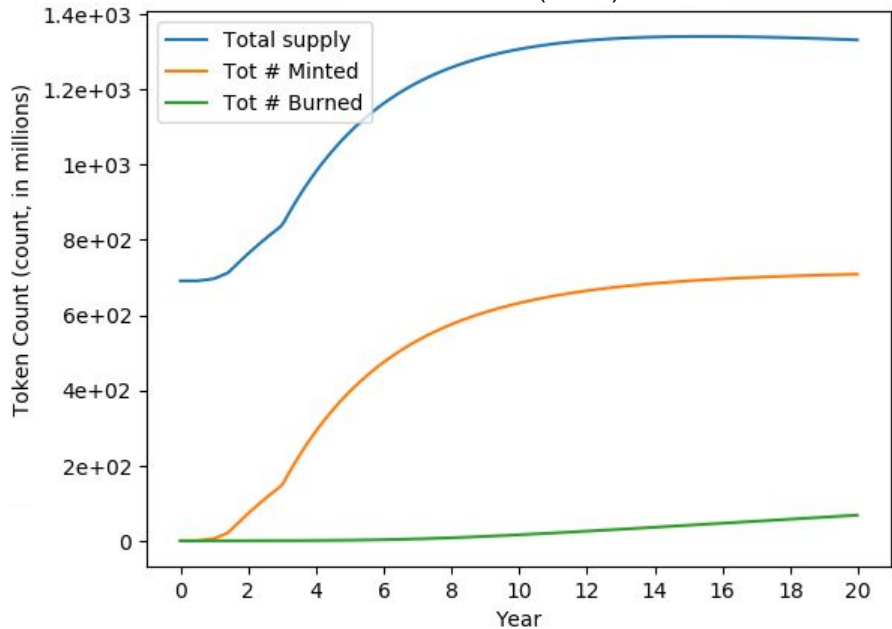


Valuation

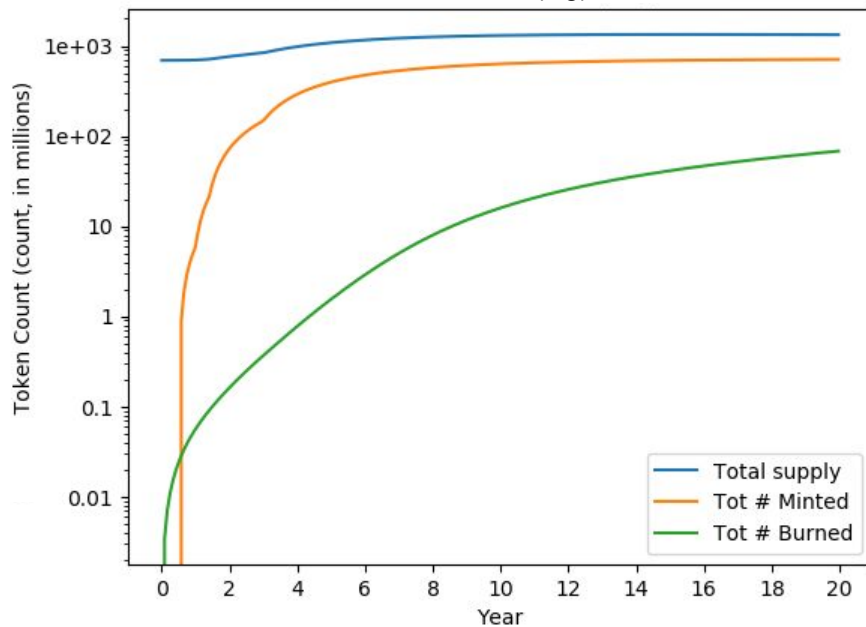


Token count

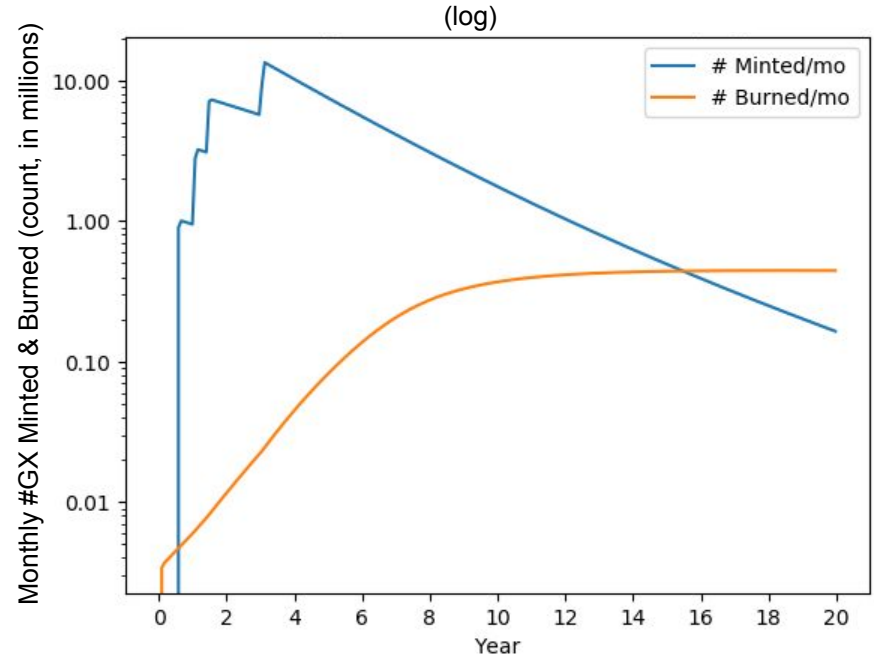
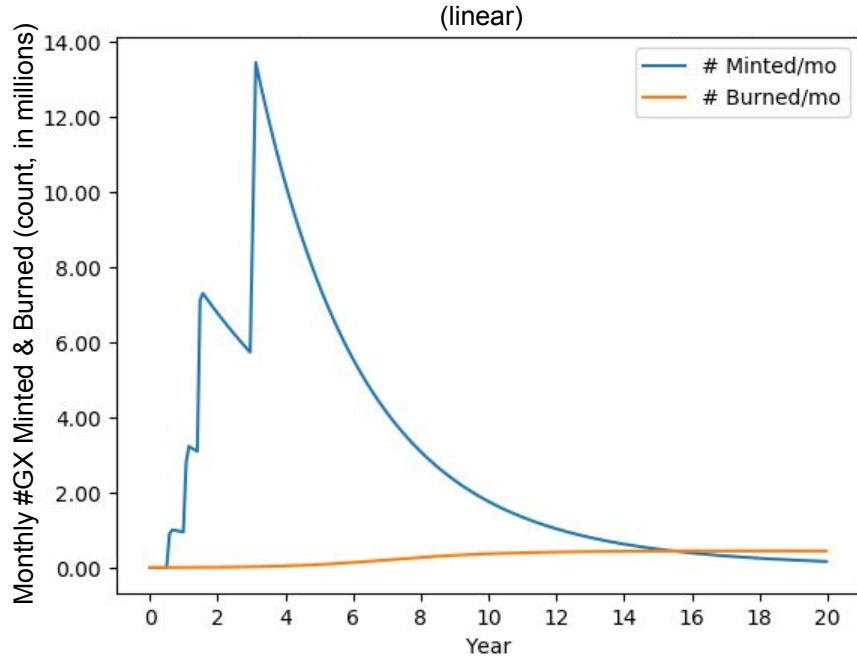
GX Token count (linear)



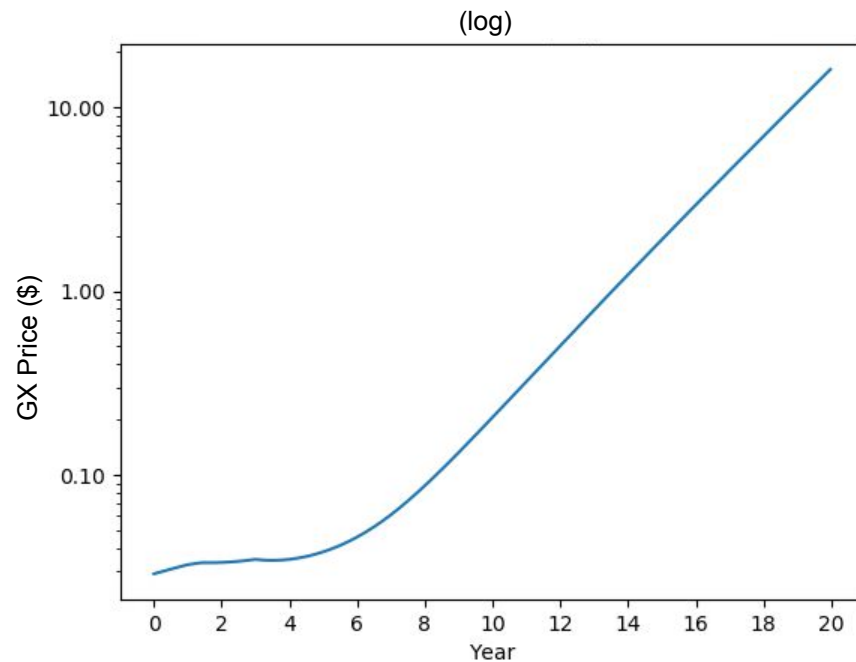
GX Token count (log)



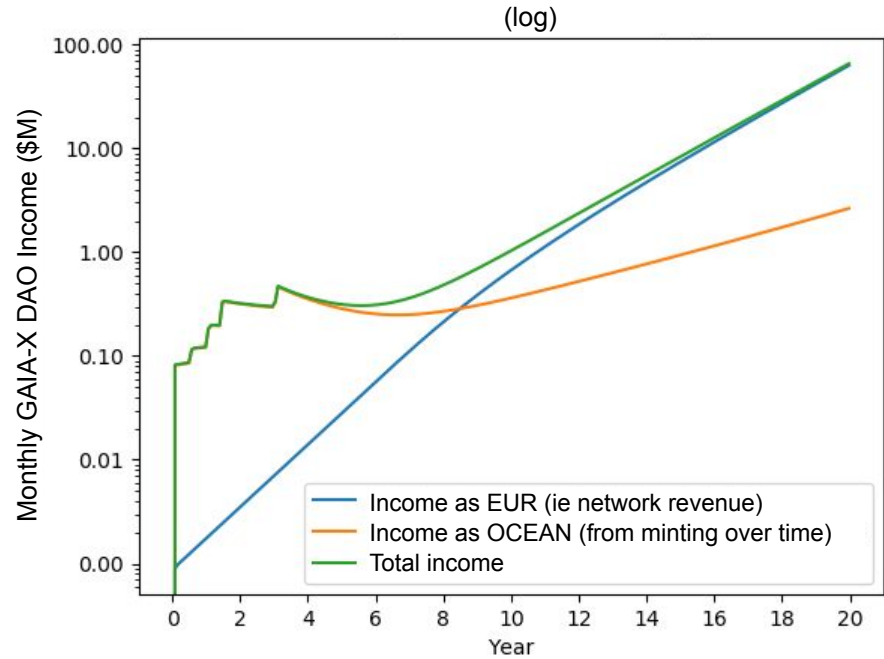
Monthly # GX minted & burned



GX price = valuation / (num tokens)



GAIA-X DAO Income



Revisiting System-Level Goals



On GAIA-X Sustainability Goals

Summary: The “GAIA-X Sustainability Loop” meets the goals.

- ✓ GAIA-X ecosystem *sustainable and growing*, towards *ubiquity*
- ✓ Funding goes to teams writing code, doing outreach, over the long term (10+ years)
- ✓ GAIA-X funding grows as usage of network grows

Including:

- ✓ Basic design is simple to understand and communicate
- ✓ Can be implemented in a pragmatic fashion, over time
- ✓ Get people to do “work”
- ✓ Encourage skin-in-the-game by users

Now, given that a choice of system-level design will lead to goals of sub-blocks in the system.

Let's zoom into sub-blocks.



**We have a system-level design.
What about the sub-blocks?**



GAIA-X Sub-block goals & how

A choice of system-level design leads to specific goals for sub-blocks, as follows:

- Data Ecosystem: Blockchain, smart contracts, and backend services
 - **Goal: meet GAIA-X specs for data sharing. (Many specs!!)**
 - How: pragmatic design & open-source implementation of smart contracts, backend services, libraries
 - **Goal: as tx volume goes up, it drives \$GX**
 - How: 10% of network tx fees go to GAIA-X community. A fraction of that is burned.

- Data Ecosystem: Marketplace apps:
 - **Goal: Get “work” and skin-in-the-game by curators, referrers, third-party marketplace owners**
 - How: pragmatic design & open-source implementation of marketplace app

- GAIA-X DAO:
 - **Goal: curation of projects (governance) encourages skin-in-the-game and long-term sustainability**
 - How: DAO where anyone can propose projects, GX token to vote. Funded by GX token minting & network revenues.



Sub-Block: GAIA-X DAO



GAIA-X and DAOs

4.1 Decentralized Autonomous Organization

Decentralized Autonomous Organization¹, DAO, is a type of governing model where:

- There is no central leadership.
- Decisions are made by the community's members.
- The regulation is done by a set of automatically enforceable rules on a distributed ledger whose goal is to incentive its community's members to achieve a shared common mission.
- The organization has its own rules, including for managing its own funds.

4.2 Gaia-X Association roles

Based on the objective and constraints to achieve those objectives, Gaia-X Association is creating a Gaia-X DAO.



How might GAIA-X DAO look?

GAIA-X DAO is a grants DAO to help fund GAIA-X community projects, curated by the GAIA-X community.

- Anyone can propose a project
- There is open discussion in forums and town halls
- Vote on proposals with GX token
- \$100K to \$1M+ per month funding available (see simulations)

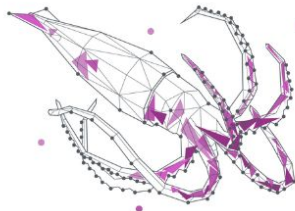
- Key constraint: expected ROI > 1.0 of grants over time



Example landing page - OceanDAO

Funding Rounds

Register & Vote on Proposals



Round 9

\$300K USD available in grants
Submit your proposal by **Sept 7**
Vote from **Sept 9 - 13**

Builders

Create a Proposal, Submit it to port, and we'll take it from there.

[SUBMIT PROPOSAL](#)

Voters

Learn and vote on the best projects that deserve funding from the DAO!

View Proposals

Each Team can register one Proposal per Funding Round. Funding Rounds take place at the beginning of each month.

- [Sep 2021 - Round 9 Proposals](#)
- [Aug 2021 - Round 8 Proposals](#)
- [Jul 2021 - Round 7 Proposals](#)
- [Jun 2021 - Round 6 Proposals](#)
- [May 2021 - Round 5 Proposals](#)

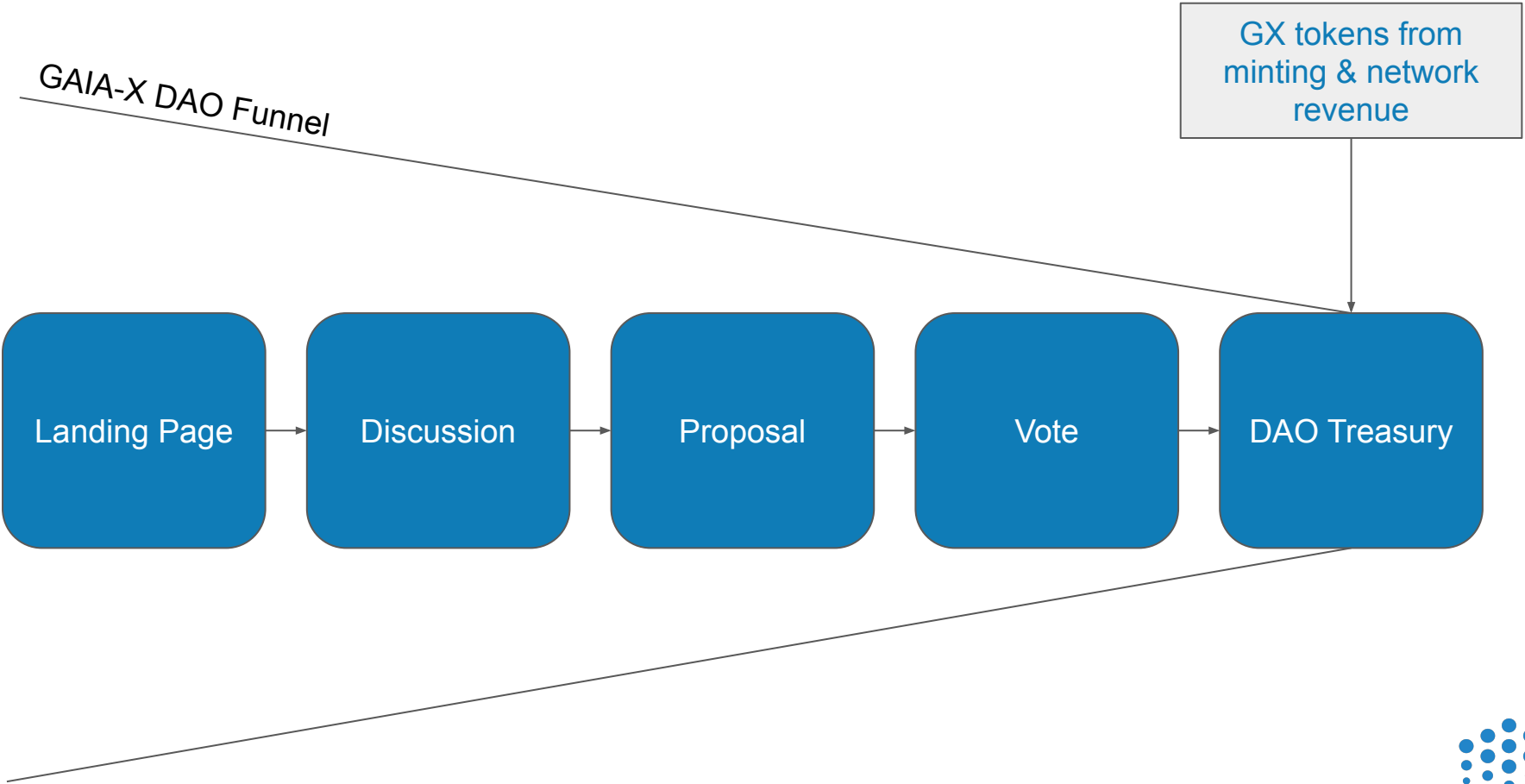
Vote On Proposals

Support teams and projects across a wide range of categories! Vote on the best projects, and help Ocean grow!

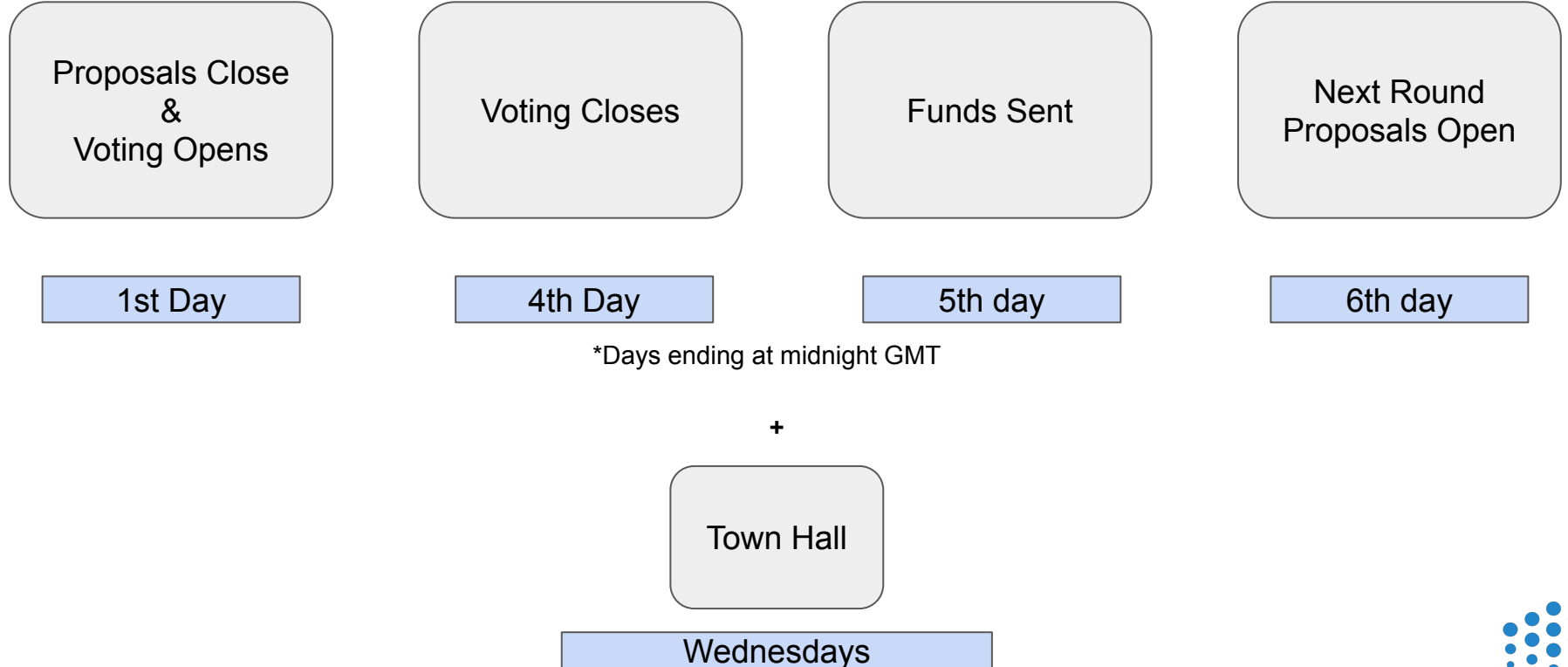
- [Sep 2021 - Round 9 Votes](#)
- [Aug 2021 - Round 8 Votes](#)
- [Jul 2021 - Round 7 Votes](#)
- [Jun 2021 - Round 6 Votes](#)
- [May 2021 - Round 5 Votes](#)



GAIA-X DAO Component Stack



A monthly cadence of funding cycles



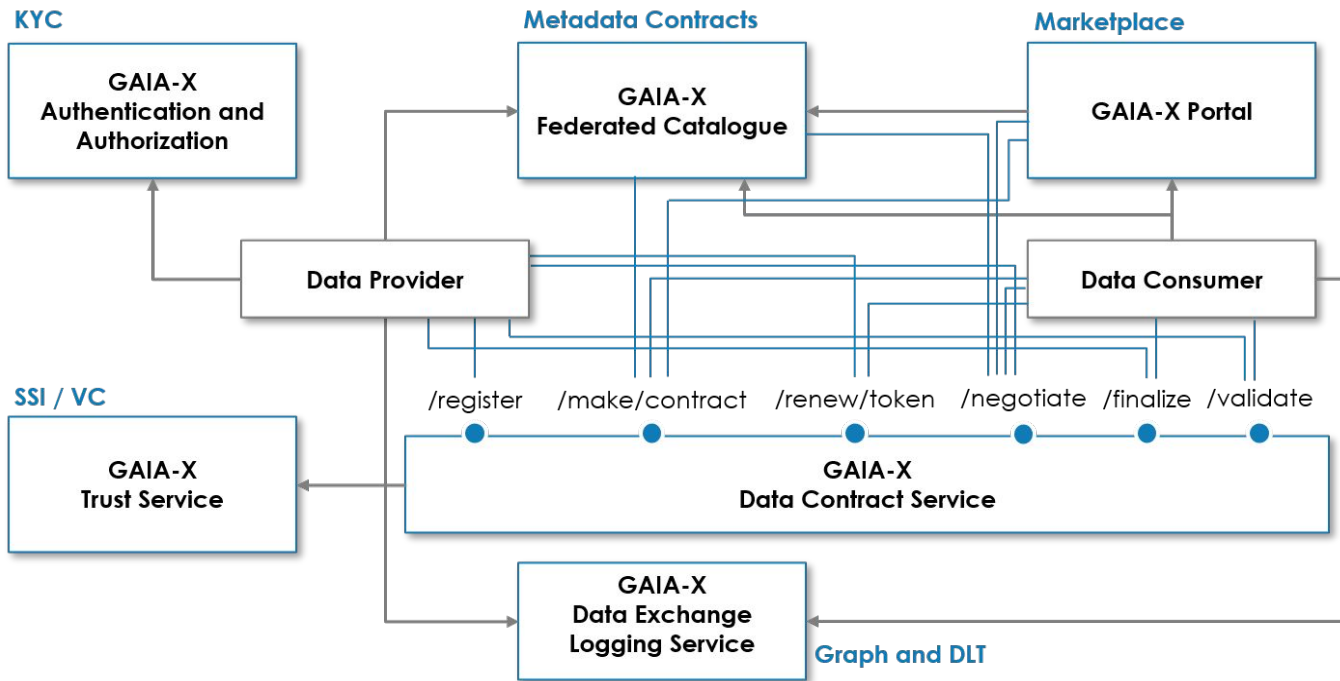
Sub-Block: Data Ecosystem



Q: How to implement a data ecosystem reconciling GAIA-X Sustainability Loop?

A: Support GX token at data ecosystem level, via DLT

Example: GAIA-X Reference Architecture with DLT components (ref. Ocean Protocol)



Source: Sovereign Data Exchange Data Contract Service
<https://www.qxfs.de/federation-services/overview-specification-documents/>

Image is licensed under a [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/) license, [Gaia-X](https://www.gaia-x.eu/), European Association for Data and Cloud, AISBL.
Remixed by deltaDAO AG for illustration purposes regarding the [Gaia-X architecture document 21.06](https://www.gaia-x.eu/document/21.06).

Access Control

Tokenized data access control on DLT

Access to data services managed by smart contracts

If a consumer spends a **datatoken**, access is granted.
More **conditions** in the SC are possible.

Data access rights in the form of datatokens can be transferred on-chain. Smart Contracts become a tool to pool data and conditionalize data sharing.



Access control

Token-based data access control on DLT.

Data Traceability and Integrity

Each access to data services is recorded on-chain

Results of computations can be registered on chain as well

Subsequent data uses can be tracked and traced

Smart Contracts enable trustless traceability and auditability of data services, also for subsequent data use.



Ensure Data Traceability and Integrity
AI model and Data Lineage Tracking. Traceability
by design. Enabled by Smart Contracts.

Data Portals

Buy & sell data services on data portals, enabled by Smart Contracts

Download, stream, or access data via [compute-to-data](#) enabled by Smart Contracts

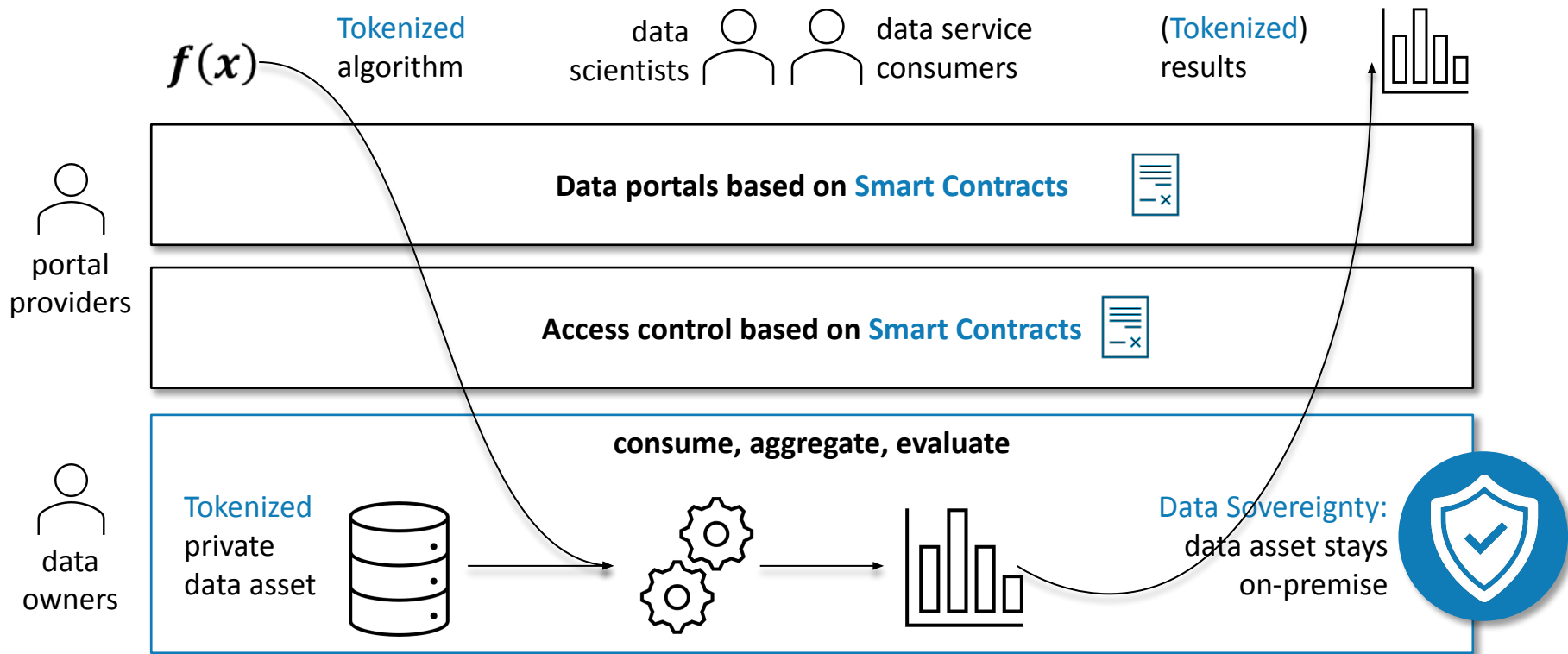
Smart Contracts enable on-chain datamarkets with integrated price discovery.



Simplify Data Exchange and Monetization

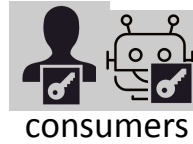
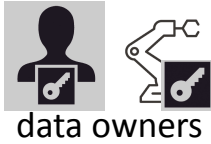
Easy to share, consume, sell and buy.

Layered design for privacy-preserving data sharing

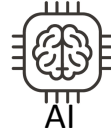


GAIA-X Stakeholders per layer

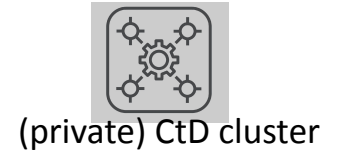
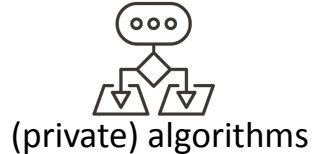
U
Users



L3
Applications



L2
Infra-
structure



L1
DLT



Benefits of DLT-based implementations of GAIA-X

Ecosystem sustainability
(our focus here)

Sustainable
business models and
aligned incentives for
all participants

GDPR-compliance by
design

Data monetization with
automatic price discovery

Data owners always keep
full control

Accessibility and
Availability

Auditability, Provenance
and transparency by
design

Scaling: cross-listing
of datasets across
all datamarkets

No vendor lock-in

Sub-Sub-Block: GAIA-X Portal



MVG Portal Demo - Splash Screen

<https://portal.minimal-gaia-x.eu/>

portal.minimal-gaia-x.eu

gaia-x

Publish History Bookmarks

Connect Wallet

MVG Portal Demonstrator

A platform to find, publish and consume Data Services in the Gaia-X Test Network.

This demonstrator is powered by

ocean

What is a Gaia-X Portal?

This demonstrator aims to bring to life a minimal viable Gaia-X Portal showing how the next generation of data infrastructure can look and feel like: An open, decentralized, transparent and secure digital ecosystem, where data and services are made available, collated and shared in an environment of trust.

CERFIS-7 | ALGORITHM

Demonstrator Algorithm A Europ...

deltaDAO AG

The Vision The future of data markets is embedded in the European Digital Single Market and the Gaia...

1 OCEAN

BREOYS-75 | DATA SET

Demonstrator Data A European Data Econ...

deltaDAO AG

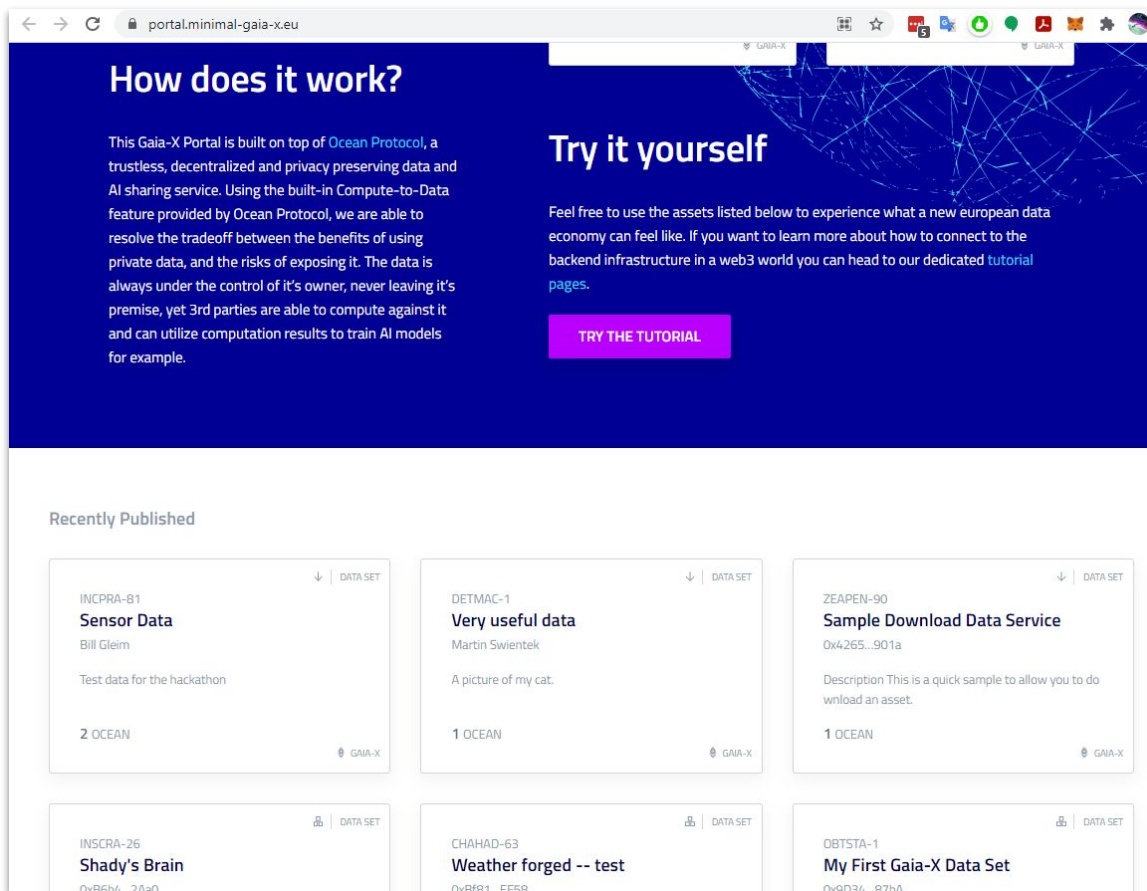
The Vision The future of data markets is embedded in the European Digital Single Market and the Gaia...

1 OCEAN



MVG Portal - Browse Assets

<https://portal.minimal-gaia-x.eu/>



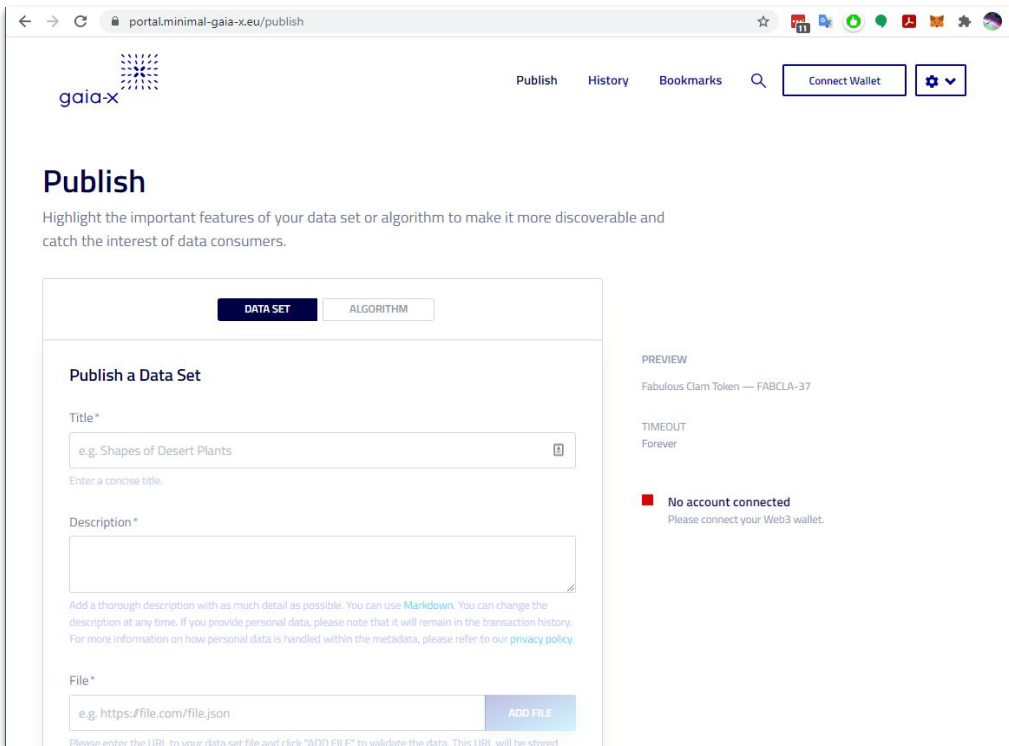
The screenshot shows a web browser window with the URL `portal.minimal-gaia-x.eu`. The page has a dark blue header with a network diagram background. The main content is divided into three sections:

- How does it work?**: A text block explaining that the Gaia-X Portal is built on top of Ocean Protocol, a trustless, decentralized, and privacy-preserving data and AI sharing service. It highlights the Compute-to-Data feature, which resolves the tradeoff between using private data and the risks of exposing it. It states that data is always under the control of its owner, never leaving its premise, yet 3rd parties can compute against it and utilize computation results to train AI models for example.
- Try it yourself**: A section with a text block inviting users to use the listed assets to experience a new European data economy. It includes a link to tutorial pages and a prominent purple button labeled **TRY THE TUTORIAL**.
- Recently Published**: A grid of asset cards, each with a title, author, description, and a 'DATA SET' icon. The cards are:
 - INCPRA-81 Sensor Data** by Bill Gleim: Test data for the hackathon. 2 OCEAN.
 - DETMAC-1 Very useful data** by Martin Swientek: A picture of my cat. 1 OCEAN.
 - ZEAPEN-90 Sample Download Data Service** by 0x4265...901a: Description This is a quick sample to allow you to do winload an asset. 1 OCEAN.
 - INSCRA-26 Shady's Brain** by 0xB6b4...2a30.
 - CHAHAD-63 Weather forged -- test** by 0xBf81...E558.
 - OBTSTA-1 My First Gaia-X Data Set** by 0x9D3A...87b0.

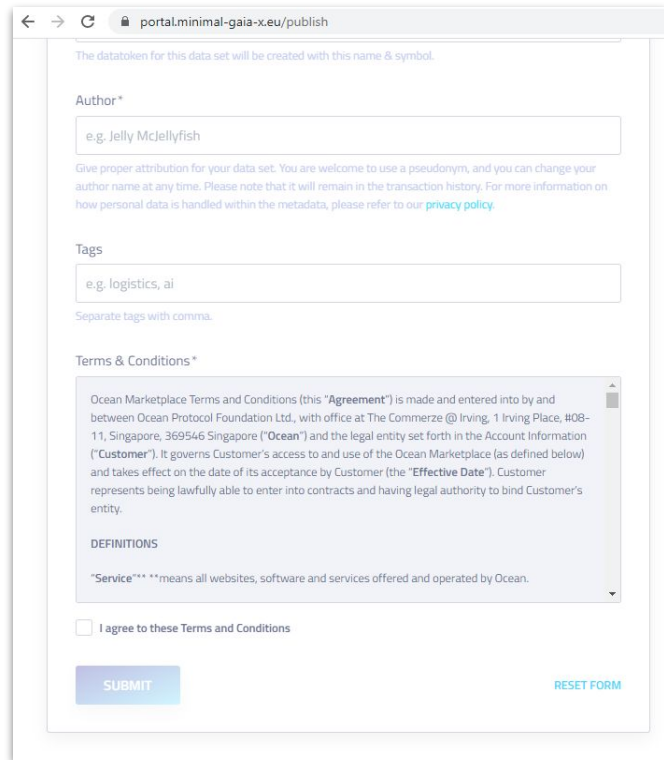


MVG Portal - Publish Flow

<https://portal.minimal-gaia-x.eu/publish>



The screenshot shows the 'Publish' page of the MVG Portal. At the top, there is a navigation bar with 'Publish', 'History', and 'Bookmarks' links, a search icon, and a 'Connect Wallet' button. The main heading is 'Publish', followed by a sub-heading: 'Highlight the important features of your data set or algorithm to make it more discoverable and catch the interest of data consumers.' Below this, there are two tabs: 'DATA SET' (selected) and 'ALGORITHM'. The 'Publish a Data Set' section contains three main input fields: 'Title*' with the example 'e.g. Shapes of Desert Plants', 'Description*' with a large text area, and 'File*' with the example 'e.g. https://file.com/file.json' and an 'ADD FILE' button. A 'PREVIEW' section shows 'Fabulous Clam Token — FABCLA-37' and a 'TIMEOUT Forever' setting. A red error message states 'No account connected' with the instruction 'Please connect your Web3 wallet.' At the bottom, a note says 'Please enter the URI to your data set file and click "ADD FILE" to validate the data. This URI will be stored'.






The screenshot shows the 'Terms & Conditions' page of the MVG Portal. At the top, it says 'The databoken for this data set will be created with this name & symbol.' Below this, there are three input fields: 'Author*' with the example 'e.g. Jelly McJellyfish', 'Tags' with the example 'e.g. logistics, ai', and 'Terms & Conditions*'. The 'Terms & Conditions*' section contains a scrollable text area with the following text: 'Ocean Marketplace Terms and Conditions (this "Agreement") is made and entered into by and between Ocean Protocol Foundation Ltd., with office at The Commerze @ Irving, 1 Irving Place, #08-11, Singapore, 369546 Singapore ("Ocean") and the legal entity set forth in the Account Information ("Customer"). It governs Customer's access to and use of the Ocean Marketplace (as defined below) and takes effect on the date of its acceptance by Customer (the "Effective Date"). Customer represents being lawfully able to enter into contracts and having legal authority to bind Customer's entity.' Below this, there is a 'DEFINITIONS' section with the text: '"Service"' means all websites, software and services offered and operated by Ocean.' At the bottom, there is a checkbox for 'I agree to these Terms and Conditions' and two buttons: 'SUBMIT' and 'RESET FORM'.



Example Data Asset: Fixed Pricing (ATOS data)


<https://portal.minimal-gaia-x.eu/asset/did:op:Dfa927A926481ce8Da68A9909785AD8d829804F2>

Publish History Bookmarks  Connect Wallet 

QUICK - Copernicus Sentinel Data Fusion with CNES Orfeo toolbox (Dataset)

GAIA-X

DATA SET | Mannered Cod Token — MANCOD-15

Published By  ATOS SE — Profile | Explorer
about 7 hours ago — updated about 6 hours ago

Metadata QUICK ATOS dataset

Title

QUICK - Copernicus Sentinel Data Fusion with CNES Orfeo toolbox

Keywords

GaiaX, space, imaging, remote-sensing, application, hackathon, demonstration, OTB, ESA, Copernicus, SAR

Timeout

1 day


Description

Important:

This is the "quick" version for the 1st Gaia-X Hackathon. It runs much faster and only delivers a final result without the intermediate steps to illustrate the functionality of Compute-to-Data and the Data Exchange Logging Service and Data Audit Trails in Gaia-X.

About the use case

USE



tar

4.9 GB

1 OCEAN
≈ €0.70

Select an algorithm to start a compute job

QUICK - Copernicus Sentinel Data Fusion with CNES Orfeo toolbox (Algorithm) 71 1 OCEAN

FF7108-68 | did:op:88C3C964881105F4a735e34A11a10091FF8F2076

You will pay **1 OCEAN**

BUY COMPUTE JOB

For using this dataset, you will buy 1 MANCOD-15 and immediately spend it back to the publisher and pool.



MVG Catalogue Demonstrator

<https://catalogue.minimal-gaia-x.eu/>


gaia-x

Search...

MVG Catalogue Demonstrator

Browse and discover Data and their Self-Descriptions in the Gaia-X Test Network.

This demonstrator is powered by








ocean

18 results

DATASETS ALGORITHMS CATEGORIES

SORT Published

Demonstrator Data  A European Data Economy in 2021	INCPRA-81	↓ DATA SET	2 OCEAN
A dataset published through the tutorial	DETMAC-1	↓ DATA SET	1 OCEAN
Weather forged -- test	ZEAPEN-90	↓ DATA SET	1 OCEAN
Sensor Data	INSCRA-26	 DATA SET	1 OCEAN
FULL - Copernicus Sentinel Data Fusion with CNES Orfeo toolbox (Algorith...	CHAHAD-63	 DATA SET	1 OCEAN
QUICK - Copernicus Sentinel Data Fusion with CNES Orfeo toolbox (Algorit...	OBTSTA-1	 DATA SET	1 OCEAN
...	MANCOD-15	 DATA SET	1 OCEAN



Conclusion



Conclusion

- Introduced an approach for GAIA-X sustainability
 - Drawing on a \$GX token
 - System-level design: Web3 Sustainability Loop
 - Sub-block: GAIA-X DAO for grants
 - Sub-block: Data ecosystem
- Verified with agent-based simulation (TokenSPICE)
- Provided an example DLT-based implementation (Ocean)

