

# Klima 2.0

The Dark Sole Enterprise Ltd [ds@darksole.vip](mailto:ds@darksole.vip)  
with contributions from the Klima and Carbonmark teams

27 Jan 2026 (Version 1.48)

## Notice to Readers

This document describes a proposed technical and economic model developed by 01X as part of exploratory research conducted in connection with the Klima ecosystem. It reflects conceptual design work informed by prior learnings from KlimaDAO and related on-chain carbon market initiatives.

The model presented herein is illustrative only and is intended to explore one possible approach to scaling carbon market infrastructure using blockchain-based systems. It does not represent a commitment to implement any specific architecture, mechanism, parameter, or economic outcome. The Klima Protocol is expected to deploy a production system for on-chain carbon market infrastructure in or around February 2026. At that time, a separate implementation whitepaper will be released describing the deployed system, and the corresponding smart contract code will be made publicly available as open-source software.

This document should not be relied upon as a description of the final protocol, its operation, or its economics. It does not constitute an offer, solicitation, investment advice, or a representation regarding the legal, regulatory, or economic characteristics of any future deployment.



## Copyright Notice

This document represents original work by dark\_sole [ds@darksole.vip](mailto:ds@darksole.vip). While contributions from others are gratefully acknowledged, all intellectual property rights remain with the author. The models, algorithms, processes, products, methodologies, and concepts described herein are licenced exclusively for commercial use by the Klima Protocol. No other party may implement, copy, modify, or derive works from these materials without explicit written permission from the author.

© 2025 dark\_sole. All rights reserved.

## 1 Prologue

Klima 2.0 is an autonomous, rules-based coordination protocol designed to support the retirement of carbon credits through continuous and transparent execution terms.

It is not a financial product, investment vehicle, or asset management system, but a piece of market infrastructure that enables carbon supply and retirement demand to interact under predefined conditions.

The protocol operates through a dual-token architecture that facilitates coordination without discretionary control: **kVCM** functions as the internal unit of account and pricing reference for protocol-facilitated carbon retirement, while **K2** provides signalling inputs related to system capacity. Together, these tokens inform protocol parameters through deterministic smart-contract logic. This architecture enables the protocol to:

- define execution rates and intake eligibility for carbon credits against transparent, pre-defined rules;
- make acquired credits available exclusively for irreversible retirement;
- coordinate liquidity provision and participation incentives required for continuous operation.

Participant actions such as locking tokens, signalling preferences, or providing liquidity serve inputs into a coordination mechanism that adjusts protocol parameters within predefined bounds. These inputs do not confer ownership rights, redemption rights, or claims on protocol-held carbon, nor do they constitute discretionary management of assets.

The protocol consists of three interdependent functional layers:

- a carbon inventory layer that holds credits solely for the purpose of facilitating retirement;
- a coordination layer that aggregates participant signals to inform protocol parameters; and
- a liquidity layer that supports access and withdrawal from the system through external markets.

These layers are designed to operate together as a self-contained system, adjusting to observable supply and retirement demand without reliance on external oracles, manual intervention, or fee-extractive intermediaries.

Klima 2.0 abstracts complex carbon market interactions into a transparent and auditable execution framework, enabling participants to interact with carbon retirement infrastructure directly, programmatically, and on equal terms.

Any economic effects arising from protocol activity result from predefined rules and market interaction, rather than from asset ownership, portfolio management, or profit extraction.

## 2 Klima 2.0

KlimaDAO launched in 2021 on the Polygon blockchain as an early experiment in applying tokenisation and onchain liquidity to voluntary carbon markets. The initial design centred on the KLIMA token and a treasury-based mechanism intended to bootstrap liquidity and participation in a nascent onchain carbon ecosystem.

That first iteration played a meaningful role in demonstrating that carbon credits could be represented, transferred, and retired using blockchain infrastructure. It also catalysed the development of a broader ecosystem of tools and services, including integrations with multiple carbon registries, marketplaces and point-of-sale interfaces, APIs for third-party applications, and direct onchain issuance by project developers.

Over time, it became clear that the original architecture was not well suited to serving large-scale, enterprise carbon buyers or to supporting continuous, rules-based market operation without manual intervention. In particular, treasury-centric designs introduced complexity, opacity, and governance challenges that limited scalability and operational clarity.

Klima 2.0 is a ground-up redesign informed by these lessons. Rather than relying on treasury management or discretionary allocation, the new protocol is structured as neutral, non-extractive market infrastructure focused exclusively on facilitating carbon retirement through transparent pricing, programmatic settlement, and open participation.

The Klima 2.0 protocol replaces treasury-backed mechanisms with a rules-based coordination model that uses protocol-native tokens to parameterise execution rates, intake capacity, and participation incentives. Carbon credits handled by the protocol are acquired solely to fulfil retirement demand and are not held, traded, or managed for financial gain.

This shift reflects a deliberate move away from capital-centric designs toward infrastructure that prioritises auditability, predictability, and long-term operational resilience. Klima 2.0 is intended to function as a shared execution layer for carbon markets, enabling suppliers, buyers, and integrators to interact under predefined conditions without reliance on discretionary intermediaries.

## 2.1 Protocol Tokens

Klima 2.0 operates using two protocol-native tokens, **kVCM** and **K2**, which together enable rules-based coordination and participation within the system. These tokens do not confer ownership rights, redemption rights, or claims on protocol-handled carbon, and do not represent investment interests.

**kVCM** functions as the internal unit of account and pricing reference for protocol-facilitated carbon retirement, while **K2** provides signalling inputs related to system capacity. Both tokens are used exclusively to parameterise protocol behaviour through deterministic smart-contract logic.

**kVCM** tokens set core allocation choices, whereas **K2** acts as the calibration mechanism for inventory development.

## 2.2 High-Level Architecture

Klima 2.0 is composed of three interdependent functional layers that together support continuous, non-discretionary operation:

### 1. Carbon Inventory Layer:

- Accumulates carbon credits by minting **kVCM**.
- Sells carbon certificates by burning **kVCM**.
- Sets carbon execution rates based on the system's code.

Carbon credits handled by the protocol cannot be withdrawn, transferred, or resold. They may only be retired.

### 2. Governance Layer:

- **kVCM** holders may **time-lock** their **kVCM** for a fixed time period and become eligible to select carbon assets for the inventory.
- This action creates a **kVCM** Base Accrual curve, which is distributed to the time-locked holders. This is utilised to derive discount rates and governance weightings.

### 3. Liquidity Layer:

- **kVCM** and **K2** holders are able to pair their tokens together, or in the case of **kVCM** with USDC, in order to generate liquidity fees in the standard way.

- Staking the resulting liquidity provider tokens may generate a share of protocol incentives.
- Liquidity locked in the **kVCM/K2** liquidity pool participates in general governance alongside time-locked **kVCM** holders.

These layers operate together as a self-contained system that responds only to its own observable state, without reliance on external oracles or centralised intervention.

## 2.3 Incentives and Participation

The protocol issues incentives to participants who provide defined services necessary for system operation.

### 2.3.1 kVCM Incentives

**kVCM** incentives are continuously emitted to:

1. Time-locked **kVCM** ('**kVCM** Base Accrual').
2. User-locked **K2**.
3. Both **kVCM** and **K2** liquidity providers.

### 2.3.2 K2 Incentives

The supply of **K2** is allocated at various rates, depending on overall system balances:

1. Time-locked **kVCM**.
2. User-locked **K2**.
3. Both **kVCM** and **K2** liquidity providers.

## 2.4 Carbon Inventory

The protocol's carbon inventory layer accumulates and retires carbon. It is driven by parameters determined by its rules-based smart contracts, and user activities.

Carbon credits are acquired from suppliers, and consumed by offset buyers. Carbon credits are grouped by pre-defined classifications called **carbon classes**.

Aggregate token holder allocations collectively set the parameters for the execution rates of **each class** for, both suppliers and retirees, by defining:

- Inventory weighting.
- Capacity.

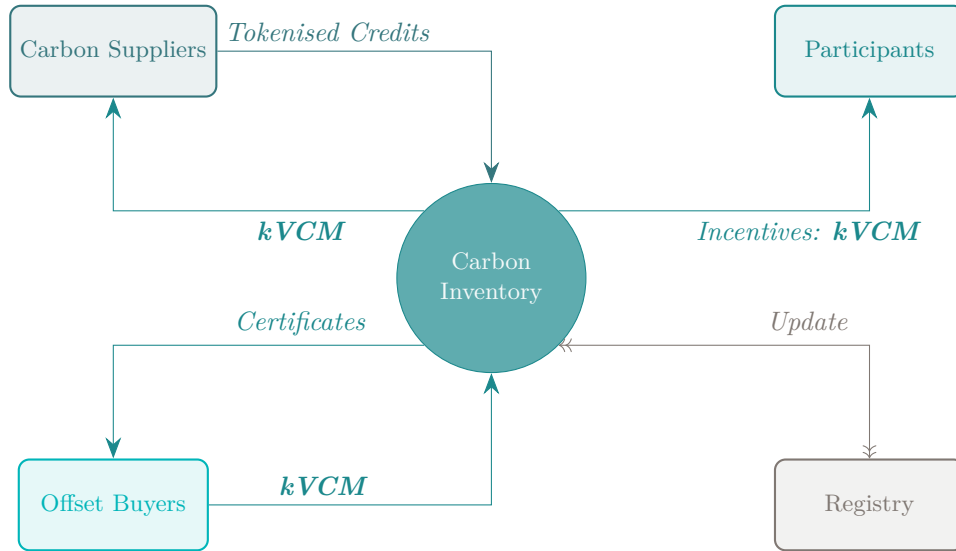


Figure 1: Klima 2.0 Carbon Inventory.

Additional **global** parameters are also determined by the aggregate allocations, including the **kVCM** incentive curve.

Thus the Protocol is driven in response to its own native token balances, acting as rules-based carbon market infrastructure to connect available supply with retirement demand. It is able to do so without using oracles or external inputs, and without discretionary allocation, resale, or optimisation of inventory.

## 2.5 Tokens

Locking or staking the protocol's tokens allows participants to signal pricing preferences and capacity parameters within the protocol. However, holding or locking the tokens does not represent risk ownership, profit participation, or exposure to carbon price movements. Participants may receive protocol incentives for performing defined coordination functions, distributed according to transparent, rules-based mechanisms.

Together, **kVCM** and **K2** enable the protocol to operate as neutral, non-extractive infrastructure, coordinating participation and execution without discretionary management.

### 2.5.1 kVCM

**kVCM** is the protocol's primary utility token. Its supply is not capped: it grows when new carbon is supplied to the protocol, and contracts when it is retired.

- When **time-locked**:
  - It *may* vote for carbon classes for inventory weighting.
  - It receives **kVCM** base accrual and **K2** incentives.
  - In aggregate, it determines the rate of incentive issuance.
- **Transactional** usage:

- **Mint**: when suppliers deliver carbon to the protocol.
- **Burn**: when credits are retired from the protocol.
- When **staked** in liquidity pools it is also eligible for incentives, based on the position's relative share.

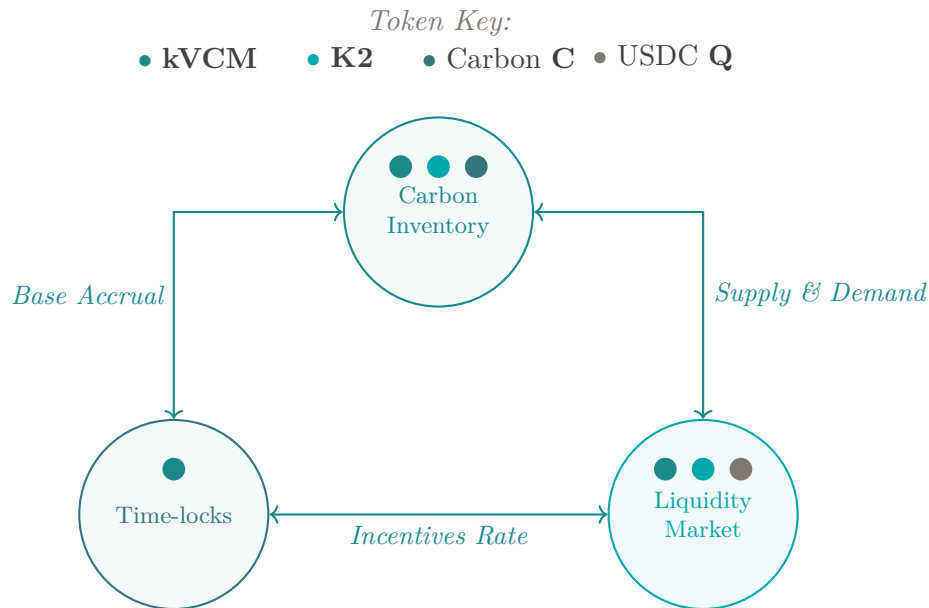


Figure 2: Token utility.

### 2.5.2 K2

**K2** is a fixed-supply token distributed programmatically over time.

- When **user-locked**:
  - It *may* vote for carbon classes to reduce the difference between execution terms on carbon intake and retirements.
  - It receives **kVCM** and **K2** incentives.
  - In aggregate, it influences the rates of incentive issuance.
- When **staked** in the kVCM/K2 liquidity pool it is also eligible for incentives, based on the position's relative share.

### 2.5.3 Utility Functions

The **kVCM** token has two utility functions which are not independent:

1. **Time lock**: The **kVCM** token is locked for a specific period of time which determines a kVCM 'base accrual' rate. This cannot be amended.

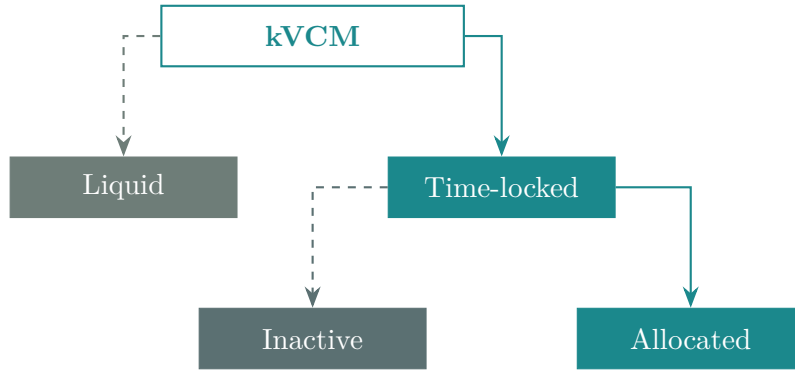


Figure 3: **kVCM** utility functions.

2. **Price allocation:** Collective selection of carbon classes by **kVCM** allocations determines the **real-time** execution ratio for carbon intake and retirements, in **kVCM** terms. This selection can be amended and withdrawn at any time to allow modulation of protocol parameters.

The **K2** token also has two utility functions:

1. **User lock:** The **K2** token remains locked for at least 24 hours.
2. **Capacity allocation:** Collective selection of carbon classes by **K2** allocations determines the rate of issuance or retirement of **kVCM** for the specified carbon class. More capacity allocations on a given carbon class reduce the impact that new transactions have on the execution ratio created by price allocations.

Both tokens facilitate the carbon market to function efficiently, with the **kVCM** token responsible for setting execution ratios, and the **K2** token modulating capacity.

## 2.6 Token Initialisation

There is an initial issuance of tokens at the genesis of Klima 2.0. All future emissions are distributed autonomously via incentives.

Token	Supply	Notes
<b>kVCM</b>	20 million	<ul style="list-style-type: none"> <li>• Supply expands and contracts programmatically in response to carbon intake and retirement activity.</li> <li>• A portion of the initial supply is allocated to existing KLIMA holders.</li> </ul>
<b>K2</b>	100 million	<ul style="list-style-type: none"> <li>• Fixed supply.</li> <li>• Distributed programmatically over time, with a portion allocated to existing KLIMA holders.</li> </ul>

Table 1: Token Summary

**kVCM** is issued when carbon credits are supplied to the protocol for the purpose of facilitating future retirement, and permanently removed from circulation when carbon is retired. This mint-and-burn process serves as an internal accounting mechanism and does not represent asset ownership or claims on protocol-held carbon.

## 2.7 Participants

### 1. Carbon Suppliers & Retirees

Participants may supply or retire eligible, tokenised carbon credits to the protocol at quoted execution rates. Supplied credits are handled solely for retirement and cannot be withdrawn, transferred, resold or otherwise arbitrated.

**Carbon inventory:** Real-time execution terms for suppliers are continuously updated based on protocol token balances.

### 2. Liquidity Providers

Participants may provide liquidity in supported token pairs to facilitate entry and exit from the system. Liquidity provision supports continuous execution and is incentivised according to predefined protocol rules.

**Staked liquidity:** Provides continuous incentives for those contributing liquidity to the system.

### 3. Governance Users

Participants who wish to affect carbon price and capacity may do so by allocating **kVCM** and **K2** tokens.

**Time locks & user locks:** Provide continuous incentives for those contributing activities that coordinate the protocol.

## 2.8 Protocol Design Principles

### 1. Infrastructure, Not Extraction:

Klima 2.0 is designed as shared market infrastructure rather than an extractive financial product. The protocol does not charge fees, take spreads, or operate profit-taking mechanisms for any sponsor, foundation, or investor. All protocol behaviour is rules-based and applies uniformly to all participants, with no privileged economic positions or revenue capture layers.

**Design intent:** Reduce opaque intermediation and hidden margins common in carbon markets, not replace them with a new rent-seeking intermediary.

### 2. Consumption-only Carbon Access:

Carbon credits handled by the protocol are not exposed for resale, speculation, or secondary trading. Once accepted by the protocol, credits may only be accessed for irreversible retirement through protocol-defined processes.

**Design intent:** Align the system with carbon's end use (retirement), rather than treating credits as financial instruments.

### 3. Coordination Through Signalling:

Protocol tokens do not represent ownership of carbon, claims on protocol-held assets, or entitlement to surplus value. Instead, tokens function as signalling and coordination inputs that influence protocol parameters (such as execution conditions and capacity) within predefined bounds.

**Design intent:** Enable decentralised coordination in a complex and competitive environment.

#### 4. Autonomous, Rules-based Operation

All protocol behaviour — including pricing logic, intake conditions, retirement execution, and incentive distribution — is governed by deterministic smart contracts. Once deployed, the system operates autonomously and does not rely on discretionary decisions by any individual, committee, or organisation.

**Design intent:** Build a trustless, auditable system, that is not based on subjective, opaque intervention.

#### 5. Equal Access and Uniform Treatment

All participants interact with the protocol on identical terms. There are no side agreements, preferential execution paths, differentiated rights, or bespoke economic arrangements. Protocol rules apply uniformly to all users, including the protocol’s creators and affiliated entities.

**Design intent:** Ensure credibility, neutrality, and resistance to capture.

#### 6. Market-driven Outcomes, Not Managed returns

Any economic effects associated with protocol participation arise solely from predefined rules and participant interaction with the system. The protocol does not manage assets on behalf of users, target returns, or seek to optimise outcomes for any class of participant.

**Design intent:** Enable transparent market coordination without positioning the protocol as an asset manager or investment vehicle

### 3 Core Protocol Layers

From this section we refer to **kVCM** tokens as **A**, **K2** tokens as **G**, **USDC** tokens as **Q**, carbon credits as **C**, and carbon offset certificates as **C\***.

Three layers enable the Klima Protocol to find equilibrium through continuous dynamic feedback loops and overall system balances (supply, demand, token holder positions). There is no centralised management entity with discretionary powers, or fees that can be turned on.

1. **Time-locking mechanics:** **A** token holders can time-lock their tokens until a set date to define system parameters and to have the ability to select carbon classes for system weighting.
  - The collective locks influence the **A** rewards, as well as the real-time execution price for carbon credit acquisitions or retirements.
2. **Carbon inventory layer:** the protocol swaps **A** for carbon credits **C** (in) or carbon offset certificates **C\*** (out).
  - Both allocations of time-locked **A** tokens and user-locked **G** tokens are used in the protocol: allocations of **A** determine the pricing of carbon, and allocations of **G** determine capacity.
3. **Liquidity layer:** External liquidity pools enable conversion between **kVCM** and supported settlement assets. Liquidity provision supports system availability and users may receive incentives through the transparent, rule-based approach.
  - $\overline{AG}$  liquidity pool: Native token swap **A** and **G**.
  - $\overline{AQ}$  liquidity pool: The asset token **A** with **USDC Q**.

The Klima system enables each participant to contribute to various aspects of the model, in the interests of their own utility. This, in conjunction with the autonomous model, enables the protocol to fulfill its mandate of facilitating retirement demand into the carbon markets.

### 3.1 Time-locking Mechanics

Time-locking **A** tokens represents a non-custodial commitment to protocol participation for a fixed duration. Lock durations are standardised at 90 days increments and expire on a rolling schedule. There are always 40 durations, extending out to approximately 10 years.

- **Discount curve:** Aggregate time-locking determines the shape of the discount curve of the **A** token with regards to execution prices.
- **Incentives:** Time-locked **A** tokens may receive incentives, with a rate determined by the base accrual. The base accrual is calculated daily based on user positions, via the ‘time-weighted incentive curve’.
- **Locks:** Time-locked tokens and any associated **A** incentives are released only upon time-lock expiration. Early exit is not possible.

**G** tokens are not involved in the time-locking mechanics. The discount curve is agnostic to carbon class although only time-locked **A** token holders can allocate their token to carbon classes for portfolio pricing.

#### 3.1.1 Time-weighted Incentive Curve

Defining:

- $S$ : Total time-locked **A** tokens expressed as a proportion of the outstanding supply of **A**.
- $S_t$ : Total **A** tokens time-locked in bucket  $t$ , expressed as a proportion of the outstanding supply of **A**, where  $\sum S_t = S$ , and  $t$  is the index of standard durations  $t \in \{1, 2, 3, \dots, 40\}$ .
- $E_t$ : Duration expressed in years.

Calculating curve parameters  $D$  and  $C$ :

$$D = \frac{1}{S} \sum_{t=1}^{40} S_t E_t \quad (1)$$

$$C = \frac{1}{S} \sum_{t=1}^{40} S_t E_t^2 \quad (2)$$

The shape of the time-weighted incentive curve is produced:

$$\gamma_t = \max \left( \frac{E_t}{D} - \frac{E_t^2}{2C}, 0 \right) \quad (3)$$

Normalising  $\gamma_t$  to  $\hat{\gamma}_t$ :

$$\hat{\gamma}_t = \frac{\gamma_t}{\sum_{t=1}^{40} \gamma_t} \quad (4)$$

With the cumulative sum of the normalised values expressed as  $\Gamma_t$ :

$$\Gamma_t = \sum_{i=1}^t \hat{\gamma}_i \quad \text{for } t = 1, \dots, 40 \quad (5)$$

The time-weighted incentive curve  $Z_t$  is solved:

$$Z_t = (1 - S) \frac{\Gamma_t}{E_t} \quad (6)$$

Whereupon, the discount rate  $B_t$  that forms the discount curve is derived:

$$B_t = \exp(-Z_t E_t) \quad (7)$$

The incentives due on time-locked **A** tokens are calculated daily and added to the locked principal, hence the daily accrual for each duration is calculated:

$$Y_t = \exp\left(\frac{Z_t}{365}\right) - 1 \quad (8)$$

Hence, any time-locked **A** stake  $S_t$  will increase by a base accrual  $\Delta S_t$ :

$$\Delta S_t = S_t Y_t \quad (9)$$

With the total **A** tokens created on a daily basis for time-locked inflation as

$$R = \sum_{t=1}^{40} \Delta S_t \quad (10)$$

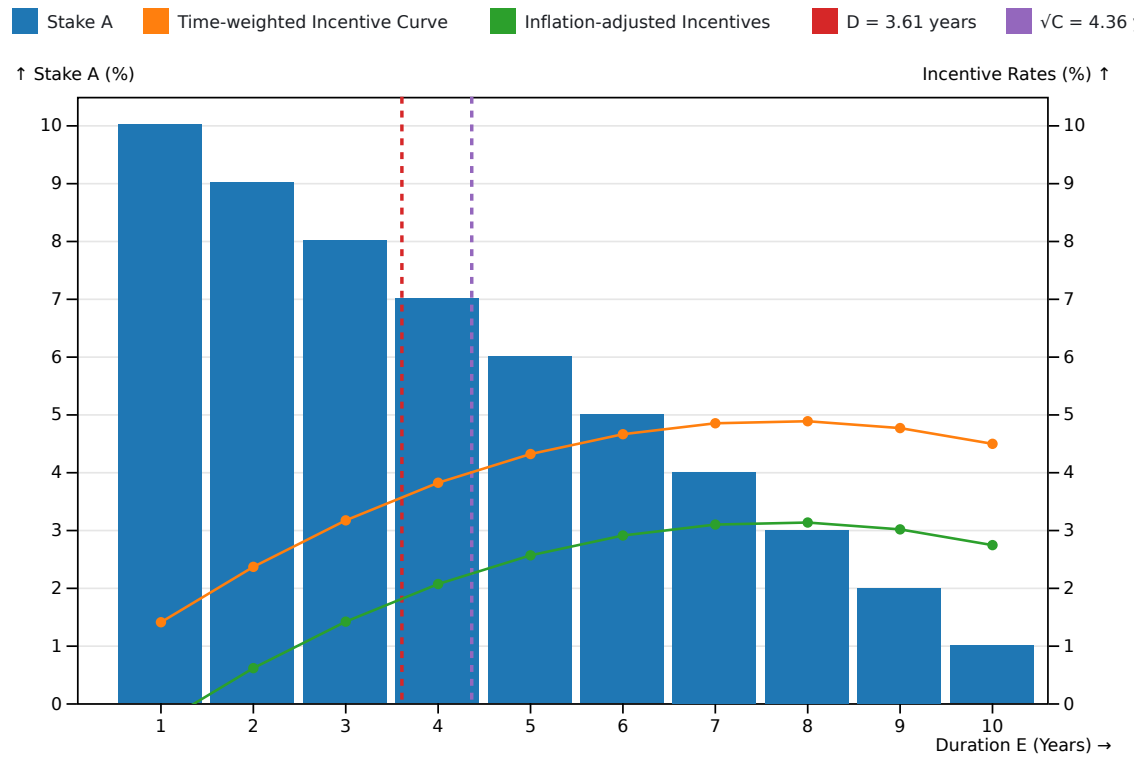
For visualising the sensitivity of overall **A** inflation rates with respect to staking and duration, Figure 5 assumes a single duration over the staking range to provide an approximation of inflation  $\Delta S \approx Z S$ .

### 3.1.2 Protocol Governance Signals

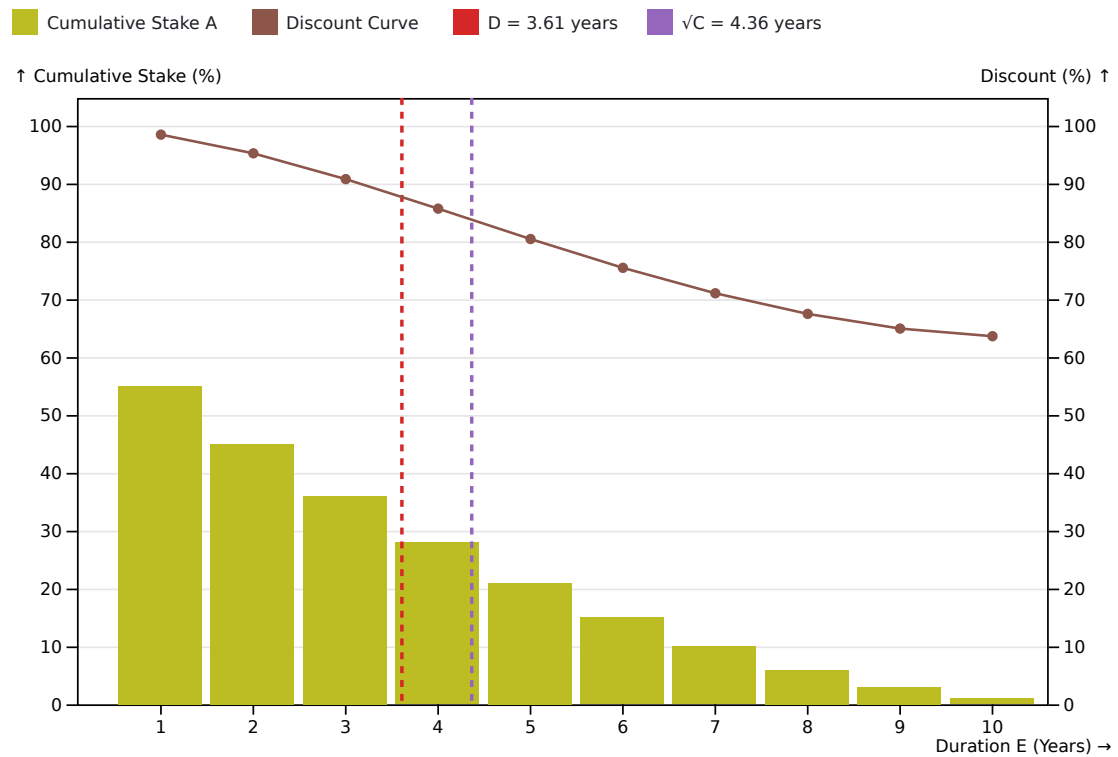
Protocol governance signals can be derived from two participation cohorts:

1. Time-locked **A** tokens:  $S_t$
2. Staked liquidity in the **A-G** pair  $\overline{\mathbf{AG}}$  (see Section 3.3), defined here as  $A_{Gt}$ , representing the quantity of **A** tokens held in the liquidity pool expressed as a proportion of circulating supply.

Voting power is allocated by time and applied to the respective balance of **A**:



(a) Time-weighted incentives (Total Stake = 55.00%, Inflation = 1.75%).



(b) Discount rates.

Figure 4: Example of time-locked incentives.

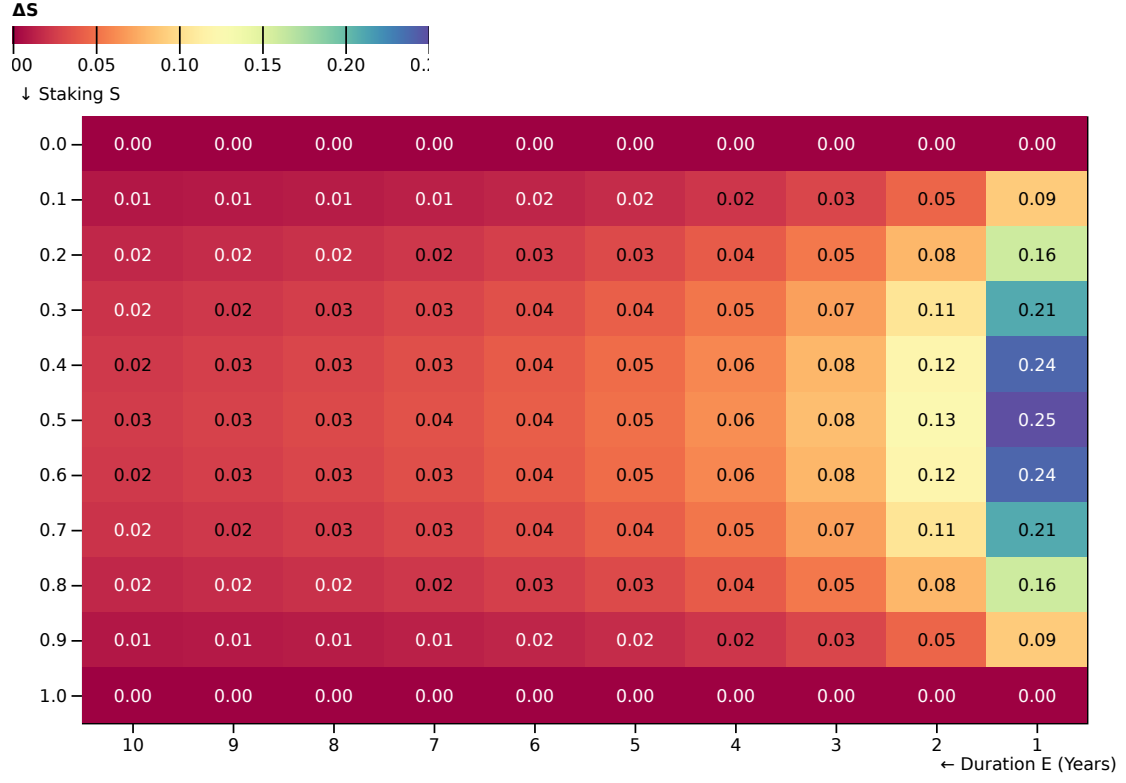


Figure 5: **A** inflation rate from base accrual  $\Delta S$ .

1. Initial voting weights for time-locked **A** tokens  $v_t$ :

$$v_t = Z_t S_t \quad (11)$$

2. Initial voting weights for staked liquidity  $w_t$ :

$$w_t = Z_t A_{Gt} \quad (12)$$

3. Final voting weights for time-locked **A** tokens  $V_t$ :

$$V_t = \frac{v_t}{\sum_{j=1}^{40} (v_j + 2w_j)} \quad (13)$$

4. Final voting weights for staked liquidity  $W_t$ :

$$W_t = \frac{w_t}{\sum_{j=1}^{40} \left( \frac{1}{2} v_j + w_j \right)} \quad (14)$$

## 3.2 Carbon Inventory Mechanics

The carbon inventory layer ultimately swaps carbon through a set of smart contracts, driven by carbon supply, demand, and user-inputs. The combined allocations of **A** and **G** tokens creates a dynamic real-time execution price curve by carbon class.

### 3.2.1 Carbon Supply

*User swaps carbon credits for **A** tokens.*

#### 3.2.1.1 Existing Carbon in the Inventory

For carbon pricing, both **A** tokens and **G** tokens may be allocated to specific carbon classes  $i \in \{1, 2, 3, \dots, n\}$  and these are independent allocations between the two tokens.

For a carbon class quantity to be supplied to the protocol, it must have a strictly positive quantity of **A** tokens allocated to that carbon class, otherwise there is no price, and the carbon cannot be sold.

Defining:

- $C_i$ : Total tonnes of carbon class  $i$  currently held in the inventory.
- $A_i$ : **A** tokens allocated to carbon class  $i$  expressed as a proportion of the outstanding supply of **A** tokens, where  $\sum A_i = A$ .
- $G_i$ : **G** tokens allocated to carbon class  $i$  expressed as a proportion of the outstanding supply of **G** Tokens.

Where  $\Delta C_i$  is expressed as the relative increment to its respective pool balance, the amount of **A** tokens issued to pay for carbon,  $\Delta A$ , expressed as a proportion of current supply, is determined as:

$$\ln(1 + \Delta A) = \left( A_i - \frac{A_i^2 (1 - G_i)^2}{2} \right) \ln(1 + \Delta C_i) \quad (15)$$

Denoting the expression on the right hand side of Equation 15 as RHS:

$$\Delta A = \exp(\text{RHS}) - 1 \quad (16)$$

Finally,  $\Delta A$  is applied to the outstanding supply of **A** to solve for token quantities.

Figure 8 illustrates the **G** token's capacity to maintain the initial execution terms of the **A** token. The data has been normalised in Figure 9 to  $\Delta C_i A_i$ .

Noting that the sensitivity to  $G_i$  increases as  $A_i$  increases and the effects become more pronounced as  $\Delta C_i$  increases.

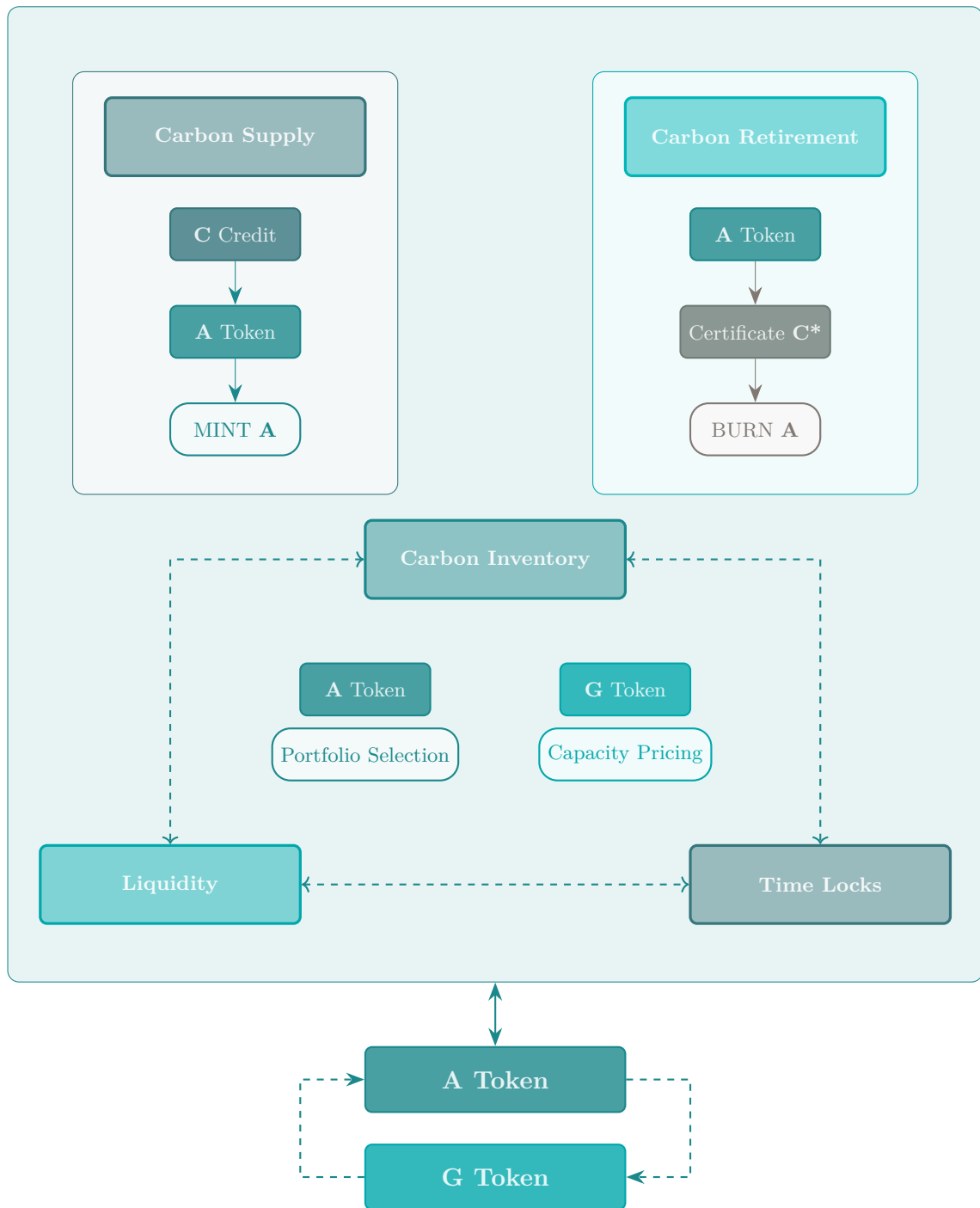


Figure 6: Klima 2.0 carbon inventory mechanics.

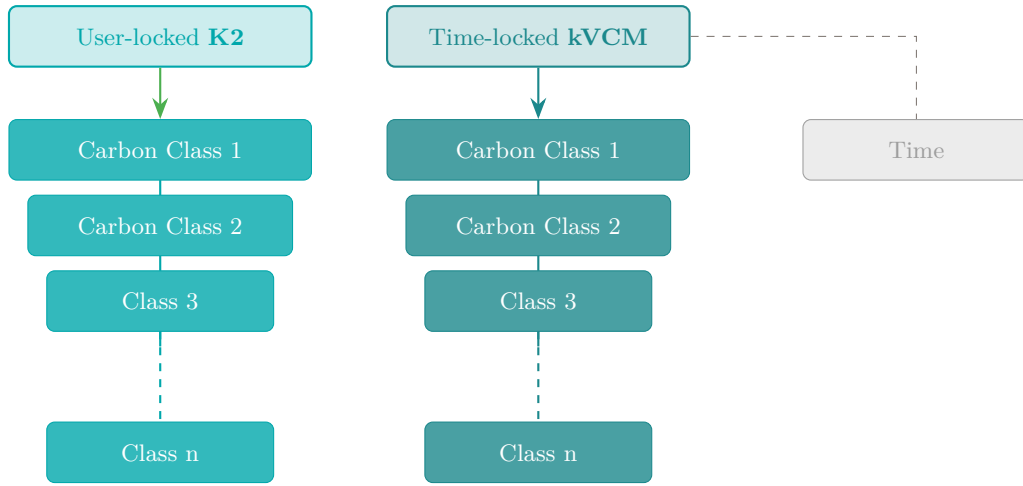


Figure 7: Token staking class structure.

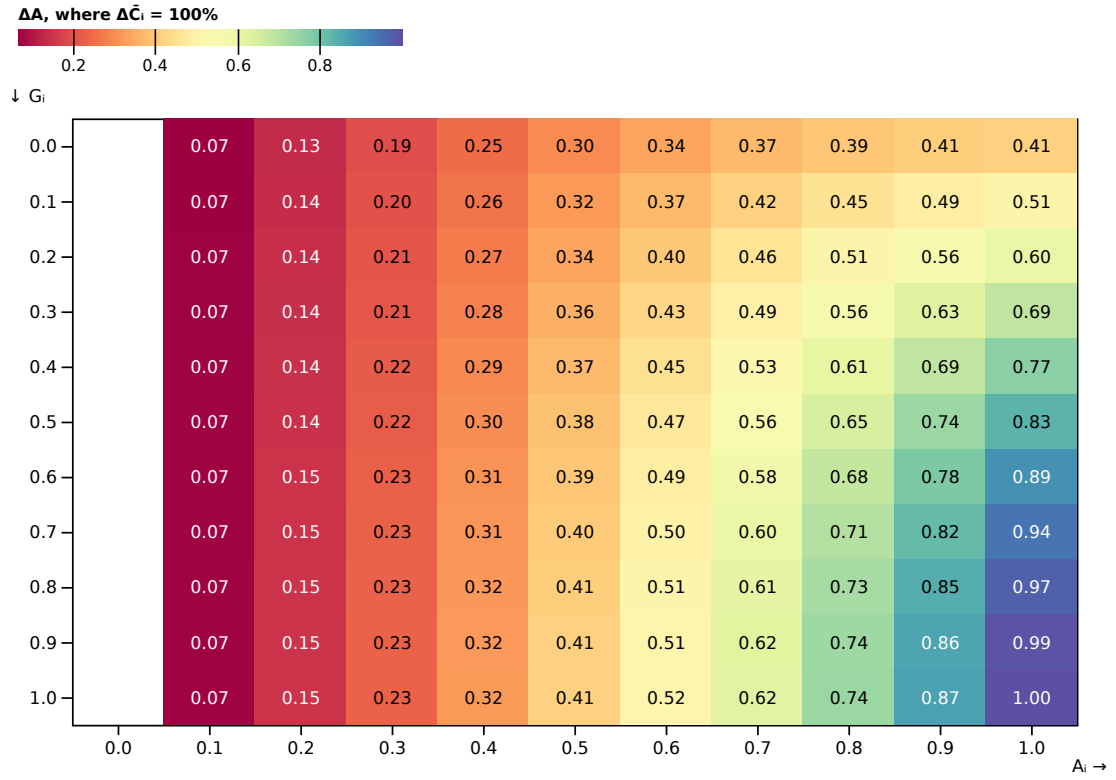


Figure 8:  $A$  price curves ( $\Delta A$ ).

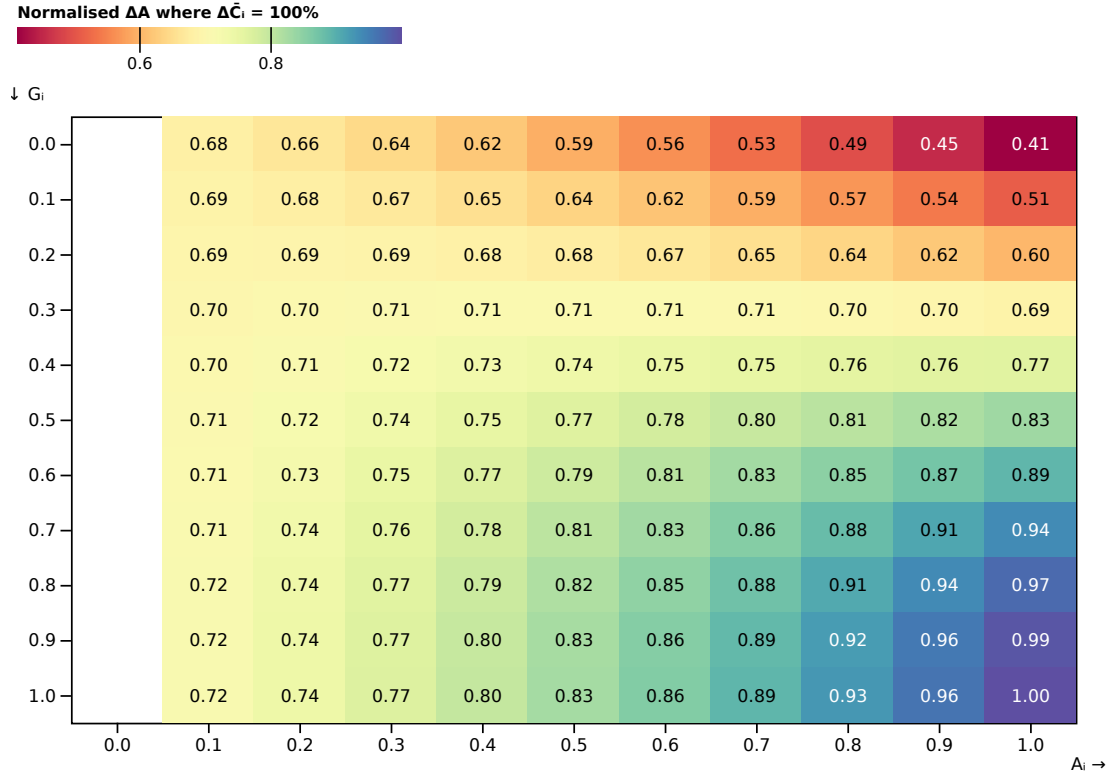


Figure 9: Normalised **A** price curves.

### 3.2.1.2 Zero Carbon Scenario

There are circumstances when there is zero carbon held in the portfolio for a particular class, i.e.  $C_i = 0$ , which invalidates the calculation of  $\Delta C_i$  and a different approach is required.

Taking  $\Delta C_\emptyset$  as the tonnes of carbon tokens (implying an existing balance of 1 tonne), adjusted for forward discounting, to be sold for any carbon class that has a strictly positive **A** allocation  $A_\emptyset$ , together with **G** allocation  $G_\emptyset$ :

$$\Delta A = \frac{\Delta C_\emptyset}{1 + \Delta C_\emptyset} \left( A_\emptyset - \frac{A_\emptyset^2 (1 - G_\emptyset)^2}{2} \right)^2 \quad (17)$$

### 3.2.2 Sell Offset Certificates

*User swaps **A** tokens for carbon offset certificates.*

#### 3.2.2.1 Weighted Carbon Class

For retiring carbon that is *weighted*, that is for which there is a strictly positive **A** token allocation, an **A** token holder can extract the carbon class offset certificate of their choice  $C_i$  but the available pool is only the liquid carbon balance, namely the element  $C_{i0}$ :

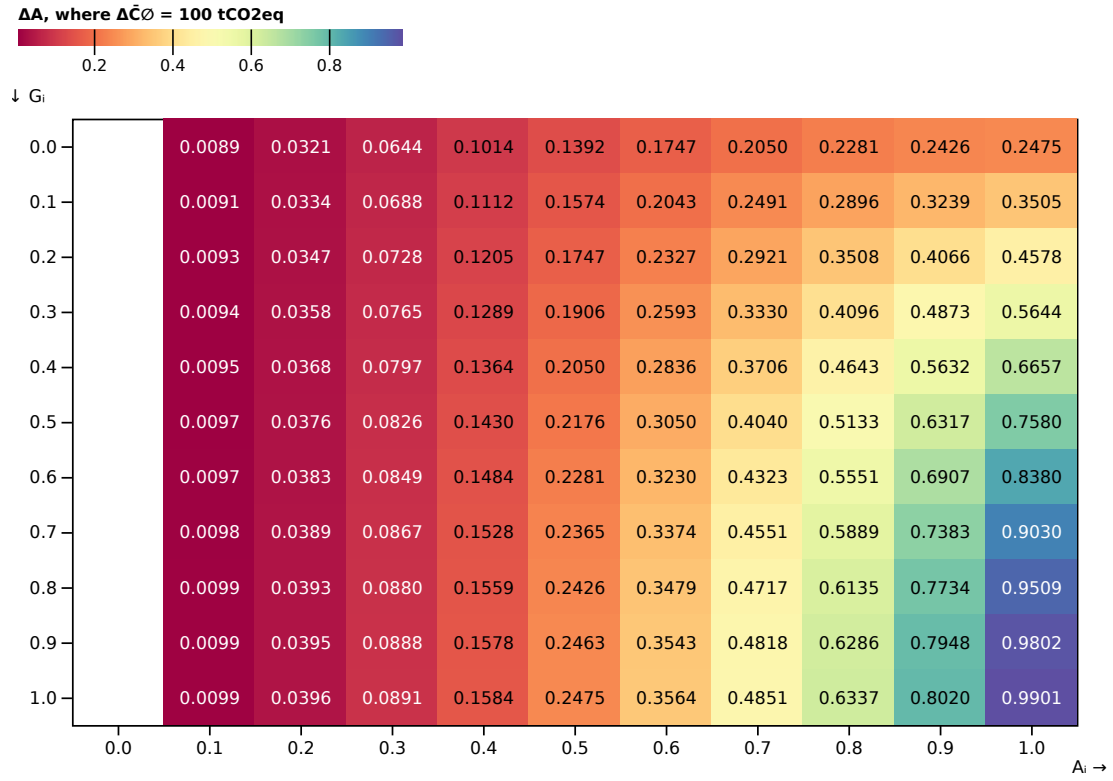


Figure 10: **A** price curves ( $\Delta A$ ) in the zero carbon scenario.

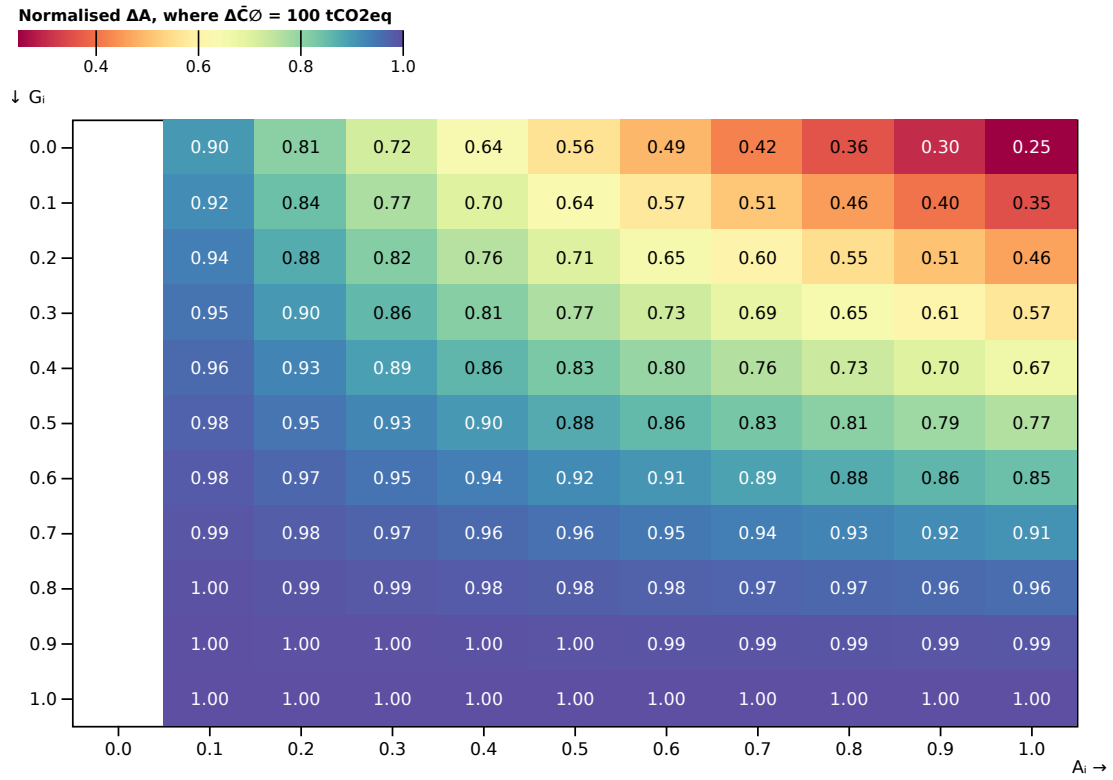


Figure 11: Normalised **A** price curves in the zero carbon scenario.

$$\ln(1 + \Delta C_i) = \frac{-\ln(1 + \Delta A)}{A_i + \frac{1}{2}A_i^2(1 - G_i)^2} \quad (18)$$

As before, denoting the expression on the right hand side of Equation 18 as RHS:

$$\Delta C_i = \exp(\text{RHS}) - 1 \quad (19)$$

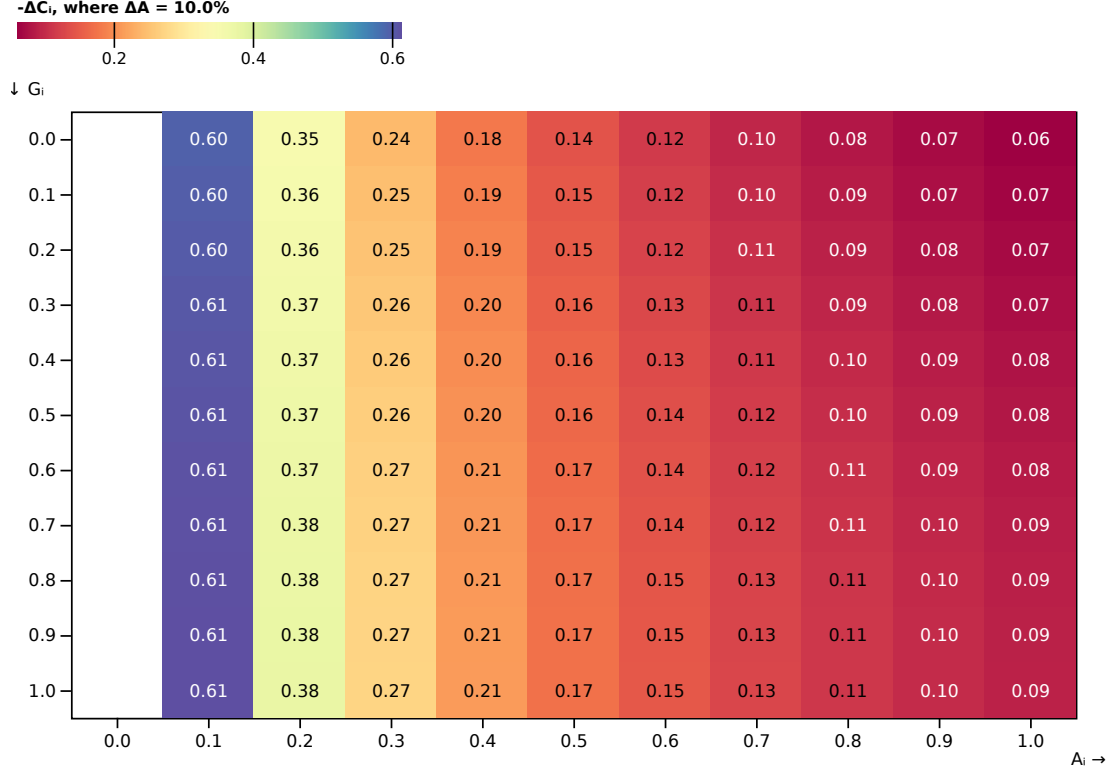


Figure 12: Proportion of carbon retired.

Figure 12 shows the cost of carbon increasing with  $A_i$  and decreasing on  $G_i$ .

### 3.2.2.2 Unweighted Carbon Class

An offset certificate for a carbon class with a zero  $\mathbf{A}$  allocation cannot be extracted from the portfolio by swapping in  $\mathbf{A}$  tokens.

### 3.2.2.3 Liquidation: $\Delta A = 1$

In the event that 100% of  $\mathbf{A}$  tokens are placed into the burn mechanism for carbon offset certificates, the balances of all carbon held in the portfolio post-trade are distributed to all  $\mathbf{G}$  token holders.

Figure 13 below shows the spread captured on a ‘round trip’ by the system where  $\varepsilon$  is the proportion retained:

Figure 14 shows the component ‘spread’ contributions on a carbon sale and purchase round trip of a carbon offset certificate.

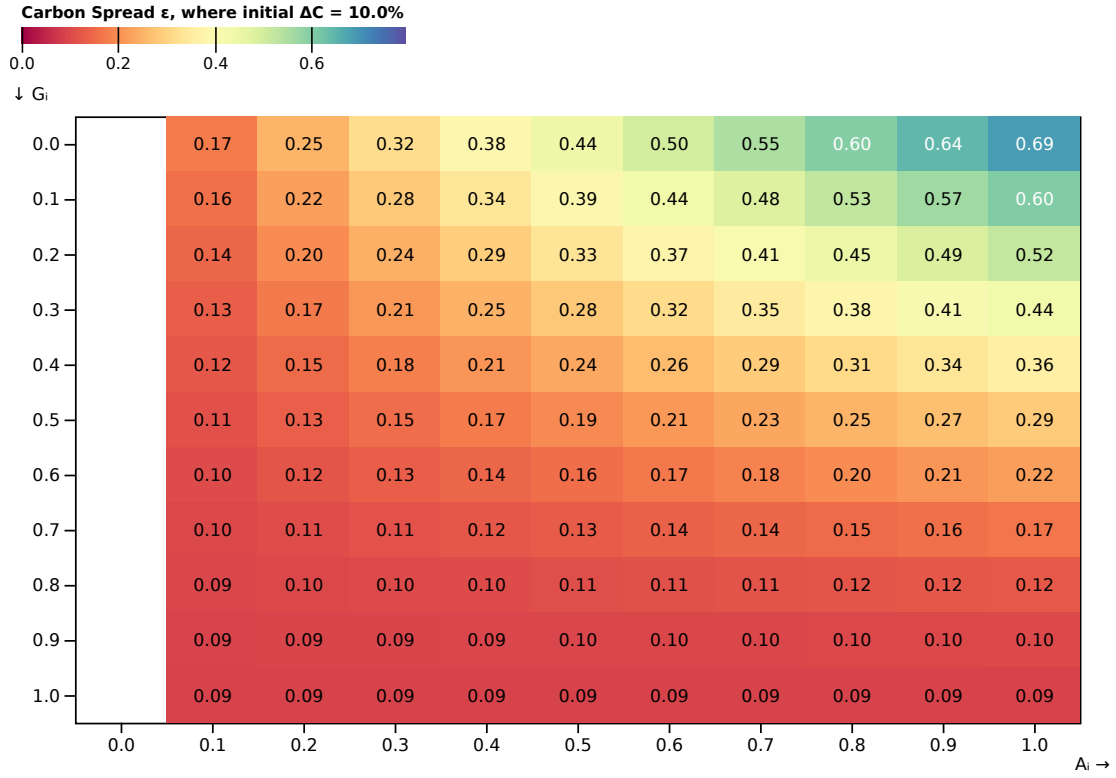


Figure 13: Carbon ‘spread’.

### 3.3 Liquidity Markets

Both **A** and **G** tokens can be used for providing liquidity.

There are two core liquidity pools:

1. An AAM 50:50 pairing of **A** and **G** tokens: pool  $\overline{AG}$ .
2. A hard currency USDC denoted as **Q** paired with **A**: pool  $\overline{AQ}$ .

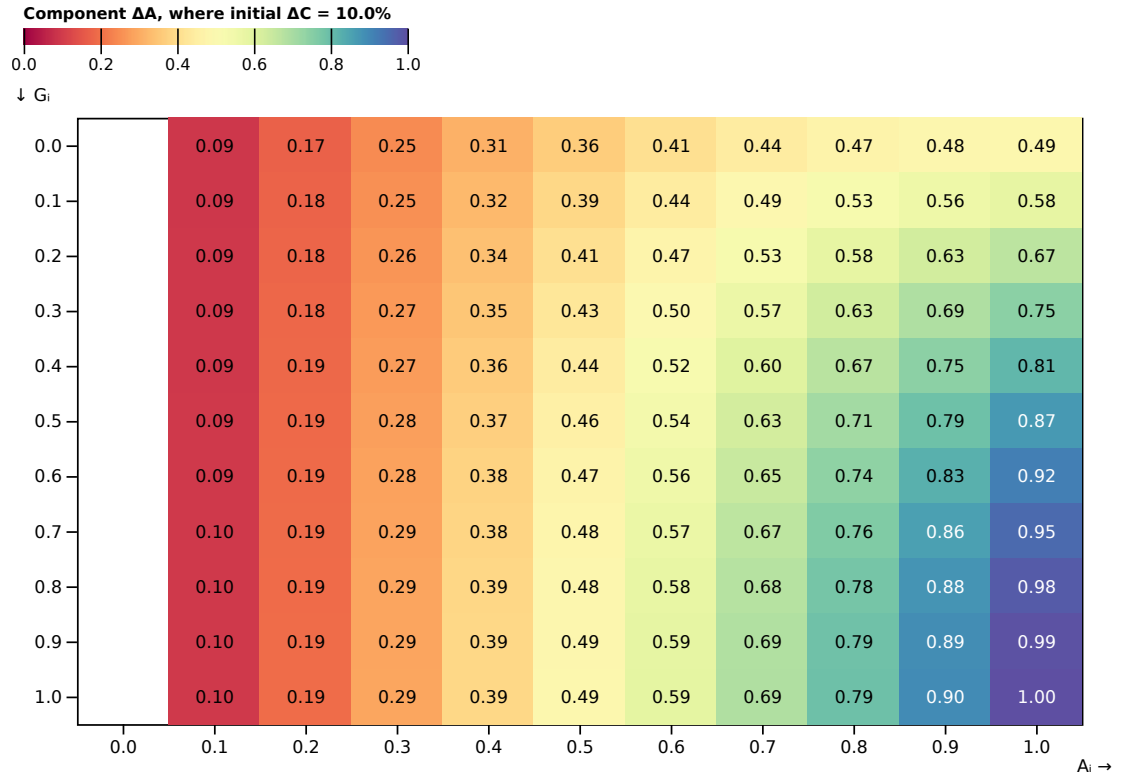
#### 3.3.1 Liquidity Fees

The  $\overline{AQ}$  pool will have its own set of fees in the normal way.<sup>1</sup>

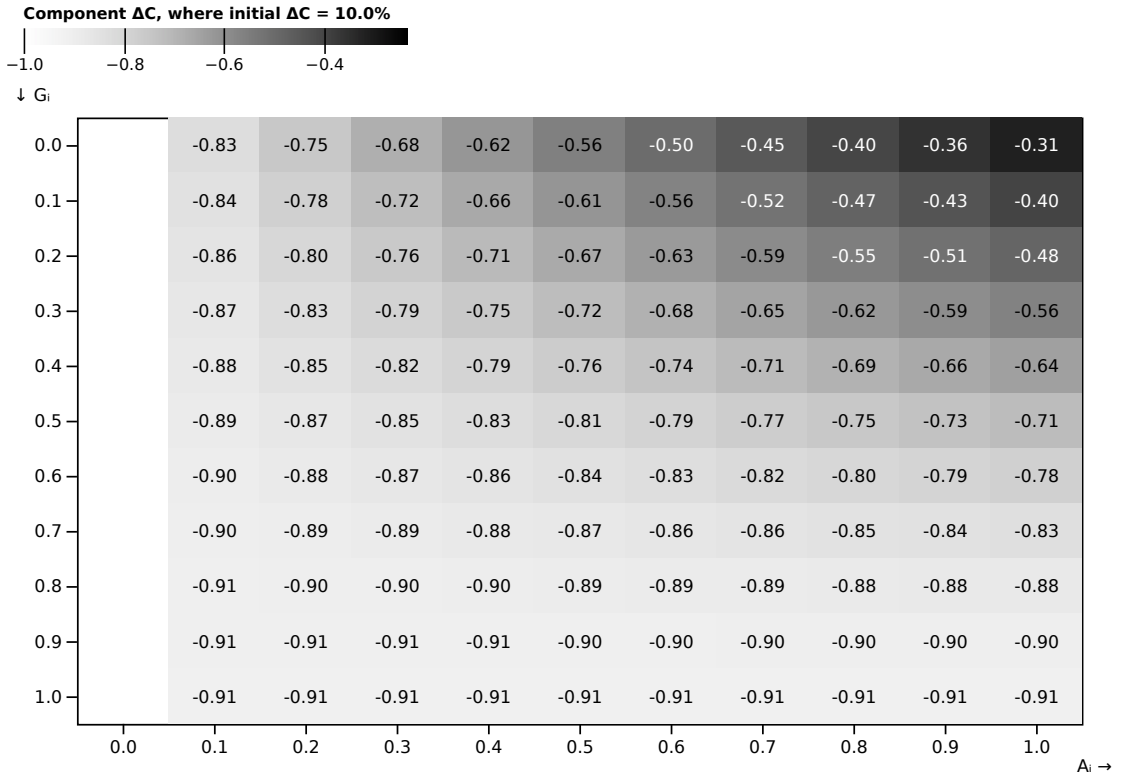
The  $\overline{AG}$  pool has different economics as the assets are highly correlated since they represent the same economy. For this reason, the fees are extremely low.

By staking liquidity (liquidity provider tokens) to the **standard maturities**, both pools may receive a distribution of **A** tokens determined from the Risk Premium calculation below. This is an additional primary issuance to the Base Accrual already discussed.

<sup>1</sup>Note the development of liquidity pool pricing functionality may be applicable.



(a) Carbon 'spread' component  $\Delta A$ .



(b) Carbon 'spread' component  $\Delta C$ .

Figure 14: Carbon 'spread' components.

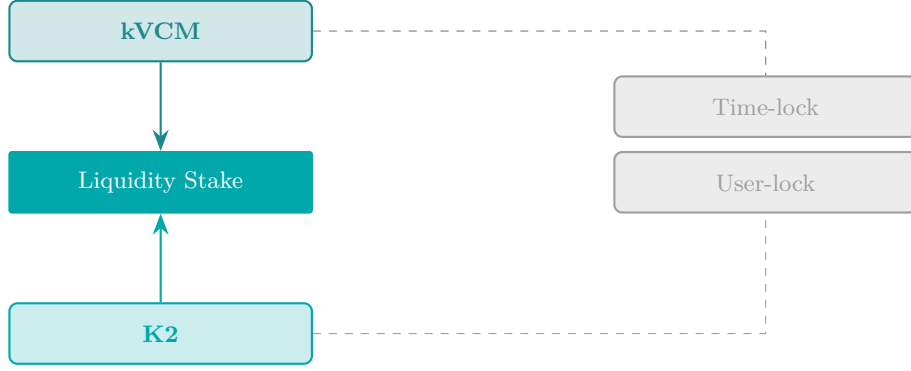


Figure 15: Token liquidity and pricing structure.

### 3.3.2 Risk Premium: Beta Determination

We can consider the Time-Locked Market yield as the system's *risk-free* rate. In addition to this mechanism, a *risky* spread is determined that is ultimately paid to the staked liquidity providers of the **A** and **G** tokens as compensation for the risk levels assumed.

As we have seen, the **G** token has an impact on risk-pricing of **A**. As **G** staking increases, the relationship between the carbon class selected under  $G_i$  and the portfolio token **A** strengthens. We can consider  $G_i$  staking as an estimate of residual or idiosyncratic risk in the carbon class and this allows us to calculate a portfolio beta  $\beta$  from the implied betas of each carbon class  $i$ .

$$\beta = \sqrt{\sum_{i=1}^n A_i - A_i (1 - G_i)^2} \quad (20)$$

The portfolio  $\beta$  determines a yield factor for the liquidity pools of **A** to compensate for the implied risk levels.

For intuition, the map in Figure 16 shows the various outputs of the function per carbon class.

The table and figure below show an example of the effects on  $\beta$  of allocating large  $G_i$  values to small  $A_i$  values where the shift in  $G_i$  results in a lower  $\beta$  (0.27 from 0.55) with no change to total **G** and **A** allocations.

Class	1	2	3	4	$\beta$
$A_i$	0.50	0.20	0.10	0.05	
Initial $G_i$	0.30	0.10	0.05	0.01	
Initial $\beta_i^2$	0.2550	0.0380	0.0098	0.0010	0.5511
New $G_i$	0.01	0.05	0.10	0.30	
New $\beta_i^2$	0.0100	0.0195	0.0190	0.0255	0.2719
$\Delta G_i$	(0.29)	(0.05)	0.05	0.29	
$\Delta \beta_i^2$	(0.2451)	(0.0185)	0.0092	0.0245	

Table 2: Effect on  $\beta$  from outsized **G** allocation.

Figure 17 shows  $\beta$ 's sensitivity to **G** allocation as a function of **A** allocation; that is to say that a large  $G_i$  stake on a small  $A_i$  stake has limited effects (notwithstanding other consequential factors).

### 3.3.3 Allocation of Risk Premium

The full issuance of **A** tokens is depicted below including now the Risk Premium for the liquidity pools accordingly.

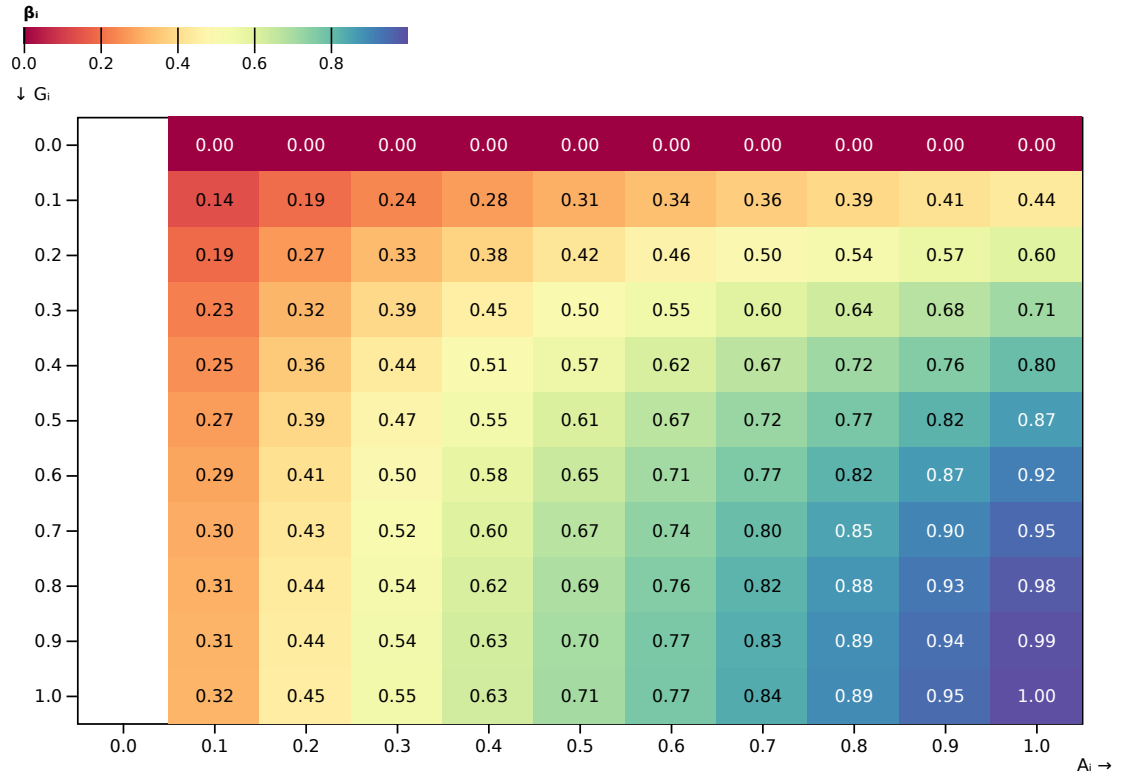


Figure 16: Range of  $\beta_i$ .

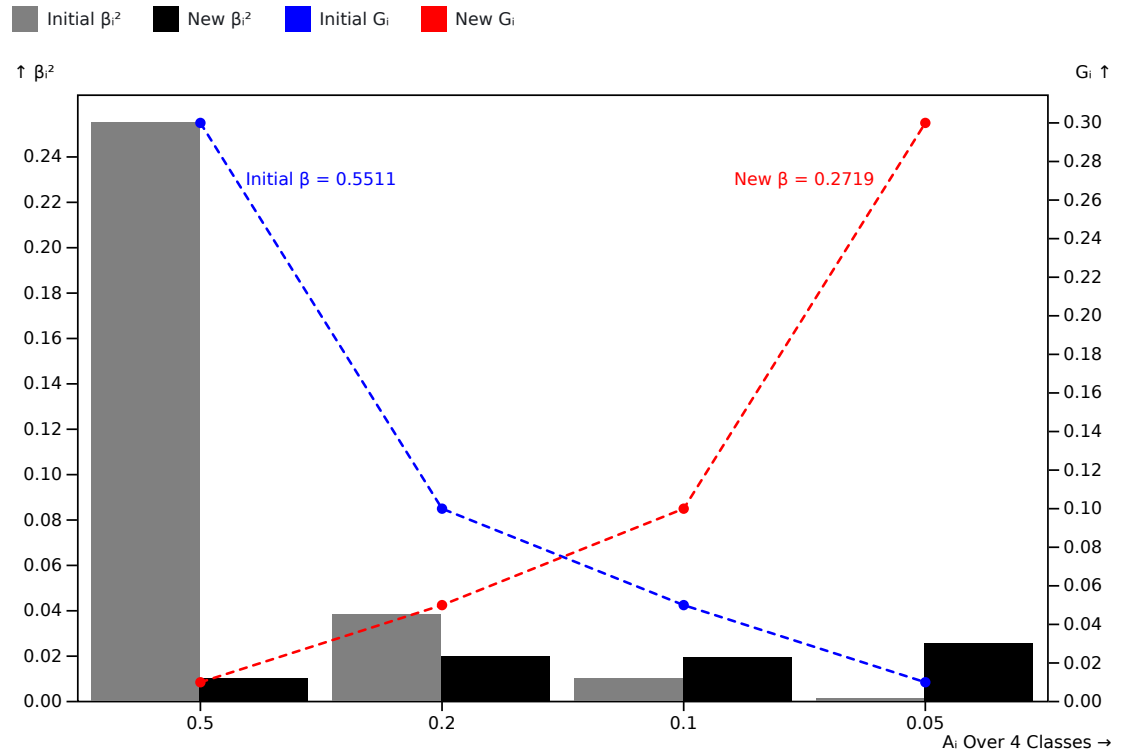


Figure 17: Example of  $\mathbf{G}$  allocation on  $\beta$ .

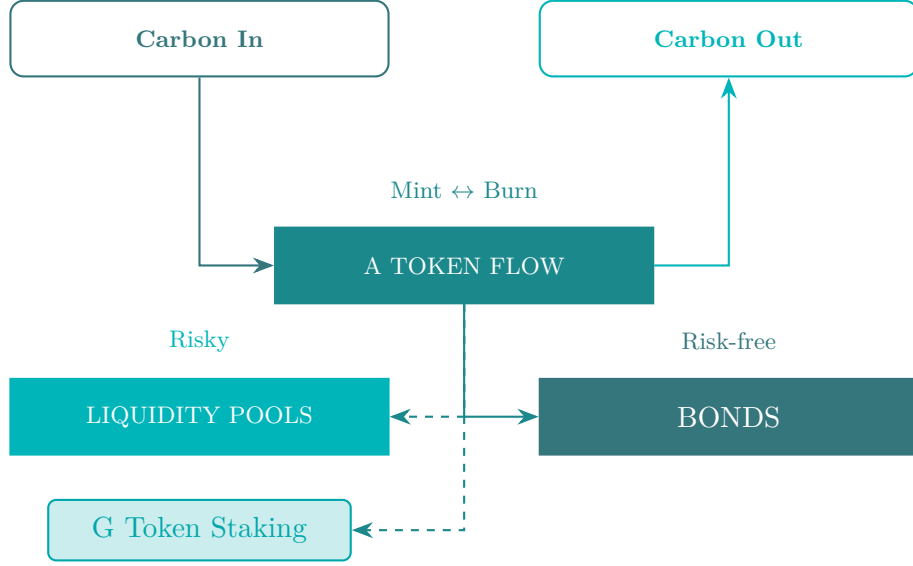


Figure 18: **A** token flow structure.

### 3.3.4 Share of Risk Premium

The Risk Premium allocation is shared between user-locked **G** tokens,  $\overline{\mathbf{AG}}$ . and  $\overline{\mathbf{AQ}}$  pools, with shares  $\lambda_{GG}$ ,  $\lambda_G$ , and  $\lambda_Q$  respectively.

Defining:

- $G_G$ : Total **G** tokens in the  $\overline{\mathbf{AG}}$  pool, expressed as a proportion of the outstanding supply of **G**.
- $A_G$ : Total **A** tokens in the  $\overline{\mathbf{AG}}$  pool, expressed as a proportion of the outstanding supply of **A**.
- $A_Q$ : Total **A** tokens in the  $\overline{\mathbf{AQ}}$  pool, expressed as a proportion of the outstanding supply of **A**.

The allocation to user-locked **G** tokens,  $\lambda_{GG}$ :

$$\lambda_{GG} = \frac{1 - A_Q}{1 + \left( \frac{\sum_{i=1}^n G_i}{G_G} \right)^2} \quad (21)$$

Noting the relationship between  $G$  and  $\beta$ , and particularly if  $G = 0$ ,  $\beta = 0$ .

The residual share,  $1 - \lambda_{GG}$ , is split between the liquidity pools:

$$\lambda_G = (1 - \lambda_{GG}) \frac{2A_G}{2A_G + A_Q\sqrt{2}} \quad (22)$$

For completeness:

$$\lambda_Q = 1 - \lambda_{GG} - \lambda_G \quad (23)$$

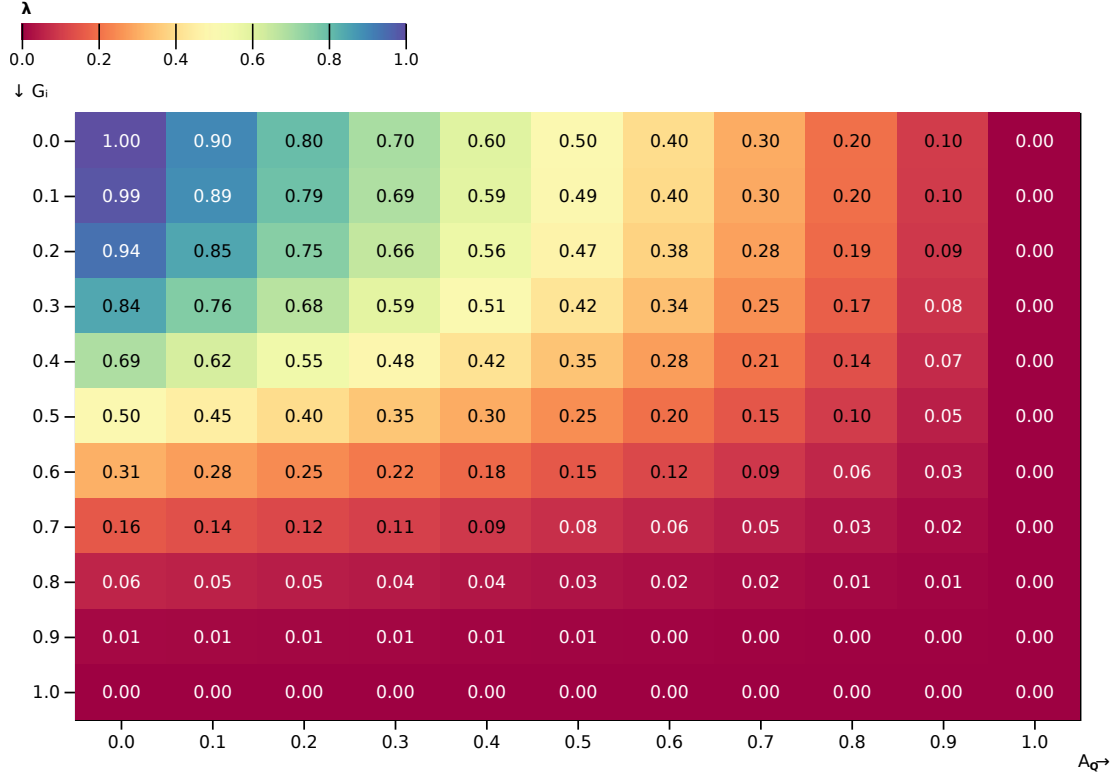


Figure 19:  $\mathbf{G}$  stake allocation (assuming  $G_G = 1 - G_i$ ).

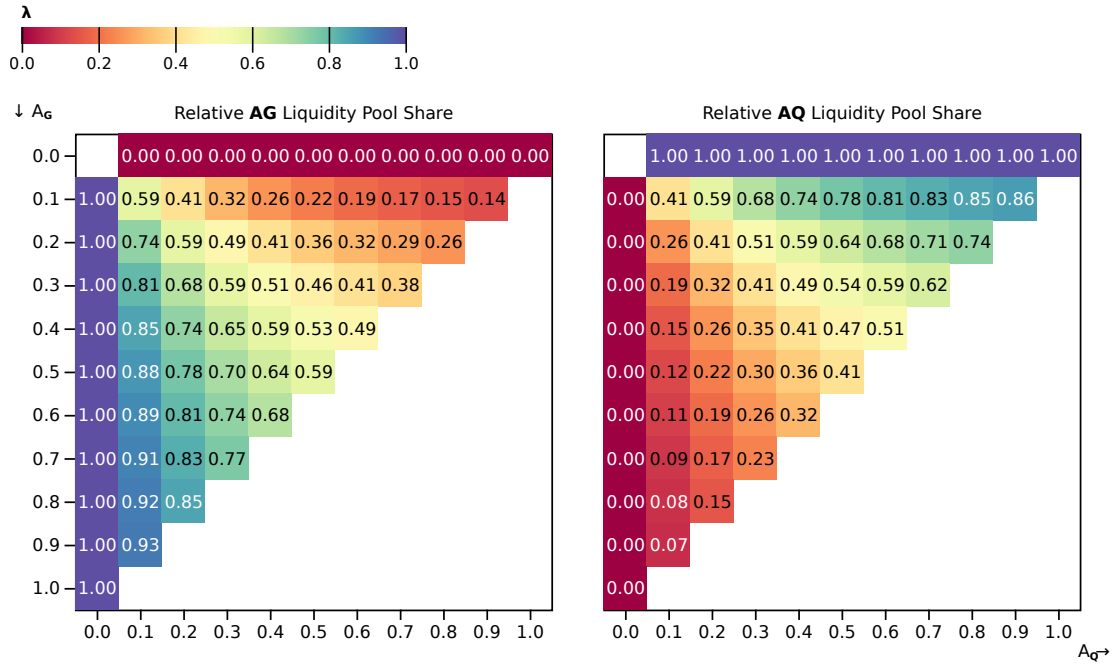


Figure 20: Liquidity pool split  $\lambda_G, \lambda_Q$ .

### 3.3.5 Risk Premium Distribution

For  $\lambda_{GG}$ ,  $\lambda_G$ ,  $\lambda_Q$  we apply  $\beta$ :

$$\Lambda_X = \lambda_X \beta, \quad \text{for } X \in \{GG, G, Q\} \quad (24)$$

Taking  $b$  as a discount parameter:

$$b = \frac{\sum_1^{40} Z_t S_t B_t}{\sum_1^{40} Z_t S_t} \quad (25)$$

The total Risk Premium tokens  $R_\lambda$ :

$$R_\lambda = b R (\Lambda_{GG} + \Lambda_G + \Lambda_Q) \quad (26)$$

The allocations of  $R_\lambda$  are pro-rata to  $\Lambda_{GG}$ ,  $\Lambda_G$ ,  $\Lambda_Q$ , and thereafter:

1. Locked **G**:  $\Lambda_{GG}$  in proportion to **G**.
2. Locked  $\overline{\mathbf{AG}}$ ,  $\overline{\mathbf{AQ}}$  tokens are allocated a weighting  $G_t$ ,  $Q_t$  depending on their time bucket  $t$ :

$$G_t = \frac{Z_t L_{Gt} B_t}{\sum Z_t L_{Gt} B_t} \quad (27)$$

$$Q_t = \frac{Z_t L_{Qt} B_t}{\sum Z_t L_{Qt} B_t} \quad (28)$$

Where  $L_{Gt}$ ,  $L_{Qt}$  are the proportion of all liquidity locked in each time bucket for  $\overline{\mathbf{AG}}$  and  $\overline{\mathbf{AQ}}$  respectively.

Thereafter each time bucket allocation is proportionate to staked liquidity provider token holdings.

## 4 Klima 2.0 Token Distribution

### 4.1 Planned Allocations

Cohort	Proportion	Quantity (m)
Klima Holders	87.5%	17.5
DAO/Treasury	10.0%	2.0
01X	2.5%	0.5
<b>Total</b>	<b>100.0%</b>	<b>20.0</b>

Table 3: **kVCM** token.

Cohort	Proportion	Quantity (m)	Liquidity
Klima Holders	40.0%	40.0	Logistic Vesting 48 months
Ecosystem Grant	5.0%	5.0	Logistic Vesting 48 months
Programmatic Incentives	40.0%	40.0	Incentive Curve
pKlima Holders	3.0%	3.0	Logistic Vesting 48 months
DAO/Treasury	4.5%	4.5	24 month locked LP of $\overline{\mathbf{AG}}$
01X	2.5%	2.5	24 month locked LP of $\overline{\mathbf{AG}}$
Product Design and Development	5.0%	5.0	Logistic Vesting 48 months
<b>Total</b>	<b>100.0%</b>	<b>100.0</b>	

Table 4: **K2** token.

## 4.2 Programmatic Incentive Curve

The incentive issuance is built on a logistic function,  $P$ , to generate total proportion of supply in issue. It is calibrated from the initial issuance at TGE  $P_0$  and the inflection point time  $T$  where 50% of  $\mathbf{G}$  token incentives have been released.

Setting  $x_0$  from the initial supply parameter:

$$x_0 = \ln \left( \frac{P_0}{1 - P_0} \right) \quad (29)$$

With  $x_t$  at time point  $t \in (0, \infty)$ :

$$x_t = x_0 \left( 1 - \frac{t}{T} \right) \quad (30)$$

Giving supply function  $P(t)$  as:

$$P(t) = \frac{\exp(x_t)}{\exp(x_t) + 1} \quad (31)$$

$P_0$  set at 7% and  $T$  at 24 months:

## 4.3 Incentive Allocations

The **relative utilisation** measurement factor  $v$  is calculated as follows.

Defining initially:

- $G$ : Total  $\mathbf{G}$  tokens staked expressed as a proportion of the circulating supply,  $G \in [0, 1]$ .
- $L$ : Total  $\mathbf{G}$  tokens held in the  $\overline{\mathbf{AG}}$  pool expressed as a proportion of circulating supply,  $L \in (0, 1]$ .

■ Incentives ■ Klima Holders ■ Product Design ■ Ecosystem Grant ■ DAO/Treasury ■ pKlima Holders

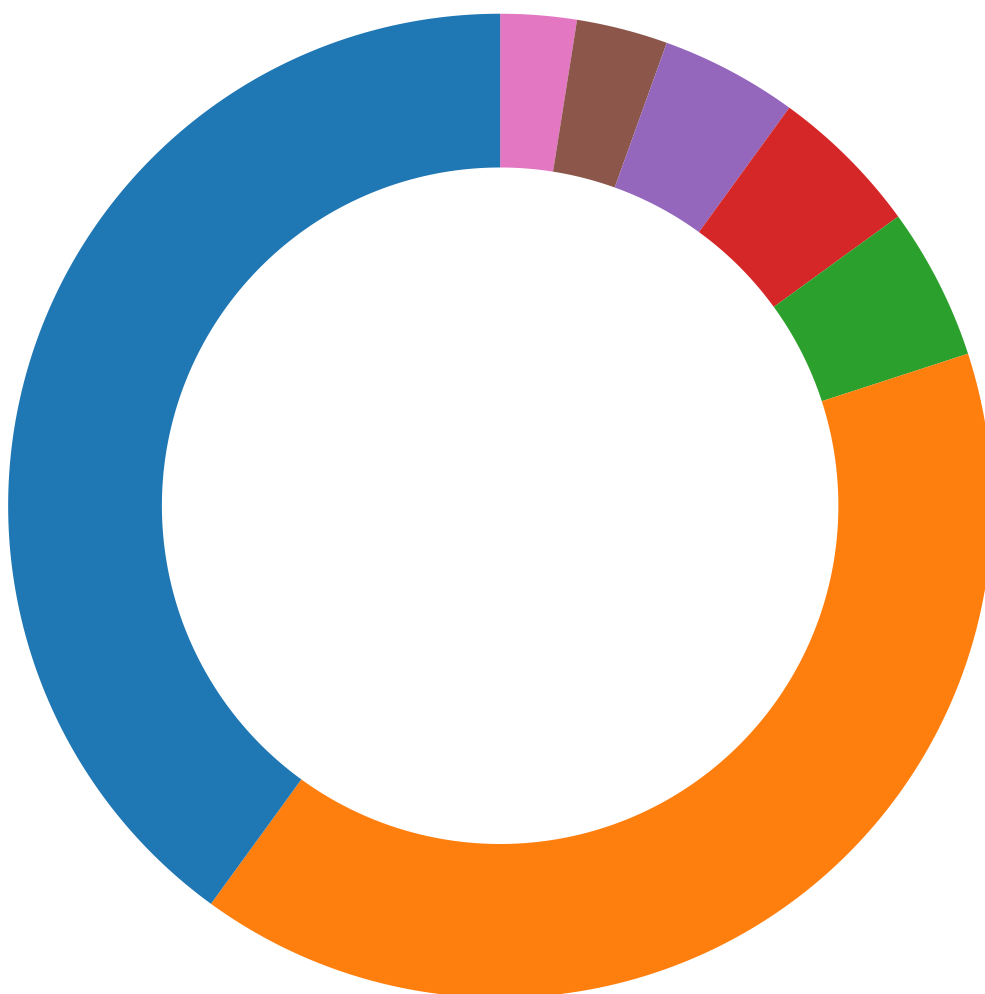


Figure 21: **K2** token allocations.

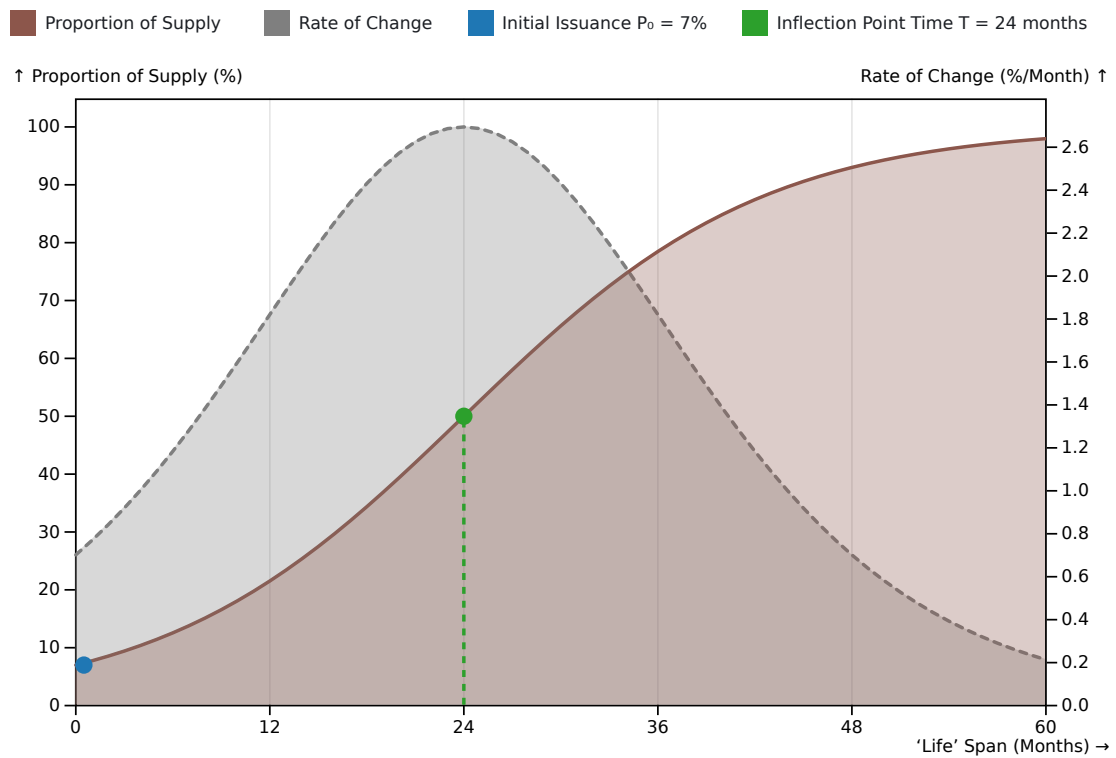


Figure 22: Incentive Issuance

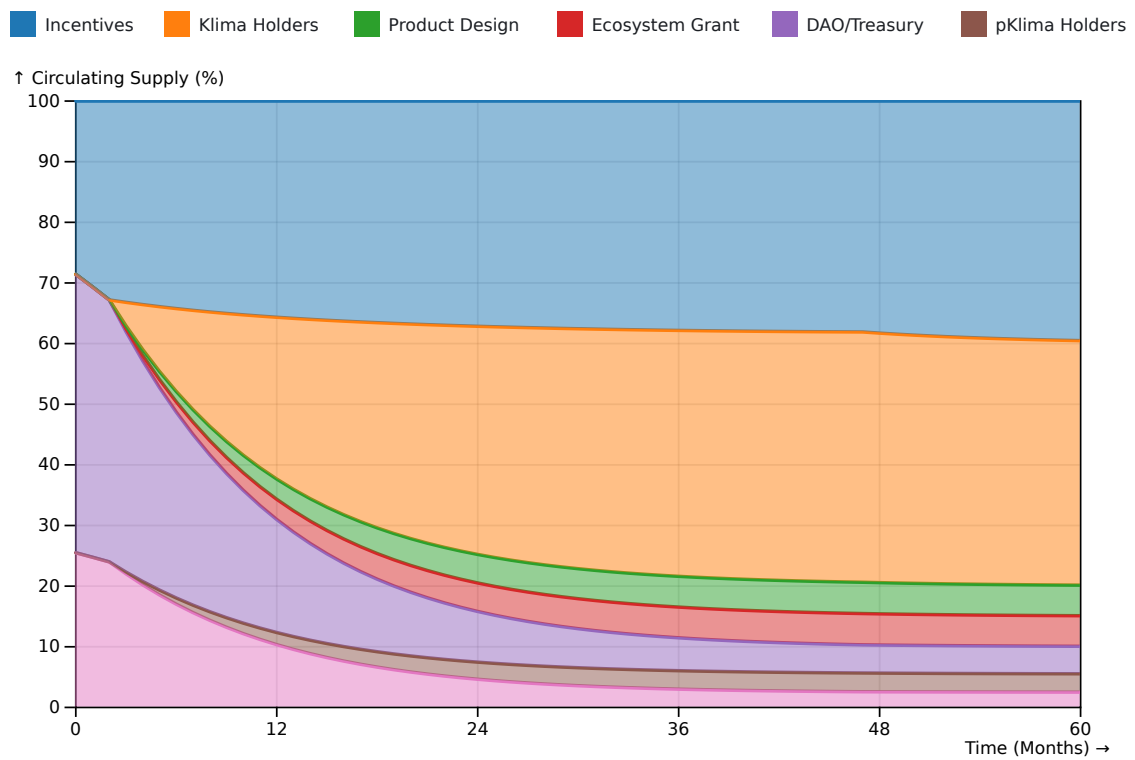
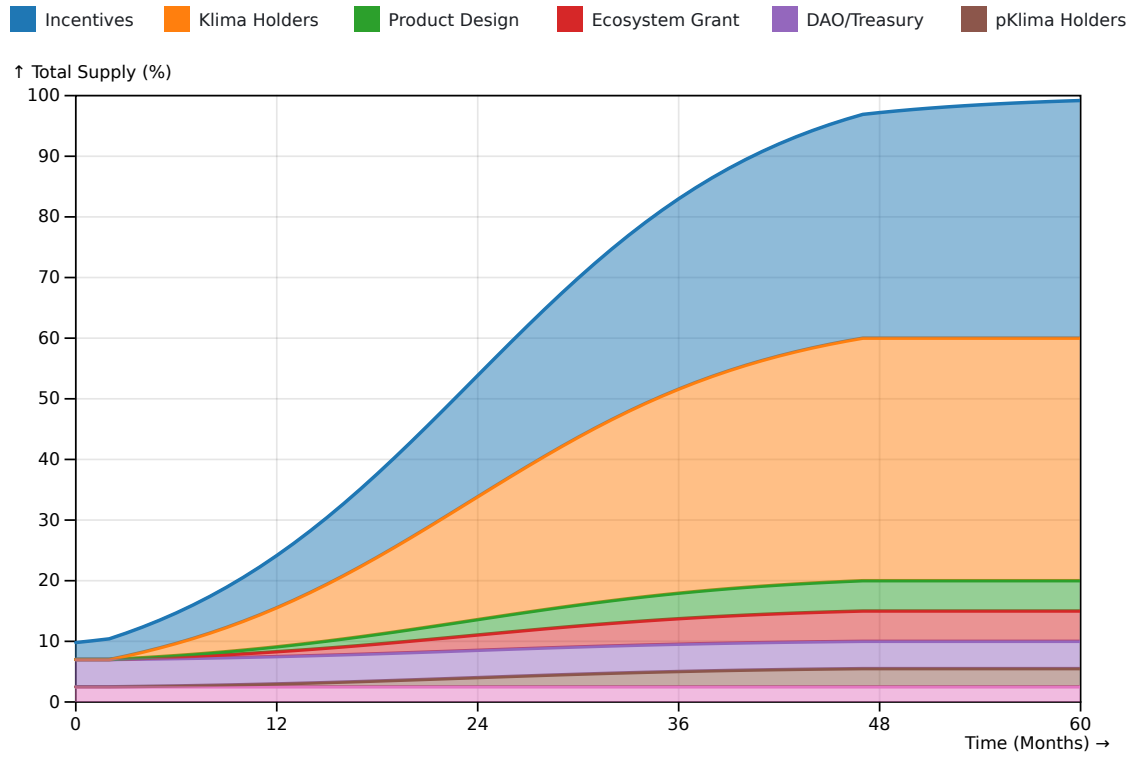
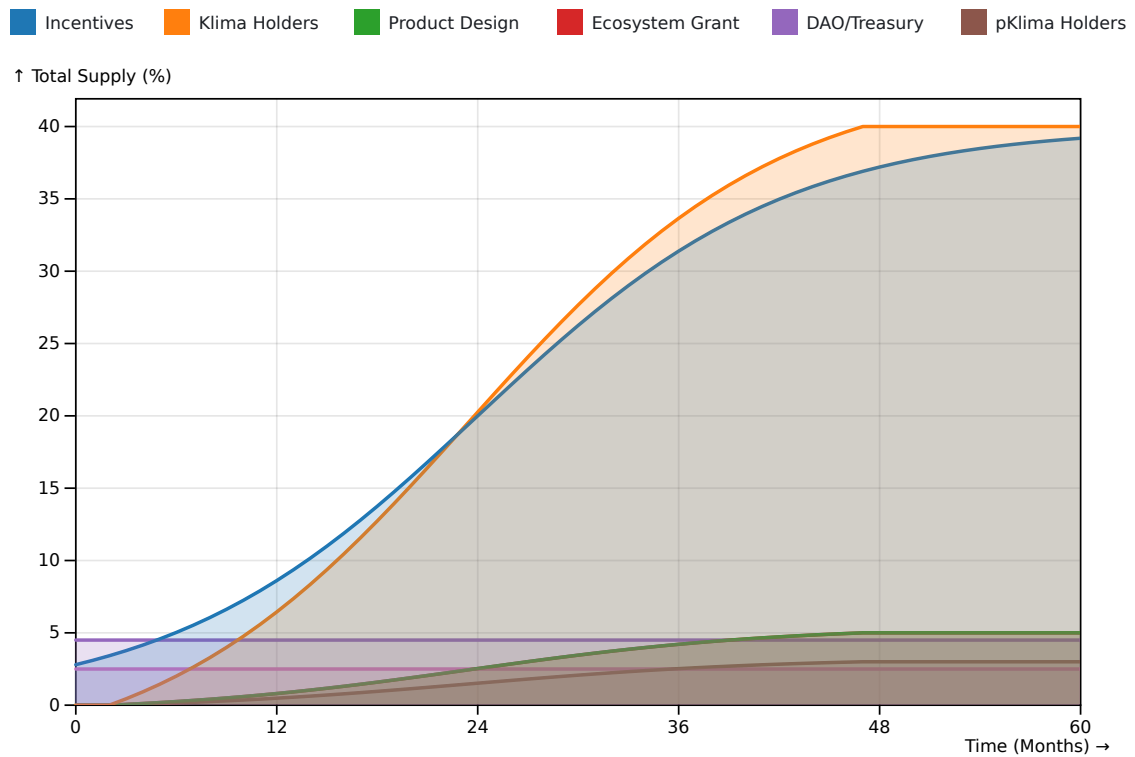


Figure 23: **K2** token circulating supply over time.

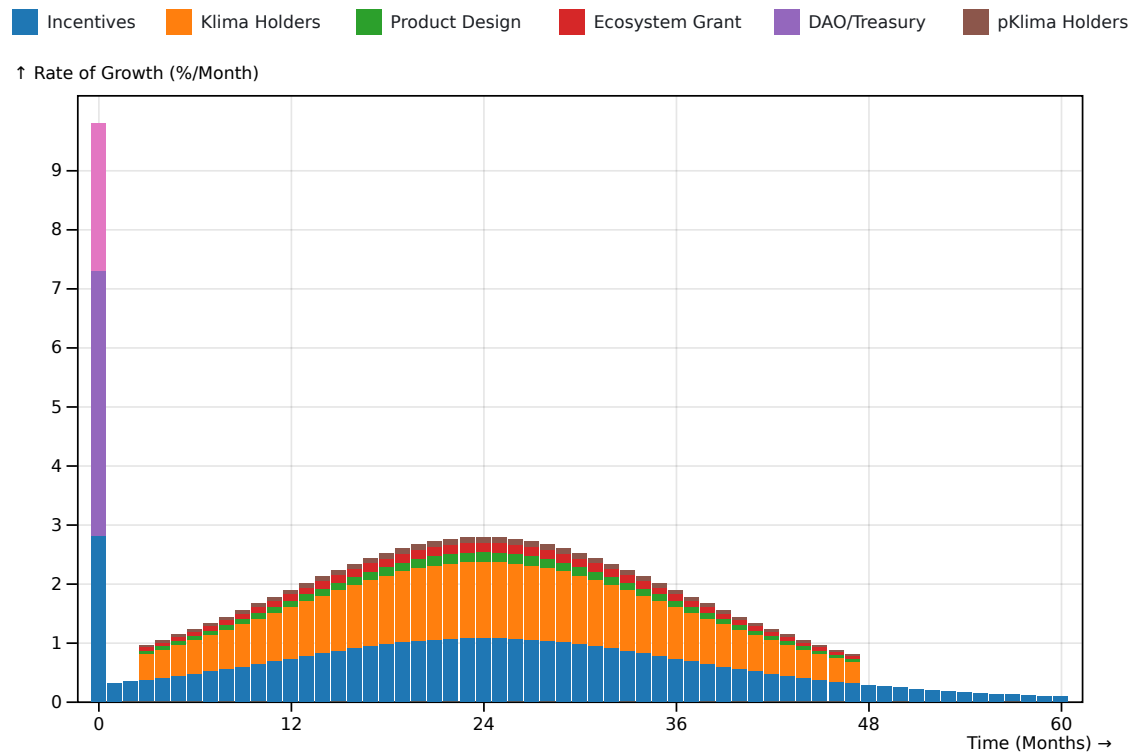


(a) Total supply (stacked).

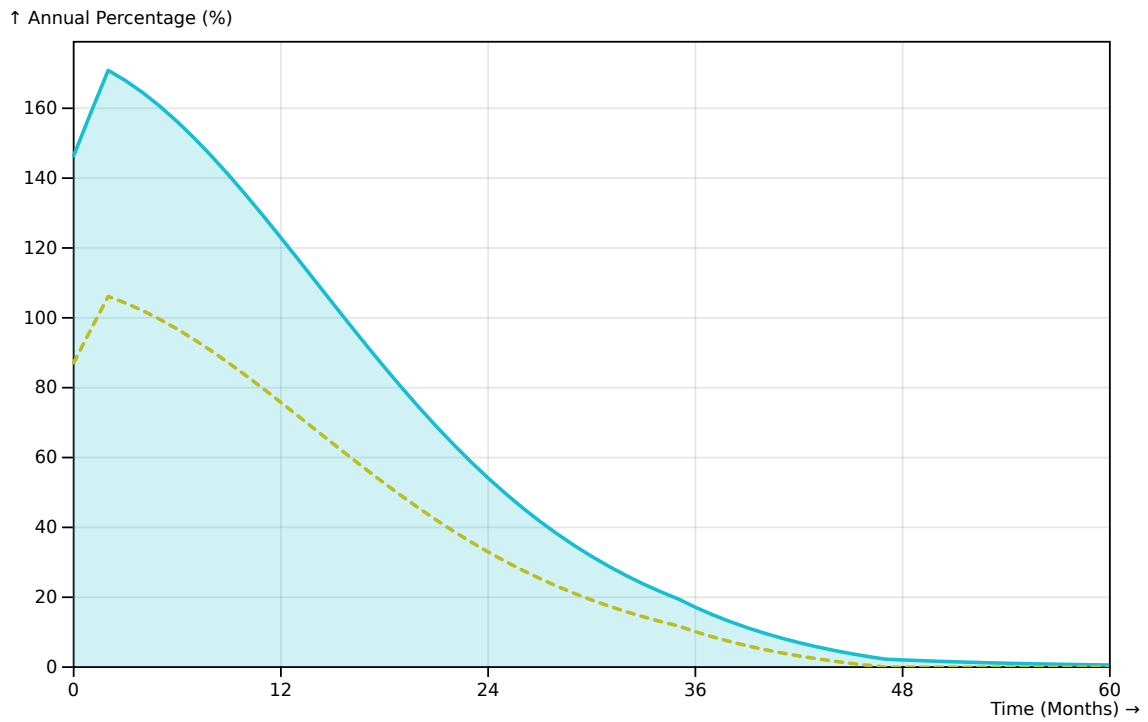


(b) Total supply (unstacked).

Figure 24: **K2** token total supply over time.



(a) Total supply differential (stacked).



(b) Utility incentive yield.

Figure 25: **K2** token supply risk metrics.

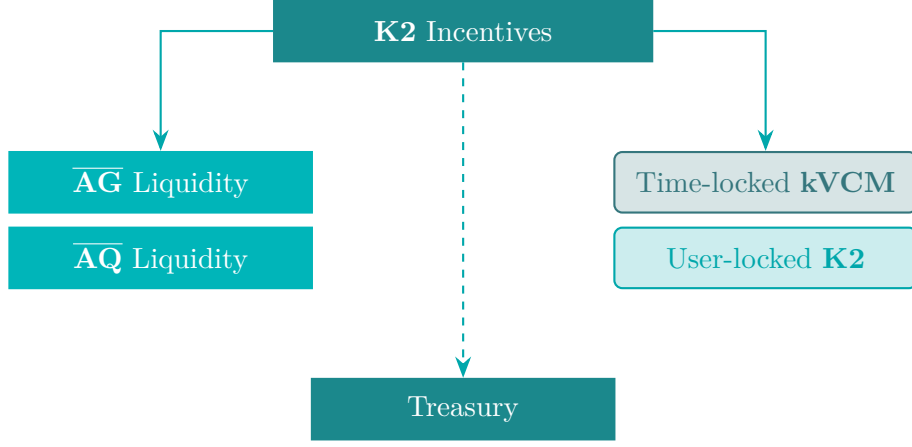


Figure 26: **K2** token incentive distribution structure.

Where  $v = 0$  if  $G + L = 0$ , otherwise:

$$v = \left( \frac{2GL}{G^2 + L^2} \right)^2 \quad (32)$$

The **absolute utilisation** parameter  $\eta$  is defined as  $\eta = 0$  if  $G + L = 0$ , otherwise:

$$\eta = \frac{2GL}{G(1 - G) + L(1 - L)} \quad (33)$$

Incentives  $I$  are allocated as follows:

#### 4.3.1 Treasury

The allocation to the Treasury  $I_T$  is the imbalance generated from  $v$ :

$$I_T = 1 - v \eta \quad (34)$$

#### 4.3.2 Post Treasury

The residual post-treasury allocation is shared four ways within 2 buckets:

1. Time-locked **A** & user-locked **G** tokens

Where  $S$  is the proportion of time-locked **A** tokens (as defined previously in Section 3.1.1):

1. Time-locked **A**,  $I_S$ :

$$I_S = S \frac{L^2}{G^2 + L^2} \quad (35)$$

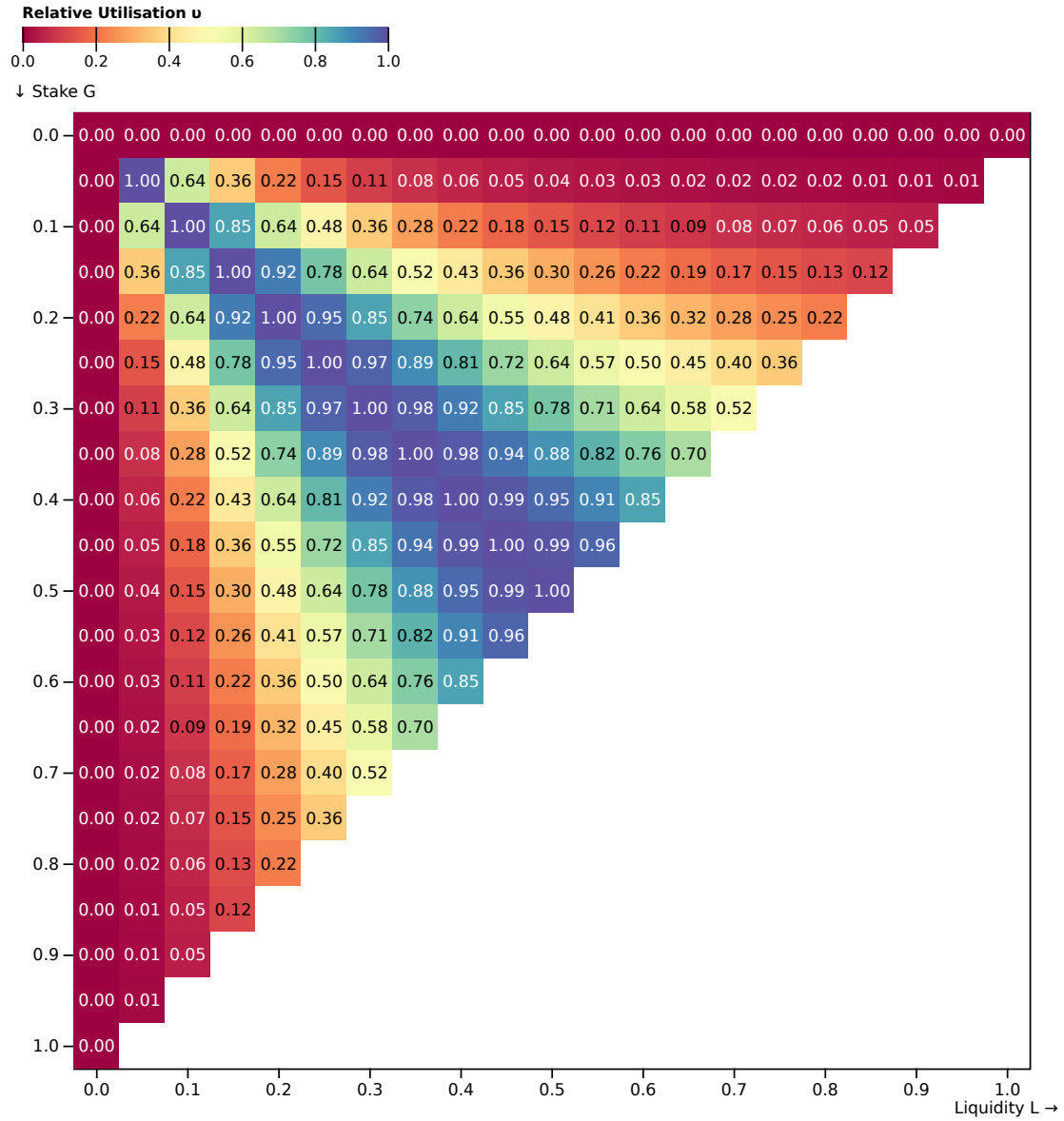


Figure 27: Upsilon  $v$  range of values.

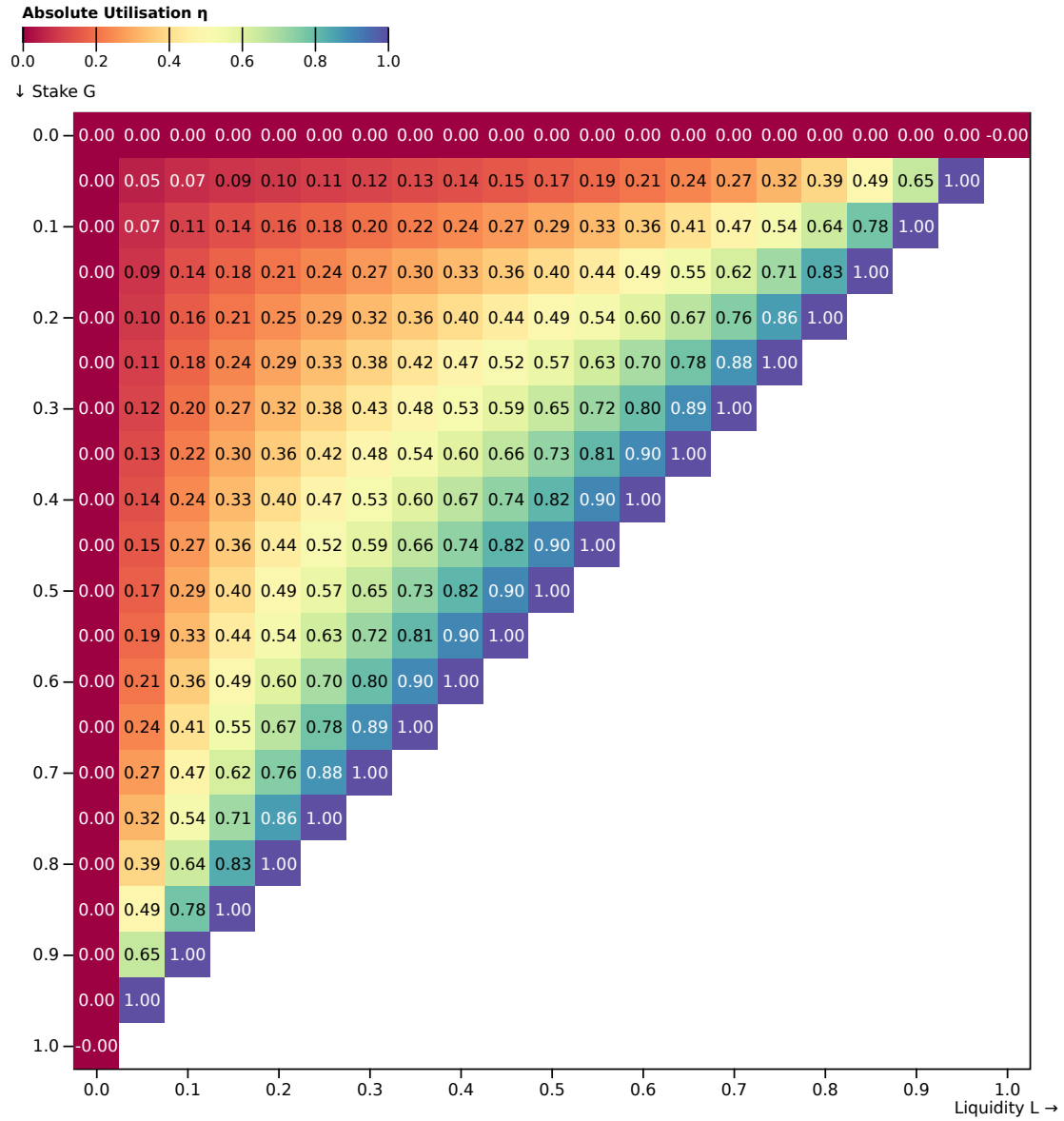


Figure 28: Eta  $\eta$  range of values.

2. User-locked  $\mathbf{G}$ ,  $I_G$ :

$$I_G = (1 - S) \frac{L^2}{G^2 + L^2} \quad (36)$$

2. Liquidity

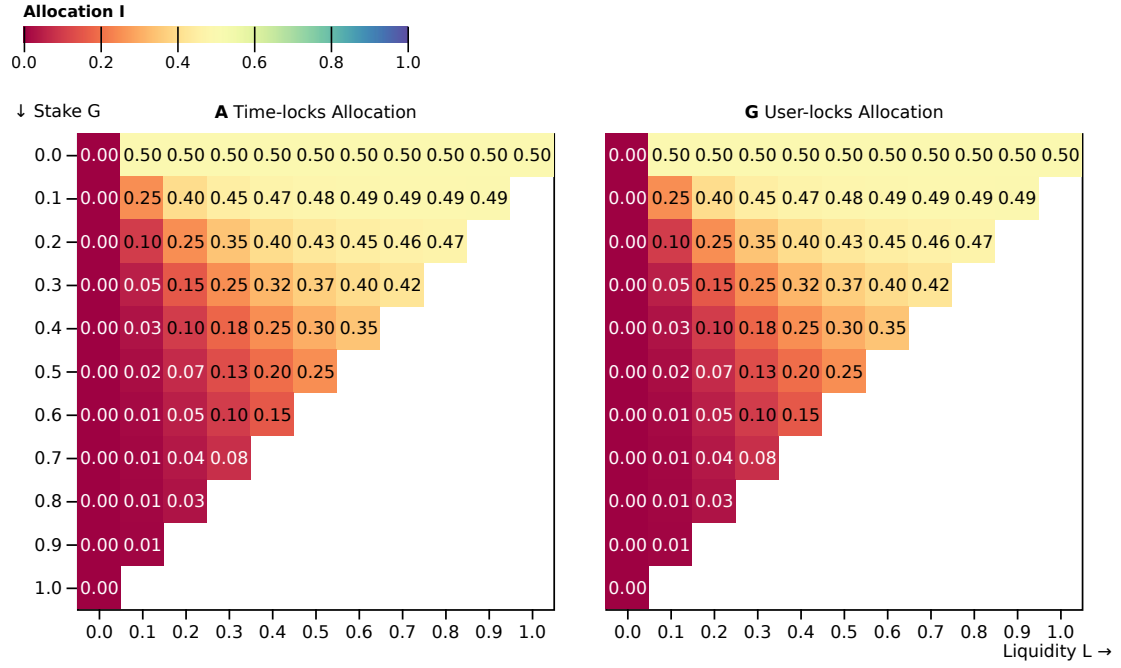
With  $\lambda_G$ ,  $\lambda_Q$ ,  $\lambda_{GG}$  as defined in Section 3.3.4:

3.  $\overline{\mathbf{AG}}$  pool  $I_{AG}$ :

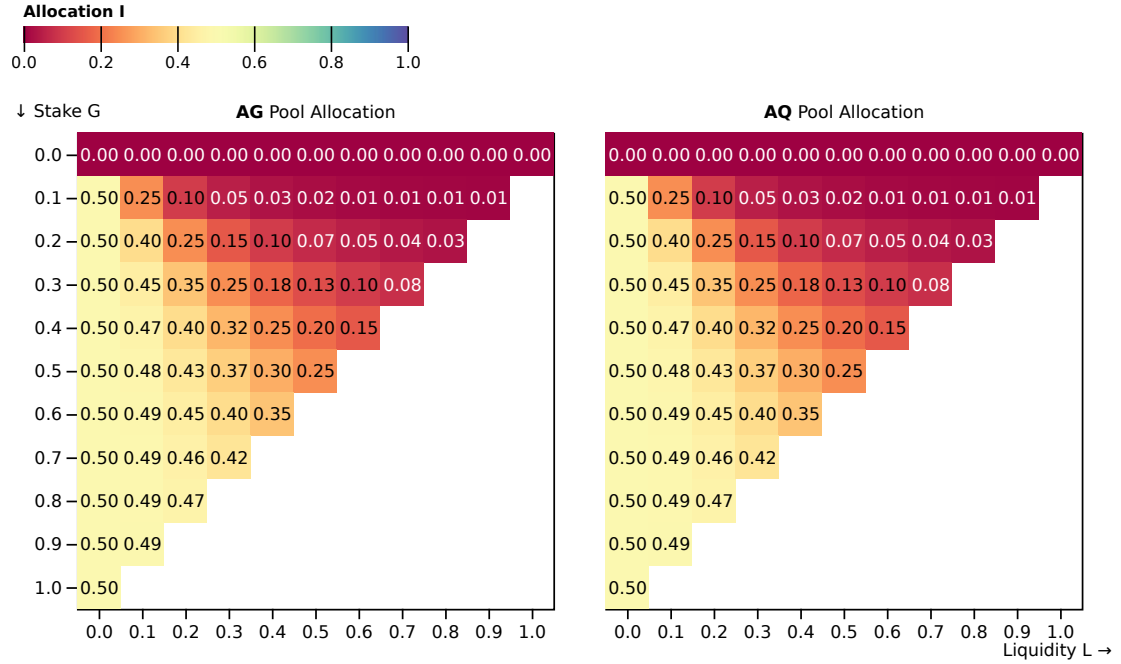
$$I_{AG} = \frac{\lambda_G}{1 - \lambda_{GG}} \frac{G^2}{G^2 + L^2} \quad (37)$$

4.  $\overline{\mathbf{AQ}}$  pool  $I_{AQ}$ :

$$I_{AQ} = \frac{\lambda_Q}{1 - \lambda_{GG}} \frac{G^2}{G^2 + L^2} \quad (38)$$



(a) Time-locked **A** and user-locked **G** allocations.



(b) Liquidity pools allocations

Figure 29: Share of non-treasury incentives  $I_S$ ,  $I_G$ ,  $I_{AG}$  and  $I_{AQ}$ .

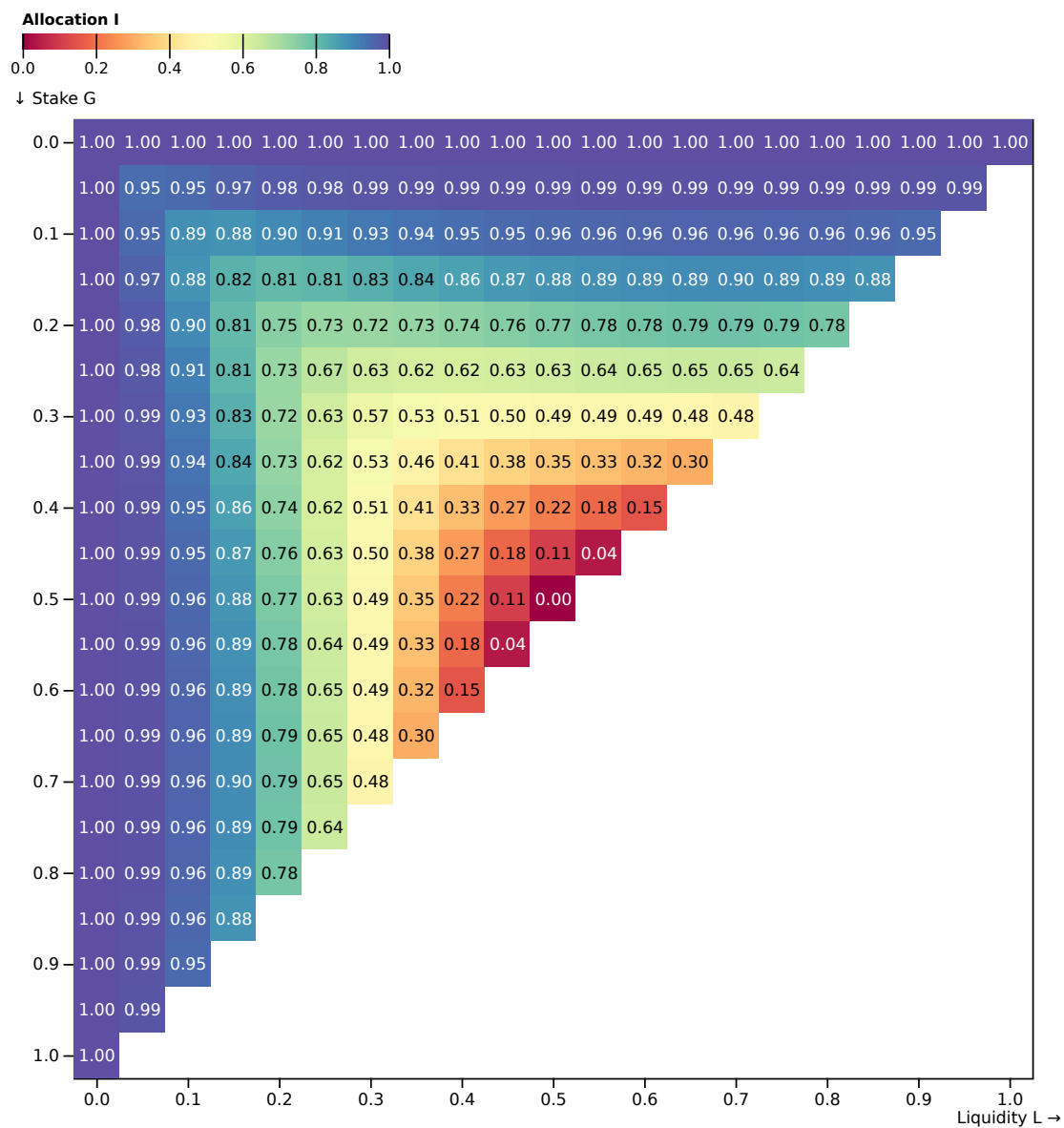


Figure 30: Treasury incentives  $I_T$ .