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ICON INCENTIVES SCORING SYSTEM

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ICON Incentives Scoring System (IISS)

The Cryptoeconomic System to Measure Various Contributions and Distribute Incentives for the Growth of the ICON Network

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1. Introduction

The ICON Incentives Scoring System (hereinafter referred to as 'IISS') is an evaluation system for accurately measuring and rewarding the contributions of various ICONists within the ICON Network. The ICON Network defines seven forms of contribution through the 'Delegated Proof-of-Contribution' incentive protocol.

ICONists can contribute to the network directly or indirectly. Direct contributions include running a node, developing a popular decentralized application, or executing an Ecosystem Expansion Project, while indirect contributions involve staking or delegating to the entities that carry out the aforementioned direct contributions.

IISS calculates and distributes I-Score, a variable used to quantify an ICONist's contribution to the ecosystem. The I-Score of each contributing ICONist is calculated after every block and accumulated every 43,120 blocks. However, the distribution of I-Score to contributors is made at the end of the next 43,120 blocks. ICX will be minted every block and sent to the Public Treasury contract, where ICONists can claim their ICX in exchange for their accumulated I-Score.

Transaction fees are another factor in determining the amount of ICX issuance. The amount of transaction fees within a block is compared to the calculated amount of ICX issuance required to reward all contributors. ICX will only be minted if the amount of transaction fees within a block is less than the required ICX issuance to reward all contributors. If the amount of transaction fees within a block is equal to the required ICX issuance to reward all contributors, no new ICX will be minted. If the transaction fees within a block exceed the required ICX to reward all contributors, the excess ICX will be burned.

IISS provides the functionality to dynamically determine rewards and issuance rates by using an advanced on-chain governance system. This governance system incorporates factors such as governance variables submitted by Public Representatives, the amount of transaction fees in a block, and the total amount of ICX staked to establish the monetary policy of the network.

Additionally, IISS utilizes a variety of artificial intelligence techniques to distribute rewards based on contribution to ICON Network participants. However, in order to construct an accurate and reliable artificial intelligence-based incentive distribution model, it is necessary to accumulate and analyze preliminary data. Therefore, we will not operate the artificial intelligence-based evaluation system until completing a sufficient data accumulation period.

This paper presents the cryptoeconomic design of the ICON Network. It includes topics such as the DPoC (Delegated Proof-of-Contribution) incentive protocol, calculation of rewards, measurement of contribution, token issuance algorithms, penalty system and

more. The on-chain governance-based cryptoeconomics of the ICON Network are designed to function flexibly and account for network conditions, while aligning the economic self-interest of all participants with the success of the network at large.

2. Token Model

The ICON Network operates on a Delegated Proof-of-Stake consensus protocol. ICONists delegate their stake on the network to elect representatives who serve as validators on the public blockchain. ICX is the basic currency used for all types of transactions and is the basic network-stake for the blockchain. Additionally, ICX is used to make key decisions in the ecosystem through stake-weighted voting and a network-wide proposal system. The ICON Network is a decentralized economic system that is constructed based on the value of ICX. The token model of the ICON Network includes ICX, Staked ICX, I-Score and Step.

2.1. ICX

The basic currency unit of the ICON Network is ICX, and all economic activities that take place on the ICON Network are based on the value of ICX. ICX can be used as a medium of exchange between users, as a reward for contributions, and as a means of fee payment for smart contracts and transactions. ICX is liquid and can be transferred to another account.

ICONists have the option of sacrificing the liquidity of their ICX through staking it. ICX can be locked through a staking mechanism and delegated to support a specific Representative, EEP, or DApp. This process enables ICONists to indirectly contribute to the growth of the ecosystem. All ICX, when issued, are automatically deposited into the Public Treasury, a fully automated reward fund that stores all ICX rewards until ICONists claim their rewards using I-Score.

2.2. Staked ICX

Staked ICX is the basic delegation unit and means of governance on the ICON Network. Staked ICX is acquired by converting ICX to a lock-up state by invoking the ‘Stake’ function. All accounts can convert their own ICX to Staked ICX, and Staked ICX is equivalent to voting weight. Voting weight gives delegation power to ICONists, allowing ICONists to support specific Representatives, EEPs, and DApps. One ICX has the value of a single vote within each respective category, and thus one ICX gives one voting weight for delegation to a Representative, one voting weight for delegation to an EEP, and one voting weight for delegation to a DApp.

Staked ICX cannot be transferred to another account. If an ICONist would like to transfer their Staked ICX, they must first convert it back to liquid ICX. Converting Staked ICX back to ICX is referred to as 'un-staking', This process has an associated 'Un-staking Period', which is determined by the total amount of Staked ICX in the entire ecosystem.

2.2.1. Un-staking Period

‘Un-staking Period’ refers to the number of days required to convert a Staked ICX to a liquid ICX on the ICON Network. The ICON Network dynamically adjusts the Un-staking Period to maintain the security and economics of the network. The minimum Un-staking Period is 5 days and the maximum is 20 days. The Un-staking Period dynamically adjusts between these extremes based on the total amount of Staked ICX in the ecosystem.

The dynamic nature of the Un-staking Period leads to greater network stability. A network with a low staking rate is insecure, as attackers can easily influence governance, while a network with a high staking rate is less susceptible to outside attackers. With this in mind, longer Un-staking periods are implemented during periods of low staking rates.

Figure 1 describes the maximum period, minimum period, and saturation point for the Un-staking Period.

Variable	Value	Description
l_{max}	20 days	Maximum Un-staking Period, hard-coded as 20 days
l_{min}	5 days	Minimum Un-staking Period, hard-coded as 5 days
l_{point}	70%	The point at which the length of Un-staking Period is no longer decreased. When the percentage of amount of Staked ICX in the ecosystem is more than 70%, the length of Un-staking Period is kept at the minimum value

Figure 1 : The Parameters of the Un-staking Period

Figure 2-1 below shows the formula that is used to calculate the Un-staking Period. The formula takes into account the total amount of Staked ICX versus liquid ICX in the ecosystem and includes the aforementioned parameters. Figure 2-2 is a graphic representation of the formula. According to the formula, the Un-staking Period will be determined dynamically from a minimum of 5 days to a maximum of 20 days, and it will be fixed at 5 days when the percentage of Staked ICX in the ecosystem is greater than 70%.

Variable	Formula
l_{period}	$\frac{(l_{max} - l_{min})}{(l_{point})^2} \times \left(\frac{\text{amount of ICX}_{staked}}{\text{total amount of ICX}} - l_{point} \right)^2 + l_{min}$

Figure 2-1 : The Un-staking Period Formula

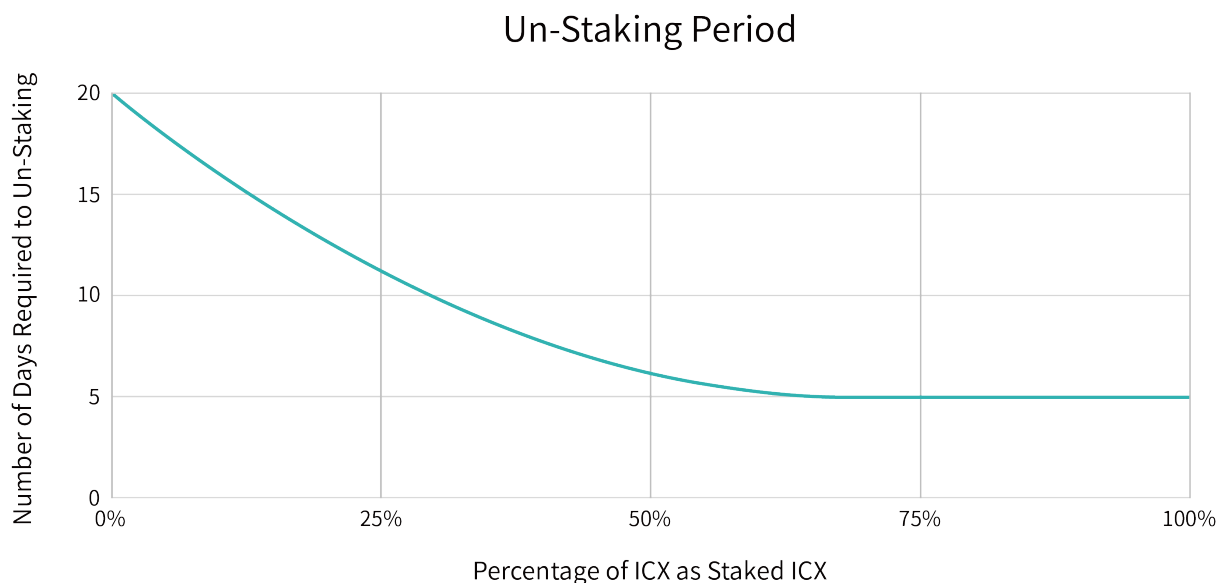


Figure 2-2 : The Un-staking Period Relative to the Percentage of Staked in the Ecosystem

2.3. I-Score

I-Score is a metric used to quantify an ICONist’s contribution to the network. ICONists can use their I-Score to claim ICX rewards at any time from the Public Treasury contract at a fixed rate of 1 *ICX* = 1,000 *I_Score*. I-Score is non-transferable between ICONists. All ICONists can obtain I-Score by contributing directly to the ecosystem (by running a P-Rep node, building a popular DApp, or executing an EEP) or by delegating to direct contributors.

2.4. Step

Step is the metric that denotes a single unit of a transaction fee payment on the ICON Network. Each transaction on the ICON Network costs a certain amount of Step. The initial Step price is approximately 1×10^{-8} *ICX*. It will be possible to adjust the Step price based on the agreement among Representatives through a governance mechanism called the ‘Network Proposal’¹. The amount of Step for a certain transaction depends on the computational resources required to execute that transaction. All transaction fees are sent to the Public Treasury, where ICONists can claim ICX with their I-Score.

¹ Network Proposal is an on-chain governance system in which each Representative can submit proposals on-chain and make decisions through voting. In order to confirm and execute a Network Proposal, $\frac{2}{3} + 1$ of the top 22 P-Reps must vote in favor of the proposal and more than 66% of the stake-weighted vote must vote in favor of the proposal. There are 4 types of Network Proposals: ‘StepPrice Proposal’, ‘Malicious SCORE Proposal’, ‘P-Rep Disqualification Proposal’ and ‘Text Proposal’. These proposals will be detailed in a separate paper.

3.Delegated Proof-of-Contribution: A Protocol to Quantify Ecosystem Contribution

An effective incentive mechanism can greatly expedite the growth and ultimate success of a decentralized ecosystem. The ICON Network utilizes the Delegated Proof-of-Contribution protocol to quantify ecosystem contributions, which allows for a more precise and decentralized distribution of economic incentives. Without an effective system like Delegated Proof-of-Contribution, valuable network resources could be allocated to entities with misaligned or apathetic interests, thus hindering the growth of the network and diluting the token holdings of ICONists that have made valuable contributions to the network. For this reason, the ICON Network focuses on selecting proven contributors through a delegation process.

Delegated Proof-of-Contribution (DPoC) is a decentralized and democratized incentive and governance protocol whereby token holders (ICONists) exercise their right to governance through delegating their stake to those that contribute directly to network growth. By delegating their stake, ICONists elect proven contributors to receive rewards from the network, while at the same time reaping rewards themselves by contributing through stake delegation.

The DPoC protocol defines seven forms of contribution and outlines the reward structure for 4 entities: Representatives, Ecosystem Expansion Projects (EEPs), the DApp Booster Program (DBP), and delegating ICONists.

Item	Description
Block Validation Reward(β_1)	When the top 22 Representatives produce and validate a block, the reward paid out according to the i_{rep} variable once a block is produced and validated.
Representative Reward(β_2)	When the top 100 Representatives receive delegation from ICONists, the reward paid out according to the i_{rep} variable.

Representative Delegation Reward(β_3)	When an ICONist is delegating their ICX to Representatives, the reward paid out according to the r_{rep} variable.
EEP Reward(β_4)	When the top 100 EEPs receive delegation from ICONists, the reward paid out according to the i_{eep} variable
EEP Delegation Reward(β_5)	When an ICONist is delegating their ICX to EEPs, the reward paid out according to the r_{eep} variable.
DApp Reward(β_6)	When the top 100 DApps are delegated their ICX from ICONists, the reward paid out according to the i_{dapp} variable.
DApp Delegation Reward(β_7)	When an ICONist is delegating their ICX to DApps, the reward paid out according to the r_{dapp} variable.

Figure 3 : Description of the Seven Forms of Contribution²

Below is a detailed description of each form of contribution. Depending on the methods defined below, each contributor can prove their contribution and receive a reward.

3.1. Representative

A Public Representative (hereinafter referred to as ‘P-Rep’) is a representative of the ICON Network that contributes to the ecosystem through participation in block validation and on-chain governance. A total of 100 P-Reps will be elected by ICONists. The top 22 P-Reps (‘Main P-Reps’) will produce blocks, verify blocks, and participate in governance, while the bottom 78 P-Reps (‘Sub P-Reps’) will add further security to the network by storing a copy of the ledger and making themselves available to replace a Main P-Rep if necessary. The top 22 representatives have the authority to produce and verify blocks for a period of 43,120 blocks. This period is called the ‘Representative Term’. At the end of each

² A description of each Monthly Reward Variable (i_{rep} , i_{eep} , i_{dapp}) and each Annual Reward Rate (r_{rep} , r_{eep} , r_{dapp}) defined in Figure 3 is further defined in ‘4.1.1 Governance Variables’.

Representative Term, the rank of each representative is recalculated to reflect the delegations of ICONists.

All ICONists delegate their stake in the network to representatives who, in their opinion, can reliably operate the ecosystem. Through this process, the top 100 P-Reps elected by ICONists can receive the 'Block Validation Reward' (Main P-Reps only) and the 'Representative Reward' (All P-Reps) according to the Monthly Reward Variable for Representative (i_{rep})

3.1.1. Block Validation Reward(β_1)

The 'Block Validation Reward' is a reward given to the top 22 Representatives for proving their contribution by producing and validating blocks. The top 22 Representatives are given roles in block production and validation, and they can acquire a certain amount of I-Score per block for providing computational resources. This system provides an economic incentive for block production and validation, thus maintaining the distributed network.

3.1.2. Representative Reward(β_2)

The 'Representative Reward' is an item that rewards the top 100 Representatives for proving their contribution by registering a node and receiving network-stake delegation from ICONists. All representatives acquire a certain amount of I-Score per block, depending on the amount of network-stake delegated to them by ICONists. The more network-stake they are delegated, the more rewards they earn. Therefore, this system provides an economic incentive for Representatives to work harder to receive more network-stake.

3.2. EEP: Ecosystem Expansion Project

An Ecosystem Expansion Project ('EEP') is a project or activity that can contribute to the growth and expansion of the ICON Network. In order to promote self-development of a decentralized network, the system should be designed in such a way that anyone who is willing to contribute to the development or expansion of the ecosystem can do so without relying on a single development or community group.

All EEP Contributors willing to propose a project can submit their project idea on-chain. EEPs include, but are not limited to: ICON Network development, 3rd Party App development, community activities, and education activities.

All ICONists can select high-quality EEPs that can contribute to increasing the value of the ecosystem by delegating ICX to specific EEPs. Only the top 100 EEPs are eligible to receive rewards depending on the amount of ICX delegated from ICONists and the Monthly Reward Variable for EEP (i_{eep}). The top 100 EEPs are elected similarly to the Representatives of the ICON Network, where ICONists delegate Staked ICX to their choice of EEPs.

3.2.1. EEP Reward(β_4)

'EEP Reward' is the reward for the top 100 EEPs according to the amount of ICX delegated. All EEPs can prove their contribution by receiving delegated ICX from ICONists. Only the top 100 EEPs acquire a certain amount of I-Score per block, depending on the amount of ICX delegated. As a result of this, EEPs have an incentive to perform better projects to receive more delegation from ICONists.

3.3. DBP: DApp Booster Program

The Decentralized Application Booster Program (DBP) is a program that selects and rewards DApps to help grow the value of the ICON Network, and all DApps on the ICON Network can register with the DBP and receive delegation from ICONists.

All ICONists can select high-quality DApps that can contribute to increasing the value of the ecosystem by delegating ICX to specific DApps. Only the top 100 DApps are eligible to receive rewards depending on the amount of ICX delegated from ICONists and the Monthly Reward Variable for DApp (i_{dapp}). The top 100 DApps are elected similarly to the Representatives of the ICON Network, where ICONists delegate Staked ICX to their choice of DApps.

3.3.1. DApp Reward(β_6)

The 'DApp Reward' is the reward for the top 100 DApps according to the amount of ICX delegated. All DApps can prove their contribution by receiving delegated ICX from ICONists. Only the top 100 DApps acquire a certain amount of I-Score per block, depending on the amount of ICX delegated. As a result of this, DApps have an incentive to develop a popular DApp to receive more delegation from ICONists.

3.4. Delegation Reward

While some ICONists will be driven to contribute directly to the growth of the ecosystem, all ICONists will have the opportunity to contribute indirectly through delegating their ICX to the highest quality Representatives, EEPs, and DApps. Through this selection and validation process, newly issued ICX will be distributed directly to those that have made the largest contribution to the network, and thus, can make the greatest impact on the growth of the network.

The DPoC protocol defines rewards for each of the following contribution items: rewards for delegating towards Representatives, rewards for delegating towards EEPs, and rewards for delegating towards DApps. All of these reward rates will be based on the percentage of the network staked in each category.

3.4.1. Representative Delegation Reward(β_3)

'Representative Delegation Reward' is the reward specified for ICONists in exchange for delegating their ICX to a Representative, thus proving the contribution of the Representative. All ICONists can delegate ICX to Representatives and can acquire a certain amount of I-Score per block, depending on the amount of ICX delegated.

3.4.2. EEP Delegation Reward(β_5)

'EEP Delegation Reward' is the reward specified for ICONists in exchange for delegating their ICX to an EEP, thus proving the contribution of the EEP. All ICONists can delegate ICX to EEPs and can acquire a certain amount of I-Score per block, depending on the amount of ICX delegated.

3.4.3. DApp Delegation Reward(β_7)

'DApp Delegation Reward' is the reward specified for ICONists in exchange for delegating their ICX to a DApp, thus proving the contribution of the DApp. All ICONists can delegate ICX to DApps and can acquire a certain amount of I-Score per block, depending on the amount of ICX delegated.

4. IISS Operation

One of the most innovative features of IISS is the dynamic nature of the currency issuance rate. The issuance rate is based on three dynamic network conditions: the total amount of transaction fees, the governance variable input, and the percentage of ICX staked. The governance variable is recalculated every 43,120 blocks, while the transaction fees and staking percentage are recalculated after the production of each block.

The concept of I-Score, the quantification of contribution to the ICON Network, is another innovation brought about by IISS. Rather than receiving ICX for each block, all contributors instead receive I-Score. The ICX is sent to the ecosystem reward fund, known as the Public Treasury, where it can be claimed in exchange for I-Score at a fixed rate of 1 *ICX* = 1,000 *I_Score*. In order to calculate the issuance amount of ICX needed to match the I-Score received by all contributors (as defined by DPoC), IISS aggregates all the transaction fees within a block, sends them to the Public Treasury, then deducts this aggregated amount from the necessary ICX issuance amount. Additionally, if the amount of transaction fees within a block exceeds the necessary ICX issuance, the excess transaction fees are burned, thus creating a deflationary environment in the case of high network utilization.

Procedure 1.
Determination of Reward Fund

Procedure 2.
Measuring and distributing
the I-Score

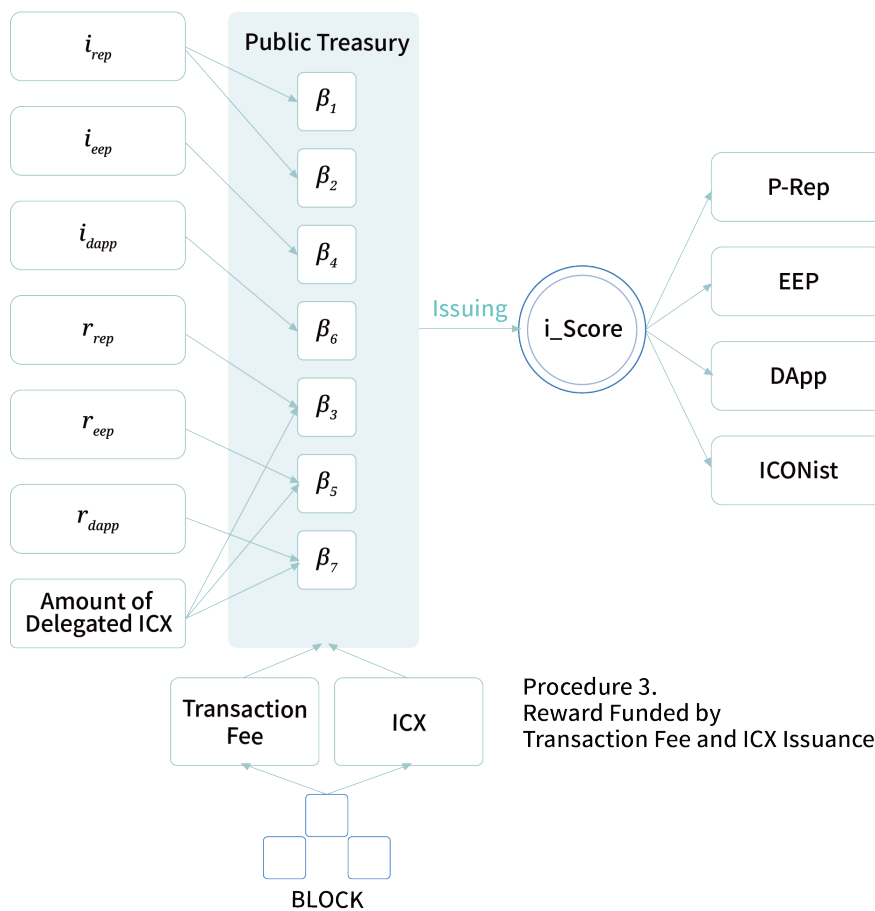


Figure 4 : Operational Process of IISS

Figure 4 above depicts the operating process of IISS. The Representatives of the ICON Network produce a block every 2 seconds, and each time a block is produced, the IISS process executes in parallel. IISS calculates the size of the reward fund for the entire ecosystem. The size of reward fund depends on the governance variables submitted by the Representatives and the total amount of ICX delegated across the ecosystem. The reward fund is called the Public Treasury, and the monetary unit of the reward fund is ICX.

Subsequently, an entity's contribution to the ecosystem is determined every block, then I-Score is issued and distributed. I-Score is determined every 43,120 blocks (approximately) and paid to each contributor. The sum of the transaction fees included

within a block and the issuance amount of ICX is deposited into the Public Treasury. ICX can be claimed from the Public Treasury with I-Score.

4.1. Determination of the Reward Fund

The determination of the reward fund is the process of calculating the necessary amount of rewards for the entire ecosystem, as defined by DPoC, during the production of each block and sending these rewards to the Public Treasury. The Public Treasury is a fully automated reward fund, operated autonomously by a smart contract deployed on the ICON Network. The size of the reward fund changes dynamically based on the governance variable submitted by Representatives and the amount of ICX delegated. Once the reward fund of the Public Treasury is determined, the total volume of I-Score issuance is determined at a fixed rate of $1\ ICX = 1,000\ I_Score$.

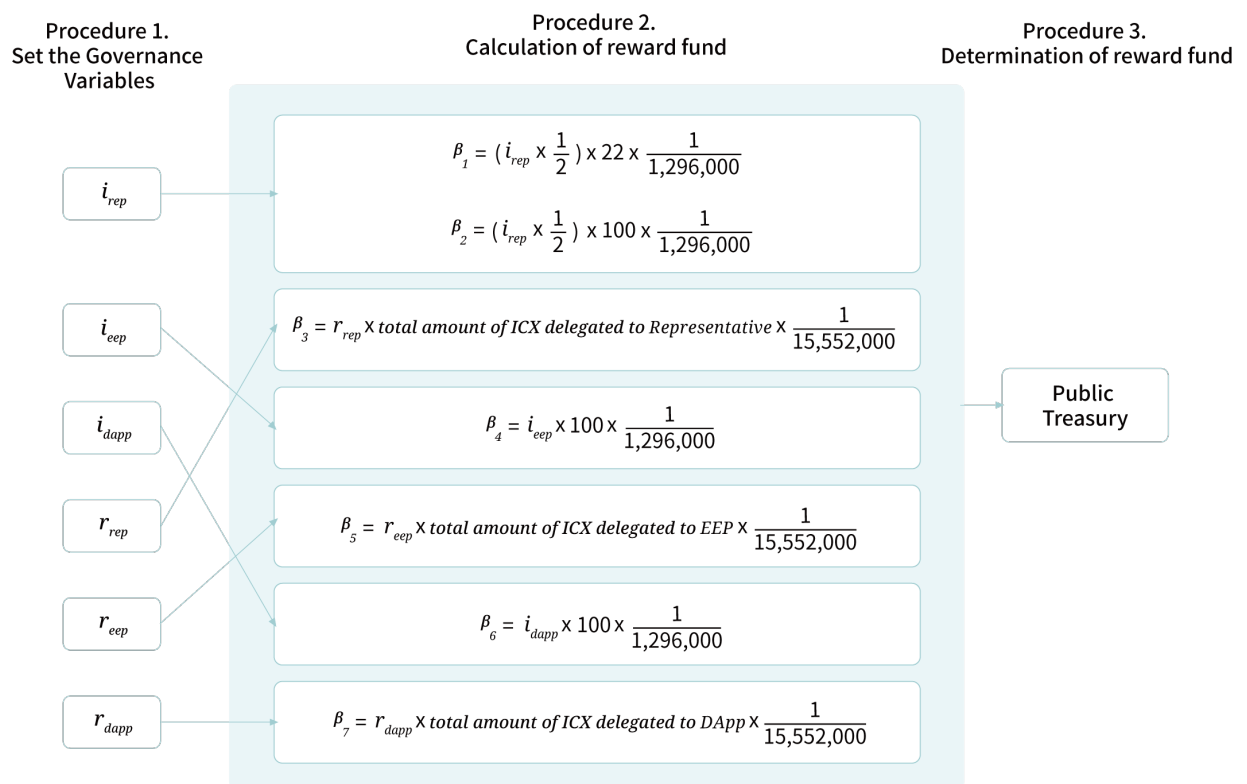


Figure 5 : Mechanism for Determining the Reward Fund

Figure 5 above describes the mechanism for determining the size of the reward fund of the ICON Network. The size of the reward fund depends on the governance variables and a calculation formula for each of the seven forms of contribution.

4.1.1. Governance Variable

Unlike other public blockchains, the ICON Network determines the rewards for the ecosystem through the use of governance variables specified by Representatives. A governance variable is a parameter that determines the size of the reward fund to be kept in the Public Treasury as determined by IISS.

All Representatives can submit the governance variable (i_{rep}), however, only the submissions of the top 22 Representatives will be factored into the final calculation for i_{rep} . The result will be calculated by taking a stake-weighted average of each of the top 22 Representatives' submissions. Representatives can control the currency issuance rate and the size of the reward fund through the use of governance variables.

Figure 6 introduces the aforementioned governance variables. Governance variables include seven items in total and are detailed below.

Item	Name	Description
i_{rep}	Monthly Reward Variable for Representative	A variable that determines the reward amount for contribution by Representatives. This variable represents the monthly amount of ICX that is assumed to be required for the operation of the Representative node. It is determined by the Representatives via a stake-weighted average of their submissions.
i_{eep}	Monthly Reward Variable for EEP	A variable that determines the reward amount for an EEP. This variable represents the monthly amount of ICX distributed to an EEP when it receives 1% of the ICX delegation across all EEPs in the top 100.

i_{dapp}	Monthly Reward Variable for DApp	A variable that determines the reward amount for a DApp in the DBP. This variable represents the monthly amount of ICX distributed to a DApp when it receives 1% of the ICX delegation across all DApps in the top 100.
r_{rep}	Annual Delegation Reward Rate for Representative	This variable is the rate received by an ICONist who delegates their ICX to a Representative. The reward rate will change dynamically depending on the amount of ICX delegated across all P-Reps.
r_{eep}	Annual Delegation Reward Rate for EEP	This variable is the rate received by an ICONist who delegates their ICX to an EEP. The reward rate will change dynamically depending on the amount of ICX delegated across all EEPs.
r_{dapp}	Annual Delegation Reward Rate for DApp	This variable is the rate received by an ICONist who delegates their ICX to a DApp. The reward rate will change dynamically depending on the amount of ICX delegated across all DApps in the DBP.
s	Step Price	A variable that determines the price of Step, which can be adjusted via Representatives reaching consensus on a Network Proposal.

Figure 6 : Definition of Governance Variables

All governance variables are determined at the beginning of each Representative's term, and the variables will be fixed during the term. The term of a Representative is 43,120 blocks.

4.1.1.1. Monthly Reward Variables³

The Monthly Reward Variable for Representative (i_{rep}), Monthly Reward Variable for EEP (i_{eep}) and Monthly Reward Variable for DApp (i_{dapp}) represent the assumed amount of ICX required to maintain each contributor's activities.

The Monthly Reward Variable for Representative (i_{rep}) is the Representative reward submitted by the 100 Representatives (only submissions of the top 22 Representatives are averaged into the final number). i_{rep} represents the amount of ICX required to cover monthly operating costs and profits of a Representative.

Representatives should consider their operational costs, profits from running a node, and the amount of transaction fees on the network when submitting i_{rep} . This variable has a significant impact on the monetary policy of the ICON Network. The i_{rep} variable will be updated every 43,120 block intervals and may be adjusted by each Representative within a 20% range from the value they submitted for the previous term. The i_{rep} variable has a minimum value of 10,000 to prevent monetary policy attacks. Additionally, the combined annualized inflation generated by i_{rep} , i_{dapp} and i_{eep} must not exceed 14%.

The rewards for DApps in the DBP (i_{dapp}) and the rewards for EEPs (i_{eep}) are a function of the rewards for Representatives (i_{rep}). Both i_{dapp} and i_{eep} are set at a fixed proportion of 25% of the i_{rep} amount.

If the i_{rep} variable is set to a high value, the values of i_{eep} and i_{dapp} will also increase, which may lead to high ICX inflation if not managed carefully. Similarly, if the i_{rep} variable is set too low, the amount of rewards in the Public Treasury will decrease and community contributors will face losses. The Monthly Reward Variable for each category is detailed below:

³ The month is equivalent to about 30 days or 1,296,000 blocks. The year is equivalent to about 365 days or 15,552,000 blocks.

Item	Formula
i_{rep}	Submitted by each Representative, determined by a stake-weighted average of the submissions of the top 22 Representatives
i_{eep}	$i_{rep} \times 0.25$
i_{dapp}	$i_{rep} \times 0.25$

Figure 6-1 : Method of Derivation of Monthly Reward Variables

4.1.1.2. Annual Delegation Reward Rate

Among the governance variables, the Annual Delegation Reward Rate for Representative (r_{rep}), Annual Delegation Reward Rate for EEP (r_{eep}), and Annual Delegation Reward Rate for DApp (r_{dapp}) are the reward rates that are dynamically determined based on the amount of ICX delegated in the ecosystem. All ICONists can delegate their ICX to Representatives, EEPs, and DApps to receive a certain percentage of the delegated amount.

An important aspect of the three Annual Delegation Reward Rate variables (r_{rep} , r_{eep} , and r_{dapp}) is that the ratio varies dynamically depending on the total amount of ICX delegated. The three reward rates above depend on the total amount of ICX delegated to each respective category (Representative, EEP, and DApp). This idea is drawn from traditional monetary policy. In order to stimulate growth in a specific sector, governments can provide monetary incentives for contributors in a certain industry.

If delegation rates are low within a specific category, the reward rate will be higher, thus incentivizing more ICONists to participate in the delegation process for that category. Conversely, if delegation rates are high within a specific category, ICONists will be incentivized to delegate their ICX to other categories within the ICON Ecosystem.

Annual Delegation Reward Rates vary from a minimum of 2% to a maximum of 12% per category depending on the amount of ICX delegated for each category. Figure 6-2-1

describes the maximum, minimum, and the saturation point of each Annual Delegation Reward Rate.

Item	Value	Description
r_{max}	12%	Maximum Reward Rate, hard-coded as 12%.
r_{min}	2%	Minimum Reward Rate, hard-coded as 2%.
r_{point}	70%	The point at which the reward rate is no longer decreased. When the percentage of ICX delegated in the ecosystem is greater than 70% of total supply, the reward rate is kept at the minimum reward rate.

Figure 6-2-1 : Parameters for Annual Delegation Reward Rate

Figure 6-2-2-1 shows the formulae that are used to calculate the Annual Delegation Reward Rate. The formulae take into account the total amount of ICX delegated in the ecosystem and include the aforementioned parameters. Figure 6-2-2-2 is a graphic representation of the formula. Using this formula, the Annual Delegation Reward Rate (r_{rep} , r_{eep} , r_{dapp}) for each of the three categories is determined dynamically from a minimum of 2% to a maximum of 12%. It will be fixed to 2% when the amount of ICX delegated in the ecosystem is greater than 70%.

Item	Formula
r_{rep}	$\frac{(r_{max} - r_{min})}{(r_{point})^2} \times \left(\frac{\text{amount of ICX delegated to Representative}}{\text{total amount of ICX}} - r_{point} \right)^2 + r_{min}$
r_{eep}	$\frac{(r_{max} - r_{min})}{(r_{point})^2} \times \left(\frac{\text{amount of ICX delegated to EEP}}{\text{total amount of ICX}} - r_{point} \right)^2 + r_{min}$
r_{dapp}	$\frac{(r_{max} - r_{min})}{(r_{point})^2} \times \left(\frac{\text{amount of ICX delegated to DApp}}{\text{total amount of ICX}} - r_{point} \right)^2 + r_{min}$

Figure 6-2-2-1 : The Formulae for the Annual Delegation Reward Rate

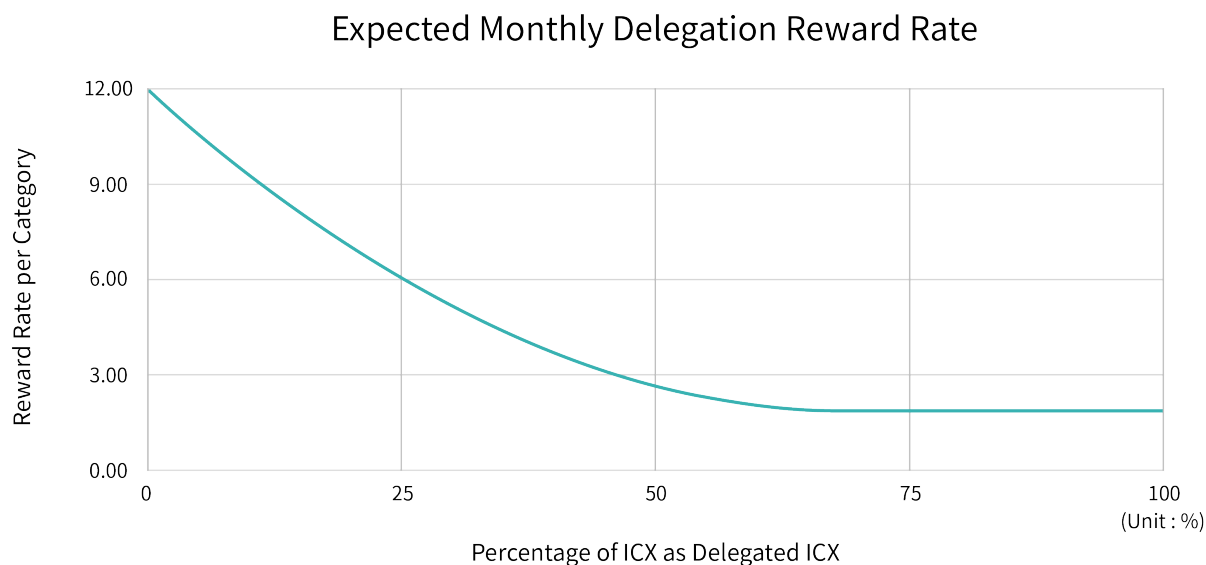


Figure 6-2-2-2 : Annual Delegation Reward Rate Relative to Percentage of Delegated ICX

4.1.2. Calculation of the Reward Fund

Once the governance variables are determined, IISS will calculate the amount of reward funds required for the Public Treasury depending on each form of contribution. An important feature of this process is that it calculates the amount of reward funds required per block.

The Block Validation Reward (β_1) Representative Reward (β_2), EEP Reward (β_4), and DApp Reward (β_6) are calculated every 43,120 blocks, therefore the size of the reward fund per block during that period is fixed for these contribution rewards.

However, the Representative Delegation Reward (β_3), EEP Delegation Reward (β_5), and DApp Delegation Reward (β_7) are calculated every block. The amount of ICX delegated in the ecosystem changes in real time, meaning the amount of ICX needed for the reward fund for these contribution items changes every block.

ICX is the monetary unit of the reward fund, while I-Score represents one's latest contributions. I-Score is issued at a fixed rate of $1 \text{ ICX} = 1,000 \text{ I_Score}$. The IISS calculation process issues the amount of I-Score required and simultaneously issues the required ICX to back the I-Score after every block is produced. The formula for

calculating the amount of reward funds required per block for each item is shown in Figure 7 below.

Item	Formula
Block Validation Reward (β_1)	$(i_{rep} \times \frac{1}{2}) \times 22 \times \frac{1}{1,296,000}$
Representative Reward (β_2)	$(i_{rep} \times \frac{1}{2}) \times 100 \times \frac{1}{1,296,000}$
Representative Delegation Reward (β_3)	$r_{rep} \times \text{amount of } ICX \text{ delegated to the Representative} \times \frac{1}{15,552,000}$
EEP Reward (β_4)	$i_{eep} \times 100 \times \frac{1}{1,296,000}$
EEP Delegation Reward (β_5)	$r_{eep} \times \text{amount of } ICX \text{ delegated to the } EEP \times \frac{1}{15,552,000}$
DApp Reward (β_6)	$i_{dapp} \times 100 \times \frac{1}{1,296,000}$
DApp Delegation Reward (β_7)	$r_{dapp} \times \text{amount of } ICX \text{ delegated to the } DApp \times \frac{1}{15,552,000}$

Figure 7 : Calculation Formulae for the Amount of Reward Funds Required per Block for Each Form of Contribution

4.2. Issuance and Distribution of I-Score

The ICON Network measures the contribution of ICONists to the development of the ecosystem and distributes I-Score. ICONists can exchange I-Score at a fixed rate of $1 ICX = 1,000 I_Score$. I-Score is issued only when necessary and is distributed based on the contributions made by each ICONist.

$$\text{sum of } I_score \text{ issued per block} = (\beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5 + \beta_6 + \beta_7) \times 1,000$$

Figure 8 : Sum of I-Score Issued per Block

The Payment Period is a concept required to understand the calculation process of I-Score. IISS does not immediately distribute I-Score after each contribution action. Distribution of I-Score instead occurs at the end of the Payment Period.

Each Payment Period is an interval of 43,120 blocks, which roughly represents 24 hours. Subsequently, the accumulated contribution is distributed at the end of the Payment Period. Each ICONist can obtain I-Score, which corresponds to their contribution and is issued in tandem with the amount of ICX reward funds accumulated per block.

Figure 9 below illustrates the Payment Period. Contributions during Payment Period t accumulate during the 43,120 block period. During Payment Period $t + 1$, all accumulated contribution activities are measured and IISS converts them to I-Score. Finally, at the end of Payment Period $t + 1$, I-Score is immediately distributed to each ICONist.

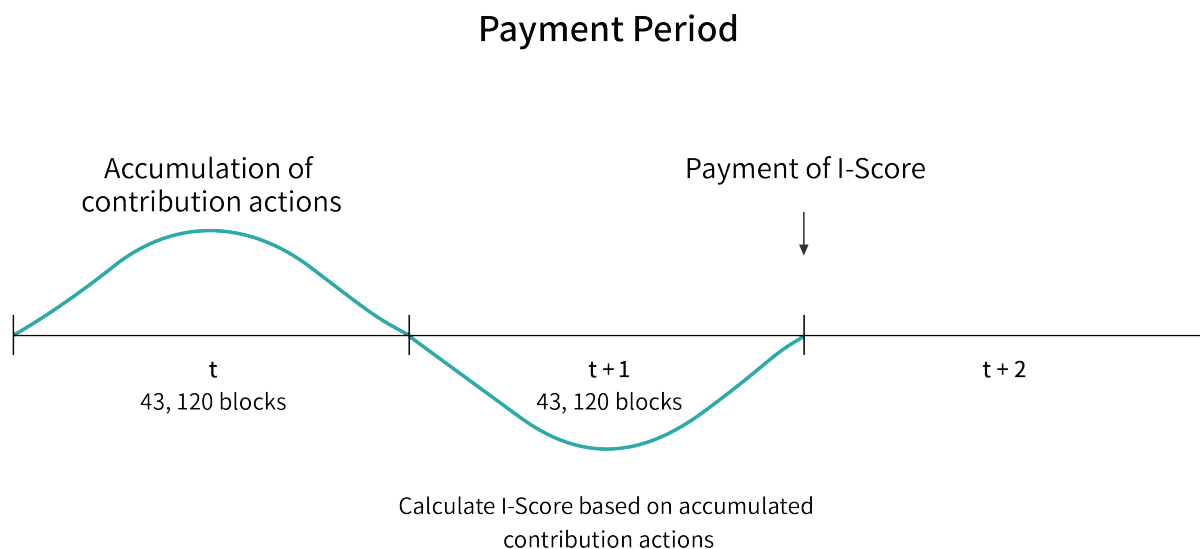


Figure 9 : Payment Period for I-Score

Figure 10 below details the measurement of the contribution of each ICONist and contains the formulae used to calculate the amount of I-Score to be distributed. The

distribution amount of I-Score depends on the amount of the ICX delegation an entity receives and the total amount of ICX delegated to that contribution category.

Item	Type	Description
Block Validation Reward	Contribution Measurement Method	When one produces a block, one gets 50% of the block validation reward that is issued per block. When one participates in the block validation, one divides the remaining 50% of the reward issued per block by the number of Representatives who participated in the block validation.
	Formula	$\beta_1 \times 0.5 \times (\text{whether produces block (0 or 1)} + \frac{\text{Whether Validates Block (0 or 1)}}{\text{number of Representative that validate the block}})$
Representative Reward	Contribution Measurement Method	Acquired as a proportion of one's delegated amount to the total delegated amount to top 100 Representatives
	Formula	$\beta_2 \times \frac{\text{delegated amount from } ICNist}{\text{amount of } ICX \text{ delegated to top 100 Representatives}}$
Representative Delegation Reward	Contribution Measurement Method	Relative to the amount one has delegated to a Representative
	Formula	$\beta_3 \times \frac{\text{delegated amount of } ICX}{\text{amount of } ICX \text{ delegated to all Representatives}}$
EEP Reward	Contribution Measurement Method	Acquired as a proportion of one's delegated amount to the total delegated amount to top 100 EEPs

	Formula	$\beta_4 \times \frac{\text{delegated amount from } \textit{ICONist}}{\text{amount of } \textit{ICX} \text{ delegated to top 100 } \textit{EEPs}}$
EEP Delegation Reward	Contribution Measurement Method	Relative to the amount one has delegated to an EEP
	Formula	$\beta_5 \times \frac{\text{delegated amount of } \textit{ICX}}{\text{amount of } \textit{ICX} \text{ delegated to all } \textit{EEPs}}$
DApp Reward	Contribution Measurement Method	Acquired as a proportion of one's delegated amount to the total delegated amount to top 100 DApps
	Formula	$\beta_6 \times \frac{\text{delegated amount from } \textit{ICONist}}{\text{amount of } \textit{ICX} \text{ delegated to top 100 } \textit{DApps}}$
DApp Delegation Reward	Contribution Measurement Method	Relative to the amount one has delegated to a DApp
	Formula	$\beta_7 \times \frac{\text{delegated amount of } \textit{ICX}}{\text{amount of } \textit{ICX} \text{ delegated to all } \textit{DApps}}$

Figure 10 : Calculation Formulae for I-Score Distribution by Contribution Item

Figure 11 shows the sum of I-Score distribution for each contribution item from the perspective of an ICONist. ICONists can figure out their I-Score distribution by using Figure 11.

I_score distribution per block to a specific *ICONist* =

$$\begin{aligned}
 & \beta_1 \times 0.5 \times ((\text{whether produces block}(0 \text{ or } 1) \\
 & \quad + \frac{\text{whether validates block}(0 \text{ or } 1)}{\text{number of Representative that validate the block}})) \\
 & + \beta_2 \times \frac{\text{delegated amount from } \textit{ICONists}}{\text{amount of } \textit{ICX} \text{ delegated to top 100 Representatives}} \\
 & \quad + \beta_3 \times \frac{\text{delegated amount of } \textit{ICX}}{\text{amount of } \textit{ICX} \text{ delegated to all representatives}} \\
 & + \beta_4 \times \frac{\text{delegated amount from } \textit{ICONists}}{\text{amount of } \textit{ICX} \text{ delegated to top 100 } \textit{EEPs}} \\
 & \quad + \beta_5 \times \frac{\text{delegated amount of } \textit{ICX}}{\text{amount of } \textit{ICX} \text{ delegated to all } \textit{EEPs}} \\
 & + \beta_6 \times \frac{\text{delegated amount from } \textit{ICONists}}{\text{amount of } \textit{ICX} \text{ delegated to top 100 } \textit{DApps}} \\
 & \quad + \beta_7 \times \frac{\text{delegated amount of } \textit{ICX}}{\text{amount of } \textit{ICX} \text{ delegated to all } \textit{DApps}}
 \end{aligned}$$

Figure 11 : I-Score Distribution per block to a Specific ICONIST

4.3. Rewards Funded by Transaction Fees and ICX Issuance

IISS issues I-Score for every produced block to pay rewards for contributions. At the same time, the Public Treasury must be backed by the right amount of ICX to be exchanged for I-Score at the fixed rate of $1 \textit{ICX} = 1,000 \textit{I_Score}$.

The ICX reserve required in the Public Treasury to match the I-Score issuance originates from two sources: transaction fees and newly minted ICX. Transaction fees are subtracted from the amount of ICX deposited into the Public Treasury to match the I-Score issuance, and, if necessary, the remainder of the necessary ICX for reward distribution is minted by the network.

Figure 12 below shows the formula that determines the amount of ICX issuance when block n is produced.

$$\begin{aligned}
 & \text{ICX issuance of block } n \\
 & = (\text{total sum of } I_score \div 1,000) - (\text{total sum of transaction fees included in block } n-1)
 \end{aligned}$$

Figure 12 : Formula for ICX Issuance of block n

The newly issued ICX are deposited into the Public Treasury and eventually transferred to ICONists when claimed through I-Score.

This is one of the biggest economic features of the ICON Network. The issuance of ICX will change dynamically depending on the amount of transaction fees in a block. ICX can be either inflationary or deflationary depending on the utilization of the network, which corresponds with the amount of transaction fees, and the decisions made by the Public Representatives.

If the transaction volume of the ICON Network is high and transaction fees provide sufficient funding for the reward fund, new ICX will not be minted. If the transaction volume increases further and the amount of transaction fees exceed the required funding sum for the reward fund, the excess transaction fees will be burned.

In regard to ICX issuance rates, IISS is designed in such a way that the annual reward fund cannot exceed 20% of the total amount of ICX. The sum of the annual rewards for 'Block Validation Reward (β_1)', 'Representative Reward (β_2)', 'EEP Reward (β_4)', and 'DApp Reward (β_6)' generated by the i_{rep} , i_{eep} , and i_{dapp} variables shall not exceed 14% of the total amount of ICX. Similarly, the sum of the annual rewards for the 'Representative Delegation Reward (β_3)', 'EEP Delegation Reward (β_5)', and 'DApp Delegation Reward (β_7)' generated by the r_{rep} , r_{eep} , and r_{dapp} variables shall not exceed 6% of the total amount of ICX.

The ICON Network incentivizes long-term economic growth through the implementation of this flexible system. When the ICON Network expands, the transaction volume of the entire ecosystem increases significantly along with transaction fees. This minimizes the

proportion of the rewards fund covered through ICX issuance and enables the network to sustain itself solely with transaction fees.

4.4. Claim ICX with I_Score

The Public Treasury on the ICON Network allows ICONists to claim ICX in exchange for their I-Score. The exchange rate is fixed at $1\text{ ICX} = 1,000\text{ I_Score}$. When an ICONist claims their ICX, their entire I-Score is extinguished and the corresponding ICX is transferred to their account from the Public Treasury.

5. Penalty

The ICON Network has included a penalty system to ensure the security of the network and further align the incentives of both ICONists and Representatives. The penalty system disincentivizes malicious and negligent behavior by Representatives while also encouraging ICONists to be more active in governance and perform deeper due diligence when delegating to a Representative. Reaching consensus without interruption is at the core of a healthy blockchain ecosystem, therefore the network must penalize representatives that disrupt the consensus process through malicious behavior or negligence. Depending on the severity of the infraction, Representatives could either lose block production rights for a period of time or suffer a burn of delegated ICX and be permanently disqualified from block production. Further details on the types of infractions and their respective penalties can be found in Figure 13 below.

Given that Representatives are elected by ICONists, incentivizing proper due diligence and regular oversight is essential to ensuring a secure and representative democracy run by ICONists. As detailed in Figure 13 below, if a Representative faces a Low Productivity Penalty or a Disqualification Penalty, 6% of ICX delegations toward such a Representative will be burned. ICONists ultimately govern the network through delegation and are held accountable, under the ethos of DPoC, for electing Representatives that do not effectively contribute to the network.

Item		Description
Validation Penalty	Set Condition	When a specific representative fails to validate blocks successively for 660 blocks.
	Penalty	Exclude such representatives from block production during the term. Block production and validation opportunities are forfeited until the next term, creating an opportunity cost.
Low Productivity Penalty	Set Condition	Applies when the Productivity Ratio of a specific representative has dropped below 85%. The Productivity Ratio is the ratio of actual blocks produced and validated divided by the number of opportunities to produce and validate a block. Representatives will not be subject to this penalty for their first 86,240 blocks as a block producing Representative.
	Penalty	Disqualify the representative in question and burn 6% of the delegated ICX.
Disqualification Penalty	Set Condition	Applies when a specific representative has been disqualified via a 'P-Rep Disqualification Proposal'
	Penalty	Disqualify the representative in question and burn 6% of the delegated ICX.

Figure 13 : The Penalty System for Representatives and ICONists

6. Scenarios

6.1. Initial Value of Governance Variables

The initial values of each governance variable upon network launch are presented in Figure 14 below. The market price of ICX is assumed to be \$0.40, and the Annual Delegation Reward Rate for Representatives, EEPs, and DApps will depend on the total amount of ICX delegated to each category in the ecosystem. The unit of measurement in Figure 14 is ICX.

Item	Initial Value
Monthly Reward Variable for Representative (i_{rep})	50,000
Monthly Reward Variable for EEP (i_{eep})	12,500
Monthly Reward Variable for DApp (i_{dapp})	12,500
Annual Delegation Reward Rate for Representative (r_{rep})	2% ~ 12%
Annual Delegation Reward Rate for EEP (r_{eep})	2% ~ 12%
Annual Delegation Reward Rate for DApp (r_{dapp})	2% ~ 12%
Step Price (s)	0.00000001

Figure 14 : Initial Values of Governance Variables

6.2. Example of IISS Operation

In an effort to illustrate the complex IISS process, an example of producing block n using the calculation formulae is outlined below. The example discusses the steps of determining the size of the reward fund, the measurement and distribution of I-Score, and the actual funding of the reward fund through ICX issuance and transaction fees.

6.2.1. Network Conditions of block n

Figure 15 provides an illustrative example based on the network conditions outlined in Figure 14. This example assumes that the percentage of Staked ICX is 30%, 20% is the

delegation rate to Representatives, EEPs, and DApps, and 18% is the delegation rate to the top 100 entities in each of the three categories.

The ICON Network produces a block every 2 seconds, and this example assumes that each Representative produces 10 blocks. This value will be set as the initial value when the ICON Network's decentralized mainnet is launched.

Finally, the total sum of transaction fees included in block $n-1$ is assumed to be 150,000,000 *Step*

Item	Value
Total amount of ICX	800,460,000
Amount of ICX Staked	$800,460,000 \times 30\% = 240,138,000$
Amount of ICX Delegated to All P-Reps	$800,460,000 \times 20\% = 160,092,000$
Amount of ICX Delegated to All EEPs	$800,460,000 \times 20\% = 160,092,000$
Amount of ICX Delegated to All DApps	$800,460,000 \times 20\% = 160,092,000$
Amount of ICX Delegated to Top 100 P-Reps	$800,460,000 \times 18\% = 144,082,800$
Amount of ICX Delegated to Top 100 EEPs	$800,460,000 \times 18\% = 144,082,800$
Amount of ICX Delegated to Top 100 DApps	$800,460,000 \times 18\% = 144,082,800$
Block Production Time	<i>2 Seconds</i>

Number of Blocks Produced per Representative	10 <i>Blocks</i>
Annual Block Production	15,552,000
Sum of Transaction fee for block <i>n</i> -1	150,000,000 <i>Step</i>

Figure 15 : Example Network Conditions of block *n*

6.2.2. Determination of the Reward Fund During block *n*

The size of the reward fund when block *n* is produced, based on the above governance variables and network conditions, is shown in Figure 16 below. The reward amount for each contribution item required in block *n* is measured in ICX.

Item	Value
Block Validation Reward (β_1)	$\frac{(37,500 \times \frac{1}{2}) \times 22}{1,296,000} = 0.4244 \text{ ICX}$
Representative Reward (β_2)	$\frac{(37,500 \times \frac{1}{2}) \times 100}{1,296,000} = 1.9290 \text{ ICX}$
Representative Delegation Reward (β_3)	$\left[\frac{(12\% - 2\%)}{(70\%)^2} \times \left(\frac{160,092,000}{800,460,000} - 70\% \right)^2 + 2\% \right] \times \frac{160,092,000}{15,552,000} = 0.7311 \text{ ICX}$
EEP Reward (β_4)	$\frac{9,375 \times 100}{1,296,000} = 0.9645 \text{ ICX}$
EEP Delegation Reward (β_5)	$\left[\frac{(12\% - 2\%)}{(70\%)^2} \times \left(\frac{160,092,000}{800,460,000} - 70\% \right)^2 + 2\% \right] \times \frac{160,092,000}{15,552,000} = 0.7311 \text{ ICX}$
DApp Reward (β_6)	$\frac{9,375 \times 100}{1,296,000} = 0.9645 \text{ ICX}$

DApp Delegation Reward (β_7)	$\left[\frac{(12\% - 2\%)}{(70\%)^2} \times \left(\frac{160,092,000}{800,460,000} - 70\% \right)^2 + 2\% \right] \times \frac{160,092,000}{15,552,000} = 0.7311 ICX$
Total	$\beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5 + \beta_6 + \beta_7 = 6.4757 ICX$

Figure 16 : Calculation of the Total Size of the Reward Fund in block n

6.2.3. Issuance and Distribution of I-Score in block n

The measurement and distribution of I-Score at block n is divided into two phases. The first phase is the issuance (per block) of the I-Score based on the size of the reward fund. The second phase is the distribution of issued I-Score to their respective contributors, which happens at the end of the Payment Period.

Figure 17 shows the first phase.

Item	Value
Block Validation Reward ($\beta_1 \times 1,000$)	$0.4244 ICX \times 1,000 = 424.4 I_score$
Representative Reward ($\beta_2 \times 1,000$)	$1.9290 ICX \times 1,000 = 1929.0 I_score$
Representative Delegation Reward ($\beta_3 \times 1,000$)	$0.7311 ICX \times 1,000 = 731.1 I_score$
EEP Reward ($\beta_4 \times 1,000$)	$0.9645 ICX \times 1,000 = 964.5 I_score$
EEP Delegation Reward ($\beta_5 \times 1,000$)	$0.7311 ICX \times 1,000 = 731.1 I_score$
DApp Reward ($\beta_6 \times 1,000$)	$0.9645 ICX \times 1,000 = 964.5 I_score$
DApp Delegation Reward ($\beta_7 \times 1,000$)	$0.7311 ICX \times 1,000 = 731.1 I_score$
Total	$6475.7 I_score$

Figure 17 : Issuance of I-Score Based on the Size of the Reward Fund

Figure 18 below shows several scenarios in which I-Score is distributed to those who have contributed to the network at the time of block n .

Scenario A

P-Rep 'Alice' is delegated 1% of the amount delegated to the top 100 P-Reps, Alice produces a block and 15 other P-Reps validate the block. Alice's acquired I-Score is:

$$\begin{aligned}
 \text{Alice's acquired } I_score &= \\
 &= (424.4 \times 0.5 \times 1) + \left(1929.0 \times \frac{800,460,000 \times 18\% \times 1\%}{800,460,000 \times 18\%} \right) \\
 &= 231.4 \text{ } I_score
 \end{aligned}$$

Scenario B

ICONist 'Bob' participates in DBP and executes an EEP. He receives 1% of the amount delegated to the top 100 EEPs and 2% of the amount delegated to the top 100 DApps, Bob's acquired I-Score is:

$$\begin{aligned}
 \text{Bob's acquired } I_score &= \\
 &= 964.5 \times \frac{800,460,000 \times 18\% \times 1\%}{800,460,000 \times 18\%} \\
 &+ 964.5 \times \frac{800,460,000 \times 18\% \times 2\%}{800,460,000 \times 18\%} = 23.9351 \text{ } I_score
 \end{aligned}$$

Scenario C

ICONist 'Charlie' stakes 100,000 ICX and delegates that amount to a P-Rep, an EEP, and a DApp. Remember that 1 ICX has the value of a single vote within each respective category. Charlie's acquired I-Score is:

$$\begin{aligned}
 \text{Charlie's acquired } I_{score} &= \\
 &= 731.1 \times \frac{100,000}{800,460,000 \times 20\%} + 731.1 \times \frac{100,000}{800,460,000 \times 20\%} \\
 &+ 731.1 \times \frac{100,000}{800,460,000 \times 20\%} = 1.3700 I_{score}
 \end{aligned}$$

Figure 18 : Distribution of I-Score in block n

6.2.4. Reward Funded by Transaction Fee and ICX Issuance in Block n

Finally, Figure 19 describes the amount of ICX issuance of the network by taking into the transaction fee of block $n-1$.

Item	Value
Transaction Fees included in block $n-1$	$150,000,000 \text{ Step} \times 0.0000000 = 1.5 \text{ ICX}$
Amount of ICX Issuance for block n	$(6475.7 I_{score} \div 1,000) - 1.5 \text{ ICX} = 4.9757 \text{ ICX}$
Annual Issuance Rate	$\frac{\text{ICX issuance amount per block} \times \text{number of annual block production}}{\text{total amount of ICX}} = 9.68\%$

Figure 19 : Reward Funded by Transaction Fee and ICX Issuance in block n