

# Validator Economics: Variable min validator deposit size

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## DATA SOURCES & GATHERING

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## 1 Overview

This document is joint work with Kerrie Mengersen and Patrick O'Callaghan, and details available information, data sources, and proposed visualisations that will provide relevant data insights to gain a deeper understanding of current validator economics and any intuitions or assumptions used in formulating proposed solutions to capping the number of validators.

The information gathering is targeted towards the proposal being evaluated, viz. a variable minimum validator balance, which is one of the proposals that Vitalik articulated in his blog post regarding single slot finality (SSF)

As the project progresses and additional data requirements are identified, this document will be updated accordingly.

Many people have generously contributed time and data, and made helpful suggestions, which has been incredibly helpful in compiling the resources listed in this document. They include, but are not limited to Barnabé Monnot and the Rigorous Incentives Group (RIG) team, Justin Drake, Alexander Tesfamichael, Ben Edgington, Paul Harris and Josh Fernandez.

## 2 Data Sources

### 2.1 Key data points

- The beacon chain **deposit contract address** is: 0x00000000219ab540356cBB839Cbe05303d7705Fa
- The beacon chain **genesis block number** is 11182202

### 2.2 Client and staking pool diversity

- *Diversify Now* dashboard by *Ether alpha* displays the current client distribution in the Consensus and Execution layers. (Figure 1, page 4).
- *Beacon Chain Network Public Dashboard* by *Miga Labs* has several visualisations:
  - Client diversity (Figure 2(a), page 5)
  - Client diversity evolution (Beacon chain client distribution over time) (Figure 2(b), page 5)

- OS distribution of active nodes (Figure 3(a), page 5)
- Geographical representation of client evolution over time (Figure 3(b), page 5)
- Active nodes round trip time distribution (RTT) (Figure 4(a), page 6)
- Graphical distribution (Beacon chain node distribution) (Figure 4(b), page 6)
- RTT distribution (Figure 5(a), page 6)
- Advertised attestation subnets subscription (Figure 5(b), page 6)
- Number of beach nodes per IP (Figure 6), page 6)

However, it is important to note that it is challenging to measure peer types in the network, and therefore the figures are at best approximations based on the information at hand.

### 2.3 Total ETH Supply

The total supply of ETH used to be fairly simple to work out, but it is now more complicated for two main reasons: implementation of EIP-1559 and the Merge. Currently we are “(a) burning ETH via the base fee and (b) the issuance is variable depending on the number of validators.” (Ben Edgington 2023).

- Ultrasound is considered a credible source for total ETH supply projections.  
*Ultra sound money* visualises various aspects of Ether supply since the Merge, gas, supply projections, the burn, total value secured - TVS and monetary premium. See figures 7 - 15, on pages 7 - 10.
- Ultrasound supplied two datasets for our analysis - the first had total supply at a more accurate and finer grained level, but shorter time period and the second dataset had data points roughly every 1,000 epochs covering from soon after Beacon chain genesis. The latter dataset is from Glassnode and would not be as accurate as the initial data provided by Alex Tesfamichael from Ultrasound.
- *Etherscan* is a good source of historic data for the growth in Ether supply since 2015. There are several pages of detailed information and the *Charts & Statistics* webpage has several visualisations, often with the ability to select different time ranges and a link to download the raw data as csv files, providing that Etherscan is acknowledged when these datasets are used.

Figures 16 to 26 on pages 11 to 15 show the visualisations that are currently available.

### 2.4 Multiple datasets

There are several resources that contain lists and visualisations of a variety of data from Ethereum Mainnet. Obtaining the raw data used on the websites and dashboards are not always easily accessible.

- *beaconcha.in*, an open source Ethereum explorer, is a rich and informative resource providing visualisations and summary statistics of various aspects of the chain. It is not clear if it is possible to gain access to the data used to generate the many graphs and summary statistics. The website currently contains the following:
  - On the home page, there is a **progress line** at the top of the page showing the *number of slots left in the current epoch*. (Figure 27, page 16)

- Immediately below the progress line, there is a **summary line** showing the *current epoch number*, the *last finalised epoch*, the *current slot number*, the *number of active and pending validators*, the *total staked ETH* and the *average validator balance*. (Figure 27)
- Below this summary there is a **graph** of the *number of active validators* and *staked ETH* for the last week (Figure 27)
- Then there are two side by side tables. The **left table** has information about the most recent epochs: *epoch number*, *time*, *whether it is final*, *the eligible ETH*, *the number of percentage of votes*. The **right table** has information about the most recent blocks: *epoch number*, *slot number*, *blockfigu number*, *status of the block (proposed or missed)*, *time* and the *proposer id*. These two tables are shown in Figure 28, page 16).
- Moreover, one can click on the epoch, slot and block numbers in the tables to obtain a detailed view of the epoch, slot or block number.
- There is also a link to the validator ID in the right table that provides a detailed view of that validator.
- Figures 29 - 33 on pages 17 - 19 gives detailed blockchain data.
- Figures 34 - 44 on pages 20 - 24 gives detailed validator data.
- Beaconcha.in provide additional visualisations and tools. For example, the ability to generate graphs to show the correlation between two variables (Figure 46 on page 25).
- *Mevboost.pics* - *Open Data* will eventually provide links to download several datasets:
  - *eth\_data* - Slots since Merge with additional MEV-Boost and validator info such as: date, slot, block number, relay, builder pubkey, proposer pubkey, mevboost value, builder, validator (*Available now*)
  - *pubkey\_mapping* - Validator public keys mapped to known entities such as Lido, Kraken ect. (*Not available*)
  - *tc\_txs* - Tornado Cash related transactions (*Not available*)
  - *staking\_txs* - Deposit transactions to the ETH2 Deposit contract (*Not available*)
  - *relays\_over\_time* - Number of successfully relayed blocks per day (*Not available*)
  - *builders\_over\_time* - Number of successfully built blocks per day (*Not available*)

## 2.5 Stakers and Staking pools

- **Data from an archive node**

We had access to a teku-besu archive node, `teku-besu-ohio-mainnet-archive-01`, against which we were able to run many API queries to provide some rich data.

We ran API calls from those listed in GitHub: Eth Beacon Node API

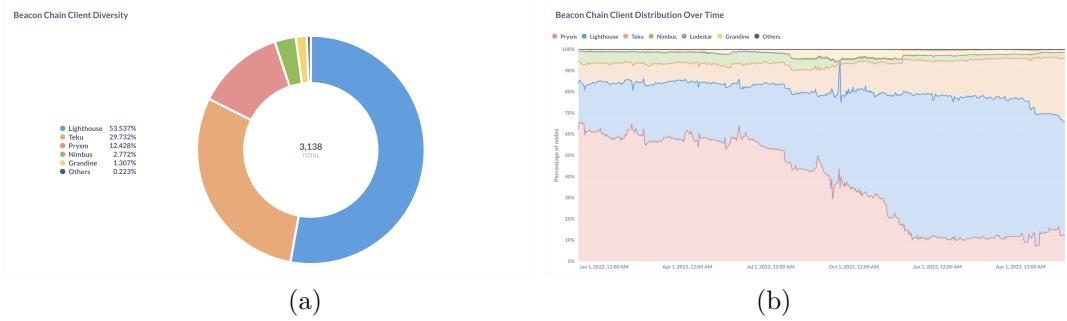
## 2.6 Existing visualisations

### Diversify Now

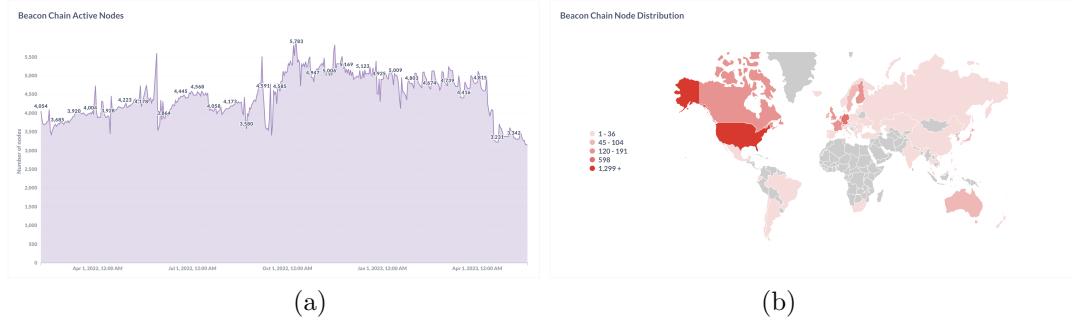


**Figure 1:** Consensus layer client diversity using Sigma Prime's Blockprint data (a) and using Migalabs data (b). Execution layer client diversity using Ethernodes data (19 May 2023)

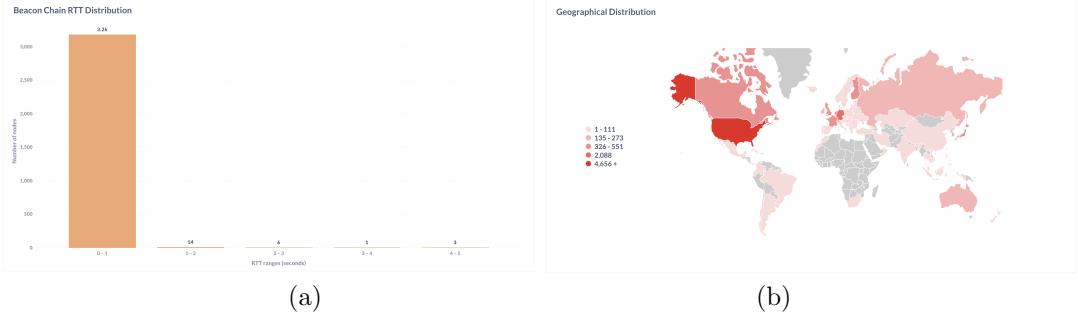
## Migalabs



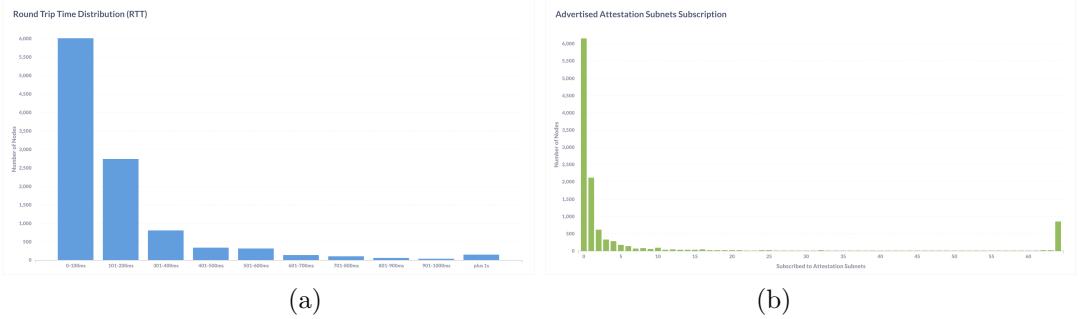
**Figure 2:** Beacon chain client diversity from Migalabs (a) and client distribution over time (b) (9 May 2023)



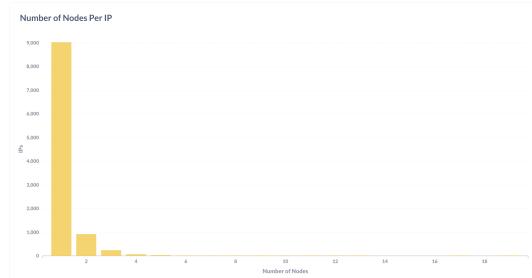
**Figure 3:** Operating system distribution of active beacon chain nodes from Migalabs (a) and client diversity evolution of beacon chain nodes (b) (9 May 2023)



**Figure 4:** Distribution of active beacon chain nodes round trip time (RTT) from Migalabs (a) and geographical distribution (b) (9 May 2023)

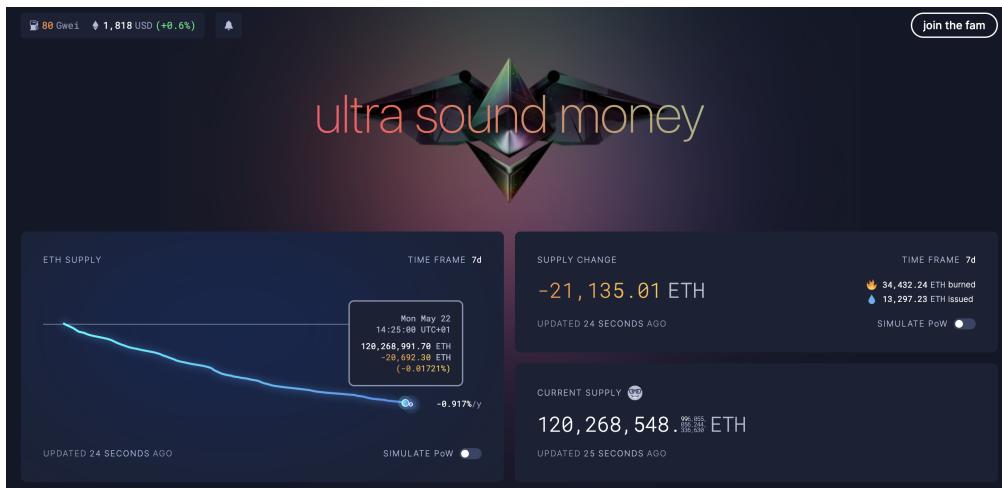


**Figure 5:** Distribution of active beacon chain nodes round trip time distribution (RTT) from Migalabs (a) and advertised attestation subnets subscription (b) (9 May 2023)



**Figure 6:** Number of beacon nodes per IP from Migalabs

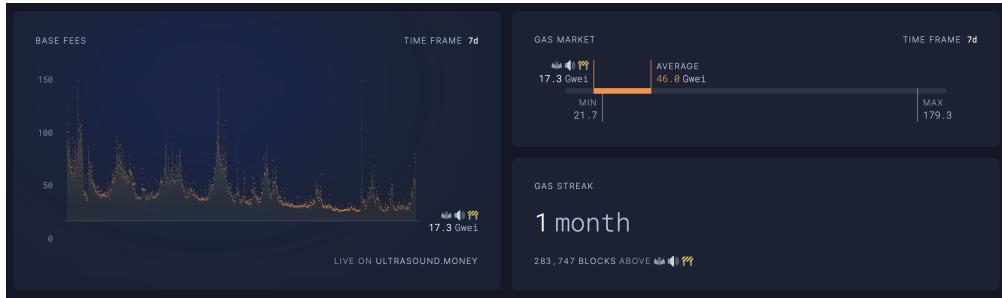
## Ultrasound money



**Figure 7:** ETH supply over time, current supply and change, 22 May 2023



**Figure 8:** Burn, supply growth, and issuance, 22 May 2023



**Figure 9:** Gas market, 22 May 2023



**Figure 10:** Interactive ETH supply projections - sliders provided for issuance rewards and burn rate , 22 May 2023



**Figure 11:** 2YETH supply projection, 22 May 2023

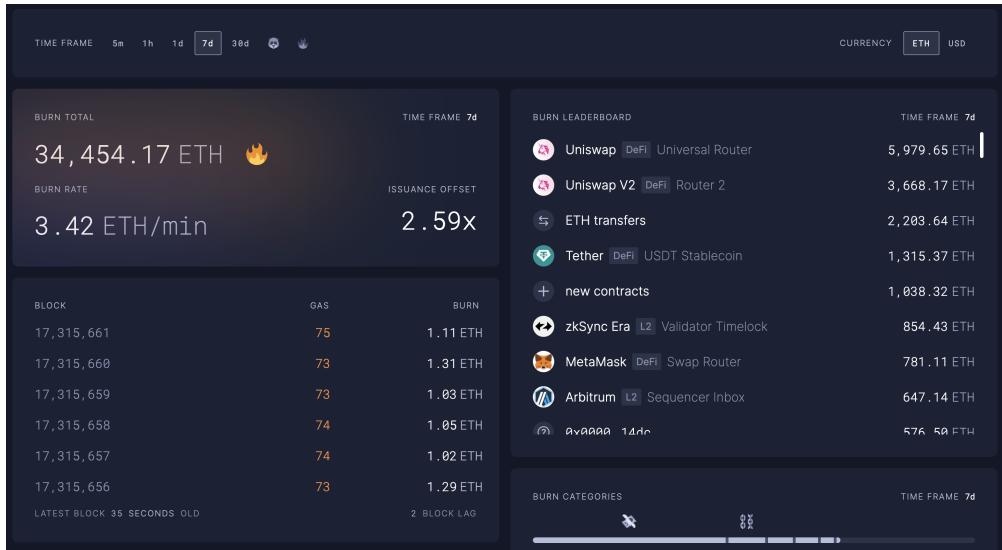


Figure 12: Total burn and rate for selected time interval; latest block gas and burn leaderboard, 22 May 2023

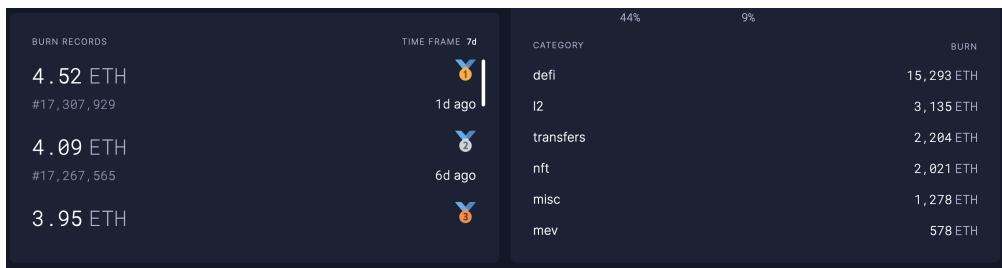
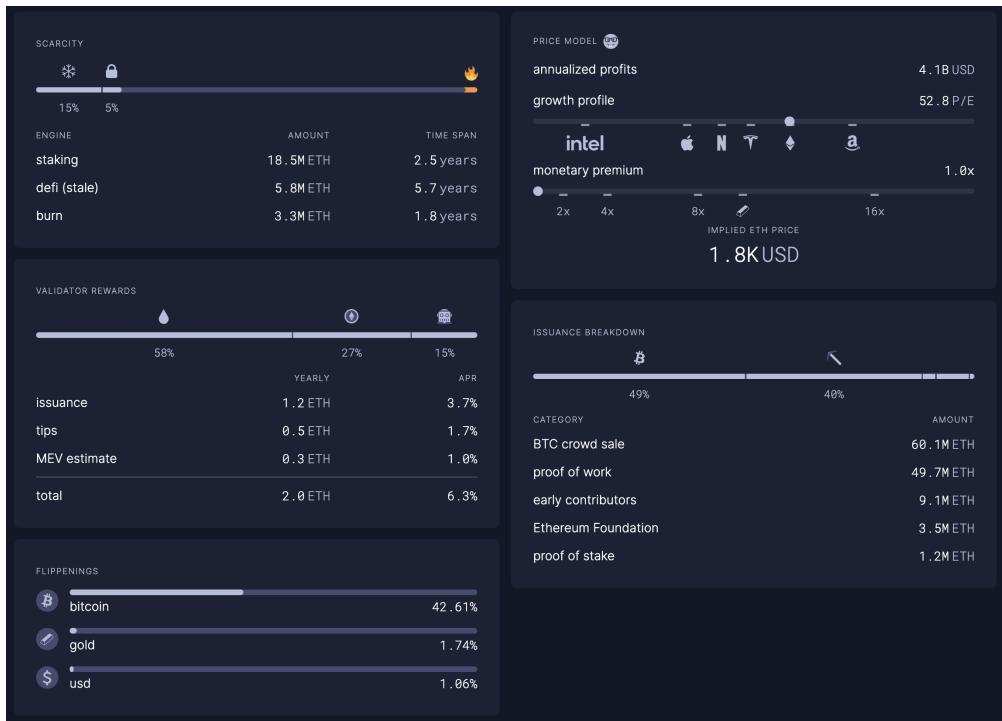


Figure 13: Burn records (top 3) and top 5 categories for most ETH burnt, 22 May 2023



Figure 14: Statistics for total value secured (TVS), including NFT and ERC20 leaderboards, 22 May 2023

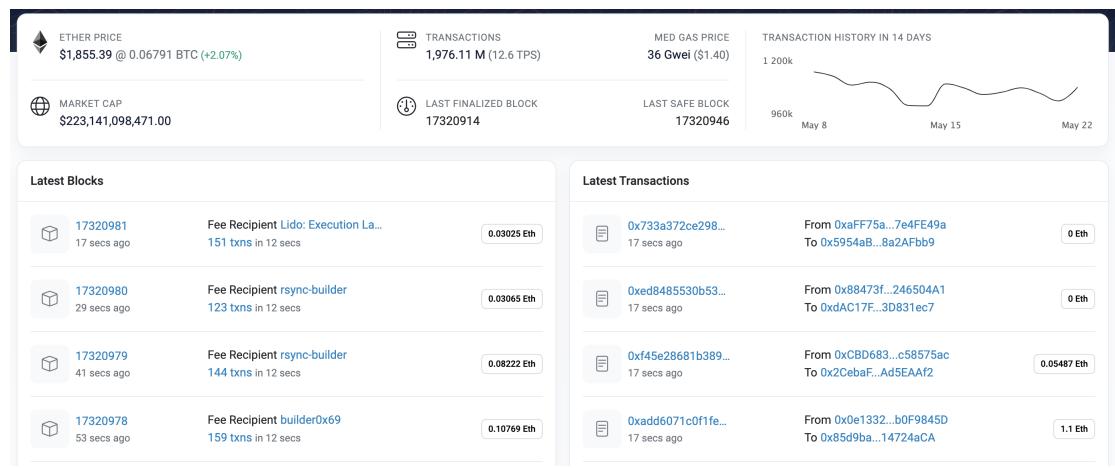


**Figure 15:** Monetary premium shows Scarcity (staking, defi, burn), Validator rewards (issuance, tips, mev, Flippennings (bitcoin, gold and usd), Issuance breakdown by category and an interactive price model based on selected growth profile and monetary premium, 22 May 2023

## Etherscan

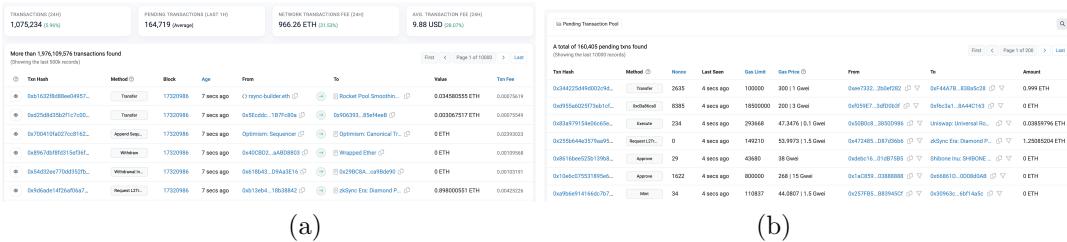
There are several webpages with detailed information on transactions, blocks, accounts and tokens. In the screenshots below, figures 17- 22 on pages 12- 13), are a few extracts from the detailed information on Etherscan and the data visualisations provided by them. Many of the dashboards allow the user to interact with the data being displayed by entering specific validators, blocks etc, that are of interest, or selecting one of the different time periods available.

Moreover, there are several summary graphs and visualisations that have been created and are displayed in the *Charts & Statistics* section of the website. These visualisations are shown in figures 23- 26 on pages 14 - 15. There is some degree of interactivity in these charts and diagrams, which includes the ability to zoom in on a section of a graph in several instances.

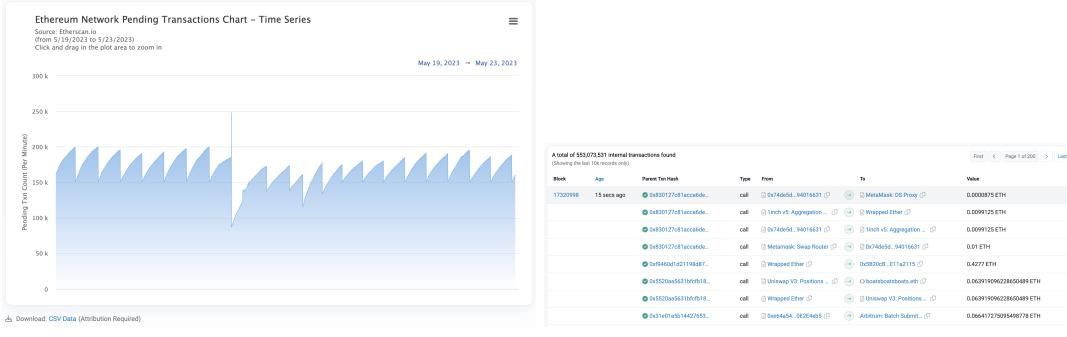


**Figure 16:** Etherscan home page, 23 May 2023

## Detailed blockchain data



**Figure 17:** Transactions (a) and pending transactions (b) from Etherscan (23 May 2023)



**Figure 18:** Chart of pending transactions (a) and contract internal transactions (b) from Etherscan (23 May 2023)

A total of 723,178 deposits found (Showing the last 10000 records)								
Tx Hash	Block	Age	Value	From	EOA/PkKey	Signature	Vald?	
0xd42a6d86c40232f...	1730919	1 min ago	32 ETH	0x0f02c5...0600017	0x0f02c5...0600017	0x6c716292d9970...	Yes	4577019 17321004
0xd42a6d86c40232f...	1730919	1 min ago	32 ETH	0x0f02c5...0600017	0x0f02c5...0600017	0x9465e8b5e5c...	Yes	4577019 17321004
0xd42a6d86c40232f...	1730919	1 min ago	32 ETH	0x0f02c5...0600017	0x0f02c5...0600017	0x6fdd5e4867c9d9...	Yes	4577019 17321004
0xd42a6d86c40232f...	1730919	1 min ago	32 ETH	0x0f02c5...0600017	0x0f02c5...0600017	0x9a918051657713...	Yes	4577019 17321004
0xd42a6d86c40232f...	1730919	1 min ago	32 ETH	0x0f02c5...0600017	0x0f02c5...0600017	0x6fb0b215e297...	Yes	4577019 17321004
0xd42a6d86c40232f...	1730919	1 min ago	32 ETH	0x0f02c5...0600017	0x0f02c5...0600017	0xadea339eac57...	Yes	4577019 17321004

(a)

(b)

**Figure 19:** Beacon chain deposits (a) and withdrawals (b) from Etherscan (23 May 2023)

A total of 172,211 blocks found (Showing the last 10000 records)								
Block	Age	Txs	Fee Recipient	Gas Used	Gas Limit	Base Fee	Reward	Base Fees (\$ETH)
17321008	12 secs ago	188	reproducer	12,758,147 (34.1% +1%)	30,000,000	27.00 Gwei	0.11021 ETH	0.74797 (0.53%)
17321007	25 secs ago	147	reproducer	20,180,892 (37.12% +15%)	30,000,000	36.38 Gwei	0.31163 ETH	0.73930 (0.30%)
17321006	37 secs ago	114	Plasticode Builder	11,277,792 (36.5% +2%)	30,000,000	37.61 Gwei	0.12413 ETH	0.41670 (0.35%)
17321005	49 secs ago	155	beavertool	17,700,997 (37.30% +1%)	30,000,000	36.44 Gwei	0.12011 ETH	0.43045 (0.11%)
17321004	1 min ago	155	builder09	11,260,808 (37.54% +2%)	30,000,000	38.12 Gwei	0.17715 ETH	0.42937 (0.12%)

(a)

(b)

**Figure 20:** Details of beacon chain blocks (a) and forked blocks (b) from Etherscan (23 May 2023)

More than 1,939,999 accounts found (130,266,413,187 ETH) (Showing the last 1000000 accounts only)								
#	Address	Name tag	Balance	Percentage	Tax Count	Filter by: 🔍 Latest 500 Verified Contracts ~	First	< Page 1 of 1000 > Last
1	0xd400000...3d77059a...	Bacon Deposit Contract	22,753,073,144,2201 ETH	18.0495405%	31,6035			
2	0xed02aa4c...3c756c2...	Wrapped Ether	3,415,610,011,5122 ETH	2.8986443%	13,670,235			
3	0xb1b485...40443388 ...	Braince 7	1,919,008,398,7898 ETH	1.6595559%	1,154			
4	0xd4d494...9ea72521	Koken 13	1,663,629,946,02600 ETH	1,4059124%	122			
5	0x7f1441...59911920	Fund 0x071...500	1,684,637,377,13501 ETH	1,3604433%	99			
6	0x7f781...744744ec	Braince 8	1,473,234,25344142 ETH	1,22290304%	10,877			
7	0x4fb15117...db76ffed	Astrum_Bridge	1,073,607,989,1519 ETH	0.8927335%	30			
8	0x4fb1517...db76ffed	Braince_Braince_Peg_Tokens	984,999,069,069158 ETH	0.8464913%	58			
9	0x50511a...bf9322f1	Bittree 19	455,118,203,0218 ETH	0.3742674%	92			
10	0x4a87c...4844849fc		428,105,052,19441 ETH	0.3559639%	23			

(a)

(b)

**Figure 21:** Top accounts by ETH balance (a) and verified contract source code (b) from Etherscan (23 May 2023)

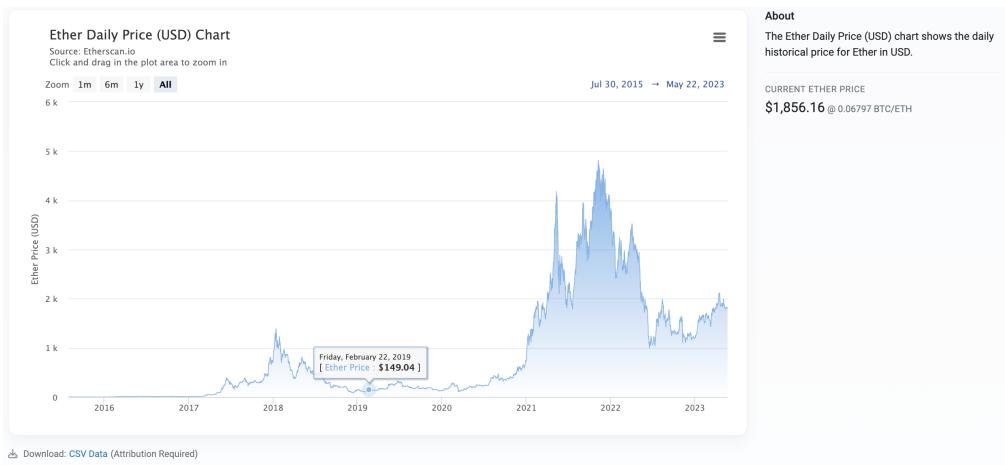
A total of 1,234 Token Contracts found								
#	Token	Price	Change (%)	Volume (\$M)	Churnig Market Cap	On-Chain Market Cap	Holders	Filter by: 🔍 Transactions with zero value are currently hidden. To show them, please go to Site Settings.
1	Tether USD (USDT)	\$1.00	-0.01%	18,888,328,243.00	982,979,280,047.00	339,823,119,845.00	4,409,450	
2	DNB (DNB)	\$513.7642	+ 1.88%	339,015,143,902.00	948,165,911,340.00	35,202,390,789.27	286,095	
3	USD Coin (USDC)	\$0.9997	-0.04%	4,021,092,567.00	22,406,572,649.00	346,593,411,388.53	1,061,19	
4	ETH (ETH)	\$1,954.00	+ 2.3%	9,204,089.00	\$1,215,032,387.00	33,430,073,972.20	204,572	
5	Matic Token (MATIC)	\$0.0826	+ 3.12%	\$275,037,677.00	\$8,140,156,110.00	\$8,205,104,218.66	185,038	

(a)

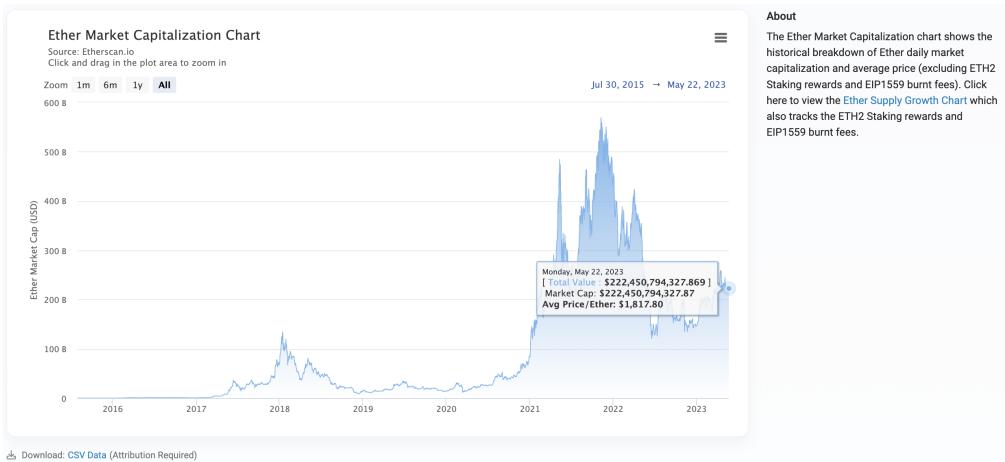
(b)

**Figure 22:** Top ERC20 tokens (a) and ERC20 token transfers (b) from Etherscan (23 May 2023)

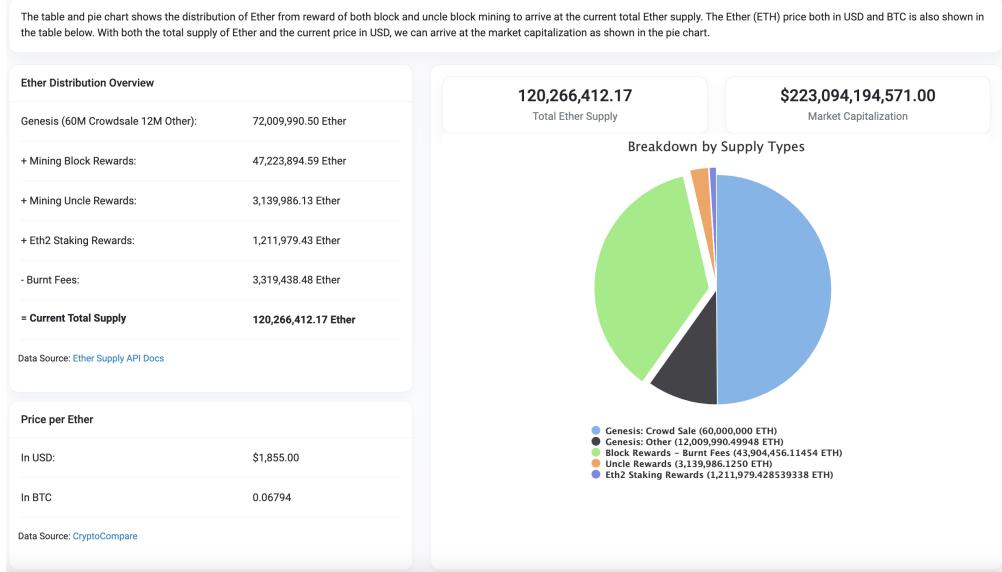
## Charts and Statistics



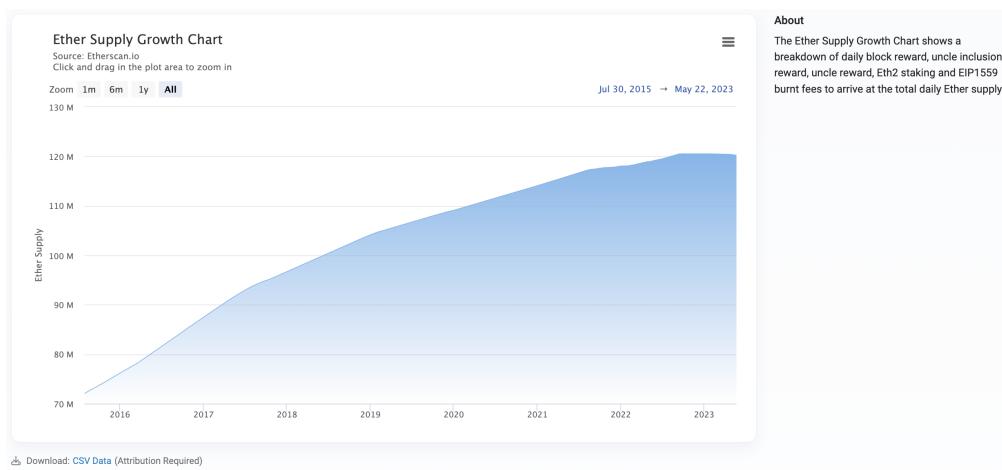
**Figure 23:** Ether daily price (USD) from Etherscan, 23 May 2023



**Figure 24:** Ether market capitalisation from Etherscan - select time range or zoom in on selected part of graph, hover mouse for details (as shown), 23 May 2023



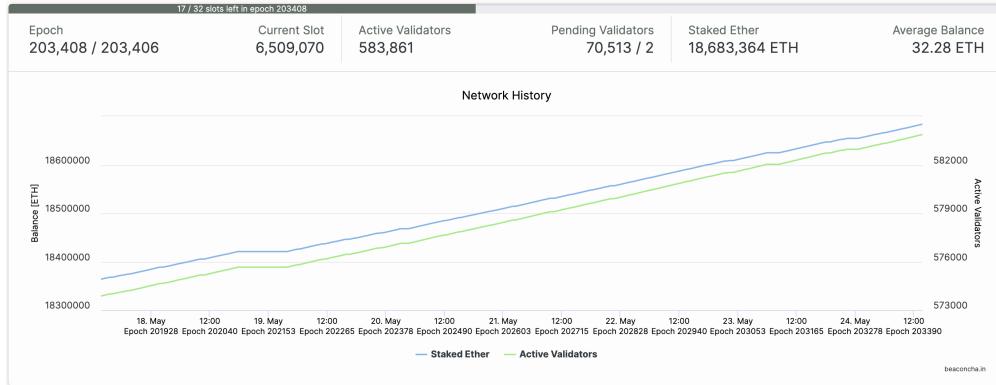
**Figure 25:** Ether total supply and market capitalisation from Etherscan, 23 May 2023



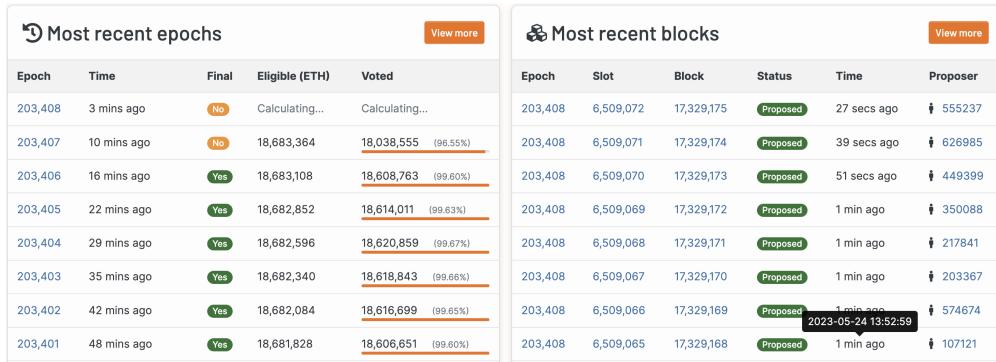
**Figure 26:** Ether supply growth chart from Etherscan - select time range or zoom in on selected part of graph, 23 May 2023

## Beaconcha.in

The website provides the ability to search using a variety of fields, including a public key, block number, block graffiti, proposer, slot, and epoch. Apart from the extensive information and visualisations shown here, there are several other



**Figure 27:** Homepage of beaconcha.in showing a progress line of the slots in the current epoch with a graph of total staked Ether and active validators over the last week, from Beaconcha.in (24 May 2023)



**Figure 28:** Homepage of beaconcha.in showing the most recent epochs and blocks, from Beaconcha.in (24 May 2023)

## Blockchain data

Epoch	Time	Attestations	Deposits / Withdrawals	Slashings P / A	Finalized	Eligible	Voted
203,408	3 mins ago	513	0 / 80	0 / 0	No	0 ETH	Calculating...
203,407	10 mins ago	2950	0 / 512	0 / 0	No	18,683,364 ETH	18,038,555 (98.55%)
203,406	16 mins ago	3110	0 / 512	0 / 0	Yes	18,683,108 ETH	18,608,763 (99.60%)
203,405	23 mins ago	3376	0 / 496	0 / 0	Yes	18,682,852 ETH	18,614,011 (99.63%)
203,404	29 mins ago	3055	0 / 512	0 / 0	Yes	18,682,596 ETH	18,620,859 (98.67%)
203,403	35 mins ago	3219	0 / 512	0 / 0	Yes	18,682,340 ETH	18,618,843 (99.66%)
203,402	42 mins ago	3003	0 / 496	0 / 0	Yes	18,682,084 ETH	18,616,699 (99.65%)
203,401	48 mins ago	3362	0 / 512	0 / 0	Yes	18,681,828 ETH	18,606,651 (99.60%)
203,400	55 mins ago	3164	0 / 496	0 / 0	Yes	18,681,572 ETH	18,484,923 (98.95%)
203,399	1 hr 1 min ago	3265	0 / 512	0 / 0	Yes	18,681,316 ETH	18,615,195 (99.65%)
203,398	1 hr 7 mins ago	3071	0 / 496	0 / 0	Yes	18,681,060 ETH	18,582,875 (99.47%)

**Figure 29:** Detailed information for epochs with the ability to search for a specific epoch, from Beaconcha.in (24 May 2023)

□ Show only empty graffiti

Slot Details											Block Number / Graffiti / Proposer N.	
Epoch	Slot	Status	Time	Proposer	Att	Deposits / Withdrawals	S- P/A	Exits	Votes	Sync Agg %	Graffiti	
203,408	6,509,087	Scheduled	in 1 min	⌚ 525099	0	0 / 0	0 / 0	0	0	0.00		
203,408	6,509,086	Scheduled	in 1 min	⌚ 530775	0	0 / 0	0 / 0	0	0	0.00		
203,408	6,509,085	Scheduled	in 1 min	⌚ 158574	0	0 / 0	0 / 0	0	0	0.00		
203,408	6,509,084	Scheduled	in 1 min	⌚ 220418	0	0 / 0	0 / 0	0	0	0.00		
203,408	6,509,083	Scheduled	in 57 secs	⌚ 410529	0	0 / 0	0 / 0	0	0	0.00		
203,408	6,509,082	Scheduled	in 45 secs	⌚ 496268	0	0 / 0	0 / 0	0	0	0.00		
203,408	6,509,081	Scheduled	in 33 secs	⌚ 403275	0	0 / 0	0 / 0	0	0	0.00		
203,408	6,509,080	Scheduled	in 21 secs	⌚ 333374	0	0 / 0	0 / 0	0	0	0.00		
203,408	6,509,079	Scheduled	in 9 secs	⌚ 118701	0	0 / 0	0 / 0	0	0	0.00		
203,408	6,509,078	Scheduled	3 secs ago	⌚ 356025	0	0 / 0	0 / 0	0	0	0.00		
203,408	6,509,077	Proposed	15 secs ago	⌚ 436846	91	0 / 16	0 / 0	0	0	99.61	teku/v23.5.0	
203,408	6,509,076	Proposed	27 secs ago	⌚ 455281	107	0 / 16	0 / 0	0	18174	99.41	CryptoManufaktur-Lido	

**Figure 30:** Detailed information for slots with the ability to search by block number, graffiti or proposer number, from Beaconcha.in (24 May 2023)

Show 10 entries

Epoch	Slot	Block	Status	Recipient	Proposer	Txn	Gas Used	Gas Limit	Base Fee	Reward	Burned Fees
203,409	6,509,088 42 secs ago	17,329,191	Proposed	0xdafef...8bc5	⌚ 458962	149 108	14,830,278 49.43% (-113%)	30,000,000	51.64781 GWel	0.08007	0.76595 Ether 958.57%
203,408	6,509,087 54 secs ago	17,329,190	Proposed	0x690b...c990	⌚ 525099	140 145	17,215,531 57.38% (+14.77%)	30,000,000	50.71154 GWel	0.06788	0.87302 Ether 1286.09%
203,408	6,509,086 1 min ago	17,329,189	Proposed	0x388c...9297	⌚ 530775	138 126	15,198,923 50.65% (+1.32%)	30,000,000	50.62761 GWel	0.07408	0.76948 Ether 1038.58%
203,408	6,509,085 1 min ago	17,329,188	Proposed	0x9522...afe5	⌚ 158574	138 54	13,661,240 45.53% (-8.92%)	30,000,000	51.19880 GWel	0.03164	0.69943 Ether 2210.23%
203,408	6,509,084 1 min ago	17,329,187	Proposed	0x1f90...c326	⌚ 220418	176 86	17,744,223 59.14% (+18.29%)	30,000,000	50.05414 GWel	0.06863	0.88817 Ether 1294.03%
203,408	6,509,083 1 min ago	17,329,186	Proposed	0x388c...9297	⌚ 410529	135 88	13,309,659 44.58% (-1.126%)	30,000,000	50.76929 GWel	0.11654	0.87572 Ether 579.79%
203,408	6,509,082 1 min ago	17,329,185	Proposed	0x1f90...c326	⌚ 496268	155 69	16,591,835 55.30% (+10.61%)	30,000,000	50.10463 GWel	0.05096	0.83132 Ether 1631.26%

**Figure 31:** Detailed information of all blocks, from Beaconcha.in (24 May 2023)

Tx Hash	Method	Block	Time	From	To	Value	Tx Fee
0xb14_df1e	0x7316b024	17,329,196	28 secs ago	0xd985_bF59	0x0000_2683	0.0000000 Ether	0.01692128 Ether
0xa7d_f667	execute	17,329,196	28 secs ago	0xbDb9_11D1	0xEf1c_BF6B	10 Ether	0.00686362 Ether
0xcfef_148e	0x8a56c398	17,329,196	28 secs ago	0xB722_11fb	0x0000_2683	0.0000000 Ether	0.20266461 Ether
0x36d6_7c5e	swapExactETHForTokensSupportingFeeOnTransferOut	17,329,196	28 secs ago	0x1e00_f2f8	Uniswap V2: Router	0.05 Ether	0.00898044 Ether
0xeb9c_1260	approve	17,329,196	28 secs ago	0x1e00_f2f8	0x916B_520e	0 Ether	0.00280960 Ether
0xb6f6_2fff	0x000000201	17,329,196	28 secs ago	0x27eb_C008	0xFd00_7AD7	0.0000000 Ether	0.01089586 Ether
0xfaa_26fc	exec	17,329,196	28 secs ago	0x62bd_a4A1	0x3CAC_83b6	0 Ether	0.03407473 Ether
0x6835_54de	deposit	17,329,196	28 secs ago	0x46ba_F459	Wrapped Ether	1.6 Ether	0.00136990 Ether
0xd8d1_e8f9	withdraw	17,329,196	28 secs ago	0x96FA_E007	Wrapped Ether	0 Ether	0.00148918 Ether
0xbb24_9844	transfer	17,329,196	28 secs ago	0x6859_2092	Tether: USDT Standard	0 Ether	0.00454948 Ether

**Figure 32:** Detailed information of all transactions, from Beaconcha.in (24 May 2023)

Show 25 entries	Search:					
Hash	From	To	Value	Gas Limit	Gas Price	Nonce
0xfecae_bdcee	0xAdf_a0c6	0xAdf_a0c6	0 Ether	21,000	99.97304 gWei	2
0x7a2d5_b2d4f	0x6E8_813e	0x6E8_813e	0 Ether	56,311	99.90639 gWei	24
0x79e0c_8a0fe	0x5f4_d2ED	0x5f4_d2ED	0 Ether	21,000	99.77602 gWei	5
0xfa912_a6451	0xC67_799A	0xC67_799A	0 Ether	51,594	99.73214 gWei	33
0xa3b34_c6532	0x7e2_c71e	0xBef_71c6	0 Ether	121,341	99.72739 gWei	124
0x85986_2a62f	0x997_8134	0xD1_eBB0	0 Ether	48,416	99.58487 gWei	21
0x80085_bcef3	0x661_2863	0xC82_6Cc2	0 Ether	25,882	99.56017 gWei	71
0x3ee72_87789	0x266_4Ed7	0x266_4Ed7	0 Ether	21,000	99.55 gWei	24
0xa6a5_2863a	0xCaA_f14e	0xC82_6Cc2	0.015 Ether	45,038	99.23455 gWei	6

**Figure 33:** Mempool transaction details, from Beaconcha.in (24 May 2023)

## Validator data

All 712863							
Public Key	Index	Balance	State	Activation	Exit	W/able	
0x80000001...	8499 (101ca7)	36.4121 ETH (32.0 ETH)	Active ⓘ	904 days 1 min ago (Epoch 0)	-	-	
0x800003d8...	197823	32.0064 ETH (32.0 ETH)	Active ⓘ	673 days 53 mins ago (Epoch 51,967)	-	-	
0x800006d4...	347967	32.0031 ETH (32.0 ETH)	Active ⓘ	401 days 9 hrs ago (Epoch 113,098)	-	-	
0x80000821...	413630	32.0015 ETH (32.0 ETH)	Active ⓘ	285 days 23 hrs ago (Epoch 139,059)	-	-	
0x80000cdd...	162791	34.9332 ETH (32.0 ETH)	Active ⓘ	712 days 4 mins ago (Epoch 43,209)	-	-	
0x8000118f...	611152	32.0101 ETH (32.0 ETH)	Active ⓘ	17 days 17 hrs ago (Epoch 199,419)	-	-	
0x80002598...	665475	32.0000 ETH (32.0 ETH)	Pending	-	-	-	
0x800026c3...	118493	0.0000 ETH (0.0 ETH)	Exited	771 days 13 hrs ago (Epoch 29,808)	24 days 20 hrs ago (Epoch 197,813)	23 days 17 hrs ago (Epoch 197,813)	
0x80002a23...	112948	32.0082 ETH (32.0 ETH)	Active ⓘ	784 days 1 hr ago (Epoch 26,999)	-	-	
0x80002b5a...	627027	32.0436 ETH (32.0 ETH)	Active ⓘ	9 days 2 hrs ago (Epoch 201,358)	-	-	

Figure 34: Overview of validators. Beaconcha.in (24 May 2023)

Show 10 entries						
Slashed Validators	Slashed by	Age	Reason	Slot	Epoch	
7506	296952	8 hrs 37 mins ago	Attestation Violation	6,506,530	203,329	
26165	22260	10 days 13 hrs ago	Attestation Violation	6,433,214	201,037	
48608	553505	11 days 17 hrs ago	Attestation Violation	6,424,518	200,766	
48607	144422	11 days 20 hrs ago	Attestation Violation	6,423,764	200,742	
48609	169630	11 days 20 hrs ago	Attestation Violation	6,423,751	200,742	
459890	188013	41 days 11 mins ago	Attestation Violation	6,213,857	194,183	
459098	501282	41 days 11 mins ago	Attestation Violation	6,213,856	194,183	
459140	501282	41 days 11 mins ago	Attestation Violation	6,213,856	194,183	

Figure 35: Slashed validators. Beaconcha.in (24 May 2023)

Show 10 entries								
Rank	Index	Public Key	Balance	Income 1 day	Income 7 days	Income 31 days	Income 1 year	
1	187309	0xa2af8d...	32.1741 ETH	+0.04976 ETH	+0.31932 ETH	+0.38695 ETH	+1.60766 ETH	
2	482263	0xb66d21...	32.1408 ETH	+0.14362 ETH	+0.28783 ETH	+0.35538 ETH	+0.80752 ETH	
3	309298	0xa0591b...	32.0039 ETH	+0.00280 ETH	+0.28397 ETH	+0.35159 ETH	+1.79926 ETH	
4	513517	0xaed547...	32.2771 ETH	+0.04941 ETH	+0.28395 ETH	+0.35162 ETH	+0.60665 ETH	
5	540440	0xb2bed9...	32.1602 ETH	+0.00278 ETH	+0.28361 ETH	+0.35122 ETH	+0.49054 ETH	
6	338833	0xa5bdc0...	32.0032 ETH	+0.00277 ETH	+0.28297 ETH	+0.38394 ETH	+1.57859 ETH	
7	118247	0x8de57f...	32.1348 ETH	+0.00277 ETH	+0.27719 ETH	+0.37807 ETH	+1.60192 ETH	
8	559719	0xb178a5...	32.1412 ETH	+0.04829 ETH	+0.27689 ETH	+0.34082 ETH	+0.40748 ETH	
9	507023	0xa378ea...	32.2698 ETH	+0.00279 ETH	+0.27650 ETH	+0.37742 ETH	+0.63083 ETH	
10	210073	0xa64d69...	34.8922 ETH	+0.00277 ETH	+0.27600 ETH	+0.37651 ETH	+1.53077 ETH	

Showing 1 to 10 of 712,863 entries

First < 1 of 71287 > Last

**Figure 36:** Validator leaderboard - default listing order is by 7day income, but it is possible to display the order by income based on 1day, 31 days or 1 year. Beaconcha.in (24 May 2023)

This table displays the leaderboard for deposits made by Ethereum Addresses to the Deposit Contract												
Address												
Address	Total Deposited	Valid	Invalid	Pen	Att	Sla	Ex	Tot				
0xF82aC5...	4,850,560 ETH	151580	0	0	133098	11	0	150926				
0xa40dfE...	1,355,040 ETH	42345	0	0	23014	0	17612	42331				
0x8dD75A...	613,440 ETH	19170	0	0	14171	0	0	19170				
0xB049E2...	467,808 ETH	14619	0	0	14619	0	0	14619				
0xdd1927...	412,480 ETH	12890	0	0	12890	0	0	12890				
0xc2288B...	351,488 ETH	10984	0	0	10981	0	0	10981				
0xA76a7D...	319,232 ETH	9976	0	0	9976	0	0	9976				
0x004447...	244,448 ETH	7639	0	0	7639	0	0	7639				
0x5a0036...	221,889 ETH	6939	0	0	5498	0	334	6880				
0x1CeDC0...	207,360 ETH	6480	0	0	5200	0	0	6480				

Showing 1 to 10 of 105,551 entries

First < 1 of 10556 > Last

**Figure 37:** Leaderboard for deposits made by Ethereum addresses to the deposit contract - default order is by total amount deposited, but it is possible to display the order using any of the other columns shown in the table. Beaconcha.in (24 May 2023)



**Figure 38:** Visualisation of deposits since beaconchain genesis. Beaconcha.in (24 May 2023)

This table displays the deposits made on Ethereum for validators who wish to join the Beacon Chain.

Address	Validator Key	Withdrawal Credential	Amount	Tx Hash	Time	Block	Validator State	Valid Signature
0xa40dFE...	0x8182c8...	0x004f_...825c	32 ETH	0xfffff...	878 days 17 hrs ago	11531360	Exited	✓
0x74b142...	0xa8f64c...	0x009b_...f17	32 ETH	0xfffffae...	505 days 15 hrs ago	13935079	Active ⓘ	✓
0x89b48C...	0xa519e7...	0x00b9_...9cf9	32 ETH	0xfffffac...	663 days 14 hrs ago	12923243	Active ⓘ	✓
0x133058...	0xa6f5ac...	0x008d_...465a	32 ETH	0xfffff73...	456 days 22 hrs ago	14250193	Active ⓘ	✓
0x44894a...	0xaa4a72...	0x0100_...d65	32 ETH	0xfffff66...	11 days 21 hrs ago	17245128	Pending	✓
0xa40dFE...	0x9a0059...	0x004f_...825c	32 ETH	0xfffff51...	510 days 1 hr ago	13906660	Active ⓘ	✓
0x449dFE...	0xa62dcf...	0x004f_...825c	32 ETH	0xfffff51...	510 days 1 hr ago	13906660	Active ⓘ	✓
0xa40dFE...	0xa73de5...	0x004f_...825c	32 ETH	0xfffff51...	510 days 1 hr ago	13906660	Active ⓘ	✓
0xB15C29...	0xaea696...	0x00dd_...1ce6	32 ETH	0xfffff2c...	814 days 13 hrs ago	11949037	Active ⓘ	✓
0x91997f...	0xb542a...	0x001f_...751b	32 ETH	0xfffffe...	907 days 20 hrs ago	11341578	Active ⓘ	✓

**Figure 39:** Initiated deposits: table of the deposits made by validators wishing to join the beaconchain.. Beaconcha.in (24 May 2023)

This table displays the deposits made on Ethereum for validators who wish to join the Beacon Chain.

Address	Validator Key	Withdrawal Credential	Amount	Tx Hash	Time	Block	Validator State	Valid Signature
0x79f05c...	0x853ba9...	0x010f82c71	1ETH	0x78805...	931 days 19 hrs ago	11193311	Active ⓘ	✓
0x354a37...	0x1a1d1d...	0x010f92_dff91	1ETH	0x0a0d...	930 days 21 hrs ago	11191448	Active ⓘ	✓
0x354a37...	0x0d2ff47...	0x010f92_dadff	1ETH	0x14f1d1...	930 days 21 hrs ago	11191485	Active ⓘ	✓
0x354a37...	0x9d6d4e4...	0x010f92_d4ec4	1ETH	0x0e100...	930 days 21 hrs ago	11191501	Active ⓘ	✓
0x354a37...	0x8022321...	0x010f92_d4ec4	1ETH	0x0e100...	930 days 21 hrs ago	11191501	Active ⓘ	✓
0x354a37...	0x8022420...	0x010f92_d7fb	1ETH	0x0e0c575...	930 days 20 hrs ago	11191912	Active ⓘ	✓
0xf1f181c...	0x82202ef...	0x010f94_...7771	32 ETH	0x04040...	930 days 20 hrs ago	11191526	Active ⓘ	✓
0x22f474e...	0x1a161d3...	0x010f92_d2674	32 ETH	0x080a7b...	930 days 20 hrs ago	11191638	Active ⓘ	✓
0x650441c...	0x1e25011...	0x010f92_d2949	32 ETH	0x07080...	930 days 20 hrs ago	11191701	Active ⓘ	✓
0xf1f181c...	0x808707...	0x010f92_d2949	32 ETH	0x090500...	930 days 20 hrs ago	11191703	Active ⓘ	✓
0xf1f181c...	0x801014...	0x010f92_d2949	32 ETH	0x090500...	930 days 20 hrs ago	11191703	Active ⓘ	✓

This table displays the deposits made on Ethereum for validators who wish to join the Beacon Chain.

Address	Validator Key	Withdrawal Credential	Amount	Tx Hash	Time	Block	Validator State	Valid Signature
0xf1f181c...	0x825c7...	0x010f92_d238	1ETH	0x07080...	30 days 31 mins ago	17193321	Pending	✓
0x6fd156...	0x8545f...	0x010f92_d7a8	1ETH	0x07080...	12 days 7 hrs ago	17242122	Pending	✓
0x742910...	0x80334...	0x010f92_d981	1ETH	0x07080...	30 days 27 mins ago	17163338	Active ⓘ	✓
0x851548...	0x846a2c...	0x010f92_d20e	1ETH	0x07080...	30 days 25 mins ago	17163348	Active ⓘ	✓
0x81554c...	0x846a2c...	0x010f92_d20e	1ETH	0x07080...	10 days 9 hrs ago	17235581	Deposited	✓
0x6fd156...	0x85399...	0x010f92_d703	1ETH	0x07080...	12 days 7 hrs ago	17242159	Pending	✓
0x1f52e...	0x87273...	0x010f92_d391	1ETH	0x07080...	9 days 14 hrs ago	17201142	Deposited	✓
0x640a02...	0x802271...	0x010f90_d340	1ETH	0x07080...	13 days 10 hrs ago	17234234	Pending	✓
0x42d102...	0x894ea...	0x010f90_d499	1ETH	0x07080...	30 days 22 mins ago	17193365	Active ⓘ	✓
0x6fd156...	0x8545f...	0x010f92_d168	1ETH	0x07080...	12 days 7 hrs ago	17242137	Pending	✓

(a)

(b)

**Figure 40:** Table of deposits ordered by time (a) and by amount deposited (b). Beaconcha.in (24 May 2023)

This table displays the deposits received by the Ethereum Beacon Chain.

Slot	Validator Key	Amount	Withdrawal Credentials	Signature
6,507,566	0xb7d1c7...	32 ETH	0x0100...adb5	0xaf5e...1048
6,507,566	0x83400c...	32 ETH	0x0100...a0d7	0xaac6...29d3
6,507,566	0x827851...	31 ETH	0x0100...2078	0xa553...327f
6,507,566	0x834c9c...	31 ETH	0x0100...7849	0xb5cc...c514
6,507,565	0xa64328...	32 ETH	0x0100...a81c	0x99fc...9673
6,507,565	0x882e17...	32 ETH	0x0100...a81c	0xb1a8...cd61
6,507,565	0xb79537...	32 ETH	0x0100...a81c	0xb63...d77a
6,507,565	0xb229c0...	32 ETH	0x0100...a81c	0x9073...776f
6,507,565	0xa3fea5...	32 ETH	0x0100...a81c	0x88e6...6ab6
6,507,565	0xb0473b...	32 ETH	0x0100...a81c	0x875c...13d3

Showing 1 to 10 of 734,155 entries

First < 1 of 73416 > Last

**Figure 41:** Included deposits: table of the deposits received by the beaconchain. Beaconcha.in (24 May 2023)



**Figure 42:** Histogram of processed withdrawals. Beaconcha.in (24 May 2023)

This table displays partial and full withdrawals.

Epoch	Slot	Index	Validator	Time	Address	Amount
203,416	6,509,332	4712767	492631	10 secs ago	0xD530d4_eD53FC	0.012949 Ether
203,416	6,509,332	4712766	492629	10 secs ago	0x91b9f0_20FE3D	0.012968 Ether
203,416	6,509,332	4712765	492628	10 secs ago	0xD530d4_eD53FC	0.012925 Ether
203,416	6,509,332	4712764	492627	10 secs ago	0xD530d4_eD53FC	0.012960 Ether
203,416	6,509,332	4712763	492626	10 secs ago	0xD530d4_eD53FC	0.012968 Ether
203,416	6,509,332	4712762	492625	10 secs ago	0xD530d4_eD53FC	0.012904 Ether
203,416	6,509,332	4712761	492624	10 secs ago	0xD530d4_eD53FC	0.012943 Ether
203,416	6,509,332	4712760	492623	10 secs ago	0xD530d4_eD53FC	0.012916 Ether
203,416	6,509,332	4712759	492622	10 secs ago	0xD530d4_eD53FC	0.012946 Ether
203,416	6,509,332	4712758	492621	10 secs ago	0xD530d4_eD53FC	0.012965 Ether

Showing 1 to 10 of 4,712,767 entries

First < 1 of 471277 > Last

**Figure 43:** Table of partial and full withdrawals. Beaconcha.in (24 May 2023)

This table displays the BLS address changes from 0x00 credentials to 0x01.

Epoch	Slot	Validator	Signature	BLS Public Key	New Withdrawal Address
203,410	6,509,142	21828	0x8dac_76da	0x8d25_c3cf	0x00B292_6bd404
203,406	6,509,008	34389	0x8951_63b9	0xa4b2_523d	0xC0FFEE_Fcc4CD
203,406	6,509,008	34375	0x8922_c529	0xa2b6_30e2	0xC0FFEE_Fcc4CD
203,406	6,509,008	3000	0xa2c9_edff	0xb369_12cf	0xC0FFEE_Fcc4CD
203,406	6,509,008	2999	0xac3a_e137	0xadaa_947e	0xC0FFEE_Fcc4CD
203,406	6,509,002	131273	0x8720_85e5	0xf65_cd83	0xFACbEb_76e38E
203,403	6,508,919	91180	0x95d8_bbdd	0xb728_9230	0xFACbEb_76e38E
203,391	6,508,526	205643	0xa5d4_e51a	0x96ff_171c	0x6F1cb7_150604
203,387	6,508,388	123865	0xae8d_ece3	0x8188_ea89	0x9Ee7bc_B6fffc5
203,379	6,508,136	1581	0xa202_81d5	0x8449_c301	0x3C6621_D188f9

Showing 1 to 10 of 270,143 entries

First < 1 of 27015 > Last

**Figure 44:** Table displaying the BLS address changes from 0x00 credentials to 0x01. Beaconcha.in (24 May 2023)

The screenshot shows the Beaconcha.in Validator dashboard. On the left, there's a search bar and a list of validators with their indices (70, 965, 22221, 353910) and balance (0 ETH). On the right, there are two sections: 'Summary' and 'History'. The 'Summary' section provides a quick overview of rewards and balance over different timeframes. The 'History' section shows a detailed log of rewards and events for epoch 24, with entries for epochs 144,557 through 144,550.

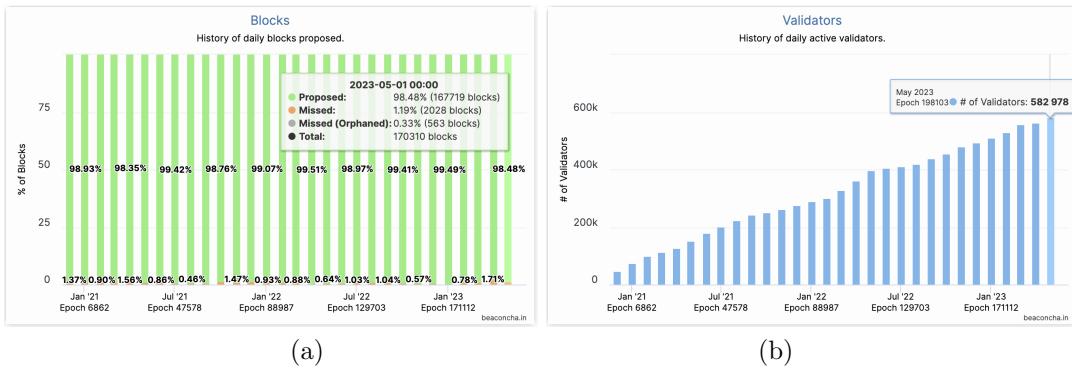
Epoch	Rewards	Events
144,557	-11,020 GWei	Miss.
144,556	-11,020 GWei	Miss.
144,555	-11,020 GWei	Miss.
144,554	-11,020 GWei	Miss.
144,553	-11,020 GWei	Miss.
144,552	-11,020 GWei	Miss.
144,551	+14,798 GWei	Att.
144,550	+14,755 GWei	Att.

**Figure 45:** Validator dashboard - add the validators of interest to the search bar. In this example we added three validators: one active, one voluntary exited and one slashed validator. Beaconcha.in (24 May 2023)

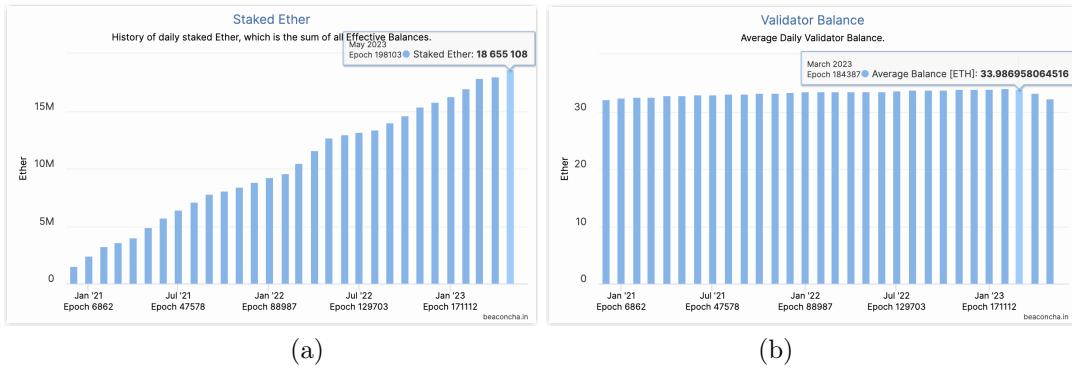
The screenshot shows the Beaconcha.in Correlations page. It features a dropdown menu for selecting X and Y variables. The X Variable dropdown is open, showing options like AVG\_BLOCK\_UTIL, AVG\_GASLIMIT, AVG\_GASPRICE, AVG\_GASUSED, and BLOCK\_COUNT. The Y Variable dropdown is also open, showing AVG\_BLOCK\_UTIL. There are fields for Start Date (24/05/2023) and End Date (24/05/2023), and a 'Generate Chart' button.

**Figure 46:** It is possible to generate correlation visualisations between several variables. Beaconcha.in (24 May 2023)

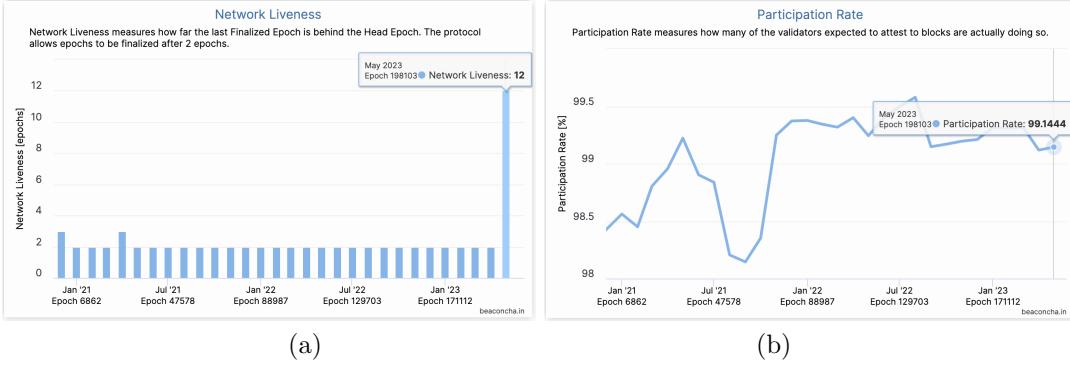
## Consensus Layer Charts



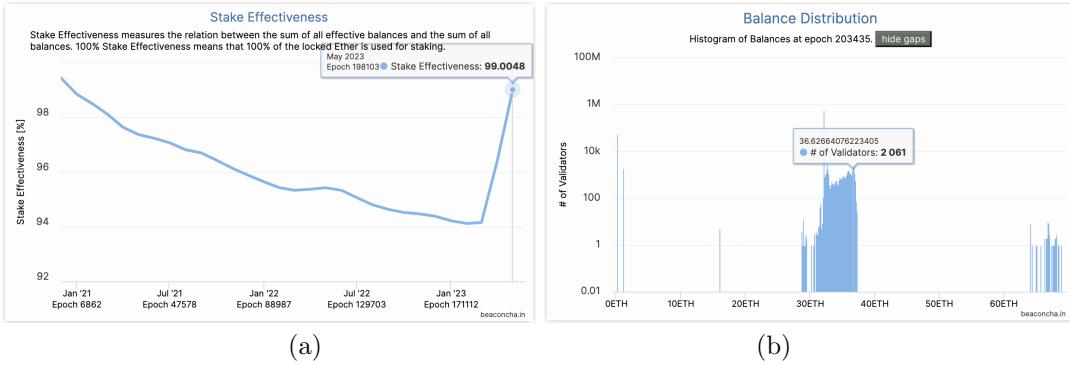
**Figure 47:** History of daily blocks proposed (a) and daily active validators (b) from Beaconcha.in (24 May 2023)



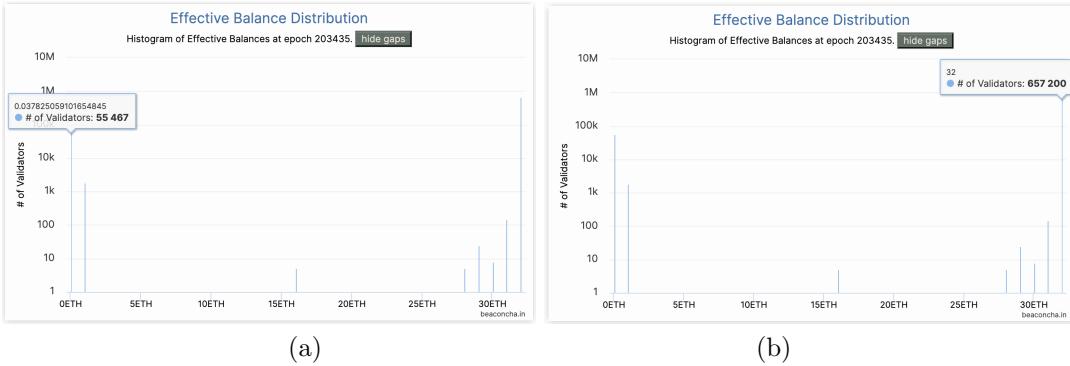
**Figure 48:** History of daily staked Ether (sum of all effective balances) (a) and average daily validator balance (b) from Beaconcha.in (24 May 2023)



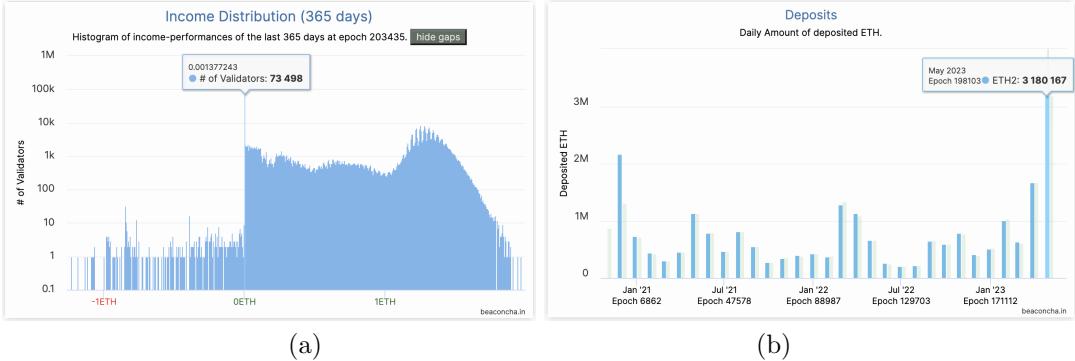
**Figure 49:** Network liveness (measures how far the last finalised epoch is behind the head epoch. The protocol allows epochs to be finalised after 2 epochs) (a) and participation rate (measures how many of the validators expected to attest to blocks are actually doing so) (b) from Beaconcha.in (24 May 2023)



**Figure 50:** Stake effectiveness (measures the relation between the sum if all effective balances and the sum of all balances. 100% stake effectiveness means that 100% of the locked ETH is used for staking) (a) and balance distribution (b) from Beaconcha.in (24 May 2023)



**Figure 51:** Effective balance distribution showing information on the lowest balance - 0.04ETH (a) and for 32 ETH (b) from Beaconcha.in (24 May 2023)



**Figure 52:** Income distribution for the last 365 days (a) and Daily amount of deposited ETH on the consensus layer (b) from Beaconcha.in (24 May 2023)



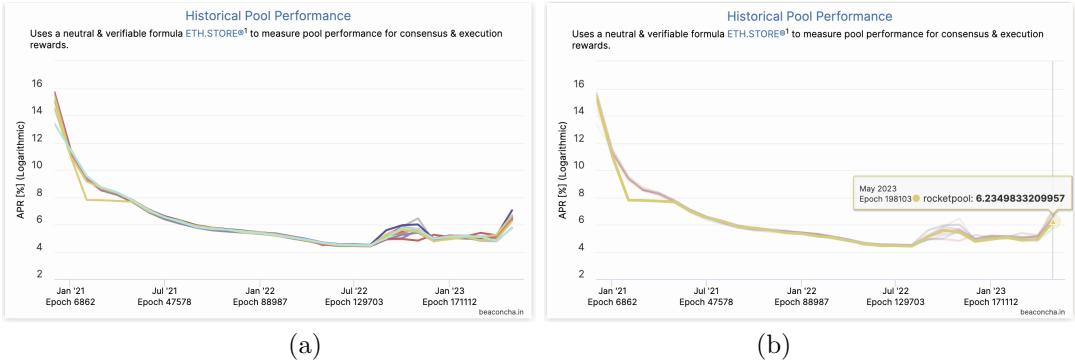
**Figure 53:** Daily amount of deposited ETH on the execution layer (a) and a graffiti word cloud of the 25 most occurring graffities (b) from Beaconcha.in (24 May 2023)



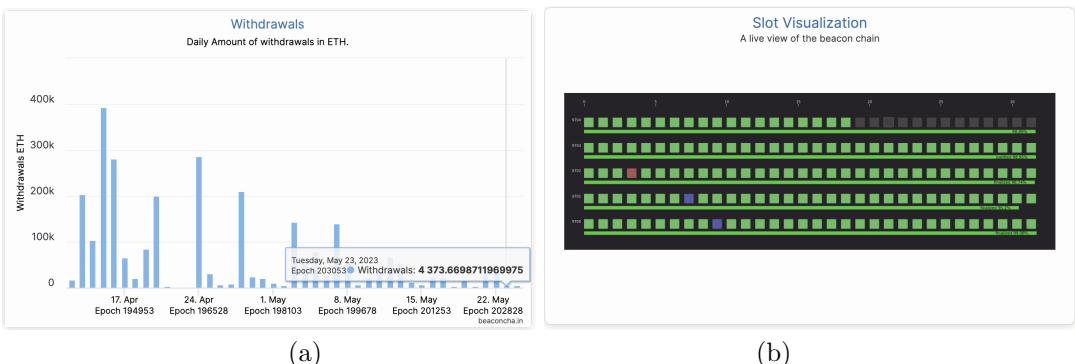
**Figure 54:** Validator distribution by staking pool (a) and honing in on the proportion of validators not allocated to a known staking pool (b) from Beaconcha.in (24 May 2023)



**Figure 55:** Validator distribution by staking pool showing the Lido pool (a) and Rocketpool (b) from Beaconcha.in (24 May 2023)

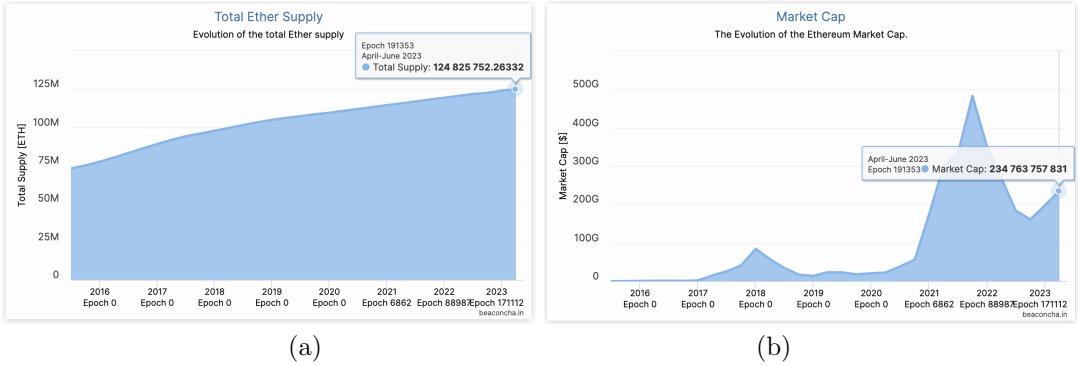


**Figure 56:** Historical pool performance (a) and honing in on Rocketpool preformance (b) from Beaconcha.in (24 May 2023)

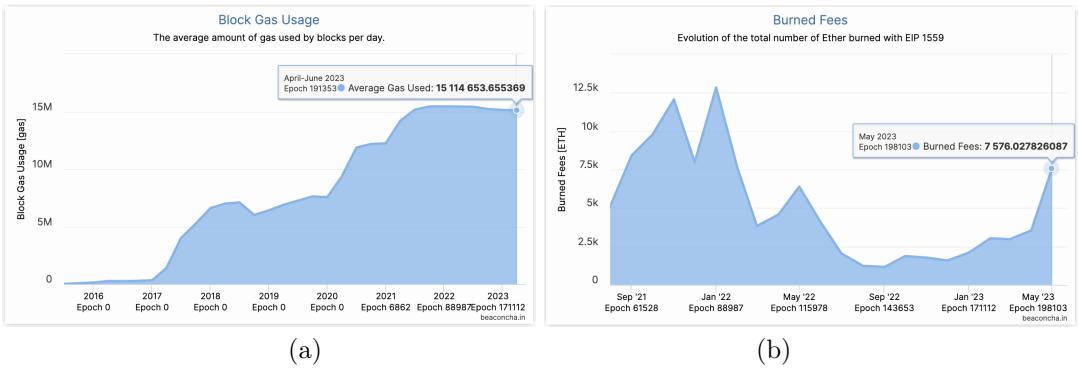


**Figure 57:** Daily amounts of withdrawals (a) and slot visualisation (click on the diagram for more detail) (b) from Beaconcha.in (24 May 2023)

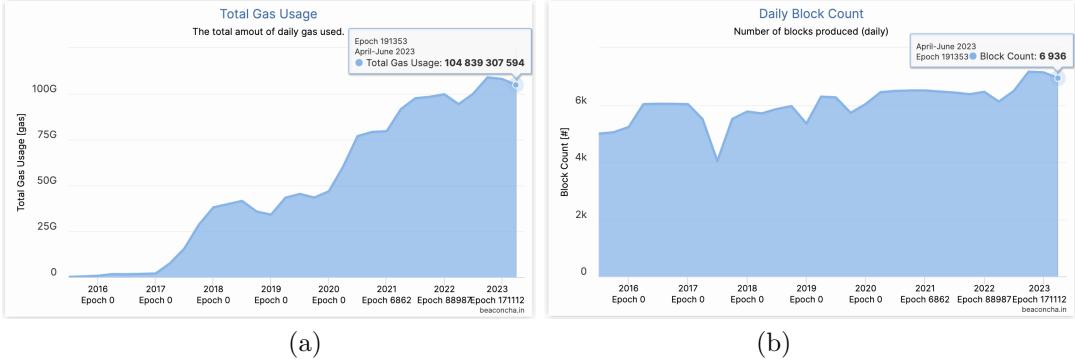
## Execution layer charts



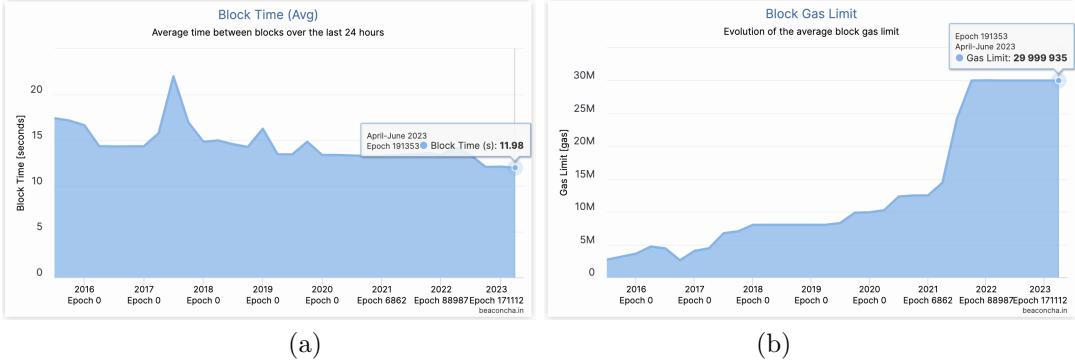
**Figure 58:** Evolution of total ether supply (a) and of the Ethereum market capitalisation (b) from Beaconcha.in (24 May 2023)



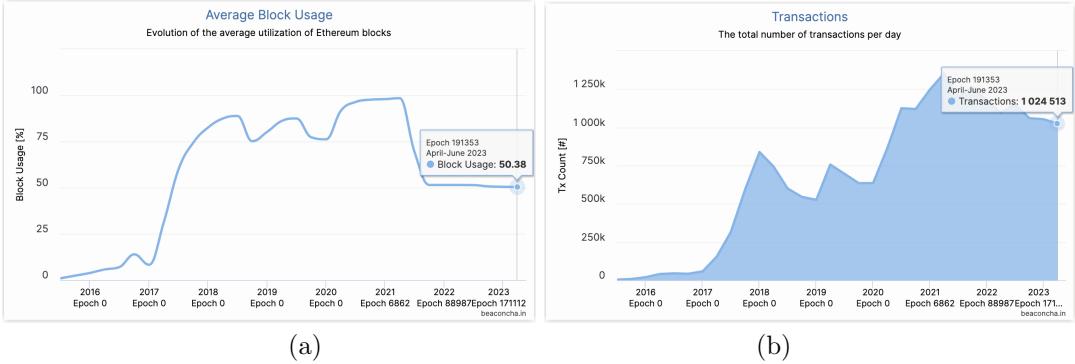
**Figure 59:** The average amount of gas used by blocks per day (a) and the evolution of the total amount of Ether burned with EIP1559 (b) from Beaconcha.in (24 May 2023)



**Figure 60:** The daily total amount of gas used (a) and the number of blocks produced daily (b) from Beaconcha.in (24 May 2023)



**Figure 61:** Average time between blocks over the last 24 hours (a) and the evolution of the average block gas limit (b) from Beaconcha.in (24 May 2023)



**Figure 62:** Evolution of the average utilisation of Ethereum blocks (a) and the total number of transactions per day (b) from Beaconcha.in (24 May 2023)