TRANSITION FROM PROOF-OF-WORK TO PROOF-OF-STAKE BLOCKCHAINS: WHY IT MATTERS MORE THAN EVER?

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Motivation and Aim

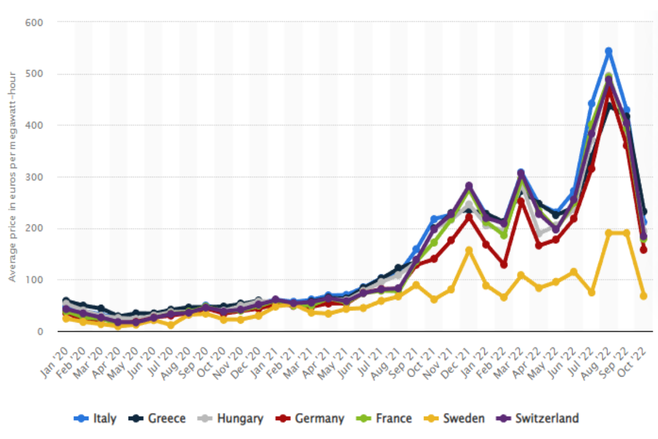
Blockchain and underlying distributed ledger technology attracted widespread attention recently due to its **transparency, decentralisation,** and **security** properties. It still faces **many challenges** that have to be solved.

The most **important current challenges** are:

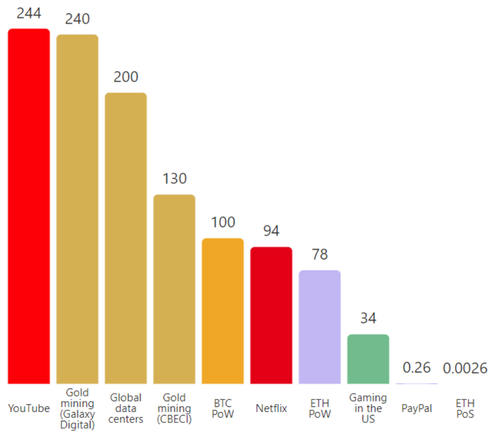
1. The enormous **energy consumption of Bitcoin and other Proof-of-Work (PoW) based blockchain networks.**
2. The **global energy crisis.**

Ranking of Bitcoin and Ethereum among countries based on annual electrical energy consumption as of July 2021 [Kohli, et al., 2022]

Rank	Country	Population (Millions)	Energy (TWh)	Share (%)
0	World	7,878.2	23,398.00	100.00
1	China	1,444.9	7,500.00	32.05
2	U.S.A	332.9	3,989.60	17.05
3	India	1,366.4	1,547.00	6.61
20	Taiwan	23.8	237.55	1.01
21	Vietnam	98.2	216.99	0.92
22	South Africa	60.1	210.30	0.89
23	**Bitcoin + Ethereum**	**N.A.**	**190.13**	**0.81**
24	Thailand	69.9	185.85	0.79
25	Poland	37.80	153.00	0.65
26	Egypt	104.3	150.57	0.64
27	Malaysia	3.1	147.21	0.62
28	**Bitcoin**	**N.A.**	**135.12**	**0.57**
29	Sweden	10.2	131.79	0.56
49	Switzerland	8.7	56.35	0.24
50	**Ethereum**	**N.A.**	**55.01**	**0.24**
51	Romania	19.1	55.00	0.23



Electricity price dynamic in 2020-2022 [Alves, 2022]

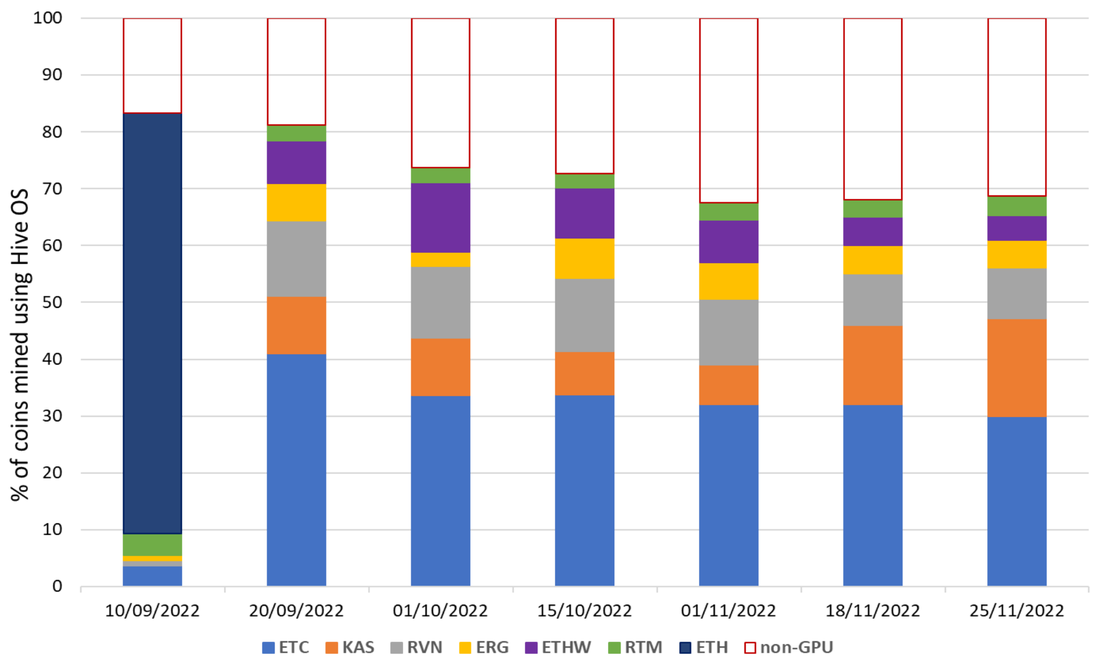


Annual energy consumption (TW/yr) by various industries [Ethereum community, 2022]

- Accurately estimating blockchains' energy consumption is more relevant than ever.
- **The main aim of this work is to propose a general and precise methodology for PoW-based blockchain energy consumption estimation.**

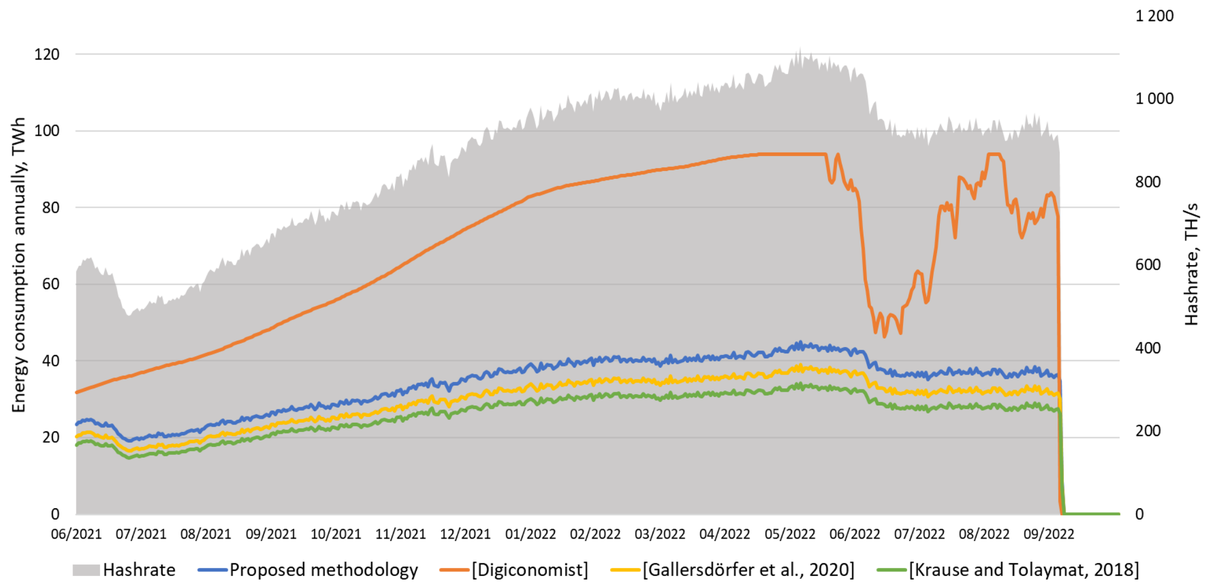
Proposed Methodology

- It is based on **continually updated statistics** provided by **Hive OS** on the use of various **GPUs for mining**.
- It considers **actual equipment utilized for mining**, **unlike** other methodologies that assume that **only profitable equipment** is involved in the mining process.



GPU-based blockchains mining distribution before and after Ethereum transition to Proof-of-Stake (PoS) [Hive OS statistics, 2022]

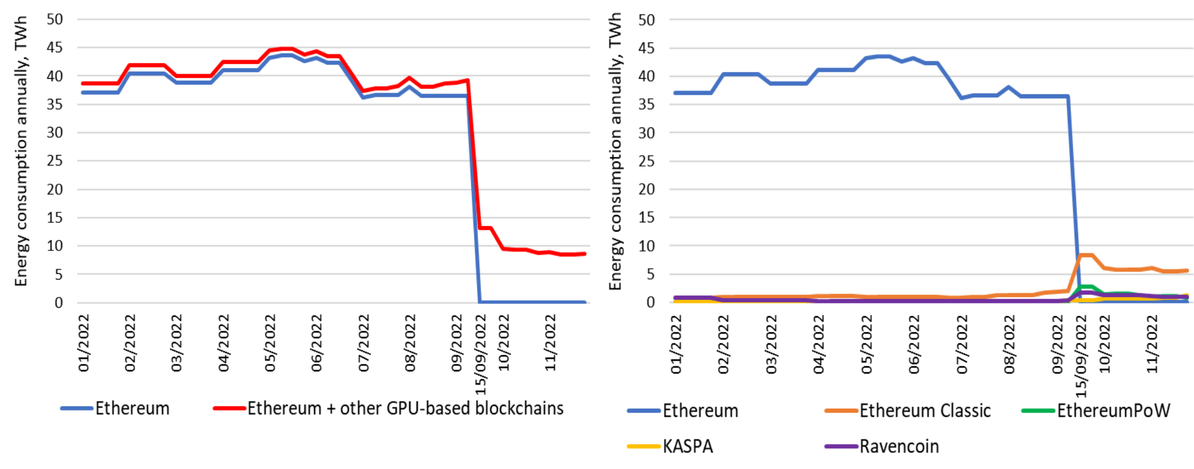
Comparison of the Ethereum network energy consumption estimation with different approaches



Ethereum network energy consumption estimation using different methodologies

Impact of the Ethereum network transition to Proof-of-Stake

- On **09/15/2022,** the **Ethereum network moved from PoW to PoS**.
- This caused a **transformation in the mining power distribution** and **energy consumption** of all mining-based blockchains.
- We use our proposed methodology to **demonstrate the impact on the remaining major GPU-based blockchains**.



Energy consumption of GPU-based networks before and after Ethereum transition to PoS

- **After the Ethereum network transitioned to PoS,** the energy consumption of other GPU-based blockchain networks increased.
- However, the **total energy utilized for mining on GPUs decreased drastically**.

Conclusions

- The **proposed methodology estimates energy consumption more realistically** and precisely.
- Using our methodology, it was shown that Ethereum's **transition to PoS caused a significant decrease in energy consumption** on GPU-based mining.
- Our **methodology could be adapted for any PoW-based blockchain** network.

Acknowledgment

This research has received funding from the Research Council of Lithuania (LMTLT), agreement No. S-MIP-21-53.

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