



# Beyond Proof-of-Work: Energy Consumption of Blockchain Systems

# SnT - Interdisciplinary Centre for Security, Reliability and Trust

## PEOPLE



**365**  
workforce



**66**  
nationalities



**36%**  
alumni who stay  
in Luxembourg

## PARTNERSHIPS & INNOVATION



**43%**  
of Doctoral  
candidates on  
Industrial projects



**56**  
partners



**8M**  
Partners annual  
contribution in Euros



**5**  
Spin-offs



# Prof. Dr. Gilbert Fridgen



Since 2020: PayPal-FNR PEARL **Chair in Digital Financial Services**, SnT - Interdisciplinary Centre for Security, Reliability and Trust, University of Luxembourg

2013 to 2019: **Professor for Information Systems Engineering and Sustainable IT Management**, University of Bayreuth

2013 to 2019: **Deputy Director**, Project Group Wirtschaftsinformatik, **Fraunhofer Institute for Applied Information Technology** and FIM  
Research Center Finance & Information Management



- Delegate to the **EBP Technical Group**



- Member of the Academic Advisory Board of **INATBA**



- **Horizon 2020** funding to explore DLT within a data market for medical device testing data – MDOT – Medical Device Obligations Taskforce



- Involved in the largest German DLT project in the public sector with the **German Federal Office for Migration and Refugees**



- First author of the expert report *Opportunities and Challenges of DLT (Blockchain) in Mobility and Logistics*, funded and published by the **German Federal Ministry for Transport and Digital Infrastructure**



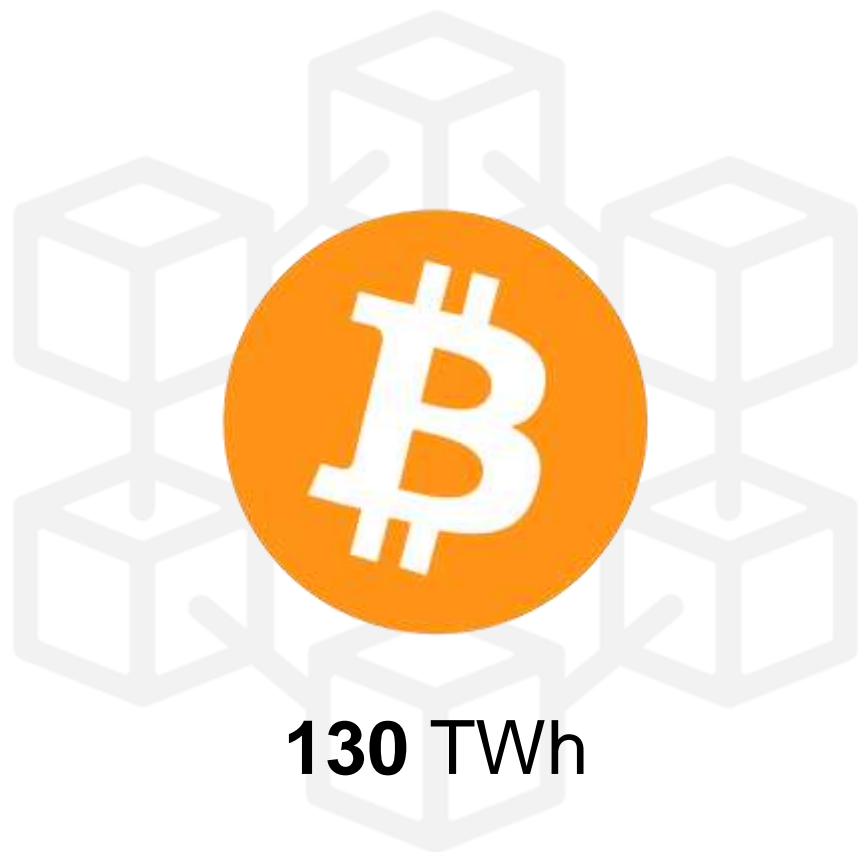
- Co-author of the expert report *Digital & Verifiable Credentials for Luxembourg* for the **Luxembourg's Ministry for Digitalisation**





# Beyond Proof-of-Work: Energy Consumption of Blockchain Systems

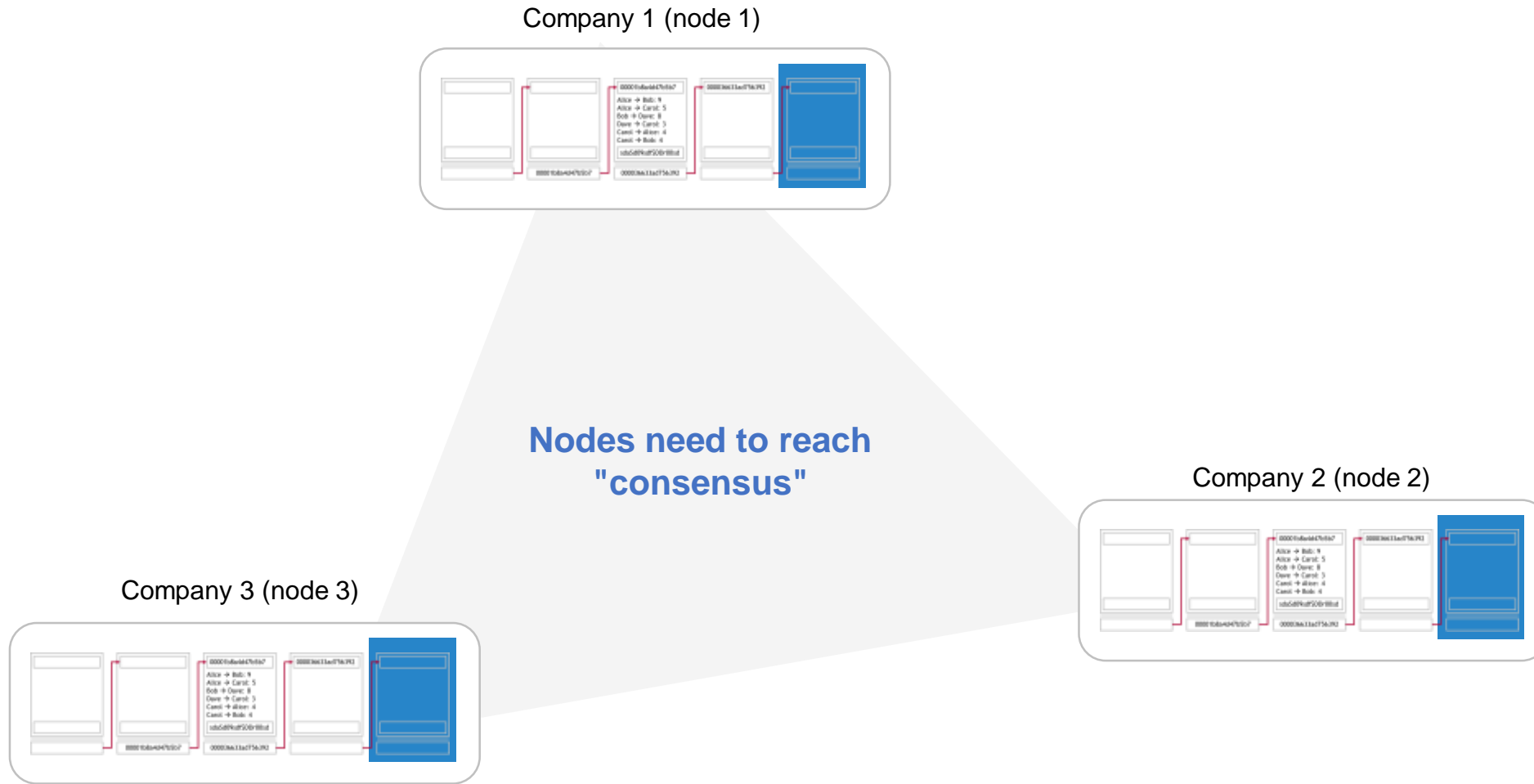
## Bitcoin's annual energy consumption (currently) exceeds Argentina's



**120 TWh**








# What is a consensus mechanism?

Consensus mechanism ensures that distributed actors agree on a single point of truth

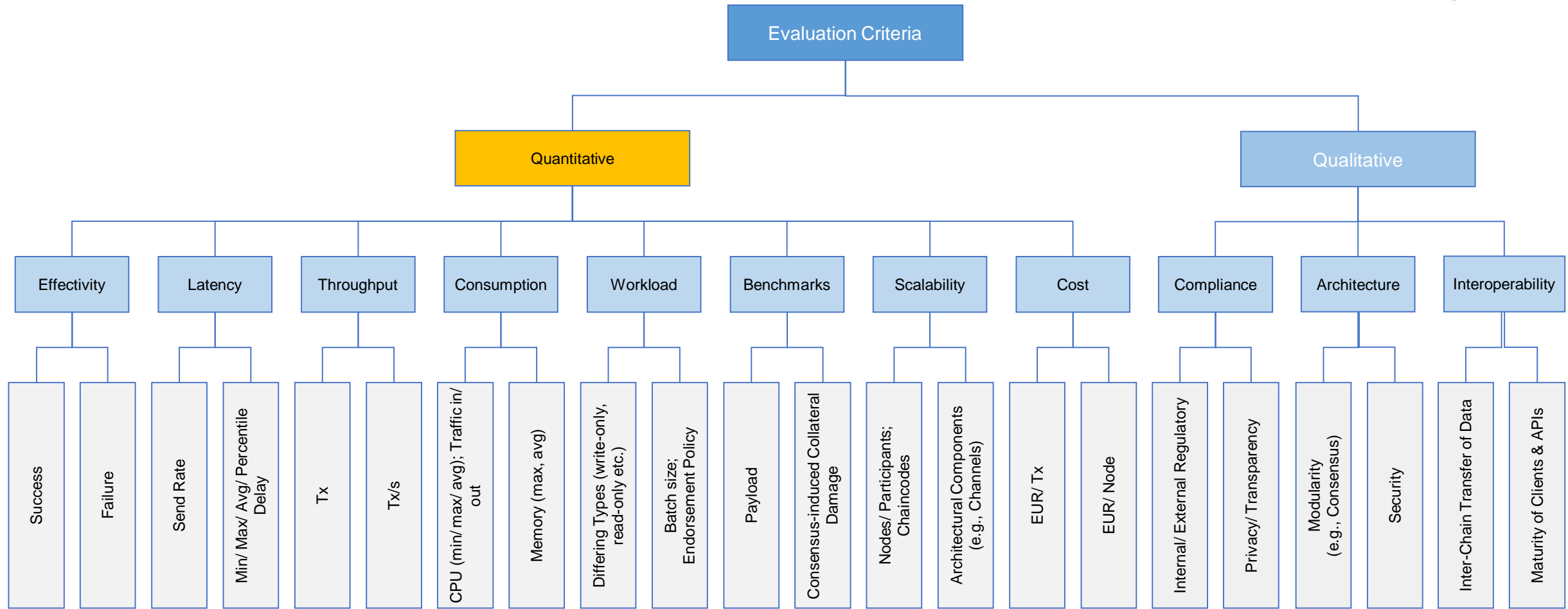


# There are alternative consensus mechanisms

Validation is linked to scarcity of a resources

Consensus mechanism	Resource	Example
Proof-of-Work	Energy (transformed into computing power)	 
Proof-of-Stake	Cryptocurrencies / tokens (as deposit)	  
Proof-of-Authority	Validator's identifier	 

# The Distributed Ledger Performance Scan (DLPS)





# DLPS supported blockchains



open  
ethereum

Ethereum Geth

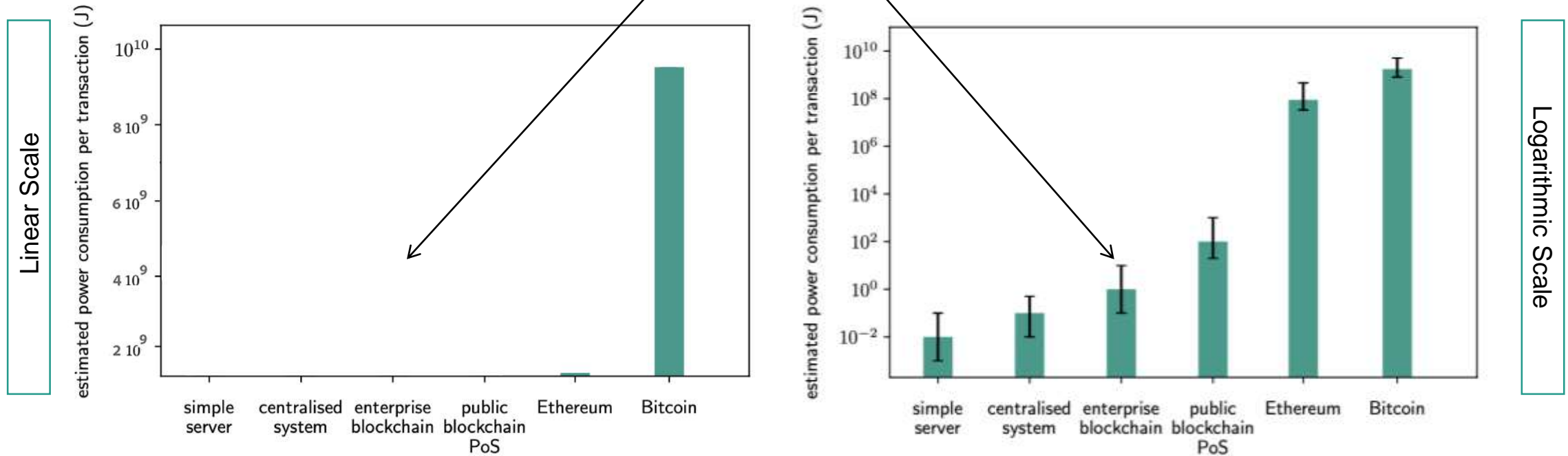


more to come...

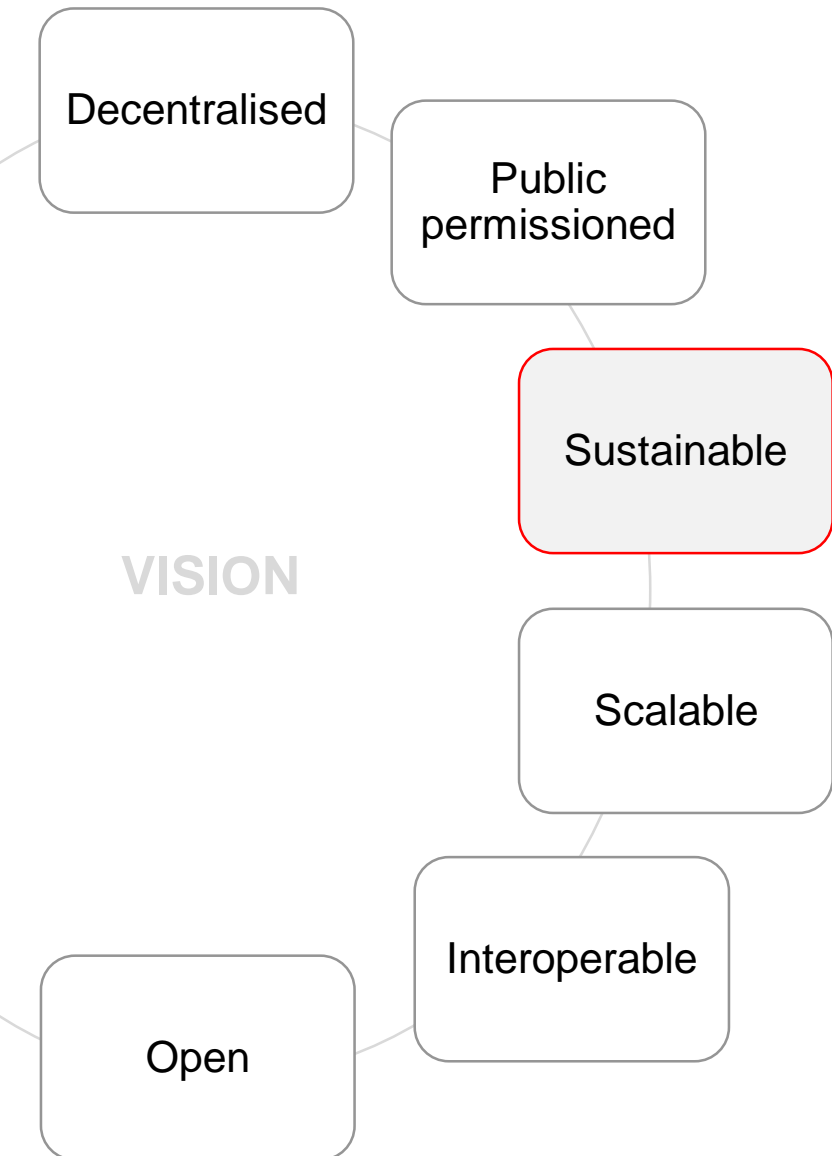
# Comparison of the order of magnitude of energy consumption per transaction for different architectures



European Blockchain Services Infrastructure



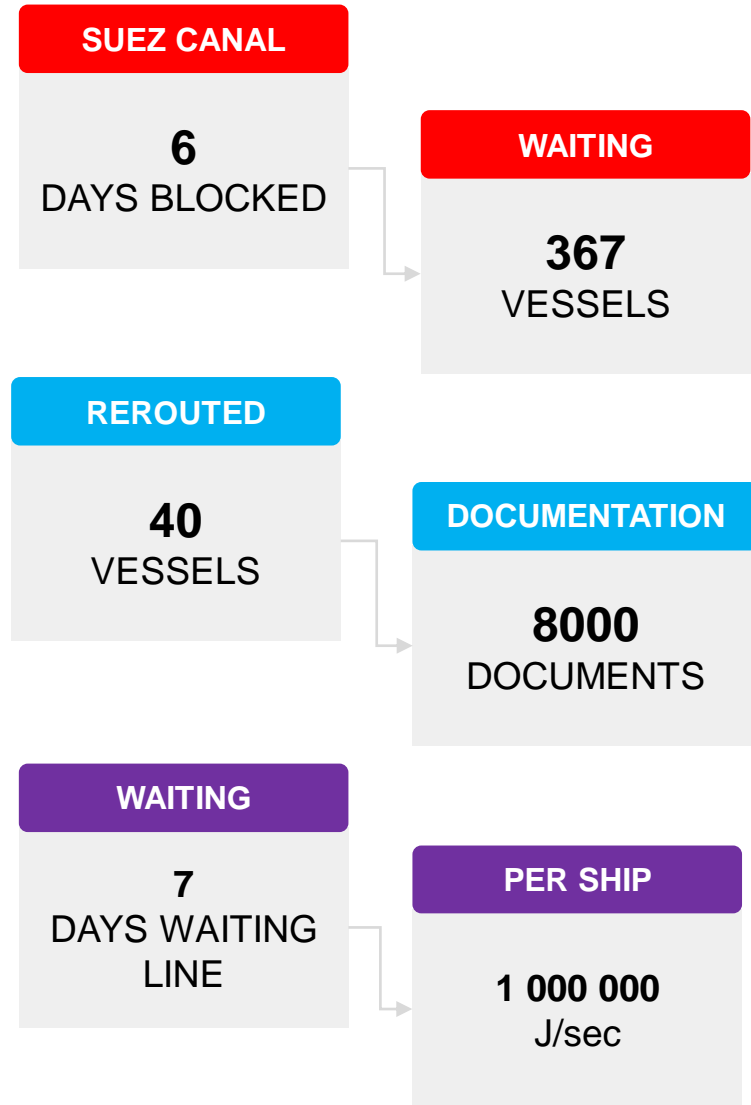
# Objective of the European Blockchain Services Infrastructure



“EBSI should give a positive contribution to the targets indicated by the Energy Efficiency Directive, thus should not use excessive amount of electricity for its operation; the **system shall not therefore have consensus mechanisms** directly or indirectly based on energy consumption as the ones today **based on Proof of Work.**”

*EBSI High Level Specifications*

# Ever Given blocks the Suez Canal



# TradeLens – energy consumption is a fraction of energy savings



	Best Case	Average Case	Worst case
J/s Per node	100	150	500
Number of Nodes	10	10	20
Total energy consumption J/s	1000	1500	10000
Compared to <b>one ship in harbour</b>	1000x smaller	667x smaller	100x smaller





## Interdisciplinary Centre for Security, Reliability and Trust

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