THE "BURN-TO-EARN" INDEX

THE GLOBAL DIGITAL ECONOMY'S ECONOMIC AND ENVIRONMENTAL IMPACT AND TRADEOFFS

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Preliminary Insights Deck

Overview

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  - However, its expansion has environmental consequences—most notably in the form of rising energy consumption, CO_2e emissions, and electronic waste
- This study seeks to answer several questions:
  - What is the impact of the economic growth associated with the digital economy and its environmental footprint and what are the tradeoffs?
  - Which countries are better at managing this tradeoff – and why?
  - Does a country's advanced digitalization lead to increased digital economic gains and reduced emissions?
  - What actions can governments and businesses take to manage the tradeoff and build greater trust in the coming generations of digital innovations?

Decision Implications for Governments and Businesses

- Which digital activities enhance productivity and economic growth? How can they be catalyzed? How do these vary across different economies?
- Should companies and countries invest in green data center technologies, establish the next set of expansions of their digital supply chains in regions with a greener energy mix or invest in more efficient computing architectures? Should countries explore nuclear energy as a way out as the growth of data centers is inevitable given the growing needs of AI?
- Are there changes in user behavior that can be encouraged by raising awareness of the economic-environmental tradeoffs?
- Can companies and countries establish a differentiated brand equity and competitive advantage by taking action to get to a better balance on the tradeoff?
- Can governments and businesses reach better agreements on emissions limits or how much energy to consume or where to locate their digital supply chains with such information on hand and make decisions with an understanding of the tradeoffs and other factors in mind? These could include cost, regulations, ability to move data across borders, reliability of the infrastructure, proximity to users, etc.
- If there are constraints in one country, because of limits placed on emissions or data protection laws, costs or other considerations, where else can a company locate parts its digital supply chain (e.g., the next tranche of data centers)?

Introducing the Burn-to-Earn Index

- The digital economy encompasses all economic activities driven by digital technologies, including the internet, mobile devices, cloud computing, semiconductors, and digital platforms. It constitutes a dynamic ecosystem involving industries, businesses, workers, and consumers engaged in activities such as e-commerce, digital media, online services, and digital innovation.
    - Despite its significance, there is no universally accepted method for measuring the economic value of the digital economy – or its environmental impact. Existing efforts—such as those by the OECD (2022), United Nations (2023), and various national statistical agencies—have primarily focused on individual countries or specific sectors.

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- This study introduces a comprehensive and standardized framework for evaluating the digital economy's dual impact worldwide: its contribution to economic growth and its environmental footprint.
- It introduces the **Burn-to-Earn Index**—that calculates the carbon dioxide equivalent (CO_2e) emissions generated per digital economy dollar produced. It allows a direct comparison of how efficiently 126 economies are converting digital activity into economic value while managing environmental costs.

Measuring the Value of the Digital Economy

A consistent and comprehensive framework is essential to evaluate the digital economy's contributions. This study defines the digital economy as a system comprising:

Hardware and Enabling Infrastructure
Communications, Data Centers, Devices, Semiconductors, DPI*

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Digital Platforms

E-commerce; Digital Media and Advertising: (music, e-publishing, video games, video streaming, etc.)
Digital Health: (fitness and well-being, treatment and care, etc.);
Other Service Platforms: (dating, event tickets, education, gambling, etc.)

Hardware and Enabling Infrastructure

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Value-added Services and Solutions
IT Services, Software, Fintech, Public Cloud,
Cybersecurity, Internet of Things, Robotics

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Measuring Emissions from the Digital Economy

Sources of emissions from the digital economy

Three primary sources of carbon dioxide emissions from the digital economy:

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Sources of emissions from the digital economy

Three primary sources of carbon dioxide emissions from the digital economy:

Within each of the above three sources, there are two main emissions types

Operational emissions attributed to the use of digital services

+

Embodied emissions attributed to the creation of infrastructure

=

Total Emissions

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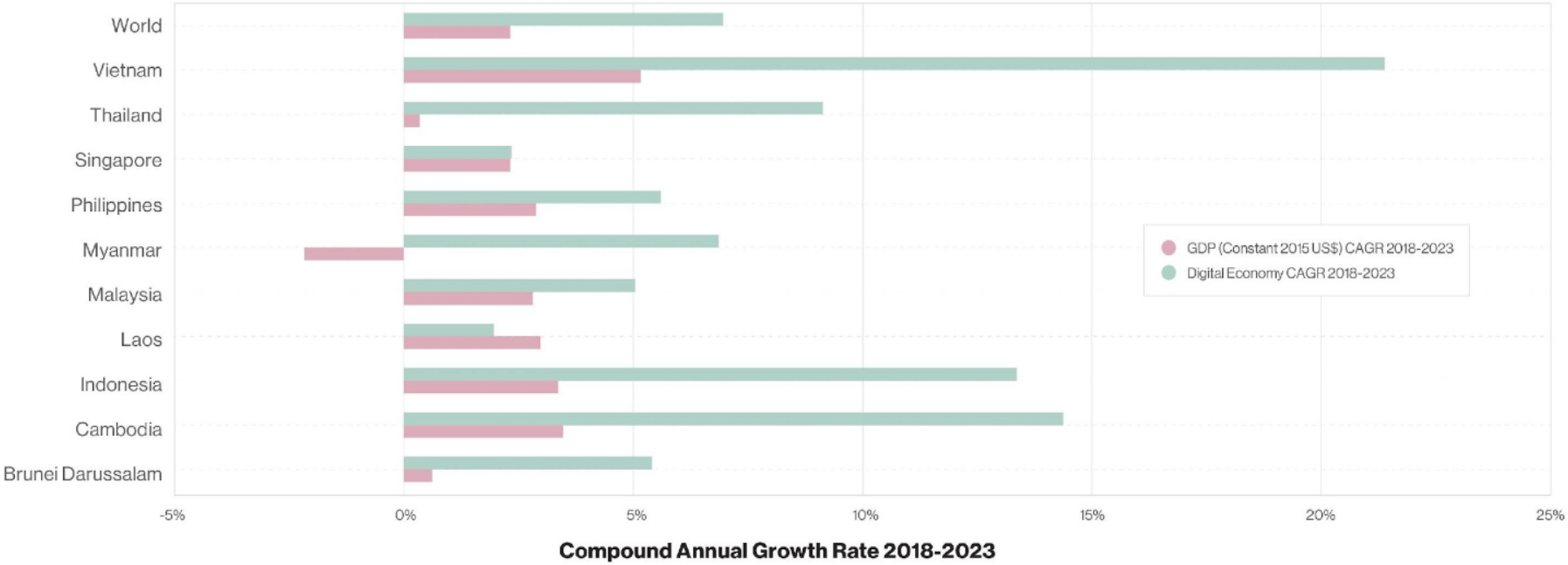
- **Insight 7:** Countries vary widely in their ability to manage emissions while growing their digital economies. The Burn-to-Earn Index offers a powerful way to assess this, enabling governments and companies to benchmark performance, set targets, and strategically adapt their digital and energy infrastructures

Executive Summary of Insights

Insight 1: Digital economies are growing 3X faster than overall GDP, making digitalization a key lever for turbo-charging economic growth



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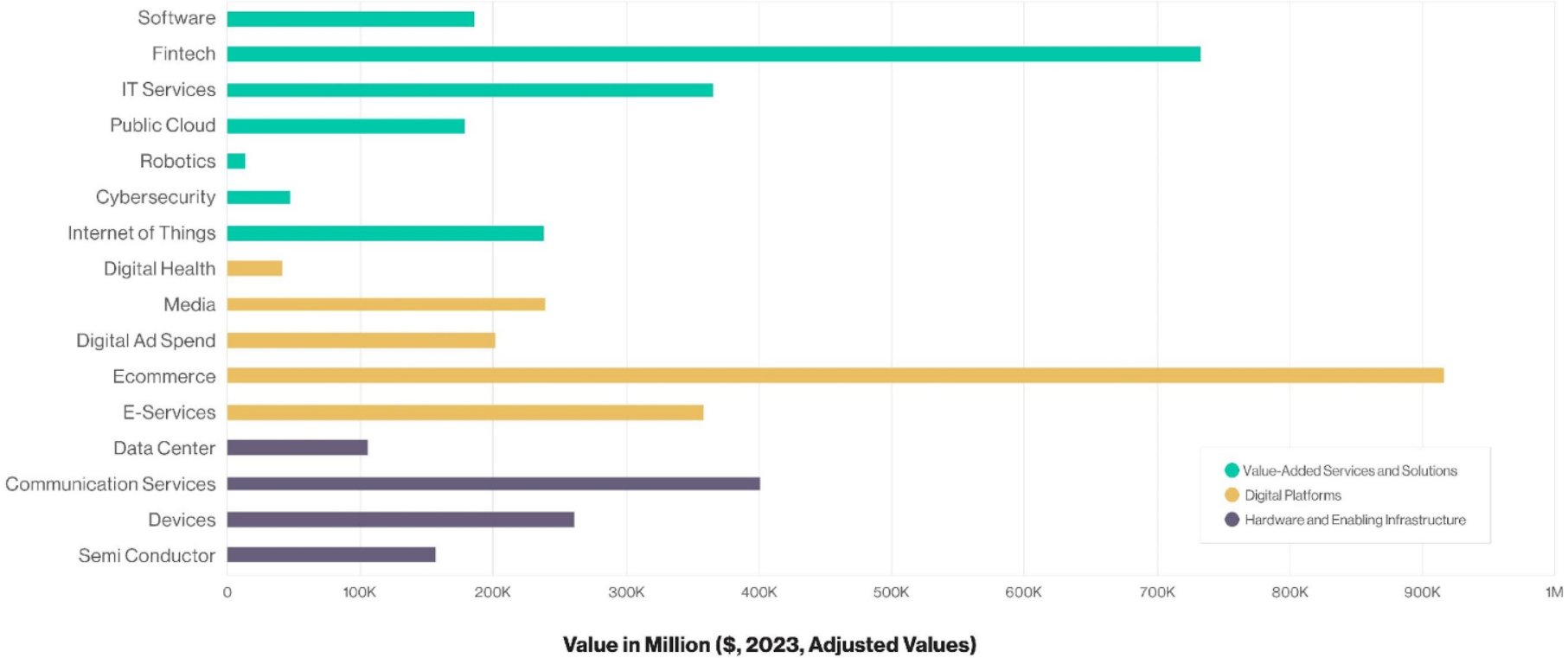

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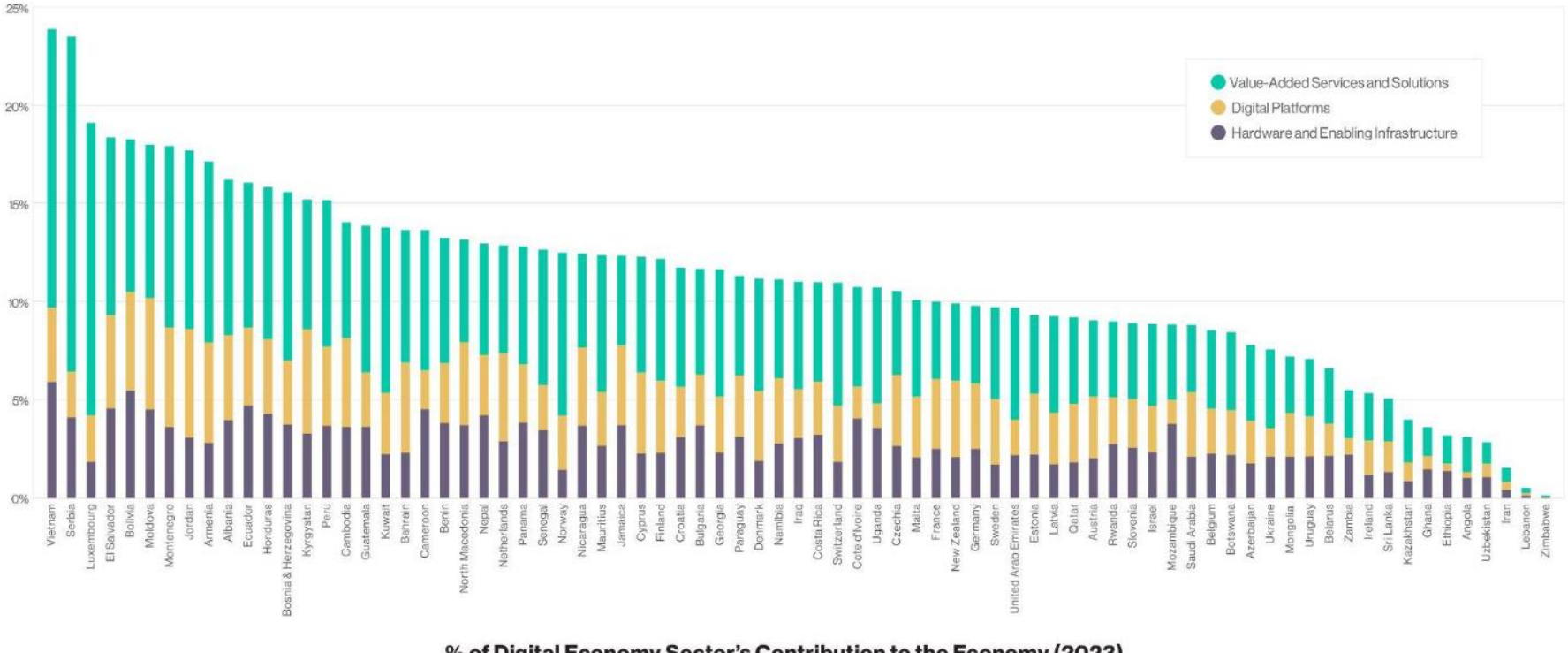

% of Digital Economy Sector's Contribution to the Economy (2023)

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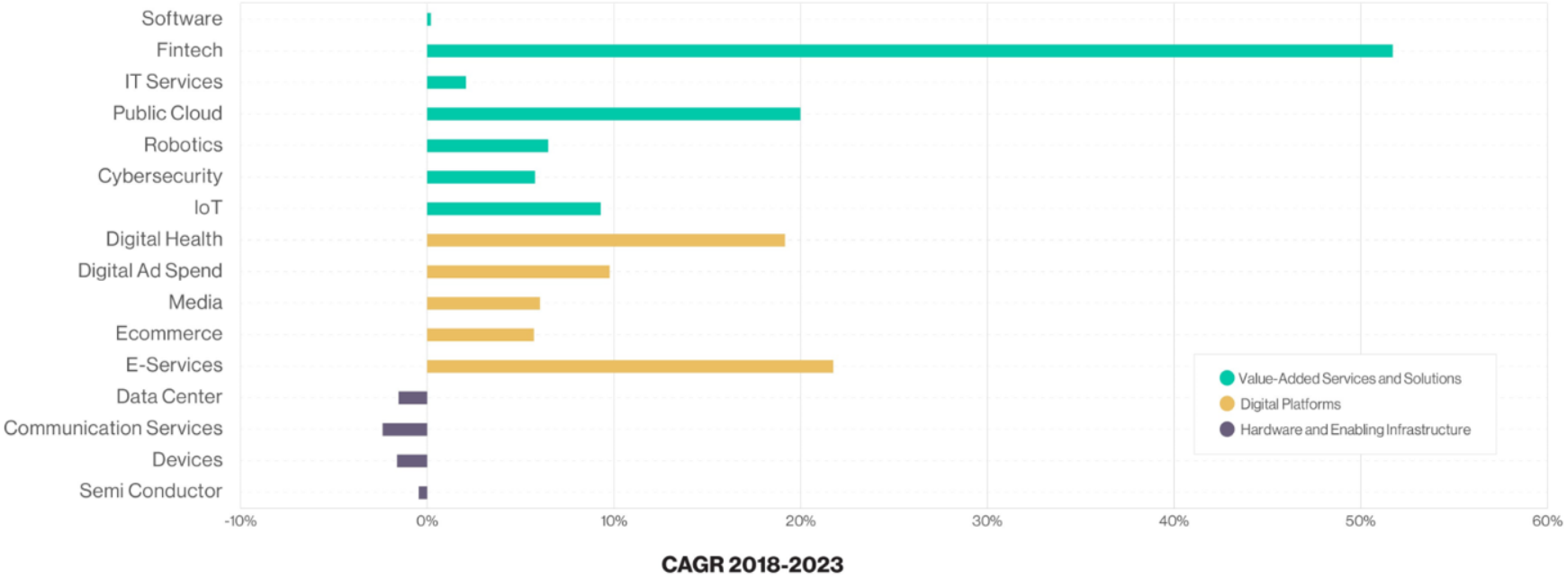

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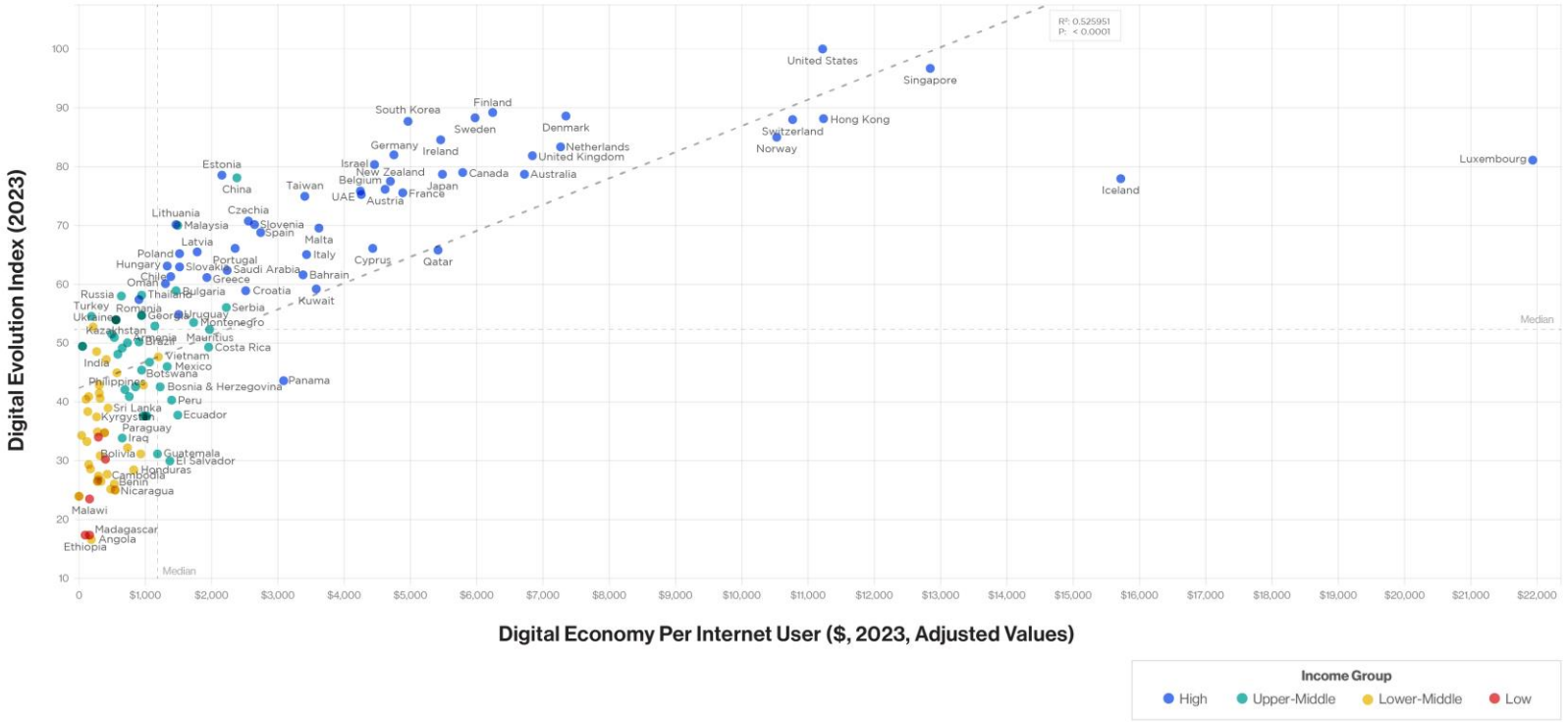
Insight 5: Value of the digital economy per internet user is correlated with an economy's state of digital evolution



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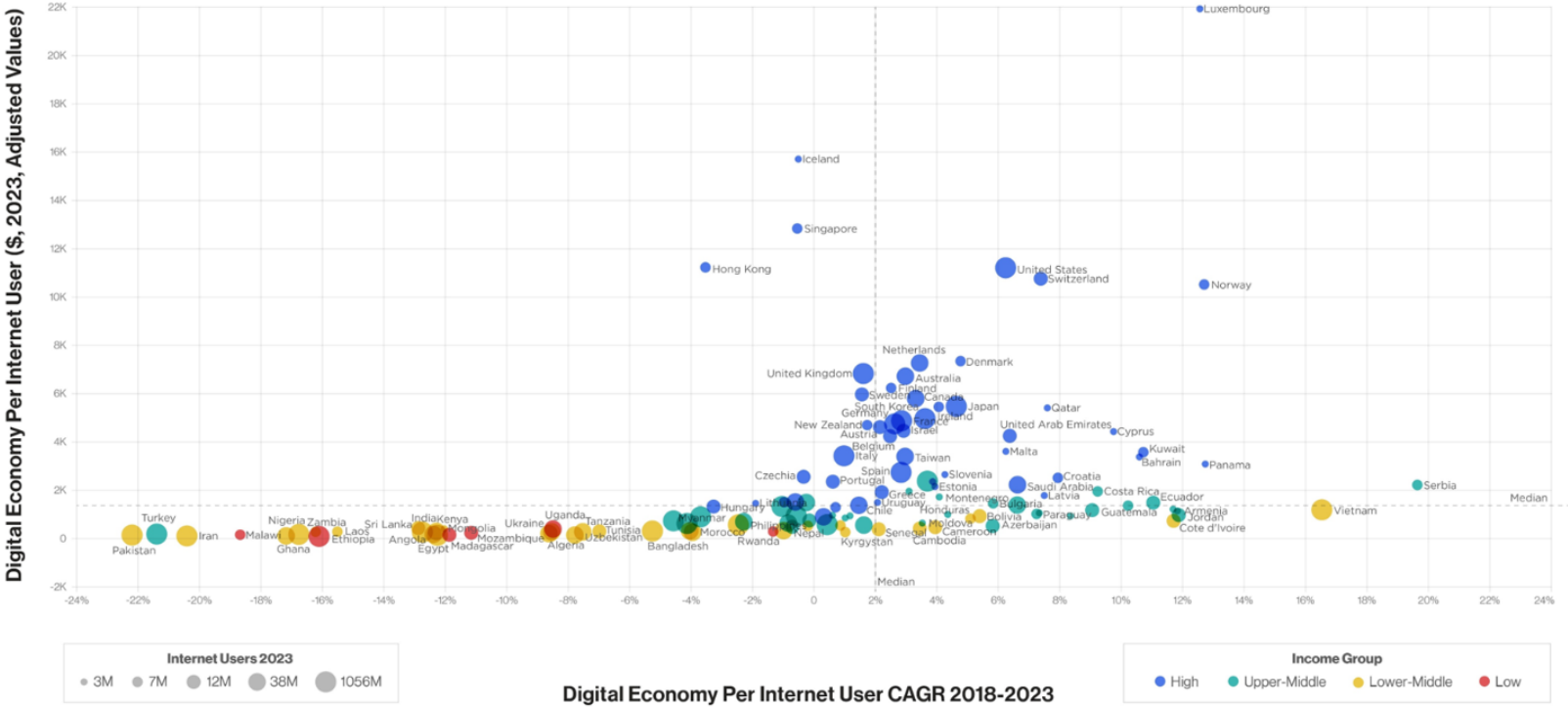

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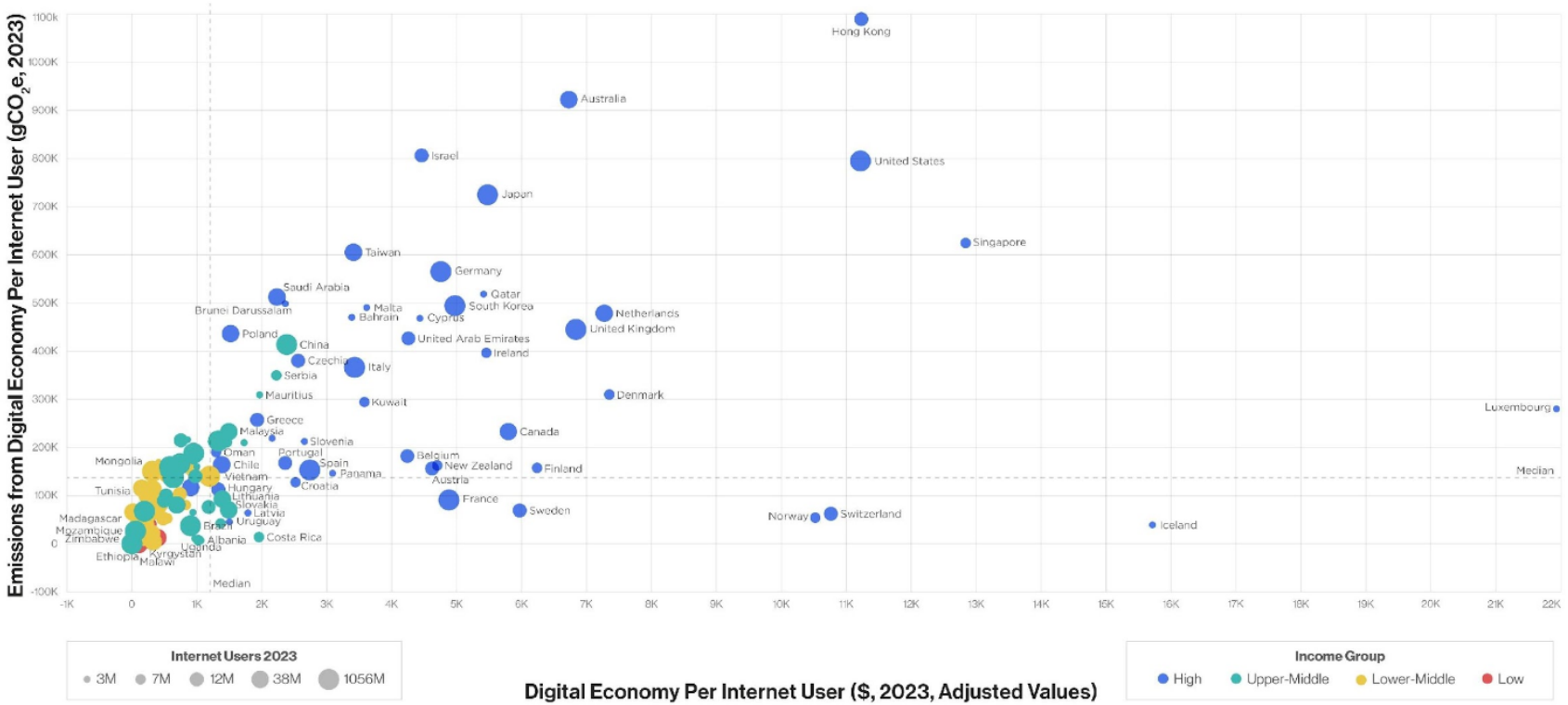
Insight 7: Countries vary widely in their ability to manage emissions while growing their digital economies



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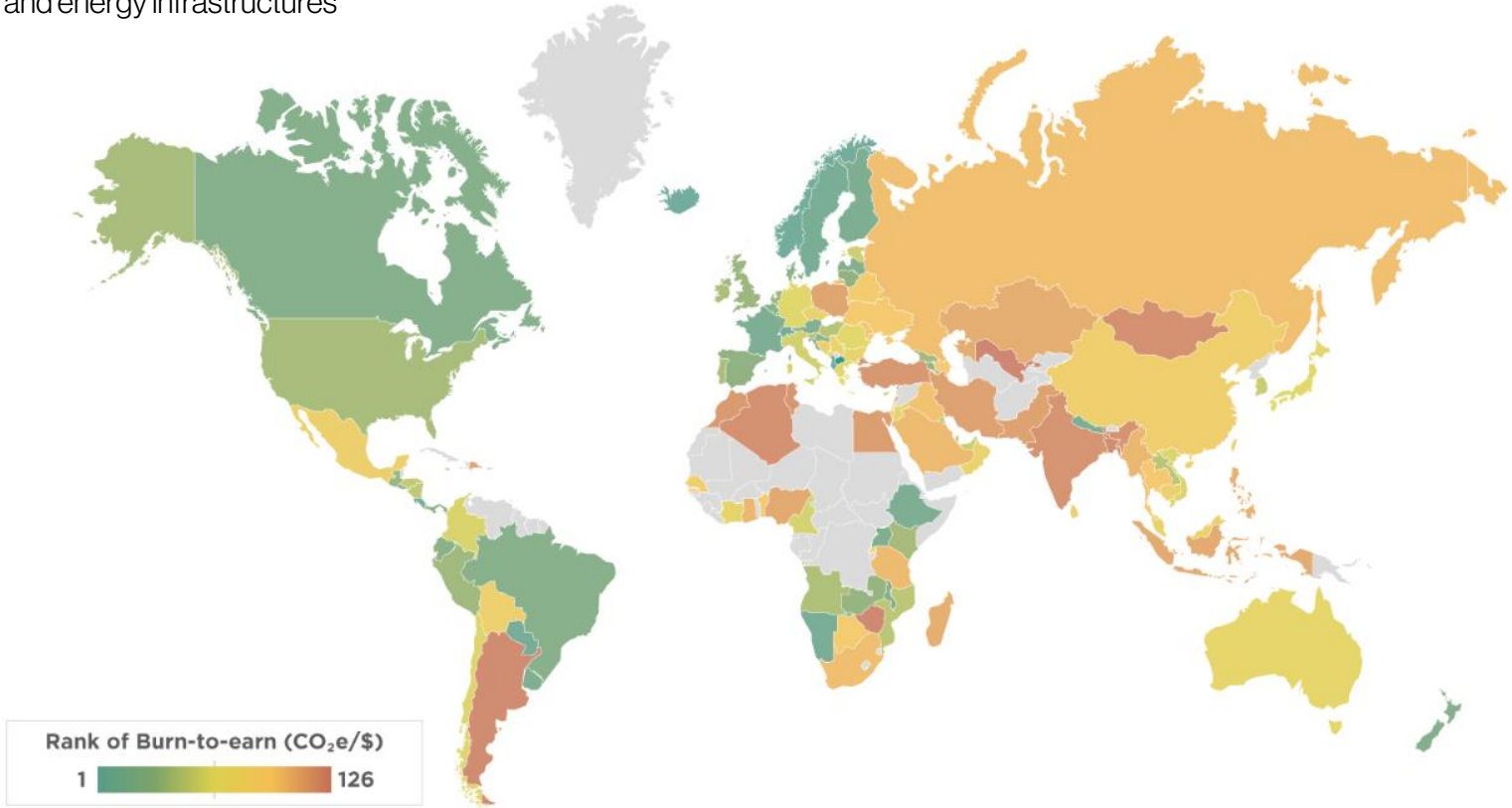

Digital Economies Ranked by Emissions Generated Per USD

Economy	Burn-to-Earn ($gCO_2e/\$$)	Rank
Iceland	2.5	1
Norway	5.1	2
Switzerland	5.8	3
Albania	6.5	4
Costa Rica	7.1	5
Paraguay	7.1	6
Namibia	11.1	7
Sweden	11.6	8
Luxembourg	12.8	9
Nepal	12.8	10
Ethiopia	17.3	11
France	18.6	12
Finland	25.2	13
Uruguay	30.2	14
El Salvador	30.9	15
Uganda	31.1	16
Austria	33.8	17
New Zealand	34.6	18
Latvia	35.7	19
Malawi	38.0	20
Canada	40.2	21

Economy	Burn-to-Earn ($gCO_2e/\$$)	Rank
Brazil	41.4	22
Denmark	42.2	23
Belgium	42.9	24
Slovakia	46.4	25
Ecuador	47.2	26
Panama	47.3	27
Singapore	48.6	28
Croatia	50.7	29
Spain	56.0	30
Kyrgyzstan	57.5	31
Lithuania	62.2	32
Armenia	63.7	33
Zambia	64.0	34
Guatemala	64.5	35
United Kingdom	65.1	36
Netherlands	65.8	37
Peru	66.6	38
Georgia	69.1	39
Kenya	70.5	40
United States	70.9	41
Portugal	71.0	42

Economy	Burn-to-Earn ($gCO_2e/\$$)	Rank
Ireland	72.7	43
Angola	73.7	44
Slovenia	79.9	45
Kuwait	82.2	46
Hungary	84.7	47
Laos	87.0	48
Mozambique	92.4	49
Qatar	95.7	50
Nicaragua	96.1	51
Honduras	96.7	52
Hong Kong	97.0	53
South Korea	99.4	54
United Arab Emirates	100.2	55
Estonia	101.3	56
Cyprus	105.5	57
Italy	106.8	58
Cameroon	109.7	59
Colombia	116.6	60
Vietnam	117.1	61
Chile	118.7	62
Germany	118.8	63

Digital Economies Ranked by Emissions Generated Per USD

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Montenegro	121.4	64
Romania	129.0	65
Japan	132.3	66
Greece	133.4	67
Malta	135.7	68
Rwanda	136.9	69
Australia	137.1	70
Bahrain	138.8	71
Cote d'Ivoire	139.6	72
Jordan	143.2	73
Bulgaria	144.1	74
Oman	146.4	75
Czechia	148.5	76
Malaysia	155.9	77
Serbia	157.3	78
Mauritius	157.3	79
Mexico	160.2	80
North Macedonia	160.3	81
Cambodia	162.8	82
Bolivia	163.3	83
China	173.5	84

Economy	Burn-to-Earn ($gCO_2e/\$$)	Rank
Bosnia & Herzegovina	174.0	85
Senegal	176.6	86
Taiwan	177.4	87
Sri Lanka	178.6	88
Israel	180.8	89
Belarus	181.3	90
Botswana	181.3	91
Benin	185.6	92
Azerbaijan	190.1	93
Ukraine	192.2	94
Thailand	197.7	95
Brunei Darussalam	211.3	96
Moldova	214.3	97
Iraq	214.4	98
Russia	215.0	99
South Africa	224.8	100
Tanzania	225.1	101
Saudi Arabia	229.4	102
Ghana	244.8	103
Myanmar	245.0	104
Jamaica	251.9	105

Economy	Burn-to-Earn ($gCO_2e/\$$)	Rank
Philippines	252.1	106
Madagascar	270.6	107
Kazakhstan	272.1	108
Indonesia	274.3	109
Nigeria	281.6	110
Dominican Republic	284.9	111
Poland	287.2	112
Pakistan	307.1	113
Iran	312.6	114
Egypt	316.6	115
Lebanon	328.9	116
Morocco	349.8	117
Turkey	351.3	118
Tunisia	361.5	119
India	374.5	120
Algeria	396.3	121
Mongolia	410.7	122
Bangladesh	474.0	123
Argentina	474.2	124
Zimbabwe	617.4	125
Uzbekistan	767.4	126

Action Recommendations (1)

1. Accelerating the Transition to Clean Energy

- Prioritizing renewable energy adoption especially by economies with high emissions per digitally generated dollar.
- Creating incentives for low-carbon power for data centers through tax incentives and subsidies for data centers and digital service providers that generate clean energy.
- Facilitating regional energy collaborations, where high-emission countries can partner with neighboring cleaner-energy economies to integrate renewable sources into their energy mix.

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2. Improving Energy Efficiency in the Digital Economy

- Adopting energy-efficient digital infrastructure by encouraging the deployment of low-energy servers, green data centers, energy-efficient networking equipment and making data center location choices in countries and regions with lower emissions per dollar.
- Optimizing AI and cloud computing for lower energy use by using advanced AI algorithms and smart cloud storage systems to reduce power consumption while increasing computing capacity. Implementing AI-driven smart grids can optimize energy use in the digital sector, reducing unnecessary power consumption.
- Encouraging circular economy practices by extending device lifespans, promoting recycling, and reducing e-waste.

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3. Enhancing Productivity of the Digital Economy

- Lower-income economies investing in domestic software, fintech, and e-commerce industries to boost their digital economy's size.
- Investing in digital public goods/infrastructure to enable access to digital platforms and applications at population-scale.
- Developing high-speed, lower-energy digital networks by expanding fiber-optic networks and 5G adoption.

Action Recommendations (2)

4. Enhancing Energy Efficiency of AI

- Leveraging innovations in energy-efficient AI: More efficient GPUs that can deliver 30X in performance while using 25X less energy; cutting cooling expenses in data centers; novel computing architectures, e.g. locating memory inside computing cores that cut energy dissipation by shortening data travel distances; deploying devices mimicking brain functions and using 1000X less energy; using models running on low-powered microcontrollers; minimizing energy-intensive operations by writing to memory cells; using distillation to enable more efficient use of computation without performance loss; integrating photonic accelerators, 3D chips, chip cooling techniques, with future gains from quantum and photonic computing.
- DeepSeek demonstrated savings on compute and energy resources by deploying a "mixture of experts" technique that splits the AI's neural networks into different categories, and other creative approaches without noticeable losses in performance.
- Instituting training programs that develop local expertise in AI and energy conservation and energy use data capture globally.

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5. Strengthening International Cooperation to Build Digital Trust through Sustainable Digitalization

- Establishing and harmonizing digital carbon pricing mechanisms to encourage low-carbon digital infrastructure investment.
- Creating global standards for sustainable digital growth by publishing Burn-to-Earn scores and seeking improvement, while harmonizing emission benchmarks for digital sectors.
- Facilitating technology transfer to lower-income economies.

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6. Enhancing Data Transparency and Measurement

- Developing standardized metrics for measuring the environmental impact of the digital economy noting leverage points for governments, industry and users, setting "carbon budgets", etc.
- Requiring digital sustainability reporting by tech firms and data center operators.
- Leveraging AI and data analysis for real-time emissions monitoring to enable behavior changes, nudges and proactive sustainability management.