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King Abdullah Petroleum Studies and Research Center

cce INDEX
Circular Carbon Economy Index
مؤشر الاقتصاد الدائري للكربون

Discussion Paper

# The Circular Carbon Economy Index 2024

## Results


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November 2024 | Doi: 10.30573/KS--2024-DP54

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# Executive Summary

The 2024 CCE Index provides a multidimensional overview of the current state of net-zero transitions worldwide, covering 125 countries globally. It is based on the holistic, technology-neutral, and flexible concept of the circular carbon economy (CCE), where a complete CCE is understood as the equivalent of net-zero emissions. The 2024 CCE Index results deliver nine major insights, which reflect the urgency of accelerating the global net-zero transition, doubling down on sustained progress and ensuring just transitions worldwide. These can be summarized into four headline policy messages:

**The world remains fragmented:** The world's largest economies, which are also responsible for the majority of GHG emissions, are performing comparatively better than the global average and have the potential to do more. A significant share of the world's population, however, lives in countries that are falling behind in the transition. While all regions have homework to do, Sub-Saharan Africa needs urgent global support.

**There is a divergence in pace:** The global pursuit of net-zero emissions continues but has slowed down. On a closer look, however, top performers across the CCE Index are accelerating their transitions significantly more than countries in the middle and bottom of the distribution. Meanwhile, countries at the bottom are stalling.

**Gaps in enablers are not closing:** Enabling environments for the net-zero transition among middle and low-performing countries need to be urgently brought up to speed with those in top-performing countries. In critical enabling dimensions – finance, technology, and policy – countries in the middle and bottom of the CCE Index ranking consistently fall below the global average scores, with the observed gaps showing no signs of closing over time.

**Policies are stronger but still volatile:** On a positive note, there has been commendable progress in policies and regulations, led by countries scoring in the middle of the CCE Index. Yet, changes in long-term policy are a source of volatility in countries' net-zero policy and regulatory frameworks – more stable targets and clear pathways are needed for consistent signaling and sustained implementation.

# 1. Introduction

As the Circular Carbon Economy (CCE) Index enters its fourth edition, global greenhouse gas (GHG) emissions are estimated to have reached a new high in 2023, with energy-related emissions increasing by 2% from the previous year despite record increases in renewable energy capacity and investment (The Energy Institute 2024; IEA 2024). Momentum on climate action appears to be slowing down, hindered by geopolitical tensions and conflict, geoeconomic competition, and weak economic growth across the world. In a report published for the United Nations Summit of the Future, multiple global science organizations underscore the urgent need for action (WMO et al. 2024). The year 2023 was the warmest on record, and the first half of 2024 has seen extreme weather and heat worldwide. A continuation of current policies would lead to a 3°C warmer world (WMO et al. 2024). While the new global targets agreed at the Dubai Climate Change Conference in 2023, including tripling renewable energy capacity and doubling energy efficiency improvements by 2030 (UNFCCC 2023), have provided a reinjection of political will, the pace of implementation currently remains insufficient to achieve the Paris Agreement's goals. Even more concerning is the fact that progress across countries toward net-zero remains highly uneven.

This year's analysis of the CCE Index results highlights two broad themes. First, the world is increasingly fragmented in its pursuit of net-zero emissions, with high-performers accelerating their progress while lower-performing countries are stalling. For the first time, the CCE Index covers 125 countries, representing 96% of global GHG emissions,[1] from all world regions and income statuses. This differentiation is starkly displayed in the total CCE Index scores for the years 2021-2024, where the top 20 countries have on average improved their scores by more than 6 points over this period, while the bottom 20 countries have on average only seen an increase of 0.5 points. The trend is visible in both of the main areas that the CCE Index measures: countries' current engagement with eight major mitigation technologies and approaches (CCE Performance) and countries' potential to transition to net-zero emissions (CCE Enablers).

Reflecting the broader global context described above, the pace of change worldwide has been slowing down since the start of the CCE Index. On average, countries improved their CCE Index scores by 2 points between 2021 and 2022, diminishing to just below 1 point in 2022-2023 and 0.5 points in 2023-2024. The lag in statistical data of usually one to two years means that the index scores are measuring events at an equivalent distance from the present. This change can therefore be largely attributed to the Coronavirus (COVID-19) pandemic and its aftermath, but it also reflects the rising focus on energy security following the war in Ukraine from 2022 onwards.

As the 2024 CCE Index shows, gaps in finance and technology and related enablers, which are crucial for global just transitions, are showing no signs of closing. A tightening in global liquidity aimed at combating

inflation, along with increased risks fueled by the recent global political crises, increases the cost of capital and uncertainty, which, overall, complicates the prospects of directing investments at sufficient scale to support net-zero transitions.

Notwithstanding this, the second theme from the 2024 edition of the CCE Index is that of careful optimism. In the area of policies and regulatory frameworks for net-zero transitions, countries are catching up. Here, larger improvements in scores took place between 2021 and 2024 in the second half of the country ranking than the first half. In other words, countries that received lower scores in 2021 have on average strengthened their climate change mitigation-relevant policies and regulations faster over the past three years than countries ranking higher in the index. The top 20 improvers in policies and regulation over this period come from all income groups and regions, including low-income Sub-Saharan Africa. However, as the analysis demonstrates, much more policy certainty and stability are still needed in this enabling area to provide the right signals and support for scaling up action.

This paper presents the results of the 2024 CCE Index and provides related analytical insights in the following order. Section 2 focuses on the CCE Index results for 2024: after a brief description of the CCE Index methodology in Section 2.1, Section 2.2 provides a high-level overview of the results, followed by more detailed analysis in Section 2.3. Section 3 examines trends over time (2021-2024), starting from the main components of the index – total CCE Index, CCE Performance, and CCE Enablers scores (Section 3.1). Section 3.2 then examines the CCE Enablers sub-index more closely, while Section 3.3 provides a further decomposition analysis of the results of the Policies and Regulation enablers dimension. Section 4 concludes by summarizing the key policy messages identified in the paper.

# 2.2024 CCE Index Results

This section provides an overview of the CCE Index methodology, presents the 2024 results, and identifies three key high-level policy insights based on countries' performance in the index in 2024.

## 2.1. The CCE Index Methodology

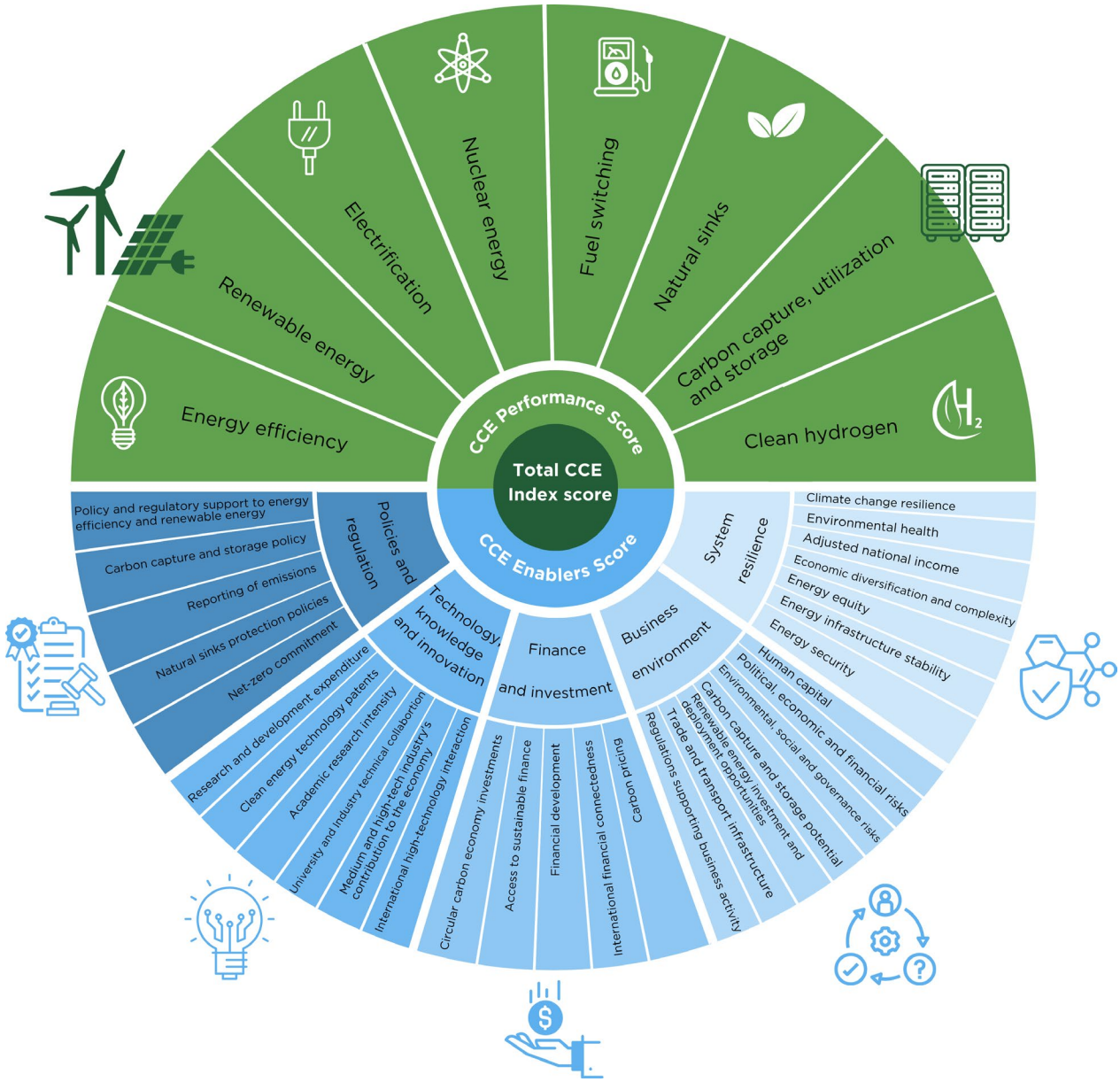
The transition to net-zero emissions is a multifaceted task as countries need to balance their multiple competing policy priorities, maintaining a long-term view on the risks of climate change while catering to pressing shorter-term issues, such as secure energy supplies, or longer-term development imperatives, such as poverty-eradication, energy access, decent jobs, and economic prosperity.

The 2024 CCE Index provides a multidimensional overview of the current state of net-zero transitions worldwide, covering 125 countries from all world regions. It is based on the holistic, technology-neutral, and flexible concept of the circular carbon economy (CCE), where a full CCE is understood as the equivalent of net-zero GHG emissions. (For further discussions on how the CCE Index operationalizes the CCE concept, see, for example, Luomi et al. 2021 and Luomi, Yilmaz, and Alshehri 2021.)

The total CCE Index score is a measure of two main aspects of countries' transition status. First, the CCE Performance sub-index benchmarks countries based on the depth and breadth of their engagement with eight primary climate change mitigation technologies and approaches, with the CCE Performance score for a country formed by first calculating a score for each of the individual indicators, on a scale of 0-100, and then aggregating these by equal weighting. (For a full description of the CCE Index methodology and annual updates, see Luomi, Yilmaz, and Alshehri 2021, Luomi, Yilmaz, and Alshehri 2024, and Luomi et al. 2021, whilst methodological updates pertaining to the CCE Index 2024 Edition can be found in Appendix 2 of this paper.)

Second, the CCE Enablers sub-index score provides a comparative measure of countries' net-zero transition potential. It contains 30 indicators, grouped into five thematic dimensions, each covering a key area of the enabling environments necessary to foster sustained net-zero transitions – namely, policies and regulation; technology, knowledge and innovation; finance and investment; business environment; and system resilience. Each country first receives a score (0-100) on the individual indicators, which are then aggregated at dimension level and subsequently at sub-index level by using equal weighting. The total CCE Index score is the equally weighted average of the CCE Performance and CCE Enablers scores. Figure 1 illustrates the full 2024 CCE Index indicator framework. The full 2024 results of the CCE Index, along with all underlying data, methodological information and analyses based on previous index editions, are available via the CCE Index web portal: https://cceindex.kapsarc.org/.[2]

**Figure 1.** 2024 CCE Index indicator framework.




*Source: CCE Index web portal 2024 (Alaa Alarfaj).*

# 2.2. 2024 CCE Index Rankings

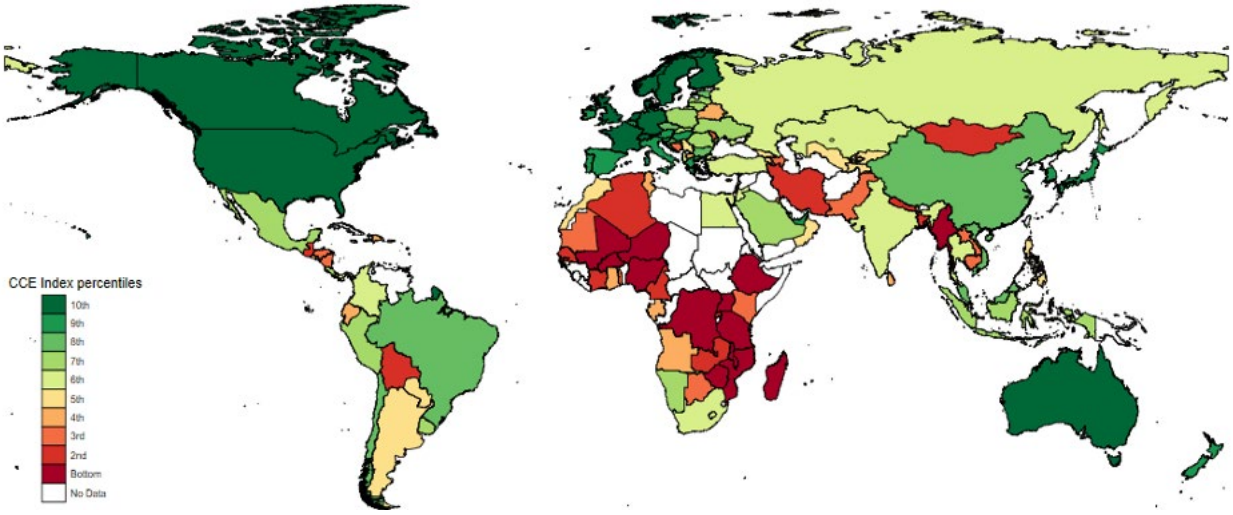
Table 1 presents the high-level results of the CCE Index in 2024. The results are also illustrated in Figure 2. Further visual illustrations of the results are included in Figures A.1, A.2, and A.3 in Appendix 1.

**Table 1.** 2024 CCE Index results and ranking.

| Country | CCE Performance | CCE Enablers | Total CCE Index | Rank | Rank change 2023-2024 |
|---|---|---|---|---|---|
| Sweden | 71.78 | 79.85 | 75.81 | 1 | ↑ |
| Norway | 69.89 | 73.35 | 71.62 | 2 | ↓ |
| Denmark | 57.39 | 80.71 | 69.05 | 3 | → |
| United Kingdom | 57.32 | 75.94 | 66.63 | 4 | → |
| Netherlands | 54.60 | 77.82 | 66.21 | 5 | → |
| Germany | 52.67 | 79.58 | 66.12 | 6 | → |
| Finland | 55.42 | 76.61 | 66.01 | 7 | ↑ |
| Canada | 56.11 | 72.13 | 64.12 | 8 | ↓ |
| Switzerland | 47.69 | 80.46 | 64.08 | 9 | ↓ |
| France | 53.01 | 71.75 | 62.38 | 10 | ↑ |
| United States | 50.55 | 71.68 | 61.11 | 11 | → |
| Australia | 52.44 | 69.11 | 60.77 | 12 | ↑ |
| Belgium | 51.32 | 69.36 | 60.34 | 13 | ↓ |
| Ireland | 48.39 | 72.01 | 60.20 | 14 | ↑ |
| Spain | 51.47 | 67.79 | 59.63 | 15 | ↓ |
| Greece | 62.52 | 54.30 | 58.41 | 16 | ↑ |
| Portugal | 51.46 | 65.10 | 58.28 | 17 | ↓ |
| Korea, Rep. | 42.55 | 72.92 | 57.74 | 18 | ↓ |
| Austria | 35.92 | 74.27 | 55.09 | 19 | → |
| New Zealand | 49.34 | 60.01 | 54.68 | 20 | ↓ |
| Japan | 38.58 | 69.75 | 54.17 | 21 | ↓ |
| United Arab Emirates | 48.07 | 57.89 | 52.98 | 22 | ↓ |
| Slovenia | 42.38 | 59.79 | 51.08 | 23 | → |
| Hungary | 36.28 | 64.16 | 50.22 | 24 | → |
| Italy | 34.09 | 64.75 | 49.42 | 25 | → |
| Chile | 44.37 | 54.25 | 49.31 | 26 | ↑ |
| Malaysia | 45.37 | 52.33 | 48.85 | 27 | ↑ |
| Singapore | 25.52 | 71.99 | 48.75 | 28 | → |
| Brazil | 47.56 | 49.12 | 48.34 | 29 | → |
| Bulgaria | 45.19 | 50.73 | 47.96 | 30 | ↓ |
| China | 33.39 | 59.75 | 46.57 | 31 | ↑ |
| Qatar | 45.51 | 47.04 | 46.27 | 32 | ↓ |
| Estonia | 29.02 | 63.50 | 46.26 | 33 | ↓ |
| Viet Nam | 39.89 | 51.74 | 45.82 | 34 | ↓ |
| Croatia | 36.87 | 53.73 | 45.30 | 35 | ↑ |
| Cyprus | 28.74 | 61.64 | 45.19 | 36 | ↑ |
| Czechia | 29.66 | 59.87 | 44.77 | 37 | ↓ |
| Slovak Republic | 36.41 | 53.08 | 44.75 | 38 | ↓ |
| Ukraine | 44.20 | 44.76 | 44.48 | 39 | ↓ |
| Uruguay | 40.97 | 47.42 | 44.20 | 40 | ↑ |
| Saudi Arabia | 39.66 | 48.38 | 44.02 | 41 | ↓ |
| Romania | 33.26 | 52.58 | 42.92 | 42 | ↓ |
| Lithuania | 29.08 | 56.39 | 42.74 | 43 | ↓ |
| Latvia | 27.80 | 56.65 | 42.23 | 44 | ↓ |
| Peru | 45.61 | 37.35 | 41.48 | 45 | ↓ |
| Costa Rica | 41.28 | 41.27 | 41.27 | 46 | ↓ |
| Poland | 24.42 | 57.15 | 40.79 | 47 | ↑ |
| Namibia | 41.04 | 40.24 | 40.64 | 48 | → |
| Mexico | 30.97 | 50.19 | 40.58 | 49 | ↓ |
| Indonesia | 40.43 | 39.86 | 40.14 | 50 | ↑ |
| Albania | 39.93 | 40.15 | 40.04 | 51 | ↑ |
| South Africa | 32.46 | 47.46 | 39.96 | 52 | ↑ |
| Kazakhstan | 32.65 | 46.54 | 39.59 | 53 | ↓ |
| Colombia | 32.07 | 46.49 | 39.28 | 54 | ↓ |
| Turkiye | 29.59 | 47.89 | 38.74 | 55 | ↑ |
| Panama | 37.75 | 39.48 | 38.62 | 56 | ↓ |
| Jordan | 37.36 | 39.53 | 38.44 | 57 | ↑ |
| Russian Federation | 32.03 | 44.40 | 38.21 | 58 | ↓ |
| Egypt, Arab Rep. | 40.76 | 35.40 | 38.08 | 59 | ↓ |
| India | 33.89 | 41.36 | 37.62 | 60 | ↑ |
| Thailand | 22.80 | 52.36 | 37.58 | 61 | ↑ |
| Bahrain | 29.82 | 45.11 | 37.46 | 62 | ↑ |
| Paraguay | 45.32 | 29.60 | 37.46 | 63 | ↓ |
| Oman | 31.10 | 43.57 | 37.34 | 64 | → |
| Georgia | 33.95 | 39.11 | 36.53 | 65 | ↓ |
| Morocco | 33.82 | 38.57 | 36.19 | 66 | ↑ |
| Kyrgyz Republic | 38.17 | 34.15 | 36.16 | 67 | ↑ |
| Argentina | 31.07 | 41.09 | 36.08 | 68 | ↓ |
| Tajikistan | 45.81 | 26.20 | 36.01 | 69 | ↓ |
| El Salvador | 40.26 | 30.98 | 35.62 | 70 | ↓ |
| Uzbekistan | 34.18 | 36.70 | 35.44 | 71 | ↑ |
| Mauritius | 31.76 | 37.78 | 34.77 | 72 | ↓ |
| Serbia | 25.72 | 42.07 | 33.90 | 73 | → |
| Philippines | 28.61 | 38.32 | 33.47 | 74 | ↑ |
| Armenia | 32.21 | 34.27 | 33.24 | 75 | ↑ |
| Dominican Republic | 29.82 | 36.54 | 33.18 | 76 | ↓ |
| Jamaica | 32.96 | 32.94 | 32.95 | 77 | ↑ |
| North Macedonia | 28.66 | 36.49 | 32.58 | 78 | ↓ |
| Ecuador | 28.83 | 35.12 | 31.97 | 79 | ↓ |
| Tunisia | 24.40 | 39.10 | 31.75 | 80 | ↑ |
| Ghana | 31.81 | 31.17 | 31.49 | 81 | ↓ |
| Belarus | 22.00 | 40.22 | 31.11 | 82 | ↓ |
| Sri Lanka | 30.37 | 31.71 | 31.04 | 83 | ↑ |
| Kuwait | 20.36 | 41.33 | 30.85 | 84 | ↑ |
| Lebanon | 28.00 | 33.61 | 30.80 | 85 | ↑ |
| Angola | 36.02 | 24.41 | 30.22 | 86 | ↓ |
| Gabon | 20.49 | 39.92 | 30.20 | 87 | → |
| Cambodia | 28.26 | 31.59 | 29.92 | 88 | ↑ |
| Azerbaijan | 24.48 | 35.10 | 29.79 | 89 | ↓ |
| Trinidad and Tobago | 21.89 | 37.32 | 29.60 | 90 | ↓ |
| Mauritania | 32.02 | 27.16 | 29.59 | 91 | ↓ |
| Lao PDR | 23.75 | 35.26 | 29.50 | 92 | ↑ |
| Bosnia and Herzegovina | 24.84 | 32.95 | 28.90 | 93 | ↓ |
| Botswana | 24.28 | 32.91 | 28.59 | 94 | ↓ |
| Moldova | 21.79 | 34.94 | 28.37 | 95 | ↓ |
| Nicaragua | 28.75 | 26.65 | 27.70 | 96 | ↑ |
| Honduras | 26.12 | 28.72 | 27.42 | 97 | ↓ |
| Pakistan | 29.02 | 25.70 | 27.36 | 98 | ↑ |
| Togo | 22.77 | 31.86 | 27.31 | 99 | ↓ |
| Kenya | 24.57 | 29.84 | 27.21 | 100 | ↑ |
| Cote d'Ivoire | 24.09 | 28.80 | 26.44 | 101 | ↑ |
| Senegal | 22.07 | 30.70 | 26.38 | 102 | ↓ |
| Iran, Islamic Rep. | 17.61 | 34.79 | 26.20 | 103 | ↓ |
| Algeria | 18.78 | 33.22 | 26.00 | 104 | ↓ |
| Guatemala | 20.59 | 30.91 | 25.75 | 105 | ↓ |
| Zambia | 22.40 | 26.79 | 24.59 | 106 | → |
| Nepal | 22.43 | 26.42 | 24.42 | 107 | ↑ |
| Mongolia | 17.64 | 31.09 | 24.37 | 108 | → |
| Bangladesh | 24.70 | 23.03 | 23.86 | 109 | ↑ |
| Bolivia | 21.62 | 25.48 | 23.55 | 110 | ↓ |
| Rwanda | 16.25 | 29.27 | 22.76 | 111 | → |
| Cameroon | 22.53 | 21.87 | 22.20 | 112 | ↑ |
| Malawi | 20.75 | 23.29 | 22.02 | 113 | ↓ |
| Nigeria | 14.15 | 29.56 | 21.85 | 114 | ↓ |
| Myanmar | 22.39 | 20.20 | 21.29 | 115 | → |
| Mozambique | 17.36 | 25.02 | 21.19 | 116 | ↑ |
| Niger | 19.03 | 23.10 | 21.07 | 117 | ↓ |
| Ethiopia | 15.18 | 25.74 | 20.46 | 118 | ↑ |
| Tanzania | 17.23 | 23.47 | 20.35 | 119 | → |
| Zimbabwe | 14.59 | 25.28 | 19.93 | 120 | ↓ |
| Burkina Faso | 15.45 | 21.31 | 18.38 | 121 | → |
| Uganda | 11.06 | 25.54 | 18.30 | 122 | → |
| Mali | 13.69 | 20.98 | 17.33 | 123 | → |
| Congo, Dem. Rep. | 11.07 | 21.54 | 16.30 | 124 | → |
| Madagascar | 10.73 | 18.25 | 14.49 | 125 | → |

*Source: Authors.*

**Figure 2.** 2024 CCE Index results heatmap.




*Source: Authors.*

In 2024, the total CCE Index ranking (Table 1) is led by developed economies from Europe, North America, and Asia, with three Nordic countries – Sweden, Norway and Denmark – in the lead. These countries generally rank in the top 20 across all of the main areas of the index, with the exception of Policies and Regulation. The average score of these three leading countries is 4.5 times the average score of the three countries receiving the lowest scores – Madagascar, the Democratic Republic of Congo, and Mali, all of which are low-income Sub-Saharan African countries. At the lower end of the rankings, countries generally struggle in all areas of the index, but challenges are particularly pronounced in the technology and finance-related enablers. In the Technology, Knowledge and Innovation dimension and the Finance and Investment dimension, the average scores of the top three countries in the CCE Index are, respectively, 9 and 12 times those of the bottom three countries.

## 2.3. 2024 Insights

Figures 3-6 provide further insights by displaying the 2024 high-level CCE Index results in the contexts of economy size, population size, region, and income group. Each figure shows countries' CCE Performance results on the X axis and their CCE Enablers scores on the Y axis. The closer to the top right corner a country is situated, the higher its overall standing in the index. The four quadrants can be read as follows:

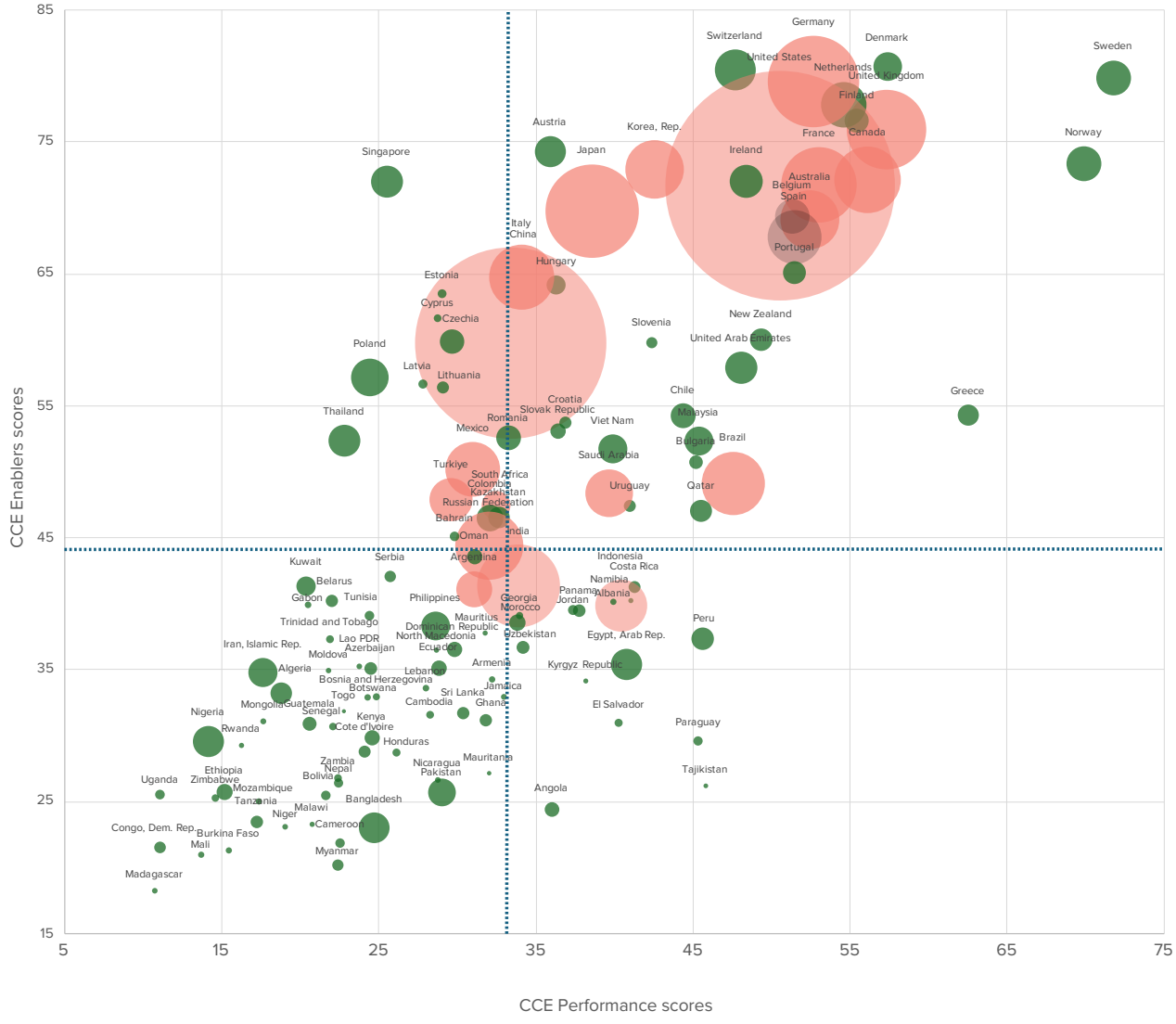
- **Leading countries:** Countries in the top right quadrant perform above the average in both areas of the index. They are showing the way on net-zero transitions but still need to step up their efforts given the insufficient speed of the global transition at present.
- **Countries performing below their potential:** In the top left quadrant are countries which score above the average CCE Enablers scores but which score below the global average in CCE Performance. The index indicates these countries have the potential to do much more.
- **Countries with transitions at risk:** In the lower-right quadrant are countries that score below the average on CCE Enablers but above it on CCE Performance. They are currently performing fairly, but their transitions are at risk, given the weaker enabling environments.
- **Countries falling behind:** In the bottom left quadrant is a large number of countries that are performing below the global average in both main areas of the index.

In each of the figures, the global average score is located in the intersection of the two dotted lines, which indicate the global average scores for CCE Performance and CCE Enablers. Each figure highlights a key message from the 2024 edition of the CCE Index.

***Insight 1: The world's largest economies, which are also responsible for the majority of GHG emissions, are performing comparatively better than the global average and have the potential to do more.***

Figure 3 displays all 125 index countries with the size of the country bubbles indicating economy size (nominal gross domestic product [GDP] in 2022). The largest economies – the 19 country members of the Group of Twenty (G20) – are highlighted in pink. The G20 countries collectively account for 75% of global GHG emissions (Climate Watch 2024), which puts them center stage in delivering on global net-zero ambitions.[3]

**Figure 3.** 2024 CCE Index results and economy size (nominal GDP 2022).




*Source: Authors (index data); World Bank (2024) (GDP data).*

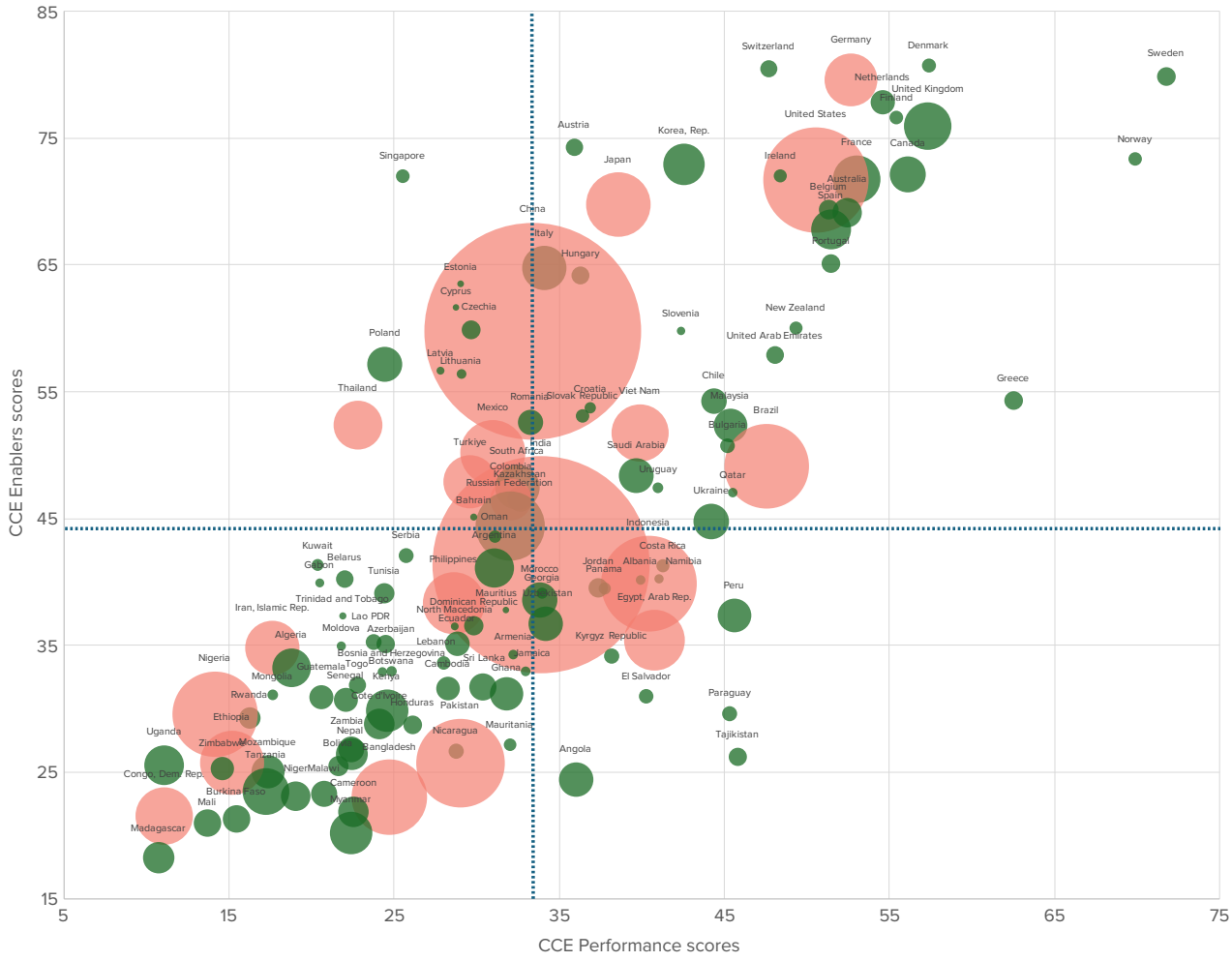
While the leading countries in the CCE Index are smaller economies, a number of large G20 economies also perform well – namely, the United Kingdom, Germany, Canada, France, the United States, Australia, the Republic of Korea, and Japan (Figure 2). Italy, Brazil, China, and Saudi Arabia are also situated well above the global average scores. The remaining G20 countries, namely, Mexico, Indonesia, South Africa, Türkiye, the Russian Federation, India, and Argentina, score slightly above or below the global average. With the exception of India (lower middle income), they all are upper middle or high-income emerging economies and therefore generally possess the different types of capital required to accelerate clean technology deployment and strengthen the necessary enablers for net-zero transitions.

A large number of smaller economies are situated well below the global average, closer to the bottom left corner of Figure 3. While these countries' contribution to reducing, reusing, recycling, and removing emissions – the four Rs of the CCE – may not significantly move the needle on the global net-zero transition in terms of emissions, their low scores are of concern from a just transition perspective.

***Insight 2: A significant share of the world's population lives in countries that are falling behind.***

Figure 4 shows the index countries with the size of the country bubbles indicating population size (2022). The 20 countries with the largest population are highlighted. A total of 5.55 billion people, or 70% of the world's population,

**Figure 4.** 2024 CCE Index results and population size (2022).




*Source: Authors (index data); World Bank (2024) (GDP data).*

live in these countries. The world's two most populous countries, India and China, account for half of this (2.8 billion people). While China ranks in the top quartile of the index (rank 31), India is positioned in the middle (rank 60), slightly below the global average score. In total, 12 of the world's 20 most populous countries score below the global average, home to more than a third of the global population (2.9 billion people). Eight of these 12 are low- or lower-middle-income countries, which implies that they may not possess the means to put in place all of the required enabling factors for successful net-zero transitions. Of particular concern in this regard appear to be Pakistan (236 million people, rank 98), Bangladesh (171 million people, rank 109), Nigeria (219 million people, rank 114), Ethiopia (123 million people, rank 118), and the Democratic Republic of Congo (99 million people, rank 124).

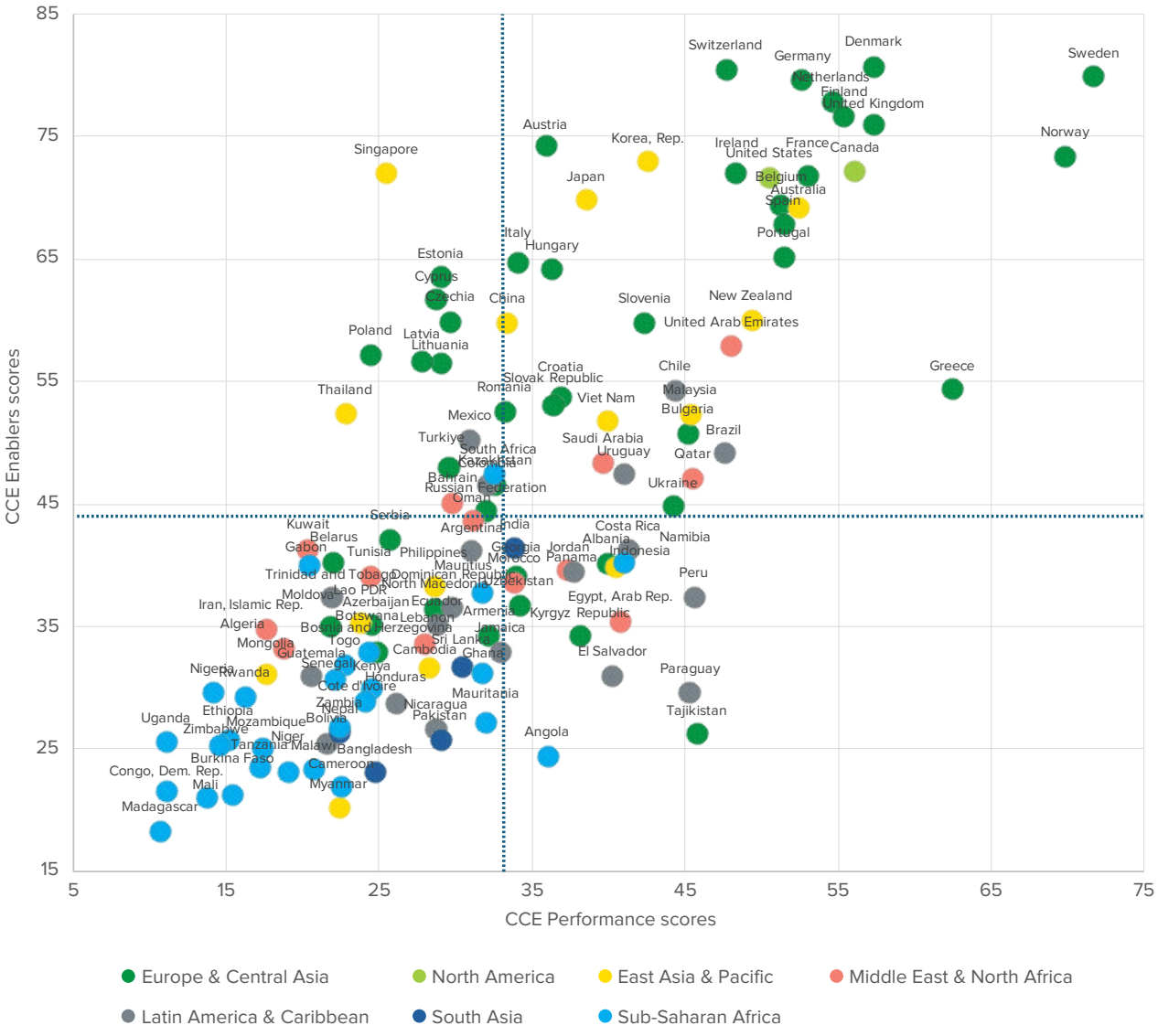
***Insight 3: While all regions have homework to do, Sub-Saharan Africa needs urgent global support.***

Figure 5 displays the 125 countries based on their region. There is a relatively large number of countries positioned in the "leaders" (top right) quadrant, which are mainly located in Europe, North America, or higher-income Asia. Three Gulf countries and three countries from Latin America are also situated here. Greece stands out with a significantly higher CCE Performance score compared to its CCE Enablers. The country receives high scores across most Performance areas, with no single one standing out.

In the smaller group of countries that perform below their potential (top left quadrant), Singapore, along with various Eastern European countries, stands out (Figure 5). Singapore is the world's leading country in the Technology, Knowledge and Innovation CCE Enablers dimension and also ranks high in System Resilience (5th) and Finance and Investment (20th). However, in an opposite case to Greece, Singapore receives low scores on all clean technologies (deployment or project pipelines) measured by the index. In the "transitions at risk" (bottom right) quadrant, there is another smaller group of countries. Here, Tajikistan, Angola, and three Latin American countries stand out as outliers. Tajikistan scores significantly higher on CCE Performance compared to CCE Enablers. It has no hard-to-abate sector technology project pipeline (clean hydrogen or CCUS), but it receives extremely high scores on renewable energy, energy efficiency, and electrification. According to Enerdata, 38.4% of the country's total primary consumption of energy came from renewables in 2022.[4]

The countries at the very bottom of the bottom left quadrant are located in Sub-Saharan Africa, but this very large group also includes countries from all world regions (Figure 5). Figures 6a-d provide a zoom-in into this quadrant, showing these countries in various comparative contexts.

**Figure 5.** 2024 CCE Index results and regions.




*Source: Authors (index data); World Bank 2024 (regions).*

**Figure 6.** 2024 CCE Index results and economy size, population, region, and income group – bottom quadrant.


*Source: Authors (index data); World Bank 2024 (regional groups, GDP, population and income group).*

Figure 6 shows the wide structural diversity of the bottom quadrant of the 2024 CCE Index. Not only are these countries located in all world regions, but they also include the world's 5th largest economy, and some of the world's most populous countries. In terms of income levels, while the lowest-scoring countries tend to be low-income economies, the bottom quadrant also includes a large number of emerging economies, including 3 high-income countries and 18 upper middle-income countries.

Overall, as Figures 3-6 show, a large number of countries are situated toward the bottom left corner that generally have smaller economies but relatively sizeable populations. The majority of these countries are located in Sub-Saharan Africa, but closer to the global average lies a diverse group of countries both region- and income-wise. If these economies fail to transition to CCEs in tandem with the rest of the world, they run the risk of suffering serious economic impacts as higher-performing and better-enabled countries increasingly integrate climate change policy considerations and targets into their trade policies, creating higher trade barriers for countries that do not decarbonize at the same speed.

Examples of such policies include climate club-type arrangements that reward their members or penalize non-participants through, for example, higher economic costs (such as the EU Carbon Border Adjustment Mechanisms) or trade bans (e.g., the Kigali Amendment to the Montreal Protocol) (World Economic Forum 2023; Montreal Protocol on Substances that Deplete the Ozone Layer 2016). Engagement with domestic carbon pricing mechanisms can serve as an early indication of this emerging differentiation: in 2024, out of the bottom half of countries in the CCE Index ranking, only 12 had in place or had plans to implement a carbon tax, an emissions trading scheme, or a crediting mechanism. In the top-half, only eight countries did not have a regulated carbon pricing mechanism or plans to implement one.[5]

# 3. Trends 2021-2024

With the CCE Index in its fourth edition, index scores are now available for four years, allowing for the identification of emerging trends. This section provides an overview of changes in scores in the three major areas of the index, followed by a more detailed explanation of the underlying drivers of said changes in one of the five enabling dimensions of the index – Policies and Regulation. Based on an analysis of changes and related patterns in the index scores between 2021 and 2024, the section identifies six further key policy insights.

In 2021-2024, the biggest individual improvers on the CCE Index were Sweden (13 points), Greece (12 points), and Malaysia (12 points). These score increases are mainly due to significant increases in their CCE Performance scores over this period – of 20-22 points. Sweden, for example, saw major improvements in the areas of renewable energy, clean hydrogen, and CCS. In CCE Enablers, Cyprus, Albania, and Gabon achieved the largest increases – of 8-10 points. Cyprus, the top riser, saw increases across its policy, technology, and finance enabler scores. Over the three years, relative to its small population and economic size, the country strengthened both its policy commitment and knowledge creation, and it raised a sizable amount of sustainable debt, among other things.

Out of the 125 countries, nearly a third (38) improved their CCE Index scores by more than 5 points since 2021. Yet, there were 20 countries that witnessed a weakening in their scores over this period – even if by only 1 point in most cases. (See Figure A.4 in Appendix 1 listing the countries with the most improvements and those with the largest decreases in selected areas of the CCE Index in 2021-2024.)

## 3.1. Trends Insights – High Level

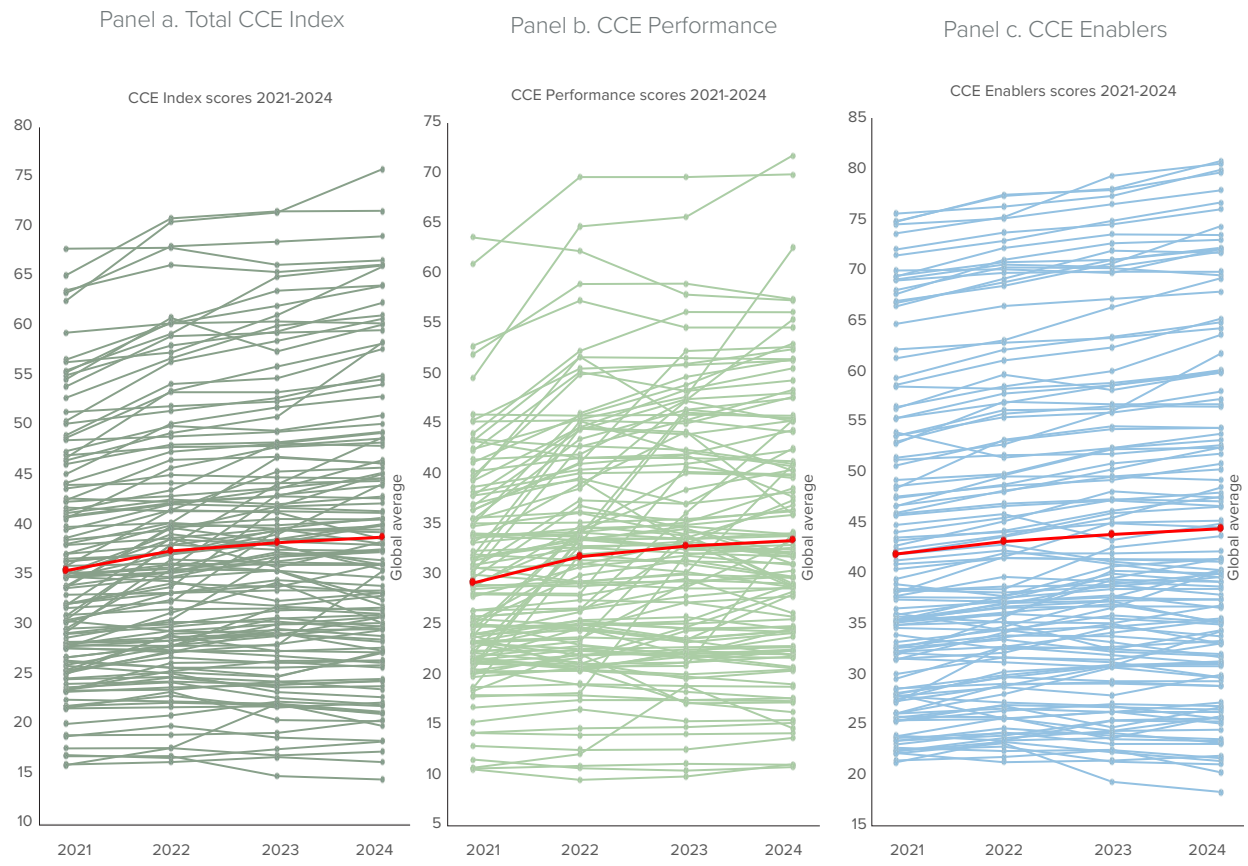
Given the policy attention climate action receives globally, it is only reasonable to assume that countries' CCE Index scores on average would see some improvement each year. While this has been the case since the start of the CCE Index in 2021, the pace of improvement has been slowing down, as is shown in Figure 7. The first finding in this area therefore reads:

***Insight 4: The global pursuit of net-zero emissions continues but has slowed down.***

Over the period 2021-2024, the global average of the 125 CCE Index countries improved by 3.4 points. Year-on-year, countries improved their CCE Index scores by 2 points between 2021 and 2022, diminishing to just below 1 point in 2022-2023 and 0.5 points in 2023-2024 (Figure 7, panel a). The lag in statistical data of usually one to two years means that the index scores are measuring events at an equivalent distance from the present. This change can therefore be, to a large extent, attributed to the Coronavirus (COVID-19) pandemic and its long economic aftermath, but it also reflects the rising focus on energy security following the war in Ukraine from 2022 onwards.

The CCE Performance and CCE Enablers sub-index scores show a similar trend where, overall, countries' scores have improved from 2021 by 4.3 and 2.6 points in these two areas, respectively (Figure 7, panels b and c). However, the increases have slowed down – from 2.7 points (2021-2022) to 1 point (2022-2023) and 0.6 points (2023-2024) in CCE Performance, and from 1.3 points (2021-2022) to 0.7 points (2022-2023) and 0.5 points (2023-2024) in CCE Enablers.[6]

**Figure 7.** Trends in CCE Index scores 2021-2024, all countries.

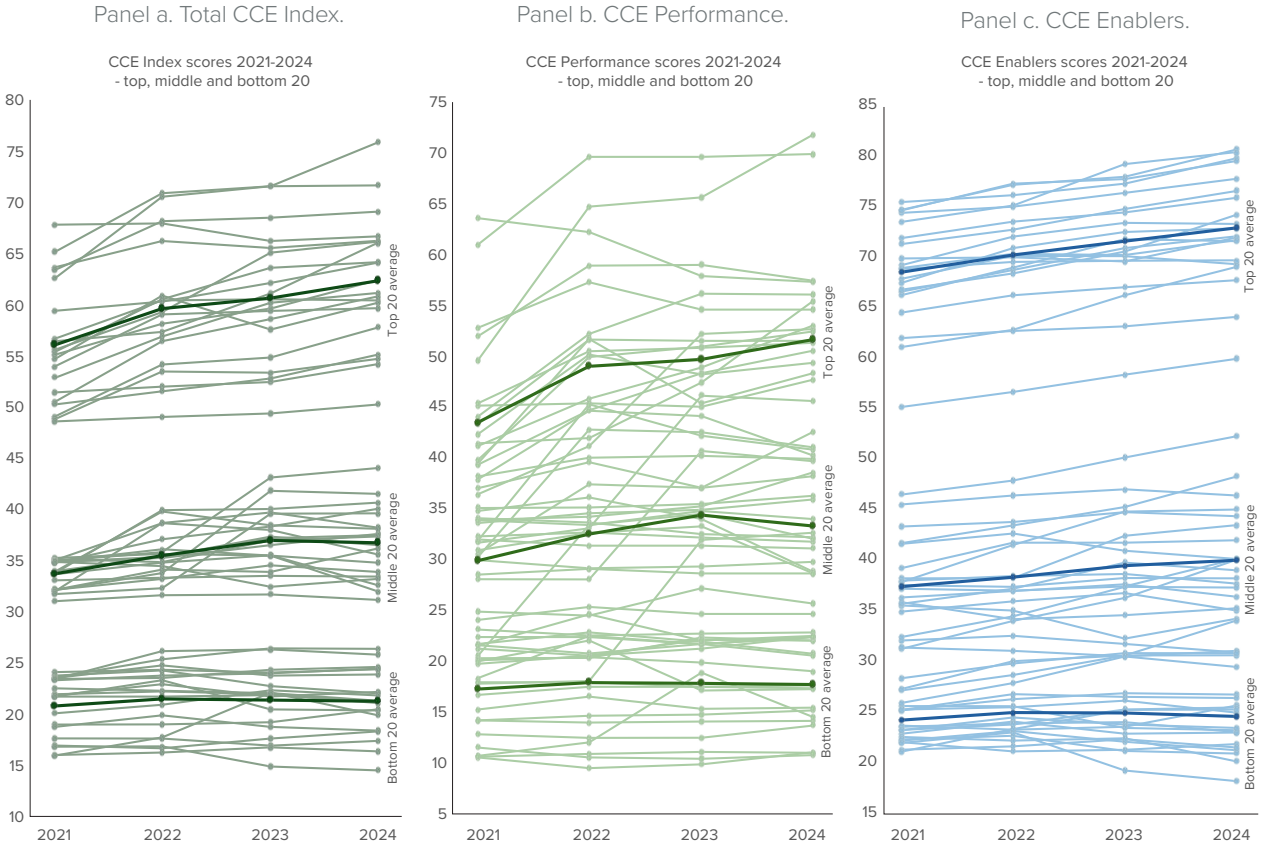



*Source: Authors.*
*Note: Each line indicates a country score and its change in 2021-2024. The departure points in the figure are countries' CCE Index scores for 2021, from the 2024 CCE Index edition.*

***Insight 5: Top performers are accelerating their transitions significantly more than countries in the middle and bottom of the distribution. Countries at the bottom are stalling.***

While a slower pace of improvement characterizes trends at the aggregate level, major divergences are also apparent at a country level, where those already at the top of the distribution are progressing much faster than those toward the bottom (Figure 8).

**Figure 8.** Trends in CCE Index scores 2021-2024, top 20, middle 20 and bottom 20 countries.




*Source: Authors.*
*Note: Each line indicates a country score and its change in 2021-2024. The departure points in the figure are countries' CCE Index scores for 2021, from the 2024 CCE Index edition.*

As shown in Figure 8, panel a, the top 20 countries in the index improved their scores by an average of 6.3 points, whereas the middle 20 increased by 3.0 and the bottom 20 only by 0.5 points on average. The same pattern is present in both CCE Performance and CCE Enablers (Figure 8, panels b and c). In CCE Performance, the top 20 improved on average by 8.1 points, the middle 20 by 3.4 points, and the bottom 20 by 0.5 points only. In CCE Enablers, these average improvements were 4.4, 2.6, and 0.4 points, respectively.[7]

***Insight 6: Enabling environments among middle and low-performing countries need to be urgently brought up to speed with those in top-performing countries.***

Figure 8 also displays a further source of divergence across countries, where high-performing countries (top 20) have significantly stronger enabling frameworks than those in the middle and toward the bottom. In 2024, the average CCE Enablers score for the top 20 countries (73 points) is nearly twice that of the middle 20 countries (40 points) and three times that of the bottom 20 countries (25 points) (Figure 8, panel c).

## 3.2. Trends Insights – Enabler Dimensions

Further analysis of the trends in enablers can help explain the global divergence in CCE Index scores. Examining these dimensions allows for a better understanding of the drivers of both progress and challenges in achieving circular carbon economies across countries.

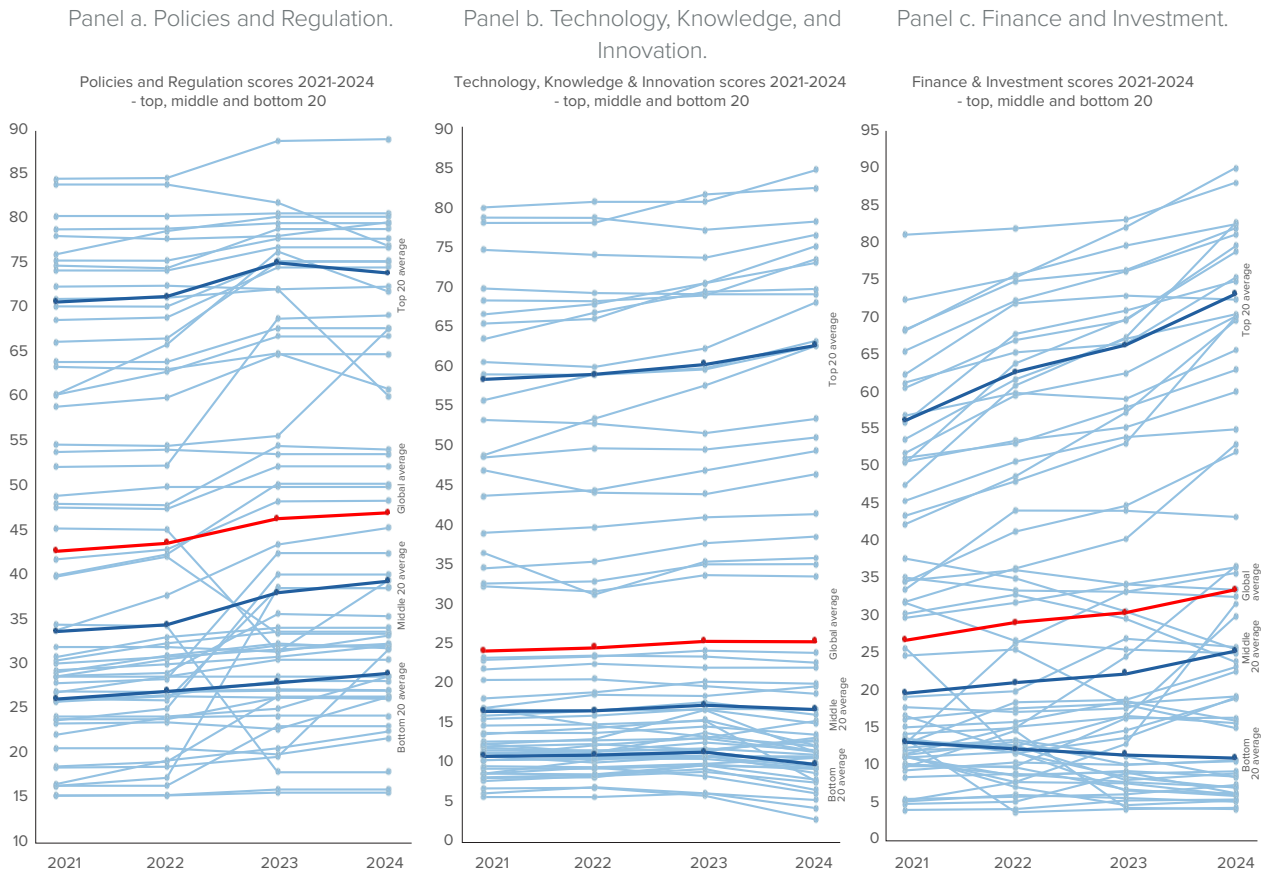
Figure 9 displays the 125 index countries' scores in the three most dynamic CCE Enablers dimensions in 2021-2024 in a similar format as above (see Figures 7 and 8): Policies and Regulation, Technology, Knowledge and Innovation, and Finance and Investment. Since 2021, the most significant improvements globally have taken place in these three dimensions.[8] Notably, the Finance and Investment saw a substantial uptick, driven by a growing global focus on sustainable finance,[9] with the average score in this dimension being 25% higher in 2024 than in 2021 (34 compared to 27, respectively) (Figure 9, panel c). The Policies and Regulation dimension also showed a notable improvement of 10% (47 in 2024, 43 in 2021), reflecting increased climate policy ambition in recent years (Figure 9, panel a). Meanwhile, the Technology, Knowledge and Innovation dimension, which covers the creation and dissemination of clean technologies, recorded a more modest improvement of 5% (25 in 2024, 24 in 2021), partly due to persistent gaps between top- and bottom-performing countries (Figure 9, panel b).

From Figure 9, the following high-level message can be identified:

***Insight 7: In critical enabling dimensions of the net-zero transition, countries in the middle and bottom of the CCE Index ranking consistently fall below the global average scores, with the observed gaps showing no signs of closing over time.***

This finding is underpinned by distinct findings related to each of the three dimensions. In the area of Finance and Investment, most of the global improvement seen in 2021-2024 was driven by the top-performing countries (Figures 9, panel c). The middle 20 countries showed gradual progress, which is in line with the global average score, while the bottom 20 exhibited a clear decline. The widening gaps between nations in the Technologies, Knowledge and Innovation dimension, in turn, reflect the fact that innovation remains concentrated in a small number of countries and that its global dissemination is progressing slowly (Figure 9, panel b). The following section zooms into the Policies and Regulation dimension, providing a more detailed analysis of 2024 results and 2021-2024 trends in this area.

**Figure 9.** Trends in Enabling Dimensions, 2021-2024 – top 20, middle 20, and bottom 20 countries.




*Source: Authors.*
*Note: The departure points in the figure are countries' CCE Index scores for 2021 from the 2024 CCE Index edition.*

# 3.3. 2024 and Trends Insights – Policies and Regulation Enabler Dimension

Previous CCE Index analyses have drawn attention to the wide gaps across countries in finance and technology.[10] This year's analysis hones in on the Policies and Regulation dimension, presenting key insights from this critical enabling area for net-zero transitions.

The indicators in this dimension measure the strength of countries' policy frameworks in four areas (energy efficiency, renewable energy, CCS, and natural sinks), as well as their compliance with emissions reporting obligations under the UN Framework Convention on Climate Change (UNFCCC) and the strength of their commitment to net-zero emissions. In aggregate, they provide a measure of the robustness of the policies and the practices in place to enable holistic climate action – not the actual content of climate change policies or performance.

The three leading countries in Policies and Regulation in 2024 are the United Kingdom, Germany, and France (Figure 10). As can be expected, high-income countries tend to score higher on this indicator, albeit with exceptions, such as Bahrain, Trinidad and Tobago, and Qatar, which all rank lower than 100. Countries from other income groups also rank across the remaining distribution, with lower middle-income countries, instead of low-income countries, dominating the bottom end. Differences between the top and bottom performers in this CCE Enabler dimension are three-fold.

While the overall trend in the Policies and Regulation dimension scores in 2021-2024 has been, on balance, rather positive, scores are characterized by volatility over time. These two findings are discussed below.

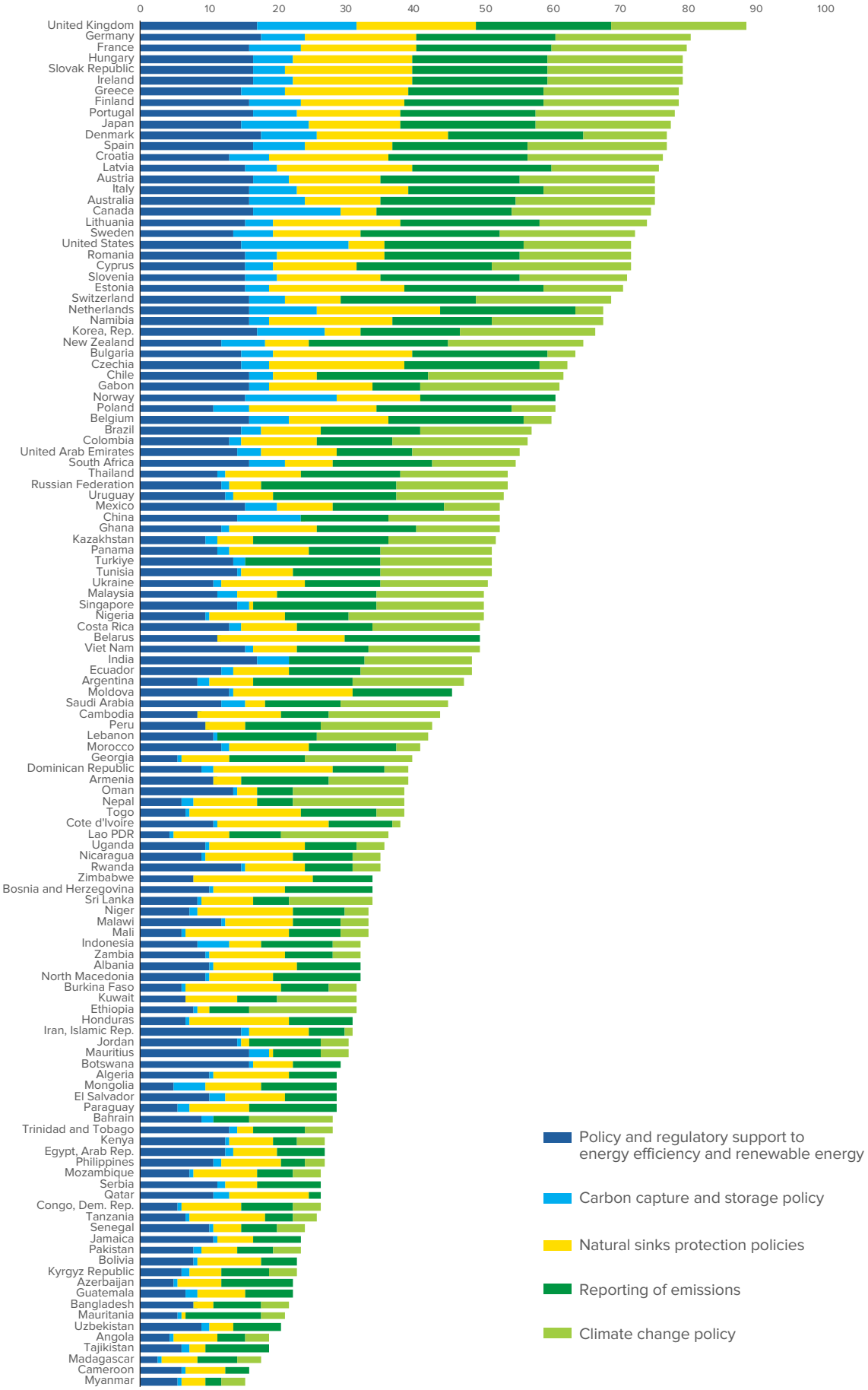
***Insight 8: On a positive note, there has been good progress in policies and regulations, led by countries that score in the middle of the CCE Index.***

On average, over 2021-2024, the 125 countries in the CCE Index have improved their Policies and Regulation enabler dimension scores by 4.3 points. This is more than the average rate of increase in total CCE Index scores in the same period (3.4 points). Figure 9, panel a displays score changes in 2021-2024 across the index countries, focusing on the top, middle, and bottom 20 ranked countries (based on their total CCE Index rank in 2021). As shown in Figure 9, the largest increases over this period took place among the 20 middle performers in the CCE Index – of 5.7 points on average. (More broadly, the middle tertile of countries, i.e., the 42 countries in the middle of the index rank, improved their scores by 5.9 points on average.) The top 20 countries in the overall index improved their scores by 3.2 points on average, while the bottom 20 countries improved by 2.9 points on average.

There is no immediately evident common denominator among the highest-improving countries, as they are located in all global regions and represent all income groups. When segmenting all 125 countries' performance in Policies and Regulation based on income groups, upper-middle-income- and low-income countries have seen the greatest improvement in 2021-2024 – of 5.6 and 5.9 points on average, respectively. The two other groups have improved by only 3.4 (high-income) and 3.5 (lower middle income) points on average.

The message from these findings is carefully optimistic, as it indicates positive trends in even lower-income countries, which generally tend to face challenges in other areas of the index (see Figure 6, panel d). The slower progress among high-income countries may be partly attributable to saturation, as countries approach the high end of scores where improvement becomes more difficult, but it may also be a reflection of a broader deprioritization of climate change policy.

**Figure 10.** 2024 Policies and Regulation Enabler dimension country scores and ranking.




*Source: Authors.*
*Note: The height of each color in the bar represents its relative contribution to the total dimension score.*

***Insight 9: Changes in long-term policy are a source of volatility in countries' net-zero policy and regulatory frameworks, and more stable targets and clear pathways are needed for consistent signaling and sustained implementation.***

The CCE Index scores are generally more volatile at the indicator – as opposed to aggregate – level. Understanding the aggregate scores (total CCE Index, CCE Performance, CCE Enablers) therefore requires a decomposition analysis that allows the identification of the causes of score changes.

Since 2021, there have been major changes in the Policies and Regulation scores in both directions at the individual country level. Out of the five-dimension indicators, the net-zero policy commitment indicator had the strongest influence on country scores, followed by emissions reporting. More than a third of the countries (44 in total) improved their scores by more than 5 points. Out of these, 19 countries gained more than 10 points in 2021-2024. The top improvers were three developing countries at various income levels – Gabon, Oman, and Tunisia. Over this period, 14 countries have seen their scores fall, with Madagascar, Belgium, and Denmark – again, a diverse group – registering the largest drops (see Figure A.4 in Appendix 1). A closer look at the top and bottom performers helps us understand what contributed to these increases and decreases.

Gabon, which climbed from rank 67 to 34 in this dimension, declared during the observed time period that it had achieved carbon neutrality, stating that the country net absorbs more than 100 million tonnes of $CO_2$ equivalent (MtCO2e) per year (République Gabonaise 2022). The country also committed in its second NDC "unconditionally to remain carbon-neutral up to and beyond 2050" (République Gabonaise 2022). It also made some improvements across three other indicators. Oman, the second-highest riser, registered a significant improvement in its regulatory frameworks for energy efficiency and renewables, as measured by the World Bank's RISE indicators (ESMAP 2023). It also announced a net-zero target, enshrining it in the long-term policy planning document, National Strategy for an Orderly Transition to Net Zero (Sultanate of Oman 2022). On the other end of the scale, a closer look reveals the largest reductions relating to downgrading of countries' net-zero target status in the Net Zero Tracker database, which is the data source for the CCE Index in this area (ECIU et al. 2024).[11]

Fundamentally, what the changes described above can primarily be seen to reflect are the broader dynamics of net-zero policies. First, net-zero targets are a relatively recent phenomenon, which only began to emerge on the global climate policy agenda in the 2020s. As of mid-2024, 23 countries included in the CCE Index had no net-zero target or had no communicated plans that considered setting one (ECIU et al. 2024). Second, there is no centrally defined, harmonized way for countries to set net-zero targets, no unified reporting platform that enjoys international legitimacy, and no mechanism for holding countries accountable for making progress in line with their net-zero targets. Notably, net-zero target-setting at the country level is not a party obligation under the Paris Agreement, unlike the NDCs.[12]

Third, this lack of agreed norms and rules can easily lead to a lack of accountability, which is reflected in the difficulties faced by multi-institutional research initiatives, such as the Net Zero Tracker, to keep track of countries' net-zero commitments. The volatility in the Policies and Regulation scores discussed above is a reflection of this broader challenge. One way to interpret the CCE Index results in this area is therefore that while there are generally positive, albeit modest, improvements in policy and regulatory frameworks on the ground, stronger and more consistent signals from governments – in the form of stable and reliable net-zero targets and implementation strategies – are still needed as a compass for the direction of travel.

# 4. Policy Messages

The 2024 CCE Index results deliver nine major insights, highlighted in sections 2-3, which reflect the urgency of accelerating the global net-zero transition, doubling down on sustained progress, and ensuring just transitions worldwide. These are summarized below:

**The differences are wide:** The world's largest economies, which are also responsible for the majority of GHG emissions, are performing comparatively better than the global average and have the potential to do more. A significant share of the world's population, however, lives in countries that are falling behind in the transition. While all regions have homework to do, Sub-Saharan Africa needs urgent global support.

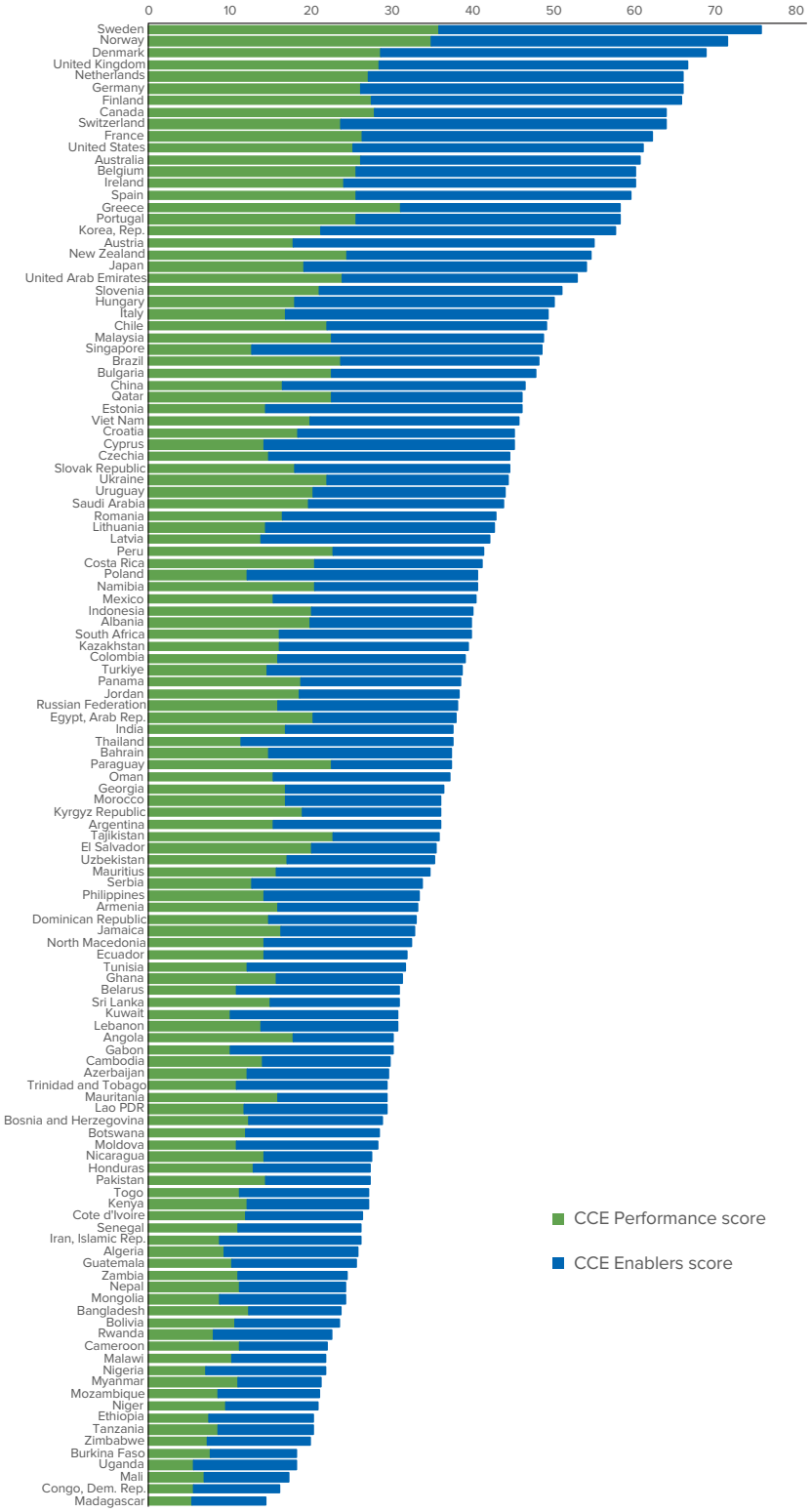
**There is a divergence in pace:** The global pursuit of net-zero emissions continues but has slowed down. On a closer look, however, top performers are accelerating their transitions significantly more than countries in the middle and bottom of the distribution. Meanwhile, countries at the bottom are stalling.

**Gaps in enablers are not closing:** Enabling environments for the net-zero transition among middle and low-performing countries need to be urgently brought up to speed with those in top-performing countries. In critical enabling dimensions – finance, technology, and policy – countries in the middle and bottom of the CCE Index ranking consistently fall below the global average scores, with the observed gaps showing no signs of closing over time.

**Policies are stronger but still volatile:** On a positive note, there has been good progress in policies and regulations, led by countries scoring in the middle of the CCE Index. However, changes in long-term policy are a source of volatility in countries' net-zero policy and regulatory frameworks, and more stable targets and clear pathways are needed for consistent signaling and sustained implementation.

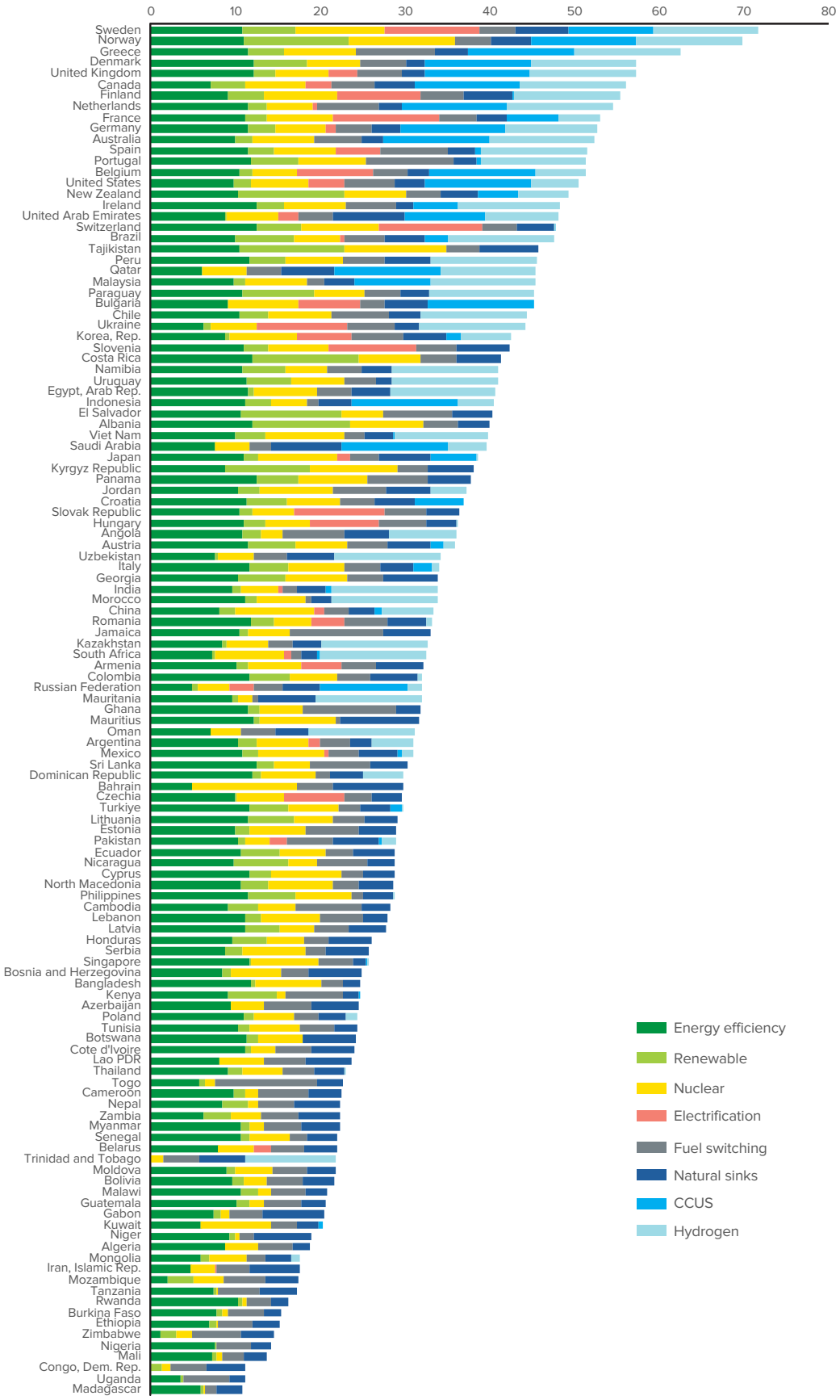
# Appendix 1.
# Additional Visualizations

**Figure A.1.** 2024 total CCE Index scores.



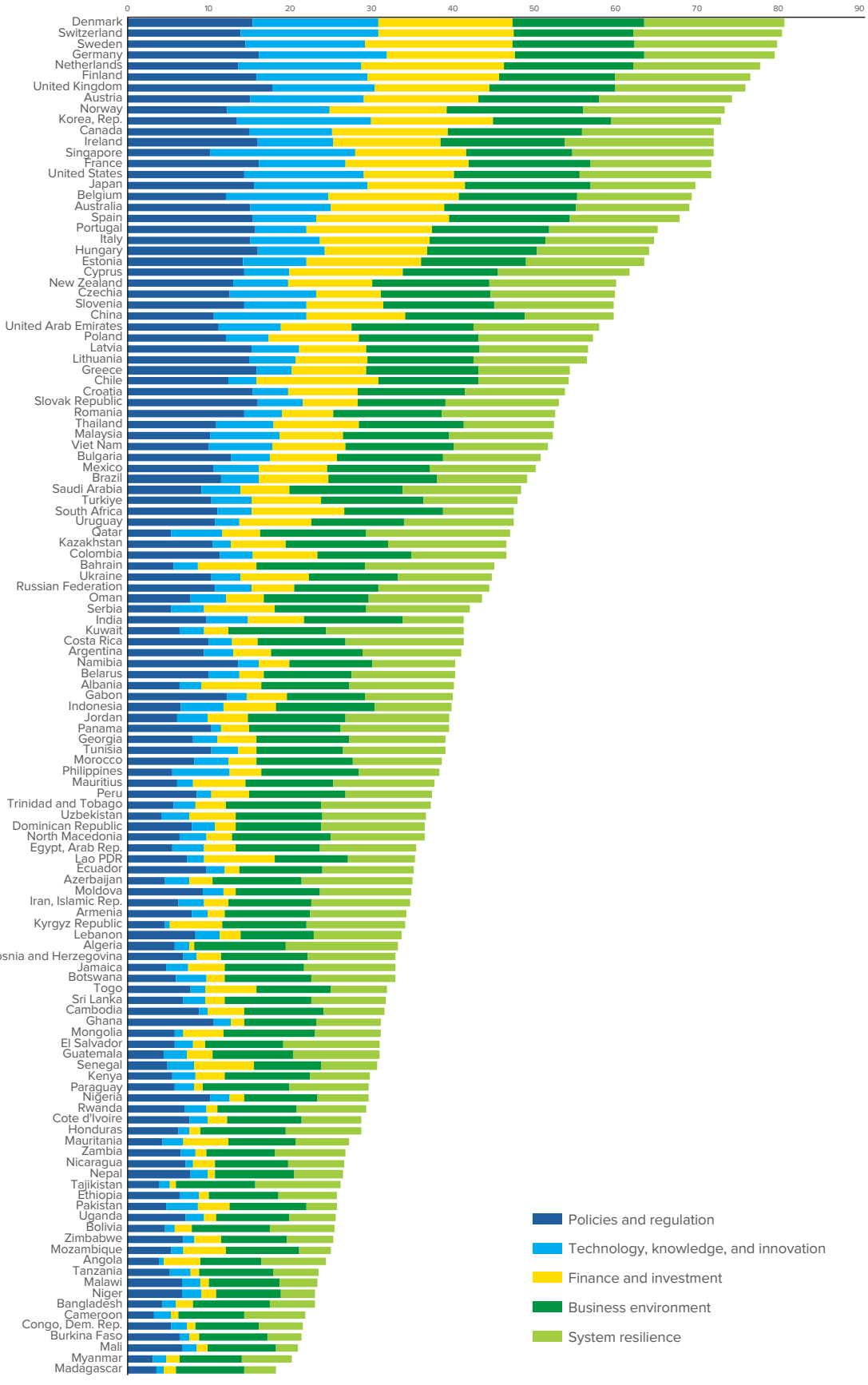

*Source: Authors.*

**Figure A.2.** 2024 CCE Performance scores.



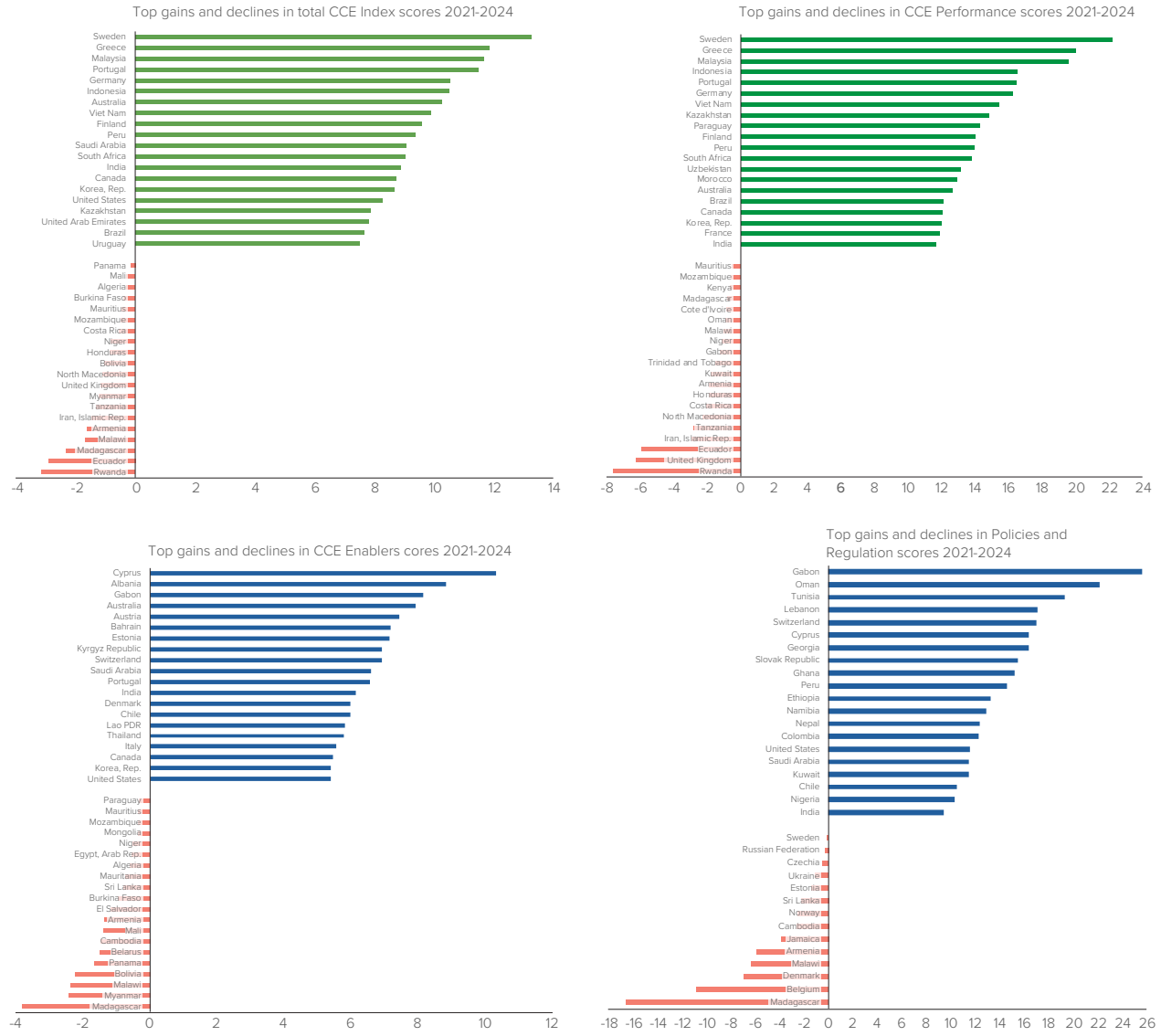

*Source: Authors.*

**Figure A.3.** 2024 CCE Enablers scores.




*Source: Authors.*

**Figure A.4.** Top gains and declines in CCE Index country scores 2021-2024.




*Source: Authors.*

# Appendix 2. Methodological Updates

The CCE Index 2024 edition extends country coverage to 125, including all nations with an average population of at least 1 million over the past five years, provided that they meet the index's stringent data availability and quality criteria. The data requirements are set at high standards to maintain the index's robustness and reliability. Specifically, countries and indicators must demonstrate at least 80% data availability prior to any imputation procedures to be included in the index. While this requirement is applied strictly, exceptions were granted to two indicators in a few cases. These include CCS policy (with 71.2% data coverage) and Renewable energy investment and deployment opportunities (measured by the "RECAI" index) (with 76% data coverage), and, finally, CCS storage where data coverage was improved based on the guidance from the data provider that eventually satisfied the 80% data availability rule.

Once the countries and indicators are selected, missing observations are imputed following a standardized procedure. First, zero-imputation is used where applicable, after confirming the accuracy of this approach with data providers. For example, indicators such as carbon capture and storage capacity, clean hydrogen capacity, sustainable debt issuances, and energy transition investments, from the Bloomberg New Energy Finance (BNEF) database, are treated this way, based on the assumption that missing observations indicate the non-existence of the indicator's subject in BNEF's comprehensive dataset.

Second, missing observations are imputed using the most recent available data – either historical or future observations – in order to prevent the creation of artificial trends over time. Third, in cases where a country provides no data for any year, the missing values are imputed using region-income averages for that specific year. With the expansion of country coverage, we are now able to utilize all seven World Bank's regions (East Asia and Pacific, Europe and Central Asia, Latin America and the Caribbean, Middle East and North Africa, South Asia, Sub-Saharan Africa, and North America) and all four income groups (Low-Income Countries, Lower-Middle-Income Countries, Upper-Middle-Income Countries, and High-Income Countries). In previous years, we were able to use only three income groups. This has strengthened our imputation strategy. There were only two cases in which this approach was not applicable, namely, CCS policy and RECAI, due to insufficient data availability, where we used three income groups by combining upper- and middle-income into middle-income groups.

# Endnotes

[1] According to Climate Watch (2024), in 2021, the 125 countries represented 96.12% of global GHG emissions including land use change and forestry (LUCF) and 96.69% excluding LUCF.

[2] In addition, the CCE Index generates an add-on score called the Oil Producers Lens score for leading oil and gas-producing countries. This "lens" introduces five additional indicators that measure the carbon circularity performance of industries in these countries. It is aggregated with the CCE Performance and Enablers scores to form the total Oil Producers Lens score for the world's top 30 oil and gas producers. The results are available via the CCE Index web portal: https://cceindex.kapsarc.org/.

[3] G20 emissions are calculated with the contributions of all EU members. G20 countries were estimated to have accounted for 75.10% of total global emissions (incl. LUCF) and 78.72% of total emissions (excl. LUCF) in 2021 (Climate Watch 2024).

[4] The country ranks eighth in the world in hydropower capacity, and, according to the IEA, only 4% of Tajikistan's hydro potential is being exploited (IEA 2022).

[5] The carbon pricing indicator rewards countries for having an emissions trading scheme, carbon tax, or crediting mechanism implemented, under development, or under consideration at national or subnational levels.

[6] Naturally, as base (reference point for comparison) increases, the potential for increase also diminishes.

[7] Both CCE Performance and CCE Enablers receive an equal weight in the total CCE Index score calculation. The CCE Performance sub-index, however, only has eight indicators that are based on technology implementation or project pipelines, or other types of performance metrics. Individual CCE Performance indicators therefore have more influence on the total CCE Index score. Additionally, changes in these indicators can be expected to be larger in magnitude than those in the CCE Enablers sub-index, which comprises 30 indicators. This is mainly because performance-related indicators (as the output of the process) directly reflect any project or activity implementation on the aggregate scores. On the contrary, the enabling factors (as the inputs of the process) are more indirect, requiring a longer time and wider efforts to improve, and, hence, have more gradual impact on the aggregate scores.

[8] In contrast, progress in the Business Environment and System Resilience dimensions has been more moderate.

[9] It is, however, worth noting that the increased cost of capital due to the high-interest environment (to fight inflationary pressure created by the stimuli during the COVID-19 era) negatively affects investors' appetite that manifested itself in the declining trend of global sustainable finance flows in the last couple of years (Yilmaz and Cilekoglu 2024).

[10] As highlighted above (Section 2.1) and in previous CCE Index editions, the widest gaps across countries persist in the CCE Enablers areas of Technology, Knowledge and Innovation and of Finance and Investment. This has been discussed in, for example, Luomi, Yilmaz, and Alshehri (2021, 2024).

[11] Madagascar mainly lost points due to a downgrading of its status from having achieved net-zero emissions based on its self-declaration of having one under discussion. According to Climate Watch, the country's net emissions in 2021 were 40.4 MtCO2e (Climate Watch 2024). Belgium and Denmark were similarly downgraded by the same registry due to a change in status. In the case of Denmark, this may be a temporary fall, as a previous 2050 target in law was replaced in the Net Zero Tracker database by a declaration by the government to explore moving the target year to 2045 (ECIU et al. 2024).

[12] Paris Agreement Article 4.19 simply states: "All Parties should strive to formulate and communicate long-term low greenhouse gas emission development strategies, mindful of Article 2 taking into account their common but differentiated responsibilities and respective capabilities, in the light of different national circumstances" (UNFCCC 2015).

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# Notes

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# About the Project

KAPSARC's Circular Carbon Economy (CCE) Index project expands and adds rigor to the conceptual basis of the CCE concept, as well as its practical operationalization, by providing a robust quantitative framework to measure countries' performance and their progress toward CCEs, or net-zero emissions. The resulting CCE Index is a composite indicator that measures various dimensions of the CCE and net-zero transitions in a national context across countries. Its main foci are current performance and enabling factors for future progress.

The first edition of the CCE Index, published in November 2021, covered 30 countries. Editions 2022 and 2023 covered 64 major economies and oil- and gas-producing countries. From the 2024 edition onwards, the index includes 125 countries, providing wide representation of from all world regions and covering 96% of global greenhouse gas (GHG) emissions. The index is disseminated through various research outputs, including KAPSARC discussion papers and commentaries, which present the index results and analyze them in depth, as well as KAPSARC methodology papers, conferences, workshops and other events, and an online platform, located at https://cceindex.kapsarc.org/. The index is updated annually, with the 2024 edition launched in November 2024.


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