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Commentary

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Circular Carbon Economy Index
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Measuring Carbon Circularity in the World's Major Forest Economies

The CCE Index Forest Industry Lens

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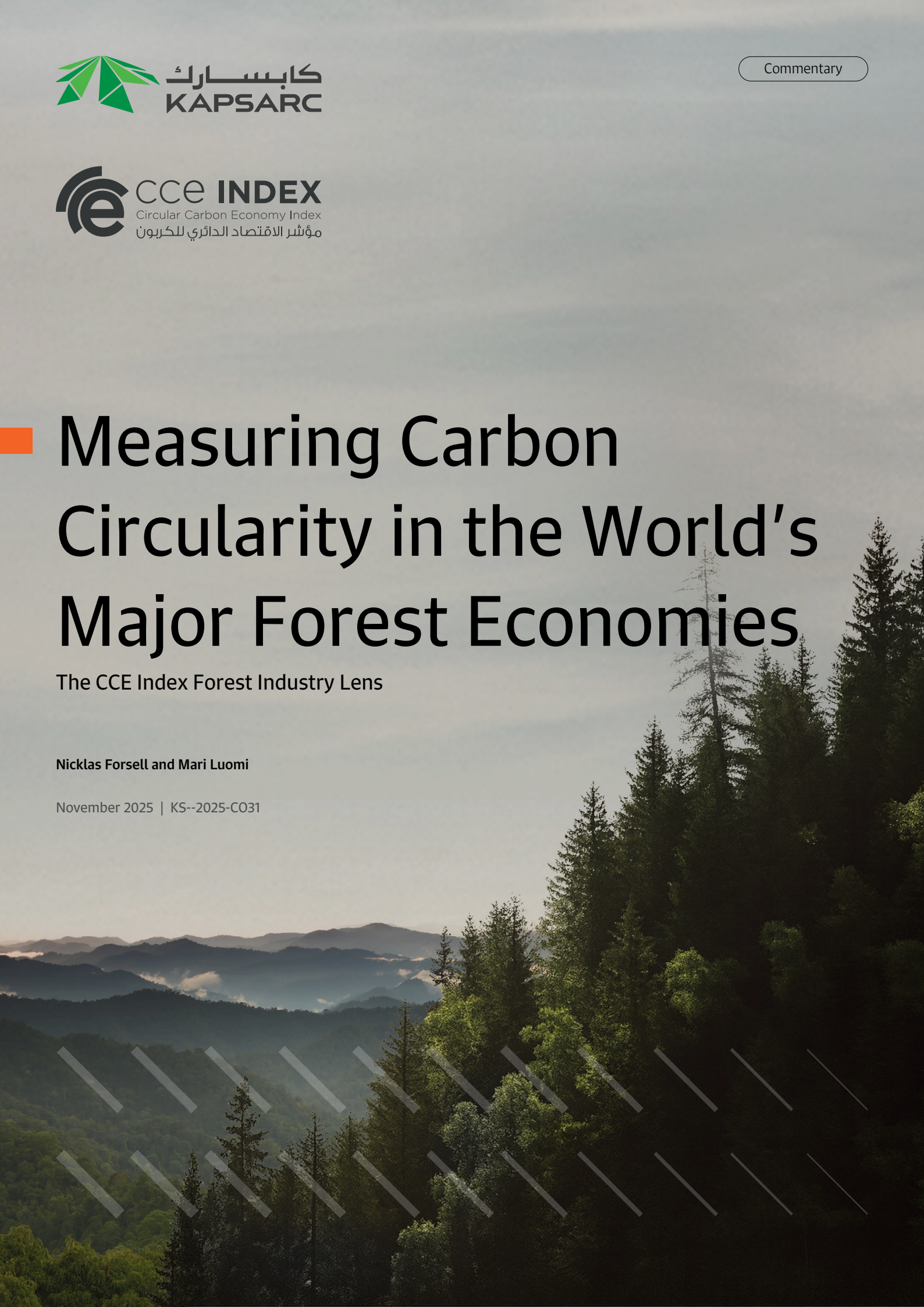

About KAPSARC

KAPSARC is an advisory think tank within global energy economics and sustainability providing advisory services to entities and authorities in the Saudi energy sector to advance Saudi Arabia's energy sector and inform global policies through evidence-based advice and applied research.

This publication is also available in Arabic.

Legal Notice

Overview

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Forest industries have the potential to play an important role in the development of a circular carbon economy, as wood can both sequester carbon dioxide (CO_2) and is a highly reusable and recyclable material. Wood can effectively store the carbon initially absorbed by the forest through photosynthesis, thereby ensuring that the carbon emissions are not released until the wood products themselves are decaying (Fuller et al. 2025; Sato and Nojiri 2019; Steel 2021). It is, therefore, crucial to focus on understanding how carbon circularity in the forest industry sector can be achieved and how these key producers are faring compared to one another.

The world's 30 largest forest industry countries (including China, the United States, and the Russian Federation) together account for 93% of the world's production of semi-finished wood products and 90% of the global output of industrial roundwood, which makes them an important group to focus on (FAOSTAT 2025).

This commentary uses KAPSARC's Circular Carbon Economy (CCE) Index methodology (Luomi, Yilmaz, and Alshehri 2021) to construct an aggregate score called the Forest Industry Lens (FIL), which measures the carbon circularity of the world's major forest industry nations in the four areas of the CCE: reduce, reuse, recycle, and remove. The FIL constitutes a novel contribution to the field of country comparison indices, and its results can be analyzed either as a standalone composite indicator or as an add-on score to the total CCE Index, similar to the CCE Index Oil Producers Lens (Luomi, Yilmaz, and Alshehri 2022).

The 2025 FIL results indicate that the global forest industry exhibits uneven performance in carbon circularity, with most countries excelling in one area but showing uneven development in others. No country scores well on all four indicators corresponding to the four Rs of carbon circularity. Rather, many countries perform well in only one or two dimensions. These results reflect that countries generally tend to strongly specialize in one area of the forest industry, with significant variations across countries. For example, Malaysia and Viet Nam score high in the use of recycled paper, corresponding to the "recycle" pillar of carbon circularity, while France and Latvia score high in the use of recovered and reusable material, corresponding to the "reuse" pillar of carbon circularity.

Over the five-year period measured by the 2025 FIL, covering the years 2019 to 2023, the results indicate a small reduction in the overall carbon circularity of forest industries, with the global

average score falling slightly over this period. This decrease is primarily driven by an overall deterioration in resource efficiency ("reduce"). However, this is partially offset by improvements in the reuse of materials ("reuse"), paper recycling ("recycling") rates, and the production of long-lived wood products ("remove"). At the level of individual countries' indicator scores, many have made progress in one or two indicators, but progress is in most cases offset by setbacks in other indicators. This signifies that additional policies are necessary to enhance the use of biomass resources more effectively, and such policies should not undermine progress in other indicators; instead, they should be based on win-win solutions that benefit the overall circularity of the forest industries.

Overall, the 2025 FIL indicates that sustainability strategies in the world's major forest industries are not yet holistic and that significant gains can still be achieved through policies that support the development of circular carbon economies. Furthermore, these policies should be better integrated and balanced to ensure that progress in one area is not undermined by weaknesses in another.

Conceptual and Indicator Framework for the FIL

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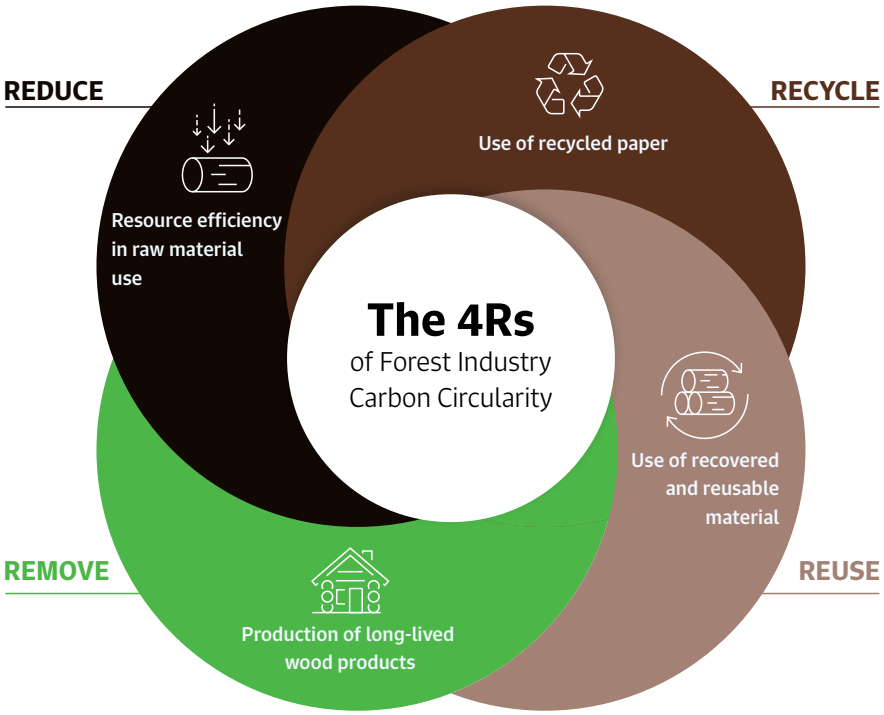
Forest biomass and forest products are important resources for the decarbonization of the economy. Forest materials offer a unique possibility to support a sustainable and climate-neutral circular carbon economy. In contrast to many other materials, harvested wood products directly sequester carbon from the atmosphere for the lifetime of their use and are both renewable and biodegradable. This means that when they cannot be reused or recycled, they can be returned to the biosphere in the form of nutrients.

The use of these materials can be an environmentally friendly alternative to high-emission building materials, and they can also serve as a carbon-neutral energy source. Wood is a renewable resource that can replace finite resources, and numerous wood-based materials can be reused and recycled back into the wood-based value chain in multiple ways. Moreover, forests, when managed sustainably to maintain a long-lasting supply of wood-based materials and support other forest ecosystem services, can provide wood, fiber, and fuel, as well as multifaceted ecosystem services such as land erosion prevention, nutrient cycling, water purification, and climate regulation, while serving as a basis for recreation and tourism (Caicoya et al. 2023; Mazziotta et al. 2022).

Thus, it is vital that the production of wood-based materials and other forest ecosystem services does not deplete natural resources or compromise ecosystem integrity. Promoting the efficient use of bio-based resources and enhancing the cascaded use of biomass within forest industries are essential strategies for achieving sustainable circular carbon economies.

Conceptual framework and indicators: In keeping with the concept of the CCE, the four indicators of the FIL follow the "4Rs" framework (reduce, reuse, recycle, and remove) of carbon circularity associated with a transition to a circular carbon economy in which various complementary approaches to minimizing the amount of CO_2 and other GHGs released into the atmosphere result in a carbon balance, or net-zero emissions (Alshehri et al. 2022). The conceptual framework of the FIL and how it reflects the four Rs of the CCE is displayed in Figure 1, which shows the four indicators that constitute the lens. The four indicators selected were chosen with the understanding that the FIL's system boundary is the performance of the forest industries. A more detailed methodological description of how each indicator is calculated is provided in Appendix 1. The conceptual relationship to carbon circularity of each of the indicators is as follows:

Figure 1. Visualization of the FIL and its four indicators.



Source: Authors (visualization by Alejandra Dander, KAPSARC).

- **REDUCE – Resource efficiency in raw material use:** The promotion and maximization of resource efficiency is an essential component of reducing the forest industry's overall environmental impacts. As a measure of resource efficiency, this indicator examines the efficiency with which raw biomass resources are used in the national production of semi-finished harvested wood products, namely sawnwood, wood-based panels, and paper and paperboard (see Appendix 2 for more information on the terminology). Increasing resource efficiency reduces the demand for raw biomass, increases forest carbon stocks, and reduces emissions associated with the transportation of biomass resources from the forest to industries.

- **RECYCLE – Use of recycled paper:** Paper recycling has significant environmental benefits, including conserving natural resources, reducing energy consumption, reducing GHG emissions, and reducing landfill waste by preserving landfill space. A measure of how much recovered and recycled paper is used in the national production of paper and paperboard products is represented by this indicator. Increasing the use of recycled paper extends the lifespan of biomass in use and enhances the circularity of carbon sequestered in paper.

- **REUSE – Use of recovered and reusable material:** A wood-based value chain in a circular carbon economy prioritizes the reuse of wood products and materials. This indicator measures the share of recovered and reusable material (i.e., wood chips and particles) used in the production of semi-finished harvested wood products. Increasing the use of recovered and reusable materials extends the lifespan of biomass in use and enhances the circularity of the carbon sequestered in the wood products.

- **REMOVE – Production of long-lived wood products:** Long-lived wood products help store the carbon absorbed by trees for decades, contributing to climate change mitigation by keeping CO_2 out of the atmosphere. The longer these products remain in use, the longer the carbon is stored, effectively delaying carbon emissions and providing a climate benefit. This indicator measures the production of long-lived wood products as a share of the total output of semi-finished harvested wood products.

Aggregation: The FIL country score is an aggregate of four indicator scores. For each indicator, the underlying values are scaled to a score range of 0 to 100, with the thresholds for maximum (100) and minimum (0) scores determined based on the averages of the three top and bottom values in the dataset, respectively. The indicators are then aggregated by equal weighting to provide a country score between 0 and 100. The approach follows that of the CCE Index.

Data selection: As in the CCE Index, the FIL uses harmonized datasets for all indicators. Both the data and the definitions of harvested wood products commodity classes are derived from the Food and Agriculture Organization of the (FAO)'s statistics database (FAOSTAT 2025). The latest year of data available from this source at the time of data retrieval was 2023. Consistent with the CCE Index, which covers five years in its 2025 edition, the 2025 FIL calculates scores for the years 2021 to 2025, using data from 2019 to 2023 – the latest years for which global statistical data are accessible through the FAO. Further information regarding the use of statistics for each indicator is provided in Appendix 1.

Scope and accounting method: In interpreting the results, it is important to note that the FIL measures the carbon circularity performance of forest industries and not the actions taken by individuals or the overall carbon circularity within a country. For example, the Remove indicator measures the production of long-lived products by the forest industries, and not their consumption at a national level. By doing so, the FIL follows the currently prevailing method of accounting for national emissions and the logic that the nation (or in this case, industry) producing the emissions is also the one held accountable for them. Furthermore, it is essential to note that the system boundary of the FIL is intentionally limited to the performance of the forest industries to ensure that its scope does not overlap with the main CCE Index. Thus, the FIL does not measure the carbon circularity performance of countries' forests, which is covered under the main CCE Index, nor the full range of ecosystem services provided by forests. In many countries, the performance of the forest industries has a significant impact on the state of a country's forests, the provisioning of forest ecosystem services, as well as the overall economy, but such aspects go beyond the system boundaries of the FIL and are thus not captured by the four indicators.

Country selection: Since the FIL targets the performance of countries' forest industries, the selection of countries is based on their contributions to the global forest market.[1] A total of 30 countries, which jointly account for 93% of global production of semi-finished wood products and 90% of global production of industrial roundwood, were selected for the 2025 FIL. The progress and developments for these 30 countries towards carbon circularity in the forest industry sector, therefore, serve as a good indicator of overall progress in a circular carbon economy. The number of countries may be expanded in possible future editions of the lens.

[1] In this first version of the FIL, countries are selected based on the national production of roundwood and industrial roundwood (each to be higher than 0.5% of global production) and the share of total land being forested (to be higher than 20%). Countries with questionable data quality were removed based on expert judgment. Ukraine is not included in the index due to the currently ongoing conflict.

2025 FIL Results

03

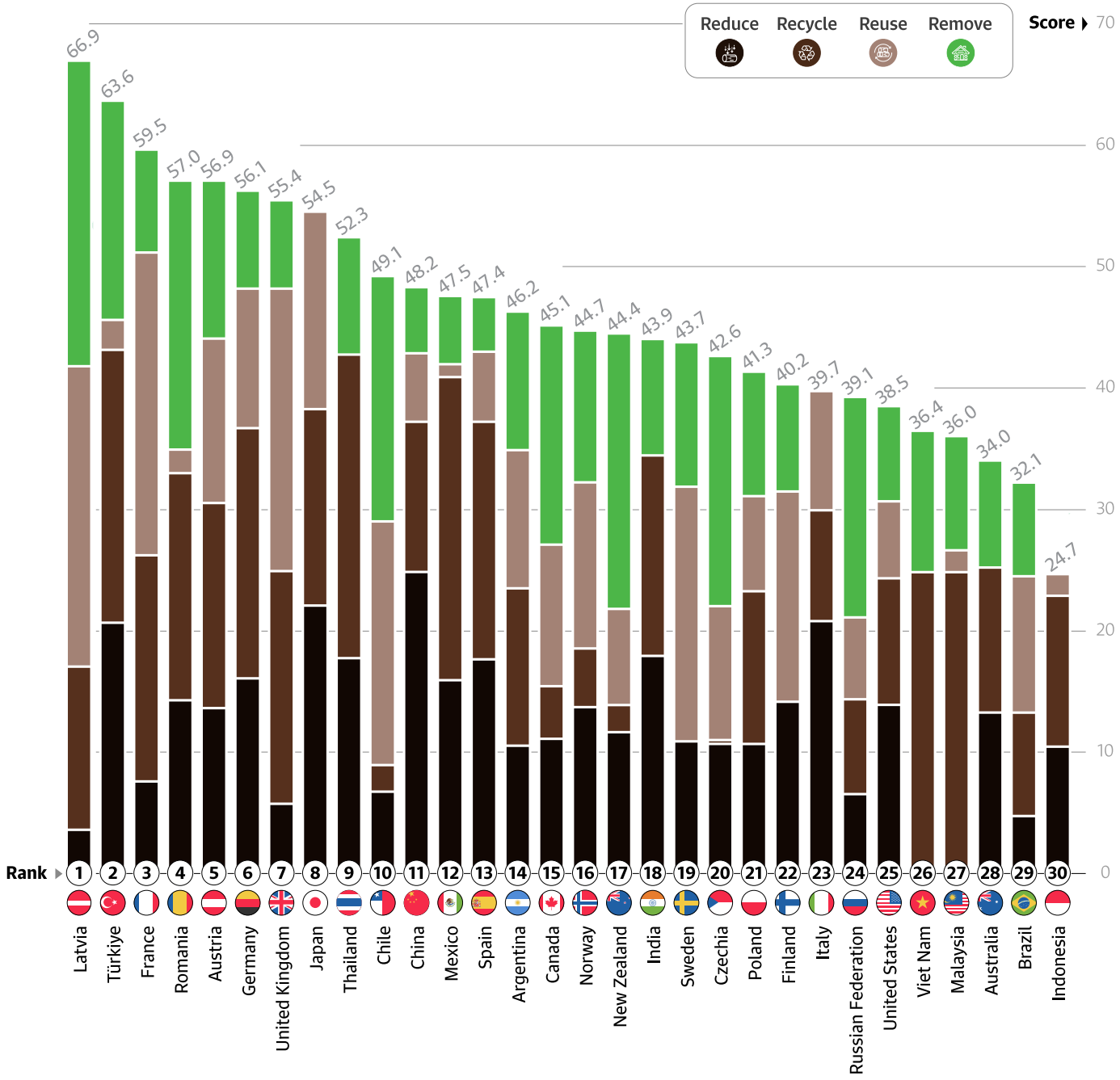
In 2025, Latvia, Türkiye, and France rank the highest among the FIL countries (Figure 2), with total country scores of 66.9, 63.6, and 59.5, respectively. There are differences in the specialization of the forest industries in these three countries, as highlighted by the scores. Latvia receives the maximum score (100) in the Remove indicator, while France gets the maximum score (100) in the Reuse indicator. Finally, Türkiye does not receive a maximum score on any individual indicator but has more balanced and high scores for the Reduce (83), Recycle (90), and Remove (71) indicators. The full results are available via the CCE Index web portal downloads section (https://cceindex.kapsarc.org/cceindex/downloads).

The results demonstrate the strong specialization of countries in specific areas of the forest industry and how these areas of specialization vary significantly across countries. Countries often excel in one indicator (e.g., China and Japan in Reduce, with scores of 89 and 100, respectively) but show weaker results elsewhere (e.g., Japan receiving a score of 0 in Remove). No country's forest industry scores high on all indicators. Among the top 10 countries, all score higher than 50 on at least two indicators, but only one country, Austria (ranked 5th) scores above than 50 on all four indicators. This suggests that the sustainability strategies of world's forest industry nations' are not yet truly holistic and that significant gains can still be made within the industries to assist with the development of circular bio-based economies.

The average score of the three leading countries (Latvia, Türkiye, and France), 63, is roughly double the average score of the three countries with the lowest scores (Australia, Brazil, and Indonesia), 30, indicating a sizeable gap in performance across countries, on average. In the lower rankings, countries tend to struggle across multiple indicators while performing well on one indicator at most. Australia gets a score close to the 30-country average in Reduce (54 compared to 50), Brazil gets a similar "average" score in Reuse (45 compared to 39), and Indonesia gets an "average score" in Recycle (50 compared to 53).

In terms of regional country groups, Europe and Central Asia dominate the top of the ranking, with seven out of the top 10 coming from this region. In terms of income, high-income countries occupy eight of the top 10 positions, although Türkiye, a middle-income country, ranks second. On average, high-income countries score slightly higher than middle-income countries: 49 and 41, respectively. However, notably, only three of the FIL countries that rank in the top 10 of the 2025 total CCE Index also rank in the top 10 of the 2025 FIL (United Kingdom, France, and Germany).

Figure 2. FIL 2025 country scores and ranks.



Note: The length of each bar represents its relative contribution to the total score.
Source: Authors (visualization by Alejandra Dander, KAPSARC).

Changes Over Time – FIL Results 2021-2025

04

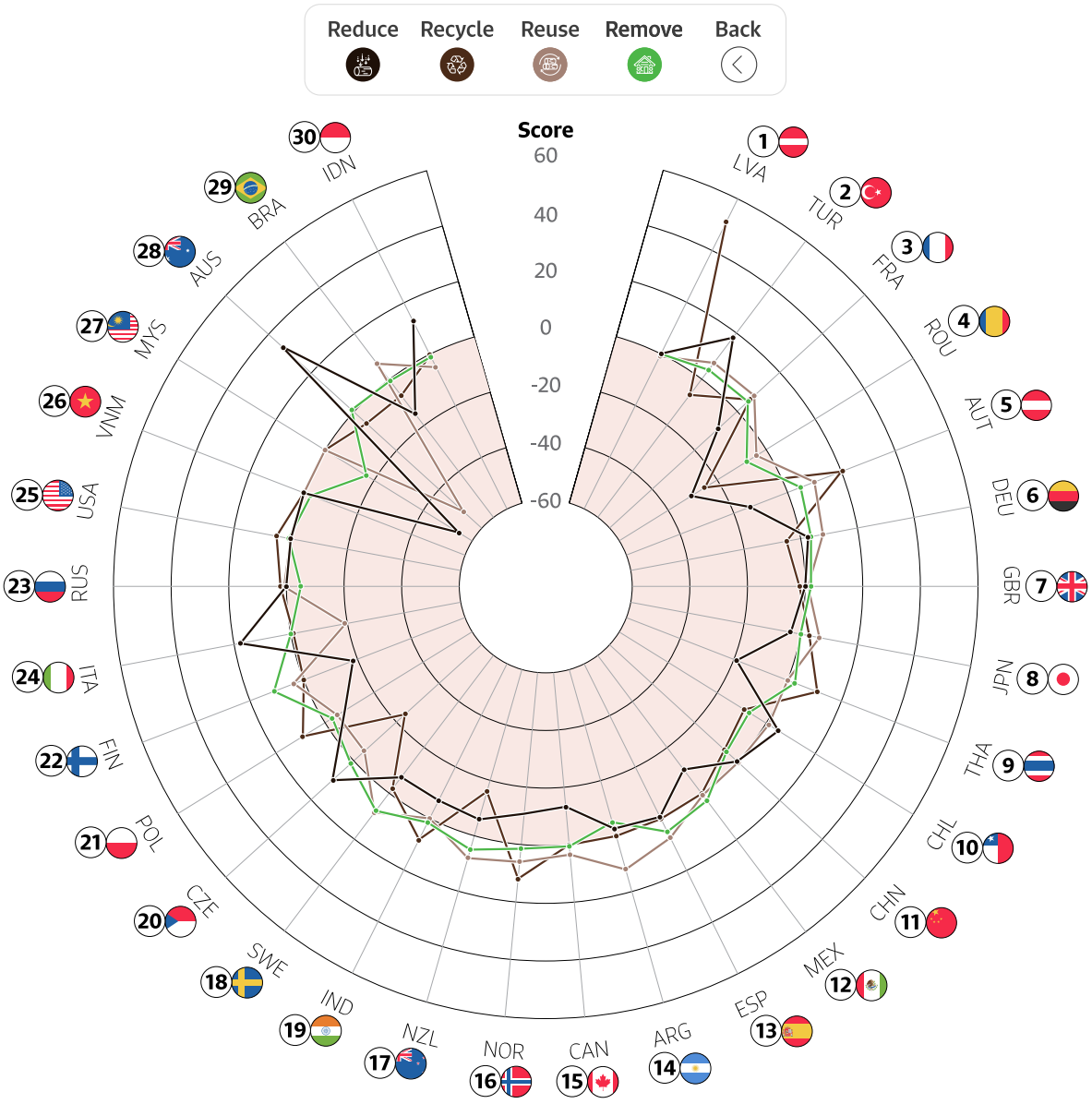
Many countries have seen a reduction in the overall carbon circularity of their forest industries over the index period 2021-2025 (Figure 3). On average, the 30 countries' scores have fallen by 0.85 points during this period. This decline is primarily driven by a decrease in countries' Reduce indicator scores, which fell by 4.47 points on average, representing an 8.3% fall over the five-year period. This is partially offset by improvements in the Recycle (+0.52 points), Reuse (+0.32 points), and Remove (+0.24 points) indicators.

Progress toward carbon circularity in the five-year period covered by the 2025 edition of the FIL has not been one-directional, neither at the indicator nor the country level; rather, results are mixed in both cases. First, regarding indicators, as shown in Figure 3, changes in individual countries' scores come in both directions (improvement and deterioration). In the case of three indicators (Recycle, Reuse, and Remove), these differences largely cancel each other out. In the case of Reduce, many countries have seen important drops in their scores, mainly due to increased reliance on stemwood instead of wood chips, thereby reducing their overall biomass efficiency rate. While countries like Australia (+34 points), Italy, and Türkiye (both +18 points) achieved strong progress, countries such as Malaysia (-54 points) and Romania (-31 points) recorded significant setbacks for this indicator. Only eight out of the 30 countries covered by the FIL registered an improvement in this indicator.

Mixed results are similarly observable in Recycle, with Latvia (+52 points) showing the largest leap forward in terms of its score. Several European and Asian countries also improved their scores for this indicator, reflecting investments in recycling infrastructure and policies. At the same time, particularly strong setbacks in Recycle are visible in Romania (-25 points), Czechia (-24 points), and New Zealand (-17 points). The mixed results for this indicator can be largely attributed to the fact that in many countries, recycled paper consumption has declined at a faster rate than the reduction in paper and paperboard production. Also, the international competition for recycled paper appears to be increasing, with countries that have experienced setbacks in recycling exporting more and/or importing less recycled paper.

Reuse shows a similar pattern, with Argentina (+12 points) and Austria (+10 points) leading the way in terms of improvements in this indicator. However, strong deterioration in the score for this indicator has occurred in Australia (-51 points) and Italy (-19 points). In several countries, the consumption of recovered and reusable materials has been reduced, while the overall production of semi-finished wood products has remained relatively unchanged, thereby reducing the overall reuse rate and leading to mixed results for this indicator. In the case of Australia, the production and consumption of wood chips and particles has gone down primarily due to

Figure 3. Changes in indicator scores for each FIL country from 2021 to 2025.



Source: Authors (visualization by Alejandra Dander, KAPSARC).

falling international demand (particularly from China and Japan), increased global competition, loss of forest access due to environmental regulations and government policies, and the impact of natural disasters like the Black Summer bushfires of 2019-2020.

Remove has seen less extreme score changes over the observation period, with only two countries recording a score change of more than 10 points. From 2021 to 2025, Finland showed the largest increase in the share of production of long-lived woody products (+11 points), while Malaysia's performance in this indicator fell by 17 points.

Regarding changes in individual countries' indicator scores from 2021 to 2025, as can be seen in Figure 3, many countries have made progress in one or two indicators, but progress is, in most cases, offset by setbacks in other indicators. For example, Australia has made significant progress in terms

of Reduce (+34 points), which has been offset by the major decrease in its Reuse score (-54 points). These changes were driven by the country's significant efficiency gains in the utilization of raw biomass resources to produce semi-finished products (Reduce) and a decision to export large quantities of wood chips and particles rather than use them to produce semi-finished products at home (Reuse).

The strongest improver in the FIL from 2021 to 2025 was Latvia (+13 points, rising from rank 4 to rank 1), while the countries with the largest drops in scores were Romania (-17 points, falling from rank 1 to rank 4) and Malaysia (-18 points, falling from rank 7 to rank 27). Additionally, over the last five years, the gap between high- and middle-income countries has slightly increased, from 5.56 points to 7.68 points. Overall, the mixed performance within indicators and countries, along with the lack of progress towards circular carbon economy goals, is of concern and merits further attention to understand its causes.

Conclusions and Policy Recommendations

05

The analysis shows that there is considerable specialization in the forest industries across countries and that the specialization varies significantly from country to country. Specialization also means that countries rarely excel across all four indicators but instead demonstrate strength in one area and weakness in another. While some nations, such as Australia, perform well in reducing overall raw biomass resource use, they do poorly in reusing these resources, indicating that sustainability strategies are not yet holistic in nature.

The FIL suggests that the overall carbon circularity of countries' forest industries has unfortunately decreased over the period of 2021-2025. During this specific period, incremental improvements are noticeable in terms of the Recycle, Remove, and Reuse indicators. However, these improvements are offset by setbacks in the Reduce indicator. At the individual country level, no country shows progress in all four indicators. Instead, progress in one or two indicators is impeded by setbacks in other indicators, highlighting a fragmented, if not stalling, transition towards circular carbon economy goals.

To enable a thriving forest industry that supplies a wide range of wood-based products, a paradigm shift towards integrated and balanced policies will be required. Such policies need to ensure that progress in one area (such as Reduce) does not undermine progress in another (such as Reuse) and that, instead, win-win solutions across the indicators are being implemented. Such a shift will support the global development of a sustainable and climate-neutral circular carbon economy where materials never become waste and nature is regenerated as the environmental impacts across the wood value chain are minimized.

The FIL constitutes the world's first composite indicator measuring the carbon circularity in the world's major forest industry nations in the four areas of the CCE: reduce, reuse, recycle, and remove. The FIL presents a novel contribution in the space of country comparison indices in that it specifically targets the forest industries, a sector commonly overlooked by other indicators.

Beyond the 2025 edition, the FIL indicator framework can be developed further based on feedback from the forest carbon expert community and the integration of new data sources. Possible areas for future refinement and expansion of the FIL include:

- **Data quality:** Although the overall quality of the data being used for the FIL is high, countries can still improve the accuracy of their reporting. This is particularly the case for import and export data, as well as data pertaining to the production of recovered post-consumer wood. Improvements in the quality of the data provided by the countries to international agencies, such as the FAO, will

both improve the results of indices such as the FIL and allow for better, data-driven policymaking.

- **System boundaries of wood products:** Currently, the FIL focuses on the main semi-finished products, which are sawnwood, wood-based panels, and paper and paperboard. Although these three aggregate commodities account for the majority of harvested wood products, they do not encompass the production and use of finished wood products such as windows, wall paneling, wall systems, furniture, and entire wooden houses. The system boundaries of the FIL can be extended as consistent datasets about such commodities become available at a global level.
- **Incorporating the biomanufacturing sector:** The use of wood to produce solid chemicals, gases, biopolymers, and textiles is excluded from this specific analysis. It would be important to integrate such data into the FIL when it becomes available at a global level and within a comprehensive dataset.
- **Values of the forest industries not covered by the FIL:** Within the current scope of the FIL, the index does not fully account for the net-positive effect of the forest industries on nature, the economy, and overall society. Expanding the FIL to account for aspects such as job creation, income generation for individuals and communities, reduction of CO_2 emissions, protection of forests, and overall support of ecosystems would enhance its accuracy and its ability to provide a comprehensive picture of the forest industries.
- **Issue of scale:** As is the case for any country comparison index, the FIL scores for each country do not consider the scale of production occurring within that country. Increasing the efficiency rate of all sawmills within the United States is more challenging than improving the efficiency of all sawmills in Austria.

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Appendix

Appendix 1. Data Sources and Calculations of Indicators

REDUCE – Resource Efficiency in Raw Material Use

This indicator measures the resource efficiency of the forest-based industries in terms of their use of raw biomass resources to produce the semi-finished harvested wood products. The higher the share, the greater the output the industry can produce from the raw biomass resources being consumed.

Calculations

In terms of the different components, production always refers to the national production of a commodity, and consumption refers to national production plus imports minus exports. Also, to ensure consistency, all variables not reported in cubic meters (m^3) by FAOSTAT are converted into cubic meters using the 2024 Joint Forest Sector Questionnaire conversion factors. The actual conversion factors used are displayed below in the Conversion Factors subsection.

Components		Units	Source
PSW	Production of sawnwood	m^3	FAOSTAT
PWBP	Production of wood-based panels	m^3	FAOSTAT
PPP	Production of paper and paperboard	t	FAOSTAT
CIRW	Consumption of industrial roundwood	m^3	FAOSTAT
CWCP	Consumption of wood chips and particles	m^3	FAOSTAT
CRP	Consumption of recovered paper	t	FAOSTAT
CRPW	Consumption of recovered post-consumer wood	t	FAOSTAT
COP	Consumption of other pulp	t	FAOSTAT
IWP	Net import of wood pulp	t	FAOSTAT

The Reduce indicator RED is calculated for each reference year as follows:

$$\mathrm{RED} = \frac{P_{SW} + P_{WBP} + P_{PP}}{C_{IRW} + C_{WCP} + C_{RP} + C_{RPW} + C_{OP} + I_{WP}}$$

RECYCLE – Use of Recycled Paper

The indicator measures the amount of recovered and recycled paper used in the country for the manufacture of paper and paperboard products.

Calculations

Components		Units	Source
C_{IRW}	Consumption of recovered paper	t	FAOSTAT
P_{PP}	Production of paper and paperboard	t	FAOSTAT

The Recycle indicator REC is calculated for each reference year as follows:

$$\text{REC} = \frac{C_{IRW}}{P_{PP}}$$

REUSE – Use of Recovered and Reusable Material

This indicator measures the share of recovered material and wood residues being used for the production of harvest wood products compared to the use of industrial roundwood.

Calculations

Components		Units	Source
C_{WCP}	Consumption of wood chips and particles	m^3	FAOSTAT
C_{RPW}	Consumption of recovered post-consumer wood	t	FAOSTAT
P_{SW}	Production of sawnwood	m^3	FAOSTAT
P_{WBP}	Production of wood-based panels	m^3	FAOSTAT
P_{PP}	Production of paper and paperboard	t	FAOSTAT

The Reuse indicator REU is calculated for each reference year as follows:

$$\text{REU} = \frac{C_{WCP} + C_{RPW}}{P_{SW} + P_{WBP} + P_{PP}}$$

It should be noted that of the 30 countries covered by the FIL, FAOSTAT does not provide data regarding "Recovered post-consumer wood" for 12 countries (Canada, Argentina, Brazil, New Zealand, Russian Federation, Ukraine, Malaysia, Mexico, India, Australia, Thailand, and Viet Nam).

REMOVE – Production of Long-Lived Wood Products

This indicator measures the production of long-lived wood products as a share of the total production of harvested wood products. The production of products for each of the harvested wood product commodity classes is scored according to the default half-lives as documented in the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2019).

Calculations

Components		Units	Source
PSW	Production of sawnwood	m^3	FAOSTAT
PWBP	Production of wood-based panels	m^3	FAOSTAT
PPP	Production of paper and paperboard	t	FAOSTAT

The Remove indicator REM is calculated for each reference year as follows:

$$\text{REM} = \frac{35 * P_{SW} + 25 * P_{WBP} + 2 * P_{PP}}{35 * (P_{SW} + P_{WBP} + P_{PP})}$$

CONVERSION FACTORS

To ensure consistency in the calculation of the indicators, all FAOSTAT data sources that are not reported in cubic meters (m^3) are converted following the 2024 Joint Forest Sector Questionnaire conversion factors. The conversion factors applied are as follows.

Calculations

Components	Reported unit	Conversion factor
Paper and paperboard	t	3.37 m^3/t
Recovered paper	t	3.37 m^3/t
Recovered post-consumer wood	t	1.5 m^3/ t
Other pulp	t	3.37 m^3/t
Wood pulp	t	3.37 m^3/t

Appendix 2 – Terminology

Forest industries: Industries using wood, paper, or recovered wood and paper as their main raw material. These include manufacturers of sawnwood, wood-based panels, and other wooden products, pulp and paper, as well as the packaging and printing industries.

Industrial roundwood: All roundwood except wood fuel. In the removal statistics, it represents the sum of sawlogs and veneer logs; pulpwood, round and split; and other industrial roundwood.

Other pulp: Pulp manufactured from recovered paper or from fibrous vegetable materials other than wood and used for the manufacture of paper, paperboard, and fiberboard. In the production and trade statistics, it represents the sum of pulp from fibers other than wood and recovered fiber pulp.

Paper and paperboard: The paper and paperboard category is an aggregate category. In the production and trade statistics, it represents the sum of graphic papers; sanitary and household papers; packaging materials; and other paper and paperboard. It excludes manufactured paper products such as boxes, cartons, books, and magazines, etc.

Recovered paper: Waste and scraps of paper or paperboard that have been collected for reuse or trade. It includes paper and paperboard that have been used for their original purpose and residues from paper and paperboard production.

Recovered post-consumer wood: Recovered wood such as pallets, private household waste, as well as used wood arising from the construction or demolition of buildings or from engineering works, whether contaminated or not. It can be recycled or reused for material or energy purposes. It excludes post-consumer wood that will not be reused (e.g., sent to landfill).

Roundwood: All roundwood felled or otherwise harvested and removed. It comprises all wood obtained from removals (i.e., the quantities removed from forests and from trees outside the forest, including wood recovered from natural, felling, and logging losses during the period, calendar year, or forest year). It includes all wood removed with or without bark, including wood removed in its round form, or split, roughly squared, or in other forms (e.g., branches, roots, stumps, and burls – where these are harvested), and wood that is roughly shaped or pointed. It is an aggregate comprising wood fuel, including wood for charcoal and industrial roundwood (wood in the rough).

Sawnwood: Wood that has been produced from both domestic and imported roundwood, either by sawing lengthways or by a profile-chipping process, and that exceeds 6 mm in thickness. It includes planks, beams, joists, boards, rafters, scantlings, laths, boxboards, and "lumber," etc., in the following forms: unplaned, planed, end-jointed, etc. It excludes sleepers, wooden flooring, moldings (sawnwood continuously shaped along any of its edges or faces, like tongued, grooved, rebated, V-jointed, beaded, molded, rounded, or the like), and sawnwood produced by re-sawing previously sawn pieces.

Wood chips and particles and residues: Wood that has been reduced to small pieces and is suitable for pulping, for particle board and/or fiberboard production, for use as a fuel, or for other purposes. It includes chips made directly from roundwood in chipping mills. It excludes wood chips made as part of a continuous industrial process (e.g., chips produced from roundwood or wood residues in the production of pulp, particle board, and fiberboard) and wood chips made directly in the forest from roundwood (i.e., already counted as pulpwood or wood fuel).

Wood fuel: Roundwood that is used as fuel for purposes such as cooking, heating, or power production. It includes wood harvested from main stems, branches, and other parts of trees (where these are harvested for fuel), round or split, as well as wood that will be used for the production of charcoal (e.g., in pit kilns and portable ovens), wood pellets, and other agglomerates.

Wood pulp: Fibrous material prepared from pulpwood, wood chips, particles, or residues by mechanical and/or chemical processes for further manufacture into paper, paperboard, fiberboard, or other cellulose products. In the production and trade statistics, it represents the sum of mechanical and semi-chemical wood pulp; chemical wood pulp; and dissolving wood pulp. It excludes pulp made from recovered paper or from fiber other than wood.

Wood-based panels: This product category is an aggregate comprising veneer sheets, plywood, particle board, and fiberboard. It is reported in cubic meters of solid volume.

About the Authors

Nicklas Forsell

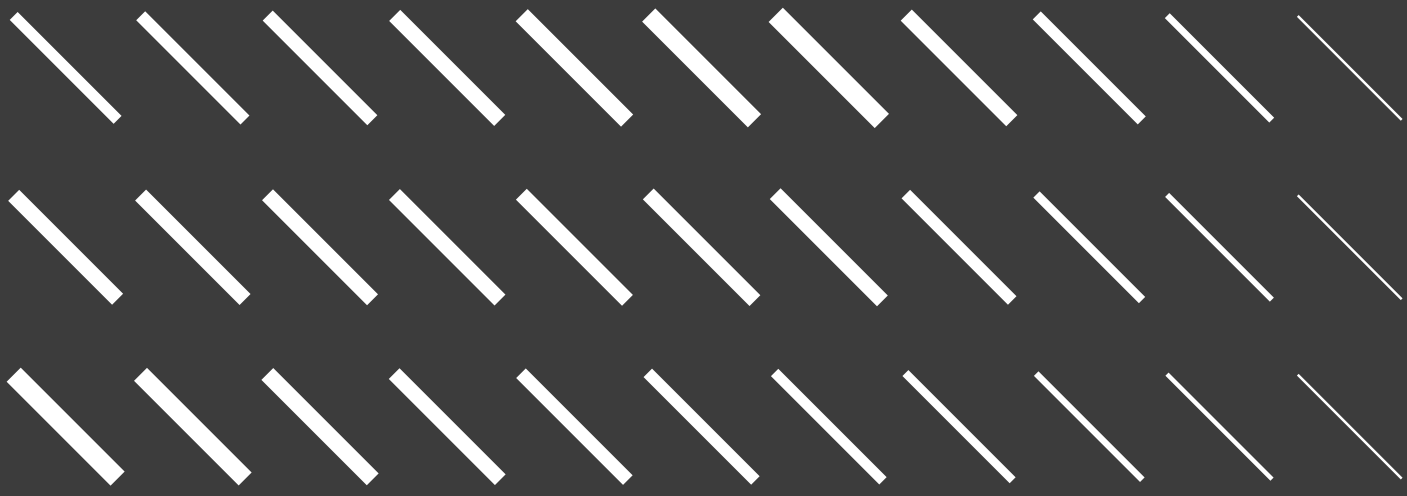
Nicklas Forsell is a Senior Researcher with more than a decade of work in systemic thinking, sustainability, climate change, climate legislation, economics, governance, and greenhouse gas reporting. Through his career, Nicklas has successfully conducted projects for international organizations (e.g., IEA, Energy Foundation China), governmental bodies (e.g., European Commissions Directorate-General for Climate Action and Environment, United States Environmental Protection Agency (U.S. EPA), UK Department for Energy Security and Net Zero (DESNZ), EFTA Surveillance Authority), and international companies (BASF, ICF). Nicklas holds a Ph.D. in Forest Economics from the Swedish University of Agricultural Science (SLU) and a Master of Science Degree in Mathematics/Applied Mathematics from the Mid Sweden University.

Mari Luomi

Mari Luomi is a Principal Fellow in the Climate and Sustainability Department at KAPSARC. She is a policy-oriented social scientist who has been studying climate change, energy transitions, and sustainable development policy in the Gulf and globally for close to two decades. She has worked for other leading energy, sustainable development, and foreign policy research institutions, including the Oxford Institute for Energy Studies, the International Institute for Sustainable Development (Earth Negotiations Bulletin), Georgetown University, the Finnish Institute of International Affairs, and the Emirates Diplomatic Academy. Mari holds a Master's degree in Political Science and International Politics from the University of Helsinki and a Ph.D. in Middle Eastern Studies from Durham University. In addition to a broad research publication portfolio, she has substantial experience in executive training, presentations, policy advisory, and reporting services for multilateral environmental negotiations.

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 has included 125 countries, providing wide representation 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 2025 edition launched in November 2025.



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