WORKING PAPER

Eurofound

Living conditions and quality of life

Composite indicators in key areas of well-being: Literature review

European Quality of Life Survey 2016: Quality of life, quality of public services and quality of society

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Contents

Introduction

Scope and structure of the working paper

In preparation for the 2026 European Quality of Life Survey (EQLS), this literature review lays the foundational work by critically examining composite indicators that assess well-being in European countries. The complexity of modern societies, with their intertwined economic, social, and environmental progresses and challenges, demands robust tools for assessment. Composite indicators serve this purpose, providing a synthesised reflection of diverse societal aspects, thereby guiding EU countries in informed policymaking and progress measurement.

This literature review endeavours to identify and critically examinate existing composite indicators that investigate the multifaceted performance across six key dimensions of societal well-being: economic performance, living standards, institutional effectiveness, digital transformation, ecological transition, and social cohesion. These dimensions represent the pillars of a holistic approach to evaluating the European quality of life, each requiring nuanced measurement tools that can adapt to the dynamism of societal progress.

A methodological section precedes the main analysis, clarifying the review approach and the criteria for selecting composite indicators. The review then investigates the 37 identified indicators, focusing on their component dimensions, metrics, employed methodologies, data sources, and potential limitations.

Acknowledging the pivotal role of gender dynamics in societal well-being, the review includes six additional indicators for gender-specific analysis. These indicators will be incorporated into the literature review to deepen the analytical scope and promote a gender-conscious perspective. In doing so, the review recognises the significance of gender in societal analysis for an inclusive interpretation of well-being that reflects the diversity of gender experiences.

Finally, the literature review concludes with a cross-dimensional synthesis, offering a summary of the key findings and putting forth recommendations for the most pertinent indicators.

Methodology of literature study

The Methodology section of this literature review encompasses a systematic approach to selecting and analysing composite indicators across various dimensions, namely economic performance, living conditions, institutional quality, digitalisation, climate change and green transition, and social cohesion. The objective is to ensure the reliability, relevance, and comparability of the selected indicators.

To initiate the literature review, the primary criterion for the selection of composite indicators is their relevance to the study's dimensions. This criterion ensures that the indicators under consideration are pertinent to the specified objectives, enhancing the study's precision and applicability.

The second criterion, data availability and reliability, addresses the fundamental importance of using indicators backed by high-quality and consistently available data. A comprehensive review prioritises indicators relying on robust datasets, thus fostering the accuracy and credibility of the resulting

composite scores. This criterion establishes a foundation for the subsequent analysis, emphasising the significance of data quality in evaluating the overall reliability of composite indicators.

The third criterion, data homogeneity, underscores the necessity for indicators to share a similar unit of measurement or the potential for transformation into a common scale. This criterion facilitates the aggregation of diverse indicators into composite scores, enabling meaningful comparisons across dimensions. Ensuring data homogeneity enhances the interpretability and coherence of the synthesised information, contributing to a more comprehensive understanding of the multidimensional aspects under investigation.

The literature review began with a systematic and exhaustive search strategy to pinpoint pertinent studies and reports on composite indicators within the defined dimensions. This process entailed identifying key terms linked to each dimension, guaranteeing thorough coverage of indicators related to economic performance, living conditions, institutional quality, digitalization, climate change, and social cohesion.

Several prominent academic databases were selected to conduct the search, including, SpringerLink, SageJournals, Wiley, among others. The choice of databases was made based on their relevance to the subject areas covered in the literature review. Moreover, specialised repositories and databases pertinent to each dimension, such as those from the European Commission, the World Bank, and the OECD, were also consulted to ensure the comprehensive gathering of relevant data.

In the following phase, an in-depth critique of methodologies, data sources, and constraints linked to each composite indicator was conducted. By examining prior studies, this review illuminates each indicator's merits and shortcomings, providing a discerning evaluation of their dependability and relevance to the objectives. This lays down a solid groundwork, offering a holistic overview of the indicators while setting the stage for further analysis.

Literature review

Living conditions and quality of life

A range of studies have explored the construction and application of composite indicators for quality of life. In this literature review, three composite indexes and three dashboards of indicators have been identified. The composite indicators reviewed include The Better Life Index, the Happy Planet Index, the Human Development Index (HDI), the Quality of Human Development Dashboard, the Quality of Life (QoL), and the Social Scoreboard. Subsequent sections will provide detailed descriptions of each.

The Better Life Index

Introduced by the OECD in 2011, as one of the two pillars of the OECD Better Life initiative, the Better Life Index is aimed to quantify societal well-being and actively involve citizens in the policymaking process. Encompassing 40 countries, it includes OECD members as well as emerging economies such as Brazil, Russia, and South Africa, offering a comprehensive perspective through 24 indicators spanning across 11 diverse topics: Housing, Income, Jobs, Community, Education, Environment, Governance, Health, Life Satisfaction, Safety, and Work–life balance.

The Index's distinctive approach involves a user-driven process for assigning weights, initially set at default values for simplicity. Users actively contribute by rating each topic, with these scores converted into weights. To enable cross-unit comparisons, a vital normalisation process utilises a standard formula, transforming values into a standardised range between 0 and 1.

Methodologically, the Index compiles data comprehensively from diverse sources to create a nuanced portrayal of quality of life. Over 80% of the indicators originate from reputable organisations such as the OECD, EU-SILC, National Statistical Offices, Eurostat, IDEA, and the Gallup World Poll, reinforcing the data's reliability.

While imputed values, applied to less than 5% of the data, require caution, they minimally impact results. Nonetheless, certain limitations merit consideration. The reliance on self-reported data introduces subjectivity, potentially affecting accuracy and comparability. Challenges also arise in assigning weights to dimensions, given the varying importance of well-being aspects across diverse populations. The aggregation of national-level data may mask regional or demographic disparities, potentially overlooking pockets of inequality. Additionally, the dynamism of societal values raises questions about the Index's adaptability over time.

Various methodologies proposed for enhancing the Better Life Index include Önay (2016) and Marković (2016) applying multi-criteria decision-making methods for alternative rankings, Monteiro (2019) utilising a clustering algorithm to segment countries, and Mizobuchi (2017) incorporating sustainability concerns. These collective efforts showcase a commitment to continually refining and evolving the Better Life Index to provide a comprehensive understanding of societal well-being.

Happy Planet Index

The Happy Planet Index (HPI) incorporates three crucial components to assess the effectiveness of environmental resource utilisation in promoting enduring happiness among residents of diverse countries. It is based on two objective indicators, life expectancy and ecological footprint per capita, and one subjective indicator 'life satisfaction'.

The index, calculated annually since 2006 and last published in 2019, evaluates 152 countries. The calculation process involves multiplying mean life expectancy and mean experienced well-being, then dividing the result by the country's Ecological Footprint per capita, yielding the average 'Happy Life Years' generated per unit of environmental demand.

Equation 1: Happy Planet Index = (Life Expectancy × Experienced Wellbeing) / Ecological Footprint

Concerning life expectancy in the HPI, the primary source for rankings, especially those reported in 2019, is the data prepared for the 2020 UN Human Development Report.

Well-being data are derived from the 'Ladder of Life' question in the Gallup World Poll, part of the World Happiness Report. Adjustments are made to ensure data consistency, considering selection probability, non-responses, and demographic profiles. Missing data points between 2006 and 2019 (17% of potential year-country data) are estimated, employing rules like averaging adjacent-year data and establishing mini-linear trends for gaps.

For Ecological Footprint in the HPI, the 2017 data comes from the Global Footprint Network's National Footprint and Biocapacity Accounts, extracted through their API. In the absence of 2018-2019 data, changes in CO_2 emissions were used as a proxy. For 2020, data from the 2021 Statistical Review of World Energy informed the percentage change in emissions, adjusted based on the Earth Overshoot Day 2020 and 2021 reports. This comprehensive approach ensures the HPI's ecological footprint assessments align with global trends, enhancing the reliability of its evaluations.

As regards the weights applied, technical adjustments are implemented to prevent any single component from disproportionately influencing the overall score.

Firstly, well-being scores undergo an adjustment to equalise their coefficient of variance with that of life expectancy scores. This entails adding a constant (β in Equation 2) to each country's well-being score, ensuring equal contribution of variance to the 'Happy Life Years' product term from both life expectancy and well-being variables.

Subsequently, Ecological Footprint scores are adjusted to match the coefficient of variance of the 'Happy Life Years' measure. This adjustment involves adding a constant (ε in Equation 2) to the Ecological Footprint. The aim is to maintain equal sensitivity of the overall Happy Planet Index score to changes in both 'Happy Life Years' and Ecological Footprint.

Additionally, two scaling constants (α and γ in Equation 2) are incorporated, with an HPI score of 100 representing excellent performance across all indicators: an inequality-adjusted life expectancy of 85 years, maximum well-being score, and an environmentally sustainable Ecological Footprint. Conversely, an HPI score of zero signifies an inequality-adjusted life expectancy of 25 years, minimum well-being score, and an Ecological Footprint exceeding that of any single country during the covered period.

Equation 2:

$$Happy\ Planet\ Index = \alpha \times Life\ Expectancy \times (Ladder + \beta) - \gamma/EF + \varepsilon$$

Despite having received considerable interest from influential stakeholders, the Happy Planet Index (HPI) has yet to be formally embraced by any nation as a benchmark for gauging development or progress. This aligns with the index's initial objective, which was to reshape the narrative on progress, moving away from the GDP-centric approach and serving as a tool for discourse rather than formal policy (McGough, 2012). The HPI distinguishes itself by considering life satisfaction and longevity, surpassing GDP limitations and fostering innovation through an easily understood calculation methodology. According to Yanne Goossens (2007), the scheme for calculating it is simple and reproducible as data are available online, even if partially. Also, the mixed nature of the index, combining soft and hard criteria, can mirror effectively people's well-being while monitoring resources use of the countries. Besides, when compared with GDP, the HPI yields classifications that diverge significantly, underscoring its ability to capture aspects of reality beyond economic metrics (Campus, Porcu, 2010).

Nevertheless, the HPI confronts challenges, notably in data availability, leading to gaps in environmental footprint data and reliance on estimations, especially with irregular surveys like the World Values Survey. Critics emphasise the complexity of ensuring data completeness and point to potential biases in government-collected data (Goossens, 2007).

In conclusion, diverse methodological approaches, such as Data Envelopment Analysis (DEA) models and multiple criteria decision-making techniques, have been employed to reassess the HPI, showcasing the ongoing quest for precision and balance in measuring the intersection of well-being and environmental impact (Jablonský, 2013).

How's Life Report

The "How's Life?" report, a flagship publication by the Organisation for Economic Co-operation and Development (OECD), stands as the second pillar of the OECD Better Life Initiative. It conducts an exhaustive examination of well-being across member nations, meticulously evaluating material living standards, quality of life, and the sustainability of well-being (Beech, 2015; Balestra, 2011). Beyond offering a mere snapshot of current well-being conditions, this report delves into the complex dynamics of well-being inequalities, shedding light on disparities prevalent among diverse demographic groups (Balestra, 2011).

As a comprehensive repository for over 80 indicators, with breakdowns by age, gender, and education, from the OECD Well-being Dashboard, "How's Life?" provides insights into present well-being outcomes, disparities, and factors shaping future well-being prospects. Spanning eleven dimensions, the assessment encompasses material conditions influencing economic choices (Income and Wealth, Housing, Work and Job Quality), alongside quality-of-life considerations such as health, knowledge, environmental conditions, subjective perceptions, and safety. Additionally, it explores social connectivity, engagement, and time allocation (Work-Life Balance, Social Connections, Civic Engagement).

Unlike the Better Life Index (BLI), "How's Life?" adopts a more comprehensive approach that encompasses not only economic aspects but also environmental, human, and social factors, often referred to as "capitals." Moreover, while both assessments draw upon the OECD Well-being Framework as their foundational structure, they diverge significantly in methodologies. Notably, the BLI data cannot be compared across different editions due to ongoing methodological refinements, whereas "How's Life?" provides longitudinal analysis through the How's Life – Well-being database.

In 2020, the OECD Well-being Framework underwent significant revisions following extensive consultations with member nations and alignment with global best practices in measuring well-being. This iterative process led to refinements in certain dimensions within the framework, such as renaming "Jobs" to "Work and Job Quality" to underscore the importance of a conducive work environment. Additionally, the updated framework incorporates emerging themes like mental health and unpaid work, reflecting evolving societal understandings of well-being.[1]

Human Development Index

The Human Development Index (HDI) serves as a comprehensive measure, encompassing the overall achievement in key aspects of human development: life expectancy, education, and per capita income. Rooted in the human development approach pioneered by Mahbub ul-Haq and deeply informed by Sen's (1999) and Nussbaum (2000) human capabilities' approach.

The index made its debut in 1990 and underwent revisions, with the most recent edition published in 2021, covering 195 countries.

The HDI underwent a substantial methodological change in 2011, introducing intricate changes in the calculation of its core dimensions: life expectancy, education, and income.

In the realm of life expectancy, the Life Expectancy Index (LEI) was introduced, offering a more detailed measurement with a range from 20 to 85 years. This index is derived from a formula that assigns a score of 1 at 85 years and 0 at 20 years, providing a nuanced assessment of the health dimension.

Education saw significant transformations. The Education Index (EI) was created by combining the Mean Years of Schooling Index (MYSI) and the Expected Years of Schooling Index (EYSI). MYSI represents mean years of schooling, projected to a maximum of 15 by 2025, while EYSI signifies expected years of schooling, equating 18 years to a master's degree in most countries. These specific indices allow for a more nuanced evaluation of education, considering factors like the maximum projected years of schooling.

Income underwent changes for better accuracy too. The Income Index (II) was introduced, measured using the logarithm of Gross National Income (GNI) per capita, with a refined range from $100 to $75,000. This addressed the limitations of the previous methodology and reflected the disparities in income levels more accurately.

[1] See at: https://www.oecdbetterlifeindex.org/about/better-life-initiative/#question22

The HDI calculation in the post-2011 methodology involves normalising and aggregating these indicators onto a scale of 0 to 1. This is achieved by setting minimum and maximum values for each indicator, ensuring a standardised assessment.

Having defined the minimum and maximum values, the dimension indices are calculated as:

Dimension index = (actual value – minimum value) / (maximum value – minimum value)

The resulting HDI scores provide a comprehensive representation of human development, utilising a geometric mean and assigning equal weight to all three dimensions.

The data sources for Human Development Index (HDI) indicators exhibit a diverse range and rely on esteemed international organisations. Life expectancy data, specifically life expectancy at birth, is typically drawn from UNDESA. For education indicators such as Mean Years of Schooling (MYS) and Expected Years of Schooling (EYS), national education statistics form the foundation, supplemented by renowned organisations like UNESCO. The Expected Years of Schooling component specifically draws from sources such as the UNESCO Institute for Statistics, United Nations Children's Fund (UNICEF) Multiple Indicator Cluster Surveys, ICF Macro Demographic and Health Surveys, and Mean Years of Schooling from Barro and Lee, UNESCO Institute for Statistics, and updates from the Human Development Report Office based on UNESCO Institute for Statistics, UNICEF Multiple Indicator Cluster Surveys, and ICF Macro Demographic and Health Surveys. GNI per capita data is frequently sourced from international economic databases, including the IMF, UNSD, and World Bank.

Over time, the Index has faced substantial scrutiny, with critics emphasising its inherent simplification and limited capacity to comprehensively assess human development. Notably, the HDI overlooks crucial quality-of-life aspects, such as empowerment movements and overall feelings of security. Scholars like Morse (2003) and Salas-Bourgoin (2014) propose modifications, advocating for the inclusion of environmental and resource-consumption dimensions, as well as employment and political freedoms. The Stiglitz-Sen-Fitoussi Commission Report identifies eight integral dimensions to well-being, including material living standards, health, education, personal activities, political voice and governance, social connections, environmental sustainability, and economic/physical security (Stiglitz et al., 2010).

In response to these critiques, the U.N. Human Development Report Office (HDRO) introduced supplementary composite indices, addressing dimensions like gender (Gender Development Index) and racial inequality (Inequality Development Index). Despite methodological changes in 2010, the HDI faces criticism, particularly regarding strong correlations among GNI, education, and life expectancy, referred to as the 'socioeconomic gradient.' This raises questions about the HDI's added value as a composite index compared to its individual components.

Other issues involve changes in HDI calculation methods over time and implied trade-offs between its components. Significant measurement errors, especially in GNI per capita calculation, and a temporal misalignment due to periodic GNI per capita computation add complexity. Methodological changes have made comparing scores across different years challenging, and Morse (2014) argues that alterations increased turbulence in country ranking, notably affecting Romania, Jamaica, Botswana, Iran, and Belize. The trade-offs within HDI components, determining how much income increase compensates for a decrease in life expectancy, add further complexity (Ravallion, 2010).

For these reasons, scholars like Deb (2015) extensively review methodological changes to the HDI, advocating for continuous improvements. These critical examinations collectively underscore the

imperative for ongoing refinement and evaluation of the HDI to ensure its relevance and effectiveness as a comprehensive measure of societal development.

Quality of Human Development Dashboard

The Quality of Human Development Dashboard, a pivotal creation of the United Nations Development Programme (UNDP), serves as a cornerstone within the comprehensive framework of the Human Development Report. Meticulously crafted, this dashboard represents a multifaceted approach to assessing human development by intricately interconnecting indicators related to health, education, and standard of living.

Covering 14 key indicators across 195 countries, the dashboard transcends the limitations of traditional single metrics or composite indices, providing a nuanced and comprehensive understanding of human development dynamics. Its structure revolves around three foundational pillars: the quality of health, education, and living standards. Within each pillar lies a rich tapestry of sub-indicators that delve deeply into various dimensions of human well-being.

Furthermore, it examines the quality of living through four pivotal indicators, including vulnerable employment, access to rural electricity, and the provision of safe drinking-water and sanitation services.

Leveraging data from esteemed organisations such as the World Bank, International Labour Organisation (ILO), World Health Organisation (WHO), Organisation for Economic Co-operation and Development (OECD), and utilising calculations from the Institute for Health Metrics and Evaluation (IHME), these authoritative sources bolster the credibility and reliability of the insights derived from the dashboard. The headline indicators are described in table 1.

Table 1: Headline indicators of the Quality of Human Development Dashboard

Quality of health	Quality of education	Quality of standard of living
Lost health expectancy (%)	Pupil-trained teacher ratio in primary schools (pupils per trained teacher)	Vulnerable employment (% of total employment)
Number of physicians (per 10,000 people)	Primary school teachers trained to teach (%)	Rural population with access to electricity (%)
Number of hospital beds (per 10,000 people)	Schools with access to the Internet - Primary schools (%)	Population using safely managed drinking-water services (%)
	Schools with access to the Internet - Secondary schools (%)	Population using safely managed sanitation services (%)
	Programme for International Student Assessment (PISA) score - Reading Programme for International Student Assessment (PISA) score - Mathematics Programme for International Student Assessment (PISA) score - Science	

Source: UNPD, 2022

Quality of Life (QoL)

The European Commission's Quality of Life Indicators, analysed by Eurostat, constitutes a comprehensive initiative that delves into nine dimensions statistically measurable to encapsulate various complementary facets of quality of life. Spanning 37 countries and territories, this initiative encompasses 102 indicators from the years 1960 to 2022, providing a robust and contemporary understanding of quality-of-life dynamics. This approach serves as a vital supplement to the conventional measure of economic and social development, gross domestic product (GDP).

Eight of these dimensions focus on the functional capabilities that individuals require to effectively pursue their self-defined well-being based on personal values and priorities. These dimensions encompass a diverse array of factors, including material living standards, employment opportunities, social connections, and environmental conditions. The ninth dimension scrutinises personal achievements in life satisfaction and overall well-being, providing a holistic perspective on individual fulfilment.

Specifically, the dimensions encompass: material living conditions; productive or main activity; health; education; leisure; social interactions; economic security and physical safety; governance and basic rights; natural and living environment; overall experience of life.

Each dimension is complemented by a curated selection of pertinent statistical indicators, presented in the Annex section, offering a nuanced and multifaceted view of quality of life.

To further bolster the robustness of QoL assessment, an analytical framework has been devised to categorise indicators based on their objectivity and subjectivity, thereby offering a structured and systematic approach to QoL evaluation. While objective indicators, such as income and health statistics, are grounded in tangible data, subjective measures, such as life satisfaction and happiness, reflect individuals' personal evaluations and perceptions. Besides, indicators have been developed based on expert recommendations.

The data originate from various sources within the European Statistical System (ESS), providing valuable insights into quality of life (QoL) dimensions. These include EU statistics on income and living conditions, the EU labour force survey, the European Health Interview Survey, and administrative sources. In cases where ESS data is unavailable, external links to non-ESS sources such as the European Quality of Life Survey (EQLS) are utilised as substitutes. These data sources contribute to a comprehensive understanding of individuals' well-being across different aspects.

Social Scoreboard

The European Pillar of Social Rights (EPSR) is complemented by the Social Scoreboard, a dynamic tool designed to monitor and evaluate the performance and trends of Member States. This system empowers the European Commission to oversee the effective implementation of EPSR principles within the comprehensive policy coordination framework of the European Semester. The data integral to the EPSR derives from a diverse array of statistical sources, with Eurostat assuming a central role in providing crucial indicators. These indicators, derived from sources such as the EU Labour Force Survey (LFS) and the EU Statistics on Income and Living Conditions (SILC), offer a robust foundation for making accurate cross-country comparisons and discerning trends over time.

The EPSR, structured around three pivotal dimensions: equal opportunities, fair working conditions, and social protection and inclusion—selects principles based on their profound economic and social relevance to participating EU countries. This multifaceted approach ensures a comprehensive evaluation of the social landscape.

The Social Scoreboard comprises a comprehensive set of 42 indicators, which includes breakdowns by age, gender, and education, organised into three primary dimensions and 12 specific areas as delineated below. Additionally, data are accessible at the regional level (NUTS 2) and categorised by degree of urbanisation (NUTS 3), facilitating a nuanced understanding of social dynamics across different geographical contexts. The headline indicators are described in table 2.

Table 2: Headline indicators of the Social Scoreboard

Equal opportunities	Fair working conditions	Social protection and inclusion
Early leavers from education and training	Employment rate	At-risk-of-poverty or social exclusion rate (AROPE)
Individuals who have basic or above basic overall digital skills	Unemployment rate	At-risk-of-poverty-rate (AROP)
Young people neither in employment nor in education and training	Long-term unemployment rate	Severe material and social deprivation rate (SMSD)
Gender employment gap	Real gross disposable income of households	Persons living in a household with a very low work intensity
Income quintile share ratio (S80/S20)		At-risk-of poverty rate for children
		Severe material and social deprivation rate (SMSD) for children
		Children living in a household with a very low work intensity
		Impact of social transfers (other than pensions) on poverty reduction
		Disability employment gap
		Housing cost overburden
		Children aged less than 3 years in formal childcare
		Self-reported unmet need for medical care

Source: https://ec.europa.eu/eurostat/web/european-pillar-of-social-rights/scoreboard

Economic performance

In the subsequent sections, the discussion will delve into three indices and two dashboards specifically designed to evaluate the economic performance, competitiveness, and sustainable development of EU countries: the Competitive Sustainability Index, the Economic Sentiment Indicator (ESI), the Global Competitiveness Index, the Sustainable Development Indicators (SDIs), and the Resilience Dashboards - EU Context.

Competitive Sustainability Index

The Competitive Sustainability Index (CSI), a collaborative creation by the Cambridge Institute for Sustainability Leadership, Breakthrough Energy, and Cambridge Econometrics, represents an innovative tool for appraising and monitoring the sustainable competitive performance of EU countries. The Competitive Sustainability Index has been developed to complement the European Commission's own strategy for competitive sustainability, firstly published in the 2020.

Comprehensively covering 27 EU countries with 84 indicators, the CSI's methodology is underpinned by the use of geometric averaging, both within and across its four pivotal dimensions: Economy, Society, Governance, and Environment. This statistical approach ensures that extreme values do not disproportionately skew the results, providing a balanced perspective on each country's progress toward sustainability. The framework of the CSI aligns with the Commission's strategy for sustainability, while also integrating contemporary understandings of innovation and competitive dynamics.

Key indicators within the CSI encompass a wide range of factors, from greenhouse gas emissions and renewable energy usage to social indicators like education quality and economic indicators such as GDP growth rates and unemployment levels. Each of these indicators provides insights into different aspects of sustainability and competitiveness, making the CSI a relevant tool for comparing countries on a global scale.

The index taps into a wealth of diverse sources, including ITU, Eurostat, the Global Entrepreneurship Monitor, and the IMF, as well as data from specialised entities like the Cleantech Group, the Harvard Kennedy School of Government, and the OECD. Additionally, it draws from globally recognised databases and surveys such as the Gallup World Poll, WHO, World Bank, and the databases housing the Sustainable Development Goals (SDGs) and FAOSTAT data, among others. This array of sources ensures a robust and multifaceted dataset, enhancing the CSI's ability to capture the complex interplay between sustainability and economic competitiveness.

The Joint Research Centre (JRC) provided a comprehensive evaluation (Saisana et al 2022) of the Competitive Sustainability Index (CSI), affirming its statistical coherence and methodological soundness in benchmarking the competitive sustainability of EU Member States.

The JRC's audit affirms that the CSI, developed by the Cambridge Institute for Sustainability Leadership, is statistically justified, evidencing a high degree of reliability with a Cronbach alpha score of 0.84.

Notably, eight components, such as Innovation readiness and Human capital, demonstrate transversal impacts across multiple dimensions of the index, thereby emerging as significant predictors of competitive sustainability in the EU. However, certain components like Entrepreneurial activity and

Biodiversity show weaker correlations with the overall index, suggesting the need for methodological refinement and possibly new data sources to accurately reflect these areas.

The JRC's analysis also indicates that the CSI has excellent data coverage, with missing data having a minimal impact on the rankings. For most countries, the index allows for a reliable benchmark of national competitive sustainability, although caution is advised for interpreting the rankings of countries like Cyprus and Malta due to wider intervals of variability.

In conclusion, the CSI not only aligns with international quality standards but also offers unique insights that are not captured by other international indices. This adds external validity to the CSI, indicating its value as a complementary tool to existing indices. The JRC suggests that the rich array of indicators, components, and dimensions of the CSI should be leveraged for more in-depth policy analysis and discussions on competitive sustainability within the EU (Saisana et al 2022).

Economic Sentiment Indicator (ESI)

The Economic Sentiment Indicator (ESI), produced by the Directorate-General for Economic and Financial Affairs (DG ECFIN) of the European Commission, serves as a composite indicator to monitor GDP growth trends across Member States, the EU, and the euro area. The ESI aggregates responses from businesses across five sectors—industry (with a 40% weight), services (30%), consumers (20%), retail trade (5%), and construction (5%)—derived from the EU Business and Consumer Surveys. This calculation is based on the balances of positive and negative responses, with EU and euro-area aggregates seasonally adjusted and calculated from national results.

Structured around a long-term mean of 100 and a standard deviation of 10, the ESI assigns values where figures above 100 signify higher-than-average economic sentiment and vice versa, providing a quantifiable measure of economic mood and expectations. Covering 35 countries, the harmonised surveys responsible for feeding data into the ESI are conducted by a network of national entities, including ministries, statistical offices, central banks, research institutes, and private companies.

DG ECFIN is tasked with calculating the EU and euro area aggregates, ensuring that the data is appropriately seasonally adjusted. The sampling size of the ESI survey is proportionate to the heterogeneity and population size of each economy, engaging approximately 134,000 firms and 32,000 consumers monthly. This extensive data collection offers an insight on economic sentiment, making the ESI a relevant tool for economic analysis and forecasting within the European Union.

A significant critique of the European Economic Sentiment Indicator (ESI) is its uniform application across all EU Member States, utilizing a standardized set of sector weights which are selected without specific tailoring to individual economies. Such an approach can result in suboptimal forecasting accuracy of the ESI for certain member states. The recent global crisis has starkly highlighted the urgent need for developing more precise macroeconomic forecasting models that can adapt to the unique economic landscapes of each country (Sorić et al., 2016).

Global Competitiveness Index

The Global Competitiveness Index (GCI), developed by the World Economic Forum, is an extensive dataset covering 141 countries, the GCI has evolved into a tool for understanding the complexity of

productivity determinants. Drawing on a rich pool of data updated annually since its first edition in 2004, the latest edition was published in 2020.

The methodology of the Global Competitiveness Index is designed to capture a broad spectrum of factors that WEF deems critical for the economic productivity and prosperity of a nation. It leverages an integrated approach, combining publicly available data and the responses from the Executive Opinion Survey, which collects business leaders' perceptions on various aspects of the economy. The GCI framework is structured around 12 pillars of competitiveness, which include institutions, infrastructure, ICT adoption, macroeconomic stability, health, skills, product market, labour market, financial system, market size, business dynamism, and innovation capability. This comprehensive structure allows for a detailed assessment of a country's competitive landscape, emphasising both the current economic environment and future growth potential.

Each pillar consists of individual indicators, totalling around 103 indicators that contribute to a country's overall score. These metrics are chosen based on their demonstrated relevance to competitiveness and economic performance, and they are weighted according to their perceived importance in the current economic context. This methodology allows the GCI to provide insights into the multifaceted nature of economic competitiveness, highlighting areas of strength and potential vulnerabilities within national economies.

The GCI adapts its weighting scheme to reflect the varying impact of its twelve pillars on countries at different stages of economic development. This nuanced weighting is not arbitrary but is derived from econometric analyses that pinpoint the combination of factors most aligned with recent patterns of economic growth. For example, innovation and sophistication factors are weighted to contribute 30% to the overall score in economies that are innovation-driven, acknowledging the pivotal role these factors play in such advanced stages of economic development. In contrast, the same factors are weighted at 10% in factor and efficiency-driven economies, highlighting the differential drivers of growth across the economic spectrum.

The GCI's has a dualistic approach to data collection. Survey data from the Executive Opinion Survey provide the subjective experiential insights from business leaders, offering a real-time pulse on economic conditions from those at the forefront of industry. This subjective lens is balanced by the empirical rigor of hard data, sourced from several esteemed organisations, including the Economist Intelligence Unit, the Inclusive Internet Index, the International Union for Conservation of Nature, the World Bank, and various UN agencies. This methodological synergy ensures a balanced perspective, integrating perceptions with empirical evidence to yield a more rounded view of competitiveness.

Despite its comprehensive approach, the GCI is not without limitations. One significant critique lies in the high percentage of qualitative data (approximately 75%) and arbitrary selection of weights. They note that rankings include countries with missing quantitative data, suggesting data treatment without inclusion in the database (Benítez-Márquez et al., 2022).

To address these concerns, Benítez-Márquez proposes a new Competitiveness Index (CSI) based solely on quantitative indicators from the WEF, using factor analysis to eliminate subjectivity, advocating for a competitiveness index based on official, quantitative data to eliminate biases. The CSI rankings show a high association with GCI rankings, especially in the European context. However, this results in a non-representation of some pillars in the CSI due to lacking hard data indicators.

The Sustainable Development Indicators (SDIs)

Eurostat's Sustainable Development Indicators (SDIs) monitor progress towards the Sustainable Development Goals within the European Union. The set of indicators, revisited annually, facilitates a cross-comparison of sustainability milestones among the 27 EU member states, accession candidates, and members of the European Free Trade Association, all contingent on data availability. The compilation of 102 indicators is sourced from an array of data providers, including the EU Labour Force Survey and the European Institute for Gender Equality, under the stewardship of the SDI Task Force. This task force is dedicated to ensuring consistency and methodical alignment with past communications from the European Commission and the strategic directions set forth by global summits such as the World Summit on Sustainable Development.

The SDIs are stratified into a three-tiered hierarchy, each catering to varying analytical depths—from the macroscopic vantage point of economic indicators like GDP per capita, to the granular scrutiny required for comprehensive policy evaluation and thematic dissection.

Furthermore, these indicators not only provide an overview of sustainable development at the national level but also extend to regional assessments at the NUTS2 level, offering a more localised perspective. The SDI set is praised for its balanced approach, with a substantial portion of the indicators encapsulating multiple dimensions of sustainable development—34% integrating all three dimensions and a significant 86% addressing at least two. However, critiques have been raised about the set's inadequacy in concurrently capturing social and environmental aspects, indicating an area ripe for refinement in future iterations of the SDI framework (Ledoux et al., 2005).

Resilience Dashboards - EU Context

The Resilience Dashboard, a tool from the EU Commission, is designed to meticulously analyse the resilience of the European Union and its Member States across four distinct dimensions: social and economic, green, digital, and geopolitical. The framework of the dashboard is composed of two primary classes—vulnerabilities and capacities—each further dissected into three to four sub-pillars. These sub-pillars capture nuanced elements within each domain, enhancing the tool's clarity and facilitating focused analysis for policy interventions.

Each indicator is carefully examined through its percentile ranking within a comprehensive dataset of all EU countries from 2007 to 2017. By representing a country’s recent performance relative to its historical standing and to other countries, and then taking the median of these percentiles, the Dashboard distils a synthesised representation of national vulnerabilities and capacities. The choice of median over averages for aggregation is deliberate, reflecting its conceptual suitability for quantile-based indicators and its heightened sensitivity to data variations, as detailed in each dashboard’s dedicated chapter.

The incorporation of indicators into the Dashboard follows a stringent inclusion criterion based on data availability—a minimum of 108 observations, ensuring a robust dataset for reliable percentile calculations and sufficient variability. In instances where this threshold is not met, the reference period is adjusted to 2015-2020 to maintain data integrity. This pragmatic approach adheres to standards set forth by the JRC's audit, guaranteeing quality and relevance.

Diverse and authoritative data sources underpin the Dashboard, ranging from Eurostat to the World Economic Forum, ensuring a rich, multi-dimensional analysis. This plurality of perspectives is critical in depicting a comprehensive picture of resilience, covering trends and policies across economic, environmental, digital, and geopolitical realms.

The Joint Research Centre's (JRC) audit of the Resilience Dashboards (Caperna & De, 2021) underscores their multifunctional nature. While these dashboards synthesise data into composite indicators for vulnerabilities, capacities, and the various sub-pillars, they are primarily crafted as a monitoring instrument. This design is intentional, allowing for a comprehensive portrayal of a wide array of information, accommodating even conflicting data sets to offer a holistic view. The aggregated measures, therefore, are intended to guide users through the complex layers of the dashboards. The JRC's audit emphasises the necessity for prudent interpretation of these measures. Ranks and synthetic measures are subject to fluctuations arising from methodological adjustments, thus, they are best utilised as navigational aids rather than absolute judgments.

Further reinforcing the value of these dashboards, the JRC's audit acknowledges their adherence to rigorous statistical standards. However, their utility extends beyond mere data compilation; they provide deep insights. The dashboards are recognised as a significant analytical tool, going beyond simplifying data into scores, to illuminate the diverse and intricate facets of resilience across the EU. This analytical capacity makes the dashboards a resource for understanding resilience in its multiple dimensions, informing policy and decision-making processes with a nuanced and comprehensive perspective.

Institutional quality

The quality of institutional governance is a dimension evaluated by various studies and indicators from different organizations. The upcoming sections will provide a detailed examination of four indices and two dashboards of indicators that offer insights into this area, including the Bertelsmann Stiftung Sustainable Governance Indicators (SGI), the Chandler Good Government Index, the European Quality of Government Index, the Global State of Democracy Indices, the Liberal Democracy Index, and the World Bank Worldwide Governance Indicators (WGI).

Bertelsmann Stiftung Sustainable Governance Indicators (SGI)

The Bertelsmann Stiftung Sustainable Governance Indicators (SGI) serve as a pivotal tool for evaluating the quality of institutional governance, emphasizing the sustainability of governance practices among 41 OECD and EU member countries. Initiated by Bertelsmann Stiftung, the SGI represents an exhaustive framework designed to scrutinize the governance efficacy within these nations. It is articulated through a tripartite structure: Sustainable Policies, Robust Democracy, and Effective Governance, each subdivided into specific components and indicators to facilitate a nuanced examination of governance facets.

- Sustainable Policies aim at appraising the sustainability and reformative direction of a country's policy outcomes, encompassing economic, social and environmental policies.
- Robust Democracy seeks to measure a country's democratic integrity, examining both the procedural and structural dimensions that underpin a functional democracy.
- Effective Governance reflects the government's executive capacity and accountability, indicating its capability to govern and administer public affairs proficiently.

This framework incorporates 152 indicators, derived from both official statistics and qualitative expert evaluations. The qualitative component leverages insights from a network of scholars, whose assessments are integrated with quantitative data, thus shaping the survey's overarching architecture (Kraus & Schmidt, 2022). Missing data is imputed by full information maximum likelihood estimations (FIML) as recommended by the EU Commission (OECD/EU/JRC, 2008).

While expert evaluations are standardized on a scale from 1 to 10, quantitative indicators undergo a linear standardization to facilitate their amalgamation into composite indices, employing a straightforward, additive, and equally weighted aggregation method.

Nonetheless, the SGI's methodology and its comparative stance against other governance indices, like the World Bank Worldwide Governance Indicators, have encountered critique. Croissant and Pelke (2022) underscore the post-2014 methodological revisions and conceptual validity concerns. Questions about the SGI's theoretical underpinning, the demarcation of governance capabilities, and democratic standards, as well as the combination of various accountability dimensions, highlight potential conceptual and methodological ambiguities. Furthermore, the reliance on expert judgment introduces subjectivity, while the aggregation approach may obscure detailed insights, and the lack of a universally accepted framework for evaluating public policy performance signifies prevailing challenges.

Conversely, the SGI's pioneering emphasis on policy performance, conceptualizing and quantifying public policy outcomes across diverse domains, marks a significant advancement. The integration of global public goods into its analysis enriches the discourse on domestic policymaking. Despite the potential for biases inherent in expert-driven assessments and the possible limitations on findings' reproducibility due to the iterative review process, the SGI endeavors to present a balanced perspective through its combined methodology.

In sum, the SGI contributes notably to the discourse on sustainable governance measurement, offering a unique and holistic approach. Nevertheless, it invites criticism regarding its conceptual coherence and methodological clarity. Refinements in conceptualisation, data collection, and expert evaluation procedures could further bolster its validity and practical applicability. (Croissant & Pelke, 2022)

Chandler Good Government Index

The Chandler Good Government Index (CGGI) is a critical evaluative framework designed to appraise the functional capacities and outcomes of governance in 104 nations, encompassing roughly 90% of the global citizenry. The latest iteration was disseminated in 2023. This index is founded on a series of pillars, each encapsulating different facets of governance and the efficacy of governmental institutions. These pillars are comprised of various indicators that quantify discrete governance elements:

- Leadership and foresight: Evaluates the government's ability to lead with vision and plan for the future, taking into account long-term considerations and potential scenarios.
- Robust Laws and policies: Measures the strength and effectiveness of the country's legal framework and policy-making processes.
- Quality of bureaucracy: Assesses the efficiency, competency, and professionalism of the civil service and its impact on the implementation of government policies.
- Financial stewardship: Considers the government's management of the economy and public finances, including aspects like government debt, budget surplus, and spending efficiency.
- Attractive marketplace: Looks at how favourable the country's market conditions are for doing business, including the protection of property rights and the overall macroeconomic environment.
- Global influence and reputation: Measures the country's impact and standing on the global stage, including its engagement in international trade and diplomacy, and the strength of its national brand.
- Helping people rise: Focuses on the government's role in promoting the well-being of its citizens, taking into account education, health, and satisfaction with public services, as well as broader social issues like environmental performance, income equality, and social mobility.

The CGGI sources its data from a broad array of organizations, including Transparency International, the World Economic Forum, the World Bank, and the United Nations, among others. This diversity enriches the CGGI's database, allowing for a comprehensive view of governance.

Missing data from the metrics is imputed with two methods. Firstly, the process involves seeking an alternative indicator or study that quantifies a concept or theme analogous to the one under consideration. This step ensures the maintenance of thematic consistency within the data set.

Secondly, the method entails calculating the mean values from a cohort of peer nations, subsequent to a stratification based on geographical location and economic status. This approach allows for the establishment of a comparative baseline that reflects the collective experience of similar entities, thereby providing a contextualized imputation of the missing data.

Analytically, the CGGI standardizes each indicator on a scale from 0 to 1, to ensure comparability and facilitate aggregation across countries. The CGGI's methodology assigns equal weight to each indicator before aggregation and rescaling. Consequently, the final index score is derived from an equal weight averaging method, assigning each of the 35 indicators equal importance to prevent that any single governance aspect overly influence the composite index. Chandler Good Government Index, 2022

European Quality of Government Index

The European Quality of Government Index (EQI) is a composite indicator developed by the the Quality of Government Institute to assess the quality of governance at the regional level within the European Union. The 2021 version, which is the most expansive to date, aims to capture perceptions and experiences regarding governance quality from over 129,000 respondents across 208 regions within the 27 EU member states, in accordance with the NUTS1 or NUTS2 classifications. The survey interrogated participants on their views and personal encounters with public healthcare, education, and law enforcement, framing the inquiry within a broad, multi-faceted conception of governmental quality. This conception is characterised by high impartiality, superior public service delivery, and minimal corruption. The EQI primarily seeks to reflect the actual exercise of power within the EU, concentrating on the informal practices of formal institutions as perceived and experienced by citizens, rather than strictly on formal legal frameworks.

The 2021 edition of the EQI not only enhances the data from its preceding editions (2010, 2013, and 2017) but also reveals marked regional disparities in the perceived quality of government within certain EU nations—particularly in Italy, Spain, Belgium, Ireland, Poland, France (inclusive of its overseas territories), and Slovenia. Conversely, such regional disparities appear to be substantially less pronounced in the Nordic countries, Austria, and Slovakia. A notable advancement in this latest edition is the application of the new NUTS2 classification, which, for the first instance, enables the independent evaluation of the capital region (IE06) from other regions. Here, the capital region's quality of government scores notably lower than the Southern region (IE05), even when considering the margin of error.

Its construction is based on a tripartite framework focusing on corruption, impartiality, and quality. According to the authors of the index (Charron et al., 2021), each of these dimensions is crucial to understanding the overall quality of governance, as they provide a nuanced picture of the institutions that affect citizens' daily lives.

- Corruption: This dimension of the EQI is composed of perceptions and experiences of corruption, providing both a subjective and an objective view of corruption's prevalence in different public sectors.
- Impartiality: This dimension evaluates the fairness and equality with which individuals are treated by public institutions, reflecting the absence of undue favouritism.
- Quality: This dimension assesses the perceived level of quality in public services, including education, health care, and law enforcement.

Individual responses are aggregated at the NUTS 2 region level, weighted by post-stratification factors for representativeness. The regional data combines 17 survey questions, standardised and harmonized for consistency. The EQI score is an arithmetic mean of three pillars, standardized at each aggregation stage, with margins of error provided. Adjustments are made for comparability over time.

The European Quality of Government Index (EQI), despite integrating subjective and objective metrics, confronts variability challenges due to its reliance on personal corruption perceptions and public service experiences. This reliance may skew actual governance representations because of personal biases or media influence. Furthermore, survey participation biases could arise from the over- or underrepresentation of certain groups, notwithstanding efforts to mitigate these through post-stratification weighting. Yet, sensitivity analyses by Charron et al. on earlier EQI data suggest the index's construction methods—aggregation, weighting, normalization—maintain the results' integrity, indicating strong correlations among indicators and with previous EQI rounds, as well as with other socio-economic development measures. This supports the EQI's external validity and ensures discriminant validity, as it shows no correlation with irrelevant factors like population or area size. (Charron et al., 2021)

Global State of Democracy Indices

The Global State of Democracy (GSoD) Indices provide systematic and nuanced data that captures trends at the global, regional and national levels related to International IDEA's comprehensive understanding of democracy.

The GSoD Indices measure democracy at the country level across 28 concepts. Additionally, the GSoD Report incorporates the Democracy Tracker, which continuously monitors democratic developments in 173 countries. This combination of quantitative and continuous monitoring provides a comprehensive view of the state of global democracy.

The Global State of Democracy Indices (GSoDI) are based on a theoretical framework that organizes specific measures of aspects of democratic performance into five high-level attributes: Representative Government, Fundamental Rights, Checks on Government, Impartial Administration, and Participatory Engagement.

The GSoDI are composite measures that are built from 116 individual indicators collected by other organizations using different types of sources, including expert surveys, standards-based coding by research groups and analysts, and observational data. The GSoDI draw upon a rich tapestry of sources to inform their multifaceted analysis. These sources include the Lexical Index of Electoral Democracy (LIED), the International Country Risk Guide (ICRG), and the Global Media Freedom Dataset (MFD), among others. They also incorporate insights from the Global Gender Gap Report and the Global Educational Attainment Distributions. Data from the Food and Agriculture Organization of the United Nations (FAO) on food balances are utilised, alongside indices such as Freedom in the World, Freedom on the Net, CIRIGHTS, and the Civil Liberties Dataset (CLD). The compilation further extends to include the Bjørnskov-Rode Regime Data (BRRD) and the Bertelsmann Stiftung's Transformation Index (BTI), providing a comprehensive substrate for the GSoD Indices' robust democratic assessment.

The GSoD Indices are scaled from 0 to 1, with 1 indicating the highest level of democratic achievement based on the best and worst observed values globally. They provide annual global rankings of country performance for each category of democratic performance, classifying countries as high-performing, mid-range, or low-performing. This focus on specific categories rather than an aggregate score enables a nuanced understanding of the state of democracy and identifies areas suitable for targeted reform and intervention. For most indices, the yearly scores for each country are accompanied by uncertainty estimates, which can be used to assess whether differences between countries and within countries over time are significant. These uncertainty estimates are in the form of confidence intervals (margins of error) and reflect the statistically likely range for the country–year index scores based on the indicators used. The GSoD Indices confidence levels refer to one standard deviation below and above the estimated score (Tufis, 2022).

Liberal Democracy Index

The V-Dem Liberal Democracy Index (LDI) is a key component of the Varieties of Democracy (V-Dem) project, which aims to measure and analyse different aspects of democracy. Sigman (2015) has contributed to the development of this index, providing theoretical considerations and discussing the aggregation of indicators and components into high-level measures of democracy.

The V-Dem Liberal Democracy Index (LDI) is a nuanced measurement that incorporates both liberal and electoral elements of democracy, informed by 71 indicators from the Liberal Component Index (LCI) and the Electoral Democracy Index (EDI).

The Electoral Democracy Index (EDI) assesses the extent to which regimes uphold clean and fair elections. It also considers the actual freedom of expression, alternative sources of information, association rights, and male and female suffrage. Furthermore, it evaluates the extent to which elected officials determine government policy.

The Liberal Component Index (LCI) is designed to capture the essence of liberal democracy. It assesses various elements including the checks and balances in place to regulate the executive arm of the government, the respect for civil liberties, the rule of law, and the independence of the legislature and judiciary.

To create the index, V-Dem uses a specific aggregation method known as the "Bayesian Item Response Theory" (IRT) model. This method allows for the combination of multiple indicators into a single index while accounting for measurement error and the varying reliability of different data sources. The scores obtained through the aggregation process are then normalised to make them comparable across countries and over time. This ensures that the index reflects relative changes in the quality of democracy in a way that is meaningful and interpretable. To ensure the reliability and validity of the data collected from experts, V-Dem employs inter-coder reliability assessments. This step checks for consistency among expert responses and helps to refine the data collection process.

World Bank Worldwide Governance Indicators (WGI)

The Worldwide Governance Indicators (WGI) project, initiated by the World Bank Institute and Research Department, offers comprehensive governance assessments for over 200 countries and territories across six key dimensions: Voice and Accountability; Political Stability and Absence of Violence; Government Effectiveness; Regulatory Quality; Rule of Law; and Control of Corruption.

The construction of each of the six aggregate WGI measures involves several steps. Firstly, individual data from various sources are allocated to the corresponding aggregate indicators. For instance, data regarding the regulatory environment from a firm survey would contribute to Regulatory Quality, while indicators of press freedom would fall under Voice and Accountability. The specific variables used and their allocation to the six aggregate indicators can be accessed by clicking on the respective indicator names. It's important to note that not all data sources cover every country, resulting in varying sets of underlying data for different nations.

Secondly, the individual data from these sources are rescaled to range from 0 to 1, with higher values indicating better outcomes. For example, if a survey question ranges from 1 to 4, a score of 2 would be rescaled as (2-min)/(max-min) = (2-1)/3 = 0.33. When multiple questions from a single source pertain to a particular governance dimension, their rescaled scores are averaged together.

Finally, an Unobserved Components Model (UCM) is employed to construct a weighted average of the individual indicators for each source. This statistical tool ensures comparability of the rescaled data across sources and generates a weighted average of data from each source for every country. The UCM assumes that the observed data from each source are a linear function of the unobserved level of governance, adjusting for any remaining non-comparability among the rescaled data units. The resulting governance estimates are weighted averages, with weights reflecting the correlation pattern among data sources, assigning greater weight to sources with stronger correlations.

The data sources for the WGI include a wide array of institutions and surveys, such as the World Bank Country Policy and Institutional Assessments, Transparency International Global Corruption Barometer Survey, and Freedom House Index of Economic Freedom, among others.

Scholarly discourse surrounding the WGI has been ongoing. Apaza (2009) points out conceptual and empirical challenges in constructing these indicators, particularly due to their reliance on perception data. Madrid (2007) further emphasises the necessity for more detailed and objective data, especially concerning corruption. However, Kaufmann (2010) defends the WGI, asserting that they enable meaningful cross-country and over-time comparisons, despite the inherent measurement difficulties in assessing governance.

Digitalisation

Concerning digitalisation, this literature review identifies four indices, a benchmark, and a monitoring mechanism that measure countries' advancement in digital performance and innovation: the Benchmark for Fifth Generation Digital Collaborative Regulation, the Berlin Declaration Monitoring Mechanism, the Digital Economy and Society Index (DESI), the E-Government Development Index, the Green, Digital, and Competitive SME Index, and the ICT Development Index (IDI).

The Benchmark for Fifth Generation Digital Collaborative Regulation

The Benchmark for Fifth Generation Digital Collaborative Regulation, commonly referred to as the G5 Benchmark, represents a significant initiative by the International Telecommunication Union (ITU) to evaluate and direct countries in navigating the complex terrain of digital transformation. This benchmark signifies the progressive shift in regulatory frameworks necessitated by the advent of 5G technology (ITU, 2022).

The G5 Benchmark is constructed on four foundational pillars:

- National Collaborative Governance: This measures the interagency cooperation among ICT regulators and their counterparts, considering both the structural and procedural dimensions of regulatory collaboration.
- Policy Design Principles: It zeroes in on the conceptualization of regulatory frameworks, ensuring that they are tailored to facilitate digital progression.
- Digital Development Toolbox: This pillar targets the essential instruments that regulators require to foster a resilient digital economy, taking into account the evolving needs of consumers, new business models, and market dynamics within the digital ecosystem.
- Digital Economic Policy Agenda: This encompasses the range of policies and strategic measures a nation adopts to encourage digital economic growth, from fostering innovation to addressing sector-specific taxation and establishing international linkages.

Spanning across 193 nations with 70 distinct indicators, the G5 Benchmark offers an extensive appraisal of the regulatory and policy landscapes that are critical to the cultivation of competitive digital economies (ITU, 2022).

Its scoring mechanism, which extends from 0 to 2 for each indicator, facilitates a granular evaluation aligned with internationally acclaimed best practices. The aggregate scores, normalized on a scale from 0 to 100, provide an integrative perspective on each country's stance in digital regulation (ITU, 2021).

The qualitative data utilised for scoring derives from a myriad of sources, primarily self-reported data collated from responses to the ITU World Telecommunications Regulatory Survey, supplemented by desktop research, and data from reputable entities such as the World Bank, United Nations sources like UNCTAD and UNTC, the World Trade Organization (WTO), the Consultative Group to Assist the Poor (CGAP), and the Council of Europe. This is further enriched by direct communications with ICT regulatory authorities.

In their work, scholars such as Katz et al. (2022) have acknowledged the robustness of the benchmark, recognizing its efficacy in measuring the growth and stability of countries' digital economies.

Berlin Declaration Monitoring Mechanism

The Berlin Declaration on Digital Society and Value-based Digital Government monitors EU Member States' commitment to digitalisation.

The declaration, encompassing 28 countries, has been published annually, with the latest edition released in 2023.

At its core, the declaration's monitoring mechanism evaluates the enactment of policy actions by EU member states, ensuring alignment with the declaration's principles across seven distinct policy areas, utilising a set of 43 indicators.

These Policy Actions, which member states have pledged to implement by 2024, are organised into seven Policy Areas. Each area correlates with one of the seven Principles articulated within the Declaration, namely:

- Validity and respect for fundamental rights and democratic values.
- Social participation and digital inclusion to shape the digital world.
- Empowerment and digital literacy.
- Trust and security in digital government interactions.
- Digital sovereignty and interoperability.
- Human-centred systems and innovative technologies in the public sector.
- Resilience and sustainability in the digital society.

The implementation percentage for each Policy Action is derived from the arithmetic mean of its corresponding indicators, under the premise that each indicator carries equal significance and weight. The implementation percentage for each Policy Area, in turn, is calculated from the mean of the implementation percentages of its associated Policy Actions.

For the aggregation process to yield a result at any granularity level, at least two-thirds (66.66%) of the underlying data must be available. If more than one-third (33.33%) of the data is missing, the result is classified as 'no data' to maintain the statistical integrity and relevance of the aggregated outcomes.

Primary data sources for this mechanism include the Open Data Portal and the Digital Economy and Society Index (DESI), which collectively offer an open and comprehensive data foundation for assessing the digital governance landscape across the European Union (European Commission, 2022).

Digital Economy and Society Index (DESI)

Established by the European Commission and published annually since 2014, the Digital Economy and Society Index (DESI) scrutinises Europe's digital performance, providing EU countries with critical insights.

DESI's structure is hierarchical, comprising five main indicators across three levels. The first level includes Human Capital, Connectivity, Integration of Digital Technology, and Digital Public Services. These are further delineated into ten second-level subgroups and 32 third-level subgroups (DESI, 2022).

Indicators used in DESI, according to the DESI methodology, must be collected on a regular basis, must be relevant to policy areas and must not be redundant.

The methodology of DESI mandates that indicators must be regularly collected, policy-relevant, and non-redundant. Normalisation is executed using the min-max method, scaling each indicator's values between 0 and 1. The index aggregates the indicators into sub-dimensions, and these into dimensions, culminating in the overall index through simple weighted arithmetic. While the four dimensions of the Digital Compass are weighted equally, indicators targeting the 2030 Digital Compass goals are deemed more critical, thus receiving double weights within their respective sub-dimensions (DESI, 2022).

In their work, Bruno et al. (2023) critique the complexity and limitations inherent in Composite Indicators (CIs) like DESI, which can become unwieldy due to a high number of indicators and intricate constructions. They propose a more streamlined tool for assessing digital divides both between and within countries, focusing particularly on regional disparities. By employing a Principal Component Analysis (PCA), they identified redundancies within DESI's framework and developed a simplified index. Utilising data from 29 EU countries from the year 2020, they reduced the number of indicators from 37 to 15 without compromising the index's analytical integrity. This refined version facilitates easier application across geographical levels, enabling more precise policy interventions to address digital inequalities, as evidenced by its application in Italy to discern regional digital disparities (Bruno et al., 2023).

Similarly, Kutnjak et al. (2020) distilled key indicators from DESI to facilitate more streamlined policymaking regarding digital competitiveness. They identified pivotal indicators such as fast broadband, internet user skills, online transactions, business digitalisation, and e-health, each serving as a lever for enhancing digital proficiency and competitive edge (Kutnjak et al., 2020).

E-Government Development Index

The E-Government Development Index (EGDI), conceived by the United Nations, stands as a comprehensive measure of e-government development, assessing 193 countries biennially since 2001. This index furnishes stakeholders with crucial insights into the global trends and progressions of e-government initiatives (United Nations, 2022).

Incorporating 13 indicators, the EGDI evaluates three cardinal dimensions: the scope and quality of online services (Online Service Index, OSI), the development status of telecommunication infrastructure (Telecommunication Infrastructure Index, TII), and human capital (Human Capital Index, HCI). Each of these indices is an independent composite measure, allowing for both individual analysis and contribution to the overarching EGDI (United Nations, 2022).

A methodical approach is utilised in the computation of the EGDI, with Z-score standardisation applied to each component indicator. This standardisation is essential for ensuring an equitable contribution from each dimension — Online Service Index (OSI), Telecommunication Infrastructure Index (TII), and

Human Capital Index (HCI) — to the composite EGDI score, thus preventing any one index with larger variance from dominating the results.

The EGDI is underpinned by a wealth of sources from UNDESA reports to inputs from the OECD and the World Bank, charting the evolution of e-government from its nascent stages to its current form (UNDESA, 2001-2014; WB, 2015).

Recent scholarship has proposed methodological enhancements to the EGDI. Whitmore (2012) suggests employing factor analysis for setting empirical weights for the indicators, thus refining the index's accuracy and reliability. Such statistical rigor would also aid in selecting the most pertinent variables and confirming their correlation with e-government effectiveness.

Osman & Zablith (2021) introduce a hybrid model utilising Shannon entropy, the Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS), and Data Envelopment Analysis (DEA) to reassess the EGDI, particularly in the context of the Sustainable Development Goals (SDGs). Their innovative approach calls for a more scientific and unbiased weighting of indicators and improved benchmarking of country rankings. The recalibration according to these methods could necessitate infrastructural upgrades and may result in notable shifts in country rankings.

Collectively, these studies underscore the necessity of continual refinement of the EGDI to better mirror the rapidly transforming technological and socio-economic conditions. They advocate for UN-led methodological updates to better align the index with the objectives of the SDGs and propose further research to optimise the assessment of e-government initiatives.

Green, Digital, and Competitive SME Index

The Lisbon Council's Green, Digital, and Competitive SME Index was crafted to facilitate small and medium-sized enterprises' (SMEs) transition to a green and digital economy. The index encompasses evaluations from 27 countries and employs nine indicators to provide a comprehensive assessment of SMEs, with a focus on environmental initiatives, digital integration, and overall competitiveness.

In the computation of the index, each component – pillars, indicators, and sub-indicators – is accorded equal significance in the aggregation process, which is conducted using the arithmetic average. This means the performance of an individual indicator is determined by averaging its sub-indicators. Likewise, the performance of each pillar is the average of its constituent indicators, culminating in a country's overall evaluation being the arithmetic mean of its pillars (Hofheinz, et al., 2022).

When it comes to normalisation, the index uses the min-max method within a range of 10 to 100 to standardise the values of sub-indicators. In this schema, for the predominant majority of sub-indicators (20 out of 22), the highest value denotes peak performance, meriting 100 points, while the lowest value indicates the least favourable performance, assigned 10 points. However, this approach is inverted for two specific sub-indicators related to environmental performance — SME Emissions and Overall Change in Greenhouse Gas Emissions — where the lowest values represent the best performance, earning 100 points, and the highest values the worst, being allotted 10 points (Hofheinz, et al., 2022).

The data for this index is sourced from authoritative databases including Eurostat; the European Commission's Structural Business Statistics; Air Emissions Accounts within the Annual National Accounts; and International Trade in Goods data.

ICT Development Index (IDI)

The ICT Development Index (IDI), conceptualised by the International Telecommunication Union (ITU), serves as a barometer for the Information and Communication Technology (ICT) sector's infrastructure and usage for 169 countries.

Initially released annually from 2009 until its suspension in 2017 due to data quality and availability concerns, the IDI was reconstituted in 2023 with an updated methodological framework. This reintroduction marks a new era for the index, with the 2023 report laying the foundation for future analyses (ITU, 2023).

The revised IDI is structured around two core pillars with a total of 10 indicators:

- Universal Connectivity Pillar: This aims to encapsulate indicators pertaining to individuals, households, communities, and businesses, charting the primary spheres of connectivity such as homes, educational institutions, community centers, and workplaces. Due to data constraints, the current IDI iteration primarily incorporates indicators related to households and individuals.
- Meaningful Connectivity Pillar: Ideally, this pillar would measure five critical enablers of connectivity: infrastructure, affordability, devices, skills, and safety and security. Given the reliance on principally official data and existing data limitations, the index currently evaluates only infrastructure, affordability, and devices.

The IDI's aggregation method unfolds in two stages: first, individual indicator scores are amalgamated to formulate pillar scores; then, these pillar scores are combined to compute the overall IDI score, using the arithmetic mean. In the absence of definitive conceptual and statistical rationales, a neutral stance has been adopted, favouring equal weights at each aggregation tier.

The ITU cautions that while the IDI offers a high-level overview of meaningful connectivity, it does not encapsulate the nuanced specificities of individual countries. Therefore, the results of the IDI should be interpreted with prudence, necessitating contextualisation and supplementation with further data and qualitative analyses (ITU, 2023).

It is pertinent to note that the 2023 edition represents a cross-sectional snapshot. Future iterations will enable time series analysis, yielding deeper insights into the trajectories of ICT development across the globe (ITU, 2023).

Green transition and climate change

The following sections review the most substantial number of composite indices (eight) and scoreboards (three), highlighting the growing importance of the green transition and climate change in policymaking. These include the Clean Energy Innovation Index (CEII), Climate Change Performance Index (CCPI), Climate Perceptions Index, Environmental Performance Index (EPI), Global Green Economy Index (GGEI), Green Growth Index, Just Transition Score, Transitions Performance Index (TPI), Energy Union Scoreboard, European Energy Efficiency Scoreboard, and Urban Environment and Social Inclusion Index (UESI).

Clean Energy Innovation Index (CEII)

The Clean Energy Innovation Index (CEII), instituted by the European Commission, is designed to monitor the clean energy innovation of 59 countries and the European Union. It acts as a barometer for evaluating advancements and investments in clean energy technologies, which are pivotal for sustainable development (European Commission, 2022b).

The CEII is built upon three foundational dimensions that reflect the multifaceted nature of clean energy innovation:

- Scientific Publications: This dimension assesses the academic contributions to clean energy, encompassing both the overall volume of publications and those recognised as highly cited, indicating their influence and impact on the field.
- Patents: This facet evaluates the inventive output, quantifying the number of clean energy inventions, including those deemed as high-value, and those with international reach, signalling the global competitiveness and potential commercial application of the innovations.
- Trade: The trade dimension measures the economic aspects, looking at the exports of clean energy technologies (CET) and the value-added these technologies contribute to the GDP, underscoring the economic implications of clean energy innovation.

To validate and refine its methodology, the CEII employs linear correlation analysis alongside multivariate techniques. These statistical methods are crucial for affirming the index's capacity to capture the dynamics of clean energy innovation accurately, ensuring that the CEII remains a relevant and robust tool for policymakers and stakeholders in the energy sector ().

The CEII's comprehensive approach not only sheds light on the current state of clean energy innovation but also informs strategic decisions and policy directions that can accelerate the transition towards a more sustainable and cleaner energy future

Climate Change Performance Index (CCPI)

The Climate Change Performance Index (CCPI) is an innovative instrument devised by Germanwatch, the NewClimate Institute, and the Climate Action Network. This index was developed to provide a detailed assessment of the climate protection performance for 59 countries and the European Union, engaging 14 indicators that span across diverse aspects of climate action.

The CCPI's multifaceted framework includes four key dimensions: Greenhouse Gas (GHG) Emissions, Renewable Energy, Energy Use, and Climate Policy, each with a set of carefully selected indicators aimed at capturing the comprehensive nature of a country's commitment to mitigating climate change.

- Greenhouse Gas (GHG) Emissions: This dimension is critical as it directly measures the emissions that contribute to global warming. Indicators such as the current level of GHG emissions per capita, the trajectory of these emissions, and their correlation with the 2°C pathway provide a quantitative foundation for assessing each country's emission reduction efforts. The CCPI critically evaluates whether the 2030 targets set by countries are ambitious enough to meet the 'well-below-2°C' target, a cornerstone of the Paris Agreement.
- Renewable Energy: Within this dimension, the CCPI investigates the share of renewable energy sources in the national energy mix, tracking progress over time and benchmarking against a 2°C-compatible path. This evaluation is not just about present performance but also about future commitment, as seen in the scrutiny of the 2030 renewable energy targets.
- Energy Use: The Energy Use dimension considers the efficiency and sustainability of energy consumption patterns. By examining the total primary energy supply (TPES) per capita and its evolution, the CCPI reveals insights into how energy use aligns with sustainable pathways and scrutinises the 2030 targets for energy efficiency.
- Climate Policy: The CCPI's assessment extends beyond numbers to include a qualitative review of a country's climate policies at both national and international levels, evaluating the depth and breadth of these policies in driving meaningful climate action.

The 2023 edition of the CCPI introduces an enhanced methodology that has been refined since its initial conception in 2017. This new approach ensures comprehensive coverage of greenhouse gas emissions and the integration of 2030 targets, reflecting the global ambition towards maintaining a 'well-below-2°C' increase in temperatures. While this evolution in methodology means that direct comparisons with past editions are limited, it guarantees consistency and relevance with the latest scientific benchmarks.

For the purpose of scoring, the CCPI adopts a systematic approach, treating each indicator equally within its dimension, culminating in a weighted average score.

Zero points represent the least favourable performance, while 100 points signify the most favorable performance relative to other countries in the index. It is critical to interpret these scores contextually, as a perfect score of 100 does not necessarily equate to the attainment of all climate protection goals but signifies a leading position in the international comparison.

The CCPI's final ranking is calculated from the weighted average of the achieved scores in the separate indicators with the following formula:

$I = \sum_{i=1}^{n} wi\ \mathrm{Xi}$

In this formula, "I" stands for the CCPI score, "Xi" is the score of each normalized indicator, and "wi" is the weight given to each indicator. The sum of these weighted scores gives the final CCPI ranking, balancing each indicator's influence on the overall assessment.

The CCPI's robustness is guaranteed by the quantitative data it employs, sourced from esteemed organisations such as the IEA, PRIMAP, the FAO, and the official national greenhouse gas inventories

submitted to the UNFCCC. This substantial reliance on authoritative data ensures the CCPI's credibility and enhances its utility as a tool for policymakers and environmental stakeholders (Burck, et al., 2023)

Climate Perceptions Index

The Climate Perceptions Index (CPI), developed by the Social Progress Imperative, stands as a critical instrument that encapsulates societal attitudes toward climate change across 107 nations. The CPI investigates public sentiment into three distinct dimensions: Awareness, Risk Perception, and Commitment to Action, each providing a window into the collective stance on climate change (Social Progress Imperative, 2022).

- Awareness: Within this dimension, the CPI measures the extent of public knowledge regarding climate change, belief in its occurrence, perceived severity, and the frequency with which individuals engage with climate discourse. These indicators are pivotal as they reflect the level of societal enlightenment and interaction with climate-related content.
- Risk Perception: This dimension delves into how individuals perceive the imminent threats posed by climate change, affecting not just their personal lives but also the prospects of future generations and national well-being. The indicators here aim to capture the public's assessment of climate change as a pervasive risk over the coming decades.
- Commitment to Action: Moving from perception to the propensity for action, this dimension examines the values and priorities that shape individual and collective commitment to climate change mitigation and adaptation. It encompasses indicators that evaluate public support for governmental policies, pollution reduction initiatives, and the sense of personal and societal responsibility in combating climate change.

The CPI's empirical foundation is the extensive data collected by Meta through the Facebook Climate Change Opinion Survey, developed in collaboration with the Yale Program on Climate Change Communication. This survey annually produces a wealth of data on public climate change awareness, attitudes, policy preferences, and behaviours, offering a comprehensive overview of global climate consciousness.

The index adopts a 0-100 scale, where the extremes represent hypothetical worst and best cases, facilitating cross-country comparability and providing clarity in interpreting data.

Aggregation of data within the CPI employs the arithmetic mean, chosen for its simplicity and full compensability, though other methods were tested giving similar results.

Multivariate analyses at both the individual and country levels validate the question groupings and confirm a statistically robust structure of the index, as evidenced by consistency checks including correlations between indicators, principal component analysis for unidimensionality, and tests of internal consistency using Cronbach’s Alpha and the Kaiser-Meyer-Olkin measure. (Social Progress Imperative, 2022)

Despite the CPI's analytical depth, it is not without limitations. The index’s reliance on self-selected respondents from the Facebook platform may introduce biases, potentially affecting the sample's representativeness. Furthermore, cross-cultural and linguistic variances may pose challenges to the uniform interpretation and comparability of survey responses. Nevertheless, the CPI remains an

indispensable resource for discerning and shaping global public opinion on climate change, contributing significantly to the discourse on environmental policy and action.

Environmental Performance Index (EPI)

Developed by Yale and Columbia Universities, the EPI ranks 180 countries according their achievements in environmental health, ecosystem vitality, and climate change mitigation, assessing how closely countries are meeting their environmental policy targets based on three main dimensions: Environmental Health, Ecosystem Vitality, and Climate Change.

- Environmental Health: This dimension focuses on assessing the quality of environmental factors that directly impact human health. It includes indicators such as air quality, sanitation, and exposure to hazardous substances like heavy metals. Key indicators in this dimension may include PM2.5 exposure, household solid fuels, ozone exposure, and sanitation access.
- Ecosystem Vitality: Ecosystem Vitality measures the overall health and resilience of ecosystems within a country. It includes indicators related to biodiversity, habitat protection, and ecosystem services. This dimension evaluates factors such as terrestrial and marine protected areas, species habitat indices, and the loss of tree cover, grasslands, and wetlands.
- Climate Change: Climate Change dimension assesses a country's efforts to mitigate and adapt to climate change. It includes indicators related to greenhouse gas emissions, renewable energy adoption, and climate policy effectiveness. Indicators in this dimension may cover adjusted emission growth rates for various greenhouse gases, renewable energy shares, and climate change mitigation policies.

To holistically address these objectives, the EPI assesses 40 indicators across 16 policy categories.

The indicators are normalized on a 0-100 scale, allowing for comparability across nations and regions. The EPI's aggregation method utilises weighted arithmetic means, designed to translate complex environmental data into actionable insights for policymakers.

However, the index is not without critique. The Joint Research Centre (JRC)’s audit of the EPI highlighted several areas where statistical coherence could be improved, particularly in the correlation structure between policy issues and objectives. For instance, while most correlations were found to be positive and significant, the Ecosystem Services policy issue displayed negative correlations with other policy issues within the Ecosystem Vitality objective, suggesting a potential area for methodological refinement.

Moreover, the JRC's uncertainty analysis revealed wide confidence intervals for the rankings of half the countries, indicating significant sensitivity to changes in normalisation methods, weights, and aggregation formulas. Thus, while the EPI offers valuable benchmarks and cross-country comparisons, its rankings should be interpreted with caution due to potential shifts arising from methodological adjustments (Smallenbroek, et al., 2023).

Goossens (2007) highlights the EPI's strengths in providing benchmarks for environmental performance and facilitating international comparisons. Yet, he also notes the inherent limitations, such as the potential confusion stemming from its multidimensional aggregation approach and the arbitrary nature of the weights assigned to different indicators. Furthermore, there is a concern over

the adequacy of the measurement infrastructure, such as the regularity of updates, which is crucial for tracking progress over time.

In summary, the EPI emerges as a relevant tool for understanding environmental performance, directing nations towards improved health and ecosystem protection. However, its methodology and the need for regular updates require ongoing scrutiny to ensure its effectiveness as a barometer for environmental action.

Global Green Economy Index (GGEI)

The Global Green Economy Index (GGEI), conceptualized by Dual Citizen LLC, serves as a comprehensive barometer for evaluating 160 countries on their transition to a green economy. It utilizes 18 indicators, processed through z-score normalisation and percentile ranking, to offer a nuanced portrait of each country's performance in crucial areas like climate change mitigation and sectoral decarbonization.

The GGEI is structured around four main dimensions:

- Climate Change and Social Equity: This dimension assesses the balance between a nation's greenhouse gas (GHG) emissions and its socio-economic parameters, including per capita income and gender equality in the workplace.
- Sector Decarbonization: It scrutinizes progress across key sectors such as energy, manufacturing, and waste management, emphasizing the reduction of carbon footprint and the enhancement of resource efficiency.
- Markets and ESG Investment: This dimension evaluates the attractiveness of countries for green investments, the level of innovation, and the integration of gender equality within governance structures, reflecting the sustainability orientation of financial markets.
- Environmental Health: Indicators in this dimension measure a country's commitment to preserving agriculture, air quality, biodiversity, and other natural resources, crucial for long-term environmental sustainability.

Normalisation using GDP (PPP) ensures comparability by adjusting for economic size. The aggregation strategy involves statistical techniques to derive z-scores, offering an equitable composite score on a scale from 0 to 100, tailored to guide policymakers in sustainability endeavours. (Dual Citizen, 2018).

Green Growth Index

Developed by the Global Green Growth Institute, the Green Growth Index meticulously tracks the progress of 243 countries towards key sustainability benchmarks, including the Sustainable Development Goals, Paris Climate Agreement, and Aichi Biodiversity Targets. The Index encapsulates the essence of green growth across four dimensions:

- Efficient and Sustainable Resource Use: Monitoring the efficiency of resource utilization, this dimension emphasizes the sustainable management of energy, water, land, and materials.

- Natural Capital Protection: Focused on the conservation of biodiversity and ecosystems, this dimension also measures environmental quality and efforts to curtail greenhouse gas emissions.
- Green Economic Opportunities: Analysing the economic landscape for green investments, trade, employment, and innovation, this dimension highlights the potential for growth in sustainable industries.
- Social Inclusion: Reflecting on the societal aspect of green growth, this dimension accounts for equitable access to services, gender balance, and overall social equity and protection.

With 16 indicators normalized via the min-max method, the Green Growth Index empowers decision-makers to prioritise sustainable interventions and monitor developmental progress with precision. (Acosta, et al., 2020).

Just Transition Score

The Just Transition Score, devised by the Social Progress Imperative, integrates environmental and social dimensions to assess 158 countries' alignment with climate action and social development. The index incorporates 61 indicators, with a unique approach that juxtaposes per capita CO_2 emissions against the Social Progress Index (SPI) to gauge carbon efficiency in social advancement.

The Just Transition Score operates on a ratio of CO_2 emissions per unit of social progress, calibrated on a 0-100 scale. Higher scores signify a more effective balance between minimizing environmental impact and enhancing social well-being. The index also considers consumption-based CO_2 emissions, sourced from the Climate Watch and Our World in Data, complemented with predictive linear regression to impute missing values. To align with the SPI's temporal data, CO_2 emissions from 2019 are projected to 2022, ensuring contemporaneous relevance and accuracy in evaluation. (Social Progress Imperative, 2022).

Transitions Performance Index (TPI)

The Transitions Performance Index (TPI), an analytical tool devised by the European Commission, is aimed at evaluating countries' progression towards equitable and sustainable futures. It encompasses a multidimensional approach, reflecting upon four critical facets of sustainability: Economic, Social, Environmental, and Governance.

Spanning a total of 72 countries, the TPI meticulously quantifies transition efforts through 28 indicators. These indicators are normalized on a scale from 0 to 100 to facilitate direct comparison, with higher scores indicating closer alignment to sustainability targets. The normalization process ensures that disparate data points are rendered comparable, thus reflecting the relative performance of each country consistently.

The index architecture involves a layered aggregation method, where elementary indicators are collated into sub-pillars, which in turn contribute to overarching pillars, finally culminating in the comprehensive index score. This is achieved through the use of weighted arithmetic averages, with

each layer of aggregation thoughtfully designed to reflect the relative importance of its constituent components. (European Commission, 2022c).

Drawing from an array of sources, including the IMF, WHO, ILO, and various other reputable databases such as Eurostat and the OECD, the TPI boasts a robust empirical foundation. The data assimilated from these institutions provides a rich tapestry of information, from economic metrics and social indicators to environmental records and governance evaluations.

Moraliyska's (2023) critique of the TPI sheds light on the index's capacity to serve as a barometer for green transitions. The TPI is lauded for its broad-spectrum analysis, integrating diverse indicators to deliver an in-depth assessment of nations' sustainability efforts. This holistic perspective is crucial, as it transcends the environmental dimension to embrace the full scope of the green transition, incorporating socioeconomic dynamics and governance quality.

Nevertheless, the TPI is not without its criticisms. Moraliyska points out that the index may not fully account for the social costs associated with the transition to a green economy. The index's current framework may overlook the nuanced impacts of environmental policies on social welfare, such as economic displacement and the exacerbation of existing inequalities. The inclusion of additional indicators that can capture the intrinsic social value of environmental policies, the reduction of pollution, and the amplification of social participation would significantly enhance the index's capability to offer a more rounded and socially attuned perspective, thereby making it an even more effective instrument for policymakers to steer countries towards just and sustainable futures.

Energy Union Scoreboard

The Energy Union Scoreboard, instituted by the European Commission, is an evaluative framework designed to track the progress of the EU's Energy Union objectives from 2013 to 2020. It encompasses 25 indicators, encapsulating the multifaceted nature of the Union’s energy strategy across five domains: Energy security, solidarity, and trust; an integrated internal energy market; energy efficiency; decarbonisation of the economy; and research, innovation, and competitiveness.

The scoreboard synthesizes data from Eurostat and the European Commission to provide a transparent and methodical assessment of energy and climate policies implemented by the 27 member states. One of the Scoreboard's distinctive features is its integration with the Social Progress Index to formulate the Just Transition Score. This measure reflects the carbon efficiency of countries in fostering positive social outcomes, scaled from 0 for the worst to 100 for the best performance, thus offering a nuanced perspective on the intersection of climate action and social progress.

By offering a comprehensive assessment of energy governance, the Energy Union Scoreboard aids in steering policy direction, ensuring energy security, and promoting the transition towards a sustainable, competitive, and low-carbon economy. (European Commission, 2022d).

European Energy Efficiency Scoreboard

The European Energy Efficiency Scoreboard, a collaborative effort among various organizations, rates EU member states, along with Norway, the UK, Serbia, and Switzerland, on their achievements in

energy efficiency. The Scoreboard utilizes 13 indicators to reflect energy efficiency levels, trends since 2010, and the effectiveness of policies in place.

Scoring is based on three primary areas:

- Level: This metric offers a cross-sectional view of energy efficiency across sectors, including industry, transportation, households, and services, based on consumption and other pertinent metrics.
- Trend: This aspect analyses historical data, charting the trajectory of energy efficiency improvements and shifts in consumption patterns over time.
- Policy: This segment appraises the suite of policies and regulatory measures that aim to advance energy efficiency in various economic sectors.

Employing data from the ODYSSEE and MURE databases, the Scoreboard adopts the OECD Composite Indicator methodology, normalizing scores between 0 and 1 for each area. The composite score, an average of the normalized values, offers a singular measure reflecting a country's stance in the energy efficiency landscape.

The European Energy Efficiency Scoreboard is distinguished by its adjusted indicators that account for structural and climatic factors, its quantitative evaluation of policy impacts, and its comprehensive temporal scope that considers past actions and future implications. This multifaceted approach ensures a fair and realistic depiction of each country's energy efficiency trajectory and contributes to informed policy-making for sustainable energy futures (Odyssee-Mure, 2023).

Urban Environment and Social Inclusion Index (UESI)

The Urban Environment and Social Inclusion Index (UESI), an analytical brainchild of Data-Driven Yale and the Samuel Centre for Social Connectedness, stands as a cutting-edge metric assessing urban performance at the nexus of environmental sustainability and social equity. It is composed of 16 indicators that dissect urban environments across 164 countries into five primary dimensions: Air, Climate, Water, Transportation, and Demographics.

Each dimension serves as a crucial probe into distinct aspects of urban life:

- Air: Concentrates on air quality by evaluating average exposure to PM2.5 and NO2, alongside the frequency of PM2.5 level exceedances.
- Climate: Addresses urban adaptation to climate change through assessments of the urban heat island effect, climate policy efficacy, and metrics related to CO2 emissions and tree cover.
- Water: Scrutinizes water resource management within cities by examining water stress levels and access to wastewater treatment.
- Transportation: Explores the infrastructure of urban mobility, including the reach and accessibility of public transportation within city bounds.
- Demographics: Considers city area, population size, and income, which collectively influence urban environmental and social dynamics.

The UESI is the result of research and expert consultation, drawing upon the Environmental Performance Index (EPI) for key environmental issues and identifying areas where the UESI could add

distinct value, particularly concerning environmental justice. A unique aspect of the UESI is the delineation of urban and non-urban areas to ensure relevance to city sustainability. Advanced tools like Google Earth Engine have been employed to manage the vast datasets required for this expansive work.

Scores for environmental performance and equity are calculated using target-based methods for each city or neighbourhood, providing disaggregated issue-based scores that cater to the development spectrum of the cities involved. Data sources include satellite imagery from LANDSAT and MODIS, gridded global population data, and national and local government statistics on population and income. (UESI, 2021).

The UESI not only evaluates environmental factors but also pioneers the measurement of distributional equity within cities. It exposes the disproportionate environmental burdens on lower-income communities, such as higher pollution levels and limited access to green spaces, despite high environmental performance in some cities. This index, however, does face challenges due to data gaps, census inaccuracies, and the difficulty of standardizing urban definitions and income measurements across diverse city landscapes (Hsu et al., 2020).

Zhao et al. (2023) critique the UESI for its environmental focus, noting that it does not encompass other aspects of inclusivity such as economic conditions, gender equality, and the integration of immigrants or the LGBTQ+ community, which are fundamental to other indices' conceptualizations of inclusive cities (Zhao et al., 2023).

Social cohesion

The application of composite indicators to quantify social cohesion has been the focus of extensive scholarly inquiry. Pivotal to this field are instruments such as the Bertelsmann Social Cohesion Radar (Dragolov et al., 2016), the VALCOS Index (Dickes and Valentova, 2013; Dickes et al., 2010), the European Social Progress Index (EU-SPI), and the OECD Social Cohesion Indicators, each contributing uniquely to the conceptualisation and measurement of social cohesion. The forthcoming section will critically examine these studies.

European Regional Social Progress Index

The European Regional Social Progress Index (EU-SPI), a joint initiative by the European Commission and the Social Progress Imperative, seeks to comprehensively evaluate social progress in ways that transcend economic metrics, prioritising the well-being of individuals and the fabric of communities. Encompassing a dataset that spans 55 indicators across 240 NUTS 2 regions, the EU-SPI provides an extensive dataset that encapsulates the diversity and complexity of European regions.

The index disaggregates social progress into three main dimensions—Basic Human Needs, Foundations of Wellbeing, and Opportunity—each comprising several components that are instrumental in assessing the quality of societal development:

- Basic Human Needs: This dimension includes components like Nutrition and Basic Medical Care, Water and Sanitation, Shelter, and Personal Safety. The data for these components are often sourced from public health databases, environmental agencies, and crime statistics.
- Foundations of Wellbeing: This dimension covers Access to Basic Knowledge, Access to Information and Communications, Health and Wellness, and Environmental Quality. Indicators for these components are collected from educational statistics, telecommunications data, public health records, and environmental monitoring data.
- Opportunity: This includes Personal Rights, Personal Freedom and Choice, Inclusiveness, and Access to Advanced Education. Data for these indicators come from human rights organisations, surveys on social attitudes, and educational achievement records.

The EU-SPI has been documented in two editions, specifically for the years 2016 and 2020. In its 2020 iteration, a significant share of the data—approximately 56%—was sourced from Eurostat, while EU-SILC indicators contributed to 22% of the data, complemented by an additional 25% from the Gallup World Poll.

Methodologically, the EU-SPI adopts a 0-100 scaling system for its scores, where 0 represents the lowest level of social progress and 100 the highest. The index applies a hybrid aggregation method, which blends a straightforward, unweighted arithmetic mean within each component with a generalised unweighted geometric aggregation across the components. This dual-faceted approach permits a nuanced synthesis of individual and collective social progress measures, reflecting both the universal and particular dimensions of well-being.

Regarding the differences from previous editions, several improvements have been implemented, which are crucial for a sub-national aggregate index that is highly susceptible to change. Even if the methodology remains statistically consistent with the last edition, direct comparability between the

two editions is unattainable. It is worth noting that among the 14 newly added indicators, two in the opportunity dimension distinctly emphasise women's lifelong learning and active citizenship, thereby integrating a gender equality perspective into the index.

The EU Social Progress Index (EU-SPI) is distinguished by its holistic method of quantifying societal advancement. It transcends traditional economic indicators such as GDP, offering a multidimensional view of societal health. This comprehensive perspective is supported by research, such as that conducted by Beltrán-Esteve et al. (2023), which indicates a general correlation between income levels and social progress across European regions. However, the study also reveals disparities; it notes that approximately 80% of regions identified as 'less developed' based on GDP per capita would retain their status under social progress evaluations. This finding emphasises that while interconnected, social progress and income levels are distinct dimensions of regional development.

Beltrán-Esteve et al. (2023) further evaluated the robustness of the 2020 iteration of the EU-SPI against various methodological decisions taken during its construction. This assessment, conducted under both local and global uncertainty scenarios, suggests that while the EU-SPI's absolute scores exhibit sensitivity to methodological variations—particularly in the normalisation process—the relative rankings of regions display considerable stability. This robustness underscores the index's utility for policymakers, as it provides consistent and reliable information for policy decision-making, even when certain parameters of index construction are modified.

Despite these strengths, the EU-SPI is not without its limitations. A critique by Annoni and Bolsi (2020) highlights a significant trade-off: in aiming for a singular, composite measure of progress, the EU-SPI may inadvertently oversimplify complex realities. Specifically, the index has been noted to focus primarily on material well-being, while potentially overlooking negative social and environmental externalities such as pollution or crime. Moreover, it may not adequately capture other crucial quality-of-life aspects, including health and education outcomes. These critiques suggest that while the EU-SPI is a valuable tool for understanding social progress, it should be considered alongside other measures and qualitative assessments to provide a more complete picture of a region's development.

The EU SPI has been applied in various studies and policy analyses to assess and compare the social progress of EU countries, identifying areas of strength and opportunities for improvement. For example, the European Commission has used the index to inform its social policy and cohesion strategies, aiming to address disparities and foster more inclusive growth across the Union.

The Bertelsmann Social Cohesion Radar

The Bertelsmann Stiftung's Social Cohesion Radar (SCR) is a comprehensive framework developed to assess and compare the levels of social cohesion within and across societies. Its methodology is rooted in a multidimensional approach that conceptualises social cohesion through three primary dimensions: social relations, connectedness, and focus on the common good. Each dimension is further broken down into sub-dimensions, which are quantified using a variety of indicators derived from survey data and official statistics.

Therefore, the Radar utilises a set of nine core indicators, distributed across the three broad dimensions:

- Social Relations: This dimension includes indicators such as trust in people, social networks, and acceptance of diversity, reflecting the interpersonal aspect of cohesion.
- Connectedness: This encompasses indicators like identification with a community, trust in institutions, and perception of fairness, which measure the links between individuals and their broader social and political environments.
- Focus on the Common Good: This dimension is gauged through indicators of solidarity and helpfulness, respect for social rules, and civic participation, highlighting the collective aspect of social cohesion.

The Bertelsmann Social Cohesion Radar has been implemented through four distinct waves, each wave representing a comprehensive survey period that captures and analyses data on social cohesion at different times: from 1989 to 1995; from 1996 to 2003; from 2004 to 2008; from 2009 to 2012.

The Social Cohesion Radar draws exclusively on large scale internationally comparative secondary data from high-quality academic and institutional sources. Below a table categorising sources by type.

Table 3: Social Cohesion Radar's sources categorized by typology

Survey data	Expert Ratings	Institutional Data
World Values Survey (WVS or WEVS)	Shadow economy in OECD countries (S&B)	International Crime Victim Survey (ICVS)
European Values Study (EVS or WEVS)	Index of democracy (VAN)	International Country Risk Guide (ICRG)
Gallup World Poll (GWP)		
European Social Survey (ESS)		
European Quality of Life Survey (EQLS)		
International Social Survey Programme (ISSP)		
International Social Justice Project (ISJP)		
Eurobarometer (EB)		

Source: Dragolov et al. (2016)

The methodological process for constructing the composite index or radar involved five integral steps the initial selection of indicators; data preparation; final selection of indicators; reflective measurement of dimensions; formative measurement of social cohesion.

In particular, the process of data preparation involves deleting on an item-per-item basis the missing values on individual responses and, when necessary, to recode or dichotomise indicators. Most of the data, even when originating from surveys of individuals, are available at country level, such as the Gallup World Pull.

After obtaining scores for each dimension of social cohesion through the reflective measurement approach, scores are standardised and aggregated these scores to construct the overall index of social cohesion. The aggregation involves averaging the scores across the nine dimensions for each country. Similarly, partial indices for specific domains of cohesion (such as social relations, connectedness, and focus on the common good) are calculated by averaging the scores for relevant dimensions.

Unlike the standardised dimension scores, the overall index of cohesion and the partial indices were not standardised after compilation. Therefore, their standard deviation is less than one. This approach allows to maintain consistency in the measurement of social cohesion across different dimensions and domains while ensuring that the aggregated scores reflect the relative strengths of each country in these areas.

The methodology includes rigorous validation processes, such as sensitivity analysis and robustness checks, to ensure the reliability and validity of the findings. The framework is periodically reviewed and updated to reflect new insights and data availability.

Several studies have utilised the Bertelsmann Social Cohesion Radar to analyse social cohesion within different contexts, demonstrating its utility and adaptability. For example, Dragolov et al. (2016) applied the radar to examine social cohesion in the European Union, providing insights into the diversity and commonalities across member states and highlighting the radar's strengths and weaknesses.

One of the primary strengths of the Bertelsmann Social Cohesion Radar lies in its comprehensive and nuanced approach to assessing social cohesion, enabling not only international comparisons but also longitudinal tracking of changes over time. Moreover, the incorporation of diverse data sources allows for a balanced evaluation, encompassing both subjective and objective measures of social cohesion.

However, the reliance on existing survey data and the challenge of operationalising complex social concepts into quantifiable indicators can introduce biases and oversimplifications. Cultural nuances and the subjective nature of social cohesion are particularly difficult to capture solely through quantitative means. Furthermore, the complexity of the framework and the need for extensive data may limit its applicability in contexts with limited data availability.

Finally, the use of evolving indicators and a reflective measurement approach in data analysis introduces uncertainty, hindering the ability to determine whether changes in social cohesion reflect genuine societal shifts or are due to alterations in indicators. Despite efforts such as confirmatory factor analyses, absolute certainty is challenging to achieve. Additionally, the reflective measurement approach limits the assessment of absolute trends in social cohesion, as it allows only for relative conclusions based on comparisons with other countries. Absolute trends can only be inferred from consistent indicators across multiple time periods, and a country's relative position in cohesion may change without indicating an absolute change in its level.

VALCOS Index

The VALCOS Index, developed by Acket (2011) for the OECD, represents a significant leap forward in quantifying social cohesion, building upon the micro-based index crafted by Dickes et al. (2009, 2010). Rooted in data from the European Values Study (EVS) 2008, this index provides an assessment of social cohesion, encompassing both political and sociocultural dimensions. Through validation procedures,

it has demonstrated robust correlations with macro indicators, affirming its reliability (Acket et al., n.d.).

Drawing from the conceptualisations of social cohesion by Bernard (1999) and Chan et al. (2006), the VALCOS Index aims to encapsulate formal and substantive aspects of political and sociocultural life. By analysing EVS 2008 data alongside macro indicators, researchers have been able to not only rank social cohesion across 39 European countries but also explore nuanced differences among these nations. Furthermore, the validation process involved correlating the index with national-level variables, thereby enhancing its credibility and utility in capturing the multifaceted nature of social cohesion.

Empirical analyses leverage the fourth wave of EVS in 2008 across countries and regions. Methodologically, the researchers selected and validated EVS questionnaire items, which were then subjected to Multidimensional Scaling (MDS) and Confirmatory Factor Analysis (CFA) to ascertain their compatibility across different countries and regions. Despite the overall consistency observed in the analysis, certain reliability issues surfaced in three specific countries, including one European country (Belgium), necessitating further investigation.

The construction process of the VALCOS Index involves procedures aimed at transforming individual-level data into macro variables. This process includes aggregating standardised scores derived from intermediate variables and integrating them with a multitude of macro-level indicators.

In addition to key indicators such as legitimacy/illegitimacy, acceptance/rejection, and participation/passivity, the VALCOS Index incorporates a comprehensive array of auxiliary indicators. These include social macro variables such as those found in the Spearman rank (employment, work, economy; health, education, demography, and subjective well-being), as well as other indicators sourced from VALCOS and elsewhere, such as suicides, life satisfaction, happiness, voting patterns, unemployment rates, at-risk-of-poverty rates, GDP per inhabitant, lifelong learning, internet access levels, income per capita, minimum wages, fertility rates, cinema attendance, emigration rates, and infant mortality. Furthermore, reconciliation indicators, which encompass stereotypes, intergroup anxiety, social distance, threats, active discrimination, and positive feelings for other groups, are integral to understanding various dimensions of societal well-being.

The resultant index not only exhibits robustness, coherence, and adaptability across diverse socio-economic and cultural contexts but also adheres closely to the OECD definition of social cohesion, which emphasises factors such as social mobility and economic vectors. Moreover, the periodic nature of the EVS facilitates longitudinal analyses, enabling researchers to track temporal trends and variations in social cohesion over time.

Social Cohesion Indicators

Ultimately, although the OECD lacks a comprehensive indicator for gauging social cohesion, it is noteworthy to highlight potential social cohesion indicators that could supplement existing composite metrics, such as the Social Progress Index (SPI). The Organisation for Economic Co-operation and Development (OECD) has undertaken extensive scholarly investigations into the realm of social cohesion. A noteworthy research endeavour, conducted in 2029, specifically scrutinises the experiences of LGBTQ communities. In this particular publication, social cohesion is conceptually

characterised as the extent to which individuals participate in communal activities or perceive a sense of security, with four identified indicators considered relevant for its evaluation.

In this study, life satisfaction is proposed as a pivotal measure, considering not only economic progress but also diverse life experiences and living conditions. Additionally, the study underscores the significance of confidence in institutions and active involvement in the electoral process as crucial gauges reflecting individuals' trust in their country's establishments and societal participation. Moreover, online activities represent another essential component in evaluating social cohesion, covering aspects like online interconnectedness and the incidence of cyberbullying among adolescents. Notably, an omission from the aforementioned composite indicators, is the evaluation of Violence against Women. Its inclusion is vital to underscore the persistent and alarmingly high prevalence of such violence. Incorporating this indicator provides a more comprehensive depiction of social cohesion, capturing the existence and troubling escalation of this phenomenon within society.

The ensuing table delineates the four aforementioned indicators along with their respective definition.

Table 4: OECD Social Cohesion Indicators

Indicator	Definition
Life satisfaction	The Gallup World Poll employs an eleven-rung ladder, with 0 representing the worst possible life and 10 the best. Respondents indicate their current life position. The primary metric is the average country score. The poll, conducted in 150+ countries, ensures comparability. Positive and negative experience indexes supplement, aggregating responses to inquiries about enjoyment, laughter, well-restedness, physical pain, worry, stress, sadness, and anger.
Confidence in institutions	Data from the Gallup World Poll, covering 150+ countries, assess confidence in national government, financial institutions, the judicial system, courts, the local police force, and the military. Aggregated over two years for stability, results may be influenced by sampling and non-sampling errors. Caution is advised in interpretation.
Online activities	Metrics from the ICT Access and Usage by Households and Individuals database and European Social Survey. Internet usage data include daily time online from the European Social Survey. Cyberbullying data from Health Behaviour in School-aged Children Survey 2013-14 focus on 11, 13, and 15-year-olds. The European Social Survey measures attitudes, beliefs, and behaviour patterns across over thirty nations.

Violence against Women	Data from the Gender, Institutions and Development Database 2019. It includes percentages of ever-partnered women experiencing intimate partner physical and/or sexual violence, those encountering such violence in the past 12 months, and women aged 15-49 justifying husband-inflicted violence for specified reasons. Additional data on feeling unsafe walking alone at night are from the Gallup World Poll, emphasising safety perceptions within the context of gender-based discrimination and violence against women.

Source: OECD (2019), Society at a Glance 2019: OECD Social Indicators, OECD Publishing, Paris, https://doi.org/10.1787/soc_glance-2019-en.

Gender

Gender is a multidimensional and cross-cutting aspect that plays a pivotal role in shaping societal dynamics. Although inherently transversal, incorporating gender considerations into the development of tools for monitoring European performance across various dimensions is crucial. This section explores existing composite indicators that assess gender equality on both a regional and global scale, capturing diverse facets of this complex construct.

The **EU Regional Gender Equality Monitor**, developed by the EU Commission, introduces two composite indices, namely the Female Achievement Index (FemAI) and the Female Disadvantage Index (FemDI). These indices intricately address distinct yet complementary aspects of gender equality at the regional level, covering all EU regions with a comprehensive dataset of 235 regions and 33 indicators. The most recent release of this monitor occurred in 2021. The data are at NUTS2 level.

N26's **Female Opportunity Index**, encompassing four categories with nine factors, evaluates female achievement, equality, and support in 100 countries. This comprehensive index, featuring 35 indicators, was last released in 2021.

The **Gender Equality Index**, jointly developed by the EU Commission and the European Institute of Gender Equality (EIGE), serves as a valuable tool for measuring gender equality progress within the EU. With coverage of the EU27 and 31 indicators, its latest release took place in 2022. This index sheds light on areas in need of improvement, aiding policymakers in crafting more effective gender equality measures.

The United Nations Development Programme's **Life-Course Gender Gap Dashboard** offers a nuanced perspective by presenting indicators that highlight gender gaps in choices and opportunities across different life stages. Covering 195 countries and employing 13 indicators, the latest release occurred in 2022. It is one of the dashboards constructed to complement the Human development index with insights on inequalities and gender.

Equal Measures 2030's **SDG Gender Index** serves as a global snapshot of progress toward gender equality embedded in the 2030 Agenda. Spanning 144 countries and assessing 56 indicators, the most recent release took place in 2022.

The **Women in Digital Scoreboard (WiD Scoreboard)** by the European Commission evaluates women's inclusion in digital jobs, careers, and entrepreneurship. Assessing Member States' performance across internet use, user skills, specialist skills, and employment through 12 indicators, the most recent release was in 2022. This index plays a pivotal role in assessing and promoting gender equality in the digital domain.

Cross-dimension analysis and conclusions

The evolution of composite indicators demonstrates an advancing complexity in the evaluation of EU countries' performance across multiple domains. These indicators encompass societal, economic, environmental, and governance considerations, illustrating their interdependence.

Progress can be seen in the adoption of inclusive metrics that reflect diverse aspects of well-being and societal progress. For instance, economic performance is now seen in the context of digitalisation, with implications for productivity and societal inclusiveness. Simultaneously, the urgency of climate change and sustainable practices is now recognised as central to economic robustness and social fairness.

A noteworthy trend is the growing attention on green transition and digitalisation indicators. Within this literature review, these areas were predominant, underscoring the importance of monitoring their advancement and addressing potential challenges.

Moreover, the breadth of these indicators is significant as they traverse multiple dimensions. They are essential in assessing developments from economic strength to social cohesion, underscoring the importance of inclusivity and progress in defining overall well-being.

For example, instruments like the Transitions Performance Index and the Just Transition Score acknowledge that a just and sustainable shift requires a comprehensive approach, considering economic, social, environmental, and governance aspects.

Additionally, measures such as the Digital Economy and Society Index and the ICT Development Index emphasize the growing importance of digitalisation—a theme that is integral to economic competitiveness, social inclusion, and the efficiency of governance. The integration of digital metrics into broader indicators not only reflects the digital era but also underscores the foundational role of digital infrastructure in modern societies.

Finally, instruments like the Bertelsmann Stiftung's Sustainable Governance Indicators go beyond traditional institutional quality measures to encompass sustainable policies.

This review also indicates a strong emphasis on local sustainable development assessments, with indicators providing region-specific analysis within EU countries, highlighting the necessity for policies tailored to regional distinctiveness.

A considerable challenge highlighted in the literature pertains to the construction and methodology of composite indicators that effectively capture impacts across various dimensions. This includes the need for data comparability, addressing gaps in data, and creating weighting systems to account for the varied effects of different indicators.

In conclusion, the literature underscores the relevance of a unitary approach to measuring well-being that goes beyond standard economic indicators. The interconnectedness of multiple dimensions indicates that a holistic, composite indicator framework is crucial for capturing the nuances of societal well-being. Advancements in this area will equip policymakers and stakeholders with the tools necessary to monitor progress effectively and implement targeted strategies to improve well-being across the EU.

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