SUSTAINABLE CITIES INDEX

METHODOLOGY

2023

INTRODUCTION

The Corporate Knights Sustainable Cities Index is the world's first interactive, crowd-sourced sustainability index for cities. Local government officials can log in to our user-friendly data hub, provide 15 simple data points, and join municipalities from around the world in a comparative assessment of sustainability metrics. The interactive data hub will promote engagement with the participating cities and continuous improvements in the index.

Drawing on leading world experts and our 20 years of experience in rating and ranking, we produced a concise and robust index that tracks 12 key indicators of urban sustainability related to climate change, air quality, land use, transportation, water, waste, policy, and resilience.

Our research division has expanded the quantitative, outcomes-focused index to a group of 70 cities using public data that will grow as cities visit the interactive data hub and submit their metrics to the database.

This year, we factored in socio-economic differences between cities by developing the Corporate Knights Socio-Economic Adjustment Factor (CKSEAF).

FAST FACTS

Overview:

- Annual ranking of cities' sustainability performance
- Released each year in Corporate Knights magazine

Approach:

- The ranking is based on publicly disclosed data (e.g., C40 Knowledge Hub, CDP Cities, World Bank, and UN Habitat Urban Indicators Database)
- Cities are encouraged to engage in our user-friendly data hub for data submission to participate in the ranking
- Methodology is based on 12 key indicators of city sustainability performance

Eligibility:

- Universe: While the 70 cities included in this release of the index were chosen based on their size or established sustainability reputation, any municipality is welcome to visit the data hub, enter their information in the database and receive a scorecard.

PRINCIPLES

RELEVANCE
This sustainable city ranking is meant to be representative of sustainable cities in the current context.

TRANSPARENCY
The precise methodology of ranking and results of the process are fully disclosed.

OBJECTIVITY
Cities are assessed using quantitative data and performance indicators.

PUBLIC DATA
This ranking relies primarily on data points that are in the public domain and mostly accessible from free databases.

COMPARABILITY
Cities are compared on the same indicators.

ENGAGEMENT
Cities selected for the inaugural ranking were informed prior to publication and invited to review data.

STAKEHOLDERS
Stakeholder feedback is actively solicited throughout the project.

CITIES UNIVERSE

The Sustainable Cities Index includes populous cities, often called megacities, and several mid-sized cities, with a total of 70. Cities are in Canada, United States, Central & South America, Europe, Africa, Asia-Pacific, and China & Taiwan.

Abidjan	Accra	Amsterdam	Arequipa	Auckland
Beijing	Belén	Berlin	Bogotá	Boston
Buenos Aires	Calgary	Canberra	Cape Town	Chicago
Copenhagen	Curitiba	Dakar	Dar es Salaam	Dhaka
Dubai	Edmonton	Guangzhou	Halifax	Hong Kong
Houston	Hsinchu	Istanbul	Johannesburg	Karachi
Lagos	Lahti	London, UK	London, Canada	Los Angeles
Madrid	Medellín	Mexico City	Minneapolis	Montréal
Mumbai	Nairobi	New York City	Oslo	Ottawa
Paris	Philadelphia	Pingtung	Providencia	Quezon City
Rio de Janeiro	San Francisco	São Paulo	Saskatoon	Seattle
Seoul	Shanghai	Shenzhen	Singapore	Stockholm
Sydney	Taichung	Taipei	Tianjin	Tokyo
Toronto	Vancouver	Washington, DC	Winnipeg	Yaoundé

Cities that wish to be included in the Corporate Knights Sustainable Cities Index are encouraged to submit their city's sustainability data in our data hub.

INDICATORS

The 2023 Sustainable Cities Index is composed of 12 quantitative indicators of environmental sustainability performance. The method is simple: for each of the indicators, the necessary data points are collected, either from public data sources or directly from the cities themselves, through our interactive data hub.

INDICATOR	METHOD
Scope 1 GHG emissions	Divide the city's sector-based inventory of Scope 1 emissions by the city's population. This indicator reflects fossil fuel consumption in the city.
Consumption-based emissions	Divide the city's consumption based GHG emissions inventory by the city's population. Corporate Knights developed a simplified method for estimating a city's consumption-based inventory, described below. Cities' GHG footprints typically far exceed the emissions included in their direct, sector-based inventories, and this indicator captures that aspect of urban sustainability.
Particulate air pollution	Micrograms of fine particulates (less than 2.5 μm diameter) per cubic metre of air, known as PM2.5,a standard indicator of air pollution.
Open public space	Divide city area for public parks, recreation areas, greenways, and other areas accessible to the public by total city area.
Water access	The percentage of city population with access to potable water.
Water consumption	The average amount of water consumed in litres per capita per day.
Automobile dependence	Divide number of registered road vehicles by number of households.
Road infrastructure efficiency	Divide the length of the road network in kilometres by square kilometres of city area.
Sustainable transport	Divide number of trips by sustainable modes (walking, cycling, or public transit) by the total of all trips.
Solid waste generated	Divide the amount of municipal solid waste generated in tonnes per year by the city population.
Climate change resilience	Divide the national Notre Dame GAIN Readiness Score by the Notre Dame GAIN Vulnerability Score. A higher ratio indicates a high level of readiness for climate disasters and/or a low level of vulnerability to climate disasters.
Sustainable policies	The key sustainability policies, as reported to CDP Cities, enacted in the city including: (i) renewable energy target, (ii) electric vehicle target, (iii) emission reduction target, (iv) net-zero GHG target, and (v) renewable energy enabling policy. Amended with additional information to support renewable energy policies and targets as provided by cities.

THE CK SOCIO-ECONOMIC ADJUSTMENT FACTOR (CKSEAF)

Understanding and comparing environmental performance indicators requires consideration of the underlying social and economic dimensions of sustainability. For example, indicators such as per capita greenhouse gas emissions or per capita water consumption will be low in high-income countries and cities if water conservation and efficiency are priorities, but they will also be low in low-income countries and cities because of poverty and low access to fuels, electricity, and potable water.

The Corporate Knights Socio-Economic Adjustment Factor (CKSEAF) has been developed and incorporated in the Sustainable Cities Index to discount environmental KPI scores to the extent they coincide with unsustainable social and economic conditions.

$$\text{CKSEAF} = \frac{\log(10a \times 10b \times 10c)}{3}$$

where

a is the UNDP Human Development Index, a statistical composite of life expectancy, education, and per capita income indicators.

b is one minus the GINI coefficient for income distribution. To be consistent with the other two indices where 0 indicates low performance and 1 indicates high performance, the index is based on (1-GINI coefficient). For example, very high degree of income equality in Slovak Republic results in a GINI index coefficient of 0.232, which is subtracted from 1 to result in a value of 0.768.

c is an index of per capita GDP, expressed as a fraction of US$48,480 purchasing power parity (PPP), equal to the GDP PPP for the EU, up to a maximum of 1.

The three indices are scaled from 0 to 10 in the application of the CKSEAF formula above.

The CKSEAF is based on the product of the component indices rather than on a simple average so that, for a given average of the three indices, a higher CKSEAF will result when the values of the three indices are more evenly distributed. For example, a set of values of 7, 7, and 7 will yield a higher CKSEAF than a set of values of 9, 9 and 3, even though the average of the two sets are equal.

The formula yields a CKSEAF that is a decimal fraction of 1 and can be used to discount KPI scores that are also expressed as decimal fractions of 1.

CKSEAF is applied to the scoring of the ten environmental indicators. The two indicators where socio-economic dimensions already come into play are Sustainable Policies and Climate Change Resilience.

THE CK SOCIO-ECONOMIC ADJUSTMENT FACTOR (CKSEAF) CONT'D

Country	Scaled GDP PPP per capita	Scaled GINI index	Scaled HDI	Corporate Knights Socio-Economic Adjustment Factor (CKSEAF)
Norway	1.00	0.94	1.00	0.99
Denmark	1.00	0.94	0.99	0.99
Finland	1.00	0.94	0.98	0.99
United Arab Emirates	1.00	0.96	0.95	0.99
Sweden	1.00	0.92	0.98	0.99
Netherlands	1.00	0.92	0.98	0.99
Germany	1.00	0.89	0.98	0.98
Australia	1.00	0.86	0.99	0.98
Canada	1.00	0.87	0.97	0.98
Korea	0.97	0.89	0.96	0.97
France	1.00	0.88	0.94	0.97
United Kingdom	1.00	0.85	0.97	0.97
New Zealand	0.96	0.85	0.97	0.97
Japan	0.89	0.87	0.96	0.96
United States of America	1.00	0.76	0.96	0.95
Hong Kong	1.00	0.69	0.99	0.95
Spain	0.84	0.86	0.94	0.94
Singapore	1.00	0.45	0.98	0.88
Turkey	0.63	0.76	0.87	0.87
Chile	0.59	0.72	0.89	0.86

THE CK SOCIO-ECONOMIC ADJUSTMENT FACTOR (CKSEAF) CONT'D

Country	Scaled GDP PPP per capita	Scaled GINI index	Scaled HDI	Corporate Knights Socio-Economic Adjustment Factor (CKSEAF)
Argentina	0.49	0.75	0.88	0.84
Costa Rica	0.48	0.66	0.84	0.81
China & Taiwan	0.40	0.80	0.66	0.78
Mexico	0.42	0.71	0.65	0.76
Brazil	0.33	0.67	0.64	0.72
Peru	0.28	0.73	0.65	0.71
Colombia	0.35	0.60	0.64	0.71
South Africa	0.30	0.48	0.57	0.64
Philippines	0.18	0.75	0.54	0.63
Bangladesh	0.13	0.88	0.48	0.58
India	0.15	0.84	0.43	0.58
Ghana	0.12	0.74	0.43	0.53
Pakistan	0.12	0.92	0.28	0.49
Cote d'Ivoire	0.12	0.82	0.29	0.48
Kenya	0.11	0.77	0.33	0.48
Nigeria	0.11	0.85	0.26	0.46
Cameroon	0.08	0.70	0.33	0.43
Senegal	0.08	0.81	0.22	0.38
Tanzania	0.06	0.77	0.28	0.37

SCORING AND WEIGHTING

Values of each of the 12 indicators are converted to a score out of 1.0 as described in the table below. The environmental KPI scores are then multiplied by the CKSEAF to produce an adjusted score. Based on the adjusted scores of each indicator, each city receives a letter grade and rank for their overall score on the index.

INDICATOR	SCORE	WEIGHT
Scope 1 GHG emissions	Score is inversely related to the indicator, with a score of 1.0 equated to the average of the lowest indicator values in the database. All other cities' indicator values are scaled against this standard.	10%
Consumption-based emissions	Score is inversely related to the indicator, with a score of 1.0 equated to the average of the lowest indicator values in the database. All other cities' indicator values are scaled against this standard.	10%
Particulate air pollution	A score of 1.0 to cities below the WHO Guideline annual average of 5 µg/m3 and all other cities are ranked against that standard.	20%
Open public space	A score of 1.0 equated with the average percentage of top cities in the database. All other cities ranked against that standard.	5%
Water access	A score of 1.0 is given to cities with 100% potable water access, where any access less than 100% is given a score equivalent to the percentage of the population with potable water access.	5%
Water consumption	A score of 1.0 is given to cities that consume 100 litres/capita/day, and cities that consume more are ranked against that standard. Cities that consume less than 100 litres/capita/day are likely experiencing water scarcity and insecurity rather than efficient use, and cities that consume less are ranked against that standard.	5%
Automobile dependence	Score is inversely related to the indicator, with a score of 1.0 equated to the average of the lowest indicator values in the database. All other cities' indicator values scaled against this standard.	5%
Road infrastructure efficiency	Score is inversely related to the indicator, with a score of 1.0 equated to the average of the lowest indicator values in the database. All other cities' indicator values scaled against this standard.	5%
Sustainable transport	A score of 1.0 equated with the average percentage of top cities in the database. All other cities ranked against this standard.	5%
Solid waste generated	Score is inversely related to the indicator, with a score of 1.0 equated to the average of the lowest indicator values in the database. All other cities' indicator values scaled against this standard.	10%
Climate change resilience	A score of 1.0 equated with the average percentage of top ratios in the database. All other cities scaled against that standard.	10%
Sustainable policies	0.2 points for each policy, for a maximum score of 1.0.	10%

CONSUMPTION BASED EMISSIONS

A unique feature of this index is the inclusion of consumption-based emissions of cities. A country or city's consumption-based emissions are the GHG emissions that result from production and delivery of all the goods and services consumed in the country, regardless of where those goods and services are produced. It differs from the more commonly employed sector-based emissions inventory, which counts the emissions that take place within the city or country, whether they are the result of production for domestic consumption and does not count emissions embedded in goods and services imported from outside the city and country.

The calculation of detailed and precise consumption-based inventories is complex, but they can be estimated with simple methods, which is the approach we have taken.

1 | We begin with the country's sector-based inventory, using the Emissions Database for Global Atmospheric Research (EDGAR) and partition it into two parts: the emissions associated with the final consumption of the household sector, which we call the final consumption emissions, and the emissions that are used to generate the country's GDP, which we call the productive economy emissions.

2 | Emissions associated with final consumption in the household sector are estimated as the sum of three components:

a. The EDGAR residential sector emissions from fuel combustion, plus 50% of the waste sector emissions in the EDGAR inventory
b. the EDGAR power sector emissions multiplied by the portion of national electricity consumption in the residential sector*, according to the IEA World Energy Balances, and
c. the EDGAR transportation sector emissions multiplied by the portion of transportation energy used for personal transportation, according to the IEA Energy Efficiency data product.

This sum is then divided by the country population to get per capita final consumption emissions. This is multiplied by city population to estimate the final consumption emissions for the city.

*Cities in Canada and the United States of America are provided electricity from regional electricity grids, not a national grid, as is common in many other countries. Regional grids, in the state, territory or province, have varying carbon intensities from the national average. This year, we have factored the local (provincial/territorial or state) grid intensity factors into calculations for consumption-based emissions relating to Step 2b.

CONSUMPTION BASED EMISSIONS CONT'D

3 | After subtracting the emissions from final consumption in the household sector from the EDGAR inventory to get the emissions of the productive economy, we divide the country's productive economy emissions into the portion associated with domestic consumption and the portion that is exported. We do this by multiplying the country's productive economy emissions by the percent of the country's GDP that is exported, according to the World Bank trade statistics. This involves the simplifying assumption that the portion of a country's productive economy emissions that is exported can be equated with the portion of a country's GDP that is exported. The emissions related to domestic consumption of the output of the productive economy are divided by population to get a per capita value for emissions embedded in domestic consumption, and this is multiplied by city population to assign a share of the productive economy emissions to the city.

4 | Two of these three components of the country's emissions inventory – the final consumption emissions and the portion of the productive economy emissions associated with domestic consumption – form two components of the consumption-based emissions. What remains is to estimate the emissions that are embodied in imports.

5 | To estimate emissions that are embodied in imports, we start with the portion of each country's emissions inventory that is exported, as calculated in Step 2 above. Using World Bank data, we distribute each country's exported emissions to each other country on the assumption that the share of the emissions embedded in a country's exports that are received by another country is equal to the share of exports received by that country. We can then sum the imported emissions for each country to get an estimate of the total emissions embedded in imports for each country. This total is pro-rated to cities on a per capita basis.

6 | We add the result of Step 5 to the final consumption emissions and the share of the productive economy emissions associated with domestic consumption to obtain the consumption-based emissions.

CONTACT & LEARN MORE

- To confirm the correct contacts for your city or to have your city added to our database, please email cities@corporateknights.com.
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