

## **How Best to Measure Progress Toward Sustainability in Cities: Ranking Lists vs Sustainability Plans**

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### **Part 1: The Arcadis Sustainable Cities Index**

In 2015, Arcadis NV, a global design, engineering and management consulting company based in the Netherlands, published a report called Sustainable Cities Index 2015: Balancing the economic, social and environmental needs of the world's leading cities. The index listed 50 world cities and ranked them according to metrics focusing on three factors: People, Planet and Profit. The purpose of the report, as stated by Global Cities Director, John J. Batten, was to "take 50 of the world's most prominent cities and look at how viable they are as places to live, their environmental impact, their financial stability, and how these elements complement one another" (Arcadis 2015, page 5). In a sense, the report presupposes that each city is striving to be 'sustainable', and Arcadis adopts the general UN definition of sustainable development (meeting the needs of the present without compromising the ability of future generations to meet their needs) by stating that, in an urban context, sustainability means "cities that work well for their citizens in the present without causing problems for themselves and the rest of the world in the future" (Arcadis 2015, page 10). In broader terms, this means that cities should have fast, efficient and affordable transportation systems, clean and safe water, strong social structures and effective institutions, a healthy and well-educated workforce, and an 'environment' that favors strong economic performance (Arcadis 2015).

Those familiar with the seven targets under Sustainable Development Goal (SDG) 11 – Make cities and human settlements inclusive, safe, resilient and sustainable – will note some similarities to the Arcadis view of sustainability, particularly with respect to transportation, as well as differences. SDG 11's targets (see Appendix 1) are much more focused on making cities better for all, especially the disadvantaged, as opposed to just a 'healthy and well-educated workforce'. As a result, care should be taken over how one interprets a ranking list such as this one with respect to not only calling a city 'sustainable', but also in comparing it to other cities and tracking its relative sustainability over time.

The 50 cities in the 2015 report (see Appendix 2) doubled into 100 cities in the 2016 report (see Appendix 3), with a new 'number 1' appearing in the 2016 report, and, in fact, 6 of the top 10 in the 2015 report were not in the top 10 in the 2016 report. Furthermore, 2015's number 1 (Frankfurt) fell to number 6, and 2015's number 2 (London) fell to number 5. Granted, some of this change in ranking is directly related to a much larger pool of cities, but the changes in position gives rise to some important questions. For example, did those 6 cities (Copenhagen, Amsterdam, Rotterdam, Berlin, Hong Kong and Madrid) that dropped out of the top 10 become less sustainable, or are they just not as sustainable as the new cities that were evaluated in 2016? And how did Singapore (number 10 in 2015) vault to number 2 in 2016? How can such big swings in 'sustainability' occur in just one year? Given the attention the media has paid to the 2016 list (see, for example, <https://www.indy100.com/article/the-10-most-sustainable-cities-in-the-world--ZJkLY4gtb> and <https://www.bloomberg.com/news/articles/2016-09-15/look-outside-the-u-s-for-the-world-s-most-sustainable-cities>), one needs to be careful in describing what is or is not a sustainable city, and how cities differ in terms of their sustainability.

The purposes of this paper, then, are threefold. The first is to look a little more closely at the metrics that drive the Arcadis Sustainable Cities Index, fleshing out what is meant by 'people, planet and profit'. The second is to examine the published sustainability reports of cities ranked 1<sup>st</sup> through 3<sup>rd</sup> (Zurich, Singapore and Stockholm), 49<sup>th</sup> through 51<sup>st</sup> (Denver, Los Angeles and Philadelphia) and the 99<sup>th</sup> (Cairo; 100<sup>th</sup> is Kalkota, but it does not seem to have a sustainability report) to see how what these cities see as important issues to address compares to the Arcadis metrics. And the third is to contrast the Arcadis metrics with SDG 11's targets as a way to address the relevancy of this kind of ranking list to the SDGs.

## **The Arcadis Metrics**

To prepare both of its indices, Arcadis partnered with the Center for Economic and Business Research (CEBR) to measure how the cities were doing with respect to sub-indices of people, planet and profit. The measures used in each of these sub-indices are detailed in Appendices 4, 5 and 6, however it is worth noting how those measures changed. In 2015, the measure 'transportation infrastructure' was used in both the People and Planet sub-indices, however in 2016 that measure was confined to just Profit. Also, the 'dependency ratio' and 'literacy' measures used in 2015 were not used at all in 2016 for People, nor was 'energy efficiency' carried over to Profit from 2015 to 2016. In addition, 'cost of doing business' and 'importance to global networks', which were part of the measures for Profit in 2015 were replaced in 2016 by 'tourism', 'connectivity' and 'employment'. Other changes included 'green spaces', which was a People measure in 2015 becoming a 'Planet' measure in 2016, 'crime' being added to People in 2016, 'property prices' (2015) being renamed 'affordability' (2016), 'energy use and renewables' in 2015 changing to 'energy' in 2016, and 'national catastrophe exposure' being renamed 'environmental risks' from 2015 to 2016. No doubt the reason behind all these changes is a refinement in the way CEBR thought about how best to both categorize and measure the most important factors affecting People, Planet and Profit.

Because of the number of changes made in how the three sub-indices were evaluated, it is difficult to attempt to explain how some of the scores for the 50 cities in the 2015 index changed in 2016. So, for the purpose of this study, only the measures and indicators used in the 2016 index will be discussed. For the 2016 index, CEBR used 32 different indicators (see Appendix 7) across these three sub-indices.<sup>2</sup> The scores for each sub-index were accumulated and then averaged to derive the final score. As will be discussed below, performance (i.e., ranking) tended to be determined by just a few specific indicators in each sub-index.

For People, which could be interpreted as quality of life, the measured indicators included health (life expectancy and obesity), education (literacy and universities), income inequality, work-life balance, the dependency ratio (the ratio of people aged 14 and under and 65 and over to the total population), crime, housing and living costs. The Planet sub-index can be thought of as how 'green' the city is, and the categories measured included energy consumption, the percentage of energy being supplied by renewables, recycling/composting activities, greenhouse gas emissions, the amount of available green space, water quality, sanitation, air pollution and vulnerability to natural catastrophes. For the Profit sub-index, a business

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<sup>1</sup> As can be seen in Appendix 4, dependency ratio became an indicator under demographics and literacy became an indicator under education in People.

<sup>2</sup> CEBR used a variety of sources including the World Bank, the World Trade Organization, the OECD, etc. for its indicators.

perspective was used. Here measures focused on 'economic health' and included such things as ease of transportation, ease of doing business, tourism, GDP per capita, the city's importance in global economic networks, connectivity in terms of mobile and broadband access and employment rates. So let us now take a look at the rankings in each sub-index.

## **People**

The top 3 cities in this sub-index were Seoul, Rotterdam and Hamburg. Zurich, Singapore and Stockholm, in contrast, ranked 27<sup>th</sup>, 48<sup>th</sup> and 14<sup>th</sup>, respectively. As noted in the 2016 report, the most reliable predictor of where a city ranks in this sub-index is income inequality, which can be linked as well to crime, education, work-life balance, health and affordability. Income inequality as a main driver of this sub-index's ranking is illustrated by noting that the bottom two cities – Johannesburg and Cape Town – have extremely low scores in that metric, as does Hong Kong (81<sup>st</sup>) and Singapore (48<sup>th</sup>).

## **Planet**

For this sub-index, Zurich was ranked 1<sup>st</sup>, Stockholm 2<sup>nd</sup> and Geneva 3<sup>rd</sup>; Singapore was 12<sup>th</sup>. Here, no one category stands out as influencing ranking, and the more balanced a city is with respect to the measures of natural disaster risk, energy use, green space, air pollution, greenhouse gas emissions, waste management, drinking water and sanitation, the better. Imbalances such as low scores in energy, green space and air pollution can drive down a ranking in a city such as Doha (ranked 98<sup>th</sup>), while high environmental risk, relatively low energy and greenspace scores can drive a city like San Francisco, which some may think of as being 'green' to become ranked just 50<sup>rd</sup>.

## **Profit**

The two main keys to scoring well in this sub-index were a combination of ease of doing business and city's per capita GDP. The top 3 cities were Singapore, Hong Kong and London, with Zurich ranking 5<sup>th</sup> and Stockholm 10<sup>th</sup>. While one might conclude that being a financial center is essential for being ranked high in Profit, that is not necessarily the case. Shanghai, for instance, is ranked just 77<sup>th</sup>, being brought down by low per capita GDP, barriers to entry for business and high low employment (Arcadis 2016).

## **Overall Ranking and Changes in Ranking**

At least for the top ranking cities, dominance in just one sub-index does not necessarily lead to a high ranking; it is how the sub-indices balance out that is important. But why this helps understand a ranking in a single year, it does not help determining why a city might have changed its ranking from 2015 to 2016. It therefore should be interesting to see how the People, Planet and Profit scores moved from 2015 to 2016 for the top 3 2015 cities, Frankfurt, London and Copenhagen, as well as for Singapore, which had a large jump in the rankings.

Frankfurt's total scores stayed the same (70) from 2015 to 2016, but its People score increased from 18 to 22 and its Profit score decreased from 24 to 20, with Planet remaining at 28. London's total increased from 70 to 71, driven by a 1 point increase in Profit (scores for People and Planet were unchanged). Copenhagen also stayed the same (68), with a 1 point increase in People offset by a 1 point decrease in Profit. Singapore's large increase in the rankings was driven almost exclusively by its score in Profit, going from 21 in 2015 to 28 in 2016 (offset by a 1 point drop in People). So for Frankfurt, London and Copenhagen it was not as if they were

slipping in overall sustainability; other than for Singapore's surge in Profit their shift in ranking from 2015 to 2016 is due primarily to more 'sustainable' cities being ranked. But because the individual measures for People, Planet and Profit changed from 2015 to 2016 (see Appendices 8, 9 and 10), it really is not possible to explain how, for example, Frankfurt's Profit ranking decreased. This will be something to examine more closely going forward.

Arcadis has not yet published its 2017 list, but it is doubtful that it will include more than 100 cities. As a result, it may be more interesting to see how the scores for the individual cities change rather than how the rankings change, because progression in the three sub-indices could give an indication that the cities are being pro-active with respect to 'sustainability', at least as it corresponds to the metrics behind the Arcadis list. Given that, for now, the Arcadis list is the only one that has attempted to grade cities and has, therefore, received media attention, an interesting question to ask is whether or not cities think about that ranking when developing their own sustainability plans. This next section will review elements of several cities' sustainability plans to try to answer that question.

## **Part 2 – City Sustainability Plans**

From the above discussion, we know what metrics Arcadis uses to define a city's sustainability, but what are the cities themselves saying? To answer that, a review of selected city sustainability plans was conducted for the top 2 cities (Zurich and Singapore), middle-ranked cities (Los Angeles and Philadelphia), and a bottom-ranked city (Cairo).

### **Zurich**

Zurich's overall sustainability plan is detailed in its 'Zurich Strategies 2035', however that report is written in German. An English language report, 'Sustainability Monitoring in the City of Zurich: Summary 2015', though, is available. In this summary, a commitment to achieve the targets detailed in the 'Zurich Strategies 2035' plan is confirmed, and the summary focuses on the measures that will be used to measure progress. 21 such indicators were identified and will be monitored.

These 21 indicators are subdivided into 3 different categories: economic performance; ecological responsibility; and social solidarity. Listed below are the various indicators under each subdivision.

#### **Economic Performance:**

1. A place to do business, measured by real achieved value creation in the City of Zurich at year 2000 prices in CHF per capita
2. A place to work, measured by number of people employed in the City of Zurich with a contractually-agreed occupation of > 6 hrs/week
3. Unemployment, measured by the number of registered unemployed among working population as a %
4. Financial strength, measured as real taxation revenue in Zurich at year 2000 prices in CHF per inhabitant

5. Public financing, measured as net debt ratio: Net debts as a percentage of value creation
6. Material wealth, which is taxable income per single-rate taxpayer in CHF
7. Living, measured as net living space in square meters per inhabitant

#### Ecological Responsibility

8. Climate protection, indicated by tons of CO<sub>2</sub> equivalent per person per year
9. Energy, using primary energy consumption and renewable energy, or average continuous primary energy output in Watts per inhabitant, as the measure
10. Mobility (transportation), measured by the proportion of environmentally-friendly means of transport as a % of total kilometers per person travelled daily by Zurich residents
11. Material flows (municipal waste), measured as municipal waste in kg per inhabitant per year
12. Air quality measured in terms of nitrogen dioxide pollution, the average annual amount in Zurich in µg/m<sup>3</sup>
13. Noise as defined by noise pollution caused by traffic, or the proportion of population suffering from excessive noise pollution (%)
14. Nature and countryside, defined as sealed areas, or m<sup>2</sup> per inhabitant/proportion (%) of the area of the city

#### Social Solidarity

15. Quality of life measured by population satisfaction levels with the City of Zurich's facilities and what it has to offer
16. Social security, using persons requiring support, or those receiving social benefits or extended AHV/IV (old-age/disability) benefits as a % of population, as a measure
17. Safety as determined by the registered cases of homicide, bodily harm, assault, endangering life and attacks/affray (§ 111-136 Swiss penal code) per year per 100,000 inhabitants
18. Equal opportunities, or the wage gap between men and women in % in the private sector in the canton and the City of Zurich
19. Work/family balance using child care, or the number of children of pre-school or school age receiving out-of-school-hours care, in %, as the measure
20. Integrating people from abroad using employment and education opportunities for foreign youngsters - % without an opportunity for further training/% attending high school in the City of Zurich as the measure

21. Solidarity across the regions, measured as The City of Zurich's contributions to development and humanitarian aid abroad (in CHF per inhabitant per year)

## Singapore

Singapore's sustainability plan is encompassed in the document "Our Home, Our Environment, Our Future: Sustainable Singapore Blueprint 2015". This blueprint is prefaced by these questions: What if you could live, work and play in your own neighborhood?; What if businesses thrive because they care for the earth?; and What if looking after the environment is second nature to us? (Singapore 2015). As with Zurich, Singapore's sustainability plan has set targets for the future; in Singapore's case, 2030. Singapore's targets are divided into 6 different categories – green and blue spaces; mobility; resource sustainability; air quality; drainage; and community stewardship – and 18 measures. Those 18 measures Singapore will be monitoring in these categories are described below.

### Green and Blue Spaces

1. Amount of skyscraper greenery
2. Amount of park space and waterfalls open to recreational activity in:
  - a. Parks
  - b. Waterbodies
3. Length of park connectors and waterways open to recreational activity in:
  - a. Park connectors
  - b. Waterways
4. Length of nature ways
5. Proportion of households within a 10-minute walk of a park

### Mobility

6. Length of cycling paths
7. Modal share of journeys during peak hours made via public transport
8. Length of rail network
9. Proportion of households within a 10-minute walk of a train station

### Resource Sustainability

10. Proportion of buildings to achieve the BCA 'Green Mark Certified' rating
11. Energy intensity improvement from 2005 levels
12. Domestic water consumption per capita per day
13. National recycling rate (domestic and non-domestic)

### Air Quality

14. Air quality with respect to:
  - a. Particulate Matter 2.5 (annual and 24-hour mean, 99<sup>th</sup> percentile)
  - b. Particulate Matter 10 (annual and 24-hour mean, 99<sup>th</sup> percentile)
  - c. Sulphur Dioxide (24-hour mean, maximum)
  - d. Ozone (8-hour mean, maximum)
  - e. Nitrogen Dioxide (annual and 1-hour mean, maximum)

- f. Carbon Monoxide (8-hour mean, maximum and 1-hour mean, maximum)

#### Drainage

- 15. Flood prone areas

#### Community Stewardship

- 16. Number of active green volunteers
- 17. Number of community in bloom gardens
- 18. Number of litter-free bright spots

### **Los Angeles**

The categories Los Angeles focuses on in its sustainability program are taken from its Sustainable City pLAN 2nd Annual Report 2016-2017. Los Angeles divides its plan into 3 main categories – environment, economy and equity. The separate areas of emphasis under each of these three categories is as follows.

#### Environment

- Local Water
- Local Solar
- Energy Efficient Buildings
- Carbon & Climate Leadership
- Waste & Landfills

#### Economy

- Housing & Development
- Mobility & Transportation
- Prosperity & Green Jobs
- Preparedness & Resiliency

#### Equity

- Air Quality
- Environmental Justice
- Urban Ecosystem
- Livable Neighborhoods
- Lead by Example

### **Philadelphia**

Philadelphia's approach to sustainability is detailed in the City of Philadelphia document *Greenworks: A Vision for a Sustainable Philadelphia* published in 2016. Philadelphia has 8 visions (see below) in which 4 benefits are derived. These benefits are: Equity (meaning, essentially, 'quality of life'); Health (accessible food and water and healthy air for all); *Environmental (preserving green space and reducing the city's carbon footprint); and Economic (spurring business and job growth via the 'green' economy).* (Philadelphia 2016)

## Philadelphia's Visions

Accessible Food and Drinking Water  
Healthy Outdoor and Indoor Air  
Clean and Efficient Energy  
Climate Prepared and Carbon Neutral Communities  
Quality Natural Resources  
Accessible, Affordable and Safe Transportation  
Zero Waste  
Engaged Students, Stewards and Workers

## Cairo

Cairo has prepared a comprehensive plan encapsulated in *Vision of Cairo 2050: Within a national vision of Egypt* published in 2009. This plan centers around 3 main visions – Global, Green and Connected – with separate objectives identified for each vision.

### Global

1. African gate and one of the best Middle Eastern capitals.
2. Regional and international pole for: political, administrative, cultural, tourism and economical sectors.
3. Capital of world heritage with all its historical heritage.
4. Act effectively in the global culture networks and an active partner in the global knowledge exchange.
5. Includes tourism and commercial activities and high level business.
6. Includes social, cultural and tourism institutions to protect, attract different talents.
7. Global city with high technology.

### Green

1. Good living condition for its citizens (to be among the 30 best cities in the world).
2. One of pioneer cities on the context of environmental level.
3. Restoration of urban and architecture heritage of the city and elimination of slums.
4. Reach the international standard for green areas/per capita.
5. Containing routes for pedestrians, open and green areas and public squares.

### Connected

1. Socially connected
2. Road and transportation network connected
3. Technology connected

In addition, the Cairo plan identifies 2 sectors – upgrade living conditions to an international standard and increase Cairo's competitiveness – each with specific themes or areas to address, as summarized below (Cairo 2009, page 38).

### Upgrade Living Conditions to an International Standard

1. Better governance
2. Decentralization and redistribution of the population



3. Improving the environment and increasing green areas
4. Roads and transportation
5. Water and sewage

Increase Cairo's competitiveness through these sectors

1. Culture and media
2. Industrial
3. Tourism
4. Education
5. Health
6. Finance and trade
7. Technology and communication

### **Arcadis Metrics and City Plans**

For the most part, the range of items that drive the metrics used for the Arcadis list are consistent with what the selected cities are identifying as essential to attain sustainability. The major source of discrepancy between Arcadis and the cities, though, is with respect to profit. As noted above, the key determinants for scoring well in Profit in the Arcadis list are GDP per capita and ease of doing business. Only Zurich explicitly addresses wealth, doing so in 3 of the 7 indicators of its Economic Performance category. Singapore does not address wealth at all. Los Angeles and Philadelphia connect economic performance to participating more and creating opportunities in the 'green' economy. And Cairo essentially treats improved economic performance as an outcome of its overall efforts to reach its long range targets.

But does this mean that Profit is not something Arcadis should use? Not necessarily. While in 2016 GDP per capita and ease of doing business were the main drivers of scoring well, the Profit category also includes ease of transportation, tourism, connectivity in terms of mobile and broadband access and employment rates. These are all areas of interest in the city sustainability plans that have been reviewed. So, in a sense, factors that can influence a city's economic growth (and, as a consequence, wealth) are embedded in the cities' plans; they just do not identify profit the same way Arcadis does. What this implies is that perhaps Arcadis should either weight its Profit score differently (not equal to People and Planet), or look at year to year changes in their metrics to better gauge how a city's efforts in those areas are advancing. Cities such as Cairo, which start from a low base and which are for the most part located in developing countries, are in effect punished in the Arcadis ranking vis a vis cities in more advanced economies. Factoring in year to year changes would be one way to compensate for this inherent disadvantage.

### **Part 3 - Arcadis, City Sustainability Plans and SDG 11**

SDG 11 is 'Make cities and human settlements inclusive, safe, resilient and sustainable'. The targets associated with SDG 11, in summary, are that by 2030:

1. Ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums.
2. Provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety.
3. Enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management.
4. Strengthen efforts to protect and safeguard the world's cultural and natural heritage.

5. Significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters.
6. Reduce the adverse per capita environmental impact of cities..... paying special attention to air quality and municipal and other waste management.
7. Provide universal access to safe, inclusive and accessible, green and public spaces.
8. Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning.

These targets are supplemented by two 2020 goals targeting policies and plans relating to actions to mitigate and adapt to climate change and become more resilient to disasters, and provide financial and technical support to least developed countries for sustainable and resilient buildings using local materials.

Broadly speaking, the objectives detailed in each city's sustainability plan and the goal and targets of SDG 11 are not dissimilar. If anything, the difference is in semantics; the wording in SDG 11 reflects a global focus, whereas the wording in the city sustainability plans, naturally, has a local focus. And, broadly speaking, the metrics used by Arcadis also are not really dissimilar from the targets in SDG 11; if one wanted to, each metric in People, Planet and Profit probably could be mapped to an SDG 11 target. One could argue, then, that as the cities on the Arcadis list increase their sustainability scores, they, as a group, will contribute to the achievement of SDG 11.

To be sure, though, the Arcadis metrics should not be seen as a roadmap to achieve SDG 11. Nor should those metrics be guiding a city's sustainability plan, as concentrating efforts to improve a score in one sub-index could damage what can be done in another. For example, trying to make it easier to do business (Profit) may adversely affect income equality (People). What the Arcadis ranking methodology does not do that individual city sustainability plans and SDG 11 do is recognize that attaining sustainability involves the interactions of many moving parts and that it is up to policymakers to determine which part to emphasize when and for how long. The biggest danger in paying too much heed to how a city performs in the Arcadis list is forgetting that the list is a sentence whereas reaching sustainability is a story. As more sentences are written, though, a better story about how the cities comprising the Arcadis list are becoming increasingly sustainable will be told.

## References

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## **Appendix 1 SDG 11 and Targets**

Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable

Targets:

11.1 By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums

11.2 By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons

11.3 By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries

11.4 Strengthen efforts to protect and safeguard the world's cultural and natural heritage

11.5 By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations

11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management

11.7 By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities

11.a Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning

11.b By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015–2030, holistic disaster risk management at all levels

11.c Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials

Source: *Transforming our world: the 2030 Agenda for Sustainable Development* Resolution adopted by the General Assembly on 25 September 2015

**Appendix 2**  
**Cities in the 2015 Arcadis Sustainable Cities Index**  
**(by ranking)**

1	Frankfurt	26	Kuala Lumpur
2	London	27	San Francisco
3	Copenhagen	28	Los Angeles
4	Amsterdam	29	Dallas
5	Rotterdam	30	Santiago
6	Berlin	31	São Paulo
7	Seoul	32	Mexico City
8	Hong Kong	33	Dubai
9	Madrid	34	Abu Dhabi
10	Singapore	35	Shanghai
11	Sydney	36	Istanbul
12	Toronto	37	Johannesburg
13	Brussels	38	Buenos Aires
14	Manchester	39	Beijing
15	Boston	40	Rio de Janeiro
16	Paris	41	Doha
17	Melbourne	42	Moscow
18	Birmingham	43	Jeddah
19	Chicago	44	Riyadh
20	New York	45	Jakarta
21	Houston	46	Manila
22	Philadelphia	47	Mumbai
23	Tokyo	48	Wuhan
24	Rome	49	New Delhi
25	Washington, D.C.	50	Nairobi

Source: SUSTAINABLE CITIES INDEX 2015: Balancing the economic, social and environmental needs of the world's leading cities, Arcadis

**Appendix 3**  
**Cities in the 2016 Arcadis Sustainable Cities Index**  
**(by ranking)**

1.	Zurich	35.	Dublin	69.	Detroit
2.	Singapore	36.	Glasgow	70.	Kuwait City
3.	Stockholm	37.	Warsaw	71.	Santiago
4.	Vienna	38.	Leeds	72.	Doha
5.	London	39.	San Francisco	73.	Beijing
6.	Frankfurt	40.	Brussels	74.	Shanghai
7.	Seoul	41.	Macau	75.	Muscat
8.	Hamburg	42.	Milan	76.	Riyadh
9.	Prague	43.	Seattle	77.	Istanbul
10.	Munich	44.	Washington	78.	Guangzhou
11.	Amsterdam	45.	Tokyo	79.	Sao Paulo
12.	Geneva	46.	Lisbon	80.	Buenos Aires
13.	Edinburgh	47.	Lyon	81.	Jeddah
14.	Copenhagen	48.	Taipei	82.	Rio de Janeiro
15.	Paris	49.	Denver	83.	Lima
16.	Hong Kong	50.	Los Angeles	84.	Mexico City
17.	Berlin	51.	Philadelphia	85.	Tianjin
18.	Canberra	52.	Dubai	86.	Amman
19.	Rotterdam	53.	Baltimore	87.	Hanoi
20.	Madrid	54.	Miami	88.	Jakarta
21.	Sydney	55.	Kuala Lumpur	89.	Chennai
22.	Rome	56.	Dallas	90.	Johannesburg
23.	Vancouver	57.	Moscow	91.	Bengaluru
24.	Barcelona	58.	Abu Dhabi	92.	Mumbai
25.	Manchester	59.	Houston	93.	Chengdu
26.	New York	60.	Chicago	94.	Wuhan
27.	Wellington	61.	New Orleans	95.	Cape Town
28.	Montreal	62.	Pittsburgh	96.	Manila
29.	Antwerp	63.	Atlanta	97.	New Delhi
30.	Brisbane	64.	Shenzhen	98.	Nairobi
31.	Birmingham	65.	Indianapolis	99.	Cairo
32.	Melbourne	66.	Athens	100.	Kolkata
33.	Toronto	67.	Bangkok		
34.	Boston	68.	Tampa		

Source: SUSTAINABLE CITIES INDEX 2016: Putting people at the heart of sustainability, Arcadis

**Appendix 4**  
**Center for Economic and Business Research Indicators**  
**For 2016 Arcadis Index**

<b><u>Indicator Name</u></b>	<b><u>Indicator Description</u></b>
<b>For People:</b>	
Education	Literacy rate University rankings Share of population with tertiary education
Health	Life expectancy Obesity rate
Demographics	Dependency ratio
Income Inequality	Gini coefficient
Affordability	Consumer price index
Work-life balance	Property prices
Crime	Homicide rate
<b>For Planet:</b>	
Environmental risks	Natural catastrophe exposure
Green spaces	Green space as % of city area
Energy	Energy use Renewables share Energy consumption per \$GDP
Air pollution	Mean level of pollutants
Greenhouse gas emissions	Emissions in metric tons (per capita)
Waste management	Solid waste management (landfill v recycling) Share of wastewater treated
Drinking water and sanitation	Access to drinking water (% of households) Access to improved sanitation (% of households)
<b>For Profit:</b>	
Transport infrastructure	Congestion Rail infrastructure Airport satisfaction
Economic development	GDP per capita
Ease of doing business	Ease of doing business index
Tourism	International visitors per year, absolute & per capita
Connectivity	Mobile connectivity Broadband connectivity
Employment	Number of people employed, % of city population

Source: SUSTAINABLE CITIES INDEX 2016: Putting people at the heart of sustainability, Arcadis, page 37.

**Appendix 5**  
**Measures for 'People', 2015 and 2016 Indices**

<u>2015 Index</u>	<u>2016 Index</u>
Transportation infrastructure	Demographics
Dependency ratio	Education
Income inequality	Income inequality
Literacy	Work-life balance
Education	Crime
Work-life balance	Health
Green spaces	Affordability
Property prices	

Sources: SUSTAINABLE CITIES INDEX 2015: Balancing the economic, social and environmental needs of the world's leading cities, Arcadis; SUSTAINABLE CITIES INDEX 2016: Putting people at the heart of sustainability, Arcadis



**Appendix 6**  
**Measures for 'Planet', 2015 and 2016 Indices**

<u>2015 Index</u>	<u>2016 Index</u>
Energy use & renewables mix	Environmental risks
Natural catastrophe exposure	Energy
Air pollution	Green space
Greenhouse gas emissions	Air pollution
Solid waste management	Greenhouse gas emissions
Drinking water & sanitation	Waste management
	Drinking water & sanitation

Sources: SUSTAINABLE CITIES INDEX 2015: Balancing the economic, social and environmental needs of the world's leading cities, Arcadis; SUSTAINABLE CITIES INDEX 2016: Putting people at the heart of sustainability, Arcadis

**Appendix 7**  
**Measures for 'Planet', 2015 and 2016 Indices**

**2015 Index**

Transportation infrastructure

Energy efficiency

Economic development

Ease of doing business

Cost of doing business

Importance to global networks

**2016 Index**

Transportation infrastructure

Economic development

Ease of doing business

Tourism

Connectivity

Employment

Sources: SUSTAINABLE CITIES INDEX 2015: Balancing the economic, social and environmental needs of the world's leading cities, Arcadis; SUSTAINABLE CITIES INDEX 2016: Putting people at the heart of sustainability, Arcadis

## Appendix 8 Rankings for 'People' - 2015 and 2016

### 2015 Index

1. Rotterdam
2. Seoul
3. London
4. Sydney
5. Copenhagen
6. Hong Kong
7. Amsterdam
8. Melbourne
9. Frankfurt
10. Berlin
11. Brussels
12. Manchester
13. Boston
14. Madrid
15. Toronto
16. Singapore
17. Birmingham
18. Chicago
19. Beijing
20. Paris
21. Tokyo
22. Shanghai
23. Kuala Lumpur
24. Philadelphia
25. Abu Dhabi
26. Dubai
27. Houston
28. San Francisco
29. Los Angeles
30. Dallas
31. Moscow
32. Rome
33. New York
34. Doha
35. Washington
36. Buenos Aires
37. Jeddah
38. Santiago
39. São Paulo
40. Istanbul
41. Johannesburg
42. Riyadh
43. Mexico City
44. Jakarta
45. Wuhan
46. Rio de Janeiro
47. Manila
48. Mumbai
49. New Delhi
50. Nairobi

### 2016 Index

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. Seoul</li> <li>2. Rotterdam</li> <li>3. Hamburg</li> <li>4. Vienna</li> <li>5. Berlin</li> <li>6. Prague</li> <li>7. Amsterdam</li> <li>8. Munich</li> <li>9. Muscat</li> <li>10. Montreal</li> <li>11. Antwerp</li> <li>12. Brussels</li> <li>13. Barcelona</li> <li>14. Stockholm</li> <li>15. Warsaw</li> <li>16. Frankfurt</li> <li>17. Canberra</li> <li>18. Madrid</li> <li>19. Lyon</li> <li>20. Paris</li> <li>21. Brisbane</li> <li>22. Melbourne</li> <li>23. Vancouver</li> <li>24. Copenhagen</li> <li>25. Sydney</li> <li>26. Leeds</li> <li>27. Zurich</li> <li>28. Birmingham</li> <li>29. Lisbon</li> <li>30. Geneva</li> <li>31. Manchester</li> <li>32. Taipei</li> <li>33. Rome</li> <li>34. Milan</li> <li>35. Moscow</li> <li>36. Kuwait City</li> <li>37. London</li> <li>38. Edinburgh</li> <li>39. Dublin</li> <li>40. Toronto</li> <li>41. Boston</li> <li>42. Glasgow</li> <li>43. Shanghai</li> <li>44. Tokyo</li> <li>45. Beijing</li> <li>46. Hanoi</li> <li>47. Denver</li> <li>48. Singapore</li> <li>49. Los Angeles</li> <li>50. Wellington</li> </ol> | <ol style="list-style-type: none"> <li>51. Pittsburgh</li> <li>52. Athens</li> <li>53. Kuala Lumpur</li> <li>54. San Francisco</li> <li>55. Dubai</li> <li>56. Riyadh</li> <li>57. Doha</li> <li>58. Jakarta</li> <li>59. Jeddah</li> <li>60. Abu Dhabi</li> <li>61. Seattle</li> <li>62. Wuhan</li> <li>63. Chengdu</li> <li>64. Bangkok</li> <li>65. Guangzhou</li> <li>66. Philadelphia</li> <li>67. Washington</li> <li>68. Tianjin</li> <li>69. Macau</li> <li>70. Atlanta</li> <li>71. Amman</li> <li>72. Detroit</li> <li>73. Shenzhen</li> <li>74. Chicago</li> <li>75. Bengaluru</li> <li>76. Chennai</li> <li>77. New York</li> <li>78. Kolkata</li> <li>79. Houston</li> <li>80. Baltimore</li> <li>81. Hong Kong</li> <li>82. Dallas</li> <li>83. Indianapolis</li> <li>84. Tampa</li> <li>85. Santiago</li> <li>86. Mumbai</li> <li>87. New Delhi</li> <li>88. Buenos Aires</li> <li>89. Miami</li> <li>90. Istanbul</li> <li>91. Lima</li> <li>92. Cairo</li> <li>93. New Orleans</li> <li>94. Manila</li> <li>95. Rio de Janeiro</li> <li>96. Mexico City</li> <li>97. Sao Paulo</li> <li>98. Nairobi</li> <li>99. Johannesburg</li> <li>100. Cape Town</li> </ol> |
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Sources: SUSTAINABLE CITIES INDEX 2015: Balancing the economic, social and environmental needs of the world's leading cities, Arcadis; SUSTAINABLE CITIES INDEX 2016: Putting people at the heart of sustainability, Arcadis

**Appendix 9**  
**Rankings for 'Planet' - 2015 and 2016**

**2015 Index**

1. Frankfurt
2. Berlin
3. Copenhagen
4. Madrid
5. Rotterdam
6. Amsterdam
7. Singapore
8. Rome
9. Toronto
10. Birmingham
11. Paris
12. London
13. Seoul
14. Manchester
15. Brussels
16. Sao Paulo
17. Rio de Janeiro
18. Sydney
19. Hong Kong
20. New York
21. Boston
22. Washington
23. Melbourne
24. Kuala Lumpur
25. Buenos Aires
26. Mexico City
27. Santiago
28. Tokyo
29. Chicago
30. Houston
31. Philadelphia
32. Istanbul
33. Shanghai
34. Manila
35. Johannesburg
36. Mumbai
37. San Francisco
38. Jakarta
39. Jeddah
40. Riyadh
41. Moscow
42. Dallas
43. Los Angeles
44. Abu Dhabi
45. Nairobi
46. Beijing
47. Dubai
48. Wuhan
49. New Delhi
50. Doha

**2016 Index**

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. Zurich</li> <li>2. Stockholm</li> <li>3. Geneva</li> <li>4. Vienna</li> <li>5. Frankfurt</li> <li>6. Wellington</li> <li>7. Rome</li> <li>8. Sydney</li> <li>9. London</li> <li>10. Hamburg</li> <li>11. Madrid</li> <li>12. Singapore</li> <li>13. Copenhagen</li> <li>14. Manchester</li> <li>15. Birmingham</li> <li>16. Berlin</li> <li>17. Rotterdam</li> <li>18. Vancouver</li> <li>19. Amsterdam</li> <li>20. Glasgow</li> <li>21. Leeds</li> <li>22. Edinburgh</li> <li>23. Barcelona</li> <li>24. Munich</li> <li>25. Canberra</li> <li>26. Seoul</li> <li>27. Montreal</li> <li>28. Toronto</li> <li>29. Hong Kong</li> <li>30. Sao Paulo</li> <li>31. Prague</li> <li>32. Paris</li> <li>33. New York</li> <li>34. Brussels</li> <li>35. Seattle</li> <li>36. Milan</li> <li>37. Antwerp</li> <li>38. Rio de Janeiro</li> <li>39. Dublin</li> <li>40. Lyon</li> <li>41. Brisbane</li> <li>42. Baltimore</li> <li>43. Lisbon</li> <li>44. New Orleans</li> <li>45. Boston</li> <li>46. Philadelphia</li> <li>47. Miami</li> <li>48. Washington</li> <li>49. Melbourne</li> <li>50. Tokyo</li> </ol> | <ol style="list-style-type: none"> <li>51. Macau</li> <li>52. Athens</li> <li>53. San Francisco</li> <li>54. Warsaw</li> <li>55. Amman</li> <li>56. Tampa</li> <li>57. Santiago</li> <li>58. Mexico City</li> <li>59. Dallas</li> <li>60. Los Angeles</li> <li>61. Indianapolis</li> <li>62. Bengaluru</li> <li>63. Buenos Aires</li> <li>64. Denver</li> <li>65. Detroit</li> <li>66. Shenzhen</li> <li>67. Chicago</li> <li>68. Houston</li> <li>69. Chennai</li> <li>70. Cape Town</li> <li>71. Taipei</li> <li>72. Johannesburg</li> <li>73. Pittsburgh</li> <li>74. Istanbul</li> <li>75. Mumbai</li> <li>76. Hanoi</li> <li>77. Tianjin</li> <li>78. Atlanta</li> <li>79. Bangkok</li> <li>80. Guangzhou</li> <li>81. Jeddah</li> <li>82. Riyadh</li> <li>83. Nairobi</li> <li>84. Kuala Lumpur</li> <li>85. Jakarta</li> <li>86. Manila</li> <li>87. Moscow</li> <li>88. Muscat</li> <li>89. Kuwait City</li> <li>90. New Delhi</li> <li>91. Shanghai</li> <li>92. Chengdu</li> <li>93. Cairo</li> <li>94. Lima</li> <li>95. Abu Dhabi</li> <li>96. Dubai</li> <li>97. Beijing</li> <li>98. Doha</li> <li>99. Wuhan</li> <li>100. Kolkata</li> </ol> |
|---|---|

Sources: SUSTAINABLE CITIES INDEX 2015: Balancing the economic, social and environmental needs of the world's leading cities, Arcadis; SUSTAINABLE CITIES INDEX 2016: Putting people at the heart of sustainability, Arcadis

## Appendix 10 Rankings for 'Profit' - 2015 and 2016

### 2015 Index

1. Frankfurt
2. London
3. Hong Kong
4. Amsterdam
5. Melbourne
6. Seoul
7. San Francisco
8. Brussels
9. Singapore
10. Madrid
11. Copenhagen
12. Chicago
13. New York
14. Boston
15. Houston
16. Sydney
17. Los Angeles
18. Toronto
19. Rotterdam
20. Philadelphia
21. Manchester
22. Kuala Lumpur
23. Dallas
24. Tokyo
25. Washington
26. Berlin
27. Dubai
28. Paris
29. Birmingham
30. Doha
31. Mexico City
32. Johannesburg
33. Santiago
34. Abu Dhabi
35. Rome
36. Istanbul
37. Beijing
38. Shanghai
39. Sao Paulo
40. Manila
41. Jeddah
42. Buenos Aires
43. Jakarta
44. Riyadh
45. Moscow
46. Rio de Janeiro
47. Mumbai
48. New Delhi
49. Nairobi
50. Wuhan

### 2016 Index

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. Singapore</li> <li>2. Hong Kong</li> <li>3. London</li> <li>4. Dubai</li> <li>5. Zurich</li> <li>6. Edinburgh</li> <li>7. Prague</li> <li>8. New York</li> <li>9. Paris</li> <li>10. Stockholm</li> <li>11. Munich</li> <li>12. San Francisco</li> <li>13. Abu Dhabi</li> <li>14. Vienna</li> <li>15. Macau</li> <li>16. Amsterdam</li> <li>17. Copenhagen</li> <li>18. Seoul</li> <li>19. Kuala Lumpur</li> <li>20. Canberra</li> <li>21. Washington</li> <li>22. Boston</li> <li>23. Frankfurt</li> <li>24. Denver</li> <li>25. Hamburg</li> <li>26. Melbourne</li> <li>27. Taipei</li> <li>28. Tokyo</li> <li>29. Vancouver</li> <li>30. Brisbane</li> <li>31. Dallas</li> <li>32. Berlin</li> <li>33. Seattle</li> <li>34. Madrid</li> <li>35. Sydney</li> <li>36. Warsaw</li> <li>37. Houston</li> <li>38. Toronto</li> <li>39. Dublin</li> <li>40. Antwerp</li> <li>41. Miami</li> <li>42. Geneva</li> <li>43. Barcelona</li> <li>44. Moscow</li> <li>45. Chicago</li> <li>46. Rotterdam</li> <li>47. Los Angeles</li> <li>48. Atlanta</li> <li>49. Rome</li> <li>50. Doha</li> </ol> | <ol style="list-style-type: none"> <li>51. Manchester</li> <li>52. Baltimore</li> <li>53. Bangkok</li> <li>54. Montreal</li> <li>55. Philadelphia</li> <li>56. Shenzhen</li> <li>57. Milan</li> <li>58. Wellington</li> <li>59. New Orleans</li> <li>60. Birmingham</li> <li>61. Lisbon</li> <li>62. Indianapolis</li> <li>63. Pittsburgh</li> <li>64. Glasgow</li> <li>65. Detroit</li> <li>66. Brussels</li> <li>67. Beijing</li> <li>68. Kuwait City</li> <li>69. Leeds</li> <li>70. Tampa</li> <li>71. Lyon</li> <li>72. Athens</li> <li>73. Johannesburg</li> <li>74. Lima</li> <li>75. Istanbul</li> <li>76. Santiago</li> <li>77. Shanghai</li> <li>78. Guangzhou</li> <li>79. Riyadh</li> <li>80. Cape Town</li> <li>81. Jeddah</li> <li>82. Buenos Aires</li> <li>83. Mexico City</li> <li>84. Sao Paulo</li> <li>85. Muscat</li> <li>86. Rio de Janeiro</li> <li>87. Tianjin</li> <li>88. Jakarta</li> <li>89. Wuhan</li> <li>90. Nairobi</li> <li>91. Manila</li> <li>92. Chengdu</li> <li>93. Mumbai</li> <li>94. Hanoi</li> <li>95. Chennai</li> <li>96. New Delhi</li> <li>97. Amman</li> <li>98. Cairo</li> <li>99. Bengaluru</li> <li>100. Kolkata</li> </ol> |
|---|---|

Sources: SUSTAINABLE CITIES INDEX 2015: Balancing the economic, social and environmental needs of the world's leading cities, Arcadis; SUSTAINABLE CITIES INDEX 2016: Putting people at the heart of sustainability, Arcadis