HUGSI

2021 report

Quantifying greenness of global cities

Powered by Husqvarna

About the report

Husqvarna Urban Green Space Index (HUGSI), is produced by Husqvarna in collaboration with Overstory this report aggregates multiple data points captured in 2020 for 177 cities in 60 countries to produce the HUGSI 2021 index.

Please refer to our website hugsi.green for more information and specific details by identified cities.

City boundaries identified in the report are defined based on an Open Street Map (OSM) boundaries dataset, which is made available here under the Open Database License (ODbL). Population data from Global Human Settlement Layer (GHS-POP) was used to adjust city boundaries, consideration was taken to identify areas where citizens actually reside. For more information on GHS-POP, please see Schiavina, Marcello; Freire, Sergio; MacManus, Kytt (2019): GHS population grid multitemporal (1975, 1990, 2000, 2015) R2019A. European Commission, Joint Research Centre (JRC) DOI: 10.2905/42E8BE89-54FF-464E-BE7BB-F9E64DA5218
PID: http://data.europa.eu/89h/0c6b9751-a71f-4062-830b-43c9f432370

Satellite image data is acquired from the Copernicus project, available here, and it has been modified in order to establish this report. For the avoidance of doubt, it should be clarified that HUGSI is not officially endorsed or affiliated with any European Union institution.

Legal disclaimer: All results are assumptions based on our open methodology and AI-models used. HUGSI Terms of use also apply to this report. hugsi.green/terms-of-use

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Regional results

This year HUGSI cover more cities than ever, adding up to 177 cities in 60 countries grouped by 7 regions. Get the Top-10 list for all regions and their top achievers to find out how your city ranks.

10

17

In this report

Urban green space has proven more important than ever

At Husqvarna we make a great difference to those who shape green spaces and urban environments, through our leadership in sustainable, user-centered solutions. We are driven by an intuitive passion for innovation, a true understanding of application and a commitment to improved experiences for customers around the World.

In the last year we have all yet again become reminded of why urban green space is so important, as millions of people have been affected by the global pandemic and the restrictions that followed. Many of us have found walking in parks as one of the big relievers when facing lock-down and travel restrictions.

Urban green space, a matter of life and death

The fact that urban green space is contributing greatly to social and economic factors in cities as well as sustainability, biodiversity and climate adaption is well known.

Recent published research in the Lancet Planetary Health (October 2021) Barboza et al. also concludes that *A large number of premature deaths in European cities could be prevented by increasing exposure to green space. Among European capitals, Athens, Brussels, Budapest, Copenhagen, and Riga showed some of the highest mortality burdens due to the lack of green space. This also adds life* expectancy *as a factor to the benefits*.

The World Health Organization (WHO) recommendation is that all people should have access to at least 0,5 hectares of green space within 300 meters from where they live. Meeting the WHO recommendation for universal access to green space really is a matter of life and death.

HUGSI contribute with green KPI's

By applying computer vision and deep learning techniques on satellite images, HUGSI measures and analyzes urban green space in select cities across the globe. With objective and recuring quantification of urban green space, cities can track their development and benchmark with global pairs.

We created HUGSI – to raise the awareness about the value of urban green space among citizens, to support city officials and politicians to make data informed decisions.

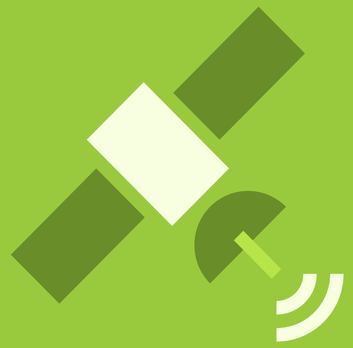
HUGSI is another example of Husqvarna's 330-year commitment to nature, understanding the people and products that help shape what we love and where we live. We want to recognize policies and practices that have made significant contributions to preservation of greenspace as well as actively greenifying their cities. By identifying the green KPI's, derived from recurring and thorough monitoring, cities can benchmark other leading cities and challenge themselves to greenify their city.

Sustainability and Innovation – it's how we're meeting the future.

Glen Instone
CFO, and Acting President Husqvarna Division

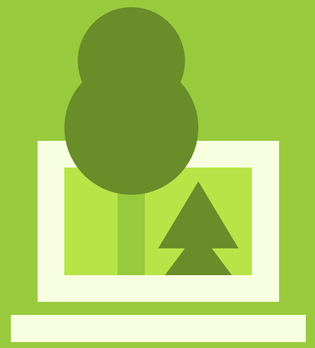
Viewing the World from above

How green are the cities of the world really? Do they get greener or is densification of cities also reducing the valuable green in the cities? We wanted to find out! By applying computer vision and enhanced learning techniques on satellite images, HUGSI unveils insights about the current state and historic development of vegetation and its surrounding environment in urban areas.



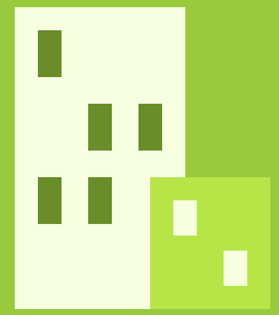
1 Satellite data acquisition

Satellite image data is acquired from Copernicus project supported by European Commission and European Space Agency (ESA). City boundaries are based on Open Street Map (OSM) data to identify the city administrative area, it is important to note that but unpopulated areas within city limit were excluded.



2 Data processing

Computer vision and machine learning techniques are applied to turn satellite image data into a range of urban green space metrics. Data from individual dates for each city is analyzed to find their individual peak green day during the full year.



3 Calculating the index

The overall greenness scores are calculated and are used to rank select cities. To score well the city included should have healthy and well distributed vegetation, with greater proportion in the populated parts of the city.

Trees are awarded twice the value of grass.

The Green KPI’s

HUGSI is based on a unique data set together with algorithms to analyze satellite images monitoring the proportion and health of green spaces in cities across the globe. To be able to compare and track the development of urban green spaces we have created the following six Key Performance Indicators (KPI’s)

Percentage of urban green space

The area in actual size of green space, divided by size of total urban area of the city being measured.

Urban green space per capita

The area in actual size of green space, divided by population residing in urban area of a city

Percentage of urban green space covered by trees

HUGSI uses a machine learning model to specifically differentiate trees from other vegetation including bush.

Average health of urban green space

HUGSI measures health of vegetation with NDVI, a widely used indicator of vegetation health based on the absorption of visible and invisible light. NDVI value of living vegetation ranges from 0 to 1.

Distribution of urban green space

The greenness of a city can also be identified by how well distributed or spread out the vegetation is. Is all vegetation concentrated in one large park or is the green space spread throughout the city?

HUGSI measures the distribution of green space based on the median percentage of green space across all defined grids of a city.

Percentage of urban green space covered by grass

HUGSI uses a machine learning model to differentiate grass from other vegetation.

Compare cities

Greenness is not a competition, although comparing cities and creating benchmarks can be a great learning opportunity. This year we have added “The Compare Cities” feature to HUGSI, where you can compare two cities based on their green KPI’s.

Have fun, but be nice to your opponent!

Try it for yourself

Is the world getting greener?

Through the passage of time all cities change. These changes can be negative, positive or neutral depending on the viewpoint. The result is often derived from both deliberate actions from city development and the impact of specific weather conditions.

On a global average there has been a slight decline in urban greenspace, -0.08% less vegetation in 2020 compared to 2019. Overall, the amplitude of change has declined in 2020 comparing with 2019 even though there is a negative net and larger decline compared to 2019.

More and healthier urban green space

We have now compiled and analyzed urban green space data since 2016 and for the 98 original HUGSI cities. We can see a very happy development over this longer period.

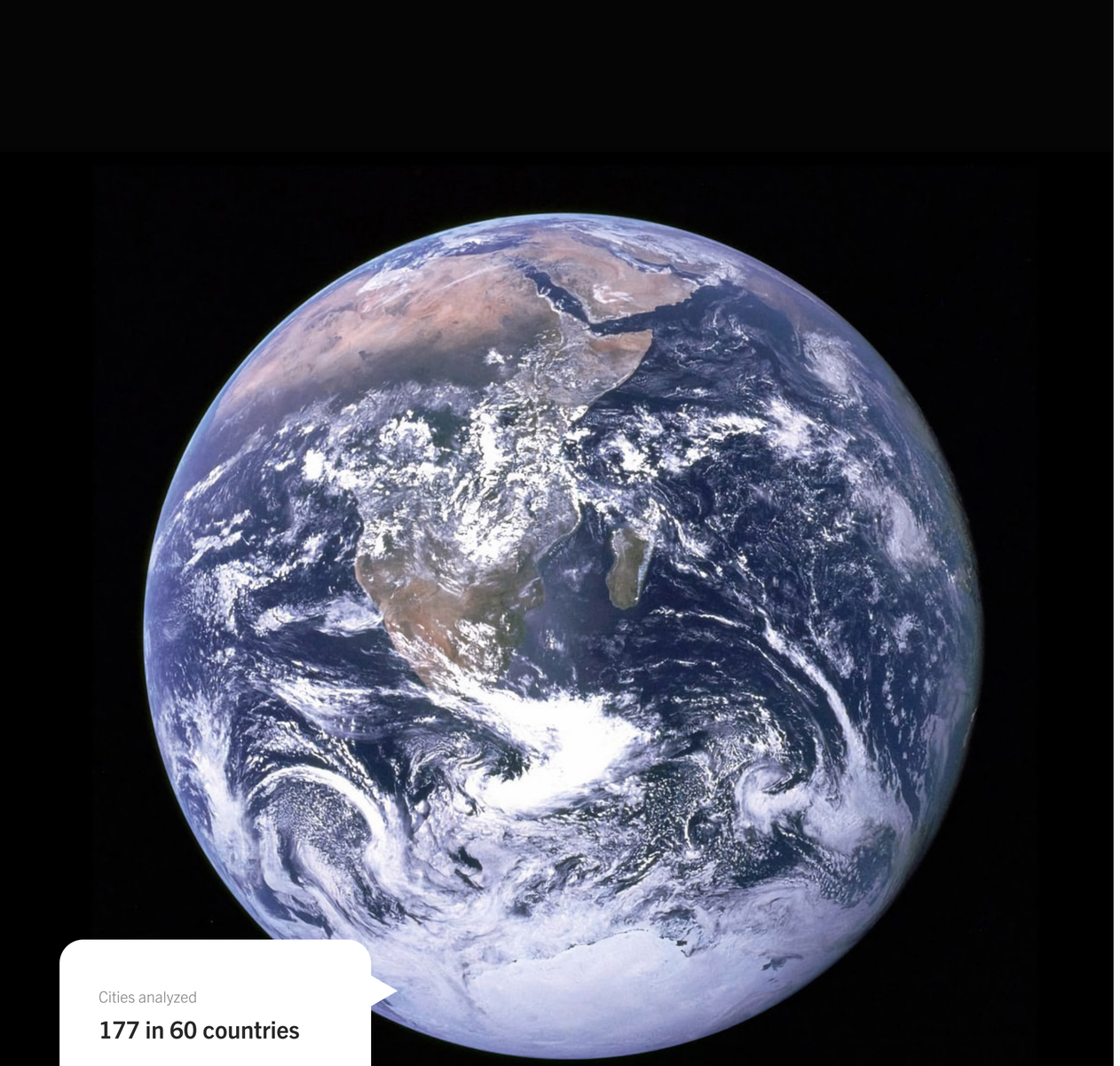
Over the last five years the green cover percentage has grown from 34% to 35% and the health and vitality has increased with 10% rendering almost 1.8 M m2 more green space in total for the original 98 cities.

We wanted to find out

When we first started developing HUGSI we had two main questions that we wanted to answer; How green are the cities of the world? Are they getting greener? These are our north stars, that drive us to continue our efforts and the expansion of the HUGSI report. We have updated the report to include detailed Change analysis. To produce this new data set, we have analyzed the land use within the HUGSI-boundaries.

Adding a new layer to HUGSI

Adding a new layer to the HUGSI data, all cities were divided into multiple 250x250 m hexagon shapes. By applying learning models to the material, we were able to define a main class to each hexagon; trees, grass, water or other (urban hard made surfaces like houses, roads etc.). When we compare this main class for the last two years, our report detects any change. From a vegetation perspective the change is either positive, negative or neutral. We have classified positive change as water or other, into trees or grass – increasing the vegetation.



Cities analyzed

177 in 60 countries

Total urban population covered

595 million

Urban area analyzed

99 792 km²

Photo by NASA

Results from

World

Recognized achievements

Highest percentage of urban green space

Utrechtse Heuvelrug, NL

Best health of urban green space

Zoeterwoude, NL

Best distribution of urban green space

Utrechtse Heuvelrug, NL

Most urban green space per capita

Neder-Betuwe, NL

Highest % of urban green space covered by trees

Charlotte (NC)

Highest % of urban green space covered by grass

West-Betuwe, NL

World top 10

	City	Country	Rating	Score	Distribution of land use
1st	Charlotte (NC)	USA	A-	80	
2nd	Durban	South Africa	B	79.1	
3rd	Vilnius	Lithuania	B+	77.1	
4th	Krakow	Poland	B	76.9	
5th	Dortmund	Germany	B	76.3	
6th	Stuttgart	Germany	B	76.2	
7th	Austin	USA	B	74.9	
8th	Wroclaw	Poland	B	74.1	
9th	Hamburg	Germany	B	76.5	
10th	Wuerzburg	Germany	B	73.6	

Greenness does not come by itself

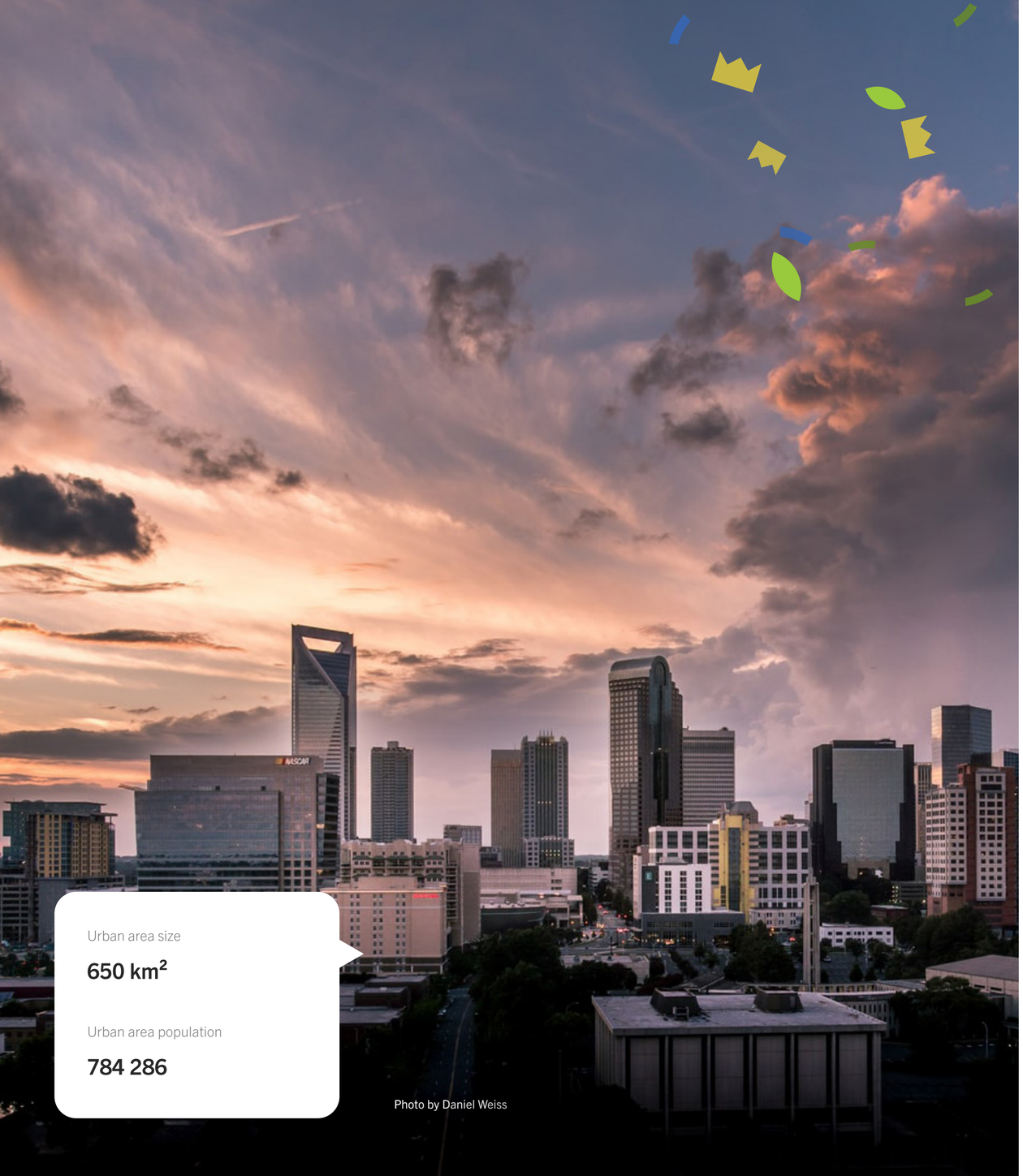
Why are some cities greener than others? It is not a competition; it is a fact. Of course, the urban greenness of a city can depend on many things such as geographic location, overall climate and socio-economic factors – to just mention a few. Our HUGSI report identifies big differences in how the cities distribute in the ranking. But more importantly it is clear that top achievers are very green as a result of decisive actions to greenify their cities. They do not just sit and wait for their vegetation to grow, they have employed policies and set ambitious targets and goals.

Greenification, an active decision

A greener city may have many potential benefits such as reduction of heat stress, better handling of excessive rainwater, reduction of noise levels, improved biodiversity and better air quality. They also benefit from an improved quality of life for the people living in or visiting the city. Urbanization is ongoing, city densification and expansion is how cities respond. To cope with these mega trends and large-scale changes many cities have begun to formulate a green plan.

Role models for change

Husqvarna is passionate about green spaces and the solutions used to manage and develop them. HUGSI can be used as a monitor for a city's current vegetative state and track their development. The Global Green Model City of 2019 as identified by HUGSI was Durban (South Africa). The vision for this coastal city is to be Africa's most caring and livable city by 2030. As part of a five-year strategic plan to develop and sustain spatial, natural and built environments, the city is implementing several projects focused on improving in these areas. This trend continues with Charlotte, NC (USA) the Global Green Model City of 2020/2021. They have set an ambitious goal to have a 50% tree canopy cover in 2050. We can already see that the populated parts of the city analyzed by HUGSI have a 56% canopy cover. By engaging their community, the city gets support by many hands, such as the organizations like Trees Charlotte that every year plant 15 000 trees. It is our hope to continue to share examples and role to help greenify cities all over the globe.



Urban area size

650 km²

Urban area population

784 286

Photo by Daniel Weiss

Global Green Model City of 2021

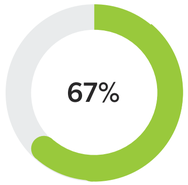
Charlotte (NC)

For the second consecutive year we are happy and proud to award the City of Charlotte, North Carolina (USA) as the Global Green Model City. Charlotte is a true role model as they exceed global achievements in almost all categories identified by HUGSI. For Charlotte the greenness does not only come naturally; they have taken decisive action and put-up extensive targets to greenify their city, especially when it comes to tree canopy cover. Charlotte has many diverse ongoing projects and programs, they are engaging their community – people, companies and organizations to help care for and plant new trees and tend to green spaces.

Rating

A-

Percentage of urban green space



Urban green space distrubution

Trees Grasses Water Others

Distribution of urban green space

73%

Average health of urban green space

Urban green space per capita

557 m²

Percentag of urban green space covered by trees

56%

Percentage of urban green space covered by grass

11%

Unleashing green space data in the name of science

Over the years many researchers have been in contact with us to access to our data for various research projects. With HUGSI for Research we hope to provide an efficient and comprehensive solution supporting the research community in the best possible way. We are happy and eager to share and support new research initiatives that help us telling the story about the value of green space and how urban green space contribute to the living conditions for humans, animals and all other living things in urban environments.

Access to consistent, objective and timely urban green space data that can be used to track development and compare cities globally has not been available at this scale before. With HUGSI for research we are providing data for all cities part of the HUGSI-index.

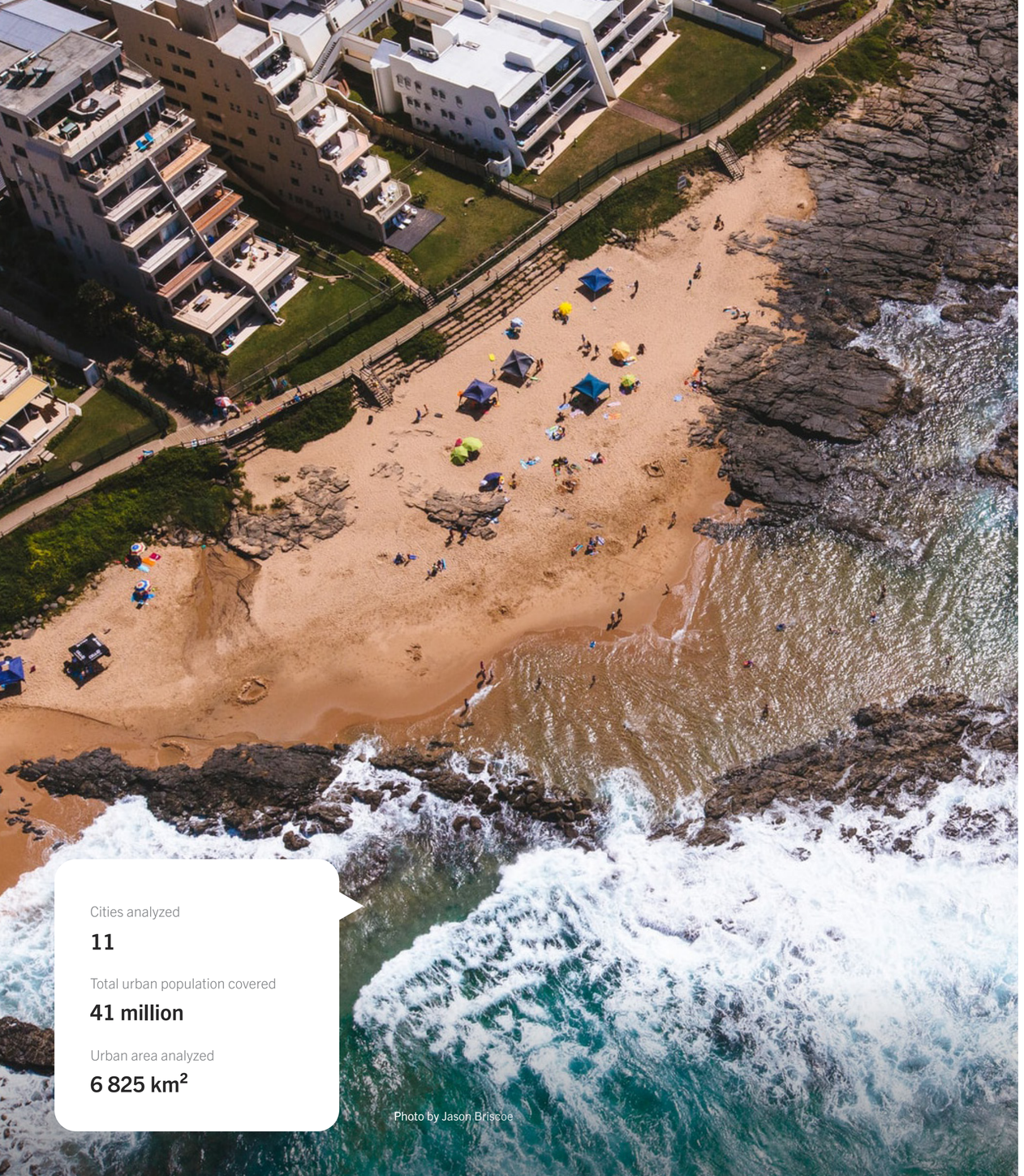
Pick your 3 cities

Any named researcher part of a recognized academic- or other non-profit research organization are eligible to apply for our full data from any three (3) cities covered by HUGSI.

What researchers will gain access to is information about land use (grey area, water, vegetation trees / grass), health and vitality of the vegetation and the distribution of vegetation over the city compiled for two consecutive years, right now 2020 vs. 2019.

- City level Green KPI scoring
- Hexagon level analytics (width 250m)
- Pixel level green data (width 10m)
- Data dictionary, to understand how to user and interpret the data
- The HUGSI Methodology Whitepaper, to understand how the data was collected and the KPI's calculated

To apply for your three cities, go to
go.hugsi.green/hugsi-for-research/



Cities analyzed

11

Total urban population covered

41 million

Urban area analyzed

6 825 km²

Photo by Jason Briscoe

Results from

Africa

Recognized achievements

Highest percentage of urban green space

Durban

Best health of urban green space

Durban

Best distribution of urban green space

Durban

Most urban green space per capita

Durban

Highest % of urban green space covered by trees

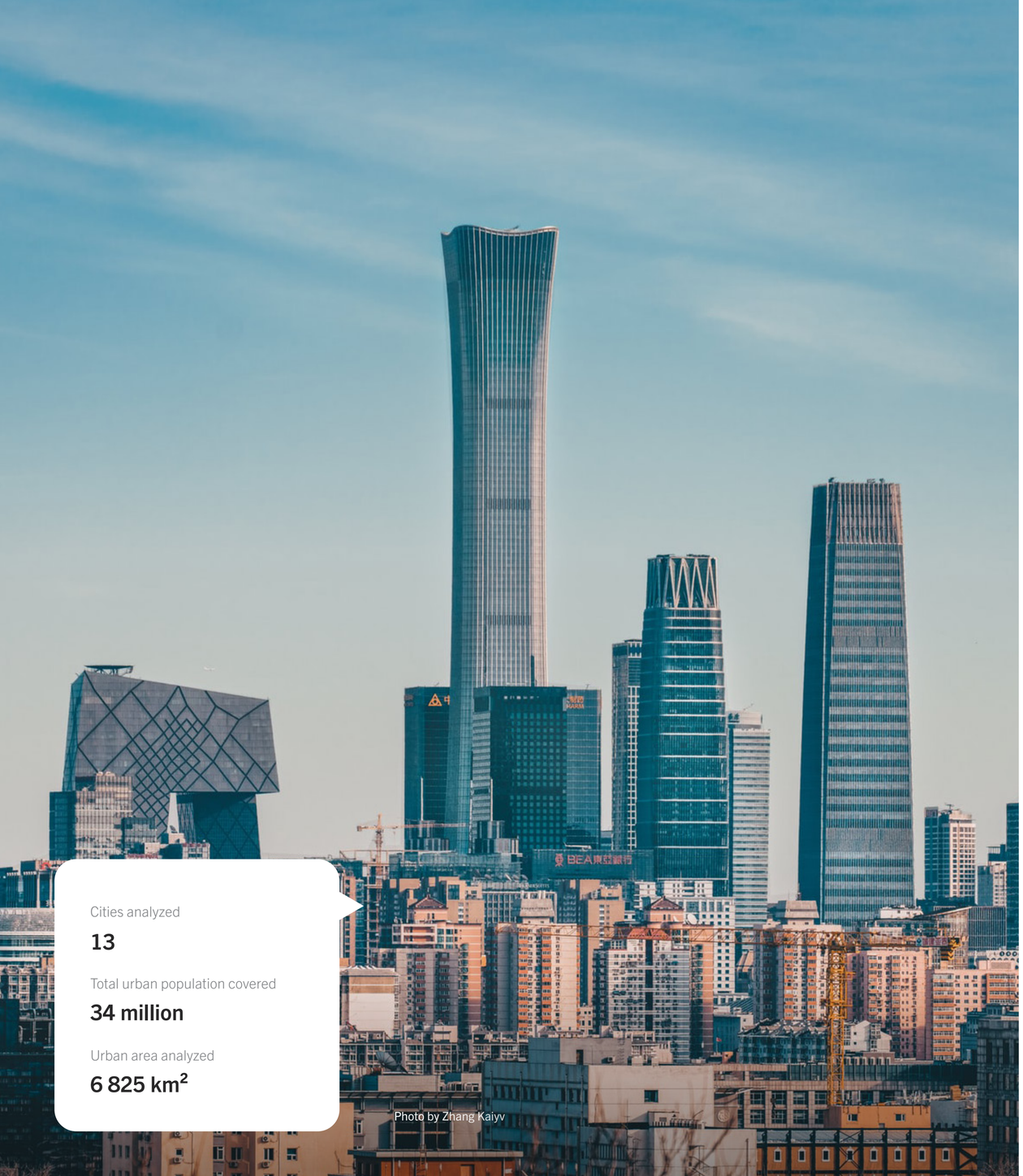
Durban

Highest % of urban green space covered by grass

Tshwane

Regional top 10

	City	Country	Rating	Score	Distribution of land use
1st	Durban	South Africa	B	79.1	
2nd	Dar Es Salaam	Tanzania	C-	70.4	
3rd	Johannesburg	South Africa	C-	61.3	
4th	Tshwane	South Africa	C	62.5	
5th	Nairobi	Kenya	D	54.7	
6th	Cape Town	South Africa	D	51.4	
7th	Addis Ababa	Ethiopia	E+	37	
8th	Dakar	Senegal	E+	23.5	
9th	Accrea	Ghana	E	21	
10th	Lagos	Nigeria	E	11.2	



Cities analyzed

13

Total urban population covered

34 million

Urban area analyzed

6 825 km²

Photo by Zhang Kaiyv

Results from

Central East Asia

Recognized achievements

Highest percentage of urban green space

Hong Kong

Best health of urban green space

Hong Kong

Best distribution of urban green space

Dalian

Most urban green space per capita

Zhenjiang

Highest % of urban green space covered by trees

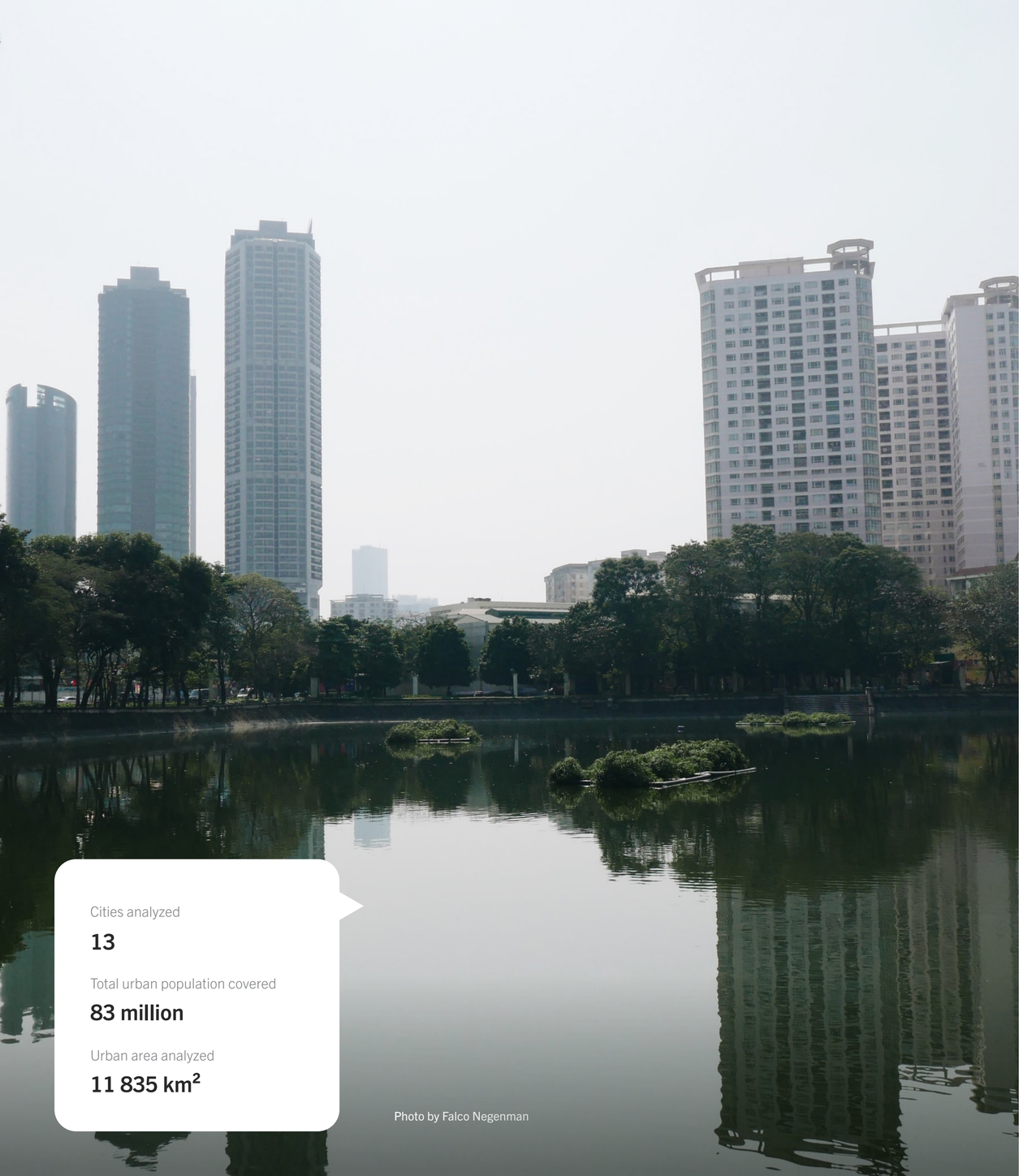
Hong Kong

Highest % of urban green space covered by grass

Zhenjiang

Regional top 10

	City	Country	Rating	Score	Distribution of land use
1st	Beijing	China	C	70	
2nd	Hong Kong	China	C-	68	
3rd	Dalian	China	C+	67.9	
4th	Nanjing	China	C-	64.8	
5th	Fuzhou	China	C+	64.4	
6th	Qingdao	China	C+	63	
7th	Zhenjiang	China	B-	61.8	
8th	Chengdu	China	C-	61.4	
9th	Shanghai	China	D+	59.1	
10th	Hangzhou	China	C-	58.1	



Cities analyzed

13

Total urban population covered

83 million

Urban area analyzed

11 835 km²

Photo by Falco Negenman

Results from

East, Southeast Asia and Oceania

Recognized achievements

Highest percentage of urban green space

Hanoi

Best health of urban green space

Sydney

Best distribution of urban green space

Hanoi

Most urban green space per capita

Auckland

Highest % of urban green space covered by trees

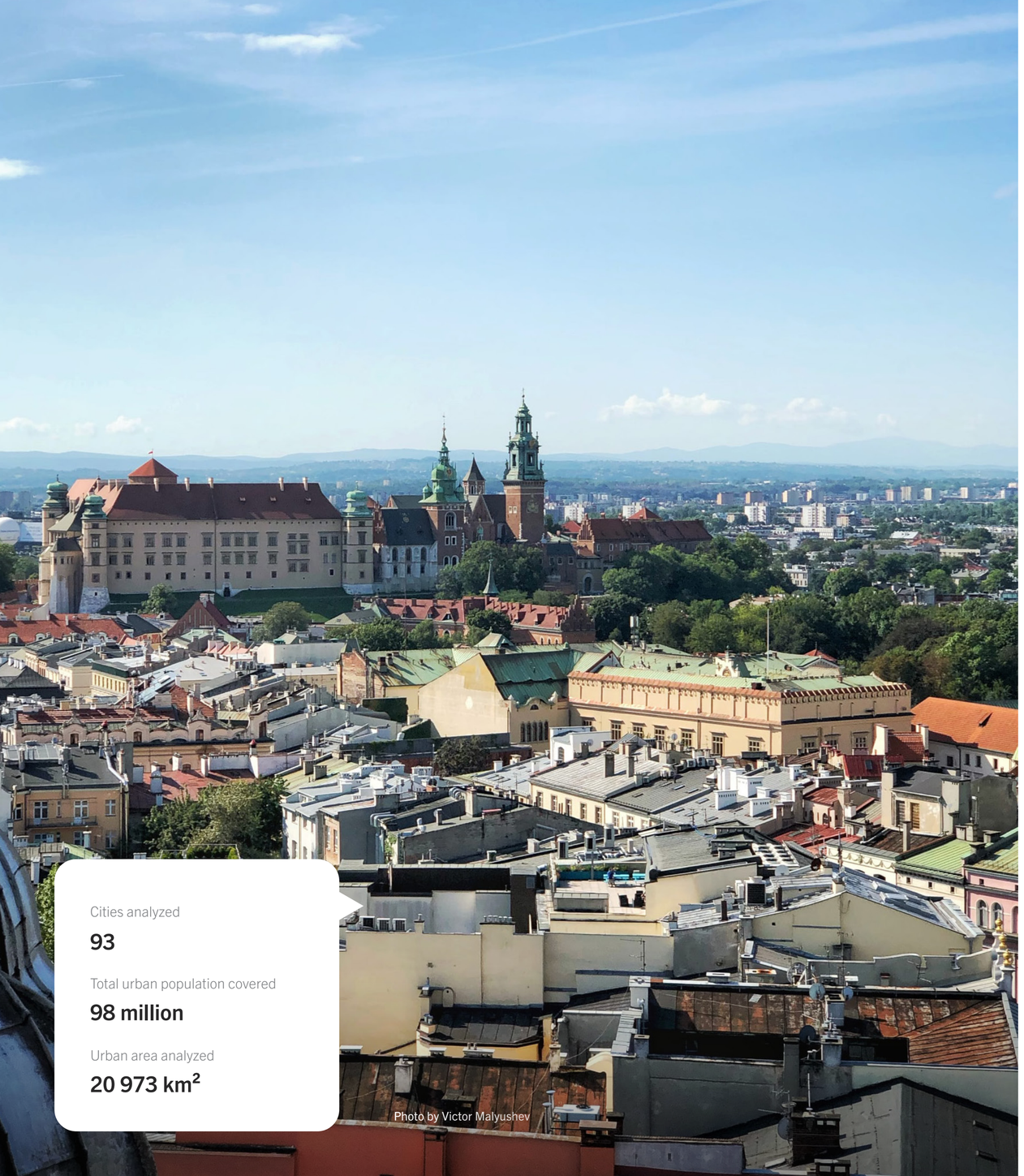
Sydney

Highest % of urban green space covered by grass

Hanoi

Regional top 10

	City	Country	Rating	Score	Distribution of land use
1st	Hanoi	Vietnam	C	61.1	
2nd	Ho Chi Minh City	Vietnam	D+	60.5	
3rd	Auckland	New Zealand	C	57.2	
4th	Singapore	Singapore	D	56.7	
5th	Kuala Lumpur	Malaysia	D	52.9	
6th	Bangkok	Thailand	D-	52.4	
7th	Melbourne	Australia	C-	51.3	
8th	Sydney	Australia	C	50.6	
9th	Seoul	South Korea	D-	46.4	
10th	Quezon City	Philippines	E+	33.9	



Cities analyzed

93

Total urban population covered

98 million

Urban area analyzed

20 973 km²

Photo by Victor Malyushev

Results from

Europe

Recognized achievements

Highest percentage of urban green space

Utrechtse Heuvelrug, NL

Best health of urban green space

Zoeterwoude, NL

Best distribution of urban green space

Utrechtse Heuvelrug, NL

Most urban green space per capita

Neder-Betuwe, NL

Highest % of urban green space covered by trees

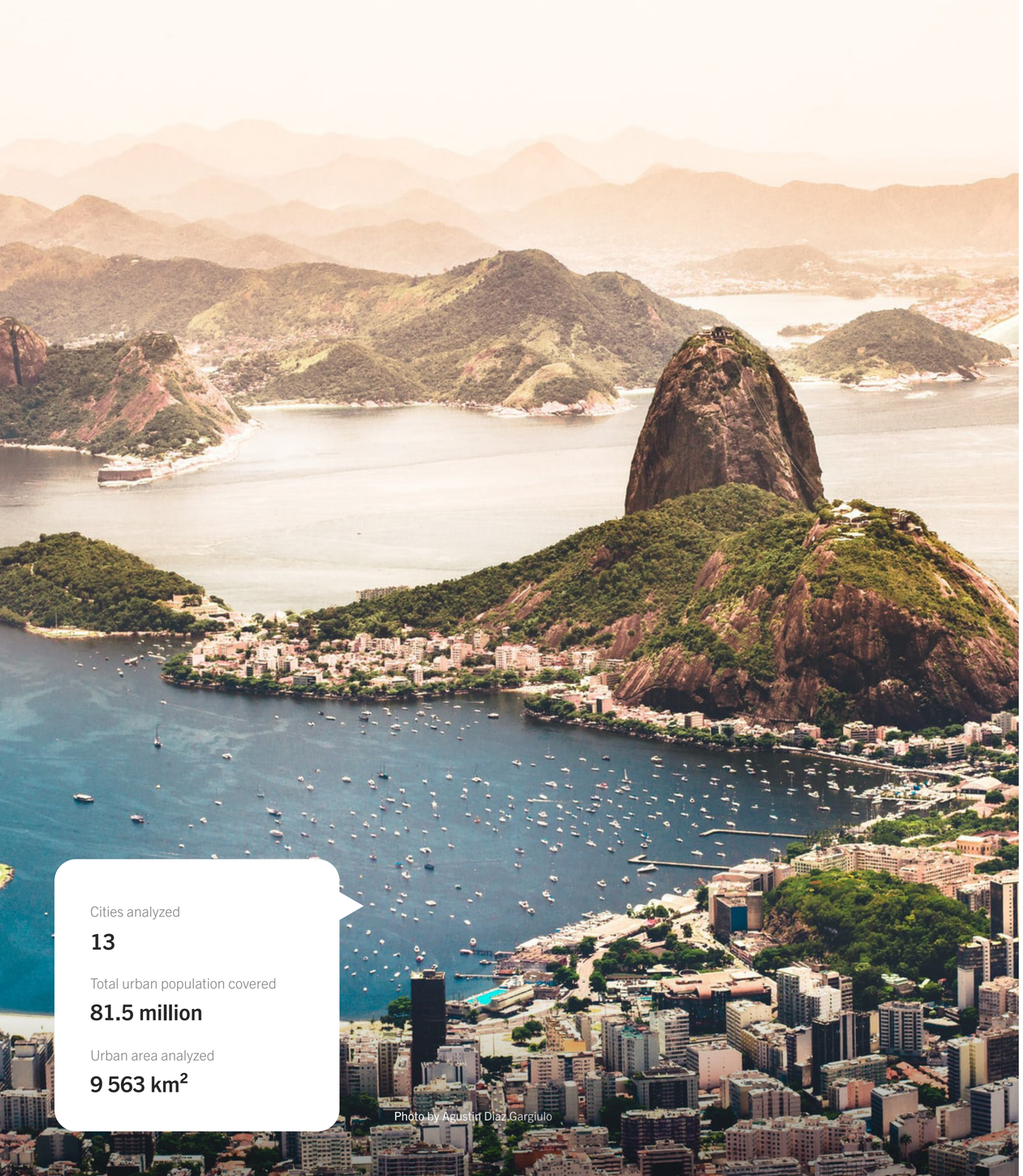
Utrechtse Heuvelrug, NL

Highest % of urban green space covered by grass

West-Betuwe, NL

Regional top 10

	City	Country	Rating	Score	Distribution of land use
1st	Vilnius	Lithuania	B+	77.1	
2nd	Krakow	Poland	B	77	
3rd	Dortmund	Germany	B	76.3	
4th	Stuttgart	Germany	B	76.3	
5th	Wroclaw	Poland	B-	74.1	
6th	Hamburg	Germany	B	73.8	
7th	Wuerzburg	Germany	B	73.6	
8th	Zürich	Switzerland	C+	73.1	
9th	Gothenburg	Sweden	B-	72.8	
10th	Heidelberg	Germany	B-	72.4	



Cities analyzed

13

Total urban population covered

81.5 million

Urban area analyzed

9 563 km²

Photo by Agustin Diaz Gargiulo

Results from

Latin America

Recognized achievements

Highest percentage of urban green space

Rio de Janeiro

Best health of urban green space

Rio de Janeiro

Best distribution of urban green space

Rio de Janeiro

Most urban green space per capita

Rio de Janeiro

Highest % of urban green space covered by trees

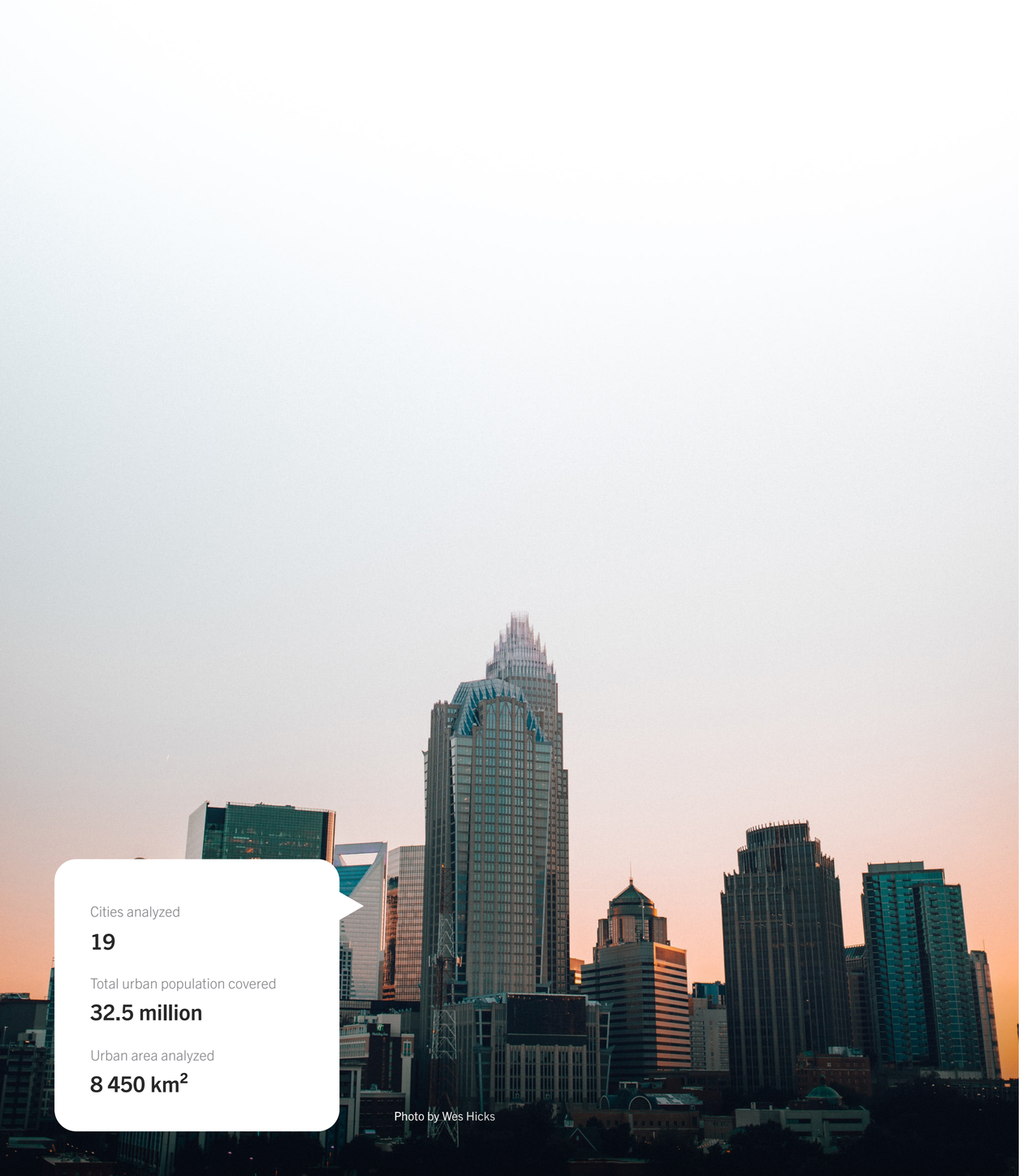
Rio de Janeiro

Highest % of urban green space covered by grass

Bogotá

Regional top 10

	City	Country	Rating	Score	Distribution of land use
1st	Rio de Janeiro	Brazil	C	71.6	
2nd	Caracas	Venezuela	C-	70.5	
3rd	Curitiba	Brazil	D	58.4	
4th	São Paulo	Brazil	D	57.7	
5th	Salvador	Brazil	D	55.5	
6th	Quito	Ecuador	D	53.6	
7th	Medellín	Colombia	D-	53.4	
8th	Bogotá	Colombia	D-	38.9	
9th	Mexico City	Mexico	D-	35.6	
10th	Buenos Aires	Argentina	E	15.7	



Cities analyzed

19

Total urban population covered

32.5 million

Urban area analyzed

8 450 km²

Photo by Wes Hicks

Results from

North America

Recognized achievements

Highest percentage of urban green space

Charlotte (NC)

Best health of urban green space

Charlotte (NC)

Best distribution of urban green space

Charlotte (NC)

Most urban green space per capita

Charlotte (NC)

Highest % of urban green space covered by trees

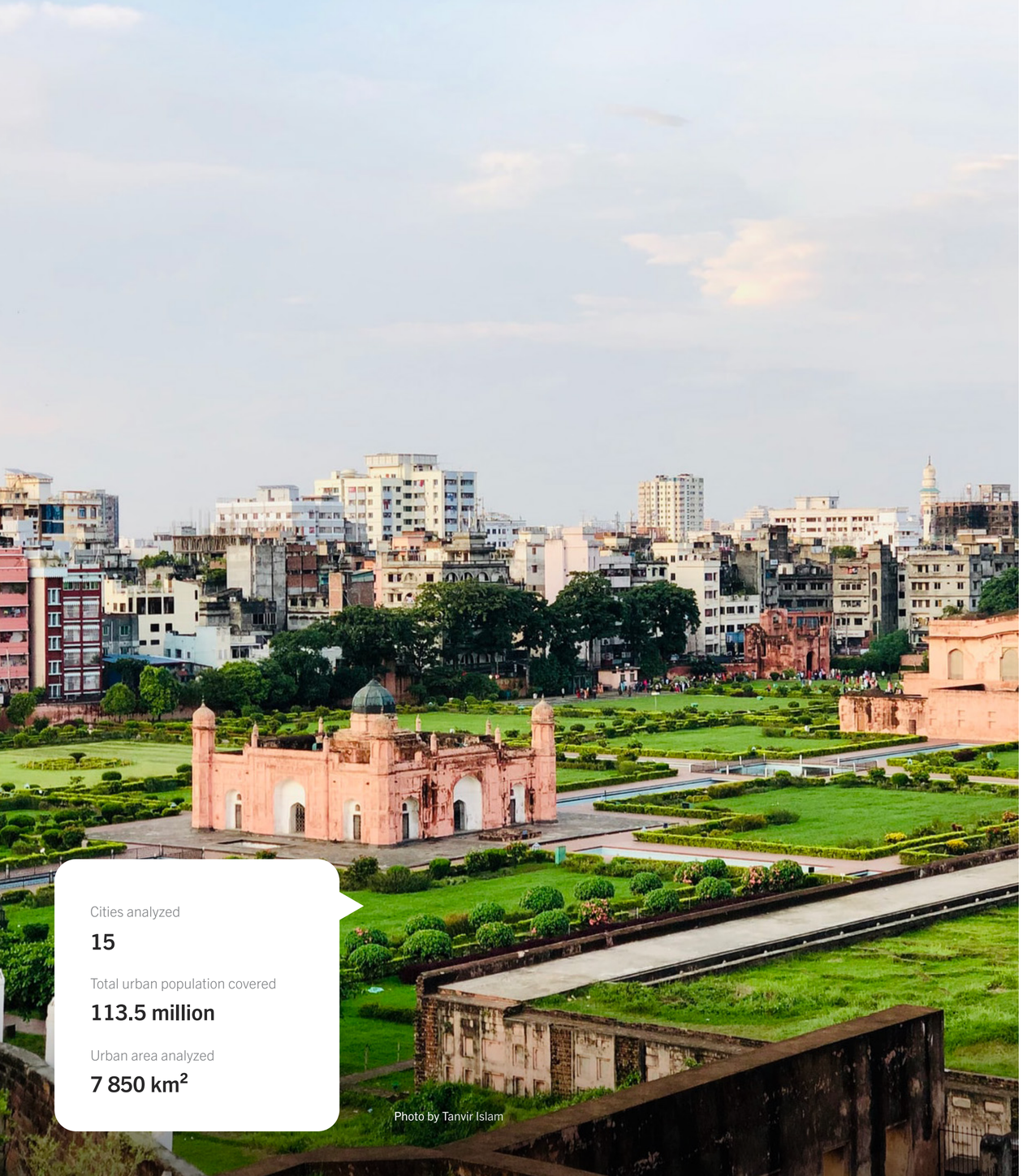
Charlotte (NC)

Highest % of urban green space covered by grass

New Orleans (L)

Regional top 10

	City	Country	Rating	Score	Distribution of land use
1st	Charlotte (NC)	USA	A	80.2	
2nd	Austin	USA	B+	75	
3rd	Tampa (FL)	USA	B	72	
4th	Houston	USA	B-	70.7	
5th	Minneapolis (MN)	USA	C+	69.6	
6th	Washington, DC	USA	C	66.7	
7th	Vancouver	Canada	C-	61.5	
8th	Portland	USA	C	61.2	
9th	Toronto	Canada	D+	59.6	
10th	Seattle	USA	C-	51.2	



Cities analyzed

15

Total urban population covered

113.5 million

Urban area analyzed

7 850 km²

Photo by Tanvir Islam

Results from

South and West Asia

Recognized achievements

Highest percentage of urban green space

Dhaka

Best health of urban green space

Dhaka

Best distribution of urban green space

Dhaka

Most urban green space per capita

Amman

Highest % of urban green space covered by trees

Dhaka

Highest % of urban green space covered by grass

Jaipur

Regional top 10

	City	Country	Rating	Score	Distribution of land use
1st	Dhaka	Bangladesh	C-	70	
2nd	Pune	India	D	57.1	
3rd	Delhi NCT	India	D	51.6	
4th	Bengaluru	India	D-	47.4	
5th	Surat	India	D-	43.4	
6th	Chennai	India	E+	41.9	
7th	Mumbai	India	D-	37.2	
8th	Jaipur	India	D+	34.6	
9th	Hyderabad	India	E+	31	
10th	Amman	Jordan	D-	29.4	

Request your city

We are really proud of the 177 cities covered in this report. Even though we monitor cities spread over the globe accumulating to almost 600 million people with our analysis there are more areas to discover.

Please reach out to us and request a city relevant to you!

hugsi.green/request-your-city

About Husqvarna

Husqvarna is a brand within Husqvarna Group. Since 1689, Husqvarna has manufactured high performing products and delivered industry-changing innovations such as anti-vibration and automatic chain-break on chainsaws, as well as robotic mowers. Today, Husqvarna offers a broad range of high performing outdoor power products for parks, forest and garden, and represents technological leadership in the key areas; chainsaws, trimmers, ride-on mowers and robotic mowers. Husqvarna products are sold in more than 100 countries, mainly through servicing dealers.

About Husqvarna Group

Husqvarna Group is a global leading producer of outdoor power products and innovative solutions for forest, park and garden care. Products include chainsaws, trimmers, robotic lawn mowers and ride-on lawn mowers. The Group is also the European leader in garden watering products and a global leader in cutting equipment and diamond tools for the construction and stone industries. The Group's products and solutions are sold under brands including Husqvarna, Gardena, McCulloch, Poulan Pro, Weed Eater, Flymo, Zenoah and Diamant Boart via dealers and retailers to consumers and professionals in more than 100 countries. Net sales in 2020 amounted to SEK 42bn and the Group has some 12,000 employees in 40 countries.