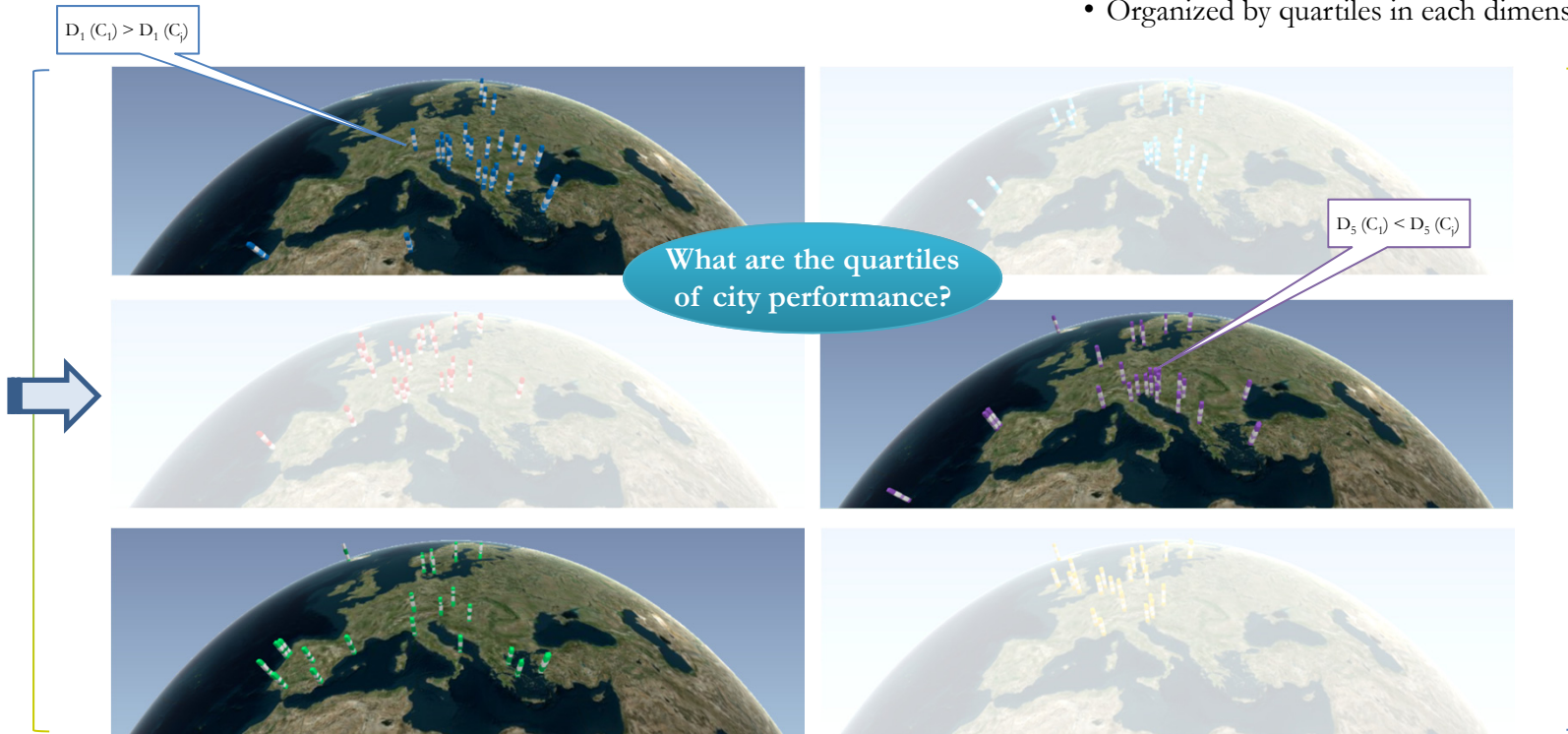


The SDEWES Index Atlas

The SDEWES Index Atlas

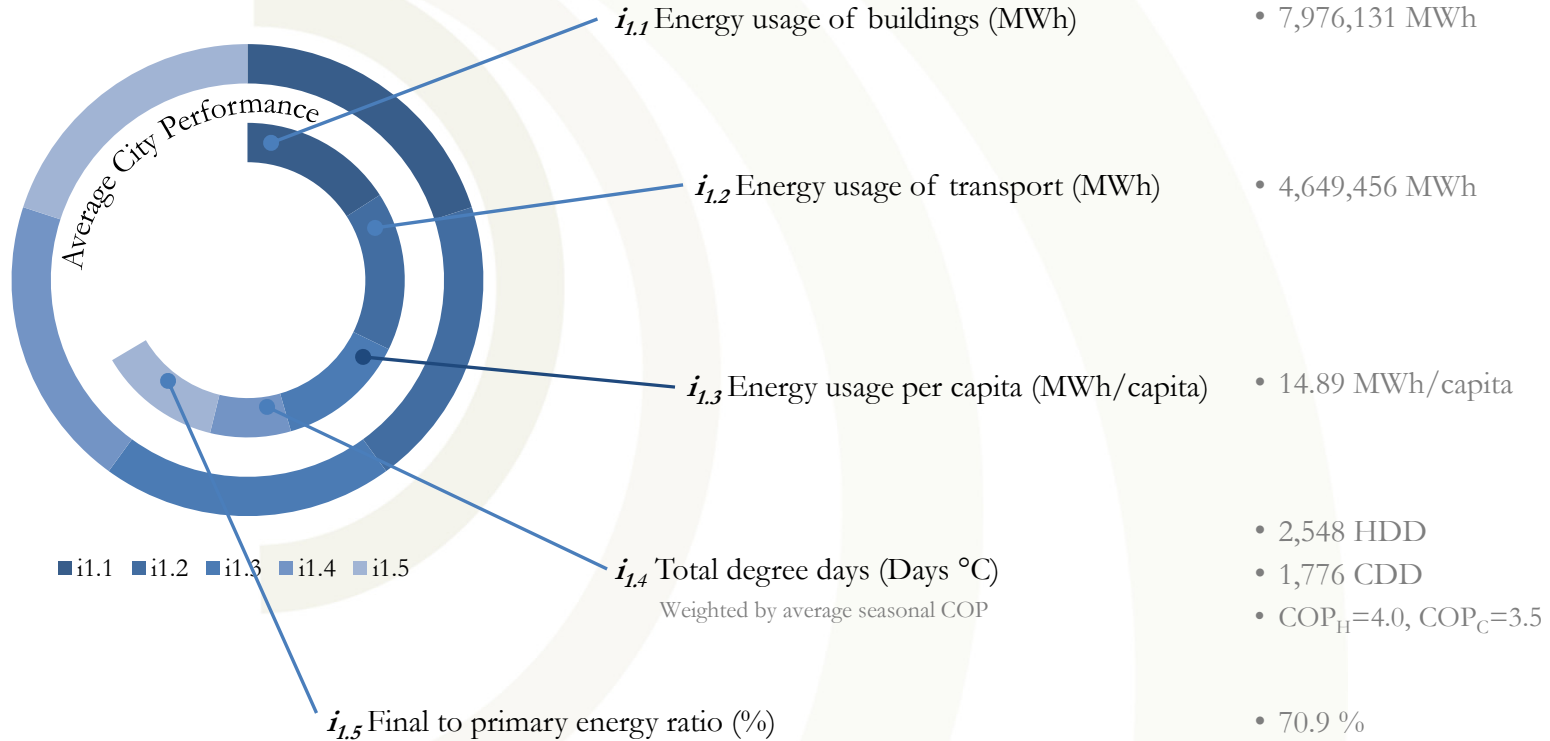
- Normalized results are mapped spatially
- Organized by quartiles in each dimension

Data for the main indicators: 4,200 inputs

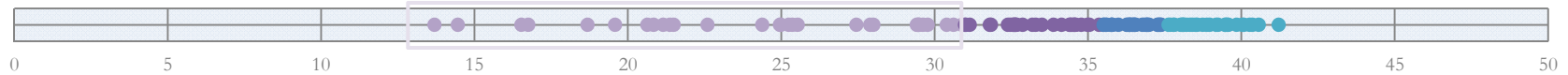


Source: Kılıç, Ş. (2017), "Benchmarking the Sustainability of Urban Energy, Water and Environment Systems with the SDEWES City Index and Envisioning Scenarios for the Future" Plenary Lecture at 12th SDEWES Conference, Dubrovnik, Croatia.

Energy Usage and Climate (D₁)



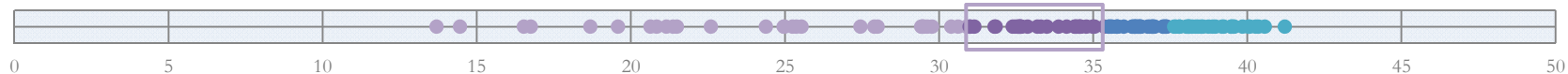
Quartile Performances in D_1



City	D_1	$\% \Delta M$	City	D_1	$\% \Delta M$	City	D_1	$\% \Delta M$
Tianjin	13.698	-61.3	Athens	21.495	-39.3	Gothenburg	28.007	-21.0
London	14.459	-59.2	Hamburg	22.602	-36.2	Amsterdam	29.422	-17.0
Beijing	16.532	-53.4	Christchurch	24.386	-31.2	Frankfurt	29.466	-16.9
Nagoya	16.759	-52.7	Rome	24.958	-29.6	Birmingham	29.474	-16.8
Washington D.C.	18.687	-47.3	Incheon	24.992	-29.5	Warsaw	29.522	-16.7
Cape Town	19.586	-44.7	Grand Lyon	25.250	-28.7	Bangalore	29.627	-16.4
Johannesburg	20.641	-41.8	Istanbul	25.372	-28.4	Antwerp	29.779	-16.0
Berlin	20.842	-41.2	São Paulo	25.543	-27.9	Rio de Janeiro	30.399	-14.2
Paris	21.157	-40.3	Bogotá	27.452	-22.5	Budapest	30.624	-13.6
Cologne	21.375	-39.7	Madrid	27.902	-21.3	Glasgow	30.897	-12.8



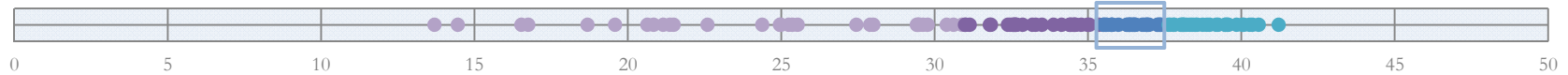
Quartile Performances in D_1



City	D_1	$\% \Delta M$	City	D_1	$\% \Delta M$	City	D_1	$\% \Delta M$
Sofia	30.995	-12.5	Milan	32.637	-7.9	Zaragoza	34.428	-2.9
Belgrade	31.023	-12.5	Grenoble	32.657	-7.8	Pisa	34.460	-2.8
Stockholm	31.151	-12.1	Vienna	32.677	-7.8	Sevilla	34.520	-2.6
Dublin	31.803	-10.3	Nice	32.874	-7.2	Zagreb	34.569	-2.5
Barcelona	31.842	-10.1	Sarajevo	33.194	-6.3	Porto	34.572	-2.4
Bratislava	32.392	-8.6	Lisbon	33.307	-6.0	Lviv	34.609	-2.3
Sydney	32.478	-8.4	Antalya	33.505	-5.5	Florence	34.788	-1.8
Tallinn	32.552	-8.1	Burgas	33.879	-4.4	Bydgoszcz	34.994	-1.3
Leuven	32.582	-8.1	Vila Nova de Gaia	34.145	-3.6	Bijeljina	35.052	-1.1
Aalborg	32.613	-8.0	Bologna	34.404	-2.9	Genoa	35.362	-0.2



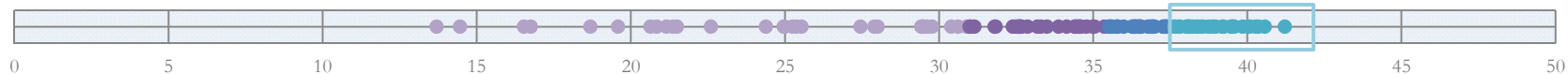
Quartile Performances in D_1



City	D_1	$\% \Delta M$	City	D_1	$\% \Delta M$	City	D_1	$\% \Delta M$
Thessaloniki	35.515	0.2	Valencia	36.350	2.6	Århus	36.839	4.0
Venice	35.520	0.2	Maribor	36.367	2.6	Bilbao	36.914	4.2
Ljubljana	35.587	0.4	Reykjavík	36.370	2.6	Heraklion	36.924	4.2
Málaga	35.617	0.5	Turin	36.401	2.7	Patras	36.954	4.3
Murcia	35.766	0.9	Helsinki	36.462	2.9	Bari	36.995	4.4
Varna	35.790	1.0	Gdynia	36.473	2.9	Batna	37.271	5.2
Naples	35.798	1.0	Volos	36.520	3.1	Niš	37.294	5.2
Braga	35.997	1.6	Kranj	36.539	3.1	Eskişehir Tepebaşı	37.341	5.4
Copenhagen	36.272	2.4	Funchal	36.557	3.2	Ostrava	37.366	5.4
Zenica	36.288	2.4	Pula	36.775	3.8	Dubrovnik	37.390	5.5



Quartile Performances in D_1



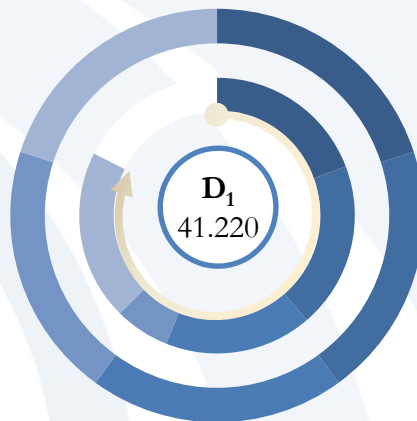
City	D_1	% ΔM	City	D_1	% ΔM	City	D_1	% ΔM
Bornova	37.633	6.2	Celje	38.337	8.2	Ohrid	39.492	11.4
Nitra	37.690	6.4	Velenje	38.418	8.4	Seferihisar	39.549	11.6
Skopje	37.806	6.7	Karşıyaka	38.514	8.7	Cluj-Napoca	39.584	11.7
Bursa Nilüfer	37.806	6.7	Espoo	38.568	8.8	Klagenfurt	39.852	12.5
Pécs	38.027	7.3	Osijek	38.748	9.3	Bregenz	40.042	13.0
Podgorica	38.072	7.4	Riga	38.886	9.7	Rijeka	40.086	13.1
Timișoara	38.093	7.5	Vilnius	38.971	10.0	Karlovac	40.278	13.7
Bucharest*	38.125	7.6	Zadar	39.186	10.6	Braşov	40.368	13.9
Izola	38.136	7.6	Constanța	39.244	10.7	Salé	40.571	14.5
Kalamariá	38.228	7.9	Sfax	39.483	11.4	Tirana	41.220	16.3



Best Practice Examples from D₁



Tirana



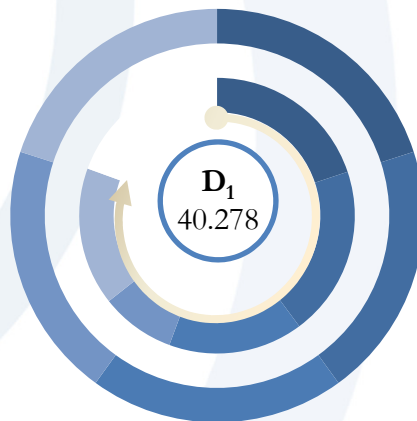
■ i1.1 ■ i1.2 ■ i1.3 ■ i1.4 ■ i1.5

Tirana

Indicators D ₁	Value	
i1.1	1,708,236	MWh
i1.2	678,520	MWh
i1.3	7.44	MWh/capita
i1.4	1,082	-
i1.5	90.5	%

Karlovac

Indicators D ₁	Value	
i1.1	436,863	MWh
i1.2	126,081	MWh
i1.3	10.21	MWh/capita
i1.4	1,160	-
i1.5	80.3	%



■ i1.1 ■ i1.2 ■ i1.3 ■ i1.4 ■ i1.5



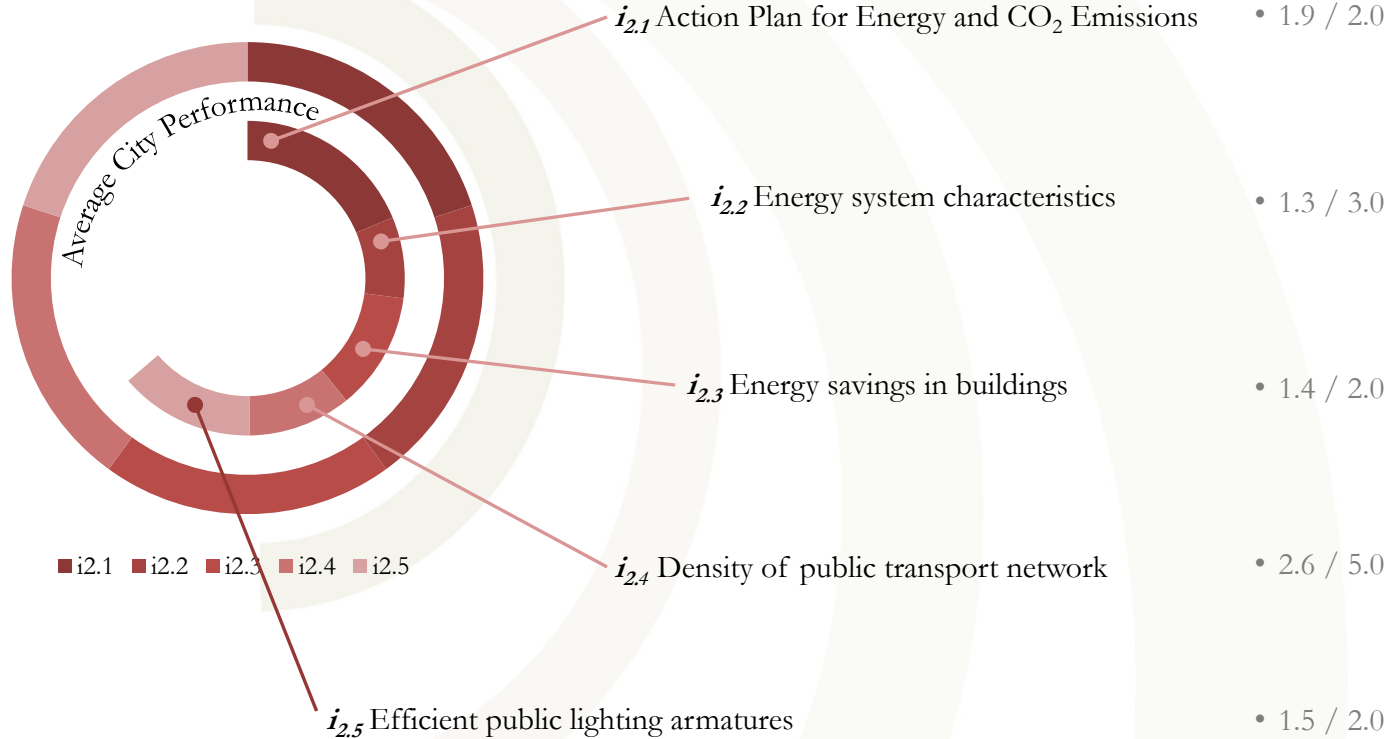
Karlovac

- i_{1.2} reduced by 9.7% from 139,558 MWh with more than a 40% reduction in i_{1.1} from the baseline year



Penetration of Energy and CO₂ Saving Measures (D₂)

Average City Performance:



Sub-indicators:

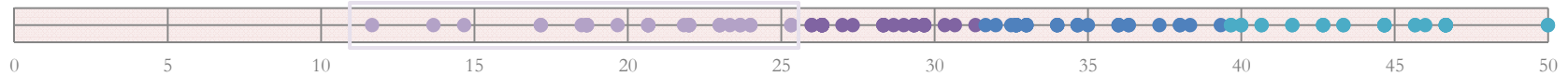
- Heat only district heating (1)
- CHP-based district heating (2)
- Developments for 4GDH (3)
 - 25%, 50% and 75% shares

Sub-indicators:

- Urban rail: 0.12 km/km²
- 7,828 daily ridership per km



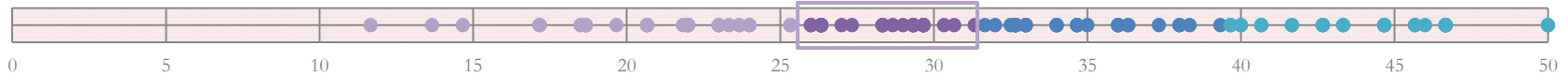
Quartile Performances in D_2



City	D_2	$\% \Delta M$	City	D_2	$\% \Delta M$	City	D_2	$\% \Delta M$
Istanbul	11.667	-63.0	Tirana	19.667	-37.6	Seferihisar	23.000	-27.0
Johannesburg	13.667	-56.6	Bursa Nilüfer	20.667	-34.4	Karlovac	23.000	-27.0
Cape Town	14.667	-53.4	Porto	20.667	-34.4	Constanța	23.000	-27.0
São Paulo	17.167	-45.5	Vila Nova de Gaia	20.667	-34.4	Belgrade	23.333	-25.9
Rio de Janeiro	17.167	-45.5	Salé	20.667	-34.4	Izola	23.667	-24.9
Bangalore	18.500	-41.3	Tianjin	21.833	-30.7	Eskişehir Tepebaşı	23.667	-24.9
Athens	18.667	-40.7	Zenica	22.000	-30.2	Kranj	24.000	-23.8
Batna	18.667	-40.7	Bijeljina	22.000	-30.2	Bydgoszcz	24.000	-23.8
Funchal	18.667	-40.7	Braga	22.000	-30.2	Podgorica	25.333	-19.6
Sfax	18.667	-40.7	Gdynia	22.000	-30.2	Celje	25.333	-19.6



Quartile Performances in D_2



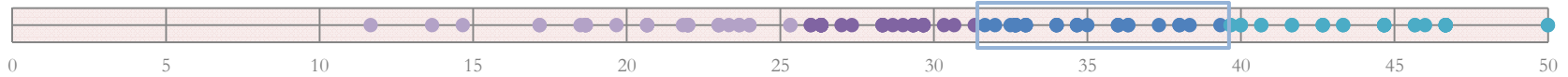
City	D_2	$\% \Delta M$
Bilbao	26.000	-17.5
Florence	26.000	-17.5
Zadar	26.333	-16.4
Heraklion	26.333	-16.4
Kalamariá	26.333	-16.4
Bogotá	26.333	-16.4
Niš	26.333	-16.4
Braşov	26.333	-16.4
Nitra	26.333	-16.4
Murcia	26.333	-16.4

City	D_2	$\% \Delta M$
Ohrid	27.000	-14.3
Pisa	27.333	-13.2
Sarajevo	28.333	-10.1
Karşıyaka	28.333	-10.1
Cluj-Napoca	28.333	-10.1
Ostrava	28.333	-10.1
Volos	28.667	-9.0
Christchurch	29.000	-7.9
Sevilla	29.333	-6.9
Timişoara	29.333	-6.9

City	D_2	$\% \Delta M$
Lviv	29.333	-6.9
Washington D.C.	29.333	-6.9
Bregenz	29.667	-5.8
Rijeka	29.667	-5.8
Dubrovnik	29.667	-5.8
Pula	29.667	-5.8
Patras	29.667	-5.8
Antalya	30.333	-3.7
Bari	30.667	-2.6
Bornova	31.333	-0.5



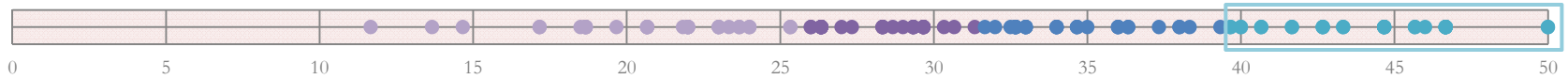
Quartile Performances in D_2



City	D_2	$\% \Delta M$	City	D_2	$\% \Delta M$	City	D_2	$\% \Delta M$
Venice	31.667	0.5	Velenje	33.000	4.8	Sofia	36.000	14.3
Varna	32.000	1.6	Klagenfurt	33.000	4.8	Bratislava	36.000	14.3
Beijing	32.500	3.2	Osijek	34.000	7.9	Riga	36.000	14.3
Málaga	32.667	3.7	Pécs	34.000	7.9	Thessaloniki	36.333	15.3
Grenoble	32.667	3.7	Bologna	34.000	7.9	Reykjavik	36.333	15.3
Antwerp	32.667	3.7	Aalborg	34.000	7.9	Leuven	37.333	18.5
Dublin	32.667	3.7	Rome	34.667	10.1	Nagoya	38.000	20.6
Vilnius	32.667	3.7	Valencia	34.667	10.1	Madrid	38.000	20.6
Skopje	33.000	4.8	Nice	34.667	10.1	Sydney	38.333	21.7
Burgas	33.000	4.8	Naples	35.000	11.1	Glasgow	39.333	24.9



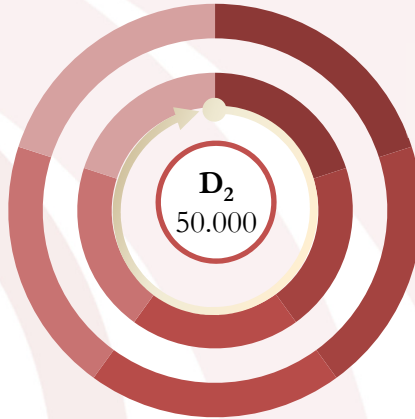
Quartile Performances in D_2



City	D_2	% ΔM	City	D_2	% ΔM	City	D_2	% ΔM
Espoo	39.667	25.9	Gothenburg	42.667	35.4	Århus	46.000	46.0
Maribor	39.667	25.9	Amsterdam	43.333	37.6	Barcelona	46.667	48.1
Milan	40.000	27.0	Helsinki	43.333	37.6	Paris	46.667	48.1
Warsaw	40.000	27.0	Zagreb	44.667	41.8	Vienna	46.667	48.1
Ljubljana	40.667	29.1	Cologne	44.667	41.8	Budapest	46.667	48.1
Tallinn	40.667	29.1	Frankfurt	44.667	41.8	Turin	46.667	48.1
Genoa	41.667	32.3	Grand Lyon	44.667	41.8	Berlin	46.667	48.1
Birmingham	41.667	32.3	Hamburg	44.667	41.8	London	46.667	48.1
Incheon	42.667	35.4	Bucharest*	45.667	45.0	Stockholm	50.000	58.7
Zaragoza	42.667	35.4	Lisbon	45.667	45.0	Copenhagen	50.000	58.7



Best Practice Examples from D₂



Copenhagen

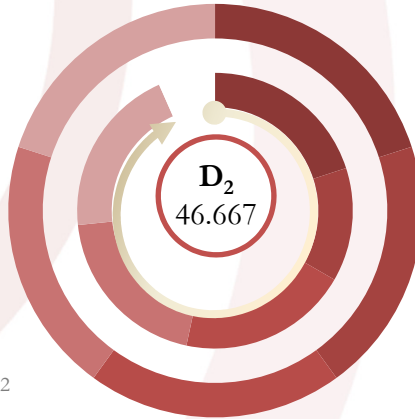
Indicators D ₂	Value
i2.1	2.0
i2.2	3.0
i2.3	2.0
i2.4	5.0
i2.5	2.0

- District heating coverage is 98%
- The suburbs of the city are renovated for low temperature district heating network

■ i2.1 ■ i2.2 ■ i2.3 ■ i2.4 ■ i2.5

Budapest

Indicators D ₂	Value
i2.1	2.0
i2.2	2.0
i2.3	2.0
i2.4	5.0
i2.5	2.0

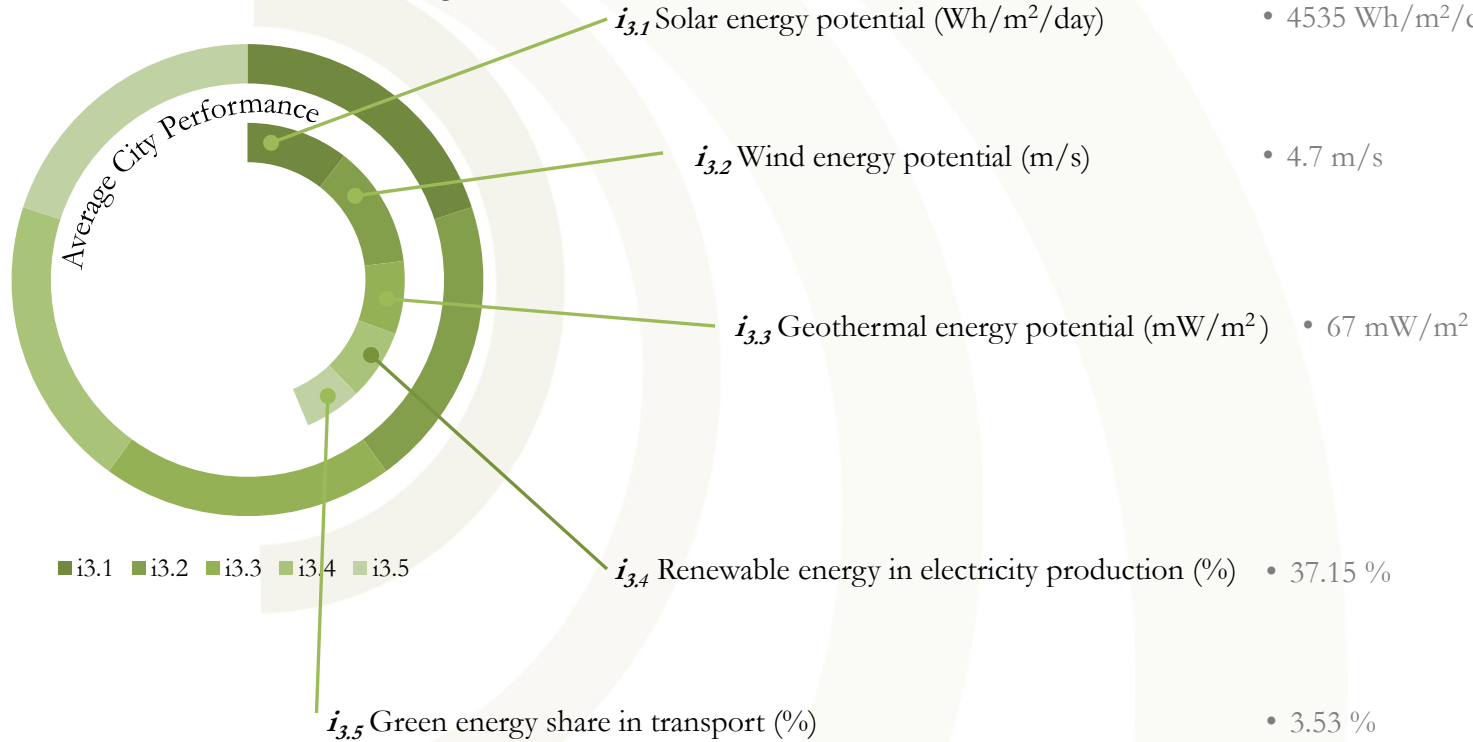


- Urban rail density 0.37 km/km²
- Daily ridership: 25,100 per km

■ i2.1 ■ i2.2 ■ i2.3 ■ i2.4 ■ i2.5



Renewable Energy Potential and Utilization (D₃)



Average City Performance:

• 4535 Wh/m²/day

• 4.7 m/s

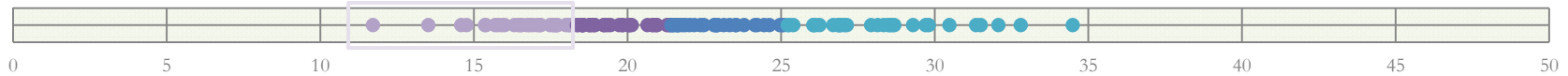
• 67 mW/m²

• 37.15 %

• 3.53 %



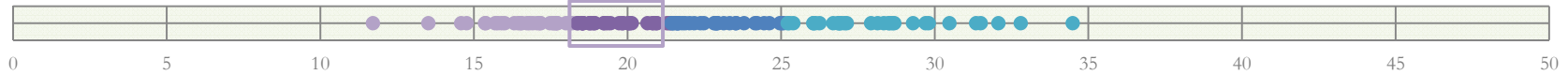
Quartile Performances in D_3



City	D_3	$\% \Delta M$	City	D_3	$\% \Delta M$	City	D_3	$\% \Delta M$
Lviv	11.716	-45.3	Warsaw	16.319	-23.8	Turin	17.477	-18.4
Tallinn	13.521	-36.9	Bologna	16.449	-23.2	Washington D.C.	17.579	-17.9
Birmingham	14.588	-31.9	Beijing	16.522	-22.9	London	17.605	-17.8
Tianjin	14.767	-31.1	Zenica	16.561	-22.7	Braşov	17.673	-17.5
Bydgoszcz	15.364	-28.3	Johannesburg	16.734	-21.9	Venice	17.709	-17.3
Sarajevo	15.393	-28.1	Timișoara	16.814	-21.5	Kranj	17.717	-17.3
Bangalore	15.692	-26.7	Batna	16.921	-21.0	Skopje	17.995	-16.0
Bogotá	15.786	-26.3	Glasgow	17.065	-20.3	Ljubljana	18.098	-15.5
Incheon	15.909	-25.7	Velenje	17.150	-19.9	Rijeka	18.125	-15.4
Vilnius	16.005	-25.3	Maribor	17.177	-19.8	Izola	18.205	-15.0



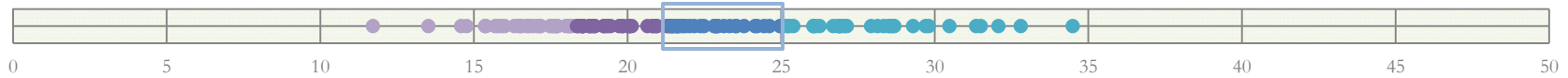
Quartile Performances in D_3



City	D_3	$\% \Delta M$	City	D_3	$\% \Delta M$	City	D_3	$\% \Delta M$
Bilbao	18.356	-14.3	Belgrade	18.938	-11.6	Bijeljina	20.071	-6.3
Berlin	18.406	-14.1	Celje	19.228	-10.2	Salé	20.140	-6.0
Podgorica	18.538	-13.5	Kalamariá	19.254	-10.1	Espoo	20.650	-3.6
Ohrid	18.544	-13.4	Dublin	19.350	-9.7	Hamburg	20.819	-2.8
Milan	18.546	-13.4	Thessaloniki	19.448	-9.2	Pécs	20.842	-2.7
Varna	18.552	-13.4	Paris	19.728	-7.9	Christchurch	20.947	-2.2
Ostrava	18.755	-12.4	Zadar	19.841	-7.4	Amsterdam	20.952	-2.2
Budapest	18.776	-12.4	Sofia	19.847	-7.4	Riga	21.287	-0.6
Nagoya	18.840	-12.1	Cluj-Napoca	20.021	-6.5	Sfax	21.351	-0.3
Gdynia	18.914	-11.7	Burgas	20.061	-6.4	Bursa Nilüfer	21.412	-0.05



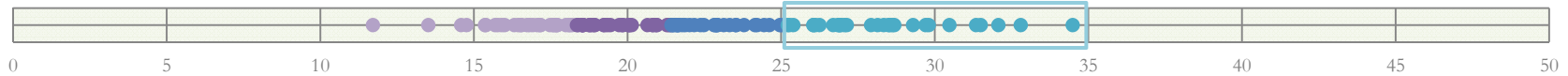
Quartile Performances in D_3



City	D_3	% ΔM	City	D_3	% ΔM	City	D_3	% ΔM
Nitra	21.432	0.05	Genoa	22.180	3.5	Bucharest*	23.530	9.8
Niš	21.490	0.3	Florence	22.380	4.1	Cape Town	23.539	9.9
Antwerp	21.506	0.4	Grenoble	22.490	4.5	Rome	23.796	11.1
Cologne	21.600	0.8	Eskişehir Tepebaşı	22.822	5.0	Antalya	24.151	12.7
Pula	21.631	1.0	Patras	22.863	6.5	Nice	24.218	13.1
Naples	21.635	1.0	Karlovac	22.895	6.7	Málaga	24.450	14.1
Istanbul	21.687	1.2	Leuven	22.925	6.9	Zagreb	24.620	14.9
Bratislava	21.795	1.7	Sydney	22.931	7.0	Tirana	24.959	16.5
Funchal	21.884	2.2	Zaragoza	23.139	7.0	Heraklion	25.018	16.8
Frankfurt	22.026	2.8	Constanța	23.328	7.9	Dubrovnik	25.084	17.1



Quartile Performances in D_3

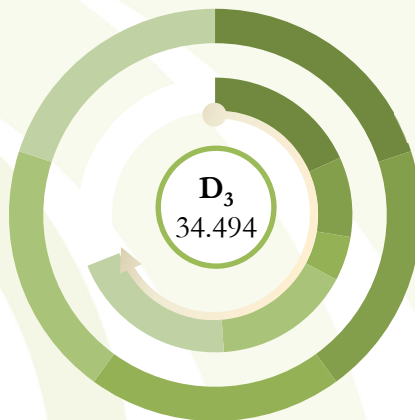


City	D_3	% ΔM	City	D_3	% ΔM	City	D_3	% ΔM
Murcia	25.214	17.7	Braga	26.905	25.6	Bregenz	28.684	33.9
Osijek	25.272	18.0	Aalborg	26.958	25.8	Gothenburg	29.294	36.8
Grand Lyon	25.402	18.6	Copenhagen	27.069	26.4	Valencia	29.707	38.7
Helsinki	26.055	21.6	Athens	27.139	26.7	Seferihisar	29.809	39.2
Århus	26.056	21.6	Porto	27.932	30.4	Barcelona	30.480	42.3
Madrid	26.115	21.9	Vienna	28.147	31.4	Lisbon	31.348	46.3
Bari	26.254	22.6	Sevilla	28.344	32.3	Stockholm	31.500	47.0
Klagenfurt	26.699	24.6	Vila Nova de Gaia	28.500	33.0	Reykjavík	32.076	49.7
Pisa	26.852	25.3	Bornova	28.543	33.2	São Paulo	32.799	53.1
Volos	26.901	25.6	Karşıyaka	28.627	33.6	Rio de Janeiro	34.494	61.0



Best Practice Examples from D₃

Rio de Janeiro



■ i3.1 ■ i3.2 ■ i3.3 ■ i3.4 ■ i3.5

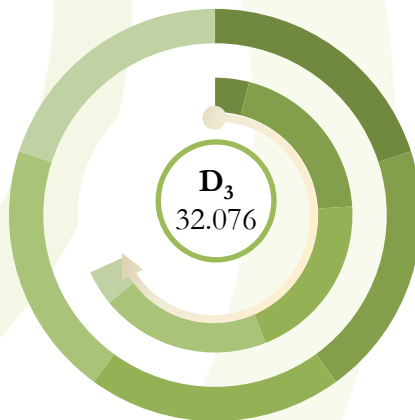
Rio de Janeiro

Indicators D ₃	Value	Unit
i3.1	5910	Wh/m ² /day
i3.2	4.1	m/s
i3.3	56	mW/m ²
i3.4	81.19	%
i3.5	17.87	%

- i_{3,4} improved from 73.86 % in 2015 (+9.9%)

Reykjavík

Indicators D ₃	Value	Unit
i3.1	2640	Wh/m ² /day
i3.2	8.0	m/s
i3.3	310	mW/m ²
i3.4	100.00	%
i3.5	2.50	%



■ i3.1 ■ i3.2 ■ i3.3 ■ i3.4 ■ i3.5



Reykjavík

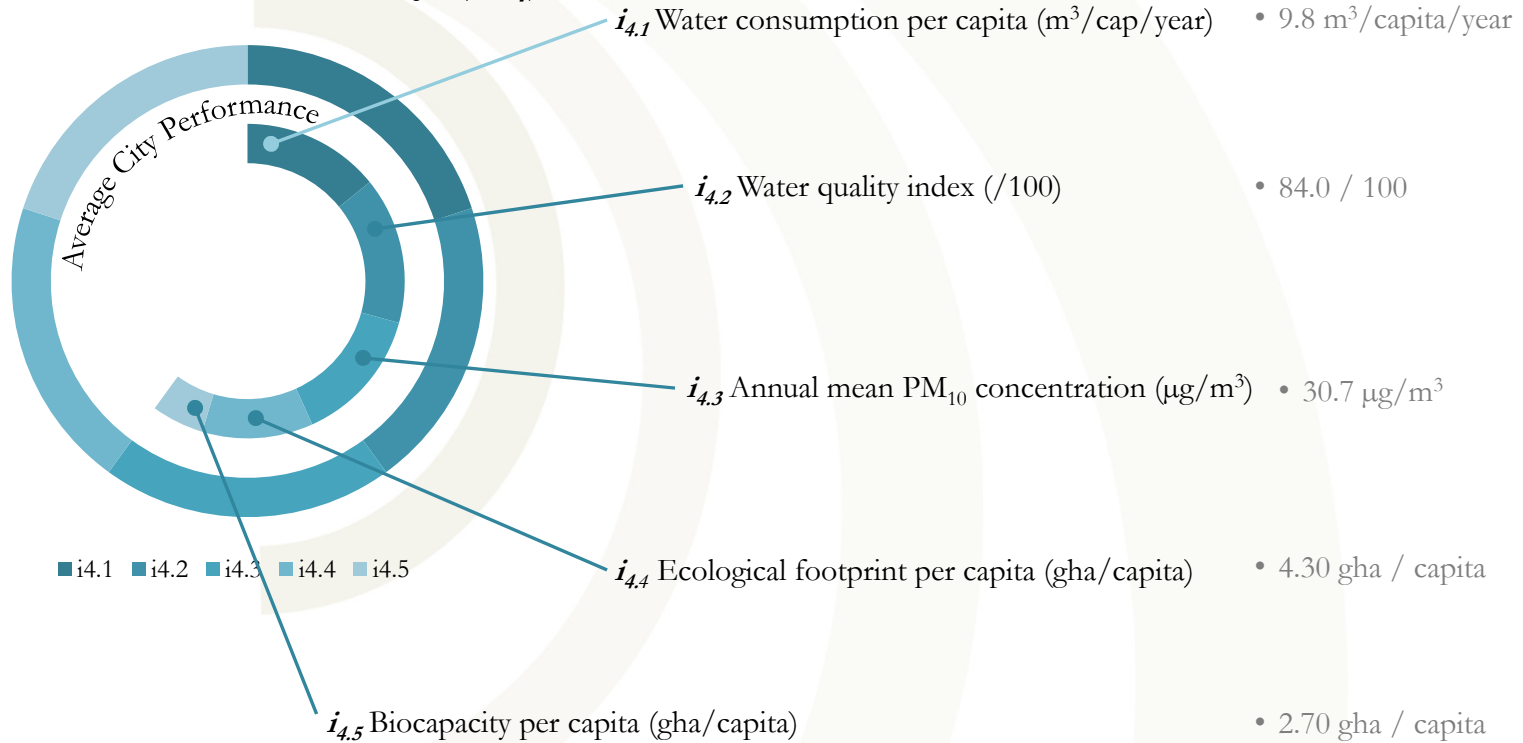
- Winsorized value for i_{3,3} is 128 mW/m²



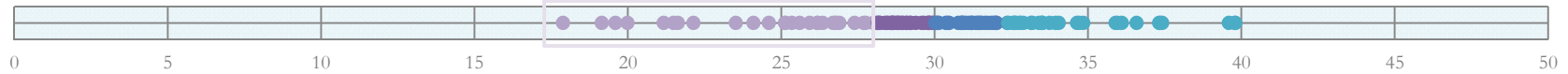
Water Usage and Environmental Quality (D₄)

Average City Performance:

Indicators:



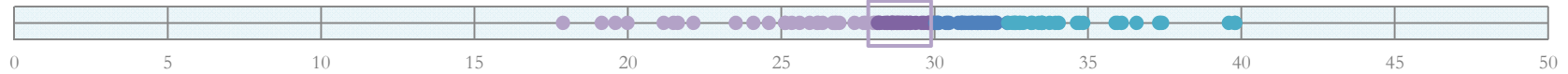
Quartile Performances in D_4



City	D_4	$\% \Delta M$	City	D_4	$\% \Delta M$	City	D_4	$\% \Delta M$
Batna	17.890	-40.4	Lviv	24.599	-18.0	Patras	26.764	-10.8
Skopje	19.149	-36.2	Antwerp	25.131	-16.2	Milan	26.802	-10.7
Ostrava	19.597	-34.7	Istanbul	25.133	-16.2	Bornova	26.902	-10.3
Johannesburg	19.993	-33.4	Leuven	25.351	-15.5	Bogotá	27.393	-8.7
Incheon	21.172	-29.4	Nagoya	25.605	-14.7	Vienna	27.690	-7.7
Washington D.C.	21.493	-28.4	Athens	25.932	-13.6	Bursa Nilüfer	27.755	-7.5
Sfax	21.635	-27.9	Bangalore	26.179	-12.7	Sarajevo	28.008	-6.6
Beijing	22.140	-26.2	Antalya	26.206	-12.7	Volos	28.052	-6.5
Tianjin	23.521	-21.6	Turin	26.355	-12.2	Klagenfurt	28.128	-6.2
Zenica	24.095	-19.7	Cape Town	26.691	-11.0	Rome	28.147	-6.2



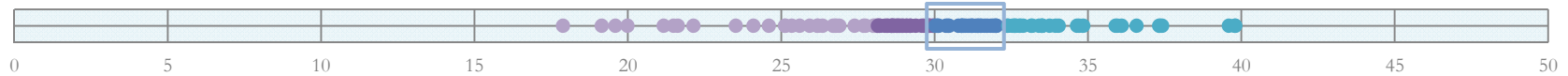
Quartile Performances in D_4



City	D_4	$\% \Delta M$	City	D_4	$\% \Delta M$	City	D_4	$\% \Delta M$
Sevilla	28.153	-6.2	Bari	28.693	-4.4	Nitra	29.220	-2.6
Barcelona	28.208	-6.0	Bregenz	28.778	-4.1	Amsterdam	29.396	-2.0
Venice	28.218	-5.9	Bologna	28.786	-4.1	Heraklion	29.587	-1.4
Nice	28.382	-5.4	Pisa	28.839	-3.9	Bilbao	29.659	-1.1
Paris	28.452	-5.2	Varna	28.875	-3.8	Madrid	29.786	-0.7
Málaga	28.486	-5.1	Grand Lyon	28.948	-3.5	Thessaloniki	29.820	-0.6
Murcia	28.605	-4.7	Eskişehir Tepebaşı	28.978	-3.4	Kalamariá	29.820	-0.6
Florence	28.606	-4.7	Genoa	29.083	-3.1	Bydgoszcz	29.869	-0.4
Grenoble	28.624	-4.6	Bratislava	29.104	-3.0	Valencia	29.947	-0.2
Naples	28.662	-4.5	Reykjavík	29.213	-2.6	Constanța	29.976	-0.1



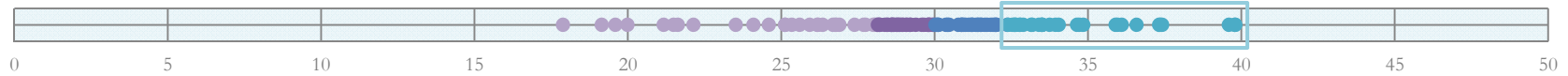
Quartile Performances in D_4



City	D_4	$\% \Delta M$	City	D_4	$\% \Delta M$	City	D_4	$\% \Delta M$
Frankfurt	30.030	0.1	Hamburg	30.903	3.0	Cluj-Napoca	31.511	5.0
Zaragoza	30.073	0.2	Bucharest*	30.959	3.2	Osijek	31.530	5.1
Sofia	30.115	0.4	Copenhagen	31.018	3.4	London	31.644	5.5
Warsaw	30.137	0.4	Porto	31.122	3.7	Vila Nova de Gaia	31.723	5.7
Cologne	30.376	1.2	Zagreb	31.191	4.0	Funchal	31.842	6.1
Berlin	30.426	1.4	Celje	31.232	4.1	Århus	31.920	6.4
Salé	30.476	1.6	Seferihisar	31.242	4.1	Ljubljana	31.976	6.6
Tirana	30.779	2.6	Burgas	31.353	4.5	Braşov	32.016	6.7
Karşıyaka	30.879	2.9	Timișoara	31.421	4.7	Kranj	32.019	6.7
Maribor	30.889	3.0	Aalborg	31.432	4.8	Bijeljina	32.380	7.9



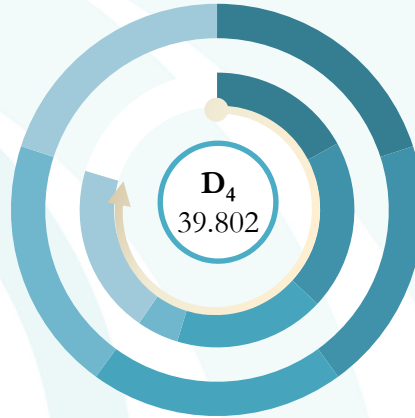
Quartile Performances in D_4^*



City	D_4	% ΔM	City	D_4	% ΔM	City	D_4	% ΔM
Belgrade	32.402	8.0	Niš	33.406	11.3	Ohrid	35.905	19.7
Sydney	32.548	8.5	Birmingham	33.502	11.7	Vilnius	35.968	19.9
Velenje	32.606	8.7	Pécs	33.509	11.7	Stockholm	36.104	20.3
Karlovac	32.624	8.7	Dublin	33.515	11.7	Tallinn	36.587	21.9
Lisbon	32.668	8.9	Budapest	33.752	12.5	Gothenburg	37.323	24.4
Izola	32.780	9.3	Rijeka	33.950	13.2	Riga	37.363	24.5
Glasgow	32.803	9.3	Podgorica	34.051	13.5	Rio de Janeiro	37.420	24.7
Gdynia	32.896	9.6	Pula	34.645	15.5	São Paulo	39.594	32.0
Braga	33.153	10.5	Zadar	34.724	15.7	Espoo	39.802	32.7
Christchurch	33.188	10.6	Dubrovnik	35.053	16.8	Helsinki	39.802	32.7



Best Practice Examples in D_4



■ i4.1 ■ i4.2 ■ i4.3 ■ i4.4 ■ i4.5

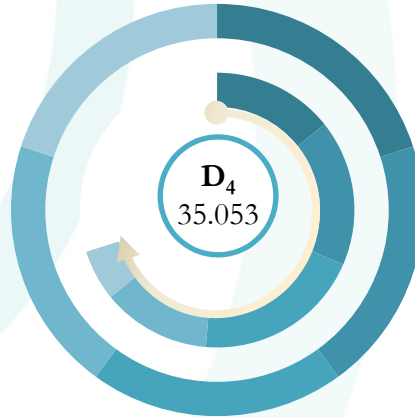
Helsinki

Indicators D_4	Value	Unit
i4.1	6.6	$m^3/\text{cap}/\text{year}$
i4.2	99.1	(/100)
i4.3	19.1	$\mu\text{g}/m^3$
i4.4	6.73	gha
i4.5	13.34	gha

- Winsorized value for $i_{4,5}$ is 8.59

Dubrovnik

Indicators D_4	Value	Unit
i4.1	9.7	$m^3/\text{cap}/\text{year}$
i4.2	90.4	(/100)
i4.3	12.66	$\mu\text{g}/m^3$
i4.4	3.77	gha
i4.5	2.97	gha



■ i4.1 ■ i4.2 ■ i4.3 ■ i4.4 ■ i4.5



CO₂ Emissions and Industrial Profile (D₅)



Indicators:

*i*_{5.1} CO₂ emissions of buildings (t CO₂)

*i*_{5.2} CO₂ emissions of transport (t CO₂)

*i*_{5.3} Average CO₂ intensity (t CO₂/MWh)

*i*_{5.4} Number of CO₂ intense industries

*i*_{5.5} Airport ACA level and measures

Airport Carbon Accreditation (ACA)

Average City Performance:

- 2,275,621 t CO₂

- 1,093,392 t CO₂

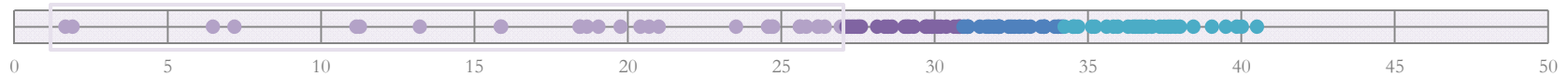
- 0.29 t CO₂ / MWh

- 3.5 / 8.0

- 1.4 / 6.0



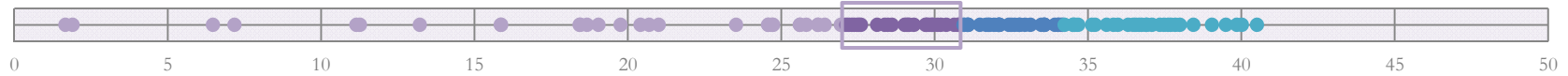
Quartile Performances in D_5



City	D_5	$\% \Delta M$	City	D_5	$\% \Delta M$	City	D_5	$\% \Delta M$
Tianjin	1.667	-94.6	Rio de Janeiro	18.455	-40.3	Madrid	24.700	-20.1
Beijing	1.903	-93.8	Istanbul	18.673	-39.6	Belgrade	24.741	-19.9
Cape Town	6.476	-79.0	Cologne	19.043	-38.4	Ostrava	25.611	-17.1
Nagoya	7.176	-76.8	Hamburg	19.764	-36.0	Sofia	25.619	-17.1
Berlin	11.153	-63.9	Washington D.C.	20.417	-33.9	Genoa	25.823	-16.4
Athens	11.269	-63.5	São Paulo	20.700	-33.0	Turin	26.198	-15.2
Johannesburg	13.221	-57.2	Bogotá	21.008	-32.0	Tallinn	26.208	-15.2
London	15.858	-48.7	Sydney	23.532	-23.8	Antalya	26.422	-14.5
Warsaw	15.873	-48.6	Thessaloniki	24.576	-20.5	Frankfurt	26.947	-12.8
Incheon	18.431	-40.3	Birmingham	24.589	-20.4	Bangalore	27.054	-12.4



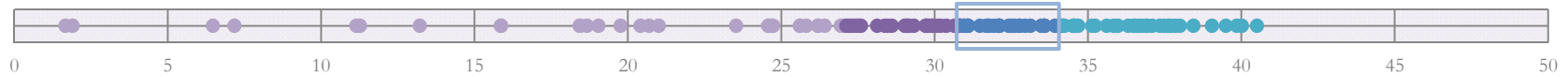
Quartile Performances in D_5



City	D_5	$\% \Delta M$	City	D_5	$\% \Delta M$	City	D_5	$\% \Delta M$
Paris	27.128	-12.2	Zenica	28.615	-7.4	Eskişehir Tepebaşı	29.924	-3.1
Lviv	27.207	-11.9	Salé	29.029	-6.0	Gdynia	29.942	-3.1
Skopje	27.305	-11.6	Budapest	29.088	-5.8	Vienna	30.102	-2.6
Bratislava	27.391	-11.3	Antwerp	29.141	-5.7	Riga	30.208	-2.2
Zaragoza	27.486	-11.0	Valencia	29.179	-5.6	Timișoara	30.387	-1.6
Bydgoszcz	27.548	-10.8	Ljubljana	29.328	-5.1	Sarajevo	30.642	-0.8
Glasgow	27.605	-10.6	Barcelona	29.704	-3.9	Florence	30.756	-0.4
Sevilla	28.131	-8.9	Cluj-Napoca	29.746	-3.7	Lisbon	30.807	-0.3
Braşov	28.378	-8.1	Dublin	29.765	-3.7	Porto	30.823	-0.2
Rome	28.487	-7.8	Murcia	29.840	-3.4	Århus	30.845	-0.2



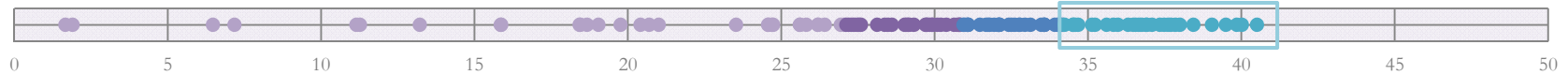
Quartile Performances in D_5



City	D_5	$\% \Delta M$	City	D_5	$\% \Delta M$	City	D_5	$\% \Delta M$
Amsterdam	30.945	0.2	Sfax	32.081	3.8	Málaga	33.128	7.2
Grenoble	30.982	0.3	Grand Lyon	32.106	3.9	Pula	33.480	8.4
Volos	31.078	0.6	Niš	32.113	3.9	Klagenfurt	33.580	8.7
Christchurch	31.096	0.7	Zagreb	32.120	4.0	Varna	33.581	8.7
Bucharest*	31.101	0.7	Podgorica	32.422	4.9	Milan	33.590	8.7
Batna	31.480	1.9	Tirana	32.511	5.2	Vilnius	33.922	9.8
Bilbao	31.687	2.6	Bornova	32.619	5.6	Patras	34.032	10.2
Naples	31.754	2.8	Kalamariá	32.766	6.1	Pécs	34.045	10.2
Bursa Nilüfer	31.801	2.9	Heraklion	32.785	6.1	Nitra	34.135	10.5
Bari	31.950	3.4	Burgas	32.954	6.7	Pisa	34.189	10.7



Quartile Performances in D_5



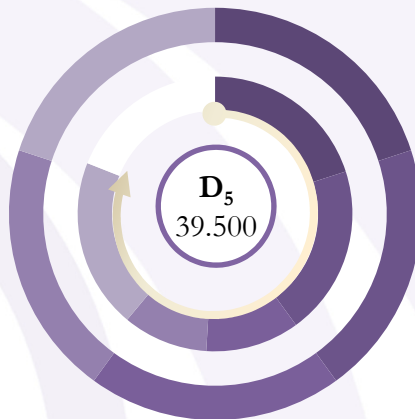
City	D_5	$\% \Delta M$	City	D_5	$\% \Delta M$	City	D_5	$\% \Delta M$
Zadar	34.242	10.8	Espoo	36.313	17.5	Copenhagen	37.620	21.8
Bologna	34.524	11.7	Helsinki	36.486	18.1	Bregenz	37.709	22.1
Maribor	34.526	11.8	Velenje	36.562	18.3	Dubrovnik	37.856	22.5
Bijeljina	34.585	11.9	Izola	36.672	18.7	Stockholm	38.004	23.0
Rijeka	34.687	12.3	Venice	36.757	19.0	Kranj	38.443	24.4
Osijek	35.136	13.7	Karlovac	36.907	19.5	Leuven	39.048	26.4
Constanța	35.238	14.1	Vila Nova de Gaia	36.921	19.5	Karşıyaka	39.500	27.9
Gothenburg	35.612	15.3	Aalborg	37.095	20.1	Ohrid	39.854	29.0
Celje	35.835	16.0	Braga	37.346	20.9	Nice	40.020	29.5
Funchal	35.983	16.5	Reykjavik	37.491	21.4	Seferihisar	40.514	31.1



Best Practice Examples from D₅



Karsiyaka



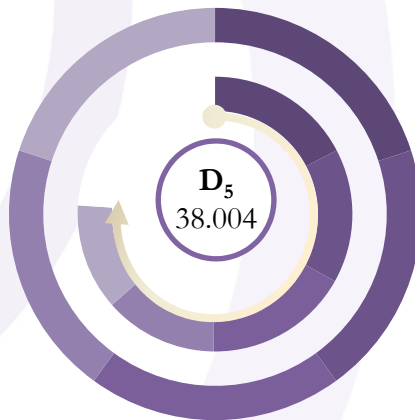
■ i5.1 ■ i5.2 ■ i5.3 ■ i5.4 ■ i5.5

Karsiyaka

Indicators D ₅	Value	
i5.1	442,115	t CO ₂
i5.2	133,809	t CO ₂
i5.3	0.32	t CO ₂ / MWh
i5.4	3.0	-
i5.5	0.0	-

Stockholm

Indicators D ₅	Value	
i5.1	1,458,000	t CO ₂
i5.2	1,116,000	t CO ₂
i5.3	0.14	t CO ₂ / MWh
i5.4	4.0	-
i5.5	3.0	-



■ i5.1 ■ i5.2 ■ i5.3 ■ i5.4 ■ i5.5



Stockholm

- i_{5,3} improved from 0.15 in previous reporting



Urban Planning and Social Welfare (D₆)



Indicators:

*i*_{6.1} Waste and wastewater management

*i*_{6.2} Compact urban form and green spaces

*i*_{6.3} Gross domestic product per capita
201x constant prices

*i*_{6.4} Inequality adjusted well-being

*i*_{6.5} Tertiary education rate (%)

Average City Performance:

• 4.6 / 6.6

Sub-indicators:

Waste valorization:

- 433 kg waste per cap. 27% recycling and composting

• 1.9 / 3.0

Sub-indicators:

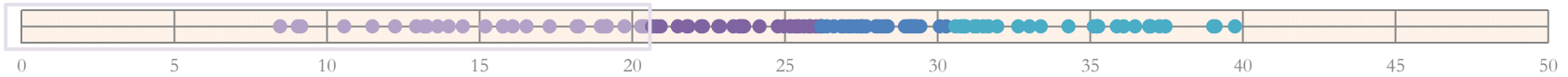
- Sprawl index: 0.80%
- Impermeable surfaces: 52.7%

• 31,152 PPP\$

• 6.9 / 10.0

• 34.3 %

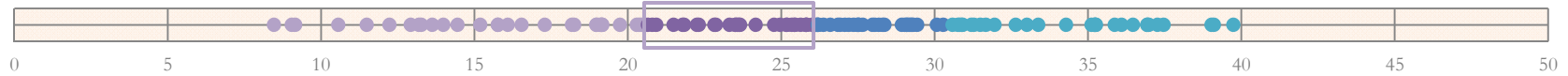
Quartile Performances in D_6



City	D_6	% ΔM	City	D_6	% ΔM	City	D_6	% ΔM
Salé	8.468	-67.6	Podgorica	13.986	-46.5	Johannesburg	18.972	-27.5
Zenica	9.047	-65.4	Eskişehir Tepebaşı	14.449	-44.8	Bursa Nilüfer	18.997	-27.4
Bangalore	9.159	-65.0	Lviv	15.191	-41.9	Seferihisar	19.100	-27.0
Bijeljina	10.566	-59.6	Bornova	15.766	-39.7	São Paulo	19.151	-26.8
Batna	10.690	-59.1	Karşıyaka	15.766	-39.7	Bogotá	19.157	-26.8
Tirana	11.492	-56.1	Tianjin	16.090	-38.5	Rio de Janeiro	19.169	-26.7
Sarajevo	12.232	-53.3	Belgrade	16.539	-36.8	Skopje	19.747	-24.5
Sfax	13.191	-49.6	Antalya	17.294	-33.9	Timișoara	20.292	-22.4
Istanbul	13.269	-49.3	Bucharest*	18.180	-30.5	Constanța	20.370	-22.1
Niš	13.625	-47.9	Beijing	18.253	-30.2	Cluj-Napoca	20.442	-21.9



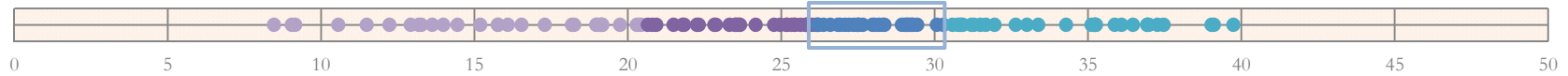
Quartile Performances in D_6



City	D_6	$\% \Delta M$	City	D_6	$\% \Delta M$	City	D_6	$\% \Delta M$
Zadar	20.656	-21.1	Nitra	23.318	-10.9	Heraklion	25.184	-3.8
Pula	20.803	-20.5	Volos	23.517	-10.1	Sevilla	25.349	-3.1
Sofia	20.933	-20.0	Kalamariá	23.517	-10.1	Zagreb	25.440	-2.8
Rijeka	21.492	-17.9	Athens	23.579	-9.9	Bratislava	25.460	-2.7
Cape Town	21.790	-16.7	Budapest	23.629	-9.7	Pécs	25.636	-2.0
Pisa	21.840	-16.5	Karlovac	23.663	-9.6	Málaga	25.813	-1.4
Osijek	22.253	-15.0	Funchal	24.170	-7.6	Zaragoza	25.823	-1.3
Burgas	22.318	-14.7	Lisbon	24.769	-5.3	Florence	25.826	-1.3
Braşov	22.824	-12.8	Riga	24.972	-4.6	Vila Nova de Gaia	26.014	-0.6
Varna	22.875	-12.6	Thessaloniki	25.184	-3.8	Dubrovnik	26.139	-0.1



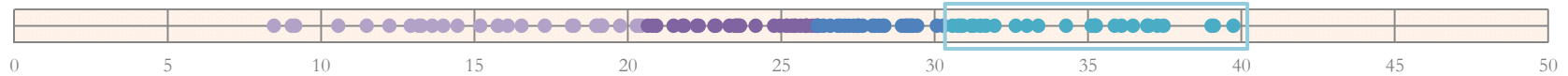
Quartile Performances in D_6



City	D_6	% ΔM	City	D_6	% ΔM	City	D_6	% ΔM
Genoa	26.193	0.1	Bologna	27.487	5.0	Naples	29.034	11.0
Ostrava	26.193	0.1	Porto	27.533	5.2	Murcia	29.096	11.2
Milan	26.225	0.2	Braga	27.533	5.2	Valencia	29.105	11.2
Celje	26.386	0.8	Vilnius	27.663	5.7	Venice	29.167	11.5
Ohrid	26.602	1.7	Turin	27.978	6.9	Gdynia	29.222	11.7
Patras	26.851	2.6	Barcelona	28.056	7.2	Madrid	29.267	11.9
Nagoya	26.927	2.9	Velenje	28.190	7.7	Bydgoszcz	29.312	12.0
Bari	27.083	3.5	Rome	28.313	8.2	Washington D.C.	29.437	12.5
Tallinn	27.211	4.0	Warsaw	28.369	8.4	Paris	30.079	15.0
Kranj	27.366	4.6	Bilbao	28.936	10.6	Maribor	30.285	15.7



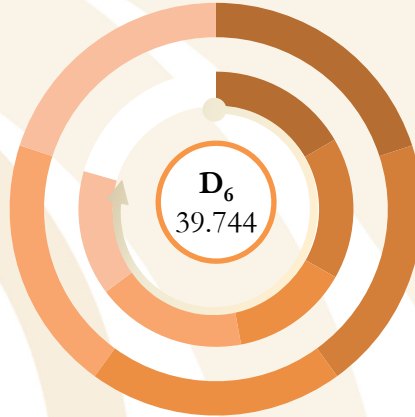
Quartile Performances in D_6



City	D_6	% ΔM	City	D_6	% ΔM	City	D_6	% ΔM
Incheon	30.587	16.9	Frankfurt	32.649	24.8	Århus	36.098	38.0
Izola	30.767	17.6	Ljubljana	33.012	26.2	Reykjavik	36.468	39.4
Grand Lyon	30.815	17.8	Birmingham	33.381	27.6	Espoo	36.931	41.1
Leuven	30.884	18.0	Bregenz	34.289	31.0	Klagenfurt	36.945	41.2
Grenoble	30.920	18.2	Berlin	35.121	34.2	Copenhagen	36.985	41.3
Antwerp	31.201	19.2	Dublin	35.224	34.6	Amsterdam	37.272	42.4
Christchurch	31.286	19.6	Glasgow	35.228	34.6	Vienna	37.471	43.2
Hamburg	31.495	20.4	Sydney	35.251	34.7	Stockholm	39.031	49.2
Cologne	31.678	21.1	Helsinki	35.265	34.8	Gothenburg	39.107	49.5
Nice	31.961	22.1	London	35.874	37.1	Aalborg	39.744	51.9



Best Practice Examples from D₆



■ i6.1 ■ i6.2 ■ i6.3 ■ i6.4 ■ i6.5

Aalborg

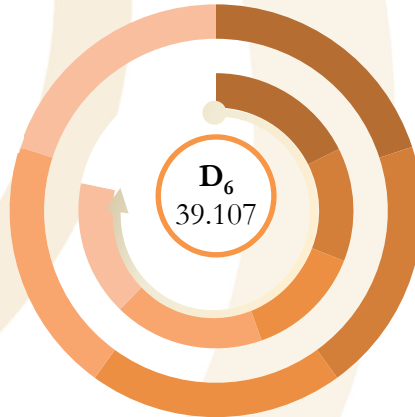
Indicators D ₆	Value	
i6.1	5.5	-
i6.2	2.7	-
i6.3	49,696	PPP\$
i6.4	7.9	/ 10.0
i6.5	47.7	%

- Recycling and composting: 36%
- Waste per capita: 380 kg
- Green urban area 30.32%
- Impermeable surfaces 26.39%

Gothenburg

Indicators D ₆	Value	
i6.1	5.8	..
i6.2	2.3	..
i6.3	49,175	PPP\$
i6.4	7.9	/ 10.0
i6.5	51.0	%

- Sprawl index: -1.97%
- Share of population in core areas: 56.15%



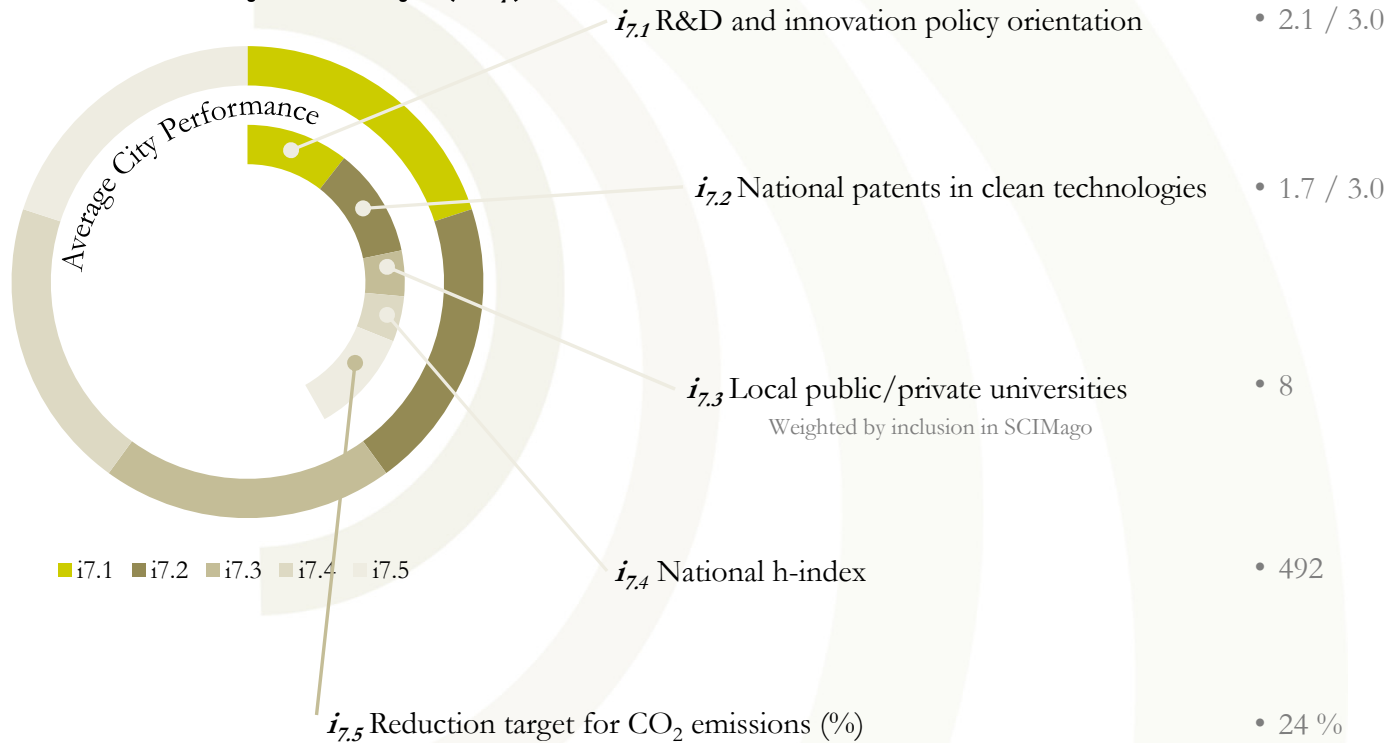
■ i6.1 ■ i6.2 ■ i6.3 ■ i6.4 ■ i6.5



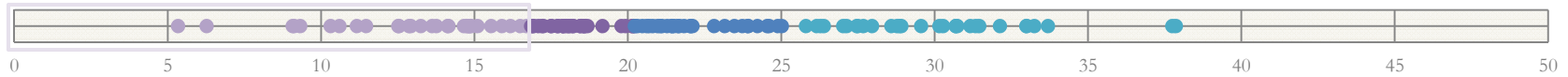
R&D, Innovation and Sustainability Policy (D₇)

Average City Performance:

Indicators:



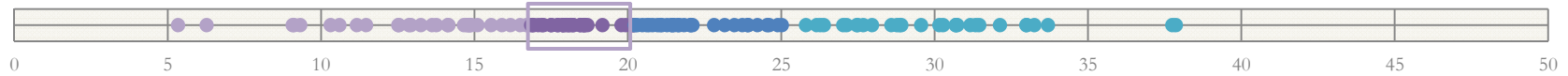
Quartile Performances in D_7



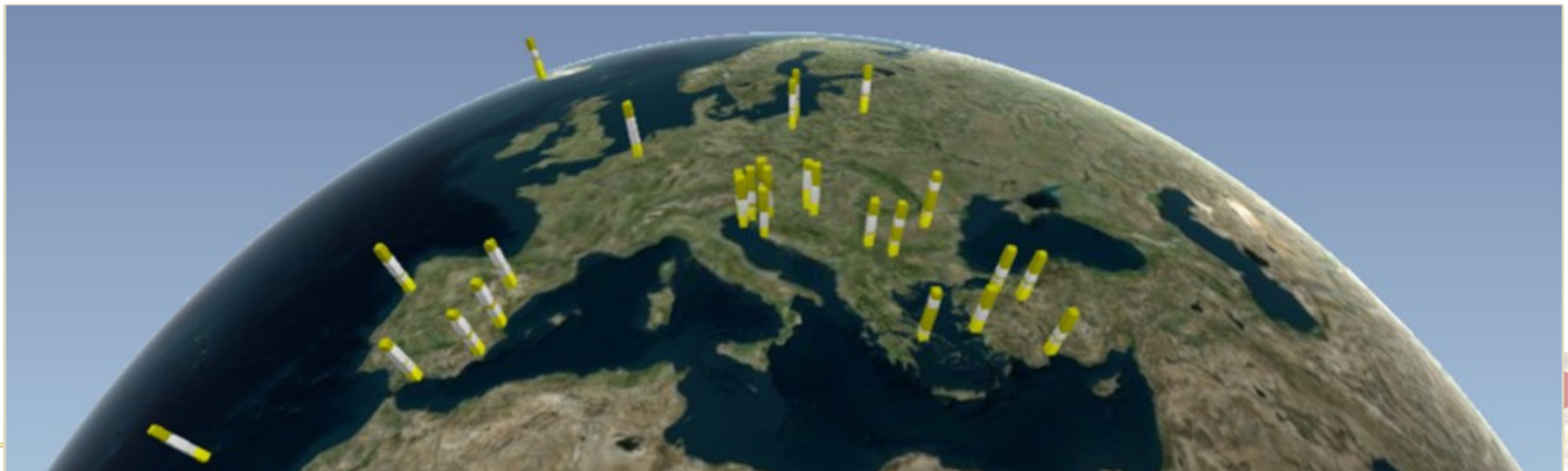
City	D_7	% ΔM	City	D_7	% ΔM	City	D_7	% ΔM
Sfax	5.342	-73.6	Timișoara	12.543	-38.0	Bratislava	14.795	-26.8
Zenica	6.272	-69.0	Patras	12.873	-36.3	Lviv	14.841	-26.6
Bijeljina	9.074	-55.1	Bogotá	12.930	-36.1	Brașov	14.852	-26.6
Sarajevo	9.129	-54.9	Cluj-Napoca	13.257	-34.4	Salé	14.902	-26.3
Podgorica	9.325	-53.9	Skopje	13.622	-32.6	Burgas	15.103	-25.3
Tirana	10.314	-49.0	Volos	13.761	-32.0	Kalamariá	15.547	-23.1
Batna	10.600	-47.6	Maribor	14.127	-30.1	Heraklion	15.896	-21.4
Ohrid	11.170	-44.8	Ostrava	14.159	-30.0	Varna	16.175	-20.0
Constanța	11.471	-43.3	Thessaloniki	14.658	-27.5	Kranj	16.492	-18.5
Nitra	12.517	-38.1	Tallinn	14.758	-27.0	Christchurch	16.698	-17.4



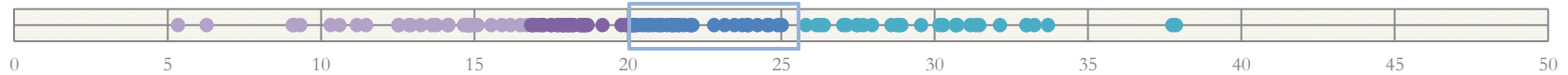
Quartile Performances in D_7



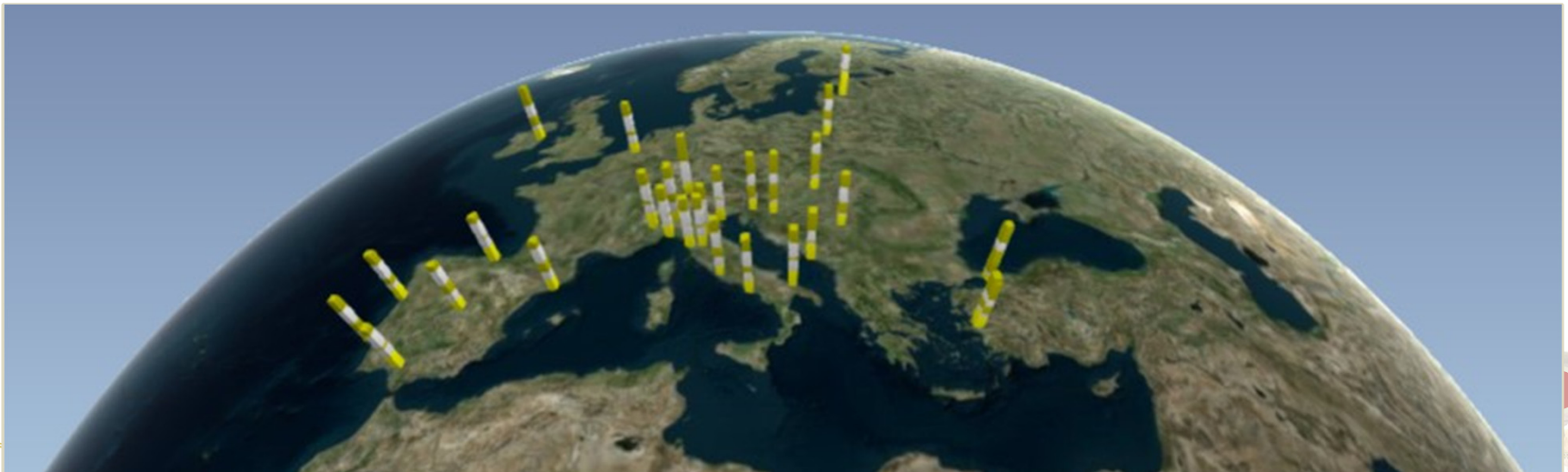
City	D_7	$\% \Delta M$	City	D_7	$\% \Delta M$	City	D_7	$\% \Delta M$
Izola	16.849	-16.7	Karlovac	17.885	-11.6	Eskişehir Tepebaşı	18.569	-8.2
Gdynia	16.905	-16.4	Bursa Nilüfer	17.902	-11.5	Braga	18.586	-8.1
Velenje	16.937	-16.3	Reykjavík	17.908	-11.5	Valencia	18.588	-8.1
Pécs	17.091	-15.5	Cape Town	18.009	-11.0	Osijek	18.686	-7.6
Celje	17.206	-14.9	Seferihisar	18.077	-10.6	Rijeka	19.178	-5.2
Niš	17.257	-14.7	Zadar	18.107	-10.5	Sofia	19.794	-2.1
Vilnius	17.499	-13.5	Antalya	18.212	-9.9	Johannesburg	19.935	-1.4
Málaga	17.516	-13.4	Murcia	18.231	-9.9	Leuven	20.139	-0.4
Bydgoszcz	17.707	-12.4	Funchal	18.452	-8.8	Athens	20.158	-0.3
Zaragoza	17.739	-12.3	Pula	18.464	-8.7	Bucharest*	20.217	-0.03



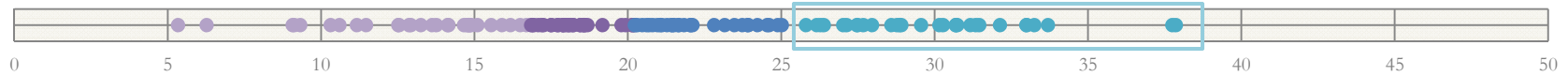
Quartile Performances in D_7



City	D_7	$\% \Delta M$	City	D_7	$\% \Delta M$	City	D_7	$\% \Delta M$
Sevilla	20.231	0.03	Lisbon	21.444	6.0	Ljubljana	23.159	14.5
Bilbao	20.318	0.5	Madrid	21.445	6.0	Milan	23.476	16.1
Warsaw	20.477	1.3	Bornova	21.514	6.4	Karşıyaka	23.736	17.4
Bologna	20.619	2.0	Venice	21.643	7.0	Turin	23.913	18.2
Riga	20.700	2.4	Belgrade	21.677	7.2	Bregenz	23.931	18.3
Dubrovnik	20.821	3.0	Vila Nova de Gaia	21.840	8.0	Naples	24.230	19.8
Florence	20.976	3.7	Bangalore	22.037	9.0	Rome	24.547	21.4
Pisa	21.063	4.2	Budapest	22.059	9.1	Istanbul	24.609	21.7
Antwerp	21.123	4.4	Barcelona	22.112	9.3	Zagreb	24.893	23.1
Genoa	21.286	5.2	Dublin	22.816	12.8	Bari	25.024	23.7



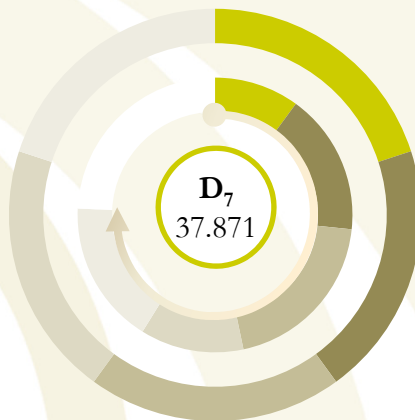
Quartile Performances in D_7



City	D_7	% ΔM	City	D_7	% ΔM	City	D_7	% ΔM
Espoo	25.807	27.6	Glasgow	28.594	41.4	Cologne	31.167	54.1
Grand Lyon	26.160	29.3	Grenoble	28.779	42.3	Incheon	31.346	55.0
Porto	26.285	30.0	Klagenfurt	28.867	42.7	Copenhagen	31.460	55.6
São Paulo	26.393	30.5	Aalborg	28.920	43.0	Nagoya	32.134	58.9
Gothenburg	27.023	33.6	Stockholm	29.563	46.2	Hamburg	32.992	63.1
Nice	27.136	34.2	Washington D.C.	30.159	49.1	Sydney	33.009	63.2
Rio de Janeiro	27.465	35.8	Amsterdam	30.281	49.7	Frankfurt	33.254	64.4
Vienna	27.502	36.0	Beijing	30.695	51.8	Paris	33.699	66.6
Helsinki	27.680	36.9	Tianjin	30.695	51.8	Berlin	37.754	86.7
Birmingham	27.967	38.3	Århus	30.746	52.0	London	37.871	87.3



Best Practice Examples from D₇



London

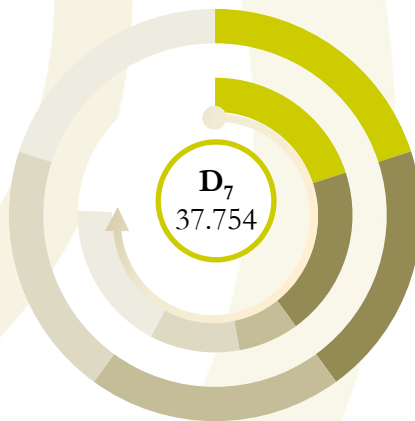
Indicators D ₇	Value	
i7.1	2.0	
i7.2	2.5	
i7.3	19	
i7.4	1213	
i7.5	38	%

- GERD / GDP: 1.72 %
- Y02 and Y04 Patents: > 25,000 (3.8 %)
- Prior to SCIMago weighting (i7.3)

Berlin

Indicators D ₇	Value	
i7.1	3.0	
i7.2	3.0	
i7.3	11	
i7.4	1059	
i7.5	40	%

- GERD / GDP: 2.98 %
- Y02 and Y04 Patents: > 150,000 (2.6%)



■ i7.1 ■ i7.2 ■ i7.3 ■ i7.4 ■ i7.5

