CITIES 4.0
Climate Innovation Through Interactive Ecosystem Summits

Deliverable 2.3

Consolidated report on innovation challenges and joint business opportunities

Document Title	Consolidated report on innovation challenges and joint business opportunities	**Author**	Jarmo Vehmas
Deliverable No	D2.3	**Due date**	28/2/2023
Document type	R-Document, Report	**Dissemination level**	PU
Description	The list of key stakeholders to interview to identify opportunities for joint actions and technology transfer.		

Project	Cities 4.0	**Grant number**	101070827
Work package No	WP2	**Lead beneficiary**	TScP
Project Manager	Aino Ukkola	**Project start date**	01/09/2022

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Quality assurance

To ensure the quality and correctness of this deliverable, we implied an internal review and validation process. The deliverable was drafted by the work package leader. All partners contributed to and reviewed the overall draft. Finally, the project coordinator (BRAINPORT) made a review and validation.

Version	Date	Status	Authors	
V0	1/2/2023	Draft	TScP	Creation of the document
V1	21/2/2023	Draft	TScP	Corrections, suggestions and edits
V2	27/2/2023	Final	TScP	Final corrections, suggestions and edits

List of participants and abbreviations

Partner	Location and Country	Short Name
Brainport Development NV	Eindhoven, The Netherlands	BRP
Leuven Mindgate	Leuven, Belgium	MIND
Fondazione Innovazione Urbana	Bologna, Italy	FIU
Turku Science Park OY AB	Turku, Finland	TScP
Ecosystem Thinking Institute	Eindhoven, The Netherlands	ESTI

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Introduction

This consolidated report on innovation challenges and joint business opportunities is part of Cities 4.0 Work Package 2 “Understanding and translating cities’ challenges and society needs to business opportunities”. Turku Science Park Ltd is responsible for this WP and does cooperation with the University of Turku, Finland Futures Research Centre.

The key stakeholders represent the main sectors identified from the cities’ applications for NetZeroCities (Cities 4.0 deliverable 2.1. These sectors include energy, transport, waste/wastewater, and digitalization/smart city activities. The identified stakeholders may represent also other sectors since the innovation potential and business opportunities are not necessarily limited to the above-mentioned important sectors identified by the cities.

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The questionnaire

The number of identified stakeholders in Cities 4.0 deliverable 2.2. was 38–84 stakeholders per city (Table 1). Therefore, and due to difficulties in identifying a reasonable group of the most important stakeholders, the interviews were replaced by a web-based questionnaire targeted to the stakeholders identified in Cities 4.0 deliverable 2.2

Table 1. The number of identified stakeholders in the cities and the distribution of the questionnaire (Cities 4.0 deliverable 2.2; Question 1).

Sector	Number of identified stakeholders				
	Bologna	Eindhoven and Helmond	Leuven	Turku	Total
Energy	5	9	8	5	27
Transport	1	5	3	9	18
Waste/wastewater	2	3	1	6	12
Digitalization and smart city solutions	9	6	2	29	17/46
Other sectors	67	45	24		136/165
Total	84	68	38	49	239
Distribution of the questionnaire	84	68	38	54	244
Received responses	25	25	13	16	79
Response rate (%)	29.8	36.8	34.2	29.6	32.4

The questionnaire's major focus is identifying potential areas of innovations and ideas for business opportunities in the participating cities, and collecting good examples of good practices in climate policies and related innovations. In addition to the questions dealing with the major focus above, the questionnaire includes questions related to the stakeholder organizations and the respondents' roles in their background organization. The questionnaire includes no personal questions. Responses to the questionnaire made between January

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17 and February 8 have been included in the analysis. The questionnaire is available in Annex 1.

Based on the results presented in this deliverable, the cities can identify promising areas and good practices for targeting their policies and measures and possible activities for attracting new businesses in the city. The cities can also learn from each other based on their specific responses to the questionnaire. However, it can be expected that the questionnaire does not reveal information on the stakeholders' current business plans and related innovations (including technological, social, and systemic innovations), and this is the reason why the focus is on the perceptions of business opportunities and innovation potential related to activities in specific sectors of the economy.

From the distribution of 244 identified stakeholders, 79 responses were received, so the overall response rate was 32.4 %. At the city level, the response rate varied between 29.6% (Turku) and 36.8% (Eindhoven and Helmond; Table 1) The coverage of different stakeholder groups are presented in Table 2.

Table 2. The number of responses to the questionnaire from different stakeholder groups (Question 2).

Stakeholder group	Number of responses				
	Bologna	Eindhoven and Helmond	Leuven	Turku	Total
City administration	1		3	1	5
Public company		5	2	6	13
Other public organization	1	5	1	3	10
Private company	4	7	3	2	16
NGO	4	2	2		8
Academia	2	1		4	7
Student	1				1
Politician	1		1		2
Citizen/inhabitant	8	5	1		14
Other	3				3
Total	25	25	13	16	79

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The respondents and sustainability

Questions 3–9 in the questionnaire mapped the respondent's relationship with sustainability at a general level. The results are presented in Figures 1–7.

Figure 1 shows how important sustainability was for the respondents (Question 3). They were asked to give a value on a scale of 1–10. The results are coded as follows: responses 10 and 9 are sustainability promoters, 5–8 are passive regarding sustainability, and 0–4 are sustainability detractors. As expected, a vast majority of respondents in all cities were sustainability promoters. The share of sustainability promoters varies between 76% (Bologna) to 92% (Eindhoven and Helmond).

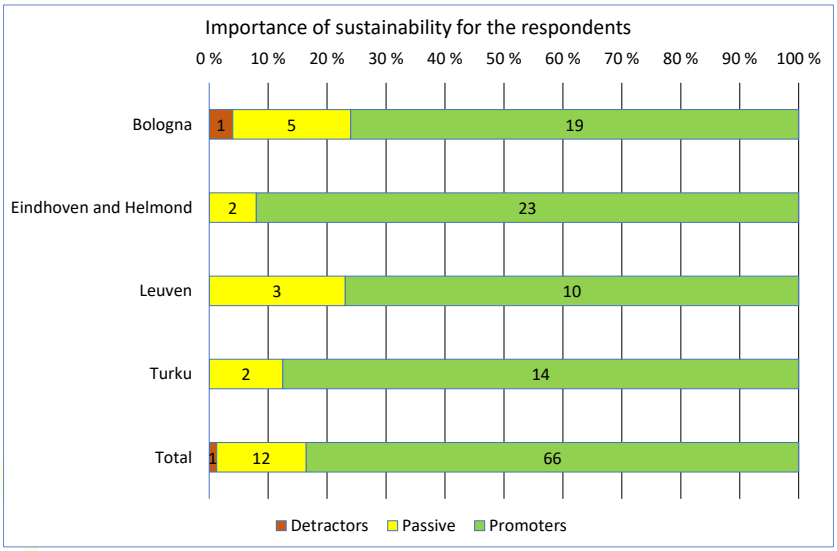

Figure 1. Answers to Question 3: How important is sustainability for you?

Figures 2 and 3 show that almost all respondents took sustainability actions in their work or daily life and had plans to continue also in the future.

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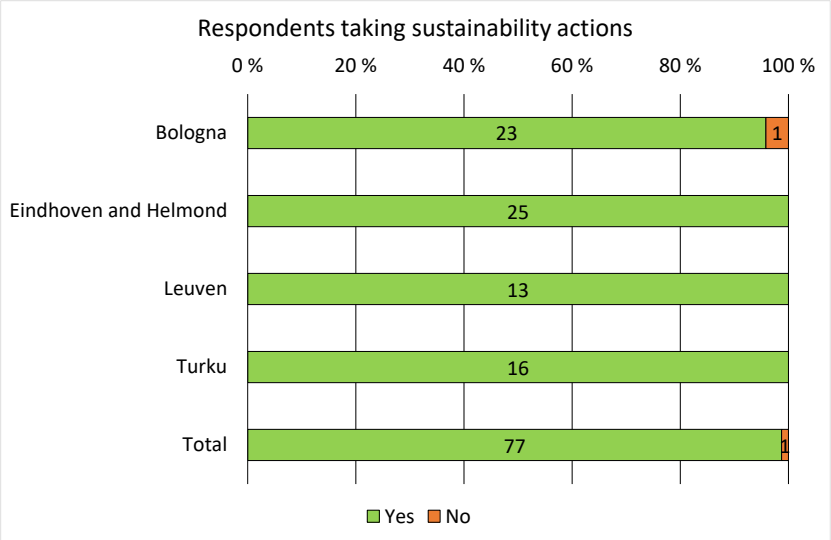

Figure 2. Answers to Question 4: Do you take action to make your daily life/business more sustainable?

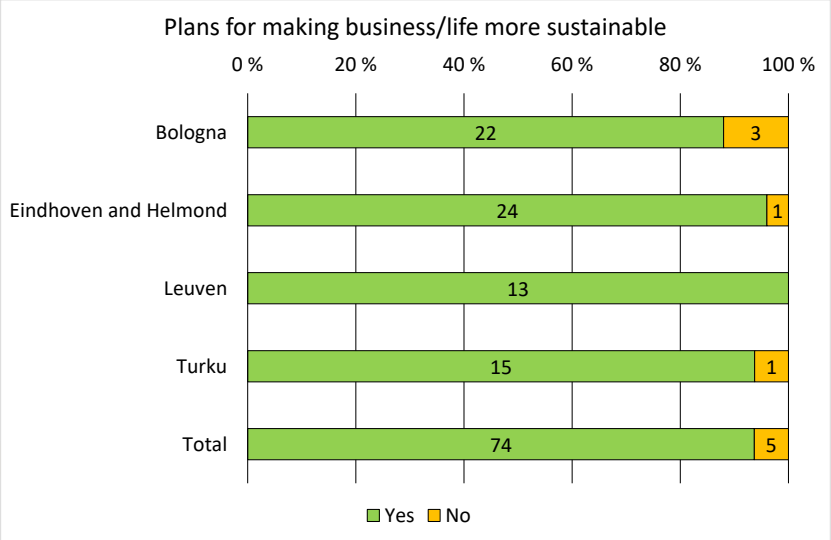

Figure 3. Answers to Question 5: Do you have plans to make your daily life/business more sustainable?

The reasons why the respondents were taking sustainability actions varied a lot, but the most common reason was personal ones in all cities (Figure 4). The least

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important reason was time-saving in all cities. For some reason, making the company's attractiveness to employees was much less important in Bologna than in other cities. It can be partly due to the largest share of the stakeholder group "citizen/inhabitant" in Bologna (cf. Table 2 above).

Figure 4. Answers to Question 6: Why do you take sustainability actions?

The most important needs for taking sustainability actions were "knowledge and expertise", "cooperation with other stakeholders", and "time" (Figure 5). The same holds also for the individual cities; only Leuven was a slight exception because there "easier access to finance" was more important than "time". The relatively low importance of financial resources can be considered as a small surprise.

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Figure 5. Answers to Question 7: What do you need to take more sustainability actions?

Question 8 on offering solutions for sustainability-related more to the respondents' work than their daily life. A vast majority of respondents in all cities answered that they do offer sustainability solutions, but their relative amount was much lower in Bologna than in the other cities (Figure 6).

The sectors where the respondents offered sustainability solutions are shown in Figure 7. In addition to the given sectors, "other" was often chosen, especially by respondents from Bologna where the stakeholder group "citizen/inhabitant" was largely represented (cf. Table 2) and Leuven. The given specifications varied a lot. Examples include environment, food, education, media/information, culture, and arts.

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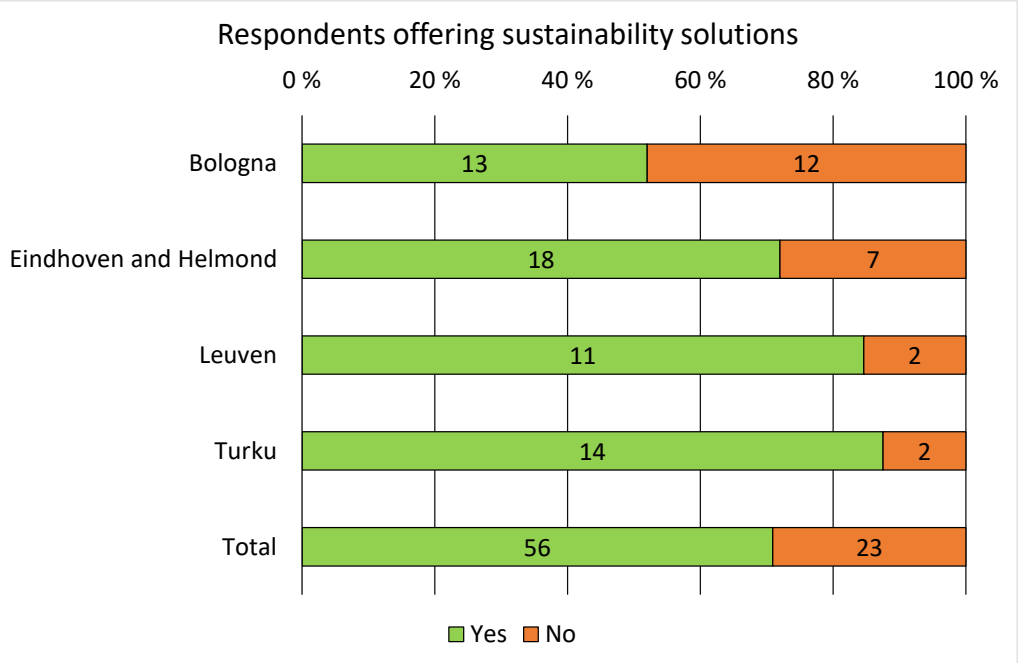

Figure 6. Answers to Question 8: Do you offer solutions for sustainability?

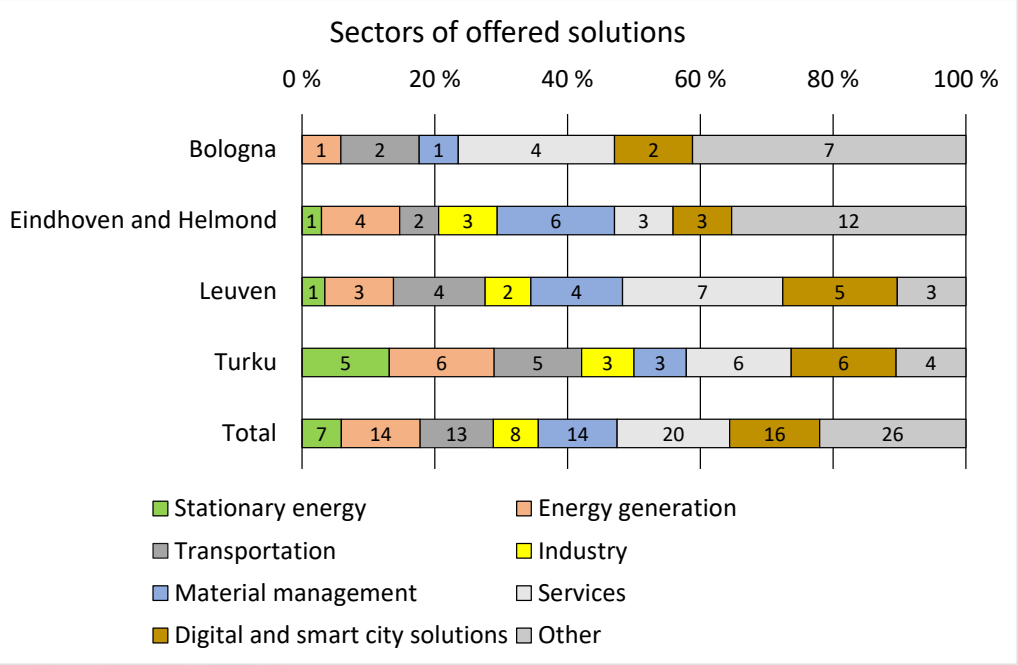

Figure 7. Answers to Question 9: In which sector(s) do you offer sustainability solutions?

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Business opportunities and innovation potential of sectoral activities

In Questions 10–14, the respondents were asked to evaluate the importance of sectoral activities by using a given set of criteria. The included sectors were the following:

- stationary energy (Question 10, 13 activities)
- energy generation (Question 11, 19 activities)
- transport (Question 12, 15 activities)
- material management (Question 13, 12 activities)
- digitalization and smart city solutions (Question 14, 10 activities)

Sectors such as agriculture, industry, and services were excluded because the possibilities of cities and city administration to influence these sectors are limited in most cities.

In addition to the criteria mentioned in the title of this deliverable (innovation challenges and joint business opportunities), the Cities 4.0 consortium considered also additional criteria for the evaluation of sectoral activities. The criteria included in the questionnaire were the same for all sectors, and they included:

- importance in climate change mitigation
- business opportunities
- possibilities for cooperation between stakeholders
- innovation potential
- attractiveness of the city.

In the sectoral Questions 10–14, the respondents were asked to select the five most important activities against the five criteria listed above. In the following,

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the results are presented in separate tables for each sector and each city (Bologna, Eindhoven and Helmond), Leuven, and Turku) as well as for all the cities together – so the following sectoral chapters include five tables each and 25 tables altogether (Tables 3–7 for stationary energy, Tables 8–12 for energy generation, Tables 13–17 for transport, Tables 18–22 for material management, and Tables 23–27 for digitalization and smart city solutions).

The columns in Tables 3–27 include all the individual evaluation criteria above. In addition to this, the tables include two aggregated criteria, (1) business opportunities and innovation potential together, and (2) all five criteria together. From the data presented in the tables, it is easy to generate additional aggregates by calculating an arithmetic mean value of the selected criteria.

The individual numbers in each table can be interpreted as “selections per respondent” because at the city level, the value has been calculated by dividing the category-specific sum of selections of activity by the number of respondents from that city. The higher the value for a sectoral activity, the more respondents selected it in their answers. A theoretical maximum value is therefore = 1 at all levels of the results.

An alternative is to multiply the value of an activity by 100 and interpret it as the percentage of respondents chose that activity. If the value of an activity is e.g. 0.35, the interpretation can be that 35 % of the respondents have chosen that activity.

The three highest values under each criterion are marked in green. If a top-3 value is shared by two or more activities, all those values have been marked in green as well. Moreover, the activities with a top-3 value in both aggregated criteria (“business opportunities and innovation potential” and “all criteria”) are written in bold. Identification of the important activities in the analysed sectors is the most important result from Questions 10–14.

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When making any conclusions one cannot forget that the number of respondents was rather limited in each city, and the coverage of different stakeholder groups varied between cities (Table 2 above).

Stationary energy

In Question 10, the respondents were asked to choose the most important activities from the listed 13 activities in the sector of stationary energy. Up to five (5) activities could be selected against each criterion (importance in climate change mitigation, business opportunities, stakeholder cooperation opportunities, innovation potential, and attractiveness of the city). Table 3 shows the results for Bologna, Table 4 for Eindhoven and Helmond, Table 5 for Leuven, Table 6 for Turku, and Table 7 for all cities together.

Table 3 shows that “energy renovation of existing buildings is the most important activity of stationary energy in Bologna. Both aggregated values are the highest ones, and this activity is among the top-3 with all criteria. Also “solar roofs” has top-3 value in both aggregated criteria and has an extremely high value in importance in climate change mitigation. Other important activities in Bologna are “energy positive buildings” and “behavioural changes” in the sector of stationary energy.

In Eindhoven and Helmond, the activities of “energy positive buildings”, “smart buildings”, and “behavioural changes”, had a top-3 value in both aggregated criteria (Table 4).

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Table 3. Answers to Question 11 on the importance of activities in the sector of stationary energy, Bologna (N=25).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Energy renovation of existing buildings	0.84	**0.48**	0.40	0.36	0.44	**0.42**	**0.50**
Energy positive buildings	0.36	0.32	0.16	0.36	0.28	0.34	0.30
Zero energy buildings	0.56	0.24	0.12	0.36	0.24	0.30	0.30
Smart buildings	0.44	0.28	0.12	0.32	0.36	0.30	0.30
Heat recovery - ventilation	0.40	0.04	0.08	0.20	0.12	0.12	0.17
Heat recovery - wastewater	0.28	0.20	0.08	0.16	0.04	0.18	0.15
Solar roofs	**0.88**	0.44	0.24	0.28	0.36	0.36	0.44
Insulation	0.36	0.32	0.08	0.12	0.08	0.22	0.19
Street lighting	0.32	0.12	0.16	0.16	0.40	0.14	0.23
Education and information	0.56	0.24	0.48	0.40	**0.48**	0.32	0.43
Demand side management	0.16	0.24	0.28	0.16	0.20	0.20	0.21
Behavioural changes	0.60	0.20	**0.52**	**0.44**	0.44	0.32	0.44
Other (please specify)	0.04	0.00	0.04	0.04	0.04	0.02	0.03
Average	0.45	0.24	0.21	0.26	0.27	0.25	0.28

Table 4. Answers to Question 11 on the importance of activities in the sector of energy generation, Eindhoven and Helmond (N=25).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Energy renovation of existing buildings	0.72	0.36	0.24	0.20	0.32	0.28	0.37
Energy positive buildings	0.48	**0.48**	0.20	**0.52**	**0.40**	**0.50**	0.42
Zero energy buildings	0.60	0.32	0.16	0.32	0.28	0.32	0.34
Smart buildings	0.36	0.44	0.28	0.48	0.36	0.46	0.38
Heat recovery - ventilation	0.40	0.12	0.04	0.16	0.12	0.14	0.17
Heat recovery - wastewater	0.40	0.08	0.04	0.20	0.16	0.14	0.18
Solar roofs	0.56	0.24	0.04	0.16	0.16	0.20	0.23
Insulation	0.68	0.28	0.08	0.16	0.08	0.22	0.26
Street lighting	0.20	0.08	0.00	0.16	**0.40**	0.12	0.17
Education and information	0.44	0.08	0.28	0.36	0.20	0.22	0.27
Demand side management	0.24	0.16	0.24	0.24	0.20	0.20	0.22
Behavioural changes	**0.76**	0.24	**0.44**	0.48	0.28	0.36	**0.44**
Other (please specify)	0.08	0.00	0.04	0.00	0.00	0.00	0.02
Average	0.46	0.22	0.16	0.26	0.23	0.24	0.27

In Leuven, two activities received a top-3 value in all criteria and business opportunities and innovation potential (Table 5). These activities are “energy renovation of existing buildings” and “solar roofs”. Top-3 value in one aggregate criterion was received by “energy positive buildings”, “smart buildings” and “behavioural changes”. In Leuven, the highest value in innovation potential, the attractiveness of the city, and the aggregate criterion of business opportunities

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and innovation potential were shared by two activities. In innovation potential, the second highest value was shared by three different activities, and in attractiveness of the city, by two activities.

Table 5. Answers to Question 11 on the importance of activities in the sector of energy generation, Leuven (N=13).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Energy renovation of existing buildings	**0.77**	**0.62**	0.38	0.31	**0.38**	**0.46**	**0.49**
Energy positive buildings	0.38	0.38	0.15	**0.54**	0.15	**0.46**	0.32
Zero energy buildings	0.38	0.31	0.15	0.23	0.23	0.27	0.26
Smart buildings	0.15	0.23	0.08	**0.54**	0.31	0.38	0.26
Heat recovery - ventilation	0.31	0.00	0.08	0.00	0.08	0.00	0.09
Heat recovery - wastewater	0.15	0.08	0.08	0.15	0.00	0.12	0.09
Solar roofs	0.54	0.46	0.46	0.31	0.23	0.38	0.40
Insulation	0.46	0.15	0.08	0.08	0.08	0.12	0.17
Street lighting	0.00	0.08	0.00	0.08	0.31	0.08	0.09
Education and information	0.23	0.00	0.54	0.31	0.23	0.15	0.26
Demand side management	0.31	0.15	0.38	0.15	0.15	0.15	0.23
Behavioural changes	0.31	0.15	**0.62**	0.31	**0.38**	0.23	0.35
Other (please specify)	0.15	0.15	0.15	0.23	0.23	0.19	0.18
Average	0.32	0.21	0.24	0.25	0.21	0.23	0.25

Table 6 shows that in Turku, like in Eindhoven and Helmond, three activities received a top-3 value in both aggregate criteria. the most important activities of stationary energy in Turku are different from the ones in Eindhoven and Helmond, they include “energy renovation of existing buildings”, “smart buildings”, and “education and information”. The third top-3 value in business opportunities was shared by three different activities and in stakeholder cooperation opportunities and attractiveness of the city by two activities (Table 6).

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Table 6. Answers to Question 11 on the importance of activities in the sector of energy generation, Turku (N=16).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Energy renovation of existing buildings	**0.75**	0.56	0.44	0.31	0.44	0.44	**0.50**
Energy positive buildings	0.19	0.38	0.19	0.31	0.38	0.34	0.29
Zero energy buildings	0.25	0.38	0.06	0.19	0.38	0.28	0.25
Smart buildings	0.25	**0.69**	0.38	**0.44**	0.38	**0.56**	0.43
Heat recovery - ventilation	0.31	0.19	0.13	0.13	0.00	0.16	0.15
Heat recovery - wastewater	0.25	0.19	0.25	0.13	0.06	0.16	0.18
Solar roofs	0.38	0.38	0.06	0.25	0.25	0.31	0.26
Insulation	0.19	0.06	0.00	0.06	0.00	0.06	0.06
Street lighting	0.06	0.06	0.06	0.13	**0.50**	0.09	0.16
Education and information	0.44	0.31	**0.63**	**0.44**	0.19	0.38	0.40
Demand side management	0.13	0.13	0.19	0.25	0.00	0.19	0.14
Behavioural changes	**0.75**	0.19	0.38	0.38	0.13	0.28	0.36
Other (please specify)	0.13	0.13	0.13	0.13	0.06	0.13	0.11
Average	0.31	0.28	0.22	0.24	0.21	0.26	0.25

Table 7 shows the results of important activities in stationary energy for all cities together. Two activities reached top-3 values in both aggregate criteria. “Energy renovation of existing buildings” received the highest value in all criteria together, and “smart buildings“ in business opportunities and innovation potential together. The third important activity in all cities together was “behavioural changes” with the highest value (together with “renovation of existing buildings”) in importance in climate change mitigation.

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Table 7. Answers to Question 11 on the importance of activities in the sector of energy generation, all cities (N=79).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Energy renovation of existing buildings	**0.77**	**0.48**	**0.35**	0.29	**0.39**	0.39	**0.46**
Energy positive buildings	0.37	0.39	0.18	**0.43**	0.32	0.41	0.34
Zero energy buildings	0.48	0.30	0.13	0.29	0.28	0.30	0.30
Smart buildings	0.33	**0.41**	0.22	**0.43**	**0.35**	**0.42**	0.35
Heat recovery - ventilation	0.37	0.09	0.08	0.14	0.09	0.11	0.15
Heat recovery - wastewater	0.29	0.14	0.10	0.16	0.08	0.15	0.15
Solar roofs	**0.62**	**0.37**	0.18	0.24	0.25	0.30	0.33
Insulation	0.44	0.23	0.06	0.11	0.06	0.17	0.18
Street lighting	0.18	0.09	0.06	0.14	**0.41**	0.11	0.17
Education and information	0.44	0.16	**0.46**	**0.38**	0.29	0.27	**0.35**
Demand side management	0.20	0.18	0.27	0.20	0.15	0.19	0.20
Behavioural changes	**0.63**	0.20	**0.48**	0.42	0.32	0.31	0.41
Other (please specify)	0.09	0.05	0.08	0.08	0.06	0.06	0.07
Average	0.40	0.24	0.20	0.26	0.23	0.25	0.27

Energy generation

In Question 11, the respondents were asked to choose up to five most important ones from 19 activities in the sector of energy generation against their importance in climate change mitigation, business opportunities, stakeholder cooperation opportunities, innovation potential, and attractiveness of the city. Table 8 shows the results for Bologna, Table 9 for Eindhoven and Helmond, Table 10 for Leuven, Table 11 for Turku, and Table 12 for all cities together.

In Bologna, solar energy was considered very important, because both “solar PV” and “solar thermal” received top-3 values in the aggregated criteria for activities (Table 8). Other important activities with one top-3 value in the aggregated criteria were “energy storage, batteries” and “self-sufficient energy communities”.

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Table 8. Answers to Question 11 on the importance of activities in the sector of energy generation, Bologna (N=25).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Solar PV	**0.88**	0.40	0.36	0.40	0.24	0.40	**0.46**
Solar thermal	0.80	**0.52**	0.24	0.40	0.20	0.46	0.43
Heat pumps (air/water/ground source)	0.48	0.36	0.12	0.28	0.04	0.32	0.26
Geothermal	0.40	0.28	0.08	0.20	0.04	0.24	0.20
Wind energy	0.36	0.16	0.16	0.16	0.16	0.16	0.20
Small/micro hydropower	0.24	0.24	0.12	0.20	0.08	0.22	0.18
Small modular nuclear reactors (SMR)	0.16	0.20	0.12	0.20	0.08	0.20	0.15
Biomass-based CHP	0.20	0.24	0.12	0.16	0.04	0.20	0.15
Biomass-based electricity	0.24	0.28	0.12	0.32	0.04	0.30	0.20
Biomass-based district heating	0.16	0.28	0.08	0.16	0.08	0.22	0.15
Synthetic fuels (P2X technologies)	0.12	0.16	0.12	0.20	0.00	0.18	0.12
Hydrogen economy	0.44	0.28	0.20	**0.48**	0.12	0.38	0.30
Other renewable energies (please specify)	0.04	0.08	0.08	0.08	0.04	0.08	0.06
Energy storage, batteries	0.40	0.48	0.20	**0.48**	0.12	**0.48**	0.34
Energy storage, thermal	0.20	0.16	0.04	0.28	0.00	0.22	0.14
Self-sufficient energy communities	0.52	0.32	**0.44**	0.44	**0.48**	0.38	0.44
Education and information	0.36	0.08	0.40	0.36	0.24	0.22	0.29
Behavioural changes	0.36	0.16	**0.44**	0.24	0.36	0.20	0.31
Other (please specify	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average	0.33	0.25	0.18	0.27	0.12	0.26	0.23

In Eindhoven and Helmond, two activities in energy generation received top-3 values in the two aggregated criteria: “solar PV” and “energy storage, batteries” (Table 9). One top-3 value in the aggregated criteria was received by four activities: “hydrogen economy”, “energy storage, thermal”, “self-sufficient energy communities”, and “education and information”.

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Table 9. Answers to Question 11 on the importance of activities in the sector of energy generation, Eindhoven and Helmond (N=24).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Solar PV	**0.67**	0.29	**0.29**	0.21	0.33	0.25	**0.36**
Solar thermal	0.46	0.17	0.21	0.17	0.13	0.17	0.23
Heat pumps (air/water/ground source)	0.54	0.25	0.13	0.21	0.17	0.23	0.26
Geothermal	0.42	0.13	0.08	0.08	0.08	0.10	0.16
Wind energy	0.38	0.08	0.08	0.25	0.21	0.17	0.20
Small/micro hydropower	0.17	0.17	0.04	0.17	0.08	0.17	0.13
Small modular nuclear reactors (SMR)	0.08	0.08	0.00	0.08	0.00	0.08	0.05
Biomass-based CHP	0.13	0.04	0.08	0.08	0.04	0.06	0.08
Biomass-based electricity	0.08	0.04	0.08	0.08	0.04	0.06	0.07
Biomass-based district heating	0.13	0.04	0.13	0.08	0.04	0.06	0.08
Synthetic fuels (P2X technologies)	0.13	0.04	0.00	0.13	0.00	0.08	0.06
Hydrogen economy	0.17	0.17	0.21	0.33	0.08	0.25	0.19
Other renewable energies (please specify	0.08	0.04	0.04	0.04	0.04	0.04	0.05
Energy storage, batteries	0.58	**0.42**	0.13	**0.42**	0.13	**0.42**	0.33
Energy storage, thermal	0.42	0.38	0.13	0.33	0.08	0.35	0.27
Self-sufficient energy communities	0.58	0.17	0.21	0.29	**0.42**	0.23	0.33
Education and information	0.38	0.21	**0.29**	0.29	0.25	0.25	0.28
Behavioural changes	0.50	0.17	**0.29**	0.21	0.25	0.19	0.28
Other (please specify	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average	0.31	0.15	0.13	0.18	0.13	0.17	0.18

Table 10 shows that in Leuven, none of the activities received a top-3 value in both all criteria and business opportunities and innovation potential together. However, one top-3 value was received by six activities: “geothermal energy”, “small/micro hydropower”, “small modular nuclear reactors (SMRs)”, “hydrogen economy”, self-sufficient energy communities”, and “behavioural changes”. The last one is quite challenging to interpret in the context of energy generation. High values for hydropower and nuclear are surprising, but due to the high innovation potential seen by the respondents in Leuven.

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Table 10. Answers to Question 11 on the importance of activities in the sector of energy generation, Leuven (N=12).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Solar PV	0.42	**0.33**	0.25	0.08	0.17	0.21	0.25
Solar thermal	0.42	0.17	0.08	0.08	0.17	0.13	0.18
Heat pumps (air/water/ground source)	**0.58**	0.25	0.08	0.08	0.00	0.17	0.20
Geothermal	0.50	0.25	0.25	0.25	0.17	0.25	**0.28**
Wind energy	**0.58**	**0.33**	0.17	0.08	0.00	0.21	0.23
Small/micro hydropower	0.17	0.17	0.17	**0.42**	0.08	0.29	0.20
Small modular nuclear reactors (SMR)	0.33	0.25	0.08	**0.42**	0.00	**0.33**	0.22
Biomass-based CHP	0.08	0.08	0.00	0.00	0.00	0.04	0.03
Biomass-based electricity	0.08	0.08	0.00	0.00	0.00	0.04	0.03
Biomass-based district heating	0.08	0.08	0.08	0.00	0.00	0.04	0.05
Synthetic fuels (P2X technologies)	0.08	0.17	0.00	0.17	0.00	0.17	0.08
Hydrogen economy	0.25	0.17	0.08	**0.42**	0.08	0.29	0.20
Other renewable energies (please specity	0.08	0.00	0.00	0.00	0.00	0.00	0.02
Energy storage, batteries	0.25	0.17	0.17	0.33	0.08	0.25	0.20
Energy storage, thermal	0.33	0.00	0.17	0.17	0.08	0.08	0.15
Self-sufficient energy communities	0.17	0.25	0.42	0.17	0.33	0.21	0.27
Education and information	0.25	0.00	**0.50**	0.17	0.33	0.08	0.25
Behavioural changes	0.33	0.08	0.42	0.17	**0.42**	0.13	**0.28**
Other (please specify	0.08	0.17	0.08	0.08	0.08	0.13	0.10
Average	0.27	0.16	0.16	0.16	0.11	0.16	0.17

In Turku, two activities in energy generation gained a top-3 value in both aggregated criteria: “synthetic fuels (P2X technologies” and “hydrogen economy” (Table 11). These two can have a connection, which may partly explain the result. “Wind energy” had a top-3 value in the aggregate of all five criteria, and “energy storage, batteries” had a top-3 value in the aggregate criterion of business opportunities and innovation potential together.

Table 12 shows the results regarding the importance of activities of energy generation in all cities together. Two activities, “solar PV” and “energy storage, batteries” had a top-3 value in both aggregated criteria. In addition to these, “hydrogen economy” and “self-sufficient energy communities” had a top-3 value in business opportunities and all criteria together, respectively.

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Table 11. Answers to Question 11 on the importance of activities in the sector of energy generation, Turku (N=15)

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Solar PV	0.47	0.33	**0.33**	0.07	0.27	0.20	0.29
Solar thermal	0.20	0.33	0.13	0.13	0.13	0.23	0.19
Heat pumps (air/water/ground source)	0.27	0.33	0.27	0.13	0.13	0.23	0.23
Geothermal	0.27	0.27	0.00	0.13	0.20	0.20	0.17
Wind energy	**0.60**	0.33	**0.33**	0.13	0.13	0.23	0.31
Small/micro hydropower	0.07	0.27	0.20	0.20	0.00	0.23	0.15
Small modular nuclear reactors (SMR)	0.07	0.20	0.13	0.13	0.00	0.17	0.11
Biomass-based CHP	0.07	0.07	0.13	0.13	0.07	0.10	0.09
Biomass-based electricity	0.07	0.00	0.07	0.00	0.07	0.00	0.04
Biomass-based district heating	0.07	0.07	0.07	0.13	0.13	0.10	0.09
Synthetic fuels (P2X technologies)	0.27	**0.60**	0.27	**0.40**	0.07	**0.50**	0.32
Hydrogen economy	0.47	0.40	0.27	**0.40**	0.13	0.40	**0.33**
Other renewable energies (please specity	0.07	0.00	0.00	0.00	0.00	0.00	0.01
Energy storage, batteries	0.20	0.40	0.27	0.33	0.07	0.37	0.25
Energy storage, thermal	0.20	0.27	0.20	0.27	0.00	0.27	0.19
Self-sufficient energy communities	0.07	0.00	0.13	0.13	**0.33**	0.07	0.13
Education and information	0.40	0.00	**0.33**	0.20	0.27	0.10	0.24
Behavioural changes	0.40	0.07	**0.33**	0.27	0.27	0.17	0.27
Other (please specify	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average	0.22	0.21	0.18	0.17	0.12	0.19	0.18

Table 12. Answers to Question 11 on the importance of activities in the sector of energy generation, all cities (N=76).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Solar PV	**0.66**	**0.34**	**0.32**	0.22	**0.26**	0.28	**0.36**
Solar thermal	**0.51**	**0.32**	0.18	0.22	0.16	0.27	0.28
Heat pumps (air/water/ground source)	**0.47**	0.30	0.14	0.20	0.09	0.25	0.24
Geothermal	0.39	0.22	0.09	0.16	0.11	0.19	0.19
Wind energy	0.45	0.20	0.17	0.17	0.14	0.18	0.23
Small/micro hydropower	0.17	0.21	0.12	0.22	0.07	0.22	0.16
Small modular nuclear reactors (SMR)	0.14	0.17	0.08	0.18	0.03	0.18	0.12
Biomass-based CHP	0.13	0.12	0.09	0.11	0.04	0.11	0.10
Biomass-based electricity	0.13	0.12	0.08	0.13	0.04	0.13	0.10
Biomass-based district heating	0.12	0.13	0.09	0.11	0.07	0.12	0.10
Synthetic fuels (P2X technologies)	0.14	0.21	0.09	0.21	0.01	0.21	0.13
Hydrogen economy	0.33	0.25	0.20	**0.41**	0.11	0.33	0.26
Other renewable energies (please specity	0.07	0.04	0.04	0.04	0.03	0.04	0.04
Energy storage, batteries	0.39	**0.39**	0.18	**0.41**	0.11	**0.40**	**0.30**
Energy storage, thermal	0.29	0.22	0.12	0.28	0.04	0.25	0.19
Self-sufficient energy communities	0.39	0.20	0.30	**0.29**	**0.41**	0.24	**0.32**
Education and information	0.36	0.09	**0.37**	0.28	**0.26**	0.18	0.27
Behavioural changes	0.41	0.13	**0.37**	0.22	**0.32**	0.18	0.29
Other (please specify	0.01	0.03	0.01	0.01	0.01	0.02	0.02
Average	0.29	0.19	0.16	0.20	0.12	0.20	0.19

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Transportation

In Question 12, the respondents were asked to choose up to 5 most important ones from 15 activities in the sector of transport against their importance in climate change mitigation, business opportunities, stakeholder cooperation opportunities, innovation potential, and attractiveness of the city. Table 13 shows the results for Bologna, Table 14 for Eindhoven and Helmond, Table 15 for Leuven, Table 16 for Turku, and Table 17 for all cities together.

In Bologna, “electric vehicles, person transport” received the highest value in both aggregated criteria. Another activity with top-3 values in both aggregated criteria was “improved logistics (less transportation needs” (Table 13). Three activities received one top-3 value, these included “electric vehicles, freight transport”, “vehicle battery loading points”, and “behavioural changes”.

In Eindhoven and Helmond, “mobility as a service (MAAS)” and “behavioural changes” received a top-3 value in both aggregated criteria (Table 14). Other important activities in transport included “integration between transport modes”, ”shared use of vehicles, and “education and information”.

Table 13. Answers to Question 12 on the importance of activities in the transport sector, Bologna (N=24).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Mobility as a service (MAAS)	0.38	0.29	0.29	0.21	0.46	0.25	0.33
Electric vehicles, person transport	**0.75**	**0.50**	0.25	**0.50**	**0.58**	**0.50**	**0.52**
Electric vehiclres, freight transport	0.42	0.42	0.17	0.42	0.33	0.42	0.35
Vehicle battery loading points	0.38	0.46	0.21	0.33	0.33	0.40	0.34
Accessibility of public transport	0.33	0.25	0.38	0.33	0.42	0.29	0.34
Modal shift	0.21	0.13	0.21	0.17	0.21	0.15	0.18
Integration between transport modes	0.42	0.33	0.29	0.25	0.25	0.29	0.31
Shared use of vehicles	0.42	0.25	0.33	0.33	0.33	0.29	0.33
Improved logistics (less transportation needs)	0.46	0.42	0.25	0.38	0.29	0.40	0.36
Road/street user fees	0.13	0.25	0.08	0.04	0.04	0.15	0.11
Driving ban/period zones	0.29	0.08	0.17	0.13	0.13	0.10	0.16
Autonomous driving	0.08	0.17	0.08	0.25	0.08	0.21	0.13
Education and information	0.46	0.21	0.38	0.38	0.25	0.29	0.33
Behavioural changes	0.46	0.21	**0.50**	0.29	0.42	0.25	0.38
Other (please specify)	0.08	0.04	0.04	0.08	0.08	0.06	0.07
Average	0.35	0.27	0.24	0.27	0.28	0.27	0.28

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Table 14. Answers to Question 12 on the importance of activities in the transport sector, Eindhoven and Helmond (N=23).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Mobility as a service (MAAS)	0.48	**0.26**	0.17	0.26	0.26	0.26	0.29
Electric vehicles, person transport	0.39	0.13	0.00	0.09	0.17	0.11	0.16
Electric vehiclres, freight transport	0.43	0.13	0.09	0.13	0.22	0.13	0.20
Vehicle battery loading points	0.26	0.17	0.09	0.13	0.26	0.15	0.18
Accessibility of public transport	0.52	0.13	0.09	0.13	**0.52**	0.13	0.28
Modal shift	0.26	0.17	0.09	0.13	0.17	0.15	0.17
Integration between transport modes	0.17	**0.26**	0.26	**0.30**	0.17	**0.28**	0.23
Shared use of vehicles	0.43	0.13	0.22	**0.30**	0.39	0.22	0.30
Improved logistics (less transportation needs)	0.30	0.22	**0.30**	0.22	0.22	0.22	0.25
Road/street user fees	0.17	0.04	0.00	0.09	0.09	0.07	0.08
Driving ban/period zones	0.17	0.00	0.00	0.00	0.35	0.00	0.10
Autonomous driving	0.04	0.17	0.00	0.22	0.17	0.20	0.12
Education and information	0.26	**0.26**	0.13	0.22	0.22	0.24	0.22
Behavioural changes	**0.70**	0.17	0.22	**0.30**	0.30	0.24	**0.34**
Other (please specify)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average	0.31	0.15	0.11	0.17	0.23	0.16	0.19

Table 15 shows that “mobility as a service (MAAS)” was the only transport activity with a top-3 value in both aggregated criteria. In general, transportation activities received relatively low values in Leuven. However, “accessibility of public transport”, “improved logistics (less transportation needs”, “autonomous driving”, and behavioural changes” received a top-3 value in either business opportunities and innovation potential together or in all criteria together. Leuven was the only city where “autonomous driving” had a high value among the activities in the transport sector.

In the city of Turku, “mobility as a service (MAAS)” was considered by the respondents as the most important activity in both aggregated criteria as well as three individual criteria (Table 16). Another activity with a top-3 value in both aggregated criteria was “improved logistics (less transportation needs)”. Other important transportation activities in Turku included “electric vehicles, freight transport” and “accessibility of public transport”.

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Table 15. Answers to Question 12 on the importance of activities in the transport sector, Leuven (N=12).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Mobility as a service (MAAS)	0.33	**0.42**	0.58	0.50	0.50	0.46	**0.47**
Electric vehicles, person transport	0.25	0.25	0.17	0.25	0.25	0.25	0.23
Electric vehiclres, freight transport	0.25	0.33	0.00	0.17	0.17	0.25	0.18
Vehicle battery loading points	0.33	0.33	0.25	0.17	0.17	0.25	0.25
Accessibility of public transport	0.50	0.17	0.50	0.25	**0.67**	0.21	0.42
Modal shift	**0.67**	0.08	0.42	0.17	0.25	0.13	0.32
Integration between transport modes	0.17	0.17	0.33	0.17	0.33	0.17	0.23
Shared use of vehicles	0.17	0.25	0.50	0.17	0.42	0.21	0.30
Improved logistics (less transportation needs)	0.25	**0.42**	0.33	0.33	0.33	0.38	0.33
Road/street user fees	0.08	0.17	0.25	0.17	0.25	0.17	0.18
Driving ban/period zones	0.17	0.08	0.17	0.08	0.25	0.08	0.15
Autonomous driving	0.08	**0.42**	0.08	**0.58**	0.08	**0.50**	0.25
Education and information	0.25	0.00	0.58	0.17	0.25	0.08	0.25
Behavioural changes	0.42	0.17	**0.67**	0.25	0.58	0.21	0.42
Other (please specify)	0.08	0.08	0.00	0.08	0.00	0.08	0.05
Average	0.27	0.22	0.32	0.23	0.30	0.23	0.27

Table 16. Answers to Question 12 on the importance of activities in the transport sector, Turku (N=16).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Mobility as a service (MAAS)	0.38	**0.75**	**0.56**	**0.50**	0.50	**0.63**	**0.54**
Electric vehicles, person transport	0.31	0.25	0.13	0.19	0.19	0.22	0.21
Electric vehiclres, freight transport	0.38	0.38	0.06	0.25	0.00	0.31	0.21
Vehicle battery loading points	0.13	0.25	0.19	0.06	0.31	0.16	0.19
Accessibility of public transport	0.44	0.00	0.31	0.13	**0.69**	0.06	0.31
Modal shift	0.19	0.06	0.19	0.00	0.06	0.03	0.10
Integration between transport modes	0.13	0.38	0.50	0.19	0.31	0.28	0.30
Shared use of vehicles	0.19	0.31	0.19	0.19	0.31	0.25	0.24
Improved logistics (less transportation needs)	0.44	0.38	0.50	0.31	0.25	0.34	0.38
Road/street user fees	0.00	0.06	0.00	0.00	0.00	0.03	0.01
Driving ban/period zones	0.06	0.00	0.06	0.00	0.19	0.00	0.06
Autonomous driving	0.00	0.19	0.13	0.31	0.00	0.25	0.13
Education and information	0.50	0.06	0.38	0.19	0.13	0.13	0.25
Behavioural changes	**0.63**	0.00	0.19	0.19	0.31	0.09	0.26
Other (please specify)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average	0.25	0.20	0.23	0.17	0.22	0.19	0.21

Table 17 presents the results of transport for all the cities together. Two activities received a top-3 value in both aggregated criteria: “mobility as a service (MAAS)” and “improved logistics (less transportation needs)”. “Mobility as a service (MAAS)” received the highest value in all individual and aggregated criteria except “importance in climate change mitigation”. Other important activities are

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”electric vehicles, person transport”, “electric vehicles, freight transport”, “accessibility of public transport”, and “behavioural changes”.

Table 17. Answers to Question 12 on the importance of activities in the transport sector, all cities (N=75).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Mobility as a service (MAAS)	0.40	**0.40**	**0.36**	**0.33**	**0.41**	**0.37**	**0.38**
Electric vehicles, person transport	0.47	0.29	0.13	0.27	0.32	0.28	0.30
Electric vehiclres, freight transport	0.39	**0.31**	0.09	0.25	0.20	0.28	0.25
Vehicle battery loading points	0.28	**0.31**	0.17	0.19	0.28	0.25	0.25
Accessibility of public transport	0.44	0.15	0.29	0.21	**0.55**	0.18	**0.33**
Modal shift	0.29	0.12	0.20	0.12	0.17	0.12	0.18
Integration between transport modes	0.24	0.29	**0.33**	0.24	0.25	0.27	0.27
Shared use of vehicles	0.33	0.23	0.29	0.27	0.36	0.25	0.30
Improved logistics (less transportation needs	0.37	**0.35**	**0.33**	**0.31**	0.27	0.33	**0.33**
Road/street user fees	0.11	0.13	0.07	0.07	0.08	0.10	0.09
Driving ban/period zones	0.19	0.04	0.09	0.05	0.23	0.05	0.12
Autonomous driving	0.05	0.21	0.07	**0.31**	0.09	0.26	0.15
Education and information	0.37	0.16	0.33	0.25	0.21	0.21	0.27
Behavioural changes	**0.56**	0.15	**0.37**	0.27	**0.39**	0.21	**0.35**
Other (please specify)	0.04	0.03	0.01	0.04	0.03	0.03	0.03
Average	0.30	0.21	0.21	0.21	0.26	0.21	0.24

Material management

In Question 13, the respondents were asked to choose up to five most important ones from 12 activities in the sector of material management against their importance in climate change mitigation, business opportunities, stakeholder cooperation opportunities, innovation potential, and attractiveness of the city. The activities of material management include mostly ones related to waste management and circular economy business models. Table 18 shows the results for Bologna, Table 19 for Eindhoven and Helmond, Table 20 for Leuven, Table 21 for Turku, and Table 22 for all cities together.

In all cities, the activities of material management relating to circular economy business models received both top-3 values in the two aggregated criteria

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(Tables 18, 19, 20, 21, and 22). Also “industrial symbiosis between companies” was among the three most important activities in all cities except Leuven.

In Bologna, other important activities included also “municipal waste prevention” (Table 18). In Eindhoven and Helmond, other important activities included “municipal waste prevention” and “platform for exchange of production side streams”. In Leuven, “platform for exchange of production side streams” received top-3 values in both aggregated criteria, in addition to the two “circular economy business models” (Table 20). In Turku, it was also among the three most important material management activities (Table 21). In all cities together, both “circular economy business models”, “municipal waste prevention”, and “platform for exchange of production side streams” were the most important activities of material management (Table 22).

Table 18. Answers to Question 13 on the importance of activities in the sector of material management, Bologna (N=24).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Municipal waste prevention	0.54	0.38	0.38	0.33	0.29	0.35	0.38
Waste collection, separation, and sorting	**0.58**	0.38	0.33	0.21	0.25	0.29	0.35
Platform for exchange of production side streams	0.25	0.33	0.33	0.21	0.13	0.27	0.25
Industrial symbiosis between companies	0.08	0.54	0.17	0.38	0.08	0.46	0.25
Circular economy business models for reuse and/or repairability of products	**0.58**	**0.71**	**0.50**	**0.58**	**0.38**	**0.65**	**0.55**
Circular economy business models for recycling products and materials	0.38	0.58	0.38	0.33	0.29	0.46	0.39
Waste/landfill gas use for energy production	0.33	0.38	0.21	0.33	0.13	0.35	0.28
Waste incineration	0.21	0.29	0.17	0.17	0.08	0.23	0.18
Wastewater reuse	0.50	0.42	0.21	0.42	0.21	0.42	0.35
Education and information	0.42	0.25	0.46	0.38	0.33	0.31	0.37
Behavioural changes	0.42	0.21	0.38	0.29	0.21	0.25	0.30
Other (please specify)	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Average	0.36	0.38	0.30	0.31	0.20	0.34	0.31

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Table 19. Answers to Question 13 on the importance of activities in the sector of material management, Eindhoven and Helmond (N=24).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Municipal waste prevention	0.46	0.21	0.17	0.33	**0.38**	0.27	0.31
Waste collection, separation, and sorting	0.38	0.29	0.25	0.17	0.33	0.23	0.28
Platform for exchange of production side streams	0.38	0.29	0.38	0.33	0.17	0.31	0.31
Industrial symbiosis between companies	0.33	0.38	0.33	0.29	0.08	0.33	0.28
Circular economy business models for reuse and/or repairability of products	**0.71**	0.46	**0.46**	0.38	0.33	0.42	**0.47**
Circular economy business models for recycling products and materials	0.54	**0.50**	**0.46**	**0.46**	0.21	**0.48**	0.43
Waste/landfill gas use for energy production	0.04	0.13	0.08	0.08	0.08	0.10	0.08
Waste incineration	0.08	0.08	0.04	0.08	0.08	0.08	0.08
Wastewater reuse	0.29	0.13	0.04	0.13	0.25	0.13	0.17
Education and information	0.38	0.17	0.17	0.17	0.29	0.17	0.23
Behavioural changes	0.58	0.13	0.21	0.13	0.25	0.13	0.26
Other (please specify)	0.04	0.00	0.00	0.00	0.00	0.00	0.01
Average	0.35	0.23	0.22	0.21	0.20	0.22	0.24

Table 20. Answers to Question 13 on the importance of activities in the sector of material management, Leuven (N=12).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Municipal waste prevention	**0.42**	0.00	0.17	0.00	**0.50**	0.00	0.22
Waste collection, separation, and sorting	**0.42**	0.08	0.25	0.17	0.33	0.13	0.25
Platform for exchange of production side streams	0.25	0.50	**0.50**	0.50	0.17	0.50	0.38
Industrial symbiosis between companies	0.17	0.42	0.42	0.17	0.00	0.29	0.23
Circular economy business models for reuse and/or repairability of products	**0.42**	**0.58**	0.33	**0.58**	0.33	**0.58**	0.45
Circular economy business models for recycling products and materials	**0.42**	0.50	**0.50**	0.50	0.42	0.50	**0.47**
Waste/landfill gas use for energy production	0.17	0.08	0.00	0.08	0.00	0.08	0.07
Waste incineration	0.08	0.00	0.00	0.00	0.00	0.00	0.02
Wastewater reuse	0.25	0.25	0.17	0.25	0.17	0.25	0.22
Education and information	0.17	0.08	0.33	0.17	0.33	0.13	0.22
Behavioural changes	0.17	0.17	0.25	0.17	0.33	0.17	0.22
Other (please specify)	0.08	0.17	0.08	0.08	0.00	0.13	0.08
Average	0.25	0.24	0.25	0.22	0.22	0.23	0.23

Table 21. Answers to Question 13 on the importance of activities in the sector of material management, Turku (N=15).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Municipal waste prevention	**0.60**	0.20	0.20	0.33	**0.60**	0.27	0.39
Waste collection, separation, and sorting	0.47	0.20	0.20	0.47	**0.60**	0.33	0.39
Platform for exchange of production side streams	0.07	0.60	0.33	0.53	0.07	0.57	0.32
Industrial symbiosis between companies	0.27	0.53	**0.73**	0.33	0.27	0.43	0.43
Circular economy business models for reuse and/or repairability of products	0.53	0.53	0.40	0.60	0.13	0.57	0.44
Circular economy business models for recycling products and materials	**0.60**	**0.73**	0.47	**0.67**	0.13	**0.70**	**0.52**
Waste/landfill gas use for energy production	0.33	0.33	0.13	0.07	0.20	0.20	0.21
Waste incineration	0.00	0.00	0.07	0.00	0.07	0.00	0.03
Wastewater reuse	0.13	0.20	0.07	0.20	0.20	0.20	0.16
Education and information	0.33	0.07	0.40	0.20	0.20	0.13	0.24
Behavioural changes	**0.60**	0.07	0.20	0.13	0.33	0.10	0.27
Other (please specify)	0.00	0.00	0.07	0.00	0.00	0.00	0.01
Average	0.33	0.29	0.27	0.29	0.23	0.29	0.28

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Table 22. Answers to Question 13 on the importance of activities in the sector of material management, all cities (N=75).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Municipal waste prevention	0.51	0.23	0.24	0.28	**0.41**	0.25	0.33
Waste collection, separation, and sorting	0.47	0.27	0.27	0.24	0.36	0.25	0.32
Platform for exchange of production side streams	0.25	0.40	0.37	0.36	0.13	0.38	0.30
Industrial symbiosis between companies	0.21	0.47	0.37	0.31	0.11	0.39	0.29
Circular economy business models for reuse and/or repairability of products	**0.59**	**0.57**	**0.44**	**0.52**	0.31	**0.55**	**0.49**
Circular economy business models for recycling products and materials	0.48	**0.57**	**0.44**	0.47	0.25	0.52	0.44
Waste/landfill gas use for energy production	0.21	0.24	0.12	0.16	0.11	0.20	0.17
Waste incineration	0.11	0.12	0.08	0.08	0.07	0.10	0.09
Wastewater reuse	0.32	0.25	0.12	0.25	0.21	0.25	0.23
Education and information	0.35	0.16	0.33	0.24	0.29	0.20	0.27
Behavioural changes	0.47	0.15	0.27	0.19	0.27	0.17	0.27
Other (please specify)	0.04	0.04	0.04	0.03	0.01	0.03	0.03
Average	0.33	0.29	0.26	0.26	0.21	0.27	0.27

Digitalization and smart city solutions

In Question 14, the respondents were asked to choose up to 5 most important ones from 10 activities in the sector of digitalization and smart city solutions against their importance in climate change mitigation, business opportunities, stakeholder cooperation opportunities, innovation potential, and attractiveness of the city. Table 23 shows the results for Bologna, Table 24 for Eindhoven and Helmond, Table 25 for Leuven, Table 26 for Turku, and Table 27 for all cities together.

In all cities, “smart buildings” received the highest value in both aggregated criteria except the second highest value (after “use of open standards” in the aggregate of all criteria) in Eindhoven and Helmond (Tables 23–27). The top-3 value in both aggregated criteria was received also by “education and information” in Bologna (Table 23), by “use of open standards” and “bi-directional electricity distribution network” in Eindhoven and Helmond (Table 24), by ”Internet of things (IoT) technologies” and “distribution platform for shared use” in Turku (Table 26).

Other important activities with one top-3 value in the aggregated criteria included “use of open standards”, “online data management and governance”,

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”Internet of things (IoT) technologies”, and “behavioural changes” in Bologna (Table 23), “online data management and governance” and “digital twins” in Leuven (Table 25).

In all cities together, “use of open standards”, ”Internet of things (IoT technologies”, “distribution platforms for shared use”, and “bi-directional electricity distribution networks” had one top-3 value in the aggregated criteria.

Table 23. Answers to Question 14 on the importance of activities in the sector of digitalization and smart city solution, Bologna (N=24).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Use of open standards	0.13	0.21	0.25	**0.46**	0.13	0.33	0.23
Online data management and governance	0.13	0.29	0.33	0.38	0.29	0.33	0.28
Internet of things (IoT) technologies	0.17	0.33	0.21	0.33	0.08	0.33	0.23
Digital Twins	0.21	0.21	0.25	0.29	0.17	0.25	0.23
Distribution platforms for shared use	0.21	0.25	0.29	0.29	0.17	0.27	0.24
Bi-directional electricity distribution networks	0.46	0.33	0.21	0.33	0.17	0.33	0.30
Smart buildings	**0.58**	**0.50**	0.33	0.42	**0.33**	**0.46**	**0.43**
Education and information	0.38	0.25	0.38	0.42	**0.33**	0.33	0.35
Behavioural changes	0.42	0.21	**0.42**	0.33	**0.33**	0.27	0.34
Other (please specify)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average of activities	0.27	0.26	0.27	0.33	0.20	0.29	0.26

Table 24. Answers to Question 14 on the importance of activities in the sector of digitalization and smart city solution, Eindhoven and Helmond (N=23).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Use of open standards	**0.48**	0.22	**0.39**	0.39	0.13	0.30	**0.32**
Online data management and governance	0.22	0.13	0.13	0.22	0.09	0.17	0.16
Internet of things (IoT) technologies	0.13	**0.26**	0.13	0.26	0.13	0.26	0.18
Digital Twins	0.13	0.13	0.04	0.22	0.09	0.17	0.12
Distribution platforms for shared use	0.22	0.22	**0.39**	0.22	0.22	0.22	0.25
Bi-directional electricity distribution networks	0.39	0.22	0.26	0.39	0.26	0.30	0.30
Smart buildings	0.35	**0.26**	0.13	**0.48**	**0.35**	**0.37**	0.31
Education and information	**0.48**	**0.26**	0.13	0.30	0.22	0.28	0.28
Behavioural changes	**0.48**	0.22	0.13	0.09	0.22	0.15	0.23
Other (please specify)	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Average of activities	0.29	0.20	0.18	0.26	0.17	0.23	0.22

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Table 25. Answers to Question 14 on the importance of activities in the sector of digitalization and smart city solution, Leuven (N=12).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Use of open standards	0.17	0.25	**0.50**	0.50	0.00	0.38	0.28
Online data management and governance	0.08	0.17	0.42	**0.67**	0.17	0.42	0.30
Internet of things (IoT) technologies	0.17	0.25	0.17	0.33	0.08	0.29	0.20
Digital Twins	0.33	0.42	0.17	0.42	0.00	0.42	0.27
Distribution platforms for shared use	0.33	0.33	0.42	0.33	0.33	0.33	0.35
Bi-directional electricity distribution networks	**0.42**	0.42	0.42	0.33	0.17	0.38	0.35
Smart buildings	**0.42**	**0.50**	0.08	0.42	**0.42**	**0.46**	**0.37**
Education and information	0.17	0.08	0.42	0.08	0.25	0.08	0.20
Behavioural changes	0.25	0.17	0.42	0.17	0.33	0.17	0.27
Other (please specify)	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Average of activities	0.24	0.27	0.31	0.33	0.18	0.30	0.27

Table 26. Answers to Question 14 on the importance of activities in the sector of digitalization and smart city solution, Turku (N=16).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Use of open standards	0.13	0.25	0.38	0.19	0.00	0.22	0.19
Online data management and governance	0.19	0.38	0.31	0.25	0.19	0.31	0.26
Internet of things (IoT) technologies	0.25	0.50	**0.44**	**0.63**	0.31	**0.56**	0.43
Digital Twins	0.06	0.25	0.31	0.19	0.00	0.22	0.16
Distribution platforms for shared use	0.19	0.44	0.38	0.38	0.31	0.41	0.34
Bi-directional electricity distribution networks	0.38	0.31	0.19	0.31	0.25	0.31	0.29
Smart buildings	**0.63**	**0.63**	0.25	0.50	**0.50**	**0.56**	**0.50**
Education and information	0.38	0.06	0.31	0.19	0.13	0.13	0.21
Behavioural changes	0.56	0.06	0.19	0.31	0.25	0.19	0.28
Other (please specify)	0.00	0.00	0.00	0.00	0.06	0.00	0.01
Average of activities	0.28	0.29	0.28	0.29	0.20	0.29	0.27

Table 27. Answers to Question 14 on the importance of activities in the sector of digitalization and smart city solution, all cities (N=75).

	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportinities and innovation potential	All criteria
Use of open standards	0.24	0.23	**0.36**	0.39	0.08	0.31	0.26
Online data management and governance	0.16	0.24	0.28	0.35	0.19	0.29	0.24
Internet of things (IoT) technologies	0.17	0.33	0.23	0.37	0.15	0.35	0.25
Digital Twins	0.17	0.23	0.19	0.27	0.08	0.25	0.19
Distribution platforms for shared use	0.23	0.29	**0.36**	0.29	0.24	0.29	0.283
Bi-directional electricity distribution networks	0.41	0.31	0.25	0.35	0.21	0.33	0.31
Smart buildings	**0.49**	**0.45**	0.21	**0.45**	**0.39**	**0.45**	**0.40**
Education and information	0.37	0.19	0.29	0.28	0.24	0.23	0.27
Behavioural changes	0.44	0.17	0.28	0.23	0.28	0.20	0.280
Other (please specify)	0.03	0.03	0.03	0.03	0.04	0.03	0.03
Average of activities	0.27	0.25	0.25	0.30	0.19	0.27	0.25

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Rankings of the most important sectoral activities

Tables 28–34 show the top-10 rankings of all activities in the five sectors using each of the criteria: importance in climate change mitigation (Table 28), business opportunities (Table 29), stakeholder cooperation opportunities (Table 30), innovation potential (Table 31), attractiveness of the city (Table 32), business opportunities and innovation potential together (Table 33), and all five individual criteria together (Table 34). Full ranking tables of all 69 sectoral activities are available in Annex 2.

Based on the ranking presented in Table 28, stationary energy is the most important sector in climate change mitigation, because the most important and in total four activities in the top-10 ranking were from this sector. “Energy renovation of existing buildings” has the highest value of importance, 77 % of all respondents have chosen this activity. Behavioural changes are also considered very important in climate change mitigation, this activity had the 3rd (stationary energy) and 6th (transport) position in the ranking. However, none of the sectors can be neglected in climate change mitigation, because all the included sectors have at least one position in the top-10 ranking.

Table 28. Top-10 sectoral activities regarding their importance in climate change mitigation.

	Sectoral activity	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportunities and innovation potential	All criteria
1	Energy renovation of existing buildings	0.77	0.48	0.35	0.29	0.39	0.39	0.46
2	Solar PV	0.66	0.34	0.32	0.22	0.26	0.28	0.36
3	Behavioural changes (stationary energy)	0.63	0.20	0.48	0.42	0.32	0.31	0.41
4	Solar roofs	0.62	0.37	0.18	0.24	0.25	0.30	0.33
5	Circular economy business models for reuse and/or repairability of products	0.59	0.57	0.44	0.52	0.31	0.55	0.49
6	Behavioural changes (transport)	0.56	0.15	0.37	0.27	0.39	0.21	0.35
7	Solar thermal	0.51	0.32	0.18	0.22	0.16	0.27	0.28
8	Municipal waste prevention	0.51	0.23	0.24	0.28	0.41	0.25	0.33
9	Smart buildings (digitalization and smart city solutions)	0.49	0.45	0.21	0.45	0.39	0.45	0.40
10	Zero energy buildings	0.48	0.30	0.13	0.29	0.28	0.30	0.30

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According to Table 29, material management is the most important sector from the perspective of business opportunities, because three out of the four most important activities come from this sector. Especially activities of the circular economy business models, both reuse & repair of products and recycling of materials, are the most important ones because they have been chosen by 57 % of all respondents. However, all the analysed sectors have at least one activity in the top-10 ranking.

Table 29. Top-10 sectoral activities regarding their importance in business opportunities.

	Sectoral activity	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportunities and innovation potential	All criteria
1	Circular economy business models for reuse and/or repairability of products	0.59	0.57	0.44	0.52	0.31	0.55	0.49
2	Circular economy business models for recycling products and materials	0.48	0.57	0.44	0.47	0.25	0.52	0.44
3	Energy renovation of existing buildings	0.77	0.48	0.35	0.29	0.39	0.39	0.46
4	Industrial symbiosis between companies	0.21	0.47	0.37	0.31	0.11	0.39	0.29
5	Smart buildings (digitalization and smart city solutions)	0.49	0.45	0.21	0.45	0.39	0.45	0.40
6	Smart buildings (stationary energy)	0.33	0.41	0.22	0.43	0.35	0.42	0.35
7	Mobility as a service (MAAS)	0.40	0.40	0.36	0.33	0.41	0.37	0.38
8	Platform for exchange of production side streams	0.25	0.40	0.37	0.36	0.13	0.38	0.30
9	Energy storage, batteries	0.39	0.39	0.18	0.41	0.11	0.40	0.30
10	Energy positive buildings	0.37	0.39	0.18	0.43	0.32	0.41	0.34

Table 30 shows the results of sectoral activity ranking from the perspective of cooperation opportunities between stakeholders. according to the respondents, behavioural changes in three different sectors (stationary energy, transport, and energy generation) have a top-10 position in cooperation opportunities. In this criterion, the balance between the sectors is the most equal: material management has three positions, digitalization and smart city solutions one position, and stationary energy, energy generation, and transport two positions each in the top-10 ranking.

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Table 30. Top-10 sectoral activities regarding their importance in opportunities for cooperation between different stakeholders.

	Sectoral activity	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportunities and innovation potential	All criteria
1	Behavioural changes (stationary energy)	0.63	0.20	0.48	0.42	0.32	0.31	0.41
2	Education and information (stationary energy)	0.44	0.16	0.46	0.38	0.29	0.27	0.35
3	Circular economy business models for reuse and/or repairability of products	0.59	0.57	0.44	0.52	0.31	0.55	0.49
4	Circular economy business models for recycling products and materials	0.48	0.57	0.44	0.47	0.25	0.52	0.44
5	Behavioural changes (transport)	0.56	0.15	0.37	0.27	0.39	0.21	0.35
6	Platform for exchange of production side streams	0.25	0.40	0.37	0.36	0.13	0.38	0.30
7	Industrial symbiosis between companies	0.21	0.47	0.37	0.31	0.11	0.39	0.29
8	Education and information (energy generation)	0.36	0.09	0.37	0.28	0.26	0.18	0.27
9	Behavioural changes (energy generation)	0.41	0.13	0.37	0.22	0.32	0.18	0.29
10	Mobility as a service (MAAS)	0.40	0.40	0.36	0.33	0.41	0.37	0.38

Regarding innovation potential, the circular economy business models (material management) are the most important sectoral activities (Table 31). In this criteria, “smart buildings” is in the top-10 two times, because it was listed as an activity in two different sectors, stationary energy and digitalization and smart city solutions. One could say that when 45% and 43% of respondents have chosen “smart buildings”, it could be the most important sectoral activity. However, many respondents have chosen “smart buildings” in both sectors, so this saying cannot be confirmed. However, “smart buildings” seems to offer a lot of innovation potential. Innovation potential is the only criterion that does not have all sectors represented in the top-10 ranking. Transport activities are missing in the top-10, the highest ranking (15) has “mobility as a service (MAAS)”.

Table 31. Top-10 sectoral activities regarding their importance in innovation potential.

	Sectoral activity	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportunities and innovation potential	All criteria
1	Circular economy business models for reuse and/or repairability of products	0.59	0.57	0.44	0.52	0.31	0.55	0.49
2	Circular economy business models for recycling products and materials	0.48	0.57	0.44	0.47	0.25	0.52	0.44
3	Smart buildings (digitalization and smart city solutions)	0.49	0.45	0.21	0.45	0.39	0.45	0.40
4	Energy positive buildings	0.37	0.39	0.18	0.43	0.32	0.41	0.34
5	Smart buildings (stationary energy)	0.33	0.41	0.22	0.43	0.35	0.42	0.35
6	Behavioural changes (stationary energy)	0.63	0.20	0.48	0.42	0.32	0.31	0.41
7	Hydrogen economy	0.33	0.25	0.20	0.41	0.11	0.33	0.26
8	Energy storage, batteries	0.39	0.39	0.18	0.41	0.11	0.40	0.30
9	Use of open standards	0.24	0.23	0.36	0.39	0.08	0.31	0.26
10	Education and information (stationary energy)	0.44	0.16	0.46	0.38	0.29	0.27	0.35

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Table 32 shows that the transport sector has four activities in the top-10 ranking regarding the attractiveness of the city; positions 1, 2, 7, and 9. All four transport activities target decreasing driving and the number of vehicles in the city. Material management has positions 3 and 10, stationary energy positions 5 and 6, energy generation has position 4, and digitalization and smart city solutions position 8.

Table 32. Top-10 sectoral activities regarding their importance in the attractiveness of the city.

	Sectoral activity	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportunities and innovation potential	All criteria
1	Accessibility of public transport	0.44	0.15	0.29	0.21	0.55	0.18	0.33
2	Mobility as a service (MAAS)	0.40	0.40	0.36	0.33	0.41	0.37	0.38
3	Municipal waaste prevention	0.51	0.23	0.24	0.28	0.41	0.25	0.33
4	Self-sufficient energy communities	0.39	0.20	0.30	0.29	0.41	0.24	0.32
5	Street lighting	0.18	0.09	0.06	0.14	0.41	0.11	0.17
6	Energy renovation of existing buildings	0.77	0.48	0.35	0.29	0.39	0.39	0.46
7	Behavioural changes (transport)	0.56	0.15	0.37	0.27	0.39	0.21	0.35
8	Smart buildings (digitalization and smart city solutions)	0.49	0.45	0.21	0.45	0.39	0.45	0.40
9	Shared use of vehicles	0.33	0.23	0.29	0.27	0.36	0.25	0.30
10	Waste collection, separation, and sorting	0.47	0.27	0.27	0.24	0.36	0.25	0.32

The top-10 ranking of sectoral activities in the aggregated criterion of business opportunities and innovation potential together (Table 33) is very close to the ranking based on business opportunities alone (Table 29). The activities are the same, with only small differences in the ranking position. When compared to the ranking of innovation potential (Table 31), the top-3 is the same but the activities in the lower top-10 positions are different, this can be identified by comparing Table 33 to Table 29.

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Table 33. Top-10 sectoral activities regarding their importance in the aggregated criteria of business opportunities and innovation potential.

	Sectoral activity	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportunities and innovation potential	All criteria
1	Circular economy business models for reuse and/or repairability of products	0.59	0.57	0.44	0.52	0.31	0.55	0.49
2	Circular economy business models for recycling products and materials	0.48	0.57	0.44	0.47	0.25	0.52	0.44
3	Smart buildings (digitalization and smart city solutions)	0.49	0.45	0.21	0.45	0.39	0.45	0.40
4	Smart buildings (stationary energy)	0.33	0.41	0.22	0.43	0.35	0.42	0.35
5	Energy positive buildings	0.37	0.39	0.18	0.43	0.32	0.41	0.34
6	Energy storage, batteries	0.39	0.39	0.18	0.41	0.11	0.40	0.30
7	Industrial symbiosis between companies	0.21	0.47	0.37	0.31	0.11	0.39	0.29
8	Energy renovation of existing buildings	0.77	0.48	0.35	0.29	0.39	0.39	0.46
9	Platform for exchange of production side streams	0.25	0.40	0.37	0.36	0.13	0.38	0.30
10	Mobility as a service (MAAS)	0.40	0.40	0.36	0.33	0.41	0.37	0.38

Finally, Table 34 shows the top-10 ranking of all sectoral activities based on all five individual criteria (importance in climate change mitigation, business opportunities, stakeholder cooperation opportunities, innovation potential, and attractiveness of the city.

Table 34. Top-10 sectoral activities regarding their importance in the aggregated criteria of importance in climate change mitigation, business opportunities, opportunities for cooperation between stakeholders, innovation potential, and attractiveness of the city.

	Sectoral activity	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportunities and innovation potential	All criteria
1	Circular economy business models for reuse and/or repairability of products	0.59	0.57	0.44	0.52	0.31	0.55	0.49
2	Energy renovation of existing buildings	0.77	0.48	0.35	0.29	0.39	0.39	0.46
3	Circular economy business models for recycling products and materials	0.48	0.57	0.44	0.47	0.25	0.52	0.44
4	Behavioural changes (stationary energy)	0.63	0.20	0.48	0.42	0.32	0.31	0.41
5	Smart buildings (digitalization and smart city solutions)	0.49	0.45	0.21	0.45	0.39	0.45	0.40
6	Mobility as a service (MAAS)	0.40	0.40	0.36	0.33	0.41	0.37	0.38
7	Solar PV	0.66	0.34	0.32	0.22	0.26	0.28	0.36
8	Smart buildings (stationary energy)	0.33	0.41	0.22	0.43	0.35	0.42	0.35
9	Education and information (stationary energy)	0.44	0.16	0.46	0.38	0.29	0.27	0.35
10	Behavioural changes (transport)	0.56	0.15	0.37	0.27	0.39	0.21	0.35

Stationary energy has positions 2, 4, 8, and 9, material management has positions 1 and 3, transport has positions 6 and 10, digitalization and smart city solutions has position 5, and energy generation has position 7. Regarding the aggregated criteria, the most important sectoral activity is “circular economy

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business models for reuse and/or repairability of products” chosen by 49% of all respondents. The highest value for this activity is in its importance in climate change mitigation, where 59% of all respondents have chosen it. The lowest value is in the attractiveness of the city with a choice percentage of 31%.

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The greatest challenges of cities

In the open Question 15, the respondents were asked to describe what they see as the biggest challenge that needs to be solved to make the city climate neutral by 2030. Because of time constraints, the received 67 answers are analysed all together, not at the city level (number of answers from Bologna 19, Eindhoven and Helmond 23, Leuven 12, and Turku 13).

Identifying the biggest challenge is not an easy task, because defining an individual challenge may be difficult, and comparison of different challenges is often like comparing apples and oranges.

Regarding the answers to Question 15, one-half of the respondents (34) named only one challenge, but another half (33) listed two or more challenges. Some of the respondents seemed to focus on possible solutions instead of actual challenges. The challenge of implementing action plans and policy measures was typical examples.

The most popular challenge was clear, however. 22 out of 67 respondents (33%) named transport as the biggest challenge to be solved to make the city climate neutral before 2030. Most of the respondents focused on personal transport, private cars, modal shift, or electrification of transport and those who looked at the solutions emphasized mobility as a service and sharing of vehicles.

15 out of 67 respondents (22%) referred to energy production and consumption with different foci, e.g. dependency on fossil fuels, difficulties in the transition to renewables, or different energy-consuming activities such as air conditioning and cooling.

Other challenges mentioned by several respondents included bureaucracy (especially in the building sector), the behaviour of the inhabitants, and

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cooperation between different actors or stakeholders (lack or quality of cooperation due to siloing).

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The best contributions to innovation

In the open Question 16, the respondents were asked to describe what they see as the biggest contribution in innovation from their region to contribute to climate neutrality. Because of time constraints, the received 67 answers are analysed all together, not at the city level (answers from Bologna 19, Eindhoven and Helmond 23, Leuven 11, and Turku 14).

The respondents identified two types of contributions to climate neutrality. The first type was relatively concrete actions, and the other type was more about creating a framework or suitable conditions for reaching climate neutrality. Like in the biggest challenges (Question 15, previous chapter), also in Question 16, the respondents' identifications were shared between one and two or more contributions.

Examples of technological innovation included:

- energy production: green hydrogen, micro hydropower, trials on energy storage, battery solutions (e.g. salt batteries)
- stationary energy: energy positive smart buildings
- digitalization: integration to other city digital platforms
- other: carbon capture industry, tree planting, bio-based building materials, use of big data and artificial intelligence in problem identification

Examples of the suitable conditions for innovation climate neutrality are:

- technological development in general or in a specific sector such as energy production, transport, or digitalization
- climate neutrality plans, either at the city level or sectoral plans
- statement on joint activities toward climate neutrality
- cooperation with stakeholders in general or in a specific context

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Summary and conclusions

This deliverable 2.3 of the Cities 4.0 project includes the results based on the Webropol questionnaire (in Annex 1) to different stakeholder groups in the cities of Bologna (Italy), Eindhoven, and Helmond (the Netherlands), Leuven (Belgium), and Turku (Finland). The questionnaire was distributed to the 324 stakeholders listed in deliverable 2.2, and 79 responses were included in the analysis. The average response rate was 32.4 % with some variation between the cities (Table 1). In the responses, the number of answers to individual questions varied between 67 and 79.

The respondents were well aware of sustainability and climate neutrality, and a vast majority of them took sustainability actions in various sectors of their work and daily life. There were some differences between cities in the sustainability actions, but also in the stakeholder groups represented in the responses from different cities (cf. Table 2). The major needs for increasing sustainability actions slightly varied between cities, but the most important ones included cooperation with other stakeholders, knowledge and expertise, and time. All these were more important than financial resources in most of the cities, but this does not decrease the importance of additional financial resources. For further details, see Figures 1–7.

Activities in five sectors (stationary energy – 13 activities, energy generation – 19 activities, transport – 15 activities, material management – 12 activities, and digitalization and smart city solutions – 10 activities) were selected for analysing the importance of sectoral activities in different criteria: (1) importance in climate change mitigation, (2) business opportunities, (3) cooperation opportunities between stakeholders, (4) innovation potential, and (5) attractiveness of the city. The results were presented for a list of activities in each of the sectors per city and on average for all the cities using the five criteria above plus two aggregated

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criteria: business opportunities and innovation potential together, and all five criteria together. The results of the sectors varied between the criteria and between the cities (see Figures 8–27). A top-10 ranking based on all sectoral activities using the five individual criteria and the two aggregated criteria was presented (see Tables 28–34), and the full ranking including all 69 activities in the five sectors can be found in Annex 2.

None of the activities was among the top-10 ranking in all of the used criteria. In the conclusions, the two aggregated criteria can be emphasized. In both, "circular economy business models for reuse and/or repairability of product was the most important. Interpretation of this result can be that 55 % of all respondents saw this activity among the most important activities both in business opportunities and innovation potential; and 49 % in all five criteria. However, in attractiveness of the city and stakeholder cooperation opportunities this activity did not reach that high values, because the values of the aggregated criteria are only averages of the individual criterion values. Other important activities in both top-10 rankings include "circular economy business models for recycling of products and materials", smart buildings (stationary energy)", "energy renovation of existing buildings", and "mobility as a service (MAAS)". All sectoral activity lists included "education and information" and "behavioural changes". "Behavioural changes (stationary energy)", "education and information (transport)", and "behavioural changes (transport)" reached the top-10 in all criteria together.

The biggest challenge that needs to be solved to reach climate neutrality in 2030 and the biggest contribution to innovation for climate neutrality was asked by open questions. Identifying jus tone was not an easy task for many respondents, but the biggest challenge was quite clear: transport. Other significant challenges were the behaviour of the people, bureaucracy, and lack of cooperation between stakeholders. From the biggest contributions, the respondents paid more

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attention to generic things than to concrete actions. Technology development, climate plans, and cooperation between stakeholders were the major types of important contributions.

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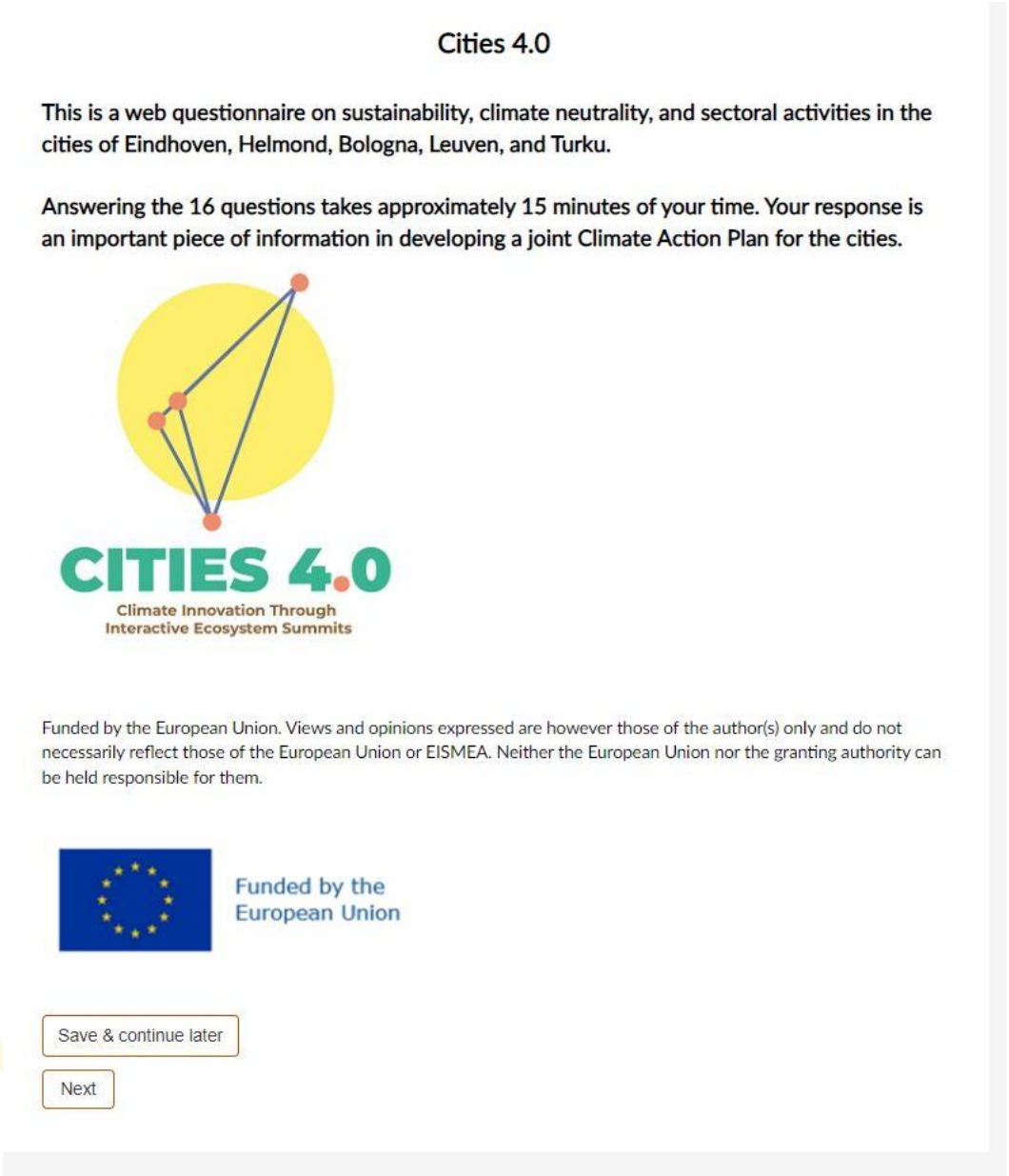
Annex 1. The Webropol questionnaire



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This is a web questionnaire on sustainability, climate neutrality, and sectoral activities in the cities of Eindhoven, Helmond, Bologna, Leuven, and Turku.

Answering the 16 questions takes approximately 15 minutes of your time. Your response is an important piece of information in developing a joint Climate Action Plan for the cities.

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Questions 1 and 2 are for identifying responses from different cities and different stakeholder groups.

1. Your city

- ◯ Bologna
- ◯ Eindhoven
- ◯ Helmond
- ◯ Leuven
- ◯ Turku
- ◯ Other, please specity

2. Your stakeholder group

- ◯ City administration
- ◯ Public company
- ◯ Other public organization
- ◯ Private company (business/ndustry)
- ◯ Mixed company
- ◯ Other non-governmental organization (NGO)
- ◯ Academia
- ◯ Politician
- ◯ Citizen/inhabitant
- ◯ Other (please specify)

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Questions 3–9 are general questions about sustainability in your work and life.

3. How important is sustainability for you?

	0	1	2	3	4	5	6	7	8	9	10	
Not at all important	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely important

4. Do you take action to make your daily life/business more sustainable?

- ◯ Yes
- ◯ No

5. Do you have plans to make your daily life/business more sustainable?

- ◯ Yesw
- ◯ No

6. Why do you take sustainability actions?

You can select more than one.

- ☐ It saves money
- ☐ It saves time
- ☐ It brings new business opportunities
- ☐ It makes my company/organization more attractive for employees
- ☐ It improves my company's/organization's imago
- ☐ It's important for me personally to contribute

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7. What do you need to take more sustainability actions?

You can select more than one.

- [ ] Easier access to finance
- [ ] Knowlede and expertise
- [ ] New personnel
- [ ] Business partners
- [ ] Coopearation with other stakeholders
- [ ] Time

8. Do you offer solutions for sustainability?

- ◯ Yes
- ◯ No

9. In which sector(s) do you offer sustainability solutions?

You can select more than one

- [ ] Stationary energy
- [ ] Energy generation
- [ ] Transportation
- [ ] Industry
- [ ] Material management
- [ ] Services
- [ ] Digital and smart city solutions
- [ ] Other (please specify) [ ]

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Questions 10–14 focus on sectors and the role of sectoral activities in your city. The sectors are limited to stationary energy, energy generation, transport, material management, and digitalization and smart city solutions.

10. Stationary energy

Please select the topics (max 5) that are most important for each of the following criteria:
a) climate change mitigation
b) business opportunities
c) cooperation between different stakeholders
d) social and organizational innovations
e) attractiveness of your city in terms of quality of life and wellbeing

	a) Importance in climate change mitigation	b) Business opportunities	c) Stakeholder cooperation opportunities	d) Innovation potential	e) Attractiveness of the city
Energy renovation of existing buildings	☐	☐	☐	☐	☐
Energy positive buildings	☐	☐	☐	☐	☐
Zero energy buildings	☐	☐	☐	☐	☐
Smart buildings	☐	☐	☐	☐	☐
Heat recovery - ventilation	☐	☐	☐	☐	☐
Heat recovery - wastewater	☐	☐	☐	☐	☐
Solar roofs	☐	☐	☐	☐	☐
Insulation	☐	☐	☐	☐	☐
Street lighting	☐	☐	☐	☐	☐
Education and information	☐	☐	☐	☐	☐
Demand side management	☐	☐	☐	☐	☐
Behavioural changes	☐	☐	☐	☐	☐
Other (please specify)	☐	☐	☐	☐	☐

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11. Energy generation

Please select the topics (max 5) that are most important for each of the following criteria:
a) climate change mitigation
b) business opportunities
c) cooperation between different stakeholders
d) social and organizational innovations
e) attractiveness of your city in terms of quality of life and wellbeing

	a) Importance in climate change mitigation	b) Business opportunities	c) Stakeholder cooperation opportunities	d) Innovation potential	e) Attractiveness of the city
Solar PV	☐	☐	☐	☐	☐
Solar thermal	☐	☐	☐	☐	☐
Heat pumps (air/water/ground source)	☐	☐	☐	☐	☐
Geothermal	☐	☐	☐	☐	☐
Wind energy	☐	☐	☐	☐	☐
Small/micro hydropower	☐	☐	☐	☐	☐
Small modular nuclear reactors (SMR)	☐	☐	☐	☐	☐
Biomass-based CHP	☐	☐	☐	☐	☐
Biomass-based electricity	☐	☐	☐	☐	☐
Biomass-based district heating	☐	☐	☐	☐	☐
Synthetic fuels (P2X technologies)	☐	☐	☐	☐	☐
Hydrogen economy	☐	☐	☐	☐	☐
Other renewable energies (please specity)	☐	☐	☐	☐	☐
Energy storage, batteries	☐	☐	☐	☐	☐
Energy storage, thermal	☐	☐	☐	☐	☐
Self-sufficient energy communities	☐	☐	☐	☐	☐
Education and information	☐	☐	☐	☐	☐
Behavioural changes	☐	☐	☐	☐	☐
Other (please specify	☐	☐	☐	☐	☐

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12. Transport

Please select the topics (max 5) that are most important for each of the following criteria:
a) climate change mitigation
b) business opportunities
c) cooperation between different stakeholders
d) social and organizational innovations
e) attractiveness of your city in terms of quality of life and wellbeing

	Importance in climate change mitigation	b) Business opportunities	c) Stakeholder cooperation opportunities	d) Innovation potential	e) Attractiveness of the city
Mobility as a service (MAAS)	☐	☐	☐	☐	☐
Electric vehicles, person transport	☐	☐	☐	☐	☐
Electric vehiclres, freight transport	☐	☐	☐	☐	☐
Vehicle battery loading points	☐	☐	☐	☐	☐
Accessibility of public transport	☐	☐	☐	☐	☐
Modal shift	☐	☐	☐	☐	☐
Integration between transport modes	☐	☐	☐	☐	☐
Shared use of vehicles	☐	☐	☐	☐	☐
Improved logistics (less transportation needs)	☐	☐	☐	☐	☐
Road/street user fees	☐	☐	☐	☐	☐
Driving ban/period zones	☐	☐	☐	☐	☐
Autonomous driving	☐	☐	☐	☐	☐
Education and information	☐	☐	☐	☐	☐
Behavioural changes	☐	☐	☐	☐	☐
Other (please specify)	☐	☐	☐	☐	☐

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13. Material management

Please select the topics (max 5) that are most important for each of the following criteria:
a) climate change mitigation
b) business opportunities
c) cooperation between different stakeholders
d) social and organizational innovations
e) attractiveness of your city in terms of quality of life and wellbeing

	a) Importance in climate change mitigation	b) Business opportunities	c) Stakeholder cooperation opportunities	d) Innovation potential	e) Attractiveness of the city
Municipal waste prevention	☐	☐	☐	☐	☐
Waste collection, separation, and sorting	☐	☐	☐	☐	☐
Platform for exchange of production side streams	☐	☐	☐	☐	☐
Industrial symbiosis between companies	☐	☐	☐	☐	☐
Circular economy business models for reuse and/or repairability of products	☐	☐	☐	☐	☐
Circular economy business models for recycling products and materials	☐	☐	☐	☐	☐
Waste/landfill gas use for energy production	☐	☐	☐	☐	☐
Waste incineration	☐	☐	☐	☐	☐
Wastewater reuse	☐	☐	☐	☐	☐
Education and information	☐	☐	☐	☐	☐
Behavioural changes	☐	☐	☐	☐	☐
Other (please specify)	☐	☐	☐	☐	☐

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14. Digitalization and smart city solutions

Please select the topics (max 5) that are most important for each of the following criteria:
a) climate change mitigation
b) business opportunities
c) cooperation between different stakeholders
d) social and organizational innovations
e) attractiveness of your city in terms of quality of life and wellbeing

	a) Importance in climate change mitigation	b) Business opportunities	c) Stakeholder cooperation opportunities	d) Innovation potential	e) Attractiveness of the city
Use of open standards	☐	☐	☐	☐	☐
Online data management and governance	☐	☐	☐	☐	☐
Internet of things (IoT) technologies	☐	☐	☐	☐	☐
Digital Twins	☐	☐	☐	☐	☐
Distribution platforms for shared use	☐	☐	☐	☐	☐
Bi-directional electricity distribution networks	☐	☐	☐	☐	☐
Smart buildings	☐	☐	☐	☐	☐
Education and information	☐	☐	☐	☐	☐
Behavioural changes	☐	☐	☐	☐	☐
Other (please specify) ☐	☐	☐	☐	☐	☐

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And finally, questions 15 and 16 focus on the most important things for the joint Climate Action Plan of Bologna, Eindhoven, Helmond, Leuven, and Turku.

15. Please describe what you see as the biggest challenge that needs to be solved to make your city climate neutral by 2030.

16. Please describe what you see as the biggest contribution in innovation from your region to contribute to climate neutrality?

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Annex 2. Ranking of sectoral activities

Importance in climate change mitigation

	Sectoral activity	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportunities and innovation potential	All criteria
1	Energy renovation of existing buildings	0.77	0.48	0.35	0.29	0.39	0.39	0.46
2	Solar PV	0.66	0.34	0.32	0.22	0.26	0.28	0.36
3	Behavioural changes (stationary energy)	0.63	0.20	0.48	0.42	0.32	0.31	0.41
4	Solar roofs	0.62	0.37	0.18	0.24	0.25	0.30	0.33
5	Circular economy business models for reuse and/or repairability of products	0.59	0.57	0.44	0.52	0.31	0.55	0.49
6	Behavioural changes (transport)	0.56	0.15	0.37	0.27	0.39	0.21	0.35
7	Solar thermal	0.51	0.32	0.18	0.22	0.16	0.27	0.28
8	Municipal waste prevention	0.51	0.23	0.24	0.28	0.41	0.25	0.33
9	Smart buildings (digitalization and smart city solutions)	0.49	0.45	0.21	0.45	0.39	0.45	0.40
10	Zero energy buildings	0.48	0.30	0.13	0.29	0.28	0.30	0.30
11	Circular economy business models for recycling products and materials	0.48	0.57	0.44	0.47	0.25	0.52	0.44
12	Heat pumps (air/water/ground source)	0.47	0.30	0.14	0.20	0.09	0.25	0.24
13	Electric vehicles, person transport	0.47	0.29	0.13	0.27	0.32	0.28	0.30
14	Waste collection, separation, and sorting	0.47	0.27	0.27	0.24	0.36	0.25	0.32
15	Behavioural changes (material management)	0.47	0.15	0.27	0.19	0.27	0.17	0.27
16	Wind energy	0.45	0.20	0.17	0.17	0.14	0.18	0.23
17	Insulation	0.44	0.23	0.06	0.11	0.06	0.17	0.18
18	Education and information (stationary energy)	0.44	0.16	0.46	0.38	0.29	0.27	0.35
19	Accessibility of public transport	0.44	0.15	0.29	0.21	0.55	0.18	0.33
20	Behavioural changes (digitalization and smart city solutions)	0.44	0.17	0.28	0.23	0.28	0.20	0.28
21	Bi-directional electricity distribution networks	0.41	0.31	0.25	0.35	0.21	0.33	0.31
22	Behavioural changes (energy generation)	0.41	0.13	0.37	0.22	0.32	0.18	0.29
23	Mobility as a service (MAAS)	0.40	0.40	0.36	0.33	0.41	0.37	0.38
24	Geothermal	0.39	0.22	0.09	0.16	0.11	0.19	0.19
25	Energy storage, batteries	0.39	0.39	0.18	0.41	0.11	0.40	0.30
26	Self-sufficient energy communities	0.39	0.20	0.30	0.29	0.41	0.24	0.32
27	Electric vehiclres, freight transport	0.39	0.31	0.09	0.25	0.20	0.28	0.25
28	Improved logistics (less transportation needs)	0.37	0.35	0.33	0.31	0.27	0.33	0.33
29	Education and information (transport)	0.37	0.16	0.33	0.25	0.21	0.21	0.27
30	Education and information (digitalization and smart city solutions)	0.37	0.19	0.29	0.28	0.24	0.23	0.27
31	Energy positive buildings	0.37	0.39	0.18	0.43	0.32	0.41	0.34
32	Heat recovery - ventilation	0.37	0.09	0.08	0.14	0.09	0.11	0.15
33	Education and information (energy generation)	0.36	0.09	0.37	0.28	0.26	0.18	0.27
34	Education and information (material management)	0.35	0.16	0.33	0.24	0.29	0.20	0.27
35	Shared use of vehicles	0.33	0.23	0.29	0.27	0.36	0.25	0.30
36	Smart buildings (stationary energy)	0.33	0.41	0.22	0.43	0.35	0.42	0.35
37	Hydrogen economy	0.33	0.25	0.20	0.41	0.11	0.33	0.26
38	Wastewater reuse	0.32	0.25	0.12	0.25	0.21	0.25	0.23
39	Modal shift	0.29	0.12	0.20	0.12	0.17	0.12	0.18
40	Heat recovery - wastewater	0.29	0.14	0.10	0.16	0.08	0.15	0.15
41	Energy storage, thermal	0.29	0.22	0.12	0.28	0.04	0.25	0.19
42	Vehicle battery loading points	0.28	0.31	0.17	0.19	0.28	0.25	0.25
43	Platform for exchange of production side streams	0.25	0.40	0.37	0.36	0.13	0.38	0.30
44	Integration between transport modes	0.24	0.29	0.33	0.24	0.25	0.27	0.27
45	Use of open standards	0.24	0.23	0.36	0.39	0.08	0.31	0.26
46	Distribution platforms for shared use	0.23	0.29	0.36	0.29	0.24	0.29	0.28
47	Industrial symbiosis between companies	0.21	0.47	0.37	0.31	0.11	0.39	0.29
48	Waste/landfill gas use for energy production	0.21	0.24	0.12	0.16	0.11	0.20	0.17
49	Demand side management	0.20	0.18	0.27	0.20	0.15	0.19	0.20
50	Driving ban/period zones	0.19	0.04	0.09	0.05	0.23	0.05	0.12
51	Street lighting	0.18	0.09	0.06	0.14	0.41	0.11	0.17
52	Internet of things (IoT) technologies	0.17	0.33	0.23	0.37	0.15	0.35	0.25
53	Digital Twins	0.17	0.23	0.19	0.27	0.08	0.25	0.19
54	Small/micro hydropower	0.17	0.21	0.12	0.22	0.07	0.22	0.16
55	Online data management and governance	0.16	0.24	0.28	0.35	0.19	0.29	0.24
56	Small modular nuclear reactors (SMR)	0.14	0.17	0.08	0.18	0.03	0.18	0.12
57	Synthetic fuels (P2X technologies)	0.14	0.21	0.09	0.21	0.01	0.21	0.13
58	Biomass-based CHP	0.13	0.12	0.09	0.11	0.04	0.11	0.10
59	Biomass-based electricity	0.13	0.12	0.08	0.13	0.04	0.13	0.10
60	Biomass-based district heating	0.12	0.13	0.09	0.11	0.07	0.12	0.10
61	Road/street user fees	0.11	0.13	0.07	0.07	0.08	0.10	0.09
62	Waste incineration	0.11	0.12	0.08	0.08	0.07	0.10	0.09
63	Other (stationary energy)	0.09	0.05	0.08	0.08	0.06	0.06	0.07
64	Other renewable energies (please specity)	0.07	0.04	0.04	0.04	0.03	0.04	0.04
65	Autonomous driving	0.05	0.21	0.07	0.31	0.09	0.26	0.15
66	Other (transport)	0.04	0.03	0.01	0.04	0.03	0.03	0.03
67	Other (material management)	0.04	0.04	0.04	0.03	0.01	0.03	0.03
68	Other (digitalization and smart city solutions)	0.03	0.03	0.03	0.03	0.04	0.03	0.03
69	Other (energy generation)	0.01	0.03	0.01	0.01	0.01	0.02	0.02

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Business opportunities

	Sectoral activity	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportunities and innovation potential	All criteria
1	Circular economy business models for reuse and/or repairability of products	0.59	0.57	0.44	0.52	0.31	0.55	0.49
2	Circular economy business models for recycling products and materials	0.48	0.57	0.44	0.47	0.25	0.52	0.44
3	Energy renovation of existing buildings	0.77	0.48	0.35	0.29	0.39	0.39	0.46
4	Industrial symbiosis between companies	0.21	0.47	0.37	0.31	0.11	0.39	0.29
5	Smart buildings (digitalization and smart city solutions)	0.49	0.45	0.21	0.45	0.39	0.45	0.40
6	Smart buildings (stationary energy)	0.33	0.41	0.22	0.43	0.35	0.42	0.35
7	Mobility as a service (MAAS)	0.40	0.40	0.36	0.33	0.41	0.37	0.38
8	Platform for exchange of production side streams	0.25	0.40	0.37	0.36	0.13	0.38	0.30
9	Energy storage, batteries	0.39	0.39	0.18	0.41	0.11	0.40	0.30
10	Energy positive buildings	0.37	0.39	0.18	0.43	0.32	0.41	0.34
11	Solar roofs	0.62	0.37	0.18	0.24	0.25	0.30	0.33
12	Improved logistics (less transportation needs)	0.37	0.35	0.33	0.31	0.27	0.33	0.33
13	Solar PV	0.66	0.34	0.32	0.22	0.26	0.28	0.36
14	Internet of things (IoT) technologies	0.17	0.33	0.23	0.37	0.15	0.35	0.25
15	Solar thermal	0.51	0.32	0.18	0.22	0.16	0.27	0.28
16	Electric vehiclres, freight transport	0.39	0.31	0.09	0.25	0.20	0.28	0.25
17	Vehicle battery loading points	0.28	0.31	0.17	0.19	0.28	0.25	0.25
18	Bi-directional electricity distribution networks	0.41	0.31	0.25	0.35	0.21	0.33	0.31
19	Zero energy buildings	0.48	0.30	0.13	0.29	0.28	0.30	0.30
20	Heat pumps (air/water/ground source)	0.47	0.30	0.14	0.20	0.09	0.25	0.24
21	Electric vehicles, person transport	0.47	0.29	0.13	0.27	0.32	0.28	0.30
22	Integration between transport modes	0.24	0.29	0.33	0.24	0.25	0.27	0.27
23	Distribution platforms for shared use	0.23	0.29	0.36	0.29	0.24	0.29	0.28
24	Waste collection, separation, and sorting	0.47	0.27	0.27	0.24	0.36	0.25	0.32
25	Wastewater reuse	0.32	0.25	0.12	0.25	0.21	0.25	0.23
26	Hydrogen economy	0.33	0.25	0.20	0.41	0.11	0.33	0.26
27	Waste/landfill gas use for energy production	0.21	0.24	0.12	0.16	0.11	0.20	0.17
28	Online data management and governance	0.16	0.24	0.28	0.35	0.19	0.29	0.24
29	Insulation	0.44	0.23	0.06	0.11	0.06	0.17	0.18
30	Shared use of vehicles	0.33	0.23	0.29	0.27	0.36	0.25	0.30
31	Municipal waaste prevention	0.51	0.23	0.24	0.28	0.41	0.25	0.33
32	Use of open standards	0.24	0.23	0.36	0.39	0.08	0.31	0.26
33	Digital Twins	0.17	0.23	0.19	0.27	0.08	0.25	0.19
34	Geothermal	0.39	0.22	0.09	0.16	0.11	0.19	0.19
35	Energy storage, thermal	0.29	0.22	0.12	0.28	0.04	0.25	0.19
36	Autonomous driving	0.05	0.21	0.07	0.31	0.09	0.26	0.15
37	Small/micro hydropower	0.17	0.21	0.12	0.22	0.07	0.22	0.16
38	Synthetic fuels (P2X technologies)	0.14	0.21	0.09	0.21	0.01	0.21	0.13
39	Behavioural changes (stationary energy)	0.63	0.20	0.48	0.42	0.32	0.31	0.41
40	Wind energy	0.45	0.20	0.17	0.17	0.14	0.18	0.23
41	Self-sufficient energy communities	0.39	0.20	0.30	0.29	0.41	0.24	0.32
42	Education and information (digitalization and smart city solutions)	0.37	0.19	0.29	0.28	0.24	0.23	0.27
43	Demand side management	0.20	0.18	0.27	0.20	0.15	0.19	0.20
44	Behavioural changes (digitalization and smart city solutions)	0.44	0.17	0.28	0.23	0.28	0.20	0.28
45	Small modular nuclear reactors (SMR)	0.14	0.17	0.08	0.18	0.03	0.18	0.12
46	Education and information (stationary energy)	0.44	0.16	0.46	0.38	0.29	0.27	0.35
47	Education and information (transport)	0.37	0.16	0.33	0.25	0.21	0.21	0.27
48	Education and information (material management)	0.35	0.16	0.33	0.24	0.29	0.20	0.27
49	Accessibility of public transport	0.44	0.15	0.29	0.21	0.55	0.18	0.33
50	Behavioural changes (transport)	0.56	0.15	0.37	0.27	0.39	0.21	0.35
51	Behavioural changes (material management)	0.47	0.15	0.27	0.19	0.27	0.17	0.27
52	Heat recovery - wastewater	0.29	0.14	0.10	0.16	0.08	0.15	0.15
53	Road/street user fees	0.11	0.13	0.07	0.07	0.08	0.10	0.09
54	Biomass-based district heating	0.12	0.13	0.09	0.11	0.07	0.12	0.10
55	Behavioural changes (energy generation)	0.41	0.13	0.37	0.22	0.32	0.18	0.29
56	Modal shift	0.29	0.12	0.20	0.12	0.17	0.12	0.18
57	Waste incineration	0.11	0.12	0.08	0.08	0.07	0.10	0.09
58	Biomass-based CHP	0.13	0.12	0.09	0.11	0.04	0.11	0.10
59	Biomass-based electricity	0.13	0.12	0.08	0.13	0.04	0.13	0.10
60	Education and information (energy generation)	0.36	0.09	0.37	0.28	0.26	0.18	0.27
61	Heat recovery - ventilation	0.37	0.09	0.08	0.14	0.09	0.11	0.15
62	Street lighting	0.18	0.09	0.06	0.14	0.41	0.11	0.17
63	Other (stationary energy)	0.09	0.05	0.08	0.08	0.06	0.06	0.07
64	Driving ban/period zones	0.19	0.04	0.09	0.05	0.23	0.05	0.12
65	Other (material management)	0.04	0.04	0.04	0.03	0.01	0.03	0.03
66	Other renewable energies (please specity)	0.07	0.04	0.04	0.04	0.03	0.04	0.04
67	Other (transport)	0.04	0.03	0.01	0.04	0.03	0.03	0.03
68	Other (digitalization and smart city solutions)	0.03	0.03	0.03	0.03	0.04	0.03	0.03
69	Other (energy generation)	0.01	0.03	0.01	0.01	0.01	0.02	0.02

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Cooperation opportunities between stakeholders

	Sectoral activity	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportunities and innovation potential	All criteria
1	Behavioural changes (stationary energy)	0.63	0.20	0.48	0.42	0.32	0.31	0.41
2	Education and information (stationary energy)	0.44	0.16	0.46	0.38	0.29	0.27	0.35
3	Circular economy business models for reuse and/or repairability of products	0.59	0.57	0.44	0.52	0.31	0.55	0.49
4	Circular economy business models for recycling products and materials	0.48	0.57	0.44	0.47	0.25	0.52	0.44
5	Behavioural changes (transport)	0.56	0.15	0.37	0.27	0.39	0.21	0.35
6	Platform for exchange of production side streams	0.25	0.40	0.37	0.36	0.13	0.38	0.30
7	Industrial symbiosis between companies	0.21	0.47	0.37	0.31	0.11	0.39	0.29
8	Education and information (energy generation)	0.36	0.09	0.37	0.28	0.26	0.18	0.27
9	Behavioural changes (energy generation)	0.41	0.13	0.37	0.22	0.32	0.18	0.29
10	Mobility as a service (MAAS)	0.40	0.40	0.36	0.33	0.41	0.37	0.38
11	Use of open standards	0.24	0.23	0.36	0.39	0.08	0.31	0.26
12	Distribution platforms for shared use	0.23	0.29	0.36	0.29	0.24	0.29	0.28
13	Energy renovation of existing buildings	0.77	0.48	0.35	0.29	0.39	0.39	0.46
14	Integration between transport modes	0.24	0.29	0.33	0.24	0.25	0.27	0.27
15	Improved logistics (less transportation needs)	0.37	0.35	0.33	0.31	0.27	0.33	0.33
16	Education and information (transport)	0.37	0.16	0.33	0.25	0.21	0.21	0.27
17	Education and information (material management)	0.35	0.16	0.33	0.24	0.29	0.20	0.27
18	Solar PV	0.66	0.34	0.32	0.22	0.26	0.28	0.36
19	Self-sufficient energy communities	0.39	0.20	0.30	0.29	0.41	0.24	0.32
20	Accessibility of public transport	0.44	0.15	0.29	0.21	0.55	0.18	0.33
21	Shared use of vehicles	0.33	0.23	0.29	0.27	0.36	0.25	0.30
22	Education and information (digitalization and smart city solutions)	0.37	0.19	0.29	0.28	0.24	0.23	0.27
23	Online data management and governance	0.16	0.24	0.28	0.35	0.19	0.29	0.24
24	Behavioural changes (digitalization and smart city solutions)	0.44	0.17	0.28	0.23	0.28	0.20	0.28
25	Waste collection, separation, and sorting	0.47	0.27	0.27	0.24	0.36	0.25	0.32
26	Behavioural changes (material management)	0.47	0.15	0.27	0.19	0.27	0.17	0.27
27	Demand side management	0.20	0.18	0.27	0.20	0.15	0.19	0.20
28	Bi-directional electricity distribution networks	0.41	0.31	0.25	0.35	0.21	0.33	0.31
29	Municipal waaste prevention	0.51	0.23	0.24	0.28	0.41	0.25	0.33
30	Internet of things (IoT) technologies	0.17	0.33	0.23	0.37	0.15	0.35	0.25
31	Smart buildings (stationary energy)	0.33	0.41	0.22	0.43	0.35	0.42	0.35
32	Smart buildings (digitalization and smart city solutions)	0.49	0.45	0.21	0.45	0.39	0.45	0.40
33	Modal shift	0.29	0.12	0.20	0.12	0.17	0.12	0.18
34	Hydrogen economy	0.33	0.25	0.20	0.41	0.11	0.33	0.26
35	Digital Twins	0.17	0.23	0.19	0.27	0.08	0.25	0.19
36	Solar thermal	0.51	0.32	0.18	0.22	0.16	0.27	0.28
37	Energy storage, batteries	0.39	0.39	0.18	0.41	0.11	0.40	0.30
38	Energy positive buildings	0.37	0.39	0.18	0.43	0.32	0.41	0.34
39	Solar roofs	0.62	0.37	0.18	0.24	0.25	0.30	0.33
40	Vehicle battery loading points	0.28	0.31	0.17	0.19	0.28	0.25	0.25
41	Wind energy	0.45	0.20	0.17	0.17	0.14	0.18	0.23
42	Heat pumps (air/water/ground source)	0.47	0.30	0.14	0.20	0.09	0.25	0.24
43	Electric vehicles, person transport	0.47	0.29	0.13	0.27	0.32	0.28	0.30
44	Zero energy buildings	0.48	0.30	0.13	0.29	0.28	0.30	0.30
45	Waste/landfill gas use for energy production	0.21	0.24	0.12	0.16	0.11	0.20	0.17
46	Wastewater reuse	0.32	0.25	0.12	0.25	0.21	0.25	0.23
47	Small/micro hydropower	0.17	0.21	0.12	0.22	0.07	0.22	0.16
48	Energy storage, thermal	0.29	0.22	0.12	0.28	0.04	0.25	0.19
49	Heat recovery - wastewater	0.29	0.14	0.10	0.16	0.08	0.15	0.15
50	Electric vehiclres, freight transport	0.39	0.31	0.09	0.25	0.20	0.28	0.25
51	Driving ban/period zones	0.19	0.04	0.09	0.05	0.23	0.05	0.12
52	Geothermal	0.39	0.22	0.09	0.16	0.11	0.19	0.19
53	Biomass-based CHP	0.13	0.12	0.09	0.11	0.04	0.11	0.10
54	Biomass-based district heating	0.12	0.13	0.09	0.11	0.07	0.12	0.10
55	Synthetic fuels (P2X technologies)	0.14	0.21	0.09	0.21	0.01	0.21	0.13
56	Waste incineration	0.11	0.12	0.08	0.08	0.07	0.10	0.09
57	Small modular nuclear reactors (SMR)	0.14	0.17	0.08	0.18	0.03	0.18	0.12
58	Biomass-based electricity	0.13	0.12	0.08	0.13	0.04	0.13	0.10
59	Heat recovery - ventilation	0.37	0.09	0.08	0.14	0.09	0.11	0.15
60	Other (stationary energy)	0.09	0.05	0.08	0.08	0.06	0.06	0.07
61	Road/street user fees	0.11	0.13	0.07	0.07	0.08	0.10	0.09
62	Autonomous driving	0.05	0.21	0.07	0.31	0.09	0.26	0.15
63	Insulation	0.44	0.23	0.06	0.11	0.06	0.17	0.18
64	Street lighting	0.18	0.09	0.06	0.14	0.41	0.11	0.17
65	Other (material management)	0.04	0.04	0.04	0.03	0.01	0.03	0.03
66	Other renewable energies (please specity)	0.07	0.04	0.04	0.04	0.03	0.04	0.04
67	Other (digitalization and smart city solutions)	0.03	0.03	0.03	0.03	0.04	0.03	0.03
68	Other (transport)	0.04	0.03	0.01	0.04	0.03	0.03	0.03
69	Other (energy generation)	0.01	0.03	0.01	0.01	0.01	0.02	0.02

Funded by the European Union

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GA 101070827 - HORIZON-EIE-2021-CONNECT-01

Innovation potential

	Sectoral activity	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportunities and innovation potential	All criteria
1	Circular economy business models for reuse and/or repairability of products	0.59	0.57	0.44	0.52	0.31	0.55	0.49
2	Circular economy business models for recycling products and materials	0.48	0.57	0.44	0.47	0.25	0.52	0.44
3	Smart buildings (digitalization and smart city solutions)	0.49	0.45	0.21	0.45	0.39	0.45	0.40
4	Energy positive buildings	0.37	0.39	0.18	0.43	0.32	0.41	0.34
5	Smart buildings (stationary energy)	0.33	0.41	0.22	0.43	0.35	0.42	0.35
6	Behavioural changes (stationary energy)	0.63	0.20	0.48	0.42	0.32	0.31	0.41
7	Hydrogen economy	0.33	0.25	0.20	0.41	0.11	0.33	0.26
8	Energy storage, batteries	0.39	0.39	0.18	0.41	0.11	0.40	0.30
9	Use of open standards	0.24	0.23	0.36	0.39	0.08	0.31	0.26
10	Education and information (stationary energy)	0.44	0.16	0.46	0.38	0.29	0.27	0.35
11	Internet of things (IoT) technologies	0.17	0.33	0.23	0.37	0.15	0.35	0.25
12	Platform for exchange of production side streams	0.25	0.40	0.37	0.36	0.13	0.38	0.30
13	Online data management and governance	0.16	0.24	0.28	0.35	0.19	0.29	0.24
14	Bi-directional electricity distribution networks	0.41	0.31	0.25	0.35	0.21	0.33	0.31
15	Mobility as a service (MAAS)	0.40	0.40	0.36	0.33	0.41	0.37	0.38
16	Improved logistics (less transportation needs)	0.37	0.35	0.33	0.31	0.27	0.33	0.33
17	Autonomous driving	0.05	0.21	0.07	0.31	0.09	0.26	0.15
18	Industrial symbiosis between companies	0.21	0.47	0.37	0.31	0.11	0.39	0.29
19	Distribution platforms for shared use	0.23	0.29	0.36	0.29	0.24	0.29	0.28
20	Energy renovation of existing buildings	0.77	0.48	0.35	0.29	0.39	0.39	0.46
21	Zero energy buildings	0.48	0.30	0.13	0.29	0.28	0.30	0.30
22	Self-sufficient energy communities	0.39	0.20	0.30	0.29	0.41	0.24	0.32
23	Municipal waaste prevention	0.51	0.23	0.24	0.28	0.41	0.25	0.33
24	Education and information (digitalization and smart city solutions)	0.37	0.19	0.29	0.28	0.24	0.23	0.27
25	Energy storage, thermal	0.29	0.22	0.12	0.28	0.04	0.25	0.19
26	Education and information (energy generation)	0.36	0.09	0.37	0.28	0.26	0.18	0.27
27	Electric vehicles, person transport	0.47	0.29	0.13	0.27	0.32	0.28	0.30
28	Shared use of vehicles	0.33	0.23	0.29	0.27	0.36	0.25	0.30
29	Behavioural changes (transport)	0.56	0.15	0.37	0.27	0.39	0.21	0.35
30	Digital Twins	0.17	0.23	0.19	0.27	0.08	0.25	0.19
31	Electric vehiclres, freight transport	0.39	0.31	0.09	0.25	0.20	0.28	0.25
32	Education and information (transport)	0.37	0.16	0.33	0.25	0.21	0.21	0.27
33	Wastewater reuse	0.32	0.25	0.12	0.25	0.21	0.25	0.23
34	Solar roofs	0.62	0.37	0.18	0.24	0.25	0.30	0.33
35	Integration between transport modes	0.24	0.29	0.33	0.24	0.25	0.27	0.27
36	Waste collection, separation, and sorting	0.47	0.27	0.27	0.24	0.36	0.25	0.32
37	Education and information (material management)	0.35	0.16	0.33	0.24	0.29	0.20	0.27
38	Behavioural changes (digitalization and smart city solutions)	0.44	0.17	0.28	0.23	0.28	0.20	0.28
39	Solar PV	0.66	0.34	0.32	0.22	0.26	0.28	0.36
40	Solar thermal	0.51	0.32	0.18	0.22	0.16	0.27	0.28
41	Small/micro hydropower	0.17	0.21	0.12	0.22	0.07	0.22	0.16
42	Behavioural changes (energy generation)	0.41	0.13	0.37	0.22	0.32	0.18	0.29
43	Accessibility of public transport	0.44	0.15	0.29	0.21	0.55	0.18	0.33
44	Synthetic fuels (P2X technologies)	0.14	0.21	0.09	0.21	0.01	0.21	0.13
45	Demand side management	0.20	0.18	0.27	0.20	0.15	0.19	0.20
46	Heat pumps (air/water/ground source)	0.47	0.30	0.14	0.20	0.09	0.25	0.24
47	Vehicle battery loading points	0.28	0.31	0.17	0.19	0.28	0.25	0.25
48	Behavioural changes (material management)	0.47	0.15	0.27	0.19	0.27	0.17	0.27
49	Small modular nuclear reactors (SMR)	0.14	0.17	0.08	0.18	0.03	0.18	0.12
50	Wind energy	0.45	0.20	0.17	0.17	0.14	0.18	0.23
51	Heat recovery - wastewater	0.29	0.14	0.10	0.16	0.08	0.15	0.15
52	Waste/landfill gas use for energy production	0.21	0.24	0.12	0.16	0.11	0.20	0.17
53	Geothermal	0.39	0.22	0.09	0.16	0.11	0.19	0.19
54	Heat recovery - ventilation	0.37	0.09	0.08	0.14	0.09	0.11	0.15
55	Street lighting	0.18	0.09	0.06	0.14	0.41	0.11	0.17
56	Biomass-based electricity	0.13	0.12	0.08	0.13	0.04	0.13	0.10
57	Modal shift	0.29	0.12	0.20	0.12	0.17	0.12	0.18
58	Insulation	0.44	0.23	0.06	0.11	0.06	0.17	0.18
59	Biomass-based CHP	0.13	0.12	0.09	0.11	0.04	0.11	0.10
60	Biomass-based district heating	0.12	0.13	0.09	0.11	0.07	0.12	0.10
61	Waste incineration	0.11	0.12	0.08	0.08	0.07	0.10	0.09
62	Other (stationary energy)	0.09	0.05	0.08	0.08	0.06	0.06	0.07
63	Road/street user fees	0.11	0.13	0.07	0.07	0.08	0.10	0.09
64	Driving ban/period zones	0.19	0.04	0.09	0.05	0.23	0.05	0.12
65	Other (transport)	0.04	0.03	0.01	0.04	0.03	0.03	0.03
66	Other renewable energies (please specity)	0.07	0.04	0.04	0.04	0.03	0.04	0.04
67	Other (material management)	0.04	0.04	0.04	0.03	0.01	0.03	0.03
68	Other (digitalization and smart city solutions)	0.03	0.03	0.03	0.03	0.04	0.03	0.03
69	Other (energy generation)	0.01	0.03	0.01	0.01	0.01	0.02	0.02

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The attractiveness of the city

	Sectoral activity	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportunities and innovation potential	All criteria
1	Accessibility of public transport	0.44	0.15	0.29	0.21	0.55	0.18	0.33
2	Mobility as a service (MAAS)	0.40	0.40	0.36	0.33	0.41	0.37	0.38
3	Municipal waaste prevention	0.51	0.23	0.24	0.28	0.41	0.25	0.33
4	Self-sufficient energy communities	0.39	0.20	0.30	0.29	0.41	0.24	0.32
5	Street lighting	0.18	0.09	0.06	0.14	0.41	0.11	0.17
6	Energy renovation of existing buildings	0.77	0.48	0.35	0.29	0.39	0.39	0.46
7	Behavioural changes (transport)	0.56	0.15	0.37	0.27	0.39	0.21	0.35
8	Smart buildings (digitalization and smart city solutions)	0.49	0.45	0.21	0.45	0.39	0.45	0.40
9	Shared use of vehicles	0.33	0.23	0.29	0.27	0.36	0.25	0.30
10	Waste collection, separation, and sorting	0.47	0.27	0.27	0.24	0.36	0.25	0.32
11	Smart buildings (stationary energy)	0.33	0.41	0.22	0.43	0.35	0.42	0.35
12	Electric vehicles, person transport	0.47	0.29	0.13	0.27	0.32	0.28	0.30
13	Energy positive buildings	0.37	0.39	0.18	0.43	0.32	0.41	0.34
14	Behavioural changes (stationary energy)	0.63	0.20	0.48	0.42	0.32	0.31	0.41
15	Behavioural changes (energy generation)	0.41	0.13	0.37	0.22	0.32	0.18	0.29
16	Circular economy business models for reuse and/or repairability of products	0.59	0.57	0.44	0.52	0.31	0.55	0.49
17	Education and information (material management)	0.35	0.16	0.33	0.24	0.29	0.20	0.27
18	Education and information (stationary energy)	0.44	0.16	0.46	0.38	0.29	0.27	0.35
19	Vehicle battery loading points	0.28	0.31	0.17	0.19	0.28	0.25	0.25
20	Behavioural changes (digitalization and smart city solutions)	0.44	0.17	0.28	0.23	0.28	0.20	0.28
21	Zero energy buildings	0.48	0.30	0.13	0.29	0.28	0.30	0.30
22	Improved logistics (less transportation needs)	0.37	0.35	0.33	0.31	0.27	0.33	0.33
23	Behavioural changes (material management)	0.47	0.15	0.27	0.19	0.27	0.17	0.27
24	Solar PV	0.66	0.34	0.32	0.22	0.26	0.28	0.36
25	Education and information (energy generation)	0.36	0.09	0.37	0.28	0.26	0.18	0.27
26	Integration between transport modes	0.24	0.29	0.33	0.24	0.25	0.27	0.27
27	Circular economy business models for recycling products and materials	0.48	0.57	0.44	0.47	0.25	0.52	0.44
28	Solar roofs	0.62	0.37	0.18	0.24	0.25	0.30	0.33
29	Distribution platforms for shared use	0.23	0.29	0.36	0.29	0.24	0.29	0.28
30	Education and information (digitalization and smart city solutions)	0.37	0.19	0.29	0.28	0.24	0.23	0.27
31	Driving ban/period zones	0.19	0.04	0.09	0.05	0.23	0.05	0.12
32	Education and information (transport)	0.37	0.16	0.33	0.25	0.21	0.21	0.27
33	Wastewater reuse	0.32	0.25	0.12	0.25	0.21	0.25	0.23
34	Bi-directional electricity distribution networks	0.41	0.31	0.25	0.35	0.21	0.33	0.31
35	Electric vehiclres, freight transport	0.39	0.31	0.09	0.25	0.20	0.28	0.25
36	Online data management and governance	0.16	0.24	0.28	0.35	0.19	0.29	0.24
37	Modal shift	0.29	0.12	0.20	0.12	0.17	0.12	0.18
38	Solar thermal	0.51	0.32	0.18	0.22	0.16	0.27	0.28
39	Demand side management	0.20	0.18	0.27	0.20	0.15	0.19	0.20
40	Internet of things (IoT) technologies	0.17	0.33	0.23	0.37	0.15	0.35	0.25
41	Wind energy	0.45	0.20	0.17	0.17	0.14	0.18	0.23
42	Platform for exchange of production side streams	0.25	0.40	0.37	0.36	0.13	0.38	0.30
43	Industrial symbiosis between companies	0.21	0.47	0.37	0.31	0.11	0.39	0.29
44	Waste/landfill gas use for energy production	0.21	0.24	0.12	0.16	0.11	0.20	0.17
45	Geothermal	0.39	0.22	0.09	0.16	0.11	0.19	0.19
46	Hydrogen economy	0.33	0.25	0.20	0.41	0.11	0.33	0.26
47	Energy storage, batteries	0.39	0.39	0.18	0.41	0.11	0.40	0.30
48	Autonomous driving	0.05	0.21	0.07	0.31	0.09	0.26	0.15
49	Heat pumps (air/water/ground source)	0.47	0.30	0.14	0.20	0.09	0.25	0.24
50	Heat recovery - ventilation	0.37	0.09	0.08	0.14	0.09	0.11	0.15
51	Road/street user fees	0.11	0.13	0.07	0.07	0.08	0.10	0.09
52	Use of open standards	0.24	0.23	0.36	0.39	0.08	0.31	0.26
53	Digital Twins	0.17	0.23	0.19	0.27	0.08	0.25	0.19
54	Heat recovery - wastewater	0.29	0.14	0.10	0.16	0.08	0.15	0.15
55	Waste incineration	0.11	0.12	0.08	0.08	0.07	0.10	0.09
56	Small/micro hydropower	0.17	0.21	0.12	0.22	0.07	0.22	0.16
57	Biomass-based district heating	0.12	0.13	0.09	0.11	0.07	0.12	0.10
58	Insulation	0.44	0.23	0.06	0.11	0.06	0.17	0.18
59	Other (stationary energy)	0.09	0.05	0.08	0.08	0.06	0.06	0.07
60	Other (digitalization and smart city solutions)	0.03	0.03	0.03	0.03	0.04	0.03	0.03
61	Biomass-based CHP	0.13	0.12	0.09	0.11	0.04	0.11	0.10
62	Biomass-based electricity	0.13	0.12	0.08	0.13	0.04	0.13	0.10
63	Energy storage, thermal	0.29	0.22	0.12	0.28	0.04	0.25	0.19
64	Other (transport)	0.04	0.03	0.01	0.04	0.03	0.03	0.03
65	Small modular nuclear reactors (SMR)	0.14	0.17	0.08	0.18	0.03	0.18	0.12
66	Other renewable energies (please specity)	0.07	0.04	0.04	0.04	0.03	0.04	0.04
67	Other (material management)	0.04	0.04	0.04	0.03	0.01	0.03	0.03
68	Synthetic fuels (P2X technologies)	0.14	0.21	0.09	0.21	0.01	0.21	0.13
69	Other (energy generation)	0.01	0.03	0.01	0.01	0.01	0.02	0.02

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Business opportunities and innovation potential

	Sectoral activity	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportunities and innovation potential	All criteria
1	Circular economy business models for reuse and/or repairability of products	0.59	0.57	0.44	0.52	0.31	0.55	0.49
2	Circular economy business models for recycling products and materials	0.48	0.57	0.44	0.47	0.25	0.52	0.44
3	Smart buildings (digitalization and smart city solutions)	0.49	0.45	0.21	0.45	0.39	0.45	0.40
4	Smart buildings (stationary energy)	0.33	0.41	0.22	0.43	0.35	0.42	0.35
5	Energy positive buildings	0.37	0.39	0.18	0.43	0.32	0.41	0.34
6	Energy storage, batteries	0.39	0.39	0.18	0.41	0.11	0.40	0.30
7	Industrial symbiosis between companies	0.21	0.47	0.37	0.31	0.11	0.39	0.29
8	Energy renovation of existing buildings	0.77	0.48	0.35	0.29	0.39	0.39	0.46
9	Platform for exchange of production side streams	0.25	0.40	0.37	0.36	0.13	0.38	0.30
10	Mobility as a service (MAAS)	0.40	0.40	0.36	0.33	0.41	0.37	0.38
11	Internet of things (IoT) technologies	0.17	0.33	0.23	0.37	0.15	0.35	0.25
12	Hydrogen economy	0.33	0.25	0.20	0.41	0.11	0.33	0.26
13	Improved logistics (less transportation needs)	0.37	0.35	0.33	0.31	0.27	0.33	0.33
14	Bi-directional electricity distribution networks	0.41	0.31	0.25	0.35	0.21	0.33	0.31
15	Behavioural changes (stationary energy)	0.63	0.20	0.48	0.42	0.32	0.31	0.41
16	Use of open standards	0.24	0.23	0.36	0.39	0.08	0.31	0.26
17	Solar roofs	0.62	0.37	0.18	0.24	0.25	0.30	0.33
18	Zero energy buildings	0.48	0.30	0.13	0.29	0.28	0.30	0.30
19	Online data management and governance	0.16	0.24	0.28	0.35	0.19	0.29	0.24
20	Distribution platforms for shared use	0.23	0.29	0.36	0.29	0.24	0.29	0.28
21	Solar PV	0.66	0.34	0.32	0.22	0.26	0.28	0.36
22	Electric vehicles, person transport	0.47	0.29	0.13	0.27	0.32	0.28	0.30
23	Electric vehiclres, freight transport	0.39	0.31	0.09	0.25	0.20	0.28	0.25
24	Education and information (stationary energy)	0.44	0.16	0.46	0.38	0.29	0.27	0.35
25	Solar thermal	0.51	0.32	0.18	0.22	0.16	0.27	0.28
26	Integration between transport modes	0.24	0.29	0.33	0.24	0.25	0.27	0.27
27	Autonomous driving	0.05	0.21	0.07	0.31	0.09	0.26	0.15
28	Municipal waaste prevention	0.51	0.23	0.24	0.28	0.41	0.25	0.33
29	Wastewater reuse	0.32	0.25	0.12	0.25	0.21	0.25	0.23
30	Waste collection, separation, and sorting	0.47	0.27	0.27	0.24	0.36	0.25	0.32
31	Heat pumps (air/water/ground source)	0.47	0.30	0.14	0.20	0.09	0.25	0.24
32	Energy storage, thermal	0.29	0.22	0.12	0.28	0.04	0.25	0.19
33	Vehicle battery loading points	0.28	0.31	0.17	0.19	0.28	0.25	0.25
34	Shared use of vehicles	0.33	0.23	0.29	0.27	0.36	0.25	0.30
35	Digital Twins	0.17	0.23	0.19	0.27	0.08	0.25	0.19
36	Self-sufficient energy communities	0.39	0.20	0.30	0.29	0.41	0.24	0.32
37	Education and information (digitalization and smart city solutions)	0.37	0.19	0.29	0.28	0.24	0.23	0.27
38	Small/micro hydropower	0.17	0.21	0.12	0.22	0.07	0.22	0.16
39	Synthetic fuels (P2X technologies)	0.14	0.21	0.09	0.21	0.01	0.21	0.13
40	Education and information (transport)	0.37	0.16	0.33	0.25	0.21	0.21	0.27
41	Behavioural changes (transport)	0.56	0.15	0.37	0.27	0.39	0.21	0.35
42	Waste/landfill gas use for energy production	0.21	0.24	0.12	0.16	0.11	0.20	0.17
43	Education and information (material management)	0.35	0.16	0.33	0.24	0.29	0.20	0.27
44	Behavioural changes (digitalization and smart city solutions)	0.44	0.17	0.28	0.23	0.28	0.20	0.28
45	Geothermal	0.39	0.22	0.09	0.16	0.11	0.19	0.19
46	Demand side management	0.20	0.18	0.27	0.20	0.15	0.19	0.20
47	Wind energy	0.45	0.20	0.17	0.17	0.14	0.18	0.23
48	Education and information (energy generation)	0.36	0.09	0.37	0.28	0.26	0.18	0.27
49	Accessibility of public transport	0.44	0.15	0.29	0.21	0.55	0.18	0.33
50	Small modular nuclear reactors (SMR)	0.14	0.17	0.08	0.18	0.03	0.18	0.12
51	Behavioural changes (energy generation)	0.41	0.13	0.37	0.22	0.32	0.18	0.29
52	Insulation	0.44	0.23	0.06	0.11	0.06	0.17	0.18
53	Behavioural changes (material management)	0.47	0.15	0.27	0.19	0.27	0.17	0.27
54	Heat recovery - wastewater	0.29	0.14	0.10	0.16	0.08	0.15	0.15
55	Biomass-based electricity	0.13	0.12	0.08	0.13	0.04	0.13	0.10
56	Modal shift	0.29	0.12	0.20	0.12	0.17	0.12	0.18
57	Biomass-based district heating	0.12	0.13	0.09	0.11	0.07	0.12	0.10
58	Heat recovery - ventilation	0.37	0.09	0.08	0.14	0.09	0.11	0.15
59	Street lighting	0.18	0.09	0.06	0.14	0.41	0.11	0.17
60	Biomass-based CHP	0.13	0.12	0.09	0.11	0.04	0.11	0.10
61	Road/street user fees	0.11	0.13	0.07	0.07	0.08	0.10	0.09
62	Waste incineration	0.11	0.12	0.08	0.08	0.07	0.10	0.09
63	Other (stationary energy)	0.09	0.05	0.08	0.08	0.06	0.06	0.07
64	Driving ban/period zones	0.19	0.04	0.09	0.05	0.23	0.05	0.12
65	Other renewable energies (please specity)	0.07	0.04	0.04	0.04	0.03	0.04	0.04
66	Other (transport)	0.04	0.03	0.01	0.04	0.03	0.03	0.03
67	Other (material management)	0.04	0.04	0.04	0.03	0.01	0.03	0.03
68	Other (digitalization and smart city solutions)	0.03	0.03	0.03	0.03	0.04	0.03	0.03
69	Other (energy generation)	0.01	0.03	0.01	0.01	0.01	0.02	0.02

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GA 101070827 - HORIZON-EIE-2021-CONNECT-01

All five criteria (Importance in climate change mitigation business opportunities, cooperation opportunities between stakeholders, innovation potential, and attractiveness of the city

	Sectoral activity	Importance in climate change mitigation	Business opportunities	Stakeholder cooperation opportunities	Innovation potential	Attractiveness of the city	Business opportunities and innovation potential	All criteria
1	Circular economy business models for reuse and/or repairability of products	0.59	0.57	0.44	0.52	0.31	0.55	0.49
2	Energy renovation of existing buildings	0.77	0.48	0.35	0.29	0.39	0.39	0.46
3	Circular economy business models for recycling products and materials	0.48	0.57	0.44	0.47	0.25	0.52	0.44
4	Behavioural changes (stationary energy)	0.63	0.20	0.48	0.42	0.32	0.31	0.41
5	Smart buildings (digitalization and smart city solutions)	0.49	0.45	0.21	0.45	0.39	0.45	0.40
6	Mobility as a service (MAAS)	0.40	0.40	0.36	0.33	0.41	0.37	0.38
7	Solar PV	0.66	0.34	0.32	0.22	0.26	0.28	0.36
8	Smart buildings (stationary energy)	0.33	0.41	0.22	0.43	0.35	0.42	0.35
9	Education and information (stationary energy)	0.44	0.16	0.46	0.38	0.29	0.27	0.35
10	Behavioural changes (transport)	0.56	0.15	0.37	0.27	0.39	0.21	0.35
11	Energy positive buildings	0.37	0.39	0.18	0.43	0.32	0.41	0.34
12	Municipal waaste prevention	0.51	0.23	0.24	0.28	0.41	0.25	0.33
13	Solar roofs	0.62	0.37	0.18	0.24	0.25	0.30	0.33
14	Accessibility of public transport	0.44	0.15	0.29	0.21	0.55	0.18	0.33
15	Improved logistics (less transportation needs)	0.37	0.35	0.33	0.31	0.27	0.33	0.33
16	Waste collection, separation, and sorting	0.47	0.27	0.27	0.24	0.36	0.25	0.32
17	Self-sufficient energy communities	0.39	0.20	0.30	0.29	0.41	0.24	0.32
18	Bi-directional electricity distribution networks	0.41	0.31	0.25	0.35	0.21	0.33	0.31
19	Platform for exchange of production side streams	0.25	0.40	0.37	0.36	0.13	0.38	0.30
20	Energy storage, batteries	0.39	0.39	0.18	0.41	0.11	0.40	0.30
21	Zero energy buildings	0.48	0.30	0.13	0.29	0.28	0.30	0.30
22	Electric vehicles, person transport	0.47	0.29	0.13	0.27	0.32	0.28	0.30
23	Shared use of vehicles	0.33	0.23	0.29	0.27	0.36	0.25	0.30
24	Industrial symbiosis between companies	0.21	0.47	0.37	0.31	0.11	0.39	0.29
25	Behavioural changes (energy generation)	0.41	0.13	0.37	0.22	0.32	0.18	0.29
26	Distribution platforms for shared use	0.23	0.29	0.36	0.29	0.24	0.29	0.28
27	Behavioural changes (digitalization and smart city solutions)	0.44	0.17	0.28	0.23	0.28	0.20	0.28
28	Solar thermal	0.51	0.32	0.18	0.22	0.16	0.27	0.28
29	Education and information (material management)	0.35	0.16	0.33	0.24	0.29	0.20	0.27
30	Education and information (digitalization and smart city solutions)	0.37	0.19	0.29	0.28	0.24	0.23	0.27
31	Integration between transport modes	0.24	0.29	0.33	0.24	0.25	0.27	0.27
32	Education and information (energy generation)	0.36	0.09	0.37	0.28	0.26	0.18	0.27
33	Education and information (transport)	0.37	0.16	0.33	0.25	0.21	0.21	0.27
34	Behavioural changes (material management)	0.47	0.15	0.27	0.19	0.27	0.17	0.27
35	Use of open standards	0.24	0.23	0.36	0.39	0.08	0.31	0.26
36	Hydrogen economy	0.33	0.25	0.20	0.41	0.11	0.33	0.26
37	Internet of things (IoT) technologies	0.17	0.33	0.23	0.37	0.15	0.35	0.25
38	Electric vehiclres, freight transport	0.39	0.31	0.09	0.25	0.20	0.28	0.25
39	Vehicle battery loading points	0.28	0.31	0.17	0.19	0.28	0.25	0.25
40	Online data management and governance	0.16	0.24	0.28	0.35	0.19	0.29	0.24
41	Heat pumps (air/water/ground source)	0.47	0.30	0.14	0.20	0.09	0.25	0.24
42	Wastewater reuse	0.32	0.25	0.12	0.25	0.21	0.25	0.23
43	Wind energy	0.45	0.20	0.17	0.17	0.14	0.18	0.23
44	Demand side management	0.20	0.18	0.27	0.20	0.15	0.19	0.20
45	Geothermal	0.39	0.22	0.09	0.16	0.11	0.19	0.19
46	Energy storage, thermal	0.29	0.22	0.12	0.28	0.04	0.25	0.19
47	Digital Twins	0.17	0.23	0.19	0.27	0.08	0.25	0.19
48	Insulation	0.44	0.23	0.06	0.11	0.06	0.17	0.18
49	Modal shift	0.29	0.12	0.20	0.12	0.17	0.12	0.18
50	Street lighting	0.18	0.09	0.06	0.14	0.41	0.11	0.17
51	Waste/landfill gas use for energy production	0.21	0.24	0.12	0.16	0.11	0.20	0.17
52	Small/micro hydropower	0.17	0.21	0.12	0.22	0.07	0.22	0.16
53	Heat recovery - wastewater	0.29	0.14	0.10	0.16	0.08	0.15	0.15
54	Heat recovery - ventilation	0.37	0.09	0.08	0.14	0.09	0.11	0.15
55	Autonomous driving	0.05	0.21	0.07	0.31	0.09	0.26	0.15
56	Synthetic fuels (P2X technologies)	0.14	0.21	0.09	0.21	0.01	0.21	0.13
57	Small modular nuclear reactors (SMR)	0.14	0.17	0.08	0.18	0.03	0.18	0.12
58	Driving ban/period zones	0.19	0.04	0.09	0.05	0.23	0.05	0.12
59	Biomass-based district heating	0.12	0.13	0.09	0.11	0.07	0.12	0.10
60	Biomass-based electricity	0.13	0.12	0.08	0.13	0.04	0.13	0.10
61	Biomass-based CHP	0.13	0.12	0.09	0.11	0.04	0.11	0.10
62	Road/street user fees	0.11	0.13	0.07	0.07	0.08	0.10	0.09
63	Waste incineration	0.11	0.12	0.08	0.08	0.07	0.10	0.09
64	Other (stationary energy)	0.09	0.05	0.08	0.08	0.06	0.06	0.07
65	Other renewable energies (please specity)	0.07	0.04	0.04	0.04	0.03	0.04	0.04
66	Other (material management)	0.04	0.04	0.04	0.03	0.01	0.03	0.03
67	Other (transport)	0.04	0.03	0.01	0.04	0.03	0.03	0.03
68	Other (digitalization and smart city solutions)	0.03	0.03	0.03	0.03	0.04	0.03	0.03
69	Other (energy generation)	0.01	0.03	0.01	0.01	0.01	0.02	0.02

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