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CITIES IN EUROPE
WHAT EU INNOVATION CAN DO FOR CLIMATE NEUTRALITY

Abstract

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Ursula von der Leyen has chosen to make the 'European Green Deal' her number one priority, with the aim to reach climate-neutrality in 30 years. This crosscutting challenge should federate the European Union (EU), Member States, local authorities and private sector.

Research and innovation (R&I) is a vital enabler of the transition towards climate neutrality. We indeed need to develop and scale-up the new business models, processes, technologies and behaviours of an inclusive and climate-neutral society.

The EU now has a comprehensive energy policy and research and innovation policy. One of its more recent –and promising- component is the EU Research and Innovation Missions (R&I Missions) that aim to provide inspiration and direction to European innovation. One area identified for those missions is 'climate-neutral and smart cities'.

In this paper, we explore how such an EU R&I Mission could foster the creation of solutions to deliver clean transport, heating, cooling and electricity to those who live in cities. **In essence, our research finds that Europe now has many ingredients but lacks a recipe to deliver climate-neutrality in cities. This R&I Mission could be most useful if it succeeds to connect the dots between available technologies, economic incentives, new behaviours, infrastructure and popular support.**

The first part of this paper recalls why clean energy innovation for cities is key to fight climate change. The second part presents the state of play in terms of existing city-level initiatives and collaborations, and the existing EU toolkit in urban, R&I and energy policies. Finally, the paper recommends to (1) clearly define what a climate neutral city is, (2) select 100 cities that reflect the diversity of European cities and (3) make this R&I Mission on cities international by design.

1 . EUROPEAN CITIES ARE A KEY ACTOR TO INNOVATE FOR A CLEAN ENERGY FUTURE

1.1 . The global fight against climate change requires radical innovation, and Europe can lead this movement

The International Panel on Climate Change recently recalled that, if humanity wishes to avoid the most catastrophic consequences of climate change[1], the transition to a climate-neutral economy[2] needs to start now and be finalised in the next decades.

Making our economy climate-neutral entails a speedy and radical transformation of the sectors most responsible for greenhouse gas emissions: electricity, buildings, transport, industry, agriculture and forestry. At the EU level, reaching climate neutrality by 2050 is likely to become the official EU objective in the months to come.[3]

To meet climate neutrality by 2050, Europe must successfully operate its energy transition. Such a speedy and profound transformation can only occur through innovation[4] with new business models, behaviours, social norms, processes, technologies and skills.

Moreover, innovation may be Europe's most potent tool to support the global endeavour towards climate neutrality. In the global fight against climate change, Europe's main contribution is to become the prototype of a successful clean transition. Indeed, while Europe emits less than 10% of global greenhouse gas emissions, it accounts for 20% of the global economy and 30% of high-level scientific publications. By supporting clean innovation, the EU helps innovators to develop the clean solutions that are deployed in Europe, and can be exported to the rest of the world.

1.2 . Building an innovative clean energy future strengthens the competitiveness of European businesses

In the global economy, the competitiveness of European businesses rests on their capacity to innovate[5]. Private sector innovation is supported by research and innovation policies coming from both the EU and its Member States. Europeans should indeed properly support their businesses so they can gain a competitive edge in the booming energy transition markets (e.g. wind turbines, batteries, electric cars, energy efficiency services).

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1. IPCC, 1,5°C Report, October 2018.
2. Reaching climate-neutrality entails to reduce greenhouse gas emissions to such an extent that it becomes possible to offset the remaining emissions (e.g. coming from the military or the aviation sector) with carbon sinks (e.g. forest, agriculture, carbon capture and storage/usage)
3. Thomas Pellerin-Carlin, Emilie Magdalinski, Jean-Arnold Vinois, 'The European Green Deal starts with the Energy Transition', Policy Brief, Jacques Delors Institute, September 2019.
4. Broadly speaking, an innovation can be defined as the action of introducing something new to a given organisation. For innovation to be beneficial, this 'something' must be useful and valuable, and is sometimes –but not always something new to the world that is the outcome of a research activity. For a short free online course on innovation, check the Jacques Delors Institute MOOC on energy innovation: https://www.youtube.com/watch?v=D0q_sL34Bck&list=PLn9Er_PQcqQKjNwirPjXd86FSOs3ymiSf
5. Thomas Pellerin-Carlin and Pierre Serkine, "From Distraction to Action – towards a bold Energy Union Innovation Strategy", Policy Paper No. 167, Jacques Delors Institute, June 2016.

As European businesses become the leaders of the clean energy transition, they generate economic activity and can create quality jobs.

Innovation can thus fight climate change while improving the competitiveness of European businesses. This is why the EU has already created a comprehensive set of tools to support innovation (see section 2.3).[6] The last European Commission notably proposed the introduction of the European Innovation Council[7] and the EU Research and Innovation Missions (see Box 1). For the latter, the European Commission decided to focus on a key level of action of the transition to a climate-neutral economy: cities.

Box 1 ▪ the EU R&I Mission: an inspirational newcomer in the EU landscape

In 2019, the European Commission launched five European research and innovation (R&I) Missions. Such Missions are inspired by the work of academic Marianna Mazzucato, and the word 'Mission' is a reference to the Apollo 11 Mission that put a man on the moon.[1] In essence, the aim of the Mission is to provide inspiration and a sense of direction to the innovative efforts of the EU, Member States and private sector. This should help Europe deliver solutions for deep societal change, to tackle some key societal challenges.

So far, the EU has identified five 'mission areas': (1) climate change adaptation, (2) cancer, (3) healthy oceans, seas, coastal and inland waters, (4) climate-neutral and smart cities and (5) soil health and food. It has also appointed a Mission Board made of external stakeholders tasked with proposing "concrete targets and timelines for each mission by the end of 2019".

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1. Marianna Mazzucato, Mission-oriented research & innovation in the European Union, European Commission, February 2018.

1.3 ▪ Cities can address the systemic challenge that lies at the heart of the clean energy transition

First, what are 'cities'? Policy makers use this same word to describe different realities. There are indeed many ways of understanding a 'city'.

"A city" can refer to an administrative unit, such as the city of Paris and its two million inhabitants. This definition has the advantage of identifying a clear level of governance.

"A city" can also refer to an organic area composed of several administrative units where the connectivity between inhabitants is very high. In that sense, the "city of Paris" includes other neighbouring administrative cities (e.g. Versailles), and a total of ten million inhabitants. This definition has the advantage of being a people-centred definition that reflects the reality of human and economic interactions on the ground.
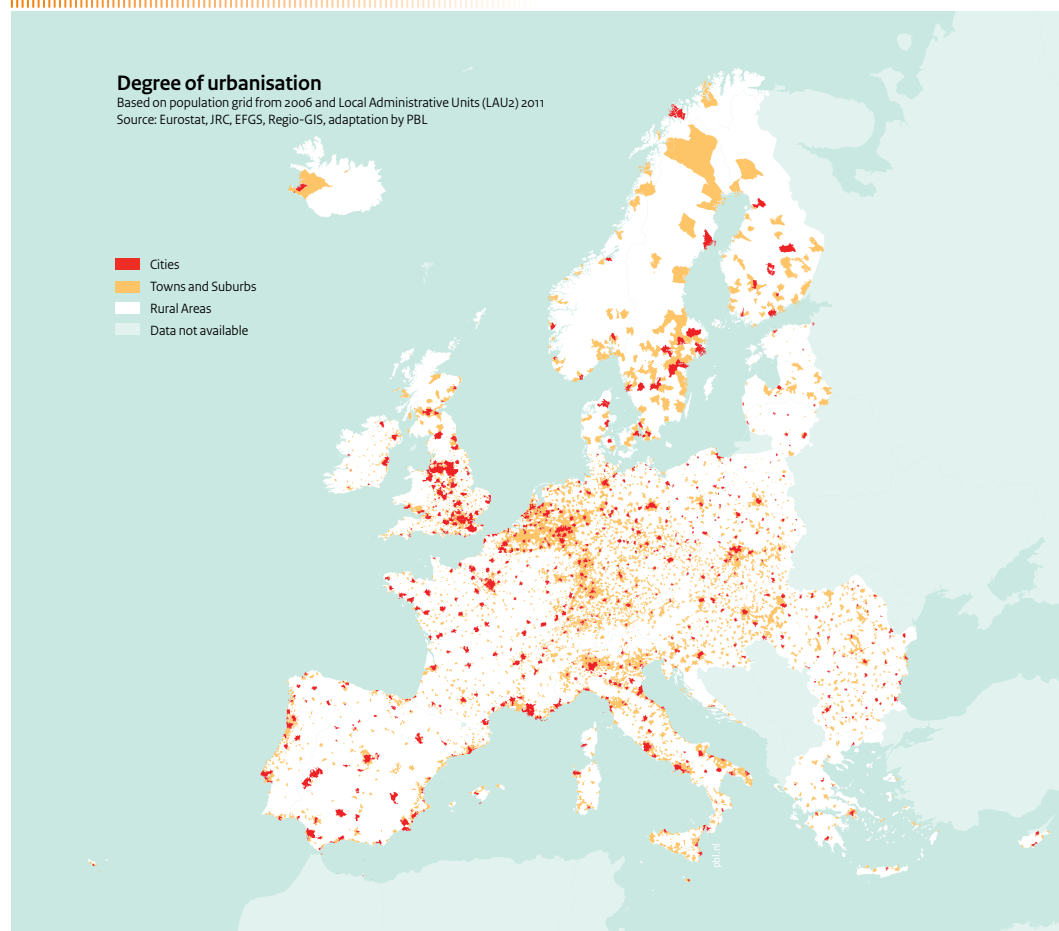
The European Commission generally uses a version of the latter definition, defining a city as an **urban centre** consisting of "contiguous grid cells [of 1km^2] with a density of at least 1 500 inhabitants per km2 and a total population of at least 50 000"[8]. Under this definition, there are around 800 cities in the EU (see map), with 700 with a population between 50,000 and 250,000 inhabitants, 100 cities with more than 250,000 inhabitants, with only two EU cities (London and Paris) with more than 10 million inhabitants.

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6. Eulalia Rubio, Fabian Zuleeg, Thomas Pellerin-Carlin, Emilie Magdalinski, Marta Pilati, Philipp Ständer, Mainstreaming innovation funding in the EU budget, Jacques Delors Institute, Study, May 2019
7. Philipp Staender, "Research policy: guide to the negotiations on Horizon Europe", Jacques Delors Institute-Berlin, July 2018
8. https://urban.jrc.ec.europa.eu/thefutureofcities/what-is-a-city#the-chapter

Map 1 ■ Map of EU cities, town and suburbs and rural areas.

Degree of urbanisation
Based on population grid from 2006 and Local Administrative Units (LAU2) 2011
Source: Eurostat, JRC, EFGS, Regio-GIS, adaptation by PBL

- Cities
- Towns and Suburbs
- Rural Areas
- Data not available

Source: PBL Netherlands Environmental Assessment Agency.[9]

Second, **cities are an appropriate level to achieve systemic change,** both from a technical and from a policy perspective.

From a technical perspective, we now have most of the technologies needed to reach climate-neutrality: [10] net-zero energy buildings, renewable energies, electric cars. What is however lacking is how we connect the dots between those technologies, as well as between those technologies and the society in which they are embedded: regulations, infrastructure, economic incentives, urban planning, social norms, everyday routines, etc. In other words, we have many ingredients to reach climate neutrality happen, but we still lack the recipe. Here, cities are an appropriate level of governance as it is a location where many technologies, infrastructure, routines etc. interact, with different infrastructure and habits shaping energy choices –such as walking in Pontevedra (see box 1).

From a policy perspective, policy makers still struggle to put the holistic approach into practice. The transition to a climate-neutral economy indeed requires systemic change, while individual policies tend to focus only on a specific sector –i.e. a single element of the system.

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9. https://www.pbl.nl/sites/default/files/cms/publicaties/PBL-2016-Cities-in-Europe-2469.pdf
10. Climate Strategy & Partners, Funding Innovation do Deliver EU Competitive Climate Leadership, October 2018.

This can lead to incoherencies when a policy targeting one sector neglects the positive –or negative- effects it could have on another sector

For instance, renewable energy sources like wind and solar power are variable energy sources: their production is driven by natural conditions (wind, sun) rather than by human energy demand. Electric vehicles, in the meantime, are only as green as their electricity[11]. It therefore makes a lot of sense to develop wind and solar power together with electric vehicles: the more we produce renewable energy, the more we need electric vehicles that can charge when the sun shines and the wind blows; the more electric vehicles we have, the more we need important quantities of 'green electricity'.

This systemic challenge is relevant at the European and national level. It is also relevant at the city level, **as cities can ensure that a holistic approach to the transition leads to a coherent systemic change** –for instance by articulating the deployment of electric buses and cars together with a development of local renewable electricity generation.

Third, **cities are also a relevant level of governance.** Many mayors are able to build personal trust with citizens and bring about long-term project across party affiliations. This is a critical asset to ensure that the changes needed to build a clean energy future come from society itself, rather than being imposed in top-down manner that can encounter popular opposition.

1.4 ▪ Health, jobs, poverty, security: how climate-neutral cities can improve the European way of life

We live today with a dirty and inefficient energy system that we inherited from 19th and 20th century choices. As we build a clean energy future, based on renewables and energy efficiency, we also improve Europeans' daily lives in terms of health, poverty, living standards, employment and energy security.

In terms of health, a cleaner energy system reduces air pollution and therefore improves the health of people, especially children and the elderly. Real lives are at stake here, as 400,000 Europeans die prematurely because of air pollution every year[12]. Today, more than 70% of European urban population still suffers from pollution concentration above required levels[13].

In terms of living standards, optimisation and decarbonisation of cities' transport networks will ensure a better quality of life for all citizens. Indeed, European citizens typically spend two hours a day held up in public transport or in road traffic as they commute from their home to the workplace. Such time can be reduced and made more comfortable by rethinking urban policies and developing clean mobility solutions[14].

Our current energy systems in Europe do not ensure that all Europeans can heat and cool their homes throughout the year. A concrete way to reduce energy poverty is to retrofit inefficient buildings in such a way that it reduces the energy bill of a household to near-zero.

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11. Emilie Magdalinski and Thomas Pellerin-Carlin, Electric vehicles : european mobility and industrial leadership at stake, Policy Brief, Jacques Delors Institute, May 2019.

12. Source: European Environment Agency

13. European Environment Agency, based on data for ozone and particulate matter (PM2,5

14. Emily Magdalinski, Clean mobility: The European Way, Policy Paper, Jacques Delors Institute, January 2019.

On that front, the technologies are already available (e.g. heat pumps, solar heating, quality insulation, biomass, solar photovoltaic panels, tools to optimise consumption) but are insufficiently scaled-up[15].

As innovative clean solutions are developed, new jobs are created in new sectors. This creates a window of opportunity to ensure that Europeans, especially young ones, can acquire the right skills to do those jobs.

Climate-neutral cities reduce the dependence on fossil fuels. This helps Europeans to better manage their energy security. However, some renewable and battery technologies rely on specific raw materials, such as lithium and cobalt, leading to new energy security challenges[16].

Finally, as global temperatures continue to rise, our societies need to adapt to a new climate, with more frequent and more severe extreme weather events, such as droughts, floods, hurricanes, or heatwaves. The EU has set-up an ad hoc R&I Mission Area on climate change adaptation, and this gives a chance to liaise the work of this Mission Area with the one on climate neutral cities, to ensure that European cities do embed the climate change adaptation necessity in their policy choices towards climate neutrality.

The number one objective of the EU Mission area on climate neutral cities remains to reach climate neutrality. It is however politically important to embed the several co-benefits: health, energy poverty, living standards, jobs, energy security and climate change adaptation. Such comprehensive approach would strengthen local popular support to the transformation of their cities into climate-neutral ones.

2 ▪ THE EU R&I MISSION ON CLIMATE-NEUTRAL CITIES MUST LEVERAGE EXISTING TOOLS AND INITIATIVES

When it comes to working with cities to deliver clean energy innovation, the EU does not start from scratch. First, cities are already engaged in the clean energy transition, both as individual cities and in the networks they built. Second, the EU already has a comprehensive set of urban, R&I and energy policy tools, that can be leveraged by the EU R&I Mission on climate neutral-cities.

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15. For an example of an EU-funded projects aimed at scaling up deep energy efficiency renovation of buildings, see for instance EnergieSprong.
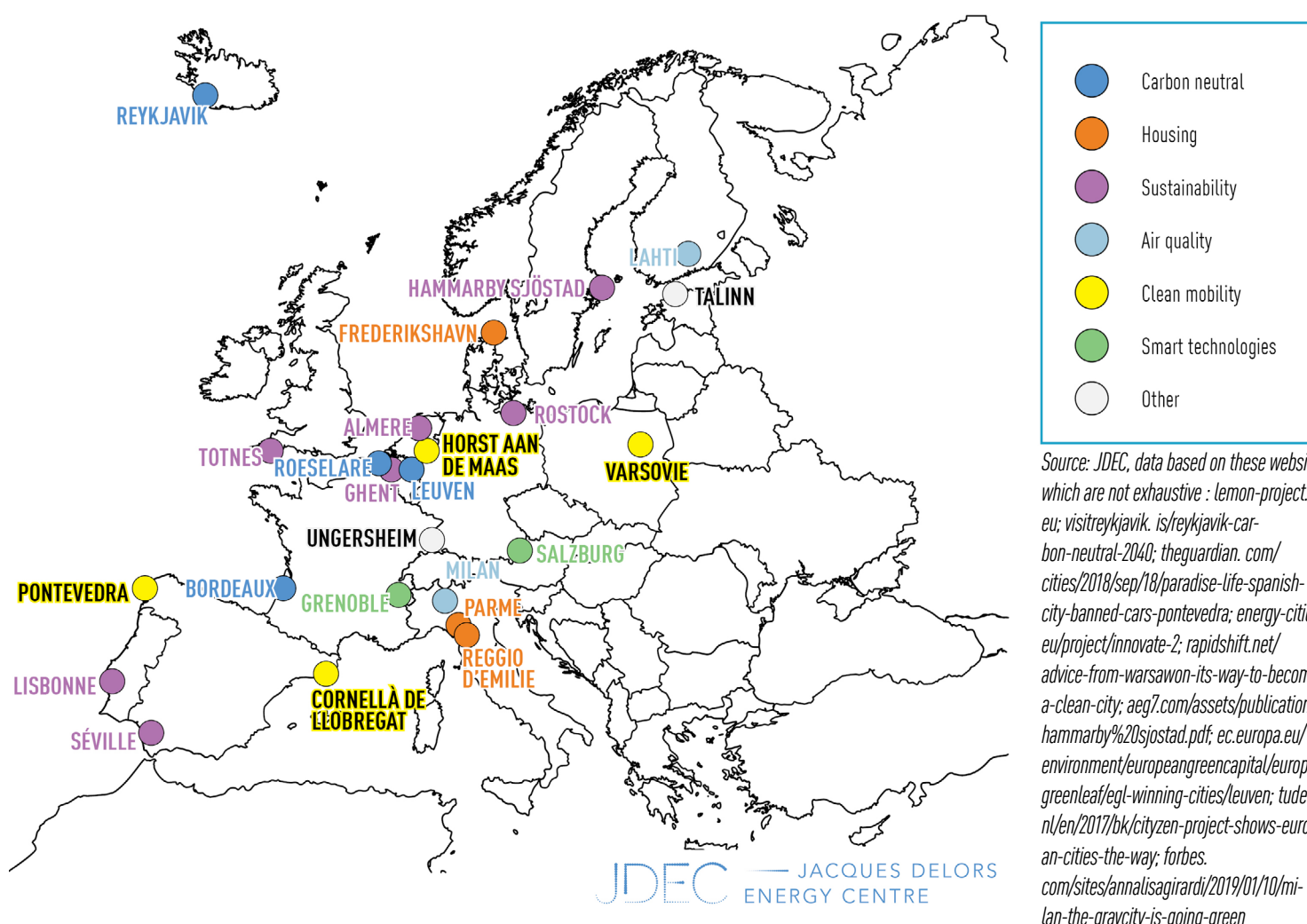16. IRENA, A New World: the geopolitics of the energy transformation, January 2019.

2.1 ■ Urban initiatives are numerous, but they need scale to make a difference at European level

Many cities are already innovating to build their own clean energy future. They have already adopted plans to perform their own energy transition (see Map 2, for a few selected examples). They develop renewable energy production, support clean mobility (see Box n°1 on Pontevedra) and renovate city buildings. Several of those cities even adopted objectives that are more ambitious than those of their national governments –example of the city of Leuven (Belgium) aims to be carbon neutral by 2030[17].

MAP 2 ■ **Map of EU city initiatives**

Legend:
- Carbon neutral
- Housing
- Sustainability
- Air quality
- Clean mobility
- Smart technologies
- Other

Source: JDEC, data based on these website which are not exhaustive : lemon-project. eu; visitreykjavik. is/reykjavik-car-bon-neutral-2040; theguardian. com/cities/2018/sep/18/paradise-life-spanish-city-banned-cars-pontevedra; energy-cities. eu/project/innovate-2; rapidshift.net/advice-from-warsawon-its-way-to-becoming-a-clean-city; aeg7.com/assets/publications/hammarby%20sjostad.pdf; ec.europa.eu/environment/europeangreencapital/european-greenleaf/egl-winning-cities/leuven; tudelft. nl/en/2017/bk/cityzen-project-shows-europe-an-cities-the-way; forbes. com/sites/annalisagirardi/2019/01/10/mi-lan-the-graycity-is-going-green

Cities shown on map: REYKJAVIK, LAHTI, HAMMARBY SJÖSTAD, TALINN, FREDERIKSHAVN, ALMERE, ROSTOCK, HORST AAN DE MAAS, VARSOVIE, TOTNES, ROESELARE, GHENT, LEUVEN, UNGERSHEIM, SALZBURG, MILAN, PONTEVEDRA, BORDEAUX, GRENOBLE, PARME, REGGIO D'EMILIE, LISBONNE, CORNELLÀ DE LLOBREGAT, SÉVILLE

17. https://ec.europa.eu/environment/europeangreencapital/europeangreenleaf/egl-winning-cities/leuven/

Box 2 ■ Innovating for clean mobility, the experience of Pontevedra (Spain)

Pontevedra is a city of around 100,000 inhabitants in North-West Spain, which has a car-free regulation in place since 1999.[1] This was accompanied by a policy promoting walking and cycling, in order to reduce air pollution and road traffic fatalities, but also to promote local economic activity. Part of this policy was the development of the metro-minuto: a pedestrian map showing the distance in terms of walking time (see below).

1. https://www.theguardian.com/cities/2018/sep/18/paradise-life-spanish-city-banned-cars-pontevedra

Map 3 ■ Map of Pontevedra showing walking times across the city (Spain)

However, the majority of these initiatives are sector-based and there are only few cities with an objective of carbon neutrality as a whole. Moreover, whereas many cities are clearly pushing for sustainability, current day-to-day activities are still ongoing in numerous polluting fields (e.g. diesel cars, emitting industries, inefficient energy buildings).

There is therefore a general discrepancy between the wish to act against climate change and the current day-to-day activities in cities, what could be called an 'ambition/action gap'. This gap is very hard to fill and initiatives led by cities on their own are not sufficient to reach the climate neutrality target. Cities would benefit from synergies with other cities which face similar challenges. For instance, when a city buys electric buses –as Warsaw does[18], it may benefit from lower prices if it can pool its own electric bus purchase together with other cities, thus reaping economies for scale.

As urban initiatives have emerged in the past 20 years, we recommend that the EU R&I Mission on climate neutral cities builds on such experiences and provides a clear direction towards climate neutrality. It should also help create synergies and raise the ambition of already existing and forthcoming local initiatives.

18. https://www.electrive.com/2019/07/23/warsaw-orders-130-electric-buses-from-solaris/

2.2 ■ Cities have already structured networks to cooperate notably on energy and climate

Beyond local action, cities have also created several city-grouping structures (see Table n°1) in order to exchange information, share best practices and find funding for clean solutions.

The most prominent example is the EU Covenant of Mayors for Climate and Energy. It introduced the Sustainable Energy and Climate Action Plans[19] where a city commits to develop a plan to cut its greenhouse gas emissions by 40% by 2030 and to develop a strategy for climate change mitigation and adaptation, and tackling energy poverty. Through this movement, cities gather and share information to develop sustainable solutions at local level. This EU Covenant also produced a global spin-off: the Global Covenant of Mayors For Climate and Energy that gathers cities with a total of 330 million inhabitants in 59 countries.

Table 1 ■ Selected examples of associations and alliances of cities at the EU and international levels

	MEMBERS	PERIMETER	OBJECTIVE AND SCOPE	BENEFITS
C40	94 cities of different sizes	International	Contributing toward the goal to limit global warming to 1.5° Celsius, Adaptation Implementation, Air Quality, Energy & Buildings, Food, Waste & Water, Transportation & Urban Planning	Localised direct support, improved access to data, broad-based partnered efforts around finance, city diplomacy, and inclusive climate action
CCRE/CEMR	60 associations of local and regional authorities	EU	Construction of a united, peaceful and democratic Europe founded on local self-government, respect for the principle of subsidiarity and the participation of citizens. All major carbon neutral initiatives plus Governance, democracy and citizenship, economic, social and territorial cohesion	Network
CIVITAS	200 cities	Europe	Promote mobility and support cities for developing urban transport policies	Developed 2020 framework programme. Working with cities to ensure transferability of tested mobility and transport solutions.
Climate Alliance	1,700 municipal authorities plus regional governments, NGOs	Europe	Reduce CO2 emissions by 10 percent every 5 years, strive for a per capita emissions level of 2.5 tonnes CO2 equivalent, work towards social justice. Initiatives in energy conservation, energy efficiency and the use of renewable energy	Working directly with the administrative and technical level of municipal structures: project funding opportunities, developing CO2 monitoring instruments, running campaigns, carrying out projects both with and for member cities.
CNCA (climate neutral city alliance)	19 leading global cities	International	80-100% greenhouse gas-reduction target by 2050 or sooner	Funding innovation projects
Energy Cities	1000 local authorities	Europe, Morocco, New Zealand, Turkey	Transformation of the energy systems and policies, giving citizens the power to shape a decentralised and renewable energy future.	Better access to EU funding
EU Covenant of Mayors for climate and energy	9000 local authorities	EU + EU Eastern Partnership countries	40% greenhouse gas-reduction target in the EU by 2030	Better financial opportunities for local climate and energy projects, Practical support (helpdesk), guidance material and tools
Euro Cities	185 cities	Europe + neighbourhood	Achieve a carbon neutral Europe by 2050, boost the digital transformation across the EU, recognise the vital contribution of cities to the implementation of the European Pillar of Social Rights	Network and advocacy to shape the EU agenda.
FEDARENE	80 Regional and local energy agencies, ministries and departments	EU	Liaison between local / regional authorities and European institutions for climate and energy actions	Exchange platform, information and influence
ICLEI	1,750 local and regional governments, national agencies plus NGOs and universities	Europe, Middle East, North Africa, and Asian countries	Addressing environmental, economic and social challenges : from Cultural Heritage, Food, Waste and circular economy to Energy and Procurement	A platform to engage with peers, incubate innovation, funding opportunities
METREX	50 metropolitan regions and areas	Europe	Contributes to the metropolitan dimension of policies, programs and projects. Representation of metropolitan regions in relation to European institutions, the research community, organisations	Share knowledge and expertise. Join action in common areas of interest
Rockefeller Foundation for cities	97 cities	International	Financing of leading cities	Giving the resources (funding) necessary to develop a roadmap to resilience
SCIS (Smart Cities information system)	Includes 40 lighthouse cities and 53 cities in learning	Europe	Collaboration on the creation of smart cities. Focuses on energy, mobility, and information and communication technology. Goal to foster replication.	Knowledge platform to exchange data, experience, projects and know-how. Financing of projects by the European Commission (Celsius, City-zen…)

Source: JDEC, data based on associations' websites

19. https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/guidebook-how-develop-sustainable-energy-and-climate-action-plan-secap

Platforms where cities exchange knowledge already exist, including platforms specialised on energy. The EU R&I Mission should therefore work with them and provide an added value by giving a renewed ambition (see Section 3).

2.3 ■ European tools for cities already exist: urban policy, research and innovation, energy policy

While the EU has established a regional policy since 1957, urban pilot projects were only launched in 1989 and there is currently no fully-fledged EU Urban Policy.[20]

There are however different EU tools relevant for cities, including the Leipzig Charter on sustainable European Cities[21], the Amsterdam Pact and the 2016 Urban agenda of the EU, the European Regional Development Fund (ERDF) and the Cohesion Policy of the EU for 2014-2020 supporting European towns and cities through investments.

The context of the Green Deal[22] and the EU R&I Mission on climate-neutral cities gives an opportunity to improve the effectiveness of the EU action for cities.

The **EU research and innovation (R&I) policy** decisively began in the 1980s. It is now a major EU policy that aims at orienting national and private R&I investment in directions that are considered to be in the European public interest −e.g. R&I on climate change, clean energy, cancer, artificial intelligence, clean oceans, heathy food etc.

The cornerstone of this EU R&I policy is Horizon 2020 −that will become 'Horizon Europe as of 2021. It currently has a budget of around €10Bn per year and finances projects all across the research and innovation value chain: from basic research (mostly financed through the European Research Council), to close-to-market innovation (for instance via the European Institute of Innovation and Technology (EIT), or the newly created European Innovation Council).

Several EU R&I tools exist, with both crosscutting and sectorial instruments[23]. Those most relevant for the clean energy transition are:

- The forthcoming Horizon Europe's strategic planning, the SET Plan and the European Commission's communication on Accelerating Clean Energy Innovation, that can guide EU, national and private research and innovation in a common direction,

- The Innovation Fund −that uses revenues from the EU's carbon market (EU-ETS) to finance an estimated €10Bn of demonstration projects for the clean energy transition in the next ten years, [24]

- InnoEnergy and Climate-KIC, which are the two EIT branches dealing with clean energy and climate change[25].

20. https://urbact.eu/rough-guide-european-urban-policy
21. https://ec.europa.eu/regional_policy/archive/themes/urban/leipzig_charter.pdf
22. Thomas Pellerin-Carlin, Emilie Magdalinski, Jean-Arnold Vinois, 'The European Green Deal starts with the Energy Transition', Policy Brief, Jacques Delors Institute, September 2019.
23. For a comprehensive overview of the main EU R&I tools, see Eulalia Rubio, Fabian Zuleeg, Thomas Pellerin-Carlin, Emilie Magdalinski, Marta Pilati, Philipp Ständer, Mainstreaming innovation funding in the EU budget, Jacques Delors Institute, Study, May 2019.
24. https://ec.europa.eu/clima/policies/innovation-fund_en
25. For an overview of the EIT activities, cf. Thomas Pellerin-Carlin and Pierre Serkine, "From Distraction to Action – towards a bold Energy Union Innovation Strategy", Policy Paper No. 167, Jacques Delors Institute, June 2016.

The EU R&I Mission Board that has been created in the summer of 2019 should establish contact with the actors in charge of those tools, to see what have already been their successes and limits.

In only ten years, the European Union went from not having a clear legal competence[26] for acting on energy, to implementing **a comprehensive energy policy**. The EU now has targets to reduce greenhouse gas emissions, develop renewables and improve energy efficiency. It has regulatory measures in place that support energy efficiency, energy-market integration and renewable-energy production. Those legislations are underpinned by a new EU governance architecture to coordinate national energy policies. The EU also offers tools for key industrial sectors (e.g. European Battery Alliance), coal regions (e.g. Coal Regions in Transition Platform) and energy-poor Europeans (e.g. EU Energy Poverty Observatory), which includes support from the EU budget (e.g. from funding research and innovation projects, to supporting the renovation of social housing).

One role of the EU R&I Mission can be to help better communicate and ensure consistency between EU decisions and local initiatives, so that the implementation of EU decision and local decisions can mutually reinforce each other.

Figure 1 ▪ Main EU energy policy tools in 2019
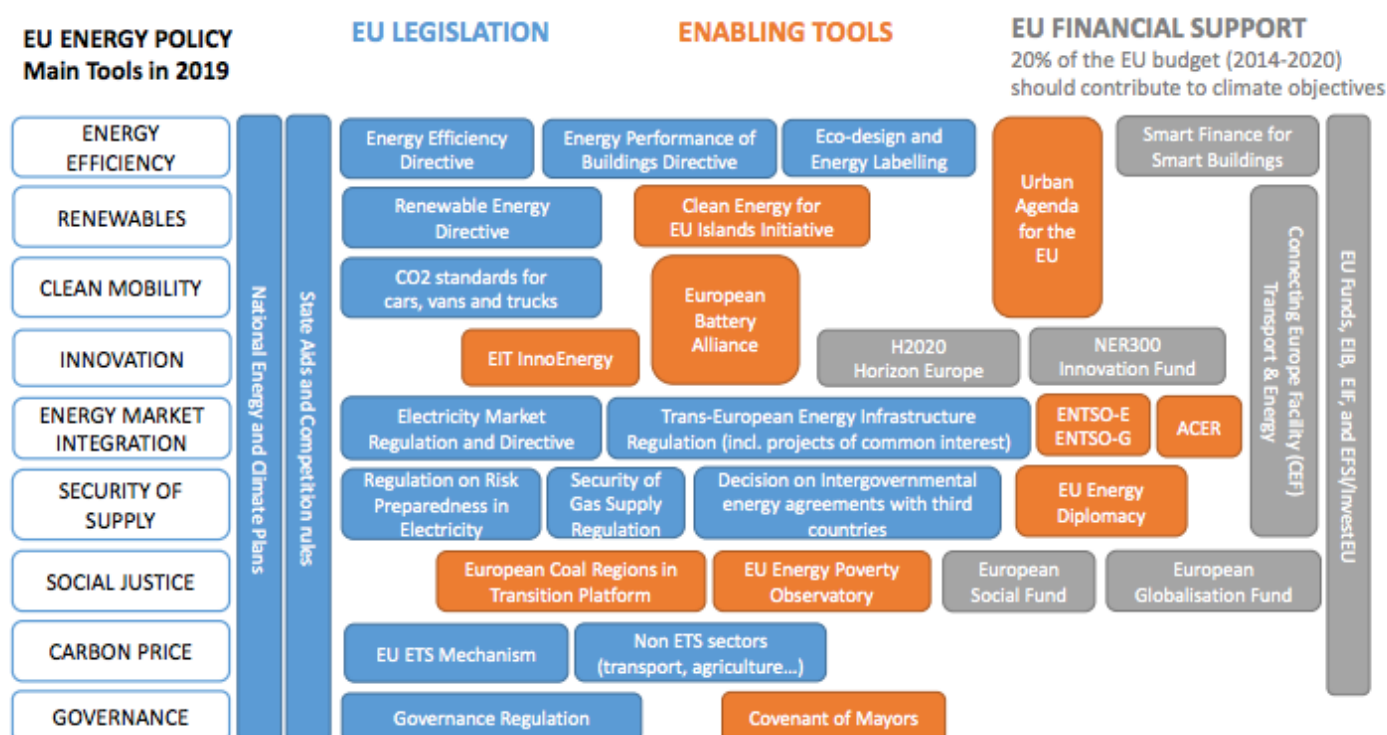
Source : Jacques Delors Institute, own elaboration

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26. In EU Treaties, the first article that granted the EU a legal competence to develop an energy policy was the Article 194 introduced in December 2009, with the entry into force of the Treaty of Lisbon.

3 . WORKING WITH 100 PIONEERING EU CITIES TO PAVE THE WAY FOR A GLOBAL CLEAN ENERGY TRANSITION : 3 RECOMMENDATIONS

Governing an EU R&I mission on climate-neutral cities is a challenging task. Rather than proposing a comprehensive programme for this mission, this policy paper suggests three key policy recommendations for this R&I Mission.

- First, the Mission should clearly define what a 'climate neutral city' is. Such definition will indeed determine the real level of ambition of the Mission.

- Second, the Mission should start working with a selected number of cities that reflect the diversity of European nations and cities.

- Third, the international dimension of this Mission should be included by design. Indeed, the aim of this Mission is not only to make a handful of European cities climate-neutral, but to create blueprints that can be used by all European cities, and many global cities.

■ Recommendation n°1: the Mission Board should clearly define what a 'climate neutral' city is

Defining a 'climate neutral city' means determining the scope of the emissions to take into account for a city.

First, will the EU R&I Mission focus on an administrative city, an urban centre, a commuting zone or a functional urban area (see Section 1.3). The Mission Board could even suggest to focus on climate neutral 'territories' rather than cities.

- Second, what is the scope of emissions to be taken into account to calculate the carbon footprint of the city? For sure, the emissions happening in the city (e.g. transport) need to be accounted for. One can also argue to account for the emissions coming from the production of the energy used in the city (e.g. electricity), and of the goods (e.g. food, manufactured goods) used by local citizens. The Mission Board could also choose to include emissions coming from travelling in and out of the city (train, airplane, cars). Finally, a similar reasoning applies for carbon sinks (e.g. the capture of CO_2 coming from the growth of plants and trees).

Figure 2 ■ **Emissions of green house gases by Paris in 2014**
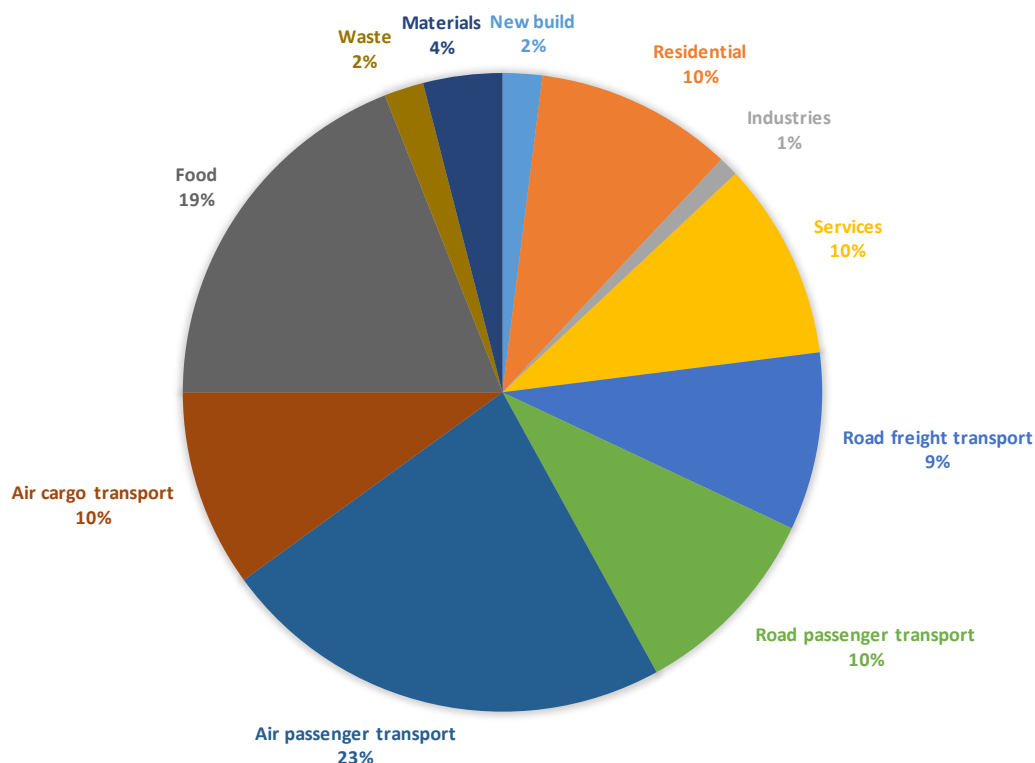
In the example of Paris (see figure 2), aviation is the single most important source of emissions (i.e. 33%, with 23% for air transport of people, and 10% for air transport of goods). Paris is indeed a city where business trips and tourism are important activities. However, aviation is a sector where the city of Paris has virtually no legal powers. The same goes for food production, as food is seldom produced within cities.

There is therefore the need to address the definition of climate-neutrality from the start of the R&I Mission. This will indeed determine the real level of ambition of this Mission, as well as its scope.

■ Recommendation n°2: select 100 cities that reflect the diversity of European cities

Understanding a 'city' as an **urban centre** consisting of "contiguous grid cells [of 1km2] with a density of at least 1 500 inhabitants per km2 and a total population of at least 50 000"[27], there are around 800 cities in the EU (see map n°1).

With this in mind, this paper suggests that the EU R&I Mission should aim for making around **100 climate-neutral cities in Europe**[28] in order to meet two concerns:

- First, the number of cities should be small enough to ensure that the EU R&I Mission is manageable. In that regard, the Mission could even start with an even smaller vanguard of, say, 20 cities.

27. https://urban.jrc.ec.europa.eu/thefutureofcities/what-is-a-city#the-chapter
28. Marianna Mazzucato, Mission-oriented research & innovation in the European Union, European Commission, February 2018.

- Second, there is also a need to achieve a critical mass, to see how the clean energy transition can be realised in a significant number of cities, with a long-term view of ensuring that virtually all EU cities can become climate-neutral.

Those cities must reflect the diversity of EU cities, with a **wide variety of starting points**. This paper specifically recommends to account for the following characteristics:

- **Size of the city**: to ensure that both smaller cities (50.000-100.000 inhabitants) as well as big ones (above 1 million inhabitants) take part in the Mission,

- **Geography and climate**: to account for the diversity of city-level energy needs (e.g. demand for heat in the winter, demand for cold in the summer), geographical location (e.g. island, costal, mountain) and access to energy resources (e.g. local access to biomass, solar, geothermal, etc.).

- **Economic specialisation**: to account for the diversity of economic activities, including services, tourism and industry.

- **Historical legacy**: European cities indeed have different histories that shaped their energy system. Some have a well-developed transport systems (e.g. trams in Vienna, metro in Paris, cycling in Amsterdam) that others lack. Some (e.g. Rome, Venice, Krakow) have important patrimonial concerns. Others suffer from the persistence of harmful past energy choices (e.g. soviet-style district heating of inefficient buildings).

- In turn, such objective **criterion can be used to set-up *ad hoc* working groups, or clusters, within the Mission**. A sub-group can be the place to tackle specific challenges −e.g. those that do have heavy industrial activities in/near the city. This is one case where close collaboration with existing city networks could be beneficial, for instance with the Clean Energy for EU islands initiative or the EU Covenant of Mayors (see Section 2.2).

■ Recommendation n°3: Making the R&I Mission on cities 'international by design'

From an international perspective, the EU accounts for less than 10% of global emissions, but is a scientific and innovation powerhouse. It can therefore best contribute to fighting climate change through the development of clean solutions that can be implemented globally.

The EU R&I Mission on climate-neutral cities must therefore be 'international by design', i.e. think from the outset about the best ways to promote the forthcoming EU clean innovations in other cities outside Europe. To do so, we recommend five concrete steps:

- First, the geographical scope of the mission should be the same as for most H2020 projects: the EU, plus other European countries such as Norway, Switzerland or Ukraine −and, ideally, a post-Brexit United Kingdom.

- Ensure that some EU cities from the outermost regions (e.g. Saint Denis de la Réunion, near Madagascar) take part in the Mission. Some outermost regions may present common features with some non-European countries (e.g. climate conditions, cultural traits and/or geography), and for some particular cases, the relative scarcity of infrastructure (especially small islands).[29]

29. Thomas Pellerin-Carlin and Pierre Serkine, "From Distraction to Action – towards a bold Energy Union Innovation Strategy", Policy Paper No. 167, Jacques Delors Institute, June 2016.

• Engage non-European cities that already support clean energy innovation, such as New York City, Sydney or Tokyo[30].

• Use already existing tools where the European cities take part, to foster the transfer of European innovations to the rest of the world. Such organisations include the C40, the Global Covenant of Mayors (see Section 2.2.) and Mission Innovation.

• Use existing local, national and EU economic diplomacy tools to support those EU cities that can act as ambassadors, showcasing best practices and attracting interest from foreign investors.

30. https://cleantechnica.com/2018/08/27/from-london-to-new-york-19-cities-commit-to-net-zero-carbon-buildings-by-2030/

CONCLUSION ■

In this paper, we explored how such an EU R&I Mission could foster the creation of solutions to deliver clean transport, heating, cooling and electricity to those who live in cities.

In essence, our research finds that Europe now has many ingredients but lacks a recipe to deliver climate-neutrality in cities. This R&I Mission could be most useful if it succeeds to connect the dots between available technologies, economic incentives, new behaviours, infrastructure and popular support.

To do so, we recommend that the European Union in general, and the EU R&I Mission Board on 'smart and climate-neutral cities' in particular do:

- clearly define what a climate neutral city is,

- select 100 cities that reflect the diversity of European cities and

- make this R&I Mission on cities international by design.

These are necessary first steps in the right direction for the R&I Mission, which will need to be followed up by a wider set of actions to ensure its success.